MODERNIST PIZZA

Techniques and Ingredients

MODERNIST PIZZA

Volume 2
Techniques and Ingredients

MODERNIST PIZZA

Nathan Myhrvold
Francisco Migoya

Photography by Nathan Myhrvold
and The Cooking Lab Photography Team

The Cooking Lab

Volume 1

HISTORY AND FUNDAMENTALS

Volume 2

TECHNIQUES AND INGREDIENTS

Volume 3

RECIPES

CHAPTER 6
MAKING PIZZA DOUGH


PIZZA

MAKING PIZZA DOUGH

Most pizza doughs are made more or less the same way, but pizza's diversity shines in the final outcomes, ranging from ultra-thin, crisp, and cracker-like to something that is almost as thick as a piece of bread. The differences between pizza styles are created in the details. A slight change in the proportion of ingredients, or in the duration of the mixing, proofing, or shaping, will produce different results. Environmental conditions, storage practices, and equipment can play a role, too. The combination of all those small details will produce the characteristics of a specific style of pizza.

Our pizza doughs fall into three categories: thin crust (which includes our master recipes for thin-crust, Brazilian thin-crust, and deep-dish pizzas), medium crust (Neapolitan, New York, and artisan pizzas), and bread-like crust (focaccia; New York square, al taglio, and Detroit-style pizzas). Traditionally, each of these pizzas have had a different kind of dough, but we cross-tested making each pizza style with the other master doughs, and it turns out that one dough can work for many styles of pizza (see page 96).

Regardless of the dough's thickness, one of the most important attributes of any pizza is its crust, whether it's the outermost charred rim of a Neapolitan pizza (known as the cornicione) or the crispy cheese-edged corner of a Detroit-style pizza (known as frico). Toppings and sauce affect the crust, too, because they help determine how the pizza will bake and how the dough expands in the oven.

As with anything, it takes practice to become proficient in making pizza dough. Some styles, such as our thin-crust pizza, are easier to master; others, like Neapolitan, require a lot of practice and also some special equipment. We met many pizzaioli who told us that they're still honing their craft, even after decades. This seemed unlikely to us as we watched their beautiful pizzas come out of the oven one after another, but for them, perfecting pizza is a lifelong endeavor.

In this chapter, we'll elaborate on some of the most critical aspects of making pizza dough: mixing, dividing the dough into pizza-sized portions, preshaping, and proofing. We'll cover the specifics of shaping and baking in the Iconic Recipes chapter on page 3:3 since they vary by pizza style. Don't worry if your earliest attempts aren't perfectly round (or square or rectangular, or whatever shape you're going for). In the end, each pizza is a learning experience that will make you a better pizza maker. No matter how it turns out, you'll still have a hot pizza to eat, and even big mistakes can be tasty when topped with sauce and melted cheese.

Some pizzaioli swear by a particular type of flour, saying that's the key to their excellent crust. While it's possible that their favorite flour makes a difference (certain flours may be more appropriate for specific pizza styles; see page 1:283), it's far more likely that practice and experience, not flour, are what make their finished product excel.

Italian pizzaioli tend to be adamant that pizza is not bread—it's its own thing (even though naming conventions for pizza and pizza-like items can be blurry; see page 1:96). It's worth noting, however, that lots of fantastic pizzerias are owned and operated by bread bakers because they understand how to make crusts that people want to eat. You can look at pizza as a very specialized kind of bread (due to the shaping techniques, thickness and toppings) that takes you in a very different direction.

NEW DISCOVERIES AND TECHNIQUES

The triangle test is the best way to evaluate your recipe (see page 9)

The kind of mixer you use doesn't matter (see page 39)

Two simple tricks can prevent black spots on your dough (see page 72)

Dough CPR can resuscitate your overproofed dough (see page 77)

NAMING THE PARTS OF A PIZZA

A Great Dane and a Chihuahua are both dogs, albeit different breeds with completely different characteristics and sizes. Pizza styles are similar—they all fall under the umbrella of "pizza" but can vary widely in size, texture of the crust, and appearance.

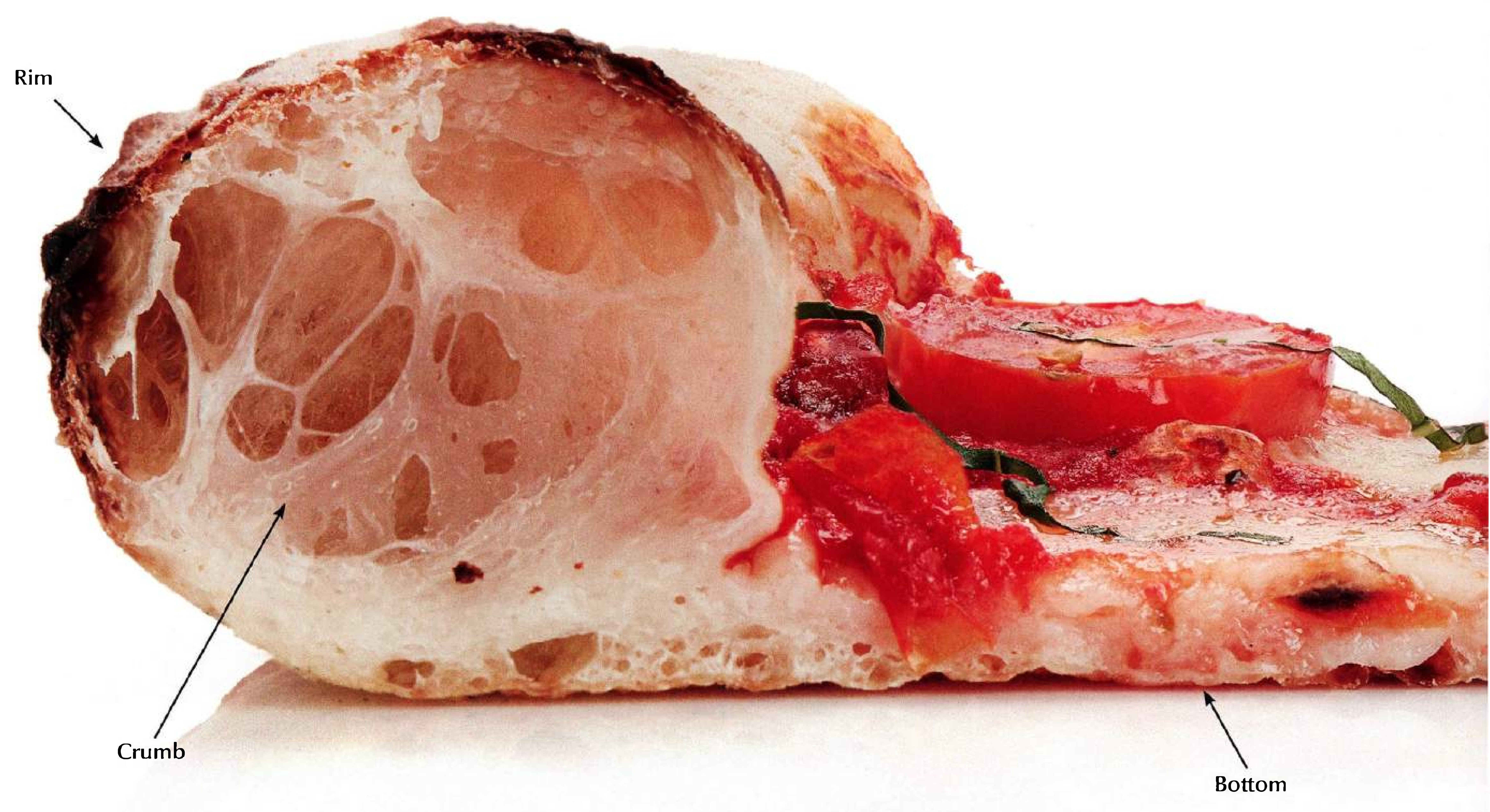
All of our pizza doughs contain at least four ingredients: flour, water, salt, and yeast (some also include fat or other less significant ingredients like diastatic malt powder, malt powder, or malt syrup). By adjusting the proportion of ingredients and how they're mixed, fermented, and baked, we can achieve different results that vary in crust and crumb. A thin-crust pizza will have a look, flavor, and texture that's very different from an al taglio pizza, yet they are undoubtedly both pizza. Pizza styles are a bit like dog breeds. A Great Dane and a Chihuahua are both in the same genus, *Canis*, even though there are substantial differences in their size, head shape, and fur length.

A perfect pizza crust can be crisp on the surface and yield to a soft, chewy interior. Or it can be thin and almost cracker-like, depending on the style. Sometimes, the outer rim of the pizza crust is what people leave behind. These uneaten pieces are known as pizza bones. If the crust is good enough, though, you won't find as many bones left on the plate.

We believe that eating this part of the pizza is the best way to experience the true expression of the baked dough, since the flavor of the crust doesn't have sauce, cheese, or anything else to compete with. This is especially true if you used a levain-raised recipe; it would be hard to taste the distinctive tang of sourdough, and to appreciate all the work that went into building and maintaining the levain, if you ate it only when it was covered in sauce and cheese. But there's more to pizza crust than just the rim. Actually, we spent some time thinking through what seems to be a simple question: What, exactly, are pizza crust and crumb?

The Difference between the Rim and Under Crust

To a bread baker, the crust is the outside layer of the bread and the center is the crumb (the latter term is used less often, but it's the technical term). When it comes to pizza, the term "crust" is used to mean the entire base of the baked pizza. That's not very helpful to us, which is why we're clarifying the terms that we are using.



We call the outer crust the rim (or cornicione). The rim isn't weighed down with sauce or cheese, which allows it to expand and brown in the oven. (Some professional pizza makers consider the shaping and crumb structure of the cornicione to be indicative of the skill and talent of the pizza maker.)

The width of the rim is determined by how far you spread the sauce and cheese, and the thickness by how you shape the pizza (and the steam that forms while it bakes). When you intentionally press down on the entirety of the dough with your hands or a rolling pin, you'll have a lower-volume rim than if you handle it minimally.

The under crust is what supports all the sauce, cheese, and toppings. In general, the longer a pizza bakes, the crispier the under crust will be. A crispier under crust won't sag when you pick it up; instead, it's able to hold what we call a plank. How a pizza is baked, how thick it is, the order of topping placement, and how many ingredients you put on top also play a role in whether a slice will sag or hold a plank (see page 6).

When we say crumb, we mean the center of the rim and the center of the under crust in pan-baked pizzas. On, say, a New York pizza, there's a clear differentiation between the rim, crumb, and under crust. The key difference between the rim and the rest of the crust is the rim is generally unsauced (see page 3:71). If you sauce a pizza all the way to the edge, then it won't have a rim. This is a characteristic of some styles (see page 4). This taxonomy only works for relatively thin floor-baked pizzas. Pizzas baked in a pan can be baked in a pan with sauce and toppings covering the entire top (such as New York square and Detroit-style) or it can be baked without a topping or without much topping or sauce (such as al taglio). Either way, it won't have a pronounced rim. Deep-dish is in contact with the sauce and toppings, so there is not as much of a rim. Typically, the sauce covers the dough almost entirely, with just a thin border left uncovered. The rim bakes to the same height as the rest of the pizza.

The bottom of the pizza (or the bottom of the crust) means the same thing for all styles of pizzas, but the bottom of a Neapolitan pizza will look very different than a Detroit-style pizza. Some pizzas have special features, like Detroit-style, which has cheese baked around the crust, or Chicago double crust, which has two crusts, like a pie. We cover the finer points of making these pizza doughs in this chapter and discuss sauces on page 203, cheese on page 285, and toppings on page 343.

Some pizzas, like a Neapolitan slice (top), have a natural tendency to droop at the end (what we call tip sag). Others, like the artisan (middle) and thin-crust (bottom) pizzas, are sturdier and can hold a plank when folded.

CRUMB

The holy grail for some pizza makers is to obtain a huge open-crumb structure. Pizza makers love to use social media to show off examples of big uneven alveoli in the rim or even in the under crust of thicker pizzas. But this doesn't apply to every kind of pizza, and the crumb structure will vary based on the pizza style. Thicker high-hydration doughs, like al taglio pizzas, have more open crumb structures—this is one of the reasons we call these pizzas bread-like. Thin-crust pizzas don't have much of a crumb structure to speak of. This doesn't make thin-crust pizzas inferior to open-crumb crusts; they're just different. And an open crumb does not always mean a better pizza.

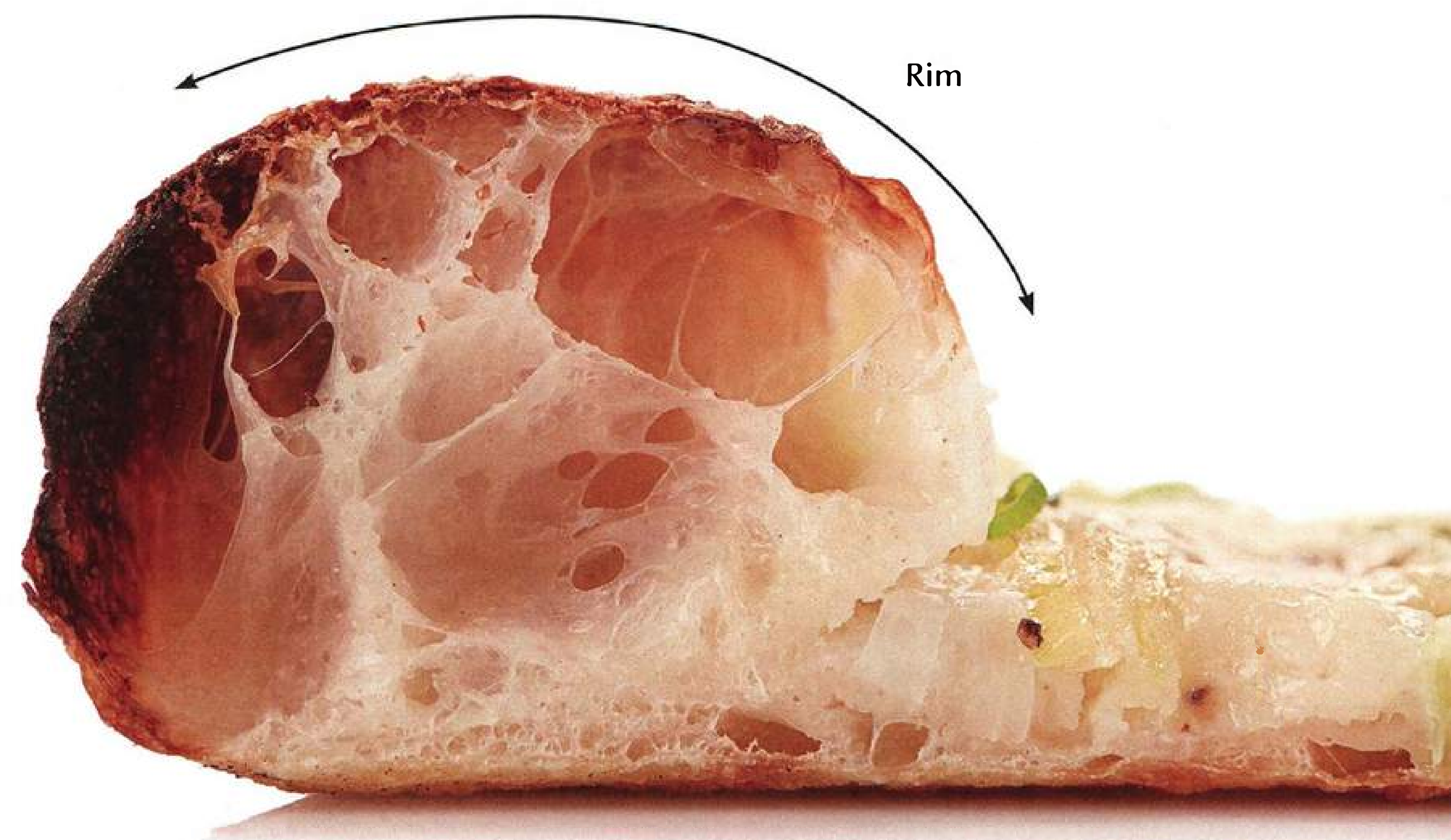
Thin-Crust Pizzas

Several factors contribute to the interior texture of a thin-crust pizza. Most thin-crust pizzas are generally lower in hydration than other styles. Less water in the dough means less steam to inflate bubbles during baking (see page 392). What matters most is how the dough is extended. Making the dough thin, either by sheeting the dough mechanically or rolling it out by hand with a rolling pin, will often produce a small or tight crumb structure. These flattening methods force most of the fermentation bubbles to pop; it's different from gently pulling on a dough and then stippling (or dimpling) it, which coalesces the bubbles and forms nucleation points for them to expand rather than collapse. Thin-crust doughs may also contain oil, or other fat, which adds flavor and makes them a little softer and easier to roll out. The oil contributes to a shorter texture in the crumb as well.

Other Pizzas

Hydration can be a factor in creating an open-crumb texture, but it isn't always. Some thicker-crust pizzas in this book (Detroit-style and New York square) are not dramatically higher in hydration than those with thin crusts. They can actually be even lower in hydration and still have a dramatically larger crumb. The main difference is how they're shaped. Artisan and New York pizzas are flattened at the center, but the outer rim is left untouched or at most is minimally handled. The intent is that it will expand while it bakes to serve as a handle of sorts to hold the pizza while you eat it. In both these styles of pizza, bubbles form in the rim and, to a lesser extent, in the under crust. Pizzas that are baked in a pan are gently stretched and stippled to coax them to fill the pan completely without tearing the dough. The gentle pulling, stretching, and stippling helps the bubbles coalesce into each other to form even larger bubbles.

Thin-crust pizzas are only crust with no crumb.



Medium-crust pizzas contain crumb, bottom crust, and a rim.

Bread-like pizzas are all crust with significant interior crumb.

THE QUALITY CHARACTERISTICS OF PIZZA

Some pizzaioli believe that using a particular flour is the key to good pizza. The AVPN (Associazione Verace Pizza Napoletana; see page 1:74) takes that idea even further, strictly regulating the type of flour that can be used to make "true" Neapolitan pizza dough according to their guidelines. Until recently, only Tipo 00 pizza flours were permitted. In 2019, they finally began allowing other types. Now, AVPN-certified pizzerias are permitted to use Tipo 0, 1, and 2 Italian flours as well.

Unlike most foods, pizza spans a range of styles. Some pizzas have desired characteristics that would be considered flaws if they were present in other styles. A key example of this is that Neapolitan pizza is supposed to be soft whereas New York or artisan pizzas are supposed to be crispy. In the case of Neapolitan, there is a whole set of rules that the AVPN has made governing both the qualities of the final pizza as well as every aspect of how it's made (see page 3:43).

It's clear, however, that people enjoy multiple types of pizzas and we don't believe in imposing a fixed set of rules. That said, in our view, there are certain quality characteristics that are universal that transcend personal preference. One of those is the presence of a gum line (see page 1:370). Under many circumstances, the dough will not fully bake due to the moisture content of the sauce on top and the relatively quick baking time, so a layer of gooey unbaked dough often lies underneath the sauce. While it's not very noticeable in thin-crust and some medium-crust pizzas, to us, any substantial amount of this gel layer is a flaw.

Another quality characteristic that must be spot on is salt. You need to strike a balance between the salt present in the dough and how much is in the sauce (both should be seasoned rather than having one underseasoned and the other overly salted). When we were gathering recipes for our database, we observed ridiculous amounts of salt called for (we chalked this up to the likelihood of typos). But then we saw that the anomalies didn't stop there.

Traditionally, Neapolitan pizzaioli added more salt to their dough in the summer because they ferment their doughs at room temperature; they want to slow down fermentation so that the dough doesn't overproof (see page 76). These days, there's no reason to vary the percentage of salt in your dough because you can proof in a refrigerator. We've also experienced both pizzerias that serve undersalted dough as well as entire styles that were undersalted (see page 1:113).

Another quality characteristic to consider is the doneness of the pizza. We were frequently served underbaked and overbaked pizzas during our travels. We also found many people who say that they prefer overbaked pizzas. Although we don't believe that we should tell them what they should like, the bitter taste of a burnt crust or topping is unpleasant to us.

We've even seen food "experts" who will argue that some things that we believe are flaws are correct. A poorly baked Neapolitan pizza is wet and soupy in the center; in Naples, and as far as we're concerned, that would be a serious flaw. But some food writers wax rhapsodic about how the center of a Neapolitan pizza should have sauce and cheese that slosh.

There are many factors to consider when evaluating the quality of a pizza, from the ratio of the rim to the center of the pizza, to the char on the bottom crust, to bubble distribution. We discuss the key characteristics and flaws for each style in the Iconic Recipes chapter on page 3:3.

Many of the attributes of a pizza style come from exaggerating some aspect of the crust (making it super thin or thick) or the amount of toppings (using a wide variety or loading them on the pizza) or the amount of cheese (in our travels, Argentinian pizzas had the most by far; see page 1:201). Each of the pizza styles have to be fairly judged according to its characteristics. When people from the U.S. first have a traditional Neapolitan pizza, either in Naples or in a VPN pizzeria, they are surprised by how soft it is and think that it is a flaw. After eating hundreds of them, we understand the draw of the soft crust. But we also noticed that in some pizzerias outside of Naples, but still in Campania, we found crispy pizza.

We don't want to say you're supposed to like something because of a specific characteristic; it's more nuanced than that. Maybe a pizza doesn't have to be crispy (e.g. traditional Neapolitan pizza in Naples) or maybe you like it a little crispy. It's important to know what the goals of the style are, but if you don't like it, make something else. We provide you with delicious recipes on page 3:3, so eat what you like.

When evaluating pizza, we use techniques similar to those used for tasting bread, like pulling the crust apart to inhale the aroma of the interior crumb. One key difference is that we have to work quickly so that the pizza doesn't cool too much, which will impact the eating experience and our evaluation.

HOW TO Set Up a Triangle Test

For many aspects of pizza, we try to have an objective measure in addition to the subjective flavor evaluation; for example, the volume of the crust (see page 1:325). But even with that, many of the aspects of making pizza have a random element. As a result, even on an objective criterion, you cannot draw a conclusion without sampling enough pizzas to understand the statistical differences (see page 396).

Most people, especially professional chefs, have an unshaken faith in their ability to taste accurately and to detect differences between ingredients, but decades of research by flavor and food scientists have shown that if we don't know the result up front, this is incredibly difficult to do. In short, if we don't know there's a difference, we don't taste it. You have to then ask, if you can't taste the difference, what's the point? Conversely, if you know there's a difference, there's a tendency to taste it even if it isn't there.

This test is designed to determine two things—first, can you tell there's a difference? Second, if there's a difference, which do you think is better? **This seems like a really simple thing, but we believe using this method can have a huge impact**. We think it's one of the most important things we cover in this book! To us, the key to making a great recipe is to ask ourselves the question, what is the difference that makes a difference, either in the ingredients or technique.

It's called a triangle test because it uses three samples, but its aim is to determine whether there's an overall difference between *two* products. The triangle consists of two samples that are identical and one that's different. We use this kind of test to determine whether a certain ingredient or technique makes a difference in a recipe.

1. A triangle test is worth doing even if it's for one person. But if you want a statistically strong result, it's better to have a panel of people—ideally 10 or more.

2. Give each taster three samples, two of the same product and a third of the comparison product. If there are visual clues to the difference, turn the lights out or blindfold the tasters.

3. Vary the order of the samples given to each taster to alleviate any prejudice that order of presentation may impose. One taster might get A A B, the next A B A, the third B A A, and so on.

4. Have the tasters taste each sample and score it. The goal is to see if the tasters can detect a difference in the samples and identify which two samples are the same. Testers often must taste the samples several times to determine the different one. To avoid taster fatigue, no more than two sets (six samples) should be evaluated in one tasting session.

We kept the plates from every triangle test performed while working on this book. The resulting stack from one taster gives a glimpse at the amount of pizzas ingested in the name of science!

PIZZA MAKING TOOLS

Ovens are the basic heavy-duty tools of the pizzaiolo (see page 1:375), but a multitude of smaller pieces of equipment are enormously helpful or even essential. In our view, a well-stocked kitchen includes the following equipment (also illustrated on page 12).

1. **Scale:** We recommend this emphatically: use a scale not measuring spoons. Measuring ingredients by weight, rather than volume, will make a huge difference in your results. For general use, the scale should measure single-gram increments. Additionally, it's useful to have a precision scale for weighing small quantities, such as the 0.06 g of yeast called for in one of our preferments. You'll find plenty of low-cost choices on the market that meet these requirements.
2. **Thermometers:** A digital probe version is best. Home pizza makers will also want an oven thermometer. You can also get a combination timer / probe thermometer and take care of two helpful tools in one.
3. **Timers:** It's best to have several. Make sure their alarms are loud.
4. **Plastic tubs:** Square clear plastic bins with airtight lids in a variety of sizes are essential. We use the Cambro brand, which is so prevalent in professional kitchens that "Cambro" has become almost a generic term for tubs.
5. **Plastic bags or tarps:** Even clean trash bags can be used to cover your dough to keep it from drying out. We prefer transparent compostable bags.
6. **Mixer:** We use an electric mixer for all of the pizza doughs in this book. You can certainly mix by hand (see page 45), but this requires more time and physical effort. We highly recommend electric mixers since most of the doughs require mixing to full gluten development.
7. **Bench knife (sometimes called a bench scraper):** Use a sharp metal version for cleanly cutting dough, lifting sticky dough, and scraping dough residue off the worktable. Plastic ones are acceptable but are generally thicker, which can sometimes be a drawback. There's a narrow bench knife we like specifically for pizza because it's also perfect for when we need to lift a ball of dough after fermenting (see Resources, page 3:377). This bench knife does a much better job than the wider ones. This tool is so practical that some pizzerias use it to cut garlic.
8. **Fermentation tubs:** Once the dough is balled, it needs to be kept in an airtight plastic tub while fermenting. Pizzerias use stackable tubs because they need to handle a large volume. At home you can use the plastic tub you bulk fermented the dough in.
9. **Peels:** Metal peels are more suitable than wooden ones for flatbreads and pizzas because they're thinner and can easily slide under the crusts (see page 388). Perforated metal peels have the advantage that any excess flour used for dusting the dough will fall through. (Baking excess flour onto a pizza dough is undesirable because it can burn.)
10. **Water spritzer:** The spritzer itself is basic, but remember to change the water in it at least weekly.
11. **Sheet pans and specialized pizza pans:** For some styles, making something that looks and tastes like the real deal can hinge on the pan. While you could technically bake all the pizzas in this book on an aluminum sheet pan, specialized pans produce markedly better results. Some have reinforced frames that keep them from warping in the oven or cured surfaces to prevent the pizza from sticking. Others are made of thicker, denser metal that produces a crispier base.
12. **Sauce spoon / spoodle:** This is used to spoon sauce onto pizza dough and to spread it evenly. Many pizzerias know how many "spoonfuls" is the right amount for each pizza. We like a spoon with a flat base for spreading.
13. **Food mill:** Tomatoes are passed through the mill to make sauce (try using one with a 8–10 mm / 0.31–0.39 in holes). Some models have interchangeable grates with different-sized holes that allow for different-textured sauces.
14. **Box cheese grater / food processor or Robot Coupe (both with cheese-grating attachment blade) / cheese-grater attachment for mixer:** Any of these can be used for shredding blocks of cheese.
15. **Squeeze bottle:** Fill with extra-virgin olive oil or your preferred oil to easily squeeze onto your pan or pizza before or after baking. Some pizzerias (especially those serving Neapolitan-style pizza) use a metal cruet with a long neck for oil, but we prefer a clear squeeze bottle because you can more easily control dosing and also see how much is left in the bottle.
16. **Wheel cutter:** This tool is very popular for cutting pizza. It does not tend to be very sharp but it works well for cutting pizza.
17. **Scissors:** Some pizzerias use scissors (especially al taglio pizza; see page 1:109) instead of wheel cutters or mezzalunas. Scissors give pizza a clean cut and don't squash the rim crust that you just worked so hard on.
18. **Baking steel or baking stone:** A steel or stone will help properly bake pizza in a home oven, combi oven, or convection oven. For more even heat radiation, you can stack two together, but this is optional.


4
6
8
5
7
10
14
13
12
11
17
15
16
9
18

PIZZA MAKING TOOLS

(19) **Kitchen towels:** Keep a stack of clean, dry kitchen towels on hand in place of oven mitts, which tend to be washed less frequently and are therefore less sanitary. Use cotton rather than synthetic fabrics, which could melt.

(20) **Bench brush:** This is useful for sweeping flour away from your work space.

(21) **Marble, granite, or wooden worktable or surface:** Working directly on a stainless steel table is not recommended for dividing and shaping dough because it tends to stain the dough with grayish-black streaks.

(22) **Bowls:** It's best to have an assortment of sizes, ideally metal, as glass tends to chip.

(23) **Rock and Roll Pizza Cutter or mezzaluna:** Either of these can be used to quickly cut pizza into slices in a seesaw motion. A serrated knife also works well when cutting bread-like pizzas.

(24) **Large bench scraper or wide offset spatula:** This is helpful for lifting pan-baked pizzas out of the pan without damaging the pizza. A rubber spatula can be used if you don't have a wide bench scraper, but be careful not to damage the crust.

(25) **Rolling pin:** This tool is helpful when rolling out thin-crust doughs. In a commercial setting, a sheeter serves the same function in a fraction of the time.

(26) **Wire rack:** Use this for cooling pan-baked pizzas after they're baked.

(27) **Oven brush:** Use this to sweep debris, such as semolina, out of the oven. Sometimes a pizza bottom will rip, leaving a cheesy, saucy mess on your oven floor. When this happens, you'll need a metal bristle brush.

(28) **Storage bins:** We use wheeled plastic bins that can easily be stored underneath counters. Lidded bins can store large quantities of grains, flour, sugar, or other ingredients.

SPECIALIZED TOOLS

(29) **Pizza trays:** Once a pizza is taken out of the oven (a floor-baked pizza, that is), it's typically put on one of these round pizza trays for serving.

(30) **Meat slicer:** This is the most efficient way to uniformly slice meats or cheeses.

(31) **Garlic slicer:** This single-use tool is very handy to slice garlic thinly à la minute.

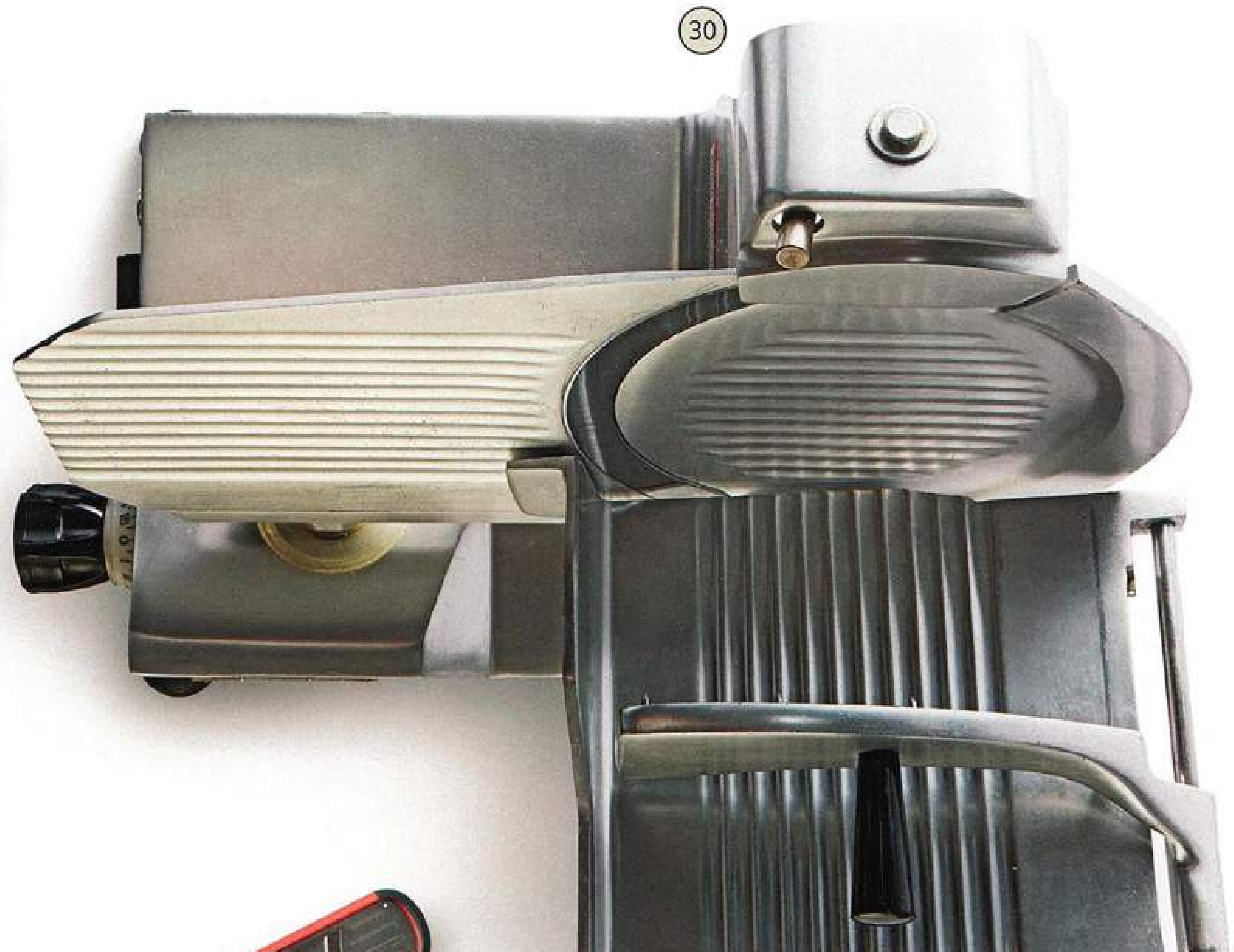
(32) **Deli containers:** Small, lightweight, reusable plastic containers with lids are invaluable for storing small amounts of salts, spices, or other ingredients.

(33) **Hotel pans in various sizes:** These are useful for holding mise en place items (cheese, sauce, other toppings).

(34) **Dough docking tool:** Docking evenly distributes a pattern of small holes across a dough's surface and keeps it from puffing up significantly. We use a rolling docker, but a fork or the tip of a skewer or knife is a handy alternative.

(35) **Dough bubble poker:** Sometimes a bubble in the dough (typically in the rim) will get big and out of control, compromising the integrity of the pizza. This long pole with a spike at the end will take care of it quickly by allowing you to deflate the bubble while the pizza is in the oven.

(36) **Sheet pan clamps:** These make it easy to move sheet pans around and out of the oven.




MODERNIST PIZZA DEPARTURES
Departure
Pizza Track
Destination
Remarks
8:00 p.m. Thin-Crust Pizza Electric pizza oven Can take 15 3/4–46 h, depending on the
3:15 p.m. Brazilian Thin-Crust Pizza Deck oven Arrives in 2–3 3/4 h
4:30 p.m. Neapolitan Pizza Gas-fired pizza oven Route can take 23 1/4–28 1/2 h
9:30 a.m. New York Pizza Deck oven Can take 38 3/4–66 3/4 h, depending on
10:00 a.m. Artisan Pizza Gas-fired pizza oven Can take 38 3/4–66 3/4 h, depending
3:30 p.m. Deep-Dish Pizza Deck oven Arrives in 2–3 3/4 h
4:00 p.m. Detroit-Style Pizza Impinger oven Arrives in 2–3 3/4 h
7:30 p.m. New York Square Pizza Electric deck oven Can take 15 3/4–46 h, depending on
7:00 p.m. Focaccia Deck oven Can take 15 3/4–46 h, depending on
7:15 p.m. Al Taglio Pizza Electric deck oven Can take 15 3/4–46 h, depending on
TICKET VENDING MACHINES

PLANNING TO MAKE PIZZA

With all things dough related, the number one question you need to ask before even starting is: When is this going to be eaten? Work backward from there to figure out when you need to begin making your dough. Some of our doughs are best when they have cold-proofed for 24–48 hours. Others have a preferment that needs to ripen before mixing into the dough. Some have a preferment *and* a 24-hour cold-proof time. Others have long bulk fermentation times. And some can be made the same day they are eaten.

What about those times when you're just not able to plan that far ahead? Not to worry. We developed what we call emergency doughs for many of the master recipes (see pages 131, 137, 147, and 163). In a pinch, they do a pretty decent job.

When you plan to make a pizza, you must also consider your location (altitude, temperature, and humidity will all influence the outcome) and type of oven (a cold wood-fired oven takes hours to reach temperature). Adjusting for these factors will ensure your dough doesn't overferment while sitting out on a hot counter.

Part of your planning will involve simple math. While dough recipes call for specific quantities of various ingredients, it's actually the percentages of those ingredients that are most meaningful. Interpreting, understanding, and applying these percentages will increase your chances of success and give you more flexibility. You'll be able to scale recipes up or down, for example, and determine how much dough you can make with the amount of flour you have on hand.

Make sure to factor in the timing for all aspects of pizza making when deciding when to start mixing your dough. For example, New York pizza dough takes significantly more time than Detroit-style or deep-dish, so you'll need to plan ahead when making that style of pizza.

We made each of our master pizza doughs and then proofed and baked them in the style of every other master pizza dough to come up with a list of which doughs work for different styles. This will allow you to make more than one style without investing the extra time of making a separate dough (see page 96).

FACTORS TO CONSIDER

Ingredients: What type of flour do I have? Hopefully you have the best type for the pizza style you want to make (see page 1:283). If you have only pastry or cake flour in your pantry, Pizza Gourmet Dough (see page 165) is your best choice since most other pizza doughs require stronger flours. Also, how much flour do you have? A pizzeria usually has sacks on hand, but at home, that's typically not the case. Also check how old your flour is. The same goes for yeast. Water isn't a huge consideration since most tap water is fine (see page 1:291).

Thermometer: Make sure it's well calibrated. Calibrate your scale while you're at it.

Preferments: Allot enough time to ripen your preferment. Check for ripeness before you mix it into a dough (see page 1:301).

Mixer(s): What is the capacity of your mixer? See our guide on page 34 to ensure you aren't making too much (or too little) dough for it to handle.

Room temperature: When we say room temperature, we mean 21–24° C / 70–75° F. Extreme conditions aren't ideal for dough, but if you can't control the temperature of the room, you can compensate by controlling the temperature of the ingredients. If the room is too hot, start with lukewarm or cold water. If it's too cold, start with warm water.

Types of dough: Many pizza doughs can be slowed down by cold-proofing them, and others have long bulk fermentations. This allows a lot of flexibility and gives you more control in getting the timing right. While there are a couple doughs that are better day-of (like Detroit-style pizza), you can control your timing comfortably with most pizza doughs.

Factors specific to pizzerias and other commercial pizza makers: We're not a commercial pizzeria, but we've learned a ton talking to hundreds of pizzaioli and pizzeria owners in our research. Throughout the book, we're including some of the tips they shared with us. Of course, every pizzeria's needs are different.

Equipment: As with mixer(s), the capacity of the oven is important. How many pizzas can you bake at the same time? The answer will vary depending on the types of pizza you make and your oven type. Neapolitan pizzas are made to order; typically, a maximum of two or three are baked at the same time, while the rest of the dough balls sit in a covered tray or sheet pan. If you're baking al taglio pizzas, you can bake all of the dough ahead of time. If you don't have the oven capacity to bake your proofed dough, you're in trouble. The solution to this dilemma doesn't necessarily involve buying a bigger oven; the thriftier solution is to space out mixing the dough, fermentation time, and baking it to get the most out of your equipment. You can also opt to slow down the dough's fermentation by cold-proofing (see page 70).

Experienced pizzaioli know how much of their dough, sauce, and cheese to have on hand at the correct temperature during service.

If you have forgotten to drain your fior di latte mozzarella or mozzarella di bufala ahead of time (see page 319), you can press fresh mozzarella on a paper towel to squeeze out the moisture. Or if you are making a lot of pizzas, try our method for vacuum sealing mozzarella on page 321.

Making a sauce can be as simple as pureeing and seasoning canned tomatoes, but if you would like to speed up the process of thickening a sauce, you can add xanthan gum to instantly thicken the sauce (see page 243).

MANAGING YOUR DOUGH SCHEDULE

Pizza dough takes time to ferment. It's a required step, and while some doughs take longer than others (see page 75), you cannot rush fermentation without drastic effects on quality. We include recipes for emergency versions of our master doughs that can suffice when you're short on time, but there are undeniable tradeoffs in flavor. And once your dough has completed the fermentation stage, the clock is ticking. Therefore, one of the key factors for success is to manage the schedule.

Generally, there are two types of fermentation—cold-proofing in refrigeration or room-temperature proofing. (Our bread-like doughs also do well when proofed at higher temperatures in a proofer.) Keep in mind that cold-proofed doughs require some time to come up to temperature before you shape and bake them. This takes longer than you'd think because fermented dough is a foam, so it's a good insulator (like styrofoam and other foams).

For those in the pizza business, there are additional considerations. Making cold-proofed doughs allows you to hold dough over for a day or two if you don't use all of it in one sitting.

Another good practice is to pull your cold-proofed doughs out of the refrigerator to temper (come up to room temperature) in stages instead of pulling them all out at once. With cold-proofed doughs you have a window of 24–48 hours (sometimes even more). If the dough feels like it is getting too gassy (bubbly) in refrigeration, reball it and let it rest at room temperature for at least 3–4 hours before you bake it (keep it covered at all times). Some pizza doughs may take longer, especially if they use stronger flour (see page 1:277). Alternatively, once you have reballed it, it can hold in refrigeration for up to 72 more hours.

If you know how many pizzas you expect to make throughout the day, you can determine more or less how many doughs you need to have ready to bake at any given point. The key is to not forget to take the doughs out of refrigeration 2 hours before you need them, to temper (if they are cold-proofed). This is a practice that we highly encourage. Some pizzaioli recommend a minimum internal temperature of 13°C / 55°F before shaping. In our experience, we found that after 2 hours, the pizza reached at least 18°C / 65°F. In pizzerias that do not cold-proof, you can be sure that the pizzas served at 6 p.m. will not be the same as those served at 11 p.m. In a hot pizzeria, the change could be drastic. If you decide not to cold-proof, you should at least make dough in batches 2 hours apart so your customers can experience the best pizza possible. You can make doughs with varying quantities of yeast. Use the doughs with more yeast at the beginning of service and the doughs with less yeast last.

The Timing of Pizza Making

The diagram on the next page below will guide you through the basic steps from mixing to tempering. We provide a comparison table for the baking times and temperatures on page 3:8. Remember, dough can be forgiving so long as you know how to take advantage of its flexibility.

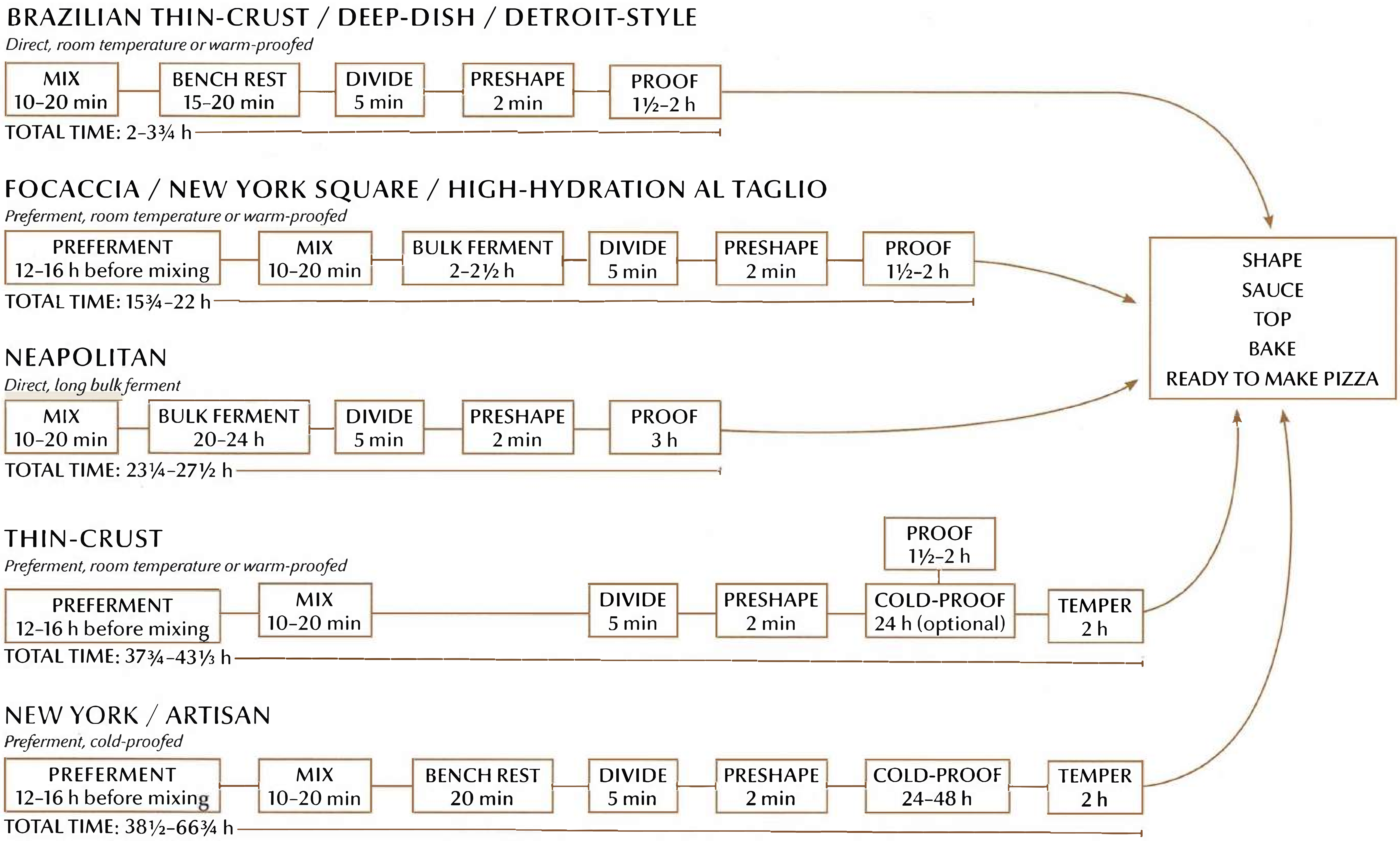
FACTORS THAT AFFECT FERMENTATION

All pizza dough has to ferment or rise, and temperature is critically important to the rate at which it rises. Technically, this includes the temperature you start the dough at (and its ingredients) and what temperature you keep the dough at as it ferments. The higher the temperature, the faster the fermentation. It's an exponential relationship, so small factors can make a big difference.

The ambient humidity is a factor if you leave your dough out and uncovered, which we don't recommend. We strongly advise fermenting in a temperature-controlled environment. If the temperature fluctuates in your kitchen, we suggest proofing in a cupboard or pantry. It's true that master pizzaioli in Naples proof at ambient temperature, but their high skill offsets the challenges of this proofing setup (see page 88).

THERE'S MORE THAN ONE WAY TO MAKE A PIZZA

A little planning goes a long way when it comes to making pizzas. Below, we showcase the breakdown of the timing for each of the steps in our ten master dough recipes. As you can see, not all doughs go through the same steps and the total time for the styles can vary widely. If you are aware of the overall amount of time you need to make each style of pizza, you can better plan for when you need to start, or select something that will fit better into your schedule, like a pizza made the same day.



EMERGENCY DOUGH TEMPERING

There are certain doughs, primarily our medium-crust doughs such as New York, artisan, and Neapolitan pizza with poolish, that benefit from cold-proofing. We recommended tempering these doughs for 2 hours before baking the pizza to produce a more relaxed dough that is easier to shape.

Tempered dough also bakes faster. A cold dough will make other components of the pizza cold, most importantly the sauce since it is in contact with the dough, and this slows down the overall baking time. Cold dough will also cool your oven floor down much more dramatically; the oven floor will need time to recover its heat.

But maybe you forgot to temper the dough, or you get swamped and don't keep up with pulling out dough to temper during service. What can you do? One solution is within reach, assuming you have a microwave.

Microwaves have their fans and detractors. They are fantastic for certain things, like making popcorn, and awful at others, like reheating cold pizza (see page 3:312).

A microwave works by reheating different internal areas of the food. Because modern microwaves can be adjusted for power and intensity, they can be controlled to microwave at minimal power, which will slowly bring the dough up to temperature without cooking it.

The challenge is that individual microwaves have different settings, so it is not easy to give specific instructions on how to warm your dough. Some microwaves have power settings that range from 10%–100% in 10% increments, while other have ambiguous buttons that are labeled for specific foods, like "fish sticks."

We suggest using the lowest possible setting on your microwave, and then warming the dough in short increments of 20–30 seconds and then letting it rest for 20–30 seconds before repeating. We successfully tempered 250 g dough balls that were at refrigerator temperatures in about 5 minutes total, including the waiting time between heating the dough, using the 10% power setting.

It helps to have a probe thermometer to monitor the temperature in the dough as it warms so that you don't overheat it. Ideally, do this just once or twice since poking holes in the dough can create weak spots and possible tears or holes as you shape the dough.

In addition to tempering, there are other emergencies that might arise. Making dough can take a significant chunk of time, depending on the style, so we have provided emergency versions of doughs that take longer than 24 hours in our Pizza Dough Recipes chapter on page 81.

UNDERSTANDING BAKER'S PERCENTAGE

You can use ingredient lists and net contents tables to compare recipes to one another, to easily scale recipes up or down, and to understand the composition of any dough at a glance. Knowing a dough's hydration, for instance, or its ratio of fat to flour, can help you know ahead of time how the dough will mix and shape, as well as how it's supposed to turn out.

These ratios are difficult to calculate using recipe volumes and weights, which led bakers to develop what is called baker's percentage, also known as baker's math. We have developed a specific percent sign to indicate when we're using baker's percentage (%) rather than scaling percentage (%). The approach is based on the premise that everything revolves around one primary ingredient: flour. For each dough recipe, the flour (or flour mixture) is set to 100%. All other ingredients are set relative to flour, rather than to the total weight of the recipe.

This may seem confusing at first because we're accustomed to thinking about percentages as pieces of a whole, but by keeping flour as the constant, we can easily compare the ingredients of one recipe to the ingredients of another. Recipe A (bottom left) is a typical example of a scaled recipe, with each ingredient occupying a percentage of the recipe's total weight. Recipe B (bottom middle), in contrast, is centered on the weight of flour. The weights of ingredients in the two recipes are identical, but the assigned percentages for recipe B—calculated relative to flour—are different. That is, the total percentage for recipe A is 100%, which tells you the overall makeup of the dough; in recipe B, however, the percentages add up to 171.11 %, which tells you that 71.11% of the flour's weight is made up of other ingredients besides flour—water, salt, and yeast in this example. But what happens when a recipe calls for a mixture of flours? You could theoretically set one of the flours to 100%, but you'll find that this approach makes comparisons between recipes more difficult. We have a simpler approach: add the flours together and set their combined weight to 100%, as shown in recipe C (bottom right). For example, a recipe that uses 375 g bread flour, 125 g medium rye flour, and 85 g spelt flour contains a total of 585 g of flour, which we set to 100%. Each additional ingredient is then assigned a percentage that's relative to the flour mixture.

RECIPE A

INGREDIENT	WEIGHT	%
Bread flour	585 g	58.44
Water	400 g	39.96
Fine salt	12 g	1.2
Instant dry yeast	4 g	0.4
Total weight	1001 g	100

RECIPE B

flour set to 100% — Bread flour

INGREDIENT	WEIGHT	%
Bread flour	585 g	100
Water	400 g	68.38
Fine salt	12 g	2.05
Instant dry yeast	4 g	0.68
Total weight	1001 g	171.11

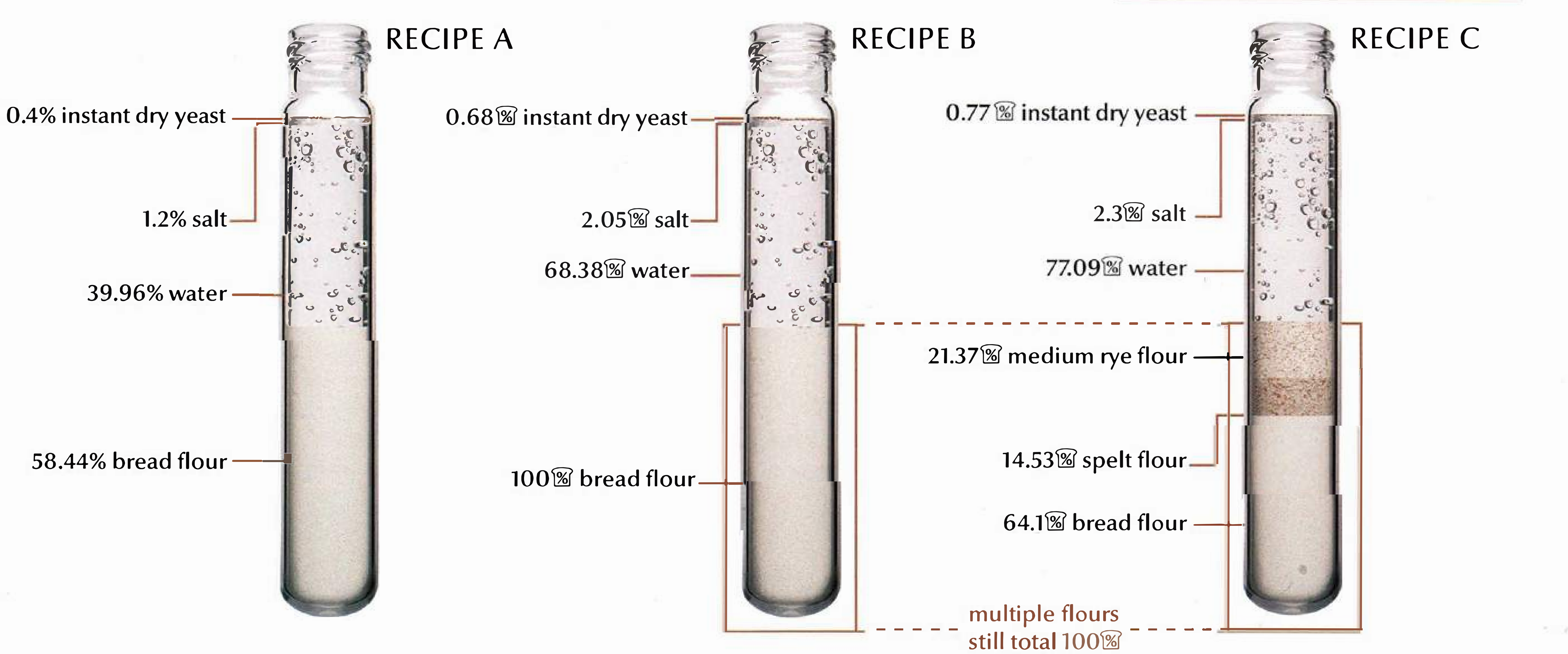
recalculated as a percentage of flour

RECIPE C

585 g total flour weight

INGREDIENT	WEIGHT	%
Bread flour	375 g	64.1
Spelt flour	85 g	14.53
Medium rye flour	125 g	21.37
Water	451 g	77.09
Fine salt	13.5 g	2.3
Instant dry yeast	4.5 g	0.77
Total weight	1054 g	180.14

—100%



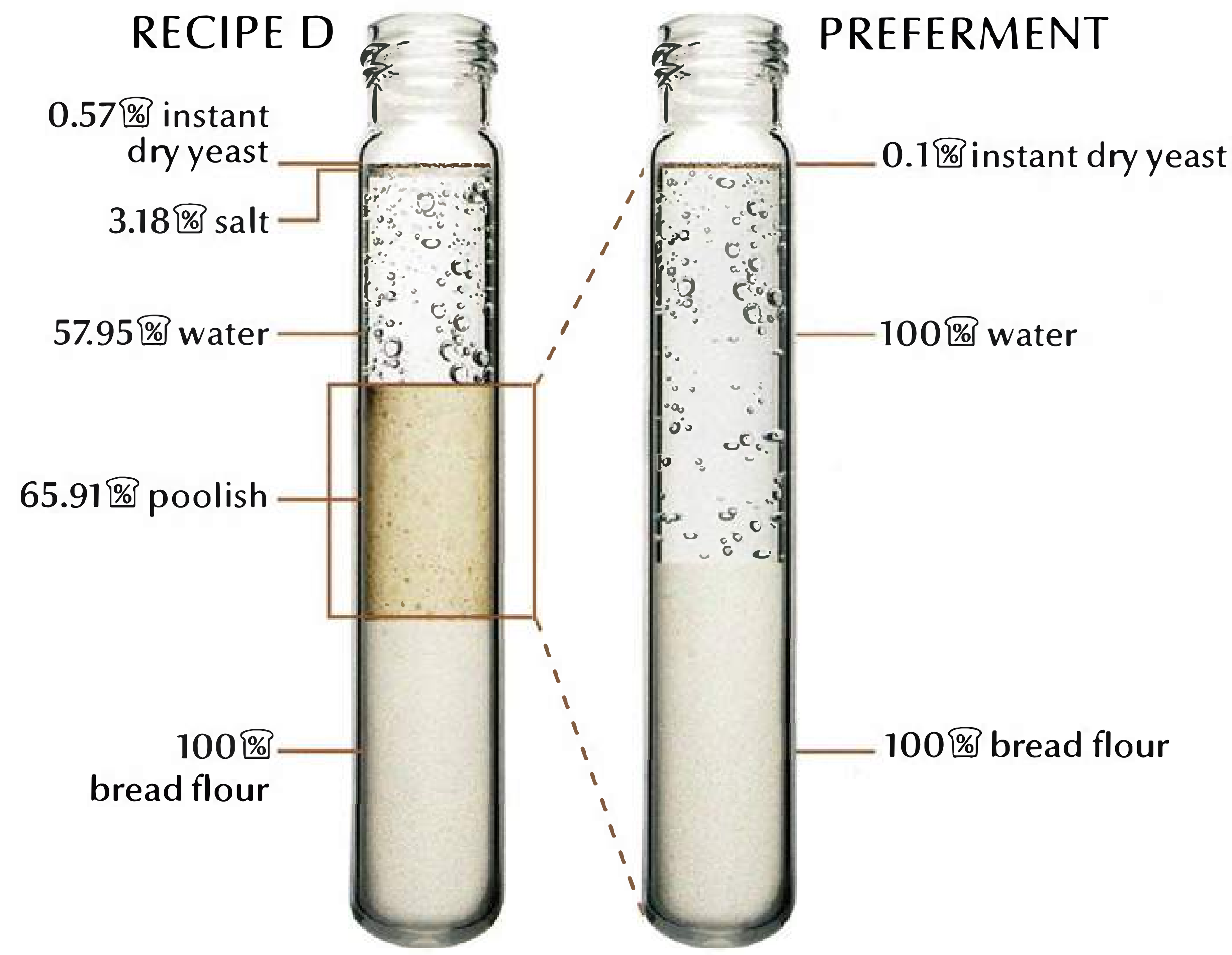
HOW TO Calculate Baker's Percentage with a Preferment

When a preferment is required, as shown in Recipe D (below), the baker's percentage column doesn't accurately reflect the net contents of the recipe because a preferment contains water, flour, and sometimes yeast, and those ingredients must be accounted for in the total percentage. This is why we include a separate table that contains the recipe's net contents. When scaling a recipe up or down, it's impossible for you to know exactly how much water a dough needs if the water for the preferment is not factored in; this logic also applies to the amount of flour.

For any dough that uses a preferment, we detail the ingredients and quantities for that part of the recipe separately. As you work through the recipes, it's a good idea to memorize the ratios for the two preferments we use (poolish and levain; see pages 1:299 and 1:302) because that knowledge will serve as a base from which to develop your own recipes.

RECIPE D

INGREDIENT	WEIGHT	%
Preferment (poolish)		
Bread flour	145 g	100
Water	145 g	100
Instant dry yeast	0.15 g	0.1
Final dough		
Bread flour	440 g	100
Water	255 g	57.95
Poolish (from above)	290 g	65.91
Fine salt	14 g	3.18
Instant dry yeast	2.5 g	0.57
Total weight of dough	1001.65 g	



Calculating Net Contents

The poolish in recipe D comprises equal parts flour and water and contains a small percentage of yeast. To create a net contents table, we must add the flour, water, and yeast from the poolish to the flour, water, and yeast in the final dough:

145 g flour from the poolish + 440 g flour from the final recipe = 585 g (this is our new 100%)

145 g water from the poolish + 255 g water from the final recipe = 400 g (68.37%)

0.15 g yeast from the poolish + 2.5 g yeast from the final recipe = 2.65 g (0.45%)

These are the net contents of Recipe D:

NET CONTENTS

Ingredients	Weight	%
Bread flour	585 g	100
Water	400 g	68.37
Poolish*		
Fine salt	14 g	2.39
Instant dry yeast	2.65 g	0.45
Total weight	1,001.65 g	

No longer exists as an item because its components have been subsumed into their respective categories

Don't confuse this table with a recipe; it is only a general outline of a recipe's contents. This recipe could be described as a lean dough that has 68.37% hydration, contains 2.39% salt, and is leavened with 0.45% yeast.

SAMPLE RECIPE

The following table and accompanying notes outline the calculations we used when we created our Deep-Dish Pizza Dough with Poolish recipe (see page 121). You'll see that there are various fats and preferments to account for in the baker's percentage column and in the final net contents. Note that the water and flour in the net contents are different than in the ingredient list because of the flour and water that the poolish contributes.

DEEP-DISH PIZZA DOUGH WITH POOLISH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	*	0.1
For the Dough			
Water, 21 °C / 70 °F	165 g	¾ cup	51.56
Instant dry yeast	3.1 g	1⅛ tsp	0.97
Bread flour, 11.5%–12% protein	320 g	2⅓ cups	100
Fine-ground cornmeal	40 g	⅓ cup	12.5
Lard, softened	18 g	1 Tbsp + ¾ tsp	5.63
Unsalted butter, softened	18 g	1 Tbsp + ¾ tsp	5.63
Fine salt	8 g	1½ tsp + ⅛ tsp	2.5
	Yield: ~700 g		

**You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

Our recipe's custom-built preferment is a poolish made of equal amounts bread flour and water and a small amount of yeast. You can calculate the percentage of yeast to use depending on when you want to use the poolish (see Strategies for Using Poolish, page 1:300). Both the flour and water are set to 100 %.

The fine-ground cornmeal doesn't contribute to the gluten structure of the dough, so we don't include it in the 100 % flour percentage.

Butter is made up of about 81 % fat and 19 % water, so you must add these values separately to the lard and water amounts to arrive at the correct figures for the Net Contents table.

NET CONTENTS

Ingredients	Weight	%
Flour	380 g	100
Water	228 g	60
Cornmeal	40 g	10.53
Fat	33 g	8.68
Salt	8 g	2.11
Yeast	3.16 g	0.83

Don't forget to include the components of the poolish (flour, water, and yeast) and the butter (fat and water) in the net contents. The baker's percentages in the Net Contents table are calculated based on this new flour amount.

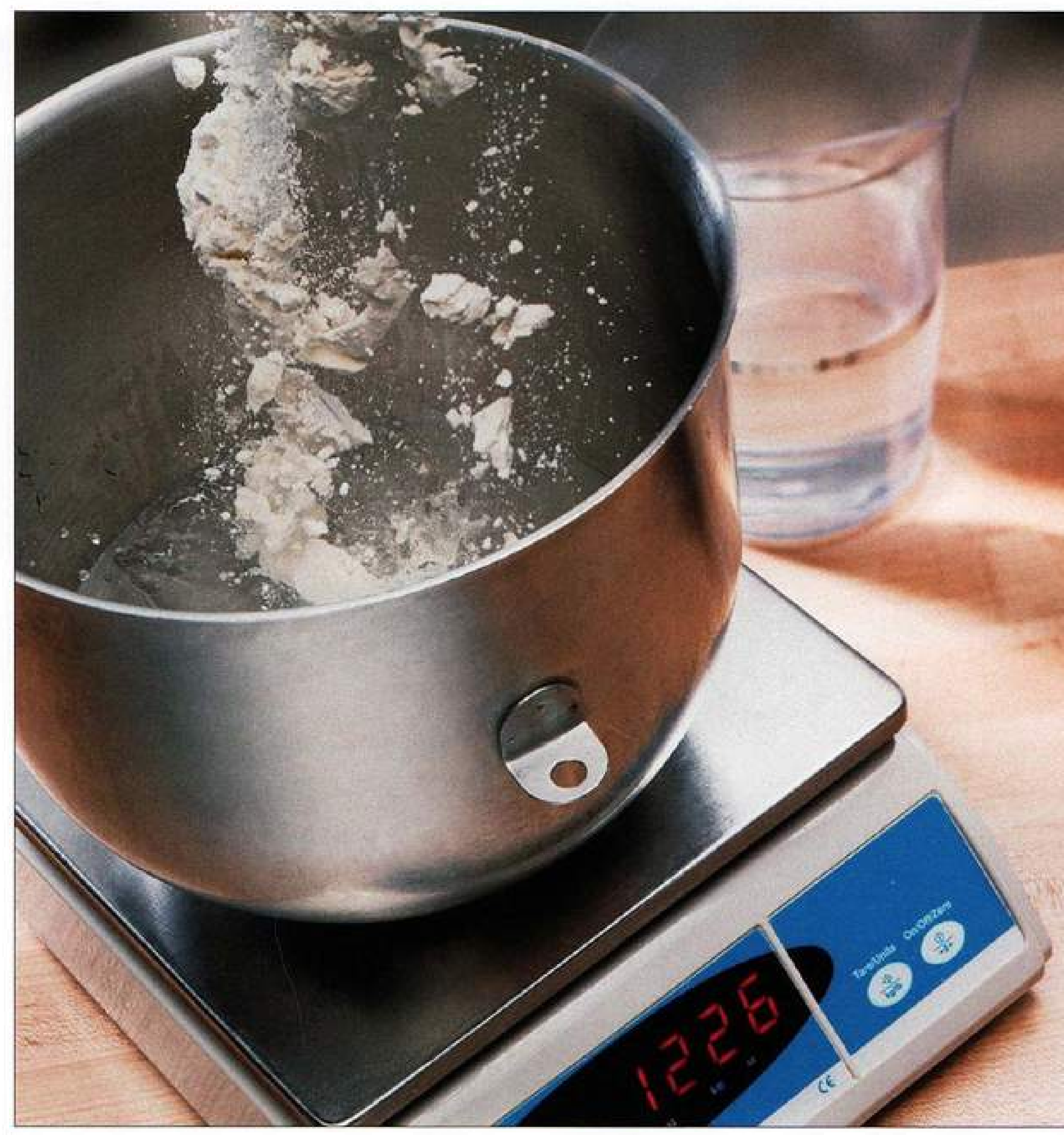
HOW TO Calculate Ingredient Weight Using Baker's Percentage (%)

If you know only the baker's percentage and need to calculate the weight of each ingredient, use the following method:

1. Determine the desired yield or desired dough weight (DDW). (Example: DDW = 10 kg)
2. Add up all the baker's percentages. (Example: total baker's percentage = 228.31%)
3. Divide the DDW by the total baker's percentage of the formula (DDW ÷ total baker's percentage). This is the weight equivalent to 1% of the formula. (Example: 10 kg ÷ 228.31 = 43.8 g)
4. Multiply the 1% weight by the baker's percentage for each ingredient to obtain its weight.

INGREDIENTS	%
Bread flour	100
Water	57.9
Poolish	66.64
Fine salt	3.19
Instant dry yeast	0.58
Total %	228.31

INGREDIENTS	%	1% PART WEIGHT	INGREDIENT WEIGHT
Bread flour	100	× 43.8	= 4.38 kg
Water	57.9	× 43.8	= 2.54 kg
Poolish	66.64	× 43.8	= 2.92 kg
Fine salt	3.19	× 43.8	= 139.72 g
Yeast	0.58	× 43.8	= 25.4 g
Total	228.31		~10 kg



It's important to accurately weigh ingredients. If you plan to mix right away, we recommend adding the ingredients straight into a mixing bowl on the scale. Weighing out ingredients in advance can save time. Store the ingredients in separate containers until the moment of mixing, at which point the ingredients can go into the mixing bowl all at once.

HOW TO Scale Recipes without Using Baker's Percentage

Sometimes you need to adjust a recipe's total dough yield. If you want to determine the weight of ingredients for a new recipe yield without using baker's percentage, you should calculate the recipe conversion factor (RCF). Once you know the RCF, you can figure out the amount needed of each ingredient through simple math. You should keep in mind that the dough may behave differently if you are scaling up the recipe dramatically.

1. Calculate the RCF by dividing the desired new yield by the original yield.

$N_y \div O_y$ = RCF
(Example: 3 kg ÷ 1.707 kg = 1.76)

N_y = new yield
O_y = original yield

2. Multiply the weight of each ingredient in the original recipe by the RCF to obtain the new weights for your dough.

ORIGINAL RECIPE

INGREDIENT	WEIGHT
Bread flour	1 kg
Water	700 g
Instant dry yeast	5 g
Salt	2 g
Yield	1.707 kg

NEW RECIPE

INGREDIENT	WEIGHT
Bread flour	1.76 kg
Water	1.23 kg
Instant dry yeast	8.8 g
Salt	3.5 g
Yield	3.002 kg

MIXING

Gluten is a self-organizing protein. This doesn't mean you can pour water on flour and walk away, hoping that dough will develop. You have to give it a little jump-start to distribute the ingredients evenly. That jump-start involves mixing. The most important function of mixing is to force the flour to hydrate, which unleashes a cascade of chemical reactions. Hydration, not kneading, is what allows a gluten network to develop (see page 29).

Hydration can be accomplished slowly by simply combining the ingredients and allowing the flour to absorb the water over time, or faster by manipulating the dough by hand, or in minutes or seconds by machines. The faster the mix, the faster the hydration—and the faster the dough will develop. We cover both approaches in this chapter.

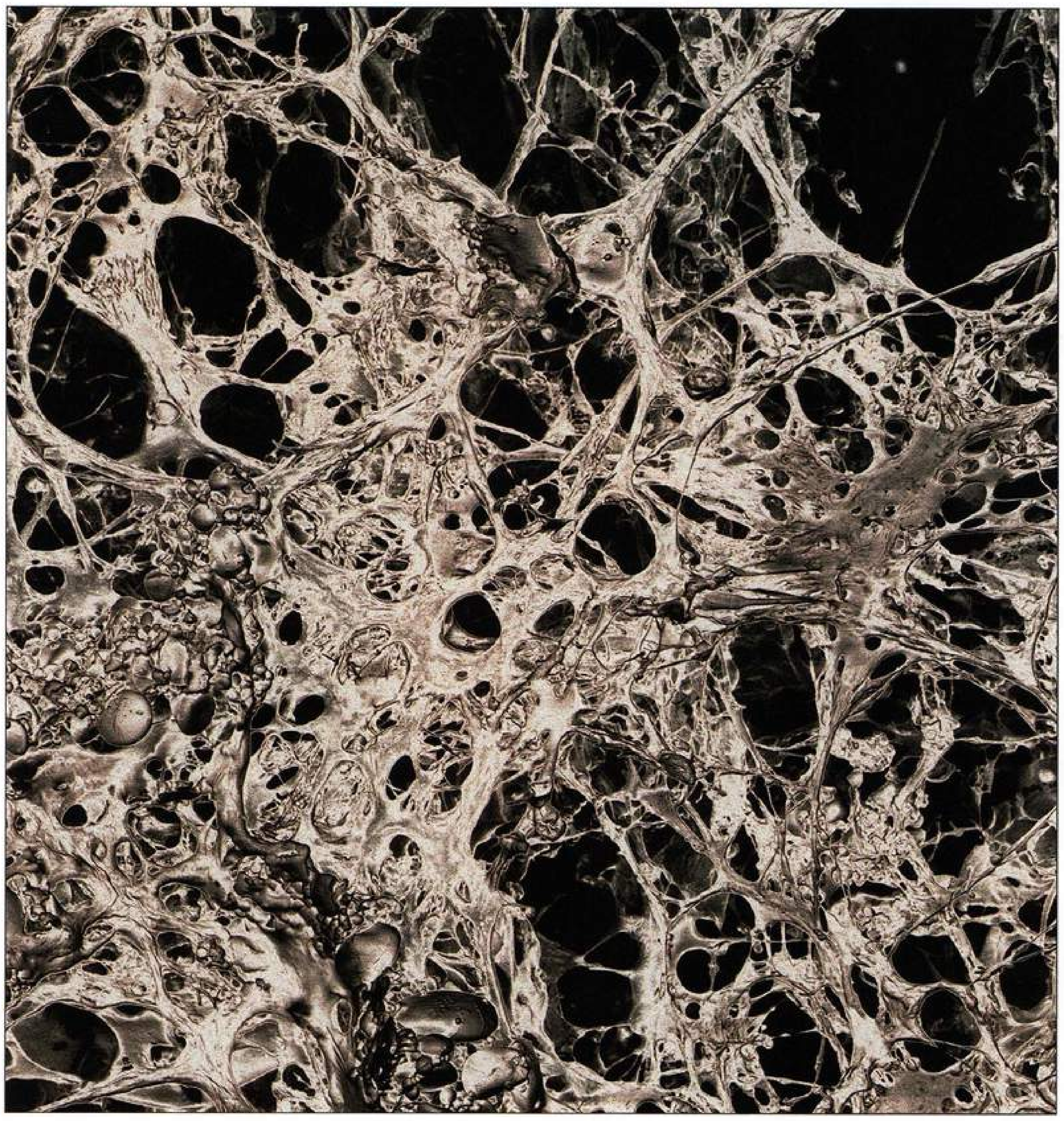
Pizza makers tend to passionately promote their own chosen mixing method above all others or insist that a specific mixer must be used for a particular type of pizza dough (such as the fork mixer for Neapolitan pizza dough). If one method works well for you, great. But the strong opinions tend to be more about personal preferences and production requirements rather than absolute rules. The reality is, there's more than one way to make very good dough, and the choice is yours. This is not to say that all mixing methods are the same (or that all mixing methods are suited for all styles of pizza dough). Machine mixing speeds up the overall process and can create a different texture in the final pizza. And it's certainly possible to overmix and create a ropy dough (see page 36).

Moreover, while hand-mixing can produce good results, it's not always practical, especially when making large amounts of dough in commercial environments. Also, most pizza doughs require mixing to full gluten development, which is daunting to do by hand. We like to let the machines do the work.

Machine mixing has a secondary effect: it creates friction, which generates heat and warms the dough. This heat helps not only with hydration but also with fermentation because yeast works faster at warmer temperatures. These factors make a mixer particularly helpful if you don't have time to let the dough fully hydrate on its own as the no-knead method requires. The amount of mixing affects how all the ingredients function together.

We mix most of our thin- and medium-crust pizza doughs to full gluten development, which means that no bulk fermentation is needed; the exception is our master Neapolitan dough, which is bulk fermented for 20–24 hours. We then divide and preshape the dough, which needs to relax for 3–4 hours before shaping and baking. The majority of our bread-like doughs are mixed to medium gluten development and then bulk fermented, with a series of folds that allow the dough to finish developing (Detroit-style pizza dough is the exception).

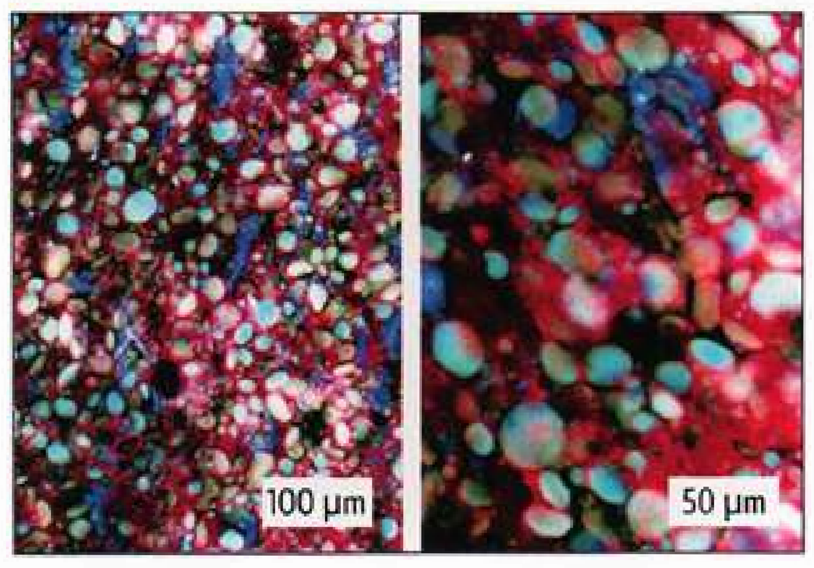
Another concept that's intertwined with mixing is autolyse (see page 32). The intent is to decrease the amount of active time spent mixing because the flour becomes hydrated in this initial rest time so the gluten development chain reaction can begin. Note that while autolyse does shorten the time spent mixing, it doesn't really save any time since the dough rests for 20–30 minutes. We found that it is not a necessary step if you are going to mix a dough to full gluten development in the mixer. However, for our high-hydration doughs that are mixed to medium gluten development, we do generally recommend an autolyse step (we do autolyse our Quad Cities pizza dough, which is mixed to full gluten development).



This image shows the gluten network at the microscopic level. We washed away the starch granules before looking at the dough under a scanning electron microscope. The resulting image shows an entangled network of gluten strands that resemble a jumble of highway interchanges.

The proofing method we developed for our master Neapolitan dough is exceptional. We discovered it only after extensive experimentation on many mixing and proofing variables (see page 88).

Although you can mix either by hand or by machine, we recommend machine mixing for all of our doughs and provide instructions for a variety of mixers in the Pizza Dough Recipes chapter on page 81.



Dough develops its structure with mixing and time. Here, dough has been stained and observed at low (left) and high (right) magnification. The gluten appears red, and the white and pale-blue discs are the starch. When dough reaches full gluten development, its components have organized into a cohesive and regular structure, with the starch granules evenly spread throughout the gluten matrix.

What happens if you don't mix? We sprinkled a few drops of water onto flour to find out. Even given an hour, the water could penetrate only a few millimeters. Then as it dried, the surface tension caused it to curl. Water stops migrating into the flour because the flour particles swell and effectively dam up the flow. Flour needs help—it's why you need to put effort into mixing.

THE DETAILS OF MIXING

The main point of mixing is to hydrate the flour. Environmental and physical factors also play a part in the speed of gluten development and the size and distribution of bubbles in the dough. The size of your flour particles will make a difference, as will the temperature of your dough, which will depend on your choice of mixing methods (see pages 34 and 45). There are many methods, and the one you choose will affect your workflow and the characteristics of your final dough.

When flour is mixed with water, proteins in the flour called glutenin and gliadin are hydrated. They're known as gluten-forming proteins because they bind almost immediately to form gluten. Proteases (protein-snipping enzymes) cut the gluten strands into smaller pieces that are able to make additional connections (see page 29). As the gluten further develops through the mixing process, the chains become more numerous and elongated, and they organize into a cross-linked net that is both extensible and elastic. That rubbery framework will give the dough structure and allow it to expand as the yeast creates gas.

Using an electric mixer will speed up the process, which has practical importance to pizza makers. The amount of water in the mix also influences this process. The more water you add, the more extensible the dough will be, which can make it unwieldy. On the other hand, the stiffer the dough, the stronger it will be, which can make it harder to stretch. Often, the area in between those extremes is the best. The amount of water also has a direct effect on both enzymatic activity and fermentation: more water means increased activity and vice versa.

While proteases are slicing up strands of gluten, other enzymes are at work on starch. Flour typically contains only 1%–2% simple sugar, which isn't enough food for the yeasts; without greater sustenance, they can't make a dough rise because there isn't enough sugar to create carbon dioxide. The flour's starch must be broken down into simple sugars that yeasts can consume and convert. The multistep enzymatic process that breaks down the starch begins with amylase, which works on the components of damaged starch: amylose and amylopectin. (About 4% of the starch granules are broken during milling, which is an important step; an enzyme can't enter an intact starch granule.)

The Mixing Trade-Off: Intensity versus Time

You can mix fast and hard or slowly and gently, but mixing is mandatory. Stir dry flour as quickly as you like; it will never turn into dough unless you add water. Or, conversely, add flour to water and let it sit in the bowl without stirring—again, the mixture will not turn into dough on its own.

The reason you have to mix flour with water to fully develop the gluten network comes down to physical chemistry. Mixing performs two indispensable operations. First, it spreads the water evenly throughout the flour, a process called dispersion. Second, mixing chemically alters the gluten proteins in the flour, a process known as hydration. To get a good, uniform dough, you have to do both operations—and dispersion has to happen either before hydration or in tandem with it.

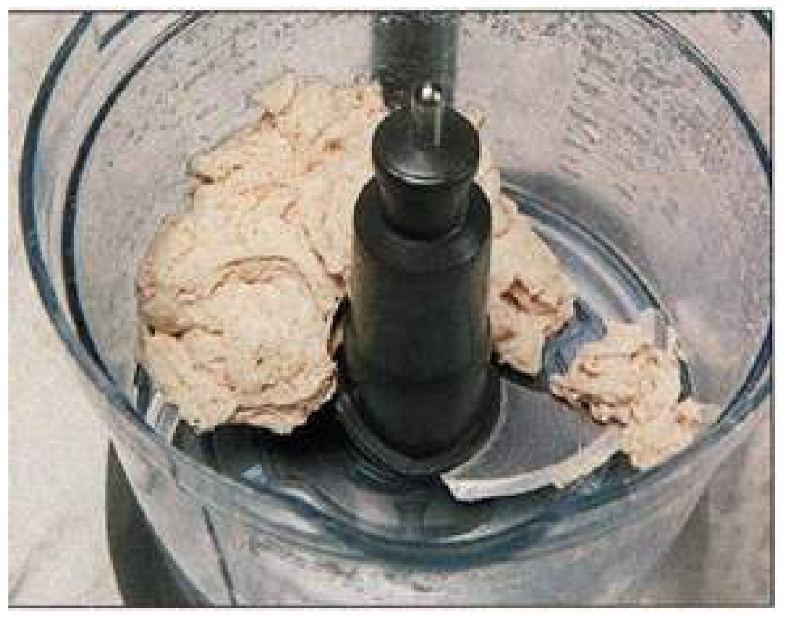
But there is no law that dictates the best mixing method, speed, or time to produce a particular kind of dough. You can get the same good results using a wide range of methods if you understand how to trade off time and intensity—and how high-energy mixing can cause side effects.

Water can move only so far on its own through a mass of flour. It needs the push of mechanical agitation to achieve full dispersion. That's why even slow-mixing techniques used for autolyse and no-knead doughs include an initial stirring step. Hydration happens quickly, but it takes time to form the chemical attachments that knit gluten proteins together into an elastic network. That's why even very high-energy mixing techniques involve some stirring.

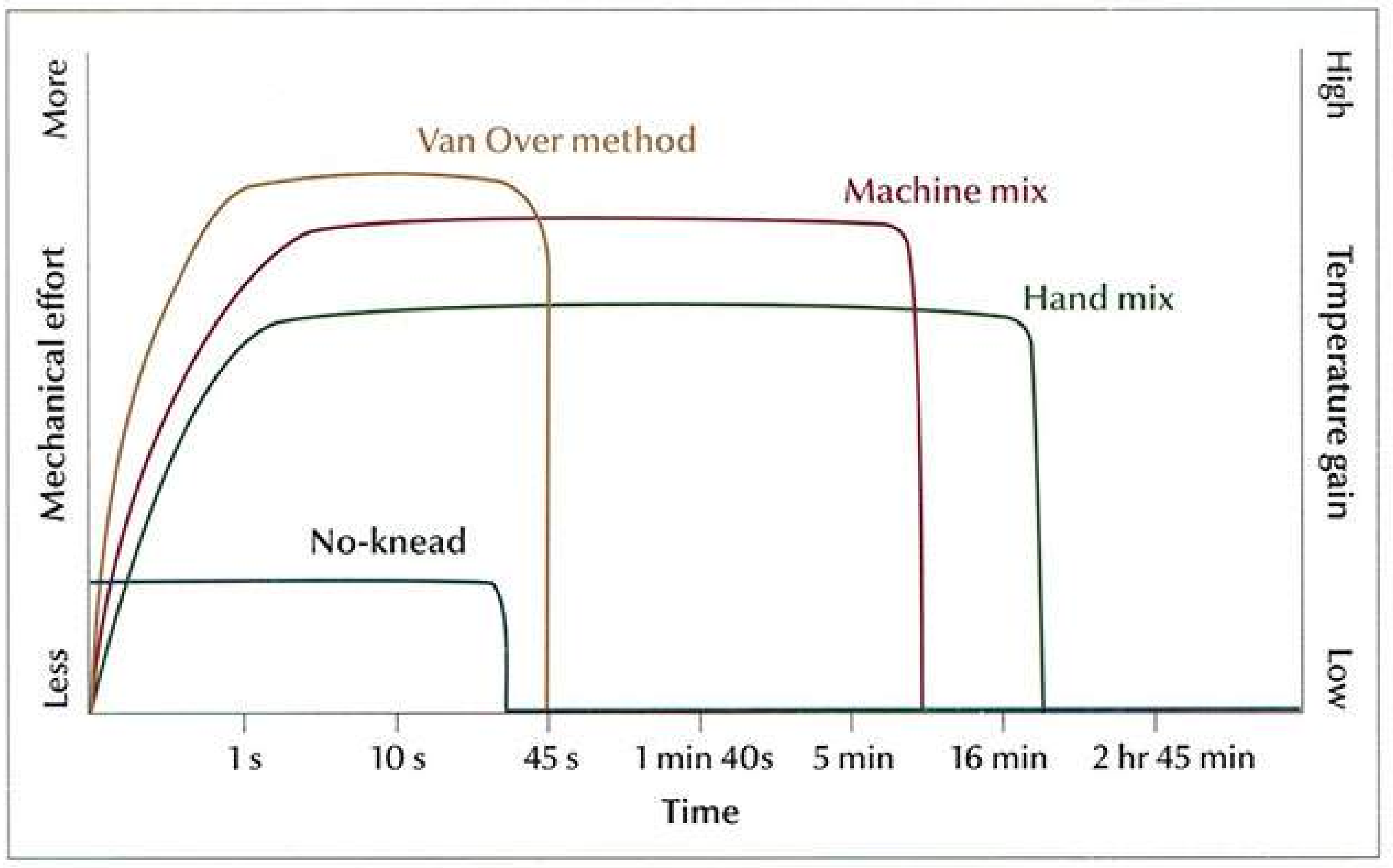
Think of it this way: mixing = mechanical power × time. The more time you allow, the less energetic the stirring can be. You can make a no-knead dough using very little physical effort if you have hours to spare. Pros typically make the opposite trade-off: they use powerful, fast-moving mixers to shorten the timelines.

Machine mixing can have side effects that may be desirable in some situations. Friction is one of them: the faster you stir, the more the dough heats up. This can accelerate fermentation. Excessive heat also can impact fermentation. If yeasts get too warm, they feed too quickly, and flavor doesn't develop properly. Also, your dough can quickly overproof.

All mixing methods perform essentially the same operations—diffusion and hydration—but at different rates and with subtle differences in their side effects.



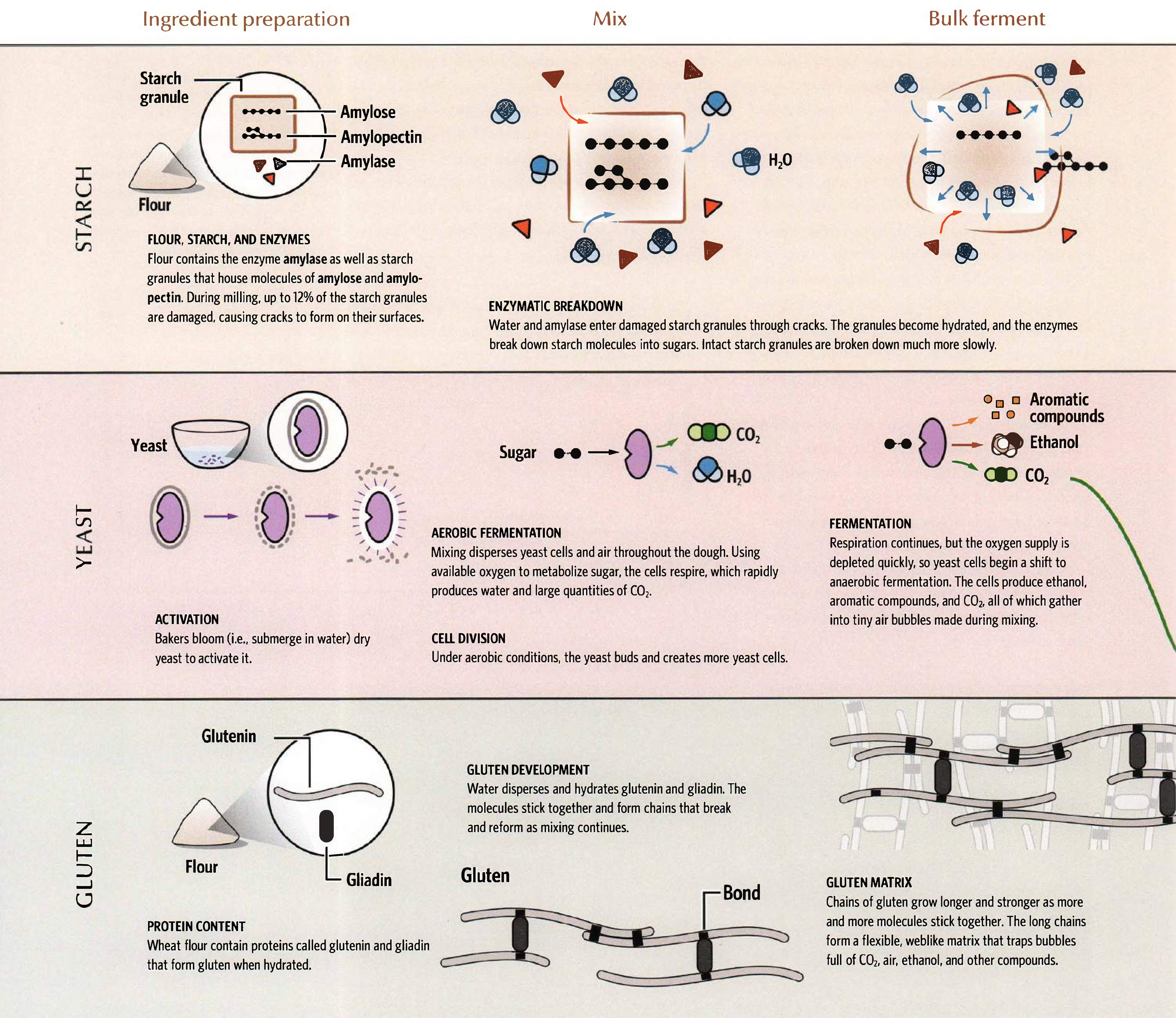
Mixing = mechanical power × time. This graph depicts the trade-off between mechanical power and time when mixing dough. The more powerful the mixer, the less time needed to mix the dough. However, the more powerful the mixer, the more friction is produced, which can lead to unwanted heat transfer.



Doughs mixed in a food processor (top) use a high amount of mechanical power in a very short amount of time: 45 seconds to reach full gluten development. Doughs mixed by hand (left) are on the other end of the spectrum and require a long bulk fermentation stage to allow the gluten to develop.

WHAT HAPPENS INSIDE PIZZA DOUGH

If you want to control the quality of your pizza or adjust the recipe for different circumstances, it helps to know what's happening behind every change that you see, feel, and smell. As flour is hydrated, enzymes break down some damaged starch molecules into sugars, and proteins combine to form elastic gluten strands, as we discuss at length on page 29. Through respiration and fermentation, yeast cells produce carbon dioxide, which gathers in tiny air pockets in the dough (see page 71). These bubbles inflate, are trapped by the web of gluten strands in the



FLOUR, STARCH, AND ENZYMES
Flour contains the enzyme **amylase** as well as starch granules that house molecules of **amylose** and **amylopectin**. During milling, up to 12% of the starch granules are damaged, causing cracks to form on their surfaces.

ENZYMATIC BREAKDOWN
Water and amylase enter damaged starch granules through cracks. The granules become hydrated, and the enzymes break down starch molecules into sugars. Intact starch granules are broken down much more slowly.

ACTIVATION
Bakers bloom (i.e., submerge in water) dry yeast to activate it.

AEROBIC FERMENTATION
Mixing disperses yeast cells and air throughout the dough. Using available oxygen to metabolize sugar, the cells respire, which rapidly produces water and large quantities of CO_2.

CELL DIVISION
Under aerobic conditions, the yeast buds and creates more yeast cells.

FERMENTATION
Respiration continues, but the oxygen supply is depleted quickly, so yeast cells begin a shift to anaerobic fermentation. The cells produce ethanol, aromatic compounds, and CO_2, all of which gather into tiny air bubbles made during mixing.

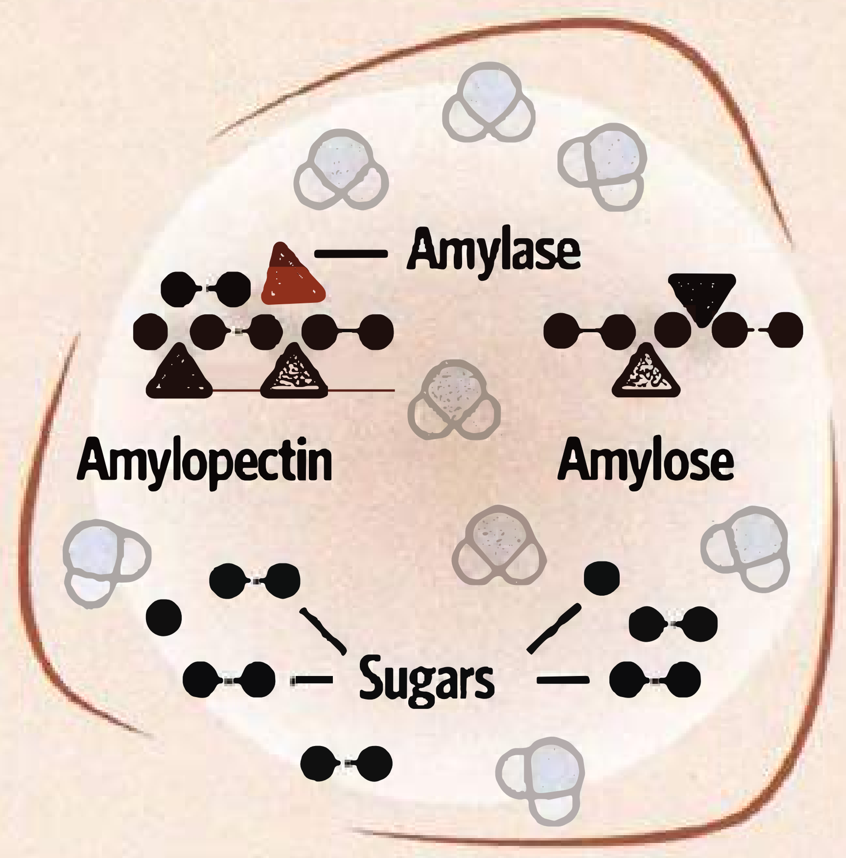
PROTEIN CONTENT
Wheat flour contain proteins called glutenin and gliadin that form gluten when hydrated.

GLUTEN DEVELOPMENT
Water disperses and hydrates glutenin and gliadin. The molecules stick together and form chains that break and reform as mixing continues.

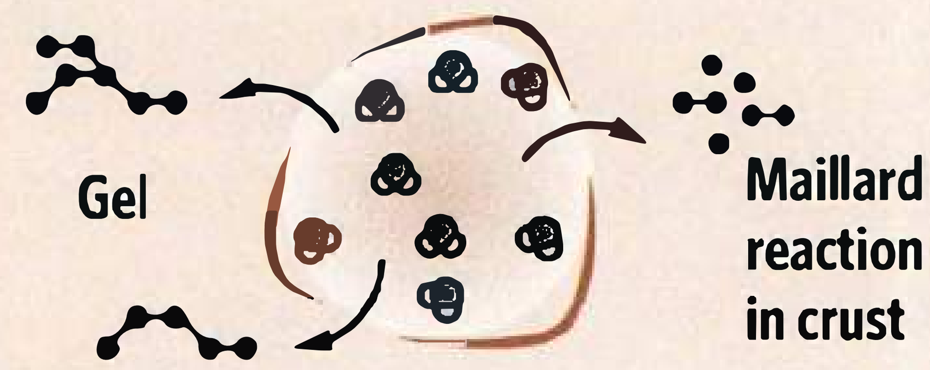
GLUTEN MATRIX
Chains of gluten grow longer and stronger as more and more molecules stick together. The long chains form a flexible, weblike matrix that traps bubbles full of CO_2, air, ethanol, and other compounds.

dough, redistribute and subdivide as the pizza dough is shaped, and then expand again in a controlled way as the dough proofs. The dough further expands in the oven, in a process known as oven spring, as yeast cells produce a final rush of carbon dioxide when heated until the dough becomes hot enough to kill the yeast. With the oven's heat, starch granules gelatinize, while sugars brown the crust through the Maillard reaction (see page 393).

Shape | Final proof | Bake | Cool

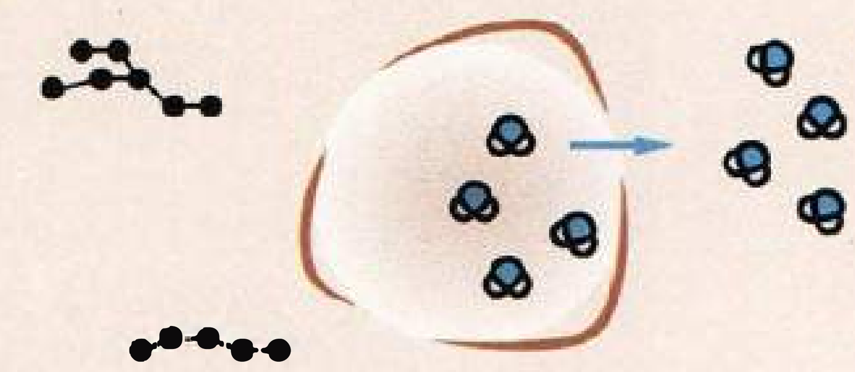


ENZYMATIC BREAKDOWN (CONTINUED)

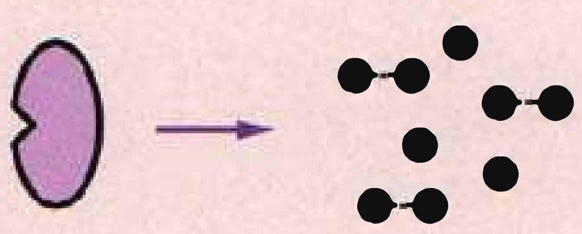


BROWNING
The surface of the rim and under crust dries out, allowing the surface temperature to exceed 100 °C / 212 °F, causing Maillard reactions to occur more and more quickly.

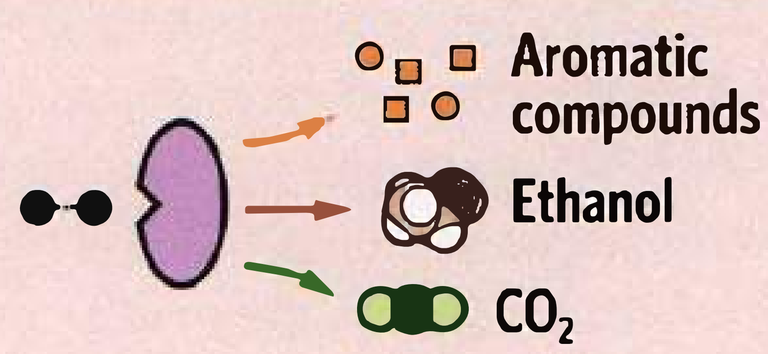
GELATINIZATION
As the dough heats, the surfaces of undamaged granules crack. They swell with water and expel starch molecules. Between 60 °C and 80 °C / 140 °F and 176 °F, the molecules form a gel.



RETROGRADATION
Gelatinized starch slowly recrystallizes. Water migrates out of the granules, and the molecules restructure into more organized chains. Staling occurs through **retrogradation** and dehydration.

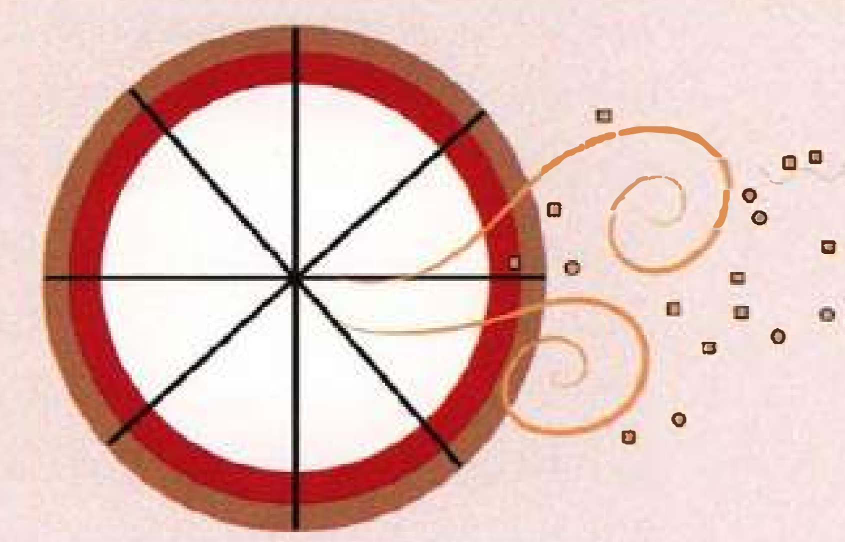


REDISTRIBUTION
Yeast cells are redistributed as the dough takes shape, exposing the cells to new supplies of sugar to ferment.

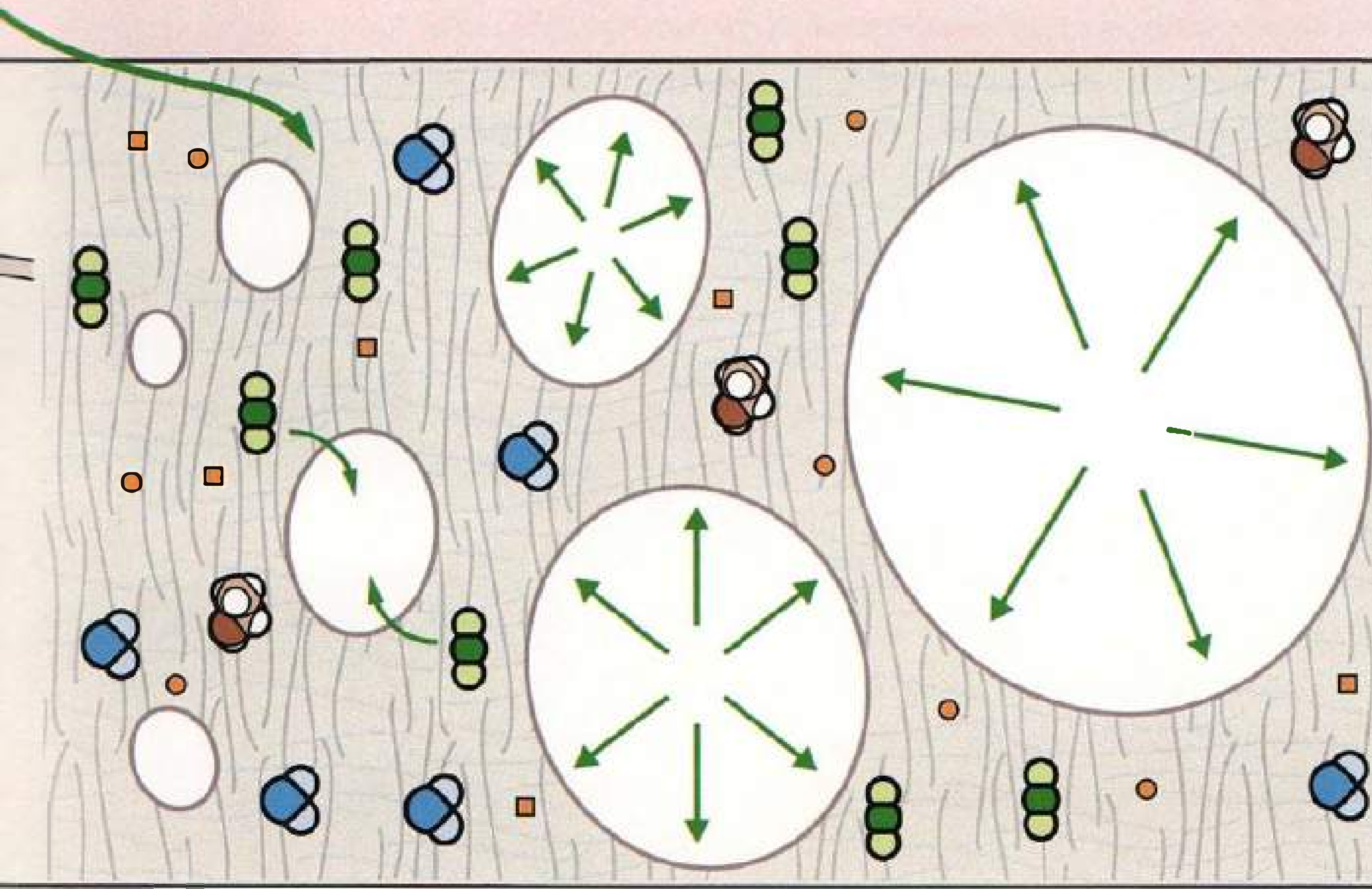


FERMENTATION
Fermentation continues, but the baker can regulate proofing time by adjusting the temperature.

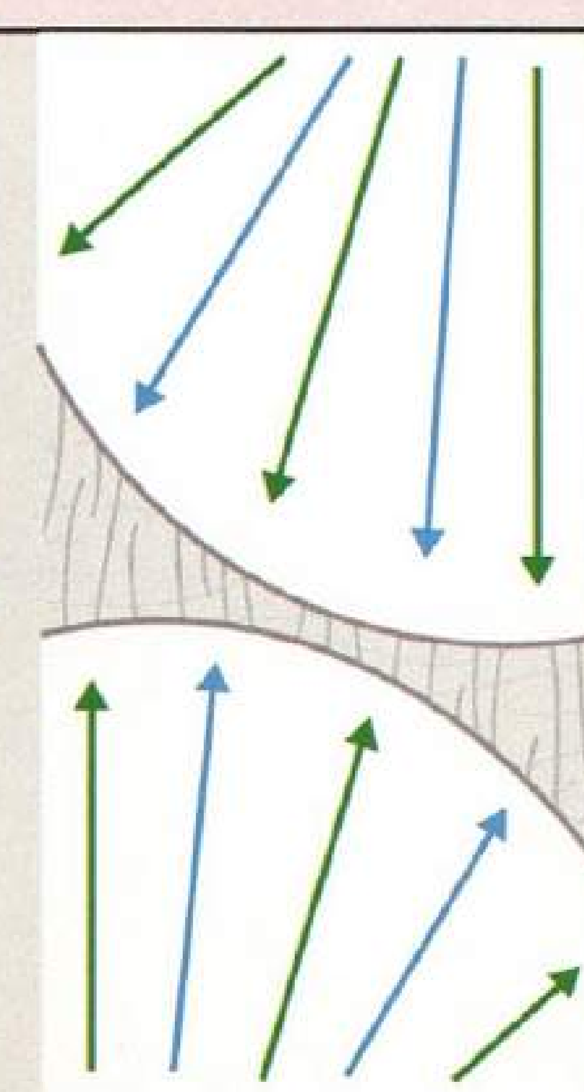
OVEN SPRING
The rate of fermentation increases as the dough heats. Yeast cells expel bursts of CO_2 until the temperature reaches 50 °C / 122 °F, at which time the microbes begin to die. The Maillard reaction occurs when the crust exceeds 130 °C / 265 °F, causing it to brown.

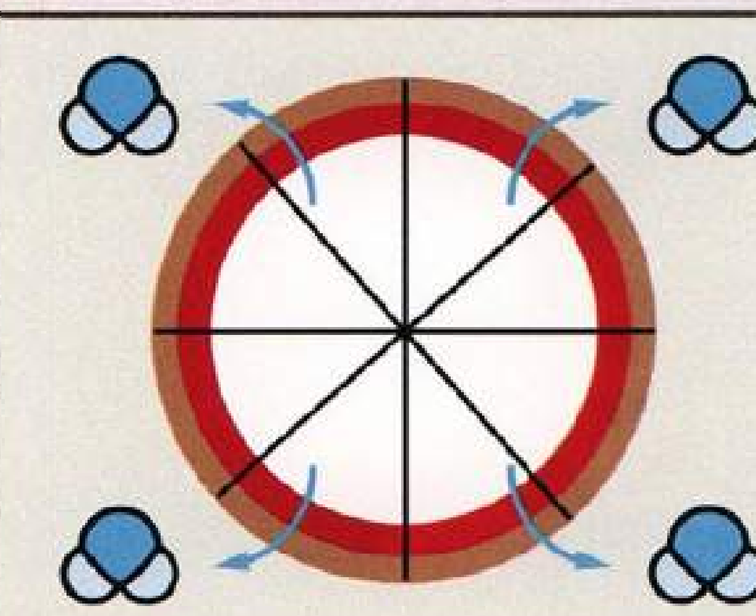


FLAVOR LOSS
Aromatic compounds contribute to the crust's freshly baked flavor. Over time, they dissipate, changing the taste and aroma.



STRETCHING
The **gluten matrix** stretches to accommodate increasing gas pressure in the bubbles caused by the expansion of CO_2 and the vaporization of water. Proteins coagulate, and starches gelatinize to set the structure of the crumb.





MIGRATION
Water migrates back into the gluten matrix and/or escapes from the crust. The pizza crust dries as more water is lost.

THE SCIENCE OF HOW BUBBLES ARE BORN

Mixing transforms ingredients into dough in four distinct ways. The first is obvious: it disperses the flour, water, and other ingredients. The second and third are subtler but intuitive: mixing hydrates the starches and proteins in the flour by attaching water molecules to them, and it develops bonds among gluten strands. Hydration and gluten development are what make dough stretchy.

The fourth function is just as indispensable as the others, yet it's rarely mentioned: mixing aerates the dough. Although air is never listed in recipes, it's a crucial ingredient, not for what it is—mostly nitrogen and oxygen—but for what it does: it forms myriad minuscule bubbles throughout the dough.

In a classic experiment in the 1940s, researchers (one of them aptly named J. C. Baker) tried making dough without air by mixing inside a vacuum chamber. The resulting bread was bizarre. The crumb looked like a honeycomb. Instead of the usual arrangement of thousands of small cells spread throughout the loaf, all the cells were huge and there were far fewer of them. The researchers' conclusion, which other work has confirmed, was that air bubbles created during mixing are essential to a proper crumb structure because they serve as nucleation sites, starting points for the balloon-like cells that inflate during fermentation and the initial stages of baking.

Why doesn't yeast make the bubbles itself? The short answer is, it can't. The longer answer involves a phenomenon known as Laplace pressure. You know about surface tension, which is what draws a raindrop into a spherical shape as it falls through the air. Laplace pressure is the surface tension that squeezes a bubble of gas drifting in a fluid (or in a stretchy semifluid, like dough). The smaller the gas bubble, the higher the Laplace pressure and the harder it is to inflate the little bubble. Taken to its logical extreme, this is why we can't form an infinitesimal bubble. A bubble's surface tension is inversely dependent on its radius, so a zero radius bubble would require infinite energy to form.

When yeast secretes carbon dioxide, that gas is always dissolved in the water surrounding the yeast cells. Absent a nucleation site, the only way a bubble can form is if the carbon dioxide happens to collect in one spot, come out of solution, and build up enough concentration to overcome the Laplace pressure. That's a bit like an empty balloon spontaneously inflating. It just doesn't happen.

But when you stir ingredients together or tumble them into each other in a mixer, you trap little pockets of air inside the forming dough. These bubbles are mostly so small—typically under 0.01 mm across—that they are barely visible to the naked eye. But they're big enough to reduce the Laplace pressure to the point that inflation can get going.

The same principle is at work when beer foams as it's poured into a pint glass. Beer in the bottle is highly carbonated. Yet it just sits there when you pop off the cap. It's not until you pour the liquid out and entrain air bubbles that you get a fine, bubbly head.

Bubbles also form so readily in dough because the geography is welcoming. The rough edges of flour particles are ideal territory for trapping the little air bubbles that act as nucleation sites. You can see the importance of texture if you plunge a wooden dowel into a glass of soda water versus a glass rod. Tiny bubbles will cling much more readily to the rough dowel than to the smooth rod.

Each of the air bubbles created during mixing has the potential to turn into a larger cell in the crumb as it expands during proofing and baking (for details on the latter, see The Science of How Bubbles Grow in Dough, page 70). You can thus exercise some control over the texture of the crumb by changing the number of bubbles in the dough. And you do that by adjusting your mixing technique.

It's like beating egg whites. If you stir the whites with a spoon, you can make an egg-white omelet that is slick and solid. Beat them gently with a fork for a slightly airy omelet, or vigorously with a whisk for a much fluffier one. With a hand blender, you can whip eggs into a foam as thick and uniform as shaving cream. Similarly, when you mix dough, the more energy you put in and the higher the speed and shear forces of the mixing tool, the smaller, more uniform, and more numerous the air bubbles will be. Smaller, however, is not necessarily better. Remember the Laplace pressure: smaller bubbles resist inflation more than bigger ones do.

Bubbles must appear from somewhere; they have to grow from nucleation sites. The nooks and crannies of a rough wooden dowel (right) serve as better nucleation sites than the smooth surface of a glass rod (left). When we inserted both into a glass of carbonated water, the agitation caused the carbon dioxide to come out of solution, making more bubbles stream off from the wooden dowel than the glass rod. The nucleation sites in dough come from tiny air bubbles introduced during mixing.

GLUTEN DEVELOPMENT

Gluten goes through many changes from the time the dough is barely mixed until it's fully developed, but the three distinct stages outlined below are generally accepted as benchmarks. The method used to check gluten development is called the windowpane test (see page 30) and involves taking a portion of dough in your hands and stretching it: the more the dough can stretch without tearing, the more the gluten has developed. Visual and tactile clues identify each stage, but both home and commercial pizza makers can have issues assessing gray areas.

Factors of Proper Gluten Development

Gluten gives body and structure to a dough, holding all the components in place. It's what makes a baked pizza pleasantly chewy and springy. It's also the elusive element that's hard to re-create when you make gluten-free doughs, which can depend on other ingredients such as egg whites for structure. Nearly every element of the mixing process can affect the gluten's development and the corresponding strength of the dough.

Ingredients are the first variables in the process, particularly flour. Protein content varies among flours, and the higher the protein content, the more gluten the dough can typically form. Some wheat varieties, including semolina and most ancient grains, don't have good gluten-forming properties, which is why they are often blended with other flours in dough recipes (see page 181).

The quantity of water also plays into the process. Adding too little water won't work; the flour must be sufficiently hydrated to activate the proteins that form gluten. Too much water also causes problems, resulting in more of a batter than a dough; a gluten network will form but never produce a cohesive mass. Salt strengthens gluten bonding, which is why dough tightens when you add salt after autolyse. Fats also slow down the process by coating the protein strands, which is one reason enriched doughs call for longer mixing times.

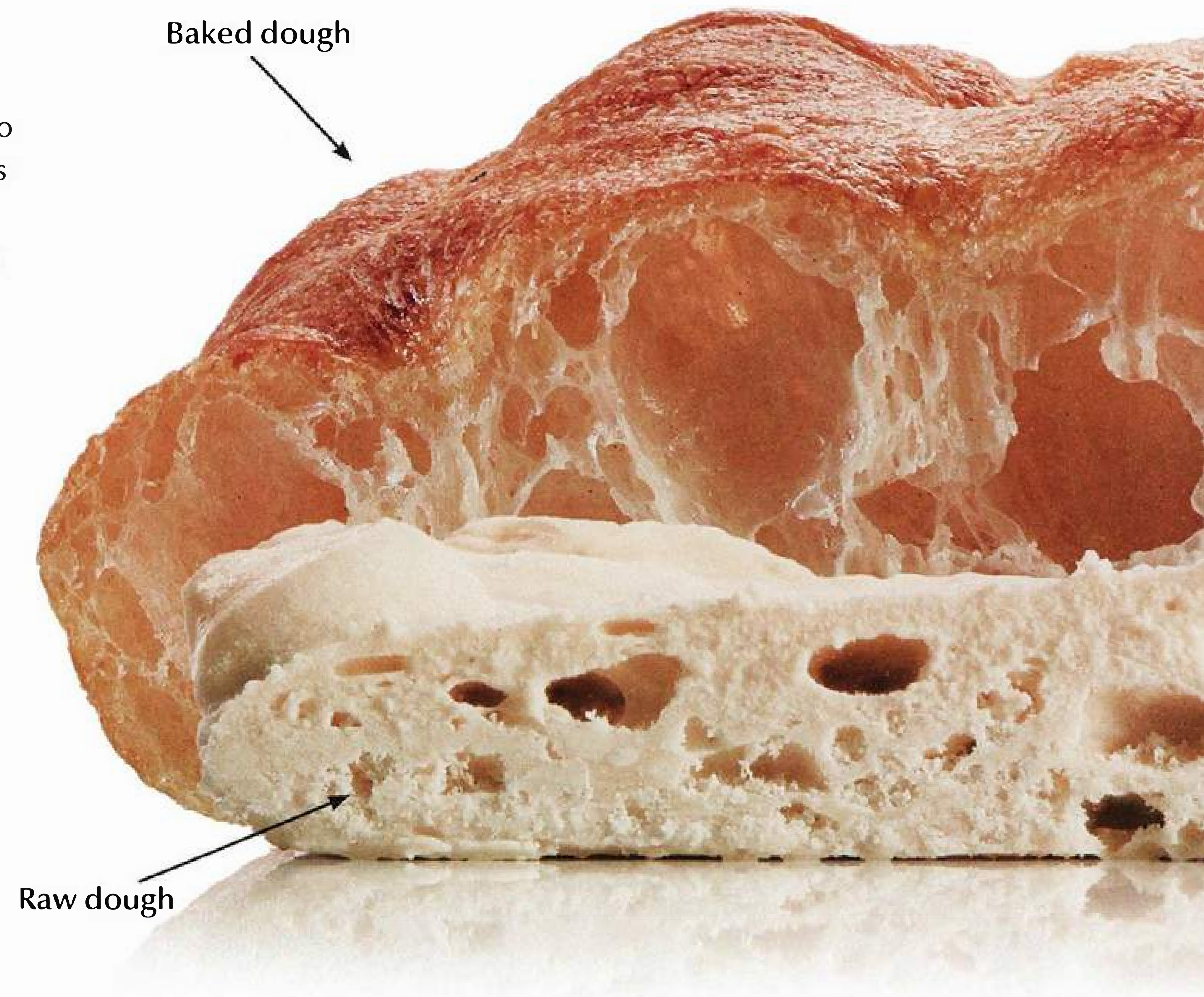
Time serves as a general tool for controlling gluten development: the longer the flour and water spend together during the hydration process, the more numerous the gluten bonds will be, while a longer mixing time will speed up hydration by forcing the water into the flour. Time also allows enzymes to assist in gluten development and, most notably, in extensibility. Mixing methods also matter. Hand-mixing techniques won't hydrate the dough—and develop the gluten—as fast as machines.

We highly recommend mixing high-hydration dough by machine because it will take significantly longer to develop sufficient gluten if you mix by hand. These slack doughs are also hard to handle, so it's better to let your mixer handle the job.

WHAT KIND OF STUFF IS DOUGH?

Is dough, in chemical terms, a mixture, a colloid, a solution, or a gel? Once you have added the liquid ingredients to the dry and stirred the mixture sufficiently to make it homogeneous, it's no longer a mixture because there's no mechanical process that can separate the flour, salt, water, and other ingredients back into their starting states. A colloid, also known as a colloidal suspension, consists of chemically distinct particles dispersed evenly throughout a liquid medium. A well-blended vinaigrette, for example, is a colloid; so is mayonnaise. Dough is not because the substances in it don't aggregate into particles (some gluten-free doughs are exceptions).

Dough made with wheat flour certainly contains a highly concentrated solution of salts, sugars, proteins, fats, and starches, all dissolved in a relatively small amount of water. But the network of tangled gluten proteins that gives dough its elasticity traps minuscule pockets of that solution, like fish in a net. Raw dough is thus a gel, technically speaking. Dough that has risen contains tiny bubbles of gas, which fill with water vapor, carbon dioxide, and ethanol as the dough bakes and solidifies. Proofed dough is a closed-cell foam; baked pizza dough is an open-cell foam (like a sponge). Fully baked pizza, then, is a set foam. Like other solid foams, baked pizza (the dough part) is an insulator that tends to trap heat rather than transmit it.



Low Gluten Development

Mixing a dough to low gluten development involves combining all the ingredients by hand or machine and then allowing for a long bulk fermentation in combination with a series of folds to develop the gluten and strengthen the dough. In this book we do not mix any doughs to this stage, but if you choose to mix your doughs by hand, this is a way to produce a dough without a lot of physical effort.

After mixing to low gluten development, gluten chains have begun to form, and the dough is more cohesive. If you were to perform a windowpane test, the dough would tear immediately. The primary difference between mixing to shaggy mass and low gluten development is that the dough is smoother and more uniform in the latter case. This time will vary depending on the type of mixer that you are using. The higher the hydration percentage of the dough, the longer it will take to mix.

Medium Gluten Development

Our higher-hydration doughs are mixed to medium gluten development to strengthen them and form an open crumb structure. These doughs are then bulk fermented to allow the dough to reach full gluten development.

The dough is now much smoother and more cohesive. As you mix, it will start to pull away from the side of the bowl but not completely. If you perform the windowpane test, the dough will stretch for 2–3 seconds before it tears. The average mixing time can vary greatly, ranging from 4 minutes for a stand mixer to over an hour for a diving arm mixer. We recommend mixing to this point for bread-like pizza doughs like New York square pizza dough and high-hydration al taglio pizza dough.

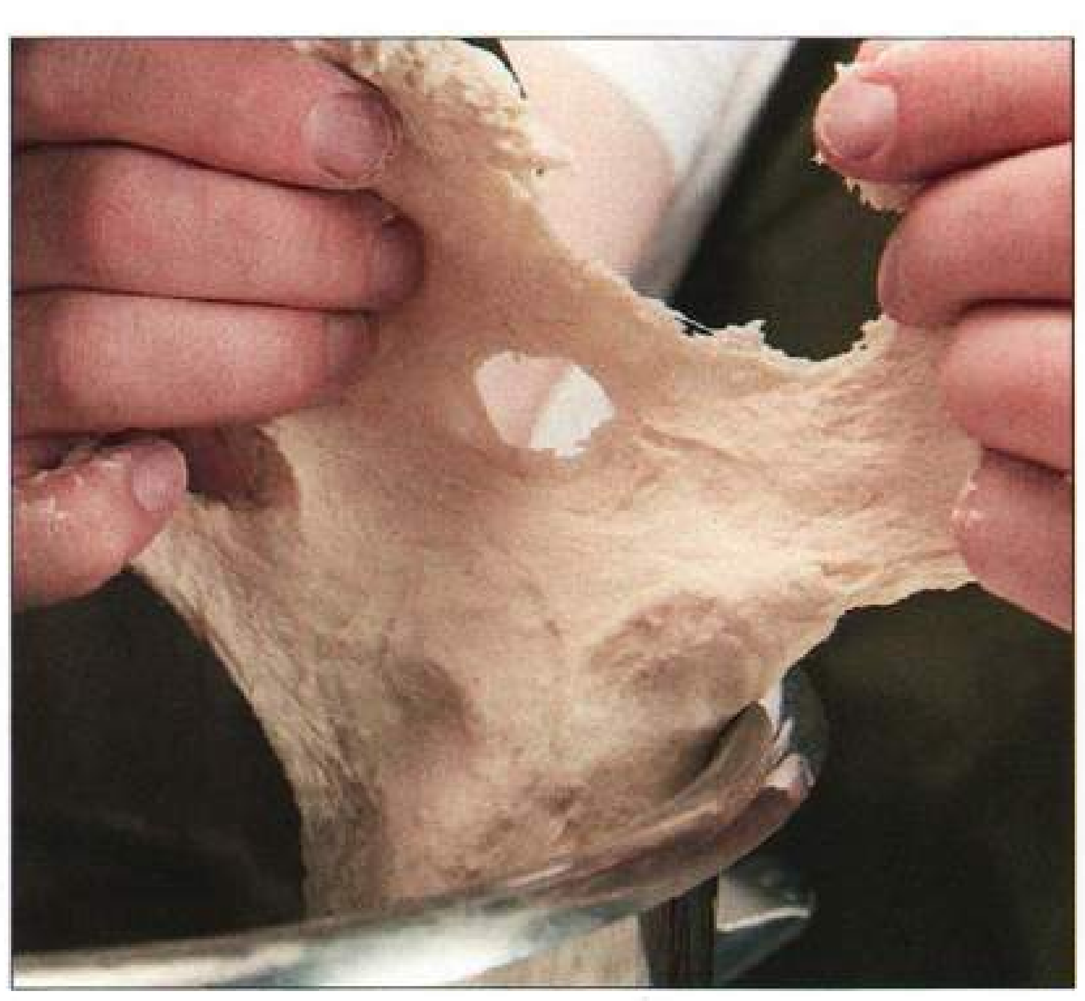
Full Gluten Development

Full gluten development consists of fully developing the dough in the mixer, followed by a very short bulk fermentation—less than an hour if used at all; otherwise just a bench rest of 15–20 minutes—before dividing and shaping. At this point the gluten has completely developed in the dough. The dough will look very smooth and have a lot of stretch (due to the gluten) and in some instances a bit of shine (mostly in doughs that contain fat, like our Brazilian thin-crust pizza dough).

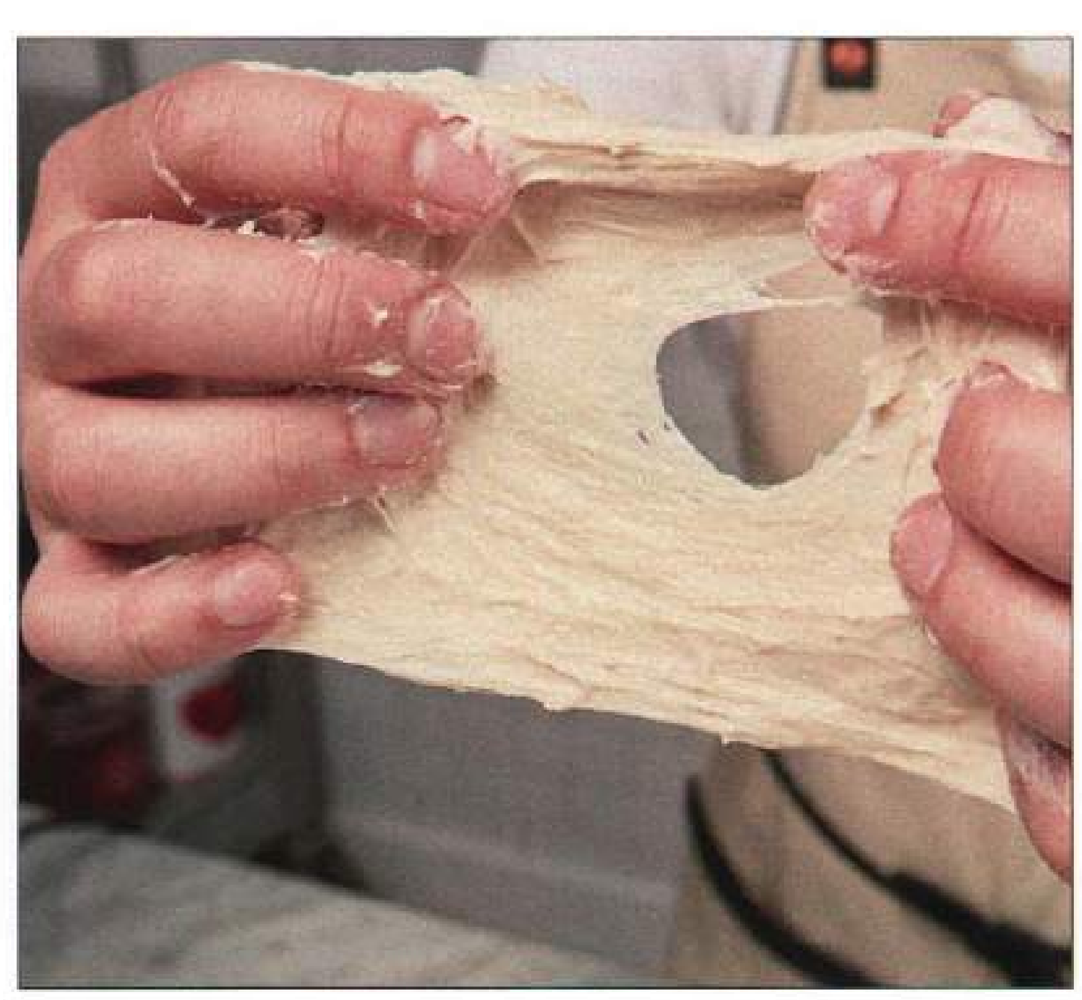
The dough spends a long time in the mixer, being relentlessly mixed by the hook. This results in two distinct effects on the baked pizza: because of the excessive oxidation of the dough, the pizza will have a very white crumb, and because gluten development in the dough is aggressive, the crumb will usually be very tight if it's in the lower hydration range (50%–60%). In higher-hydration doughs, we don't see a negative effect on the crumb.

Despite these often undesirable consequences, we recommend mixing the majority of our doughs to full gluten development. We mix our high-hydration doughs to medium gluten development and then use folds to develop the gluten fully. It's important for these doughs to reach full gluten development because you need a very strong gluten network to support the additional water.

If you perform a windowpane test, the dough will hold the window for at least 8–10 seconds (see image below), and it can be stretched to the point that it is nearly see-through. This mixing stage is best done by machine, as it requires a lot of effort; it is recommended for most of the thin- and medium-crust doughs. Average mixing time will depend on the type of mixer that you are using and the style of dough (see our recommended times in each of the master recipes).



Low gluten development



Medium gluten development

Full gluten development

6

Thin-Crust Pizza Dough (see page 110)

Neapolitan Pizza Dough (see page 124)

New York Pizza Dough (see page 132)

Sfincione Dough (see page 157)

Pizza Gourmet Dough (see page 165)

Deep-Dish Pizza Dough (see page 118)

Although proper gluten development is crucial when mixing a dough, it isn't the only factor in how a pizza turns out. Thin-crust and Neapolitan pizza dough are both mixed to full gluten development, but they have very different crumbs because of their hydration levels and the way they are shaped. The same is true of deep-dish dough, which is mixed to the same gluten development stage as the pan-baked pizzas shown above, but it has 15%-25% less water than the other doughs.

We aim for a maximum dough temperature of 25°C / 78°F when it comes off the mixer (it should be within 3-4°C / 5-7°F of this temperature). If it is warmer than this temperature, you can place it in the refrigerator or on a marble surface to cool.

DESIRED DOUGH TEMPERATURE

Controlling temperature is one of the prerequisites for great baking, and temperature affects the outcome at several stages of the pizza-making process. It obviously matters a great deal during baking, and also during fermentation and proofing. Some baking books and experts go on at great length about the importance of temperature during mixing as well. They give rules for determining the desired dough temperature (DDT), a target temperature that will let you know when mixing is done. And they offer formulas for calculating how warm or cold the water should be when you add it to the flour—though these formulas usually use an imprecise, empirically derived friction factor that isn't very accurate. But does temperature really matter that much during mixing? We did a set of experiments to find out.

We prepared doughs and varied the mixer used, mix time, and water temperature to see the effects on DDT. Our conclusion is that hitting the DDT on the nose isn't important for most pizza makers in homes, restaurants, and small commercial operations, especially if you can extend your bulk fermentation time. It's much more important to control the temperature of the fermentation environment. We do want to note that pizza dough doesn't immediately cool down in the refrigerator when you cold-proof it. If you start with a dough that is too warm, it may overproof by the time the 48 hours is up. The ideal temperature of the final dough should be 24–25°C / 75–78°F. You should also make sure that all of the ingredients are at around 21°C / 70°F. Otherwise, you might need to start with colder water.

WHAT IS AUTOLYSE?

Autolyse is a two-stage mixing technique that gained currency—and a fancy name—back in 1974, when French baker Raymond Calvel published a technical article that described the method and touted it as a way to deal with extremely strong wheat flours. Calvel coined the term "autolyse" (sometimes spelled "autolyze") from "autolysis," a term used in biology to describe the process of self-digestion that cells undergo as they die and are dismantled by the enzymes inside them. A peach ripening in a fruit basket, for example, softens mainly due to the enzymatic destruction of autolysis. Flour contains natural enzymes, too, and Calvel's idea was that giving those enzymes water and time would boost their activity and allow them to soften up the starches and proteins in the dough.

Definitions of the term and opinions on its use have taken off in many directions in the decades since. This method is most often used in bread bakeries rather than pizzerias. There's considerable disagreement as what to include in an autolyse and whether it's actually useful in a contemporary setting. The more popular variants differ in what initially goes into the flour and water and how long the wet flour is left to sit before salt and other ingredients are added and mixing begins in earnest. Many books even refer to autolyse as a resting period after combining all ingredients. And modern cookbooks from many leading bakers do not include an autolyse step.

There are plenty of ways to mix a proper dough and make a fine baked pizza, and including an autolyse stage is just one of them. Is it worth it? Are there

We perform an autolyse on both our focaccia (top) and high-hydration al taglio (bottom) doughs to give the flour additional time to hydrate. These doughs have the two highest hydration levels in the book.

certain applications where it's best? The whole point of autolyse is to hydrate the flour, which kick-starts enzymatic activity and gluten development, thus reducing mixing time (though perhaps not overall time). Autolyse also reduces the chance of overmixing, which can harm the flavor, crumb texture, and color of the pizza.

That's the argument, anyway. We conducted a series of experiments when we wrote *Modernist Bread* and concluded there is some value to this step for making bread, but it depends on your time, workflow, and what kind of bread you're making. We saw the best results using a methodology that's somewhat different from that developed by Raymond Calvel. In our experiments with French lean breads, autolyse improved volume and produced a dough that was easier to handle, easier to shape, and more attractive, with a pleasing creamy-yellow tint. These benefits exist, but they're also not particularly pronounced. And when we tested this method for pizza, there was practically no benefit for doughs mixed to full gluten development—which is most of our thin- and medium-crust doughs. We did find some benefits of autolyse for high-hydration doughs, like Focaccia Dough (see page 148) and High-Hydration al Taglio Pizza Dough (see page 158). The bottom line is, autolyse isn't anything magical. It was simply Calvel's technique-focused recommendation for boosting volume, but as we've found, there are many other techniques and ingredients that can achieve the same goal (see page 1:324).

THE ORDER OF THE INGREDIENTS

In theory, for simple doughs—such as our Brazilian thin-crust or deep-dish—the order in which you mix the ingredients shouldn't matter. Mindful of time constraints, many pizzaioli learn quickly that it doesn't matter whether the water or flour goes into the mixer first so long as they turn the machine on at low speed (or start mixing by hand) soon after the ingredients are combined.

Some pros recommend starting with the liquid components (water/preferments), adding the yeast next so that it blooms, and then adding the flour last (in some recipes, salt and any oil is added once the dough has mixed for a few minutes). The thinking is that this sequence results in a more efficient mix, and we do use this method in the bulk of our recipes. In our tests, however, the order in which the ingredients were combined made little difference in terms of the final product. For consistency, all our recipes specify adding the ingredients in a particular order, because this forms a habit of following a process, which will come in handy so you don't forget to add ingredients (salt being the one a lot of people forget, followed by yeast). This approach also helps those who are new to mixing and baking develop consistent skills.

There are a few caveats, however. If you're using the autolyse method, mix the salt in some of the water (about 5%–10%) that is called for in the recipe. Mix the flour and the rest of the water (you may bloom commercial yeast in the water or mix it in with the flour to disperse it first) to a shaggy mass, let the dough rest 20–30 minutes, and then add the salt water; doing so will help disperse the salt more evenly throughout the dough.

For nearly all preferments, you'll pour the water into the bowl or tub the dough is being mixed in, then pour the preferment on top of the water. We like to pour our preferments on *top* of the water to see if they float; this shows if the preferment is healthy and ripe. You can dissolve the preferment into the water with your hands by squeezing and stirring it, before adding the flour on top, which may save some mixing later.

For more involved doughs, the order of the ingredients becomes less flexible. Solid ingredients (inclusions) such as nuts and fruit should be added to the dough when it has reached medium gluten development. The inclusions are placed on top of the dough in the mixer, which should be turned to low speed. The dough should continue to mix slowly and only until all the inclusions have been fully incorporated. Inclusions with sharp edges, such as slivered almonds, can potentially tear the dough and cause structural damage.

We recommend withholding the salt from the dough if you are using the autolyse method. Just be sure not to forget to add it in when the autolyse step is complete.

Pour in the oil into the dough in a slow, steady stream while the mixer is running on low or medium speed. Make sure that it isn't running so fast that the oil sloshes out.

Stand mixers and commercial planetary mixers are designed so that the hook (or paddle or whip) attachment doesn't come in contact with the bowl. Metal rubbing on metal can be dangerous—and metal particles that find their way into the dough can turn up in the baked pizza, which is a health hazard.

MACHINE MIXING

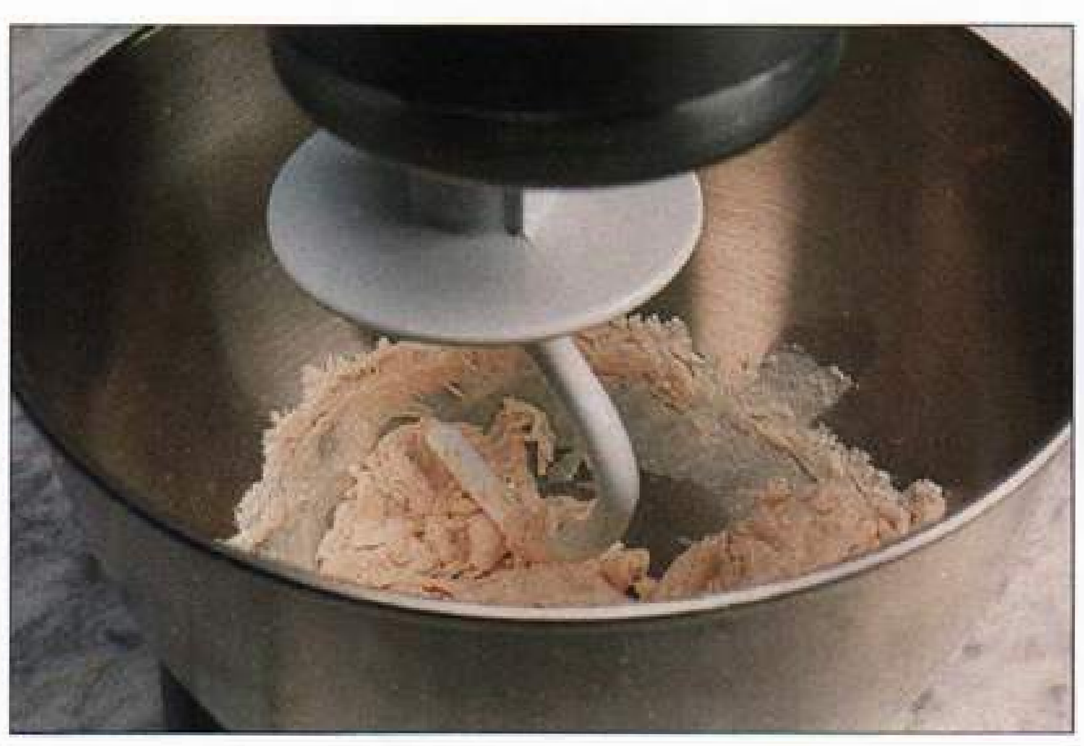
Each type of mixer has characteristics that make it better suited for a specific work environment. There are differences in size and capacity; a stand mixer, for example, works in much the same way a commercial planetary mixer does, but the amount of dough they can handle varies. There are also differences in the *way* they mix. The goal for any mixer is to emulate how the human hand mixes—and which machine does that best depends on the pizza maker's preferences. We use a stand mixer for small/home quantities (1–2 kg / 2.2–4.4 lb), a commercial planetary mixer for larger quantities (3–8 kg / 6.6–17.6 lb), and a spiral mixer, a diving arm mixer, or a fork mixer for larger amounts (8 kg / 17.6 lb and above).

The larger the volume of dough, the longer the mixing time, which is not always ideal. Keep in mind that for any given mixer, increasing the mixing time or speed will increase the energy transfer to the dough and produce more heat. In extreme cases, the dough will start to leach water and become ropy, a sure sign of gluten overstrengthening (dough overmixing, although this is really hard to make happen, even deliberately). Consider the mixing times in the master dough recipes as guidelines. The real indicator is always what you see; use the windowpane test to check for gluten development.

The Right Amount of Dough

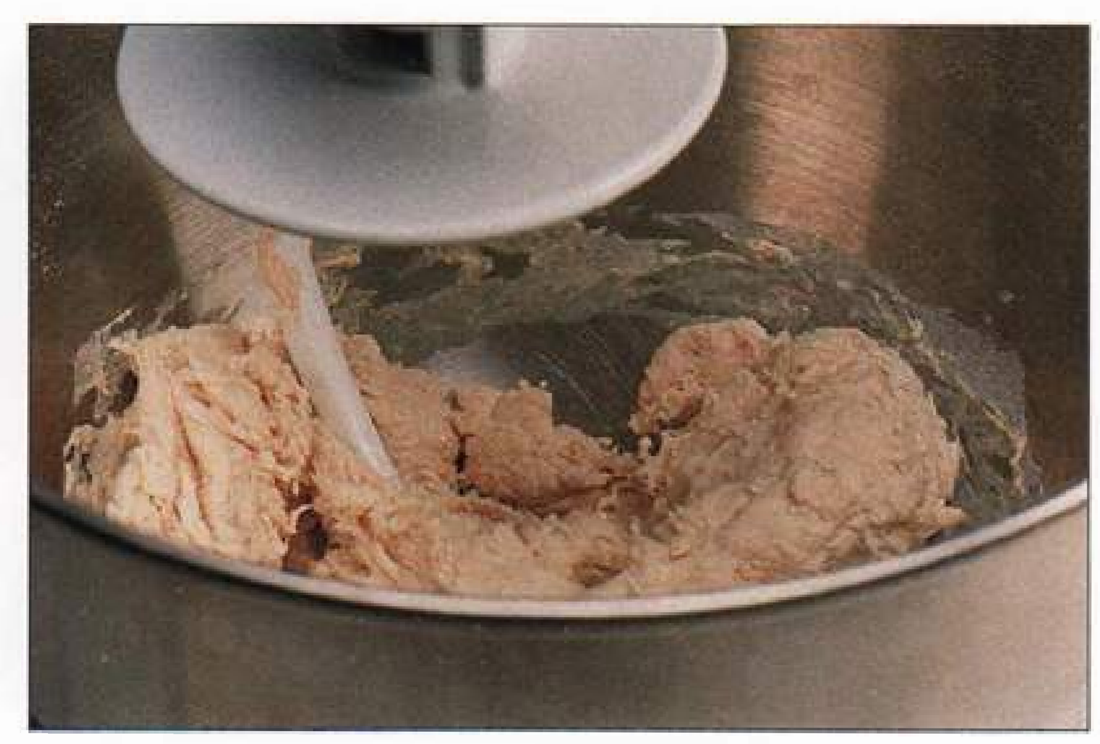
The amount of dough you can mix at any given time depends on the capacity of your mixer, of course, but a good rule of thumb is to fill the mixer's bowl no more than halfway. If you load the bowl more, your dough will take longer to mix.

When you're determining how much dough to mix, consider whether the hook will be able to catch the dough. If there's a very small amount of dough, the hook will begin to spin and then hover over the ingredients at the base of the bowl, barely touching them. At the opposite end of the spectrum, too much dough can also be a problem. The dough will start to climb up the hook, where it won't get mixed and developed, and the mixing process will take longer. In addition, using more dough than a mixer was designed to handle will generate more heat and cause more wear and tear on the motor.



Too little dough

Too much dough

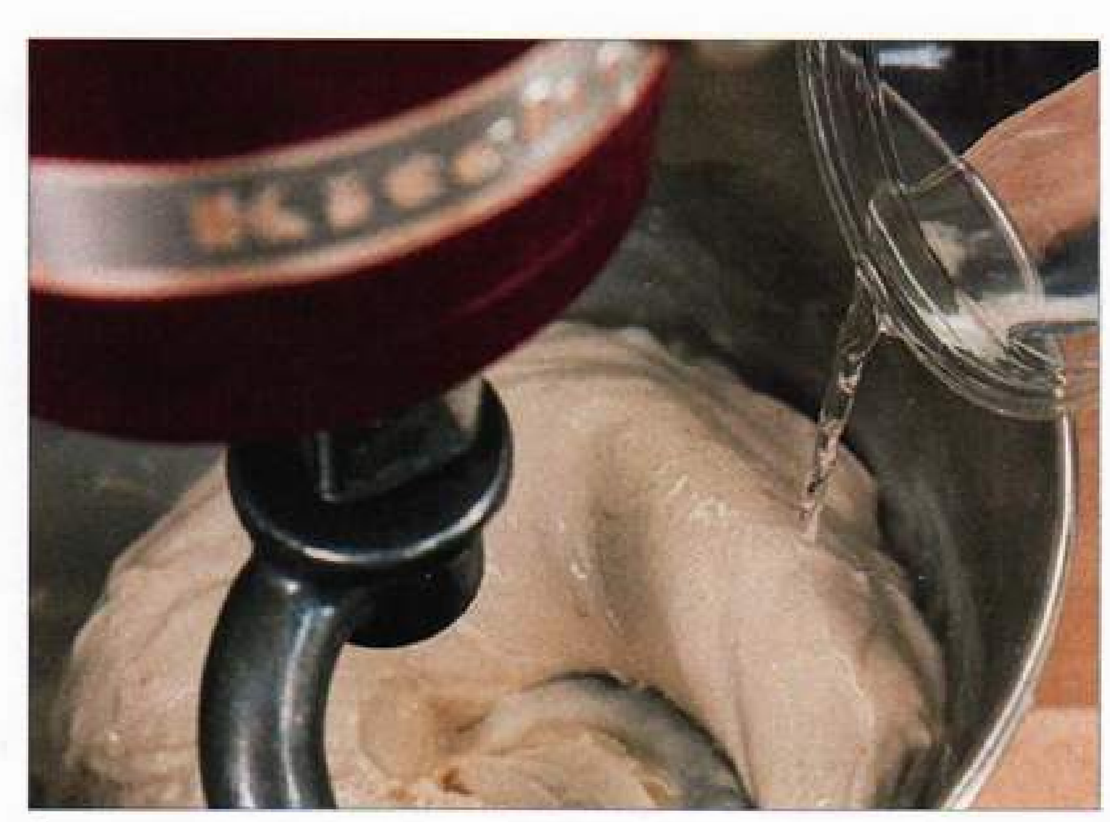


Just right

DOUGH CAPACITY

The following table provides general guidelines for the volume of dough we recommend for the most common sizes of mixer bowls.

Mixer size/type	Dough amount
3.8–4.7 L / 4–5 qt stand mixer bowl	1-1.5 kg / 2.2-3.3 lb
5.7-7.6 L / 6–8 qt stand mixer bowl	1.5-2 kg / 3.3-4.4 lb for most doughs; 1.5 kg / 3.3 lb for stiff doughs like Brazilian thin-crust pizza dough (maximum)
11.4 L / 12 qt commercial planetary mixer bowl	3–6 kg / 6.6-13.2 lb
18.9 L / 20 qt commercial planetary mixer bowl	6–8 kg / 13.2-17.6 lb
spiral mixer / diving arm mixer / fork mixer	minimum amount depends on the bowl capacity of the mixer; the bowl for our spiral mixer has a 36 L / 38 qt capacity; 8 kg / 17.6 lb is the smallest amount we mix in it, and 15 kg / 33 lb is the maximum



When using the double hydration method, it's especially important not to overfill the mixer because the water can slosh out while you are mixing the dough.

Tips for Machine Mixing

Selecting a type of mixer isn't difficult once you consider the cost, available space, quality requirements, and production needs. Because they're not designed to run for long stretches of time, stand mixers are mostly for home use and limited production in restaurants and pizzerias. They're quite useful in those environments, eliminating a lot of handwork. These machines have a relatively small footprint, come with an array of attachments, and are relatively economical.

Commercial planetary mixers are common in restaurants and pizzerias; these workhorses are used for many purposes, from mixing doughs to whipping meringues to creaming butter to making cookie dough. The efficiency of spiral mixers makes them a top choice for mixing commercial-level quantities of dough. The hook spins from the top of the machine, and the bowl itself spins, too; the combined motion results in the most friction on the dough, which will speed up gluten development. This reduces mixing time, a plus for the pizza maker as well as the dough. We mainly recommend spiral and commercial planetary mixers for restaurant and pizzeria use because many home pizza makers won't need the commercial-sized capacity of these larger machines. If home pizza makers can fit them into the space and budget of a home kitchen, though, the choice is theirs.

Make sure the amount of dough doesn't exceed the amount we recommend based on the size of the mixer you're using (see page 34 for weight ranges). Consider weighing some ingredients directly into the bowl for efficiency. Check to make sure the mixer is set to low speed before turning it on. Switch to medium speed if the recipe calls for it but not until all the ingredients have formed a homogeneous mass that stays securely in the bowl. Proceed with the mixing instructions for the dough.

Most models of spiral mixers come with a wire guard that will allow you to add ingredients to the dough while the machine is running. It won't prevent ingredients from flying out of the mixer, however, so make sure not to overload the bowl.

COMMON MIXING PROBLEMS

Combining a few ingredients seems like a simple thing, but there are some challenges. Once you understand what *not* to do, you'll also understand what sorts of things can go wrong.

UNDERMIXED

Undermixed dough won't fully hydrate because the water is unevenly distributed. Properly mixed dough should look homogeneous, with no noticeable clumps of flour or pools of liquid.

DOUGH DRIED OUT

Dough exposed to the air will begin to dry on the surface and form a skin. This reduces the extensibility (stretch) of the dough, forcing it to crack as it ferments or is manipulated. To avoid this, keep the dough covered at all times. You can use a slightly damp kitchen towel, a plastic tarp, or even a large clean plastic trash bag to protect your dough. If you're using a plastic tub, cover it with a lid.

CLIMBING THE HOOK

This often happens if the mixer is left unattended. Stop the machine and push the dough down the hook, then continue mixing.

OVERMIXING

If you've overmixed your dough—that is, if you've gone beyond full gluten development but the dough hasn't quite broken down—your dough might be salvaged. For doughs raised with levain, simply let the dough relax for a long time in the refrigerator. For yeast-raised doughs, it's a little trickier because the yeast will continue to ferment the dough even in the refrigerator. (This will occur in a levain-based dough as well, but to a lesser extent.) If the dough is overmixed to the point that it's leaching water and has become ropy, try this method: mix a half-batch of dough, minus the salt. Allow your dough to autolyse for 20 minutes, then add the salt. Add this new dough to the overmixed dough, mixing on low speed until just combined. Proceed with bulk fermentation (if applicable); it may take longer than planned. The final pizza won't be exactly as if you had mixed it correctly, but it will be close.

COMPLETE DISASTER

The only remedy for some mixing errors is to simply start over. Luckily, dough ingredients are relatively inexpensive, and the mixing process is fast enough that you'll probably still have time to make your pizza. Fatal errors like these usually stem from human fallibility: the pizza maker might have misread a measurement, transposed a number, or otherwise strayed from the protocol. To avoid such mistakes, the first time you make a recipe, check off each step when you complete it. At the very least, this will show you later where you went wrong.

Spiral Mixer

Spiral mixers have a reputation for being the most efficient machines for mixing dough. Although spiral mixers are not as common as planetary mixers in the United States, these machines mix dough efficiently without raising the temperature. Planetary mixers create a lot of friction and can overheat your dough. Although they involve an investment, we highly recommend spiral mixers for restaurant and pizzeria production. The only major drawback is that many models are hard to clean because the bowl can't be removed from the mixer.

Both the spiral hook that comes down from the top of the machine and the bowl at the base spin. Some have a spiral hook (also called a mixing blade) and a bowl that spin in the same direction. Others have a bowl that can be switched to spin in the opposite direction, making for an even faster and more efficient mix. Still others have more than one spiral hook to simultaneously help mix. Most have two mixing speeds; the first speed disperses the ingredients and creates a uniform dough, and the second develops the dough.

Countertop models can mix as little as 1 kg / 2.2 lb, while the smallest floor models we've seen can mix as little as 3.5 kg / 7.7 lb. Some models can mix up to a few hundred kilograms. Whatever the size, they're versatile machines that operate on a simple principle: two tools doing the job are better than one.

Commercial Planetary Mixer

The versatility of commercial planetary mixers means that many restaurants and pizzerias rely heavily on them, for everything from making dough to whipping mass quantities of cream to grinding meat (given the right attachments). Unlike the hook of a spiral mixer, which spins along an axis, the attachment on a commercial planetary mixer spins in circles much like the orbit of a planet around the sun. Double commercial planetary models can mix hundreds of kilograms of dough, using two spinning arms instead of one.

The smallest models have 11.4 L / 12 qt bowls, but many are designed to hold different-sized bowls. For example, our mixer holds an 11.4 L / 12 qt bowl (3–6 kg / 6.6–12.2 lb dough capacity) and an 18.9 L / 20 qt bowl (4–8 kg / 8.8–17.6 lb dough capacity). The small bowl can mix as little as 2.5–3 kg / 5.1–6.6 lb. Commercial planetary mixers are easier to clean than spiral mixers because the bowls are removable.

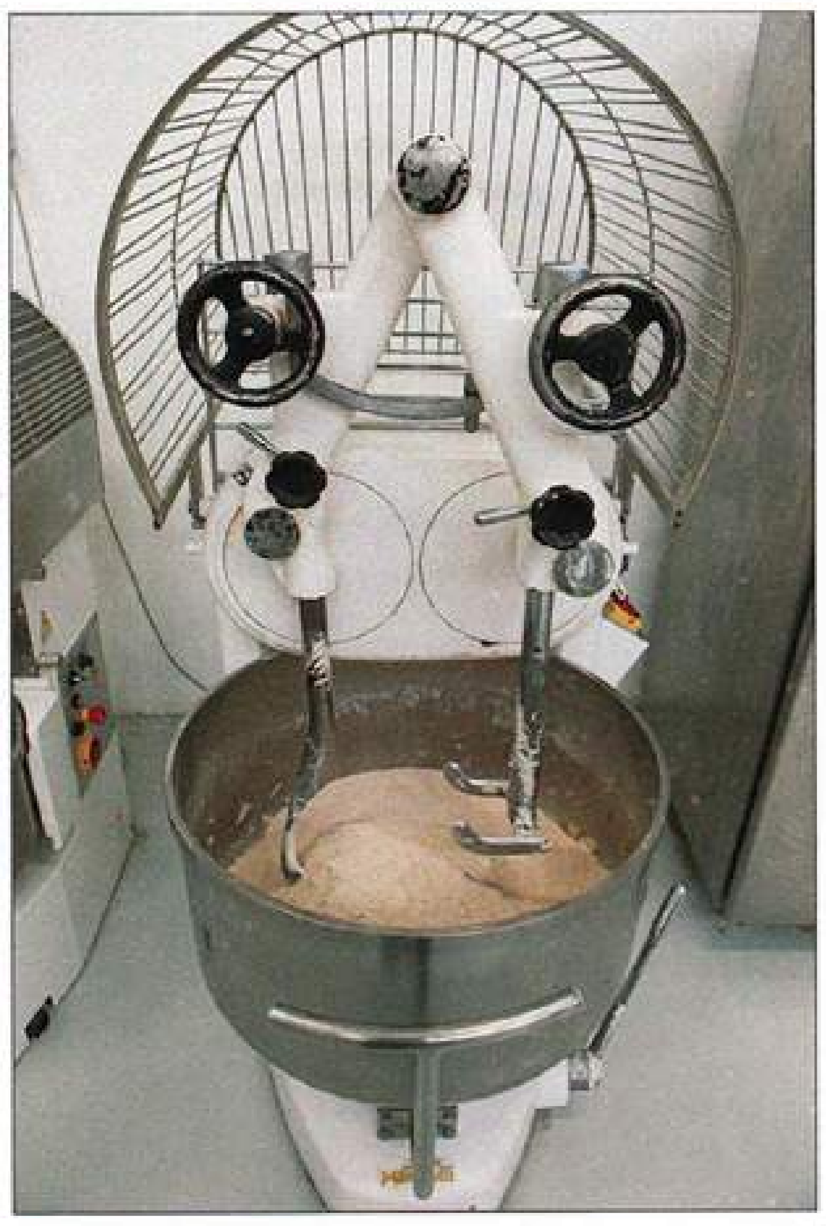
Most models have three speeds (low, medium, and high); they also have attachments that can be used for different mixing purposes. The hook attachment is used for pizza and bread doughs; the paddle attachment is used for nonbread doughs such as quick breads and cookies; and the whip attachment is used to incorporate air into things like cake batters or meringues.

There are simple versions and more advanced mixers that feature jacketed bowls with double walls

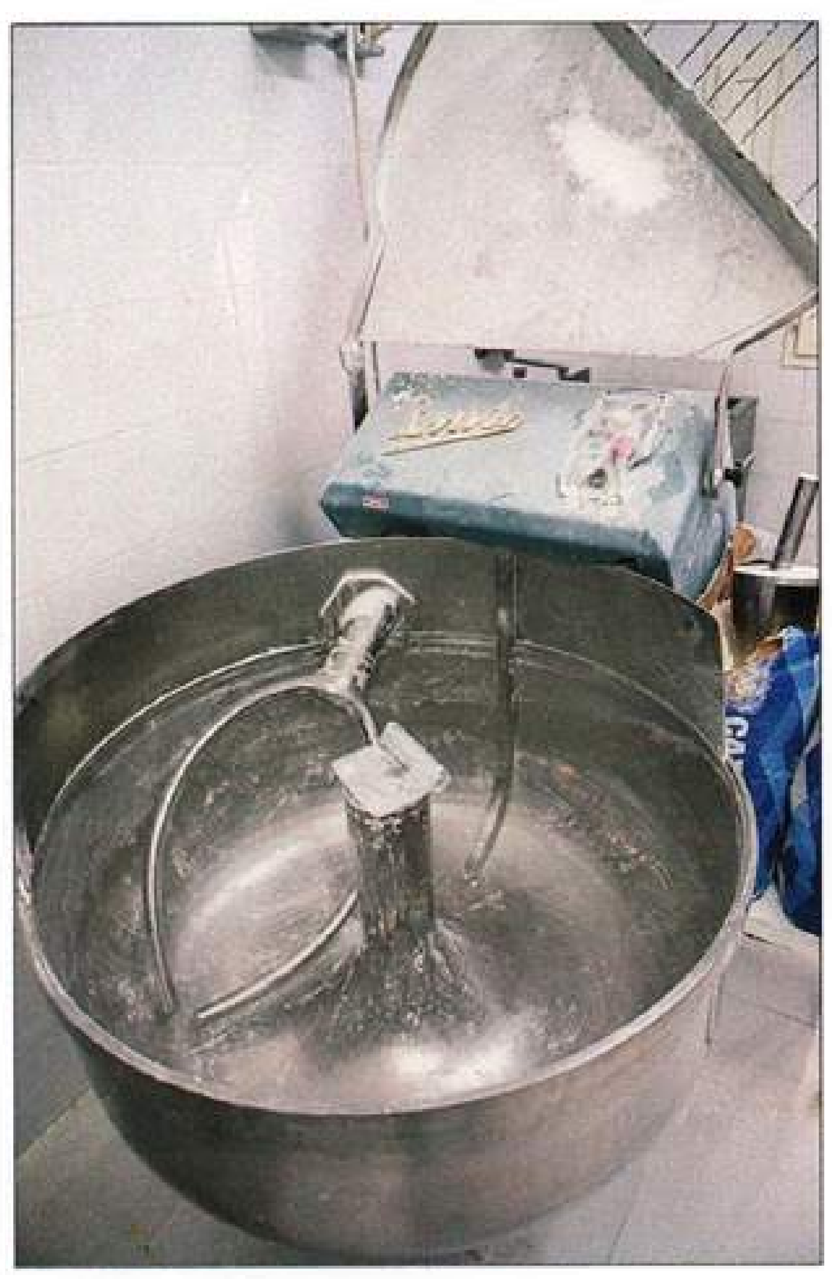
Scrape down the sides of your mixer's bowl as often as necessary during mixing to ensure that the ingredients are evenly incorporated.

Planetary mixer

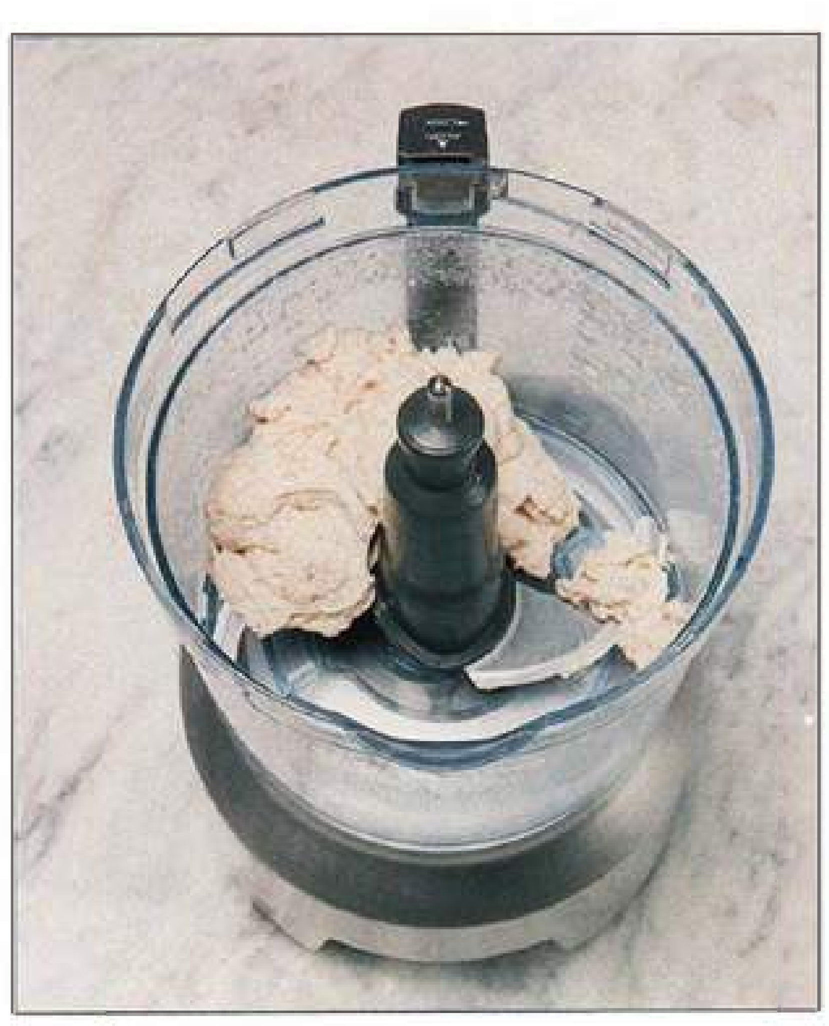
We saw an abundance of spiral mixers during our travels to pizzerias in Europe but found more planetary mixers being used when we toured the United States.



Twin-arm mixer



Fork mixer



Food processor

that contain circulating water. The temperature of the water can be regulated, which gives you more control over dough temperature.

Their smart design and flexibility make commercial planetary mixers a good value, recommended for restaurant and pizzeria production. They're sturdy and can be used for many years with minimal maintenance.

Stand Mixer

The stand mixer is a small version of a commercial planetary mixer that can comfortably sit on any work surface, occupying minimal space. We recommend these mixers for home use and small restaurant production. The pluses are clear: they're comparatively economical; many small repair shops can fix broken parts if needed; and they can perform various functions besides mixing. Their manufacturers offer many attachments (sold separately) that can use the spinning motor to sheet pasta dough, grind meat, mill grains into flour, and chop vegetables; these attachments make the stand mixer a versatile tool. The downside is that the motors of these machines are often not powerful enough for some drier doughs, and the dough capacity is relatively limited.

In addition to having the same mixing attachments as commercial planetary mixers (hook, paddle, and whip), stand mixers have a broad range of speed settings, from very slow to very fast. A hook can take much of the manual labor out of mixing to full gluten development. It works just fine on sticky doughs (although you may need to scrape the sides of the bowl periodically). The mixer can often complete mixing without adding flour, which is necessary when mixing by hand.

Twin-Arm or Diving Arm Mixer

Human arms are levers that turn in joints that don't turn all the way around. When humans started making machines, including the first mechanical mixers, they began with the idea of a wheel spinning around a single axis. Those designs have since evolved, as we see with the arms on this more complicated mixer. It is still driven by a rotary motor, but it attempts to approximate a gentle human touch while providing the convenience of a machine. The arms work in reciprocating fashion and fold ingredients from the center to the outside of the mixing bowl (which spins in some models).

Because this mixer is gentle on dough, it produces little friction, so it won't make the dough too warm even if mixing to full gluten development. This gentleness does have a negative side, though, in that it can take a very long time to mix most doughs.

Small models can mix as little as 2.5 kg / 5.5 lb, though more typical sizes mix a minimum of 8 kg / 17.6 lb. These mixers are exceptional at incorporating inclusions and are popular among Italian bakers for enriched doughs like panettone, but we also saw them being used in many pizzerias.

Fork Mixer

The AVPN and many Neapolitan pizzaioli recommend this as the mixer for Neapolitan pizza dough. It consists of a spinning bowl and a spinning two-pronged "fork" that is set at an angle that matches the incline of the side of the spinning bowl. They vary in capacity ranging from machines that mix 4 kg / 8.8 lb of dough all the way to 240 kg / 520 lb. We tested all of our doughs in this mixer and found that while it did the job in some cases and failed in others (like focaccia), the mixer didn't work as well with smaller or larger batches of dough. When we put smaller batches of dough in the mixer, the fork had a hard time catching the dough, so its motion was wasted. This resulted in a long mixing time. Additionally, it took an exceptionally long time to mix high-hydration doughs.

Food Processor

The food processors common in home kitchens have limited capacity and power, but sturdier Robot Coupe models are standard equipment in many commercial kitchens, ranging from countertop versions to an industrial-sized model that can mix about 30 kg / 66 lb of dough. Whatever their size, the machines work according to the same basic principle, which involves blending the ingredients with a double blade that spins at high speed (1,725 rpm for countertop models and up to 3,600 rpm for industrial models).

This machine is not typically used to make pizza dough, but it is quite able despite being somewhat limited by bowl capacity. The bowl should be filled only about halfway to give the blades room to maneuver. Most home models can handle about a kilogram of dough. The machine's blades spin much faster than any of the mixers mentioned previously, requiring only 45 seconds to 2 minutes to fully develop a pizza dough. Because the mixing is fast, it's wise to start with cold water (or other liquid) so as not to overheat the dough. The machine forces the water into the flour so quickly that gluten develops almost instantly.

This is a convenient method, but it comes with a trade-off: the pizza crusts tend to be tougher. That's because the gluten has to be fully developed to form a cohesive ball of dough in the mixer. Also, high-hydration pizza and focaccia doughs don't work well in a food processor.

EXPERIMENT

DOES THE MIXER MAKE A DIFFERENCE?

The mixing stage combines inert ingredients into a dynamic dough that transforms into pizza. This process has fascinated pizza makers for ages and has also produced a number of myths surrounding both hand mixing and machine mixing. There are theories that certain mixers influence the way the final baked pizza comes out. Naturally, this made us curious about whether the machine that you use actually makes a difference in the final dough.

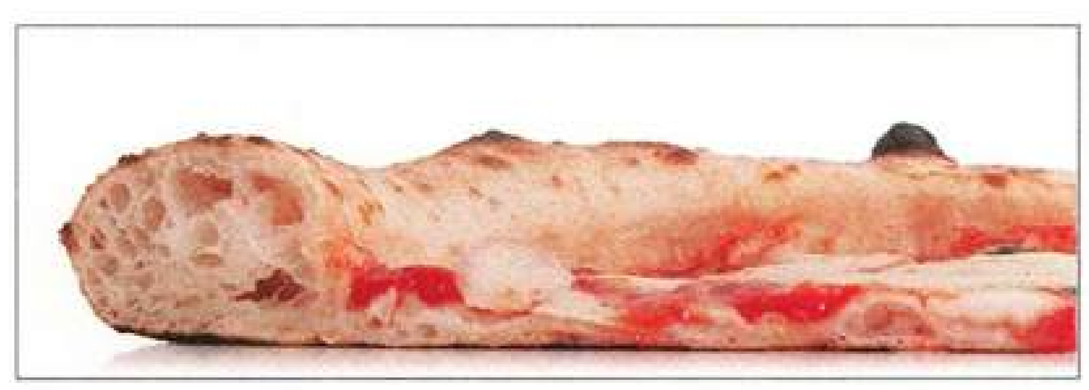
We got to work testing seven different master doughs (Brazilian thin-crust, Neapolitan, artisan, focaccia, New York square, high-hydration al taglio, and Detroit-style) using our five in-house mixers (stand, spiral, diving arm, fork, and planetary). We mixed the following amounts of each dough: 2 kg / 4.4 lb in the stand mixer, 8 kg / 17.6 lb in the spiral mixer, 4 kg / 8.8 lb in the diving arm mixer, 10 kg / 22 lb in the fork mixer, and 5 kg / 11 lb in the 12 qt planetary mixer. For each test, the initial water temperature was set to 21° C / 70° F and, when the dough was mixed to the desired stage, its final temperature was recorded. We also measured the dough's extensibility on our extensograph at the same time we started to shape the pizzas for baking. Once they were baked we scanned each pizza (3 pizzas per type of mixer were measured for each dough) on a 3D scanner and gathered quantitative data on their volume.

The Neapolitan pizza results are illustrated in the photos below. Although different mixers required different dough amounts and mixing times, and the temperatures after mixing were within 2–3 degrees of the desired dough temperature (see page 32), full gluten development was achieved in all of the conditions, and the doughs were similar in handling and by extensograph across the board. A high-quality Neapolitan pizza resulted from all the mixers. While we were working with our higher hydration doughs, however, the fork mixer failed to properly mix doughs with 72% hydration or higher (artisan, focaccia, New York square, and high-hydration al taglio). The al taglio results are shown in the photos below. Note the difference in volume for pizzas mixed with the fork mixer. For all the other mixers, the dough handling for the al taglio was normal, and the crumb was good across the board.

Different pizzerias have different mixers, and the pizzaioli have learned how to use their machines to obtain their best possible pizza doughs, sometimes using workarounds to overcome any faults or shortcomings of their machines. This is why different pizzaioli will defend or promote the use of a particular mixer; after all, it works very well for them. But we will free you from the notion that a particular mixer is better with these results. Use any mixer you like, except the fork mixer if you're mixing dough with more than 72% hydration. We must also point out that no single factor makes a key difference when making your dough (see page 396).

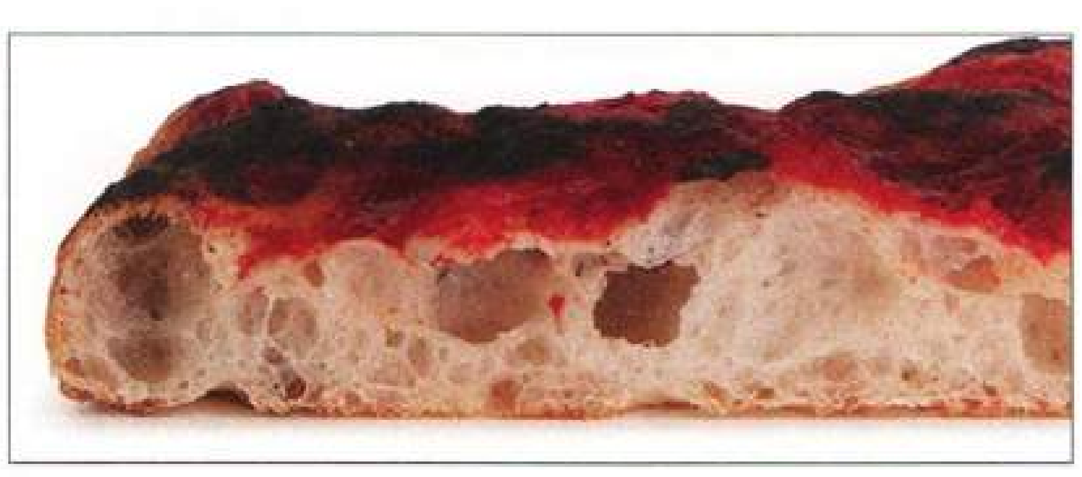
Neapolitan dough mixed 3 different ways

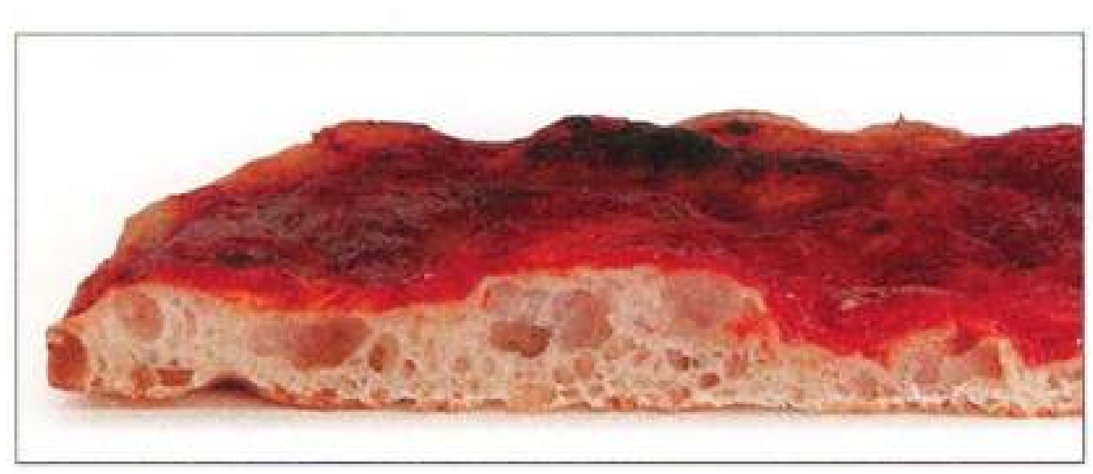

Stand

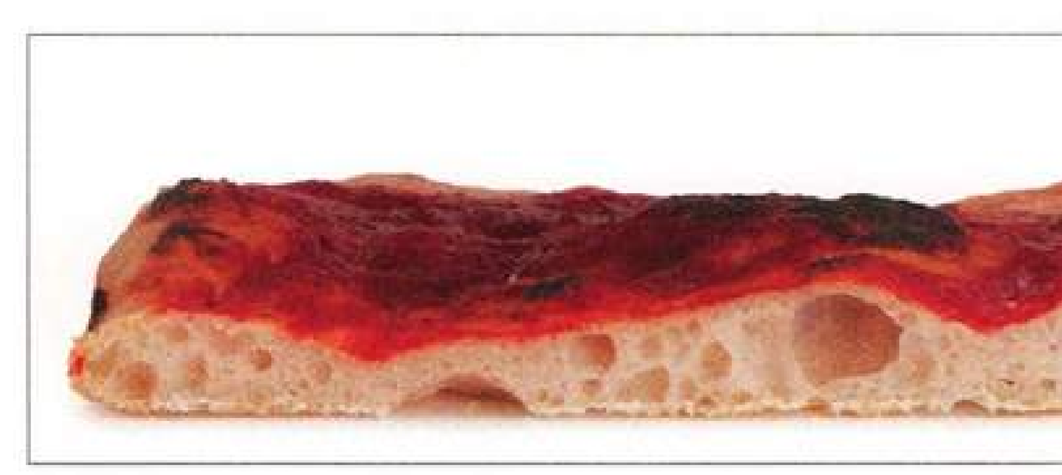

Spiral


Fork

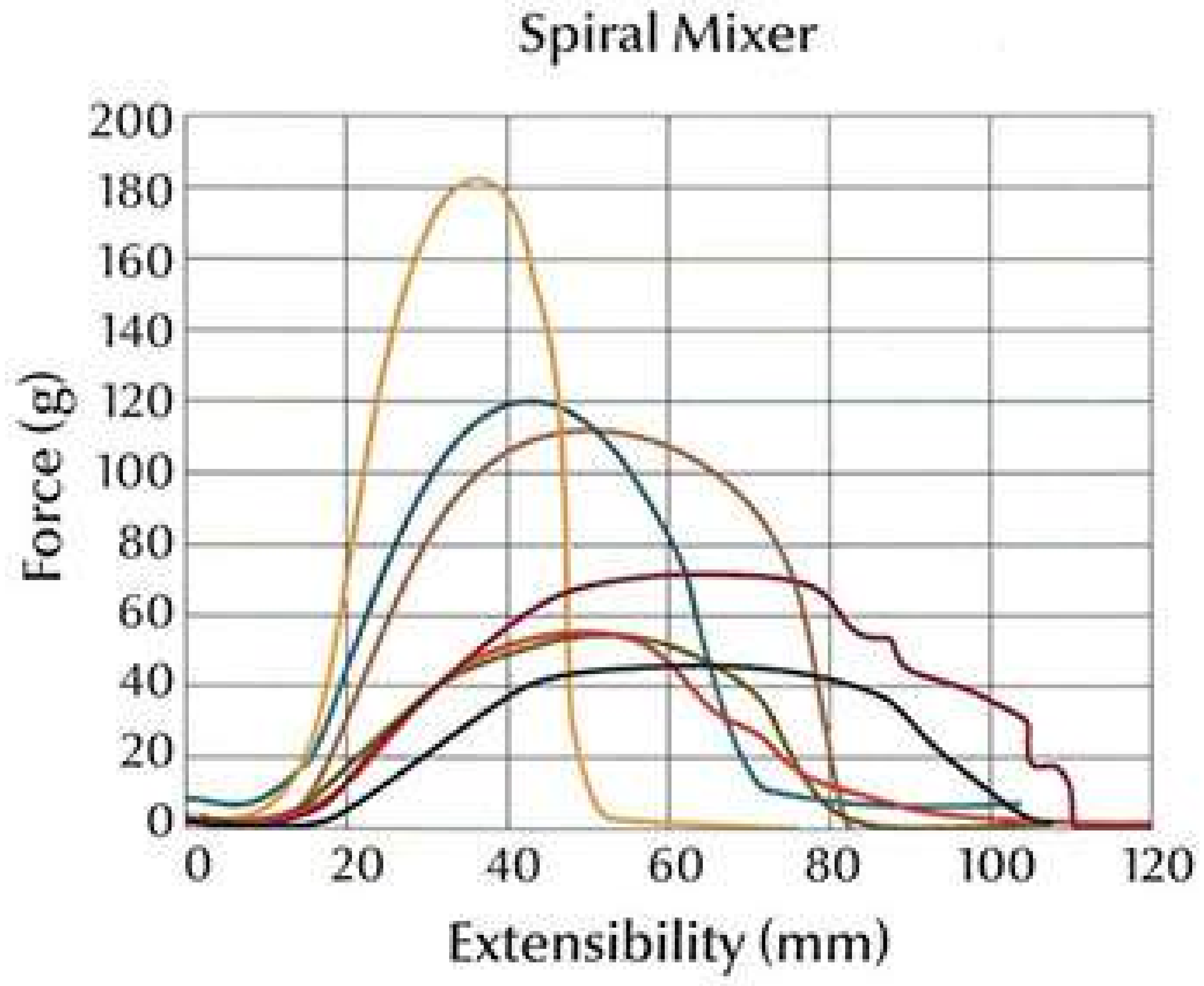
High-hydration al taglio dough mixed 3 different ways

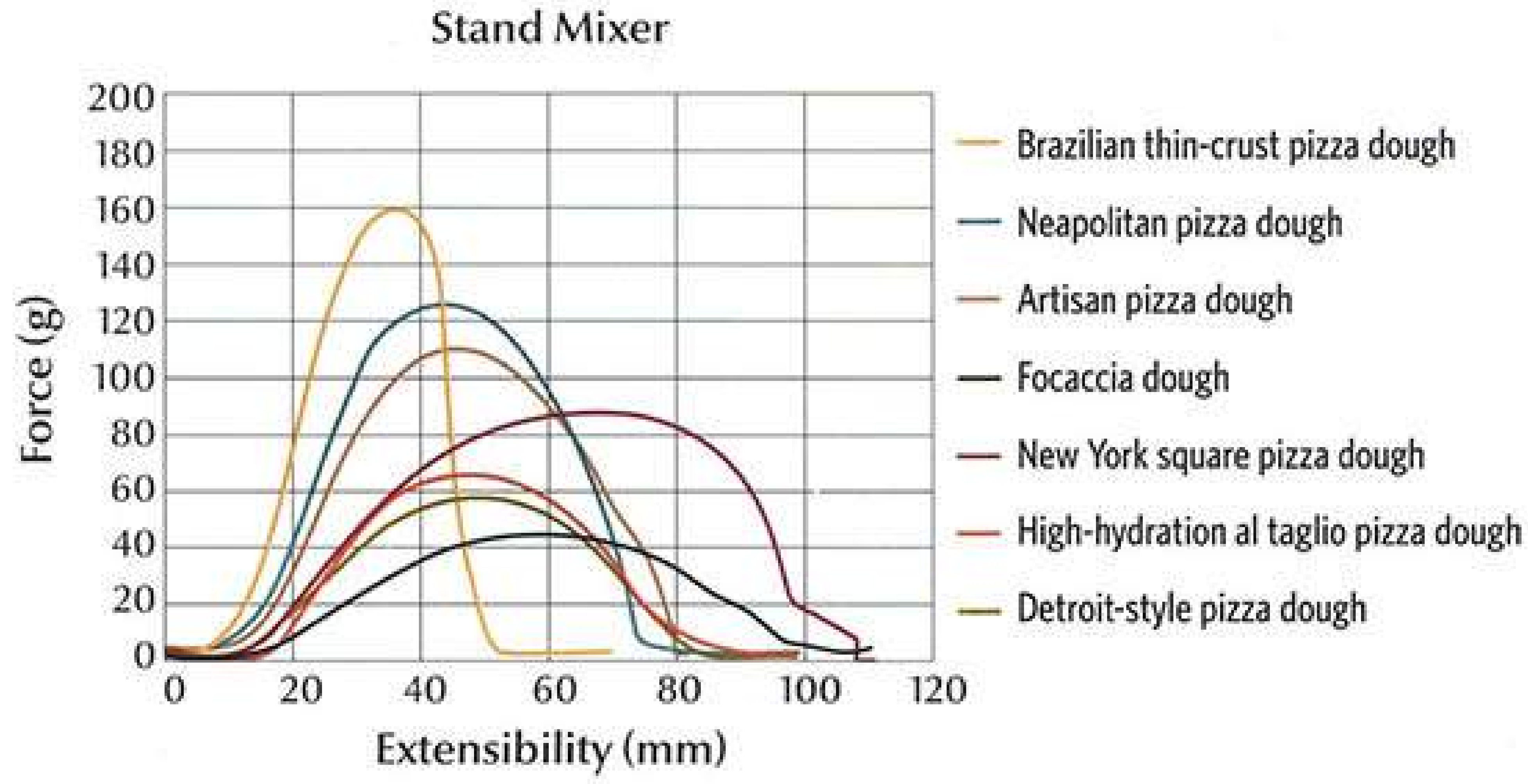

Stand


Spiral


Fork

These two graphs illustrate the force that it takes to stretch these specific master doughs. You'll notice that both mixers show the same trend—the lower the hydration, the more force it takes to mix the dough. Our Brazilian thin-crust pizza, which has our lowest hydration (50.41%), takes a factor of 3 to 4 times more force to mix than our focaccia dough, which clocks in at 86.87% hydration.





HOW TO Mix with the van Over Method

Baker and cookbook author Charles van Over developed a mixing method using the speed of food processor blades to very quickly develop gluten (it was originally developed for bread but works for pizza as well). The overall process is extremely fast: once all the water has been added, it takes just 45 seconds to complete the mix.

Van Over's original method doesn't use a preferment, but that doesn't mean that you can't use one. We have successfully mixed doughs with preferments using this method, and a preferment can add flavor. Mixing a dough for just 45 seconds, however, seems opposed, at least in spirit, to the time and patience a preferment requires to ripen. The food processor recipes in the Pizza Dough Recipes chapter will fit in a standard food processor bowl, but they can be scaled up for larger quantities (see page 21).

Although this method has its limitations, we acknowledge that a dough mixed in 45 seconds is remarkable and worthy of including; it may be suited for specific environments and purposes (home baking, some restaurants, and even large-scale industrial bakeries). The crust it produces is attractive, but the crumb can be tight. (This method doesn't work for higher-hydration pizza doughs, which take much longer to mix because there isn't enough solid mass for the blades to quite catch the dough. Instead, the blades move almost as if they were making their way through a puree.)

The van Over method works in part because it uses the sides of the food processor bowl as well as the lid to "throw" the dough around and make the actual mixing more efficient. When a wet, loose batter-like dough is in the processor, however, it doesn't quite form the strong mass that's needed for it to be thrown around the bowl, which is what happens with stiffer doughs. Additionally, the speed of the blades cutting through the dough and mixing in air would cause the dough to oxidize quickly.

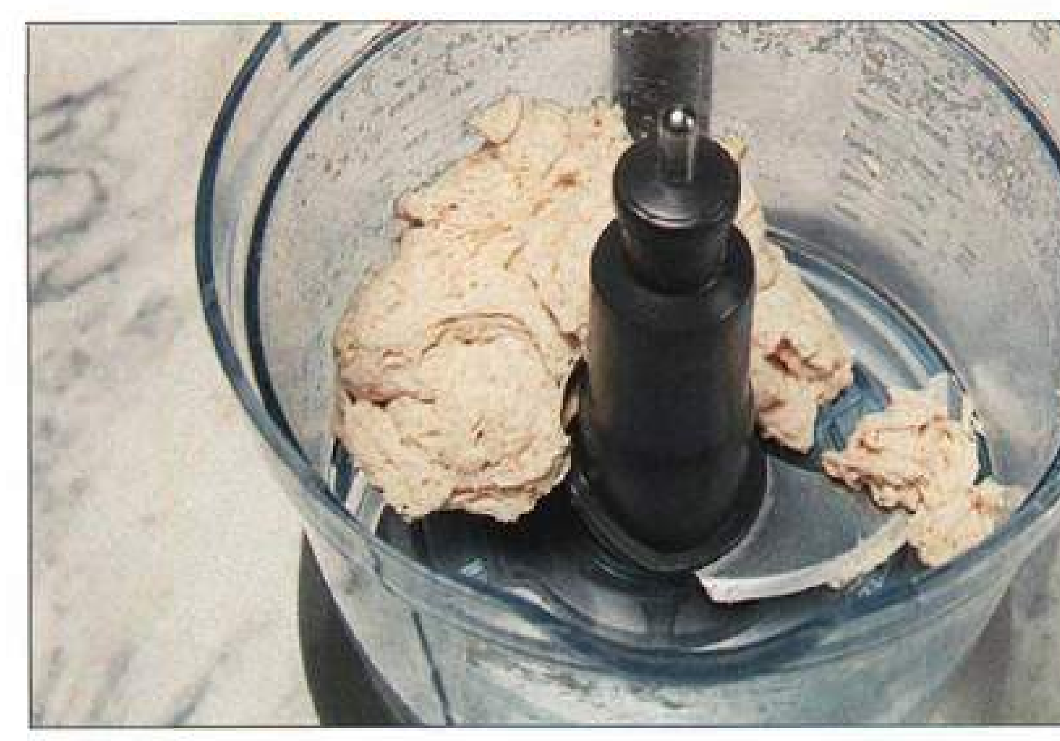
Because the friction created inside the food processor bowl heats up the dough considerably, water temperature is crucial here; this is one of the rare circumstances where nonindustrial pizza makers should take the time to calculate the water temperature. This precaution may still leave your dough considerably warmer than those mixed in other ways.

1 Combine all the dry ingredients in the food processor bowl.

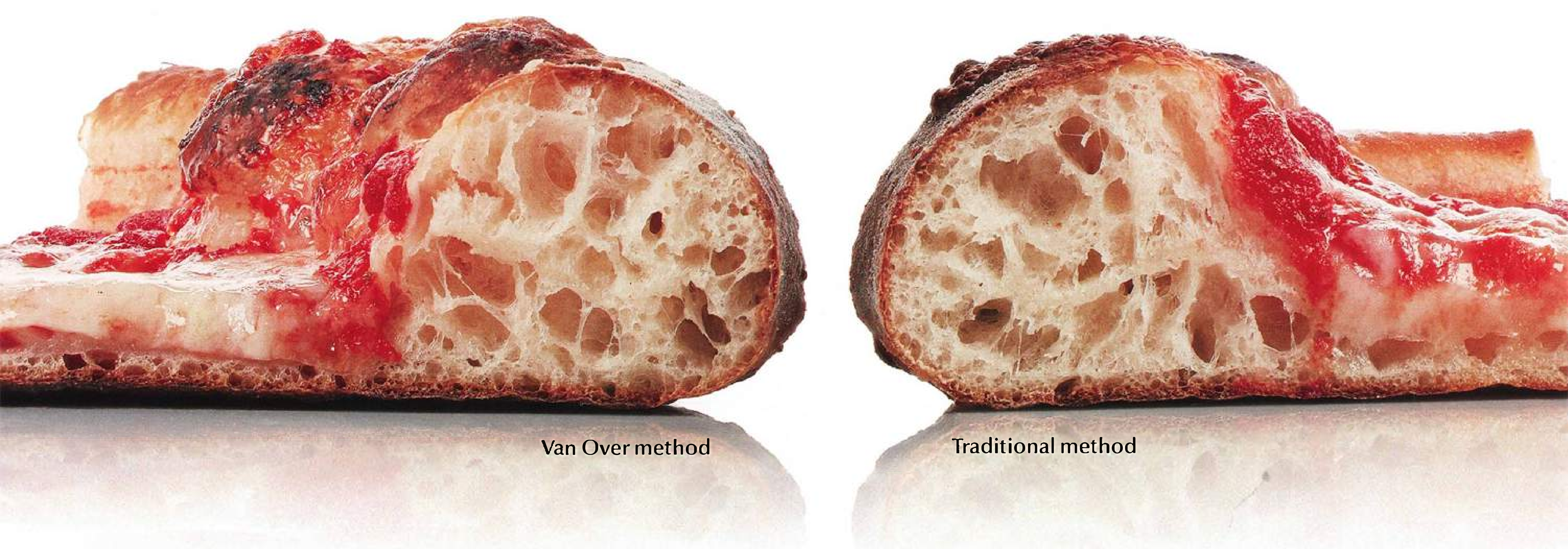
To use the van Over method with a preferment, you'll need to add it to the food processor bowl first, along with the flour and salt. Pour the water in while the machine is running. Stop once the dough has formed a ball and check to ensure that it has been mixed to full gluten development by performing the windowpane test.

2 Turn the processor on, then pour in all the water in a steady stream.

3 Process for 45 s.



4 If the gluten is not fully developed (it won't hold a windowpane; see page 30), then alternate between processing for 5 s and testing the gluten development, until you reach full gluten development.



HOW TO Mix Using the Double Hydration Mixing Method

Highly hydrated doughs, such as focaccia, take a long time to develop in a machine. The generous amount of water makes it difficult for the hook on the mixer to catch the dough well, and it instead sloshes around in the bowl. This issue can be remedied by adding the water to the mixer in two steps rather than all at once.

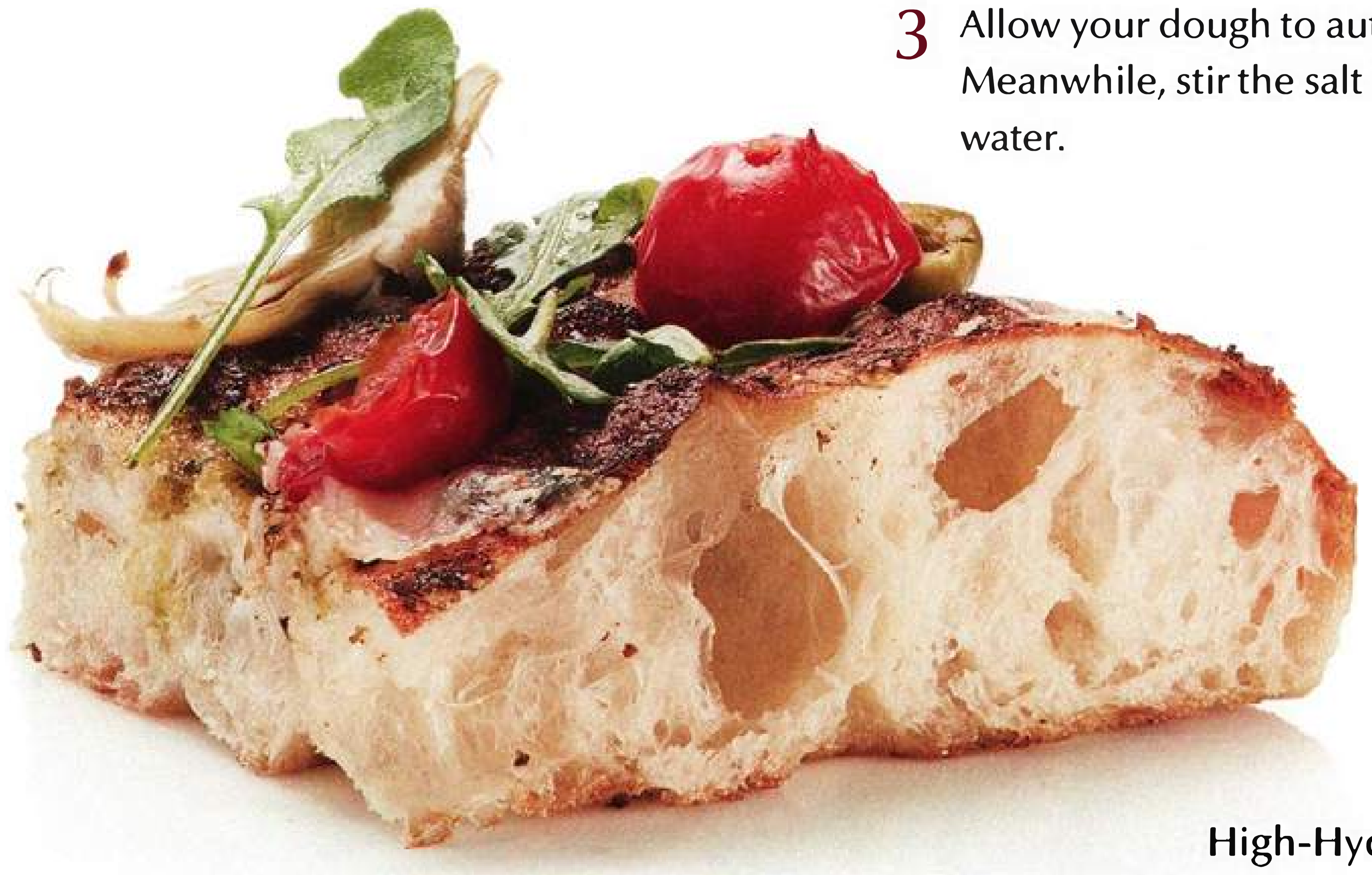
1 Add 90%–95% of the water to the mixer's bowl.

2 Add the remaining ingredients (except the salt and remaining water) and mix on low speed until you achieve a homogeneous mass.

3 Allow your dough to autolyse for 30 min. Meanwhile, stir the salt into the remaining water.

4 Turn the machine to low speed. Pour the salt solution in a steady stream as the machine mixes.

5 Mix to medium gluten development. Transfer to a lightly oiled plastic tub or bowl to bulk ferment.



High-Hydration al Taglio Pizza Dough (see page 158)

HOW TO Incorporate Inclusions by Machine

Using a mixer is dramatically faster than mixing by hand but requires some care when incorporating inclusions into a dough. The solid matter (your inclusion) is trying to bond with the dough; this can stress the dough's strength and integrity as the inclusions pull and push through it. Be careful to mix on the lowest speed to minimize damage. Mix until the inclusions are incorporated into the dough; they will be enveloped in the dough, not just hanging on to it.

1 Mix the dough to medium gluten development.

2 Stop the machine and add all of the inclusions.

3 Mix on low speed for 1–2 min, just until the inclusions are evenly distributed throughout the dough and are completely enveloped.

4 Transfer the dough to a lightly oiled tub and finish developing the gluten throughout bulk fermentation by performing a series of four-edge folds (see page 51) until it reaches full gluten development.

HOW TO Make Compleat Wheat Dough

We developed this method to produce what is technically a 100% whole wheat dough without the dense, gummy texture you often get from whole wheat flour. This allows for whole wheat flavor without the volume-killing effects of the bran and germ.

To make whole wheat flour, commercial mills grind the wheat to a fine powder and then remove the bran and germ, which is the same process used to make white flour. The separated germ is toasted since its oils can become rancid and then spoil the flour. The bran and germ are then mixed back into the white flour. Our method also involves using white flour and introducing the bran and germ back in when the dough is halfway developed (medium gluten development) to get the flavor benefits without the dense texture.

Beyond that, we toast the bran and germ to make them more flavorful and aromatic. It's like the difference between eating raw and toasted almonds. This toasting also renders useless the enzymes that hinder gluten development. And because bran and germ are notorious water thieves (they suck water away from the dough and hold on to it, part of the reason why whole wheat doughs feel dense), we presoak them so they will have already absorbed all the water they need before being mixed into the dough.

In the various compleat wheat recipes on pages 174–177, we have calculated how much bran and germ each recipe needs in order to mimic the percentages found in whole wheat flour. We opt to add the soaked and toasted bran and germ to the flour used in the master recipe. This will result in the highest possible volume and also the most flavorful whole wheat crust you've tasted.

1 Toast the bran and germ in an even layer at 175° C / 350° F in a home or deck oven. Do not use a forced fan because it will blow the bran and germ off the sheet pan. Toast until aromatic, 5–7 min. Cool completely.

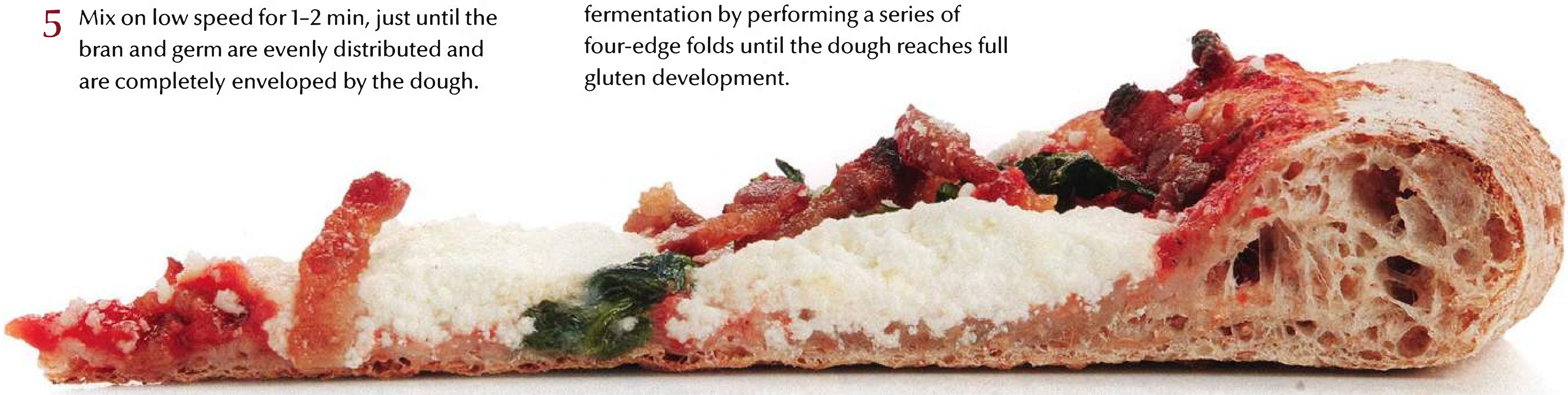
2 Mix with the water, and soak for at least 10 min (or up to 24 h).

3 Combine all of the dough ingredients except for the soaked/toasted bran and germ and mix to medium gluten development.

4 With the machine stopped, add all of the soaked/toasted bran and germ.

5 Mix on low speed for 1–2 min, just until the bran and germ are evenly distributed and are completely enveloped by the dough.

6 Transfer to a lightly oiled tub and finish developing the gluten throughout bulk fermentation by performing a series of four-edge folds until the dough reaches full gluten development.



Compleat Wheat Artisan Pizza Dough (see page 174)

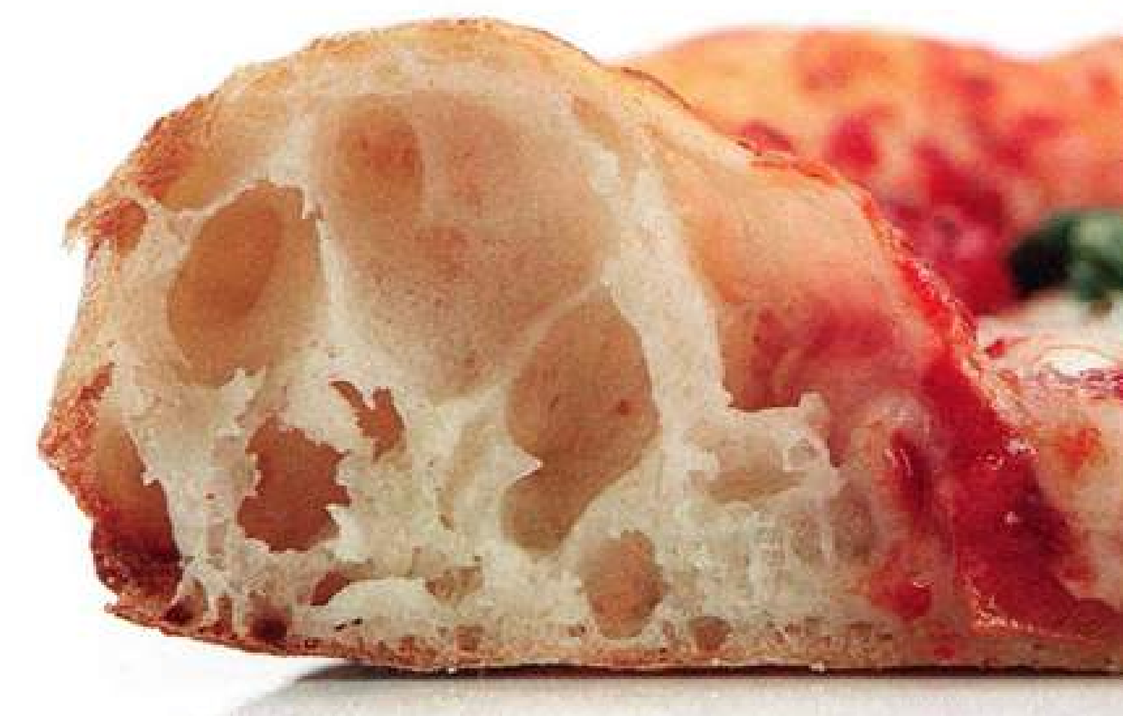
6

Your Daily Pizza

Modern lifestyles don't always make it easy to produce our proverbial daily bread or, in this case, daily pizza. We were inspired by an undemanding daily baking routine created by Jeff Hertzberg and Zoë François. Starting with 2007's *Artisan Bread in Five Minutes a Day*, Hertzberg and François showcased a make-ahead bread technique that became the centerpiece of a best-selling series of cookbooks. They demonstrated how a large batch of dough for almost any type of bread can be stored long-term in the refrigerator, with the baker harvesting a loaf's worth of dough every day for up to two weeks.

Hertzberg and François have refined their methods over time, and we have modified their recipe to make pizza dough with our own improvements while keeping the low-maintenance schedule (see recipes on page 184). We add around 0.22% ascorbic acid to strengthen the dough's gluten network and reduce oxidation, which eventually would make the dough turn gray in the refrigerator. Polydextrose is included in our Neapolitan variation to produce a very crispy crust.

If you have made your first large batch of dough, you can harvest a 500 g / 1.1 lb (or 1 kg / 2.2 lb) piece, divide it (if necessary), preshape and shape it, and then proof it. Accounting for proofing time, the recipe takes more than 5 minutes of effort per day, but with some preplanning this method supplies daily pizza with a fraction of the work.

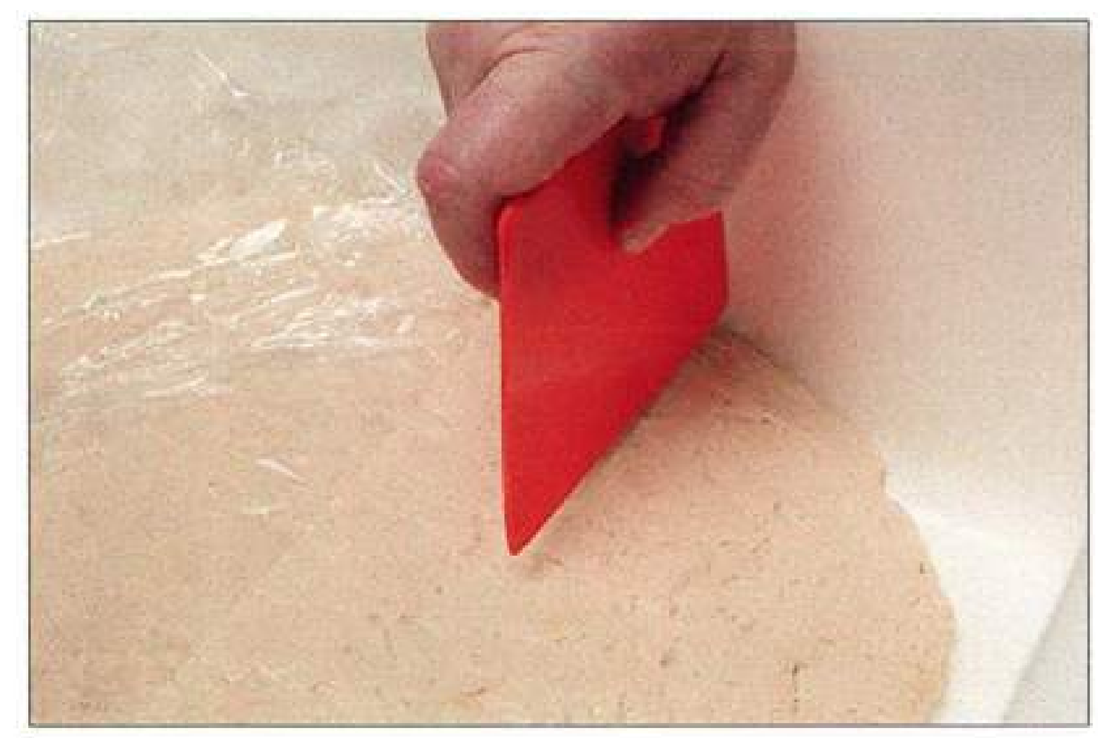


Your Daily Artisan Pizza Dough (see page 184)

HOW TO Make Your Daily Pizza

1 Combine all of the ingredients in the mixer's bowl. Mix on low speed using a paddle or hook attachment to a homogeneous mass, 2–3 min. Transfer to a lightly oiled tub and cover.

2 Bulk ferment for 1 h at 21 °C / 70 °F. Remove the lid and put a piece of plastic wrap directly on the surface of the dough to cover it completely. Refrigerate for at least 23 h before your first bake.



3 Divide the dough as instructed in the master recipe.

4 Proceed with the preshaping and shaping instructions (if applicable) in the master recipe.

5 Proof for 4½–5½ h at 21 °C / 70 °F, covered. If you are making Neapolitan pizza dough, proof for 3–4 h at 21 °C / 70 °F, covered. Proceed with the shaping and baking instructions in the master recipe.

FACTORS THAT AFFECT MIXING TIME

The following table details factors that may affect mixing time and, therefore, your dough. Suggestions for eliminating (or minimizing) any negative effects on your dough are also noted.

Factor	How it can affect your dough	How to keep it from affecting your dough
dough temperature	if the dough is too cold when it comes out of the mixer, it will take longer to ferment than a dough that comes out at our recommended range of 24–25° C / 75–78° F; a dough that comes out too hot (generally 27° C / 80° F and above) will hydrate faster and therefore proof faster, which will affect its flavor and make it harder to handle; warmer doughs are desirable in some cases, such as our Neapolitan pizza dough with poolish and our master Neapolitan pizza dough	for cold dough, adapt your schedule to compensate for the difference in fermenting time; to fix hot dough, put it on a floured sheet pan or in a large tub, and use your hands to flatten it as much as possible; cover it with plastic wrap sheet (or a clean plastic bag), and refrigerate it for at least 10–15 min or until the dough has reached the recommended temperature range
amount of dough in the mixer	too much dough will take longer to mix and increase mixer friction, and too little won't mix well or at all	know the capacity of your mixer and don't overload or underload it; for more on mixer capacity, see page 34
type of flour	some flours, such as whole wheat, contain bran, which can rip the dough; stronger flours take longer to mix; low-gluten flours mix quickly and can break down just as fast; rye flours, in addition to being low gluten, absorb more water than regular wheat flours	understand how each flour is used for different purposes, and choose the flour that's best for the dough you want to make
amount of water	high-hydration doughs take a long time to mix; low-hydration doughs are hard to mix because they're stiff and can bog down the machine	for high-hydration doughs, use the double hydration method (see page 41); for dry, stiff doughs, mix on the lowest speed and/or use a paddle attachment instead of a hook
fats	fats slow down gluten formation and interfere with the bonds that keep gluten together, by coating them and preventing them from hydrating	when possible, add high-fat ingredients after the dough has reached at least low gluten development
inclusions	as with bran, solid inclusions such as nuts and fruit can rip the dough	add solid inclusions after the dough has reached medium gluten development (see page 30)

HAND MIXING

Mixing by hand is the original method for making dough, whether bread or pizza. These days, there are a number of hand-mixing methods, each with pros and cons. To be clear, we're not proponents of mixing pizza dough by hand. We prefer machine mixing because most pizza doughs need to be mixed to full gluten development, and letting machines do the work makes sense for both home cooks and pros. We recommend to mix by hand only if you don't have an electric mixer, although mixing a few batches of dough by hand will give you a feel for how the dough comes together at different points in the mixing process.

The hand-mixing technique you choose ultimately has to do with how much effort you're willing to commit, how much time you have, and how dirty you're willing to get. When we say hand mixing, we really mean hands, not a wooden spoon or rubber spatula. The tactile connection lets you feel any changes in the dough immediately, such as whether it's becoming cohesive or is still lumpy. You can learn a lot about the dough through direct contact, and then can adjust your efforts accordingly.

Hand mixing is gentlest on the dough, preserving the carotenoids that will give it a creamy yellow hue, if that is something that matters to you (it has no effect on flavor or final texture). The process is all about practice and patience. Batch size is the main limitation, but you can make a batch that weighs anywhere from 1 kg to 10 kg / 2.2 lb to 22 lb (some pizzerias mix up to 40 kg / 88 lb by hand).

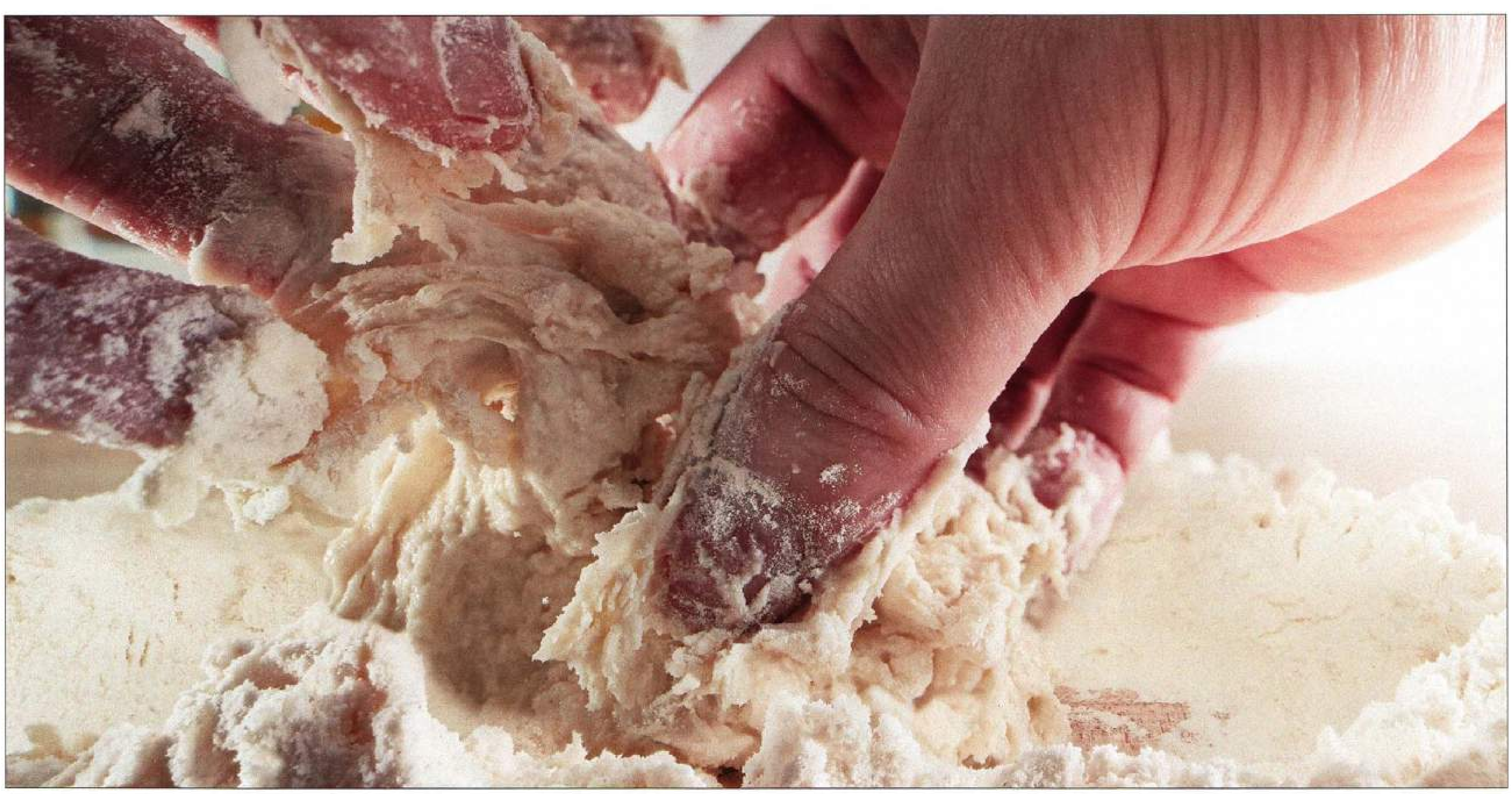
Still, you may have to work on your stamina and upper body strength if you want to mix large quantities on a regular basis.

If you use bulk fermentation and dough folding to develop gluten strength, the effort is minimal as long as you perform the folds correctly. The initial dough is mixed to a shaggy mass (by hand) and then the dough is developed during bulk fermentation through a series of folds; alternatively you can mix further by hand to a more developed dough and then finish with fewer folds and a shorter bulk fermentation.

As your hands mix the dough, you're essentially forcing the hydration of the flour by "pushing" the water into it. Every hand motion helps make this happen, little by little. Your hands won't produce the same amount of frictional heat that a machine does—not by a long shot. That's why the DDT doesn't apply at all here. Instead, you must take the ambient temperature into consideration. The goal is to have a constant working dough temperature that's neither too cold nor too hot. If the room is hot (e.g., 27°C / 80°F), start with cold water or lukewarm (15°C / 60°F); if the room is cold (e.g., 15°C / 60°F), start with warm water (24–26°C / 75–79°F). If you're working in a room that's temperature controlled, your flour (and preferment, if you're using one) will be at room temperature. As a rule of thumb, you should start with water that's about 21°C / 70°F, assuming that's the approximate

Wooden proofing boxes are commonly found in pizzerias; the AVPN (see page 1:74) also offers a wooden mixing box for hand mixing your dough.

The action of hand mixing is gentler on the dough and will provide less friction, but it takes much longer. Some doughs, like our master Focaccia Dough (see page 148), should be mixed by machine only.



temperature of your kitchen. If you aren't sure what your room temperature is and you don't have a thermometer, it's a safe bet to start with water that feels just cool to the touch.

As for getting your hands "dirty," for some methods you'll have to use only one hand for mixing. We recommend you keep one hand in the dough and the other one clean. Your clean hand will be the one you use to grab a scraper to clean your dough-mixing hand, to hold your mixing bowl, and any number of other one-handed tasks. For some methods, you'll need two hands. The good news is, using two hands makes mixing faster—albeit messier.

Our preferred method entails mixing dough in a bowl and then transferring it directly to a table. In this case, we suggest using a marble surface or wooden table; if you don't have the latter, use a custom-cut piece of untreated plywood or even a large wooden cutting board. You shouldn't use the same cutting board that you use for preparing other food because it can give an off-flavor to the dough. If the dough sits on marble for too long, it can have an impact on the temperature. Keep in mind that marble is at the same temperature as its environment even though it is cool to the touch. It can only raise or lower the dough's temperature to bring it into equilibrium with it. We don't like stainless steel as a work surface because it tends to stain dough with gray or black streaks. Granite or composite granite are also good for pizza dough but are more expensive than wood.

HOW TO Mix in a Bowl

This is our preferred method for mixing a dough by hand. This is the most basic method for mixing dough: it involves using only a bowl and your hands. Spoons or spatulas can't get into the dough as well to distribute the ingredients evenly.

1 Combine the water and yeast in a bowl. Whisk to dissolve the yeast. If you're using a preferment, dissolve it in the water.

A ripe preferment will float in the water. For more on preferments, see page 1:301.

2 Pour the flour and salt on top of the water and yeast mixture, and begin to stir with your fingertips, then with your hands.

3 Mix until you achieve a shaggy mass.

4 Turn the dough onto a wooden or marble worktable (scrape the bowl clean with a bench scraper). Knead the dough with both hands until you reach medium gluten development (perform the windowpane test to make sure; see page 30). If you wish to, you can mix to full gluten development by hand and skip to step 8.

5 Clean your hands well, scraping off the excess dough with the bench scraper. Lightly oil a rectangular or square plastic tub.

6 Transfer the dough to the tub and immediately perform a four-edge fold in it.

Typically with this method, you'll have to bulk ferment for 2–2½ hours and perform a total of four to seven four-edge folds at 30-minute intervals.

7 Rest the dough for 30 min and perform the second four-edge fold; repeat this step until the dough reaches full gluten development. Perform the windowpane test (see page 30) to make sure.

8 Rest the dough for 20–30 min after the last fold before dividing.

HOW TO Mix with the No-Knead Method

Jim Lahey, renowned baker and cookbook author, popularized this revolutionary technique. It reinforces the idea that when ingredients are combined and left alone, they'll do what's in their nature and produce a great pizza (see the recipes on page 182). Calling this technique "no-knead" isn't entirely true; there's some manipulation involved, but the handling is much less than a typical dough requires. This dough relies on time—and the pizza maker's patience—to do the work that your hands would usually tackle.

1 Combine the ingredients in a bowl and mix by hand to a homogeneous mass. Transfer to a lightly oiled tub, and cover.

2 Bulk ferment for 12–18 h at 21° C / 70° F.

3 Divide and preshape the dough as instructed in the master recipe.

4 Proof for 3–4 h at 21° C / 70° F, covered. Optional: After preshaping, you can also cold-proof this dough at 4° C / 39° F for 1–2 d for even better baking results. If you cold-proof the dough, remove it from refrigeration 1½–2 h before baking so it warms up and is easier to stretch out.

5 Proceed with the shaping and baking instructions in the master recipe. If you are making New York pizza dough, proof for 4½–5½ h at 21° C / 70° F.

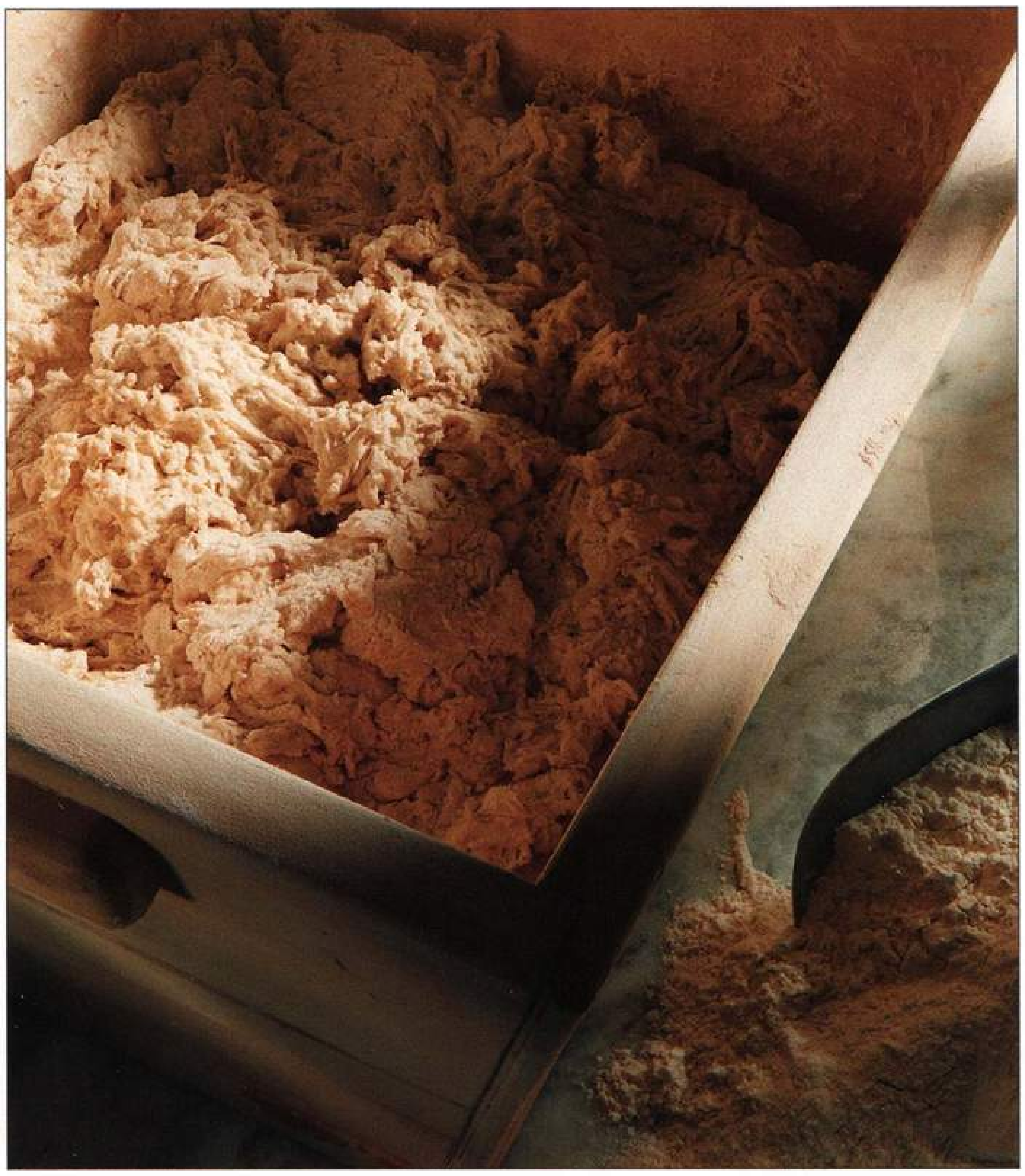
We don't recommend this method for our pan-baked pizzas since the dough doesn't get as strong as we like. We had to degas it too much in order to get the dough to fill the pan.

HAND MIXING IN WOODEN TUBS

A *madia* is the traditional Neapolitan wooden tub used for mixing dough by hand. They come in a number of sizes. These days, however, they're harder to find because many were replaced once electric mixers became available (or affordable). During our travels, we did find someone who actually still uses them. Renowned pizzaiolo Franco Pepe (of Pepe in Grani in Caiazzo, in the province of Caserta, Italy) mixes all of his dough by hand in these wooden tubs.

You can imagine the amount of work it takes to mix all of the doughs that are made in his restaurant—not just the sheer quantity of dough, but the physical effort it takes to accomplish this feat on a daily basis. But it's an integral part of his pizza-making process. Some see the hand mixing at Pepe in Grani and think, aha! This must be the secret to his fabulous pizza! But that's not the secret at all. Franco Pepe's success came because he's very good at making pizza, has had many years of practice, and has come up with a mixing method that can be effectively taught to his team through hands-on training focused on time, temperature, and the types of flour used in his pizzas.

There's no real evidence that mixing by hand has any major positive effect on dough, whether in a wooden tub or otherwise. You might think there's some magical stuff happening in the wood with yeast and bacteria, giving the dough special qualities that plastic and metal just can't provide (although the wooden box is porous and can absorb some moisture from the dough). This is part of the lore of pizza making. But there's no special sorcery to wooden tubs. There is just skill.



BULK FERMENTATION

When making some of our doughs, such as our Focaccia Dough (see page 148) and New York Square Pizza Dough (see page 152), the mixing stage is followed by bulk fermentation, also known as first proof or first fermentation. You are simply fermenting your dough at room temperature in one piece before dividing it into smaller portions. The duration of bulk fermentation is most often determined by three factors: how long the dough was mixed, the consistency of the dough, and the type of yeast (commercial, levain, or a combination) used. The bulk fermentation stage is standard in bread baking but far less common among pizzaioli, who tend to go straight from mixing their dough to balling it for the fermentation stage.

We include the bulk fermentation stage for our Neapolitan dough and for our bread-like pizzas. Neapolitan dough is not traditionally bulk fermented, but after extensive testing for the best method to proof our master Neapolitan dough (see page 124), we found it gave us the best results.

The amount of mixing time is generally inversely proportional to the duration of bulk fermentation. That is, the longer the mix (the more the gluten is developed), the shorter the bulk ferment; the shorter the mix, the longer the bulk ferment. The dough is developed during bulk fermentation through a series of folds (see page 50). The duration matters because it allows time for enzymatic activity and hydration to develop gluten; this happens when the gluten strands organize and through the acidification that occurs during a long fermentation. Acidity helps strengthen gluten strands, whether naturally produced by the yeast (commercial or wild) or added in the form of ascorbic acid during mixing (see page 1:324).

Note that the majority of our doughs are *not* bulk fermented. Instead, they're mixed to full gluten development and then go through what's called bench rest. This 15- to 20-minute rest period after mixing allows the dough to relax before dividing and preshaping. Our master Neapolitan dough is an outlier in that it's mixed to full gluten development *and* allowed to bulk ferment at room temperature in a tub for 20–24 hours.

We bulk ferment any doughs that are mixed to medium gluten development, including those that have an inclusion. We incorporate inclusions at the

Folding during bulk fermentation redistributes the yeast and carbon dioxide in the dough as well as evens out the temperature of the dough.

medium gluten development stage (see page 30) because if the gluten is fully developed, the dough will be too strong to easily take in the inclusion, which might cause tearing. Adding the inclusions at this halfway point is much gentler on the dough. We finish developing the dough during bulk fermentation through a series of gentle four-edge folds (see page 51).

THE BENEFITS OF BULK FERMENTING

Bulk fermentation allows the dough to rest after mixing, which gives the enzymes enough time to act on the components of the dough. Proteases (protein-eating enzymes) cut gluten strands into smaller strands by breaking down the peptide bonds between amino acid chains in the proteins. The act of mixing and folding strengthens these strands even as they get smaller and smaller because the latticework of the gluten network becomes more interconnected. The gluten will eventually form a network of chains and strands that become the structure of the dough. Protease is found in very small amounts; an excess of it would cut gluten strands too much and have the opposite effect. If the dough is allowed to autolyse (see page 32) or if a preferment is used, proteases will have enough time to do their work. Bulk fermentation gives these enzymes even more time. It strengthens the dough slowly and gradually without adding excessive oxygen as with long mixing times.

FACTORS THAT AFFECT BULK FERMENTATION

Multiple factors influence the time the dough spends bulk fermenting at room temperature, including dough hydration, mixing method, temperature and humidity, and yeast type. High-hydration doughs require a longer bulk fermentation time and additional folds; this allows time for the gluten to form a firm structure in what is a very slack dough. A dough mixed by hand will require a longer bulk fermentation time and more folds to strengthen its gluten structure than a dough mixed by machine to medium gluten development. Doughs that are machine-mixed to low gluten development will also require more time to bulk ferment and an increased number of folds.

The warmer the room, the faster the dough will ferment. For most doughs, try to maintain a cool environment (approximately 21°C / 70°F). If you're unsure, it's always best to err on the side of caution and go with a cooler temperature. Maintaining a consistent temperature is also an important consideration, as temperature fluctuations during bulk fermentation can impact the duration. Some kitchens have access to a proofer (see page 74), which allow you to bulk ferment your dough at a specific, consistent temperature. If you have a temperature-controlled pizzeria, however, you might not need a proofer-retarder.

A dough that contains commercial yeast will ferment much faster than a dough that contains only levain. In theory, a dough made with commercial yeast should generally be bulk fermented for a relatively short time compared to a levain-based dough, which benefits from a long bulk ferment and multiple folds. We say "in theory" because you can simply reduce the amount of commercial yeast in your dough and extend bulk fermentation time. This is key for high-hydration doughs that are mixed by hand.

Neapolitan Pizza Dough (see page 124)

STRATEGIES FOR BULK FERMENTATION

Type of mix	Length of bulk fermentation	Number of four-edge folds (unless noted in the recipe)	Recommended doughs	Doughs not recommended
medium gluten development	2–2½ h	4–6	focaccia dough New York square pizza dough high-hydration al taglio pizza dough all doughs with inclusions	thin-crust pizza dough Brazilian thin-crust pizza dough deep-dish pizza dough Neapolitan pizza dough New York pizza dough artisan pizza dough Detroit-style pizza dough
full gluten development	the dough is bench rested instead for 15–20 min before dividing	0	thin-crust pizza dough Brazilian thin-crust pizza dough deep-dish pizza dough Neapolitan pizza dough New York pizza dough artisan pizza dough Detroit-style pizza dough	New York square pizza dough high-hydration al taglio pizza dough foccacia dough

When we call for a dough to be folded, we are talking about four-edge folds the majority the time. There are times, however, when we instead recommend a simple book fold. In those cases, just fold the dough in half as though shutting an open book.

FOLDING

During bulk fermentation, folding is often performed. This strengthens the dough because the stretching breaks down weak gluten bonds and allows stronger ones to form. The gluten strands organize and align, which gives the dough the integrity to become elastic and expand as carbon dioxide (produced by the yeast) and water vapor are introduced into the bubbles. Folding gives the carbon dioxide and water vapor more "housing" to create larger bubbles throughout the dough. The more folds performed on the dough, the more bubbles that form—and the more those bubbles will be able to expand and create a better alveoli pattern in the crumb. Keep in mind that folding breaks up the large bubbles into smaller ones; with some doughs, such as focaccia, you want to keep those large bubbles so you get an open crumb, so be gentle when you perform folds.

Some of the initial carbon dioxide bubbles deflate during bulk fermentation, and the gas escapes from the dough. If the yeast is surrounded by a carbon dioxide–saturated environment, it will affect the yeast's physical and chemical properties. Folding restarts the fermentation process, allowing the dough to rise again. This extends fermentation time, which results in better formation of gluten structure as well as more pronounced flavors.

In addition to encouraging an even gluten network, folding equalizes the temperature of the dough throughout its mass. As dough sits, the core often becomes warmer than the surface. Folding the dough onto itself ensures consistent fermentation throughout. Folding also redistributes unreacted sugars, making them more readily available for yeasts to eat, which extends fermentation time. Yeasts and bacteria are also redistributed.

As a general rule, the less you mix a dough, the greater number of folds you'll need to develop the gluten. For pizza doughs mixed to medium gluten development, perform four to six four-edge folds. Doughs mixed to low gluten development can have up to eight folds or even more. Since there is less gluten development in doughs mixed to medium gluten development, the doughs rely on a high number of folds. For most of our doughs that are mixed to medium gluten development, we recommend 2–2½ hours to bulk ferment with a total of four to five folds. The first fold should happen as soon as the dough is placed in the tub (in our recipes, this is part of the mixing steps) and the remaining folds at half-hour intervals after that. Doughs mixed to full gluten development in the mixer do not need any folds or bulk fermentation time—with one exception: Neapolitan pizza dough, which is mixed to full gluten development and bulk fermented, without any folds, for 20–24 hours.

HOW TO Perform a Four-Edge Fold

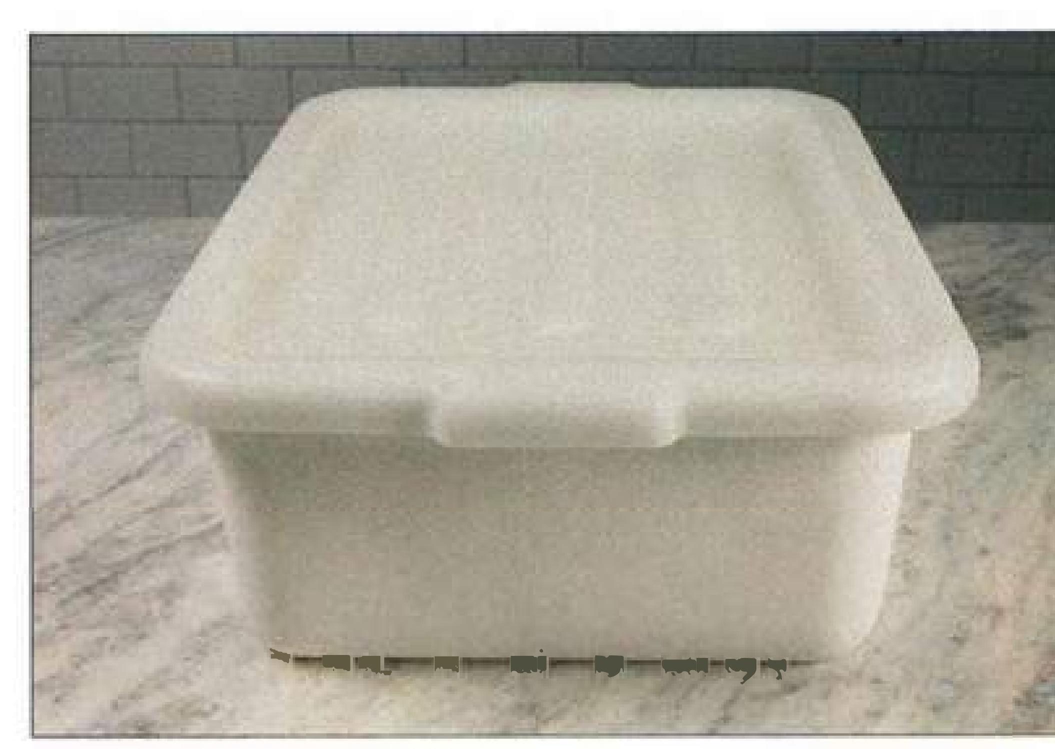
This is a crucial technique to master. Executing it properly will give the dough structure to hold its shape and expand evenly in the oven. Proper folding strengthens the dough and helps give the gluten network an organized pattern, and it improves fermentation by evening out the temperature of the dough.

1 Transfer the mixed dough to a lightly oiled plastic tub, perform a four-edge fold, and cover it with an airtight lid.

2 Lightly moisten your hands or coat them with a thin layer of oil to prevent the dough from sticking.

3 Pull up the right side of the dough and fold it over to the left side of the tub.

4 Pull the left side of the dough up and over to the right side of the tub.



5 Lift up the end that is closest to you, and then fold it away from you so that it meets the end of the dough that's farthest from you.

6 Lift up the end that's farthest from you, and then pull it toward you. Some bakers then flip the dough over so that the seam is underneath. If you are working with a drier dough, seal the seam to create a more uniform shape, since it lacks the moisture content needed for this to occur naturally.

7 Place the lid on the tub, and continue to bulk ferment.

DIVIDING AND PRESHAPING

Immediately following bulk fermentation or a short bench rest after mixing, the dough is typically divided; before you proceed, however, you must make sure your dough is ready for preshaping.

The dough should be supple and relaxed. If you developed your dough utilizing folds during bulk fermentation, such as with New York square pizza or focaccia, perform the windowpane test (see page 30). If the dough doesn't hold a windowpane, the structure won't be elastic enough and the dough will tear when it's pulled. If this happens, perform one or more additional four-edge folds and extend the bulk fermentation time. If the dough hasn't yet developed a strong structure but also feels gassy and you're concerned it will proof too much in the final proofing stage, perform a four-edge fold and then refrigerate. Continue bulk fermentation until the dough has developed enough gluten to become fully elastic.

Once the dough is strong enough to divide (and thus ready to preshape), you'll essentially be cutting a large piece of dough into smaller pieces. This step has numerous approaches, but the goal is always to divide the dough into equal pieces. Seems pretty straightforward, right? But as with so many things in life, our first attempts at a new skill can be a little rough. That's why we've simplified the steps in a way that will help whether it's your first or your thousandth pizza.

First, consider the shape of the pizza you want to make. This will determine how you begin to portion the dough. If you're making al taglio pizzas, for example, you'll need short rectangles; for Neapolitan pizzas, you will cut out squares. Make sure there's enough room on your work surface to hold the dough and the divided pieces. Be sure to use bench flour (see page 53) or semolina on your table. Very wet doughs require more care and attention since they stick to everything they touch (see page 59). If your dough has a significant amount of commercial yeast, you'll need to work quickly so it doesn't begin to proof too much before you start shaping it. (Some fermentation will inevitably occur, but you want to keep that to a minimum and let the yeast proof after the dough is preshaped.) Levain-based doughs are more tolerant.

A scale will make your life easier by allowing you to ensure that your pieces of dough are the same size. If the weighing surface is too small to hold the dough, put a sheet pan or a plate on top of the scale. Be sure to account for the weight of the container by zeroing the scale first.

Practice will help you then shape the dough as evenly as possible and minimize the amount of movements you need to make. There are many ways to preshape and then shape dough (see page 3:3 for the various methods). Try several, and see which one you prefer. The obvious reason for shaping dough is to create a uniform, round, square, oval, or rectangular pizza. A uniform shape will promote consistently distributed tension, which helps the dough expand evenly.

THE WORKSTATION

Setting up your workstation properly will make your dividing and preshaping tasks go more smoothly. The surface that you divide and shape your dough on matters. Stainless steel isn't terrible for working with dough, but wood and marble (or granite) are better. Why? Because the dough will slide over wood and marble surfaces more cleanly than stainless steel, which also tends to stain the dough a grayish black. Wood is cheaper than marble or other surface stones. If you're baking pizza at home and don't feel sure about investing in a wooden table or workbench for your kitchen, simply have a piece of untreated plywood cut to the desired size. The custom-cut plywood can be tucked away when you're not using it.

We recommend a 1 m / 3 ft square of plywood with a standard thickness of 1.25 cm / ½ in because this will suit most of your dough-shaping needs. You can also make your surface smaller—say, 60 cm / 2 ft square, especially if you find the larger board too heavy to lift. Use a paper towel in a rubbing motion to coat the board with a layer of food-grade mineral oil. Repeat this process as needed to maintain the wooden surface and let it sit for 24 hours before use. Before dividing the dough, place a rubber grip mat on your work surface, and then position the wooden board on top of it. Don't use a damp towel or anything wet to keep the board in place; this will cause warping. Each time you prepare to use the plywood board, wipe the surface clean with a lightly dampened towel to remove dust; don't wash the plywood because it will warp if it gets too wet.

You'll need flour for dusting for shaping most doughs. Before you begin, make our recommended bench flour by mixing equal parts rice and bread flours. We include rice flour in the mixture because it doesn't absorb as much moisture as bread flour and thus helps prevent wet doughs from sticking to most surfaces. We mix the rice flour with bread flour because we don't want the baked pizza to take on any of the rice flavor. As an alternative to this mixture, you can use fine semolina, which works great as dusting flour.

Use a sifter or your hand to dust your work surface and containers with the bench flour. We prefer a sifter. Although sifting may seem inefficient because it takes longer than hand-dusting, it's the best way to distribute an even layer. If you're dusting by hand, simply toss the flour on in an even layer. Use just enough to keep the dough from actually touching the work surface.

Before you begin preshaping and shaping, gather the following items: bench flour (see above), a scale, water or a water spritzer, a sifter, a bench or pastry brush, a bench knife, a plastic bag or tarp, a timer, and the container or surface where the shaped dough will proof (see page 66). Depending on the dough, this container or surface will be left as is, floured, or oiled.

We suggest keeping water handy in case your dough is sliding around because there's too much

Some pizzerias preshape their dough as they divide, it while others divide all of the dough first and then preshape it.

flour on your worktable. Use the water judiciously to give your hands and the dough more traction; too much will also make it slide. Use a sifter to disperse the bench flour evenly around the table so the dough doesn't stick. Use the bench or pastry brush to dust off excess flour. The bench knife will help you pick up and move dough pieces as well as clean the table. Make sure the plastic bag or tarp is large enough to cover all your dough pieces so they don't dry out and form a skin. The timer will help you keep track of how long your dough is resting and when to perform the next steps.

DIVIDING TIPS

Dividing a dough evenly will help ensure all of the pieces proof and bake at the same rate. Whether you're dividing 1 kg or 10 kg / 2.2 lb or 22 lb, the same guidelines apply. You should divide and shape your dough on a smooth surface so that flour or bits of dough don't get trapped in any nicks or pockets. Give yourself enough room for your ball of dough, a scale, and the divided pieces of dough, as shown in the photo on the next page. Right-handed people should put the scale on the left (and vice versa for lefties) to reduce crossover and increase efficiency of motion. Prepare your work surface by dusting it with flour or coating it with oil, depending on the type of dough you are working with. You can also dust the top of the dough with flour or coat it with oil before turning the dough out of the tub. When you remove the dough from its tub, it should ideally retain the rectangular shape of the container so that it will be easier to divide into squares or rectangles. Divide by using a bench knife to cut cleanly through the dough, taking care not to tear it. Try to divide the dough using as few cuts as possible.

If you divide your dough and it isn't the correct weight, either trim it down to size or add small pieces to make it right. Place the small pieces on top (don't stack them) and then fold them in when you flip the dough over to preshape it.

If your dough is uneven when you take it out of the tub, simply fold the dough in half and press it to even it out.

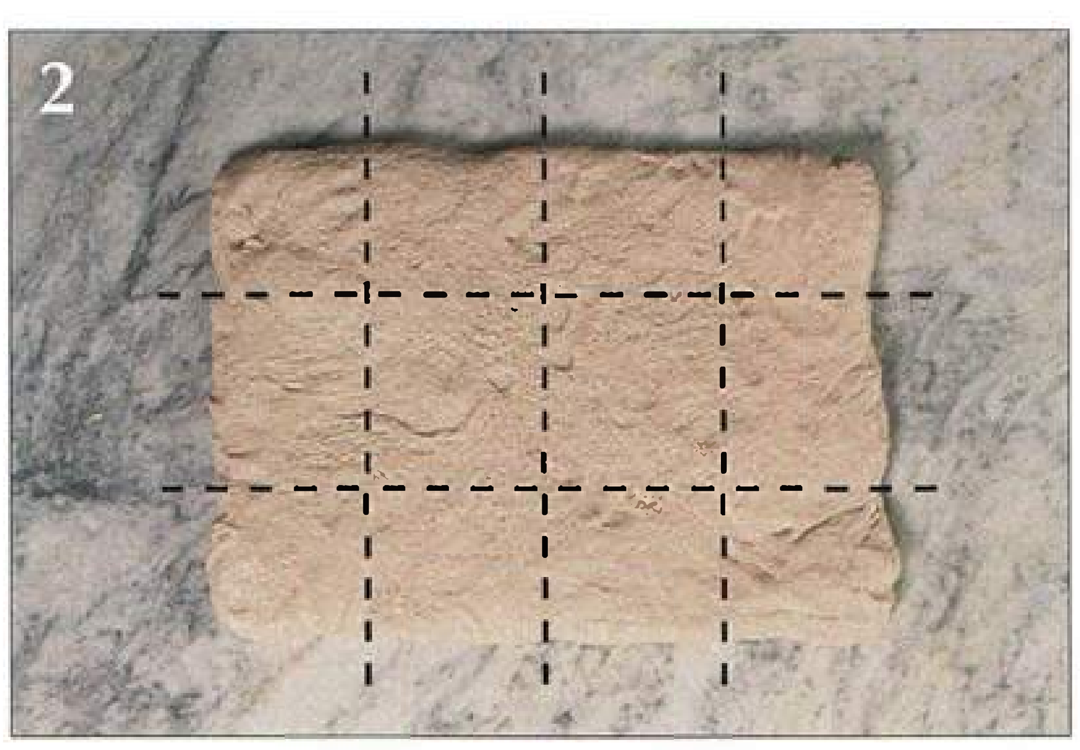
HOW TO Divide and Weigh Your Dough

The most common method of dividing dough used by both home pizza makers and professionals requires only two pieces of equipment: a bench knife and a scale. That makes it economical. More importantly, it's also the most accurate, since the scale will ensure that you divide into equal pieces. Measuring dough by volume just doesn't work. Precision and efficiency become even more important as your output increases because the dividing-and-weighing process will naturally take more time overall.

We prefer to use a square or rectangular tub for storing dough because most doughs with ≥70% hydration will take the tub's shape once they've settled. For easier handling, we also suggest lightly oiling the inside of any storage container. The square or rectangular shape also makes it easier to divide the dough into equal pieces after it's turned out onto a lightly floured surface.

It's important for the dough to be relatively flat and uniformly thick—large variations will make it hard to divide evenly. You can pat the dough to make the thickness even. If the rectangle is very uneven in thickness, the best way to even it out is to fold it over onto itself and let it rest, covered, for 30 more minutes before dividing.

The part of the dough that's in contact with the work surface is the smoothest (the most uniform). Keep this smooth side facing the worktable until you're ready to preshape, at which time you will turn the dough over. Work with a clean, sharp bench knife because it will cut your dough rather than tear it. Have your scale handy.



1 If using a tub, transfer the dough to a lightly floured surface, handling it gently so that it retains the shape of its container.

2 Mentally assess how you'll divide the dough.

3 Use your bench knife to cut cleanly through the dough, all the way to the work surface. (Don't worry if the dough degasses when you cut through it; that's not uncommon and you may be flattening the pizza dough anyway.)

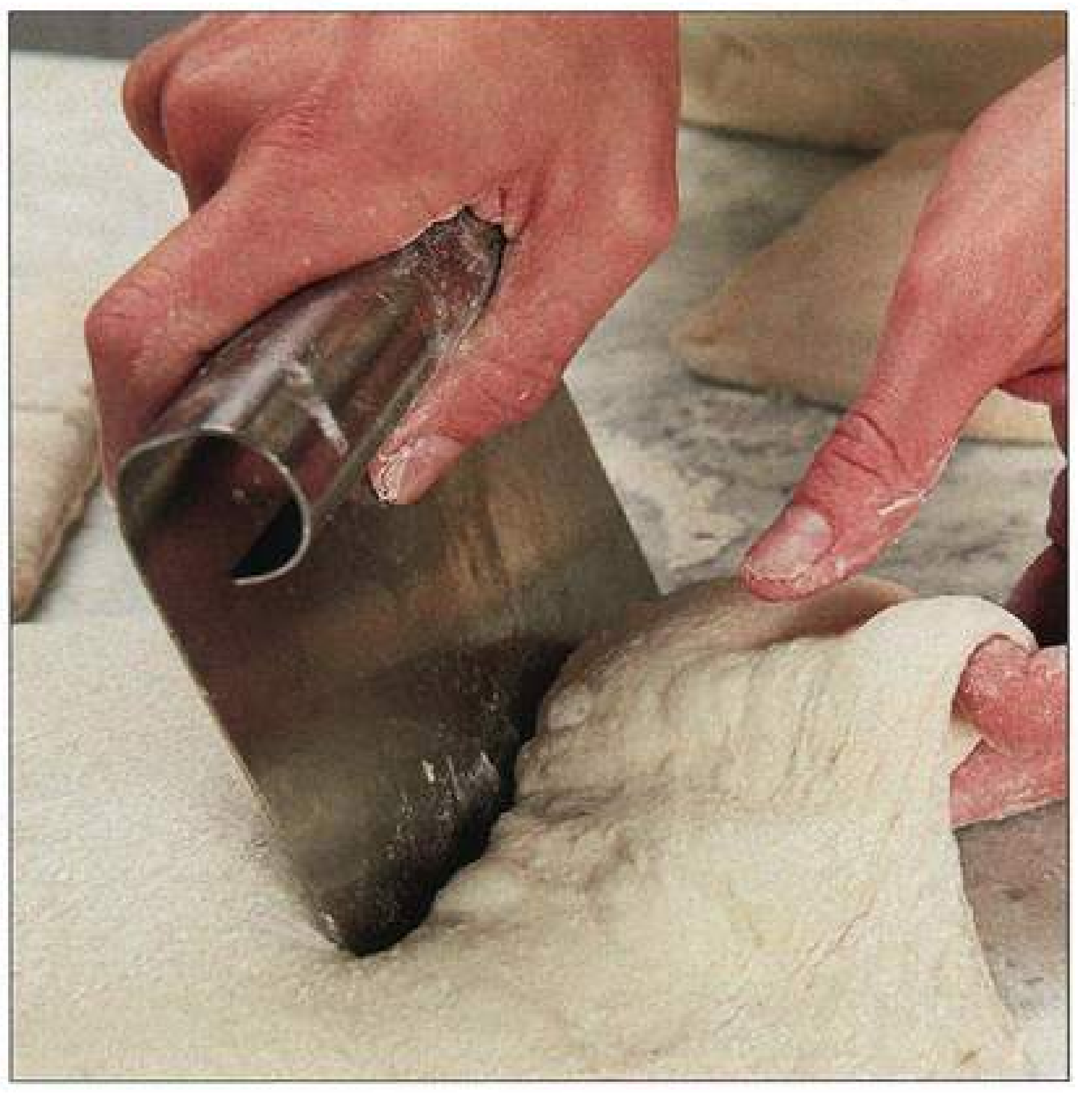
4 Weigh each piece of dough. Reserve one of the small pieces of dough from which you can harvest in case any of your divided portions come out too small (or use the excess dough if one of the main pieces was too heavy). Don't stack the extra pieces on top of each other; spread them out.

5 Keep track of the order in which you cut and weigh all the pieces of dough. You'll eventually want to shape each piece in the order that you cut it.

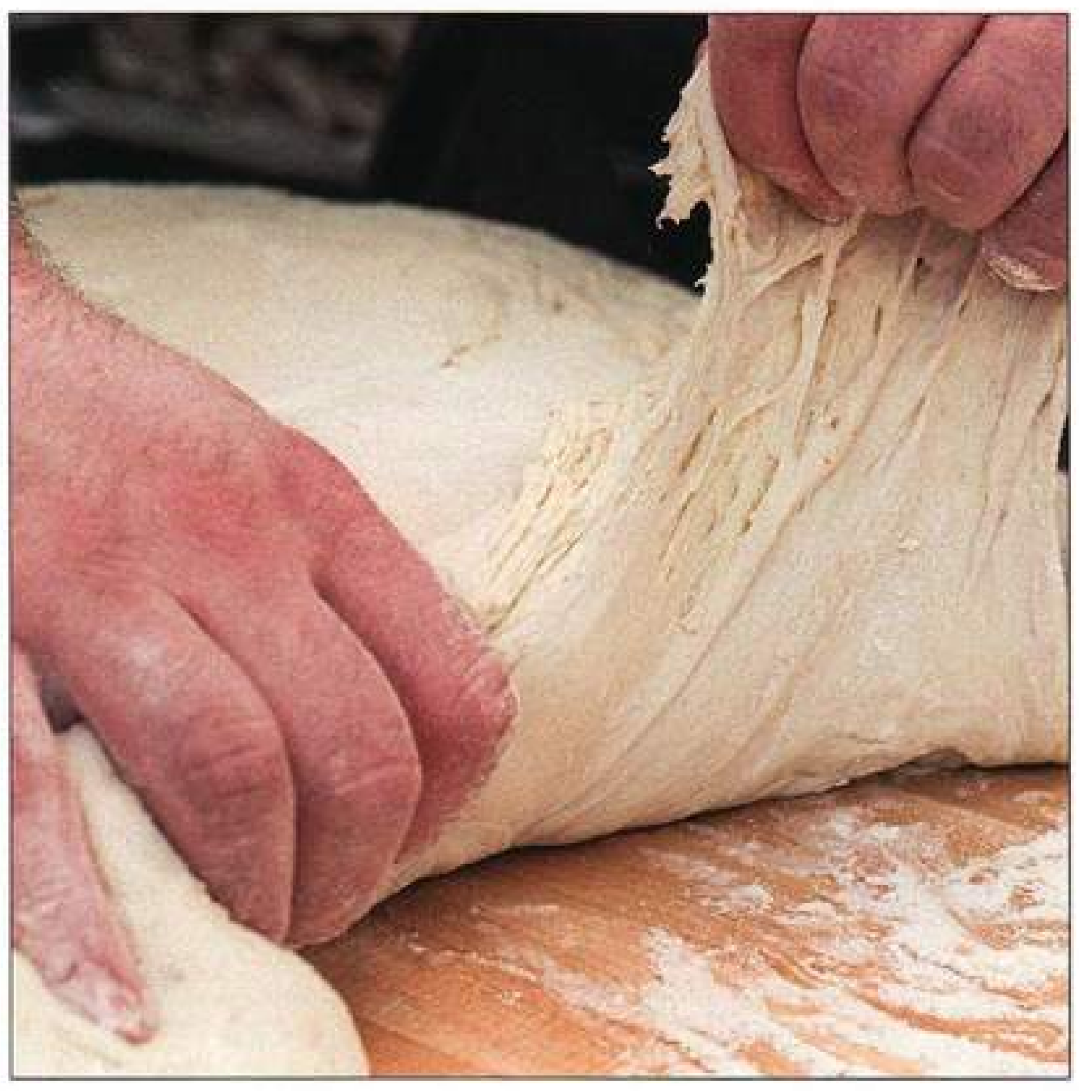
6 Cover your dough with a clean plastic bag or tarp so it doesn't form a skin.

DIVIDING BASICS

Lightly coat your surface with an even layer of flour, using a sifter or your hand.



Use a bench knife or a sturdy bowl scraper to cut cleanly through the dough.



Don't use your hands to divide the dough because it will likely tear, which could degas and damage its structure.

HOW TO Divide the Dough Without a Scale

At Modernist Cuisine, we're decidedly pro-scale. We highly recommend using this handy little device when dividing your dough. Unless you've divided and made thousands and thousands of pizzas and know your dough inside and out, the eyeball method isn't going to yield great results. Without a scale, you risk cutting uneven portions, which will require different amounts of time for proofing and baking. But if you don't have a scale at home or your trusted scale stops working during dough prep, follow these instructions.

1 If using a tub, transfer the dough to a lightly floured surface, handling it gently so that it retains the shape of its container.

2 Reshape the dough into a rectangle if it's lost some of its form.

3 Make sure the dough has a uniform thickness. If not, gently fold it in half (see page 55).

4 Mentally divide the dough into the number of pieces you need. In the photo above, we've made a triple batch (3 kg / 6.6 lb) of Thin-Crust Pizza Dough (see page 110). We plan to use it to make a dozen pizzas, so we will visualize a 4-by-3 grid.

5 Once you have an idea of where you're going to cut, use a sharp bench knife and cut cleanly all the way through the dough until you can feel your work surface beneath it.

6 Cover your dough with a clean plastic bag or tarp so it doesn't form a skin.

PRESHAPING

There are two steps that fall under the rubric of shaping: preshaping and shaping. Shaping is the step when you turn your piece of dough into the shape you want your final pizza to be, such as a round Neapolitan. We cover how to shape our master doughs in the Iconic Pizza chapter starting on page 3:3. Preshaping comes before that. It establishes a preliminary form that gives the dough a framework from which the tension and gluten will expand. This initial tension comes from folding and tucking the dough under and stretching it into place. The steps of preshaping vary depending on the style of pizza.

Proper preshaping leads to evenly risen and baked pizzas. It provides the foundation for optimal crust and crumb formation. The practical goals of preshaping are to degas the dough and to make it stronger by producing tension. You're essentially accomplishing something similar to when you perform folds during bulk fermentation (see page 50). The carbon dioxide bubbles become redistributed while the gluten strands tighten and reorganize. The even dispersion of carbon dioxide bubbles throughout the dough creates more spaces in which the gas can expand, resulting in the big, open crumb structure we prefer in certain pizzas. (For medium-crust and bread-like pizzas, avoid degassing the dough too much, which could lead to the tight, even crumb that is commonly seen in frozen pizza.)

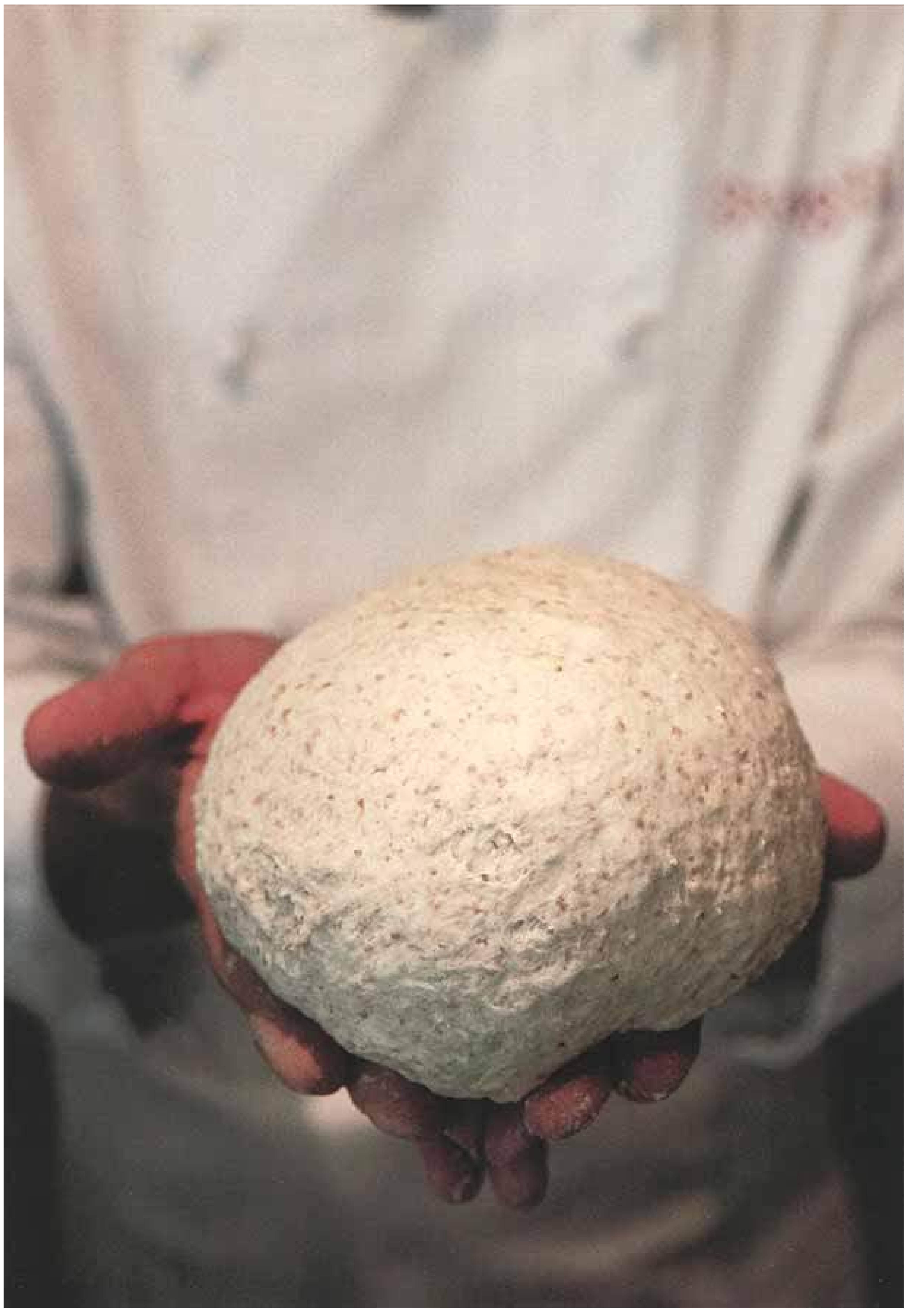
Prehaping dough is a bit like making a bed. It's not just a matter of getting things in the right place; you want to get the tension right, too. Tension is what maintains the shape through final proofing. Just as with sheets tucked around a mattress, the tension comes from pulling the dough taut and folding in the corners. Most of the preshaping processes detailed in the pages that follow apply to doughs that aren't considered high-hydration. The steps aren't necessary with wetter doughs such as our focaccia. Although they're difficult to handle, those slack doughs require fewer steps to become finished baked pizzas than some firmer doughs do. On page 59, we provide several tips for the few high-hydration doughs that need to be shaped.

For most thin- and medium-crust pizzas, such as New York pizzas, the dough is preshaped into balls, which are placed on a sheet pan or in a tub, well covered, and then allowed to ferment. The fermentation time can range from a few hours at room temperature to 24–48 hours or more in refrigeration. When they're ready, they're shaped, sauced, topped, and baked. For these pizzas, preshaping and shaping are very distinct steps.

For pan-baked pizzas, the dough is preshaped by coaxing it to start to fill the pan after bulk fermentation or bench resting; that's occasionally followed by a resting period of 30 minutes. During this time, the dough relaxes. Once the dough has rested, it can be further extended to fill the pan, then proofed, stippled, sauced, topped, and baked.

Our Neapolitan dough is a unique case. We preshape it after a long room-temperature bulk fermentation (20–24 hours); this produces a very strong dough, which needs at least 3 hours of rest before it's shaped for baking. For all pizzas, preshaping properly and evenly is important because it means all of the newly aligned gluten strands will carry the same burden of expansion.

With some doughs, like Neapolitan pizza dough, flouring the surface is not necessary during dividing, preshaping, and shaping.



For doughs preshaped into a boule, it's important to have a smooth surface and a tight seam to allow for even expansion during proofing.

For pan-baked pizzas, you'll often have to let the dough rest again after the initial stretch since it may not have reached all of the corners of the pan. Keep it covered and let it relax in intervals of 15–30 minutes before trying to stretch it again. Don't force the dough so much that it rips.

Organizing the Preshaping Process

Using the basic dough preshapes (ball and bâtard) as a starting point, you can make adjustments and achieve many variations. Regardless of which shape you choose, we recommend the first in, first out (FIFO) method when proceeding from dividing to preshaping and then to shaping dough (see page 3:3).

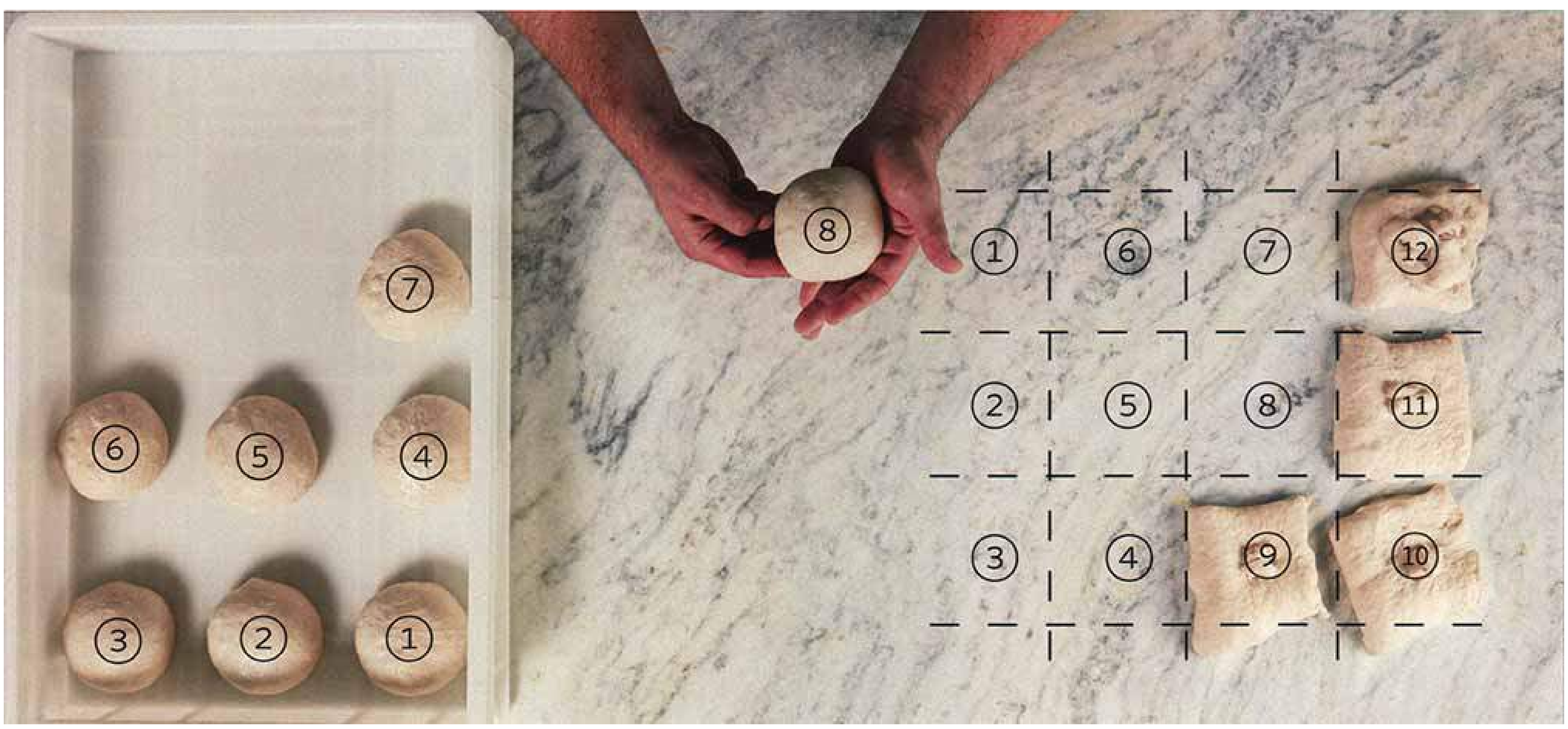
As you preshape the pieces, place them back on the worktable in a way that makes it easy for you to remember the order in which you worked them. The first piece of dough that you divided will be the first that you preshape; the last piece of dough that you divided will be the last that you preshape.

The same pattern applies later to shaping the dough if it is in the category of shaping before proofing, like our bread-like pizzas (for these pizzas, make sure that your pans are prepped before you start preshaping). The other category is proofed in balls and shaped just before baking, like Neapolitan, New York, thin-crust, Brazilian thin-crust, artisan, or deep-dish pizzas.

This approach ensures that all pieces of dough spend an equal amount of time resting on the bench, which ultimately contributes to the consistency of your pizza. Once the dough is preshaped, our preference is to place the dough seam side down. This helps the seam stay in place and makes it tighter.

HOW TO Use the First In, First Out (FIFO) Method

We proceed from left to right for dividing and preshaping the dough pieces, with the newest ones closest and the oldest ones farthest out. With that approach, once the preshaped pieces have finished bench resting for 15–20 minutes, we shape them from oldest to newest, positioning them with the first shaped pieces closest and the recently shaped pieces farthest out. The process is all about flow and efficient movement. Stay organized; if you confuse the last piece you divided with the first, that piece may not have a chance to relax enough. For thin- and medium-crust pizza doughs, you don't need to worry about FIFO after the preshaping step.



1. If making bread-like pizzas, prepare your pans as instructed in the recipes.
2. Transfer the dough to your worktable.
3. Mentally divide the dough into the number of pieces you'll need.
4. Begin dividing the dough with your bench knife.
5. Weigh each piece of dough to ensure consistency.
6. Preshape, beginning with the first piece of dough you divided and working through the pieces in order. For bread-like pizzas, place them in the oiled pans they will be proofed and baked in. Cover well.
7. Let the dough rest for 15–20 min to give it time to relax.
8. Shape (for bread-like pizzas, extend and stretch the dough to fit into the pan completely) using the same first in, first out method.

PRESHAPING VERY WET DOUGHS

Working with wet doughs is notoriously difficult. Handling them can be a gloppy and frustrating task. Fortunately, a variety of methods can make it easier, such as oiling your work surface or chilling the dough. We've also repurposed common household items such as a plaster knife to develop new techniques for handling wet doughs, which can be remarkably useful. The first approach described below, the oil-slick method, can introduce some oil into the dough. This can actually improve the volume in some doughs (see page 1:324), but if you want a dough without fat, choose another approach.

THE OIL-SLICK METHOD

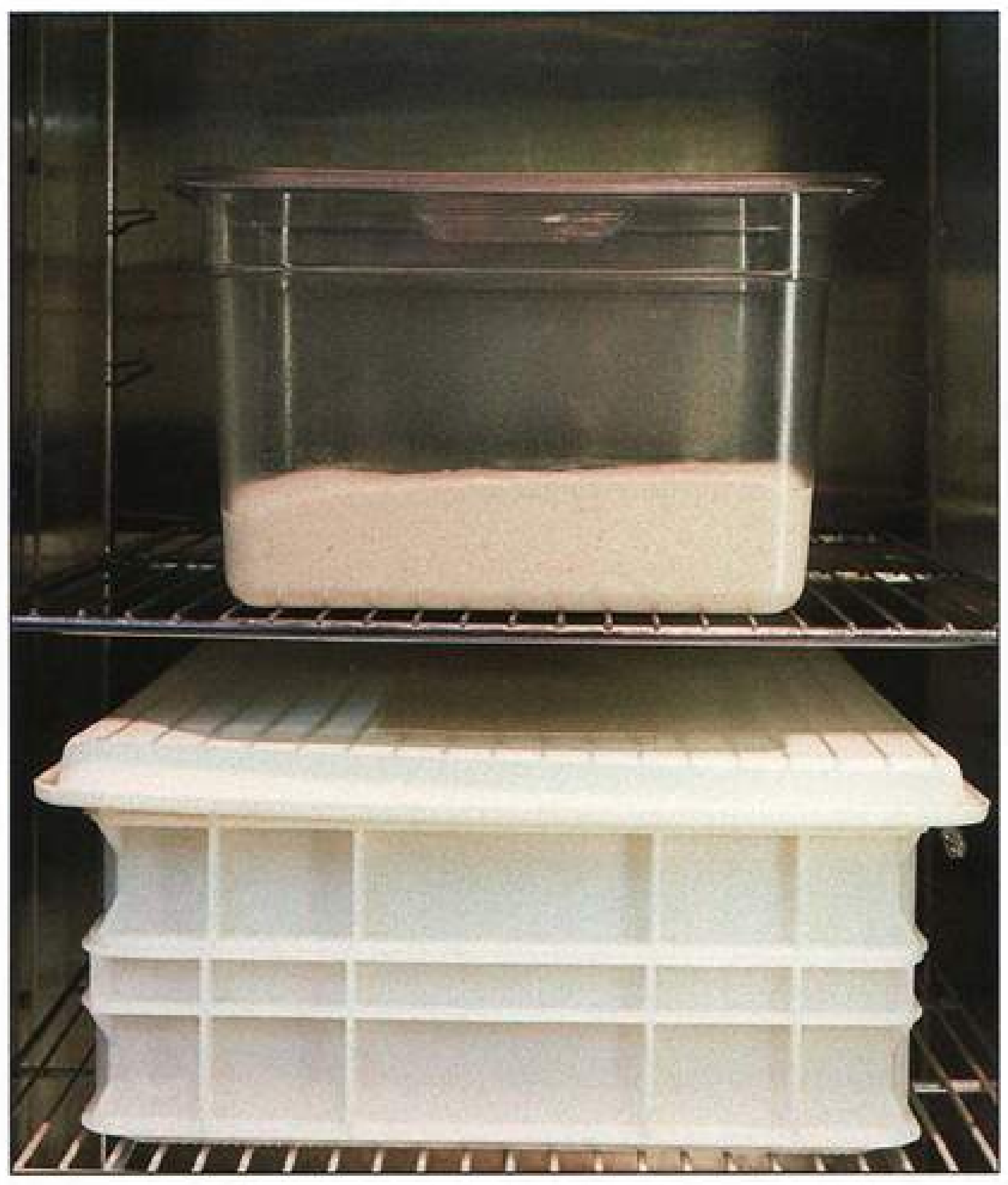
It's intuitive to add flour to a worktable hoping to keep the dough from sticking, but it's easy to overcompensate. As an alternative, don't flour the table at all. Pour oil on the table instead, and then spread it evenly with your hands (or spray oil evenly on the table). Place the dough on top of the slick, divide it, and preshape it. Put the dough in an oiled pan to ferment.

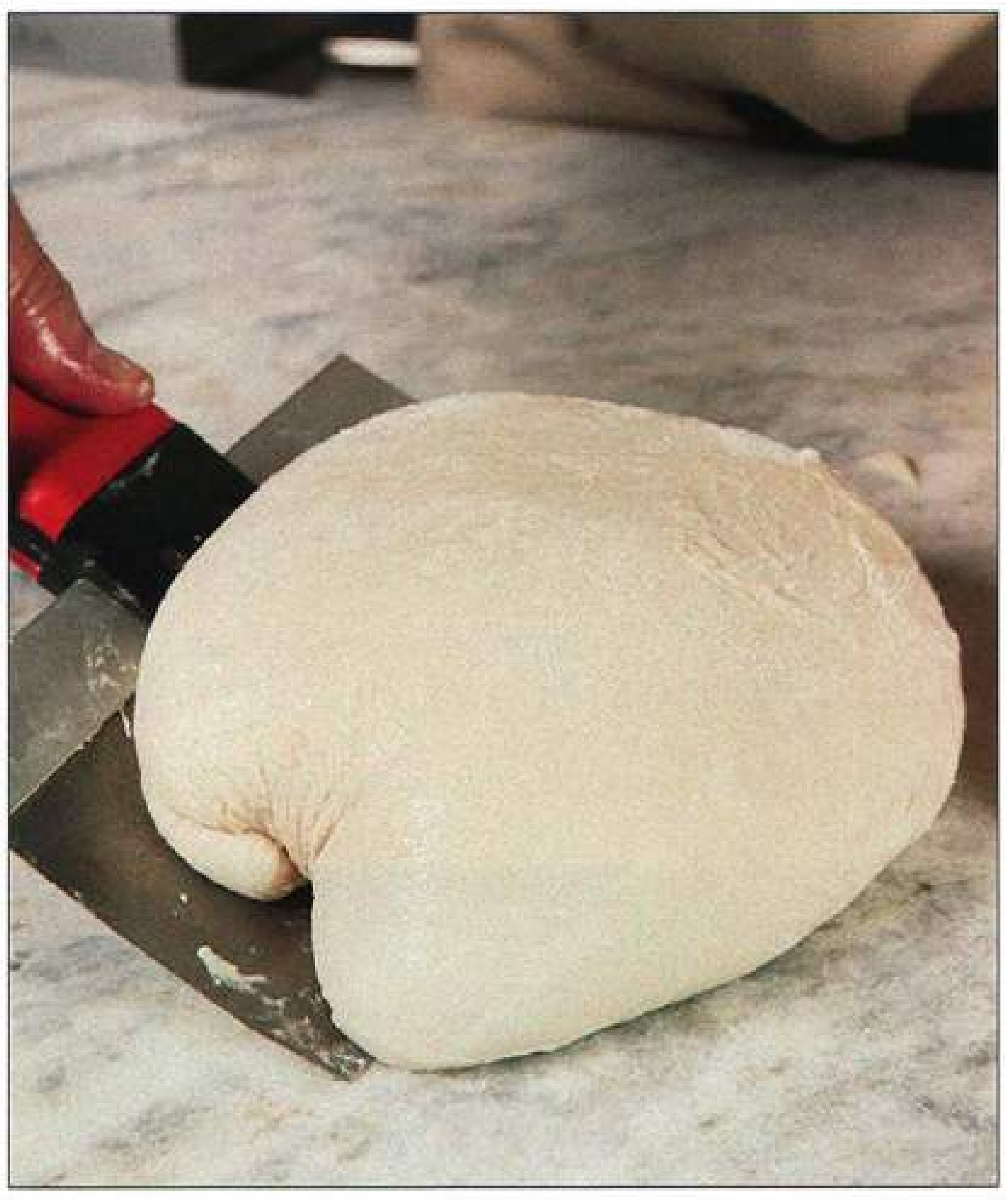
THE REFRIGERATOR

Refrigerating the dough during bulk fermentation will make the dough easier to handle. If the dough feels firm enough to handle after a few four-edge folds (see page 51) and some refrigeration time, it may be possible to move the dough to room temperature for the remainder of bulk fermentation. Wet your hands slightly so the dough doesn't stick when you perform the folds. Once the dough is preshaped, cover it well and refrigerate.

PLASTER KNIFE

The same qualities that make this common home-improvement tool useful for spreading plaster or grout make it ingeniously handy for manipulating wet doughs. The wide blade creates tension in the dough while shaping. See How to Divide and Preshape Using a Plaster Knife on page 63.





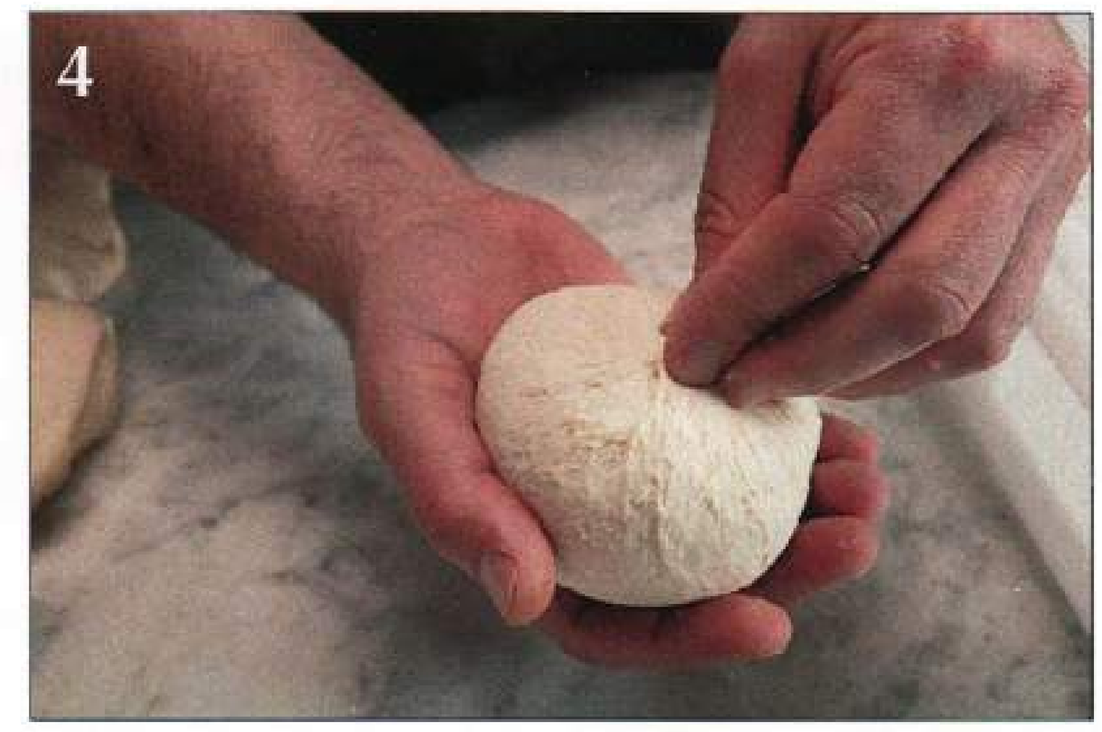
High-Hydration al Taglio Pizza Dough (see page 158)

HOW TO Preshape a Small Dough Ball

Smaller pieces of dough, such as the ones used for Neapolitan pizza (250–300 g), can be trickier to preshape. You can't really use a single hand as you would for small dinner rolls, and the typical two-handed preshaping methods (see pages 61–62) may not provide a tight, round ball. We have two suggestions.

THE RING METHOD

In this method we use our index finger and our thumb. They will form a ring to push the dough through.



1 Place the square of dough in your dominant hand.

For most doughs, mist the surface lightly with water (see the specific recipes for guidance). This keeps plastic wrap from sticking.

For more on how to shape thin-crust and medium-crust pizzas, see pages 3:12 and 3:66.

2 Form a ring with the index finger and your thumb on the same hand.

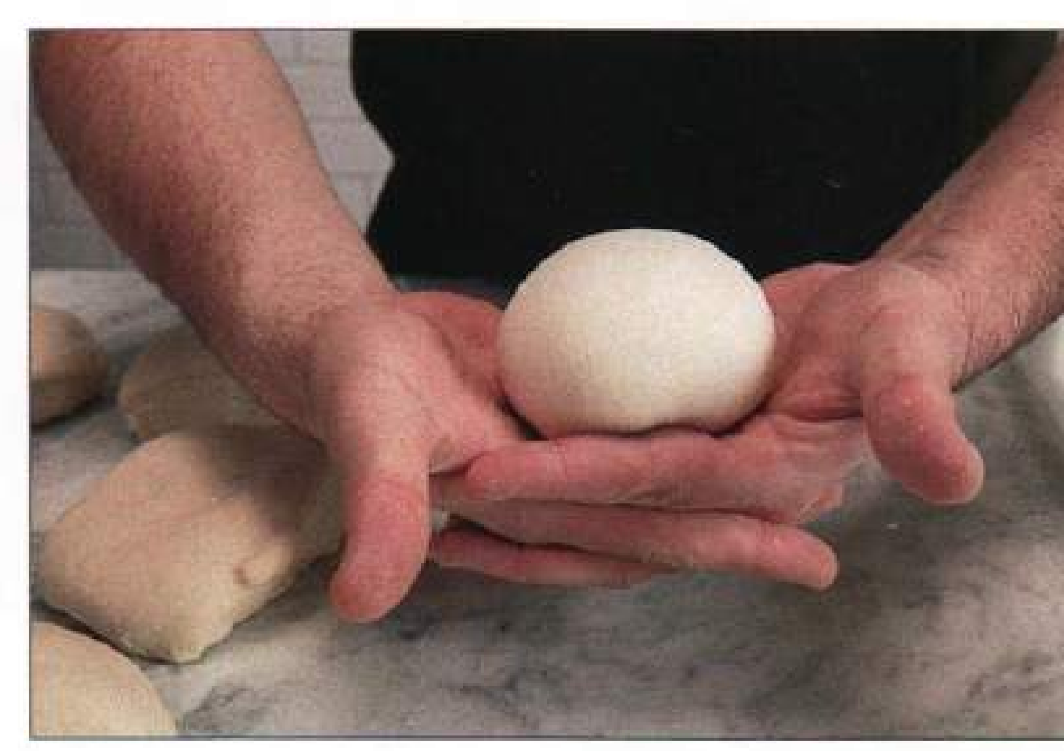
3 With your fingers from the opposite hand, push the dough through the ring. This should result in a smooth, tight ball.

4 Make sure to pinch the seams shut well. Otherwise, the dough will tear when you shape it for baking, or it might cause a weak spot that will allow sauce and toppings to break through while baking.

5 Place the dough seam side down in its fermentation tray or tub, and cover well.

THE CROSS-LINKED FINGERS METHOD

In this method we use our interlocked fingers from both hands to create a dough ball.



1 Tuck in the four corners of a square of dough. Interlock your fingers. Place the dough in your hands, tucked corners down.

2 Bring your hands together until you can't bring them any closer, to form a dough oval.

3 Rotate the dough 90° and bring your hands together again. This should result in a tight ball.

4 Make sure to pinch the seams shut well. Otherwise, the dough will tear when you shape it for baking, or it might cause a weak spot that will allow sauce and toppings to break through while baking.

5 Place the dough seam side down in its fermentation tray or tub, and cover well.

HOW TO Preshape a Medium or Large Dough Ball

This method is used for larger balls of dough, such as New York pizza dough, which can range in size from 350–400 g up to 1.2 kg. In bread-baking terms this shape would be known as a boule, which means "ball" in French. Once you have divided and weighed all your dough pieces, you can begin to preshape the dough balls using one of the following: the Square Method, the Tuck-In Method, or the Wonton-Shape Method (on the next page).

THE SQUARE METHOD

Beginners and pros alike can use this shape, proving anew that simple is sometimes best. This method is easy and produces a very good structure for the dough to keep its roundness. It's also fast.

1 To preshape, place each cut square of dough smooth side down. Fold the top one-third of the dough toward the middle, and then fold the bottom one-third toward the middle, overlapping the ends slightly to form an envelope.

2 Rotate the dough 90° and roll the dough up lengthwise.

3 Gently round the dough with both hands, leaving the seam side down, to create a tight, round package.

4 If necessary, pinch the seam shut. This is important to prevent it from ripping when you shape it.

5 Place the dough ball seam side down in its fermenting tray, pan, or tub. Cover well.

For most doughs, you won't need to flour or oil the tray, pan, or tub used for fermenting. Check the recipe for specific instructions.

THE TUCK-IN METHOD

This is the easiest method for shaping a ball, so start with this one if you're new to shaping; all you have to do is tuck in the edges of the dough to form a ball.

1 To preshape, turn each cut square of dough over so the smooth side is up.

2 Pick up the dough with your hands so none of it is touching the worktable; tuck the edges in and under to form a rudimentary ball shape.

3 Gently round the dough with your hands, leaving the seam side down, to create a tight, round package.

4 If necessary, pinch the seam shut. This is important to prevent it from ripping when you shape it.

5 Place the dough ball seam side down in its fermenting tray, pan, or tub. Cover well.

THE WONTON-SHAPE METHOD

This method (based on how some wonton dumplings are shaped) will take a few tries to get right, but it's our favorite because the dough maintains its form so well throughout fermentation. Essentially, you're creating folds in an overlapping circular pattern. The pattern gives the dough a consistent distribution of gluten tension that can expand evenly.

1 To preshape, place each cut square smooth side down.

2 Mentally divide your dough into six equal parts. Take the edge of one part, starting with a corner of the dough. Pull it out, then fold it toward the center of the dough; repeat this step with the remaining pieces. Overlap the last one to form a tight seal.

3 Gently round the dough with your hands, leaving the seam side down, to create a tight, round package.

4 Pinch the seam shut. This is important to prevent it from ripping when you shape it.

5 Place the dough ball seam side down in its fermenting tray, pan, or tub. Cover well.

HOW TO Preshape a Bâtard

The term "bâtard" describes an oval loaf of bread, no matter what size. This shape isn't often used for pizza, but we prefer it when we are shaping oval pizzas like Roman Pizza alla Pala (see page 164). This method is easy and very fast. We recommend it not only for beginners but also for busy pizza makers who have many pizzas to preshape.

1 To preshape, place the rectangle of dough lengthwise on the worktable. Fold the top one-third of the dough toward the middle, and then fold the bottom one-third toward the middle, overlapping the ends slightly to form an envelope.

2 Roll the dough away from you, and continue to gently roll it back and forth until it just comes together.

3 Place the bâtard seam side up in its fermenting tray, pan, or tub. Cover well.

Roman Pizza alla Pala Dough (see page 164) is one of the doughs we preshape into a bâtard for proofing.

HOW TO Divide and Preshape Using a Plaster Knife

This tool is typically used for applying plaster and other materials to drywall. It has a wide, sharp blade (not as sharp as a knife, though) and a centered handle. You can purchase one at any hardware store. We suggest using one that has a stainless steel blade that is at least 20 cm / 8 in wide. The length of the blade will allow you to lift and move the dough around the table with ease. Surprisingly, almost no flour is needed for this; in fact, too much flour defeats the purpose since the idea is for the dough to cling to the table while you move it with the knife.

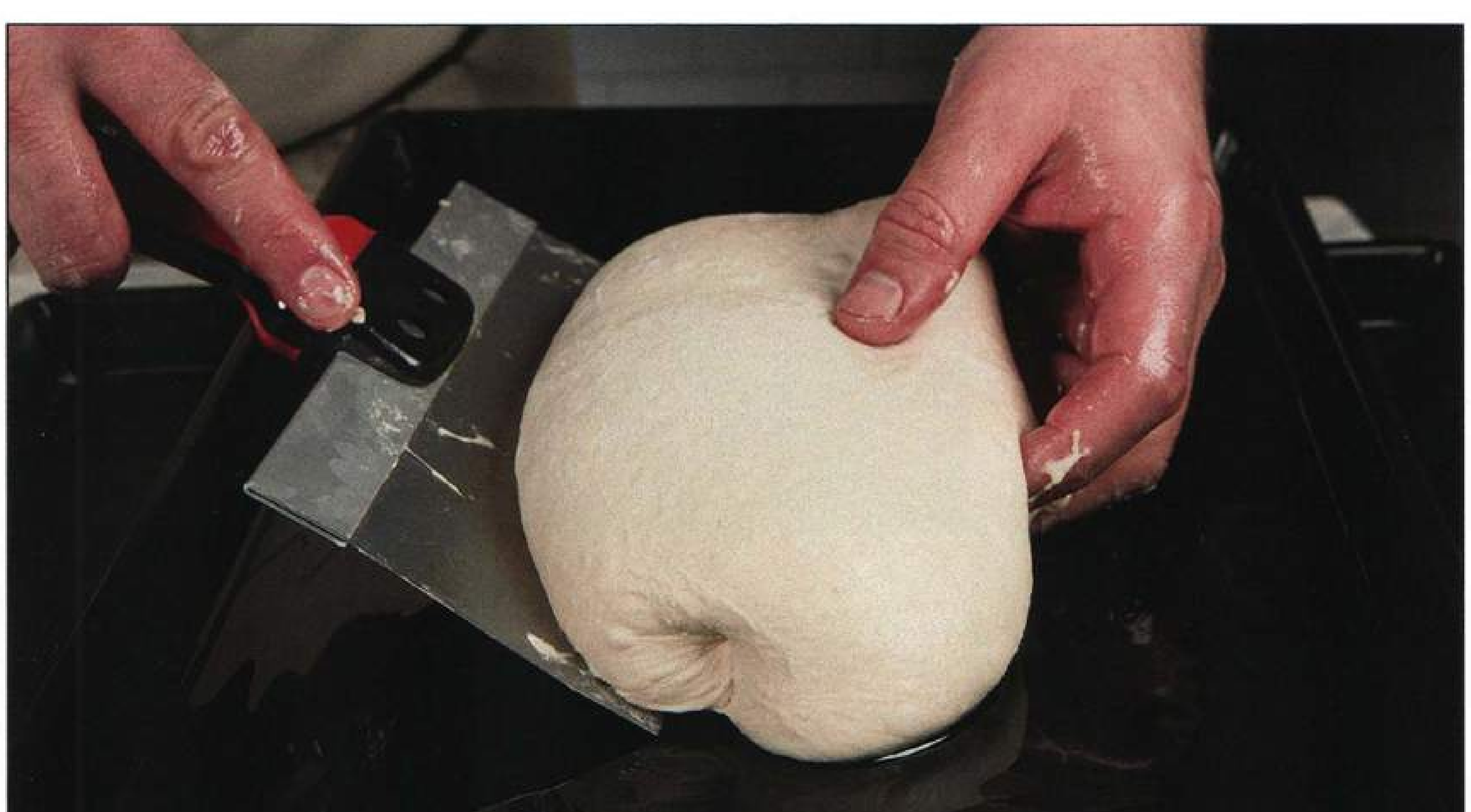
1 Transfer the dough to your worktable; dust the surface of the dough with a little bench flour.

2 Using the plaster knife, divide the dough if necessary, cutting it and pushing the pieces away from the main mass of dough.

3 Using the plaster knife, lift each piece onto the scale to weigh it, smooth side up. Coat the scale and your hands with flour or spray oil if the dough is difficult to handle. Place the dough pieces on the worktable after dividing.

4 To preshape, scrape the knife at the base of the dough and push it away from you (or pull it toward you—whichever motion is most comfortable); the dough will be oval-shaped at this point.

5 Rotate the dough 90° with the knife and push it (or pull it) again. It will still be oval-shaped. Do this on all four sides so that you generate tension throughout the entire piece of dough.



6 Place the dough ball seam side down in its fermenting tray, pan, or tub. Cover well.

COMMON PRESHAPING PROBLEMS

A number of problems can arise from shaping a dough incorrectly, but many mistakes can be salvaged.

THE SEAM IS INCORRECTLY FORMED

The seam is not binding, likely because the dough is too dry, the seam was not sealed initially, or too much flour is interfering.



SOLUTION

- If the seam is not sealed when you place the dough in the container, lightly mist some water in the seam and pinch it shut; the water should bind the seam in place.

THE SURFACE IS UNDERFLOURED

The dough is sticking to the table and ripping.



SOLUTION

- Dust the table more generously and then reshape the dough, making sure that the torn part winds up in the interior of the dough. Note that the surface of Neapolitan pizza dough should never be floured. The trick with this dough is to act quickly and never handle it for too long or it will stick to your fingers.

THE SURFACE IS OVERFLOURED

You're chasing the dough around the table and have no traction.



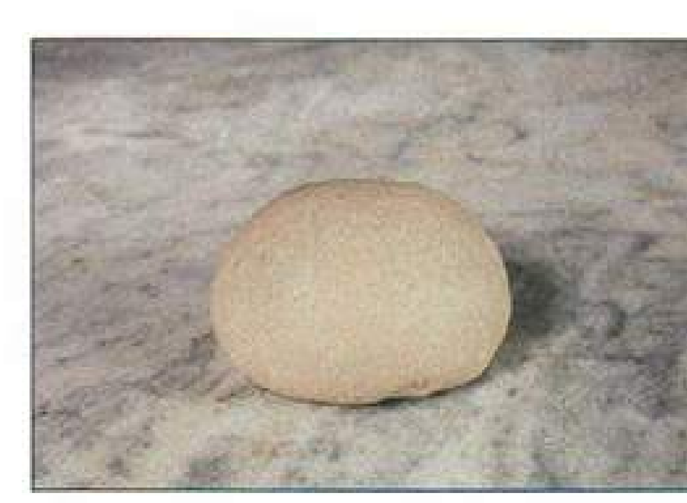
SOLUTION

- Brush off the excess flour and spray a light mist of water on the table so the dough has something to cling to while you shape it. Don't overdo the water—that creates the same problem (a slick surface) as too much flour.

THE SHAPING IS TOO LOOSE

The dough isn't tense enough; it looks like a misshapen, bubbly-surfaced blob.





SOLUTION

- Reshape your dough, but this time with a little more rigor so that it's uniform and will still hold its shape after a few minutes.

FINAL PROOFING

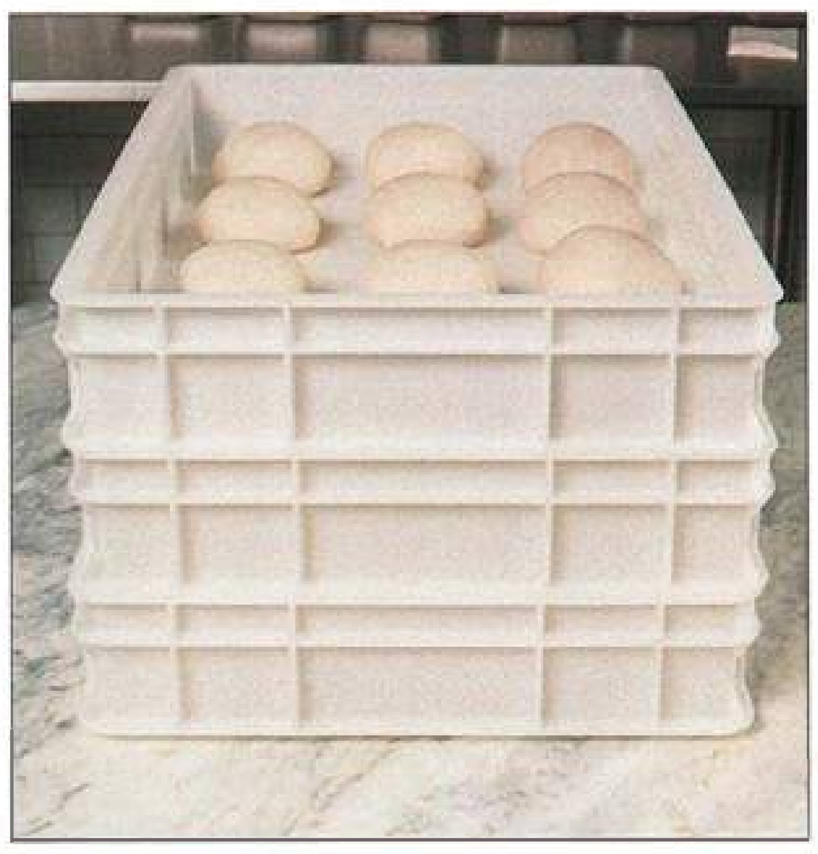
In the dividing and preshaping process, gas in the dough is depleted. Final proofing replaces that gas with new carbon dioxide, continuing the fermentation that began when the water and flour were first mixed. This new gas expands the dough's existing bubbles and (depending on the dough) creates an open crumb structure, making the baked crust soft and pleasant to eat. The pizza maker's role is to provide a protective environment for the dough to develop, and then to judge when final proofing is complete. Perfecting this assessment takes experience and patience, so paying close attention at this stage is crucial; a pizza's volume and flavor are partly determined by how accurately it's proofed.

Environmental factors and ingredients affect the final proofing time in ways that we can quantify, at least to some extent. The type of yeast (commercial yeast versus levain) and its percentage in the dough make a difference. So does the ambient temperature; generally, higher temperatures (up to a certain point) mean faster fermentation. Many of our doughs are cold-proofed (or have an optional cold-proofing step), which slows down fermentation and allows for greater flavor development. Also, longer overall fermentation times before the final proofing stage result in greater carbon dioxide production. Lower hydration doughs ferment more slowly than those with higher hydration.

But determining when final proofing is complete—known as calling proof—is also an art. There are no truly foolproof methods, nor instruments that measure that endpoint. The fingertip test (see page 76), which is the most common method for determining final proof, relies heavily on experience. Another popular method is to proof until the dough "doubles in size." We find this a somewhat misguided instruction; not all doughs must double to be fully proofed, and doubling is difficult to gauge.

We provide a range of final proofing times in our recipes, but these are guidelines rather than precise measurements. Even controlled environments, such as a proofer, can vary in humidity and temperature, altering the timeline. In general, proofing for longer than recommended will result in much less oven spring and, if the dough overproofs, it can collapse in the oven. Shortened proofing times will typically result in an irregular oven spring and a tighter crumb structure. But the dough also has a margin of forgiveness. A pizza's characteristics will not change considerably if the final proofing time varies within ±15% of our guidelines. Our dough recipes take you through the final proofing step, and then we cover the shaping and baking instructions in the Iconic Recipes chapter on page 3:3.

During our travels to Brazil, we ran across two unusual things in our visit to Bráz Quintal. The first was that they have three different doughs, which was more than most pizzerias, especially in Brazil. The house dough is made with a combination of whole wheat flour, rye flour, bread flour, and 00 flour. They also have a whole wheat dough that is 80 % hydration and a dough made with Caputo Nuvola 00 Flour. Even more astonishing was that they proof each ball of dough in an individual clear plastic container. They like being able to monitor the fermentation of each dough and shape it only when it is perfectly proofed.



Doughs can be proofed in any number of vessels, from proofing boxes (see photo above) to sheet pans (see photo on the next page) to the pans that they will be baked in (see photo below).

PROOFING CONTAINERS

Proofing in trays, sheet pans, or tubs allows you to contain and easily move the dough, and some pizza doughs are best suited to certain types of containers. Doughs that are balled up to be eventually flattened and baked directly on an oven floor, such as thin-crust, Neapolitan, New York, or artisan pizzas, or those that are baked in a deep ring pan, like deep-dish pizza, are typically placed in shallow, stackable tubs. Another option is to proof these doughs on plastic sheet pans that are then covered with plastic wrap. Doughs that are baked in pans, such as focaccia and Detroit-style, high-hydration al taglio, and New York square pizzas, are typically proofed directly in the pan in which they will be baked. This makes workflow faster and minimizes handling of the dough.

Stackable Tubs

Whether you're proofing in a cold, room-temperature, or hot environment, these plastic tubs work very well for small, medium, and large dough balls. They come in a number of sizes, so choose whatever makes sense for your production. The most common size holds a 4-by-3 grid of Neapolitan pizza dough and is 57 cm long by 36 cm wide by 8 cm deep / 22½ in long by 14½ in wide by 3¼ in deep. Stacking saves space and also keeps the dough covered to prevent it from drying out.

Plastic Sheet Pans

These are not stackable and need to be placed on a rack. We recommend plastic rather than metal sheet pans because metal can stain the dough gray. Plastic sheet pans are available in the same sizes as aluminum sheet pans. You'll need to cover the dough with plastic wrap or a tarp to keep it from drying out. We mist most doughs with water before covering to keep the plastic wrap from sticking to the dough.

Metal Baking Pans

For each of our master pan-baked pizza recipes, we specify a pan size. We also have recommended pan sizes for our Sfincione Dough (see page 157) and Argentinean-Style "al Molde" Pizza Dough (see page 170). We recommend steel pans because they're the sturdiest but, not surprisingly, they're more expensive than other metals.

In a pinch, use half or full aluminum sheet pans. In the high temperatures of a pizza oven, radiant heat transfer (infrared light) is much more important than it is for conventional baking. Therefore, the surface finish of the pan really matters. A shiny aluminum pan is reflecting more than 90% of the infrared light whereas a black pan is absorbing 90% (see page 1:351). Aluminum pans also have an unfortunate tendency to warp, which is why pizza pans are usually made of steel since they won't warp at higher temperatures.

Focaccia pan

Detroit-style pizza pan

Roman al taglio pizza pan

Grandma-style pizza pan

FOCACCIA AND SICILIAN PIZZA PANS

This pan can be used for focaccia and New York square pizza (or any rectangular dough); it's usually made of heavy-duty black steel, which conducts heat evenly and can have a nonstick coating or, ideally, be cured. The frame is reinforced with a steel bar so the pan doesn't warp on a hot deck-oven floor or baking stone. These pans come in a half-sheet-pan-size only. These pans are frequently sold as Sicilian pizza pans.

DETROIT-STYLE PIZZA PANS

This iconic tapered rectangular pan made of black steel was originally used to hold auto parts on the assembly line in factories (see page 1:250). It's sturdy and doesn't warp. The fact that it's black makes it a great absorber of radiant heat, which allows the cheese rim to reach its signature crispy texture. Look for a pan that's factory-cured. Curing makes it easier to remove the pizza without sticking. It's the deepest of the rectangular and square pans. These come in a number of sizes, but the largest (35 cm by 25 cm / 14 in by 10 in) is the classic.

ROMAN AL TAGLIO PIZZA PANS

These black steel pans have a deep and sharply angled frame that, unlike most sheet pans, isn't tapered. It's intended to produce a sharp edge on the corners of the pizza. They come in two sizes: full (60 cm by 40 cm / 24 in by 16 in) and half (60 cm by 20 cm / 24 in by 8 in). You can buy special clamps for handling Roman al taglio pans without damaging the pizza.

GRANDMA-STYLE PIZZA PANS

These pans are used to make a type of pizza common in the New York / New Jersey area (see page 1:101). They are the same as the Detroit-style pizza pans but tend to be square and shallower.

ALUMINUM SHEET PANS

Aluminum sheet pans are used for some types of pizza such as Old Forge (see page 1:249). The dough is stretched to fill either the half or full sheet pan and then proofed. Aluminum is our least favorite material for proofing and baking. It tends to stain

the dough with grayish-black streaks and, worse, warps significantly in the oven. Choose pans with reinforced frames if you can find them. Line with parchment paper to prevent staining.

ARGENTINEAN PIZZA PANS

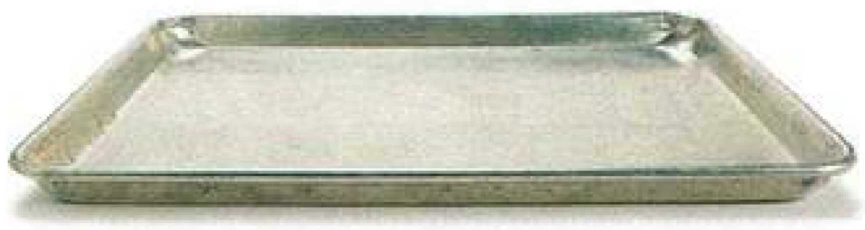
This is a large (35–38 cm / 14–15 in) round aluminum or black steel pan with a tapered frame that's used for thick-crust pizzas such as Argentinean-Style "al Molde" Pizza (see page 3:126). These pans are available in smaller sizes, but this is the most common size. If you are having trouble locating these specific pans, we provide alternatives in the Resources section on page 3:377.

CAST-IRON PANS

Black cured cast-iron pans are available in many shapes (round and square), depths (shallow and deep), and sizes. They can also come with various features such as a grill texture or different handles. Cast iron is a great conductor of heat and will produce pizzas with a crispy bottom. It's rather inexpensive and can be used for multiple purposes, but some pans can be cumbersome because they're heavy. It's important to keep them clean by scrubbing with salt; also, don't get them wet because they can rust.

DEEP-DISH PIZZA PANS

This is a round pan that happens to look like a cake pan. We highly recommend you get a pan with a removable base. Deep-dish pizza is slightly different from the other pan-baked pizzas in that it's divided after a short bench rest, balled, and then proofed, well covered, in a tray or tub. It's not proofed in the pan because it's rolled out rather than stretched to fill the pan as the dough proofs.



Sheet pan

Argentinean pizza pan

Cast-iron pan

Deep-dish pizza pan

FINAL PROOFING METHODS

All the steps that occur between mixing and baking are part of the fermentation process, but the main period of fermentation happens during final proofing. This begins once the dough is shaped and placed in a proofing vessel or on a flat surface. Final proofing will have an effect on flavor and texture and is key in determining the shape, volume, crust, and crumb of the baked pizza. Indeed, the goals of final proofing are twofold: developing flavor and increasing volume through the production of carbon dioxide.

To achieve this, you'll need to support the dough in a tub or on a surface, provide a constant temperature for the proper amount of time, and protect the dough's surface from drying out. (A dried-out surface forms a skin that will restrict the dough's rise and rip during expansion.) Still, various types of dough will proof in different ways and in different environments. It takes hands-on practice to become familiar enough with a given dough to recognize when it's properly proofed.

Most of the carbon dioxide produced during fermentation happens in the final proofing stage. The largest volume increase comes during baking, when certain styles of pizza can increase greatly in volume. To expand during both processes, the dough must be strong enough to retain the gas that's produced. Gluten makes the dough elastic enough that the bubble walls can expand without tearing. The dough's ability to retain gas results from the shear hardening of the membranes, which is measured through a test called biaxial stretching (see note on next page). When carbon dioxide exerts more pressure than a fully proofed dough can withstand, the cell membranes tear, releasing the gas and deflating the dough. Ideally, no dough will get to that point. Instead, we want to catch it just as it reaches peak proofing and bake it immediately. Doing so is known as calling proof. This is a pizza-making skill that's developed over time.

When you have multiple pizzas proofing, it is crucial to keep an eye on them during service to ensure that the dough isn't overproofing.

An overproofed dough won't expand much during baking, and neither will an underproofed one. Overproofed doughs collapse due to a weakened gluten structure and excessive gas production, while underproofed doughs don't have quite enough carbon dioxide production to expand significantly. Although overproofing is commonly thought to be a fatal error, we'll share a method we recommend for saving your dough; see Dough CPR on page 77.

The proofing methods that follow range from the simplest to the most advanced. Some of these methods are widely used, and a few are less popular. Experiment and decide which one suits you best. When we decided whether a method was simple or advanced, we mainly took into account the equipment required for it. Keeping your dough in a tub or pan, covered with plastic and in a warm spot in your kitchen (or in the refrigerator) is the most fundamental way of proofing. That, to us, is the essence of simplicity (but it's not without its complications).

Proofing at Room Temperature

This might seem like the simplest method for proofing dough that also requires the least equipment, but it can be challenging to perform consistently because it depends on keeping a consistent ambient temperature (we recommend 21°C / 70°F). The only way to do this is to have some form of temperature control. Otherwise, the temperature can vary by location, by day, and even by the hour. If you're inexperienced in calling proof, that's a lot of variation to take into account. You may want to keep the dough close to a warm oven so that fermentation happens faster than at room temperature (although the trade-off is that you might not develop as much flavor in the dough). Keep the dough well covered so it doesn't form a skin.

Cold-Proofing Your Dough

Cold-proofing slows down fermentation and is typically accomplished by refrigerating the dough for 24–96 hours. This technique lets you adapt the dough's needs to your own schedule, but it's not just about convenience. The long proofing time also improves flavor.

The long and slow final proofing also makes the dough easy to stretch and handle after it's tempered for 2 hours. Doughs leavened with levain cold-proof well, as do doughs leavened with a combination of commercial yeast and levain. However, cold-proofing doesn't work for all types of dough; we don't like it for our pan-baked doughs because it results in lower volume. Most refrigerators have temperatures in the range of 0.5–4.4°C / 33–40°F. If possible, adjust the temperature to 4°C / 39°F; temperatures lower than this can slow down yeast fermentation too much.

We noticed something very interesting about the way Neapolitan pizza is made in Naples versus elsewhere. In Naples, the doughs are proofed at room temperature regardless of the season (see page 88). Some pizzaioli adjust the yeast amount (more in the winter, less in the summer) and some, unfortunately, adjust the salt instead (but then the dough tastes different from season to season). In most other parts of the world, nearly everyone cold-proofs the dough for 24–48 hours. We have Neapolitan pizza dough recipes utilizing both ambient and cold-proofing so that you can select a recipe that works best for you. This is also a widely used proofing method for thin-crust pizza dough, New York pizza dough, and artisan pizza dough. Some al taglio pizza dough makers proof for as long as 96 hours, but we find this unnecessary.

If you extend the cold-proofing time (and if you're not using malted flours), we recommend adding some diastatic malt powder (DMP) when your dough is first mixed. DMP is primarily used to compensate for the deficiency in enzyme (mainly amylase) activity of the flour. Without sufficient amylase, the fermentation activity and crust color of the baked pizza will suffer. That's why there's malt in many commercial (and sometimes organic) flours.

Diastatic malt powder is also added to some recipes when there's a high percentage of fermented flour (a large portion of the dough is made up of a preferment; see page 1:298). During a long fermentation, the yeast consumes a large amount of simple sugars. If there's no adjustment to compensate for the depleted sugars, the finished product might have a pale crust, as adequate sugars ensure proper coloration. To eliminate this problem, DMP is added at from 0.3% to 1%, depending on the percentage of fermented flour. Adding DMP produces extra enzyme activity in the final dough and more starch degradation, which in turn results in more simple sugars, leading to more browning. You can use pure amylase as a substitute for diastatic malt powder; amylase is available at beer supply stores.

Proofing in a Proofer

An electric proofer produces heat and warm water to create a humid environment. The simplest models are enclosed metal cabinets (some of which are insulated) that have a pan at their base to hold water. The pan sits on top of a heating element, and you set the box's temperature using a dial. The basic models are fitted with shelves to accommodate wooden boards or sheet pans; because they're on wheels, proofers can be moved easily. More sophisticated versions are connected to a water line, have digital controls to set a specific relative humidity and temperature, and can be set to both cold and warm temperatures. Most of those models are not mobile and are instead positioned directly on the floor so that a rolling rack filled with dough can be wheeled into them. These proofers vary in capacity.

Researchers and industrial facilities evaluate a dough's ability to expand during proofing and baking through a procedure called biaxial stretching (or biaxial extension). It involves stretching a piece of dough in two opposing directions and then inflating it like a balloon, thereby mimicking the activity of carbon dioxide bubbles that cause dough to rise. Measuring devices, including the alveograph (see page 1:278), assess how the dough deforms or ruptures under the pressure.

Diastatic malt powder is a natural extract of malted grain, which contains the enzymes that the grain seedling needs to break the starch stored in the grain into simple sugars. Yeast has the same needs.

THE SCIENCE OF HOW BUBBLES GROW IN DOUGH

The bubbles in pizza dough are there from the start. Through the process of mixing, air is incorporated (often by sticking to particles in flour), which create myriad tiny bubbles. Those bubbles act like tiny balloons, and gluten plays the part of the rubber in the balloon (it's gas tight and very stretchy).

After mixing, the bubbles store carbon dioxide and a tiny bit of alcohol (ethanol) created by the yeast. During fermentation, the amount of gas produced depends on the volume that went in. These gases increase during the fermentation stage. Both preshaping and shaping destroy a lot of bubbles by squishing them as the pizza is formed, but there are still hundreds of thousands, if not millions, remaining.

During baking, the bubbles are inflated by steam, which comes from water boiling inside the dough. A bread baker calls this oven spring. Oven spring in most breads is a moderate factor (the rise of a loaf is much more dependent on what happens during the fermentation stage), whereas in pizza dough, because of the higher oven temperatures, it's a very large factor. For example, the rim area of most Neapolitan pizzas is quite flat when it goes into the oven (with the same amount of dough in the edges as in the center). Yet it becomes immensely taller during baking as the steam inflates the bubbles created during the mixing and proofing stages. The result is the open crumb characteristic of the Neapolitan style.

EXPERIMENT

PREVENTING BLACK SPOTS IN PIZZA DOUGH

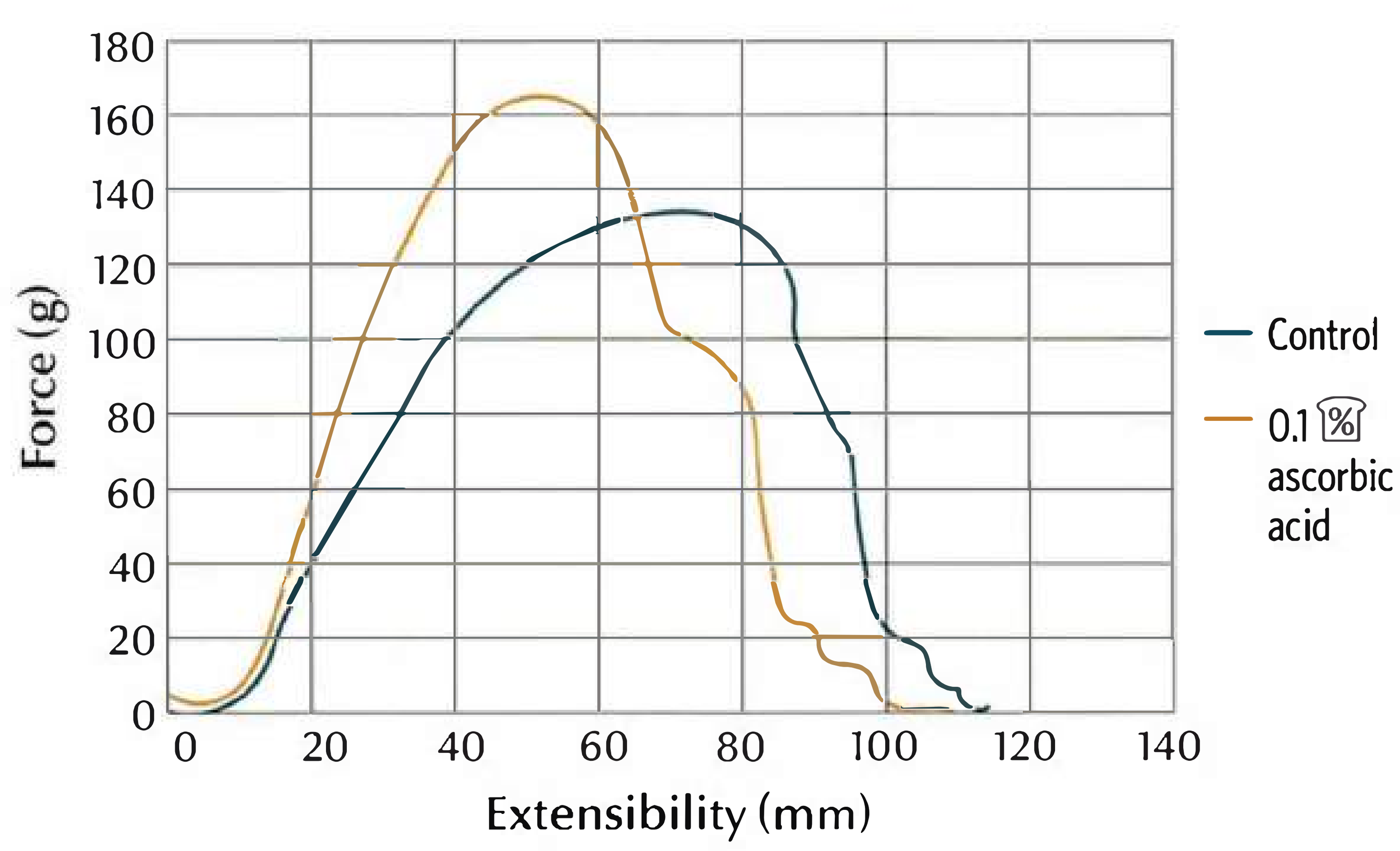
When dough is exposed to air for a significant length of time, like in the case of cold-proofed dough, the fragments of bran present in the flour will oxidize and turn a darker color. Black spots will appear, typically after several days, giving the balled dough a salt-and-pepper appearance. This doesn't mean that there is anything wrong with the dough; it can be baked and enjoyed as usual and the black specks will disappear after baking. But we still wanted to see whether we could prevent the spots from forming in the first place.

One simple solution was to add a small amount of ascorbic acid to the dough (0.1%), which allowed us to store the dough for 5–7 days without seeing any black spots. Since the formation of black spots in refrigerated doughs is associated with the oxidation of the polyphenols of the bran, it is easy to understand the role of ascorbic acid, which is an antioxidant. The downside to this method, however, was that the dough became tighter (see graph at left, below). We recommend using a small amount of dough relaxer (see page 1:327) to mitigate the strengthening of the dough.

Another way to troubleshoot this problem is to increase the amount of yeast. When baker's yeast is added, particularly instant dry yeast, it brings along a lot of monomeric glutathione into the dough. Since yeast is metabolically a scavenger of oxygen molecules, both factors would counteract oxidation during refrigerated storage. In other words, increased yeast diminishes the black specks in dough by metabolizing oxygen and producing a more anaerobic environment within the dough. More yeast creates more carbon dioxide, thus reducing the oxidation effect responsible for the development of black spots.

When we compared cold-proofed dough made with 0.25% yeast to the master dough with 0.04% yeast, the black specks are observed only in the latter, given the fact that the extra yeast removes the oxygen which would otherwise be available for oxidative changes. The speckling is different for the two yeast amounts, with the doughs with more yeast looking generally better than the ones with less yeast. If the dough aesthetics are not important to you, our advice is to bake the dough regardless of black specks. If the look of the dough plays a role for your business, ascorbic acid (with a dough relaxer) or a higher percentage of yeast will help.

Control versus 0.1% Ascorbic Acid (Day 4)



Neapolitan dough (0.04% yeast) with 0.1% ascorbic acid is firmer than the control dough and doesn't show black specks.

72 h at 4°C / 39°F

96 h at 4°C / 39°F

0.25% yeast

0.04% yeast

0.25% yeast

0.04% yeast

The pH of the dough with more yeast is higher, which effectively reduces the browning reaction rate and gives a finished Neapolitan crust with less leoparding.

HOW TO Prepare Your Dough for Cold-Proofing or Room-Temperature Proofing

FOR DOUGH BALLS PROOFED IN STACKABLE TUBS

1. Preshape the dough balls and place them in a stackable tub, spacing them out evenly in a grid. Give them room so they don't proof into each other too much.
2. Lightly mist the surface of the dough balls with water.
3. Stack another tub on top.
4. Refrigerate if cold-proofing. If room-temperature proofing, check the dough periodically by using the fingertip test (see page 76) to determine the stage of proofing.

FOR DOUGH BALLS PROOFED IN PLASTIC SHEET PANS

1. Preshape the dough balls and place them on the sheet pan; space them out evenly in a grid. Give them enough room so they don't proof into each other too much.
2. Lightly mist the surface of the dough balls with water.
3. Cover the dough balls directly with plastic wrap or a tarp.
4. Refrigerate if cold-proofing. If room-temperature proofing, check the dough periodically by lifting the plastic and using the fingertip test (see page 76) to determine the stage of proofing.

FOR DOUGHS PROOFED AND BAKED IN A PAN

1. Prehape the dough and place it in its generously oiled baking pan.
2. Cover the pan with a clean plastic bag or tarp. Tent the bag with air and tie the bag shut but not too tightly; it should be easy to open and close. You'll need easy access to the dough to stretch it out to fill the pan while it's proofing, and this might take a few tries to complete.
3. Once the dough has been stretched enough to fill the pan, refrigerate if cold-proofing. If room-temperature proofing, check the dough periodically by opening the bag and using the fingertip test (see page 76) to determine the stage of proofing.

These photos show the steps for preparing doughs proofed in plastic sheet pans, but the steps are relatively similar for the other methods.

HOW TO Proof with a Proofer (aka Proofer Cabinet or Proofing Box)

1 Set the proofer to the desired temperature and relative humidity.

2 When the proofer reaches the set temperature from step 1, place the dough inside and set the timer.

3 Check the dough after the allotted time for proofing as suggested in your recipe.

While you strive to create an optimal environment in which yeast and lactic acid bacteria will thrive—which helps ferment your dough—be aware that they're not the only microorganisms that can get comfortable in your proofer. It's a good idea to clean the box after each use; at the very least, leave the door open and let the proofer air-dry for a few hours to prevent mold from growing. We recommend 27°C / 80°F (with 65% relative humidity) across the board when using a proofer.

For many pizzerias, a proofer-retarder is not a very practical machine to have because pizzas are baked throughout the day rather than all at once (except for al taglio and New York square pizza, which is baked ahead of time). If all your doughs are warm proofed and need to be ready to bake at once, this is not a benefit by any means.

HOW TO Proof with a Rolling Rack Cover

Used in some pizzerias, bakeries, and restaurants, the rolling rack cover is similar to a home proofer but can handle a higher volume of dough. It's an economical alternative to a proofer, taking advantage of readily available equipment. The drawback is that it's difficult to maintain a consistent temperature, much less a consistent humidity, because the heat source is a solid alcohol canister. The heat output can be somewhat controlled by using either a single canister or two canisters partially covered with a metal plate. Another option is to use an enclosed metal cabinet rack, in which case no rack cover is needed. For most pizza doughs, a refrigerator for cold-proofing is a better option than a proofer.

1 Drape the cover over the rack and put a sheet pan on the bottom rung.

2 Place one or two solid alcohol canisters on the sheet pan, and light them with a torch.

3 Place a second sheet pan close to the lit fuel. Put a hotel pan directly on this second sheet pan, and fill the hotel pan with hot water.

4 Close the rack cover and allow for the environment inside the rack to get warm and humid, 15–30 min.

5 Open the rack cover, insert your dough, and close the cover promptly to minimize heat loss. We recommend using clear covers so you can see inside the rack. (Even if there's some condensation on the surface of the cover, you'll still be able to see your dough.) Make sure the water in the hotel pan doesn't completely evaporate. Try not to open and close it too much so it doesn't lose heat and humidity.

EXPERIMENT

PROOFING TIME AND TEMPERATURE RECOMMENDATIONS

Our master recipes for each kind of pizza dough include times and temperatures for proofing. These conditions will bring out the best in the dough and will consistently deliver a dough with the specific key characteristics for each pizza (see page 3:3). Be aware that these times are guidelines, however, and keep your eye on your dough as it proofs.

In some pizzerias or homes, however, it may be difficult or impossible to create the recommended conditions. For example, air conditioning or ample refrigerator storage space may not be available. You might have tight time constraints or, on the flip side, there are cases when slowing down dough development may be more practical. In the latter scenario, cold-proofed doughs that are dormant can be held relatively stable until the pizza maker is ready to use them. Note that weaker yeast activity and slower dough development will continue even when refrigerated.

We experimented to find out whether each of our master doughs can proof at different temperatures and, if so, how long that takes and whether they need to be handled differently. Using the following table, you'll be able to delay, hold, or speed up the dough development process depending on the conditions.

We cold-proofed New York and artisan pizza doughs for 7 days at 4° C / 39° F. These doughs turned out to be relatively stable and delivered a positive result after the first day and up to 4 days. After 5 days, the dough declined in yeast activity, and the pizza began to lose flavor and structure.

We tried proofing our master thin-crust pizza dough at typical room-temperature proofing conditions and then baked pizzas after 1, 2, 3, 4, 6, and 24 hours. The 2- and 3-hour proofing times produced pizzas with the best attributes, which is what we have included in our master recipe on page 110 (you can opt to cold-proof the dough after this point if you'd like; it makes the dough easier to handle). At 6 hours the dough at room temperature was overproofed, and the pizza quality started to decline.

Because many types of bread are warm proofed, we tried this with pizza. When warm-proofing, the majority of the bread-like pizzas are typically proofed for 2 hours at 27° C / 80° F. Our focaccia, New York square, and high-hydration al taglio doughs were also tested at 1-, 3-, and 4-hour proof times to see how they compared. For focaccia, the 1-hour proofed dough gave a tighter crumb with a volume that was lower than our master focaccia by a statistically significant margin. With an increase in proofing time, the focaccia dough became slacker and gassier, with gas bubbles becoming more noticeable on top of the baked pizza. The flavor of the 4-hour focaccia was very sour and the texture became softer.

For our New York square dough, the 3-hour proofed pizza resulted in a small and uneven crumb, while a drastic reduction in volume was observed after 4 hours. The high-hydration al taglio dough was malleable and supple at all of the times we tested. The volume of the 1-hour proofed pizza was inferior, however, and fell out of the statistical range of volumes (see page 396), confirming that this proof time is insufficient. The 2-, 3-, and 4-hour pizzas had an even golden color, a good flavor, an expected chew, and a crispy crumb. We concluded that these doughs can tolerate a range of 2–4 hours at warm-proofing temperatures; in our master recipes, we recommend proofing them for 3 hours.

We should caution, however, that alternative proof temperatures listed below could also lead to different results. For our cold-proofed doughs, for example, refrigeration does more than just slow down the yeast activity. During cold-proofing, the dough itself continues to develop flavor attributes that are critical to the outcome of the pizza. Because of this, we strongly recommend cold-proofing for New York and artisan pizza doughs. Using room-temperature or warm-proofing in these doughs leads to underdeveloped flavors and a lack of crispiness. Although some proofing temperatures can lead to acceptable results without major alterations to the final products, pizza makers should use the recipe's recommended proof temperatures whenever possible.

OUR PROOFING TIME AND TEMPERATURE RECOMMENDATIONS

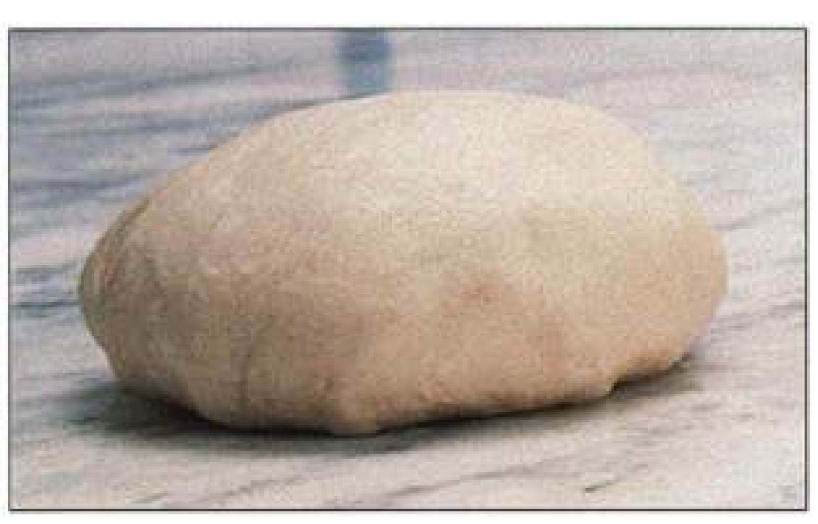
We proofed each of our master doughs in the three conditions listed below to see how each performed. Cold- and room-temperature proofing made thin-crust and medium-crust pizzas that were crisp and flavorful. Room-temperature and warm-proofing provided the best results for pan-baked pizzas, which were crisp and light with a good chew. For thin-crust pizzas, you can roll out cold-proofed dough without tempering. For medium-crust pizzas, cold-proofed dough needs to temper for 2 hours at room temperature before using.

Cold-proofing (4° C / 39° F)	Room temperature (21° C / 70° F)	Warm-proofing (27° C / 80° F)
Thin-crust pizza dough (24 h)	Thin-crust pizza dough (2 h)	Focaccia dough (2 h)
Brazilian thin-crust pizza dough (24 h)	Brazilian thin-crust pizza dough (1½ h)	New York square pizza dough (2 h)
Deep-dish pizza dough (24 h)	Deep-dish pizza dough (2–4 h)	High-hydration al taglio pizza dough (2 h)
Neapolitan pizza dough with poolish (48 h)	Neapolitan pizza dough (20–24 h)	Detroit-style pizza dough (2½ h)
New York pizza dough (48 h)	Focaccia dough (3 h)	
Artisan pizza dough (48 h)	New York square pizza dough (3 h)	
	High-hydration al taglio pizza dough (3 h)	
	Detroit-style pizza dough (3 h)	

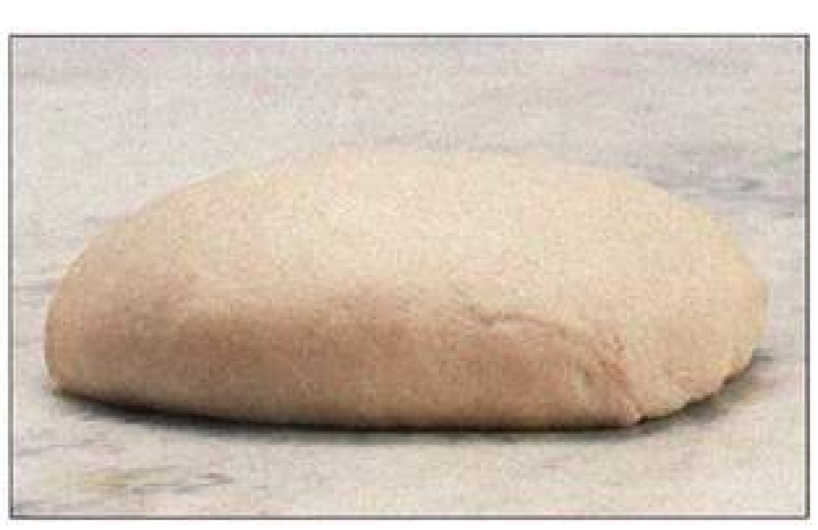
We tried proofing our focaccia and high-hydration al taglio pizza doughs, with yeast or levain or both, in the wine refrigerator at 13° C / 55° F because that was one of the tricks we learned in *Modernist Bread* to improve the results of doughs made with levain. Unfortunately, the results were less than stellar and we don't recommend it for these pizzas.

We recommend tempering cold-proofed dough for 2 h (or for however long it takes for the dough to come up to 13° C / 55° F) before baking it.

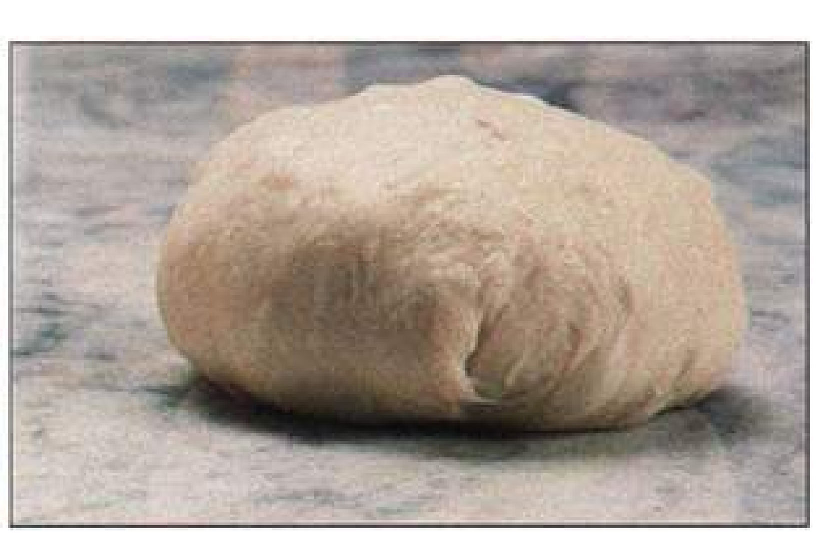
Check the dough to see if it is fully proofed and ready to bake. Use your finger to gently press the exposed surface of the dough for 2 seconds. The pressure should leave a small dent in the dough. It will slowly spring back, but the indentation will remain clearly visible.



Proper proof



Overproofed



Dough CPR performed

CALLING PROOF

Most people can't call proof accurately because their intuition is to look for a doubling in the height or diameter of the piece of dough. Even if you can judge volume accurately (we use a laser scanner to do so), doubling doesn't reflect fermentation time accurately. Nor does it give you the information you need before baking. Are the bubbles in the dough fully inflated but not ruptured? Has fermentation progressed enough to fully develop the flavor? Does the dough retain enough elasticity to accommodate oven spring without risking damage to the texture of the crumb?

Calling proof is hard to teach. Even experienced pizzaioli find it can be one of their most difficult tasks. Success comes from a hands-on familiarity with the feel of a properly proofed dough and an understanding of its fermentation process. It's important to think about the yeast and what it's doing long before the shaping and final proofing stages. Fermentation starts practically at the instant the flour and yeast become hydrated. If the dough was bulk-fermented for too long or sat on the worktable for an extended period before dividing or shaping, it will either proof very quickly once it's shaped or may even overproof before that. You can usually extend the final proof of the dough by refrigerating it once it's been shaped. The type of dough will dictate its adaptability to such factors.

The right moment for calling proof is when there's an optimal relationship between the amount of gas in the dough and the ideal gas-retention properties of the gluten network. Keep in mind that more gas will be produced during oven spring, so the gluten should still be strong enough to retain the gas and ensure proper volume and crumb structure. With experience, you'll be able to simply use touch to determine whether the dough is ready to bake, but few can call proof accurately on their first few doughs.

To further cloud the issue, some bakers slightly overproof their doughs intentionally. That's because it produces a much more open crumb structure and better flavor than just barely proofing a dough. An underproofed dough will lack flavor development and will likely have a tighter crumb because of insufficient fermentation. Note that if you err, it's safer to do so on the side of overproofing. If you've cold-proofed your dough for a long period—say, 24–48 hours—it isn't exactly necessary to call proof. By that point, it's likely ready to be pulled out, tempered for 2 hours, shaped, and then baked.

No kitchen gadget can simplify calling proof. But if you're adventurous and willing to practice on a few balls of dough, you can develop the skill through trial and error. Try the following simple experiments to get a better idea of how to call proof. Once the dough has been left to proof for the time we recommend, take a close look at it. Has its volume increased since it was shaped? Does it look bubbly and gassy? Does it jiggle when you poke it or move the tub? (It should.) Perform the fingertip test (see the next page) and bake the dough when it seems properly proofed. If the pizza turns out successfully, use that fingertip test as a guide for future balls of dough. Remember what that dough felt and looked like. Don't underestimate the power of muscle memory.

If the dough has overproofed, you'll see telltale signs. It will look like a balloon in the throes of deflating. You'll see wrinkles where there were bubbles of carbon dioxide. It will smell more like alcohol than yeast. When baked, the pizza may have a pale crust and a tight crumb, and you're likely to taste alcohol.

At the other end, dough that's underproofed will spring back quickly if you perform the fingertip test. When baked, the dough could rip and tear on the surface, and it's likely to become misshapen during baking. You'll see how flat the dough stays. This may not be a big deal for thin-crust, Brazilian thin-crust, and deep-dish pizzas, but for other styles, a super flat pizza is a telltale sign of underproofing. It's an instructive reminder of why dough needs time not only to proof but also to relax the gluten and tension created by shaping.

The Fingertip Test

In principle, there ought to be some scientific way to determine when proofing is complete. You could track the gradual decline in pH as fermentation progresses, for example, or measure the increase in the dough's volume, or quantify changes to its firmness and elasticity. We have tried all these in our lab. Our conclusion: no. Because so many things vary from one dough recipe to the next, no simple technical method can be used to accurately call proof for all kinds of dough. With enough trial and error, it's probably feasible to find values for a volume increase, drop in pH, or some other precise measure that signals the end of proofing for a specific recipe. But what most pizza makers need is an easy test that works for most recipes.

The fingertip test fits that bill. It's not a scientific method, and you'll have to practice to become proficient. But the good news is, you'll need only one tool—an index finger. And although we don't all feel proofed dough the same way, the test is good enough for making an educated assessment of whether the dough is ready to move on to baking. To perform the fingertip test, use your finger to gently press the exposed surface of the dough for 2 seconds. The pressure should leave a small dent in the dough. It will slowly spring back, but the indentation will remain clearly visible. The steps, illustrated at right, are fast and straightforward and can be done repeatedly without harming the dough. The fingertip test works reasonably well because it integrates several different factors that change during proofing, including the water content of the dough, its gluten development, bubble integrity, and the amount of captured gas.

Dough CPR

It happens to the best of us. You wait for your dough to proof so you can bake it and then, somehow, you lose track of time and it overproofs. You may even bake the overproofed dough, hoping it will magically return to life; instead, you end up with a pale flat pizza that smells like an old beer.

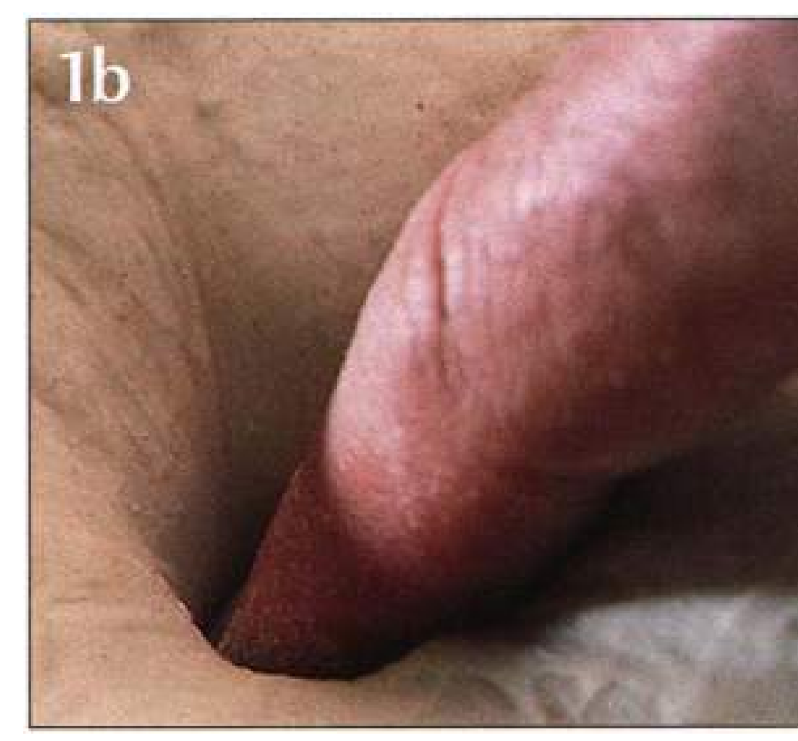
Conventional wisdom holds that overproofed doughs are irretrievably damaged and should be thrown away. Our experiments found just the opposite. In fact, we were able to resuscitate the same batch of dough up to 10 times before it suffered any serious loss in quality. The method is so simple that you'll want to cry for every batch of overproofed dough you've thrown out.

The first step is to confirm that your dough really is overproofed. It may just have excess gas rather than something more dire. During proofing, the size of the bubbles in the dough increase; as a result, the cell walls between the bubbles become thinner. Those walls undergo a process called shear hardening that makes them more elastic. At a point far beyond that, the cell walls rupture, and the bubbles coalesce. The gas stays in the dough, but there are fewer (though larger) cells. Overproofing involves an irreversible thinning and possible tearing of the cell walls during baking. It usually takes a while for this to actually occur, though.

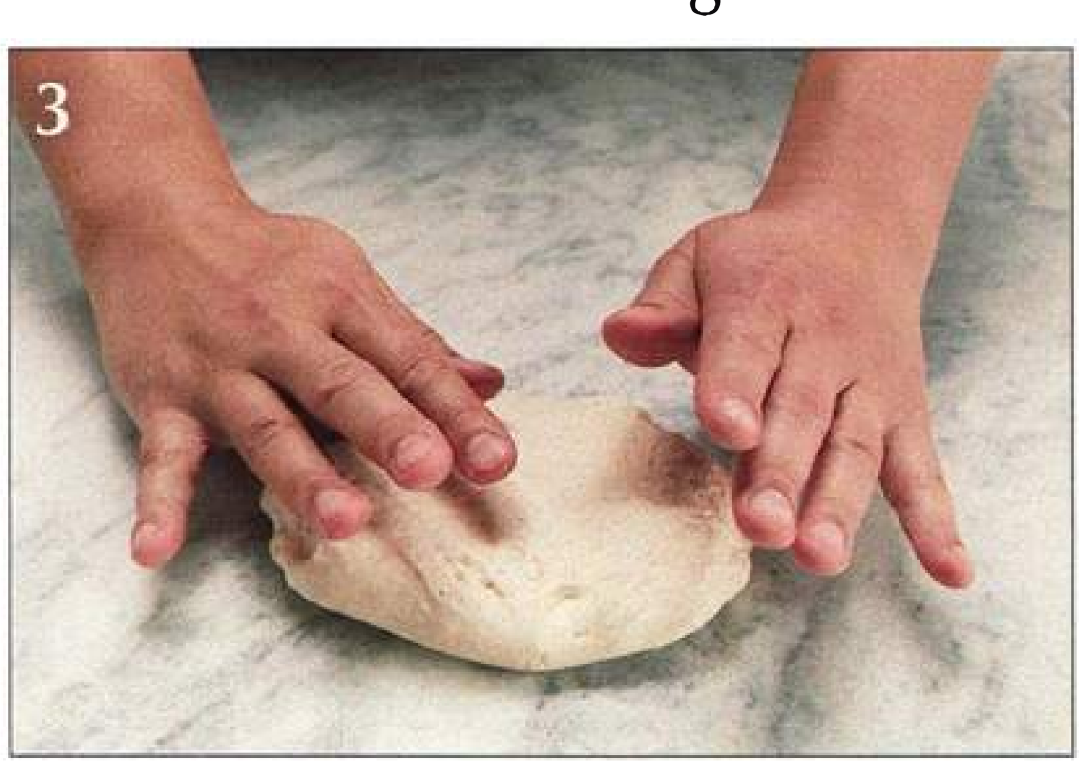
Perform the fingertip test to determine the dough's condition: if the dent you've created with your finger doesn't spring back at all, the dough is probably overproofed. The bubble walls in overproofed doughs are stretched too thin, so they are mechanically unable to spring back. The smell of alcohol is also a sign. This telltale scent was key as we developed our method for determining and rescuing overproofed dough.

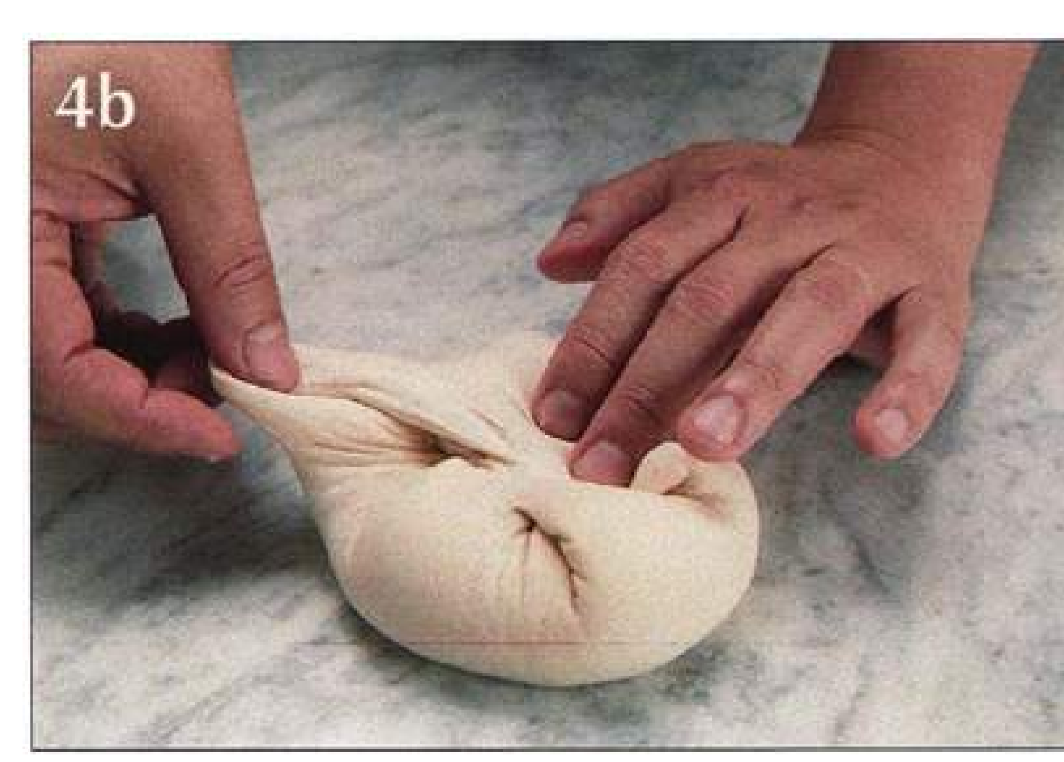
Because overproofing involves the thinning cell walls, along with excess carbon dioxide and alcohol, the trick to reviving your dough hinges on releasing the gas and alcohol and reinforcing the cell walls. Just degas the dough and reshape it. That's it.

This method works especially well for Neapolitan dough; it also works well for thin-crust, Brazilian thin-crust, New York, artisan, deep-dish, and Detroit-style pizza doughs. The key is to let the dough relax after reshaping it, giving it some time before shaping and baking. Reshaping produces a lot of tension in the dough and can make it very hard to stretch open without ripping. For our pizzas mentioned above, we wait 3–4 hours before shaping (see pages 3:12 and 3:66 for the shaping methods for these pizzas).



HOW TO Perform Dough CPR





1 Perform the fingertip test to make sure your dough is overproofed; the dent you make by gently poking the dough should be permanent (see the images in the margin above).

2 Remove the dough from the proofing vessel.

3 Degas the dough by pressing down firmly on it. Use the same pressure as you would for shaping.

4 Shape the dough into a ball, and return it to its proofing container. Cover well and let the dough relax for 3–4 h at room temperature.

CHAPTER 7

PIZZA DOUGH RECIPES

PIZZA DOUGH RECIPES

In our minds, the dough is the foundation upon which the success or failure of a pizza rests. While the flavor of a thin crust can be overshadowed by the more pronounced flavors of the sauce, cheese, and other toppings, we think any pizza with a rim is an opportunity to showcase a well-made dough. Thick, bread-like pizzas are built upon a voluminous crust, making the crust central to each bite. There are many pizza eaters out there who consider the crust not worth eating, taking the stance that it's better to leave more room for the cheesy topped part of the pizza than to just fill up on "bread." We think that we can change their minds.

For many pizza lovers, the thin crust is the definition of pizza, the quintessential slice. While there are a multitude of regional and international variations on thin-crust pizza, in our research we have identified 10 types of dough that span a wide variety of pizza styles: thin-crust, Brazilian thin-crust, deep-dish, Neapolitan, New York, artisan, focaccia, New York square, high-hydration al taglio, and Detroit-style. These doughs can be used to make the standard thin-, medium-, and thick-crust pizzas they are typically associated with (and we show you how on page 3:3), but we like to break the rules. We did a series of experiments to find out which doughs work for each different style and found that the majority of our doughs could be used in multiple applications—what we call "cross-crusting"—to good and sometimes excellent effect (see page 96).

Because of their ingredients; how the doughs are mixed, bulk fermented (or bench rested), and proofed; and the temperatures they are baked at, our pizza doughs produce a variety of textures, thicknesses, and degrees of firmness. As distinct as these crusts are, they are also versatile. We have developed an extensive set of technique variations, including no-knead doughs and some pizza doughs that you can use for up to 10 days. We include flavor variations for each of the 10 master recipes to encourage you to explore the layers of flavor that you can build in your pizza (see page 186). We also developed a number of gluten-free recipes (see pages 192–198). In this chapter, we first cover the categories of the master pizza doughs and their common characteristics, and then we get into the specifics of each pizza dough as well as the different variations.

For recipes that call for whisking together water and yeast (and sometimes a preferment), use a hand whisk, not the whip attachment for the mixer. You can also skip this step and add the ingredients all at once if you have had some practice mixing dough (see page 33).

Because many of our doughs can be made in advance (up to 2 days in some cases), we have the instructions for making the dough in this chapter and the instructions for shaping and baking the pizzas in the Iconic Recipes chapter on page 3:3.

For more on how we define pizza styles, see page 94.

NEW DISCOVERIES AND TECHNIQUES

You can use a rolling pin, a sheeter, or a dough press to shape the ultra-thin Brazilian thin-crust pizza dough shown on the previous page (see page 3:12 for shaping instructions).

PIZZA STYLES

Our 10 master styles of pizza dough produce pizzas with distinctive characteristics that we discuss in The World of Pizza, beginning on page 1:91. But some of them share traits as well. The thin-crust and Brazilian thin-crust pizza doughs produce a similar finished pizza despite the dramatic differences in hydration (20%) and fat (10% fat in the latter dough). The main difference between our New York pizza dough and artisan pizza dough is just 2.5% water. These both produce medium-crust pizzas, but that little bit of extra water provides the artisan pizzas with a wider rim than the traditional New York pizza. Our bread-like pizza doughs (focaccia, New York square, high-hydration al taglio, and Detroit-style) are virtually interchangeable (see page 96).

Half of the master dough recipes (thin-crust, New York, artisan, focaccia, and New York square) employ a poolish (see page 1:299) in addition to instant dry yeast. This preferment is essentially a partially developed dough, with the flour already hydrated and gluten development in full swing.

We have occasionally found that there is an unspoken competition among pizza makers for how long a dough can ferment or how high they can push the hydration in the dough. We have learned that the wettest dough doesn't necessarily produce the highest volume, nor does an extremely long fermentation produce a better-tasting crust. A moderately hydrated dough like our master Neapolitan Pizza Dough (see page 124) can produce a crust with a very open crumb and still remain under 70% hydration. It all has to do with how the dough is made, shaped, and baked.

Our pizza recipes showcase a wide variety of styles. Thin-crust pizza, such as Brazilian thin-crust shown at left, has a very crispy crust while the medium-crust pizzas like the New York pizza in the middle are a little chewier. This pizza features a dough with grain inclusions (see page 1:331). Bread-like pizzas have thicker crusts that can hold an array of toppings, like the high-hydration al taglio pizza with prosciutto, ricotta, arugula, and olive oil (at right).

Adding it to the mix jump-starts overall hydration and fermentation, which brings the benefit of reduced mixing time, thus lessening the risk of the dough overheating in the mixer. Preferments are added to breads for the same reasons, and their presence also lends a more complex flavor to a loaf (though this slight tang can be hard to detect in pizza dough because the toppings may mask the flavor).

Generally speaking, the bread-like doughs have higher hydration than the thin-crust doughs. The master recipes for the thin- and medium-crust doughs max out at 72% (artisan pizza dough), while the hydration of the bread-like doughs ranges from 70.43% for Detroit-style all the way up to 86.87% for focaccia. This amped-up hydration creates an open crumb that offsets the thickness of the crust, making it airier than it first appears. Pick up a piece and you'll be surprised by how light it is. Because of their higher hydration, though, these doughs are harder to mix and shape.

We have found that the commercial planetary and spiral mixers give the best results when mixing the majority of the doughs. The bread-like doughs take a particularly long time to mix in a fork mixer, so its use is not typically recommended. We like the diving arm mixer for certain doughs that aren't very high in hydration. You should use a stand mixer only if you are making smaller batches.

Machine mixing is recommended; you can mix by hand if you prefer, but it's going to take some real muscle (see page 45). The one downside to machine mixing is the danger of the dough overheating from friction; ideally you want the temperature of the dough between 24° C / 75° F and 25.5° C / 78° F when it comes off the mixer.

Each of the master recipes provides mixing instructions for the commercial planetary mixer, spiral mixer, stand mixer, diving arm mixer, fork mixer, and food processor, when applicable. They are listed in the order that we recommend for each dough.

For more on mixers, see page 37-38.

For more on our experiments with types and amount of fats in thin-crust pizza dough and Brazilian thin-crust pizza dough, see page 1:318.

For more on the variety of thin-crust pizzas that we found during our travels, see page 1:126.

It's worth noting that some pizza styles do not seem to have a single canonical dough recipe. We found widely different pizzas for both deep-dish and thin-crust. We found that the super-thin pizzas that we ate in Brazil, the various parts of the Midwest, and the Northeastern seaboard, and some attributed to Rome (see page 1:168) had very little in common in the dough or pizza, apart from being super-thin. See pages 96–99 for our cross-crusting recommendations.

We recommend docking our Brazilian thin-crust pizza dough (see photo below and next page, above). Poking small holes in the dough keeps it from puffing up too much in the oven. That way it can maintain its signature thin crust (see page 3:12 for shaping instructions).

THIN-CRUST PIZZA DOUGH

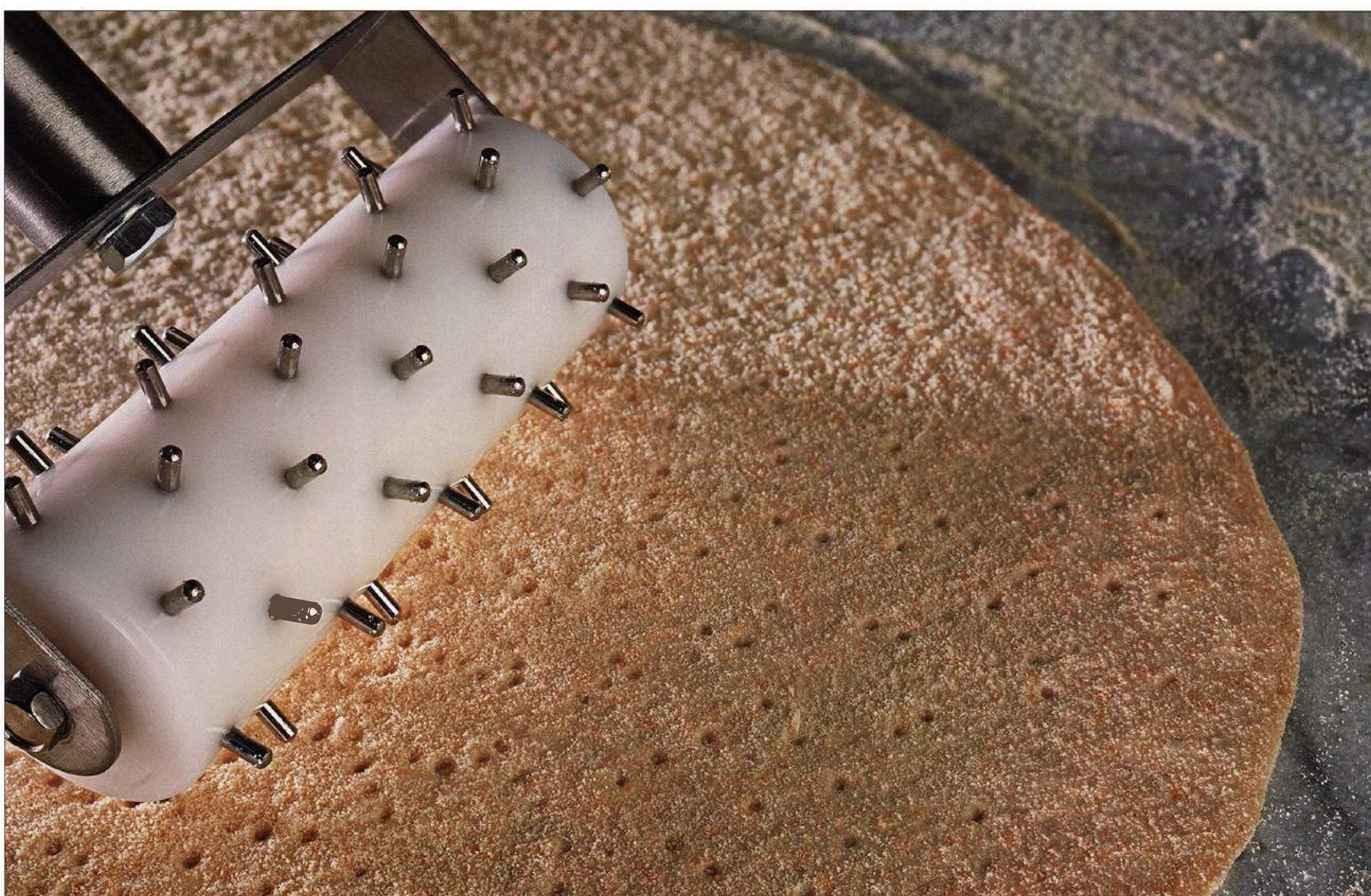
Thin-crust pizza is commonly found in Chicago and other Midwest cities (its cousins, bar pie and tavern pizza, are also found in the Midwest and along the Northeastern seaboard; see page 1:105). The dough stretches easily, is typically shaped with a rolling pin rather than by hand, and bakes to a cracker-like consistency. The pizza has a little bit of a rim and that gets the crunchiest. An idiosyncrasy of thin-crust is that even though it is a round pizza, it's often served cut into squares (see page 3:300), a method we find impractical for eating. You don't have to cut it that way, though.

One of the problems, as we see it, with the thin-crust pizzas served in Chicago pizzerias is that they are often made with deep-dish-style dough (we found that pizzerias offer both styles of pizza but make them with the same dough), which can take two forms: a biscuit-like dough prepared with a soft flour or a stronger dough enriched with shortening or butter. In our opinion, neither delivers satisfying results when used for a thin-crust pizza.

So we went about creating our own dough, one meant to be rolled out thin but sturdy enough to handle its toppings and still yield a great crunch. Thin-crust has a crunchy, but not cracker-like, rim that doesn't inflate. Some places won't even leave the rim exposed; in Chicago they cover it completely with sauce and cheese. We also wanted a dough that can be used the same day you make it, if you choose to.

We included about 10% cornmeal in the mix (it's a traditional ingredient in thin-crust pizza). Because this dough doesn't necessarily reap the benefits of a long cold-proof (it proofs for 1½ hours at room temperature), we significantly increased the percentage of yeast (0.82%). The hydration is on the high side (72%), which means it takes some time to mix, so it's particularly important that the water be the right temperature to prevent overheating.

The result is a crust that is sturdy and crunchy and has great flavor. Our one caveat: because you are rolling this dough so thin (6 mm / ¼ in), be sure to use fine-ground cornmeal in the dough—anything coarser and you run the risk of it ripping the dough as you roll. The other downside of very coarse cornmeal is that if it doesn't absorb enough moisture from the dough, it can be too crunchy to chew easily. If all you have is coarse-ground cornmeal, run it through a food processor or spice grinder first.



BRAZILIAN THIN-CRUST PIZZA DOUGH

One of the most prevalent styles of pizza in Brazil is thin crust. The dough is made with a low-protein flour, which makes it very easy to roll out and stretch because there isn't any real pullback. The rim puffs up a little, like a cracker would. It even has a bit of a cracker-like texture, which is desirable, but when you cut a slice, it'll hold the plank. The base, while firm, is not crunchy. Although there are some other styles being made in Brazil (like Neapolitan, something similar to New York, and even artisan), they're not exclusively Brazilian-style pizza.

Most Brazilian pizzas are larger and made for sharing. We were surprised to find that service for this pizza is very formal in São Paulo. A server gives you a slice (you don't grab it from a tray), and the pizzerias look like semi-fancy restaurants. And, interestingly, it is almost impossible to find a pizzeria that is open for lunch. Pizza is a dinner food, period (see page 1:190).

DEEP-DISH PIZZA DOUGH

We discuss our deep-dish pizza dough near our thin-crust pizza doughs for a reason. It turns out that the "deep" part of deep-dish pizza consists mostly of the copious toppings, while the dough itself is pretty thin. As with our Thin-Crust Pizza Dough (see page 110), this dough includes a bit of cornmeal, characteristic of the deep-dish pizzas that Chicago is famous for.

This deep-dish dough does not use a poolish and includes both butter and lard, which makes sense when you consider that deep-dish pizza is more akin to a quiche than a pizza. (We decided to make a hybrid of the two; see our recipe for Quizza on page 3:102.) The dough is mixed to full gluten development, has a bench rest of 20 minutes, and proofs at room temperature for 1½ hours, so you can make it the same day you want to serve pizza. For those with the time, we have found that cold-proofing for a day will yield a crispier, even better-tasting crust.

We wanted to pay homage to Pizzeria Uno in Chicago, which originated the deep-dish style, so we also developed an enriched dough that has more than four times the amount of fat of our master deep-dish pizza dough. This enrichment provides a flaky crust similar to pie dough that won't get soggy under the thick layer of toppings and sauce.

For more on how we replicated an iconic Brazilian flour, see page 1:277.

For more on Pizzeria Uno, see page 1:245.

You can use a rolling pin to remove any excess dough around the top of the pan when you shape deep-dish pizza dough (see page 3:88).

The fork mixer (see photo below) is not widely available in the United States but is the mixer of choice for some Neapolitan pizzaioli to make traditional Neapolitan pizza dough (see page 38). We have found that you can achieve better results with other commercial planetary mixers, and that pizzaioli in Naples use other mixers as well.

NEAPOLITAN PIZZA DOUGH

The original pizza (see page 1:12), Neapolitan pizza is traditionally baked in a scorching-hot oven (usually wood fired, at temperatures of 450–480° C / 840–900° F). The heat of the oven creates the small- to medium-sized charred bubbles around the rim of the crust, known as leoparding, which are the hallmark of this style.

In Naples, with few exceptions, the dough contains only four ingredients: flour, water, yeast, and salt. The amount of water in the dough is kept intentionally low because the more water a dough contains, the longer it will take to bake. When baking in an extremely hot oven, the crust needs to bake through in less than 2 minutes (more often 60–90 seconds)—any longer and it will burn. But the amount of water also has to be sufficient to provide the lift needed to inflate the air bubbles in the dough, resulting in those open and irregular alveoli (bubbles) that define this crust (see page 3:35).

For pizzas baked at lower (though still hot) temperatures (285–340° C / 550–650° F), it takes a little while for the dough to heat up and bake. Initially (and very briefly), the yeast is very happy with this warming environment, and there is a final burst of activity that produces carbon dioxide and ethanol, which helps inflate the air bubbles in the dough. This continues until the temperature rises to 50–60° C / 122–140° F and the yeast dies, at which point the steam being produced by the evaporating water takes over the task. In a 480° C / 900° F oven, the yeast dies very quickly, and the majority of the inflation in the dough will come from steam. So for Neapolitan pizza, the amount of water in the dough needs to hit a sweet spot—not so much that it increases the bake time, but just enough to produce steam to fully inflate the bubbles in the dough.

Because the proper degree of hydration is so important to this pizza, so is the flour. Almost all pizzaioli in Naples use a semistrong 00 flour, but more

While we recommend machine mixing for our pizza doughs, Franco Pepe, one of the most lauded pizzaioli in the world, mixes all of his doughs by hand (see page 47).

and more are combining it or replacing it with Tipo 0, or even Tipo 1 and Tipo 2 flour, to develop their own flavor and texture profiles. It has become such a trend that the AVPN has started to allow these non-00 flours, as well as the use of sourdough starter (levain), as acceptable in their (semi) strict criteria for making "true" Neapolitan pizza (see page 3:43).

Nearly all Neapolitan pizzaioli use fresh yeast, and most use a fork mixer to make their dough. But they do differ in the order in which they mix the ingredients, whether or for how long they bulk ferment, and how long they proof. Room-temperature proofing is traditional in Naples, while cold-proofing is prevalent in the rest of Italy and much of the world (see page 88). For those who bulk ferment, it can be anywhere from 5–10 hours, and proofing times range from 2–24 hours. The goal of bulk fermenting is both to ferment the dough and to convert the maximum amount of starches from complex to simple sugars to serve as food for the yeast. This is crucial to achieving proper proofing and eventual baking during Neapolitan pizza's very short time in the oven.

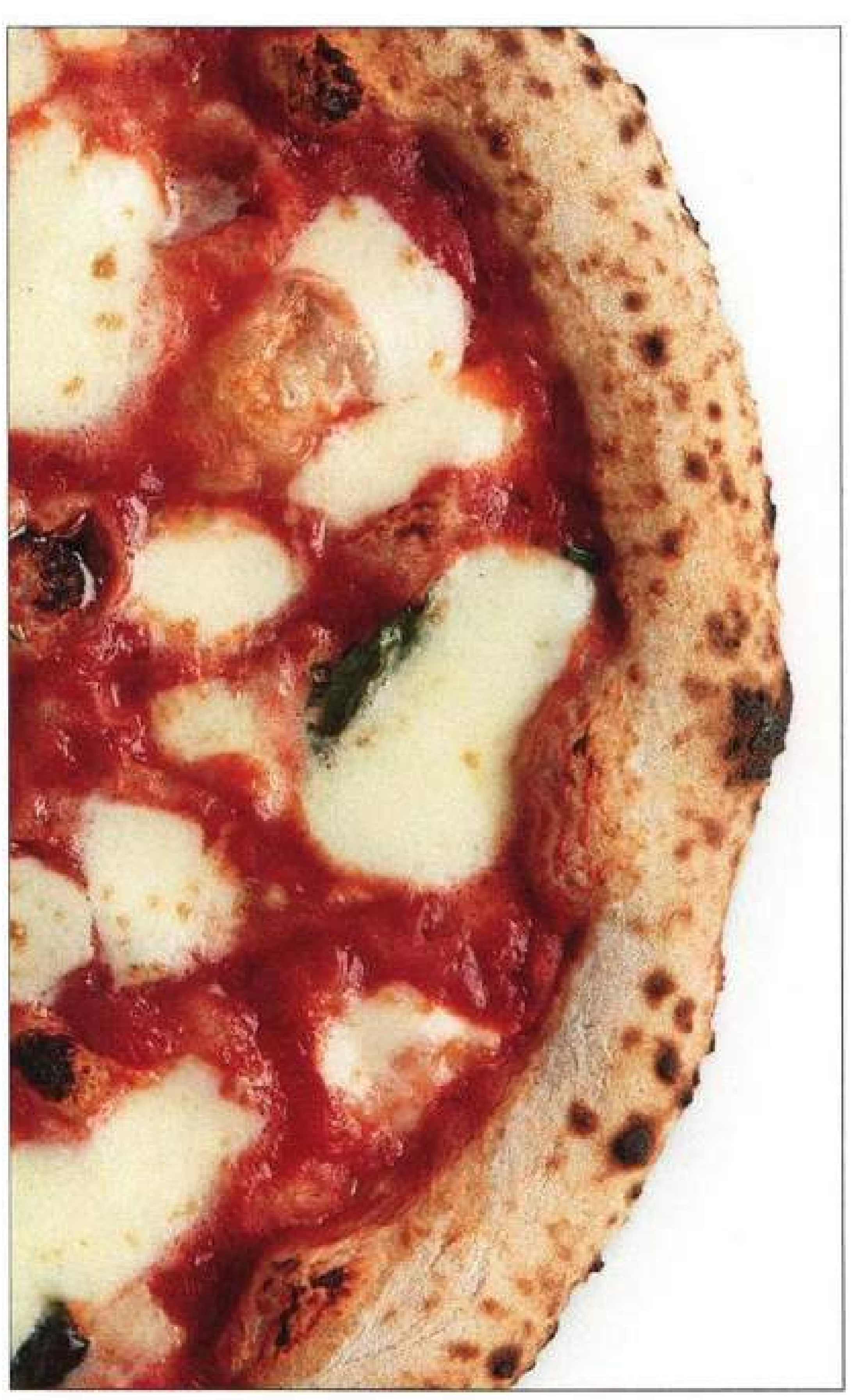
How does our Neapolitan pizza dough stack up against the traditional doughs made in Naples? They are relatively similar in ingredient proportions, but we use instant dry yeast. Our feeling is that the use of fresh yeast in Naples is driven by custom; many of these pizzerias have been run by the same family for generations, and using fresh yeast is simply the way they have always done it—the yeast is part of their history. We, on the other hand, are not constrained by that. Instant dry yeast is much more stable, has a longer shelf life, and is more reliable and convenient to store than fresh. Also, there is no flavor difference—it's the same strain of yeast (see page 1:292).

The method we use for our dough, however, is completely different from what we saw in Naples. It is the result of an extensive experiment where we tested different methods and times for mixing, bulk fermenting, and proofing Neapolitan pizza doughs (see page 88). Our best result came from a dough that was mixed to full gluten development, bulk fermented at room temperature for 20–24 hours, balled, and then proofed and relaxed for 3 more hours at room temperature. The relatively low-hydration crust (62.3%) had great flavor and a large rim with a very open crumb. Because we want to offer choices, we have also included an AVPN Neapolitan Pizza Dough (see page 130) and a Neapolitan-style pizza dough that contains a poolish and is cold-proofed (see page 128). The addition of the poolish (see page 1:299) is to aid in the full hydration of the flour and to improve its texture and baking properties. Proofing in the refrigerator minimizes the risk of overproofing while still adding the benefits of full hydration and the breakdown of starches into sugars.

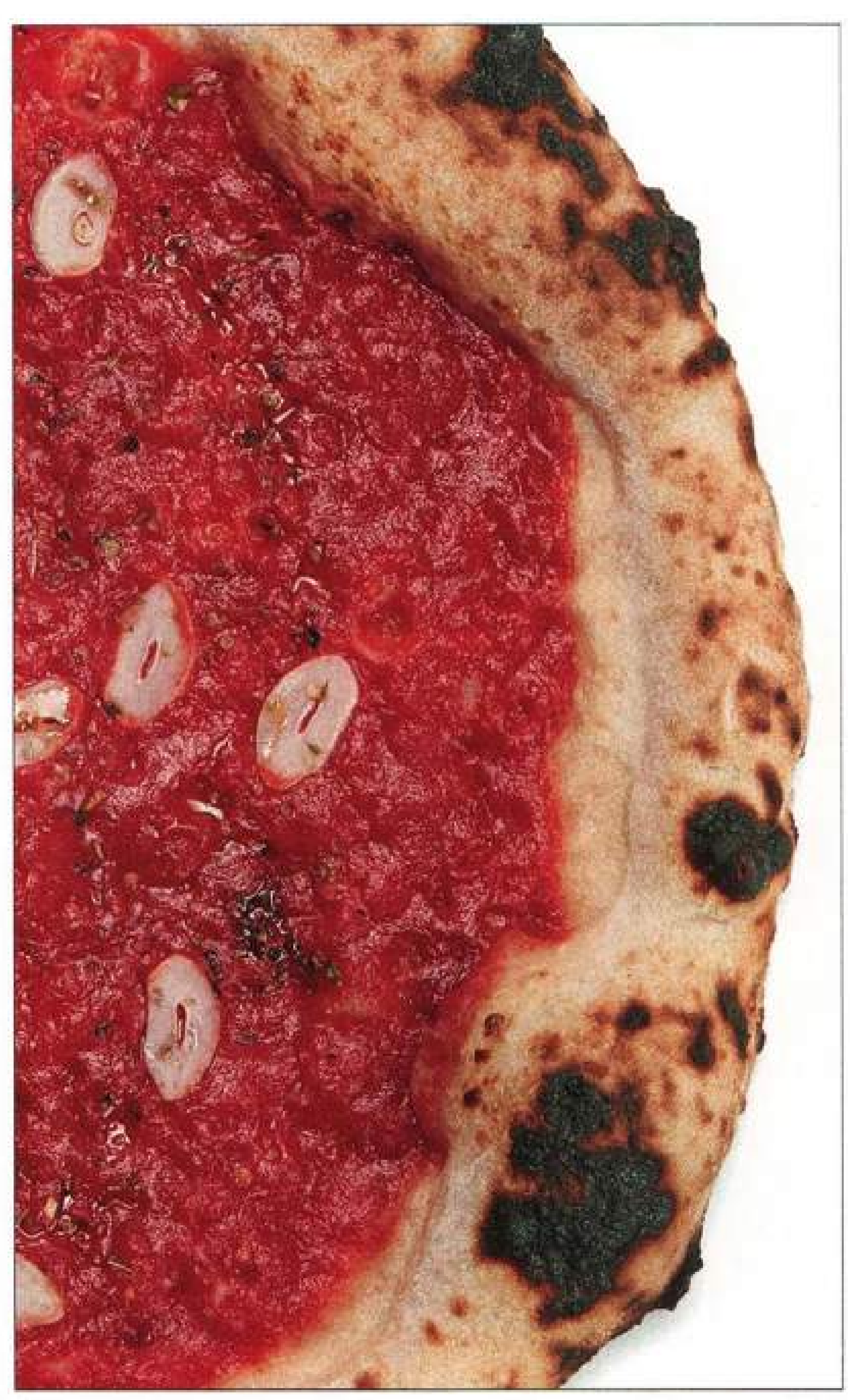
In Italy, there is an obsession with digestibility, specifically in regard to Neapolitan pizza (see page 1:133). This "digestibility" is attributed to long fermentations and the type of flour used in the pizza; it is said that you can eat a whole Neapolitan pizza and be ready for more 10 minutes later. We're not sure what this is based on, but if you want to eat several Neapolitan pizzas in an afternoon, who are we to judge?

For more on the differences between Tipo 0, Tipo 1, and Tipo 2 flour, see page 1:278.

While "true" Neapolitan pizza is supposed to be soft (see page 1:97), it shouldn't be soggy or soupy in the middle. Even the pizzaioli that we interviewed in Naples agree that sogginess is a flaw.



Neapolitan Pizza Dough with Poolish (see page 128)



AVPN Neapolitan Pizza Dough (see page 130)

Modernist High-Hydration Neapolitan Pizza Dough (see page 127)

EXPERIMENT

IS THERE A RIGHT WAY TO PROOF NEAPOLITAN PIZZA DOUGH?

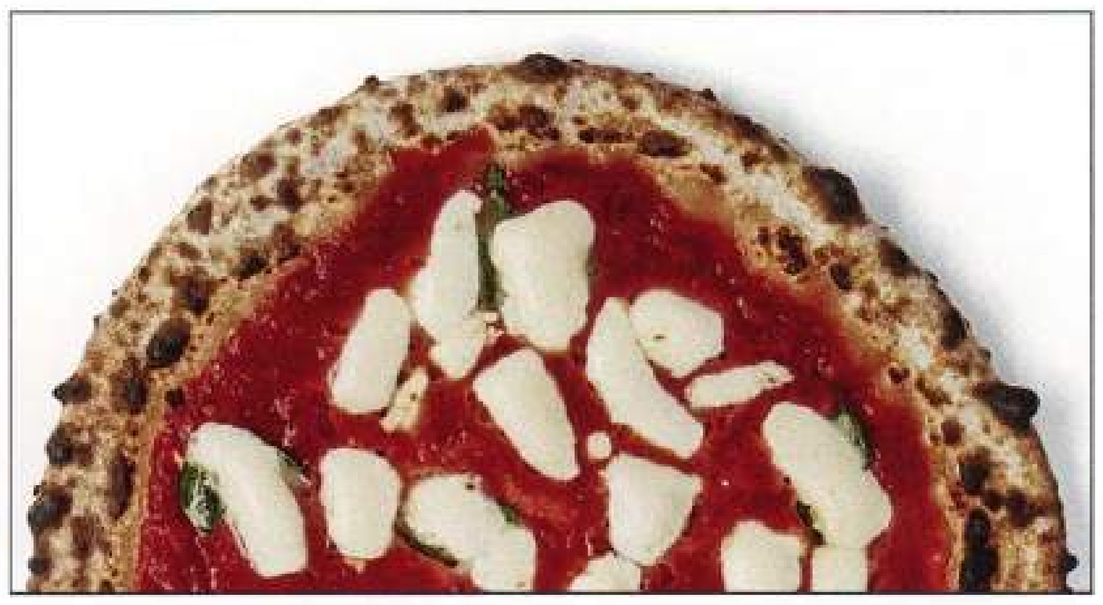
One of the biggest surprises that we found as we traveled throughout Italy was the difference in proofing times and temperatures for Neapolitan pizza dough. We expected the methods for making this iconic dough to be roughly the same no matter where we went, but we found that it was proofed at room temperature in Naples and cold-proofed pretty much everywhere else. We also found an even bigger variance in the methods used by the more established pizzaioli and the newer people on the block. When we got home, we decided to experiment with the two proofing methods to see if it made a difference.

We created a nine-part experiment that changed singular variables at several steps and led to a staggering number of result permutations. We mixed the dough to shaggy mass or full gluten development, bench rested or bulk fermented it, and proofed the dough at room temperature or under refrigeration. We used the methods that we documented during our travels as our starting point and ended up with a method for our master Neapolitan pizza dough that gives a fantastic result. We are explaining all of this because our master recipe reflects our own method. It doesn't match any of the great pizzerias in Naples and it doesn't have to be yours. But you also don't have to be constrained by the traditional rules surrounding Neapolitan pizza. To that point, we didn't visit a single pizzeria in Naples that followed the AVPN rules to a tee (see page 3:43). We found that there wasn't a single right or wrong pizza in Naples; you can make your own choice.

We developed a typical Neapolitan recipe with a poolish and 2-day cold-proofing stage (see photo at left). But then we started tinkering to see if we could improve it. Bulk fermenting the dough for 1 day at room temperature before balling and baking caused the rim of the dough to pillow, but we struggled to stretch out the dough. We tried resting the dough for 2, 3, and 4 hours after bulk fermenting. The 3-hour resting time provided the best result, and then we added dough relaxers to make shaping a little easier. This gave us our final Neapolitan dough recipe (see photo at far right).

When the dough is mixed to full gluten development (see photo at left, above) rather than to a shaggy mass (see photo at right, above), the crumb is much tighter and the crust color is darker.

We shaped the dough into a ball before bulk fermenting (see photo at left, above). When we balled the dough after bulk fermenting (see photo at right, above), it was difficult to shape the dough and keep the center area from getting too thin. It also tended to rip in the oven during baking.



A dough with a small amount of yeast needs more time to cold-proof because the lower temperature slows its development (see photo at right, above). A dough with the same amount of yeast that is proofed at room temperature for the same amount of time overproofs, resulting in a deflated rim crust that is overly browned (see photo at left, above).

Neapolitan Pizza Dough
(see page 124)

Proofing Neapolitan Pizza Dough in Naples

In the city of Naples, all the top pizzaioli that we talked to proofed their doughs at room temperature (see photo above). The research that we had done and our experience with Neapolitan dough in the United States suggested that the Neapolitans cold-proofed and used much more yeast in their dough. But, for some curious reason, we found that they were proofing the dough for up to 1 day in a non-air-conditioned space, which can vary a lot in temperature, and they used a minuscule amount of yeast (some even claimed to not add yeast to their dough; see page 1:297). They simply used their vast experience to compensate for any variations in proofing or baking.

The question we kept asking ourselves was why they wouldn't control the temperature if that resulted in a more reliable dough, especially considering the length of the proofing time. And to confound matters even further, the AVPN rules specify that the dough should be proofed in a temperature-controlled room. That said, the Neapolitan pizzaioli ultimately have the experience to cope with their dough, and we can't blame the AVPN for suggesting temperature control to people who are getting newly certified to make Neapolitan pizza.

Proper storage during proofing is crucial to the final result (see Final Proofing, page 65). If you are making multiple pizza dough balls, be sure to allow enough room for them to expand. Leaving about 5 cm / 2 in of space between the balls of dough should be sufficient.

Proofing Neapolitan Pizza Dough in the Rest of Italy

We came across a very different scenario when we ventured outside of Naples. Even though virtually all of the pizzaioli hailed from Campania (of which Naples is the capital), almost none of them proofed their dough at ambient temperature (see photo at right). And most of them were surprised that we even asked why they cold-proofed their dough.

These pizzaioli are credentialed (all of them rank in the Tre Spicchi category in the Gambero Rosso guide; see page 1:152), and though some of them make different pizza styles, many of them rival the best pizzas we ate in Naples. They also have their own style of Neapolitan, which is crispier and has a browner rim than the cornicione that we found in Naples. There isn't a single style that rules outside of Naples, but the pizzerias are serving what their customers want.

Just 75 miles from Manhattan is New Haven, home of the distinctive medium-crust apizza style (see page 1:228). We have included a traditional version of the pizza dough as well as our take on this style of pizza that is beloved by its die-hard fans.

During our pizza research, we observed that some pizzaioli would cut open the top of their dough so that they could inspect the fermentation going on under the surface of the dough (see photo at left, below).

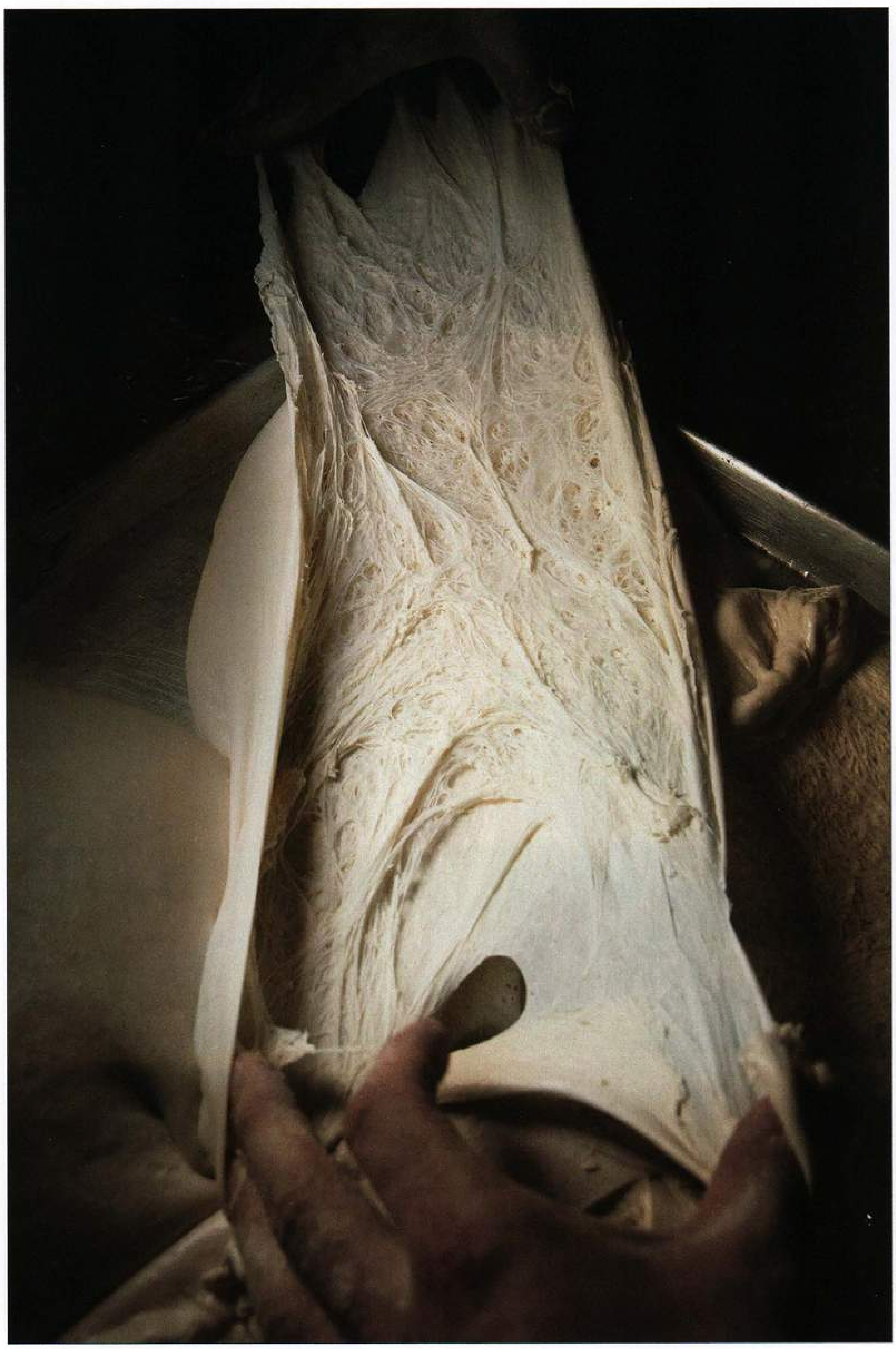
NEW YORK PIZZA DOUGH

On some level, we think of New York pizza as a Neapolitan pizza adapted for commerce. Neapolitan pizza is meant to be eaten within a maximum of 10 minutes after it comes out of the oven. Time is not kind to it. New York pizza, on the other hand, has a sturdy, slightly thicker crust that can be made larger to serve multiple people by the slice (we provide guidelines for making pizzas from 35–60 cm / 14–24 in. in diameter; see page 132). It can handle the weight of more toppings and stand up to an hour under a heat lamp. It reheats with little diminishment of quality and transports well in a box. It's also meant to be baked at a lower temperature than the Neapolitan pizza (285–315° C / 550–600° F), so a wood-fired pizza oven is not a necessity (although it is certainly a possibility; see page 3:72).

We formulated and tested our master recipe until the crust had the qualities we were searching for: chewy-crispy, thicker than Neapolitan without being bread-like, and with enough structure to handle more toppings. Because this crust is thicker and bakes at a lower temperature for a longer time, we upped the hydration on the dough (69.49% versus 62.3% for the Neapolitan) to help open up the crumb for the desired result.

Like our Neapolitan Pizza Dough with Poolish (see page 128), the dough uses a poolish, and for the same reasons. In addition to the flour, water, yeast, and salt, it includes diastatic malt powder and a small amount of olive oil. The malt powder provides food to sustain the yeast during the long fermentation time. The oil helps add volume to the dough, resulting in a fluffier texture; it also makes the dough a bit easier to work with and keeps the crust from drying out when you reheat it.

One of the big challenges with making New York pizza dough is its size. The bigger the ball of dough, the more unwieldy it is to work with. For home cooks, we recommend making a 35 cm / 14 in pizza. But the dough for 35 cm and 40 cm / 14 in and 16 in pizzas weighs 400 g and 600 g, respectively, and the minimum weight that can be properly mixed in a stand mixer is 800 g. We recommend that you make at least that amount, use what you need, and save the rest for the next day (or make a second pizza and freeze it; see page 3:331). Also, for pizza over 50 cm / 20 in, if you are using a tub for proofing, make sure you have one large enough to accommodate the increased amount of dough.



A New York slice from Brooklyn Pizza Crew

ARTISAN PIZZA DOUGH

In doing our field research on the different types of pizza, we identified a category that we came to call artisan (see page 1:38). It has the bubbly, organic look of Neapolitan pizza (but with a crust that is browned but not leoparded) and the texture and thickness of New York pizza (though some pizzerias make it a bit thinner). We found a version in virtually every city that we visited.

Because the crust is thicker than a Neapolitan pizza, it needs more time in the oven, which means a lower baking temperature (250–315 °C / 485–600 °F) to prevent burning. To ensure big bubbles around the rim of the crust, our master dough has a higher hydration (72%) than both the Neapolitan pizza dough and the New York pizza dough, which creates more steam to enlarge the bubbles. It contains a small percentage of olive oil, which makes it easier for the bubbles in the dough to expand (see page 142). We also added diastatic malt powder to give the yeast extra fuel in an effort to up the size of the bubbles in the crust.

This dough is a great option for the home baker. It's easy to handle, fits on a baking steel in a home oven, and produces a great-looking pizza. And unique to this dough, we include a high-hydration variation (see page 146) that will produce results similar to those in trendy high-hydration breads.

FOCACCIA DOUGH

Thought by some to be the original pizza (see page 1:12), focaccia is a crispy-bottomed pan-baked bread dressed with very minimal toppings (if any at all), classically just a drizzle of olive oil, a sprinkling of salt, and maybe fresh herbs. The lack of tomato as a topping points to its venerable age; its origin predates the appearance of the tomato in Italian cooking in the 17th century (see page 1:9). We argue that this lack of sauce, along with a handful of other factors, means it doesn't fit our definition of pizza (see page 1:4). That said, we found that our focaccia dough performs excellently as a crust for bread-like pizzas (see page 96), which is why we have chosen to include it here.

Our version is wonderfully chewy and has a very open crumb, more than is typical of focaccia because we based it on our ciabatta recipe from *Modernist Bread*. A primary contributor to this open crumb is the dough's high hydration, 86.87%. This provides plenty of moisture to convert into the steam needed to create the large alveoli in the crumb.

High-hydration doughs take longer and are harder to mix than doughs with lower hydration. Our focaccia recipe employs two techniques that offset these difficulties. The first is the double hydration mixing method (see page 41). For very high-hydration doughs, if you were to add the entirety of the water all at once, you would swamp the dry ingredients. In double hydration, you hold back a portion of the water while mixing the dough to a shaggy mass, or low gluten development. You then add the remaining water, along with the salt, and continue to mix. Doing this shortens the mixing time, makes for a more cohesive dough, and ensures more even distribution of the salt through the dough because it is dispersed in the water.

The second technique is autolyse (see page 32); once the dough is mixed to a shaggy mass, it's allowed to rest for 30 minutes before the salt and remaining water are added. This gives the flour the opportunity to absorb the water, which will reduce mixing time. The inclusion of both levain and poolish further improves the hydration of the flour (see Fermented Flour, page 1:298), and the levain adds flavor, which is particularly important since this dough is not cold-proofed.

Another factor that contributes to the open crumb of focaccia is mixing the dough just to medium gluten development. This is followed by a room-temperature bulk ferment for 2½ hours, with several four-edge folds performed until the dough achieves full gluten development. Doing this ensures that the dough is not overworked (which would lead to a tighter crumb), and it also allows time for flavor development.

For more on the introduction of the tomato to Italian cooking, see page 1:9.

We flavored our artisan pizza dough with an herb inclusion to create the green-hued pizza crust shown above. If you choose to include a puree or inclusion in your dough, make sure that it matches the flavor profile of the pizza's toppings. For more on dough inclusions, see page 1:331.

For more on our experiments with how pectin affected focaccia dough, see Turning Up the Volume, page 1:324.

Stippling focaccia dough (and other pan-baked pizzas) as it proofs helps to stretch it out to evenly fill the pan without degassing the dough too much. This bubbly dough will produce a pizza crust with an open crumb structure.

Our Argentinean-Style "al Molde" Pizza Dough (see page 170) produces a similar crust to the New York Square Pizza Dough; it is sturdy enough to handle the substantial amounts of cheese found on the traditional *al molde* pizza style.

We tried several versions of al taglio around Italy and the United States and found that there weren't unifying qualities across the pizzas (see page 1:109). Some were displayed in a case like Gabriele Bonci's al taglio pizza at Pizzarium in Rome (a slice of his pizza is shown in the photo below), but the pizza itself didn't look or taste anything like Bonci's. Others were served whole, for the diners to cut with scissors or baked with toppings like Angelo Iezzi (see page 1:109).

NEW YORK SQUARE PIZZA DOUGH

Our New York square pizza is called Sicilian pizza in some areas. It's purely an American creation, and we found that this style of pizza doesn't have a singular definition or execution (see page 1:101). We created a version of this pizza that improves on what we saw at the pizzerias in New York City; like the originals, it's topped with tomato sauce, cheese, and other ingredients and baked in a rectangular pan until the bottom is brown and crispy. While it is not something you will find anywhere in Sicily, its creator may have found inspiration in the Sicilian flatbread sfincione (see page 3:125). It is topped with tomato sauce, aged caciocavallo cheese, and bread crumbs and baked in a square pan, making it a distant relative that differs quite a bit in the crust.

Like the other bread-like doughs in this chapter, the New York square pizza dough produces a light, airy crust. It has lower hydration than focaccia (74.68%) and employs a poolish and instant dry yeast; as a result, it has a slightly tighter crumb than focaccia. Autolyse is used to increase the water absorption by the flour before the dough is mixed to medium gluten development, but the hydration percentage is not high enough to make double hydration necessary (see page 41). Like focaccia, this dough is bulk fermented at room temperature for 2½ hours, with folds performed until the gluten is fully developed.

New York square pizza dough's lower hydration makes it harder to shape into the pan; the only counsel we give here is patience. You'll be tempted to overstretch it so that it pulls back to where you want it, but don't—you'll end up tearing the dough. Stretch it, let it rest for 10 to 15 minutes to relax the gluten, stretch it again, and repeat until the dough fits the pan.

HIGH-HYDRATION AL TAGLIO PIZZA DOUGH

The person who inspired many pizzaioli to make Roman al taglio pizza is Gabriele Bonci, and his style is one of our inspirations as we developed our recipe for al taglio pizza. This dough produces an incredibly light and airy crust with a chewy texture and very crispy bottom. The toppings are limited only by your imagination and, depending on the ingredients, can be put on the pizza before baking or after it comes out of the oven.

This dough has the second-highest hydration of the bread-like pizza doughs, 81.08%, which is a primary contributor to its open crumb. Double hydration is used, shortening the mixing time, and it is also autolysed like the other pan-baked pizzas with high hydration (Detroit-style pizza is the exception to this rule). We like using 00 flour in this recipe. It yields a very supple dough that has both elasticity and extensibility; you can stretch it without ripping it. Make the same dough with American bread flour and it snaps back like a rubber band.

Pizza gourmet is a style slightly similar to al taglio pizza in that both pizzas are baked (or steamed), then topped with any variety of toppings before serving. The similarities pretty much end there (the dough, shape, assembly, and presentation are totally different), but we are including a recipe for our interpretation of pizza gourmet dough in the high-hydration al taglio pizza section. Also included in that section is a recipe for Roman Pizza alla Pala Dough (see page 164).

The term "al taglio" means "by the cut," and al taglio pizza, which is becoming increasingly popular in the United States (see page 1:109), is sold by the piece. In Rome, depending on the pizzeria, you can order it by weight (200 g, for instance) or by the exact size piece you want.

Modernist New York square pizza with prawns, scallops, calamari, capers, and fresh parsley

DETROIT-STYLE PIZZA DOUGH

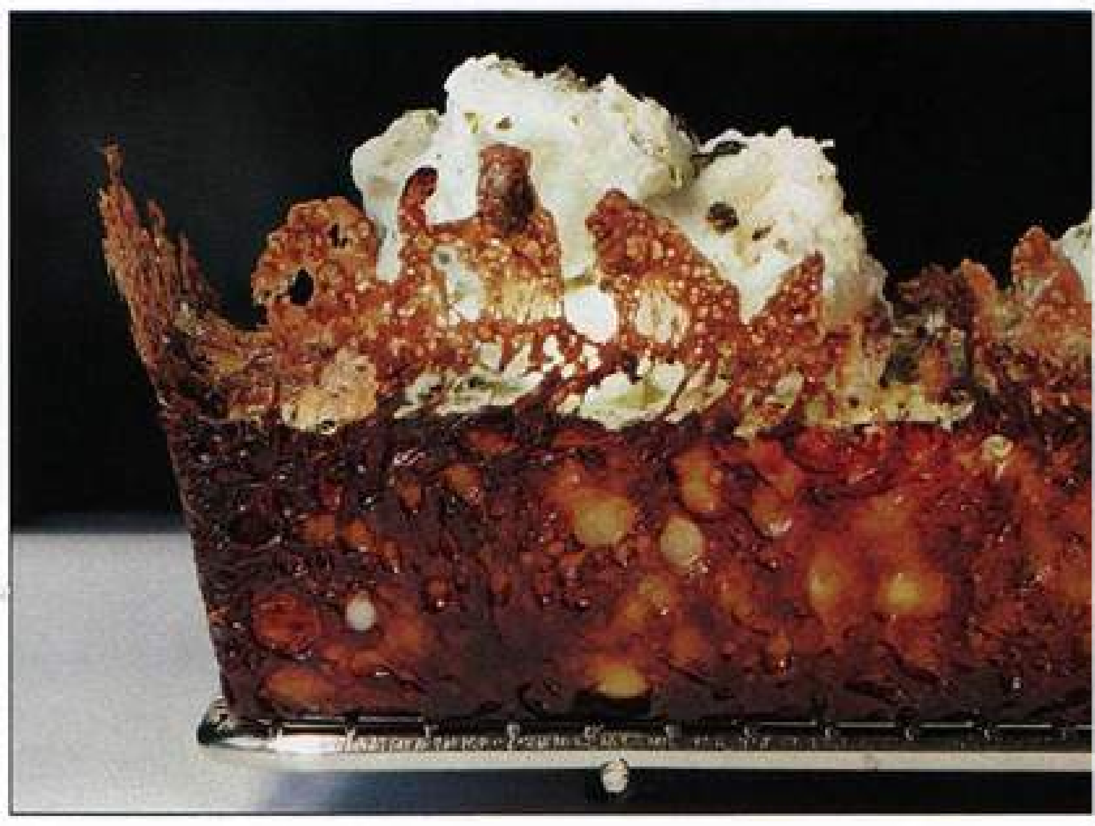
You can't talk about Detroit-style pizza without talking about cheese. The crust has the light, airy crumb and crispy bottom characteristic of all the bread-like pizza crusts. What differentiates a Detroit-style pizza is that the edge of the dough is bordered with cheese, applied so that it comes right up against the sides of the baking pan. In the oven, the cheese melts and bakes into a golden-brown, crunchy crust. The best pieces to get are the corners since they have two crispy sides to them, but the center ones are still plenty delicious.

And not any cheese will do. For a traditional Detroit-style experience, it has to be Wisconsin brick cheese mixed in equal parts with pizza cheese or cheddar cheese. Wisconsin brick cheese has a rich flavor best described as being like melted butter. If you can't find brick cheese, use a combination of white cheddar and mozzarella.

While the other bread-like pizza doughs require a preferment, our Detroit-style master dough can be made from start to finish on the day you want your pizza. After being mixed to nearly full gluten development, it gets two 15-minute bench rests separated by a four-edge fold. This allows the gluten strands to relax, making it easier to fit the dough into the pan. This is also the only one of our bread-like pizzas that is baked to order—all the others are baked ahead and then reheated—but this one can also be easily reheated with positive results (see page 3:312).

Another distinguishing characteristic of Detroit-style pizza is the inclusion of semolina flour (about 15%) along with the bread flour, which adds flavor, gives the dough a nice color, and makes it a bit easier to handle since semolina contains less gluten-forming proteins. Because this is a "day of" or direct dough, with instant yeast the only leavener, we kick-start its fermentation in two ways: by adding a lot more yeast (0.9%) and by increasing the water temperature to 30–30.5 °C / 85–87 °F (versus the usual 21 °C / 70 °F). You typically sacrifice some flavor with a faster fermentation, but that is not the case with this dough.

For more on the difference between durum and semolina flours, see page 1:335.



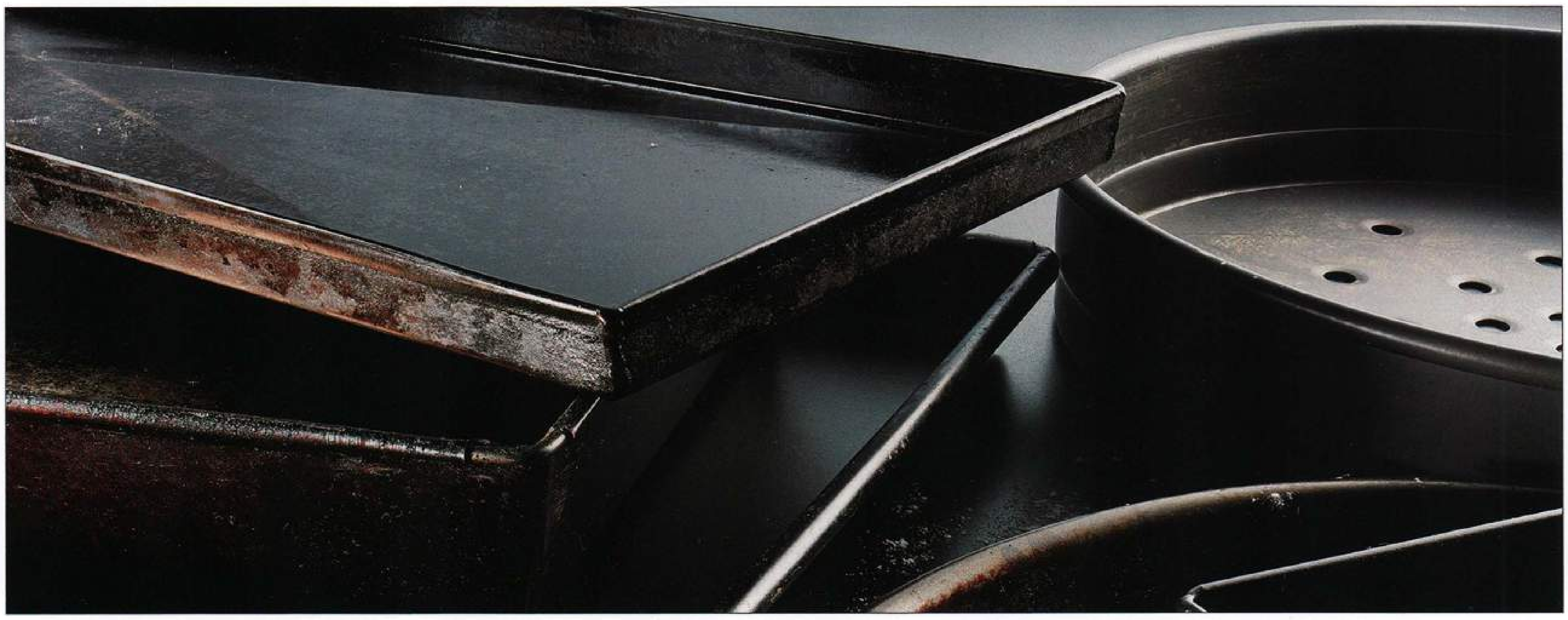
Detroit-style pizza's signature cheese-rimmed crust has helped this style gain popularity in recent years (see page 1:150). We found this particularly lacy example at Apollonia's Pizzeria in Los Angeles, CA.

Detroit-style pizza dough (left) is traditionally baked in black steel pans (above) that were originally used in the automotive industry. We recommend buying cured steel pans to make it easier to remove the pizza from the pan. See Resources, page 3:377.

BEST BETS FOR PIZZA SIZES

Most pizza sizes are dictated by the standard pans that are available. We used these measurements to guide the development of our pizza sizes and dough ball weights. Of course, we've seen myriad shapes and sizes being served in pizzerias around the world, including Neapolitan pizzas that are so large they hang over the edge of the plate. If you don't find the size you want in the table below, you can scale the dough to your desired dimensions using the recipe conversion factor formula on page 21.

Dough type	Dough weight	Pizza size	Pan size
Thin-Crust Pizza Dough see page 110	275 g	40 cm / 16 in	n/a
	370 g	50 cm / 20 in	
Brazilian Thin-Crust Pizza Dough see page 114	125 g	23 cm / 9 in	n/a
	250 g	40 cm / 16 in	
Deep-Dish Pizza Dough see page 118	230 g	21 cm / 8½ in	21 cm by 5 cm deep / 8½ in by 2 in
	700 g	32 cm / 12½ in	32 cm by 5 cm deep / 12½ in by 2 in
Neapolitan Pizza Dough see page 124	250 g	30 cm / 12 in	n/a
New York Pizza Dough see page 132	400 g	35 cm / 14 in	n/a
	600 g	40 cm / 16 in	
	800 g	45 cm / 18 in	
	930 g	50 cm / 20 in	
	1. 1kg	55 cm / 22 in	
	1.2 kg	60 cm / 24 in	
Artisan Pizza Dough see page 142	360 g	35 cm / 14 in	n/a
	400 g	40 cm / 16 in	
	470 g	45 cm / 18 in	
	500 g	50 cm / 20 in	
	580 g	55 cm / 22 in	
	620 g	60 cm / 24 in	
Focaccia Dough see page 148	1 kg	half sheet pan	46 cm by 33 cm / 18 in by 13 in
New York Square Pizza Dough see page 152	700 g	half sheet pan	46 cm by 33 cm / 18 in by 13 in
High-Hydration al Taglio Pizza Dough see page 158	700 g	half Roman al taglio pan	60 cm by 20 cm / 24 in by 8 in
	1.4 kg	full Roman al taglio pan	60 cm by 40 cm / 24 in by 16 in
Detroit-Style Pizza Dough see page 166	330 g	half Detroit pan	25 cm by 20 cm / 10 in by 8 in
	500 g	full Detroit pan	35 cm by 25 cm / 14 in by 10 in



THE RESULTS OF OUR PIZZA EXPERIMENT TRIALS AND TRIBULATIONS

When we started developing the list of experiments for *Modernist Pizza*, we looked at what we tested for *Modernist Bread* that might translate to pizza dough. The goal was to simplify what we could to produce the best possible doughs. While some pizza experiments performed as expected, others surprised us. Following are the results that provided some of the best tips, which we included in the recipes—and others that were mysteries to us.

DOUGH CPR

We were able to utilize our dough CPR method from *Modernist Bread* (see page 77) in combination with dough relaxers to develop a Neapolitan dough that would still work after it was overproofed. Simply reball the Neapolitan Pizza Dough master on page 124, relax the dough for a few hours, and shape it, and you will still obtain an airy cornicione. This technique works for pizzas that are not baked in a pan. If you try to reball pizzas baked in a pan, it becomes difficult to stretch the dough into the corners of the pan.

PECTIN

We were excited to try pectin both in pizzas with an airy rim, like the canotto pizza, and in bread-like pizza with an open crumb. We expected pectin to give us the same volume increase that we saw in several of the breads in *Modernist Bread*. With the exception of focaccia, however, we were unable to see a difference in the volumes of any of our master recipes.

FATS AND OILS

We thought we might be able to achieve brioche-level amounts of fat in our pizza doughs (around 50%) to make a decadent, flavorful base for a pizza. While we did test a dough with 50% solid fat, our favorite dough with a high fat percentage was our 30% Fat Brazilian Thin-Crust Pizza Dough (see page 117). We also succeeded with incorporating 10% liquid or solid fat in the New York Pizza Dough (see page 132), Artisan Pizza Dough (see page 142), Thin-Crust Pizza Dough (see page 110), Focaccia Dough (see page 148), and New York Square Pizza Dough (see page 152). You can include up to 5% for Detroit-Style Pizza Dough (see page 166) and Neapolitan Pizza Dough (see page 124).

DOUGH RELAXERS

Not surprisingly, we were able to shape our pan-baked pizzas more easily and make sure that the dough was pushed into the sharp corners of the pan with the addition of a dough relaxer. We have recommendations for dough relaxers in each of the Modernist variations in the chapter and discuss the role of dough relaxers on page 1:327.

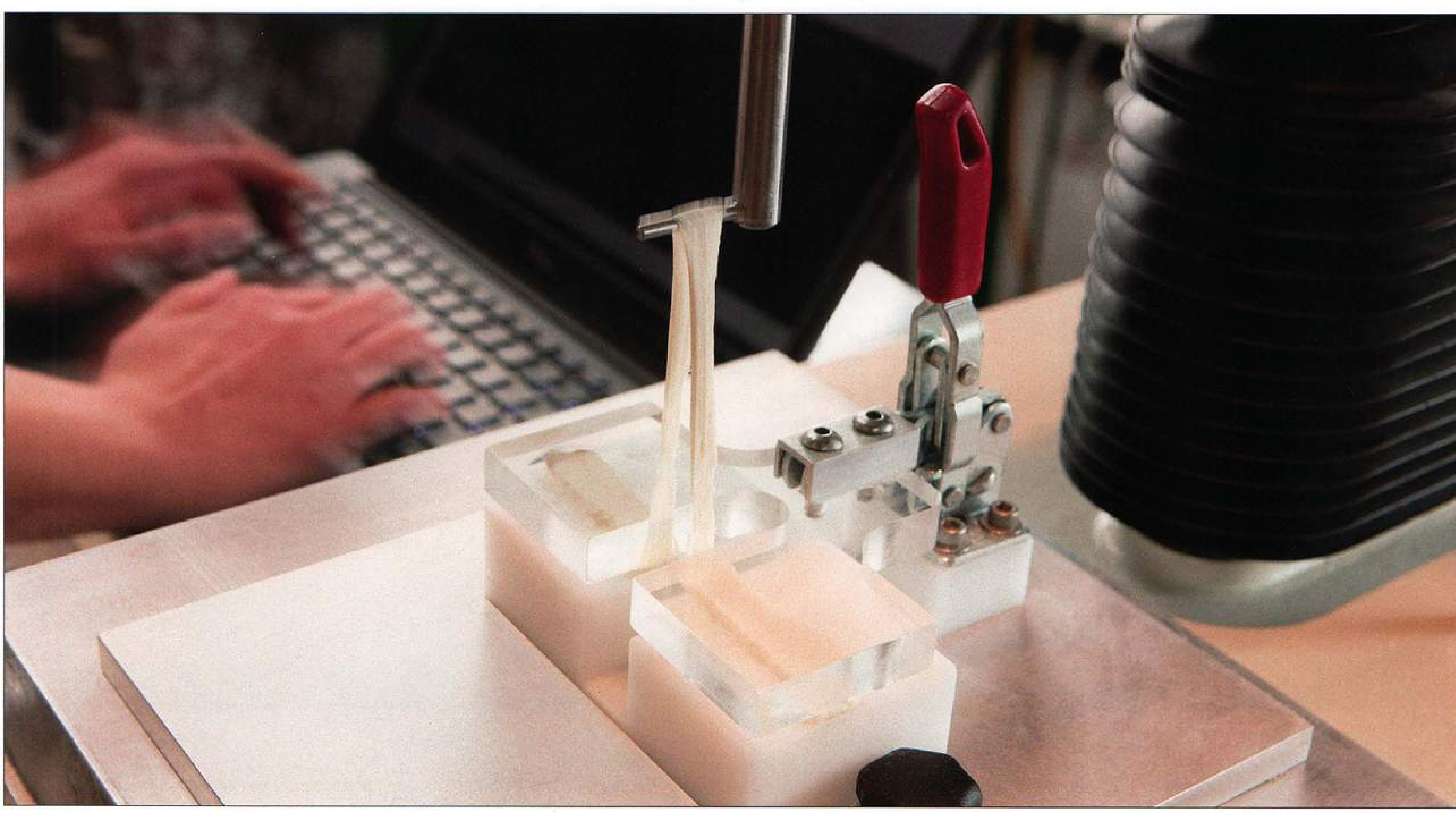
DIASTATIC MALT POWDER AND MALTED BARLEY SYRUP

We initially formulated our thin-crust recipe with diastatic malt powder and malt syrup because many recipes that we found in our research contained those ingredients. During subsequent experimentation, however, we found that their impact was negligible, so we took them out. But our experiments reinforced the usefulness of these ingredients in the browning and crispiness of the New York and artisan pizzas.

POLYDEXTROSE

We achieved the greatest success when adding polydextrose to our Thin-Crust Pizza Dough (see page 110), Brazilian Thin-Crust Pizza Dough (see page 114), and Deep-Dish Pizza Dough (see page 118). The amount of toppings on these tends to make them soggy, but the polydextrose helped keep them crispier (see page 1:329).

We fashioned an extensograph to measure how far dough can be stretched until it breaks, or its extensibility (see page 1:322). The dough's extensibility and resistance to extension give you an idea of the strength of the gluten network as well as how easy it will be to shape.



EXPERIMENT

CROSS-CRUSTING OUR MASTER DOUGHS

There are people who feel strongly that certain dough recipes are required for making specific styles of pizza. In the case of Neapolitan pizza, the AVPN has very strict rules about this (see page 3:43). We wondered what would happen if you used the "wrong" type of dough. We were pretty sure that the pizza wouldn't jump out of the oven, but we wanted to see if we could get good results if we "cross-crusted." The answer is a resounding yes.

When we take a close look at what our master recipes are made up of, it's not hard to imagine that they could be used to make other styles of pizza as well. In some instances, it seems obvious, as with focaccia, which could be used for any pizza baked in a pan. But other substitutions, such as Neapolitan pizza dough used for a deep-dish pizza crust, took us by surprise.

Another surprise for us when we experimented with cross-crusting was how tolerant the doughs were of being baked at alternate temperatures. Our initial thought was that Neapolitan dough was only formulated for high-heat ovens, but it worked at lower temperatures, like those found in home ovens, too. The resulting pizza won't have the characteristic leoparding on the crust and it'll be crispier, but it's still delicious.

Why would you want to do any of this? Because it allows you to make a wider array of pizza styles with one dough (and considerably less effort), whether you own a pizzeria or are entertaining people with a pizza bar.

After mixing and bulk fermenting each master dough, we followed the dividing, shaping, proofing, and baking instructions dictated by the style of pizza the dough was being adapted for. When we substituted the different doughs, we used the amounts of dough, sauce, and toppings that were recommended for the cross-tested master recipe.

We were excited to discover that most of the pizza doughs we tested were able to adapt to the conditions of other pizzas' assembly and baking instructions. For example, all the bread-like pizza doughs were interchangeable with great results. These same doughs were too slack to handle, however, when we tried to use them for medium- or thin-crust pizzas.

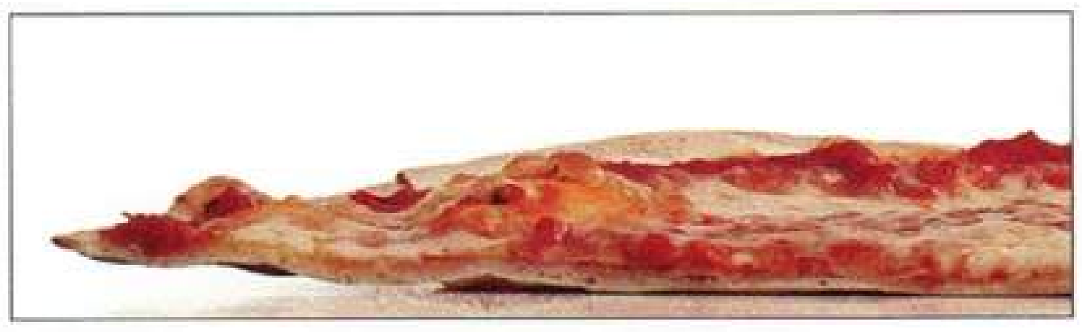
Conversely, when we made our deep-dish and thin-crust pizzas with bread-like doughs, the experiment worked—we got a finished pizza—but it wasn't quite the same. We found that high-hydration dough makes good low-hydration pizzas. We were less surprised to find that the opposite wasn't true and that the Brazilian thin-crust pizza dough made a terrible focaccia.

Of course, if you expect a specific flavor component (our thin-crust and deep-dish masters have cornmeal), then you won't get that flavor when you cross-crust. That said, there are plenty of thin-crust and deep-dish pizza recipes without cornmeal that are also delicious.

You shouldn't get too hung up on using a specific type of dough for a certain pizza style because pizza is pretty forgiving. If you have X pizza dough and you want to make Y style, it's much more possible than you think. We believe strongly in the inventiveness of home chefs and pizzaioli. These cross-crusting combinations encourage your own kinds of pizzas and variations.

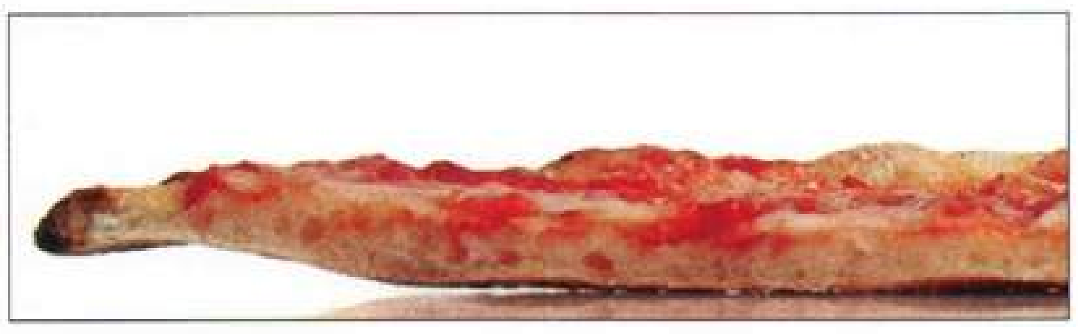
THIN-CRUST PIZZA

RECOMMENDED DOUGH SUBSTITUTIONS



BRAZILIAN THIN-CRUST PIZZA DOUGH
Crust is more cracker-like

DEEP-DISH PIZZA DOUGH
Very similar

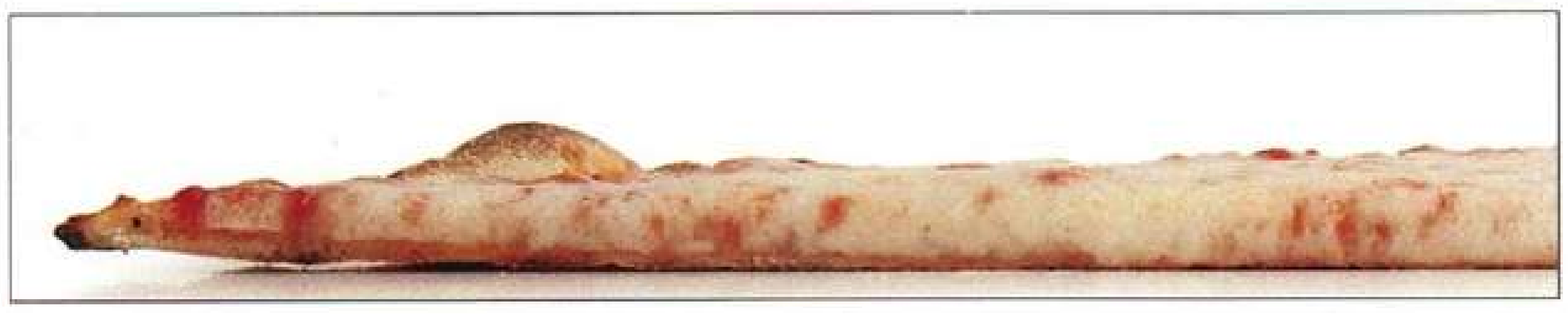


DETROIT-STYLE PIZZA DOUGH
More oven spring; crispy crust with good flavor

BRAZILIAN THIN-CRUST PIZZA

RECOMMENDED DOUGH SUBSTITUTIONS

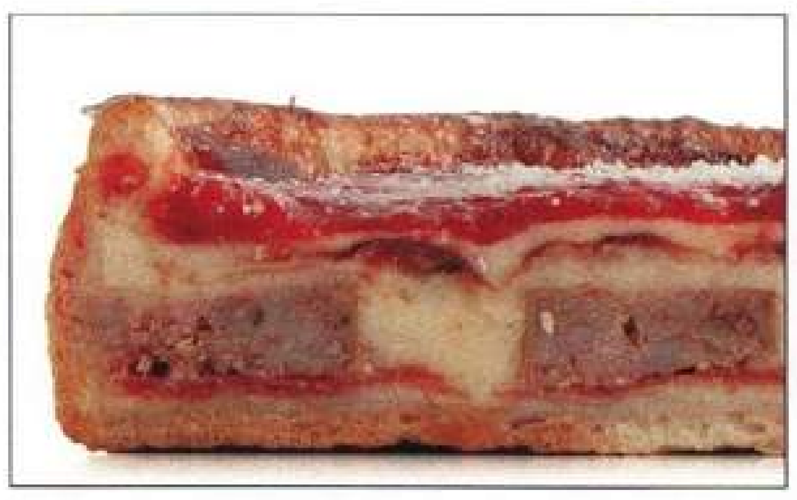
THIN-CRUST PIZZA DOUGH
Slightly denser crust texture but still crunchy; recommend 3 min baking time



DEEP-DISH PIZZA DOUGH
Slightly denser crust texture but still crunchy; recommend 3 min baking time

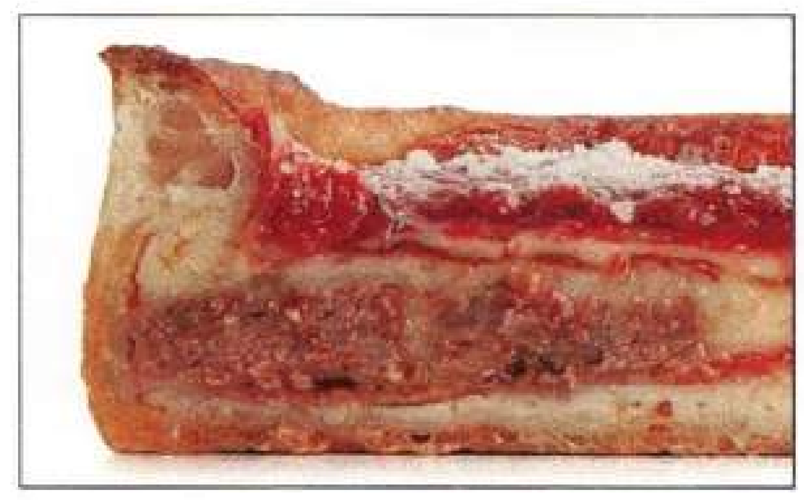
DEEP-DISH PIZZA

RECOMMENDED DOUGH SUBSTITUTIONS



NEAPOLITAN PIZZA DOUGH
Shapes well, especially if the dough is cold; different overall texture

NEW YORK PIZZA DOUGH
Shapes well, especially if the dough is cold; different overall texture



ARTISAN PIZZA DOUGH
Shapes well, especially if the dough is cold; final crust is slightly thinner

THIN-CRUST PIZZA DOUGH
Very similar

NEAPOLITAN PIZZA

RECOMMENDED DOUGH SUBSTITUTIONS

NEW YORK PIZZA DOUGH
Initial crust crispiness with good flavor; softens slightly quicker after baking

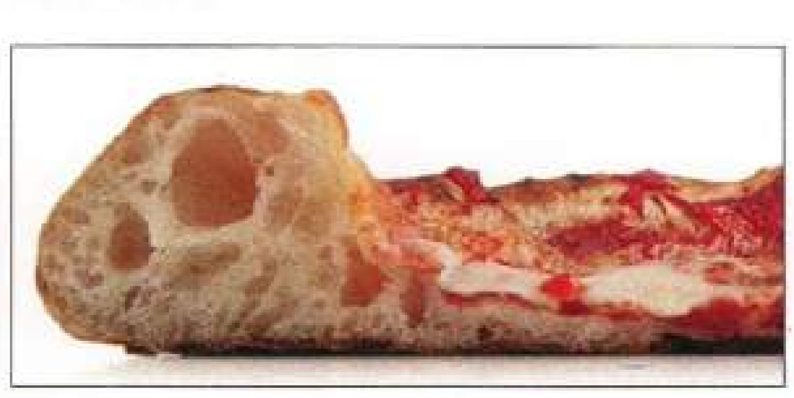
FOCACCIA DOUGH
Initial crust crispiness; softens very quickly after baking; recommended size of 25–27.5 cm / 10–11 in

NEW YORK SQUARE PIZZA DOUGH
Crust crispiness that holds well; recommended size of 25–27.5 cm / 10–11 in

NEW YORK PIZZA

RECOMMENDED DOUGH SUBSTITUTIONS

NEAPOLITAN PIZZA DOUGH
Slightly denser crumb; crunchier crust



ARTISAN PIZZA DOUGH
Very similar; recommend 5½–6 min baking time

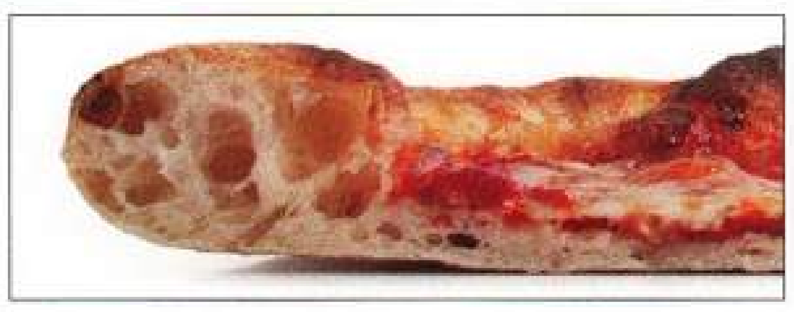
FOCACCIA DOUGH
Crispy crust; recommend 6 min baking time

NEW YORK SQUARE PIZZA DOUGH
Much flakier and crunchier crust; recommend 6 min baking time

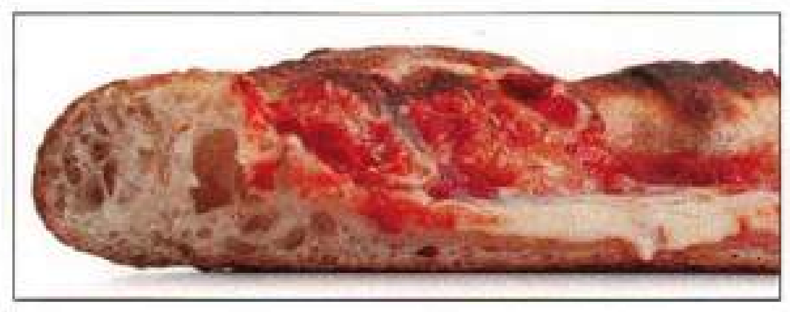
CONTINUED ON PAGE 98

ARTISAN PIZZA

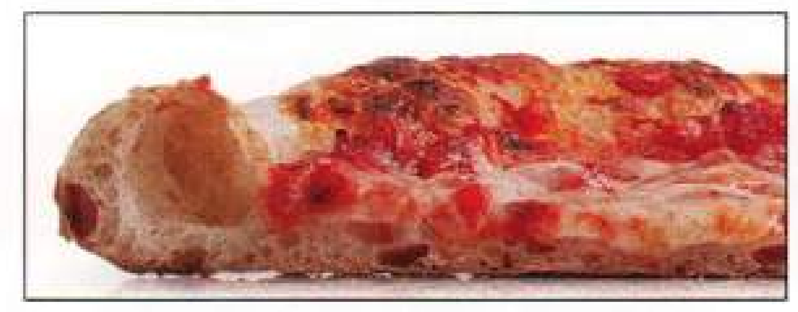
RECOMMENDED DOUGH SUBSTITUTIONS



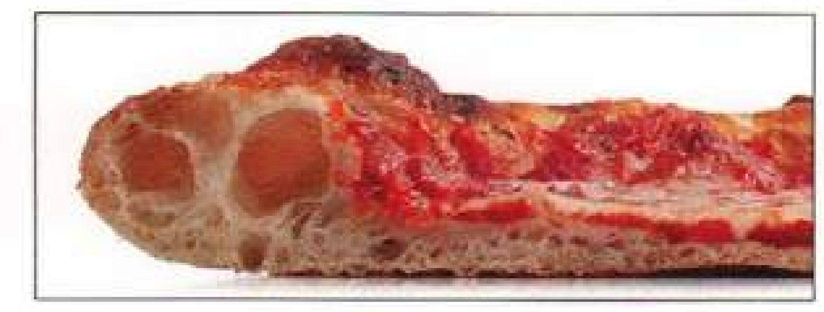
NEAPOLITAN PIZZA DOUGH
Slightly denser crumb; crunchier crust



NEW YORK PIZZA DOUGH
Very similar

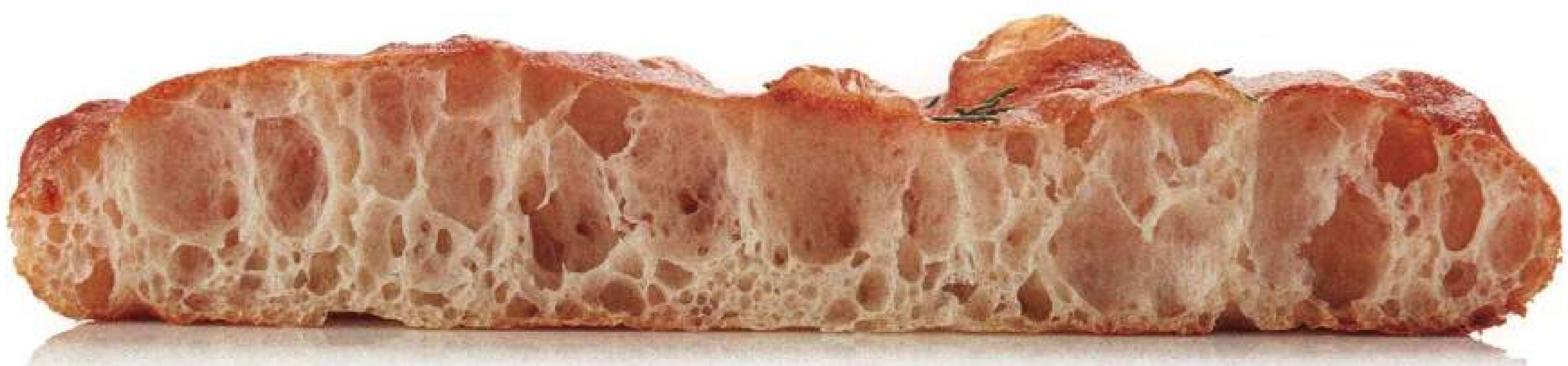


FOCACCIA DOUGH
Crispy crust; tangy sour flavor; recommend 6 min baking time

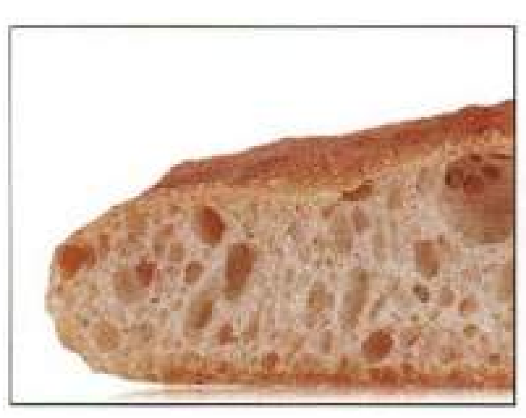


NEW YORK SQUARE PIZZA DOUGH
Much flakier and crunchier crust; recommend 6 min baking time

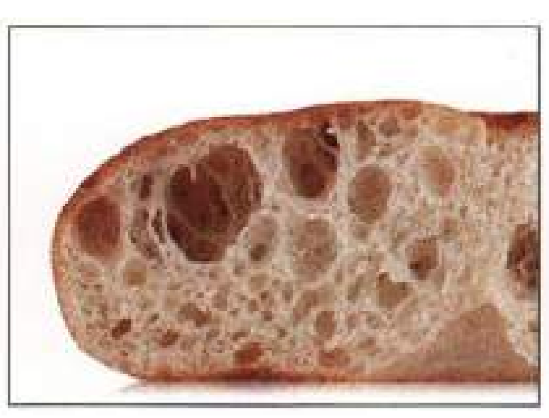
FOCACCIA



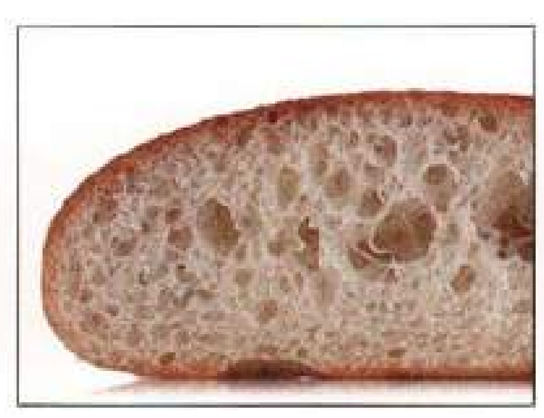
RECOMMENDED DOUGH SUBSTITUTIONS



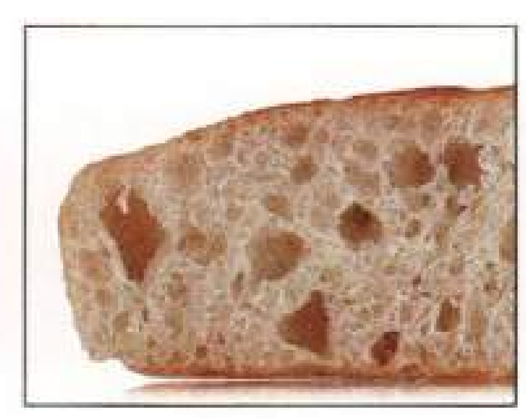
NEAPOLITAN PIZZA DOUGH
Comparable crumb; requires 30 min additional proofing time



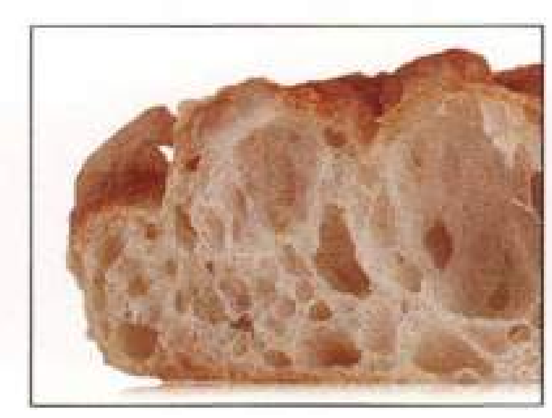
NEW YORK PIZZA DOUGH
Denser crumb, reminiscent of soft bread; recommend 13 min baking time



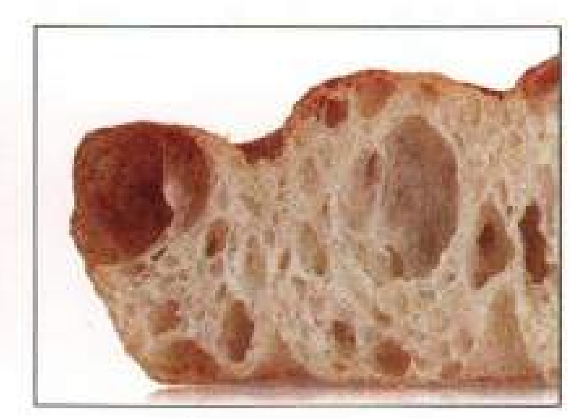
ARTISAN PIZZA DOUGH
Significantly different than focaccia but with pleasant bread texture; recommend 9-12 min of baking time



DETROIT-STYLE PIZZA DOUGH
Similar to restaurant-style focaccia; denser crumb, reminiscent of soft bread

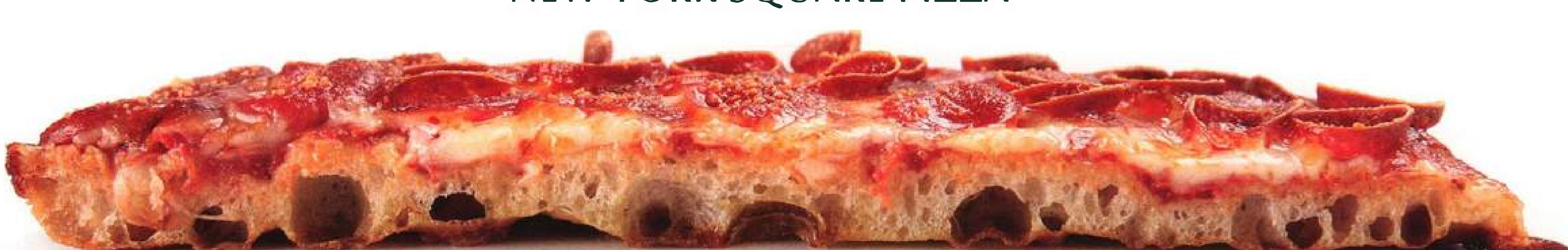


HIGH-HYDRATION AL TAGLIO PIZZA DOUGH
Very similar

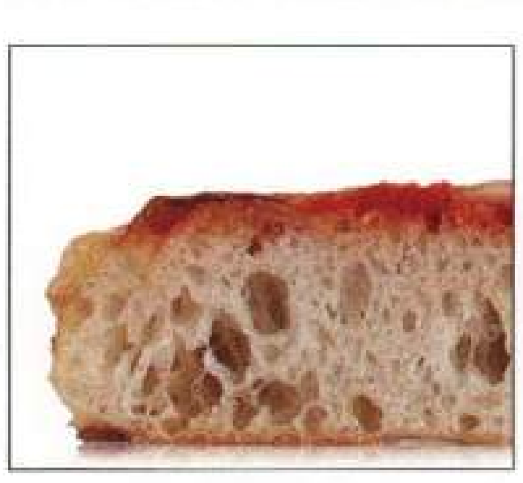


NEW YORK SQUARE PIZZA DOUGH
Slightly denser crumb; crispy crust with good flavor

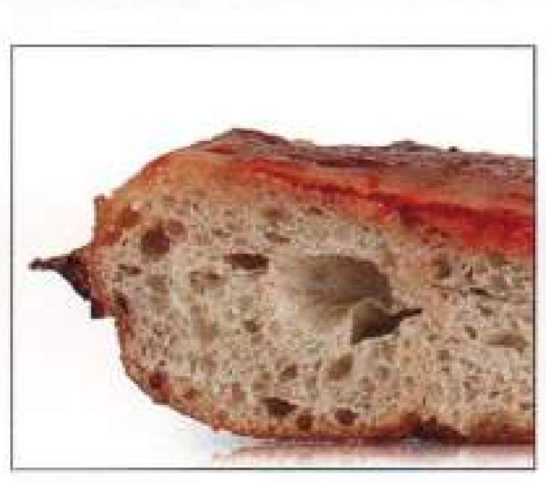
NEW YORK SQUARE PIZZA



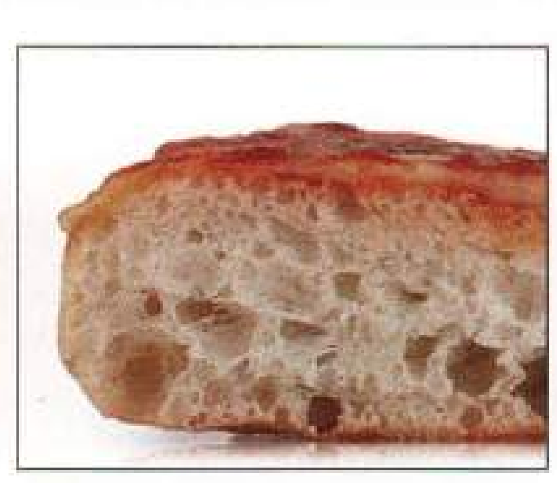
RECOMMENDED DOUGH SUBSTITUTIONS



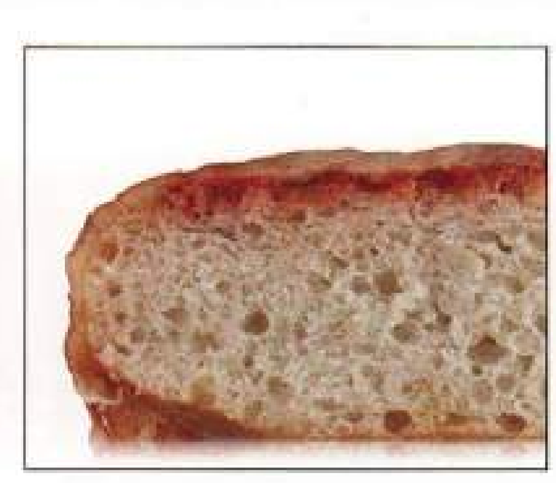
NEAPOLITAN PIZZA DOUGH
Comparable crumb with good flavor; requires 30 min additional proofing time



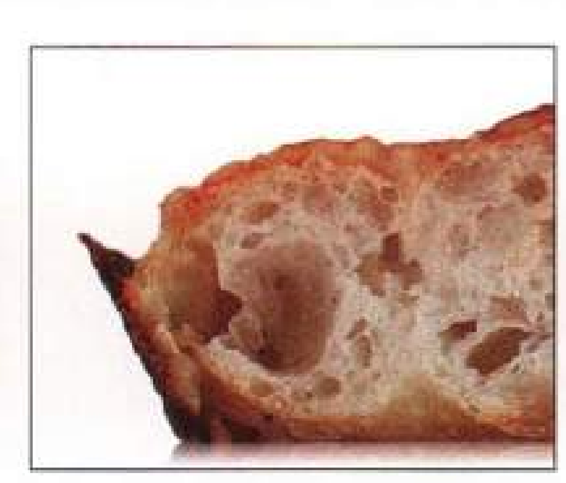
NEW YORK PIZZA DOUGH
Slightly denser crumb; recommend baking on the oven floor for 2 min for a crispy bottom crust



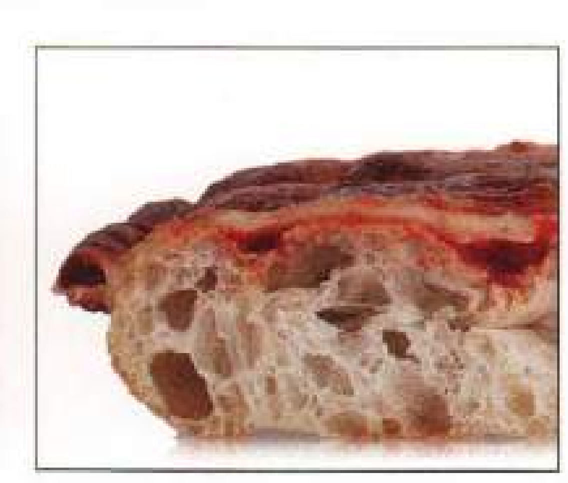
ARTISAN PIZZA DOUGH
Slightly denser crumb; recommend baking on the oven floor for 2 min for a crispy bottom crust



DETROIT-STYLE PIZZA DOUGH
Slightly denser crumb; recommend baking on the oven floor for 2 min for a crispy bottom crust



HIGH-HYDRATION AL TAGLIO PIZZA DOUGH
Very similar; slightly lighter mouthfeel

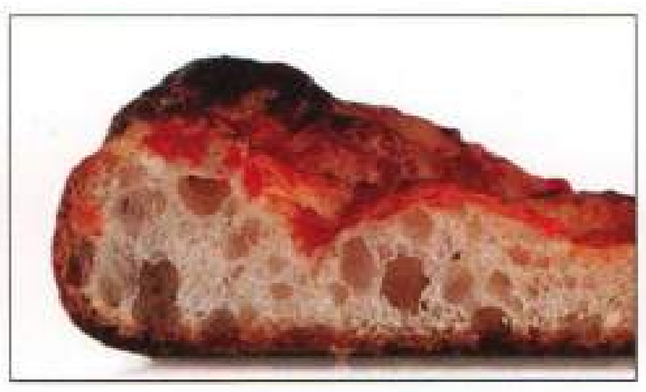


FOCACCIA DOUGH
Very similar

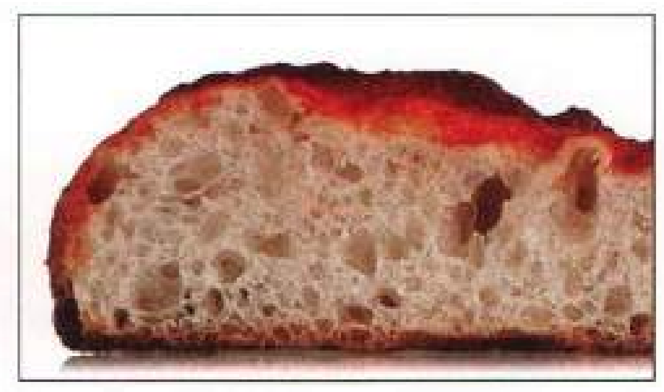
HIGH-HYDRATION AL TAGLIO PIZZA

RECOMMENDED DOUGH SUBSTITUTIONS

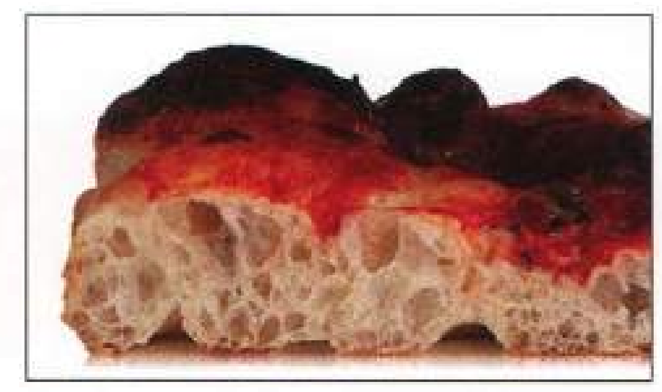
NEW YORK PIZZA DOUGH
Slightly denser crumb; similar crust crispiness; recommend 9 min baking time



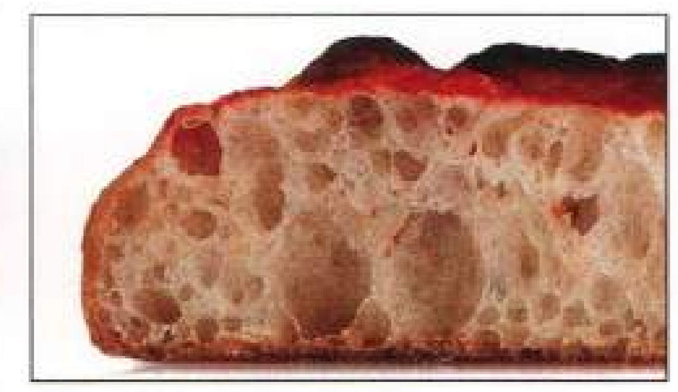
ARTISAN PIZZA DOUGH
Slightly denser crumb; similar crust crispiness; recommend 9 min baking time



DETROIT-STYLE PIZZA DOUGH
Much tighter crumb but with higher volume; crispy bottom crust

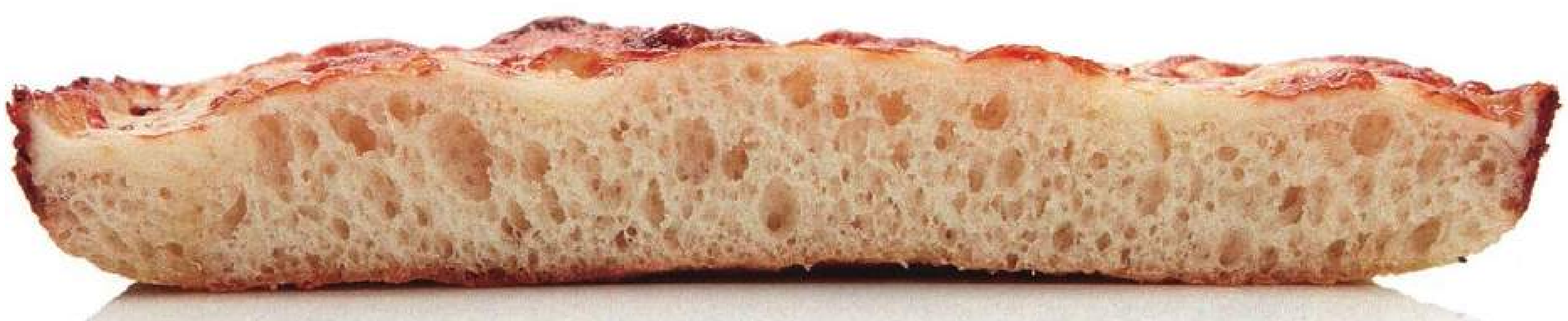


FOCACCIA DOUGH
Very similar; slightly lighter crumb

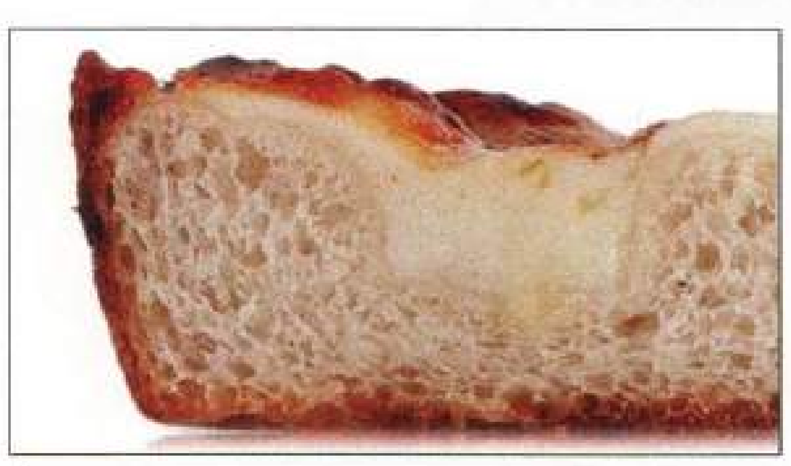


NEW YORK SQUARE PIZZA DOUGH
Slightly denser and chewier crumb; similar crust crispiness

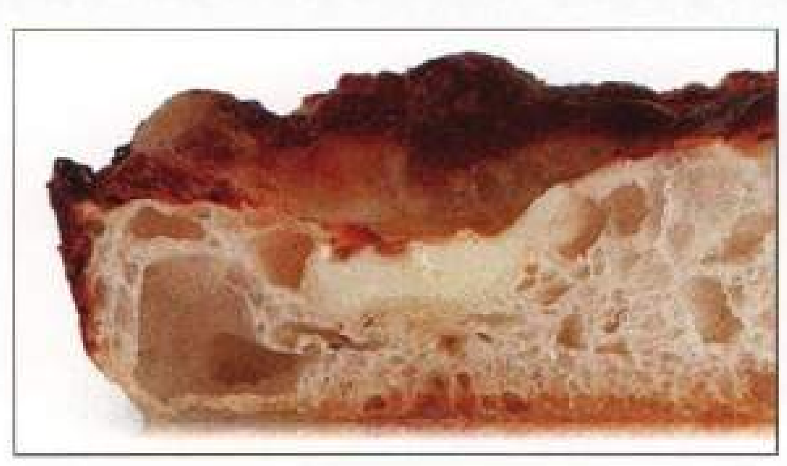
DETROIT-STYLE PIZZA



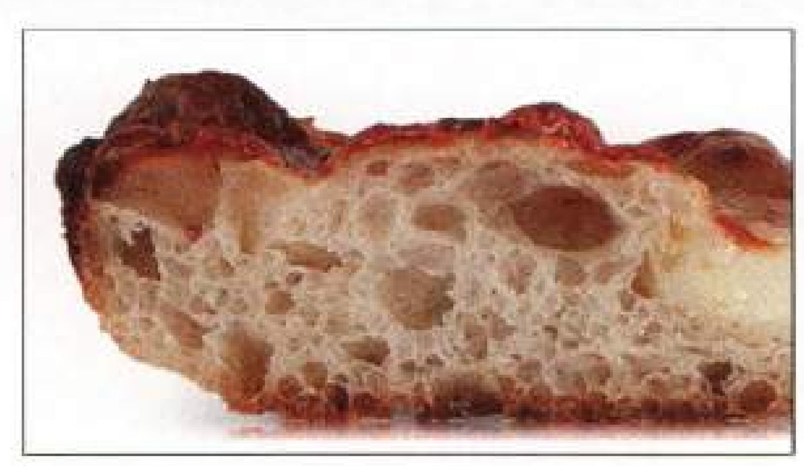
RECOMMENDED DOUGH SUBSTITUTIONS



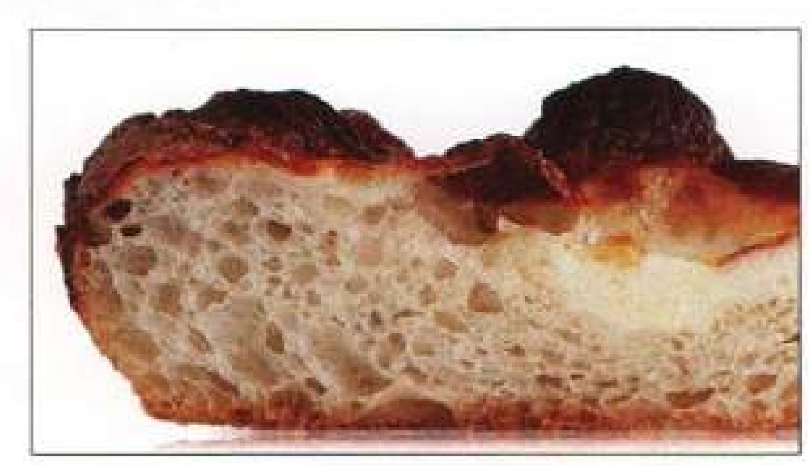
NEW YORK PIZZA DOUGH
Slightly denser crumb; crispy crust with good flavor



HIGH-HYDRATION AL TAGLIO PIZZA DOUGH
Much more open crumb; baked cheese adds crunchiness



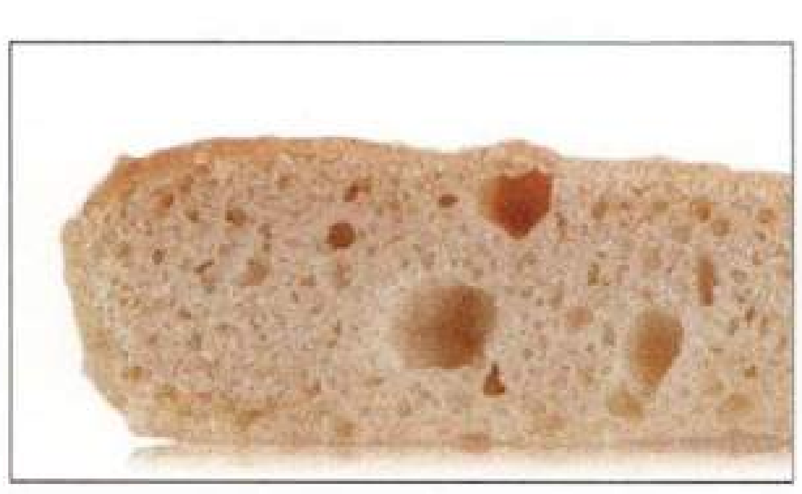
FOCACCIA DOUGH
Much more open crumb; baked cheese adds crunchiness



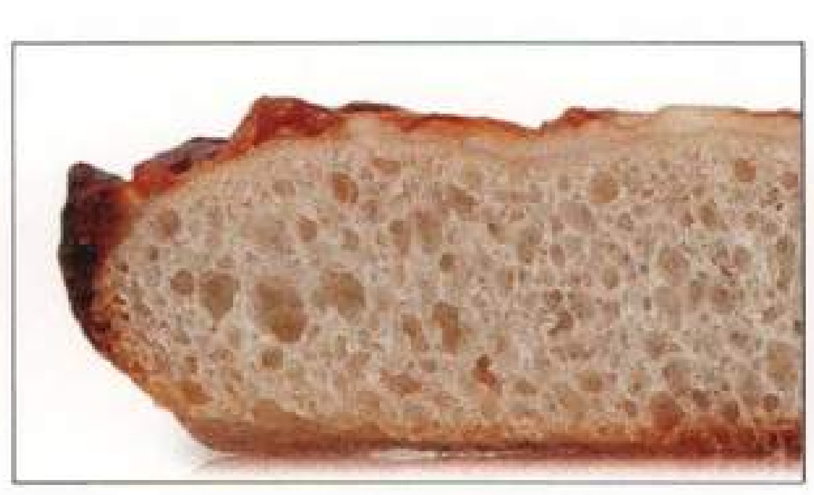
NEW YORK SQUARE PIZZA DOUGH
Much more open crumb; baked cheese adds crunchiness

THE FAILURES

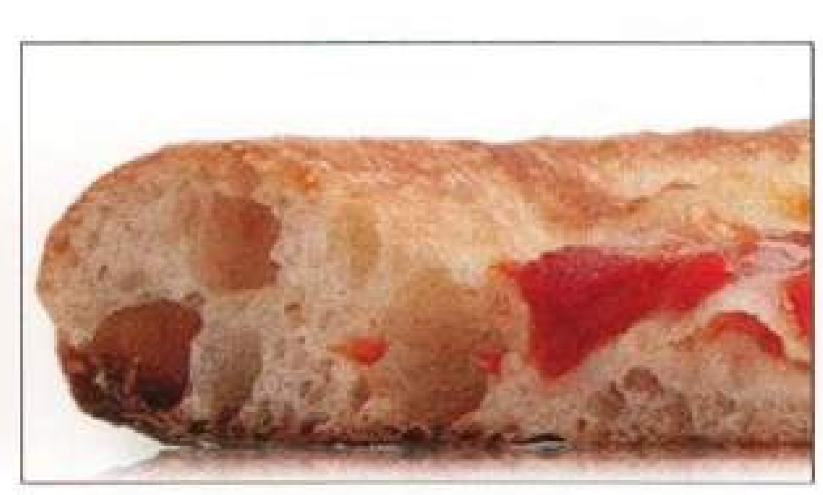
Not all of our experiments in cross-crusting were successful. The low hydration of the Brazilian thin-crust pizza dough creates a dense, pale, dry crust when it's baked as a focaccia. When we baked Neapolitan pizza dough as a Detroit-style pizza, the flavor was decent but it deflated when it came out of the oven, which produced a dense, chewy crust. Our Detroit-style pizza dough works well to shape as a New York pizza, but the texture of the crust is overly crunchy and a bit dense. The high hydration of the high-hydration al taglio pizza dough creates a Neapolitan pizza with a slightly gummy rim crust and excessive leoparding.



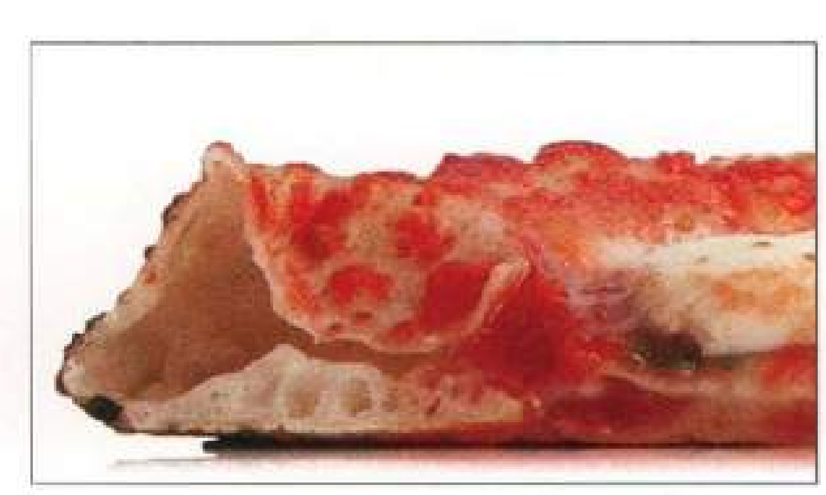
FOCACCIA BAKED WITH BRAZILIAN THIN-CRUST PIZZA DOUGH



DETROIT-STYLE PIZZA BAKED WITH NEAPOLITAN PIZZA DOUGH



NEW YORK PIZZA BAKED WITH DETROIT-STYLE PIZZA DOUGH



NEAPOLITAN PIZZA BAKED WITH HIGH-HYDRATION AL TAGLIO PIZZA DOUGH

We developed a method using pregelatinized starch that allows us to make a high-hydration Neapolitan pizza (see page 127). Its rim crust is similar to the canotto-style pizzas that we found in Italy during our pizza travels.

Direct doughs don't contain a preferment (typically they contain just flour, water, salt, and yeast). Although the flavor of a direct dough isn't as developed as that of a dough with a preferment, it is much faster to make.

OUR VARIATIONS

For each of the pizza categories, we have developed a set of variations that alter the ingredients and/or dough preparation techniques found in the master recipes. Though these variations are tailored to each particular pizza dough, their purpose in flavor and technique is largely the same, so we include an overview of each of them here. You'll find the Modernist, Direct, and Emergency variations grouped with most of the master types of dough. The other recipes are grouped by variation after the master doughs (see page 172).

MODERNIST

The goal of the majority of these recipes was to make a dough that is easy to stretch, roll out, or shape in the pan so that the dough stays in place, particularly in the corners where you want a sharp angle. We accomplished this by adding a minuscule amount of dough relaxer (although we don't have dough relaxers in every Modernist dough). We add the relaxer with either the water or the flour in the recipe, depending on whether the relaxer is fruit juice (pineapple, kiwi, or papaya, each of which contains an enzyme that breaks down proteins) or bromelain, papain, or meat tenderizer, the powdered versions of those enzymes. In the initial testing, we found that adding the dough relaxer sometimes yielded a less crispy crust, so we compensated by adding diastatic malt powder and/or polydextrose, depending on the recipe, to restore that crunchiness. We also added a little pectin to several of the master recipes to increase the volume of the dough. Of note is that our master Neapolitan pizza dough contains a dough relaxer. We liked the result so much that we made the Modernist variation into the master recipe and then created a Modernist Neapolitan pizza dough that allows you to achieve higher hydration than the master recipe (see page 127).

DIRECT

If you want your pizza and you want it now (or, rather, today), this is your recipe. There is no preferment and no long bulk ferment or cold-proofing. Some of our master recipes are direct to begin with, like Neapolitan and Detroit-style, but many of them contain some form of preferment. Mix the ingredients to full gluten development, give the dough a short bench rest to relax the gluten, then divide, shape, and proof at room temperature, and you're ready to make pizza. You can, if you like, also cold-proof this dough for 1–2 days to yield even better baking and texture results.

EMERGENCY PIZZA DOUGH

These doughs aim to give you a dough even faster than the Direct variations of some of the master recipes. We typically achieve this by increasing the amount of yeast, mixing the dough with warmer water, and decreasing the proofing times (other time-saving tips can be found on pages 16–17). You will lose some complexity of flavor, volume, and texture when compared to the master recipes, but you will still end up with a delicious pizza if you find yourself short on time.

LEVAIN RAISED

This crust is for fans of sourdough. The technique is exactly the same as for the master recipes, except that you substitute mature liquid levain for the leavener(s) used and adjust the flour and water amounts in the dough to account for the flour and water in the levain. If you're making your levain from scratch (that is, if you don't already have it on hand), it'll take at least 5 days to get it up and running, so plan accordingly. This variation produces a crust with great depth of flavor that presents well even when loaded with toppings.

SECOND CHANCE

One of the great discoveries from *Modernist Bread* was that you can make use of leftover liquid levain that either is overripe or has been frozen for several weeks and then thawed. Either way, the levain is inactive, having lost all its leavening power since the yeast is dead. What it hasn't lost is its ability to deliver wonderful flavor. Our Second Chance versions yield a great-tasting sourdough crust by adding the inactive liquid levain along with instant dry yeast (from 0.43% to 0.81%, depending on the pizza type) to compensate for the leavening power the levain no longer has.

COMPLEAT WHEAT

Compleat wheat delivers great whole wheat flavor without the dense crumb. We re-create whole wheat flour using bread flour as the foundation and then adding hydrated toasted wheat germ and bran as inclusions to the dough. We mix them in when the dough achieves medium gluten development because they would be very difficult to incorporate when the dough is at full gluten development (and adding them at the beginning of the mix would compromise the strength and structure of the dough). The dough is bulk fermented, and a series of folds is performed so that the dough reaches full gluten development without the stress of the mixer.

GRAIN, NUT, AND SEED INCLUSIONS

If you're adding grains to the dough, you can soak them, sprout them, or cook them into a porridge or puree before mixing them in. Seeds can be left whole (though some benefit from soaking), but most nuts should be chopped, otherwise they can damage the dough when they are mixed in or during shaping. The flavor of seeds and nuts can be enhanced by toasting, which is why we highly recommend it. As is the case with the Compleat Wheat and Ancient Grain variations, the inclusions are added after you've mixed the dough to medium gluten development; the dough is then bulk fermented, and folds are performed until it achieves full gluten development.

COUNTRY STYLE

This variation aims to get the taste of rye and whole wheat into the crust of each category of pizza, and we've varied the type and quantity of rye flour (light, medium, or dark) for a range of flavor. The recipes call for T85 flour, which contains a bit less wheat bran and germ than regular whole wheat flour, producing a more open-crumbed pizza that is light in texture but still has the flavor of whole wheat. If you can't find T85 flour, regular whole wheat flour is fine.

Bran and germ typically cause a decrease in volume in both pizza and bread. The compleat wheat technique that we developed (see page 42) allows you to include both components and still get a light, airy rim crust.

You can put virtually any combination of grains, nuts, or seeds into your pizza dough (see page 1:331). We don't recommend using this type of inclusion for a thin-crust dough, however, because the size of the inclusions will cause the dough to rip during shaping.

ANCIENT GRAIN

We use a 60%/40% blend of bread flour and ancient grain flour (spelt, Khorasan, emmer, einkorn, and/or buckwheat in different combinations) so the flavor of the grains comes through without sacrificing the volume of the crumb. The thin-crust version needed a bit of help to maintain its structure, so we use a high-gluten bread flour. To amp up the grain flavor in all but the thin-crust, we also add a soaked grain as an inclusion. You can use essentially any blend of ancient grain flours, so long as you don't exceed the recommended 40% amount.

NO-KNEAD

In these variations, time, not mixing, is what accomplishes the gluten development. The ingredients get stirred together just until homogeneous, and the dough is bulk fermented for 12–18 hours at room temperature. Because of this long ferment, the amount of yeast is cut back significantly to prevent overproofing. Dividing and shaping redistributes the gas produced during the fermentation process, redistributes the food for the yeast, and evens out the temperature of the dough. A final proof of several hours allows the dough to regenerate the gas bubbles as well as to develop flavor. This method is not recommended for our pan-baked pizzas since it doesn't get the dough as strong as we would like, and we had to degas it too much in order to get the dough to fill the pan.

YOUR DAILY PIZZA

Based on the technique found in *The New Artisan Bread in Five Minutes a Day*, we developed recipes and a method specifically for pizza dough. Our tests ultimately produced a dough that will allow you to make a Neapolitan, thin-crust, or deep-dish pizza

every day for 14 days, or an artisan or New York pizza every day for 10 days. This dough is mixed only to a homogeneous mass to avoid overdeveloping the gluten. It also contains considerably less yeast than the master recipes, again to prevent overproofing. Since you're starting with less yeast, you jump-start its activity by letting the dough bulk ferment for an hour before putting it in refrigeration. You will have to wait at least 23 hours before making that first pizza to be sure the dough is at full gluten development. For each pizza, pull off just enough dough for a crust, then shape it and proof for 3–4 hours before baking.

Because of the long refrigeration time, there are several additions to the ingredients. The first is ascorbic acid, which counteracts the discoloration (oxidation) that would naturally occur without it. The other is polydextrose (in some cases) and one or a combination of the following: diastatic malt powder, sugar, and/or malted barley syrup. These provide the yeast with enough fuel to sustain it for 10–14 days.

This method does not work for bread-like pizzas because the dough loses too much volume when gathered from the tub and extended in the pan. The yeast simply had too high of a mountain to climb after that many days, and in our tests the crust never developed good volume, color, or flavor.

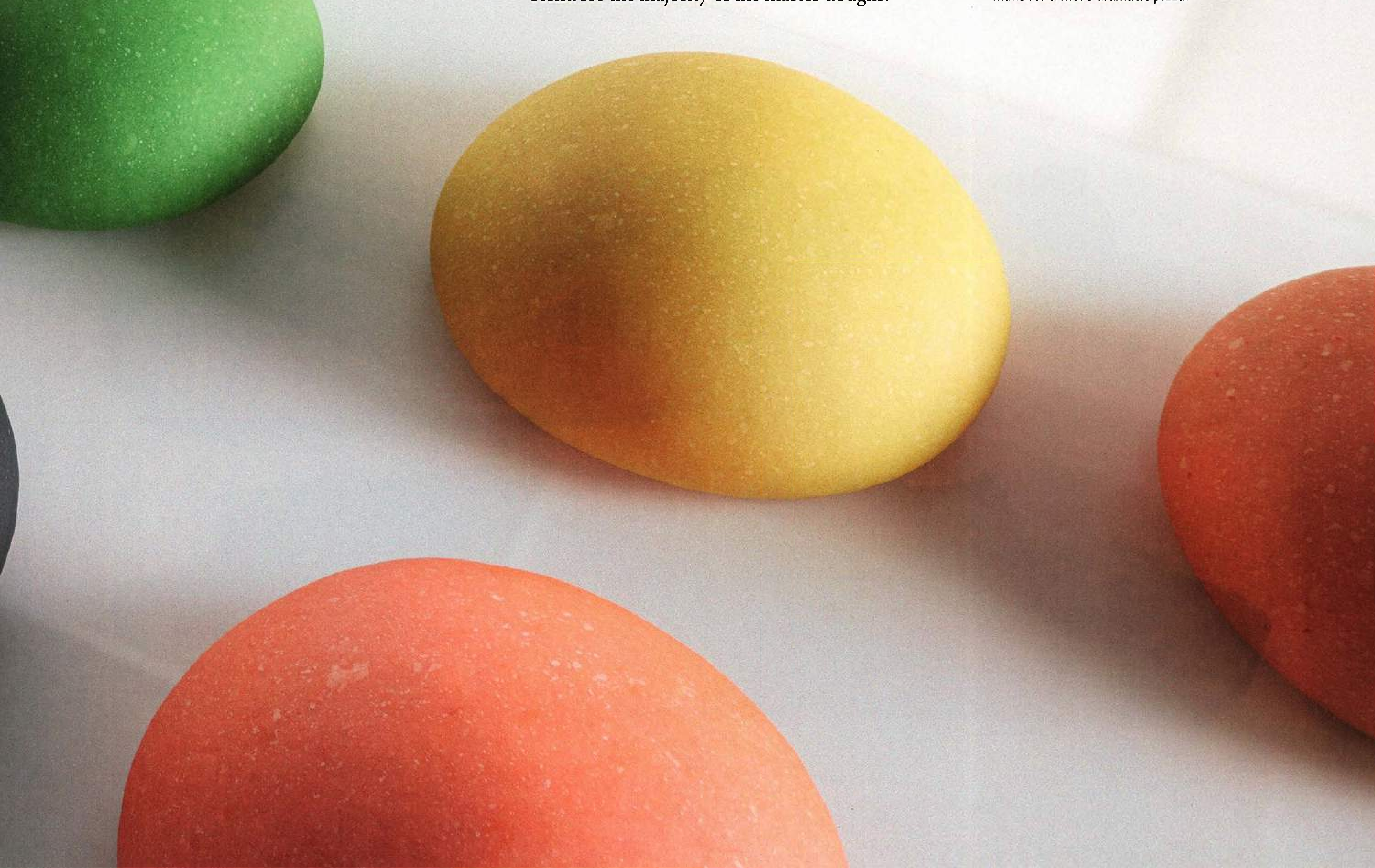
FLAVOR VARIATIONS

In addition to all these variations, you will find others for each type of pizza dough that swap a puree for some or all of the water in the recipe. Feel free to experiment with other purees or sauces of similar hydration, or with similar ingredients, like red onions instead of shallots or different types of peppers instead of poblanos. Just take care to keep the level of hydration the same to ensure proper baking results. We provide additional information on making purees on page 1:339 and on mixing purees into doughs on page 41.

GLUTEN-FREE PIZZA DOUGHS

Our gluten-free pizza doughs provide options for a multitude of styles, including Neapolitan. We recommend using our Gluten-Free Flour Blend on page 199 for each of the recipes except the Gluten-Free Pan Pizza Dough (see page 197), which has its own blend. We also offer variations with the commercially available Caputo Fiore Glut gluten-free flour blend for the majority of the master doughs.

The sky is the limit when it comes to flavoring your doughs with purees. The ones shown below include pesto, pumpkin, ube, spinach, huitlacoche, tomato, and chipotles in adobo. If you want to create a deeper hue in your dough, you can add some food coloring to make for a more dramatic pizza.



EXPERIMENT

GLUTEN-FREE PIZZA TESTING

For people diagnosed with celiac disease, keeping a strict gluten-free diet is a lifelong necessity. Many professionals in the baking industry have given their best effort to create successful versions of gluten-free breads and pizza. Of all the foods to be adapted into gluten-free versions, bread and pizza are by far the most difficult. After all, gluten is the critical component that allows the dough to trap gas effectively and gives the crumb its texture.

In order to create a gluten-free pizza recipe, we swapped the simplicity of the classic four-ingredient pizza dough for a dough containing various flours and added agents that would maintain an elastic structure during baking. We based our gluten-free pizza doughs on the gluten-free flour blend from *Modernist Bread,* which was formulated to have seven required ingredients: white, brown, and glutinous rice flours; cornstarch; tapioca starch; nonfat milk powder; and xanthan gum. The glutinous rice flour plays a major role in our baking success. When hydrated in doughs and baked, it retains a particular chewiness that is reminiscent of gluten. Xanthan gum, a thickener, is another important addition because it absorbs water and makes the mixture more viscous. Nonfat milk powder adds a bit of sweetness to gluten-free bread but, more importantly, the lactose it contains helps the pizza brown better during baking via the Maillard reaction (see page 393). Transglutaminase is optional in the recipe. This ingredient is typically used as a "meat glue" to bind meat proteins together. We found that it also binds the proteins in this flour blend to create a bread with noticeable chew and a consistency similar to wheat bread.

Although our gluten-free pizza doughs include a flour preparation step, many of them are ultimately faster than their master counterparts since all the gluten-free doughs are direct. The doughs are mixed to a homogeneous mass, bulk fermented, and then proofed to develop the flavor. Given the fact that the proofing is not done for gluten development, no folds are required.

The hydration levels and the dough weights were adjusted on a case-by-case basis. For example, our Gluten-Free Neapolitan Pizza Dough (see page 195) has a slightly lower hydration than the master (60%) but also includes 2% extra-virgin olive oil. The dough weight was increased to 300 g, and the dough was cold-proofed for 24 hours. The resulting pizza, although slightly denser than the traditional version, had good chewiness and a slight crispiness in the crust. We were even able to achieve some leoparding, the dark spots on the crust often regarded as an authentic Neapolitan attribute. For some of the larger diameter pizzas, such as New York gluten-free pizza, we also suggest baking in a 35 cm / 14 in round pan or on parchment paper because it helps maintain the structure of the pizzas.

Among bread-like pizzas, the Detroit-style gluten-free pizza was very flavorful and could probably fool someone into thinking that it wasn't gluten-free. It is surrounded by crispy cheese, which can't hurt, but it also has good crumb texture and a nice crunchiness from the bottom crust. After quite a number of failures trying to formulate a solid recipe for gluten-free focaccia, high-hydration al taglio, and New York square pizzas, we were inspired by a recipe containing psyllium husk in *Meyers Glutenfri Bageskole* by Meyers Madhus. We finally accomplished crispy pizza with the right amount of chew, and the flavor was heightened in the focaccia with the addition of rosemary and Parmesan.

We also explored several brands of commercial gluten-free mixes and tested gluten-free recipes from books. Common issues that we found were no rise in the rim and an off-flavor or chewiness. The Caputo Fiore Glut gluten-free flour blend yielded the best results of the brands we tried. In summary, all of the master pizza doughs can be made gluten-free based on the recipes in this book. But if we were to select the most adaptable to gluten-free, we'd advise you to go with thin-crust, Brazilian thin-crust, deep-dish, and Detroit-style.

Our Gluten-Free Detroit-Style Pizza Dough on page 198 (see bottom photo) produces a pizza that is slightly denser than our master Detroit-Style Pizza Dough on page 166 (see top photo). The gluten-free pizza has substantial volume, however, and a crunchy bottom crust that delivers a satisfying result.

WHEN YOU'RE IN A HURRY

It can happen to anyone. You forgot an ingredient in the dough or didn't weigh the dough ingredients accurately. You have run out of dough during a busy service. Your fridge broke down and your dough overproofed beyond rescue (see Dough CPR on page 77). You have guests coming tonight, but you misread the recipe and realize now that it needs to be made 48 hours ahead. You have a last-minute catering event and they want pizza. What can you do?

Our emergency doughs take 2–3 hours to make from start to finish. We have also listed a few shortcuts that you can take to have a dough ready to bake in a few hours (these shortcuts can all be used in combination at once). The caveat is that for any shortcut you take, there is a price to pay. You won't have as developed a flavor, and the color of the pizza might not be as deep once it is baked. The aroma of the pizza is also typically diminished. Doughs made in a hurry are not an exact substitute for the master recipes, but you will at least have an acceptable and passable version of the different styles of pizza, which is better than nothing at all.

Here are a few shortcuts you can take:

- Add 0.8–1% instant dry yeast to your recipe and you will have a dough that is ready in 2–3 hours.
- Mix the dough with water that is between 27 and 32°C / 80 and 90°F. The warmer water will help the yeast start fermenting faster. You can do this in combination with adding extra instant dry yeast.
- In some instances, as in high-hydration doughs, we recommend mixing the dough to medium gluten development because it helps maintain an open crumb while the pizzas bake. But if you are in a hurry, you can mix these doughs to full gluten development on high speed and reduce bulk fermentation time to 30 minutes to relax the dough for a little bit before you divide it and shape it.
- Proof the dough in a warm area (well covered or with humidity control).
- Use a dough relaxer (see page 1:327). Doughs that have such little time to relax after being mixed, divided, and proofed will be difficult to stretch properly.

COMMON DOUGH PROBLEMS

We discuss several tips and tricks to avoid these pitfalls in the Making Pizza Dough chapter beginning on page 3, but below is a snapshot of the most common dough problems and ways to troubleshoot them.

THE DOUGH IS OVERPROOFED

SOLUTION

- You can salvage the dough using the CPR method on page 77. The basic steps of the method are to degas and reshape the dough (see photos below).

THE DOUGH IS TOO STICKY

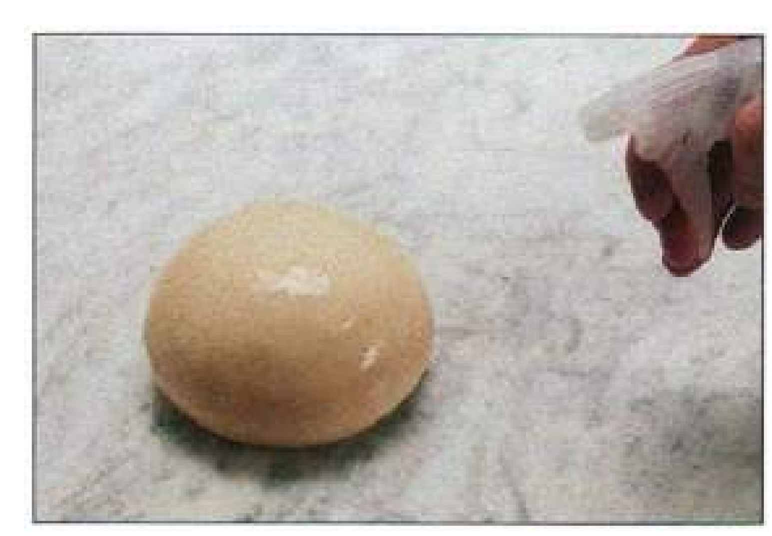
SOLUTION

- Chill the dough during bulk fermentation. Cold doughs are firmer and easier to handle. It will slow down fermentation, so be sure to make up for this time after shaping the dough.
- Oil your work surface. This is not desirable for some doughs, like Neapolitan, since they aren't supposed to be coated in oil, but it is perfectly fine for high-hydration al taglio, focaccia, New York square, and Detroit-style doughs.
- Use a large plaster knife to move the dough around and to form round dough balls without using your hands (see photos at right and on page 63).

THE DOUGH HAS DRIED ON THE SURFACE

SOLUTION

- This happens mostly with dough that has already been shaped, especially dough shaped into a ball. You will be able to tell because it will feel rough and dry on the surface instead of tacky and wet. Before you trim that dry part off, try misting the dried surface with water, covering it with plastic wrap, and waiting a few minutes for the water to become absorbed by the dough (see photos at right); alternatively, cover the dough with a slightly damp paper or cloth towel. This doesn't typically happen with doughs that are pan baked since they are often coated in oil.

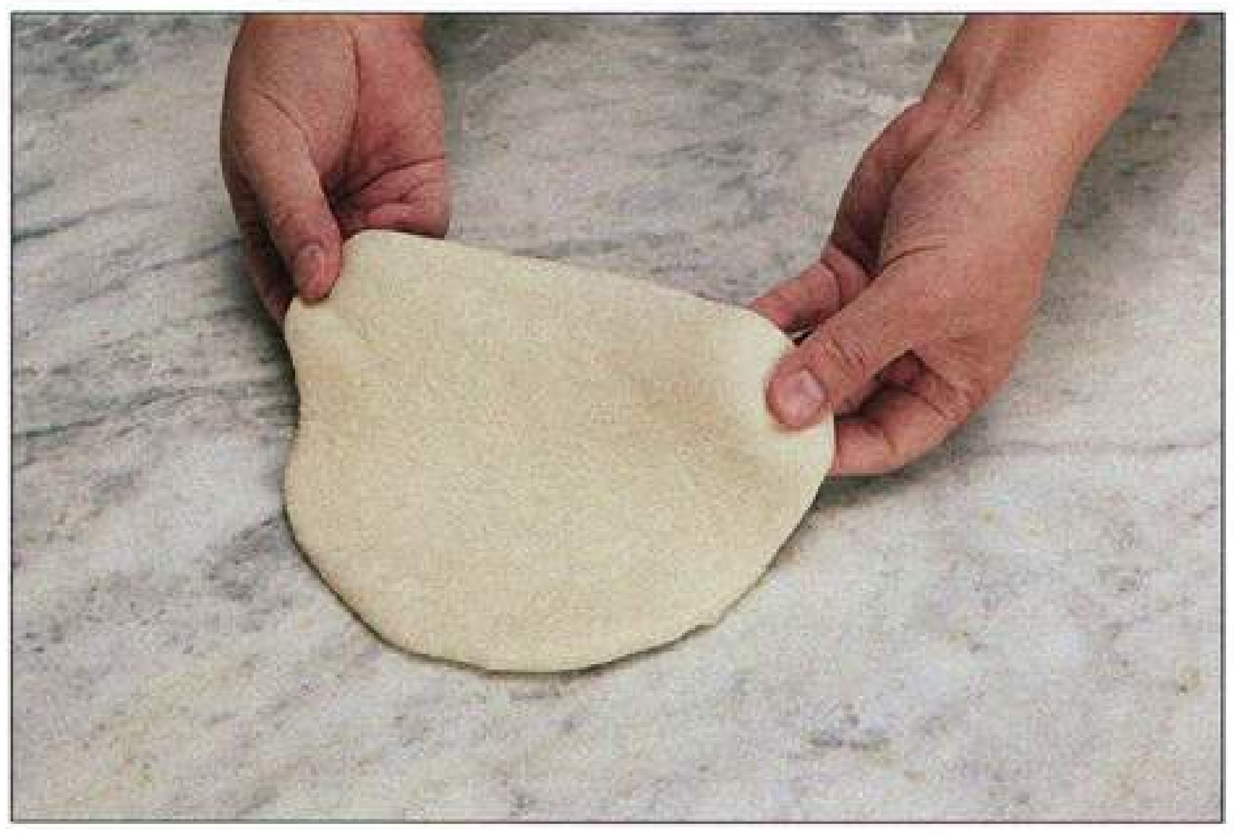


THE DOUGH HAS BLACK SPECKS

SOLUTION

- This usually happens with doughs that are cold-proofed for long periods of time, and it means the dough is oxidizing. It doesn't mean there is anything wrong with the dough itself (see page 72). Shape it and bake it as instructed in the recipe and those black specks will disappear after the dough is baked.

THE DOUGH IS HARD TO STRETCH



SOLUTION

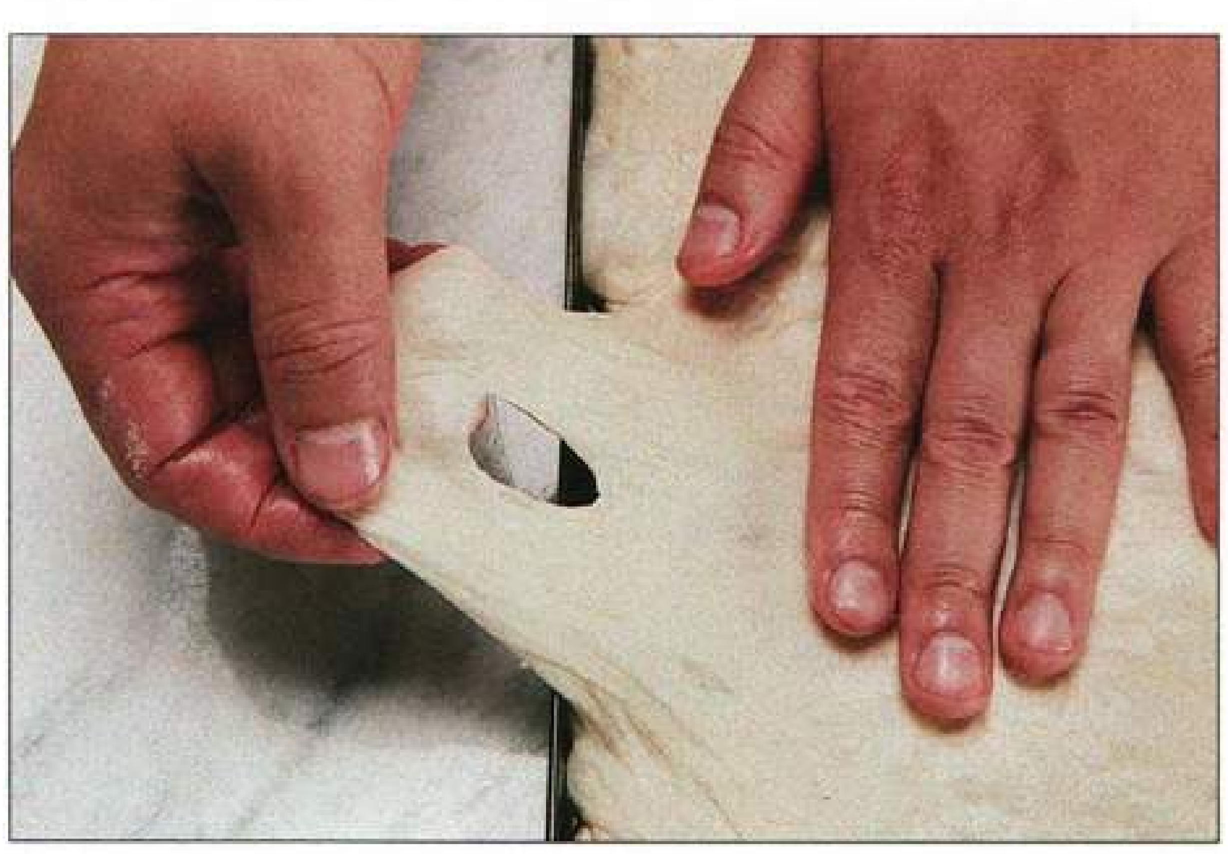
- The dough might be very low in hydration. If this is the case, using a rolling pin or sheeter to shape the dough is easier than trying to do it by hand.
- The dough may be very strong and just needs time to relax. We experience this with most of the doughs that are extended into a pan, such as high-hydration al taglio, focaccia, and Detroit-style doughs. Your best course of action is to try to extend the dough as much as possible without tearing it, and then let it rest for 20–30 minutes, well covered or in a proofer. Then try again. It might be possible that you will need to do this more than once depending on how tense or firm the dough is. You can also use one of the dough relaxers we recommend in the Modernist versions of the majority of the styles of pizza.

THE DOUGH IS NOT REACHING FULL GLUTEN DEVELOPMENT IN THE MIXER

SOLUTION

- The dough is high in hydration. If this is the case, mix on the highest speed. It will eventually get to full gluten development. Alternatively, take the dough off the mixer and develop it via bulk fermentation, performing a series of folds until the dough reaches the desired gluten development.
- There isn't enough dough in the mixer for the hook to "catch" the dough. Increase the yield of the recipe until there is enough dough in the mixer. We have dough quantity recommendations for each bowl size in the machine mixing options sections of each master recipe. Alternatively, start mixing with a paddle attachment and switch to a hook attachment once the dough has become cohesive to finish mixing it.

THE DOUGH IS TEARING (NOT STRETCHING)



SOLUTION

- Your dough may not have reached the desired gluten development yet. Mix it for longer until it does stretch. If it is already off the mixer and bulk fermenting, continue to perform folds until it develops to the point of stretching and not tearing.
- The dough is very dry (low in hydration). Mix at a lower speed or by hand. In extreme cases (say, the amount of water was incorrectly scaled), add more water to the dough while mixing on low speed until it is absorbed and the dough no longer tears.
- If the dough is tearing in the pan, it's because you are pulling too hard and the dough isn't cooperating. If you have made a tear in the dough, simply tuck it under itself as shown. Let the dough relax for at least 15–20 minutes before you try to stretch it again.

WHAT DOUGH TO PICK?

It can be difficult to tell what dough will suit you best or which type of dough best matches your skill level. If you aren't sure where to begin, here is a cheat sheet you can use to get an idea of what recipe to choose.

I'M NEW TO DOUGH

Who this is for: you've never made any kind of dough or have practiced a certain style very little.

- Thin-Crust Pizza Dough (see page 110)
- Brazilian Thin-Crust Pizza Dough (see page 114)
- Direct New York Pizza Dough (see page 136)
- Apizza Dough (see page 138)
- Quad Cities Pizza Dough (see page 140)
- No-Knead Thin-Crust Pizza Dough (see page 182) and Your Daily Thin-Crust Pizza Dough (see page 184)
- No-Knead Brazilian Thin-Crust Pizza Dough (see page 182) and Your Daily Brazilian Thin-Crust Pizza Dough (see page 184)

No-knead thin-crust pizza dough

High-hydration al taglio pizza dough

I'VE GOT BREAD EXPERIENCE

Who this is for: you are a baker or a home baker who has made bread at home frequently, so you are familiar with the process of making dough and its stages. Mixing, shaping, and proofing dough are not daunting to you, but you've never really made pizza or maybe not more than one style of pizza.

- Focaccia Dough (see page 148)
- New York Square Pizza Dough (see page 152)
- High-Hydration al Taglio Pizza Dough (see page 158)
- Detroit-Style Pizza Dough (see page 166)
- Argentinean-Style "al Molde" Pizza Dough (see page 170)
- Old Forge Pizza Dough (see page 171)

I'M IN A HURRY

Who this is for: well, clearly those who are in a hurry. These are pizzas that will take, at the most, 3½ hours to complete from start to finish, and some as little at 2 hours. Some are relatively quick to make without having to resort to any shortcuts, but we also have emergency versions of some of the master recipes in this book.

- Brazilian Thin-Crust Pizza Dough (see page 114)
- Emergency Neapolitan Pizza Dough (see page 131)
- Emergency New York Pizza Dough (see page 137)
- Emergency Artisan Pizza Dough (see page 147)
- Emergency High-Hydration al Taglio Pizza Dough (see page 163)
- Detroit-Style Pizza Dough (see page 166)

Detroit-style pizza dough

I'M MODERNIST

Who this is for: you embrace the modernist philosophy of cooking and want to make a better pizza by trying a different ingredient or technique.

- Any Modernist Pizza Dough recipe (see pages 112, 116, 121, 135, 145, 151, 155, 161, and 169)
- Modernist High-Hydration Neapolitan Pizza Dough (see page 127), New York Pizza Dough (see page 132), and Artisan Pizza Dough (see page 142) to achieve a crust with a high volume
- Any Compleat Wheat Pizza Dough recipe (see pages 174–177)

Compleat wheat artisan dough

Deep-dish pizza dough

I'M COOKING FOR A CROWD

Who this is for: you are a small pizzeria owner or a home baker who is having a large gathering. Not all pizzas work well for feeding large groups of people. Neapolitan pizza is a terrible idea for entertaining. You'll be anchored to your oven for the duration of the evening.

- Deep-Dish Pizza Dough (see page 118)
- New York Square Pizza Dough (see page 152)
- High-Hydration al Taglio Pizza Dough (see page 158)
- Detroit-Style Pizza Dough (see page 166)

I HAVE TIME

Who this is for: you planned and allotted time to get your preferments ready and for the doughs to proof or even cold-proof.

- Deep-Dish Pizza Dough (see page 118)
- New York Pizza Dough (see page 132)
- Artisan Pizza Dough (see page 142)
- Focaccia Dough (see page 148)
- High-Hydration al Taglio Pizza Dough (see page 158)

New York pizza dough

MASTER RECIPE

THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein*	55 g	⅓ cup + 1 Tbsp	100
Water	55 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21° C / 70° F	370 g	1⅔ cups	68.52
Instant dry yeast	4.8 g	1¾ tsp	0.89
Bread flour, 11.5%–12% protein*	540 g	4 cups	100
Fine-ground cornmeal	65 g	⅔ cup	12.04
Fine salt	13 g	2¼ tsp + ⅛ tsp	2.41
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15 min / Inactive 3½ h	three 50 cm / 20 in pizzas or four 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	595 g	100
Water	425 g	71.43
Cornmeal	65 g	10.92
Salt	13 g	2.18
Yeast	4.86 g	0.82

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

You can add up to 10% liquid or solid fat to this dough. Add along with the salt. For more on the experiment results that yielded this recommendation, see page 1:318.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21° C / 70° F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour and cornmeal, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 50 cm / 20 in: 370 g
40 cm / 16 in: 275 g

PRESHAPE ball (see pages 60–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2–3 h at 21° C / 70° F, covered; optional cold-proof for 1 d at 4° C / 39° F; for shaping instructions, see page 3:12; for assembly and baking instructions, see page 3:19

We typically use a dough hook to mix all our thin-crust pizza doughs. If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

You could try using a combination of 100% rye flour and 11% vital wheat gluten to create a 100% rye version of this dough. Be sure to mix according to the instructions in the 100% Rye Neapolitan Pizza Dough on page 129 and to use rye flour in the poolish as well.

If making this pizza in a home oven, the 40 cm / 16 in size is the maximum that will fit. We recommend either making this size or a 33 cm / 13 in pizza (200 g dough). This will be closer to a tavern-style pizza (see page 1:105).

MACHINE MIXING OPTIONS

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 3 min. Mix on medium speed to low gluten development, about 3 min. Add the salt, and mix on medium speed to full gluten development, about 8 min. Perform the windowpane test to assess gluten development.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, 2–3 min. Add the salt, and mix on medium speed to full gluten development, about 20 min. Perform the windowpane test to assess gluten development.

If you are using the diving arm mixer, the dough will be slightly softer than the doughs made with the other mixers, but it is easy to roll and shape.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to low gluten development, about 3 min. Add the salt, and mix on medium speed to full gluten development, about 5 min. Perform the windowpane test to assess gluten development.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 4 min. Mix on medium speed to low gluten development, about 5 min. Add the salt, and mix on medium speed to full gluten development, about 10 min. Perform the windowpane test to assess gluten development.

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

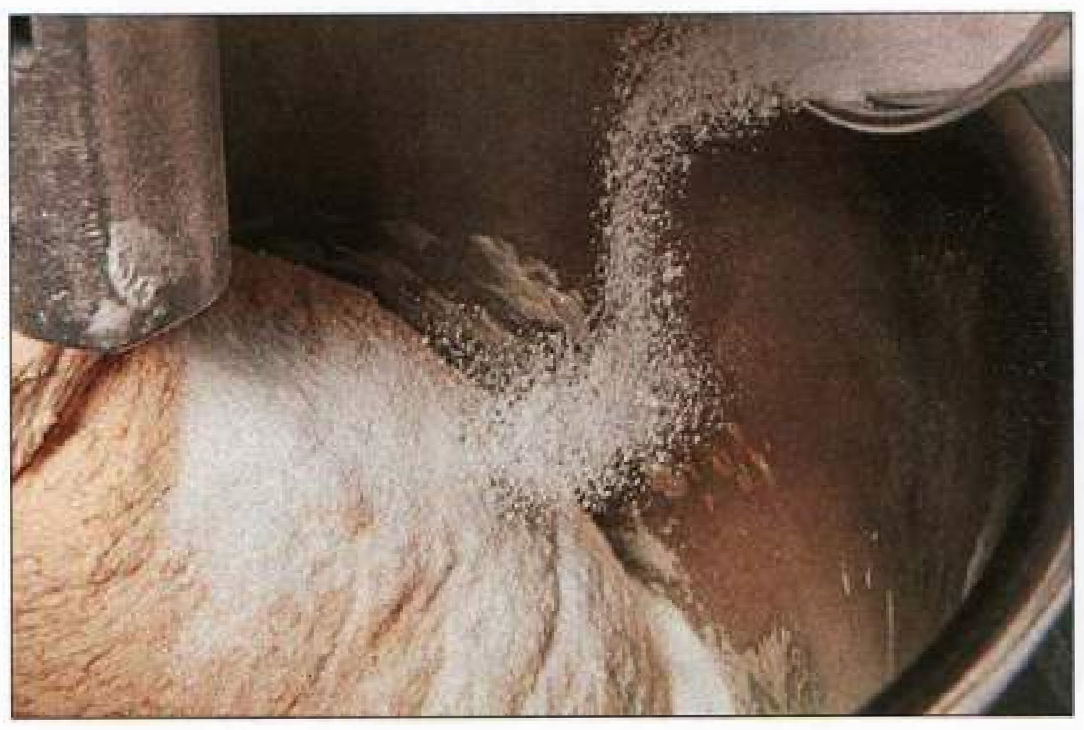
Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 4 min. Mix on medium speed to low gluten development, about 4 min. Add the salt, and mix on medium speed to full gluten development, about 8 min. Perform the windowpane test to assess gluten development.

FOOD PROCESSOR

Weight: 12–16 cup work bowl: 1 kg

Robot Coupe, 2–3 qt work bowl: 1.2 kg; industrial-sized food processors: capacity will vary

Mix: place the flour, cornmeal, salt, and yeast in the bowl. Pour the poolish on top of the dry ingredients. Turn the machine on and pour in the water. Mix for 45 s. Perform the window-pane test to assess gluten development. If the gluten is not fully developed, mix for a few more seconds and check again.



Add salt at low gluten development

Full gluten development

PREP

1 Combine the flour, water, and yeast for the poolish, and mix to a homogeneous mass. Transfer the poolish to an airtight container, cover, and let it ripen at 21° C / 70° F for 12–16 h before mixing it into the dough (see page 1:300).

MIX

2 Follow the Machine Mixing Options above.

3 Transfer the dough to a lightly floured worktable. Cover well with a plastic bag or tarp.

BENCH REST

4 Bench rest for 20 min.

DIVIDE

5 Divide into three 370 g pieces for 50 cm / 20 in pizzas or four 275 g pieces for 40 cm / 16 in pizzas (see page 55). The 50 cm / 20 in pizzas are for deck, electric deck, and wood-fired pizza ovens; the 40 cm / 16 in pizzas are meant for home, combi, and convection ovens because the larger pizzas will not fit in them.

PRESHAPE

6 Preshape each piece into a ball (see pages 60–62).

7 Place in a tub or on a sheet pan. Spray a very light mist of water over each ball of dough.

8 Cover the tub well or wrap the sheet pan with plastic wrap.

PROOF

9 Proof the dough, covered, for 2–3 h at 21 °C / 70 °F. If you are rolling the dough out right away rather than cold-proofing, skip from here to the shaping instructions on page 3:12. Assemble and bake the pizza according to the instructions on page 3:19.

COLD PROOF (OPTIONAL)

10 Transfer the dough into refrigeration and cold-proof for 1 d at 4 °C / 39 °F.

11 Remove the dough from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

12 Shape according to the instructions on page 3:12. Assemble and bake the pizza according to the instructions on page 3:19.

After proofing at room temperature, you can roll the dough out and make the pizza. We recommend cold-proofing the dough for 1 d, however, because it produces a crispier thin-crust pizza. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

INGREDIENT VARIATION

MODERNIST THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein*	55 g	⅓ cup + 1 Tbsp	100
Water	55 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21 °C / 70 °F	370 g	1⅔ cups	68.52
Dough relaxer options (see table below)			
Instant dry yeast	4.8 g	1¾ tsp	0.89
Bread flour, 11.5%–12% protein*	540 g	4 cups	100
Polydextrose	6 g	1½ tsp	1.1
Fine-ground cornmeal	55 g	½ cup	10.19
Fine salt	13 g	2¼ tsp + ⅛ tsp	2.41
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15 min / Inactive 3½ h	three 50 cm / 20 in pizzas or four 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	595 g	100
Water	425 g	71.43
Cornmeal	55 g	9.24
Salt	13 g	2.18
Polydextrose	6 g	1
Yeast	4.86 g	0.82

Follow the Prep through Proof instructions for Thin-Crust Pizza Dough on page 110. See the table at right for instructions on adding the dough relaxer. Add the polydextrose with the flour.

If making this pizza in a home oven, the 40 cm / 16 in size is the maximum that will fit. We recommend either making this size or a 33 cm / 13 in pizza (200 g dough). This will be closer to a tavern-style pizza (see page 1:105).

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract pineapple juice, kiwi juice, and papaya juice, see page 1:328.

INGREDIENT	%	ADD TO . . .
Pineapple juice, fresh	0.01	the water
Bromelain, powdered	0.0005	the flour
Kiwi juice, fresh	0.08	the water
Papain, powdered	0.01	the flour
Papaya juice, fresh	0.03	the water
Adolph's meat tenderizer	0.01	the flour

Modernist thin-crust pizza dough

INGREDIENT VARIATION

DIRECT THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	425 g	1¾ cups + 1½ Tbsp	71.43
Instant dry yeast	4.8 g	1¾ tsp	0.81
Bread flour, 11.5%–12% protein*	595 g	4¼ cups + 2½ Tbsp	100
Fine-ground cornmeal	55 g	½ cup	9.24
Fine salt	13 g	2¼ tsp + ⅛ tsp	2.18
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

For more on suggested mixing times, see the Machine Mixing Options for Thin-Crust Pizza Dough on page 111.

TOTAL TIME	YIELD/SHAPE
Active 15 min / Inactive 2 h	three 50 cm / 20 in pizzas or four 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	595 g	100
Water	425 g	71.43
Cornmeal	55 g	9.24
Salt	13 g	2.18
Yeast	4.8 g	0.81

If making this pizza in a home oven, the 40 cm / 16 in size is the maximum that will fit. We recommend either making this size or a 33 cm / 13 in pizza (200 g dough). This will be closer to a tavern-style pizza (see page 1:105).

GENERAL DIRECTIONS

MIX	combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour and cornmeal, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable
BENCH REST	20 min; cover well
DIVIDE	50 cm / 20 in: 370 g 40 cm / 16 in: 275 g
PRESHAPE	ball (see pages 60–62); place in a tub or on a sheet pan; lightly mist with water; cover well
PROOF	1½ h at 21° C / 70° F, covered; optional cold-proof for 1 d at 4° C / 39° F, covered; for shaping instructions, see page 3:12; for assembly and baking instructions, see page 3:19

After proofing at room temperature, you can roll the dough out and make the pizza. We recommend cold-proofing the dough for 1 d, however, because it produces a crispier thin-crust pizza. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

MASTER RECIPE

BRAZILIAN THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	310 g	1⅓ cups	50.41
Instant dry yeast	3 g	1⅛ tsp	0.49
Cake flour	370 g	3 cups	60.16
Bread flour, 11.5%–12% protein*	245 g	1¾ cups	39.84
Extra-virgin olive oil	60 g	¼ cup + 1 tsp	9.76
Fine salt	12.3 g	2¼ tsp	2
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Central Milling Organic Artisan Bakers Craft Bread Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2 h	four 40 cm / 16 in pizzas or eight 23 cm / 9 in pizzas

NET CONTENTS

Ingredients	Weight	%
Cake flour	370 g	60.16
Bread flour	245 g	39.84
Water	310 g	50.41
Fat	60 g	9.76
Salt	12.3 g	2
Yeast	3 g	0.49

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

When you are adding the oil to the mixer, try to pour it toward the center of the dough rather than to the outside. This helps keep it from sloshing around the bowl and makes it easier for the mixer to fully incorporate the oil into the dough.

After proofing at room temperature, you can roll the dough out and make the pizza. We recommend cold-proofing the dough for 1 d, however, because it produces a crispier thin-crust pizza. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the cake flour and bread flour, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the oil and salt, and mix on low speed until fully incorporated; mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 40 cm / 16 in: 250 g
23 cm / 9 in: 125 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1½ h at 21° C / 70° F, covered; optional cold-proof for 1 d at 4° C / 39° F, covered; for shaping instructions, see page 3:12; for assembly and baking instructions, see page 3:25

MACHINE MIXING OPTIONS

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the cake flour and bread flour, and mix on low speed to a shaggy mass, about 1 min. Mix on medium speed to low gluten development, about 3 min. Add the oil and salt, and mix on low speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, about 7 min. Perform the windowpane test to assess gluten development.

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the cake flour and bread flour, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to low gluten development, about 5 min. Add the oil and salt, and mix on low speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, about 3 min. Perform the windowpane test to assess gluten development.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the cake flour and bread flour, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to low gluten development, about 5 min. Add the oil and salt, and mix on low speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, about 6 min. Perform the windowpane test to assess gluten development.

FOOD PROCESSOR

Weight: 12–16 cup work bowl: 1 kg

Robot Coupe, 2–3 qt work bowl: 1.2 kg; industrial-sized food processors: capacity will vary

Mix: place the cake flour, bread flour, salt, and yeast in the bowl. Turn the machine on and pour in the water and oil. Mix for 45 s. Perform the windowpane test to assess gluten development. If the gluten is not fully developed, mix for a few more seconds and check again.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

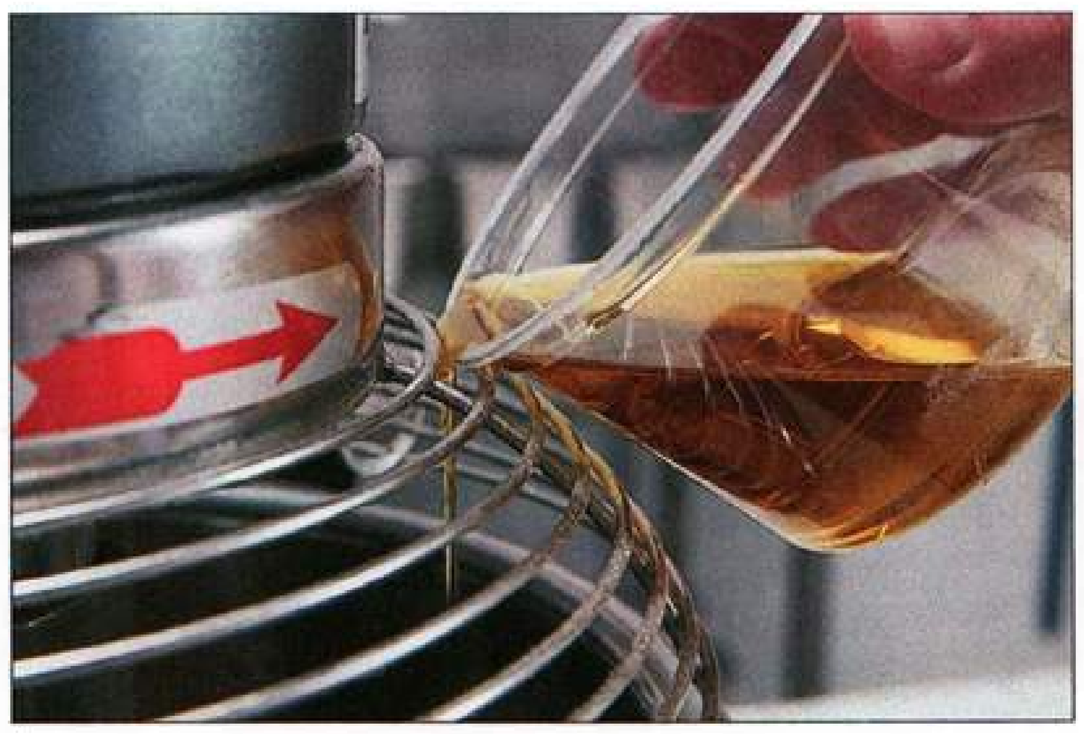
Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the cake flour and bread flour, and mix on low speed to a shaggy mass, 2–3 min. Add the oil and salt, and mix on medium speed to full gluten development, about 15 min. Perform the windowpane test to assess gluten development.

If you are using the diving arm mixer, the dough will be slightly softer than the doughs made with the other mixers, but it is easy to roll and shape.

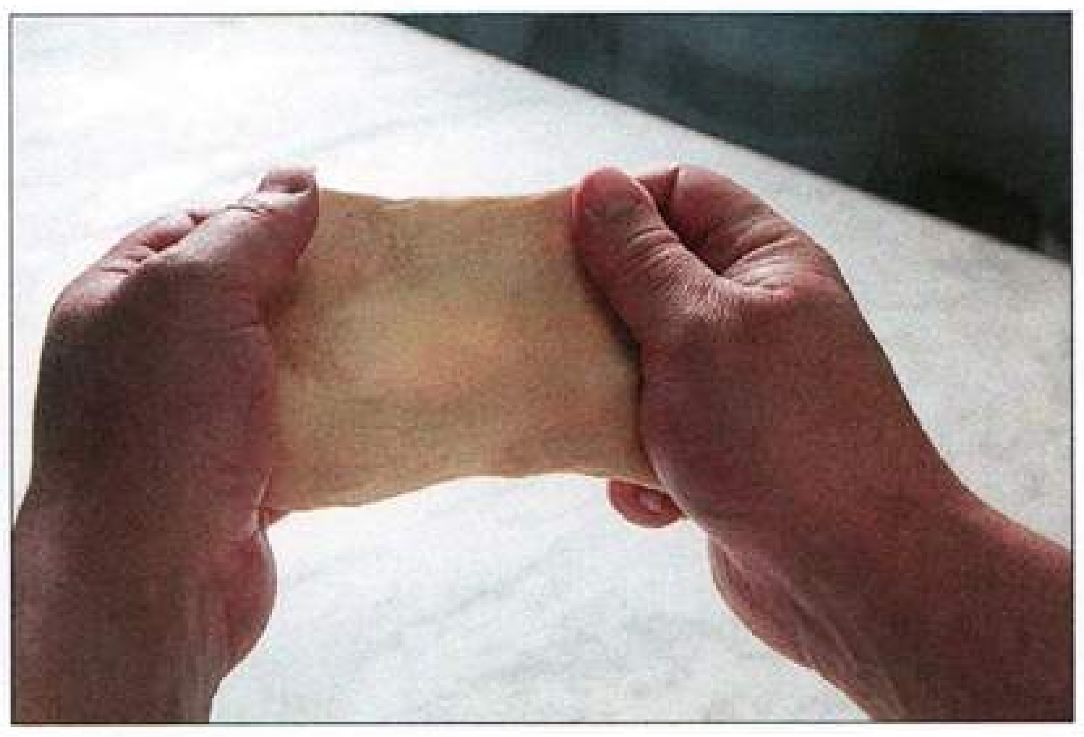
FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the cake flour and bread flour, and mix on low speed to a shaggy mass, about 3 min. Mix on medium speed to low gluten development, about 5 min. Add the oil and salt, and mix on low speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, about 20 min. Perform the windowpane test to assess gluten development.



Add oil in slow stream



Full gluten development

We typically use a dough hook to mix all our thin-crust pizza doughs. If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

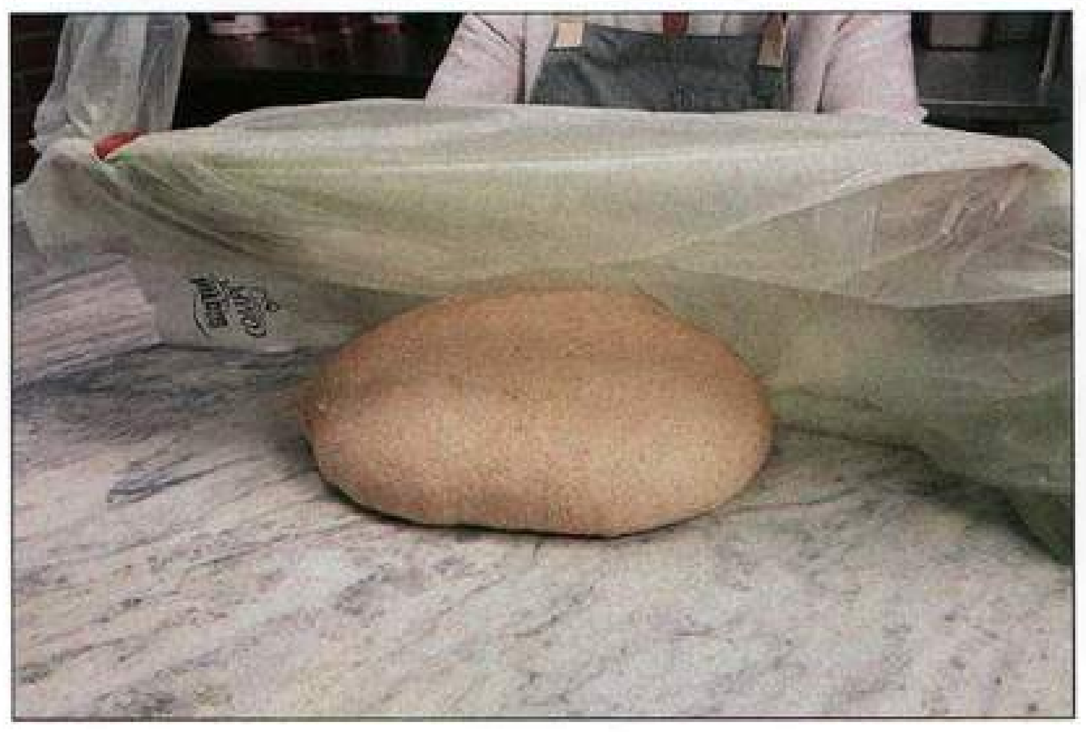
MIX

1 Follow the Machine Mixing Options above.

2 Transfer the dough to a lightly floured worktable. Cover well with a plastic bag or tarp.

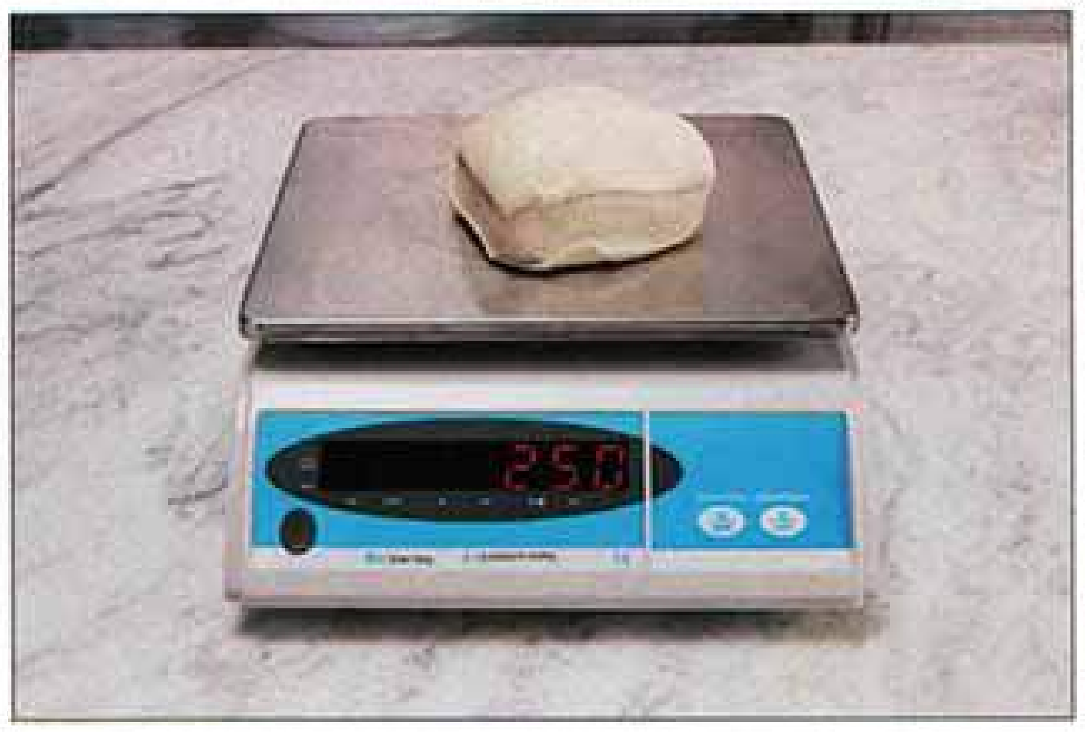
The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

BENCH REST



3 Bench rest for 20 min.

DIVIDE



4 Divide into four 250 g pieces for 40 cm / 16 in pizzas or eight 125 g pieces for 23 cm / 9 in pizzas (see page 55).

PRESHAPE

5 Preshape each piece into a ball (see page 60).

6 Place in a tub or on a sheet pan. Spray a very light mist of water over each ball of dough.

7 Cover the tub well or wrap the sheet pan with plastic wrap.

PROOF

8 Proof the dough, covered, for 1½ h at 21 °C / 70 °F. If you are rolling the dough out right away rather than cold-proofing, skip from here to the shaping instructions on page 3:12. Assemble and bake the pizza according to the instructions on page 3:25.

COLD-PROOF (OPTIONAL)

9 Transfer the dough into refrigeration and cold-proof for 1 d at 4 °C / 39 °F.

10 Remove the dough from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

11 Shape according to the instructions on page 3:12. Assemble and bake the pizza according to the instructions on page 3:25.

INGREDIENT VARIATION

MODERNIST BRAZILIAN THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21 °C / 70 °F	310 g	1⅓ cups	50.41
Instant dry yeast	3 g	1⅛ tsp	0.49
Cake flour	370 g	3 cups + 1 Tbsp	60.16
Bread flour, 11.5%–12% protein*	245 g	1¾ cups	39.84
Dough relaxer options see table below			
Polydextrose	6 g	1½ tsp	0.98
Extra-virgin olive oil	60 g	¼ cup + 1 tsp	9.76
Fine salt	12.3 g	2¼ tsp	2
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Central Milling Organic Artisan Bakers Craft Bread Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2 h	four 40 cm / 16 in pizzas or eight 23 cm / 9 in pizzas

NET CONTENTS

Ingredients	Weight	%
Cake flour	370 g	60.16
Bread flour	245 g	39.84
Water	310 g	50.41
Fat	60 g	9.76
Salt	12.3 g	2
Polydextrose	6 g	0.98
Yeast	3 g	0.49

Follow the Mix through Proof instructions for Brazilian Thin-Crust Pizza Dough on page 114. See the table at right for instructions on adding the dough relaxer. Add the polydextrose with the flour.

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract pineapple juice and kiwi juice, see page 1:328. Bromelain and meat tenderizer performed best in our tests.

INGREDIENT	%	ADD TO . . .
Bromelain, powdered	0.0005	the flour
Adolph's meat tenderizer	0.01	the flour
Pineapple juice, fresh	0.01	the water
Kiwi juice, fresh	0.08	the water
Papain, powdered	0.01	the flour

INGREDIENT VARIATION

30% FAT BRAZILIAN THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	277 g	1¼ cups	50.36
Instant dry yeast	2.7 g	1 tsp	0.49
High-gluten bread flour, 14% protein*	550 g	4 cups + 1 Tbsp	100
Powdered lecithin	16.5 g	2 Tbsp + ½ tsp	3
Ghee, softened	165 g	¾ cup	30
Fine salt	16.5 g	1 Tbsp	3
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using King Arthur Sir Lancelot High Gluten Flour.*

If the lecithin is clumping, sift it before adding to the mixer's bowl.

This recipe can be made with 30% butter and up to 50% ghee. When baking, the higher the fat, the shorter the baking time. The 50% fat dough bakes for 4 min.

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 3 h	four 40 cm / 16 in pizzas or eight 23 cm / 9 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	550 g	100
Water	277 g	50.36
Fat	165 g	30
Powdered lecithin	16.5 g	3
Salt	16.5 g	3
Yeast	2.7 g	0.49

Follow the Mix through Proof instructions for Brazilian Thin-Crust Pizza Dough on page 114. Replace the cake flour and bread flour with high-gluten flour. Add the lecithin with the flour and use the ghee in place of the olive oil. Mix in half of the ghee once the dough has reached a shaggy mass. Once incorporated, add the other half, and mix on medium speed to full gluten development. Do not cold-proof the dough because the ghee will harden and make the dough difficult to roll out.

INGREDIENT VARIATION

GRILLED BRAZILIAN THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	310 g	1⅓ cups	50.41
Instant dry yeast	3 g	1⅛ tsp	0.49
High-gluten bread flour, 14% protein*	615 g	4½ cups	100
Extra-virgin olive oil	60 g	¼ cup + 1 tsp	9.76
Fine salt	18.5 g	3¼ tsp	3
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using King Arthur Sir Lancelot High Gluten Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2 h	six 30–35 cm by 10–15 cm / 12–14 in by 4–6 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	615 g	100
Water	310 g	50.41
Fat	60 g	9.76
Salt	18.5 g	3
Yeast	3 g	0.49

Follow the Mix through Proof instructions for Brazilian Thin-Crust Pizza Dough on page 114. Replace the cake flour and bread flour with high-gluten flour. Mix in half of the oil once the dough has reached a shaggy mass. Once incorporated, add the other half, and mix on medium speed to medium gluten development. Divide the dough into 150 g pieces. Shape according to the instructions on page 3:12. Assemble and bake the pizza according to the instructions on page 3:25.

For more on grilling pizza, see page 414.

MASTER RECIPE

DEEP-DISH PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	225 g	1 cup	59.21
Instant dry yeast	3.1 g	1⅛ tsp	0.82
Bread flour, 11.5%–12% protein*	380 g	2¾ cups	100
Fine-ground cornmeal	40 g	⅓ cup	10.53
Lard, softened	18 g	1 Tbsp + ¾ tsp	4.74
Butter, softened	18 g	1 Tbsp + ¾ tsp	4.74
Fine salt	8 g	1¼ tsp + ⅛ tsp	2.11
	Yield: ~700 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

The 700 g yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 2 h	one 32 cm by 5 cm deep / 12½ in by 2 in deep pizza or three 21 cm by 5 cm deep / 8½ in by 2 in deep pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	380 g	100
Water	228 g	60
Cornmeal	40 g	10.53
Fat	33 g	8.68
Salt	8 g	2.11
Yeast	3.1 g	0.82

If you don't want to use lard, you can double the amount of butter in the dough.

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour and cornmeal, and mix on low speed to a shaggy mass; add the lard and butter, and mix on medium speed to low gluten development; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 32 cm by 5 cm deep / 12½ in by 2 in deep: do not divide
21 cm by 5 cm deep / 8½ in by 2 in deep: 230 g

PRESHAPE ball (see pages 60–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1½ h at 21° C / 70° F, covered; optional cold-proof for 1 d at 4° C / 39° F, covered; for shaping instructions, see page 3:88; for assembly and baking instructions, see page 3:93

MACHINE MIXING OPTIONS

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 3 min. Add the lard and butter, and mix on medium speed to low gluten development, 5–7 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, 7–8 min. Perform the windowpane test to assess gluten development.

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 4 min. Add the lard and butter, and mix on medium speed to low gluten development, about 5 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, about 7 min. Perform the windowpane test to assess gluten development.

We typically use a dough hook to mix all our thin-crust pizza doughs. If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 1 min. Add the lard and butter, and mix on medium speed to low gluten development, about 3 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Mix on medium speed to full gluten development, 3–4 min. Perform the windowpane test to assess gluten development.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, about 5 min. Add the lard and butter, and mix on medium speed to low gluten development, about 12 min. Add the salt, and mix on medium speed to full gluten development, about 24 min. Perform the windowpane test to assess gluten development.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and cornmeal, and mix on low speed to a shaggy mass, 2–3 min. Add the lard, butter, and salt, and mix on medium speed to full gluten development, about 21 min. Perform the windowpane test to assess gluten development.

If you are using the diving arm mixer, the dough will be slightly softer than the doughs made with the other mixers, but it is easy to roll and shape.

FOOD PROCESSOR

Weight: 12–16 cup work bowl: 1 kg

Robot Coupe, 2–3 qt work bowl: 1.2 kg; industrial-sized food processors: capacity will vary

Mix: place the flour, cornmeal, lard, butter, salt, and yeast in the bowl. Turn the machine on and pour in the water. Mix for 45 s. Perform the windowpane test to assess gluten development. If the gluten is not fully developed, mix for a few more seconds, and check again.

Add solid fat at shaggy mass

Full gluten development

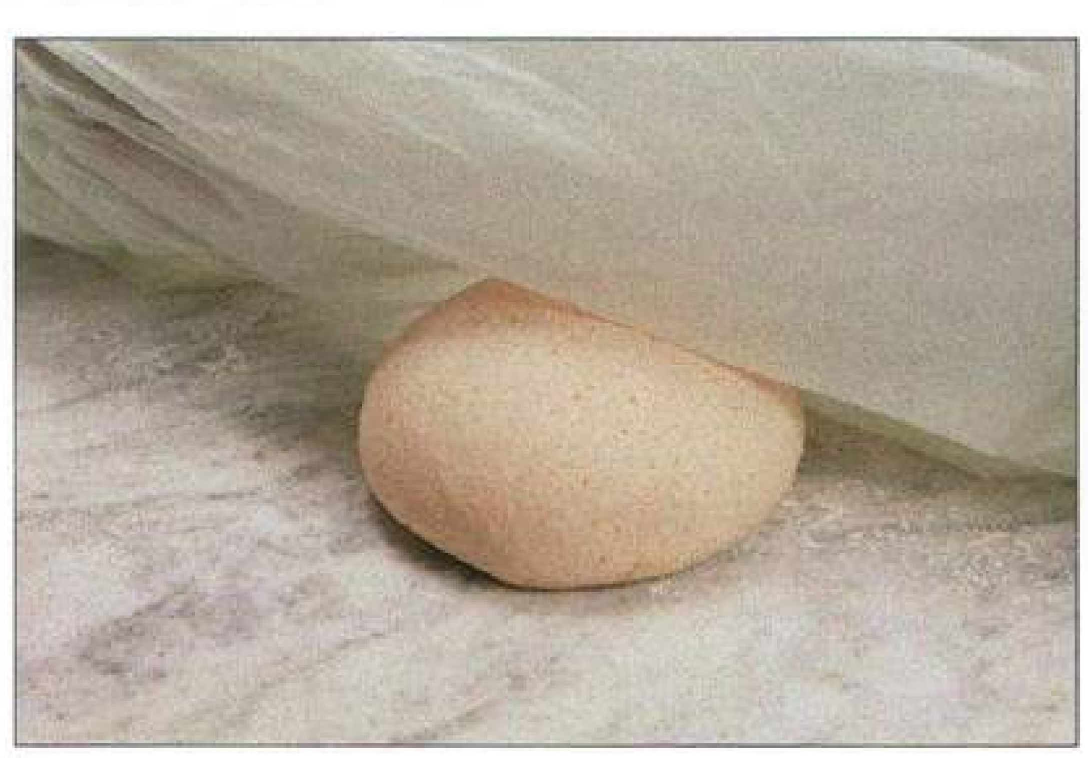
MIX

1 Follow the Machine Mixing Options above.

2 Transfer the dough to a lightly floured worktable. Cover well with a plastic bag or tarp.

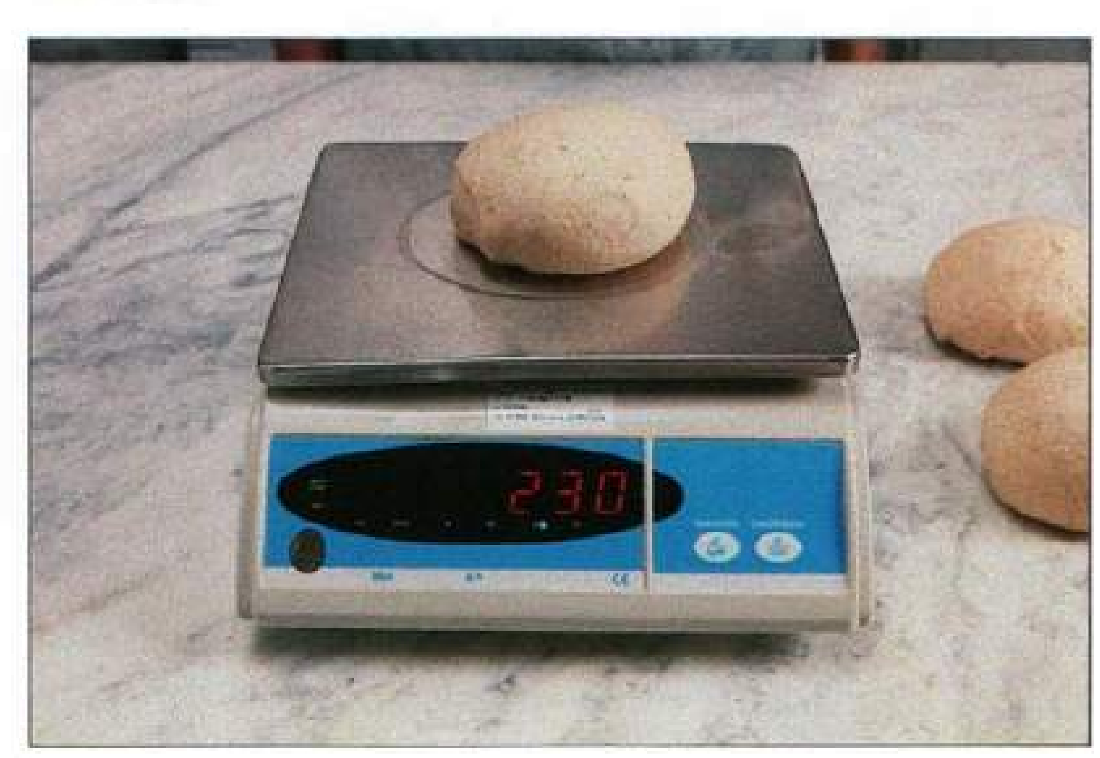
The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

BENCH REST



3 Bench rest for 20 min.

DIVIDE



4 Do not divide for a 32 cm / 12½ in pizza. Divide into three 230 g pieces for 21 cm / 8½ in pizzas (see page 55).

PRESHAPE

5 Preshape each piece into a ball (see pages 60–62).

6 Place in a tub or on a sheet pan. Spray a very light mist of water over the dough.

7 Cover the tub well or wrap the sheet pan with plastic wrap.

If you are baking only one of the 21 cm / 8½ in pizzas, individually wrap the remaining dough with plastic wrap after preshaping the dough and freeze for up to 2 mo. The dough freezes better if you flatten the ball slightly into a disc.

PROOF

8 Proof the dough, covered, for 1½ h at 21 °C / 70 °F. If you are rolling the dough out right away rather than cold-proofing, skip from here to the shaping instructions on page 3:88. Assemble and bake the pizza according to the instructions on page 3:93.

COLD-PROOF (OPTIONAL)

9 Transfer the dough into refrigeration and cold-proof for 1 d at 4 °C / 39 °F.

10 Remove the dough from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

11 Shape according to the instructions on page 3:88. Assemble and bake the pizza according to the instructions on page 3:93.

After proofing at room temperature, you can roll the dough out and make the pizza. We recommend cold-proofing the dough for 1 d, however, because it produces a crispier deep-dish pizza.

INGREDIENT VARIATION

MODERNIST DEEP-DISH PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21 °C / 70 °F	225 g	1 cup	59.21
Instant dry yeast	3.1 g	1⅛ tsp	0.82
Bread flour, 11.5%–12% protein*	380 g	2¾ cups	100
Fine-ground cornmeal	40 g	⅓ cup	10.53
Freeze-dried cheddar cheese powder	40 g	⅓ cup	10.53
Freeze-dried butter powder	40 g	½ cup	10.53
Polydextrose	3.8 g	1 tsp	1
Lard, softened	18 g	1 Tbsp + ¾ tsp	4.74
Butter, softened	18 g	1 Tbsp + ¾ tsp	4.74
Fine salt	8 g	1¼ tsp + ⅛ tsp	2.11
	Yield: ~700 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

Follow the Mix through Proof instructions for Deep-Dish Pizza Dough on page 118. Add the freeze-dried cheese powder, freeze-dried butter powder, and polydextrose with the flour.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 2 h	one 32 cm by 5 cm deep / 12½ in by 2 in deep pizza or three 21 cm by 5 cm deep / 8½ in by 2 in deep pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	380 g	100
Water	228 g	60
Cornmeal	40 g	10.53
Fat	32 g	8.42
Salt	8 g	2.11
Polydextrose	3.8 g	1
Yeast	3.1 g	0.82

The freeze-dried butter and cheese powders add flavor to the dough but also aid in browning. For where to purchase these ingredients, see Resources, page 3:377.

If you don't want to use lard, you can double the amount of butter in the dough.

INGREDIENT VARIATION

DEEP-DISH PIZZA DOUGH WITH POOLISH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein*	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21 °C / 70 °F	165 g	¾ cup	51.56
Instant dry yeast	3.1 g	1⅛ tsp	0.97
Bread flour, 11.5%–12% protein*	320 g	2⅓ cups	100
Fine-ground cornmeal	40 g	⅓ cup	12.5
Lard, softened	18 g	1 Tbsp + ¾ tsp	5.63
Butter, softened	18 g	1 Tbsp + ¾ tsp	5.63
Fine salt	8 g	1½ tsp + ⅛ tsp	2.5
	Yield: ~700 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

Mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21 °C / 70 °F, covered. Follow the Mix through Proof instructions for Deep-Dish Pizza Dough on page 118. Add the poolish to the water along with the yeast.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 2 h	one 32 cm by 5 cm deep / 12½ in by 2 in deep pizza or three 21 cm by 5 cm deep / 8½ in by 2 in deep pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	380 g	100
Water	228 g	60
Cornmeal	40 g	10.53
Fat	33 g	8.68
Salt	8 g	2.11
Yeast	3.16 g	0.83

If you don't want to use lard, you can double the amount of butter in the dough.

Using a poolish reduces mixing time and, in most doughs, makes it easier to roll it out. Some feel that it produces a better flavor in the crust, but that can get lost once you top it with sauce and cheese.

INGREDIENT VARIATION

CHEMICALLY LEAVENED DEEP-DISH PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21°C / 70°F	225 g	1 cup	59.21
Bread flour, 11.5%–12% protein*	380 g	2¾ cups	100
Fine-ground cornmeal	40 g	⅓ cup	10.53
Baking soda	1.6 g	¼ tsp	0.42
Lard, softened	18 g	1 Tbsp + ¾ tsp	4.74
Butter, softened	18 g	1 Tbsp + ¾ tsp	4.74
Fine salt	8 g	1½ tsp + ⅛ tsp	2.11
	Yield: ~700 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

Pour the water in the mixer's bowl. Add the flour, cornmeal, and baking soda, and mix on low speed to a shaggy mass. Add the lard and butter, and mix on medium speed to low gluten development. Add the salt, and mix on medium speed to full gluten development. Perform the windowpane test to assess gluten development (see page 30). Transfer to a lightly floured worktable. Follow the Bench Rest through Proof instructions for Deep-Dish Pizza Dough on page 118.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 2 h	one 32 cm by 5 cm deep / 12½ in by 2 in deep pizza or three 21 cm by 5 cm deep / 8½ in by 2 in deep pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	380 g	100
Water	228 g	60
Cornmeal	40 g	10.53
Fat	33 g	8.68
Salt	8 g	2.11
Baking soda	1.6 g	0.42

This recipe provides a finished crust that is closer to pâte brisée. Chemically leavened doughs typically have to be baked right away, but you can still bench rest this dough because the gluten in the dough has developed.

If you don't want to use lard, you can double the amount of butter in the dough.

SUBMASTER RECIPE

ENRICHED DEEP-DISH PIZZA DOUGH

ADAPTED FROM PIZZERIA UNO

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21 °C / 70 °F	342 g	1½ cups	58.76
Instant dry yeast	7.5 g	2¾ tsp	1.29
Sugar	6 g	1½ tsp	1.03
All-purpose flour, 10%–11.5% protein	582 g	4⅓ cups	100
Fine salt	3.9 g	¾ tsp	0.67
Vegetable oil	222 g	1 cup	38.14
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 1¼ h	one 32 cm by 5 cm deep / 12½ in by 2 in deep pizza or three 21 cm by 5 cm deep / 8½ in by 2 in deep pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	582 g	100
Water	342 g	58.76
Fat	222 g	38.14
Yeast	7.5 g	1.29
Sugar	6 g	1.03
Salt	3.9 g	0.67

For more on suggested mixing times, see the Machine Mixing Options for Deep-Dish Pizza Dough on page 119.

For more on how Pizzeria Uno was the originator of this style, see page 1:245.

GENERAL DIRECTIONS

MIX combine the water, yeast, and sugar in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; add the salt, and mix on low speed until fully incorporated; add the oil in a slow stream with the mixer running on low speed, and mix until it is fully incorporated; mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 32 cm / 12½ in: do not divide
21 cm / 8½ in: 230 g

PRESHAPE ball (see pages 60–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 45 min at 21 °C / 70 °F, covered; for shaping instructions, see page 3:88; for assembly and baking instructions, see page 3:93

MASTER RECIPE

NEAPOLITAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	380 g	1⅔ cups	62.3
Instant dry yeast	0.24 g	⅛ tsp	0.04
Bread flour, 11.5%–12.5% protein, or 00 flour*	610 g	4½ cups	100
Adolph's meat tenderizer (optional)	0.06 g	**	0.01
Fine salt	12.15 g	2⅛ tsp	1.99
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Le 5 Stagioni Pizza Napoletana 00 Flour, Caputo Pizzeria 00 Flour, or Polselli Classica 00 Flour.*

***You can approximate this small amount of dough relaxer by measuring ⅛ tsp meat tenderizer and dividing it into six equal parts. Use one part to make the dough.*

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt stand mixer bowl.

The meat tenderizer acts as a dough relaxer. It is optional, but we highly recommend it because it makes the dough easier to shape. Additionally, if you overproof the dough, you can reball it, proof it, and bake it. Without the dough relaxer, it would be hard to handle.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 27 h	four 30 cm / 12 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	610 g	100
Water	380 g	62.3
Salt	12.15 g	1.99
Yeast	0.24 g	0.04

We typically use a dough hook to mix all our medium-crust pizza doughs. If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

GENERAL DIRECTIONS

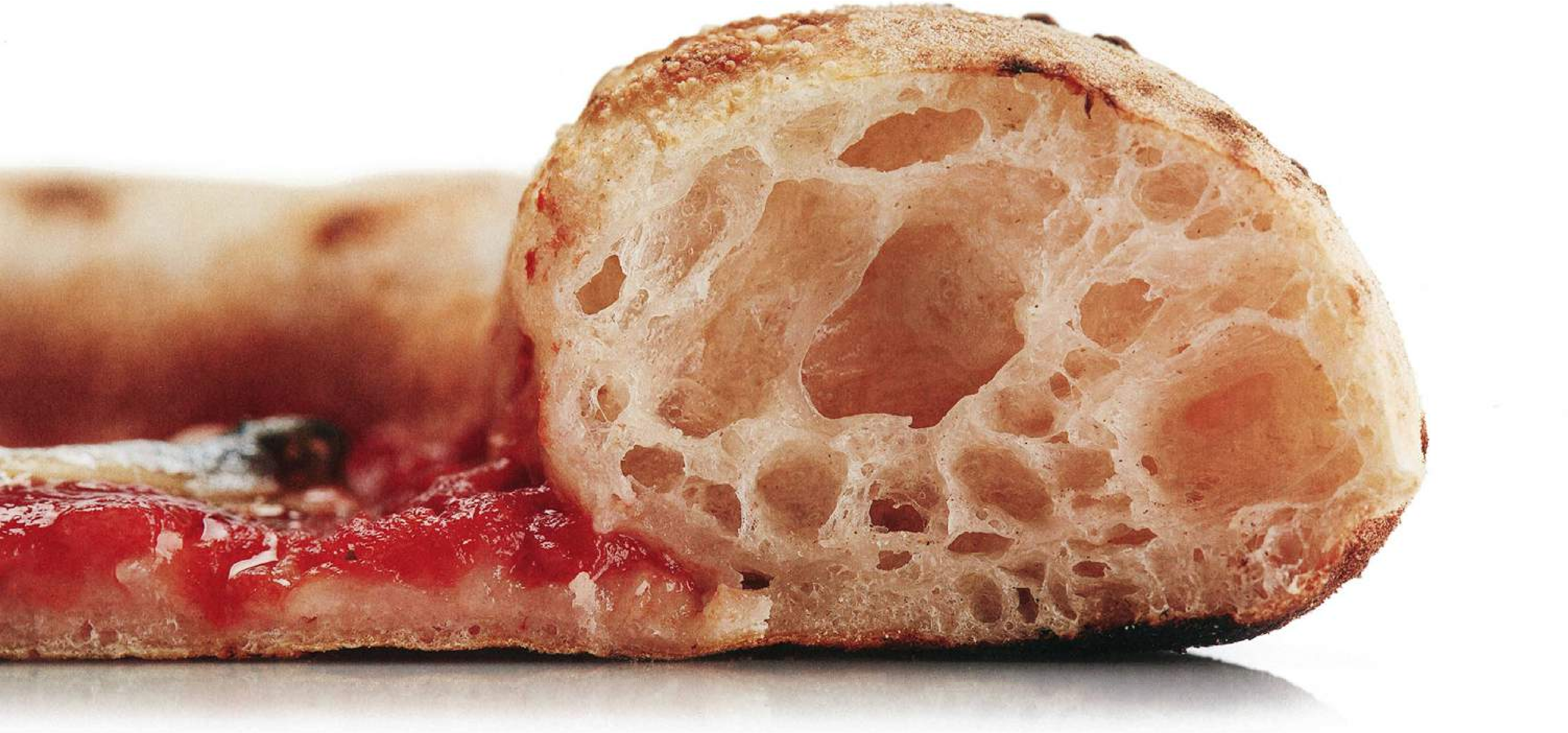
MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour and meat tenderizer, and mix on low speed to a shaggy mass; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a tub lightly misted with water

BULK FERMENT 20–24 h at 21° C / 70° F; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 3 h at 21° C / 70° F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47



MACHINE MIXING OPTIONS

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and meat tenderizer, and mix on low speed to a shaggy mass, 1–2 min. Add the salt, and mix on medium speed to full gluten development, 13–15 min. Perform the windowpane test to assess gluten development.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and meat tenderizer, and mix on low speed to a shaggy mass, 2–3 min. Add the salt, and mix on medium speed to full gluten development, about 15 min. Perform the windowpane test to assess gluten development.

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and meat tenderizer, and mix on low speed to a shaggy mass, 1–2 min. Add the salt, and mix on low speed until fully incorporated, 1–2 min. Mix on medium speed to full gluten development, 4–5 min. Perform the windowpane test to assess gluten development.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and meat tenderizer, and mix on low speed to shaggy mass, 1–2 min. Add the salt, and mix on medium speed to full gluten development, 8–10 min. Perform the windowpane test to assess gluten development.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and meat tenderizer, and mix on low speed to a shaggy mass, 1–2 min. Add the salt, and mix on low speed until fully incorporated, 1–2 min. Mix on medium speed to full gluten development, 6–8 min. Perform the windowpane test to assess gluten development.

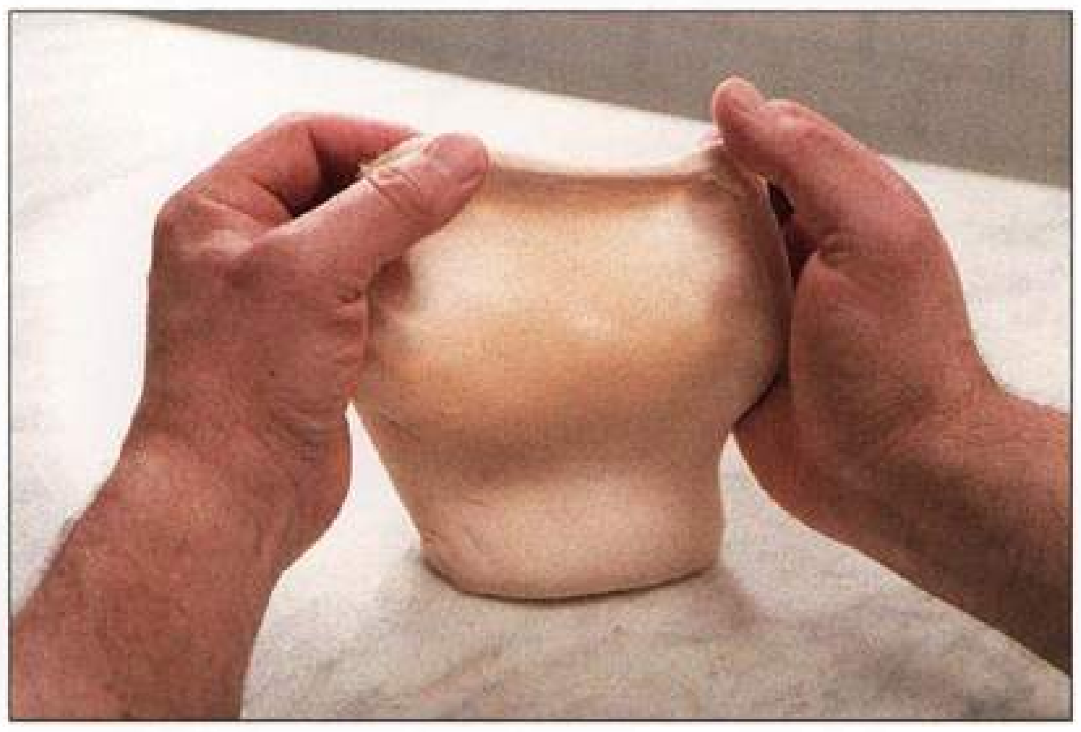
FOOD PROCESSOR

Weight: 12–16 cup work bowl: 1 kg

Robot Coupe, 2–3 qt work bowl: 1.2 kg; industrial-sized food processors: capacity will vary

Mix: place the flour, salt, yeast, and meat tenderizer in the bowl. Turn the machine on and pour in the water. Mix for 45 s. Perform the windowpane test to assess gluten development. If the gluten is not fully developed, mix for a few more seconds and check again.

Low gluten development



Full gluten development

MIX

1 Follow the Machine Mixing Options above.

2 Transfer the dough to a tub lightly misted with water. Cover well with plastic wrap.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

BULK FERMENT

3 Bulk ferment, covered, for 20–24 h at 21° C / 70° F.

Full gluten development should coincide with a final dough temperature of 27° C / 80° F. For more on desired dough temperature, see page 32.

DIVIDE

4 Divide into four 250 g pieces (see page 55).

PRESHAPE

5 Preshape each piece into a ball (see page 60).

6 Place in a tub or on a sheet pan. Spray a very light mist of water over each ball of dough.

7 Cover the tub well or wrap the sheet pan with plastic wrap.

PROOF

8 Proof the dough, covered, for 3 h at 21 °C / 70 °F.

9 Shape according to the instructions on page 3:36. Assemble and bake the pizza according to the instructions on page 3:47.

INGREDIENT VARIATION

MODERNIST HIGH-HYDRATION NEAPOLITAN PIZZA DOUGH

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 27½ h	four 30 cm / 12 in pizzas

INGREDIENTS	WEIGHT	VOLUME	%
For the Pregelatinized Flour			
Water, 21° C / 70° F	120 g	½ cup	400
00 flour*	30 g	¼ cup	100
For the Dough			
Water, 21° C / 70° F	380 g	1⅔ cups	65.5
Instant dry yeast	0.24 g	⅛ tsp	0.04
00 flour*	580 g	4⅓ cups	100
Adolph's meat tenderizer (optional)	0.15 g	**	0.03
Fine salt	13 g	2¼ tsp	2.24
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Le 5 Stagioni Pizza Napoletana 00 Flour, Caputo Pizzeria 00 Flour, or Polselli Classica 00 Flour.*

***You can approximate this small amount of dough relaxer by measuring ⅛ tsp meat tenderizer and dividing it into six equal parts. Use two parts to make the dough.*

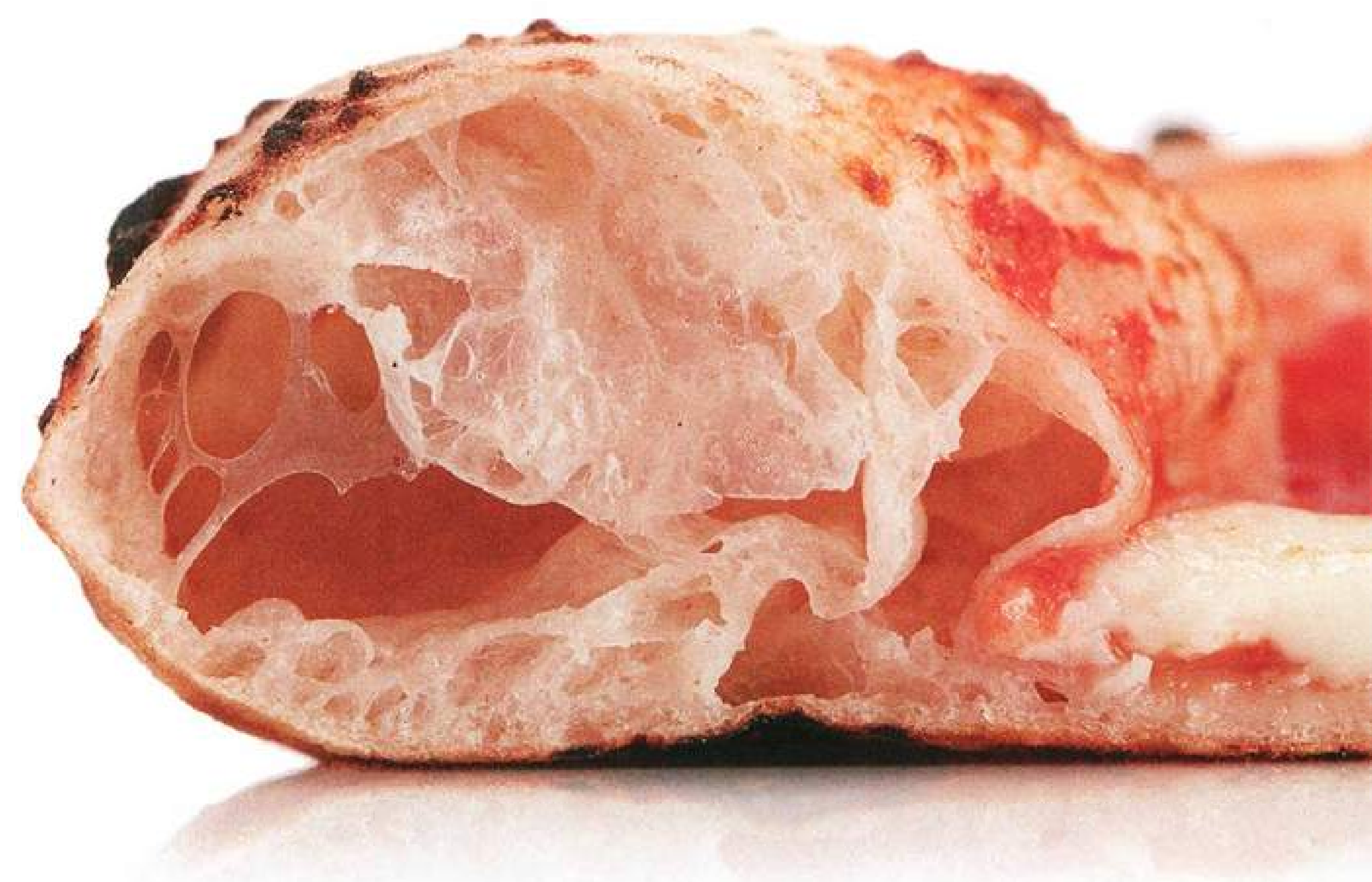
You are trying to achieve a desired dough temperature of 27–28° C / 80–82° F.

We tried increasing the hydration of our master Neapolitan pizza dough but the result was akin to modeling clay (see page 1:289). When we pregelatinized a portion of the flour, however, we were able to achieve a dough that was easy to mix and shape despite its high hydration.

For more on suggested mixing times, see the Machine Mixing Options for Neapolitan Pizza Dough on page 125.

NET CONTENTS

Ingredients	Weight	%
Flour	610 g	100
Water	500 g	81.97
Salt	13 g	2.13
Yeast	0.24 g	0.04



GENERAL DIRECTIONS

PREP whisk together the water and flour for the pregelatinized flour in a small sauce pot; cook over medium heat while whisking constantly until the mixture reaches 65° C / 175° F; cool over an ice bath to room temperature.

MIX combine the water, yeast, and pregelatinized flour in the mixer's bowl, and whisk to dissolve the yeast; add the flour and meat tenderizer, and mix on low speed to a shaggy mass; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a tub lightly misted with water

BULK FERMENT 20–24 h at 21° C / 70° F; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 3 h at 21° C / 70° F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47

Cook the water and flour

Cool over an ice bath

Full gluten development

INGREDIENT VARIATION

NEAPOLITAN PIZZA DOUGH WITH POOLISH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein, or 00 flour*	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21°C / 70°F	330 g	1½ cups	61.68
Instant dry yeast	2.3 g	¾ tsp + ⅛ tsp	0.43
Bread flour, 11.5%–12% protein, or 00 flour*	535 g	4 cups	100
Fine salt	13.4 g	2¼ tsp + ⅛ tsp	2.5
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Le 5 Stagioni Pizza Napoletana 00 Flour, Caputo Pizzeria 00 Flour, or Polselli Classica 00 Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 48½ h	four 30 cm / 12 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	595 g	100
Water	390 g	65.55
Salt	13.4 g	2.25
Yeast	2.36 g	0.4

For more on suggested mixing times, see the Machine Mixing Options for Neapolitan Pizza Dough on page 125.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21°C / 70°F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to low gluten development; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1–2 d at 4°C / 39°F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47

INGREDIENT VARIATION

100% RYE NEAPOLITAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Light rye flour*	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21 °C / 70 °F	330 g	1½ cups	54.73
Instant dry yeast	2.3 g	¾ tsp + ⅛ tsp	0.38
Light rye flour*	535 g	5¼ cups	88.72
Vital wheat gluten	68 g	½ cup	11.28
Fine salt	13.4 g	2¼ tsp + ⅛ tsp	2.22
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Bob's Red Mill Light Rye Flour or Bay State Milling Pure White Rye Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 2½ h	four 30 cm / 12 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	595 g	89.74
Vital wheat gluten	68 g	10.36
Water	390 g	58.82
Salt	13.4 g	2.02
Yeast	2.36 g	0.37

This dough does not do well with a long cold fermentation because the rye flour will cause it to overproof and be difficult to handle. You also won't be able to reball and reuse this dough after the proofing time is up.

To offset the fact that rye flour contains significantly less gluten-forming proteins, we added vital wheat gluten. It's a dense crust, but it works because we roll it out very thin, and it's full of rye flavor.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21 °C / 70 °F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour and vital wheat gluten, and mix on low speed, using a paddle attachment, to a shaggy mass (see page 30); add the salt, and mix on medium speed until the dough forms a ball; transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1½–2 h at 21 °C / 70 °F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47

INGREDIENT VARIATION

AVPN NEAPOLITAN PIZZA DOUGH

ADAPTED FROM THE ASSOCIAZIONE VERACE PIZZA NAPOLETANA

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21 °C / 70 °F	400 g	1¾ cups	64.52
Fresh yeast	0.7 g	⅛ tsp	0.11
Fine salt	17 g	1 Tbsp	2.74
00 flour, 12%–13% protein*	620 g	4½ cups	100
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using 00 flour but the AVPN recently added Tipo 0, 1, and 2 to the list of acceptable flours (see page 1:278). The flour should also have a W between 280 and 310. For more on W numbers, see page 1:278.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 26 h	four 30 cm / 12 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	620 g	100
Water	400 g	64.52
Salt	17 g	2.74
Yeast	0.7 g	0.11

For more on the AVPN rules for making Neapolitan pizza, see page 3:43.

GENERAL DIRECTIONS

MIX (BY HAND) combine 50 g (3 Tbsp + 1½ tsp) of the water with the yeast in a glass or jar, and whisk to dissolve the yeast; combine the salt with the remaining water in a madia (wooden mixing box), and whisk to combine; add 60 g (½ cup) of the flour, and stir into the salt mixture, 1–2 min (it won't mix in completely); add the yeast mixture and then the remaining flour, and mix gently to a homogeneous mass; transfer to a wooden or marble surface, and mix to full gluten development, 5–7 min (see page 30); perform the windowpane test to assess gluten development (see page 30); transfer it back to the madia or a tub lightly misted with water

MIX (BY MACHINE) combine 50 g (3 Tbsp + 1½ tsp) of the water with the yeast in a glass or jar, and whisk to dissolve the yeast; combine the salt with the remaining water in the mixer's bowl, and whisk to combine; add 60 g (½ cup) of the flour to the salt mixture, and mix on low speed, 1–2 min (it won't mix in completely); mix in the yeast mixture on low speed; gradually add the remaining flour in 4–5 additions, and mix on low speed to full gluten development, about 15 min; perform the windowpane test to assess gluten development (see page 30); transfer to a tub lightly misted with water

BULK FERMENT 12–18 h at 20–20.5 °C / 68–69 °F; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 6–8 h at 20–20.5 °C / 68–69 °F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47

In Naples, for a pizzeria to be certified as making true Neapolitan pizza, it must follow the rules of the Associazione Verace Pizza Napoletana (AVPN; see page 3:43). This recipe is consistent with the AVPN requirements regarding ingredients and method, which includes a long bulk fermentation and proofing at room temperature.

This dough is typically mixed in a fork mixer. Most fork mixers can mix only large amounts of dough (the smallest we know of mixes 12 kg batches at a time); keep this in mind when determining the quantity of dough you want to make versus the size and type of mixer that you have.

Alternatively, you can divide and preshape the balls of dough 1 h into bulk fermentation, and leave them to ferment in a tub overnight. We found that this method did not produce as good a pizza as the double fermentation method (bulk fermenting overnight first, then fermenting after balling), but it does streamline production.

MIX BY HAND

Add the yeast mixture and remaining flour, and mix to a homogeneous mass

Transfer to a wood or marble surface and mix by hand to full gluten development

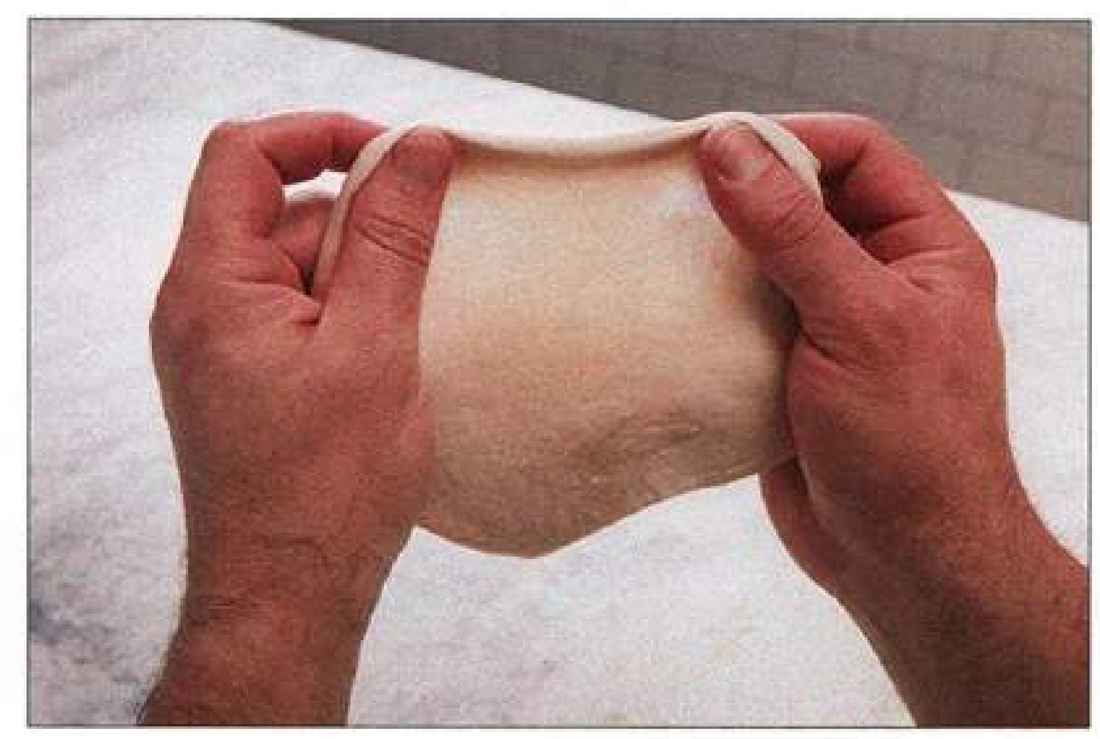
Perform the windowpane test

If you don't have a madia, you can hand mix the dough in a tub or a bowl.

MIX BY MACHINE

Mix in the yeast mixture on low speed

Mix on low speed to full gluten development



Perform the windowpane test

INGREDIENT VARIATION

EMERGENCY NEAPOLITAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Bread flour, 11.5%–12.5% protein, or 00 flour*	585 g	4⅓ cups	100
Water, 38° C / 100° F	400 g	1¾ cups	68.38
Fine salt	20 g	1 Tbsp + ½ tsp	3.42
Instant dry yeast	5.85 g	2⅛ tsp	1
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Le 5 Stagioni Pizza Napoletana 00 Flour, Caputo Pizzeria 00 Flour, or Polselli Classica 00 Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2½ h	four 30 cm / 12 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	585 g	100
Water	400 g	68.38
Salt	20 g	3.42
Yeast	5.85 g	1

For more on suggested mixing times, see the Machine Mixing Options for Neapolitan Pizza Dough on page 125.

GENERAL DIRECTIONS

MIX combine the flour, water, salt, and yeast in the mixer's bowl; mix on medium-high speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2 h at 21° C / 70° F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47

The higher water temperature will help the dough proof faster, making it ready to shape sooner.

MASTER RECIPE

NEW YORK PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	[%]
For the Poolish			
High-gluten bread flour, 13.5%–15% protein*	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21 °C / 70 °F	350 g	1½ cups	66.03
Instant dry yeast	2.8 g	1 tsp	0.53
High-gluten bread flour, 13.5%–15% protein*	530 g	3⅔ cups	100
Diastatic malt powder (optional)	15 g	1 Tbsp + ¾ tsp	2.83
Fine salt	14.5 g	2½ tsp	2.74
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.77
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii

**We recommend using Tony Gemignani California Artisan Type 00 Flour Blend.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 48½ h	one 50 cm / 20 in pizza

NET CONTENTS

Ingredients	Weight	[%]
Flour	590 g	100
Water	410 g	69.49
Fat	20 g	3.39
Salt	14.5 g	2.46
Diastatic malt powder	15 g	2.54
Yeast	2.86 g	0.48

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt stand mixer bowl.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21 °C / 70 °F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour and malt powder, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed until it is fully incorporated; add the oil with the machine running on medium speed, and mix to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1–2 d at 4 °C / 39 °F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:71

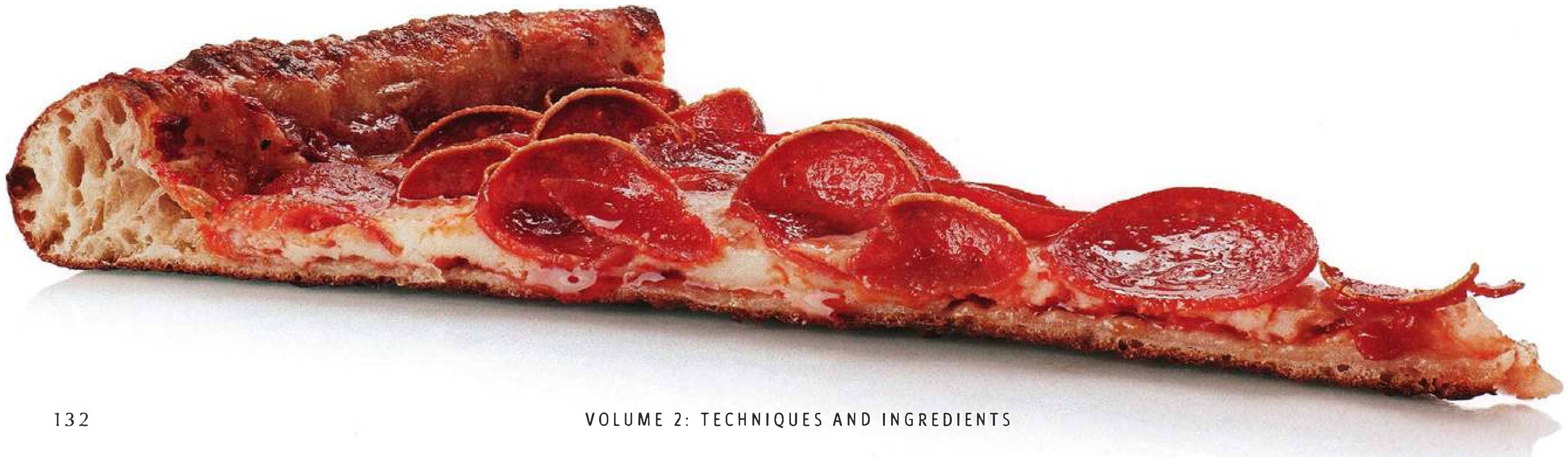
Yield/Size Table

Multiply each ingredient in the New York Pizza Dough master recipe by the number below to obtain the amount of dough for different pizza sizes. For ingredients in small amounts (such as salt, yeast, or diastatic malt powder), precision is key. You should round to the nearest hundredth of a gram.

PIZZA DIAMETER	DOUGH WEIGHT	MULTIPLIER
35 cm / 14 in	400 g	0.4
40 cm / 16 in	600 g	0.6
45 cm / 18 in	800 g	0.8
55 cm / 22 in	1.1 kg	1.1
60 cm / 24 in	1.2 kg	1.2

When you are adding the oil to the mixer, try to pour it toward the center of the dough rather than to the outside. This helps keep it from sloshing around the bowl and makes it easier for the mixer to fully incorporate the oil into the dough.

If making this pizza in a home oven, the 40 cm / 16 in size is the maximum that will fit. We recommend either making this size or the 35 cm / 14 in pizza (400 g dough).



MACHINE MIXING OPTIONS

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to low gluten development, about 5 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 6 min. Perform the windowpane test to assess gluten development.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 1 min. Mix on medium speed to low gluten development, about 5 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 8 min. Perform the windowpane test to assess gluten development.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to low gluten development, about 5 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 8 min. Perform the windowpane test to assess gluten development.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 4 min. Mix on medium speed to low gluten development, about 6 min. Add the salt, and mix on medium speed until it is fully incorporated, about 2 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 15 min. Perform the windowpane test to assess gluten development.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, 2–3 min. Add the salt and oil, and mix on medium speed to full gluten development, about 12 min. Perform the windowpane test to assess gluten development.

FOOD PROCESSOR

Weight: 12–16 cup work bowl: 1 kg

Robot Coupe, 2–3 qt work bowl: 1.2 kg; industrial-sized food processors: capacity will vary

Mix: place the flour, malt powder, salt, and yeast in the bowl. Pour the poolish on top of the dry ingredients. Turn the machine on and pour in the water. Mix for 45 s. Pour in the oil, and mix for a few seconds, until it is completely incorporated. Perform the windowpane test to assess gluten development. If the gluten is not fully developed, mix for a few more seconds and check again.

Low gluten development

Add salt at low gluten development

Full gluten development

We typically use a dough hook to mix all our medium-crust pizza doughs. If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

The larger the yield, the longer the dough will take to mix. Final mixing time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

If you want to make a 400 g or 600 g pizza that will fit in a home oven, we recommend mixing 1.2 kg of dough and dividing it into 2 or 3 pieces because these smaller yields are hard to mix in a stand mixer. To make a single 400 g or 600 g dough ball, we suggest that you hand mix the dough (see page 46).

PREP

1 Combine the flour, water, and yeast for the poolish, and mix to a homogeneous mass. Transfer the poolish to an airtight container, cover, and let it ripen at 21 °C / 70 °F for 12–16 h before using (see page 1:300).

MIX

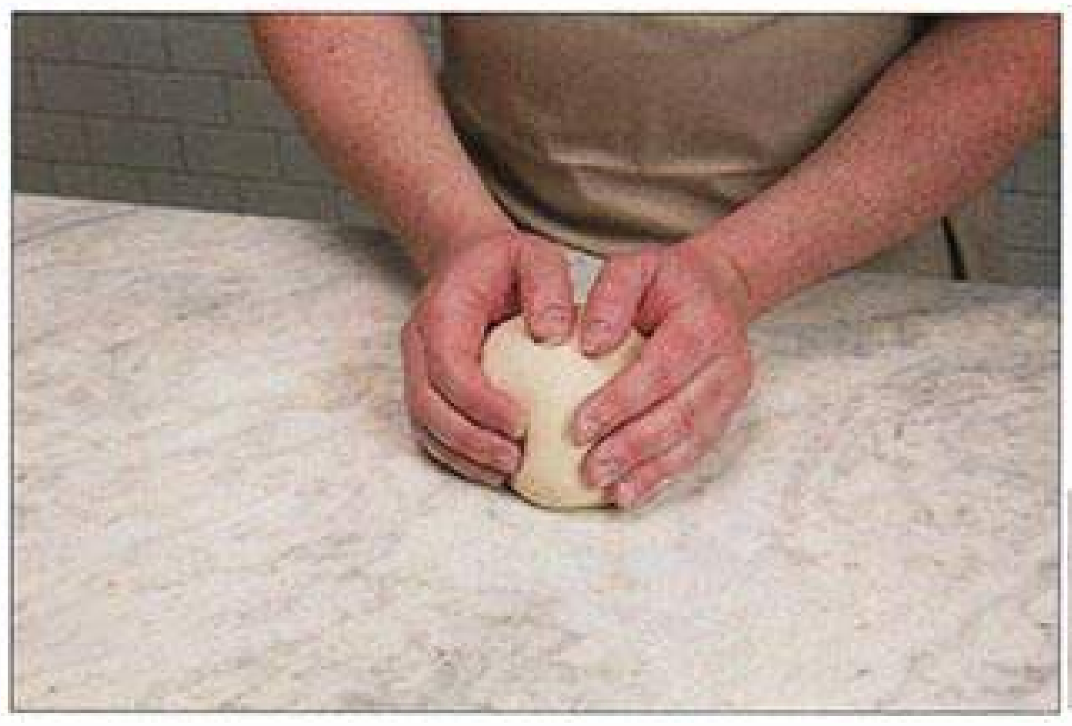
2 Follow the Machine Mixing Options on page 133.

3 Transfer the dough to a lightly floured worktable. Cover well with a plastic bag or tarp.

BENCH REST

4 Bench rest for 20 min.

PRESHAPE



5 Preshape the dough into a ball (see pages 61–62).

6 Place in a tub or on a sheet pan. Spray a very light mist of water over the dough.

7 Cover the tub well or wrap the sheet pan with plastic wrap.

Although we recommend proofing the dough for 1–2 d, you can reball the dough after 2 d and return it to refrigeration for up to another 3 d (5 d total).

If you're using a tub to proof the dough, make sure it is large enough to accommodate the expansion of the dough ball.

COLD-PROOF

8 Cold-proof the dough, covered, for 1–2 d at 4 °C / 39 °F.

9 Remove the dough from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

10 Shape according to the instructions on page 3:66. Assemble and bake the pizza according to the instructions on page 3:71.

Cold-proofing will help the dough relax without proofing it too far, making the dough easier to work with. In our tests, letting the dough proof in refrigeration for at least 24 h produced a pizza dough that was easier to stretch and had better volume and a crispier crust.

INGREDIENT VARIATION

MODERNIST NEW YORK PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13.5%–15% protein*	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21 °C / 70 °F	360 g	1½ cups	67.92
Instant dry yeast	2.8 g	1 tsp	0.53
High-gluten bread flour, 13.5%–15% protein*	530 g	3⅔ cups	100
Dough relaxer options see table below			
High-methoxyl pectin	11.8 g	1 Tbsp + 1 tsp	2.23
Diastatic malt powder	15 g	1 Tbsp + ¾ tsp	2.83
Fine salt	14.5 g	2½ tsp	2.74
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.77
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Tony Gemignani California Artisan Type 00 Flour Blend.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

Follow the Prep through Proof instructions for New York Pizza Dough on page 132. See the table at right for instructions for adding the dough relaxer. Add the pectin with the flour.

If you want to make a 400 g or 600 g pizza that will fit in a home oven, we recommend mixing 1.2 kg of dough and dividing it into 2 or 3 pieces because these smaller yields are hard to mix in a stand mixer. To make a single 400 g or 600 g dough ball, we suggest that you hand mix the dough (see page 46).

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 48½ h	one 50 cm / 20 in pizza

NET CONTENTS

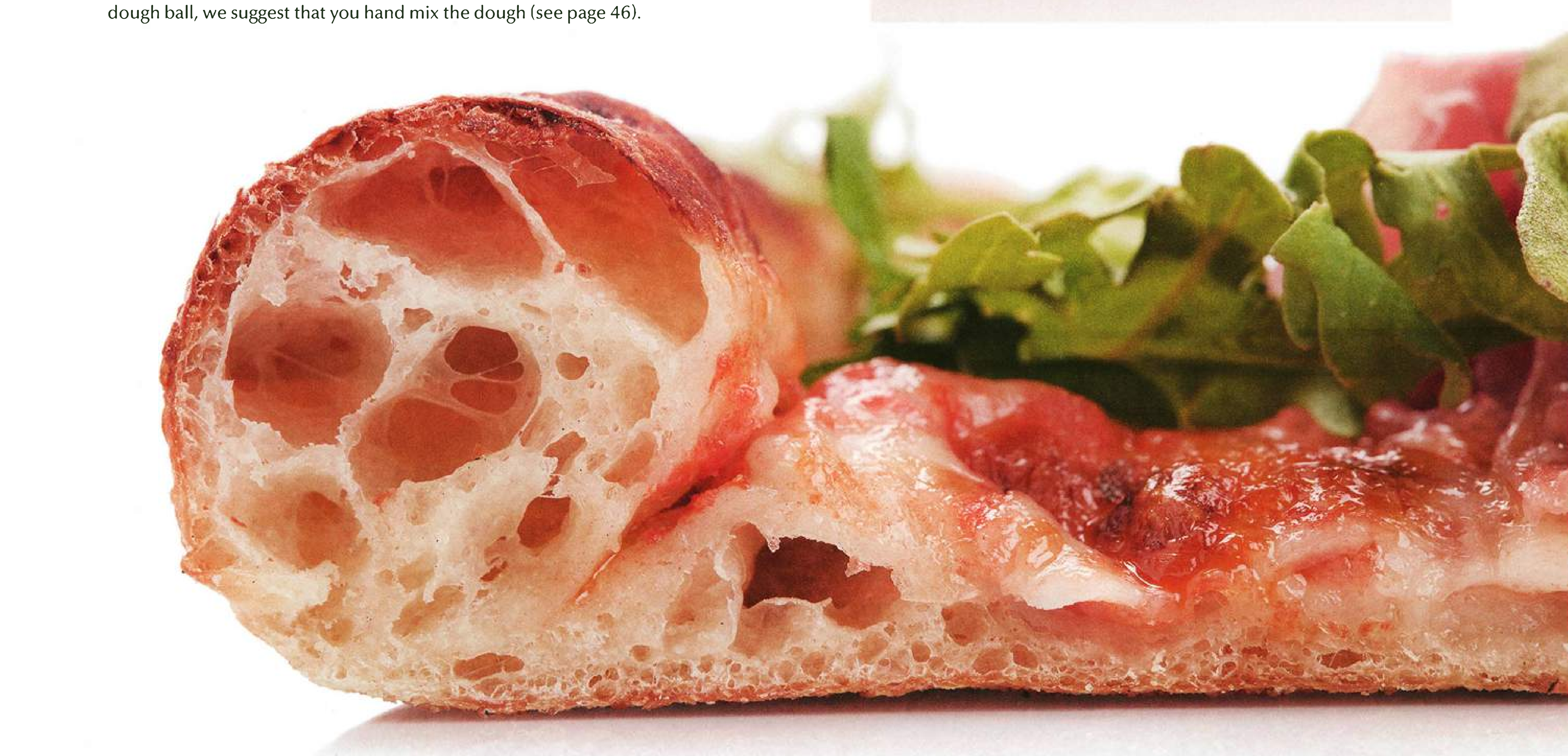
Ingredients	Weight	%
Flour	590 g	100
Water	420 g	71.19
Fat	20 g	3.39
Diastatic malt powder	15 g	2.54
Salt	14.5 g	2.46
Pectin	11.8 g	2
Yeast	2.86 g	0.48

We added pectin to this recipe to increase the volume of the crust.

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract pineapple juice, kiwi juice, and papaya juice, see page 1:328. Papain performed the best in our tests.

INGREDIENT	%	ADD TO . . .
Papain, powdered	0.01	the flour
Papaya juice, fresh	0.03	the water
Pineapple juice, fresh	0.01	the water
Kiwi juice, fresh	0.08	the water
Adolph's meat tenderizer	0.01	the flour



INGREDIENT VARIATION

DIRECT NEW YORK PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21 °C / 70 °F	410 g	1¾ cups	69.49
Instant dry yeast	2.8 g	1 tsp	0.47
High-gluten bread flour, 13.5%–15% protein*	590 g	4 cups	100
Diastatic malt powder	15 g	1 Tbsp + ¾ tsp	2.54
Fine salt	14.5 g	2½ tsp	2.46
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.39
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Tony Gemignani California Artisan Type 00 Flour Blend.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 6 h	one 50 cm / 20 in pizza

NET CONTENTS

Ingredients	Weight	%
Flour	590 g	100
Water	410 g	69.49
Fat	20 g	3.39
Diastatic malt powder	15 g	2.54
Salt	14.5 g	2.46
Yeast	2.8 g	0.47

After preshaping, you can also cold-proof this dough at 4 °C / 39 °F for 1–2 d for even better baking and texture results. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

For more on suggested mixing times, see the Machine Mixing Options for New York Pizza Dough on page 133.

GENERAL DIRECTIONS

MIX	combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour and malt powder, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed until it is fully incorporated; add the oil with the machine running on medium speed, and mix until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable
BENCH REST	20 min; cover well
PRESHAPE	ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well
PROOF	4½–5½ h at 21 °C / 70 °F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:71

If you want to make a 400 g or 600 g pizza that will fit in a home oven, we recommend mixing 1.2 kg of dough and dividing it into 2 or 3 pieces because these smaller yields are hard to mix in a stand mixer. To make a single 400 g or 600 g dough ball, we suggest that you hand mix the dough (see page 46).

INGREDIENT VARIATION

EMERGENCY NEW YORK PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Bread flour, 11.5%–12% protein*	585 g	4⅓ cups	100
Water, 38 °C / 100 °F	405 g	1¾ cups	69.23
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.42
Fine salt	14 g	2½ tsp	2.39
Instant dry yeast	5.85 g	2⅛ tsp	1
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Central Milling Organic Artisan Bakers Craft Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2½ h	one 50 cm / 20 in pizza

NET CONTENTS

Ingredients	Weight	%
Flour	585 g	100
Water	405 g	69.23
Fat	20 g	3.42
Salt	14 g	2.39
Yeast	5.85 g	1

GENERAL DIRECTIONS

MIX combine the flour, water, oil, salt, and yeast in the mixer's bowl; mix on medium-high speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

The higher water temperature will help the dough proof faster so that it will be ready to shape sooner.

If you want to make a 400 g or 600 g pizza that will fit in a home oven, we recommend mixing 1.2 kg of dough and dividing it into 2 or 3 pieces because these smaller yields are hard to mix in a stand mixer. To make a single 400 g or 600 g dough ball, we suggest that you hand mix the dough (see page 46).

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2 h at 21 °C / 70 °F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:71

For more on suggested mixing times, see the Machine Mixing Options for New York Pizza Dough on page 133.

SUBMASTER RECIPE

APIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein*	55 g	⅓ cup + 1 Tbsp	100
Water	55 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.11
For the Dough			
Water, 21° C / 70° F	330 g	1⅓ cup + 2 Tbsp	60
Instant dry yeast	2 g	¾ tsp	0.36
Bread flour, 11.5%-12% protein	550 g	4 cups + 1 Tbsp	100
Fine salt	11 g	2 tsp	2
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommended using Central Milling Organic Artisan Bakers Craft Bread Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 4 h	two 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	605 g	100
Water	385 g	63.63
Salt	11 g	1.82
Yeast	2.06 g	0.33

For more on suggested mixing times, see the Machine Mixing Options for New York Pizza Dough on page 133.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21° C / 70° F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 500 g

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 3–3½ h at 21° C / 70° F, covered, or 2–2½ h at 27° C / 80° F and 65% RH; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:73

SUBMASTER RECIPE

APIZZA DOUGH VARIATION

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	310 g	1⅓ cups	50.41
Instant dry yeast	3 g	1⅛ tsp	0.49
Bread flour, 11.5%–12% protein*	615 g	4½ cups	100
Fine salt	6 g	1 tsp	0.98
	Yield: ~900 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommended using Central Milling Organic Artisan Bakers Craft Bread Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 4 h	two 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	615 g	100
Water	310 g	50.41
Salt	6 g	0.98
Yeast	3 g	0.49

Follow the Prep through Proof instructions for Apizza Dough on previous page. Omit the poolish, and divide the dough into two 450 g pieces.

The pizza that results from this dough is similar to the ones that we sampled during our trip to New Haven, CT (see page 1:228).

SUBMASTER RECIPE

QUAD CITIES PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Flour, 11.5%–14% protein*	60 g	½ cup	100
Water	60 g	¼ cup	100
Instant dry yeast	0.06 g	**	0.1
For the Dough			
Water, 21° C / 70° F	260 g	1 cup + 2 Tbsp	49.06
Instant dry yeast	2.8 g	1 tsp	0.53
Flour, 11.5%–14% protein*	530 g	4 cups	100
Malted barley syrup	60 g	3 Tbsp	11.32
Fine salt	14.5 g	2½ tsp	2.74
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.77
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour, Tony Gemignani California Artisan Type 00 Flour Blend, Bouncer Premium High Gluten Flour, Pillsbury Balancer Hi Gluten Flour, or Grain Craft Power High Gluten Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15 min / Inactive 48½ h	two 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	590 g	100
Water	332.6 g	56.37
Sugar	42.8 g	7.25
Fat	20 g	3.39
Salt	14.5 g	2.46
Yeast	2.86 g	0.48

This recipe is our interpretation of Quad Cities dough. The variation on the next page more closely replicates what pizza makers in Quad Cities shared with us.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21° C / 70° F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour and malt syrup, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed until it is fully incorporated; add the oil while the machine is running on medium speed, and mix to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 500 g

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1–2 d at 4° C / 39° F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:84

SUBMASTER RECIPE

QUAD CITIES PIZZA DOUGH VARIATION

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	375 g	1⅔ cups	61.47
Malted barley syrup	30 g	1 Tbsp + 1¼ tsp	4.9
Instant dry yeast	2.2 g	¾ tsp	0.36
Bread flour, 11.5%–12% protein*	610 g	4½ cups	100
Fine salt	12.2 g	2⅛ tsp	2
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommended using Central Milling Organic Artisan Bakers Craft Bread Flour.*

TOTAL TIME	YIELD/SHAPE
Active 10 min / Inactive 4 h	two 40 cm / 16 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	610 g	100
Water	381 g	62.45
Sugar	21 g	3.44
Salt	12.2	2
Yeast	2.2	0.36

This recipe makes a dough that is closer to the pizzas that we tried during our visit to Quad Cities, a region of five cities in Iowa and Illinois (see page 1:248).

The optional cold-proofing provides good extensibility and makes the dough easy to stretch. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

For more on suggested mixing times, see the Machine Mixing Options for New York Pizza Dough on page 133.

GENERAL DIRECTIONS

MIX	combine the water, malt syrup, and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; autolyse for 30 min; add the salt, and mix on low speed until incorporated; mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly oiled tub
BENCH REST	1 h at 21° C / 70° F; cover well
DIVIDE	500 g
PRESHAPE	ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well
PROOF	3 h at 21° C / 70° F, covered, or 2 h 40 min at 27° C / 80° F and 65% RH; optional cold-proof for 2 d at 4° C / 39° F; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3: 84

MASTER RECIPE

ARTISAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13%–14% protein*	75 g	½ cup	100
Water	75 g	⅓ cup	100
Instant dry yeast	0.08 g	**	0.11
For the Dough			
Water, 21° C / 70° F	375 g	1⅔ cups	68.18
Instant dry yeast	2.6 g	1 tsp	0.47
High-gluten bread flour, 13%–14% protein*	550 g	3¾ cups	100
Diastatic malt powder	13 g	1 Tbsp + ¼ tsp	2.36
Fine salt	12.5 g	2¼ tsp	2.27
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.64
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Giusto's High Performer High Protein Unbleached Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into four equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 48½ h	three 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	625 g	100
Water	450 g	72
Fat	20 g	3.2
Diastatic malt powder	13 g	2.08
Salt	12.5 g	2
Yeast	2.68 g	0.43

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

This is an easy-to-work-with dough and an excellent choice for home cooks.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21° C / 70° F, covered

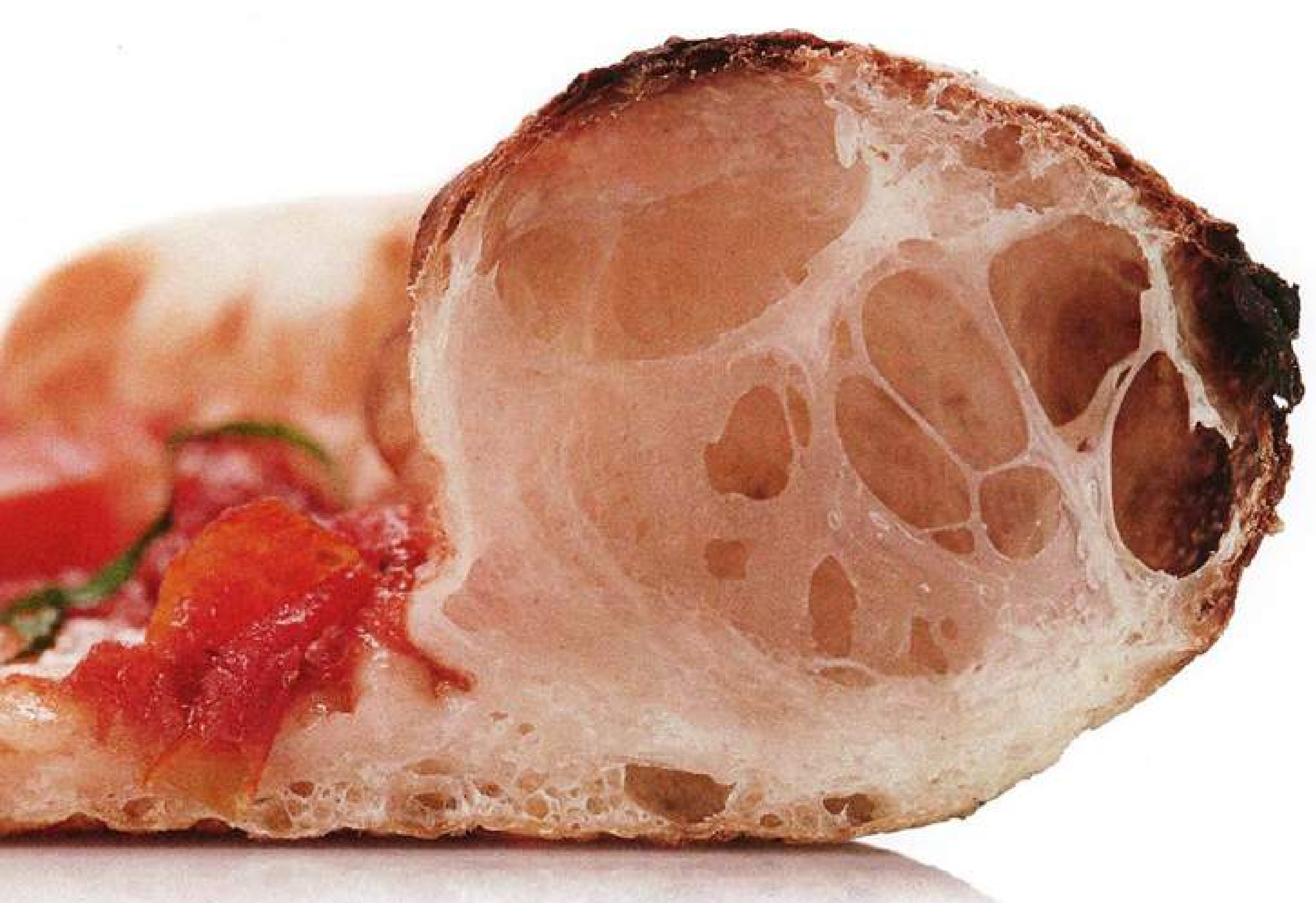
MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour and malt powder, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed until it is fully incorporated; add the oil while the machine is running on medium speed, and mix until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 360 g

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1–2 d at 4° C / 39° F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:77



Yield/Size Table

Multiply each ingredient in the Artisan Pizza Dough master recipe by the number below to obtain the amount of dough to yield three pizzas in different sizes. For ingredients in small amounts (such as salt, yeast, or diastatic malt powder), precision is key. You should round to the nearest hundredth of a gram.

PIZZA DIAMETER	DOUGH WEIGHT	MULTIPLIER
40 cm / 16 in	400 g	1.1
45 cm / 18 in	470 g	1.3
50 cm / 20 in	500 g	1.4
55 cm / 22 in	580 g	1.6
60 cm / 24 in	620 g	1.7

MACHINE MIXING OPTIONS

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 3 min. Mix on medium speed to low gluten development, about 4 min. Add the salt, and mix on medium speed until it is fully incorporated, about 2 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 7 min. Perform the windowpane test to assess gluten development.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 1 min. Mix on medium speed to low gluten development, about 5 min. Add the salt, and mix on medium speed until it is fully incorporated, about 1 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 11 min. Perform the windowpane test to assess gluten development.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to low gluten development, about 10 min. Add the salt, and mix on medium speed until it is fully incorporated, about 2 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 15 min. Perform the windowpane test to assess gluten development.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, about 3 min. Mix on medium speed to low gluten development, about 10 min. Add the salt, and mix on medium speed until it is fully incorporated, about 5 min. Add the oil while the machine is running on medium speed, and mix to full gluten development, about 20 min. Perform the windowpane test to assess gluten development.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour and malt powder, and mix on low speed to a shaggy mass, 2–3 min. Add the salt and oil, and mix on medium speed to full gluten development, about 15 min. Perform the windowpane test to assess gluten development.

Low gluten development

Full gluten development

PREP

1 Combine the flour, water, and yeast for the poolish, and mix to a homogeneous mass. Transfer the poolish to an airtight container, cover, and let it ripen at 21 °C / 70 °F for 12 h before using (see page 1:300).

When you are adding the oil to the mixer, try to pour the oil toward the center of the dough rather than to the outside of the dough. This helps keep it from sloshing around the bowl and makes it easier for the mixer to fully incorporate it into the dough.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

MIX

2 Follow the Machine Mixing Options above.

3 Transfer the dough to a lightly floured worktable. Cover well with a plastic bag or tarp.

BENCH REST

4 Bench rest for 20 min.

We typically use a dough hook to mix all our medium-crust pizza doughs. If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

DIVIDE

5 Divide into three 360 g pieces (see page 55).

PRESHAPE

6 Preshape the dough into a ball (see pages 61–62).

7 Place in a tub or on a sheet pan. Spray a very light mist of water over the dough.

8 Cover the tub well or wrap the sheet pan with plastic wrap.

COLD-PROOF

9 Cold-proof the dough, covered, for 1–2 d at 4 °C / 39 °F.

10 Remove the dough from refrigeration 1½–2 h before shaping so the dough warms up and is easier to stretch out.

11 Shape according to the instructions on page 3:66. Assemble and bake the pizza according to the instructions on page 3:77.

Cold-proofing will help the dough relax without proofing it too far, and it will make it easier to work with. In our tests, letting the dough proof in refrigeration for at least 24 h produced a better pizza dough that was easier to stretch and had better volume and a crispier crust.

Although we recommend proofing the dough for 1–2 d, you can reball the dough after 2 d and return it to refrigeration for up to another 3 d (5 d total).

INGREDIENT VARIATION

MODERNIST ARTISAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13%–14% protein*	75 g	½ cup	100
Water	75 g	⅓ cup	100
Instant dry yeast	0.08 g	**	0.11
For the Dough			
Water, 21 °C / 70 °F	375 g	1⅔ cups	68.18
Instant dry yeast	2.6 g	1 tsp	0.47
High-gluten bread flour, 13%–14% protein*	550 g	3¾ cups	100
Dough relaxer options see table below			
High-methoxyl pectin	12.5 g	1 Tbsp + 1 tsp	2.2
Diastatic malt powder	13 g	1 Tbsp + ¼ tsp	2.36
Fine salt	12.5 g	2¼ tsp	2.27
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.64
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Giusto's High Performer High Protein Unbleached Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into four equal parts. Use one part to make the poolish.*

Follow the Prep through Proof instructions for Artisan Pizza Dough on page 142. See the table at right for instructions on adding the dough relaxer. Add the pectin with the flour.

We added pectin to this recipe to increase the volume of the crust.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 48½ h	three 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	625 g	100
Water	450 g	72
Fat	20 g	3.2
Diastatic malt powder	13 g	2.08
Pectin	12.5 g	2
Salt	12.5 g	2
Yeast	2.68 g	0.43

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. Bromelain and papain performed best in our tests.

INGREDIENT	%	ADD TO . . .
Bromelain, powdered	0.0005	the flour
Papain, powdered	0.01	the flour
Adolph's meat tenderizer	0.01	the flour

INGREDIENT VARIATION

HIGH-HYDRATION ARTISAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13%–14% protein*	65 g	½ cup	100
Water	65 g	¼ cup	100
Instant dry yeast	0.07 g	**	0.11
For the Dough			
Water, 21° C / 70° F	385 g	1⅔ cups	81.91
Instant dry yeast	2.1 g	¾ tsp	0.45
High-gluten bread flour, 13%–14% protein*	470 g	3¼ cups	100
Diastatic malt powder	11 g	2¾ tsp	2.34
Fine salt	11 g	2 tsp	2.34
Extra-virgin olive oil	17 g	1 Tbsp + ½ tsp	3.62
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Giusto's High Performer High Protein Unbleached Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into five equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 48½ h	three 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	535 g	100
Water	450 g	84.11
Fat	17 g	3.18
Salt	11 g	2.06
Diastatic malt powder	11 g	2.06
Yeast	2.17 g	0.41

Follow the Prep through Proof instructions for Artisan Pizza Dough on page 142. Divide the dough into 330 g pieces.

As the extra water evaporates during baking, it really opens up the dough, yielding a bubbly crust and a crumb structure that is light as air. We don't recommend this variation for beginners; the more water a dough contains, the harder it is to handle.

INGREDIENT VARIATION

DIRECT ARTISAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	450 g	2 cups	72
Instant dry yeast	2.6 g	1 tsp	0.42
High-gluten bread flour, 13%–14% protein*	625 g	4⅔ cups	100
Diastatic malt powder	13 g	1 Tbsp + ¼ tsp	2.08
Fine salt	12.5 g	2¼ tsp	2
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.2
	Yield: ~1.1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Giusto's High Performer High Protein Unbleached Flour.*

After preshaping, you can also cold-proof this dough at 4° C / 39° F for 1–2 d for even better baking and texture results. If you cold-proof the dough, remove the dough from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 6 h	three 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	625 g	100
Water	450 g	72
Fat	20 g	3.2
Diastatic malt powder	13 g	2.08
Salt	12.5 g	2
Yeast	2.6 g	0.42

For more on suggested mixing times, see the Machine Mixing Options for Artisan Pizza Dough on page 143.

GENERAL DIRECTIONS

MIX	combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour and malt powder, and mix on low speed to a shaggy mass; mix on medium speed to low gluten development; add the salt, and mix on medium speed until it is fully incorporated; add the oil with the machine running on medium speed, and mix the dough until it reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable
BENCH REST	20 min; cover well
DIVIDE	360 g
PRESHAPE	ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well
PROOF	4½–5½ h at 21° C / 70° F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:77

Direct artisan pizza dough

INGREDIENT VARIATION

EMERGENCY ARTISAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Bread flour, 11.5%–12% protein*	575 g	4¼ cups	100
Water, 38 °C / 100 °F	415 g	1¾ cups + 1 Tbsp	72.17
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	3.48
Diastatic malt powder	11.5 g	2¾ tsp + ⅛ tsp	2
Salt	11.5 g	2 tsp	2
Instant dry yeast	4.6 g	1½ + ⅛ tsp	0.80
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommended using Central Milling Organic Artisan Bakers Craft Bread Flour.*

The higher water temperature will help the dough proof faster so that it will be ready to shape sooner.

For more on suggested mixing times, see the Machine Mixing Options for Artisan Pizza Dough on page 143.

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2½ h	three 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	575 g	100
Water	415 g	72.17
Fat	20 g	3.48
Salt	11.5 g	2
Diastatic malt powder	11.5 g	2
Yeast	4.6 g	0.80

GENERAL DIRECTIONS

MIX combine the flour, water, oil, malt powder, salt, and yeast in the mixer's bowl; mix on medium-high speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 20 min; cover well

DIVIDE 330 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2 h at 21 °C / 70 °F, covered; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:77

MASTER RECIPE

FOCACCIA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13.5%–15% protein*	65 g	½ cup	100
Water	65 g	¼ cup	100
Instant dry yeast	0.07 g	**	0.11
For the Dough			
Water, 21 °C / 70 °F	335 g	1¼ cups + 3 Tbsp	83.75
Liquid levain, mature see page 1:304	60 g	¼ cup	15
Malted barley syrup	5 g	¾ tsp	1.25
Instant dry yeast	1.2 g	½ tsp	0.3
High-gluten bread flour, 13.5%–15% protein*	400 g	2¾ cups	100
Fine salt	10 g	1¾ tsp	2.5
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	5
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into five equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in focaccia

NET CONTENTS

Ingredients	Weight	%
Flour	495 g	100
Water	432 g	87.27
Fat	20 g	4.04
Salt	10 g	2.02
Sugar	3.5 g	0.71
Yeast	1.27 g	0.25

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

You can divide this dough in half and make two quarter-sheet-pan-sized focaccias, if desired.

We like using focaccia pans (see page 68), because the black steel will make for a crispier crust

GENERAL DIRECTIONS

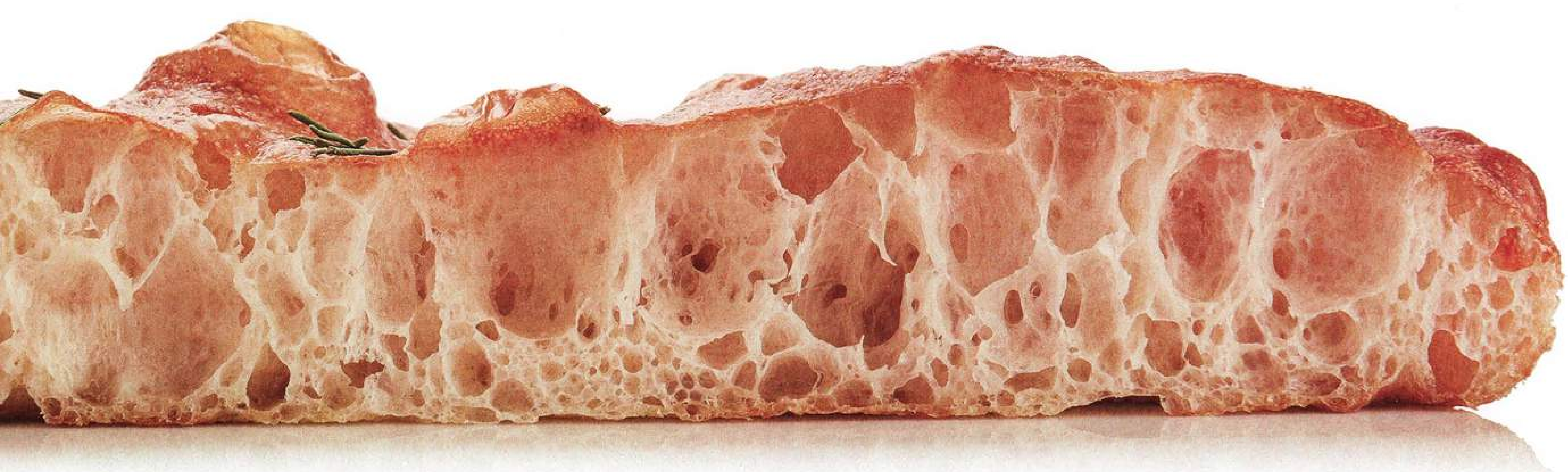
PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21 °C / 70 °F, covered

MIX combine 285 g (1¼ cups) of the water with the levain, malt syrup, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; autolyse 30 min; meanwhile, stir the salt into the remaining water; add the salt mixture, and mix on low speed until it is fully incorporated; mix on high speed to medium gluten development; add the oil in a slow stream while the machine is running on medium speed, and mix until it is fully incorporated; transfer to a lightly oiled tub, and shape into a rectangle; perform a four-edge fold

BULK FERMENT 2½ h at 21 °C / 70 °F; cover well; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); rest the dough, covered, for 30 min after the final fold; generously oil a half sheet pan

PRESHAPE transfer the dough to the prepared pan seam side down, trying to maintain the rectangular shape; coat the surface of the dough with more oil; stretch the dough gently but assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp

PROOF 3 h at 21 °C / 70 °F, covered, or 2 h at 27 °C / 80 °F and 65% RH; halfway through proofing, gently but assertively stretch the dough out again to fill the pan as evenly as possible; for shaping instructions, see page 3:117; for assembly and baking instructions, see page 3:117



MACHINE MIXING OPTIONS

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine 285 g (1¼ cups) of the water with the levain, malt syrup, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 5 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Add the salt mixture, and mix on low speed until it is fully incorporated. Mix on high speed to medium gluten development, about 10 min. Add the oil in a slow stream while the machine is running on medium speed, and mix until it is fully incorporated.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: combine 285 g (1¼ cups) of the water with the levain, malt syrup, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 1 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Add the salt mixture, and mix on low speed until it is fully incorporated. Mix on high speed to medium gluten development, about 3 min. Add the oil in a slow stream while the machine is running on medium speed, and mix until it is fully incorporated.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: combine 285 g (1¼ cups) of the water with the levain, malt syrup, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on medium speed to a shaggy mass, about 5 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Add the salt mixture, and mix on medium speed until it is fully incorporated. Mix on high speed to medium gluten development, about 10 min. Add the oil in a slow stream while the machine is running on medium speed, and mix until it is fully incorporated.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: combine 285 g (1¼ cups) of the water with the levain, malt syrup, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 8 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Add the salt mixture, and mix on low speed until it is fully incorporated. Mix on high speed to medium gluten development, about 15 min. Add the oil in a slow stream while the machine is running on medium speed, and mix until it is fully incorporated.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: combine 285 g (1¼ cups) of the water with the levain, malt syrup, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on medium speed to a shaggy mass, 2–3 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Add the salt mixture and oil, and mix on high speed to medium gluten development, about 1 h 2 min.

If you are mixing the dough with a diving arm mixer, it may feel tighter than doughs made with the other mixers.

Medium gluten development

PREP

1 Combine the flour, water, and yeast for the poolish, and mix to a homogeneous mass. Transfer the poolish to an airtight container, cover, and let it ripen at 21° C / 70° F for 12–16 h before using (see page 1:300).

You will need to mix this dough on high speed to achieve medium gluten development.

When you are adding the oil to the mixer, try to pour it toward the center of the dough rather than to the outside. This helps keep it from sloshing around the bowl and makes it easier for the mixer to fully incorporate it into the dough.

MIX

2 Follow the Machine Mixing Options above.

3 Transfer the dough to a lightly oiled tub. Shape it into a rectangle. Perform a four-edge fold. Cover well with plastic wrap.

If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and medium gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development (see page 30).

BULK FERMENT

4 Bulk ferment, covered, for 2½ h at 21 °C / 70 °F; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development.

Perform the windowpane test to assess gluten development. Rest the dough, covered, for 30 min after the final fold.

5 Drizzle olive oil evenly over a half sheet pan.

For batches larger than 1 kg, we suggest you use the following steps (this assumes you have made additional dough in 1 kg increments). We devised this method because it is very hard to maintain an even piece of dough in large batches. Shaping it with the last four-edge fold in the pan helps keep it evenly rectangular and also evenly thick. It will relax in the pan, which will make the task of shaping easier.

1. 30 min after performing the 4th four-edge fold, turn the dough out of the tub onto a lightly oiled worktable and divide the dough into 1 kg pieces, keeping the dough as rectangular as possible.
2. Place each piece of dough on a well-oiled half sheet pan and perform a four-edge fold. Coat the dough with oil and rest for 30 min.
3. Stipple the dough and extend it to fill out the pan completely and evenly. Proceed with the Proof instructions.

PRESHAPE

6 Transfer the dough to the center of the prepared pan seam side down, trying to maintain the rectangular shape.

7 Gently but assertively stretch the dough to fit the pan. Make sure the corners are sharp and fill out the corners of the pan.

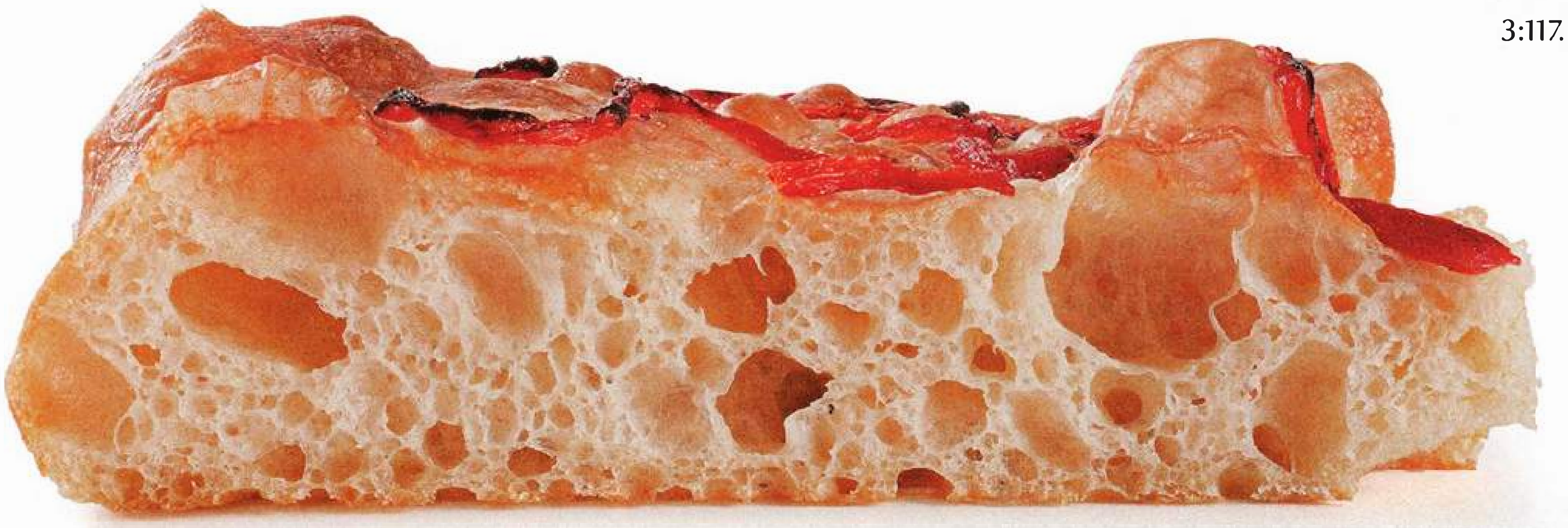
8 Drizzle the surface of the dough with more oil and stretch the dough as much as you can without damaging it to try to fill the pan evenly.

When you are stippling the dough, don't force it or the dough will tear. Let it relax for 15–20 min before stretching it again.

PROOF

9 Proof the dough, covered, for 3 h at 21 °C / 70 °F or for 2 h at 27 °C / 80 °F and 65% RH. Halfway through proofing, gently but assertively stretch the dough out again to fill the pan as evenly as possible.

10 Shape according to the instructions on page 3:117. Assemble and bake the focaccia according to the instructions on page 3:117.



INGREDIENT VARIATION

MODERNIST FOCACCIA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13.5%–15% protein*	65 g	½ cup	100
Water	65 g	¼ cup	100
Instant dry yeast	0.07 g	**	0.11
For the Dough			
Water, 21° C / 70° F	335 g	1¼ cups + 3 Tbsp	83.75
Liquid levain, mature see page 1:304	60 g	¼ cup	15
Malted barley syrup	5 g	¾ tsp	1.25
Instant dry yeast	1.2 g	½ tsp	0.3
High-gluten bread flour, 13.5%–15% protein*	400 g	2¾ cups	100
Dough relaxer options see table below			
High-methoxyl pectin	3.2 g	1 tsp	0.8
Fine salt	10 g	1¾ tsp	2.5
Shortening, lard, or ghee, softened	20 g	1 Tbsp + 1¼ tsp	5
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour.*

**You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into five equal parts. Use one part to make the poolish.*

Follow the Prep through Proof instructions for Focaccia Dough on page 148. See the table at right for instructions for adding the dough relaxer. Add the pectin with the flour.

We added pectin to this recipe to increase the volume of the crust.

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in focaccia

NET CONTENTS

Ingredients	Weight	%
Flour	495 g	100
Water	432 g	87.27
Fat	20 g	4.04
Salt	10 g	2.02
Sugar	3.5 g	0.71
Pectin	3.2 g	0.64
Yeast	1.27 g	0.26

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract pineapple juice and kiwi juice, see page 1:328. Bromelain performed best in our tests.

INGREDIENT	%	ADD TO . . .
Bromelain, powdered	0.0005	the flour
Pineapple juice, fresh	0.01	the remaining water
Kiwi juice, fresh	0.08	the remaining water
Papain, powdered	0.01	the flour
Adolph's meat tenderizer	0.01	the flour

INGREDIENT VARIATION

DIRECT FOCACCIA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	430 g	1¾ cups + 2 Tbsp	86.87
Malted barley syrup	5 g	¾ tsp	1.01
Instant dry yeast	2.5 g	1 tsp	0.51
High-gluten bread flour, 13.5%–15% protein*	495 g	3¼ cups + 2 Tbsp	100
Fine salt	10 g	1¾ tsp	2.02
Extra-virgin olive oil	20 g	1 Tbsp + 1¼ tsp	4.04
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour.*

Follow the Mix through Proof instructions for Focaccia Dough on page 148. Omit the poolish and levain.

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in focaccia

NET CONTENTS

Ingredients	Weight	%
Flour	495 g	100
Water	432 g	87.27
Fat	20 g	4.04
Salt	10 g	2.02
Sugar	3.5 g	0.71
Yeast	2.5 g	0.51

MASTER RECIPE

NEW YORK SQUARE PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13.5%–15% protein*	40 g	¼ cup + 2 tsp	100
Water	40 g	2 Tbsp + 2 tsp	100
Instant dry yeast	0.05 g	**	0.13
For the Dough			
Water, 21° C / 70° F	255 g	1 cup + 1½ Tbsp	71.83
Instant dry yeast	1.95 g	¾ tsp	0.54
High-gluten bread flour, 13.5%–15% protein*	355 g	2½ cups	100
Fine salt	7.9 g	1¼ tsp + ⅛ tsp	2.23
Extra-virgin olive oil	15 g	1 tbsp + ¼ tsp	4.23
	Yield: ~700g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active 20-25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in pizza

NET CONTENTS

Ingredients	Weight	%
Flour	395 g	100
Water	295 g	74.68
Fat	15 g	3.8
Salt	7.9 g	2
Yeast	1.95 g	0.49

The 700 g yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

GENERAL DIRECTIONS

PREP mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21° C / 70° F, covered

MIX combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; autolyse for 30 min; add the salt, and mix on low speed until it is fully incorporated; add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated; mix on medium speed to medium gluten development; transfer to a lightly oiled tub, and shape into a rectangle; perform a four-edge fold

BULK FERMENT 2½ h at 21° C / 70° F, cover well; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); rest the dough, covered, for 30 min after the final fold; generously oil a half sheet pan

PRESHAPE transfer the dough to the prepared pan seam side down, trying to maintain the rectangular shape; coat the surface of the dough with more oil; stretch the dough gently but assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp

PROOF 3 h at 21° C / 70° F, covered, or 2 h at 27° C / 80° F and 65% RH; halfway through proofing, stretch the dough gently but assertively out again to fill the pan as evenly as possible; for assembly and baking instructions, see page 3:133

MACHINE MIXING OPTIONS

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 12

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 5 min. Autolyse for 30 min. Add the salt, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on medium speed to medium gluten development, about 5 min.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 2.15, but do not exceed 2.5

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 1 min. Autolyse for 30 min. Add the salt, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on medium speed to medium gluten development, about 3 min.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 6 but do not exceed 8

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 9 but do not exceed 11

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 8 min. Autolyse for 30 min. Add the salt, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on medium speed to medium gluten development, about 15 min.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 12

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, about 8 min. Autolyse for 30 min. Add the salt, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on medium speed to medium gluten development, about 15 min.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 3 but do not exceed 4

industrial-sized mixers: capacity will vary

Mix: combine the water, yeast, and poolish in the mixer's bowl, and whisk to dissolve the yeast. Add the flour, and mix on low speed to a shaggy mass, 2–3 min. Autolyse for 30 min. Add the salt and oil, and mix on medium speed to medium gluten development, about 37 min.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and medium gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development.

Shaggy mass

Add salt

Medium gluten development

PREP

1 Combine the flour, water, and yeast for the poolish, and mix to a homogeneous mass. Transfer the poolish to an airtight container, cover, and let it ripen at 21 °C / 70 °F for 12–16 h before using (see page 1:300).

MIX

2 Follow the Machine Mixing Options above.

When you are adding the oil to the mixer, try to pour it toward the center of the dough rather than to the outside. This helps keep it from sloshing around the bowl, and makes it easier for the mixer to fully incorporate it into the dough.

3 Transfer the dough to a lightly oiled tub. Shape the dough into a rectangle. Perform a four-edge fold. Cover well with plastic wrap.

BULK FERMENT

4 Bulk ferment, covered, for 2½ h at 21 °C / 70 °F; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development. Perform the windowpane test to assess gluten development. Rest the dough, covered, for 30 min after the final fold.

5 Drizzle olive oil evenly over the base of two half sheet pans.

When you are stippling the dough, don't force it or the dough will tear. Let it relax for 15–20 min before stretching it again.

You can divide this dough in half and make two quarter-sheet-pan-sized pizzas, if desired.

PRESHAPE

6 Transfer the dough to the center of the prepared pans seam side down, trying to maintain the rectangular shape.

7 Coat the surface of the dough with more oil, and gently but assertively stretch the dough to fit the pan. Make sure the corners are sharp and fill out the corners of the pan.

PROOF

8 Proof the dough, covered, for 3 h at 21 °C / 70 °F or for 2 h at 27 °C / 80 °F and 65% RH. Halfway through proofing, gently but assertively stretch the dough out again to fill the pan completely and as evenly as possible.

9 Assemble and bake the pizza according to the instructions on page 3:133.

INGREDIENT VARIATION

MODERNIST NEW YORK SQUARE PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
High-gluten bread flour, 13.5%–15% protein*	40 g	¼ cup + 2 tsp	100
Water	40 g	2 Tbsp + 2 tsp	100
Instant dry yeast	0.05 g	**	0.13
For the Dough			
Water, 21° C / 70° F	255 g	1 cup + 1½ Tbsp	71.83
Instant dry yeast	1.95 g	¾ tsp	0.54
Dough relaxer options see table below			
High-gluten bread flour, 13.5%–15% protein*	355 g	2½ cups	100
High-methoxyl pectin	8 g	2¾ tsp + ⅛ tsp	2.25
Fine salt	7.9 g	1¼ tsp + ⅛ tsp	2.23
Shortening, lard, or clarified butter, melted and cooled	15 g	1 tbsp + ¼ tsp	4.23
	Yield: ~700 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into six equal parts. Use one part to make the poolish.*

Follow the Prep through Proof instructions for New York Square Pizza Dough on page 152. See the table at right for instructions for adding the dough relaxer. Add the pectin with the flour.

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in pizza

NET CONTENTS

Ingredients	Weight	%
Flour	395 g	100
Water	295 g	74.68
Fat	15 g	3.8
Pectin	8 g	2.03
Salt	7.9 g	2
Yeast	1.95 g	0.49

We added pectin to this recipe to increase the volume of the crust.

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract kiwi juice and papaya juice, see page 1:328. Papaya juice and meat tenderizer performed best in our tests.

INGREDIENT	%	ADD TO . . .
Papaya juice, fresh	0.03	the water
Adolph's meat tenderizer	0.01	the flour
Bromelain, powdered	0.0005	the flour
Kiwi juice, fresh	0.08	the water
Papain, powdered	0.01	the flour

INGREDIENT VARIATION

DIRECT NEW YORK SQUARE PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	295 g	1¼ cups	74.68
Instant dry yeast	1.95 g	¾ tsp	0.49
High-gluten bread flour, 13.5%–15% protein*	395 g	2¾ cups	100
Fine salt	7.9 g	1¼ tsp + ⅛ tsp	2
Extra-virgin olive oil	15 g	1 tbsp + ¼ tsp	3.8
	Yield: ~700 g		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour.*

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in pizza

NET CONTENTS

Ingredients	Weight	%
Flour	395 g	100
Water	295 g	74.68
Fat	15 g	3.8
Salt	7.9 g	2
Yeast	1.95 g	0.49

Follow the Mix through Proof instructions for New York Square Pizza Dough on page 152. Omit the poolish.

SUBMASTER RECIPE

SFINCIONE DOUGH (AKA SFINCIUNI DOUGH)

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	390 g	1¾ cups	68.42
Instant dry yeast	5 g	1¾ tsp	0.88
Bread flour, 11.5%–12% protein*	570 g	4¼ cups	100
Fine salt	11 g	2 tsp	1.93
Extra-virgin olive oil	30 g	2 Tbsp + ½ tsp	5.26
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommended using Central Milling Organic Artisan Bakers Craft Bread Flour.*

For more on suggested mixing times, see the Machine Mixing Options for Focaccia Dough on page 149.

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 3¾ h	one 46 cm by 33 cm / 18 in by 13 in pizza

NET CONTENTS

Ingredients	Weight	%
Flour	570 g	100
Water	390 g	68.42
Fat	30 g	5.26
Salt	11 g	1.93
Yeast	5 g	0.88

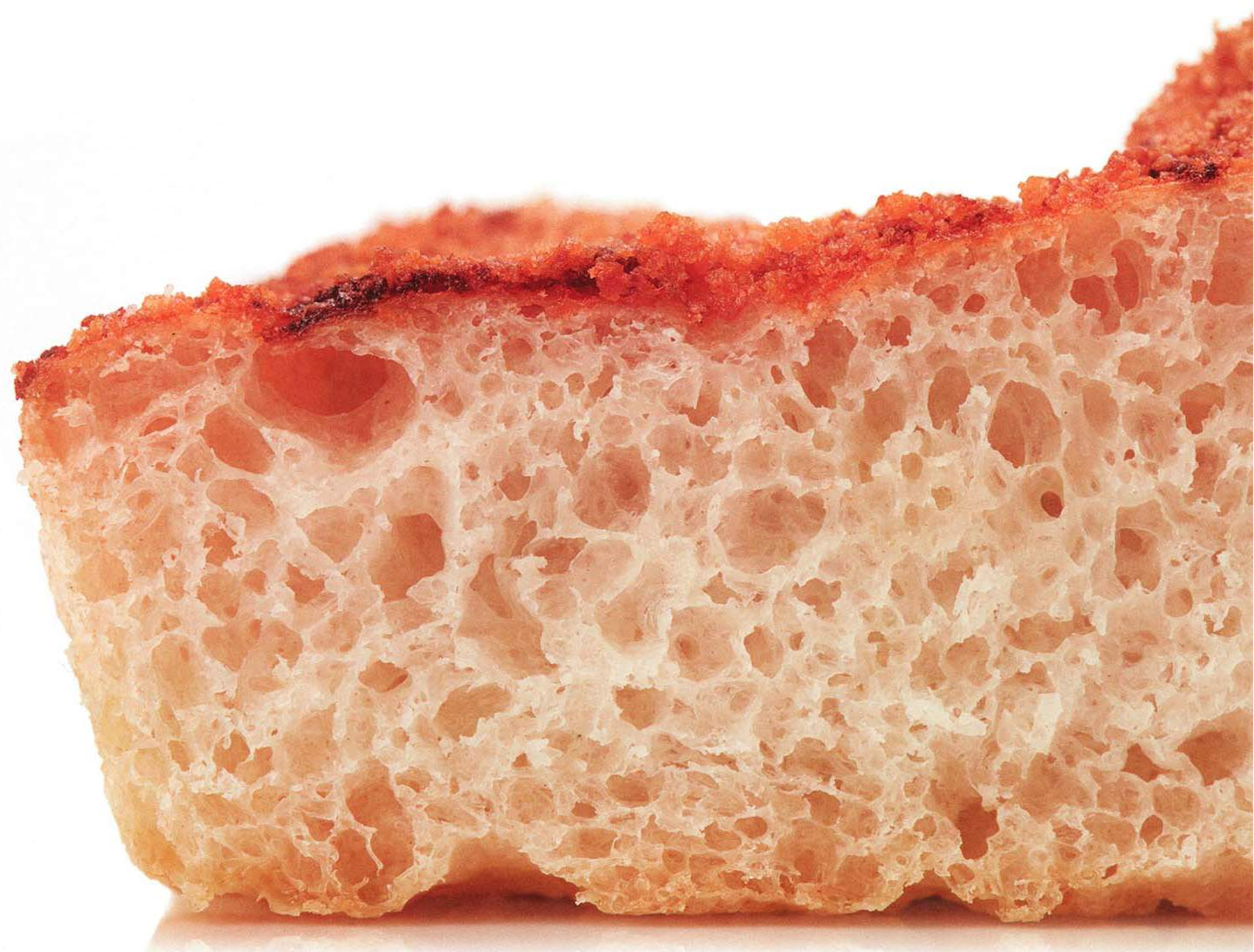
GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; add the salt, and mix on medium speed to medium gluten development; add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated; mix on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly oiled tub, and shape into a rectangle; perform a four-edge fold; generously oil a half sheet pan

BENCH REST 20 min; cover well

PRESHAPE transfer the dough to the prepared pan seam side down, trying to maintain the rectangular shape; coat the surface of the dough with more oil; stretch the dough gently but assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp

PROOF 2–3 h at 21° C / 70° F, covered, or 1–2 h at 27° C / 80° F and 65% RH; for shaping instructions, see page 3:125; for assembly and baking instructions, see page 3:125



MASTER RECIPE

HIGH-HYDRATION AL TAGLIO PIZZA DOUGH

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 5½ h	one 60 cm by 40 cm / 24 in by 16 in pizza or two 60 cm by 20 cm / 24 in by 8 in pizzas

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	480 g	2 cups	76.19
Instant dry yeast	3.7 g	1¼ tsp + ⅛ tsp	0.59
Liquid levain, mature see page 1:304	220 g	1 cup	34.92
Bread flour, 11.5%–12% protein, or 00 flour*	630 g	4⅔ cups	100
Diastatic malt powder	1.5 g	¼ tsp + ⅛ tsp	0.24
Fine salt	18.5 g	1 Tbsp + ¼ tsp	2.94
Extra-virgin olive oil	30 g	2 Tbsp	4.76
	Yield: ~1.4 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Polselli Super 00 Flour.*

NET CONTENTS

Ingredients	Weight	%
Flour	740 g	100
Water	590 g	79.73
Fat	30 g	4.02
Salt	18.5 g	2.5
Yeast	3.7 g	0.5
Diastatic malt powder	1.5 g	0.2

This dough uses the double hydration method (see page 41) and is mixed to medium gluten development twice in order to fully incorporate all of the water. You will need to mix this dough on high speed to achieve medium gluten development.

GENERAL DIRECTIONS

MIX combine 380 g (1⅔ cups) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast; add the levain, flour, and malt powder, and mix on low speed to low gluten development; autolyse 30 min; meanwhile, stir the salt into the remaining water; mix the dough on medium speed to medium gluten development; add the salt mixture, and mix on low speed until it is fully incorporated; add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated; mix on high speed to medium gluten development; transfer to a lightly oiled tub, and shape into a rectangle; perform a four-edge fold

BULK FERMENT 2½ h at 21° C / 70° F; cover well; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); rest the dough, covered, for 30 min after the final fold; generously oil the pan(s)

DIVIDE 60 cm by 40 cm / 24 in by 16 in: do not divide
60 cm by 20 cm / 24 in by 8 in: 700 g

PRESHAPE perform a four-edge fold; transfer the dough to the prepared pan(s) seam side down, trying to maintain the rectangular shape; rest for 30 min, covered; stretch the dough gently but assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp

PROOF 3 h at 21° C / 70° F, covered, or 2 h at 27° C / 80° F and 65% RH; after the first hour, using flat hands, gently but assertively stretch the dough out again to fill the pan as evenly as possible, being careful not to tear the dough; for shaping instructions, see page 3:141; for assembly and baking instructions, see page 3:141

MACHINE MIXING OPTIONS

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 5

Mix: combine 380 g (1⅔ cups) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the levain, flour, and malt powder, and mix on low speed to low gluten development, 7–8 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Mix the dough on medium speed to medium gluten development, about 10 min. Add the salt mixture, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on high speed to medium gluten development, about 10 min.

STAND MIXER

Weight: 8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by 1.25

Mix: combine 380 g (1⅔ cups) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the levain, flour, and malt powder, and mix on low speed to low gluten development, 7–8 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Mix the dough on medium speed to medium gluten development, 8–10 min. Add the salt mixture, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on high speed to medium gluten development, about 3 min.

Make sure the dough does not come off the mixer at a temperature lower than 18° C / 64° F or higher than 24° C / 75° F (see page 32).

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 3 but do not exceed 4

20 qt bowl: 6–8 kg maximum; multiply this recipe by 7

Mix: combine 380 g (1⅔ cups) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the levain, flour, and malt powder, and mix on low speed to low gluten development, 6–8 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Mix the dough on medium speed to medium gluten development, about 10 min. Add the salt mixture, and mix on low speed until it is fully incorporated. Add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated. Mix on high speed to medium gluten development, about 10 min.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by 2

industrial-sized mixers: capacity will vary

Mix: combine 380 g (1⅔ cups) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast. Add the levain, flour, and malt powder, and mix on low speed to shaggy mass, 2–3 min. Autolyse for 30 min. Meanwhile, stir the salt into the remaining water. Add the salt mixture and oil, and mix on high speed to medium gluten development, about 52 min.

If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

Add levain to the yeast mixture before adding the flour and malt powder

Add oil in slow stream

MIX

1 Follow the Machine Mixing Options above.

2 Transfer the dough to a lightly oiled tub. Shape the dough into a rectangle. Perform a four-edge fold. Cover well with plastic wrap.

When you are adding the oil to the mixer, try to pour it toward the center of the dough rather than to the outside. This helps keep it from sloshing around the bowl and makes it easier for the mixer to fully incorporate the oil into the dough.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development.

BULK FERMENT

3 Bulk ferment, covered, for 2½ h at 21° C / 70° F; perform 4 three-edge folds (1 fold every 30 min after the first 30 min). Rest the dough, covered, for 30 min after the final fold. Perform the windowpane test to assess full gluten development (see page 30).

4 Turn the dough onto a lightly oiled worktable, trying to keep it as rectangular as possible.

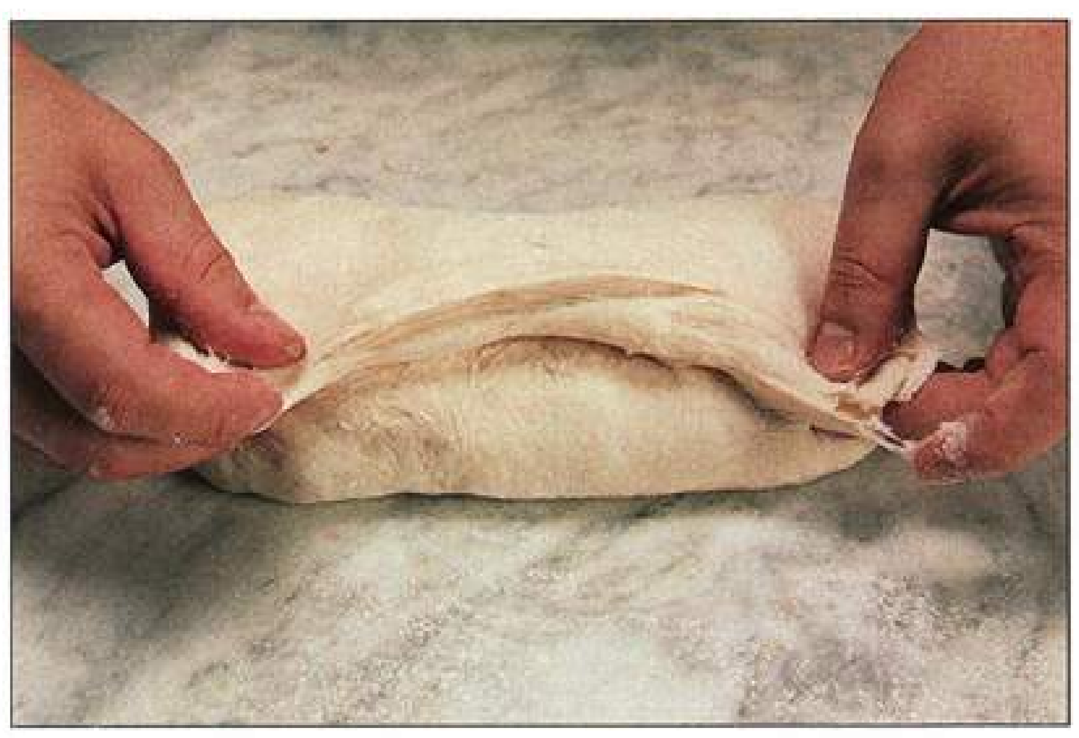
5 Generously oil the Roman al taglio pan(s).

For the large pizza we use a full-sized pizza al taglio pan measuring 60 cm by 40 cm / 24 in by 16 in and made from blue steel. The small pizzas are made in half-sized pizza al taglio pans measuring 60 cm by 20 cm / 24 in by 8 in. For more on where to find these pans, see Resources, page 3:377.

DIVIDE

6 Do not divide for a 60 cm by 40 cm / 24 in by 16 in pizza. Divide into two 700 g pieces for 60 cm by 20 cm / 24 in by 8 in pizzas (see page 55).

PRESHAPE



7 Perform a four-edge fold. Transfer the dough to the center of the prepared pan(s) seam side down, trying to maintain the rectangular shape. Rest for 30 min, covered.

8 Gently but assertively stretch the dough to fit the pan. Make sure the corners are sharp and fill out the corners of the pan. Do not force the dough if it doesn't stretch all the way out to fill the pan on the first try.

PROOF

9 Proof the dough, covered, for 3 h at 21° C / 70° F or 2 h at 27° C / 80° F and 65% RH. After the first hour, using flat hands, gently but assertively stretch the dough out again to fill the pan as evenly as possible, being careful not to tear the dough.

10 Shape according to the instructions on page 3:141. Assemble and bake the pizza according to the instructions on page 3:141.

When you are stippling the dough, don't force it or the dough will tear. Let it relax for 15–20 min before stretching it again.

INGREDIENT VARIATION

MODERNIST HIGH-HYDRATION AL TAGLIO PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water	480 g	2 cups	76.19
Instant dry yeast	3.7 g	1¼ tsp + ⅛ tsp	0.59
Liquid levain, mature see page 1:304	220 g	1 cup	34.92
Bread flour, 11.5%–12% protein, or 00 flour*	630 g	4⅔ cups	100
Dough relaxer options see table below			
High-methoxyl pectin	14.8 g	1 Tbsp + 2 tsp	2.25
Diastatic malt powder	1.5 g	¼ tsp + ⅛ tsp	0.25
Fine salt	18.5 g	1 Tbsp + ¼ tsp	2.94
Extra-virgin olive oil	30 g	2 Tbsp	4.76
	Yield: ~1.4 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Polselli Super 00 Flour.*

Follow the Mix through Proof instructions for High-Hydration al Taglio Pizza Dough on page 158. See the table at right for instructions for adding the dough relaxer. Add the pectin with the flour.

We added pectin to this recipe to increase the volume of the crust.

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 5½ h	one 60 cm by 40 cm / 24 in by 16 in pizza or two 60 cm by 20 cm / 24 in by 8 in pizzas

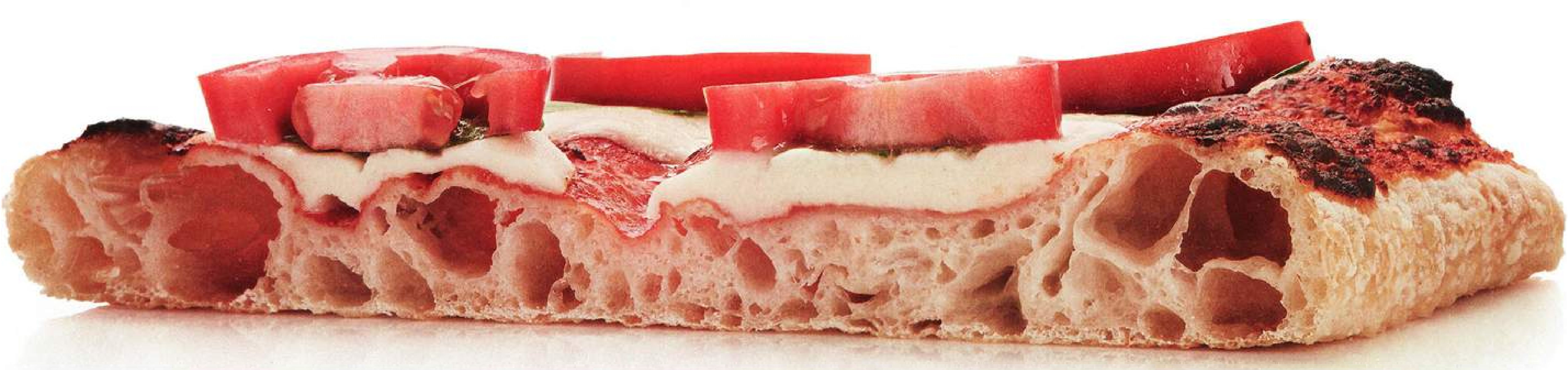
NET CONTENTS

Ingredients	Weight	%
Flour	740 g	100
Water	590 g	79.73
Fat	30 g	4.02
Salt	18.5 g	2.5
Pectin	14.8 g	2
Yeast	3.7 g	0.5
Diastatic malt powder	1.5 g	0.2

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract pineapple juice and kiwi juice, see page 1:328. Bromelain performed best in our tests.

INGREDIENT	%	ADD TO . . .
Bromelain, powdered	0.0005	the flour
Pineapple juice, fresh	0.01	the water
Kiwi juice, fresh	0.08	the water
Papain, powdered	0.01	the flour
Adolph's meat tenderizer	0.01	the flour



INGREDIENT VARIATION

HIGH-HYDRATION AL TAGLIO PIZZA DOUGH WITH POOLISH

INGREDIENTS	WEIGHT	VOLUME	%
For the Poolish			
Bread flour, 11.5%–12% protein, or 00 flour*	110 g	¾ cup + 1 Tbsp	100
Water	110 g	½ cup	100
Instant dry yeast	0.11 g	**	0.1
For the Dough			
Water	480 g	2 cups	76.19
Instant dry yeast	3.7 g	1¼ tsp + ⅛ tsp	0.59
Bread flour, 11.5%–12% protein, or 00 flour*	630 g	4⅔ cups	100
Diastatic malt powder	1.5 g	¼ tsp + ⅛ tsp	0.2
Fine salt	18.5 g	1 Tbsp + ¼ tsp	2.94
Extra-virgin olive oil	30 g	2 Tbsp	4.76
	Yield: ~1.4 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Polselli Super 00 Flour.*

***You can approximate this small amount of yeast by measuring ⅛ tsp yeast and dividing it into three equal parts. Use one part to make the poolish.*

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 5½ h	one 60 cm by 40 cm / 24 in by 16 in pizza or two 60 cm by 20 cm / 24 in by 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	740 g	100
Water	590 g	79.73
Fat	30 g	4.05
Salt	18.5 g	2.5
Yeast	3.81 g	0.51
Diastatic malt powder	1.5 g	0.2

Mix the flour, water, and yeast for the poolish 12–16 h before using; ferment at 21° C / 70° F, covered. Follow the Mix through Proof instructions for High-Hydration al Taglio Pizza Dough on page 158. Replace the levain with the poolish.

INGREDIENT VARIATION

DIRECT HIGH-HYDRATION AL TAGLIO PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water	600 g	2⅔ cups	81.08
Instant dry yeast	3.7 g	1¼ tsp + ⅛ tsp	0.5
Bread flour, 11.5%–12% protein, or 00 flour*	740 g	5½ cups	100
Diastatic malt powder	1.5 g	¼ tsp + ⅛ tsp	0.2
Fine salt	18.5 g	1 Tbsp + ¼ tsp	2.5
Extra-virgin olive oil	30 g	2 Tbsp	4.02
	Yield: ~1.4 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Polselli Super 00 Flour.*

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 5½ h	one 60 cm by 40 cm / 24 in by 16 in pizza or two 60 cm by 20 cm / 24 in by 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	740 g	100
Water	600 g	81.08
Fat	30 g	4.02
Salt	18.5 g	2.5
Yeast	3.7 g	0.5
Diastatic malt powder	1.5 g	0.2

Follow the Mix through Proof instructions for High-Hydration al Taglio Pizza Dough on page 158. Omit the levain.

INGREDIENT VARIATION

EMERGENCY HIGH-HYDRATION AL TAGLIO PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21°C / 70°F	615 g	2⅔ cups	79.35
Instant dry yeast	6.2 g	2¼ tsp	0.8
Bread flour, 11.5%–12% protein, or 00 flour*	775 g	5¾ cups	100
Diastatic malt powder	1.55g	¼ tsp + ⅛ tsp	0.2
Fine salt	19.4 g	1 Tbsp + ½ tsp	2.5
Extra-virgin olive oil	30 g	2 Tbsp + ½ tsp	3.87
	Yield: ~1.4 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Polselli Super 00 Flour.*

For more on suggested mixing times, see the Machine Mixing Options for High-Hydration al Taglio Pizza Dough on page 159.

TOTAL TIME	YIELD/SHAPE
Active: 10–15 min / Inactive: 3½ h	one 60 cm by 40 cm / 24 in by 16 in pizza or two 60 cm by 20 cm / 24 in by 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	775 g	100
Water	615 g	79. 35
Fat	30 g	3.87
Salt	19. 4g	2.5
Yeast	6.2 g	0.8
Diastatic malt powder	1.55 g	0.2

GENERAL DIRECTIONS

MIX combine 495 g (2 cups + 2 Tbsp) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour and malt powder, and mix on low speed to low gluten development; autolyse 30 min; meanwhile, stir the salt into the remaining water; mix the dough on medium speed to medium gluten development; add the salt mixture, and mix on low speed until it is fully incorporated; add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated; mix on high speed to medium gluten development; transfer to a lightly oiled tub, and shape into a rectangle; perform a four-edge fold

BULK FERMENT 2½ h at 21°C / 70°F; cover well; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); rest the dough, covered, for 30 min after the final fold; generously oil the pan(s)

DIVIDE 60 cm by 40 cm / 24 in by 16 in: do not divide
60 cm by 20 cm / 24 in by 8 in: 700 g

PRESHAPE perform a four-edge fold; transfer the dough to the prepared pan(s) seam side down, trying to maintain the rectangular shape; rest for 30 min, covered; stretch the dough gently but assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp

PROOF 1 h at 27°C / 80°F and 65% RH; after the first hour, using flat hands, gently but assertively stretch the dough out again to fill the pan as evenly as possible, being careful not to tear the dough; for shaping instructions, see page 3:141; for assembly and baking instructions, see page 3:141

SUBMASTER RECIPE

ROMAN PIZZA ALLA PALA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water	470 g	2 cups	73.34
Instant dry yeast	3.8 g	1½ tsp	0.59
Liquid levain, mature see page 1:304	250 g	1 cup + 2 Tbsp	39.06
Bread flour, 11.5%–12% protein, or 00 flour*	640 g	4¾ cups	100
Diastatic malt powder	1.6 g	¼ tsp + ⅛ tsp	0.25
Fine salt	19 g	1 Tbsp + ¼ tsp	2.97
Extra-virgin olive oil	15 g	1 Tbsp + ¼ tsp	2.34
	Yield: ~1.4 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Polselli Super 00 Flour, Caputo Pizza a Metro 00 Flour, Molino Grassi Slow H24 00 Flour, or Le 5 Stagioni Manitoba 00 Flour.*

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 5½ h	one 60 cm by 40 cm / 24 in by 16 in pizza or two 60 cm by 20 cm / 24 in by 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	765 g	100
Water	595 g	77.78
Salt	19 g	2.48
Fat	15 g	1.96
Yeast	3.8 g	0.5
Diastatic malt powder	1.6 g	0.2

Make sure to leave enough room in the tub for the dough to expand.

For more on suggested mixing times, see the Machine Mixing Options for High-Hydration al Taglio Pizza Dough on page 159.

GENERAL DIRECTIONS

MIX combine 380 g (1⅔ cups) of the water with the yeast in the mixer's bowl, and whisk to dissolve the yeast; add the levain, flour, and malt powder, and mix on low speed to low gluten development; autolyse 30 min; meanwhile, stir the salt into the remaining water; mix the dough on medium speed to medium gluten development; add the salt mixture, and mix on low speed until it is fully incorporated; add the oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated; mix on high speed to medium gluten development; transfer to a lightly oiled tub, and shape into a rectangle; perform a four-edge fold

BULK FERMENT 2 h at 21° C / 70° F; cover well; perform 3 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); rest the dough, covered, for 30 min after the final fold

DIVIDE 60 cm by 40 cm / 24 in by 16 in: do not divide
60 cm by 20 cm / 24 in by 8 in: 700 g

PRESHAPE tight oblong bâtard (see page 62); place in a lightly oiled tub; cover well

PROOF 3 h at 21° C / 70° F, covered, or 2 h at 27° C / 80° F and 65% RH; cold-proof for 16 h at 4° C / 39° F, covered, and then 2½ h at 27° C / 80° F and 65% RH

SUBMASTER RECIPE

PIZZA GOURMET DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Hong Kong flour or pastry flour	600 g	5 cups	100
Water, 21 °C / 70 °F	340 g	1½ cups	56.67
Sugar	64 g	5 Tbsp + 2 tsp	10.67
Fine salt	12 g	2⅛ tsp	1.88
Baking powder	6.6 g	1½ tsp	1.1
Instant dry yeast	6.5 g	2¼ tsp + ⅛ tsp	1.08
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

Hong Kong flour is commonly used for making bao, which share some characteristics with pizza gourmet dough. For more on where to purchase it, see Resources, page 3:377.

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 4¾ h	four 20 cm / 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	600 g	100
Water	340 g	56.67
Sugar	64 g	10.67
Salt	12 g	1.88
Baking powder	6.6 g	1.1
Yeast	6.5 g	1.08

GENERAL DIRECTIONS

MIX combine the flour, water, sugar, salt, baking powder, and yeast in the mixer's bowl; mix the dough with the paddle attachment on medium speed to full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BULK FERMENT 45 min at 21 °C / 70 °F; cover well

DIVIDE 250 g

PRESHAPE ball (see page 60); flatten to a 2.5 cm / 1 in thick disc; cover well

PROOF 3½ h at 21 °C / 70 °F, covered, or 2½ h at 27 °C / 80 °F and 65% RH; for assembly, steaming, and baking instructions, see page 3:151

MASTER RECIPE

DETROIT-STYLE PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 30–30.5° C / 85–87° F	405 g	1¾ cups	70.43
Bread flour, 11.5%–12% protein*	490 g	3⅔ cups	85.22
Semolina flour	85 g	½ cup	14.78
Fine salt	11.5 g	2 tsp	2
Sugar	8 g	2 tsp	1.39
Instant dry yeast	5.2 g	2 tsp	0.9
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Ceresota/Heckers Unbleached All-Purpose Flour. Note that they call their flour all-purpose, but the protein content places it in the bread flour category.*

The 1 kg yield of the base recipe is not enough for the dough hook to catch all the ingredients and mix a uniform dough in an 8 qt bowl.

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 3½ h	two 35 cm by 25 cm / 14 in by 10 in pizzas or three 25 cm by 20 cm / 10 in by 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Bread flour	490 g	85.22
Semolina flour	85 g	14.78
Water	405 g	70.43
Salt	11.5 g	2
Sugar	8 g	1.39
Yeast	5.2 g	0.9

GENERAL DIRECTIONS

MIX pour the water into the mixer's bowl; add the bread flour, semolina flour, salt, sugar, and yeast, and mix on low speed to a shaggy mass; mix on medium speed to just under full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a generously oiled tub, turning the dough over to coat the dough fully with the oil, and shape into a rectangle

BENCH REST 15 min; cover well; perform a four-edge fold (see page 51); bench rest for 15 min; cover well; generously oil the Detroit pans

DIVIDE 35 cm by 25 cm / 14 in by 10 in: 500 g
25 cm by 20 cm / 10 in by 8 in: 330 g

PRESHAPE transfer dough to the prepared pans seam side down, trying to maintain the rectangular shape; coat the surface of the dough lightly with oil and stretch the dough gently but assertively without damaging it to fill the pan evenly, making sure the corners are sharp

PROOF 3 h at 21° C / 70° F, covered, or 2½ h at 27° C / 80° F and 65% RH; after the first hour, gently but assertively stretch the dough out again to fill the pan as evenly as possible; for assembly and baking instructions, see page 3:109

MACHINE MIXING OPTIONS

SPIRAL MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: pour the water into the mixer's bowl. Add the bread flour, semolina flour, salt, sugar, and yeast, and mix on low speed to a shaggy mass, about 5 min. Mix on medium speed to just under full gluten development, about 18 min. Perform the windowpane test to assess gluten development.

STAND MIXER

Weight: 4.5 qt bowl: 1–1.25 kg maximum

8 qt bowl: 1.5–1.75 kg maximum; multiply this recipe by at least 1.5 but do not exceed 1.75

Mix: pour the water into the mixer's bowl. Add the bread flour, semolina flour, salt, sugar, and yeast, and mix on low speed to a shaggy mass, about 2 min. Mix on medium speed to just under full gluten development, about 4 min. Perform the windowpane test to assess gluten development.

COMMERCIAL PLANETARY MIXER

Weight: 12 qt bowl: 4–6 kg maximum; multiply this recipe by at least 4 but do not exceed 6

20 qt bowl: 6–8 kg maximum; multiply this recipe by at least 6 but do not exceed 8

Mix: pour the water into the mixer's bowl. Add the bread flour, semolina flour, salt, sugar, and yeast, and mix on low speed to a shaggy mass, about 3 min. Mix on medium speed to just under full gluten development, about 7 min. Perform the windowpane test to assess gluten development.

FORK MIXER

Weight: depends on the capacity of the mixer; at least 8 kg is recommended; multiply this recipe by at least 8

Mix: pour the water into the mixer's bowl. Add the bread flour, semolina flour, salt, sugar, and yeast, and mix on low speed to a shaggy mass, about 5 min. Mix on medium speed to just under full gluten development, about 20 min. Perform the windowpane test to assess gluten development.

DIVING ARM MIXER

Weight: 6 qt bowl: 3 kg maximum; multiply this recipe by at least 2 but do not exceed 3

industrial-sized mixers: capacity will vary

Mix: pour the water into the mixer's bowl. Add the bread flour, semolina flour, salt, sugar, and yeast, and mix on low speed to a shaggy mass, 2–3 min. Mix on medium speed to just under full gluten development, about 19 min. Perform the windowpane test to assess gluten development.

If you are mixing using the diving arm mixer, the dough will be softer and easy to shape.

FOOD PROCESSOR

Weight: 12–16 cup work bowl: 1 kg

Robot Coupe, 2–3 qt work bowl: 1.2 kg; industrial-sized food processors: capacity will vary

Mix: place the bread flour, semolina flour, salt, sugar, and yeast in the bowl. Turn the machine on and pour in the water. Mix for 45 s. Perform the windowpane test to assess gluten development. If the gluten is not fully developed, mix for a few more seconds and check again.

If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, and there are no visible clumps or unincorporated water), switch to a hook attachment.

The larger the yield, the longer the dough will take to mix. Final mix time at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and nearly full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development.

MIX

1 Follow the Machine Mixing Options above.

2 Transfer the dough to a generously oiled tub.

3 Turn the dough over to fully coat with oil.

4 Shape the dough into a rectangle. Cover well with plastic wrap.

BENCH REST

5 Bench rest for 15 min.

6 Perform a four-edge fold.

7 Bench rest for 15 min, covered.

8 Generously oil the Detroit pans.

DIVIDE

9 Divide into two 500 g pieces for 35 cm by 25 cm / 14 in by 10 in pizzas or into three 330 g pieces for 25 cm by 20 cm / 10 in by 8 in pizzas (see page 55).

When you divide the dough, try to keep the pieces as rectangular as possible.

PRESHAPE

10 Transfer the dough to the center of the prepared pans seam side down, trying to maintain the rectangular shape. Lightly coat the surface of the dough with more oil, and stretch the dough gently but assertively without damaging it to fill the pan evenly.

Make sure the corners are sharp and fill out the corners of the pan.

For the large pizzas, we use full-sized Detroit pans measuring 35 cm by 25 cm / 14 in by 10 in. The small pizzas are made in half-sized Detroit pans measuring 25 cm by 20 cm / 10 in by 8 in. Our pans are made from blue steel; for more on where to find these pans, see Resources, page 3:377.

PROOF

11 Proof the dough, covered, for 3 h at 21° C / 70° F or 2½ h at 27° C / 80° F and 65% RH. After the first hour, gently but assertively stretch the dough out again to fill the pan as evenly as possible.

12 Assemble and bake the pizza according to the instructions on page 3:109.

INGREDIENT VARIATION

MODERNIST DETROIT-STYLE PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 30–30.5° C / 85–87° F	405 g	1¾ cups	70.43
Dough relaxer options see table below			
Bread flour, 11.5%–12% protein*	490 g	3⅔ cups	85.22
Semolina flour	85 g	½ cup	14.78
Fine salt	11.5 g	2 tsp	2
Sugar	8 g	2 tsp	1.39
Instant dry yeast	5.2 g	2 tsp	0.9
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using Central Milling Organic Artisan Bakers Craft Bread Flour.*

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 3½ h	two 35 cm by 25 cm / 14 in by 10 in pizzas or three 25 cm by 20 cm / 10 in by 8 in pizzas

NET CONTENTS

Ingredients	Weight	%
Bread flour	490 g	85.22
Semolina flour	85 g	14.78
Water	405 g	70.43
Salt	11.5 g	2
Sugar	8 g	1.39
Yeast	5.2 g	0.9

Follow the Mix through Proof instructions for Detroit-Style Pizza Dough on page 166. See the table at right for instructions for adding the dough relaxer.

Dough Relaxer Options

These dough relaxer percentages are based on the net weight of the flour. For tips on how to weigh out these minuscule amounts, see page 1:328. For how to extract kiwi juice and papaya juice, see page 1:328. Kiwi juice and papaya juice performed best in our tests.

INGREDIENT	%	ADD TO . . .
Kiwi juice, fresh	0.08	the water
Papaya juice, fresh	0.03	the water
Bromelain, powdered	0.0005	the flour
Papain, powdered	0.01	the flour
Adolph's meat tenderizer	0.01	the flour

SUBMASTER RECIPE

ARGENTINEAN-STYLE "AL MOLDE" PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 30–30.5° C / 85–87° F	400 g	1¾ cups	67.8
All-purpose flour, 10%–11.5% protein	490 g	3⅔ cups	83.05
Cake flour	100 g	¾ cup	16.95
Fine salt	12 g	2⅛ tsp	2.03
Instant dry yeast	5.5 g	2 tsp	0.93
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

TOTAL TIME	YIELD/SHAPE
Active: 15–20 min / Inactive: 2¾ h	two 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
All-purpose flour	490 g	83.05
Cake flour	100 g	16.95
Water	400 g	67.8
Salt	12 g	2.03
Yeast	5.5 g	0.93

GENERAL DIRECTIONS

MIX pour the water into the mixer's bowl; add the all-purpose flour, cake flour, salt, and yeast; mix on low speed to a shaggy mass; mix on medium speed to just under full gluten development; perform the windowpane test to assess gluten development (see page 30); transfer to a lightly floured worktable

BENCH REST 15 min; cover well

DIVIDE 500 g

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well; lightly oil two 35 cm / 14 in pizza pans

BENCH REST 20 min; cover well

SHAPE transfer the dough to the prepared pans seam side down; coat the surface of the dough lightly with oil and gently but assertively stretch the dough without damaging it to try to fill the pan evenly

PROOF 2 h at 21° C / 70° F, covered, or 1½ h at 27° C / 80° F and 65% RH; halfway through proofing, gently but assertively stretch the dough out again to fill the pan as evenly as possible; for assembly and baking instructions, see page 3:126

This versatile dough is easy to mix and shape. You can also use this dough as an option for the base for the Burt Katz–inspired pizza on page 3:114.

If the ingredient quantities aren't large enough for the dough hook to mix them well in a stand mixer or commercial planetary mixer, use a paddle attachment initially to mix the ingredients uniformly. Once you have a homogeneous mass (the dough is sticky and wet, but there are no visible clumps or unincorporated water), switch to a hook attachment.

For more on suggested mixing times, see the Machine Mixing Options for Detroit-Style Pizza Dough on page 167.

The larger the yield, the longer the dough will take to mix. Final mixing times at higher speeds may vary from machine to machine. Whatever the model and yield, the goal is to achieve a good mix and to get to just under full gluten development. Consider our suggested times as guidelines only. Use the windowpane test to help determine the dough's stage of gluten development.

SUBMASTER RECIPE

OLD FORGE PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21°C / 70°F	355 g	1½ cups	59. 17
Instant dry yeast	4 g	1½ tsp	0.67
Flour, 11.5%–14% protein*	600 g	4½ cups	100
Fine salt	12 g	2⅛ tsp	2
Sugar	18 g	1 Tbsp + 1½ tsp	3
Extra-virgin olive oil	12 g	2½ tsp	2
	Yield: ~1 kg		

For salt, flours, and other notes, see page 1:xxii. For notes on substitutions, see page 1:xxii.

**We recommend using General Mills All Trumps Bakers High Gluten Enriched Flour, Tony Gemignani California Artisan Type 00 Flour Blend, Bouncer Premium High Gluten Flour, Pillsbury Balancer Hi Gluten Flour, or Grain Craft Power High Gluten Flour.*

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 6 h	one 46 cm by 33 cm / 18 in by 13 in pizza or two 33cm / by 23 cm / 13 in by 9 in pizzas

NET CONTENTS

Ingredients	Weight	%
Flour	600 g	100
Water	355 g	59.17
Sugar	18 g	3
Salt	12 g	2
Fat	12 g	2
Yeast	4 g	0.67

A whole Old Forge Pizza is sometimes colloquially referred to as a "tray."

For more on suggested mixing times, see the Machine Mixing Options for Detroit-Style Pizza Dough on page 167.

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the flour, and mix on low speed to a shaggy mass; autolyse for 30 min; add the salt, and mix on low speed until it is fully incorporated; add the sugar and oil in a slow stream while the mixer is running on low speed, and mix until it is fully incorporated; mix on medium speed to medium gluten development; transfer to a lightly oiled tub; perform a four-edge fold

BULK FERMENT 2½ h at 21°C / 70°F; cover well; perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development; perform the windowpane test to assess gluten development (see page 30); rest the dough, covered, for 30 min after the final fold; lightly oil the pan(s)

DIVIDE 46 cm by 33 cm / 18 in by 13 in: do not divide
33 cm by 23 cm / 13 in by 9 in: 500 g

PRESHAPE transfer the dough to the prepared pan(s) seam side down, trying to keep the rectangular shape; coat the surface of the dough with more oil; stretch the dough gently and assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp; if it is difficult to stretch the dough at this point, let the dough rest for 30 min, covered, in the pan, and then stretch it further to fill the pan

PROOF 3 h at 21°C / 70°F, covered, or 2 h at 27°C / 80°F and 65% RH; cold-proof for 16 h at 4°C / 39°F, covered, and then 2 h at 27°C / 80°F and 65% RH; halfway through proofing, gently but assertively stretch the dough out again to fill the pan as evenly as possible; for assembly and baking instructions, see page 3:137

OUR VARIATION RECIPES

The variation tables on pages 172–191 will allow you to create a multitude of doughs based on our master recipes. Follow the methods in the master recipes and be sure to refer back to the flour recommendations and practical tips given there when executing these variations. If you'd like more information on each of these variation types, see the descriptions in Our Variations on page 100.

LEVAIN-RAISED VARIATIONS

PIZZA STYLE	LIQUID LEVAIN, MATURE SEE PAGE 1:304			FLOUR		
	Weight	Volume	%	Weight	Volume	%
Thin-Crust Pizza Dough see page 110	160 g	¾ cup	30.77	520 g	3¾ cups + 2 Tbsp	100
Brazilian Thin-Crust Pizza Dough see page 114	180 g	½ cup	34.29	Cake flour		
				370 g	3 cups	70.48
				Bread flour, 11.5%–12% protein		
				155 g	1 cup + 2 Tbsp	29.52
Deep-Dish Pizza Dough see page 118	120 g	½ cup	37.5	320 g	2⅓ cups	100
Neapolitan Pizza Dough see page 124	130 g	⅔ cup	24.3	535 g	4 cups	100
New York Pizza Dough see page 132	140 g	⅔ cup	26.42	530 g	3⅔ cups	100
Artisan Pizza Dough see page 142	150 g	⅔ cup	27.27	550 g	3¾ cups	100
Focaccia Dough see page 148	190 g	¾ cup + 2 Tbsp	47.5	400 g	2¾ cups	100
New York Square Pizza Dough see page 152	90 g	⅓ cup + 1½ Tbsp	25.35	355 g	2½ cups	100
Detroit-Style Pizza Dough see page 166	150 g	⅔ cup	30	Bread flour, 11.5%–12% protein		
				415 g	3 cups	83
				Semolina flour		
				85 g	½ cup	17

Notes

LEVAIN-RAISED THIN-CRUST PIZZA DOUGH
Follow the Mix through Proof instructions for Thin-Crust Pizza Dough on page 110. Replace the poolish with levain. Omit the yeast.

LEVAIN-RAISED BRAZILIAN THIN-CRUST PIZZA DOUGH
Follow the Mix through Proof instructions for Brazilian Thin-Crust Pizza Dough on page 114. Replace the yeast with levain. Increase the proofing time to 4 h at 21° C / 70° F.

LEVAIN-RAISED DEEP-DISH PIZZA DOUGH
Follow the Mix through Proof instructions for Deep-Dish Pizza Dough on page 118. Replace the yeast with levain.

LEVAIN-RAISED NEAPOLITAN PIZZA DOUGH
Follow the Mix through Proof instructions for Neapolitan Pizza Dough with Poolish on page 128. Replace the poolish with levain. Omit the yeast, and add the malt powder with the flour.

LEVAIN-RAISED NEW YORK PIZZA DOUGH
Follow the Mix through Proof instructions for New York Pizza Dough on page 132. Replace the poolish with levain. Omit the yeast.

LEVAIN-RAISED ARTISAN PIZZA DOUGH
Follow the Mix through Proof instructions for Artisan Pizza Dough on page 142. Replace the poolish with levain. Omit the yeast.

LEVAIN-RAISED FOCACCIA DOUGH
Follow the Mix through Proof instructions for Focaccia Dough on page 148. Replace the poolish with levain. Omit the yeast.

LEVAIN-RAISED NEW YORK SQUARE PIZZA DOUGH
Follow the Mix through Proof instructions for New York Square Pizza Dough on page 152. Replace the poolish with levain. Omit the yeast.

LEVAIN-RAISED DETROIT-STYLE PIZZA DOUGH
Follow the Mix through Proof instructions for Detroit-Style Pizza Dough on page 166. Replace the yeast with levain.

WATER, 21 °C / 70 °F			FINE SALT			FAT			OTHER		
Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
345 g	1½ cups	66.35	13 g	2¼ tsp + ⅛ tsp	2.5	n/a			Fine-ground cornmeal 55 g	 ½ cup	 10.58
220 g	1 cup	41.9	12.3 g	2¼ tsp	2.34	Extra-virgin olive oil 60 g	 ¼ cup	 11.42	n/a		
165 g	¾ cup	51.56	8 g	1½ tsp	2.5	Lard, softened 18 g Butter, softened 18 g	 1 Tbsp + ¾ tsp 1 Tbsp + ¾ tsp	 4.74 4.74	Malted barley syrup 7 g Fine-ground cornmeal 40 g	 1 tsp ⅓ cup	 2.19 12.5
330 g	1½ cups	61.68	13.4 g	2¼ tsp + ⅛ tsp	2.5	n/a			Diastatic malt powder 1.3 g	 ¼ tsp	 0.24
345 g	1½ cups	65.09	14.5 g	2½ tsp	2.74	Extra-virgin olive oil 20 g	 1 Tbsp + ¼ tsp	 3.77	Diastatic malt powder 15 g	 1 Tbsp + ¾ tsp	 2.83
375 g	1⅔ cups	68.18	12.5 g	2¼ tsp	2.27	Extra-virgin olive oil 20 g	 1 Tbsp + ¼ tsp	 3.64	Diastatic malt powder 13 g	 1 Tbsp + ¼ tsp	 2.36
335 g	1½ cups	83.75	10 g	1¾ tsp	2.5	Extra-virgin olive oil 20 g	 1 Tbsp + ¼ tsp	 5	Malted barley syrup 5 g	 ¾ tsp	 1.25
255 g	1 cup + 2 Tbsp	71.83	7.9 g	1¼ tsp + ⅛ tsp	2.23	Extra-virgin olive oil 15 g	 1 Tbsp + ¼ tsp	 4.23	n/a		
330 g	1½ cups	66	11.5 g	2 tsp	2.3	n/a			Sugar 8 g	 2 tsp	 1.6

SECOND-CHANCE LEVAIN VARIATIONS

PIZZA STYLE	AMOUNT OF INSTANT DRY YEAST TO ADD			AMOUNT OF INACTIVE LEVAIN TO ADD		
	Weight	Volume	%	Weight	Volume	%
Thin-Crust Pizza Dough see page 110	4.8 g	1¾ tsp	0.92	160 g	¾ cup	30.77
Brazilian Thin-Crust Pizza Dough see page 114	3 g	1⅛ tsp	0.57	180 g	¾ cup	34.29
Deep-Dish Pizza Dough see page 118	4.8 g	1¾ tsp	1.5	120 g	½ cup	37.5
Neapolitan Pizza Dough see page 124	2.3 g	¾ tsp + ⅛ tsp	0.43	130 g	⅔ cup	24.3
New York Pizza Dough see page 132	2.9 g	1 tsp	0.55	140 g	⅔ cup	26.42
Artisan Pizza Dough see page 142	2.68 g	1 tsp	0.49	150 g	⅔ cup	27.27
Focaccia Dough see page 148	2.5 g	¾ tsp + ⅛ tsp	0.63	190 g	¾ cup + 2 Tbsp	47.5
New York Square Pizza Dough see page 152	2.06 g	¾ tsp	0.58	90 g	⅓ cup + 1½ Tbsp	25.35
High-Hydration al Taglio Pizza Dough see page 158	3.7 g	1¼ tsp + ⅛ tsp	0.59	220 g	1 cup	34.92
Detroit-Style Pizza Dough see page 166	5.2 g	2 tsp	1.04	150 g	⅔ cup	30

Notes

Make the recipes for the levain versions above but replace the levain with inactive levain (see page 1:310). The amount of yeast listed in the table above should be dissolved in the water portion of the recipe. Add the inactive levain to the water after dissolving the yeast.

COMPLEAT WHEAT VARIATIONS

PIZZA STYLE	PREFERMENT				WATER, 21 °C / 70 °F			INSTANT DRY YEAST		
		Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
Thin-Crust Pizza Dough see page 110	For the Poolish				395 g	1¾ cups	84.95	4.2 g	1½ tsp	0.9
	Bread flour, 11.5%–12% protein	50 g	⅓ cup	100						
	Water	50 g	3 Tbsp + 1½ tsp	100						
	Instant dry yeast	0.06 g	*	0.1						
Brazilian Thin-Crust Pizza Dough see page 114	n/a				385 g	1⅔ cups	74.76	2.5 g	1 tsp	0.49
Deep-Dish Pizza Dough see page 118	n/a				255 g	1 cup + 2 Tbsp	80.95	2.6 g	1 tsp	0.83
Neapolitan Pizza Dough see page 124	n/a				380 g	1⅔ cups	69.72	0.22 g	⅛ tsp	0.04
New York Pizza Dough see page 132	For the Poolish				355 g	1½ cups	80.68	2.3 g	¾ tsp + ⅛ tsp	0.52
	High-gluten bread flour, 13.5%–15% protein	50 g	⅓ cup	100						
	Water	50 g	3 Tbsp + 1½ tsp	100						
	Instant dry yeast	0.05 g	*	0.1						
Artisan Pizza Dough see page 142	For the Poolish				400 g	1¾ cups	85.11	2.2 g	¾ tsp	0.47
	Bread flour, 11.5%–12% protein	65 g	½ cup	100						
	Water	65 g	¼ cup	100						
	Instant dry yeast	0.07 g	*	0.11						

Compleat wheat thin-crust pizza

FLOUR			FINE SALT			FAT			OTHER			BRAN AND GERM MIXTURE		
Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
465 g	3½ cups	100	11 g	2 tsp	2.37	n/a			Fine-ground cornmeal			Wheat bran		
									50 g	⅓ cup + 1 Tbsp	10.75	65 g	1 cup	13.98
												Wheat germ		
												10 g	1 Tbsp + 1 tsp	2.15
												Water		
												75 g	⅓ cup	16.13
Cake flour			11 g	2 tsp	2.14	Extra-virgin olive oil			n/a			Wheat bran		
310 g	2½ cups	60.19				50 g	¼ cup	9.71				70 g	1¼ cups	13.59
Bread flour												Wheat germ		
205 g	1½ cups	39.81										15 g	2 Tbsp	2.91
												Water		
												85 g	⅓ cup	16.5
315 g	2⅓ cups	100	7 g	1¼ tsp	2.22	Lard, softened			Malted barley syrup			Wheat bran		
						15 g	1 Tbsp	4.76	6 g	1 tsp	1.9	45 g	¾ cup	14.29
						Butter, softened			Fine-ground cornmeal			Wheat germ		
						15 g	1 Tbsp	4.76	35 g	¼ cup	11.11	10 g	1 Tbsp + 1 tsp	3.17
									Diastatic malt powder			Water		
									7 g	1¾ tsp	2.22	55 g	¼ cup	17.46
545 g	4 cups	100	10.9 g	2 tsp	2	n/a			Adolph's meat tenderizer			Wheat bran		
									0.05 g	*	0.01	85 g	1½ cups	15.6
												Wheat germ		
												15 g	2 Tbsp	2.75
												Water		
												75 g	⅓ cup	13.76
440 g	3 cups	100	12 g	2⅛ tsp	2.73	Extra-virgin olive oil			Diastatic malt powder			Wheat bran		
						15 g	1 Tbsp + 1¼ tsp	3.41	12 g	1 Tbsp	2.73	60 g	1 cup	13.64
												Wheat germ		
												10 g	1 Tbsp + 1 tsp	2.27
												Water		
												70 g	⅓ cup	15.91
470 g	3½ cups	100	10.7 g	2 tsp	2.28	Extra-virgin olive oil			Diastatic malt powder			Wheat bran		
						18 g	1 Tbsp + 1 tsp	3.83	11 g	2¾ tsp	2.34	65 g	1 cup + 2 Tbsp	13.83
												Wheat germ		
												15 g	2 Tbsp	3.19
												Water		
												80 g	⅓ cup	17.02

CONTINUED ON PAGE 176

COMPLEAT WHEAT VARIATIONS

PIZZA STYLE	PREFERMENT				WATER, 21°C / 70°F			INSTANT DRY YEAST		
		Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
Focaccia Dough see page 148	For the Poolish				380 g	1⅔ cups	105.56	1.1 g	¼ tsp + ⅛ tsp	0.31
	Bread flour, 11.5%–12% protein	60 g	½ cup	100						
	Water	60 g	¼ cup	100						
	Instant dry yeast	0.06 g	*	0.1						
	Liquid levain, mature see page 1:304	60 g	¼ cup	16.67						
New York Square Pizza Dough see page 152	For the Poolish				220 g	1 cup	72.13	1.7 g	½ tsp + ⅛ tsp	0.56
	High-gluten bread flour, 13. 5%–15%protein	35 g	¼ cup	100						
	Water	35 g	2 Tbsp + 1½ tsp	100						
	Instant dry yeast	0.04 g	*	0.11						
High-Hydration al Taglio Pizza Dough see page 158	Liquid levain, mature see page 1:304	210 g	1 cup	41.58	510 g	2¼ cups	100.99	3.7 g	1¼ tsp + ⅛ tsp	0.73
Detroit-Style Pizza Dough see page 166	n/a				425 g	1¾ cups + 1½ Tbsp	85.86	4.4 g	1½ tsp + ⅛ tsp	0.89

**Refer to the specific master recipe when calculating this volume.*

1 Toast the bran and germ in an even layer in a still oven at 175°C / 350°F until aromatic, 5–7 min. Transfer to a bowl and cool completely. Add the specified amount of water; and soak for at least 10 min before mixing into the dough.

2 Follow the instructions for mixing the specific type of dough based on its master recipe, but mix it only to medium gluten development (see page 30). Then add the toasted and soaked bran and germ, and mix on low speed until just incorporated.

3 Place the dough in a lightly oiled tub, and perform a four-edge fold.

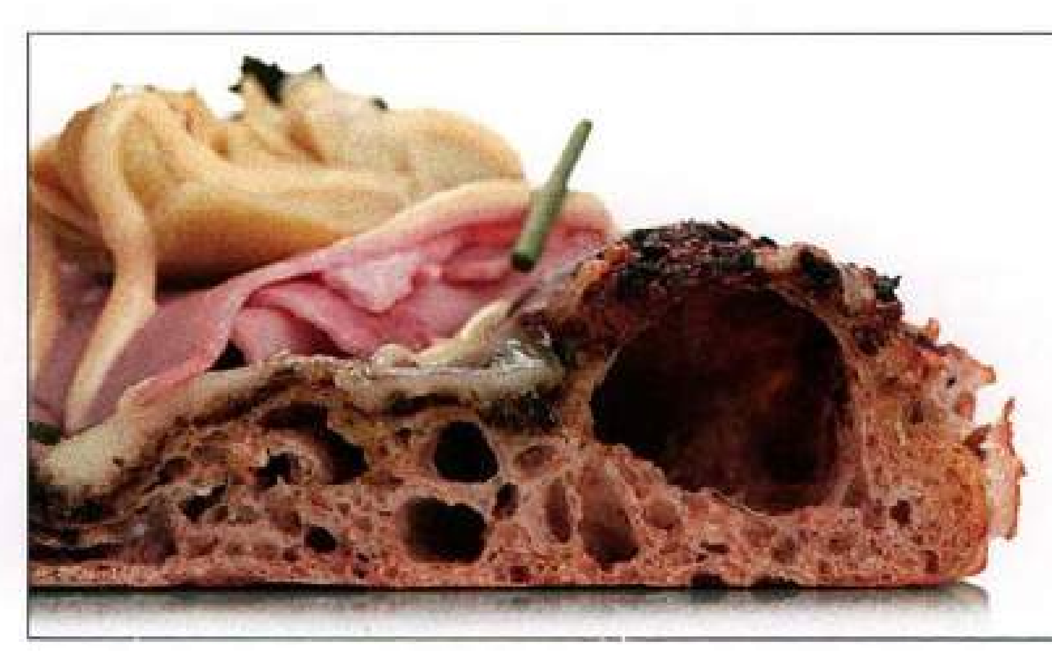
4 Bulk ferment the dough for 2½ h, covered, at 21°C / 70°F. Perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development. Perform the windowpane test to assess full gluten development (see page 30). Rest the dough, covered, for 30 min after the final fold.

5 Follow the remaining instructions for the master recipe of the pizza style you are making.

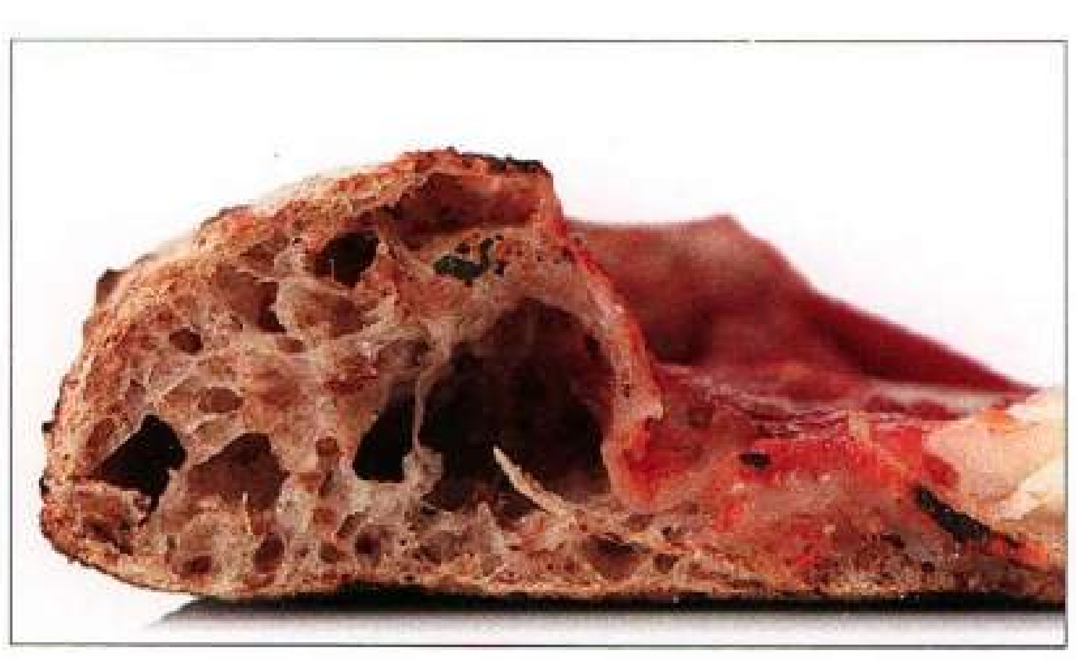
FLOUR			FINE SALT			FAT			OTHER			BRAN AND GERM MIXTURE		
Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
360 g	2⅔ cups	100	9 g	1½ tsp	2.5	Extra-virgin olive oil 18 g	 1 Tbsp + 1 tsp	 5	Malted barley syrup 4.5 g	 ½ tsp + ⅛ tsp	 1. 25	Wheat bran 50 g Wheat germ 10 g Water 60 g	 ¾ cup 1 Tbsp + 1 tsp ¼ cup	 13.89 2.78 16.67
305 g	2 cups + 2 Tbsp	100	6.8 g	1¼ tsp	2.23	Extra-virgin olive oil 15 g	 1 Tbsp + ¼ tsp	 4.92	n/a			Wheat bran 50 g Wheat germ 8 g Water 60 g	 ¾ cup + 2 Tbsp 1 Tbsp ¼ cup	 16.39 2.62 19.67
505 g	3¾ cups	100	15.2 g	2¾ tsp	3.01	Extra-virgin olive oil 24 g	 1 Tbsp + 2 tsp	 4.75	Diastatic malt powder 1.5 g	 ¼ tsp + ⅛ tsp	 0.24	Wheat bran 85 g Wheat germ 15 g Water 100 g	 1½ cups 2 Tbsp ⅓ cup + 1 Tbsp + 2 tsp	 16.83 2.97 19.8
Bread flour 425 g Semolina flour 70 g	 3 cups + 2 Tbsp ⅓ cup + 1½ Tbsp	 85.86 14.14	10 g	1¾ tsp	2.02	n/a			Sugar 7 g	 1¾ tsp	 1.41	Wheat bran 55 g Wheat germ 10 g Water 65 g	 1 cup 1 Tbsp + 1 tsp ¼ cup	 11.11 2.02 13.13

Compleat wheat New York pizza

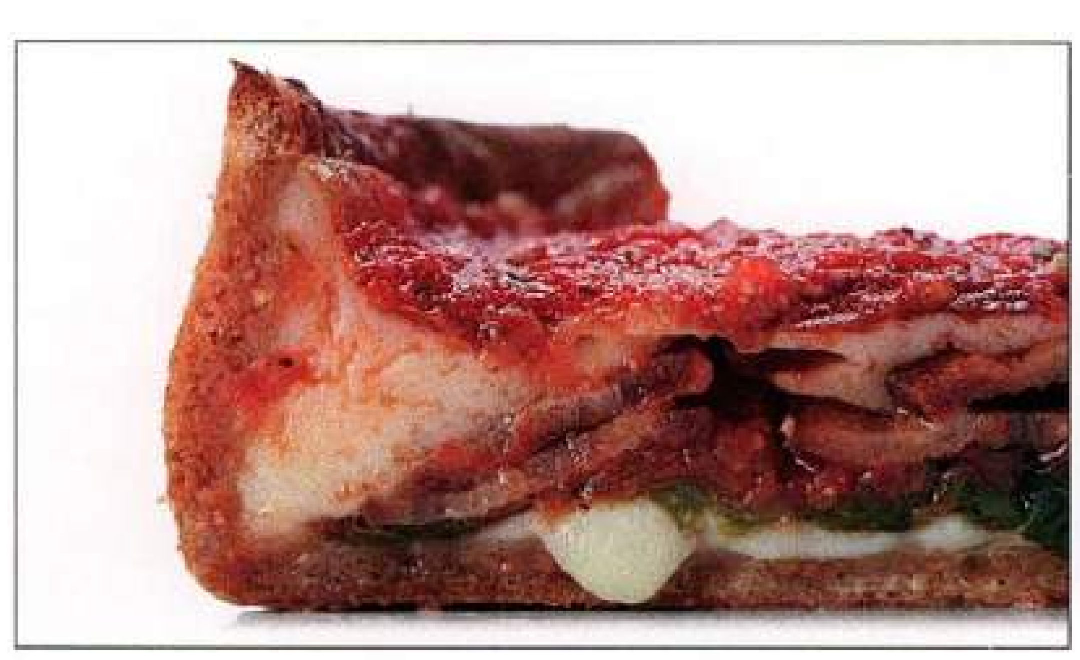
Compleat wheat Detroit-style pizza



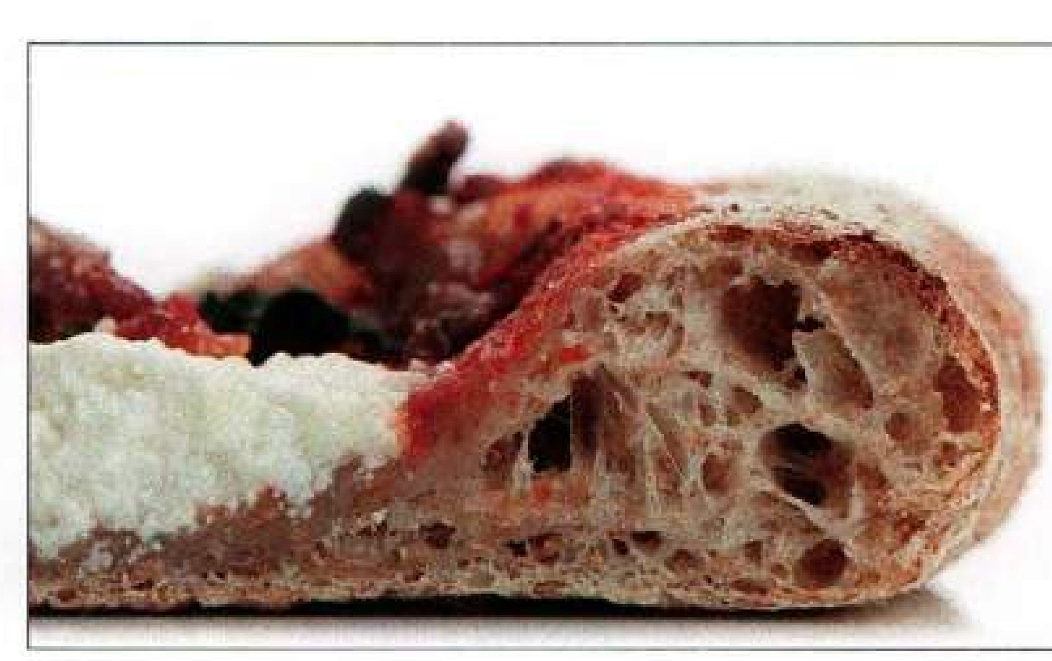
Compleat wheat high-hydration al taglio pizza



Compleat wheat Neapolitan pizza



Compleat wheat deep-dish pizza



Compleat wheat artisan pizza

GRAIN, NUT, OR SEED VARIATIONS

PIZZA STYLE	PREFERMENT				WATER, 21°C / 70°F			INSTANT DRY YEAST		
		Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
Thin-Crust Pizza Dough see page 110	For the Poolish				335 g	1½ cups	68.37	4.3 g	1½ tsp	0.88
	Bread flour, 11.5%–12% protein	50 g	⅓ cup	100						
	Water	50 g	3 Tbsp + 1½ tsp	100						
	Instant dry yeast	0.05 g	*	0.1						
Neapolitan Pizza Dough see page 124	n/a				335 g	1½ cups	62.04	0.21 g	⅛ tsp	0.04
New York Pizza Dough see page 132	For the Poolish				320 g	1⅓ cups	65.98	2.6 g	1 tsp	0.54
	Bread flour, 11.5%–12% protein	55 g	⅓ cup + 1 Tbsp	100						
	Water	55 g	¼ cup	100						
	Instant dry yeast	0.06 g	*	0.11						
Artisan Pizza Dough see page 142	For the Poolish				335 g	1½ cups	67.68	2.3 g	¾ tsp + ⅛ tsp	0.46
	Bread flour, 11.5%–12% protein	65 g	½ cup	100						
	Water	65 g	¼ cup	100						
	Instant dry yeast	0.07 g	*	0.11						
Focaccia Dough see page 148	For the Poolish				335 g	1¼ cups + 3 Tbsp	83.75	1.2 g	½ tsp	0.3
	Bread flour, 11.5%–12% protein	65 g	½ cup	100						
	Water	65 g	¼ cup	100						
	Instant dry yeast	0.07 g	*	0.11						
	Liquid levain, mature see page 1:304	60 g	¼ cup	15						
New York Square Pizza Dough see page 152	For the Poolish				230 g	1 cup	71.88	1.7 g	½ tsp + ⅛ tsp	0.53
	High-gluten bread flour, 13.5%–15% protein	35 g	¼ cup	100						
	Water	35 g	2 Tbsp + 1½ tsp	100						
	Instant dry yeast	0.04 g	*	0.11						
High-Hydration al Taglio Pizza Dough see page 158	Liquid levain, mature see page 1:304	220 g	1 cup	38.26	450 g	2 cups	78.26	3.5 g	1¼ tsp	0.61
Detroit-Style Pizza Dough see page 166	n/a				370 g	1⅔ cups	70.48	4.7 g	1¾ tsp	0.9

**Refer to the specific master recipe when calculating this volume.*

***The volume measurements of the inclusions will vary depending on the ingredients used.*

1 Follow the instructions for mixing the specific type of dough based on its master recipe, but mix it only to medium gluten development (see page 30). Then add the grain, nut, or seed inclusions, and mix on low speed until just incorporated.

2 Place the dough in a lightly oiled tub, and perform a four-edge fold.

3 Bulk ferment the dough for 2½ h, covered, at 21°C / 70°F. Perform 4 four-edge folds (1 fold every 30 min after the first 30 min; see page 51) or more until the dough reaches full gluten development. Perform the windowpane test to assess full gluten development (see page 30). Rest the dough, covered, for 30 min after the final fold.

4 Follow the remaining instructions for the master recipe of the pizza style you are making.

FLOUR			FINE SALT			FAT			OTHER			GRAIN, NUT, OR SEED		
Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
490 g	3⅔ cups	100	12 g	2⅛ tsp	2.45	n/a			Fine-ground cornmeal 50 g	⅓ cup + 1 Tbsp	10.2	110 g	**	22.45
540 g	4 cups	100	10.8 g	2 tsp	2	n/a			Meat tenderizer 0.05 g	*	0.01	110 g	**	20.37
485 g	3½ cups	100	13.5 g	2½ tsp	2.78	Extra-virgin olive oil 18 g	1 Tbsp + 1 tsp	3.71	Diastatic malt powder 14 g	1 Tbsp + ½ tsp	2.89	100 g	**	20.62
495 g	3⅔ cups	100	11 g	2 tsp	2.22	Extra-virgin olive oil 18 g	1 Tbsp + 1 tsp	3.64	Diastatic malt powder 12 g	1 Tbsp	2.42	110 g	**	22.22
400 g	3 cups	100	10 g	1¾ tsp	2.5	Extra-virgin olive oil 20 g	1 Tbsp + 1¼ tsp	5	Malted barley syrup 5 g	¾ tsp	1.25	100 g	**	25
320 g	2¼ cups	100	7.2 g	1¼ tsp	2.25	Extra-virgin olive oil 15 g	1 Tbsp + ¼ tsp	4.69	n/a			75 g	**	23.44
575 g	4¼ cups	100	17 g	1 Tbsp	2.96	Extra-virgin olive oil 27 g	2 Tbsp	4.7	Diastatic malt powder 1.5 g	¼ tsp + ⅛ tsp	0.24	130 g	**	22.61
Bread flour, 11.5%–12% protein 450 g Semolina flour 75 g	 3⅓ cups ⅓ cup + 2 Tbsp	 85.71 14.29	10.5 g	1⅞ tsp	2	n/a			Sugar 7 g	1¾ tsp	1.33	105 g	**	20

Notes

- You can soak, sprout, or cook your grains into a porridge or grain puree (see pages 3:342–3:349). If the nuts are small, leave them whole and toast them. If they are large, such as walnuts, pecans, or cashews, chop them coarsely, and then toast.
- If you make a hot preparation such as a porridge or grain puree, or if you toast the inclusion, make sure it cools down before you mix it into the dough.
- You may want to cook grains with salt because an unseasoned inclusion can dilute the flavor of the crust. Add 1% salt to the grains (based on the grain amount, not the water or flour amount).
- You can also use the amounts listed on page 1:331 to create pizza crusts with fruit, vegetable, meat, or cheese inclusions.
- For thin-crust pizzas, make sure to use inclusions that are not too big. Large chunks, pieces, or cubes will limit your ability to stretch the dough out thinly. The dimensions of the inclusions should be a maximum of about 3 mm / ⅛ in.
- For the Neapolitan pizza, you can use grano arso (burnt flour) as the inclusion in the dough to add another level of toasted flavor to the finished pizza.

COUNTRY-STYLE VARIATIONS

PIZZA STYLE	FLOUR WEIGHT IN MASTER RECIPE (100%)	ALL-PURPOSE FLOUR, BREAD FLOUR, OR A MIX (~70%)	WHOLE WHEAT FLOUR (~15%)	LIGHT, MEDIUM, OR DARK RYE FLOUR (~15%)
Thin-Crust Pizza Dough see page 110	540 g	380 g (2¾ cups)	80 g (⅔ cup)	80 g (¾ cup)
Brazilian Thin-Crust Pizza Dough see page 114	615 g	Cake flour 370 g (3 cups) Bread flour, 11.5%–12% protein 65 g (½ cup)	90 g (¾ cup)	90 g (¾ cup + 2 Tbsp)
Deep-Dish Pizza Dough see page 118	380 g	270 g (2 cups)	55 g (⅓ cup + 1½ Tbsp)	55 g (½ cup)
Neapolitan Pizza Dough see page 124	610 g	430 g (3 cups + 2 Tbsp)	90 g (⅔ cup)	90 g (¾ cup + 2 Tbsp)
New York Pizza Dough see page 132	530 g	370 g (2¾ cups)	80 g (⅔ cup)	80 g (¾ cup)
Artisan Pizza Dough see page 142	550 g	380 g (2¾ cups)	85 g (⅔ cup)	85 g (¾ cup)
Focaccia Dough see page 148	400 g	280 g (2 cups)	60 g (½ cup)	60 g (½ cup + 1½ Tbsp)
New York Square Pizza Dough see page 152	395 g	275 g (2 cups)	60 g (½ cup)	60 g (½ cup + 1 Tbsp)
High-Hydration al Taglio Pizza Dough see page 158	630 g	410 g (3 cups)	110 g (¾ cup + 2 Tbsp)	110 g (1 cup)
Detroit-Style Pizza Dough see page 166	575 g	Bread flour, 11.5%–12% protein 340 g (2½ cups) Semolina flour 85 g (½ cup)	75 g (½ cup + 1½ Tbsp)	75 g (¾ cup)

Notes

- You will be substituting 30% of the total weight of the flour (first column) for 15% whole wheat flour and 15% rye flour to create a country-style pizza dough.
- Follow the instructions for the master recipe of the pizza style you are making. The whole wheat flour and rye flour will be mixed into the dough along with the all-purpose or bread flour.
- You can replace the whole wheat and rye flours with 30% whole wheat flour if desired.
- Be sure to include the cornmeal in addition to the flours in the Thin-Crust Pizza Dough on page 110 and the Deep-Dish Pizza Dough on page 118.
- You can replace the whole wheat and rye flours with 30% masa harina flour in the Neapolitan Pizza Dough (see page 124) if desired.

Country-style Detroit-style pizza

ANCIENT GRAIN VARIATIONS

			ANCIENT GRAIN MIX TOTALS 40% OF FLOUR		
PIZZA STYLE	FLOUR WEIGHT IN MASTER RECIPE (100%)	ALL-PURPOSE FLOUR, BREAD FLOUR, OR A MIX (60%)	WHOLE SPELT FLOUR (15%)	EINKORN FLOUR (15%)	EMMER FLOUR (10%)
Thin-Crust Pizza Dough see page 110	540 g	325 g (2¼ cups + 2 Tbsp)	80 g (¾ cup)	80 g (¾ cup)	55 g (½ cup)
Brazilian Thin-Crust Pizza Dough see page 114	615 g	370 g (2¾ cups)	90 g (¾ cup)	90 g (¾ cup)	65 g (½ cup)
Deep-Dish Pizza Dough see page 118	380 g	230 g (1¾ cups)	55 g (½ cup)	55 g (½ cup)	40 g (⅓ cup)
			KHORASAN FLOUR (15%)	WHOLE SPELT FLOUR (15%)	EMMER FLOUR (10%)
Neapolitan Pizza Dough see page 124	610 g	370 g (2¾ cups)	90 g (¾ cup)	90 g (¾ cup)	60 g (½ cup)
New York Pizza Dough see page 132	530 g	320 g (2⅓ cups)	75 g (⅔ cup)	75 g (⅔ cup)	60 g (½ cup)
Artisan Pizza Dough see page 142	550 g	335 g (2½ cups)	80 g (¾ cup)	80 g (¾ cup)	55 g (½ cup)
			KHORASAN FLOUR (15%)	BUCKWHEAT FLOUR (15%)	DARK RYE FLOUR (10%)
Focaccia Dough see page 148	400 g	240 g (1¾ cups)	60 g (½ cup)	60 g (½ cup)	40 g (⅓ cup)
New York Square Pizza Dough see page 152	395 g	235 g (1¾ cups)	60 g (½ cup + 1 Tbsp)	60 g (½ cup + 1 Tbsp)	40 g (⅓ cup)
High-Hydration al Taglio Pizza Dough see page 158	630 g	375 g (2¾ cups)	95 g (¾ cup)	95 g (¾ cup)	65 g (½ cup)
Detroit-Style Pizza Dough see page 166	575 g	345 g (2½ cups)	85 g (¾ cup)	85 g (¾ cup)	60 g (⅔ cup)

Notes

- You will be substituting 40% of the total weight of the flour (first column) for a 40% mix of ancient grain flours to create an ancient grain dough for any style of pizza dough.
- You can use any type of ancient grain flours you like; these are simply the ones we liked for these types of doughs. We did a mix of 15%, 15%, and 10%, but you can shift those percentages as long as they total 40%. Using more ancient grain flour than this will make the dough very weak and hard to work with. It'll also bake with a lower volume.
- If you include flours that are gluten-free, we recommend that you add up to 5% vital wheat gluten to the dough to strengthen it. Add it to the flour before mixing the dough. You can also add 1.4 g (½ tsp) ascorbic acid with the flour to strengthen these doughs, especially those with hydrations above 70%.
- Follow the instructions for the master recipe of the pizza style you are making. The ancient grain flours will be mixed into the dough along with the all-purpose or bread flour.
- Be sure to include the cornmeal in addition to the flour in the Thin-Crust Pizza Dough on page 110 and the Deep-Dish Pizza Dough on page 118.
- Our master Brazilian thin-crust pizza dough uses a combination of cake flour and bread flour. In our ancient grain variation, we omit the cake flour and use mainly bread flour because you need a stronger flour to counteract the adverse effects the ancient grain flours have on the dough (see page 1:325).

Ancient grain New York pizza

NO-KNEAD VARIATIONS

PIZZA STYLE	FLOUR			WATER, 21 °C / 70 °F		
	Weight	Volume	%	Weight	Volume	%
Thin-Crust Pizza Dough see page 110	595 g	4¼ cups + 2 Tbsp	100	425 g	1¾ cups + 1½ Tbsp	71.43
Brazilian Thin-Crust Pizza Dough see page 114	615 g	4½ cups	100	310 g	1⅓ cups	50.41
Deep-Dish Pizza Dough see page 118	380 g	2¾ cups	100	225 g	1 cup	59.21
Neapolitan Pizza Dough see page 124	610 g	4½ cups	100	380 g	1⅔ cups	62.3
New York Pizza Dough see page 132	590 g	4 cups	100	410 g	1¾ cups	69.49
Artisan Pizza Dough see page 142	625 g	4⅓ cups	100	450 g	2 cups	72

**Refer to the specific master recipe when calculating this volume.*

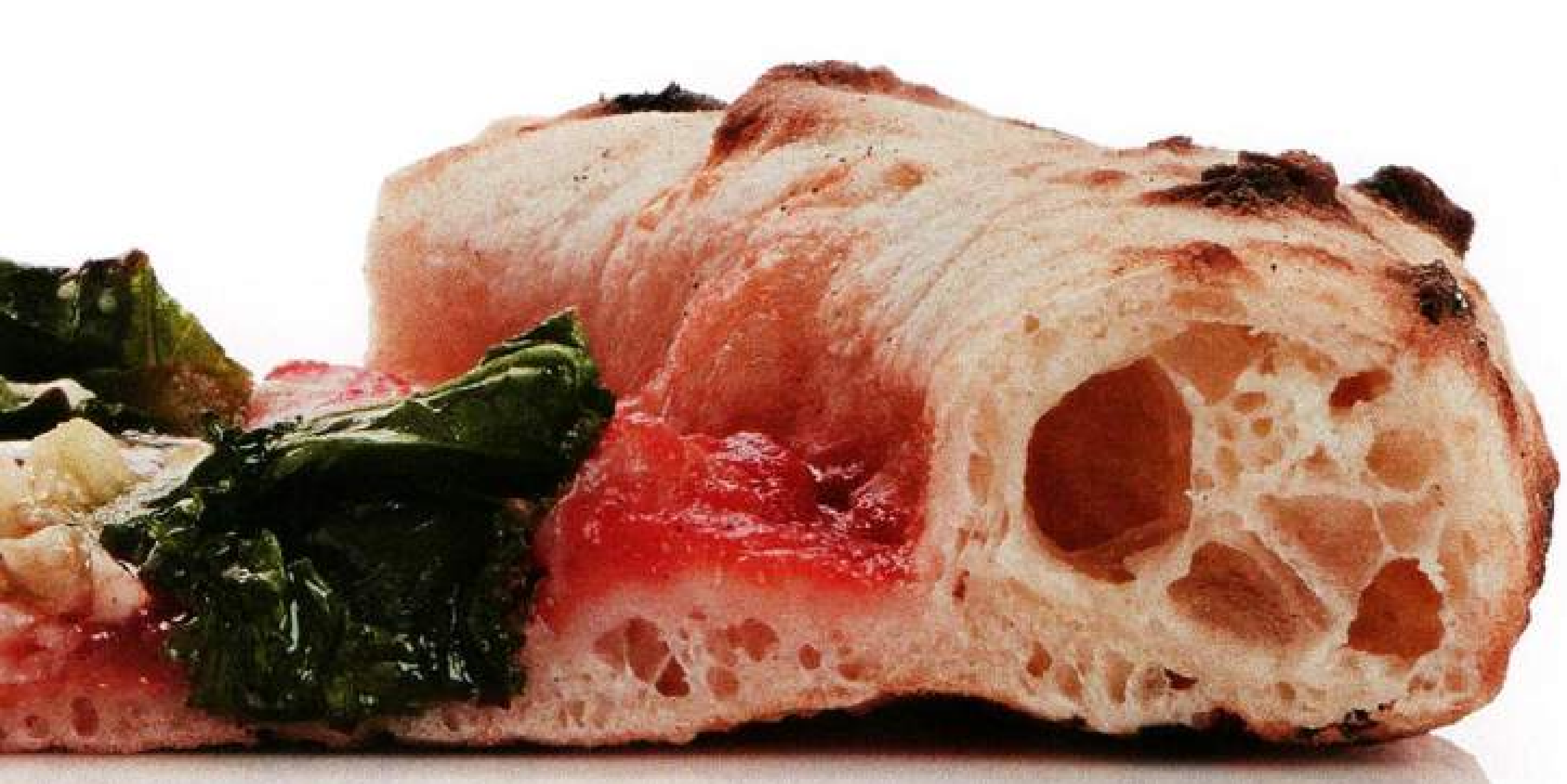
No-knead artisan pizza

FINE SALT			INSTANT DRY YEAST			FAT			OTHER		
Weight	Volume	%	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
13 g	2¼ tsp + ⅛ tsp	2.18	1.6 g	½ tsp + ⅛ tsp	0.27	n/a			Fine-ground cornmeal 55 g	 ½ cup	 9.24
12.3 g	2¼ tsp	2	1.6 g	½ tsp + ⅛ tsp	0.26	Extra-virgin olive oil 60 g	 ¼ cup + 1 tsp	 9.76	n/a		
8 g	1¼ tsp + ⅛ tsp	2.11	1 g	¼ tsp + ⅛ tsp	0.26	Lard, softened 18 g Butter, softened 18 g	 1 Tbsp + ¾ tsp 1 Tbsp + ¾ tsp	 4.74 4.74	Fine-ground cornmeal 40 g Malted barley syrup 7 g Diastatic malt powder 8 g	 ⅓ cup 1 tsp 2 tsp	 10.53 1.84 2.11
12.15 g	2⅛ tsp	1.99	0.22 g	⅛ tsp	0.04				Meat tenderizer 0.05 g	 *	 0.01
14.5 g	2½ tsp	2.46	1.6 g	½ tsp + ⅛ tsp	0.28	Extra-virgin olive oil 20 g	 1 Tbsp + 1¼ tsp	 3.39	Diastatic malt powder 15 g	 1 Tbsp + ¾ tsp	 2.54
12.5 g	2¼ tsp	2	1.7 g	½ tsp + ⅛ tsp	0.27	Extra-virgin olive oil 20 g	 1 Tbsp + 1¼ tsp	 3.2	Diastatic malt powder 13 g	 1 Tbsp + ¼ tsp	 2.08

1. Combine all the ingredients in a bowl, and mix by hand to a homogeneous mass. Transfer to a lightly oiled tub, and cover.
2. Bulk ferment for 12–18 h at 21° C / 70° F.
3. Divide and preshape the dough as instructed in the master recipe you are making.
4. Proof for 3–4 h at 21° C / 70° F, covered. If you are making New York pizza dough, proof for 4½–5½ h at 21° C / 70° F, covered.
5. Proceed with the shaping and baking instructions in the master recipe you are making.

Notes

- After preshaping, you can also cold-proof this dough at 4° C / 39° F for 1–2 d for even better baking results. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.
- Our master Brazilian thin-crust pizza dough uses a combination of cake flour and bread flour. In our no-knead variation, we use just bread flour in order to strengthen the dough since it is mixed only to a homogeneous mass.



No-knead Neapolitan pizza

No-knead New York pizza

YOUR DAILY PIZZA VARIATIONS

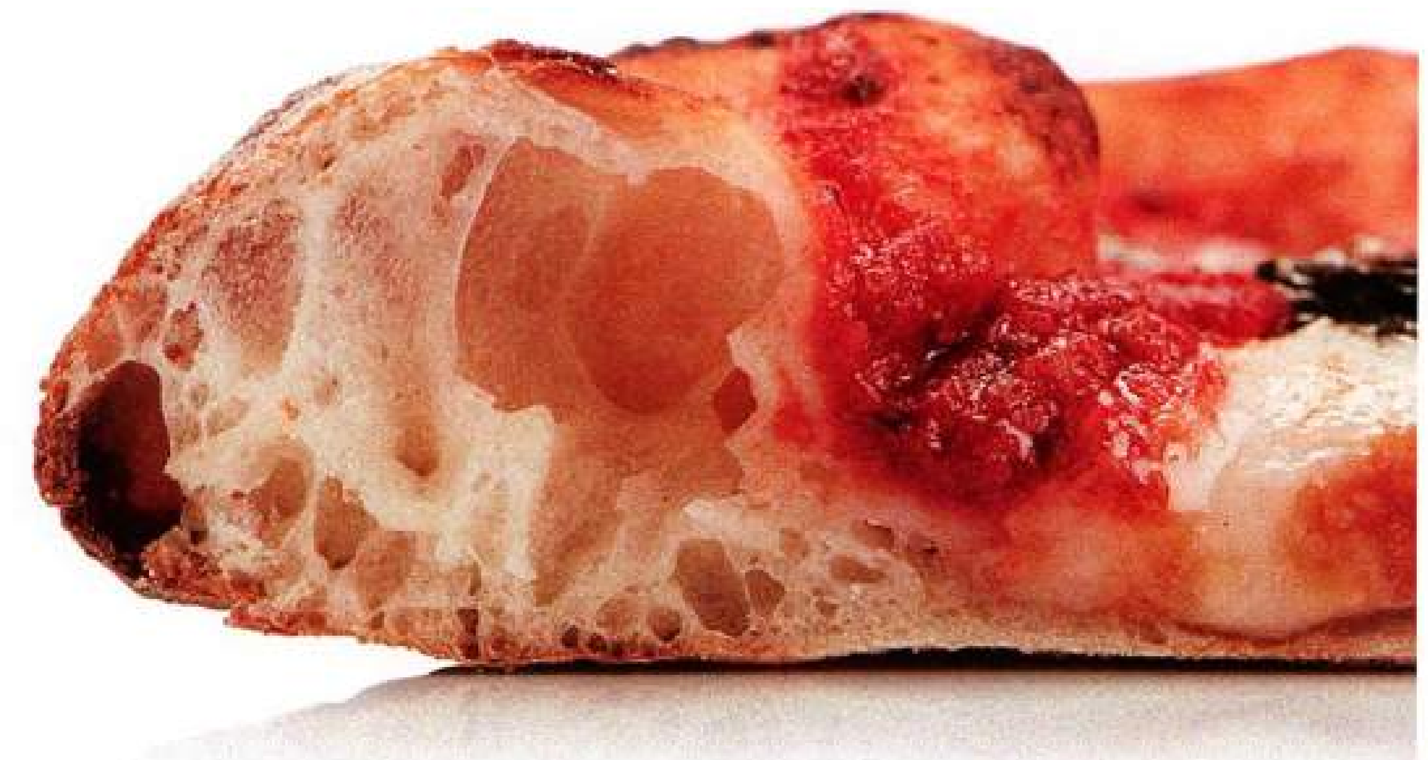
PIZZA STYLE	FLOUR			WATER, 21°C / 70°F			FINE SALT		
	Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
Thin-Crust Pizza Dough see page 110	1.97 kg	13½ cups	100	1.41 kg	6 cups + 2 Tbsp	71.57	43 g	2 Tbsp + 1¾ tsp	2.18
Brazilian Thin-Crust Pizza Dough see page 114	2.21 kg	16⅓ cups	100	1.12 kg	4¾ cups + 2 Tbsp	50.68	45 g	2 Tbsp + 2 tsp	2.04
Neapolitan Pizza Dough see page 124	2.1 kg	15½ cups	100	1.38 kg	6 cups	65.71	46 g	2 Tbsp + 2¼ tsp	2.19
New York Pizza Dough see page 132	4.2 kg	29 cups	100	2.9 kg	12⅔ cups	69.05	104 g	⅓ cup + 2½ tsp	2.48
Artisan Pizza Dough see page 142	2.06 kg	14¼ cups	100	1.48 kg	6½ cups	71.84	41 g	2 Tbsp + 1¼ tsp	1.99

1. Combine the flour, water, salt, yeast, fat (if applicable), and other ingredients in the mixer's bowl. Mix on low speed with a paddle or hook attachment to a homogeneous mass, 2–3 min. Transfer to a lightly oiled tub, and cover.
2. Bulk ferment for 1 h at 21° C / 70° F. Take the cover off, and put a piece of plastic wrap directly on the surface of the dough to cover it completely. Place in refrigeration for at least 23 h before your first bake.
3. Divide the dough as instructed in the master recipe you are making.
4. Proceed with the preshaping instructions (if applicable) in the master recipe you are making.
5. Proof for 4½–5½ h at 21° C / 70° F, covered. If you are making Neapolitan pizza dough, proof for 3–4 h at 21° C / 70° F, covered. Proceed with the shaping and baking instructions in the master recipe you are making.

Your daily thin-crust pizza

INSTANT DRY YEAST			FAT			OTHER		
Weight	Volume	%	Weight	Volume	%	Weight	Volume	%
5.3 g	2 tsp	0.27	n/a			Fine-ground cornmeal 181 g	 1½ cups	 9.19
						Ascorbic acid 4.3 g	 1¼ tsp	 0.22
6 g	2¼ tsp	0.27	Extra-virgin olive oil 215 g	 ¾ cup + 3 Tbsp	 9.73	Ascorbic acid 5 g	 1½ tsp	 0.23
5.7 g	2 tsp	0.27	n/a			Polydextrose 21 g	 1 Tbsp + 2¼ tsp	 1
						Ascorbic acid 4.7 g	 1¼ tsp + ⅛ tsp	 0.22
11.4 g	2Tbsp + 1⅛ tsp	0.27	Extra-virgin olive oil 140 g	 ⅔ cup	 3.33	Diastatic malt powder 106 g	 ½ cup + 2½ tsp	 2.52
						Ascorbic acid 9.2 g	 2¾ tsp	 0.22
5.6 g	2 tsp	0.27	Extra-virgin olive oil 64 g	 ¼ cup	 3.11	Diastatic malt powder 43 g	 3 Tbsp + 1¾ tsp	 2.09
						Ascorbic acid 4.5 g	 1¼ tsp + ⅛ tsp	 0.22

Your daily New York pizza



Your daily artisan pizza

Notes

- The yields for these doughs assume making one pizza per day for up to 10 days. The thin-crust pizza dough and Neapolitan pizza dough can last up to 14 days.
- Our master Brazilian thin-crust pizza dough uses a combination of cake flour and bread flour. In the Your Daily Pizza variation, we use only bread flour because you need a stronger flour that will hold up to being refrigerated for several days.
- The New York pizza dough has a rather large yield. To make enough dough for the smallest New York pizza (400 g) for a pizza every day for 10 days, you will need at least 4 kg of dough. This dough amount gives you the option of making slightly larger or different-sized pizzas for 10 days. If you want to make a specific size every day and this yield is not the exact amount you need, you can refer to the recipe conversion factor (RCF) section on page 21 to help calculate the amount you need.

Your daily Neapolitan pizza

FLAVOR VARIATIONS

We have developed a myriad of puree possibilities to work with our master pizza doughs. The purees in the table below are categorized by their culinary usage, so ingredients that are similar in consistency and amount of water are grouped together. We included some additional suggestions

PUREE TYPE	%	THIN-CRUST PIZZA DOUGH SEE PAGE 110 BRAZILIAN THIN-CRUST PIZZA DOUGH SEE PAGE 114	DEEP-DISH PIZZA DOUGH SEE PAGE 118	NEAPOLITAN PIZZA DOUGH SEE PAGE 124	NEW YORK PIZZA DOUGH SEE PAGE 132
Thick vegetable puree: roasted red pepper puree, carrot puree, huitlacoche puree, tomato puree, roasted zucchini puree, sautéed onion puree, kimchi puree, any pepper (including hot peppers) puree, turnip puree, parsnip puree, celery root puree, cauliflower puree					
Roasted red pepper puree	10.92	67 g (¼ cup)	42 g (2½ Tbsp)	65 g (¼ cup)	64 g (¼ cup)
Carrot puree*	50.41	310 g (1¼ cups)	192 g (¾ cup)	300 g (1¼ cups)	297 g (1¼ cups)
Huitlacoche puree*	55.46	341 g (1⅓ cups)	211 g (¾ cup + 2 Tbsp)	330 g (1⅓ cups)	327 g (1⅓ cups)
Tomato puree*	47.06	238 g (1 cup) tomato water	147 g (⅔ cup) tomato water	230 g (1 cup) tomato water	228 g (1 cup) tomato water
		52 g (3 Tbsp) tomato paste	32 g (2 Tbsp) tomato paste	50 g (3 Tbsp) tomato paste	50 g (3 Tbsp) tomato paste
Roasted zucchini puree*	57.58	354 g (1½ cups + 1 Tbsp)	219 g (1 cup)	343 g (1½ cups)	340 g (1½ cups)
Sautéed onion puree*	57.58	354 g (1½ cups + 1 Tbsp)	219 g (1 cup)	343 g (1½ cups)	340 g (1½ cups)
Kimchi puree*	65.25	401 g (1⅔ cups)	248 g (1 cup)	388 g (1½ cups)	385 g (1½ cups)
Poblano pepper puree*	67.57	416 g (1¾ cups + 1 Tbsp)	257 g (1 cup + 2 Tbsp)	402 g (1¾ cups)	399 g (1¾ cups)
Nut or seed paste: tahini, chestnut puree, sunflower seed butter, black sesame seed paste, nut butter (cashew, pecan, hazelnut), unsweetened nut paste (pistachio)					
Tahini**	15.97	98 g (½ cup)	61 g (⅓ cup)	95 g (½ cup)	94 g (½ cup)
Chestnut puree*	50.41	310 g (2½ cups)	192 g (1½ cups)	300 g (2½ cups)	297 g (2⅓ cups + 1 Tbsp)
Sunflower seed butter***	21.05	130 g (½ cup)	80 g (⅓ cup)	125 g (½ cup)	124 g (½ cup)
Legume puree: refried black beans, edamame puree, tofu puree, hummus, unsweetened peanut butter					
Refried black beans	16.81	103 g (¾ cup)	64 g (½ cup)	100 g (¾ cup)	99 g (¾ cup)
Edamame puree****	21.05	130 g (½ cup)	80 g (⅓ cup)	125 g (½ cup)	124 g (½ cup)
Silken tofu puree*	60	369 g (1¾ cups)	228 g (1 cup)	357 g (1⅔ cups)	354 g (1⅔ cups)
Thick store-bought sauce: mole sauce puree, romesco sauce puree, marinara sauce puree, salsa, curries, pasta sauce					
Mole sauce puree	13.45	83 g (⅓ cup)	51 g (¼ cup)	80 g (⅓ cup)	79 g (⅓ cup)
Romesco sauce puree*	65.25	401 g (1½ cups)	248 g (1 cup)	388 g (1½ cups)	385 g (1½ cups)
Marinara sauce puree*	65.25	401 g (1½ cups)	248 g (1 cup)	388 g (1½ cups)	385 g (1½ cups)
Starchy puree: salsify puree, sunchoke puree, corn puree, potato puree, taro root puree, poi puree, sweet potato puree					
Salsify puree*	50.41	310 g (1¼ cups)	192 g (¾ cup)	300 g (1¼ cups)	297 g (1¼ cups)
Sunchoke puree*	55.46	341 g (1½ cups)	211 g (1 cup)	330 g (1½ cups)	327 g (1½ cups)
Grilled corn puree*	50	308 g (1⅓ cups)	190 g (¾ cup)	298 g (1¼ cups)	295 g (1¼ cups)
Loose puree: hearts of palm puree, artichoke puree, olive puree, mushroom puree, black garlic puree, herb puree, squid ink puree					
Hearts of palm puree*	50.41	310 g (1¼ cups)	192 g (¾ cup)	300 g (1¼ cups)	297 g (1¼ cups)
Artichoke puree*	60	369 g (1¾ cups)	228 g (1 cup)	357 g (1⅔ cups)	354 g (1⅔ cups)
Kalamata olive puree*	60	369 g (1½ cups)	228 g (1 cup)	357 g (1½ cups)	354 g (1½ cups)
Green olive puree*	57.58	354 g (1⅓ cups)	219 g (¾ cup + 2 Tbsp)	343 g (1⅓ cups)	340 g (1⅓ cups)
Black garlic puree*	68.92	424 g (1¾ cups + 1 Tbsp)	262 g (1 cup + 2 Tbsp)	410 g (1¾ cups)	407 g (1¾ cups)
Herb puree*	60	369 g (1½ cups)	228 g (1 cup)	357 g (1½ cups)	354 g (1½ cups)
Squid ink puree*	65.25	401 g (1¾ cups)	248 g (1 cup)	388 g (1⅔ cups)	385 g (1⅔ cups)

if you want to use these amounts as guidelines with other purees. The instructions for making the purees follow the table. Unless otherwise indicated, add the puree amount with the water portion of the dough. Freeze any leftover puree for future use.

ARTISAN PIZZA DOUGH SEE PAGE 142	FOCACCIA DOUGH SEE PAGE 148	NEW YORK SQUARE PIZZA DOUGH SEE PAGE 152	HIGH-HYDRATION AL TAGLIO PIZZA DOUGH SEE PAGE 158	DETROIT-STYLE PIZZA DOUGH SEE PAGE 166
68 g (¼ cup)	54 g (3 Tbsp + 1 tsp)	43 g (2 Tbsp + 2¼ tsp)	81 g (¼ cup + 1 Tbsp)	63 g (¼ cup)
315 g (1¼ cups)	250 g (1 cup)	200 g (¾ cup + 1½ Tbsp)	373 g (1½ cups)	290 g (1¼ cups)
347 g (1⅓ cups)	275 g (1 cup + 2 Tbsp)	220 g (¾ cup +2½ Tbsp)	410 g (1⅔ cups)	319 g (1⅓ cups)
242 g (1 cup + 2 tsp) tomato water	191 g (¾ cup + 1 Tbsp) tomato water	152 g (⅔ cup) tomato water	286 g (1¼ cup) tomato water	222 g (1 cup) tomato water
53 g (3 Tbsp) tomato paste	42 g (2½ Tbsp) tomato paste	33 g (2 Tbsp) tomato paste	62 g (3¾ Tbsp) tomato paste	49 g (3 Tbsp) tomato paste
360 g (1½ cups + 1 Tbsp)	285 g (1¼ cups)	225 g (1 cup)	426 g (1¾ cups + 2 Tbsp)	331 g (1½ cups)
360 g (1½ cups + 1 Tbsp)	285 g (1¼ cups)	225 g (1 cup)	426 g (1¾ cups + 2 Tbsp)	331 g (1½ cups)
408 g (1⅔ cups)	323 g (1⅓ cups)	255 g (1 cup)	483 g (2 cups)	375 g (1½ cups)
422 g (1¾ cups + 2 Tbsp)	334 g (1½ cups)	265 g (1 cup + 2½ Tbsp)	500 g (2 cups + 3 Tbsp)	389 g (1¾ cups)
100 g (½ cup)	79 g (⅓ cup + 1 Tbsp)	63 g (⅓ cup)	118 g (⅔ cup)	91 g (½ cup)
315 g (2½ cups)	250 g (2 cups)	200 g (1¾cup)	373 g (3 cups)	290 g (2½ cups + 1 Tbsp)
132 g (½ cup)	104 g (⅓ cup + 2 Tbsp)	83 g (⅓ cup)	156 g (⅔ cup)	121 g (½ cup)
105 g (¾ cup)	83 g (⅔ cup)	65 g (½ cup)	124 g (1 cup)	97 g (¾ cup)
132 g (½ cup)	104 g (⅓ cup + 2 Tbsp)	83 g (⅓ cup)	156 g (⅔ cup)	121 g (½ cup)
375 g (1¾ cups)	297 g (1⅓ cups)	235 g (1 cup + 2 Tbsp)	444 g (2 cups)	345 g (1⅔ cups)
84 g (⅓ cup)	67 g (¼ cup)	53 g (¼ cup)	100 g (⅓ cup + 1 Tbsp)	77 g (⅓ cup)
408 g (1⅔ cups)	323 g (1¼ cups)	255 g (1 cup)	483 g (2 cups)	375 g (1½ cups)
408 g (1⅔ cups)	323 g (1¼ cups)	255 g (1 cup)	483 g (2 cups)	375 g (1½ cups)
315 g (1¼ cups)	250 g (1 cup)	200 g (¾ cup + 1½ Tbsp)	373 g (1½ cups)	290 g (1¼ cups)
347 g (1½ cups + 1 Tbsp)	275 g (1¼ cups)	220 g (1 cup)	410 g (1¾ cups + 2 Tbsp)	319 g (1½ cups)
313 g (1⅓ cups)	248 g (1 cup)	195 g (¾ cup + 1½ Tbsp)	370 g (1½ cups)	288 g (1¼ cups)
315 g (1¼ cups)	250 g (1 cup)	200 g (¾ cup + 1½ Tbsp)	373 g (1½ cups)	290 g (1¼ cups)
375 g (1¾ cups)	297 g (1⅓ cups)	235 g (1 cup + 1½ Tbsp)	444 g (2 cups)	345 g (1⅔ cups)
375 g (1½ cups)	297 g (1¼ cups)	235 g (1 cup)	444 g (1¾ cups)	345 g (1½ cups)
360 g (1⅓ cups + 1 Tbsp)	285 g (1 cup + 2 Tbsp)	225 g (¾ cup + 2 Tbsp)	426 g (1⅔ cups)	331 g (1⅓ cups)
431 g (1¾ cups + 2 Tbsp)	341 g (1½ cups)	270 g (1 cup + 2½ Tbsp)	510 g (2 cups + 3 Tbsp)	396 g (1¾ cups)
375 g (1½ cups)	297 g (1 cup + 3 Tbsp)	235 g (1 cup)	444 g (1¾ cups)	345 g (1½ cups)
408 g (1¾ cups)	323 g (1⅓ cups + 1 Tbsp)	255 g (1 cup + 1½ Tbsp)	483 g (2 cups + 1 Tbsp)	375 g (1⅔ cups)

CONTINUED ON PAGE 188

PUREE TYPE	%	THIN-CRUST PIZZA DOUGH SEE PAGE 110 BRAZILIAN THIN-CRUST PIZZA DOUGH SEE PAGE 114	DEEP-DISH PIZZA DOUGH SEE PAGE 118	NEAPOLITAN PIZZA DOUGH SEE PAGE 124	NEW YORK PIZZA DOUGH SEE PAGE 132
Leafy green puree: nettle puree, spinach puree, watercress puree, purslane puree					
Nettle puree	21.05	130 g (½ cup)	80 g (⅓ cup)	125 g (½ cup)	124 g (½ cup)
Spinach puree*	67.57	416 g (1¾ cups)	257 g (1 cup + 1 Tbsp)	402 g (1¾ cups)	399 g (1¾ cups)
Allium puree: spring garlic puree, scallion puree , onion puree, leek puree, ramp puree					
Spring garlic puree	15.79	97 g (⅓ cup + 1 Tbsp)	60 g (¼ cup)	94 g (⅓ cup + 1 Tbsp)	93 g (⅓ cup + 1 Tbsp)
Pressure-caramelized vegetable puree: pressure-caramelized shiitake mushroom puree, pressure-cooked cauliflower puree, pressure-caramelized carrot puree, pressure-caramelized zucchini puree (see page 279)					
Pressure-caramelized shiitake mushroom puree*	55.46	341 g (1⅓ cups)	211 g (¾ cup + 2 Tbsp)	330 g (1⅓ cups)	327 g (1⅓ cups)
Pressure-cooked cauliflower puree*	68.92	424 g (1¾ cups + 1 Tbsp)	262 g (1 cup + 2 Tbsp)	410 g (1¾ cups)	407 g (1¾ cups)
Fruit puree: pineapple puree, black fig puree, berry puree, currant puree, mango puree, apricot puree, peach puree, plum puree, cherry puree					
Pineapple puree*	50	308 g (1⅓ cups)	190 g (¾ cup + 1 Tbsp)	298 g (1¼ cups)	295 g (1¼ cups)
Black fig puree*	57.58	354 g (1½ cups + 1 Tbsp)	219 g (1 cup)	343 g (1½ cups)	340 g (1½ cups)

**Substitute the puree for an equal amount of water in the dough.*

***Add when the dough has reached low gluten development.*

****Add with the fat in the recipe.*

*****Add when the dough has reached medium gluten development, and then mix to full gluten development.*

Puree Variation Notes

- For the roasted red pepper, puree 80 g (½ cup) drained canned roasted red peppers and pass through a fine sieve before weighing the amount for the dough. You can also roast your own peppers, if desired. Place a red bell pepper on a sheet pan. Drizzle with olive oil. Roast in a 230° C / 450° F oven until the skin has blistered, about 35 min. Place in a bowl, and cover tightly with plastic wrap. Cool for 15 min. Remove the skin, stem, and seeds. Puree in a blender to a smooth consistency and pass through a fine sieve. Use 65 g (¼ cup) puree as directed above. Store any additional puree in an airtight container in the freezer for up to 2 mo.
- For the carrot puree, cut 200 g (this should yield 1½ cups) peeled carrots into medium dice. Bring a large pot of lightly salted water to a boil. Boil the carrots until tender, about 5 min. Transfer to the ice bath until completely chilled. Drain the carrots and transfer to a blender with 225 g (1 cup) water. Puree the carrots until smooth.
- For the huitlacoche puree, combine 165 g (¾ cup) fresh, thawed frozen, or drained canned huitlacoche and 165 g (⅔ cup) water in a blender, and process until smooth. Depending on where you live, fresh huitlacoche may be available, but it is more likely you will find it frozen or canned in Mexican or specialty food stores (see Resources, page 3:377). If you use canned, substitute the water from the can for the water called for in the recipe. Supplement with additional water if needed.
- For the tomato puree, remove the stems from 2.2 kg / 4.85 lb (10–12 large) tomatoes. Quarter and puree in a blender for a few seconds, until the mixture is slightly chunky, not smooth. Line a sieve with a clean towel, and set it over a bowl or tub. Place the blended tomatoes in the lined sieve, and refrigerate 10–12 h, covered, until the liquid has separated from the solids. Store any leftover tomato water in an airtight container in the freezer for up to 3 mo. The tomato's acidity has a positive effect on the dough, yielding an open crumb as well as good flavor and color.
- For the roasted zucchini puree, slice 650 g zucchini into 6 mm / ¼ in rounds (this should yield about 4¾ cups). Toss with 20 g (1 Tbsp + 1 tsp) olive oil. Roast in a 190° C / 375° F oven until tender, about 40 min. Cool to room temperature. Puree in a blender until smooth. Mix 85 g (¼ cup + 2 Tbsp) puree with 200 g (¾ cup + 2 Tbsp) water. This may seem like way too much zucchini when you need only 85 g, but a lot of water evaporates during roasting.
- For the sautéed onion puree, peel and cut 370 g onion into thin slices (this should yield about 3 cups). Toss with 20 g (1 Tbsp + 1 tsp) olive oil in a medium skillet. Sauté over medium-high heat until tender and amber-brown, about 5–7 min, stirring frequently. Cool to room temperature. Puree in a blender until smooth. Mix 85 g (¼ cup + 2 Tbsp) puree with 200 g (¾ cup + 2 Tbsp) water.

ARTISAN PIZZA DOUGH SEE PAGE 142	FOCACCIA DOUGH SEE PAGE 148	NEW YORK SQUARE PIZZA DOUGH SEE PAGE 152	HIGH-HYDRATION AL TAGLIO PIZZA DOUGH SEE PAGE 158	DETROIT-STYLE PIZZA DOUGH SEE PAGE 166
132 g (½ cup)	104 g (⅓ cup + 2 Tbsp)	83 g (⅓ cup)	156 g (⅔ cup)	121 g (½ cup)
422 g (1¾ cups)	334 g (1½ cups)	265 g (1 cup + 2½ Tbsp)	500 g (2 cups + 2 Tbsp)	389 g (1¾ cups)
99 g (⅓ cup + 1 Tbsp)	78 g (⅓ cup)	62 g (¼ cup)	117 g (½ cup)	91 g (⅓ cup + 1 Tbsp)
347 g (1⅓ cups + 1 Tbsp)	275 g (1 cup + 2 Tbsp)	220 g (¾ cup + 2½ Tbsp)	410 g (1⅔ cups)	319 g (1⅓ cups)
431 g (1¾ cups + 2 Tbsp)	341 g (1½ cups)	270 g (1 cup + 2½ Tbsp)	510 g (2 cups + 3 Tbsp)	396 g (1¾ cups)
313 g (1⅓ cups)	248 g (1 cup + 1 Tbsp)	195 g (¾ cup + 1 Tbsp)	370 g (1½ cups)	288 g (1¼ cups)
360 g (1½ cups + 1 Tbsp)	285 g (1¼ cups)	225 g (1 cup)	426 g (1¾ cups + 2 Tbsp)	331 g (1½ cups)

- For the kimchi puree, puree 200 g (1 cup) store-bought or homemade kimchi in a blender until smooth (do not drain before pureeing). Mix 120 g (½ cup) kimchi puree with 320 g (1⅓ cups) water.
- For the poblano pepper puree, toss 850 g (6 ea) whole poblano peppers with 10 g (2 tsp) olive oil until evenly coated. Roast in a 245° C / 475° F oven until blistered, about 20 min. Remove the seeds, stems, and skin from the peppers. Puree in a blender until smooth. Combine 150 g (½ cup + 2 Tbsp) of the poblano puree with 360 g (1½ cups + 1 Tbsp) water. Store any leftover puree in an airtight container in the freezer for up to 3 mo.
- For the chestnut puree, combine 145 g (1 cup) peeled chestnuts with 330 g (1½ cups) water in a blender and puree until smooth.
- For the edamame puree, puree 100 g (½ cup) shelled fresh or thawed frozen edamame in a blender until smooth.
- For the silken tofu puree, puree 190 g (¾ cup + 1 Tbsp + 1 tsp) water and 190 g (1 cup) silken tofu until smooth.
- We used red mole in creating our mole sauce puree, but there are many different kinds (black, green, yellow), each with its own flavor profile, so feel free to experiment. You can also substitute adobo paste. For more on where to purchase mole sauce, see Resources, page 3:377.
- For the romesco sauce puree, mix 120 g (½ cup) romesco sauce with 320 g (1⅓ cups) water.
- For the marinara sauce puree, mix 120 g (½ cup) Marinara Pizza Tomato Sauce (see page 225) with 320 g (1⅓ cups) water.
- For the salsify puree, cut 300 g (this should yield 2½ cups) peeled salsify into medium dice. Toss the salsify with 15 g (1 Tbsp) neutral oil and roast in a 218°C / 425°F oven until lightly golden brown and tender, 15–20 min, turning occasionally. While still warm, transfer the salsify to a blender and add 300 g (1⅓ cups) water. Puree until smooth. Cool the puree over an ice bath.
- For the hearts of palm puree, transfer the contents of one 400 g (14 oz) can of hearts of palm to a blender and puree until smooth.
- For the artichoke puree, puree 285 g (1¼ cups) water and 90 g (⅔ cup) canned drained artichoke hearts until smooth.
- For the Kalamata olive puree, puree 280 g (1¼ cups) water and 95 g (¾ cup) pitted Kalamata olives until smooth. We chose to make this with Kalamatas because of their intensity, but you can use any type of olive you prefer.
- For the green olive puree, puree 250 g (2 cups) pitted green Castelvetrano olives in a blender until smooth. Mix 85 g (¼ cup + 2 Tbsp) puree with 200 g (¾ cup + 2 Tbsp) water.
- For the black garlic puree, puree 135 g (1 cup) peeled black garlic cloves (see Resources, page 3:377) with 135 g (½ cup + 1 Tbsp) water in a blender until smooth. Combine 150 g (½ cup + 2 Tbsp) black garlic puree with 360 g (1½ cups + 1 Tbsp) water. Store any leftover puree in an airtight container in the freezer for up to 3 mo.

- For the herb puree, blanch 40 g (2 cups, loosely packed) fresh parsley leaves and 36 g (1½ cups, loosely packed) fresh chives in boiling water for 30 s. Drain, and transfer to an ice bath. When the herbs have completely cooled, drain on a clean kitchen towel. Squeeze the towel to remove excess moisture. This should yield approximately 25 g blanched herbs. Transfer to a blender. Add 350 g (1½ cups) water, and puree until smooth.
- For the squid ink puree, add 5 g (1 tsp) squid ink (see Resources, page 3:377) to 380 g (1⅔ cups) water.
- For the nettle puree, blanch 120 g (¾ cup) nettle leaves in boiling water for 8–10 s. Drain, and transfer to an ice bath. When the nettles have completely cooled, drain on a clean kitchen towel. Squeeze the towel to remove excess moisture. Puree in a blender until smooth.
- For the spinach puree, blanch 550 g (15¾ cups) spinach leaves in boiling water for 30 s. Drain, and transfer to an ice bath. When the spinach has completely cooled, drain on a clean kitchen towel. Pat dry, leaving some water on the leaves. Puree in a blender until smooth. Combine 150 g (½ cup + 2 Tbsp) spinach puree with 360 g (1½ cups + 1 Tbsp) water. Store any leftover puree in an airtight container in the freezer for up to 3 mo.
- For the spring garlic puree, blanch 120 g (¾ cup) trimmed spring garlic cloves in boiling water for 30–40 s. Drain, and transfer to an ice bath. When the garlic has completely cooled, drain on a clean kitchen towel. Squeeze the towel to remove excess moisture. Puree in a blender until smooth.
- For the pineapple puree, combine 150 g (⅔ cup) water and 145 g (¾ cup) canned pineapple juice. You can use fresh pineapple juice, but make sure to bring it to a simmer first, and then cool it down before using. This will deactivate the bromelain enzyme that would otherwise break down the proteins in the dough (that's why fresh pineapple juice is called for when it's being used as a dough relaxer).
- For the black fig puree, mix 85 g (¼ cup + 2 Tbsp) store-bought fig puree with 200 g (¾ cup + 2 Tbsp) water.

SUNCHOKE PUREE

Yield: 475 g (1¾ cups + 2 Tbsp)

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Sunchokes, peeled and cut into large dice	250 g	5 to 6 ea	100
Olive oil	12.5 g	2¾ tsp	5
Fine salt	2.5 g	½ tsp	1
Water	415 g	1¾ cups	166

- The sunchokes should yield about 1½ cups dice after peeling and cutting. Combine the sunchokes, oil, and salt in a bowl, and toss to evenly coat the sunchokes. Place on a sheet pan lined with aluminum foil, and roast at 220°C / 425°F until cooked through and golden brown, about 15 min, turning halfway through. Cool and transfer to a blender. Add 250 g (1 cup + 1 Tbsp + 1 tsp) of the water, and puree until smooth. Pass through a fine sieve into a nonreactive container. Combine 165 g (¾ cup) puree with the remaining water. Store any leftover puree in an airtight container in the freezer for up to 3 mo.

GRILLED CORN PUREE

Yield: 670 g (2⅔ cups)

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Sweet yellow corn on the cob	1.2 kg	4 ears	100
Vegetable oil	as needed		
Water	335 g	1⅓ cups	27.91

- Preheat a grill to high heat. As the grill is heating, remove the husks and all the silk from the corn, and brush a thin layer of oil on the cobs. Grill for 5–7 min, turning the corn with a pair of tongs every 30 s or so to obtain an even char on the surface. Allow the corn to cool to room temperature, and then cut the kernels off the cobs. This should yield about 335 g (2 cups) cooked corn kernels. Place the corn in a blender with the water and puree until smooth. Pass through a fine sieve, and cool down over an ice bath.

PRESSURE-CARAMELIZED SHIITAKE MUSHROOM PUREE

Yield: 550 g (2 cups)

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Butter	60 g	¼ cup	24
Shiitake mushrooms, cleaned, stemmed, and thinly sliced	250 g	4¼ cups	100
Fine salt	2.5 g	½ tsp	1
Baking soda	1.25 g	¼ tsp	0.5
Water	265 g	1 cup + 2 Tbsp	106

In some cases, our puree recipes yield more than what you need for 1 kg of dough because making small quantities is more difficult than making a large batch and freezing the leftover puree.

FOR PRESSURE COOKER

- Melt the butter in the base of a pressure cooker over medium heat. Add the mushrooms, salt, and baking soda, and stir to evenly distribute. Add 30 g (2 Tbsp) of the water. Pressure-cook at a gauge pressure of 1 bar / 15 psi for 30 min; start timing when full pressure is reached. Depressurize the cooker quickly by running tepid water over the rim. Transfer the mushrooms to a blender, and add the remaining water. Puree until smooth, pass through a fine sieve into a nonreactive container, and cool to 21° C / 70° F. Store any leftover puree in an airtight container in the freezer for up to 3 mo.

FOR INSTAPOT

- Set the instapot to Sauté. Melt the butter in the base of the cooker. Add the mushrooms, salt, and baking soda, and stir to evenly distribute. Add 30 g (2 Tbsp) of the water. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 1 h. Lock the lid onto the pot and pressure-caramelize the mushrooms. When the instapot has depressurized, cool the contents. Proceed with the remaining puree steps in the pressure cooker instructions above.

PRESSURE-CARAMELIZED CAULIFLOWER PUREE

Yield: 575 g (2⅓ cups)

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Cauliflower florets, 1.25 cm / 1¼ in thick	600 g	6 cups	100
Olive oil	10 g	2 tsp	1.67
Baking soda	3 g	½ tsp	0.5
Water	360 g	1½ cups + 1 Tbsp	60

FOR PRESSURE COOKER

- Combine the cauliflower, oil, and baking soda in the base of a pressure cooker over medium heat. Lightly sweat the cauliflower. Pressure-cook at a gauge pressure of 1 bar / 15 psi for 30 min; start timing when full pressure is reached. Depressurize the cooker quickly by running tepid water over the rim. Puree the mixture in a blender (or use an immersion blender) until smooth, and then pass through a fine sieve. Combine 150 g (½ cup + 2 Tbsp) of the cauliflower puree with the water. Store any leftover puree in an airtight container in the freezer for up to 3 mo.

FOR INSTAPOT

- Set the instapot to Sauté. Combine the cauliflower, oil, and baking soda, and stir to evenly distribute. Lightly sweat the cauliflower. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 1 h. Lock the lid onto the pot and pressure-caramelize the cauliflower. When the instapot has depressurized, cool the contents. Proceed with the remaining puree steps in the pressure cooker instructions above.

SUBMASTER RECIPE

GLUTEN-FREE THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21 °C / 70 °F	412 g	1¾ cups	69.24
Instant dry yeast	4.8 g	1¾ tsp	0.81
Gluten-Free Flour Blend see page 199	595 g	3¾ cups	100
Fine-ground cornmeal	55 g	½ cup	9.24
Fine salt	13 g	2¼ + ⅛ tsp	2.18
	Yield: ~1 kg		

TOTAL TIME	YIELD/SHAPE
Active 15 min / Inactive 3½ h	three 50 cm / 20 in pizzas or four 40 cm / 16 in pizzas

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the gluten-free flour blend, cornmeal, and salt, and mix on low speed with the paddle attachment until combined; scrape down the sides of the bowl and the paddle; mix on medium speed until fully incorporated; transfer to a generously oiled tub

BENCH REST 20 min; cover well

DIVIDE 50 cm / 20 in: 360 g
40 cm / 16 in: 270 g

PRESHAPE ball (see pages 60–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2–3 h at 21 °C / 70 °F, covered; optional cold-proof for 1 d at 4 °C / 39 °F, covered; for shaping instructions, see page 3:12; for assembly and baking instructions, see page 3:19

NET CONTENTS

Ingredients	Weight	%
Gluten-free flour blend	595 g	100
Water	412 g	69.24
Cornmeal	55 g	9.24
Salt	13 g	2.18
Yeast	4.8 g	0.81

After proofing at room temperature, you can roll the dough out and make the pizza. We recommend cold-proofing the dough, however, because it produces a crispier, crunchier thin-crust pizza. If you cold-proof the dough, remove it from refrigeration 1½–2 h before baking so it warms up and is easier to stretch out.

Use this dough as the foundation for any pizzas that call for thin-crust pizza dough in the Iconic Recipes chapter on page 3:3.

GLUTEN-FREE THIN-CRUST PIZZA DOUGH VARIATION

Follow the Mix through Proof instructions for Gluten-Free Thin-Crust Pizza Dough at left. Replace the gluten-free flour blend with Caputo Fiore Glut gluten-free flour.

SUBMASTER RECIPE

GLUTEN-FREE BRAZILIAN THIN-CRUST PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	325 g	1¼ cups + 2½ Tbsp	54.17
Instant dry yeast	3 g	1⅛ tsp	0.5
Gluten-Free Flour Blend see page 199	600 g	3¾ cups	100
Extra-virgin olive oil	60 g	¼ cup	10
Fine salt	18 g	1 Tbsp + ¼ tsp	3
	Yield: ~1 kg		

TOTAL TIME	YIELD/SHAPE
Active 20–25 min / Inactive 4 h	two 40 cm / 16 in pizzas or four 23 cm / 9 in pizzas

NET CONTENTS

Ingredients	Weight	%
Gluten-free flour blend	600 g	100
Water	325 g	54.17
Fat	60 g	10
Salt	18 g	3
Yeast	3 g	0.5

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the gluten-free flour blend, oil, and salt, and mix on low speed with the paddle attachment until the dough is a smooth, homogeneous mixture; transfer to a generously oiled tub

BULK FERMENT 1 h at 21° C / 70° F; cover well

DIVIDE 40 cm / 16 in: 500 g
20 cm / 8 in: 250 g

PRESHAPE ball (see pages 60–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2–3 h at 21° C / 70° F, covered; for shaping instructions, see page 3:12; for assembly and baking instructions, see page 3:25

Use this dough as the foundation for any pizzas that call for Brazilian thin-crust pizza dough in the Iconic Recipes chapter on page 3:3.

GLUTEN-FREE BRAZILIAN THIN-CRUST PIZZA DOUGH VARIATION

Follow the Mix through Proof instructions for Gluten-Free Brazilian Thin-Crust Pizza Dough at left. Replace the gluten-free flour blend with Caputo Fiore Glut gluten-free flour.

SUBMASTER RECIPE

GLUTEN-FREE DEEP-DISH PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	225 g	1 cup	59.21
Instant dry yeast	3.1 g	1⅛ tsp	0.82
Gluten-Free Flour Blend see page 199	380 g	2½ cups	100
Fine-ground cornmeal	40 g	⅓ cup	10.53
Lard, softened	18 g	1 Tbsp + ¾ tsp	4.74
Butter, softened	18 g	1 Tbsp + ¾ tsp	4.74
Fine salt	8 g	1¼ tsp + ⅛ tsp	2.11
	Yield: ~700 g		

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 3½ h	two 21 cm by 5 cm deep / 8½ in by 2 in deep pizzas

NET CONTENTS

Ingredients	Weight	%
Gluten-free flour blend	380 g	100
Water	228 g	60
Cornmeal	40 g	10.53
Fat	33 g	8.68
Salt	8 g	2.11
Yeast	3.1 g	0.82

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the gluten-free flour blend and cornmeal, and mix on low speed with the paddle attachment to a shaggy mass; add the lard, butter, and salt, and mix until the dough is a smooth, homogeneous mixture; transfer to a generously oiled tub

BENCH REST 20 min; cover well

DIVIDE 325 g

PRESHAPE ball (see pages 61–62); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 2–3 h at 21° C / 70° F, covered; optional cold-proof for 1 d at 4° C / 39° F, covered; for shaping instructions, see page 3:88; for assembly and baking instructions, see page 3:93

After proofing at room temperature, you can roll the dough out and make the pizza. We recommend cold-proofing the dough, however, because it produces a crispier thin-crust pizza. If you cold-proof the dough, remove it from refrigeration 1½–2 h before shaping so it warms up and is easier to stretch out.

Use this dough as the foundation for any pizzas that call for deep-dish pizza dough in the Iconic Recipes chapter on page 3:3.

If you don't want to use lard, you can double the amount of butter in the dough.

GLUTEN-FREE DEEP-DISH PIZZA DOUGH VARIATION

Follow the Mix through Proof instructions for Gluten-Free Deep-Dish Pizza Dough at left. Replace the gluten-free flour blend with Caputo Fiore Glut gluten-free flour.

SUBMASTER RECIPE

GLUTEN-FREE NEAPOLITAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	450 g	2 cups	60
Instant dry yeast	3 g	1 tsp	0.4
Gluten-Free Flour Blend see page 199	750 g	4¾ cups	100
Fine salt	16.88 g	1 Tbsp	2.25
Extra-virgin olive oil	15 g	1 Tbsp + ¼ tsp	2
	Yield: ~1.2 kg		

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 24½ h	four 30 cm / 12 in pizzas

NET CONTENTS

Ingredients	Weight	%
Gluten-free flour blend	750 g	100
Water	450 g	60
Salt	16.88 g	2.25
Fat	15 g	2
Yeast	3 g	0.4

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the gluten-free flour blend, salt, and oil, and mix on low speed with the paddle attachment until the dough is a smooth, homogeneous mixture; transfer to a generously oiled tub

BENCH REST 20 min; cover well

DIVIDE 300 g

PRESHAPE ball (see page 60); place in a tub or on a sheet pan; lightly mist with water; cover well

PROOF 1 d at 4° C / 39° F, covered; for shaping instructions, see page 3:36; for assembly and baking instructions, see page 3:47

Use this dough as the foundation for any pizzas that call for Neapolitan pizza dough in the Iconic Recipes chapter on page 3:3.

GLUTEN-FREE NEAPOLITAN PIZZA DOUGH VARIATION

Follow the Mix through Proof instructions for Gluten-Free Neapolitan Pizza Dough at left. Replace the gluten-free flour blend with Caputo gluten-free flour.

SUBMASTER RECIPE

GLUTEN-FREE NEW YORK/ARTISAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Water, 21° C / 70° F	460 g	2 cups	59.74
Instant dry yeast	3.5 g	1⅛ tsp	0.45
Gluten-Free Flour Blend see page 199	770 g	4¾ cups + 2 Tbsp	100
Diastatic malt powder	20 g	1 Tbsp + 2 tsp	2.6
Fine salt	18 g	1 Tbsp + ¼ tsp	2.33
Extra-virgin olive oil	25 g	1 Tbsp + 2¼ tsp	3.25
	Yield: ~1.3 kg		

TOTAL TIME	YIELD/SHAPE
Active 15–20 min / Inactive 2½ h	three 35 cm / 14 in pizzas

NET CONTENTS

Ingredients	Weight	%
Gluten-free flour blend	770 g	100
Water	460 g	59.74
Fat	25 g	3.25
Diastatic malt powder	18 g	2.33
Salt	18 g	2.33
Yeast	3.5 g	0.45

GENERAL DIRECTIONS

MIX combine the water and yeast in the mixer's bowl, and whisk to dissolve the yeast; add the gluten-free flour blend, malt powder, salt, and oil, and mix on low speed with the paddle attachment until the dough is a smooth, homogeneous mixture; transfer to a generously oiled tub

BENCH REST 20 min; cover well; oil four 35 cm diameter by 3¾ cm deep / 14 in diameter by 1¼ in deep pans with 70 g (⅓ cup) olive oil

DIVIDE 430 g

PRESHAPE ball (see pages 61–62); lightly dust the dough balls with gluten-free flour blend; extend with a rolling pin to approximately 35 cm / 14 in circles; place the dough in the prepared pans and stretch the dough to the edges of the pan

PROOF 2 h at 21° C / 70° F, covered, or 1½ h at 27° C / 80° F and 65% RH; for shaping instructions, see page 3:66; for assembly and baking instructions, see page 3:71 or 3:77

Use this dough as the foundation for any pizzas that call for New York or artisan pizza dough in the Iconic Recipes chapter on page 3:3. Top the pizza with 160 g (⅔ cup) New York / Artisan Pizza Tomato Sauce and 195 g (2 cups + 2 Tbsp) pizza cheese.

GLUTEN-FREE NEW YORK/ARTISAN PIZZA DOUGH VARIATION

Follow the Mix through Proof instructions for Gluten-Free New York/Artisan Pizza Dough above. Replace the gluten-free flour blend with Caputo Fiore Glut gluten-free flour.

SUBMASTER RECIPE

GLUTEN-FREE PAN PIZZA DOUGH

INGREDIENTS	WEIGHT	VOLUME	%
Brown rice flour	570 g	3 cups + 2 Tbsp	70.81
Tapioca flour	200 g	1⅓ cups	24.84
Potato starch	35 g	2 Tbsp + 2 tsp	4.35
Nonfat milk powder	25 g	¼ cup + 1 tsp	3.11
Fine salt	15 g	2¾ tsp	1.86
Water, 21 °C / 70 °F	1 kg	4⅓ cups	124.22
Sugar	35 g	3 Tbsp	4.35
Instant dry yeast	30 g	3 Tbsp + 2 tsp	3.73
Egg white	50 g	3 Tbsp + 1 tsp	6.21
Psyllium husk, optional	50 g	¼ cup	6.21
Parmesan cheese, grated	15 g	2 Tbsp	1.86
Fresh rosemary, minced	5 g	1 Tbsp	0.62
	Yield: ~2 kg		

TOTAL TIME	YIELD/SHAPE
Active 10–15 min / Inactive 2 h	one 46 cm by 33 cm / 18 in by 13 in pizza

NET CONTENTS

Ingredients	Weight	%
Brown rice flour	570 g	70.81
Tapioca flour	200 g	24.84
Potato starch	35 g	4.35
Water	1 kg	124.22
Egg white	50 g	6.21
Psyllium husk	50 g	6.21
Sugar	35 g	4.35
Yeast	30 g	3.73
Milk powder	25 g	3.11
Salt	15 g	1.86

This gluten-free dough works in place of the New York square, focaccia, or high-hydration al taglio doughs. If you are making gluten-free al taglio pizza, multiply the recipe ingredients by 0.75 to make the 1.5 kg dough that you need, and bake in a 60 cm by 40 cm / 24 in by 16 in Roman al taglio pan.

GENERAL DIRECTIONS

PREP lightly oil a half sheet pan; line the pan with parchment paper, and lightly oil the paper

MIX combine the brown rice flour, tapioca flour, potato starch, milk powder, and salt; for focaccia, add the Parmesan and rosemary to the dry ingredients, if desired; combine the water, sugar, and yeast in the mixer's bowl, and whisk to dissolve the yeast; let stand for 5 min; whisk together the egg white and psyllium husk, and let stand for 1 min; add egg white to yeast mixture, pour the dry ingredients onto the yeast mixture, and mix with the paddle attachment on medium speed for 3 min; scrape down the sides of the bowl and the paddle, and mix on medium speed for another 3 min

SHAPE transfer the dough to the prepared pan; drizzle a little oil on the top of the dough; slowly spread the dough with a spatula to the corners of the pan until it is filled evenly; use the edge of the spatula to push down the edges of the dough on the sides

PROOF 2 h at 21 °C / 70 °F, covered, or 1½ h at 27 °C / 80 °F and 65% RH, coverd; for assembly and baking instructions, see page 3:133

SUBMASTER RECIPE

GLUTEN-FREE DETROIT-STYLE PIZZA DOUGH

INSPIRED BY MEYERS MADHUS

INGREDIENTS	WEIGHT	VOLUME	%
Water, 30–30.5° C / 85–87° F	295 g	1¼ cups	60.2
Gluten-Free Flour Blend see page 199	490 g	3 cups + 2 Tbsp	100
Fine-ground cornmeal	85 g	⅔ cup	17.34
Fine salt	11.5 g	2 tsp	2.34
Sugar	8 g	2 tsp	1.63
Instant dry yeast	5.2 g	2 tsp	1.06
	Yield: ~900 g		

TOTAL TIME	YIELD/SHAPE
Active: 18 min / Inactive: 4¼ h	one 35 cm by 25 cm / 14 in by 10 in pizza

NET CONTENTS

Ingredients	Weight	%
Gluten-free flour blend	490 g	100
Water	295 g	60.2
Cornmeal	85 g	17.34
Salt	11.5 g	2.34
Sugar	8 g	1.63
Yeast	5.2 g	1.06

GENERAL DIRECTIONS

PREP oil a full-sized Detroit pan with 20 g (1 Tbsp + 1 tsp) olive oil

MIX pour the water into the mixer's bowl; add the gluten-free flour blend, cornmeal, salt, sugar, and yeast, and mix on low speed with the paddle attachment; scrape down the sides of the bowl and the paddle; mix on medium speed until fully incorporated; transfer to a generously oiled tub, turning it over to coat it fully with the oil, and shape into a rectangle

BENCH REST 15 min; cover well

SHAPE transfer the dough to the prepared pan seam side down, trying to maintain the rectangular shape; coat the surface of the dough lightly with oil, and stretch the dough gently but assertively without damaging it to try to fill the pan evenly, making sure the corners are sharp

PROOF 4–5 h at 21° C / 70° F, covered, or 3 h at 27° C / 80° F and 65% RH; after the first hour of proofing, stretch the dough out again to fill the pan as evenly as possible; for assembly and baking instructions, see page 3:109

Use this dough as the foundation for any pizzas that call for Detroit-style pizza dough in the Iconic Recipes chapter on page 3:3.

GLUTEN-FREE DETROIT-STYLE PIZZA DOUGH VARIATION

Follow the Prep through Proof instructions for Gluten-Free Detroit-Stle Pizza Dough above. Replace the gluten-free flour blend with Caputo Fiore Glut gluten-free flour.

GLUTEN-FREE FLOUR BLEND

INGREDIENTS	WEIGHT	VOLUME	%
White rice flour	225 g	1⅔ cups	23.2
Brown rice flour	100 g	¾ cup	10.31
Glutinous rice flour	70 g	⅔ cup	7.22
Cornstarch	350 g	2¾ cups	36.08
Tapioca starch	225 g	1¾ cups	23.2
Nonfat milk powder*	100 g	¾ cup + 2 Tbsp	10.31
Xanthan gum	10 g	1 Tbsp	1.03
Transglutaminase TI or WM, optional	9.7 g	1 Tbsp	1
	Yield ~1kg		

**Omit the milk powder to make this flour blend vegan.*

Transglutaminase is typically used as a "meat glue" that binds meat proteins to each other (it is often used in sausage making). But we found that it also binds the proteins in this flour blend. We tested transglutaminase to see whether it would act the same way as gluten does when added to a weak flour dough. While we didn't get any volume increase, we did notice a chew and consistency to the crumb that made it much more like wheat bread.

If you use transglutaminase in your gluten-free flour blend, you will have to freeze the entire quantity of the blend because the enzymes in the transglutaminase do not survive for long at room temperature. If you do freeze the flour mix, pull only what you need from the freezer, and let it warm up at room temperature for 1–2 h before you mix your dough.

1 Whisk all the ingredients together in a large bowl until homogeneous.

2 Transfer the mixture in batches to a food processor, making sure not to fill it more than halfway, and process until finely ground, 1–2 min.

3 After each batch of flour is finely ground, sift it. The flour blend (without transglutaminase) will keep for 2 mo in an airtight container at room temperature. We recommend freezing the blend (with or without transglutaminase) for up to 3 mo in portions large enough to make one recipe at a time.

For more on where to find many of these ingredients, see Resources, page 3:377.

CHAPTER 8
SAUCE


Ciao
il Pomodoro di Napoli®
AUTHENTICA
Italian Peeled
Crushed Tomatoes
in tomato puree
Product of Italy
6 lb 9 oz (3000gr)

SAUCE

You can make pizza without cheese. You can make it without toppings. But to many, if it doesn't have some kind of sauce on top, it's probably not pizza. In fact, sauce is one of the main elements that distinguishes pizza from bread. And it's part of the reason we don't consider focaccia to be pizza (see page 1:4), although we've included it in this book because it can make a great foundation for pizza.

Sauce can be as simple as a drizzle of heavy cream on a disc of dough (see page 250) or more labor-intensive, such as a mole or a thick, homemade tomato sauce. It can be traditional or unexpected, raw or cooked, savory or sweet. But no matter what sauce you choose, you'll need to take into account many of the same considerations: What's going to happen to the sauce while it bakes? What do I want the consistency of the finished sauce to be? How will the sauce affect the other toppings—will it bind with them or be a wet mess? How much is the "right" amount?

Here's one test that helps answer some of those questions: When you lift the slice, does everything slide off? If it does, the culprit is often too much sauce. It might also be a sauce that's too wet. Also, does your pizza have a gummy gel layer on top of the baked dough? That can be a sauce problem, too. Use just enough sauce to meld with the dough and the toppings—no more.

Even with that caveat, your results can, and should, vary. In a New York pizza, the sauce and cheese practically merge into a single component, while in a Neapolitan pizza, they're two completely separate entities. In a deep-dish pizza, the sauce goes on top.

The most common sauce used for pizza is tomato, of course, but don't stop there. Even the AVPN (see page 1:74) allows a green (basil pesto) or white (cheese-based) sauce on its Neapolitan pizzas. But the varieties of sauce go well beyond the Italian flag trifecta and are truly endless.

White sauces can be a particularly rich avenue for exploration—even the question of what constitutes a white sauce can inspire creativity. A white sauce can be a béchamel; it can involve a smear of ricotta and cream; you can even crack open a burrata onto a disc of dough and call it white sauce. We will cover the range of white sauces, including tips on how to make them work for different kinds of pizza, on page 251.

The chapter goes well beyond traditional recipes. We'll cover egg-based sauces, stock-based sauces, and pasta sauces remade for pizza. We performed experiments for transforming soups and store-bought sauces into pizza sauces.

NEW DISCOVERIES AND TECHNIQUES

How to solve the marinara sauce dilemma (see page 222)

How to improve tomato sauce (see page 232)

Mix-and-Match Tomato Sauce (see page 235)

How to adapt purchased soups as pizza sauce (see page 247)

Outside-of-the-Box Pizza Sauces (see page 256)

The tomatoes in the photo on the previous page wouldn't be used for industrial canning (forgive us artistic license in this case!) but could easily be preserved in a home setting either as whole tomatoes or as a canned sauce.

WHY WE PUT SAUCE ON PIZZA

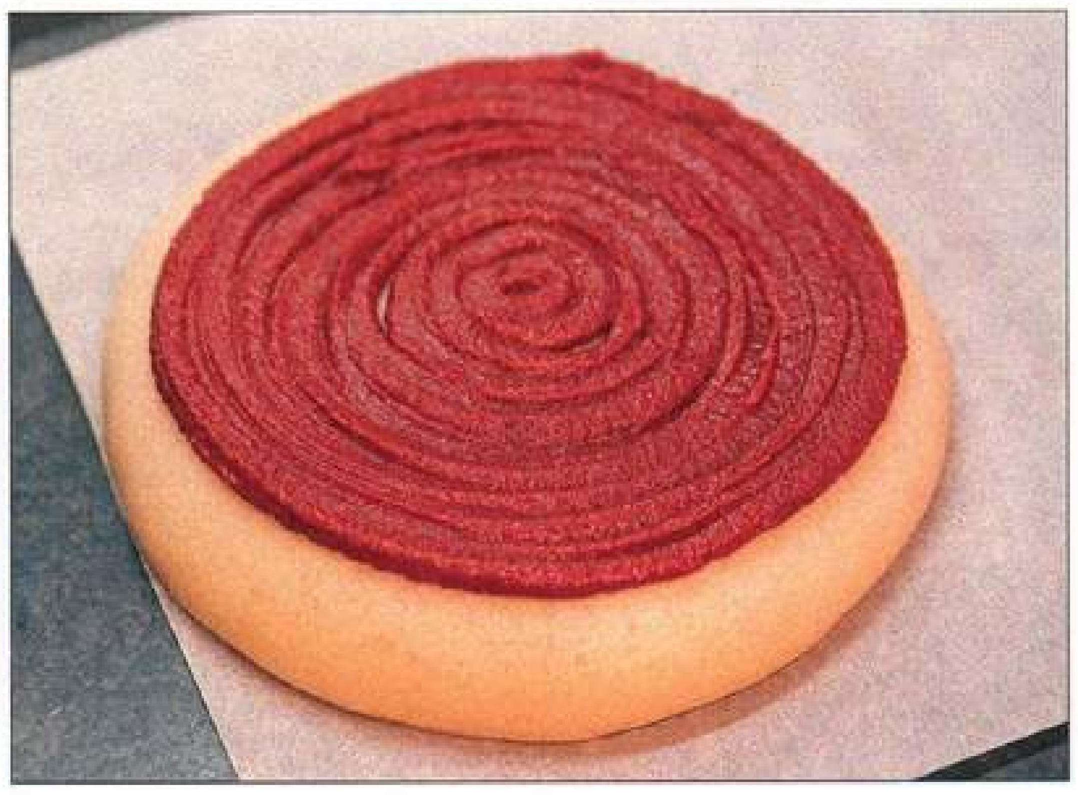
There are a multitude of ways to sauce a pizza, depending on the style. The Sicilian pizzas being made above and the Detroit-style pizza shown at left, below, are sauced before baking, while we prefer to apply the sauce after baking. Certain styles, like the pizza gourmet shown in the center, below, are always sauced after baking. Ingredients like eggs (see photo at right, below) are added close to the end of baking or after baking so that they don't overcook.

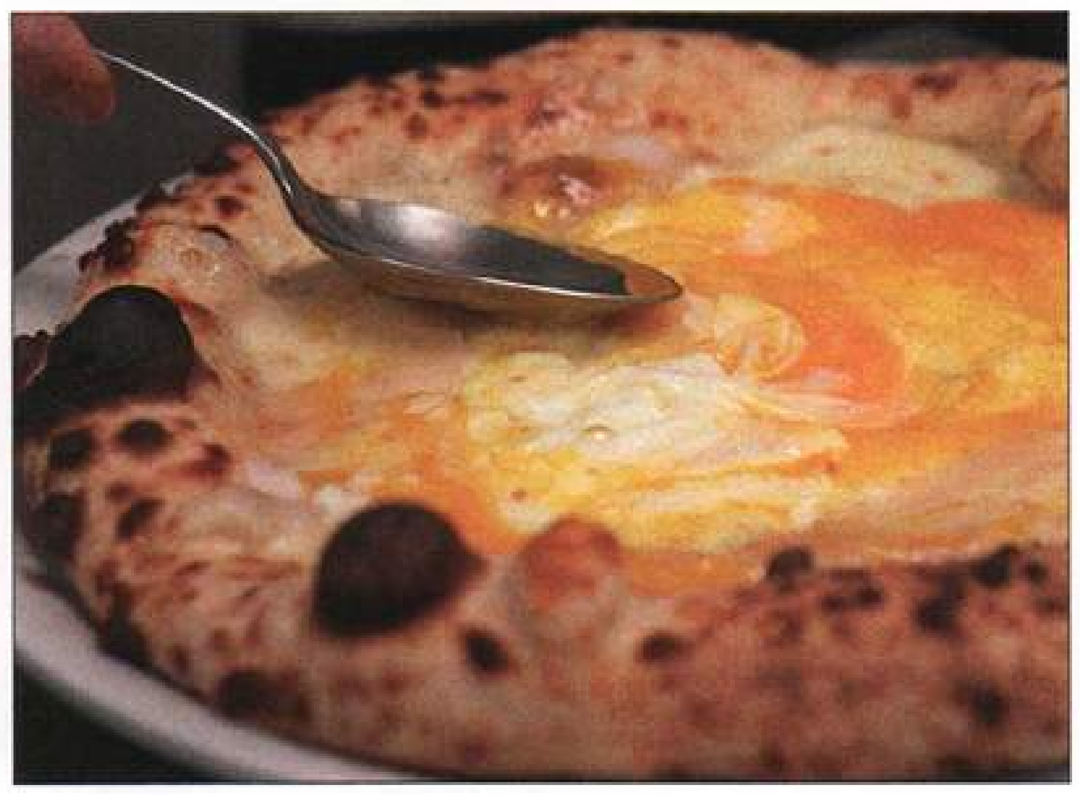
In general cooking, a sauce has two main purposes: to add moisture to a dish and to contribute flavor. In pizza making, sauce serves several additional functions. Understanding these functions will help you get your desired result. In thin-crust and medium-crust pizzas, sauce "protects" the center of the pizza dough, keeping it flat and preventing it from expanding and bubbling up during baking (see page 1:369). In addition, the sauce essentially acts as a heat sink that cannot get above 100° C / 212° F unless all of its water evaporates (see page 1:369). This property allows sauce to shield delicate toppings from the blistering heat of the oven, which is why we cover certain ingredients, like clams, with sauce before baking them in the oven.

Not all sauces work for all pizzas. You'll find that the amount of liquid matters, and there's an interplay between viscosity, baking time, and baking temperature. That's why we recommend a particular type of tomato sauce for almost every style of pizza. For example, the wettest tomato sauce in the chapter is the one for Neapolitan pizza. Neapolitan pizza bakes in an extremely hot oven, so the water in the sauce begins to evaporate within seconds. By the end of baking, the wet sauce will evaporate just enough to leave a smooth, pulpy sauce over the dough rather than a burnt paste.

Conversely, a New York pizza needs a thicker sauce with less water. If the sauce is too wet, you'll wind up with a gummy pizza with a puddle of sauce in the middle. That's because it bakes at a much lower temperature and for a longer time than a Neapolitan pizza dough (5–6 minutes at 285° C / 550°F as opposed to 60–90 seconds at 425–480° C / 800–900°F). This concept doesn't apply to just tomato sauces; it applies to all types of sauces.

Another crucial aspect of the saucing step is its temperature. As a general rule, you should never apply cold sauce to a dough because it will drop the dough temperature and impact the baking time. Sometimes, a cold sauce can be a contributing cause of a gel layer, or gum line (see page 1:370). We recommend tempering sauces at room temperature for 2 hours before using. In a few instances, such as Detroit-style and deep-dish pizzas, we apply the sauce *after* baking. Unlike all of our other sauces, these are heated and spooned on hot.





THE QUESTION OF WHERE TO SAUCE YOUR PIZZA

Should you apply the sauce when the dough is on the worktable? Or after you've slid the dough onto the peel or screen? The AVPN tells people not to assemble Neapolitan pizzas on the peel but even top pizzaioli in Naples don't agree. Franco Pepe (see page 1:161) sauces his dough on the peel while Enzo Coccia (see page 1:164) dresses his pizza on the workbench and then pulls the dough onto the peel. There are strong opinions on both methods and pizza makers fall into either camp, depending on their preferences and the style of pizza that they make.

Ultimately, it depends on your comfort level and expertise. In general, we prefer to sauce on a worktable and then transfer to a peel. The act of spreading the sauce on the dough means you're pushing down on the dough, pressing it into the surface below. If you are assembling the pizza on a screen or perforated peel, be careful to not push the dough into or through the holes. You want to be able to slide it into the oven quickly and easily.

Whether you're saucing on the worktable or on the peel, it will slide more easily if you're using the proper amount of flour under the dough. Lightly oiling a screen with cooking spray will help the dough release after it bakes partway in the oven (the oil will also create a crispier bottom). We give detailed instructions for shaping, saucing, and topping different pizza styles in the Iconic Recipes chapter on page 3:3. You'll see how to assemble pizza both on a peel and on a workbench.

In general, we prefer to sauce and top pizzas on the worktable because it gives you a little more time than if you dress the pizza on a peel. If you dress the pizza on the peel, you must work quickly so that it doesn't stick.

APPLYING SAUCE

A wet sauce applied before baking is a key element to a traditional pizza. That wet sauce cools the center of the pizza and keeps it from rising. And even distribution is extremely important. One could argue that sauce is the critical difference between pizza and putting some toppings on bread. It also happens that the most common sauce, which helped pizza's rise in popularity, is an acidic red sauce. This sauce, typically made with tomatoes, is a good counterpoint to the melted cheese. Tomato-based sauces are different than most other sauces used in professional kitchens because they often aren't made in-house from fresh ingredients. Pizzaioli often just puree and season some form of canned tomatoes.

The most important characteristic of a successful pizza sauce is how wet it is. The perfect consistency and amount of water depend on how the pizza will be baked and the style attributes you are trying to achieve. If your sauce is too wet, you will end up with a soupy pizza. If it's too dry, it might burn in the oven.

The cooling effect of the sauce can contribute to the formation of a gel layer. Whether cheese is directly against the dough or not also plays a part. There are also particular pizzas, like Trenton tomato pies, that are said to be defined by saucing on top. We think the order of sauce and cheese gets talked about too much. We did extensive experiments (see page 207) and found there will be less of a gel layer if you have the cheese against the dough, then sauce. This is especially important for bread-like pizzas such as New York square. It is thick-crusted and takes a long time to bake, so applying the cheese first helps to keep it from burning before the crust is done.

Find the piece of saucing equipment that suits you best and stick with it. This could be a wide metal spoon, a ladle, or a spoodle (pictured above), which has a flat bottom that allows you to spread the sauce evenly.

For more on how sauce behaves during baking, see The Effects of Sauce Reflectivity on Pizza on page 1:369.

For refrigerated sauces, always bring them up to room temperature before applying to the pizza. Some sauces, like those used on Detroit-style pizza, should be heated before topping the pizza.

Philosophically we consider hand-crushed tomatoes to be more of a topping than a sauce; a true sauce should be more uniform in consistency.

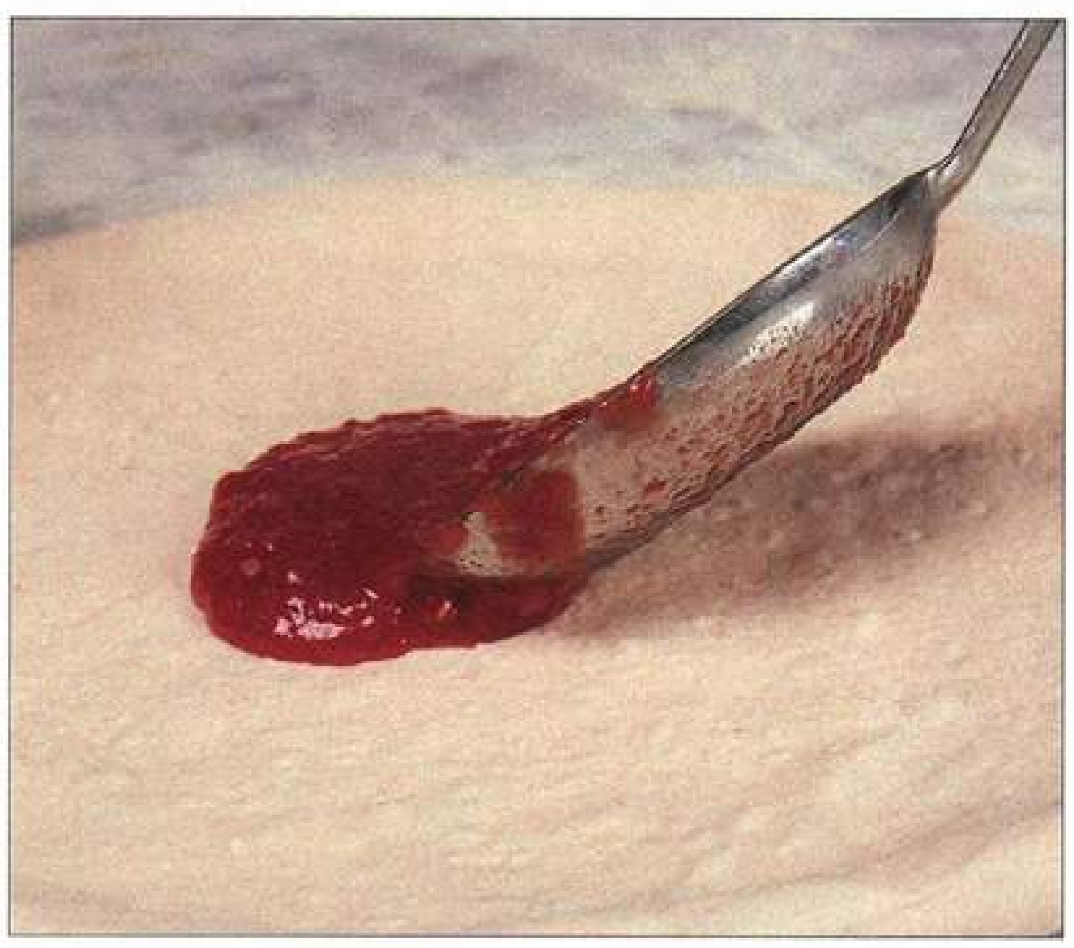
For more on how to transfer dough using a peel, see page 390.

There is another method of sauce application similar to what many chefs do when they're saucing composed dishes. Pizzaioli making Detroit-style and deep-dish pizzas apply the sauce à la minute, just before it is served. Both of these pizzas take a long time to bake, and the sauce can significantly impact that process. That's because sauce contains a lot of water, and when it covers a thick piece of pizza dough, the heat will radiate very poorly and very slowly toward the center of the crust. Taking the sauce out of the equation from the beginning significantly reduces baking time. For these types of pizzas, we keep the sauce hot and spoon or pipe it on top immediately after baking.

If you've ever watched a pizza being made at a pizzeria, you've probably seen how quickly and effectively the pizzaiolo applies the sauce and how it always seems to be just the right amount. This is no accident. Part of that comes from experience, but it also has to do with using the right tools. They likely tested a number of spoons and ladles, looking for one that would hold just the right amount of sauce. The most experienced pizzaioli will make a seemingly perfect spiral of sauce on the dough (always starting from the center and making their way out). The faster you can do this, the more pizzas you can sell.

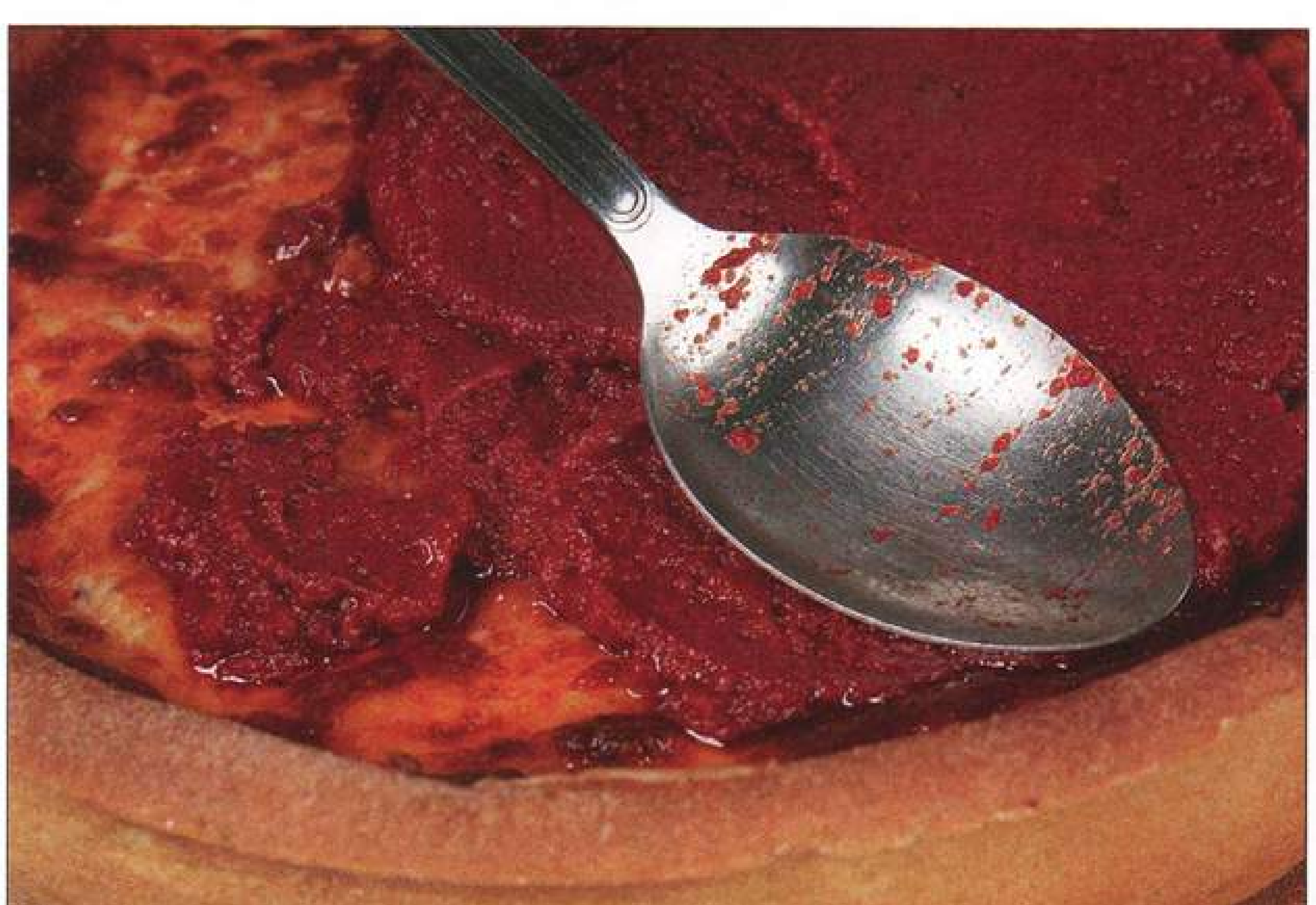
Using a dedicated sauce spoon, called a spoodle, helps achieve consistency. Part of what helps spread the sauce evenly on the dough is the design of the spoon or ladle. Some have a somewhat flat base that helps push the sauce around evenly (see page 10), but not so much that the dough peeks through.

APPLYING SAUCE BEFORE BAKING



Many of our sauces are applied to pizza dough before baking. Tomato sauce is generally applied in the center of the pizza and then spread out toward the rim. Many dairy-based sauces can be spread on the dough in a similar fashion before baking or, if they are thicker, like a soft cheese, they can be spooned on so that they'll melt with the mozzarella or other toppings. We'll show you how to apply sauces before baking in our Iconic Recipes chapter on page 3:3.

APPLYING SAUCE AFTER BAKING



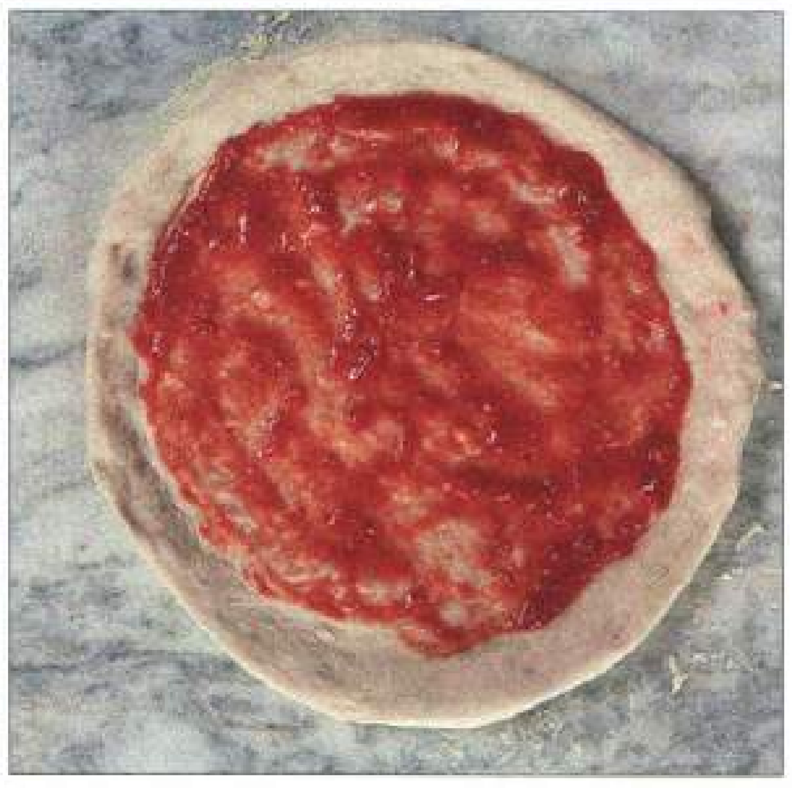
For some of our pan pizzas, including New York square and deep-dish, the main sauce is applied after baking. The sauces can be piped on (above, right), like in the Detroit-style pizza on page 3:109, or they can be spread on (see photo at left, above). When we talk about sauces being applied after baking, we don't include things like balsamic vinegar glaze, sriracha, or a ranch drizzle since those function more as a garnish than a true sauce.

While spooning a sauce is the most common method, some sauces are best applied using other tools. If you're using a very liquid sauce, a squeeze bottle will give you the best control. A very thick sauce is best extruded through a piping bag; just move it across the top of the dough as you squeeze.

Whatever tool you use, efficiency counts. Once you have shaped the dough, the clock is ticking. If you take too long, two things might happen. First, the dough will get sticky on the bottom and not slide onto your peel with ease. When this happens, it can lose its shape and/or tear. Second, the exposed dough will start to dry out, which will cause it to bake very poorly and leave the surface like a cracked desert floor. The key is to move quickly but carefully.

LIGHT, MEDIUM, AND HEAVY SAUCING

How much sauce should you put on your pizza? Personal preference can play a role, but there are also some clear lines about what works best for a particular kind of pizza. For example, you would never put the same amount of sauce on a deep-dish pizza and a Neapolitan pizza. Large amounts of sauce can result in a wet, soggy crust. Too much sauce also means the toppings won't cling, so they'll slide off when you pick up a slice. Even if you fold the slice to keep the toppings in place, the crust will be wet, gummy, and unpleasant to eat. Sauce doesn't get a lot of attention, but it plays such a crucial role in adding flavor and moisture, we're not sure why more pizzaioli don't devote the care to making it the best possible.


Light saucing


Medium saucing


Heavy saucing

EXPERIMENT

WHICH GOES FIRST: CHEESE OR SAUCE?

For many types of pizzas, including Neapolitan and New York, the sauce goes on first, followed by the cheese. While Trenton tomato pie is characterized by the sauce on top (see page 1:104), artisan pizzas made by many makers also reverse the order. This has gotten a lot of attention as an innovation. Franco Pepe's "mistaken margherita" is an example, but for almost any pizza the order of sauce and cheese could go either way.

Adding the cheese first reduces the chance of a gel layer (see page 1:370), and topping adhesion is better. One of the challenges with a Neapolitan margherita pizza is that the cheese can have a mind of its own. It frequently slides off, especially when paired with a soupy sauce. We wondered whether adding the ingredients in reverse order—that is, placing the pieces of cheese on the dough before the sauce—would help anchor the toppings. It took us slightly longer to distribute the sauce around the cheese and protect the basil under the sauce, but the pizza tasted as good as our master recipe and we avoided the dreaded cheese-slide.

We also tried making New York pizzas by distributing the shredded cheese first and the sauce second. This time, we didn't like the results. It was challenging to spread the sauce evenly on top of the shredded cheese. Also, it didn't melt cohesively, which negatively affected the texture. We tried another idea, mixing the cheese and sauce together and then spreading the mixture on the dough. Not only did it fail to improve the melt, it resulted in an unappetizing pink color.

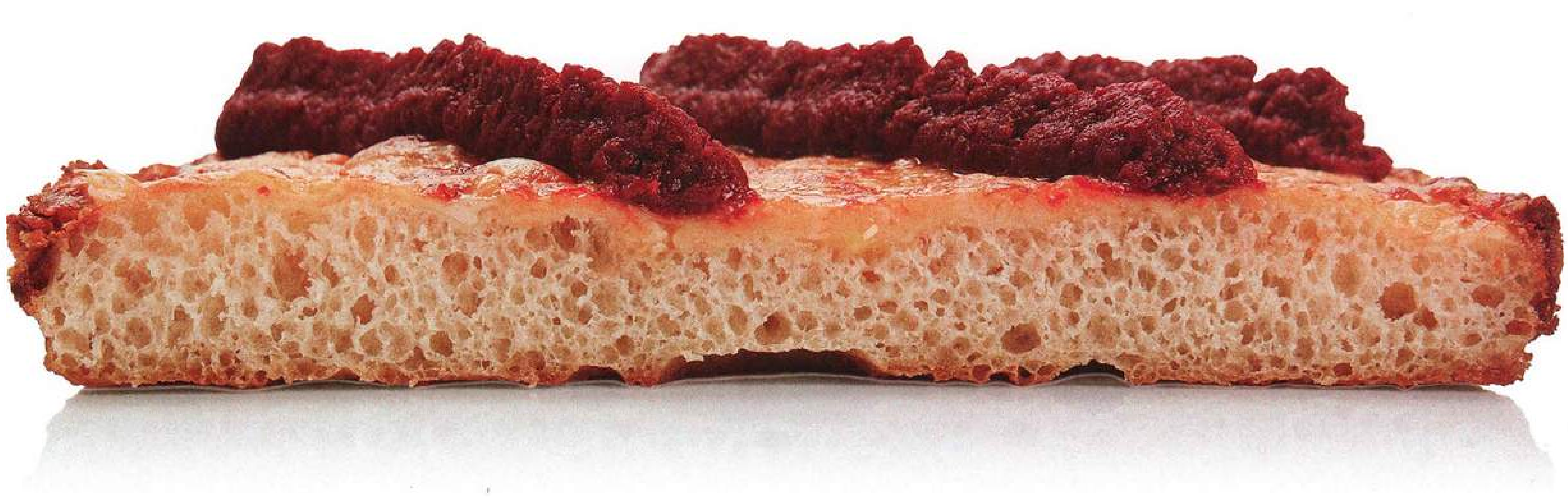
If you're using sliced cheese, as for Trenton tomato pies, adding the cheese before the sauce works well. Adding sliced cheese first also makes it easy to distribute the sauce on the thinnest possible pizzas (see page 3:13). Alternatively, sauce can be applied in even drops around the pizza with no spreading.

Reversing the order of ingredients could be done for almost any pizza. Detroit-style and deep-dish are traditionally sauced after baking (the same applies to focaccia when you are using it as a pizza base).

SAUCE AMOUNT RECOMMENDATIONS

The following table shows the interplay between the amounts of dough and sauce, as well as baking time and temperature, for different kinds of pizza. Although we are providing recommended sauce weights, these are also assuming a certain water content for the sauce appropriate for the style and aren't necessarily interchangeable. Keep in mind that this information is for a single pizza, and the size of the dough and sauce-able diameter is important. For example, it might appear that the Brazilian thin-crust pizza has a lot of sauce when compared to the weight of the dough, but the dough is rolled out very thin to make a large pizza. Baking times can vary depending on how many pizzas you're baking. Focaccia is included because it can make for a great pizza foundation even though we don't classify it as pizza. The New York square pizza dough is parbaked before applying sauce and cheese. For Detroit-styl e pizza, the sauce is heated separately and appl iedafter baking.

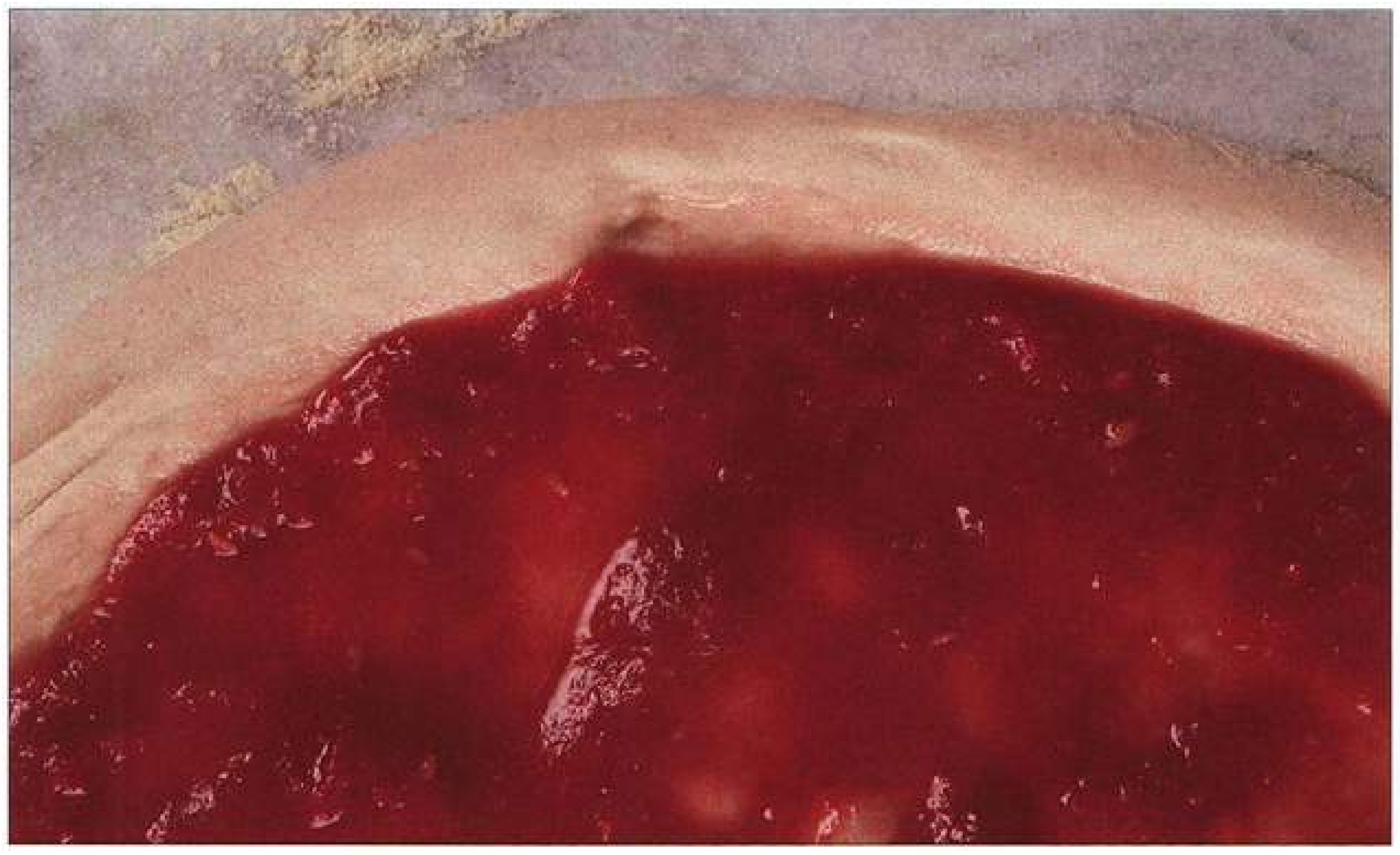
Pizza style	Dough weight	Dough size	Sauce weight	Sauce area	Baking temperature	Baking time
Thin-Crust Pizza see page 110	275 g	40 cm / 16 in	95 g	38 cm / 15 in	285°C / 550°F	5 min
	370 g	50 cm / 20 in	170 g	48 cm / 19 in		
Brazilian Thin-Crust Pizza see page 114	125 g	23 cm / 9 in	100 g	21 cm / 8 in	285°C / 550°F	5 min
	250 g	40 cm / 16 in	160 g	38 cm / 15 in		
Deep-Dish Pizza see page 118	230 g	21 cm by 5 cm / 8½ by 2 in	180 g	21 cm by 5 cm / 8½ by 2 in	250°C / 485°F	27 min
	700 g	32 cm by 5 cm / 12½ by 2 in	445 g	32 cm by 5 cm / 12½ by 2 in		
Neapolitan Pizza see page 124	250 g	30 cm / 12 in	120 g	25 cm / 10 in	425–480°C / 800–900°F	1–1½ min
New York Pizza see page 132	400 g	35 cm / 14 in	160 g	33 cm / 13 in	315°C / 600°F	4–5 min
	600 g	40 cm / 16 in	240 g	38 cm / 15 in		
	800 g	45 cm / 18 in	320 g	43 cm / 17 in		
	1 kg	50 cm / 20 in	400 g	48 cm / 19 in		
	1.1 kg	55 cm / 22 in	440 g	53 cm / 21 in		
	1.2 kg	60 cm / 24 in	480 g	58 cm / 23 in		
Artisan Pizza see page 142	360 g	35 cm / 14 in	145 g	33 cm / 13 in	285°C / 550°F	6–7 min
	400 g	40 cm / 16 in	215 g	38 cm / 15 in		
	470 g	45 cm / 18 in	290 g	43 cm / 17 in		
	500 g	50 cm / 20 in	360 g	48 cm / 19 in		
	580 g	55 cm / 22 in	400 g	53 cm / 21 in		
	620 g	60 cm / 24 in	435 g	58 cm / 23 in		
Focaccia see page 148	1 kg	46 cm by 33 cm / 18 in by 13 in	350 g	46 cm by 33 cm / 18 in by 13 in	245°C / 475°F	12–15 min
New York Square Pizza see page 152	500 g	46 cm by 33 cm / 18 in by 13 in	225 g	46 cm by 33 cm / 18 in by 13 in	285°C / 550°F	27 min
Al Taglio Pizza see page 158	700 g	60 cm by 20 cm / 24 in by 8 in	200 g	58 cm by 18 cm / 23 in by 7 in	315°C / 600°F	11 min
	1.4 kg	60 cm by 40 cm / 24 in by 16 in	400 g	58 cm by 38 cm / 23 in by 15 in		
Detroit-Style Pizza see page 166	330 g	25 cm by 20 cm / 10 in by 8 in	75 g	n/a	275°C / 525°F	15 min
	500 g	35 cm by 25 cm / 14 in by 10 in	150 g	n/a		



COMMON SAUCE PROBLEMS

Proper saucing can take practice. So can getting the right sauce consistency. On your road to pizza sauce perfection, a number of things can go wrong. The goal is trying to prevent these things from happening in the first place because once the sauce is on the pizza, mistakes get harder to fix. After the pizza is in the oven, it's practically impossible. In general, err on the side of less sauce. Sauce is a very wet thing you're putting on top of the dough and can lead to serious quality problems, such as a gel layer, or gum line (see page 1:370). Saucing your pizza and letting it sit for a long time before baking can also contribute to a more pronounced gum line.

Problem	Solution	Notes
The tomato sauce is leaching water.	Add 0.1% xanthan gum to the sauce.	This happens mostly with the more fluid and simpler tomato sauce recipes, such as Neapolitan pizza tomato sauce, but we have also seen it with thicker sauces. The effect of this is that it can create a wet place where the sauce meets the rim crust, making it soggy.
There is too much sauce.	It's not ideal, but you can use an offset spatula to lift up and move the sauce from the areas that look oversauced. Remember, the longer the dough disc sits, the greater chance it will stick to the work surface, so work quickly.	You don't want to cover the whole surface of the dough with sauce. There should be some parts where the sauce is applied thinly enough that you can see the dough through it. The bottom line is, if you don't see dough at all, you overdid it. For exact amounts, consult each recipe.
You see char marks in the sauce after you pull the pizza out of the oven. The sauce is burnt.	You can't fix burnt sauce, but you can learn from it. There are a few reasons why this happens. You may not have put enough sauce on the dough, or the water content of the sauce may have been too low. Try a different sauce with a higher water content.	If the sauce has burnt spots and the crust is too dark, it means the pizza was simply overbaked. When this happens, you don't need to change the sauce. Just reduce the baking time or temperature for the next pizza.



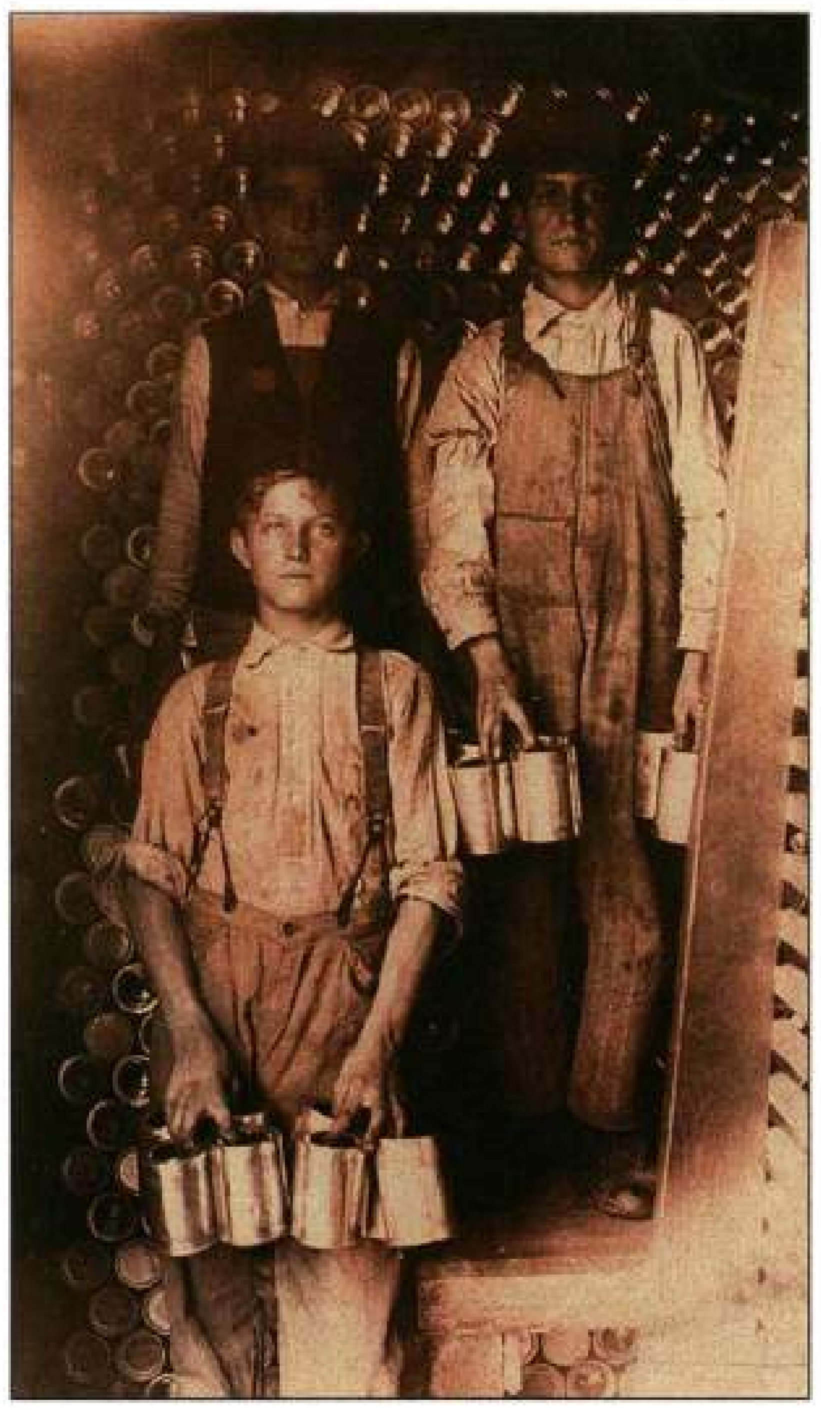
Leaching water

Too much sauce

Char marks

The term "gel layer" (sometimes called the gum line) refers to a wet, gummy surface just beneath the sauce on a baked pizza. It almost looks like the dough wasn't fully baked. The real problem is that the dough wasn't able to evaporate off enough moisture during baking, a problem that's tied to the fact that it's covered with a wet sauce. We go into more detail about the gel layer on page 1:370.

For more on the history of tomatoes, see page 210.



This photo taken in Indianapolis, Indiana, in 1908 shows young boys unloading canned tomatoes from a freight car.

TOMATO SAUCES

If you're looking for the most popular sauce for pizza, tomato-based sauce wins, hands down. For many, it's not pizza unless there's tomato sauce. There are many kinds of tomatoes used in sauce, in many different forms, ranging from fresh to preserved and canned, but most all tomato sauce is made from canned tomatoes. What we call tomato sauce can mean a preseasoned sauce straight from the can, canned tomatoes that you minimally crush (what most pizzaioli do), or a cooked sauce made from canned tomatoes. In the case of marinara pizza, we recommend making the sauce so you have the right ratio of water (see page 222). But in most cases, it's really up to you to decide on the right sauce. Do you want the pure tomato taste, or do you want to add seasoning and flavors?

In most countries, fresh tomatoes are available year-round, but just because they're available doesn't mean they're good. There's little question that in-season (mid- to late-summer) tomatoes ripened to full red-ripe under the hot sun taste the best, but in most parts of the world canned tomatoes are going to taste better than fresh ones. This runs counter to the belief that has existed through the last part of the 20th century up to now that favors using the best ingredients and using them fresh. That's not say to you can't make an excellent sauce from fresh tomatoes, but that requires really great tomatoes and really knowing what you're doing. It's for this reason that only a small amount of pizzas contain some form of fresh tomatoes and even then they are often treated as a topping. Most canned tomatoes are processed and put into a can just hours after they're picked, and canneries work 24/7 through the late-summer harvest season to get it all done. Thanks to this quick postharvest processing, canned tomatoes are an excellent option.

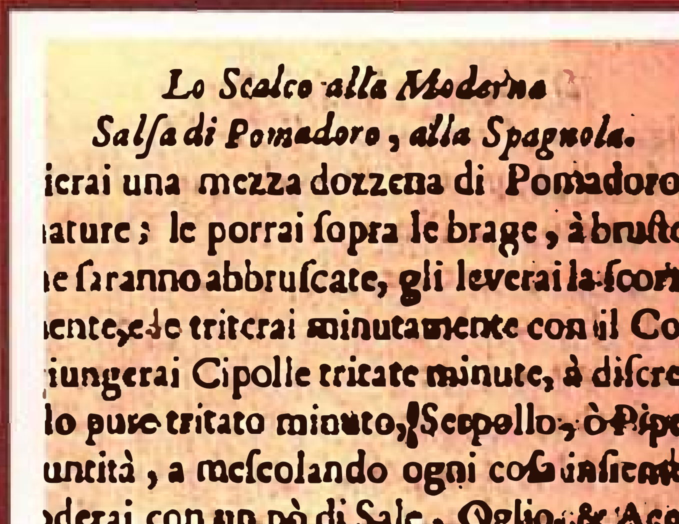
For many pizza makers, opening a can is indeed the go-to first step. For some, it's a can of premade pizza sauce. For others, it may involve hand-crushing canned tomatoes or pureeing and seasoning them to make a sauce. Because canned tomatoes are cooked during the canning process (see page 217), these sauces generally aren't cooked again. Canned

A BRIEF TIMELINE OF THE TOMATO

Europeans once considered the tomato to be poisonous, probably because it's a member of the nightshade family (see page 216). Nonetheless, the tomato has been an important part of culinary history, not just in pizza but also in cuisines around the globe (for more on where it originated, see page 1:9). This list highlights some of the points in time when tomatoes made the biggest impact, but it's by no means exhaustive.

1519
The Spanish encountered tomato cultivation in the southern part of Mexico. The Aztecs named the plant xitomatl. Its wild ancestor is believed to have been cultivated and consumed since 500 BCE.

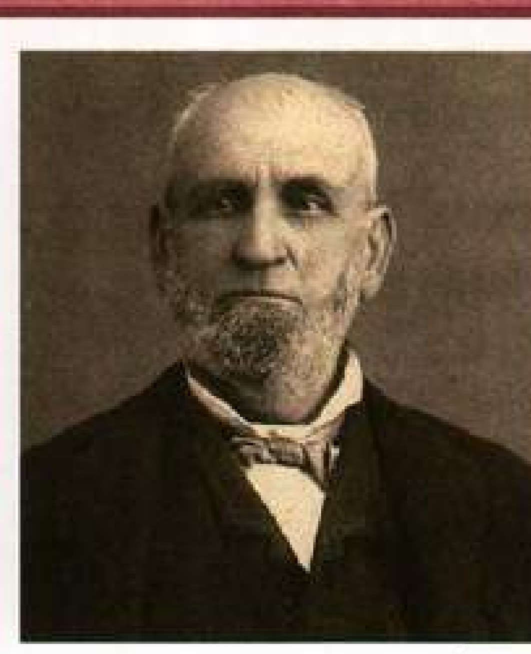
1597
John Gerard reported that "love apples" (tomatoes) were eaten in boiled form along with "pepper, salt, and oile" as a sauce.



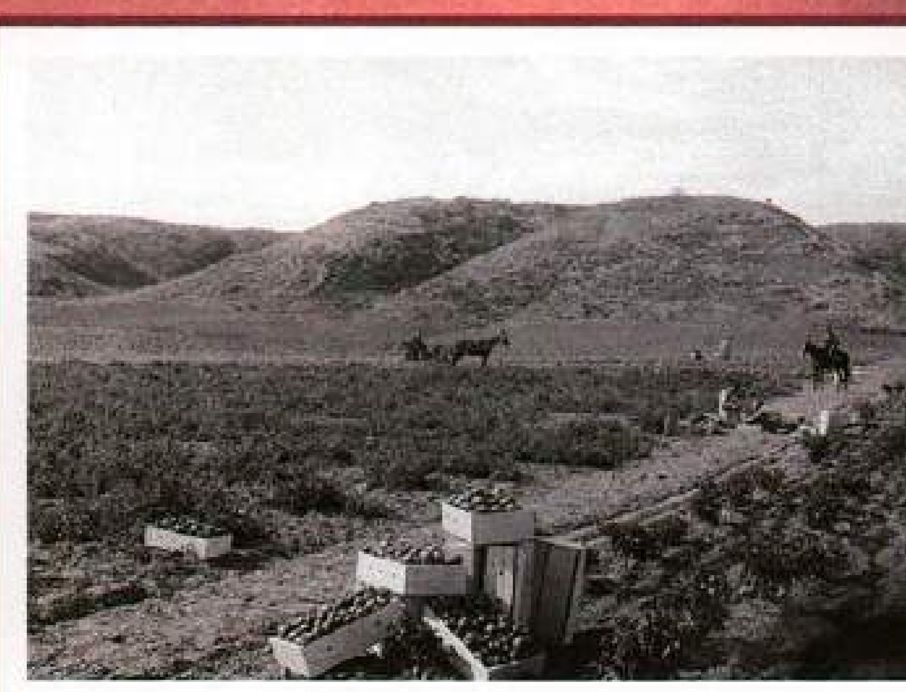
Lo Scalco alla Moderna
Salſa di Pomadoro, alla Spagnola.
ierai una mezza dozzena di Pomadoro,
ature; le porrai ſopra le brage, à bruſtol
le ſaranno abbruſcate, gli leverai la ſcorza
ente, e le triterai minutamente con il Colt
iungerai Cipolle tritate minute, à diſcreti
lo pure tritato minuto, Serpollo, ò Piper
untità, a meſcolando ogni coſa inſieme
aderai con un pò di Sale, Oglio, & Acet

1694
In *Lo Scalco alla Moderna*, there is a mention of tomatoes used to make Spanish sauce.

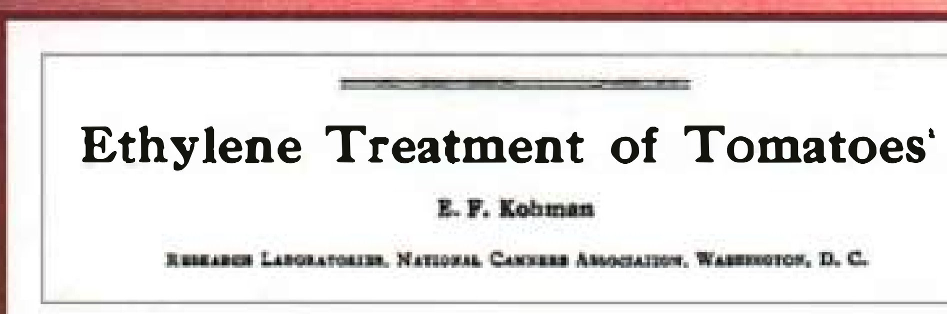
1835
A New York farmers' magazine wrote about cooking tomatoes, including using them as a sauce.



1848
Harrison Woodhull Crosby was one of the first to can tomatoes industrially.



1868
By 1870 tomatoes were among the big three canned vegetables. By 1879 more than 19 million cans of tomatoes were manufactured annually, and within a few years the production quadrupled.



Ethylene Treatment of Tomatoes[1]
E. F. Kohman
Research Laboratories, National Canners Association, Washington, D. C.

1931
E. F. Kohman observed that if "gassed with ethylene, tomatoes could be picked before they were fully ripened" and could withstand handling better. Ripe fruits of many varieties emit ethylene gas to signal ripening. The upshot is that canned tomatoes are more likely to be picked ripe than fresh tomatoes you'd find in the grocery store, which are picked green and then shipped.

tomatoes have a distinct taste since temperature alters the tomato flavor.

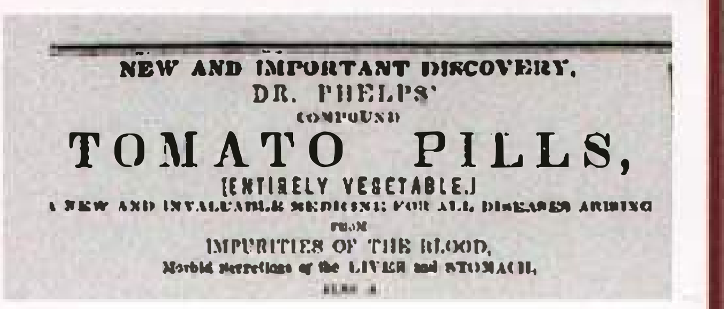
With so many different kinds of processed tomato products, choosing can be a project in itself. Here we streamline your options, but ultimately it comes down to which flavor profile you like the best. In general, we prefer the naturally sweeter tomato products (no sugar added) with high acidity. Acidity can be natural or enhanced with citric acid. The acidity is measured by pH. The lower the pH number, the more acidic the product. We like a pH between 4.1 and 4.6. There are many ways to measure pH, but we prefer to use a spear-tip waterproof pH meter (see page 292). We measure sweetness by degrees Brix. This measurement tells you the concentration of dissolved sugar per 100 g of any given liquid, and it's measured with a refractometer. In tomatoes, the dissolved solids are mostly sugars, but also include acids and soluble pectins. The higher the Brix degrees, the sweeter the liquid. We look for something between 7 and 8.5 degrees Brix in our canned tomato products.

What we would call an heirloom tomato today is clearly visible in Raphaelle Peale's still life from 1823.

1704
Francesco Gaudentio's recipe collection *Il Panuto toscano* indicates that the tomato was becoming more widely eaten in Italy and were said to be "cultivated in gardens."

1758
Hannah Glasse's *The Art of Cookery* included a recipe using tomatoes.

1770
Harriott Pinckney Horry copied a collection of recipes, including one titled "To Keep Tomatoes for Winter Use," which gave some of the earliest preservation instruction for tomatoes.



1830s
American views toward tomatoes changed when John Cook Bennett and Archibald Miles investigated the health benefits of tomatoes.

1945–50
Tomato paste began to gain in popularity as an industrial ingredient.

1960s
The mechanical tomato harvester and suitable varieties were developed by Dr. C. Lorenzen and Dr. J. Hanna at the University of California, Davis.

LATE 1980s
Growers transition to hybrid tomato seed varieties with improved yields, disease resistance, and better processing characteristics.

2010
John ("Jay") Warner Scott developed the Tasti-Lee fresh market tomato.

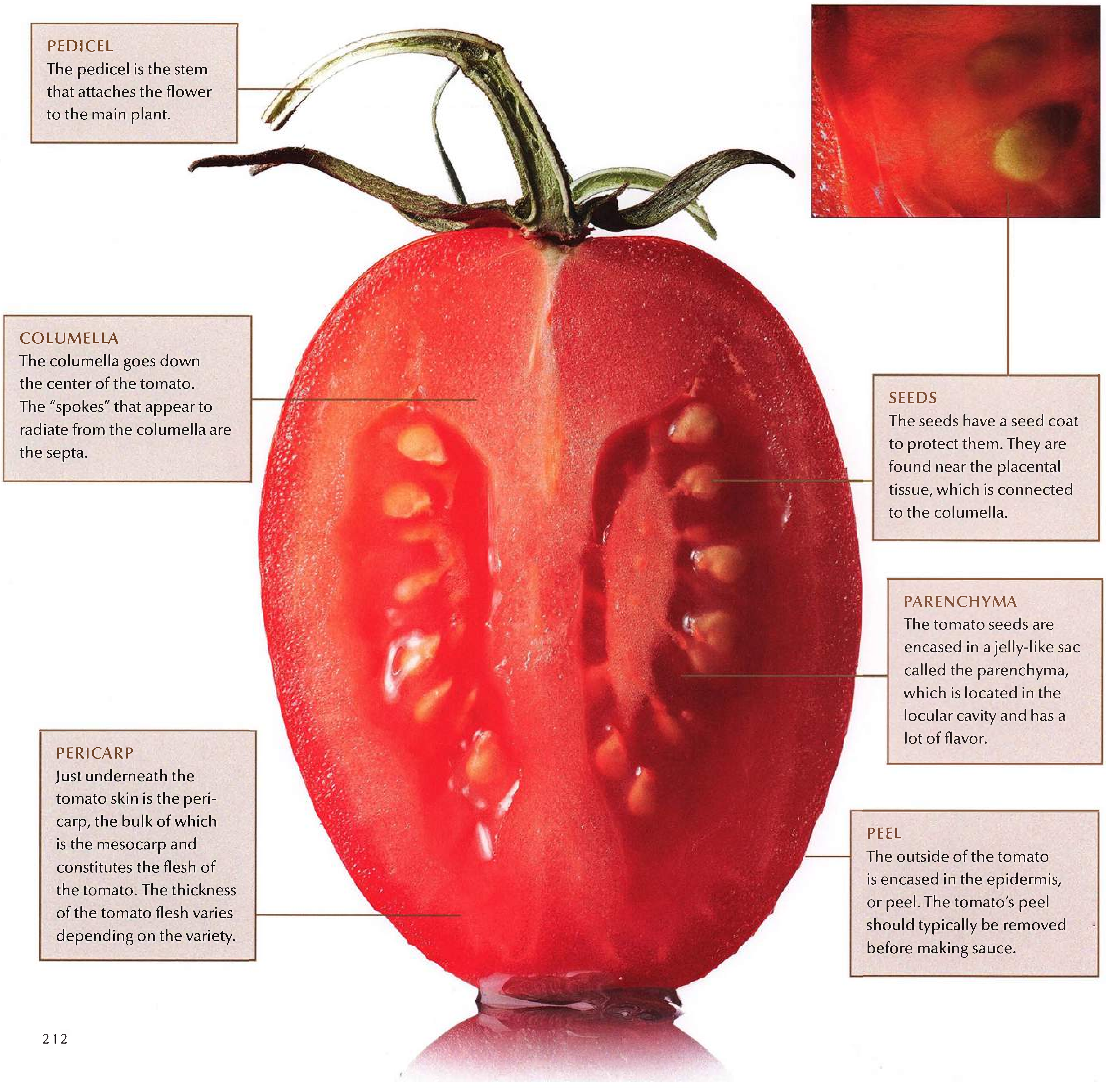
THE ANATOMY OF A TOMATO

Botanically speaking, a tomato is a berry consisting of seeds within a fleshy pericarp developed from an ovary. It's technically a fruit, but gastronomically it's treated as a vegetable.

Beefsteak tomatoes, which are soft and large, with lots of locular material, are an example of fresh market tomatoes. The heirloom variety Roma, with its oval or plum shape, is an early processing-type tomato. Over the years "roma" has become a generic name for plum-shaped tomatoes that are for either fresh market or processing. The true Roma variety is rarely grown.

There are a lot of processing varieties for canning. The processing varieties are better for cooking than those used in the fresh market because they can hold up to the heat and still retain firmness. Processing tomatoes are very firm and have been bred to be harvested red-ripe. They often contain less water and have higher levels of pectins and fiber, which is desired in pastes or purees. Thick flesh and less locular gel is important when the fruit are expected to be peeled or diced.

Seed companies and some tomato processors have developed their own varieties of tomatoes that you can't buy fresh. These are marketed to large growers, and rather than colorful names like Green Zebra or Brandywine (heirloom fresh market varieties you'd find at your local farmers' market), they're given less whimsical names, like Heinz 5608 or Woodbridge BQ 273. Every year the Processing Tomato Advisory Board generates a list of all the varieties of processing tomatoes harvested in California, and reports their quality attributes for that season. Other tomato-growing states, such as Ohio, Indiana, and Pennsylvania, will use tomato varieties that are more resistant to mold due to the fact that it rains during the growing season in those states.



THE FETISH SURROUNDING SAN MARZANO TOMATOES

San Marzano is a variety of tomato that's grown in the Campania region of Italy, in the volcanic soil around Mount Vesuvius, under exacting conditions. There are regulations around every step of the process, from the sourcing of the seeds to the way they're harvested by hand, not by machine. Only those tomatoes that meet all the requirements can get the coveted label "DOP" (Denominazione d'Origine Protetta) on the can.

All that coddling on the farm doesn't come cheap, of course, but many are willing to pay a higher price to get the real deal. The DOP San Marzanos are beloved by a great number of pizzaioli in Naples, as well as other parts of the world. Not everyone realizes, however, that not all tomatoes labeled "San Marzano" are actually grown to the DOP standards. The Campania growing area is quite small (about 60 square miles), and as we said, San Marzano is a *variety* of tomato, and it's grown in a number of places around the world. Manufacturers know there's a fetish surrounding San Marzanos, so having that name on the label is a selling point. Further complicating matters, it's legal to say something was "produced in Italy" even if it was grown elsewhere; the only requirement is that the foreign-grown tomatoes were turned into a canned product on Italian soil. You have a variety name and you have a geographic monopoly on a trademark.

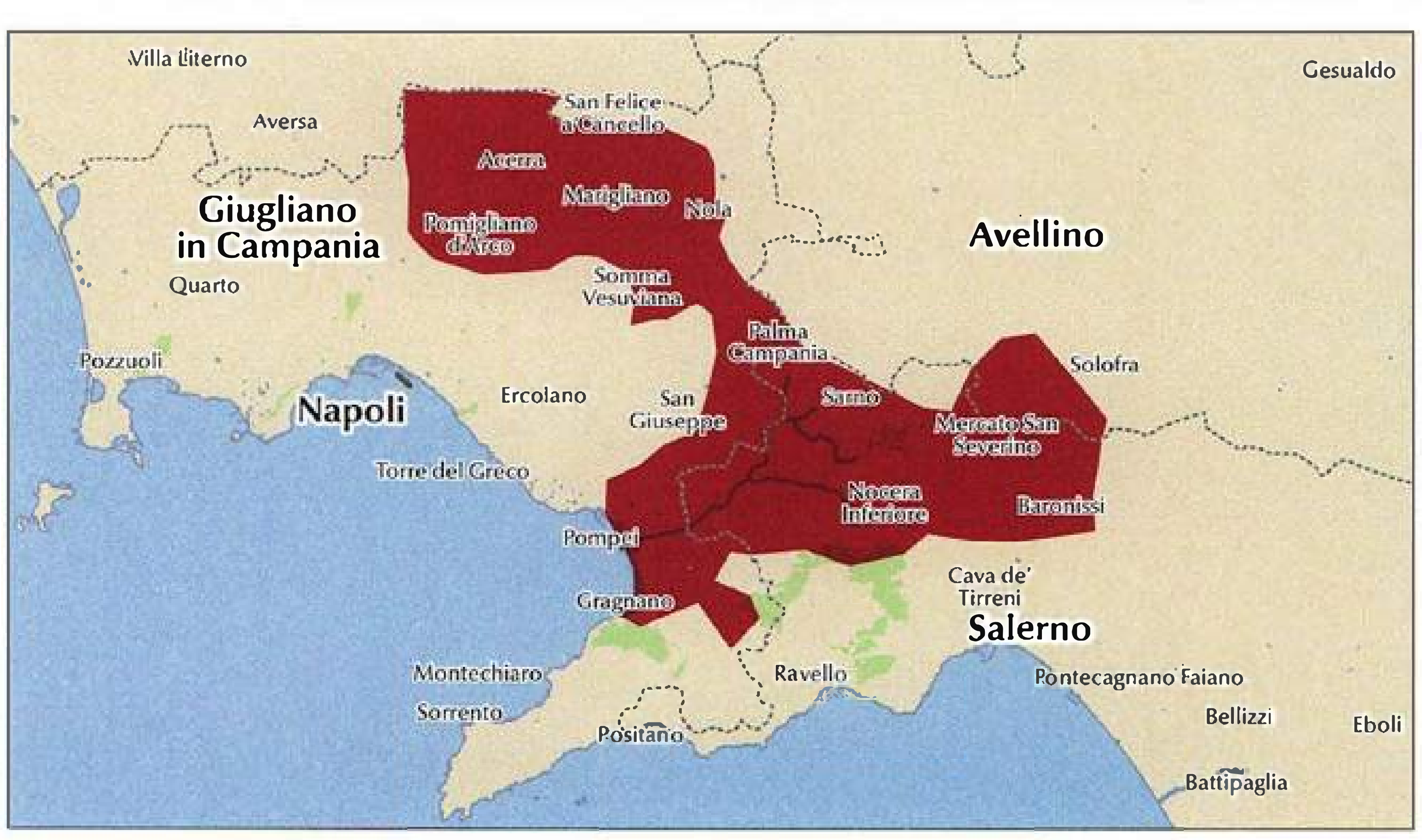
Unless you've met all the DOP standards, you can't label your tomatoes as DOP San Marzano. But it's legal outside of Italy to call your tomatoes plain old San Marzano if that's what they are. This makes the whole enterprise ripe for confusion or even fraud. In fact, the head of the DOP San Marzano governing body has said that 95 percent of tomatoes labeled "San Marzano" in the United States are grown elsewhere and don't meet the DOP standards. Fraudulently labeled pizzas and tomatoes have been seized by police.

In 2019, two federal lawsuits accused a major producer of labeling their cans in a way that made consumers think they were buying the high-end DOP product when they were actually buying something else. The plaintiffs say DNA tests prove their claims. The cans say "certified" and "San Marzano," but they do not include any reference to DOP. The company denied any wrongdoing, and the lawsuit continues to play out.

Some serious pizza makers frown on non-DOP San Marzanos, but we don't have a hard-and-fast rule like that. We've tasted some very good San Marzanos that lack the DOP seal. (Of course, we've also tasted some that aren't very good.) Here's another shocker: you can make a good pizza with other tomato varieties! There are so many kinds of tomatoes, it's shortsighted to think there's only one kind that works.

The San Marzano tomato was commercially introduced in 1926, and it's popular because of its flavor and also because its firm flesh retains its shape in the can and its peel is easily removed. Amy Goldman, author of *The Heirloom Tomato*, has called it "the most important industrial tomato of the 20th century."

When you see the DOP seal on a food item (see below), it means it was grown in a carefully delineated region, following very particular rules. Products can be granted DOP status, meaning Denominazione d'Origine Protetta, by the European Union, and it's a way to protect the product's integrity. You'll see the seal on certain cheeses, olive oils, prosciutto, and, yes, San Marzano tomatoes. For tomatoes, the label will say, "Pomodoro S. Marzano Dell'Agro Sarnese-Nocerino" and include the red and yellow DOP seal, as well as another seal depicting the tomatoes. If it doesn't have the seals, the tomatoes aren't DOP San Marzanos.



The region where DOP San Marzano tomatoes are officially allowed to grow is far too small to keep up with global demand. This, coupled with convoluted labeling laws, has led to consumers questions about what they are really getting when they buy this coveted product.

CANNED TOMATOES

Canned tomatoes come in a variety of textures from whole to paste and everything in between. How those tomatoes are harvested matters. Obviously, the more tomatoes you can harvest, the more you can sell, so most harvesting is done with machines. Because machines aren't exactly gentle, tomato varieties have been developed to be sturdier, with a thicker pericarp (see page 212), so they're more resistant to bruising. This is not without consequences. The thicker the flesh, the fewer seeds a tomato will have, and the seeds, along with the jelly-like membrane that envelops the seeds (called the parenchyma), are where the flavor resides.

While tomatoes for fresh market are handpicked, they are often harvested green or with a blush of orange (vine-ripened). Processing tomatoes, whether picked by machine or by hand (still common in some countries), are harvested at the red-ripe stage, which allows full development of the tomato's flavor compounds. Some canners adjust for flavor by adding sugar, citric acid, and/or salt to their products, and these are legitimate practices, though we prefer products that don't have these additions.

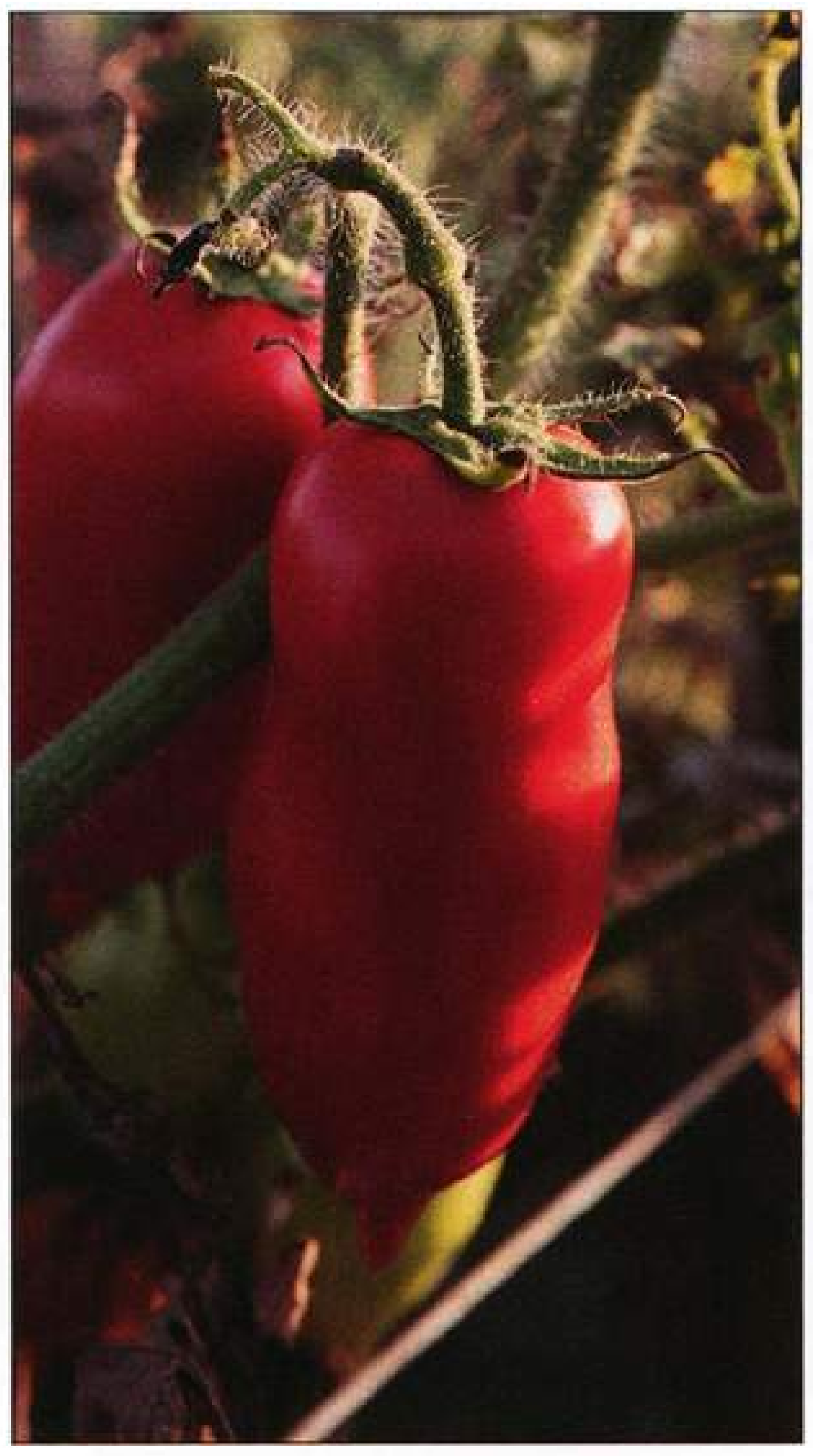
Generally, canned tomato products have their peel removed before reaching the can. Exceptions would be certain ground products and very small varieties such as Piennolo; smaller tomatoes aren't peeled because they would lose too much yield. Large pieces of tomato skin tend to take on a very firm, almost plastic-like texture when they're canned. If you do get the occasional tomato peel in a whole canned tomato product, simply remove it.

Whole peeled, diced, and crushed tomato products are peeled while the tomato is still whole. Peeling isn't easy—for individuals or for manufacturers. There are two ways to do it: using a lye solution or steaming for several seconds followed quickly by a drop in pressure. In California, about 70% of peeled tomatoes are steamed and 30% are lye-peeled. Lye peeling is more efficient at removing peels with less pericarp (flesh) loss, meaning the yields are higher and the red color just below the skin is retained. The environmental concerns of lye disposal, however, are important to consider. Both methods involve passing the tomatoes over rubber discs or pinch rollers that mechanically remove the peel before they are canned and cooked to sterilize them.

For home cooks and restaurant kitchens, the simplest way to remove the peels is to drop tomatoes in boiling water for a few seconds, shock them in an ice bath, and then manually peel them. This is also known as tomatoes concasse; we detail the method on page 226.

Tomatoes used in purees, sauces, and pastes are typically not peeled whole. Instead the tomatoes are heated, chopped, and the pulp is passed through screens to remove the seeds and fragments of peel. Much as with a food mill, the screen size used is determined by the desired texture of the final product.

Canned tomatoes can come in a variety of formats. Different types of products are made with different kinds of tomatoes. For tomato paste, you want varieties with lots of fiber and solids so that less energy is used to evaporate the moisture. For whole, diced, and crushed tomatoes, the varieties need to be easy to peel with very firm and thick pericarps. Because the heat of canning can break down softer varieties of tomatoes and turn them into mushy paste, some canners add a salt called calcium chloride to firm the flesh and help retain the shape. We consider this to be a valid manufacturing practice, but within limits. When too much calcium chloride is added, the flavor is affected and the tomatoes can take on an unnatural texture, similar to a wet sponge. The tomato products on the next few pages are often used for pizza sauce.



We were fortunate enough to visit the Ciao tomato factory and fields for their annual San Marzano tomato harvest (see photos above and below). We were also able to observe the fascinating sorting and processing of the tomatoes (see photo on previous page). Some claim that these prized tomatoes are the secret ingredient for making the best pizzas (see page 213).

Phrases like "packed fresh in season" refer to tomatoes that are cooked only one time and go directly into their final can. Because the tomato season is fairly short, some processors package the tomatoes in bulk during season, and then repack them into cans later. This results in two cooking processes and can affect the quality of the product.

Canned tomato products are generally red, but tomatoes also come in yellow, green, deep purple, and even a combination of colors. Red tomatoes get their color thanks to a carotenoid called lycopene. The more lycopene, the redder the tomato. Tomato color is measured with instruments called tristimulus colorimeters and spectrophotometers.

Canned whole tomatoes

We came across many pizza makers who said they used fresh tomato sauce when they actually were using canned tomatoes. It seemed that they thought that if *they* didn't cook them, they weren't cooked. But canned tomatoes are, in fact, cooked during the canning process. Heat kills microbes and preserves the tomatoes.

Canned Whole Tomatoes

Most pizzaioli use canned whole tomatoes—specifically San Marzano tomatoes (see page 213)—rather than fresh tomatoes. Even Neapolitan pizzaioli, who are sticklers for fresh ingredients, use canned. Given the stigma around canned foods, it might seem counterintuitive that professional pizzaioli make this choice, but there are some good reasons for this.

Consistency is the big one. Because tomatoes are picked close to their peak and promptly canned, you get a consistent product whether you open the can tomorrow or months from now. Of course, not all canned tomatoes are created equal. It is fair to say that once you find the right canned tomato for your taste, you're probably going to stick with it for a while.

You can't look at a can and see how the tomatoes were ripened, but researchers say that canning tomatoes are best when they are picked at 85%–95% ripeness (rather than being ripened off the vine). Indeed, some researchers have found that the tomatoes' stage of maturity is actually more important than the variety's genetic makeup. Immature tomatoes often have lower pH, higher acid, and lower sugars, and make a thicker juice. As tomatoes become overripe, the pH rises and the viscosity becomes thinner. Some canners carefully measure the growing tomatoes' pH, waiting until it hits 4.1–4.5 before they harvest. Most canners, however, add citric acid as a precaution. Lowering the pH is mainly for microbial concerns. The pH needs to be controlled, especially for diced or peeled tomatoes, since they have higher water activity, which creates an environment that can foster microbial growth.

Tomatoes provide flavor for the sauce, of course, but they also add texture. The amount of water in the can is such that when you process the whole peeled tomatoes with their liquid, you should wind up with a sauce that has just the right consistency. Better-quality canned tomatoes have a balance of sweetness and acidity. The sweetness should be natural (the higher the Brix, the better), and the acidity can be natural or come from citric acid. Tomato sauce needs salt, but not all manufacturers add it, and that's just fine as it's easy to add yourself. When using unsalted canned tomatoes, we recommend adding about 1% of the total weight of the can's contents for proper seasoning. If it's a brand you've never used before, always taste before adding anything or using it on a pizza.

We like canned DOP San Marzano tomatoes, but other varieties are also very good. In the United States, most canned tomatoes are plum tomatoes, and some producers make a very high-quality

ARE NIGHTSHADES REALLY BAD FOR YOU?

The fear that tomatoes are poisonous was one of the things that stymied people in Europe from eating them for hundreds of years (see page 1:9). It surprises most people to know that what is now Italy, which wasn't one country until hundreds of years after the tomato arrived from the New World, was among the last parts of Europe to accept the tomato as food.

There's been a flurry of press in the last few years about vegetables and fruits in the botanical family *Solanaceae,* commonly known as nightshades. Some argue that ingesting these plants can cause inflammation. The botanical family includes peppers, potatoes, eggplants, and tomatoes—which puts them smack dab in *Modernist Pizza* territory. Could this innocuous-seeming produce actually be harmful?

We searched the scientific literature and couldn't find any solid research proving a connection between nightshades and inflammation. So where did this idea come from? Perhaps it's because nightshades contain alkaloids, a group of chemical compounds that can be toxic in large doses. The botanical family also includes tobacco, which has obvious problems, and belladonna, a plant that numerous studies have found to be harmful beyond very small doses.

The idea that nightshades are bad for our health is being promoted by celebrities and book authors, which has brought it to the forefront. It's also popular among some communities that are highly attuned to the idea of inflammation, such as people with arthritis, inflammatory bowel disease, or psoriasis. There are many anecdotal stories about how eliminating nightshades or other foods has helped some people combat symptoms.

Certainly, medical studies confirm the connection between inflammation (as measured by a blood test for C-reactive protein) and chronic disease, and what we eat plays into all of that. But for most of us, the nutritional benefit of a varied diet, which includes all kinds of fruits and vegetables, is probably the best bet.

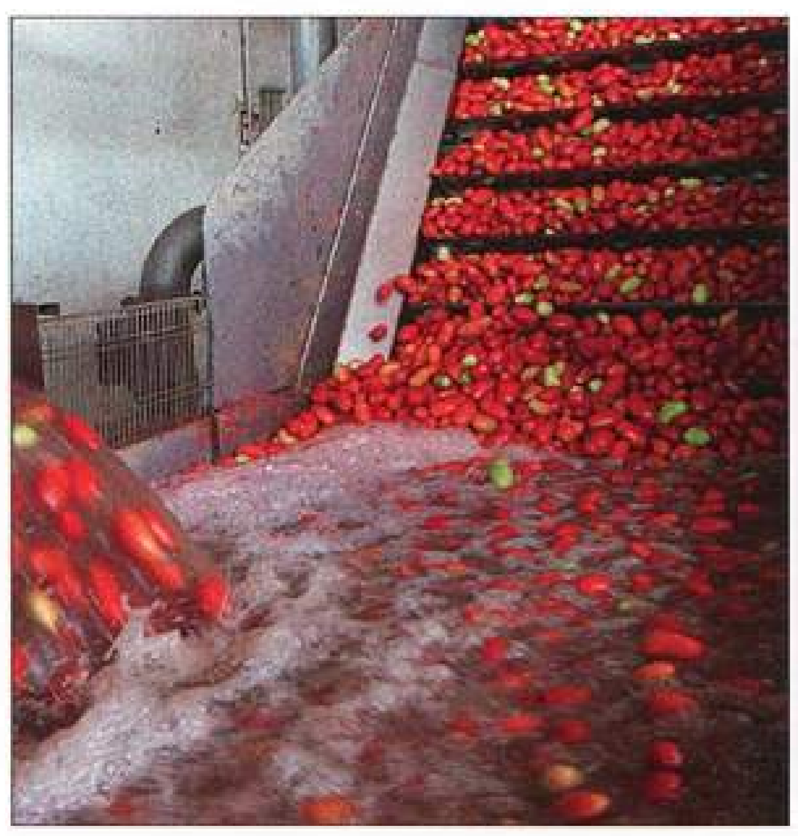
Members of the nightshade family, including the eggplant, peppers, potatoes, and tomatoes shown above, are sometimes portrayed unflatteringly when it comes to your daily diet, but the scientific evidence isn't concrete enough to back up this claim.

THE TOMATO CANNING PROCESS

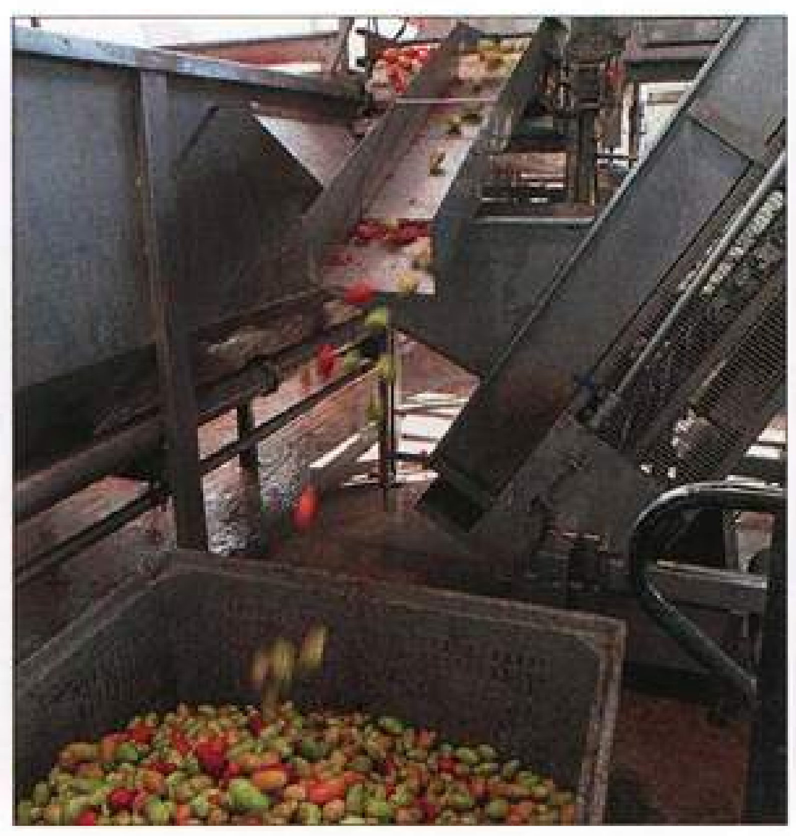
The purpose of canning tomatoes is, of course, to preserve them. Temperature and time are crucial to the preservation process. The tomatoes need to be heated to a high-enough temperature that micro-organisms are killed, making the product shelf stable. Temperature also has a dramatic impact on the flavor, color, and texture of the product, so processors monitor it closely throughout the entire process. When canning tomato sauces and paste, there are two distinct processes for concentrating tomatoes based upon their initial heating temperature: cold break processing (CBP) and hot break processing (HBP). Even when the processes use the same raw fruit, they result in very different products.

In CBP, the tomatoes are chopped and initially heated in the can to between 71° C and 77° C / 160° F and 170° F. This temperature is low enough that the tomatoes retain some of their fresh flavor and a brighter red color. Certain enzymes (namely polygalacturonase and pectin methylesterase) remain active to break down natural pectins, which results in a thinner viscosity product. Higher temperatures are applied later in the process for concentration and food safety. These kinds of tomatoes work well for Neapolitan pizza, which is aiming for that fresh tomato flavor.

In HBP, the tomatoes are heated even further, to at least 91° C / 195° F as quickly as possible. At these temperatures the enzymes are killed off almost immediately, leaving the pulp with more large-sized pectins. The result is a product that's thicker than CBP tomatoes, but also deeper red with a cooked-tomato color and flavor. Because the tomatoes break down a little bit in the heat, the liquid in the can gets pulpy and red. This is the most common kind of tomato product you'll find, and it works for many applications. In both processes, the cans are quickly cooled down to prevent overcooking.



WASH



MACHINE SORT

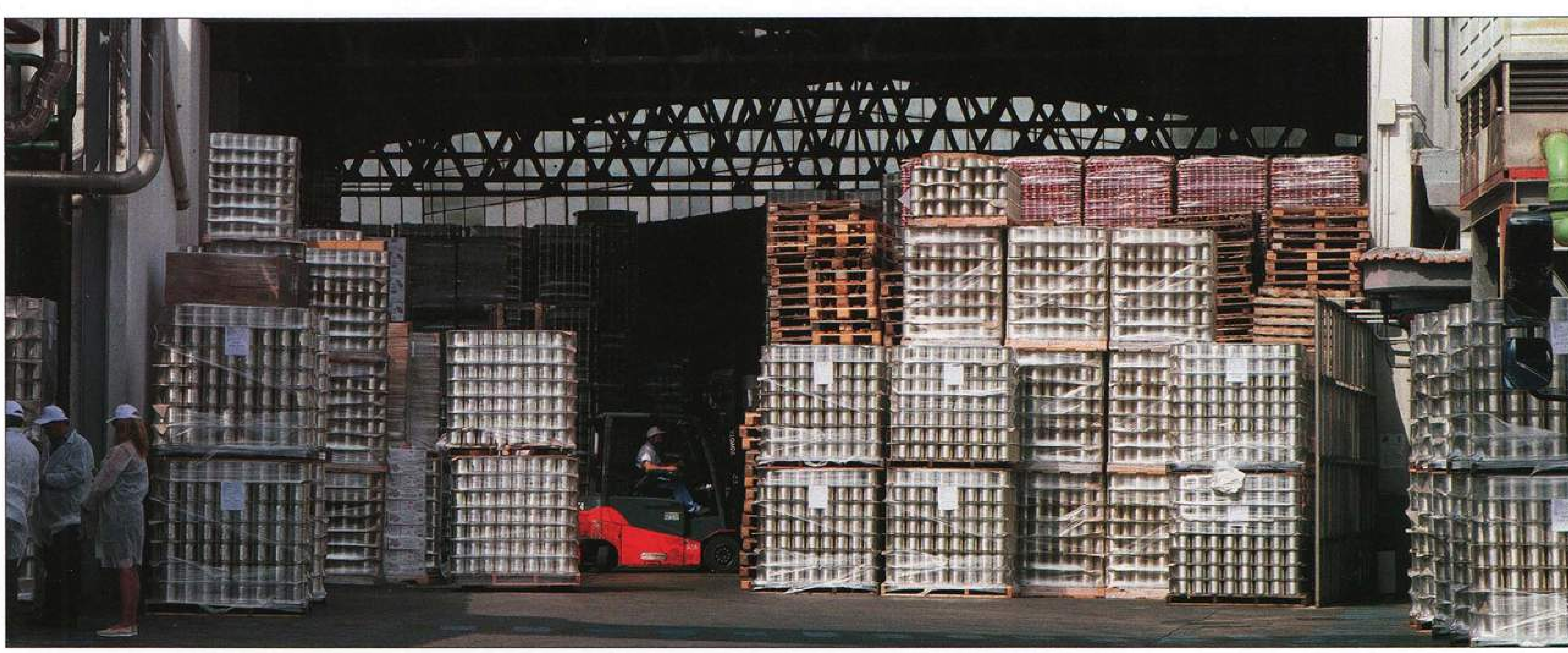
HAND SORT

COOK

ADD FLAVORS

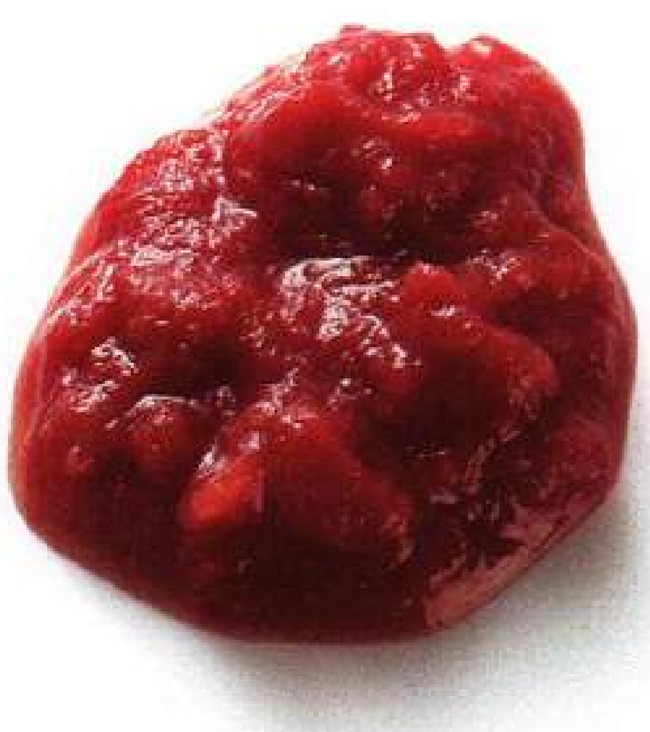
QUALITY CONTROL

CAN



DISTRIBUTE

Diced tomatoes



Crushed tomatoes

product. In Italy, you'll find other fantastic canned tomatoes, including Piennolo and Corbarino tomatoes. Both are small varieties that deliver a lot of flavor. Because they're so small, they're not peeled before canning. Normally, skins are off-putting in pizza sauce, but with these tomatoes, we don't mind it. Their skins are thinner than the skins of San Marzano and most other processing tomatoes and generally don't develop the tough texture we find unpleasant. If you can find these canned tomatoes, try leaving the skins on and see what you think. If you don't like it, simply pass the tomatoes through a food mill to remove the skins.

The main thing to remember is that tomatoes don't have to come from the foothills of Vesuvius to taste good. We sampled a number of canned tomatoes during our travels and found many we liked. See page 220 for our recommendations.

Diced Tomatoes

Size-wise, diced tomatoes are the next step down from whole tomatoes. Because the tomato pieces are small, they're likely to cook and break down more easily than whole canned tomatoes. To keep that diced shape, they're often canned in tomato juice that's been mixed with calcium chloride. The whole point of using diced tomatoes is to see the dice. If you don't care about the shape, use crushed tomatoes.

Crushed or Ground Tomatoes

Whole peeled tomatoes are turned into crushed tomatoes with a machine called a Rietz Disintegrator. It breaks them down into a coarse puree that retains some chunks and also includes the seeds. For certain ground products, unpeeled tomatoes are used to provide a distinct texture. Some pizzaioli don't process crushed tomatoes any further or make them smoother because they feel that the sauce tastes bitter as a result of pureeing the seeds. We can't discern a difference but encourage you to try both methods to see what you like. You can just stir the crushed tomatoes into another tomato sauce if you'd prefer. Some brands of crushed tomatoes are slightly chunkier than others. You'll see both "crushed" and "ground" on the labels for these tomatoes, but they are functionally the same thing.

Tomato Puree

Most tomato purees are made by cooking the unpeeled tomatoes and then straining them to remove the peels and seeds. After that, they're canned, which means they're cooked further. This makes it a completely different product from crushed tomatoes, but not necessarily worse or better. Tomato puree is useful in a number of applications, including preparations that require long cooking and those where the fresh tomato taste doesn't matter so much. Manufacturers make a

There's a large variety of canned tomato products available and they produce different sauce consistencies and flavors. Pizza makers often combine different canned products to achieve their desired pizza sauce. We've got an in-depth table of ways to customize your tomato sauce on page 232.

product called "pizza sauce," which is very similar to tomato puree but is passed through a larger finishing screen that allows some of the seeds to pass through. Many pizza makers use this sauce and add their own ingredients to customize it. Pizza sauce is typically between 8 and 14 Brix.

Tomato Paste

Tomato paste is a fantastic way to add very concentrated tomato taste and umami to any tomato preparation. To make tomato paste, the seeds and skins are filtered out and the pulp is juiced. The juice is then evaporated until it forms a paste, which can take some time. All that evaporation means it's a highly concentrated final product, but you need only a little bit to have an impact on flavor. Even in small quantities, the paste makes its presence known. By US law, tomato paste should contain at least 24% soluble solids, which is a 4- to 6-fold concentration from the raw tomatoes. When concentrated even further—to 33% or more—it's called, you guessed it, "double concentrated tomato paste." Salt is often added.

Tomato Sauce

Canned tomato sauce is a good alternative if you don't have time to make your own. There are hundreds of brands available; all you need to do is find the right one for you. Canned tomato sauce is generally thick, so it's suitable for most pizzas except Neapolitan. When you put a thick sauce on a Neapolitan pizza and bake it in a very hot oven, the sauce can burn.

Frequently, tomato sauces are pureed until smooth and may contain other ingredients, such as basil, oregano, garlic, salt, olive oil, vinegar, onion, and/or sugar. If the tomatoes aren't sweet enough, sugar may be added. We aren't fond of sugar in tomato sauce because it doesn't really improve the flavor and makes it sweeter than it should be. Sugar not only affects the sweetness of the sauce, but also the cooking, so it can't be added all at once. About one-third is added when the sauce starts to boil; this makes the red color more intense and helps it stay red throughout the process. The rest is added later; to do otherwise would lengthen the cooking time and make the pulp quality deteriorate. The average sugar content of tomato sauce brands that we tested is between 5% and 10%. Salt is added toward the end of the process because it can cause discoloration. Spices can be added at the start of boiling or before.

Commercial sauces can be made with fresh tomatoes, or with tomato paste or concentrated tomato juice, or with both. Those made with fresh tomatoes cost a bit more, but they're also higher quality. The process is as follows: concentrated juice is processed; additional flavors and ingredients are added; then comes the boiling, straining, and filling of the cans or jars; and finally the cans are sealed and pasteurized at 85°C / 185°F for 45 minutes. Most sauces must have at least 10% tomato solids.

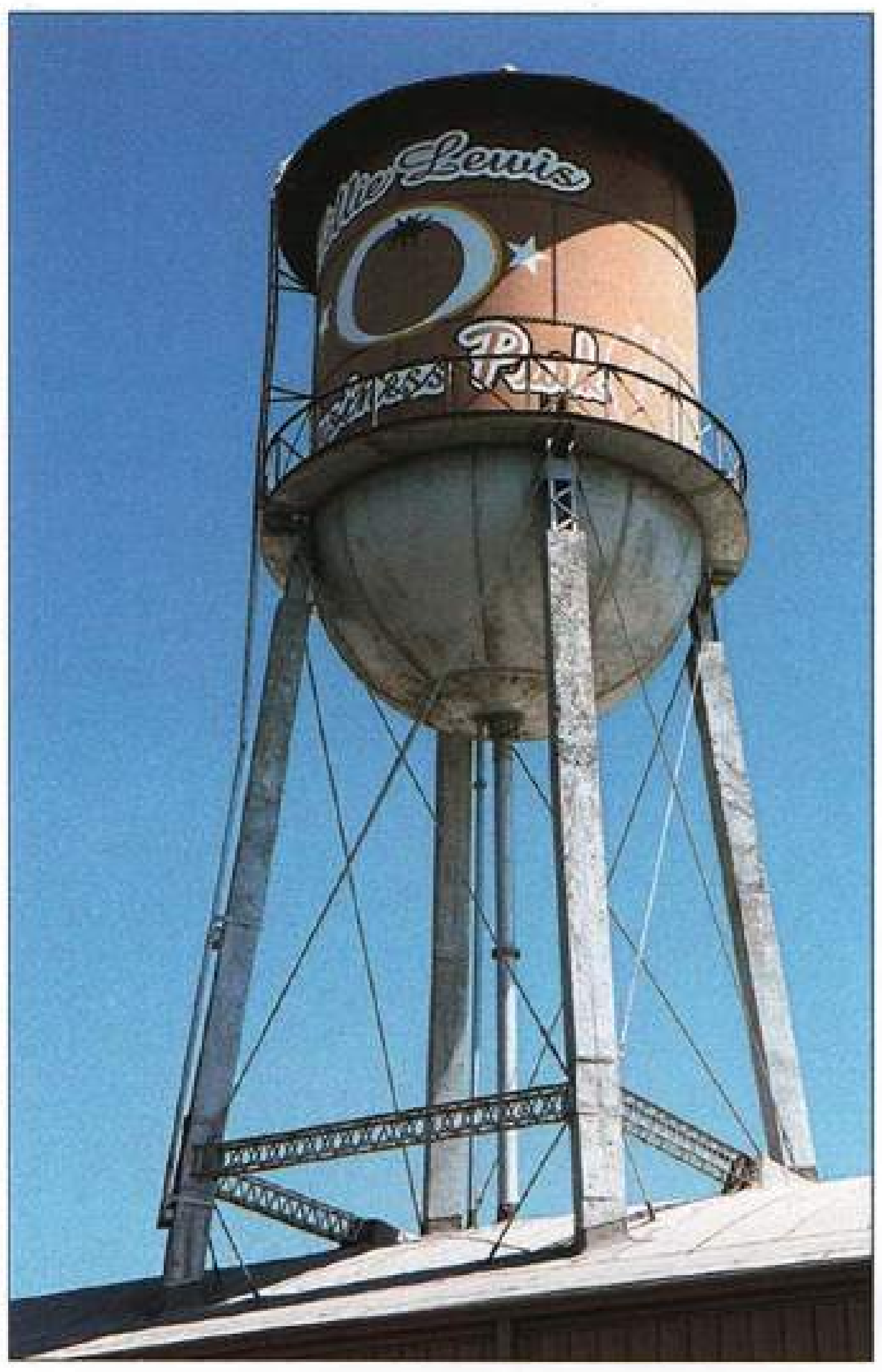
In the tomato world, Brix degrees are an expression of the soluble solids. The soluble solids in a tomato are mostly sugars but also include the acids, salts, and soluble pectins that it contains (most varieties range from 4.5 to 6 Brix). "Total solids" is another term that reflects the soluble components, but this also includes the insoluble fibers and large pectins that give the juice and sauce their consistency.

Tomato paste

OUR FAVORITE CANNED TOMATOES

There is a plethora of canned tomatoes available to professional and home pizza makers. How do you choose? Flavor should be the primary consideration, but also keep the texture in mind so that you make the optimal sauce for your style of pizza. Tomato products can be used in combination to build up flavor (one pizzaiolo we met uses a combination of six different canned tomato products). For his New York–style tomato pizza sauce, for example, Tony Gemignani adds Stanislaus Full-Red pizza sauce to canned crushed tomatoes. The crushed tomatoes are the focus, but by adding smaller quantities of the ready-made sauce, he adds flavor. There are plenty of high-quality ready-made canned pizza sauces available. It is reasonable to use them as a shortcut, especially if you are short on time or if you utilize a very large volume of sauce and simply don't have the time.

TILLIE LEWIS, THE AMERICAN WOMAN WHO TURNED INTO THE QUEEN OF ITALIAN TOMATOES



In the 1930s, Tillie Lewis was among the American entrepreneurs who saw potential in the lowly canned tomato. She helped bring a product grown and canned in Italy, and targeted mainly at the vegetable-loving Italians living in the United States, to a mainstream American audience. She also knew the value of a good story. Where her business savvy ended and her creative storytelling began is still a matter of debate. In the many news articles written about her in her heyday, the details of her rags-to-riches life often seem to change.

One thing is clear: there was nothing Italian about Lewis's background. She was born Myrtle Ehrlich to Jewish parents in Brooklyn in 1901. Nicknamed Tillie, she left high school as a teen to go to work. Some sources say she worked folding kimonos for $2.50 a week. Others say she worked at a grocery store. Still others talk about a stint selling securities on Wall Street. In any case, she met and married Louis Weisberg, a man in the wholesale grocery business, at a young age. Though she and Weisberg later divorced, it was her entrée into the world of tomatoes.

In 1930, the US government placed a hefty tariff on agricultural imports. By this time, Italian immigrants living in the United States had helped boost demand for canned tomatoes, which were also beginning to find a foothold among a homegrown American audience. After a bankruptcy in 1932, Lewis was looking for opportunity. Traveling to Italy in 1934, she met with Florindo del Gaizo, son of a cannery owner. With the family's export business stifled, del Gaizo, too, was looking for opportunity. He sent Lewis back home with bags full of Italian tomato seeds, and the two founded the Flotill Foods Corporation in 1935, with canneries near the fields of Stockton, California. He put up an 85% share. When del Gaizo died two years later, Lewis borrowed to become full owner.

It was not an easy road at first. Yields came in lower than expected. Factory equipment needed upgrading, and Lewis found herself in dire financial straits again. But eventually, everything clicked. World War II shifted trade once again, and canned tomato imports were blocked. The time was ripe for American tomatoes.

Flotill went on to can other California produce, such as asparagus, and had contracts to supply the US military with C rations. The company made calculated gambles to offer day care and other perks to attract workers. To fill wartime labor shortages, Lewis also brought in workers from Mexico under the bracero program.

In 1948, she married Meyer Lewis, a representative of the American Federation of Labor, whom she had met (and hired) several years earlier. In the early 1950s, annual sales were reported to top $20 million. Hailed as the tomato queen, she changed the name of the company to Tillie Lewis Foods in 1961. In the 1960s, she sold the company to Ogden Foods. Lewis continued on as president of the company until she retired in 1971; annual sales that year were reported to top $90 million. She died in 1977, in Stockton.

Portrait of Tillie Lewis in late 1936.

The Flotill Foods cannery in Stockton during the fourth canning season, 1938.

COMMON CANNED TOMATO SIZES

Many of our tomato sauce recipes are presented in a parametric recipe with scaling percentages so that you can choose a sauce yield that works for you. The idea is that you can utilize a whole can to make your tomato sauce and not have to worry about having leftovers. The table at right doesn't cover all of the canned tomato products that are available; they are the ones most commonly used to make tomato sauces for pizza. The can sizes and weights are also what is typically found in the United States. Standard can sizes may vary slightly around the world.

Tomato product	Weight (can size)	Volume
Whole peeled tomatoes	400 g / 14 oz (#300 can)	1⅔ cups
	800–820 g / 28 oz (#2.5 can)	3⅓–3½ cups
	2.89–3 kg / 102–106 oz (#10 can)	12–12½ cups
Diced tomatoes	400 g / 14 oz (#300 can)	1⅔ cups
	800–820 g / 28 oz (#2.5 can)	3¼–3⅓ cups
	2.89–3 kg / 102–106 oz (#10 can)	11¾–12¼ cups
Crushed or ground tomatoes	400 g / 14 oz (#300 can)	1⅔ cups
	800–820 g / 28 oz (#2.5 can)	3⅓–3½ cups
	2.89–3 kg / 102–106 oz (#10 can)	12–12⅓ cups
Tomato puree	400 g / 14 oz (#300 can)	1⅔ cups
	800–820 g / 28 oz (#2.5 can)	3¼–3⅓ cups
	2.89–3 kg / 102–106 oz (#10 can)	11½–12 cups
Tomato sauce/ pizza sauce*	227 g / 8 oz	1 cup
	400 g / 14 oz (#300 can)	1⅔ cups
	800–820 g / 28 oz (#2.5 can)	3¼–3⅓ cups
	2.92–3.15 kg / 103–111 oz (#10 can)	11¾–12¼ cups
Tomato paste	170 g / 6 oz	⅔ cup
	3–3.15 kg / 106–111 oz (#10 can)	11–11½ cups

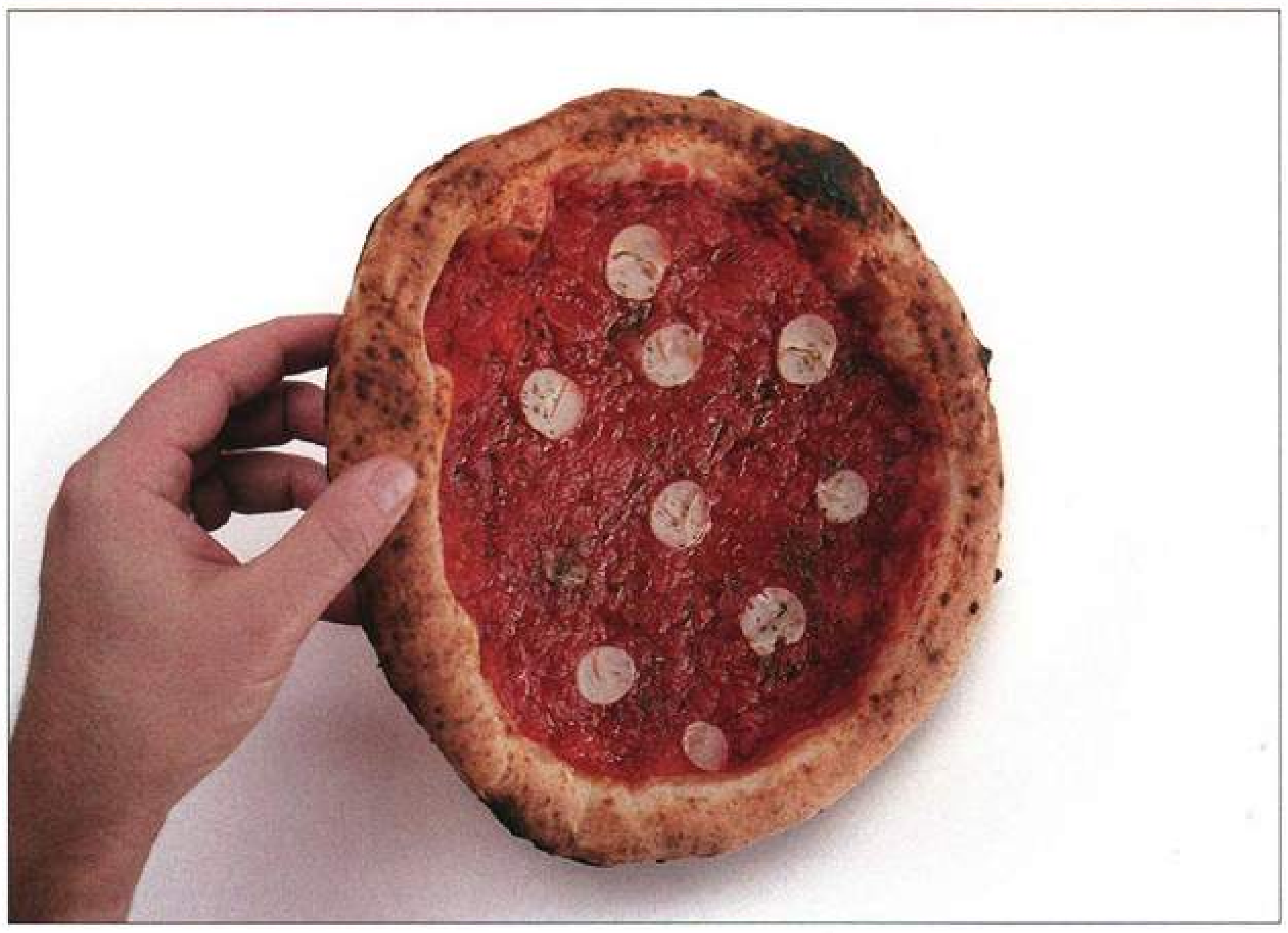
**This conversion is not for thick or super-thick pizza sauce.*

SOLVING THE MARINARA SAUCE DILEMMA

One of the challenges of baking a marinara pizza is that you need to put on more sauce than you would on a typical pizza, such as a margherita. The complication occurs during baking because the extra sauce contributes additional moisture, and it's possible that the dough will cook through but you will still have a soupy sauce at the center of the pizza. This is why pizzaioli bring the pizza to the front of the oven, where it is cooler, and spin it around for a few seconds to evaporate that excess moisture without burning the dough.

In the ideal scenario, the sauce evaporates just enough at the same time the pizza dough is fully baked. But we have a better solution: simply make a separate sauce for your marinara pizza. The marinara tomato sauce should have a lower ratio of water to solids than a margherita tomato sauce so that there is less moisture to evaporate while the pizza bakes. The average ratio of water to solids in a can of whole peeled tomatoes is 2.5 parts water to 1 part solids. This is intentionally done on the manufacturer's end so that you can just pass the tomatoes through a food mill and get the right consistency of sauce you need for a margherita pizza. In order to have the right consistency for a marinara sauce, you need to reduce the ratio of water to solids down to 1.5 parts water to 1 part solids (see page 225 for the recipe). Although it takes more time to create a separate sauce, the results are well worth it because the sauce will stay put and not slosh around.

Marinara pizza with a soupy center



Marinara pizza with a thicker sauce

RAW TOMATOES AND PIZZA

Most tomatoes that wind up on pizza go through some sort of cooking or heating step. Raw tomatoes can present problems. We all know that if you slice or dice a tomato and set it aside, it releases a lot of water. It will leach even more water if you put that cut tomato on a round of dough and put it in the oven. There just isn't enough time for the water to evaporate during baking, so you'll wind up with a puddle.

One approach we like is to slow-roast fresh tomatoes (see page 231) to evaporate some of the moisture and concentrate their flavor. But if you want to use fresh tomatoes, you can pass them through a food mill. If the resulting sauce is too watery, hang the tomatoes in cheesecloth to drain the excess water (this is flavorful and can be used for other purposes). Alternatively, you can place slices on the pizza just after it comes out of the oven. Or, if you want to warm the tomato slices slightly, you can add them just before the pizza is ready to come out.

For some longer-baking pizzas, you can get away with placing very thin slices of fresh tomatoes over the cheese. Don't put them on top of the sauce because it already has its own moisture that needs evaporating. Don't put them directly on the dough, either, because this can cause a significant gel layer (see page 1:370). And definitely don't try this with traditional Neapolitan pizza because there's just not enough time for the water to evaporate during its short bake.

There's a very popular pizza in São Paulo called margherita that features fresh tomato slices, in addition to the sauce and cheese you find on the traditional Neapolitan pizza of the same name. It takes just long enough to bake so that whatever moisture leaches, it won't create a puddle on the pizza. The key is having really great tomatoes and slicing them very thin.

PARAMETRIC RECIPE

TOMATO SAUCE FROM CANNED TOMATOES

Most pizzaioli around the world make tomato sauce by simply opening a can (or cans) of tomatoes, processing it, and seasoning the resulting sauce. There are three basic methods to make canned tomatoes into tomato sauce: hand-crushing, passing the tomatoes through a food mill, and using an immersion blender.

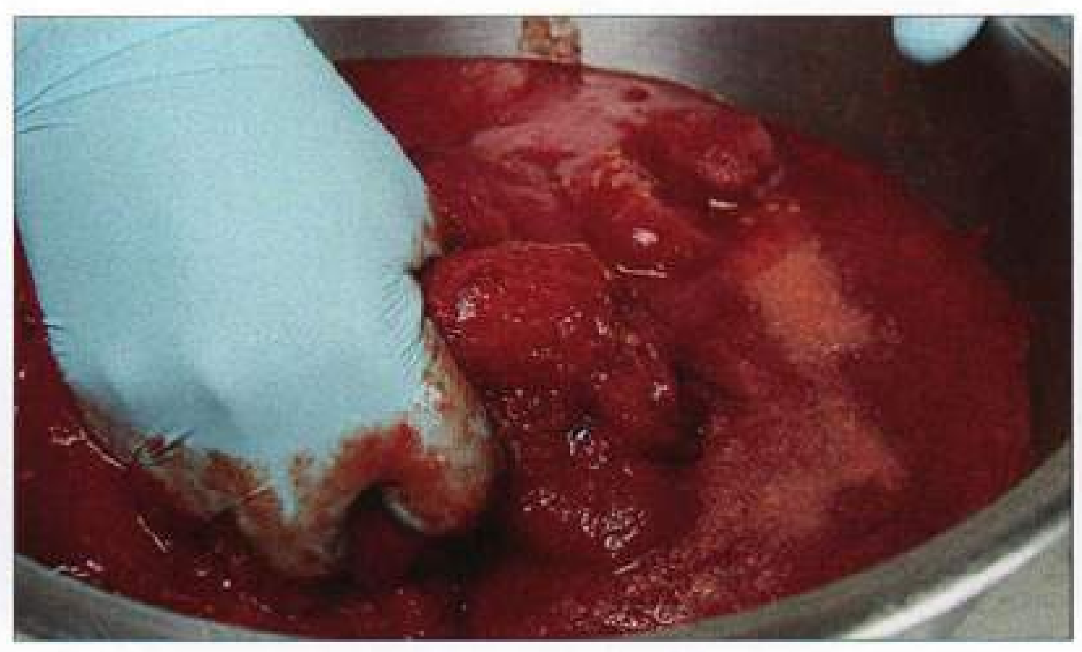
Crushing the tomatoes by hand produces a result that straddles the line between a sauce and a topping. We used gloves to do this, but they are optional. Food mills have different-size discs for the tomatoes to pass through. We recommend one that is not so big that you end up with large tomato chunks in the sauce nor so small that the seeds are left behind. Making a sauce with an immersion blender is a method that many use to save time. The methods outlined below are general instructions. We have specific notes for each of the sauce recipes in the instructions that follow.

The types of canned tomatoes, proportions, salt, and other flavors will change depending on the type of sauce you are making. There are many sizes of canned tomatoes, so you can customize your sauce yield depending on the size can you use. In general, you want to process the entire can—don't drain—to make the sauce; you need the exact mix of tomatoes and water that are in a can. The other ingredients are calculated based on the weight of the main type of tomatoes used. The sauces in the table on the next page are applied before baking the pizza, with the exception of the deep-dish pizza tomato sauce.

HOW TO Make Tomato Sauce from Whole Canned Tomatoes

HAND-CRUSHED

1 Pour the contents of the can into a bowl or plastic tub. Add the salt.

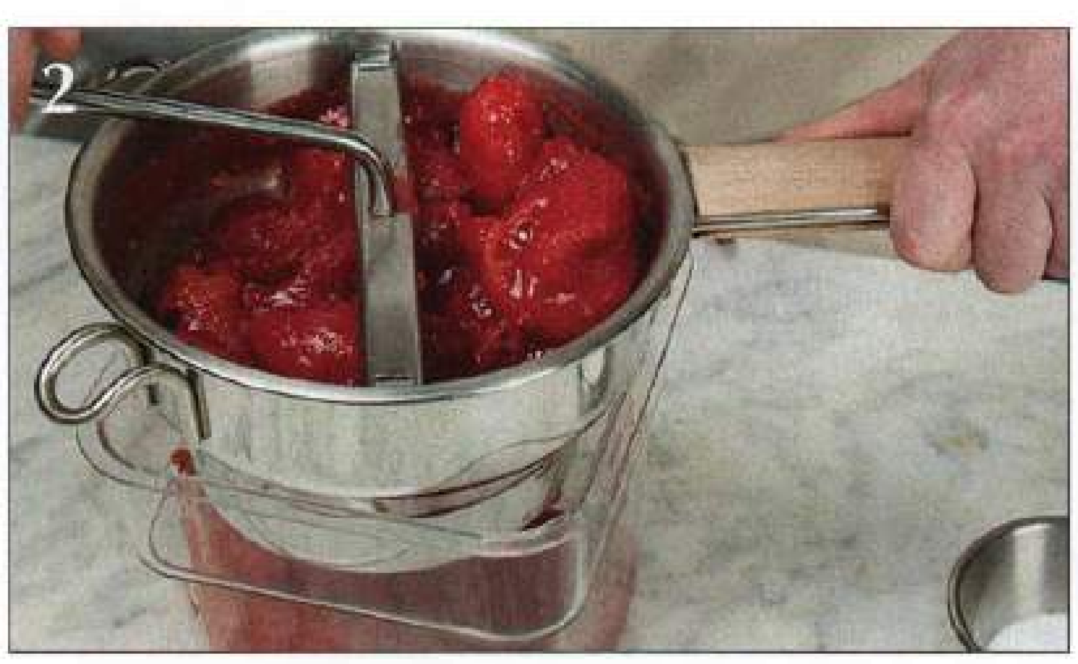


2 Crush the tomatoes as finely as you can using your hands. The sauce will be slightly chunky.

3 Make sure to remove any skins (sometimes a few are left behind).

4 Stir in any remaining ingredients.

FOOD MILL



1 Place a food mill over a bowl or plastic tub.

2 Pour in the contents of the can, and pass it through the mill.

3 Stir in the salt to dissolve completely.

4 Stir in any remaining ingredients.

IMMERSION BLENDER

1 Pour the contents of the can into a bowl or plastic tub. Add the salt.

2 Puree the ingredients until smooth using an immersion blender.

3 Stir in any remaining ingredients.

Sauce type	Main canned tomatoes	Scaling %	Other canned tomatoes	Scaling %	Other ingredients	Scaling %
Thin-Crust / Brazilian Thin-Crust Pizza Tomato Sauce	Canned crushed tomatoes	100	Canned tomato sauce	25	Fine salt	1.25
					Dried oregano	1
Classic Neapolitan Pizza Tomato Sauce	Canned whole peeled tomatoes	100	n/a	n/a	Fine salt	1
Marinara Pizza Tomato Sauce	Canned whole peeled tomatoes	100	n/a	n/a	Fine salt	as needed
Quick New York Pizza Tomato Sauce	Canned crushed tomatoes	100	Canned tomato sauce	33.33	Fine salt	0.33
					Dried oregano	0.33
Deep-Dish / Stuffed-Crust / Detroit-Style Pizza Tomato Sauce	Canned whole peeled tomatoes	100	Canned crushed tomatoes	100	Fine salt	1.5
			Canned tomato sauce	66.67	Dried oregano	0.95
					Olive oil	2.4
New York Square Pizza Tomato Sauce	Canned crushed tomatoes	100	Canned whole peeled tomatoes	46.88	Garlic, minced	1.46
			Canned tomato paste	46.88	Fine salt	1.25
					Dried oregano	0.42
					Basil or tomato leaves, torn	0.21
Al Taglio Pizza Tomato Sauce	Thick tomato puree	100	n/a	n/a	Fine salt	1

PROCEDURE

THIN-CRUST / BRAZILIAN THIN-CRUST PIZZA TOMATO SAUCE

Combine the crushed tomatoes, pizza sauce, salt, and dried oregano and puree until smooth using an immersion blender. Store for up to 3 d in refrigeration. Freeze for up to 3 mo. You can replace the canned tomato sauce with New York / Artisan Pizza Tomato Sauce (see page 227), if desired.

CLASSIC NEAPOLITAN PIZZA TOMATO SAUCE

You can use any of the methods outlined on the previous page to make the sauce. Store for up to 4 d in refrigeration. Do not freeze. This is the thinnest of all the tomato sauces since you do not drain the canned tomatoes. A drier sauce would likely burn when it bakes in a 425–480°C / 800–900°F oven. Some pizzaioli add fresh basil leaves, olive oil, or dried oregano.

MARINARA PIZZA TOMATO SAUCE

Drain the liquid from the canned tomatoes but reserve it. Pass the tomatoes through a food mill. Put the crushed tomatoes in a fine-mesh sieve lined with cheesecloth that has been placed over a bowl or plastic tub. Drain for 5 h. Collect the drained liquid and add it to the reserved tomato liquid. Weigh the crushed tomatoes and multiply their weight by 1.5. Add this amount of tomato liquid to the crushed tomatoes. Stir well. Weigh the sauce and season with 1% fine salt or as needed. Store for up to 4 d in refrigeration. Do not freeze.

QUICK NEW YORK PIZZA TOMATO SAUCE

Use the immersion blender method for this sauce. Store for up to 4 d in refrigeration. Freeze for up to 3 mo. This recipe is adapted from Tony Gemignani.

DEEP-DISH / STUFFED-CRUST / DETROIT-STYLE PIZZA TOMATO SAUCE

Drain the whole peeled tomatoes. Puree the drained tomatoes, crushed tomatoes, tomato sauce, salt, and dried oregano until smooth using an immersion blender. Stir in the olive oil. Store for up to 4 d in refrigeration. Freeze for up to 2 mo. This sauce is applied to the pizza after baking. Warm the sauce over medium-low heat while the pizza is baking and then spoon on top of the baked pizza. You can replace the canned tomato sauce with New York / Artisan Pizza Tomato Sauce (see page 227), if desired.

NEW YORK SQUARE PIZZA TOMATO SAUCE

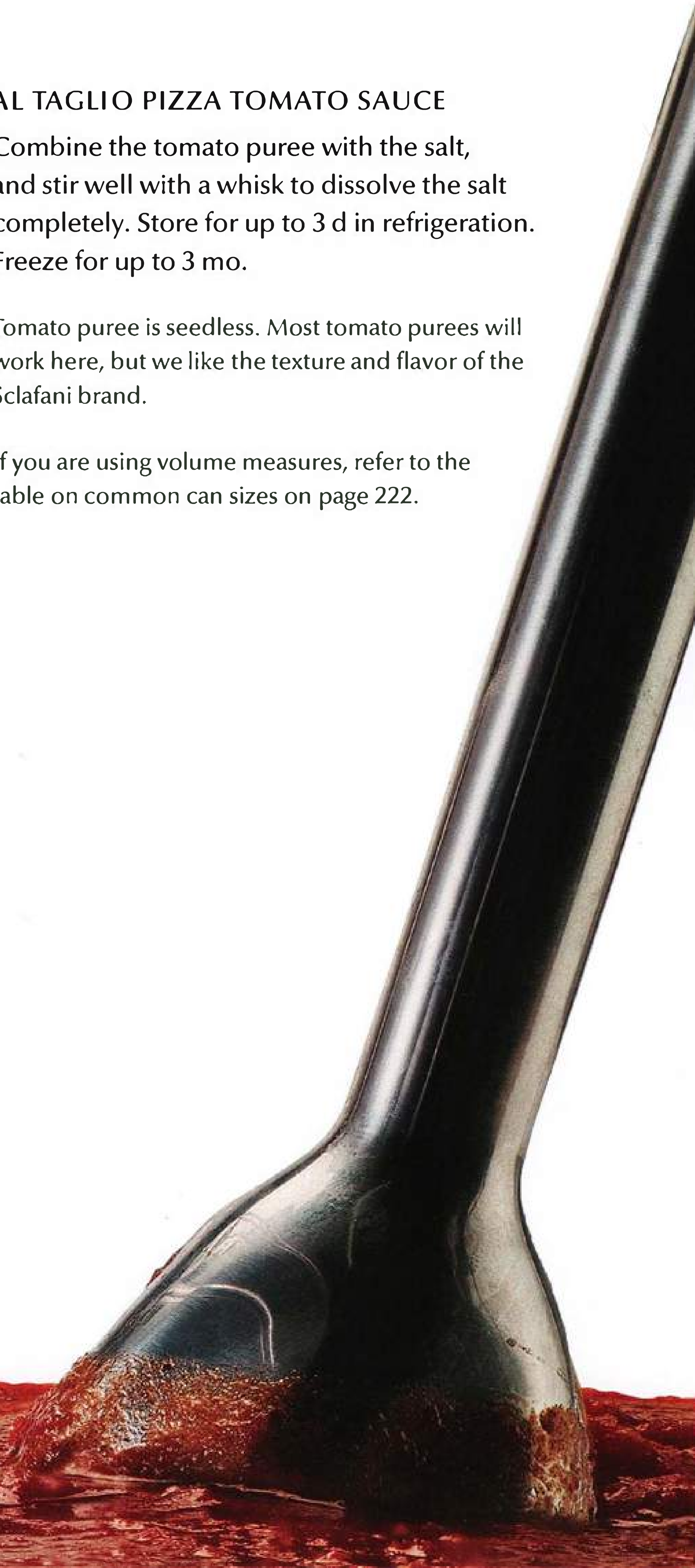
Puree the crushed tomatoes, canned whole peeled tomatoes, tomato paste, garlic, salt, and dried oregano until smooth using an immersion blender. Stir in the fresh basil or tomato leaves. Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

AL TAGLIO PIZZA TOMATO SAUCE

Combine the tomato puree with the salt, and stir well with a whisk to dissolve the salt completely. Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

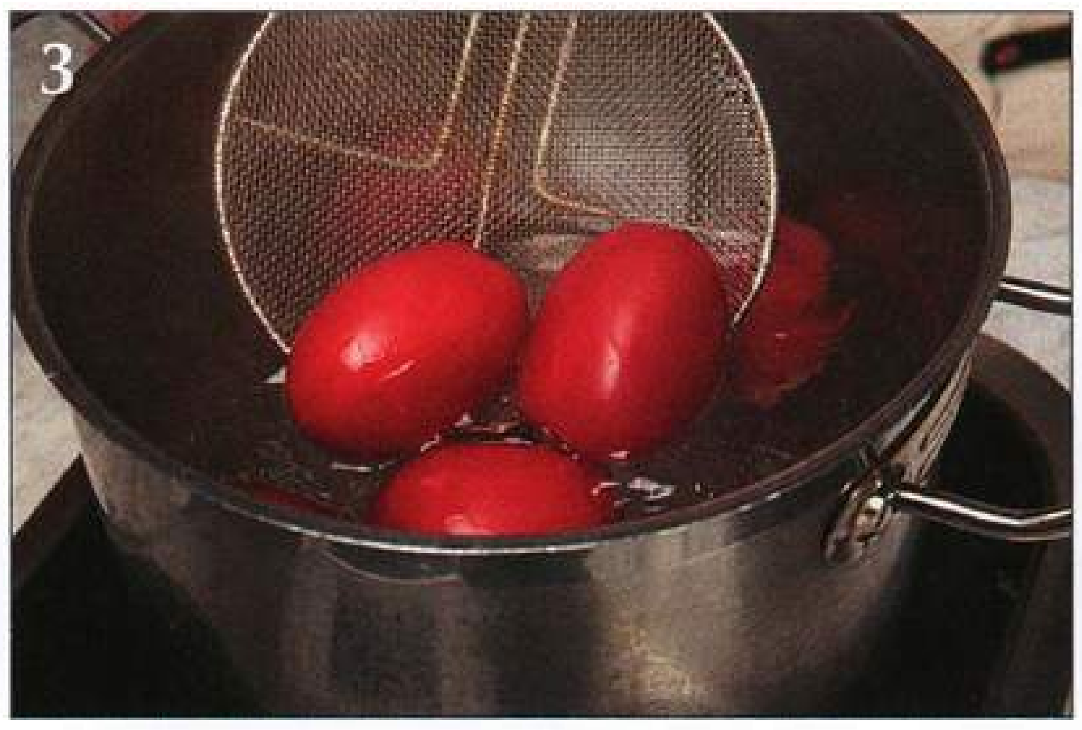
Tomato puree is seedless. Most tomato purees will work here, but we like the texture and flavor of the Sclafani brand.

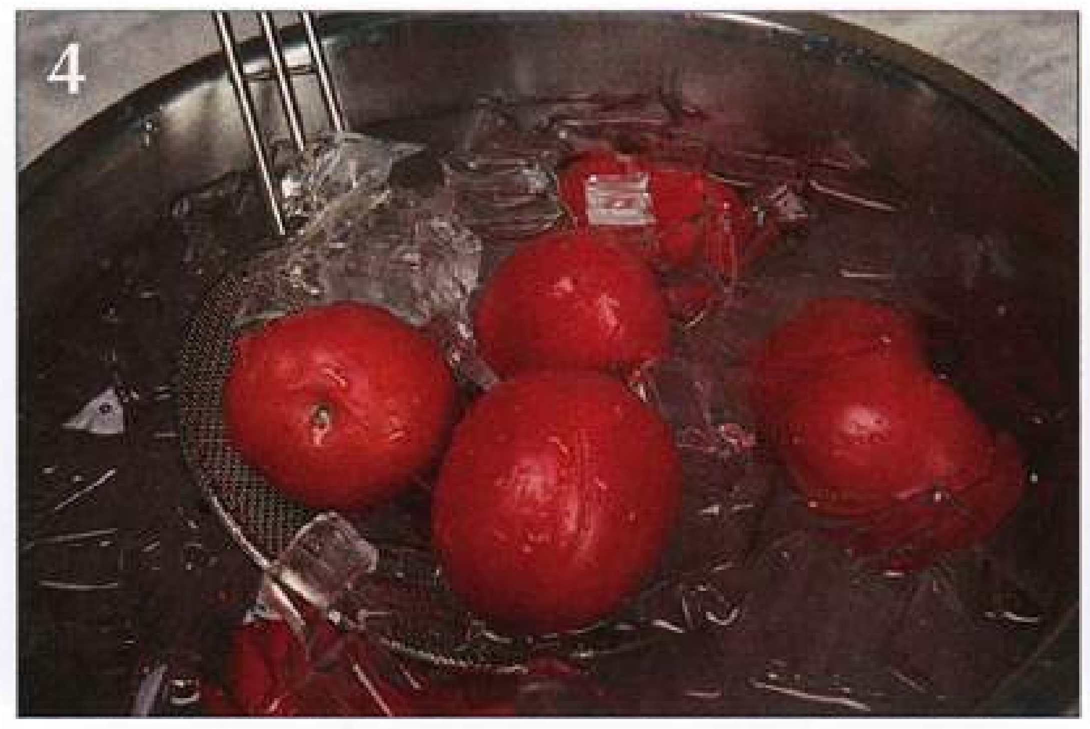
If you are using volume measures, refer to the table on common can sizes on page 222.

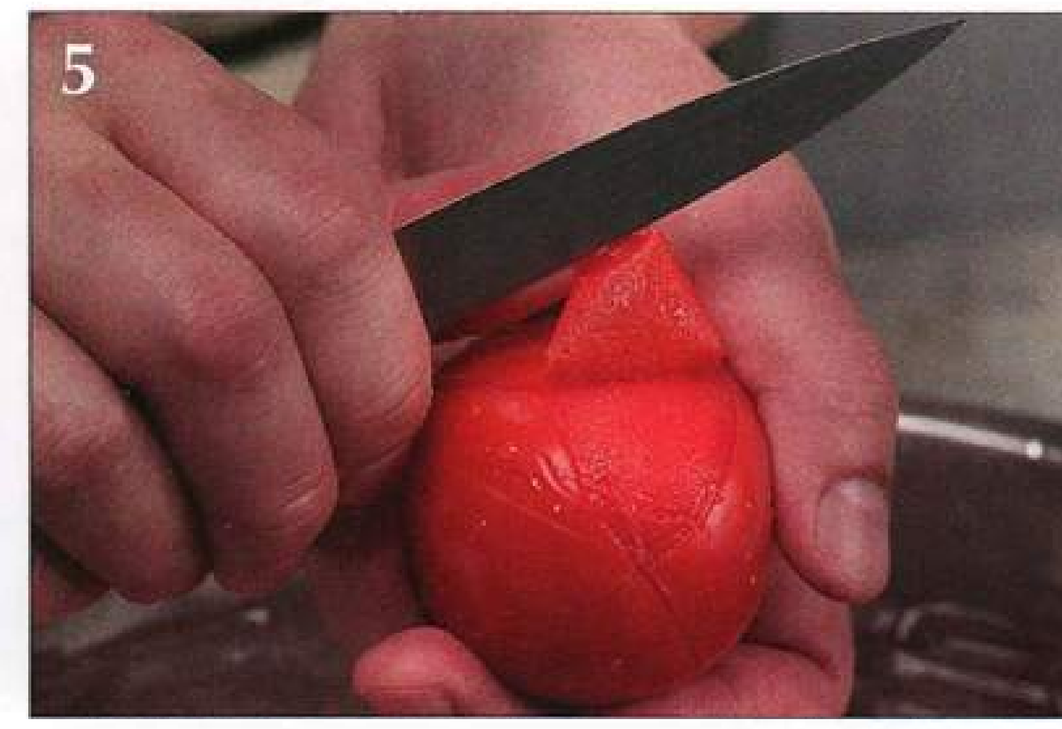


HOW TO Concasse Tomatoes

Tomato concasse is a method commonly used in professional kitchens to remove the skins from tomatoes. You score the bottom of the tomato in order to create a place to grab the peel and easily remove it. Some chefs opt not to score the tomato with an X because you can also peel the tomato from the core end.







1 Cut an X on the bottom of the tomato.

2 Bring a pot of water to a boil and have a bowl of ice water ready. The ice bath should contain equal parts ice and water and be large enough to fit all the tomatoes.

3 Drop the tomatoes carefully into the boiling water and leave in the water for 10 s.

4 Drop them into the ice bath to stop the cooking.

5 Once cool enough to handle, peel off the skin.

6 If using large tomatoes, cut them in quarters. For smaller tomatoes, cut them in half. Removing the seeds is entirely up to you; we like the seeds in there, so we keep them.

MODERNIST NEAPOLITAN PIZZA TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Canned whole peeled tomatoes	800 g	One 28 oz can	100
Fine salt	8 g	1½ tsp	1
Xanthan gum	0.5 g	¼ tsp + 1/16 tsp*	0.1

**You can approximate the 1/16 tsp of xanthan gum by measuring 1/8 tsp and dividing it into two equal parts. Use one part to make the sauce.*

TOTAL TIME	YIELD
Active 5 min / Inactive 12 h	~800 g

For more on purified ingredients, see page 1:323.

PROCEDURE

1 Use any of the methods outlined on page 224 to combine the tomatoes and salt to make the sauce base.

2 Place 160 g (½ cup) of the sauce in a small bowl.

3 Sprinkle the xanthan gum slowly over the sauce while blending with an immersion blender.

4 Whisk in the rest of the sauce to combine.

5 Allow to hydrate overnight in refrigeration.

6 Adjust seasoning if necessary.

7 Store for up to 4 d in refrigeration. Do not freeze.

The yield on this sauce will use up an entire 800 g (28 oz/#2.5) can of tomatoes. If you are using a 2.89–3 kg (102–106 oz/#10 can), divide the gram weight of your can of tomatoes by 800 and then multiply that number by the weight of the other ingredients in the recipe.

Modernist Neapolitan pizza

NEW YORK / ARTISAN PIZZA TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Canned whole peeled or crushed tomatoes	800 g	One 28 oz can	100
White onion, small dice	55 g	⅓ cup	6.88
Dried oregano	2 g	2 tsp	0.25
Extra-virgin olive oil	15 g	1 Tbsp + ¼ tsp	1.88
Anchovy oil* or canola oil	15 g	1 Tbsp + ¼ tsp	1.88
Garlic cloves, minced	14 g	2 ea	1.75
Fresh tomato leaves or basil leaves	5 g	~7 ea	0.63
Fine salt	5 g	¾ tsp + ⅛ tsp	0.63
MSG**, optional	3.2 g	¾ tsp	0.4

**The oil comes from canned anchovies.*

***The MSG is optional, but we found the savory notes that it adds work well for this sauce.*

TOTAL TIME	YIELD
Active 10-15 min / Inactive 30-35 min	~500 g

This sauce has the characteristic canned tomato flavor that you expect on a classic New York slice. We recommend using this sauce for New York pizzas as well as Trenton tomato pies (see page 1:104).

Tomato leaves in small amounts can provide a very intense tomato taste. Some people believe that they are poisonous, but we can assure you that they are not.

PROCEDURE

1. Pass the tomatoes through a food mill.
2. Sweat the onion and oregano in the olive and anchovy oil in a medium saucepot over medium heat until translucent and fragrant, about 1 min.
3. Add the garlic, and cook, stirring constantly, until aromatic, about 2 min.
4. Add the tomatoes, tomato or basil leaves, salt, and MSG.
5. Bring to a simmer, then turn the heat down to low.
6. Reduce, stirring every few minutes, until the sauce is thick, about 30 min. The sauce should bubble ever so slightly on the surface. You should have a little more than half of what you started with in the pot.
7. Adjust the seasoning if necessary. Remove the tomato or basil leaves. Cool to room temperature over an ice bath.
8. Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

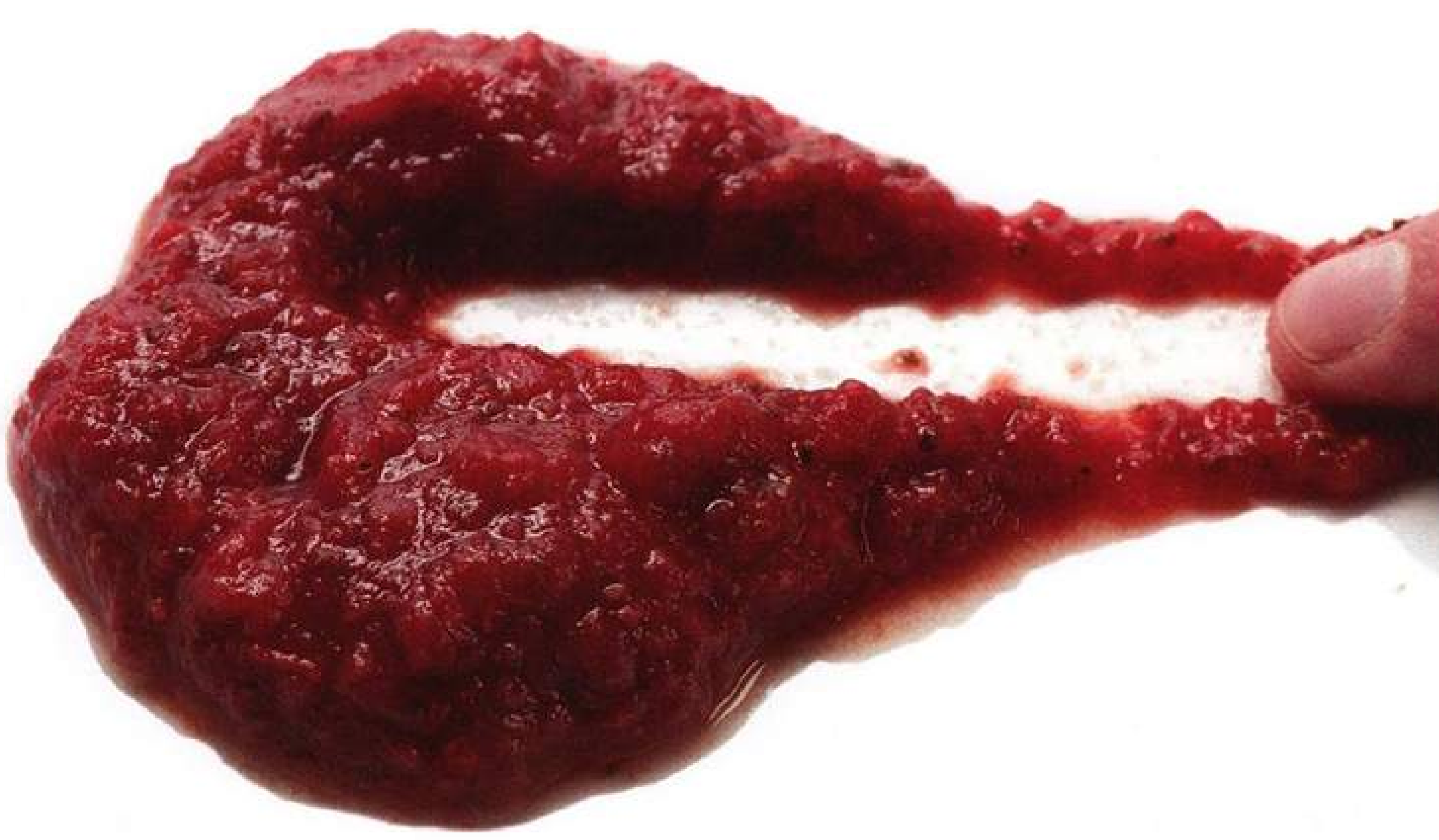
MODERNIST NEW YORK/ARTISAN PIZZA TOMATO SAUCE

If you're in a hurry, you can thicken the sauce with xanthan gum instead of reducing it. Make the sauce up through step 5 and season it. Once you have a sauce base that tastes good, place about one-quarter of the sauce in a small bowl. Sprinkle 0.2% xanthan gum slowly over the sauce while blending with an immersion blender. Whisk in the rest of the sauce to combine. Proceed with steps 7 and 8. We recommend allowing the sauce to hydrate overnight.

AMATRICIANA SAUCE

For step 2 of the New York / Artisan Pizza Tomato Sauce, sauté 115 g chopped guanciale in the olive and anchovy oil in a medium saucepot until crisp and golden brown, about 4 min. Add 2 g (½ tsp) red pepper flakes and 2 g (½ tsp) ground black pepper. Stir for 10 s. Add the onion and oregano and sweat until translucent and fragrant, about 1 min. Continue with the remaining steps in the recipe.

Our umami-rich amatriciana sauce has so much flavor that you don't need to add much else to the pizza, which is part of why we like it so much. In fact, the sauce could overwhelm certain toppings if their flavors are nuanced, so we recommend just adding cheese when you are making pizza with this sauce. You can use chopped pancetta or bacon instead of the guanciale, if desired.



To test the sauce consistency, place a spoonful of sauce on a cool plate. Allow the sauce to cool, then run your finger through it. The sauce should hold your finger swipe.

SPICY TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Deep-Dish Pizza Tomato Sauce see page 225	500 g	2 cups	100
Cayenne pepper	2.5 g	1 tsp	0.5
Crushed red pepper flakes	0.5 g	¼ tsp	0.1

TOTAL TIME	YIELD
Active 1-2 min	~500 g

PROCEDURE

1 Puree the tomato sauce, cayenne, and red pepper flakes until smooth using an immersion blender.

2 Adjust the seasoning if necessary.

3 Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

STRAWBERRY MARINARA SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Frozen strawberries, thawed	450 g	2 cups	100
Canned diced tomatoes	190 g	¾ cup	42.22
Sweet onion, finely minced	100 g	½ cup + 2 Tbsp	22.22
Dry white wine	100 g	⅓ cup + 2 Tbsp	22.22
Garlic, thinly sliced	3 g	1 tsp	0.67
Fresh basil leaves, torn	2 g	2¼ tsp	0.44
Fine salt	as needed		

TOTAL TIME	YIELD
Active 5 min / Inactive 25-30 min	~500 g

This bright-red sauce looks remarkably like marinara—after all, tomatoes and strawberries are both acidic red berries. We also recommend using fresh pears or pressure-cooked quince instead of the strawberries.

PROCEDURE

1 Pulse the strawberries in a food processor until chunky.

2 Combine the tomatoes, onion, white wine, garlic, basil, and strawberries in a pot (see note), and bring to a boil.

3 Reduce the heat to low, and simmer until thick, 25–30 min.

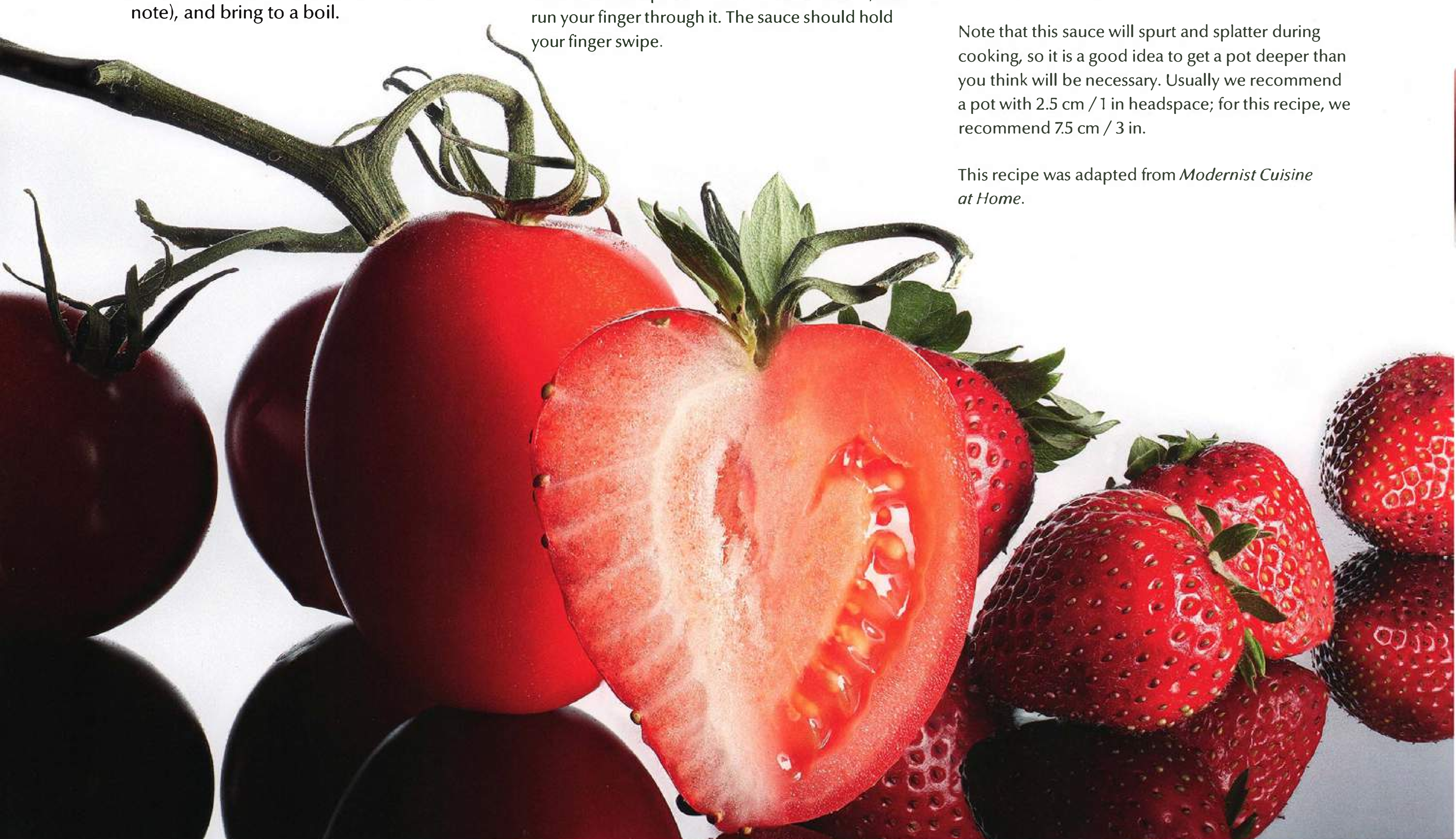
To test the sauce consistency, place a spoonful of sauce on a cool plate. Allow the sauce to cool, then run your finger through it. The sauce should hold your finger swipe.

4 Season with 1% salt by weight or as needed. Cool to room temperature over an ice bath.

5 Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

Note that this sauce will spurt and splatter during cooking, so it is a good idea to get a pot deeper than you think will be necessary. Usually we recommend a pot with 2.5 cm / 1 in headspace; for this recipe, we recommend 7.5 cm / 3 in.

This recipe was adapted from *Modernist Cuisine at Home*.



SPICY VODKA SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
New York / Artisan Pizza Tomato Sauce see page 227	425 g	1¾ cups	100
Heavy cream	50 g	3½ Tbsp	11.76
Vodka	25 g	1 Tbsp + 2 tsp	5.88
Cayenne pepper	2.5 g	1 tsp	0.59
Fine salt	as needed		

TOTAL TIME	YIELD
Active 5 min / Inactive 20–25 min	~500 g

PROCEDURE

1 Combine the tomato sauce, cream, and vodka in a small saucepot, and bring to a boil, stirring occasionally.

2 Reduce the heat to low, and simmer for 20 min, stirring occasionally.

3 Remove from the heat, and add the cayenne and salt.

4 Adjust the seasoning if necessary. Cool to room temperature over an ice bath.

5 Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

TOMATO AND MUSTARD SAUCE

INSPIRED BY PAPA'S TOMATO PIES

INGREDIENTS	WEIGHT	VOLUME	SCALING %
New York / Artisan Pizza Tomato Sauce see page 227	500 g	2 cups + 1 Tbsp	100
Mustard (Dijon or whole grain)	100 g	¼ cup + 2 Tbsp	20
Fine salt	as needed		

TOTAL TIME	YIELD
Active 1–2 min	~600 g

PROCEDURE

1 Whisk the ingredients in a bowl.

2 Adjust the seasoning and mustard amount if necessary.

3 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

WHITE TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Heavy cream	500 g	2 cups + 2 Tbsp	200
Canned whole peeled yellow tomatoes, liquid drained	250 g	2 cups	100
Garlic clove, thinly sliced	7 g	1 ea	2.8
Fresh basil leaves	5 g	6–7 ea	2
Fine salt	5 g	¾ tsp + ⅛ tsp	2

TOTAL TIME	YIELD
Active 10 min / Inactive 12 h	~500 g

This tomato sauce sounds nontraditional, but the pale-yellow, creamy, slightly acidic sauce ended up being one of our favorite tomato sauces in the chapter (though they are all delicious).

PROCEDURE

1 Combine the cream, tomatoes, garlic, basil, and salt in a vacuum sealable bag.

2 Pull an 80% vacuum.

3 Allow to sit overnight in refrigeration. Storing it longer won't adversely affect it.

4 Transfer the sauce to a fine-mesh sieve set over a bowl. Do not press the mixture in the sieve to force the liquid through. Tap the sieve to get as much liquid to pass through as possible.

5 If using immediately, leave at room temperature to temper for up to 3 h.

6 Store for up to 3 d in refrigeration. Do not freeze.

We recommend using this sauce for Neapolitan pizzas. For a thicker sauce that can be used on New York or artisan pizza as well as on Neapolitan, use mascarpone instead of heavy cream. Once you pull the vacuum, you will need to massage the bag to make sure all the ingredients combine well. Because this sauce is thicker, you will not be able to pass it through a fine-mesh sieve. Use it as is but be sure to remove the solid ingredients.

FERMENTED TOMATO SAUCE

INSPIRED BY SARAH MINNICK

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Cherry tomatoes, cut in half	250 g	1⅔ cups	50
Plum tomatoes, cut into 1.25 cm / ½ in pieces	250 g	1⅓ cups	50
Fine salt	7.5 g	1½ tsp	1.5
Instant dry yeast	0.5 g	⅛ tsp	0.1

TOTAL TIME	YIELD
Active 10 min / Inactive 8 d	~500 g

PROCEDURE

1 Mix the tomatoes, salt, and yeast together thoroughly.

2 Place the tomatoes in a jar that has a matching lid and airlock.

3 Using a ceramic dish that fits inside the jar, weigh down the tomatoes until they are submerged. It may take 10–15 min for the tomatoes to release their liquid.

4 Screw on the lid and airlock. Fill the airlock with water up to the fill line.

5 Wrap the jar in aluminum foil to block out any light. Keep at room temperature for 1 d.

6 Unwrap the jar. Ferment for 1 wk in refrigeration.

7 Remove the tomatoes from the jar and hand-crush them. Adjust the seasoning if necessary.

8 Store for 3 d in refrigeration. Freeze for up to 3 mo.

We bought this wide-mouth jar with a fermentation airlock at a brewery store. We recommend something that has a wide mouth so that you can clean it easily. A standard carboy setup would be difficult to wash (and to get the tomato sauce out of). The ceramic weight is necessary to keep the tomatoes submerged so that they don't mold. We learned this the hard way with our first couple batches.

Although this takes some time to make, the wait is well worth it. The tomato flavor intensifies significantly during the fermentation process. This method is especially useful for tomatoes that are not at their peak.

The airlock should fit snugly in the lid. Fill the airlock halfway with water to allow gas bubbles to flow through it and escape as the tomato sauce ferments.

SLOW-ROASTED TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Plum tomatoes	650 g	10–12 ea	100
Olive oil	as needed		
Fine salt	as needed		

TOTAL TIME	YIELD
Active 10–15 min / Inactive 2½ h	~500 g

PROCEDURE

1 Concasse the tomatoes (see page 226). Cut the tomatoes in half.

2 Preheat a still oven to 150° C / 300° F. Lightly oil a wire rack and place it over a sheet pan lined with aluminum foil.

3 Place the tomatoes cut side down on the prepared rack and spray them with a light coat of olive oil. Turn them over so the cut side is up and spray them again with a light coat of olive oil.

4 Roast for 2 h, or until they look wrinkled, similar to a sun-dried tomato.

5 Allow them to cool. Pass through a food mill and then season with 1% salt by weight or as needed.

6 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

It's fairly common throughout the year to find tomatoes that aren't at their peak ripeness, especially at the grocery store. (The restaurant supplier is also bringing you whatever tomatoes they got in that day.) What makes for a bad tomato? One that is hard, pale, and flavorless. The good news is that you can instead use canned tomatoes (they are canned at their ripest). Or, if you insist on using fresh tomatoes, you can slow-roast them. Slow roasting will evaporate a good amount of their moisture, concentrate their flavor, and make them sweeter. This is a good method for bad tomatoes, but it works well for good ones too.

This method works at widely different temperatures to give you different results. Roasting at 60–77° C / 140–170° F (what a food dehydrator or a very slow oven would be) will give you a concentrated tomato flavor. Turning the temperature up to 288° C / 550° F and roasting the tomatoes with the skin side up will give a very different flavor. It's up to you if you want to remove the blackened skins before passing through the food mill.

You can buy olive oil in a spray can that will produce a light and even mist of oil on the tomatoes. Or you can toss the tomatoes in olive oil, but we find that this makes the seeds separate from the flesh of the tomato.

IMPROVING TOMATO SAUCE

Many pizzaioli use sauce as a synonym for tomatoes. The strength of the sauce rests on the quality of the tomatoes. But chefs approach sauce differently, adjusting flavors and playing with balance by adding other ingredients. These approaches are two different philosophies of cooking. You can see this dichotomy when you compare Neapolitan pizza makers and Neapolitan pasta chefs. A pizza maker will open a can of tomatoes, crush them, and they're ready for use. Chefs will make complicated sauces with extensive ingredient lists. This divergent philosophy is compounded by the fact that you don't always get the best ingredients. One philosophy would say that a chef should intervene to maintain consistency by adding salt, sugar, or acids to adjust the sauce. A purist might say to get the very best tomatoes and don't worry about it. But the latter stance only works insofar as canned tomatoes because you can't get flavorful fresh tomatoes year-round. This attitude might seem strange to a chef who is only used to working with fresh ingredients.

Tomato sauce always has some general characteristics: acid, sweetness, and umami (or savoriness). These characteristics can be bumped up, or, depending on the application, used to correct a flaw or enhance flavors to get a particular result. You can view it as adjusting to improve a sauce that isn't perfect, or you can view it as a chance to make your own creation.

Even though tomatoes have a good amount of naturally occurring umami in them, they can be lacking in flavor especially if they are grown out of season or were harvested when they were not quite ripe. We typically recommend that you season your sauce with salt and/or dried oregano, but you can also attain some complex flavor profiles by adding other flavorings.

Add the following (either on their own or in combination; if using in combination, don't use as much as we recommend as a single addition). For example, if there are two additions, divide the amount for each by two; if there are three additions, divide each by three; and so on.

For more on aromatic vegetables and other ingredients that you can add to tomato sauce (including xanthan gum, which functions as a quick thickener), see page 227.

INGREDIENTS	AMOUNT	NOTES
Acidic ingredients		
Vinegar (white, champagne, red wine, white wine, and/or balsamic)	1%–2%	Most tomato sauces are somewhat acidic, but sometimes they can be flat. Use these ingredients to liven up your tomato sauce (adding salt helps too).
Lime juice		
Lemon juice		
Umami ingredients		
MSG	0.4%–0.6%	There is a stigma surrounding MSG that it's unsafe, but we can assure you that this is false. In fact, MSG is one of the principle ingredients in tomatoes.
Anchovy oil	1.5%–2.5%	The more you add, the more anchovy-like the sauce will get. Whether that is a good or bad thing is up to you (or your customer).
Mushroom powder	1%–2%	We recommend using either shiitake or porcini mushroom powder. You won't necessarily taste the mushrooms, but they will contribute a savory note.
Soy sauce	0.5-1%	These sauces have powerful flavors that can overwhelm the tomato sauce rather than just enhance it. Use these sauces sparingly.
Worcestershire sauce	2%–3%	
Fish sauce		
Tomato enhancement		
Tomato leaves	7–8 ea per kilo of sauce	Stir into the sauce and allow to sit for at least 3–4 h to flavor.
Tomato paste	8%–10%	Even the smallest tomato paste can is typically too much for most preparations. Use what you need and freeze the rest flat in a zip-top bag so that you can break off pieces of it as you need it.
Freeze-dried tomatoes	3%–4%	If you cannot find freeze-dried tomatoes, use sun-dried tomatoes, which have a slightly different taste and texture but will add the desired tomato flavor.
Sweetening ingredients		
Sugar	1%–4%	This range is wide because it is up to you how much to use, whether you want to sweeten the sauce or to tame its acidity. Add 1 g (¼ tsp) at a time and taste after each addition until it has the level of sweetness you are looking for. Liquid sugars, such as the agave syrup or honey, will disperse faster into the sauce. Hot honey has a little bit of a spicy kick to it, so be sure to take that into account when you are adding it.
Agave syrup		
Honey or hot honey		
Complementary flavors		
A.1. steak sauce	as needed	While you don't necessarily want the pizza sauce to taste like steak sauce, A.1. and other steak sauces have flavoring ingredients that work really well with pizza sauce, such as vinegar, tomato puree, garlic, onions, and celery seed.
Fresh basil leaves	5–6 ea per kilo of sauce	Stir into the sauce and allow to sit for at least 3–4 h to flavor.
Spicy ingredients (crushed red pepper flakes, commercial hot sauces, fresh chilis, dried chilis, chipotle peppers, cayenne, yuzu kosho, gochujang, sriracha)	as needed	A little bit of spiciness can really round out a tomato sauce very nicely but be careful with how much you add, depending on who you are making pizza for. Our Spicy Tomato Sauce on page 228 is a great example of a spicy sauce that works on pizza.

MIX-AND-MATCH TOMATO SAUCE

Use the table below to combine different options of fresh tomatoes and tomato products to obtain different outcomes for flavor and texture.

<table>
<tr><th>Tomato type</th><th>Taste / texture</th><th>Process</th><th>Recommended combinations</th></tr>
<tr><td>Grape tomatoes</td><td>These range in flavor from sweet to tangy. They have a good sugar-to-acid balance and are juicy.</td><td rowspan="2">Leave as is (no need to core; do not attempt to peel) and use them raw in tomato sauce.
Slow-roast them.
Char them.</td><td rowspan="2">Green beefsteak tomatoes
Canned whole peeled tomatoes
Add to Classic Neapolitan Pizza Tomato Sauce (see page 225)
Raw Tomato Sauce (see page 237)</td></tr>
<tr><td>Cherry tomatoes</td><td>These are very sweet and juicy.</td></tr>
<tr><td>Red beefsteak tomatoes</td><td>These are juicy and have the most common raw tomato flavor, which is mild.</td><td>Remove the stem and core and use them raw in tomato sauce.
Cut into quarters and slow-roast (see page 231) or char them (see page 363).</td><td>Grape and cherry tomatoes
Green beefsteak tomatoes
Use instead of canned whole peeled tomatoes in Quick New York Pizza Tomato Sauce (see page 225).
Canned whole peeled tomatoes</td></tr>
<tr><td>Green beefsteak tomatoes</td><td>These are very tart.</td><td>Slow-roast them (see page 231).</td><td>If slow-roasted, they are very good on their own as a sauce.</td></tr>
<tr><td>Cocktail tomatoes</td><td>They are similar to red beefsteak tomatoes but a little sweeter. Their aroma is very similar to that of the tomato leaf. They have very few seeds, which to some is a positive attribute.</td><td>Remove the stem and core, peel using the concasse method (see page 226), and use them in raw tomato sauce.
Slow-roast them (see page 231).
Roast them.</td><td rowspan="2">Use instead of canned whole peeled tomatoes in Quick New York Pizza Tomato Sauce (see page 225).
Deep-Dish Pizza Tomato Sauce (see page 225)
Raw Tomato Sauce (see page 237)</td></tr>
<tr><td>Tomatoes on the vine</td><td>These are herbaceous and sweet. They taste a lot like the leaves on the vine.</td><td>Remove the stem and core, peel using the concasse method (see page 226), and use them in raw tomato sauce.
Slow-roast them (see page 231).</td></tr>
<tr><td>Plum tomatoes</td><td>These are workhorse tomatoes that are used in many applications. They have a good balance of sweet and tangy flavors.</td><td>Remove the stem and core, peel using the concasse method (see page 226), and use them in raw tomato sauce.
Slow-roast them (see page 231).</td><td>Green beefsteak tomatoes and cherry tomatoes
Canned whole peeled tomatoes
Use instead of canned whole peeled tomatoes in Classic Neapolitan Pizza Tomato Sauce (see page 225).
Use instead of canned whole peeled tomatoes in Quick New York Pizza Tomato Sauce (see page 225).</td></tr>
<tr><td>Heirloom tomatoes
• Brandywine
• Early Girl
• Green Zebra
• Cherokee Purple
• Black Krim
• Green Giant</td><td>Some say these are the best-tasting tomatoes that exist. They are sweet to tangy with great depth of flavor.</td><td>Remove the stem and core, peel using the concasse method (see page 226), and use them in raw tomato sauce.</td><td>Raw Tomato Sauce (see page 237)</td></tr>
</table>

All tomatoes come from a vine, but in many grocery stores you can buy tomatoes that are midsized and almost perfectly round, attached to a vine with six to eight tomatoes per vine.

If by chance you have access to fresh San Marzano tomatoes or a relative of these medium-sized tomatoes, you can use them in the same way as plum tomatoes.

There are many varieties of heirloom tomatoes; what they have in common is that they are mostly available just during tomato season (late summer). They are prized for their flavor, which is best appreciated when the tomato is of course ripe, but also raw. Cooking them is not the worst thing to do, but a lot of the nuances of their fresh flavor get lost. These varieties also tend to be very juicy and have a thin viscosity, so additional cooking or thickening agents (such as tomato paste or xanthan gum) may be necessary to reach the proper sauce consistency.

ROTAVAP TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Fresh plum tomatoes	1 kg	8–9 ea	100
Fine salt	as needed		

TOTAL TIME	YIELD
Active 25 min / Inactive 1½ h	~500 g

PROCEDURE

1. Concasse the tomatoes (see page 226).
2. Cut the tomatoes in half. Remove the seeds but reserve them.
3. Crush the tomatoes with your hands.
4. Place the crushed tomatoes in a rotary evaporator. Set the water bath temperature to 45° C / 113° F.

Granted, you need a rotary evaporator to make this sauce. But this method concentrates the flavor of tomatoes without adding a cooked tomato flavor. The tomatoes don't necessarily have to be ripe to get good results.

5. Turn on the vacuum pump, and begin rotating at medium speed.
6. Allow the rotavap to run for 1½ h, or until the tomato pulp starts to look thick and clings to the sides of the bowl.

While most of the tomato flavor resides in the parenchyma gel surrounding the seeds, they develop unpleasant flavors when they are treated under a vacuum. That's why we add them to the sauce at the end.

7. Turn off the rotavap. Remove the pulp, and mix in the tomato seeds. Weigh the resulting sauce, and add 1% salt by weight or as needed.
8. Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

The resulting liquid that comes out on the other side of the rotating bowl is not very good. Discard it.

Add this sauce after the pizza is baked to maintain its fresh, concentrated tomato flavor. The whole point is to apply very little heat to the tomatoes.

WATER BATH VARIATION

If you don't have a rotavap, follow these steps to make this sauce. This method yields about 300 g (2 cups).

1. Follow steps 1–3 of the Rotavap Tomato Sauce, above, but discard the seeds.
2. Preheat a water bath to 45° C / 113° F.
3. Place the crushed tomatoes into a plastic bag and clip the bag to the side of the water bath with the top of the bag open.
4. Cook the sauce for 6 h, stirring intermittently.
5. Put the sauce in a fine-mesh sieve lined with cheesecloth that has been placed over a bowl or plastic tub. Drain for 12 h or overnight. Reserve the drained liquid.
6. Weigh the resulting sauce, and add 1% salt by weight or as needed. Adjust the consistency of the sauce with the reserved liquid if necessary.
7. Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

RAW CHERRY TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Cherry tomatoes	450 g	3 cups	100
Extra-virgin olive oil	35 g	2½ Tbsp	7.78
Sugar	10 g	2½ tsp	2.22
Fine salt	5 g	¾ tsp + ⅛ tsp	1.11
Fresh basil leaves, optional	5 g	6–7 ea	1.11

TOTAL TIME	YIELD
Active 5 min	~500 g

Mid- to late-summer tomatoes are best. You can use other tomato varieties as long as they are very ripe. You can also combine different-color tomatoes for a different flavor and visual effect on the pizza.

PROCEDURE

1 Combine the tomatoes, olive oil, sugar, salt, and basil in a bowl.

2 Crush with your hands until the tomatoes are completely broken up.

3 Reserve at room temperature for up to 2 h. Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

Cherry tomatoes and grape tomatoes are generally regarded as a salad ingredient. They are sweeter than larger tomato varieties and have a Brix content of 6–9 (compared to 4.5–6 in processing varieties). The varieties that have been selected and hybridized over the years contribute to these qualities. Growers pick cherry tomatoes at a more mature stage since the skins are tougher and they can withstand the transportation to stores.

RAW TOMATO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Ripe tomatoes	600 g	varies	100
Fine salt	5 g	¾ tsp + ⅛ tsp	0.83

TOTAL TIME	YIELD
Active 5–10 min	~500 g

PROCEDURE

1 Remove the stems and cores of the tomatoes with a paring knife.

2 Pass the tomatoes through a food mill with a grinding disc attachment large enough to let the seeds pass through easily.

3 Season with the salt and/or other flavorings (see page 232).

4 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

For a fresh tomato sauce to work, you need to get tomatoes at their peak of ripeness during their season, normally late summer. When tomatoes are ripe, very little needs to be done or added to them since their flavor speaks for itself.

As an optional step, you can peel the tomatoes using the concasse method (see page 226).

If the sauce is too wet or loose for you, transfer it to a fine-mesh sieve set over a bowl and allow it to drain. The drained water can be used for other purposes, including using it to thin the sauce later if needed. Just stir some back in. Test for seasoning again.

Many sources do not recommend refrigerating raw tomatoes in any form because they lose flavor (volatile aromatic compounds) and their texture changes. Do not fret! You have already changed the texture by passing them through the mill. They won't change much texturally after this point. When you bring the tomatoes back up to temperature, the flavor returns to normal.

The volume of the tomatoes will vary depending on type of tomato and size. Per kilogram, you might get six to seven large beefsteak tomatoes, eight to nine plum tomatoes, or two to three pints of small cherry or grape tomatoes.

For more on types of tomatoes and their flavor, see our Mix-and-Match Tomato Sauce guide on page 235.

If the tomatoes are too dry to be saucy, add a little bit of tomato water, tomato juice, or water to adjust the consistency of the sauce.

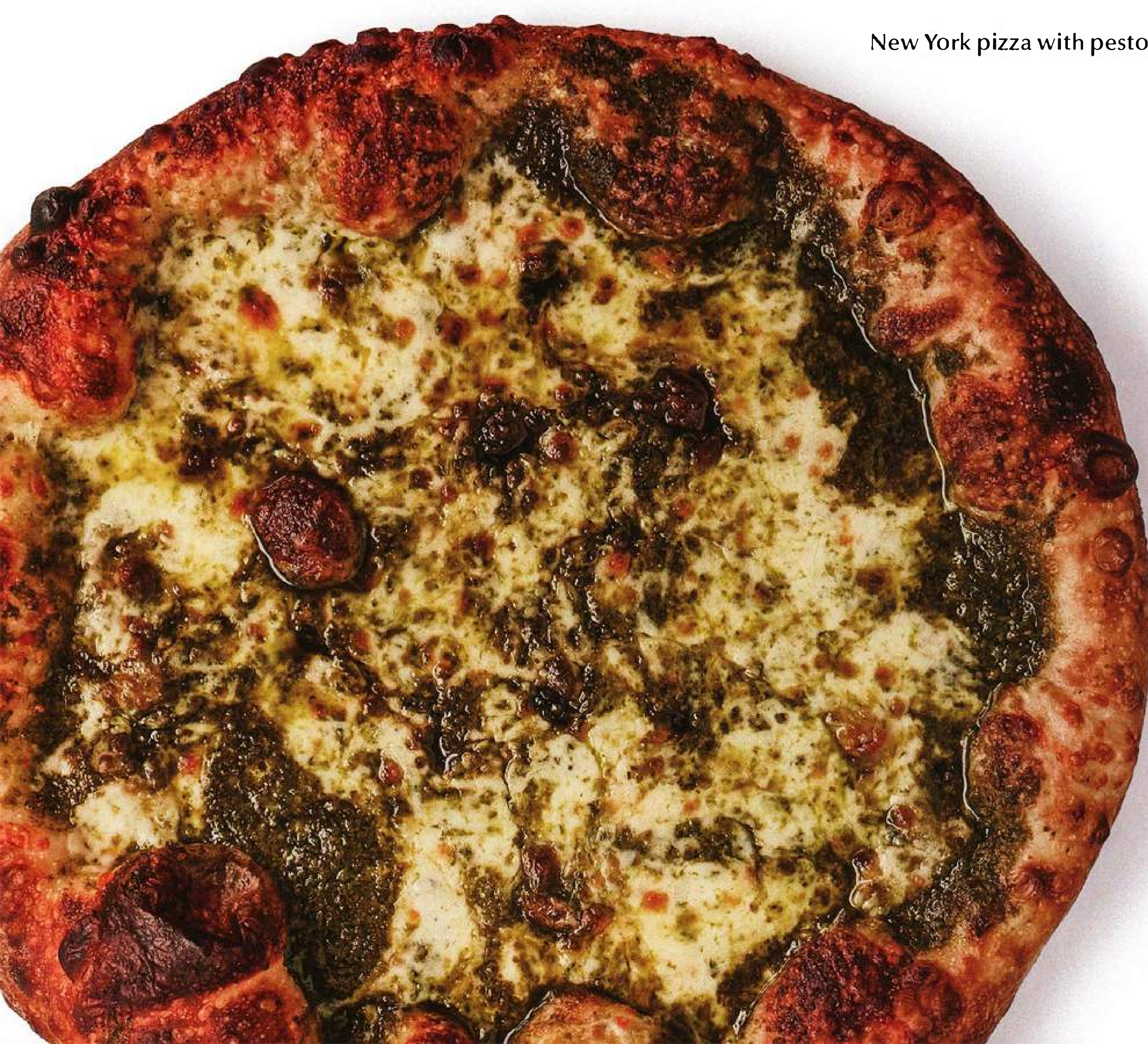
PARAMETRIC RECIPE

BEST BETS FOR PESTO

Pesto is one of the top three sauces used on pizzas. The combinations of herbs, nuts, and oil that you can blend together are virtually endless. A traditional pesto is made with a mortar and pestle. You can make it that way if you're inclined, but a countertop or immersion blender works great, as does a food processor. The classic pesto Genovese recipe is made with basil. Other herbs can work well, but drier ones such as rosemary and thyme may be too hard to puree into a paste. Try to combine these hard herbs with softer ones, which will help produce a smoother puree.

Type	Herb	Scaling %	Garlic	Scaling %	Cheese	Scaling %
Basil pesto	Fresh basil	50	Garlic cloves, peeled and blanched	15	Parmigiano-Reggiano and Pecorino Romano, grated	100
Parsley pesto	Fresh flat-leaf parsley	50	Garlic cloves, peeled and blanched	12	Pecorino Romano, grated	90
Fines herbes pesto	Mixture of fresh chervil, chives, tarragon, and flat-leaf parsley	60	n/a		Mimolette, grated	100
Leek pesto	Leeks, blanched	65	n/a		Comté, grated	75
Arugula pesto	Arugula	50	n/a		Stilton	70
Spinach pesto	Baby spinach, blanched	75	n/a		Paneer	50
Shiso pesto	Shiso leaf	50	Black garlic cloves, peeled	10	Firm tofu*	100

**Although this isn't a cheese, it provides the same structural component as the cheese in the pesto.*



New York pizza with pesto

Parsley pesto

Shiso pesto Spinach pesto Basil pesto

Nuts	Scaling %	Oil	Scaling %	Other	Scaling %
Pine nuts, toasted	15	Olive oil	100	Fine salt	1
Hazelnuts, toasted	25	Chili oil	100	Fine salt	1
Almonds, toasted	20	Canola oil	100	Fine salt	1
Walnuts, untoasted	25	Lemon olive oil	100	Fine salt	1
Macadamia nuts, untoasted	30	Extra-virgin olive oil	100	Fine salt	1
Cashews, toasted	20	Curry-Infused Oil see page 382	100	Fine salt	1
Sesame seeds, toasted	15	Toasted sesame oil mixed with canola oil	100	Fine salt	1

Arugula pesto Leek pesto Fines herbes pesto

HOW TO Make Pesto

1 Combine all of the ingredients in a blender, and blend until you obtain a smooth paste.

2 Use right away, or cover with plastic wrap pressed directly over the surface. This can help slow down oxidation, as the pesto will begin to turn brown.

3 Store for up to 3 d in refrigeration. Freeze for up to 3 mo. Bring up to room temperature at least 2 h before spooning onto baked pizza.

HOW TO Stabilize a Pesto

If you want to keep the oil in the pesto from separating, the solution is to add an emulsifier, such as propylene glycol alginate (PGA). The problem is that in order for it to work, it needs to be dispersed in water and heated to 80 °C / 176 °F to be activated. Calculate 10% of it for the water amount and 0.5% for the PGA amount. This might be a very small amount of water. If this is the case, you can make a larger batch of the PGA water, and then weigh 10.5%.

1 Sprinkle the PGA over the water while blending with an immersion blender to disperse it evenly.

2 Bring the liquid up to 80 °C / 176 °F, and keep it at that temperature for 3 min, whisking occasionally.

3 Allow to cool down completely. If you made a larger batch, weigh the 10.5% you will need. Blend it into the pesto using an immersion blender.

An alternative method is to use 0.5% gum tragacanth plus 0.2% xanthan gum instead of 0.5% PGA. For these ingredients, you need only to disperse them in the 10% cold water; they do not need to be heated at all. Sprinkle them into the water while you blend with an immersion blender. Allow the ingredients to hydrate for 1 h, and then blend into the pesto.

For more on purified ingredients, see page 1:323.

Basil pesto is a popular sauce alternative to the typical tomato sauce or white sauces. You can use it as a finishing sauce as well as a sauce base.

The marinara sbagliata, from 10 Diego Vitagliano Pizzeria in Naples, Italy, uses a striking spiral pattern made with San Marzano tomato sauce and oregano pesto.

THICKENING SAUCES

Tomato skins are sometimes used as sauce thickeners, but they are first dehydrated and pulverized and then stirred into the sauce; 3% of the weight of the sauce in powdered tomato peels is recommended.

Most canned tomato products are made to meet consistency standards first and Brix standards second. Some producers can reach the proper balance between consistency and Brix without adding sugars or thickeners. They can do so by selecting proper varieties and managing incoming tomato Brix, processing temperatures, and cooking times.

When baking the tomato sauce on a Neapolitan pizza, it is important to evaporate enough moisture so that it is not soupy but not as dry as the tomato sauce shown on the pizza above. It may look different on your pizza depending on the toppings that you are using.

When it comes to thickening sauces, we feel it's essential to know the best way to thicken the sauce, but also to understand why certain agents do not work. We tested several different thickeners, from traditional options such as starches, pectin, and hydrocolloids, to eggs and tomato powder. Although most did thicken our sauces, not all were texturally pleasing or appetizing once they were baked on a pizza. One of the major flaws of some of the tested thickeners was that they made the sauce excessively gummy. Not what you want on your pizza. This was most common with starches, pectin, and hydrocolloids, even when used in small amounts. The exception we found was that a small amount of xanthan gum (0.1%) is best at thickening tomato sauces for Neapolitan and New York pizzas (see next page).

SAUCE CONSISTENCY

Two things are key when you make your pizza sauce: flavor and texture. A good sauce needs both to work. Let's take a closer look at the physical aspect of your sauce: its consistency.

Why is consistency so important, and what should it be for optimal pizza baking? We baked several 30 cm / 12 in marinara pizzas sauced with 180 g of differently diluted sauces and recorded the results. Not surprisingly, our thickest sauce—made from pure tomato solids—completely dried out during baking, forming a skin that detached from the pizza (see photo at left).

On the opposite end of the spectrum, our thinnest sauce—prepared by diluting tomato solids with tomato water (1:2.5)—was light in color, clearly soupy, and undercooked. For marinara sauce, a 1:1.5 solid-to-liquid ratio works best because it provides just enough evaporation for an optimal consistency after 1 minute of baking. When baked according to our master recipe, the 1:1.5 dilution ratio works best, but this thickness might need adjustment depending on how much sauce you put on the pizza (for 180 g, it works very well).

If your sauce is watery once your pizza is baked, should you just carry on with the baking until it concentrates? While you can extend the baking time in some cases, you have to make sure the crust doesn't burn before the sauce is cooked. For this reason, many pizzaioli finish baking the pizza at the mouth of the oven, where it's cooler, so that the dough won't burn while the excess moisture from the sauce evaporates.

Different styles of pizza require different sauce consistencies depending on the desired attributes and baking temperatures. In our lab, we like to take a methodical approach and control the parameters of pizza making, including the consistency of the sauce.

We found two simple methods of understanding sauce consistency to help you get better results. The most straightforward way is to invest in a consistometer and use it to guide you in consistency adjustments (see page 244). Alternatively, you can do a quick experiment with baking your sauce in a pan to see what changes it undergoes in the oven (see next page).

Thin | Semi-thick | Thick

HOW TO Thicken a Thin Sauce

1. Pour one-quarter of the sauce into a bowl or container.

The thickening effect of xanthan gum is almost immediate but don't add more if the sauce seems thin. Once the xanthan gum hydrates completely (24 h), it will thicken the sauce properly.

2. Using an immersion blender, disperse 0.1% xanthan gum in the separate portion of the sauce, pouring it in slowly (don't dump it all in at once). This will take 20–30 s.

3. Return this thickened portion of the sauce to the remaining sauce, and whisk to combine.

HOW TO Test Sauce Consistency

We provide many great recipes for pizza sauce in this book that have been tested extensively, but what if you have a personal recipe you want to use or have a nontraditional pizza sauce in mind that you want to try out (see page 249)? Here is an easy way to test sauce consistency. The sauce's consistency is most often determined by the amount of water and/or fat that it contains. You could certainly test it out on an actual pizza, but with the method below, only the sauce will be affected rather than an entire pizza. A 30 cm / 12 in sauté pan can be used for round pizzas such as Neapolitan, New York, and artisan. You can use the actual Detroit-style, New York square, or al taglio pans to test the sauce for those pizzas.

1. Pick the sauce you want to test and the pizza style. Deciding what pizza you want to use the sauce on is crucial because that will determine the temperature you set your oven to.

2. Preheat the oven to the desired temperature (see page 1:392).

3. Weigh the amount of sauce recommended for the smallest size of your style of pizza.

4. Once the oven is hot, pour the sauce into a sauté pan or a pizza pan with the approximate diameter or size of your pizza. Spread it evenly.

5. Bake the sauce for the amount of time we recommend for your style of pizza.

6. Take the pan out of the oven. The sauce should be the consistency you want on your baked pizza. If your sauce is too wet, you will need to thicken it by using xanthan gum or by reducing it in a pot over medium heat to evaporate moisture. If it is too thick, simply add water, stock, or cream to loosen it up.

4

6

HOW TO Use a Bostwick Consistometer

A Bostwick consistometer, often simply referred to as a Bostwick, is a tool that allows you to measure the distance a viscous sample flows during a given amount of time. This flow rate represents the consistency of the sample, which would be expressed in cm/30 s, or the distance 100 mL of ambient-temperature (21° C / 70° F) sauce travels in 30 s.

Knowing the typical consistencies of sauces for every style of pizza can guide you in adjusting the consistency of any homemade or store-bought tomato sauce, or any nontraditional sauces that you may contemplate baking on pizza. Depending on the outcome, you may consider thinning, thickening, or straining your sauce.

1 Place the Bostwick on a level surface, and adjust the leveling screw until the gas bubble within the level is centered.

2 Close the spring-loaded gate.

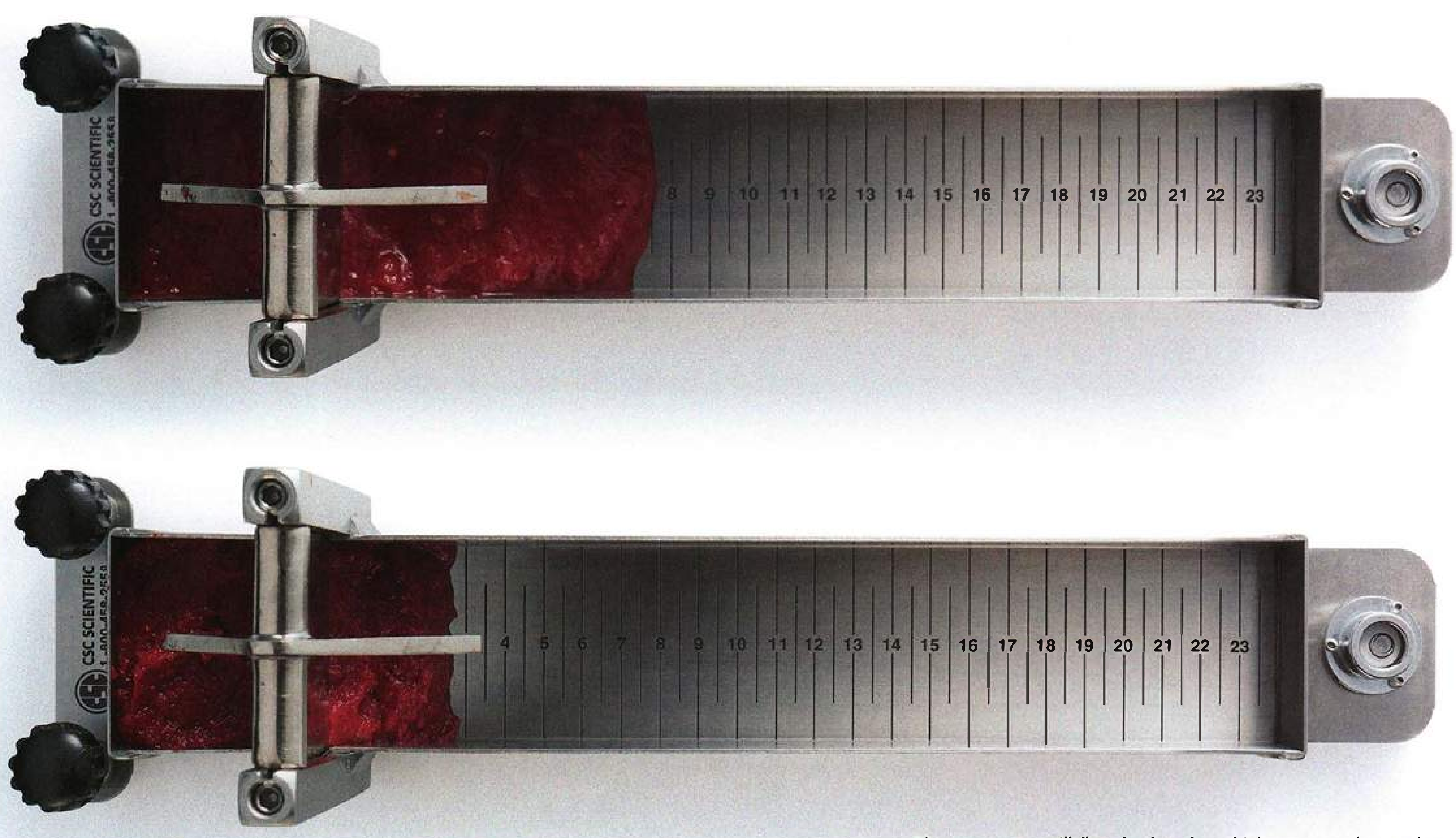
For more on methods to adjust the consistency of your sauce for baking on pizza, see the Adapting Pasta Sauces and Soups for Pizza table, page 247.

3 Fill the reservoir to the top with the room-temperature sauce to be tested (you'll need to stir the sauce first). Make sure the chamber is full and contains no air pockets.

4 Release the product by springing the gate, and at the same time start a 30-s timer.

5 After 30 s, observe and record the measurement in cm.

6 After you finish, clean the consistometer with running water and let dry.



Thinner sauces will flow farther than thicker sauces during the 30-second time period used in a Bostwick consistometer test.

RECOMMENDED PIZZA SAUCE CONSISTENCY

Type	Viscosity (cm Bostwick)*
New York Square Pizza Tomato Sauce see page 225	2–2.5
Deep-Dish / Stuffed-Crust / Detroit-Style Pizza Tomato Sauce see page 225	2–2.5
New York / Artisan Pizza Tomato Sauce see page 227	3.5–5
Thin-Crust / Brazilian Thin-Crust Pizza Tomato Sauce see page 225	5.5–6
Classic Neapolitan Pizza Tomato Sauce see page 225	7–11

**The consistency may vary depending on homogeneity and temperature. A tomato sauce is a suspension of tomato solids, which might leak the liquid. For best results, stir the sauce before measuring the consistency.*

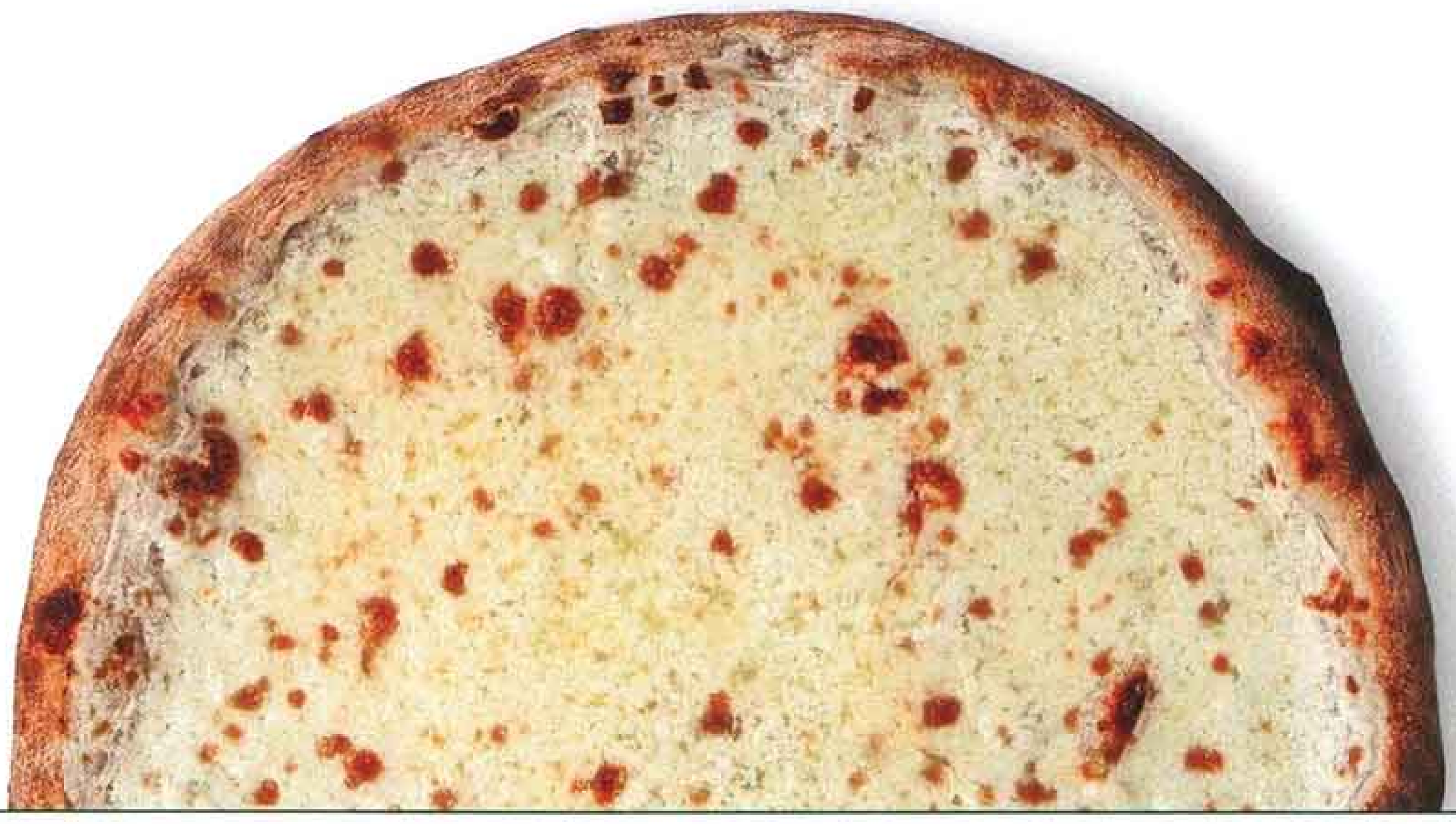
EXPERIMENT

AN ALTERNATIVE WAY OF MAKING BÉCHAMEL

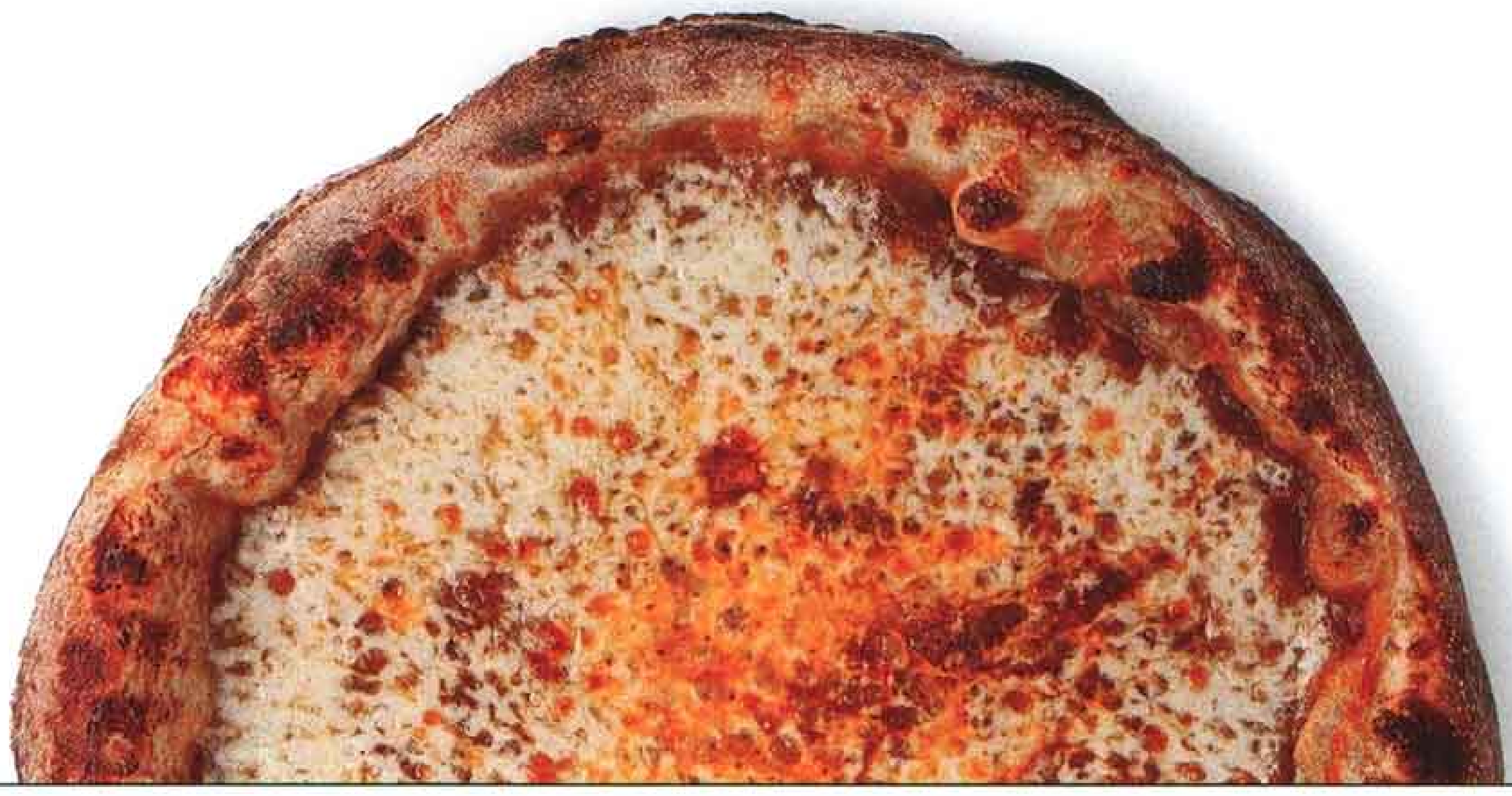
White sauces tend to use flour as a thickener, which can dilute the flavor and leave an unpleasant goopy texture in the baked pizza. We wondered if it was possible to make a white sauce without flour or starch and still obtain the proper consistency. We tested béchamel and roux-thickened soups (such as gumbo, chowder, and bisque) with three thickening agents in place of the roux (butter plus flour): low-acyl gellan gum, iota carrageenan, and a combination of methylcellulose F50 and xanthan gum.

We got our best result by dispersing 0.8% low-acyl gellan gum into the sauce/soup base, and then boiling the liquids to activate the gellan. Once the liquid was cool and fully gelled, we pureed the sauces in a blender until smooth. We use gellan in our Modernist Béchamel (see page 253). It's an optional replacement for a roux in our Laksa Sauce (see page 274), Bisque Sauce (see page 275), and Gumbo Sauce (see page 276). The béchamel and sauces were similar in consistency to their flour-thickened versions and baked well on a pizza.

Béchamel thickened with gellan gum



Gumbo sauce thickened with gellan gum



USING OUR CLASSIC NEAPOLITAN PIZZA TOMATO SAUCE ON NEW YORK PIZZA DOUGH

Can a sauce be adaptable to two different styles of pizza baked under different conditions? The answer is yes, but the surrogate sauce must have the right consistency for baking on a different style of pizza and should be able to accommodate a desired flavor profile.

For example, Neapolitan sauce without any additives is far too loose for the baking conditions of a New York pizza. However, once we developed the Modernist Neapolitan Pizza Tomato Sauce (see page 226), which is thickened with 0.1% xanthan gum, we hypothesized that it could work on New York pizza.

Xanthan gum's high degree of pseudoplasticity results in an almost instantaneous increase in viscosity, which promotes better heat transfer. This means a sauce can work baked at 450 °C / 840 °F as well as at 315 °C / 600 °F. The heat flexibility range in a xanthan gum–thickened sauce makes it a viable candidate for both Neapolitan and New York pizzas.

Although the sauce baked on a New York pizza provides a good alternative, it is important to note the flavor differences in the sauces. Our Modernist Neapolitan Pizza Tomato Sauce is very simple, with some slight acidity and salt, while the New York / Artisan Pizza Tomato Sauce has a deeper cooked tomato flavor that is seasoned with anchovy oil, garlic, oregano, fresh tomato leaves or basil leaves, and onions. While it may be convenient to have one sauce for two pizza styles, it will lack some of the traditional flavors that make each pizza style distinct.

HOW TO Disperse a Thickener

A starch, hydrocolloid, or other thickening agent will work properly only if you distribute it evenly throughout a liquid. This process is called dispersal, and just mixing dry powder into a liquid is not good enough, as you may have discovered if you have ever added cornstarch to a gravy and ended up with powdery lumps. Properly dispersing a thickener is not always as easy as it sounds. You don't get reliable visual cues when blending in the agent, so take extra care. Thickeners usually disperse most evenly in cold liquid. The notable exceptions to the rule are cellulose gums such as methylcellulose.

Whenever you need to use more than one thickener, mix all of the dry agents together before adding them to the liquid; dispersing each one separately can lead to uneven distribution. If you are going to mix in a liquid fat or oil, then you can first disperse the agents into the fat and then disperse the mixture into the liquid you want to thicken. This is how a traditional roux is made.

Many cooks simply whisk or stir thickeners into the liquid. That works fine for most starches, but many hydrocolloids are more finicky. An immersion blender or commercial blender does a fine job.

1 Bring the liquid to the correct temperature. Most—but not all—thickeners disperse best in cold liquids; see specific recipes for guidance.

2 Sprinkle the powder evenly over the surface of the liquid or a portion of the liquid. If using more than one powder, mix them dry before sprinkling. If using a blender, you can add the powder while it runs.

3 If necessary, add the portion of the thickened sauce back to the main sauce. Blend for at least 1 full min to distribute evenly. Don't blend for more than a few minutes, since this may overmix the thickener and end up thinning the sauce.

EXPERIMENT

SUGAR-FREE PANCAKE SYRUP THICKENER FOR PIZZA SAUCES

Sauce texture has always interested serious cooks. While there are dozens of ways to thicken liquids, we were particularly intrigued by an ingredient found in sugar-free pancake syrup that is responsible for giving it a smooth syrupy texture: cellulose gum (often used in combination with xanthan gum).

Cellulose gums, sold as flavorless white powders, gel when heated and stop gelling when chilled. They play a key role in commercial baking as stabilizers that hold food together in the high heat of the oven. This property also makes them attractive candidates to thicken a pizza sauce.

For this experiment, we chose methylcellulose, a versatile type of cellulose that has a proven record for being an excellent rheology modifier, film former, and water-retention agent. Additionally, it is highly soluble in cold liquids.

We used it in combination with a small amount of xanthan gum and tested it on our Classic Neapolitan Pizza Tomato Sauce (see page 225), Invincible Vinaigrette (see page 266), and commercially available Worcestershire sauce.

All three sauces were successfully thickened using methylcellulose and a small amount of xanthan gum. For the vinaigrette and Worcestershire sauce, the combination of the two thickening agents yielded sauces with higher viscosities at room temperature, which were further increased when heated due to gelling of the cellulose gum. These didn't work great as pizza sauces but could be used as finishing sauces after baking.

Although this method worked to increase the Neapolitan sauce's viscosity, it had a gummy texture after baking. For an alternative way of thickening Neapolitan sauce, see Modernist Neapolitan Pizza Tomato Sauce recipe on page 226.

ADAPTING PASTA SAUCES AND SOUPS FOR PIZZA

Bolognese and chutney don't usually spring to mind when you are thinking about the sauce that you want to put on your pizza, but we found that soups and non-pizza sauces can be adapted really well for this purpose. You just might need to adjust to their consistency. There are three basic consistencies we are looking for in pizza sauces: thin, semi-thick, and thick (see page 242). Thin pizza sauces are used for pizzas baked at high temperatures, such as Neapolitan pizza. The excess liquid evaporates in a few seconds, leaving a smooth sauce that is still moist but does not puddle. Semi-thick sauces are (obviously) thicker than thin sauces but still easily spreadable. These are used for most pizzas that bake at temperatures between 260° C and 315° C / 500° F and 600° F, like New York, artisan, and Brazilian thin-crust pizzas. Thick sauces hold their shape when they are spooned or spread on a surface and do not flow. These sauces are usually applied after baking for pizza styles like Detroit-style and deep-dish. To adapt soups and non-pizza sauces successfully, the key is knowing what style you intend to use them for and adjusting their viscosity accordingly. The following table covers broad categories of sauces and soups and what you can do to make the appropriate adjustments. We cover more about how to convert pasta sauces for use on pizza on page 247.

Type of sauce or soup	Adjustment	Apply
Oil-based sauces	If it's too thin, reduce the amount of oil. You can always add more at the end if needed. Thicken the pesto by emulsifying it (see page 240).	before or after baking
Pasta sauces	Some sauces, such as Bolognese, vodka sauce, and puttanesca, can be used as is on medium-crust pizzas like New York or artisan. Thicker sauces work on deep-dish or Detroit-style if applied after baking. If the sauce is too thick, you can thin it with heavy cream, water, stock, or wine.	before or after baking
Starchy soups	The consistency of soups such as potato soup, clam chowder, gumbo, and cream-based soup will likely work well as a pizza sauce. If the soup is roux-thickened, consider replacing the flour with other thickeners to obtain the best flavor possible (see page 245).	before baking
Vegetable or fruit soups	Thicken with xanthan gum or Wondra flour if the soup is too thin. Alternatively, reduce in a saucepot over medium heat to evaporate moisture and thicken to sauce consistency.	before baking
Vegetable or fruit purees	For a thick puree, add more liquid (water, heavy cream, or stock). For a thin puree, thicken with xanthan gum or by reduction.	before baking
Curries	"Curry" can refer to a sauce or an actual stew (vegetables or meat and vegetables served in a curry sauce). Both work well on a pizza, one as a sauce and the other as a sauce plus topping. Most curries of both types are thick enough to use as is, but if you find it to be too thin, you can thicken it by reduction or by adding tapioca maltodextrin (start with 3% and check as you go before adding more).	before baking
Stocks, jus, consommé	These are often too watery to add as a sauce on a pizza directly, but they can be thickened by reduction in a saucepot (to an extent) or with Wondra flour (start with 2%), xanthan gum, or propylene glycol alginate (PGA). Since these are relatively loose, it is best to apply as a flavoring component rather than the main sauce.	before baking (drizzle moderately over toppings)
Heat-stable emulsions, such as hollandaise (see page 260) or béarnaise	If the sauce is too thick, add clarified butter or ghee. Our base recipe for hollandaise works with all styles of pizza.	before, during, or after baking
Non-heat-stable emulsions, such as vinaigrette and beurre blanc	You can emulsify these with xanthan gum or propylene glycol alginate (PGA). Use sparingly as a condiment, not in the same quantities you would use a tomato sauce.	before baking for Invincible Vinaigrette (see page 266); after baking for other sauces
Mayonnaise (see page 262) or Aioli (see page 264)	You can use these as is, but don't use as much of them as you would a tomato sauce.	after baking (it won't separate while hot, but do not put it on before baking because the high temperatures of the oven will break the emulsion.)
Jams, jellies, and marmalades	These can be loosened by stirring them with a little water or fruit juice. Alternatively, they can be left as is and used as a topping by spooning them.	before or after baking
Chutneys	Chutney (below) is usually very chunky and doesn't really act as a sauce; it is better to think of it as a topping or a condiment. However, you can puree chutney and adjust the consistency by thinning it with water or other liquids if you want to use it as a sauce.	before baking (if pureeing) or after baking


Campbell's
CONDENSED
PARIS INTERNATIONAL EXPOSITION
1900
Tomato
SOUP
NET WT.
10 3/4 OZ
(305g)

EXPERIMENT

ADAPTING PURCHASED SOUPS FOR PIZZA

When you think about it, any sauce—any edible liquid, really—can potentially be adapted as a pizza sauce if it satisfies two conditions: the consistency is right for baking and the flavor is strong enough. For practical purposes, however, you need to take your schedule into consideration as well. Do you have the time to develop sauce bases from scratch? If the answer is no, fortunately the market offers plenty of interesting, high-quality, ready-to-use sauce options. Not all of them are adapted for baking, so we experimented with ways to adjust them to suit our needs.

We tested a number of commercially available products from different categories, such as mole, salsa, ponzu, curries (tikka masala, vindaloo, and korma), pesto, hollandaise, mango chutney, tomato soup, cream of corn soup, and canned pumpkin puree (see page 256). The idea was to provide examples of these sauces, soups, or purees for baking on various styles of pizza that require different sauce consistencies, from thin sauces for Neapolitan pizzas, to thicker versions for New York pizza and even thicker still for Detroit-style pizza.

When the sauce is applied before baking, its consistency is critical and might need adjustment. If a sauce tends to burn when baking a test run in a pan (see page 243), or if its consistometer reading is low (see page 244), the sauce is too thick and needs to be thinned. If a sauce turns out to be too liquid after baking, try adding starches or hydrocolloids before baking.

Pizza	Soup	Dilution	Thickener	Consistency (cm Bostwick) at 21° C / 70° F	Baked or garnished
Neapolitan Pizza see page 3:52	Tomato	5% water	n/a	7.5	baked (120 g)
Neapolitan Pizza see page 3:52	Cream of corn	20% water	n/a	5	baked (120 g)
New York Pizza see page 3:71	Tomato	n/a	5% Ultra-Tex 3	0.75	baked (160 g)
New York Pizza see page 3:71	Cream of corn	n/a	n/a	2	baked (160 g)
Detroit-Style Pizza see page 3:109	Tomato	n/a	5% Ultra-Tex 3	0.75	garnished warm (100 g)
Detroit-Style Pizza see page 3:109	Cream of corn	n/a	n/a	2	garnished warm (100 g)

The consistency of condensed tomato soup out of the can is a little too thick for baking on Neapolitan pizza yet too thin for baking on New York pizza. For Neapolitan, we adjusted the soup by diluting it with water. The ideal dilution amount will vary depending on the soup that you are trying to adapt to pizza. Traditional tomato sauce consistencies could be used as a ballpark reference (see page 242); note that given the fact that nontraditional sauces are different in nature, they do not have to match the tomato sauce consistency exactly. A small amount of a modified starch (5% Ultra-Tex 3) works well to thicken the sauce if you are baking your tomato soup on a New York pizza or using it on Detroit-style pizza after it comes out of the oven.

One can envision adapting any unusual sauce for pizza; you need only to get the amount and texture right. In addition to detailing thickening or thinning parameters, we provide recommendations for outside-of-the-box sauce and cheese combinations, using recipes in this chapter as well as commercial sauces, on page 256. Some suggestions for toppings are included as well.

DAIRY-BASED SAUCES

Tomato sauce might be the most common sauce used on pizza, but there's no denying the surging popularity of white sauce being used in its place. A number of sauces can fit into the traditional "white sauce" category. We have grouped ours into emulsion-based sauces (see page 259) and dairy-based sauces, plus a few that fall into our converted pasta sauces category (see page 247).

The dairy-based sauces in this section rely on milk, cream, and cheese as their main ingredients and could technically be classified as emulsions because milk itself is an emulsion straight from the cow. Butterfat (also called milk fat) is suspended in water, and the emulsion is stabilized by casein protein. But it is not stable for long because it is prone to a type of emulsion failure named for the result—creaming. The process of emulsifying and stabilizing butterfat droplets in liquid milk, known as homogenization, has become a household term. Cream and butter are also emulsions.

A dairy-based sauce can be as simple as drizzling cream over cheese on pizza dough or using a store-bought dairy product like Greek yogurt or ricotta (see page 338 for our recipe). Most dairy-based sauces, however, are thickened in some way. Many of our dairy-based sauces feature a classic roux base, while some are thickened with other starches or gums. If you'd like to try a different thickener in the recipes, see our thickening recommendations on page 243.

HEAVY CREAM AS A SAUCE

One of the simplest dairy sauces is heavy cream, which can be poured directly onto a pizza before baking. It will evaporate enough while it bakes to meld with the cheese and turn into a fantastically creamy, rich sauce. The caveat is not to add too much; a generous drizzle will suffice. Otherwise, loading your pizza into the oven will be like trying to move a kiddie pool around without spilling any water, and you could possibly pull out a soupy pizza.

We use heavy cream in our version of New Haven Clam Pie (see page 3:73), but it also works very well on white pizzas as a replacement for béchamel sauce, which could get overcooked and goopy after baking. (Remember, it has already been cooked in a pot ahead of time; baking it further will evaporate some of its moisture and make it thicker.) Drizzling cream on pizza is also much simpler than making a béchamel. Some of the moisture will evaporate from the heavy cream and the fat might separate out depending on the type of cream you use. For the most part, though, it combines with the other toppings to create a uniform sauce.

We suggest using heavy cream with the highest fat content you can find or, alternatively, crema fresca, which has an almost perfect sauce consistency. This Mexican cream is similar to heavy cream but a little thicker. You can drizzle it on pizza before or after baking. It will not lose its shape if poured over hot pizzas.

If all you have is heavy cream and you want to put it on the pizza after baking, there are a few things you can do to thicken it. Place it in a saucepot (bigger than what you think you'll need because heavy cream can boil over) and bring it to a boil, then turn the heat down to a simmer and let it reduce for 5–7 minutes. This will evaporate some of the water in the cream and concentrate all of the solid ingredients, making it thicker. Alternatively, you can add 2% Wondra flour by weight. Incorporate it using an immersion blender and allow the cream to thicken in refrigeration for 2 hours before using it. You can also use this method but with 4% tapioca maltodextrin instead. Another option is to mix 2 parts heavy cream and 1 part mascarpone or equal parts heavy cream and crème fraîche (or sour cream).

We recommend using 50 g (3 Tbsp + 2 tsp) cream for Neapolitan pizza and 120 g (½ cup) for New York pizza. Place the recommended amount of cheese on the shaped pizza dough. Gently drizzle the cream over the cheese so it spreads evenly between the cheese pieces but does not flow over the edge of the crust. Using heavy cream on a Detroit-style pizza as sauce doesn't work very well. Use 65 g (¼ cup) mascarpone instead and apply it with a spoon or piping bag.

THICK STORE-BOUGHT DAIRY SAUCES

Sour cream, crème fraîche, Devon cream, clotted cream, mascarpone, and unsweetened Greek yogurt are thick enough to spread thinly on the surface of a pizza dough to act as a sauce. We suggest tempering these for 1–2 hours before using them because they could slow down baking if they are too cold when they come in contact with the dough. They will also be easier to spread at room temperature. We use a small offset spatula to spread these sauces over the dough. Typically we place other toppings over the sauce, such as cheese and cured meats or vegetables.

These creams will bubble and some might have a little fat separation. For the most part, they will simply lose some moisture and become firmer as the pizza bakes, making them ideal in terms of consistency and flavor. Ricotta, in some forms, is another dairy product that is smooth enough to spread on pizza dough (although it arguably enters the cheese territory). You can mix ricotta with equal parts heavy cream (by weight) to make a very flavorful and spreadable base. This sauce will not lose its shape much while baking and might even brown a little, depending on the heat level of the oven.

Neapolitan pizza with a huitlacoche puree dough, heavy cream, cotija, charred poblano peppers, and squash blossoms

BÉCHAMEL

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Unsalted butter	35 g	2½ Tbsp	7.95
All-purpose flour	25 g	3 Tbsp + ½ tsp	5.68
Whole milk, cold	440 g	1¾ cups + 2 Tbsp	100
Fine salt	5 g	¾ tsp + ⅛ tsp	1.14

TOTAL TIME	YIELD
Active 5–10 min / Inactive 15 min	~450 g

PROCEDURE

1 Combine the butter and flour in a small saucepot.

2 Cook over medium heat, whisking occasionally, to make a blond roux, about 5 min.

3 Add the milk in a steady stream, and bring to a boil, whisking constantly.

4 Reduce the heat and simmer, whisking occasionally, to thicken the sauce, about 15 min.

5 Add the salt. Adjust the seasoning if necessary.

6 Strain into a container set over an ice bath to chill.

7 Store for up to 3 d in refrigeration. Do not freeze.

MODERNIST BÉCHAMEL

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Whole milk, cold	440 g	1¾ cups + 2 Tbsp	100
Low-acyl gellan gum	3.5 g	2 tsp	0.8
Fine salt	5 g	¾ tsp + ⅛ tsp	1.14

TOTAL TIME	YIELD
Active 5-10 min / Inactive 15 min	~400 g

For more on purified ingredients, see page 1:323.

PROCEDURE

1. Put the milk in a small saucepot. Sprinkle the gellan gum over the milk, and let it hydrate for 3–5 min.
2. Whisk in the gellan to incorporate. Continue to whisk constantly while bringing to a boil over medium heat.
3. Reduce the heat and simmer, whisking occasionally, for 15 min to thicken the sauce.
4. Add the salt. Adjust the seasoning if necessary.
5. Strain into a container set over an ice bath to chill until fully set.
6. Blend the set gel into a puree.
7. Store for up to 3 d in refrigeration. Do not freeze.

This sauce is best used at room temperature. You can also add a pinch of grated nutmeg to season the sauce further.

To make Ranchamel, stir 50 g (¼ cup + 2 tsp) ranch powder into 475 g (1¾ cups + 3 Tbsp) Béchamel or Modernist Béchamel after the sauce has thickened.

To make Mornay sauce, stir 85 g (¾ cup) grated Gruyère cheese into 415 g (1⅔ cups) Béchamel or Modernist Béchamel after the sauce has thickened.

New York pizza with garlic chive béchamel, cheddar cheese, sweated onions and leeks, grilled onion petals, ramps, garlic chips, and pickled onions

GARLIC CHIVE BÉCHAMEL

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Garlic chives, coarsely chopped	150 g	3 cups	42.86
All-purpose flour	25 g	3 Tbsp	7.14
Unsalted butter	25 g	1 Tbsp + 2½ tsp	7.14
Whole milk, cold	350 g	1½ cups	100
Fine salt	as needed		

TOTAL TIME	YIELD
Active 10–15 min / Inactive 20–25 min	~500 g

This garlic chive béchamel is one of the rare cases of a green sauce that keeps its color as it bakes. It also provides a balanced allium flavor, making for both a delicious and beautiful sauce.

PROCEDURE

1. Bring a large pot of heavily salted water to a boil.
2. Blanch the chives until tender, 1–2 min.
3. Transfer to a container set over an ice bath to chill.
4. Drain, then transfer to a blender.
5. Puree until smooth.
6. Pass the puree through a fine-mesh sieve. This should yield about 100 g (⅓ cup) puree.
7. Combine the flour and butter in a small saucepot.
8. Cook over medium heat, whisking occasionally, to make a blond roux, about 5 min.
9. Add the milk to the pot, and bring to a boil, whisking constantly.
10. Reduce the heat and simmer, whisking occasionally, to thicken the sauce, about 15 min.
11. Remove the pot from the heat.
12. Add the garlic chive puree and salt. Adjust the seasoning if necessary.
13. Transfer to a container set over an ice bath to chill.
14. Store for up to 3 d in refrigeration. Do not freeze.

MODERNIST CHEESE SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Water	100 g	¼ cup + 3 Tbsp	50
Wheat beer	75 g	⅓ cup	37.5
Sodium citrate	10 g	1½ tsp + ⅛ tsp	5
Fine salt	4.5 g	¾ tsp	2.25
Iota carrageenan	1.25 g	¼ tsp + ⅛ tsp	0.63
Aged gouda cheese, grated	200 g	1½ cups	100
Sharp cheddar cheese, grated	16.5 g	2 Tbsp + 1 tsp	8.25

TOTAL TIME: Active 10 min | YIELD: ~400 g

You can replace the sodium citrate with sodium hexametaphosphate (SHMP). Some people prefer this salt because it leaves less of a sour taste than sodium citrate. For more on where to find these ingredients, see Resources, page 3:377.

For more on purified ingredients, see page 1:323.

PROCEDURE

1 In a small saucepot, whisk together the water, beer, sodium citrate, salt, and iota carrageenan.

2 Bring to a simmer over medium heat, whisking constantly.

3 Stir the cheeses in slowly, until completely smooth.

4 Cool to room temperature over an ice bath.

5 If not using right away, cool to room temperature before covering.

6 Store for up to 4 d in refrigeration. Reheat to melt before using. Do not freeze.

This recipe was adapted from *Modernist Cuisine at Home*.

RACLETTE SLICE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Water	160 g	⅔ cup	42.67
Skim milk powder	3 g	2⅛ tsp	0.8
Sodium citrate	1.5 g	¼ tsp	0.4
Raclette or Gruyère, grated	375 g	3½ cups	100

TOTAL TIME: Active 5–10 min | YIELD: ~535 g

For more on purified ingredients, see page 1:323.

PROCEDURE

1 Combine the water, milk powder, and sodium citrate in a small saucepot, and bring to a simmer over medium heat, whisking constantly.

2 Gradually whisk in the cheese until completely melted.

3 Simmer for 1 min.

4 Divide the mixture evenly between two 30 cm / 12 in cake pans lined with lightly oiled plastic wrap.

5 Cover with plastic wrap pressed directly over the surface. Allow to cool.

6 Store for up to 4 d in refrigeration. Do not freeze.

This is a method we developed for *Modernist Cuisine* to make cheese slices similar to American cheese. The key ingredient is sodium citrate, which makes cheese melt in a way that is more "gooey" than "stretchy." This recipe makes two 30 cm / 12 in discs, but it can easily be adapted for larger or smaller sizes, as long as you have the right pan size to let the hot mix set in.

The disc is applied onto the pizza halfway through baking to melt the cheese completely.

You can replace the sodium citrate with sodium hexametaphosphate (SHMP). Some people prefer this salt because it leaves less of a sour taste than sodium citrate. For more on where to find these ingredients, see Resources, page 3:377.

CHARCOAL MASCARPONE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Mascarpone	450 g	2 cups	100
Food-grade activated charcoal	9 g	1 Tbsp + 1 tsp	2

TOTAL TIME: Active 1 min | YIELD: ~450 g

PROCEDURE

1 Combine the mascarpone and charcoal.

2 Store for up to 3 d in refrigeration. Do not freeze.

Although we use this as a sauce on The Dark Side Neapolitan (see page 3:56), you could also use this as a topping.

EXPERIMENT

OUTSIDE-OF-THE-BOX PIZZA SAUCE

Sauces are essential elements in cuisines all over the world, and they come in many types, forms, flavors, and applications. Although this diversity might seem intimidating, we felt that outside-of-the box sauce ideas can make for a fantastic pizza experience. In our quest for the extraordinary, we explored some interesting avenues. For example, can French onion soup be adapted into a sauce that works on pizza? Can we bake pizzas with pasta sauces? To our satisfaction, we discovered that even the most uncommon sauces can be applied successfully on pizza.

We tested about two dozen sauces, from chicken jus to hot vinaigrette, and present here our suggestions for ways to adapt them to specific consistencies: thin for Neapolitan-style pizzas; slightly thicker for New York, artisan, thin-crust, and New York square pizzas; and thick for Detroit-style and al taglio pizzas. If you find yourself wondering what sauce you should try next, look no further.

Interesting examples from this study include flour-thickened soups such as clam chowder, bisque, gumbo, and laksa that were baked with their roux-based sauces and garnished with their corresponding ingredients—we put fish balls and tofu puffs on the laksa sauce, for example. In some scenarios, we have used modernist twists as toppings, such as tomato gel cubes, a ponzu sauce thickened with agar and xanthan gum, and even fried aioli cubes.

Another modernist technique was used to create a pizza cheese sauce. In traditional mac and cheese, starch particles and milk proteins act as emulsifiers, which comes at the price of diluting the cheese flavor. For our pizza cheese sauce (see page 255), we used the silky smooth Mac and Cheese recipe from *Modernist Cuisine at Home* with sodium citrate to keep the water and fat droplets from separating when the cheese melts. The resulting texture is as smooth as melted American cheese but as complex and intense in flavor as sharp cheddar. The rich cheese sauce was baked on both Neapolitan and New York pizzas instead of the tomato sauce, providing delicious pizzas when garnished with additional mozzarella cheese and topped with fresh tomatoes and greens.

Gazpacho sauce was another exciting challenge. Knowing that gazpacho is traditionally uncooked didn't stop us from mimicking this soup and successfully creating a brightly colored Gazpacho Pizza (see page 3:266).

Neapolitan pizza with Invincible Vinaigrette (see page 266), sour cream, fresh mozzarella, and kale

Neapolitan pizza with store-bought tomato soup (diluted with 5% water), fresh mozzarella, and basil

Neapolitan pizza with store-bought cream of corn soup (diluted with 20% water), fresh mozzarella, and basil

Neapolitan pizza with store-bought pesto and fresh mozzarella

Neapolitan pizza with canned pumpkin puree (diluted with 50% water), fresh mozzarella, and basil

New York pizza with silken tofu sauce, thickened ponzu sauce garnish, and sliced octopus

New York pizza with Sabayon Sauce (see page 261), Parmesan, morels, asparagus, and chives

New York pizza with Aioli (see page 264)

Neapolitan pizza with Modernist Cheese Sauce (see page 255), fresh mozzarella, and basil

New York pizza with chicken jus sauce (see page 269) and pizza cheese

Neapolitan pizza with gazpacho sauce, fresh mozzarella, cucumbers, Tomato Water Gel (see page 3:269), onion petals, croutons, olive oil, vinegar, and chives

New York pizza with Sous Vide Hollandaise (see page 260) applied halfway through baking, and pizza cheese

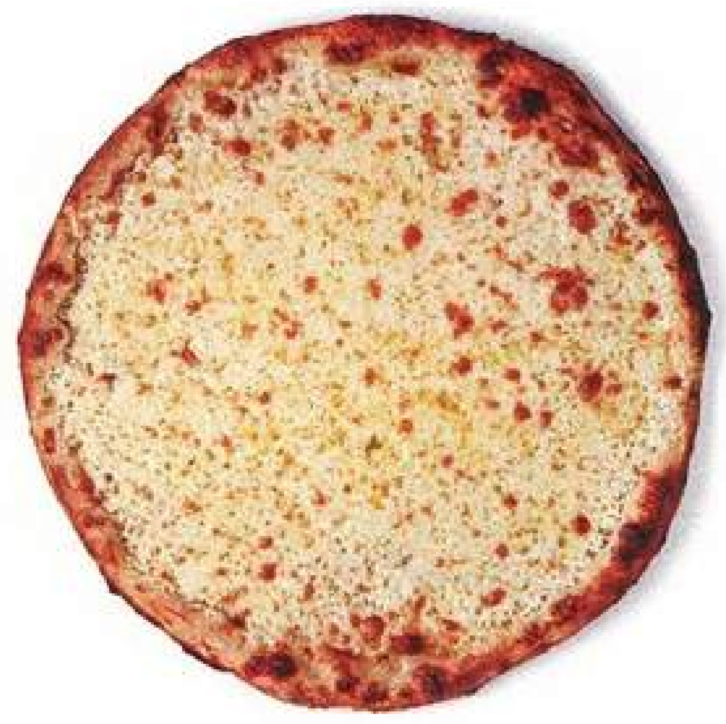
New York pizza with Amatriciana Sauce (see page 227) and pizza cheese

New York pizza with store-bought mango chutney and pizza cheese

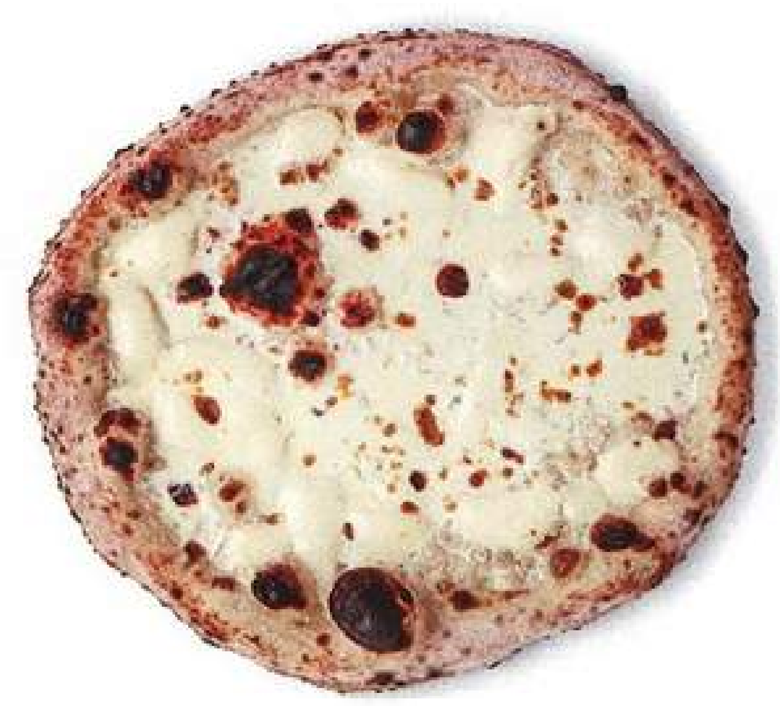
New York pizza with Aioli (see page 264) and pizza cheese

New York pizza with chicken jus sauce (see page 269) garnish and pizza cheese

Neapolitan pizza with fresh mozzarella and garnished with Aioli (see page 264)



New York pizza with chicken stock sauce (see page 269), mascarpone, and pizza cheese



Neapolitan pizza with heavy cream and fresh mozzarella

New York pizza with Invincible Vinaigrette (see page 266), pizza cheese, and spinach

New York pizza with Modernist Cheese Sauce (see page 255), spinach, and sliced cherry tomatoes

New York pizza with store-bought korma sauce and pizza cheese

New York pizza with Sabayon Sauce (see page 261), Parmesan, garlic, razor clams, Manila clams, geoduck clam, extra-virgin olive oil, and parsley

New York pizza with store-bought pesto and pizza cheese

Detroit-style pizza with Modernist Cheese Sauce (see page 255), Wisconsin brick cheese, and pizza cheese

Detroit-style pizza with chicken jus sauce (see page 269), Wisconsin brick cheese, and pizza cheese

Detroit-style pizza with store-bought vindaloo (thickened with 3% Ultra-Tex 3), Wisconsin brick cheese, and pizza cheese

Detroit-style pizza with gazpacho sauce, Wisconsin brick cheese, pizza cheese, cucumbers, Tomato Water Gel (see page 3:269), onion petals, croutons, olive oil, vinegar, and chives

EMULSION-BASED SAUCES

Many of the foods you see every day are emulsions: hot dogs and Mountain Dew, chocolate and ice cream, mayonnaise and milk. Each of these foods contains a fat mixed with a water-based solution in such a way that the two mingle without separating.

There are two stages of emulsification. The first stage, when you disperse oil in water (or vice versa) to homogenize the two, is called a primary emulsion. In this stage the droplets are fairly coarse. The next stage, when an initial emulsion is beaten to further decrease the size of the dispersed droplets, is called a secondary emulsion. Every rule about emulsions has its exceptions, but generally speaking, if you have enough emulsifier, the smaller you make the droplets, the more stable the emulsion becomes and the longer it lasts.

A primary emulsion can be made with a whisk, but you'll have pretty large droplets that won't hold up for very long. To make a longer-lasting secondary emulsion, you'll need a lot more energy behind the effort. A typical countertop blender or immersion blender can create an emulsion with droplets as small as about 10 microns / 0.0004 in. It will feel smooth and less greasy on your tongue and be perfectly acceptable for many cooking purposes. A food processor is another common tool for emulsifying, although it produces slightly coarser emulsions than a blender does because the food processor has larger blades and a slower rotation speed.

It can be challenging to create sturdy oil-water emulsions without the stabilizing properties of dairy or eggs. Vinaigrettes are perhaps the most familiar example. They are good visual paradigms of how emulsions both work and fail. Shake or whisk vinegar and oil with some mustard, garlic, and herbs, and you will create an emulsion, but it may fail in a matter of minutes. If you whirl the vinaigrette in a blender or mixer, the droplets will be smaller and better dispersed, and the recipe might stay combined for a day or two. Add an emulsifier like PGA to your recipe, and the same ratio of oil and vinegar will remain emulsified much longer. The same principles for combining fat and water can be used to blend endless combinations of other ingredients.

Be careful not to let the emulsion get too warm. The mechanical energy used to break up the droplets also produces friction—and thus heat. It can be all too easy to overheat the ingredients, leading to a broken or overcooked emulsion. We generally recommend adding these sauces to pizza after baking so that they don't break. The exceptions are the Sabayon Sauce on page 261, which can be applied during baking and toasted as it bakes, and the Ultrastable Beurre Blanc on page 261, which lives up to its name.

We use Sabayon Sauce (see page 261) to protect delicate seafood, like the clams on the pizza shown on the previous page, from the blistering heat of the pizza oven. It acts as a thermal barrier and helps prevent them from overcooking.

You don't need a whipping siphon to make emulsion-based sauces. We like it because it's super convenient during service, it lets us keep the product warm, and the foaminess allows you to build volume instead of having a dense, super-rich sauce.

Renowned chefs such as Wolfgang Puck at Spago and Matt Hyland at Emmy Squared often use aioli or ranch to top off their pizzas after they come out of the oven. Emulsion-based sauces add richness as well as an acidity that balances the flavors in the pizzas that they make.

SOUS VIDE HOLLANDAISE

INSPIRED BY DANIEL HUMM

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Dry white wine	130 g	½ cup + 1 Tbsp	130
Shallots, finely minced	65 g	¼ cup + 3 Tbsp	65
White vinegar	45 g	3 Tbsp	45
Egg yolks, large	100 g	5 ea	100
Water (or stock)	25 g	1 Tbsp + 2 tsp	25
Unsalted butter, melted	290 g	1⅓ cups	290
Fine salt	5 g	¾ tsp + ⅛ tsp	5
Malic acid	1.3 g	¼ tsp + ⅛ tsp	1

TOTAL TIME	YIELD
Active 15 min / Inactive 40 min	~450 g

In addition to being one of the most versatile emulsion sauces in the book, sous vide hollandaise is also one of the most delicious. We highly recommend that you use it in place of the tomato sauce in the Detroit-Style Pizza on page 3:109. The combination is a game changer that might have you rethinking the best sauce for the classic red-top pizza.

PROCEDURE

1 Combine the wine, shallots, and vinegar in a small saucepot, and reduce over medium-high heat until syrupy.

2 Strain. Measure 30 g of the strained reduction, and cool to room temperature.

3 Blend the egg yolks and water with the reduction using an immersion blender.

4 Vacuum seal.

5 Cook sous vide in a 65 °C / 149 °F water bath for 30 min.

6 Transfer the cooked egg mixture to a tall cup, and blend in the butter, salt, and malic acid using an immersion blender. Adjust the seasoning if necessary.

7 Transfer to a 1 L whipping siphon.

8 Charge the whipping siphon with 2 nitrous oxide charges, and shake well.

9 Hold the whipping siphon in a 60 °C / 140 °F water bath for up to 3 h. Discard any leftovers.

This hollandaise sauce is heat stable and can be used on many different styles of pizza. In some instances, it can be applied prior to baking or halfway through baking, which will make its surface brown. It can also be applied after baking.

If you choose to use stock rather than water, consider the ingredient for which the hollandaise is being prepared: use fish stock for fish, poultry stock for poultry, and so on. For stock recipes, see page 268.

Alternatively, the hollandaise base can be cooked sous vide in a 63 °C / 145 °F water bath to produce a lighter foam, or in a slightly warmer 67 °C / 153 °F water bath for a denser foam.

IMMERSION BLENDER HOLLANDAISE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Dry white wine	100 g	⅓ cup + 2 Tbsp	133.33
Shallots, thinly sliced	50 g	⅓ cup	66.67
White vinegar	35 g	3½ Tbsp	46.67
Egg yolks, large	75 g	4 ea	100
Water	20 g	1 Tbsp + 1 tsp	26.67
Unsalted butter, melted	225 g	1 cup	300
Fine salt	4 g	¾ tsp	5.33
Malic acid	1 g	¼ tsp	1.33

TOTAL TIME	YIELD
Active 15 min / Inactive 40 min	~345 g

This recipe will produce a result that is nearly identical to the sous vide hollandaise above but doesn't require a whipping siphon.

For more on purified ingredients, see page 1:323.

PROCEDURE

1 Combine the wine, shallots, and vinegar in a small saucepot, and reduce over medium-high heat until syrupy.

2 Strain. Measure 20 g of the strained reduction, and cool to room temperature.

3 Blend the egg yolks and water with the reduction using an immersion blender.

4 Vacuum seal.

5 Cook sous vide in a 65 °C / 149 °F water bath for 30 min.

6 Transfer the cooked egg mixture to a tall cup, and blend in the butter, salt, and malic acid using an immersion blender. Adjust the seasoning if necessary.

7 Hold in a 60 °C / 140 °F water bath for up to 3 h. Discard any leftovers.

New York square pizza with hollandaise sauce, pizza cheese, and baby artichokes

New York pizza with sabayon sauce, Parmesan, morels, asparagus, and chives

SABAYON SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Flavored liquid*, 21° C / 70° F	230 g	1 cup	100
Egg yolks, large	120 g	6 ea	52.17
Fine salt	2.3 g	¼ tsp + ⅛ tsp	1

**This liquid needs to be very flavorful and aromatic. It is usually a reduction of wine with shallots, spices, and herbs.*

TOTAL TIME	YIELD
Active 5–10 min / Inactive 30 min	~350 g

Apply to the pizzas halfway through or after baking. You can also toast the sabayon after applying it to pizza.

PROCEDURE

1. Blend the flavored liquid, egg yolks, and salt with an immersion blender until smooth.
2. Vacuum seal.
3. Cook sous vide in a 70° C / 158° F water bath for 30 min.
4. Transfer the egg mixture to a 1 L whipping siphon.
5. Charge the whipping siphon with 3 nitrous oxide charges, and shake well.
6. Hold the whipping siphon in a 55° C / 131° F water bath for up to 3 h. Discard any leftovers.

This sabayon is one of our favorites because it adds a layer of richness and creaminess to the finished pizza but is light at the same time. The recipe's ratio allows you to customize it for virtually any flavor profile.

ULTRASTABLE BEURRE BLANC

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Agar	1 g	¼ tsp + ⅛ tsp	0.4
Propylene glycol alginate (PGA)	1 g	¼ tsp + ⅛ tsp	0.4
Water, stock, or heavy cream, cold	250 g	1 cup + 1 Tbsp	100
Dry white wine	250 g	1 cup + 1 Tbsp	100
Champagne vinegar	75 g	⅓ cup	30
Shallots, finely minced	75 g	½ cup	30
Unsalted butter	250 g	1 cup + 2 Tbsp	100
Liquid soy lecithin	2.5 g	½ tsp	1
Fine salt	5 g	¾ tsp + ⅛ tsp	2
Lemon juice	as needed		

TOTAL TIME	YIELD
Active 15–20 min / Inactive 30 min	~550 g

Apply to the pizzas before or after baking.

For more on purified ingredients, see page 1:323.

PROCEDURE

1. Stir together the agar and PGA.
2. Put the water in a small saucepot and whisk the agar-PGA mixture into the water.
3. Heat over medium-high heat to 95° C / 203° F.
4. Transfer to a container, and cool until fully set, about 10 min.
5. Puree to a fluid gel consistency using an immersion blender. Set aside.
6. Combine the wine, vinegar, and shallots in a small saucepot, and reduce over medium-high heat until syrupy.
7. Strain. Measure 50 g of the strained reduction and cool to room temperature.
8. Melt the butter in another small saucepot over medium heat.
9. Whisk in the soy lecithin.
10. Add the salt, lemon juice, and reserved wine reduction to the fluid gel, and blend using an immersion blender.
11. Slowly pour in the melted butter mixture while blending until fully emulsified.
12. Adjust the seasoning if necessary.
13. Hold in a water bath at 55° C / 131° F for up to 3 h. Discard any leftovers.

MAYONNAISE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Egg yolks, large	100 g	5 ea	25
Lemon juice	30 g	2 Tbsp	7.5
Fine salt	4 g	¾ tsp	1
Champagne vinegar	2 g	½ tsp	0.5
Neutral oil	400 g	1¾ cups + 2 Tbsp	100

TOTAL TIME	YIELD
Active 6 min	~530 g

Apply to the pizzas after baking.

PROCEDURE

1 Blend the egg yolks, lemon juice, salt, and vinegar in a tall cup using an immersion blender or in a countertop blender until smooth.

2 While blending, slowly drizzle in the oil in a thin, steady stream. Make sure to move the blender head around while you are pouring in the oil if using an immersion blender. If using a countertop blender, blend on medium-high speed.

3 Adjust the seasoning if necessary.

4 Store for up to 3 wk in refrigeration. Do not freeze.

MODERNIST MAYONNAISE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Egg yolks, large	45 g	2 ea	15
Water	75 g	⅓ cup	25
Dijon mustard	21 g	1 Tbsp + 1¼ tsp	7
Xanthan gum	0.7g	¼ tsp	0.23
Grapeseed oil	300 g	1⅓ cups	100
Fine salt	as needed		

TOTAL TIME	YIELD
Active 5 min / Inactive 30 min	~440 g

Apply to the pizzas after baking.

This recipe was adapted from *Modernist Cuisine at Home.*

PROCEDURE

1 Vacuum seal the egg yolks.

2 Cook sous vide in a 67 °C / 153 °F water bath for 30 min.

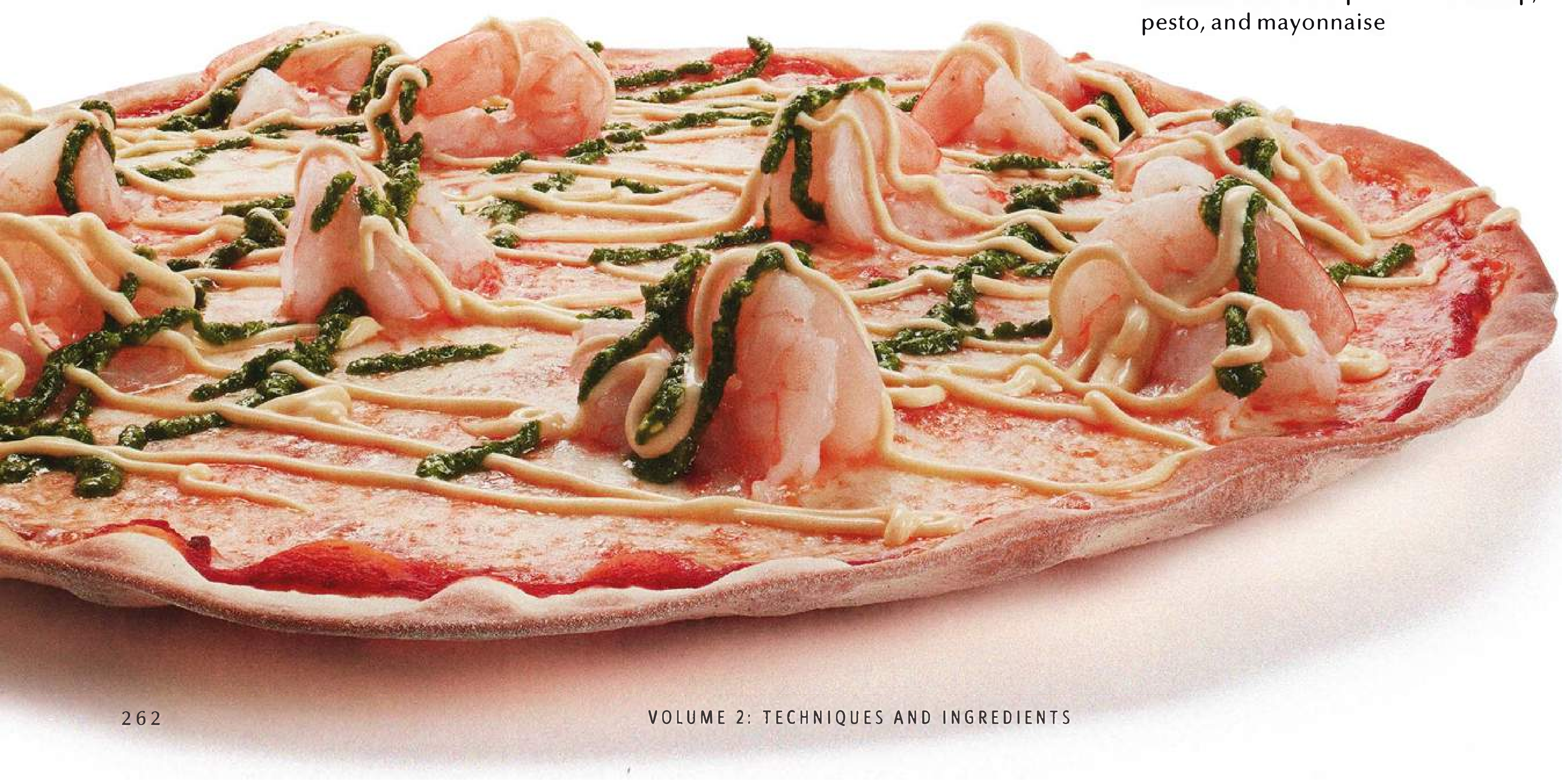
For more on purified ingredients, see page 1:323.

3 Whisk together the water, mustard, and xanthan gum, and puree using an immersion blender with the cooked egg yolks until smooth.

4 Drizzle the oil slowly into the egg mixture while blending until fully emulsified.

5 Season with 1% salt by weight or as needed.

6 Store for up to 3 wk in refrigeration. Do not freeze.



Brazilian thin-crust pizza with shrimp, pesto, and mayonnaise

ARUGULA MAYONNAISE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Arugula	150 g	7½ cups	60
Garlic Confit see page 366	100 g	½ cup	40
Egg yolks, large	40 g	2 ea	16
Extra-virgin olive oil	250 g	1 cup + 2 Tbsp	100
Fine salt	as needed		
Lemon juice	as needed		

TOTAL TIME	YIELD
Active 10 min / Inactive 5-10 min	~450 g

Apply to the pizzas after baking.

PROCEDURE

1. Bring a large pot of heavily salted water to a boil.
2. Blanch the arugula in the boiling water until tender, about 1 min. Transfer to an ice bath, and cool completely.
3. Drain the arugula and transfer to a blender.
4. Puree until smooth.
5. Pass the puree through a fine-mesh sieve and measure. You'll need about 100 g (⅓ cup) of puree.
6. Puree the garlic confit and egg yolks in a blender until smooth.
7. With the blender on high, slowly drizzle in the oil in a thin, steady stream, occasionally pausing to scrape down the sides of the blender with a silicone spatula.
8. When the oil has been incorporated, reduce the blender to low speed, and add the arugula puree.
9. Blend in the salt and lemon juice. Adjust the seasoning if necessary.
10. Store for up to 3 wk in refrigeration. Do not freeze. Allow to come to room temperature before using.

Artisan pizza with arugula mayonnaise, goat cheese, fava beans, lemon zest, and goat cheese-stuffed fried squash blossoms

AIOLI

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Egg yolks, large	40 g	2 ea	17.78
Lemon juice	10 g	2 tsp	4.44
Garlic clove, peeled	6 g	1 ea	2.67
Fine salt	4 g	¾ tsp	1.78
Vegetable oil	225 g	1 cup	100
Extra-virgin olive oil	225 g	1 cup	100

TOTAL TIME	YIELD
Active 5–7 min	~500 g

Apply to the pizzas after baking.

To make garlic confit aioli, replace the garlic clove with garlic confit (see page 366).

PROCEDURE

1 Blend the egg yolks, lemon juice, garlic, and salt in a tall cup using an immersion blender or countertop blender until smooth.

2 Combine the oils.

3 While blending, slowly drizzle in the oils in a thin, steady stream. Make sure to move the blender head around while you are pouring in the oil if using an immersion blender. If using a blender, blend on medium-high speed.

4 Adjust the seasoning if necessary.

5 Store for up to 3 wk in refrigeration. Do not freeze.

WASABI AIOLI

Add 30 g (2 Tbsp) fresh wasabi (or 7 g [2 Tbsp] wasabi powder), grated directly into the aioli, and stir well to incorporate. You can substitute prepared horseradish for the fresh wasabi if desired. You can apply the amounts from this variation to either aioli recipe in this chapter.

GOCHUJANG AIOLI

Add 45 g (2 Tbsp + ½ tsp) gochujang and stir well. You can use other hot sauces and add them to taste. You can apply the amounts from this variation to either aioli recipe in this chapter.

MILK AIOLI (EGGLESS AIOLI)

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Whole milk, cold	155 g	⅔ cup	100
Garlic cloves, peeled	9 g	1–2 ea	5.81
Fine salt	3 g	½ tsp	1.94
Vegetable oil	215 g	1 cup	138.71
Extra-virgin olive oil	110 g	½ cup	70.97

TOTAL TIME	YIELD
Active 5–7 min	~500 g

Aioli looks similar to mayonnaise, and this one does, too, but it is very white because it doesn't contain eggs.

Apply to the pizzas after baking.

PROCEDURE

1 Blend the milk, garlic, and salt in a tall cup using an immersion blender or countertop blender until smooth.

2 Combine the oils.

3 While blending, slowly drizzle in the oils in a thin, steady stream. Make sure to move the blender head around while you are pouring in the oil if using an immersion blender. If using a blender, blend on medium-high speed.

4 Adjust the seasoning if necessary.

5 Store for up to 2 wk in refrigeration. Do not freeze.

The milk aioli is one of the easiest recipes to make in this chapter, and this sauce brings so much to the table. It has a long shelf life and it works incredibly well as a canvas for other flavors. This sauce also holds well after you apply it to something hot.

Artisan pizza with aioli, blistered shishito peppers, and toasted almonds

While we don't offer vegan emulsion sauce recipes (such as a vegan mayonnaise or aioli), we tested Vegenaise to see if it could be a good substitute. We pureed garlic into it to make a vegan aioli (of sorts) as well as blended it with wasabi and gochujang, and it performed just like a regular mayonnaise. We also applied it to hot pizzas after baking and it held up pretty well. If you follow a vegan diet or if you have vegan guests, this is a very good replacement for the non-vegan counterparts.

INVINCIBLE VINAIGRETTE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Champagne vinegar	80 g	⅓ cup	80
Quince vinegar	35 g	2½ Tbsp	35
Pear juice	20 g	1 Tbsp + 1 tsp	20
Dijon mustard	5 g	1 tsp	5 g
Propylene glycol alginate (PGA)	0.98 g	¼ tsp	0.98
Extra-virgin olive oil	100 g	⅓ cup+ 2 Tbsp	100
Pistachio oil	55 g	¼ cup	55
Walnut oil	30 g	2 Tbsp	30
Liquid soy lecithin	1.85 g	½ tsp	1.85
Fine salt	as needed		

TOTAL TIME	YIELD
Active 5-10 min	~325 g

Use this recipe as a template for any basic vinaigrette. Different oils and acids can be used to create a variety of effects. The vinaigrette is completely heat stable, so it can be made with animal fats or dairy fat for use in warm salads, eggs, and cooked meats.

This recipe was adapted from *Modernist Cuisine at Home*.

PROCEDURE

1 Combine the vinegars, pear juice, mustard, and PGA in a small saucepot, and bring the mixture to 60 °C / 140 °F over medium heat.

2 Using an immersion blender, blend over the heat until the ingredients are completely incorporated. Remove from the heat.

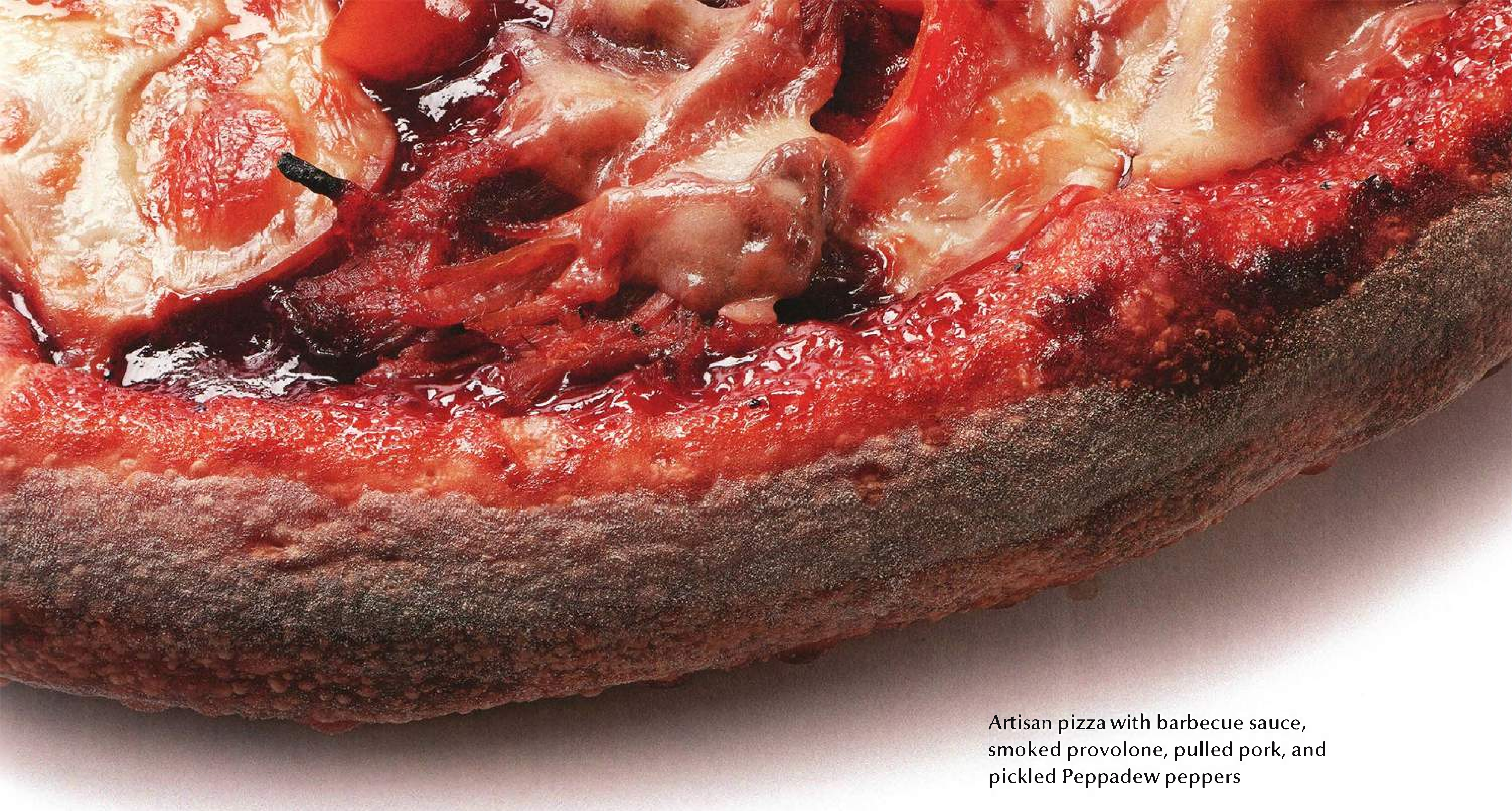
3 Combine the oils.

4 Drizzle the oils and soy lecithin slowly into the vinegar mixture while blending; process until emulsified.

5 Blend in the salt.

6 Store for up to 3 mo in refrigeration. Do not freeze.

For more on purified ingredients, see page 1:323.



Artisan pizza with barbecue sauce, smoked provolone, pulled pork, and pickled Peppadew peppers

BARBECUE SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Malt vinegar	200 g	¾ cup + 2 Tbsp	50
White Beef Stock see page 268	200 g	¾ cup + 2 Tbsp	50
Maple syrup	100 g	¼ cup + 1 Tbsp	25
Yellow onion, finely diced	60 g	¼ cup + 2 Tbsp	15
Bourbon	54 g	¼ cup	13.5
Rendered bacon fat	50 g	3 Tbsp + 1 tsp	12
Sherry vinegar	20 g	1 Tbsp + 1 tsp	5
Smoked Hungarian paprika, or other ground smoked pepper	20 g	3 Tbsp + 1 tsp	5
Cayenne pepper	2 g	1 tsp	0.5
Yellow mustard powder	2 g	1 tsp	0.5
Liquid hickory smoke	0.4 g	n/a	0.1
Freeze-dried tomatoes	80 g	4 cups	20
Microcrystalline cellulose (Avicel CG 200 or FMC BioPolymer)	4 g	1 tsp	1
Fine salt	as needed		
Red wine vinegar	as needed		

TOTAL TIME	YIELD
Active 5 min / Inactive 10 min	~480 g

For more on purified ingredients, see page 1:323.

PROCEDURE

1 Combine the malt vinegar, stock, maple syrup, onion, bourbon, bacon fat, sherry vinegar, paprika, cayenne, mustard powder, and liquid smoke in a medium saucepot.

2 Cook the mixture over low heat until reduced by half, to about 400 g.

3 Transfer to a blender, and puree until smooth.

4 Pass through a fine-mesh sieve.

5 Cool to room temperature over an ice bath. Measure 400 g of the sauce base.

6 Blend the tomatoes and microcrystalline cellulose into the cooled sauce base until evenly distributed and smooth.

7 Add the salt and red wine vinegar.

8 Store for up to 3 mo in refrigeration. Do not freeze.

STOCKS, SOUPS, AND PASTA SAUCES AS PIZZA SAUCE

When we started examining the options for pizza sauces, we knew we wanted to go beyond the typical sauces that you would find on pizzeria menus. We fully appreciate traditional pizza sauces such as tomato, pesto, and alfredo (and even some of the previously novel but now standard sauces, like barbecue sauce). But we couldn't resist the idea of transforming broths into sauces or deconstructing soups and pasta sauces into components that add extraordinary flavor and interest to pizzas.

PARAMETRIC RECIPE

BEST BETS FOR STOCK

Stock	Fat	Scaling %	Bone	Scaling %	Meat	Scaling %
Chicken	Frying oil	8	Wings	40	Ground chicken	75
Beef	Suet	5	Calf's foot, split	20	Ground beef	80
Veal	Frying oil	5	Veal knuckle	50	Ground veal	25
Lamb	Frying oil	5	Lamb shoulder and neck	35	Ground lamb	100
Pork	Frying oil	7.5	Pork ribs	50	Ground pork	50
Shellfish	Clarified unsalted butter	5	Lobster, shrimp, or crab shells and heads	65	Squid or scallop meat, optional	20
Vegetable	Vegetable oil	5	n/a		n/a	
Fish	Olive oil	10	Fish bones	100	n/a	

**For brown stock only*

HOW TO Make Basic Stock

Scale all other ingredients relative to the water weight. For every 1 kg of water, for example, use 400 g of chicken wings and 750 g of ground chicken meat for chicken stock. Although the amount of water used is the biggest factor in the yield, the moisture of the ingredients used, the cooking time, and the cooking method all affect the yield. The table lists suggested cooking methods, times, and temperatures. If pressure-cooking, set the pressure shown on the gauge to 1 bar / 15 psi.

1. Weigh the cold liquids.
2. Prepare stock ingredients.
3. Mix vegetables and aromatics (see Best Bets for Stock Aromatics on page 270).
4. Add stock ingredients and water and proceed with the cooking instructions in the Best Bets for Stock table above.
5. Rest until pressure cooker has depressurized, about 20 min. Strain.

WHITE STOCK

1. Follow steps 1 and 2. For the preparation step, blanch bones, if using, instead of roasting, by covering the bones in cold water and bringing to a boil.
2. In step 3, sweat the stock ingredients and aromatics in fat (see Best Bets for Stock Aromatics on page 270).
3. Follow steps 4 and 5 in the method above.

SHELLFISH STOCK

1. Follow steps 1 and 2. For the preparation step, sauté shellfish, aromatics, and tomato paste in fat on stove top (see Best Bets for Stock Aromatics on page 270).
2. Follow steps 4 and 5 in the method above.

RICH BROWN STOCK

1. Follow steps 1 and 2. For the preparation step, roast meat, bones, and vegetables (see Best Bets for Stock Aromatics on page 270). Cook at 190 °C / 375 °F for the time indicated in the table. Add tomato paste if desired.
2. Deglaze the roasting pan. Use wine or water.
3. Combine aromatics with roasted ingredients.
4. Follow steps 4 and 5 in the method above.

We did extensive experiments to develop these recipes and the methods to turn any soup or sauce into a pizza sauce.

Soups work as a sauce as long as the consistency is right, but keep in mind that soups that are quite thick when they are cold—such as gumbo, clam chowder, bisque, or other starch-thickened soups—become much thinner when they get heated in the oven. For this reason, we suggest thickening starch-based soups even a little more before applying them cold onto the dough. You can blend in 3%–4% Ultra-Tex 3 or 0.2% xanthan gum (based on total sauce weight, not scaling).

If you want to go the extra mile, we suggest using the liquid soup part as the sauce and the solids from the soup as toppings. With clam chowder, for example, keep the raw clams, crispy bacon, and cooked potatoes separate. Sauce the pizza with the soup, apply cheese, then place the toppings on the cheese and bake.

Cooked stocks must be used immediately or chilled quickly to prevent bacteria growth.

An instapot is a great option to pressure cook your stock.

Liquid	Scaling %	Preparation (brown stock only)	H	Cook	H	°C	°F
Water	100	roast meat and bones	½	pressure-cook	1½	n/a	n/a
Water	100	roast meat and bones	1	pressure-cook	2½	n/a	n/a
Red wine*	10						
Water	100	roast meat	¾	pressure-cook	2½	n/a	n/a
Madeira	15						
Water	100	roast meat	1	pressure-cook	1½	n/a	n/a
Water	100	roast meat and bones	1	pressure-cook	2	n/a	n/a
Dry white port	8						
Water	100	fry shells with tomato paste until golden brown	10 min	cook sous vide	¾	88	190
Dry vermouth	15						
Water	100	sauté sliced vegetables until golden brown	1	cook sous vide	3	85	185
Water	100	roast bones	20 min	cook sous vide	1¼	88	190
White wine	10						

STOCK, JUS, AND CONSOMMÉ SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Stock, jus, or consommé, 21 °C / 70 °F	500 g	2 cups + 2 Tbsp	100
Ultra-Tex 3	40 g	¼ cup + 3 Tbsp	8

TOTAL TIME	YIELD
Active 1-2 min	~540 g

PROCEDURE

1 Place the liquid in a tall cup.

2 Use an immersion blender to blend in the Ultra-Tex 3 until completely incorporated and thickened.

3 Store for up to 3 d in refrigeration. Do not freeze.

Stocks, jus, and consommé sauces can be used as a sauce base only for New York and artisan pizzas. For Neapolitan and Detroit-style pizzas, they need to be used as a finishing sauce. As a sauce base, use 160 g (½ cup + 3 Tbsp) for the 35 cm / 14 in artisan pizza or 400 g (1¾ cups) for the 50 cm / 20 in New York pizza, and then apply other toppings, like pizza cheese. As a secondary sauce or garnish for Neapolitan pizza, drizzle 10 g (1 Tbsp) on the finished pizza with a spoon; for a 50 cm / 20 in New York pizza, use 40 g (¼ cup). For the 35 cm by 25 cm / 14 in by 10 in Detroit-style pizza, pipe 100 g (½ cup + 2 Tbsp) of the sauce on the finished pizza with a piping bag.

If the base stock isn't salted, season with 1% salt by weight or as needed.

For more on purified ingredients, see page 1:323.

BEST BETS FOR STOCK AROMATICS

Aromatic ingredients provide flavor and aroma notes to complement the base stocks. The variations below are some typical combinations that we like.

Stock	Vegetable	Scaling %	Herb	Scaling %	Spice	Scaling %
Vegetable	Onion	33	Parsley	0.75	Black peppercorn	0.1
	Carrot	25	Bay leaf	0.01	Coriander seed	0.2
	Leek	8	Thyme	0.1	Star anise	0.2
	Tomato, peeled and seeded	8	Chive	1	n/a	n/a
	Celery	5	n/a	n/a	n/a	n/a
	Mushroom	5	n/a	n/a	n/a	n/a
Poultry	Onion	6	Parsley	0.5	Black peppercorn	0.1
	Carrot	5	Garlic	1	n/a	n/a
	Leek	5	n/a	n/a	n/a	n/a
Meat, beef	Onion	10	Thyme	0.8	Star anise	0.05
	Carrot	10	Rosemary	0.15	Garlic	1
	Celery	2	n/a	n/a	n/a	n/a
	Tomato paste (for brown stock)	5	n/a	n/a	n/a	n/a
Game, lamb	Onion	7	Bay leaf	0.01	Star anise	0.2
	Carrot	7	Thyme	1	Garlic	2
	Celery	2	Sage	0.2	Black peppercorn	0.2
Shellfish	Carrot	5	Parsley	0.25	Fennel seed	0.01
	Onion	5	Thyme	0.1	Saffron	0.005
	Leek	2	Basil	0.2	n/a	n/a
	Fennel	2	n/a	n/a	n/a	n/a
	Button mushroom	2	n/a	n/a	n/a	n/a
	Tomato paste (for brown stock)	5	n/a	n/a	n/a	n/a
Fish	Carrot	33	Garlic	2	n/a	n/a
	Onion	26	n/a	n/a	Star anise	0.3
	Leek	13	n/a	n/a	Coriander seed	0.2
	Fennel	13	n/a	n/a	n/a	n/a
	Tomato paste (for brown stock)	5	n/a	n/a	n/a	n/a

BOLOGNESE SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Ground pork	125 g	n/a	54.35
Olive oil	10 g	2¼ tsp	4.35
Onions, large dice	75 g	½ cup	32.61
Carrots, medium dice	45 g	⅓ cup	19.57
Garlic, minced	6 g	2 tsp	2.61
Canned crushed tomatoes	230 g	1 cup	100
Porcini mushroom powder	3 g	1½ tsp	1.3
Heavy cream	20 g	1 Tbsp + 1 tsp	8.7
Fine salt	5 g	¾ tsp + ⅛ tsp	2.17

TOTAL TIME	YIELD
Active 5-10 min / Inactive 45 min	~500 g

If using an instapot, set to Sauté. Follow steps 1-3. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 30 min. Lock the lid onto the pot and pressure-cook the sauce. When the instapot has depressurized, proceed with steps 6-8.

This recipe was adapted from *Modernist Cuisine at Home*.

PROCEDURE

1 Brown the pork in the oil in the base of a pressure cooker over medium-high heat, 4–5 min, stirring frequently.

2 Add the onions, carrots, and garlic, and sweat until tender, 2–3 min, stirring frequently.

3 Stir in the tomatoes and mushroom powder. Put the lid on the pressure cooker.

4 Pressure-cook at a gauge pressure of 1 bar / 15 psi for 45 min; start timing when full pressure is reached.

5 Depressurize the cooker quickly by running tepid water over the rim.

6 Stir the cream and salt into the sauce.

7 Adjust the seasoning if necessary. Cool to room temperature over an ice bath.

8 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

Artisan pizza with puttanesca sauce

PUTTANESCA SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Garlic, minced	15 g	1 Tbsp + 2 tsp	4
Olive oil	20 g	1 Tbsp + 1¼ tsp	5.33
Olives, pitted and sliced 3 mm thick	60 g	¼ cup + 3 Tbsp	16
Capers	30 g	2 Tbsp	8
Anchovy fillets (oil-packed), drained and finely minced	4 g	1 ea	1.07
Crushed red pepper flakes	0.6 g	¼ tsp	0.16
Canned crushed tomatoes	375 g	1½ cups	100

TOTAL TIME	YIELD
Active 10 min	~500 g

PROCEDURE

1 Lightly sweat the garlic in the olive oil in a medium saucepot over medium heat, about 1 min, stirring frequently.

2 Add the olives, capers, anchovies, and red pepper flakes, and lightly sweat, 1–2 min, stirring frequently.

3 Add the tomatoes, and simmer until the sauce has thickened to a paste, 7–8 min.

4 Cool to room temperature over an ice bath.

5 Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

BAGNA CAUDA SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Anchovy fillets (oil-packed), drained	90 g	23–24 ea	100
Unsalted butter	50 g	3½ Tbsp	55.56
Extra-virgin olive oil	50 g	3½ Tbsp	55.56
Garlic cloves, peeled	55 g	18–20 ea	61.11
Clam juice	75 g	¼ cup + 1 Tbsp	83.33
Dry white wine	50 g	3 Tbsp + 1 tsp	55.56
Fresh chives, minced	5 g	1 Tbsp + 2 tsp	5.56
Fresh thyme, minced	2.5 g	1 Tbsp + ⅛ tsp	2.78
Xanthan gum	0.35 g	⅛ tsp	0.39

TOTAL TIME	YIELD
Active 5-10 min / Inactive 10-15 min	~250 g

Bagna cauda means "hot bath" in Italian. It's the name for the mix of ingredients typically used to simmer shellfish.

We highly recommend pairing our bagna cauda with seafood toppings or other toppings that complement fish and seafood. The savory umami flavors in the sauce amplify the flavors found in seafood.

PROCEDURE

1 Finely chop the anchovies, then smash them to form a paste.

2 Combine the anchovy paste with the butter and olive oil in a small saucepot.

3 Grate the garlic cloves over the pan using a box grater or Microplane.

4 Cook over medium heat, stirring constantly, until the butter is melted and the garlic is fragrant.

5 Reduce the heat to medium low, and allow to cook for 2 more min.

6 Add the clam juice, wine, chives, and thyme, and cook until reduced by a third.

7 Whisk in the xanthan gum.

8 Keep warm for up to 3 h so the butter doesn't solidify.

9 Store for up to 1 wk in refrigeration. Reheat to melt before using. Freeze for up to 3 mo.

For more on purified ingredients, see page 1:323.

ALFREDO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Garlic, minced	15 g	1 Tbsp + 2 tsp	3.85
Unsalted butter	35 g	2½ Tbsp	8.97
All-purpose flour	35 g	⅓ cup	8.97
Whole milk, cold	390 g	1⅔ cups	100
Parmesan, grated	40 g	⅓ cup + 1 Tbsp	10.26
Fine salt	4 g	¾ tsp	1.03
Cayenne pepper	0.1 g	*	0.03

**You can approximate this small amount of cayenne pepper by measuring ⅛ tsp and dividing it into three equal parts. Use one part to make the sauce.*

TOTAL TIME	YIELD
Active 10–15 min / Inactive 20–25 min	~500 g

Some of the water might separate from the sauce in storage (you will see a thin film on the surface). Whisk the sauce to reincorporate the water.

PROCEDURE

1. Lightly sweat the garlic in the butter in a medium saucepot over medium heat, about 1 min, stirring frequently.
2. Add the flour, and cook until light brown, 2–3 min, whisking constantly.
3. Add the milk in a steady stream, and whisk until incorporated.
4. Bring to a boil over medium heat while whisking, then turn the heat down to medium low.
5. Simmer, stirring occasionally, until the sauce thickens, about 20 min.
6. Whisk in the Parmesan, salt, and cayenne until fully incorporated. Adjust the seasoning if necessary.
7. Cool to room temperature over an ice bath.
8. Cover the sauce with plastic wrap pressed directly over the surface to prevent a skin from forming.
9. Store for up to 3 d in refrigeration. Do not freeze.

CARBONARA SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Garlic, minced	15 g	1 Tbsp + 2 tsp	4.55
Unsalted butter	25 g	1 Tbsp + 2¼ tsp	7.58
All-purpose flour	25 g	3 Tbsp + 1 tsp	7.58
Whole milk, cold	330 g	1⅓ cups + 2 Tbsp	100
Rendered bacon lardons	70 g	½ cup + 2 Tbsp	21.21
Parmesan, grated	35 g	⅓ cup	10.61
Fine salt	3.3 g	½ tsp + ⅛ tsp	1
Ground black pepper	1.5 g	½ tsp + ⅛ tsp	0.45

TOTAL TIME	YIELD
Active 10–15 min / Inactive 20–25 min	~500 g

PROCEDURE

1. Lightly sweat the minced garlic in the butter in a medium saucepan over medium heat, about 1 min, stirring frequently.
2. Add the flour, and cook until light brown, 2–3 min, whisking constantly.
3. Add the milk in a steady stream, and whisk until incorporated.
4. Bring to a boil over medium heat while whisking, then turn the heat down to medium low.
5. Simmer, stirring occasionally, until the sauce thickens, about 20 min.
6. Whisk in the lardons, Parmesan, salt, and pepper until fully incorporated. Adjust the seasoning if necessary.
7. Cool to room temperature over an ice bath.
8. Cover the sauce with plastic wrap pressed directly over the surface to prevent a skin from forming.
9. Store for up to 3 d in refrigeration. Do not freeze.

We use this sauce on our Carbonara Pizza (see page 3:189). Carbonara sauce typically contains raw eggs and is usually added to hot cooked pasta just before it is served. In order for this sauce to hold, we had to keep the eggs separate. The carbonara sauce is spread over the pizza dough and baked.

Once the pizza comes out of the oven we add a soft egg just before serving. You can also drizzle with Egg Yolk Sauce (see next page) instead. Doing it this way keeps the eggs from overcooking and evokes carbonara pasta.

Some of the water might separate from the sauce in storage (you will see a thin film on the surface). Whisk the sauce to reincorporate the water.

EGG YOLK SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Egg yolks, large	200 g	10 ea	100

TOTAL TIME	YIELD
Active 5 min / Inactive 45 min	~200 g

PROCEDURE

1 Whisk the egg yolks together.

2 Vacuum seal.

3 Cook sous vide in a 67° C / 153° F water bath for 45 min.

4 Cool to room temperature.

5 Reserve in a piping bag or squeeze bottle for use.

6 Hold at room temperature for up to 3 h. Discard any leftovers.

This sauce should always be applied once the pizza comes out of the oven. The yolks are cooked in a 67° C / 153° F water bath to just set. If they get any hotter, their texture will change and harden instead of being creamy and smooth.

CACIO E PEPE SAUCE

INSPIRED BY STEFANO CALLEGARI

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Wondra flour	8 g	1 Tbsp + ¼ tsp	5.33
Xanthan gum	1.35 g	½ tsp	0.9
Water	225 g	1 cup	150
Unsalted butter	150 g	⅔ cup	100
Cracked black pepper	2 g	¾ tsp + ⅛ tsp	1.33
Pecorino Romano cheese, finely grated	300 g	3 cups	200

TOTAL TIME	YIELD
Active 5-10 min	~650 g

If you want a looser sauce, simply mix in heavy cream in small additions until you reach the desired consistency.

For more on purified ingredients, see page 1:323.

PROCEDURE

1 Blend the Wondra flour and xanthan gum together. Sprinkle the mixture over the water while blending with an immersion blender. Set aside.

2 Melt the butter in a medium saucepot over medium heat until the butter solids turn brown.

3 Whisk in the Wondra mixture and the pepper.

4 Stir in the cheese to melt completely.

5 Keep at 21° C / 70° F for up to 3 h.

6 Store for up to 3 d in refrigeration. Do not freeze.

LAKSA SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Laksa paste	110 g	½ cup	15.71
Toasted sesame oil	15 g	1 Tbsp + ¼ tsp	2.14
Chicken stock	700 g	3 cups	100
Coconut milk, full-fat	200 g	¾ cup + 1 Tbsp	28.57
Palm sugar, minced	30 g	2 Tbsp + 1 tsp	4.29
Unsalted butter	50 g	¼ cup	7.14
All-purpose flour	50 g	⅓ cup + 1 Tbsp	7.14
Fine salt	3 g	½ tsp	0.43

TOTAL TIME	YIELD
Active 15-20 min / Inactive 45 min-1 h	~700 g

This recipe yields a lot more than some of the others in this chapter, and the reason is simple. If you're going through the trouble of procuring all of these ingredients (some of them may be specialized) and spending the time to make the sauce, you might as well make a large batch and freeze the leftovers.

PROCEDURE

1 Sauté the paste in the oil in a medium saucepot over medium heat until lightly caramelized, 5-7 min, stirring occasionally.

2 Deglaze with the chicken stock.

3 Simmer to meld the flavors, about 10 min.

4 Remove from the heat, and stir in the coconut milk and palm sugar.

5 Cool to room temperature. Measure 600 g of the liquid.

6 Combine the butter and flour in a small saucepot.

7 Cook over medium heat, whisking occasionally, to make a pale-brown roux, about 7 min.

8 Pour the cooled sauce base over the hot roux and bring to a boil, whisking constantly.

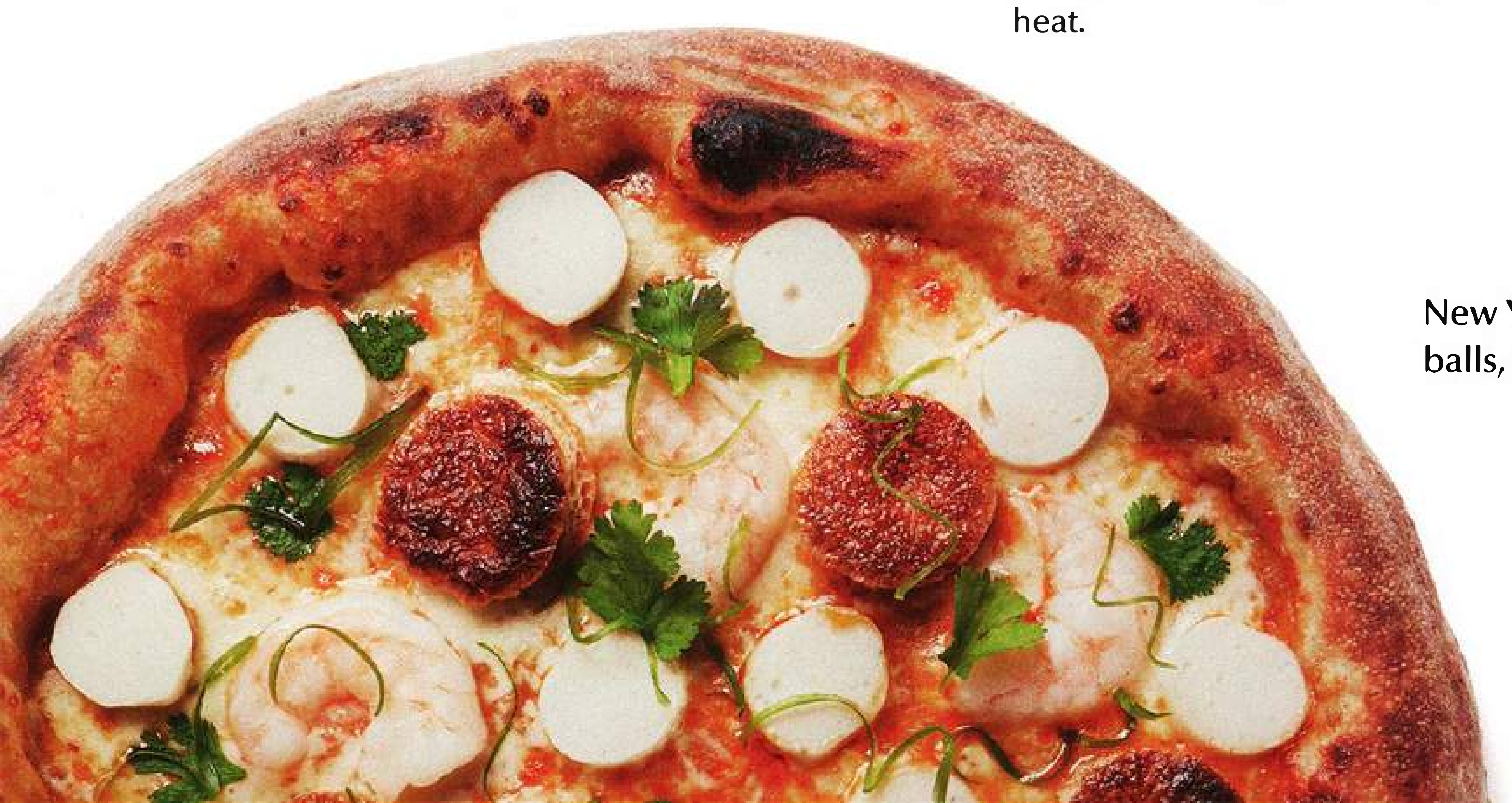
9 Reduce the heat and simmer to thicken the sauce, 25-30 min, then remove from the heat.

10 Add the salt. Adjust the seasoning if necessary.

11 Cool to room temperature over an ice bath.

12 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

If you do not want to thicken the sauce with a roux, you can replace the butter and flour with 7.2 g (1 Tbsp + 1⅛ tsp) low-acyl gellan gum. Sprinkle it on top of the cooled sauce base in step 5. Let it hydrate for 3-5 min, and then whisk it in. Bring the sauce base to a boil, whisking constantly. Season to taste with salt. Chill over an ice bath until fully set into a gel. Blend the set gel into a puree. The pureed sauce is best used at room temperature.



New York pizza with laksa sauce, shrimp, fish balls, tofu puffs, cilantro, and scallions

BISQUE SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Onions, sliced	100 g	¾ cup + 2 Tbsp	13.33
Carrots, sliced	100 g	¾ cup	13.33
Garlic cloves, sliced	10 g	1–2 ea	1.33
Extra-virgin olive oil	15 g	1 Tbsp + ¼ tsp	2
Shrimp, peeled, heads on	500 g	n/a	66.67
Tomato paste	10 g	1¾ tsp	1.33
Thyme sprigs	3 g	2 ea	0.4
Cognac	25 g	1 Tbsp + 2 tsp	3.33
Water	750 g	3¼ cups	100
Heavy cream	75 g	⅓ cup	10
Unsalted butter	70 g	⅓ cup	9.07
All-purpose flour	70 g	½ cup + 1 Tbsp	9.07
Fine salt	5 g	¾ tsp + ⅛ tsp	0.67

TOTAL TIME	YIELD
Active 20-25 min / Inactive 45 min-1 h	~950 g

If using an instaspot, set to Sauté. Follow steps 1–5. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 30 min. Lock the lid onto the pot and pressure-cook the sauce. When the instapot has depressurized, proceed with steps 8–16.

PROCEDURE

1 Sweat the onions, carrots, and garlic in the oil in the base of a pressure cooker over medium-high heat until tender, 3–4 min, stirring frequently.

2 Add the shrimp, and cook until pink, 1–2 min, stirring frequently.

3 Add the tomato paste and thyme sprigs. Cook until the tomato paste just starts to stick, about 1 min.

4 Deglaze the cooker with the cognac, and reduce until almost dry, about 1 min.

5 Add the water, and bring to a boil. Put the lid on the pressure cooker.

6 Pressure-cook at a gauge pressure of 1 bar / 15 psi for 30 min.

7 Depressurize the cooker quickly by running tepid water over the rim.

8 Strain. Measure 750 g of the strained liquid, and let cool.

9 Whisk the cream into the cooled liquid until fully incorporated.

10 Combine the butter and flour in a small saucepot.

11 Cook over medium heat, whisking occasionally, to make a pale-brown roux, about 7 min.

12 Pour the cooled sauce base over the hot roux and bring to a boil, whisking constantly.

13 Reduce the heat and simmer to thicken the sauce, 25–30 min, then remove from the heat.

14 Add the salt. Adjust the seasoning if necessary.

15 Cool to room temperature over an ice bath.

16 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

This recipe yields a lot more than some of the others in this chapter, and the reason is simple. If you're going through the trouble of procuring all of these ingredients (some of them may be specialized) and spending the time to make the sauce, you might as well make a large batch and freeze the leftovers.

If you do not want to thicken the sauce with a roux, you can replace the butter and flour with 6.6 g (1 Tbsp + ¾ tsp) low-acyl gellan gum. Sprinkle it on top of the cooled sauce base after adding the heavy cream in step 9. Let it hydrate for 3–5 min, and then whisk it in. Bring the sauce base to a boil, whisking constantly. Season to taste with salt. Chill over an ice bath until fully set into a gel. Blend the set gel into a puree. The pureed sauce is best used at room temperature.

New York pizza with bisque sauce, shrimp, mussels, lobster, and chives

GUMBO SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Red bell peppers, sliced	200 g	2 cups	26.6
Onions, sliced	100 g	¾ cup + 2 Tbsp	13.3
Celery, sliced	100 g	¾ cup	13.3
Garlic cloves, sliced	10 g	2 ea	1.3
Extra-virgin olive oil	15 g	1 Tbsp + ¼ tsp	2
Shrimp, peeled, heads on	500 g	n/a	66.6
Tomato paste	10 g	1¾ tsp	1.3
Smoked ham hock	300 g	n/a	40
Gumbo filé	3 g	¾ tsp	0.4
Water	750 g	3¼ cups	100
Unsalted butter	100 g	⅓ cup + 2 Tbsp	12.9
All-purpose flour	100 g	¾ cup + 1 Tbsp	12.9
Fine salt	6 g	1⅛ tsp	0.8

TOTAL TIME	YIELD
Active 30–35 min / Inactive 1¼–1½ h	~1.5 kg

This recipe yields a lot more than some of the others in this chapter, and the reason is simple. If you're going through the trouble of procuring all of these ingredients (some of them may be specialized) and spending the time to make the sauce, you might as well make a large batch and freeze the leftovers.

If you do not want to thicken the sauce with a roux, you can replace the butter and flour with 7.6 g (1 Tbsp + 1¼ tsp) low-acyl gellan gum. Sprinkle it on top of the cooled sauce base in step 8. Let it hydrate for 3–5 min, and then whisk it in. Bring the sauce base to a boil, whisking constantly. Season to taste with salt. Chill over an ice bath until fully set into a gel. Blend the set gel into a puree. The pureed sauce is best used at room temperature.

PROCEDURE

1. Sweat the red peppers, onions, celery, and garlic in the oil in the base of a pressure cooker over medium-high heat until tender, 5–6 min, stirring frequently.
2. Add the shrimp, and cook until pink, 1–2 min, stirring frequently.
3. Add the tomato paste, and cook until it just starts to stick, about 1 min.
4. Add the ham hock and gumbo filé.
5. Add the water, and bring to a boil. Put the lid on the pressure cooker.
6. Pressure-cook at a gauge pressure of 1 bar / 15 psi for 1 h.
7. Depressurize the cooker quickly by running tepid water over the rim.
8. Strain. Measure 950 g of the strained liquid, and let cool.
9. Combine the butter and flour in a small saucepot.
10. Cook over medium heat, whisking occasionally, to make a dark-brown roux, about 10 min.
11. Pour the cooled sauce base over the hot roux and bring to a boil, whisking constantly.
12. Reduce the heat and simmer to thicken the sauce, 25–30 min, then remove from the heat.
13. Add the salt. Adjust the seasoning if necessary.
14. Cool to room temperature over an ice bath.
15. Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

If using an instapot, set to Sauté. Follow steps 1–5. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 1 h. Lock the lid onto the pot and pressure-cook the sauce. When the instapot has depressurized, proceed with steps 8–15.

Artisan pizza with gumbo sauce, andouille sausage, chicken thigh, crawfish, and sliced okra

CLAM CHOWDER SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Onions, sliced	250 g	2 cups	71.43
Celery, sliced	125 g	1 cup	35.71
Garlic clove, sliced	8 g	1 ea	2.29
Extra-virgin olive oil	15 g	1 Tbsp + ¼ tsp	4.29
Clam juice	350 g	1½ cups	100
Whole milk	200 g	¾ cup + 2 Tbsp	57.14
Unsalted butter	60 g	¼ cup	17.14
All-purpose flour	60 g	½ cup	17.14
Fine salt	5 g	¾ tsp + ⅛ tsp	1.43

TOTAL TIME	YIELD
Active 15–20 min / Inactive 45 min–1 h	~800 g

If using an instapot, set to Sauté. Follow steps 1 and 2. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 30 min. Lock the lid onto the pot and pressure-cook the sauce. When the instapot has depressurized, proceed with steps 5–13.

PROCEDURE

1 Sweat the onions, celery, and garlic in the oil in the base of a pressure cooker over medium-high heat until tender, 5–6 min, stirring frequently.

2 Add the clam juice, and bring to a boil. Put the lid on the pressure cooker.

3 Pressure-cook at a gauge pressure of 1 bar / 15 psi for 30 min.

4 Depressurize the cooker quickly by running tepid water over the rim.

5 Strain. Measure 490 g of the strained liquid, and let cool.

6 Whisk the milk into the cooled liquid until fully incorporated.

7 Combine the butter and flour in a small saucepot.

8 Cook over medium heat, whisking occasionally, to make a pale-brown roux, about 7 min.

9 Pour the cooled sauce base over the hot roux and bring to a boil, whisking constantly.

10 Reduce the heat and simmer to thicken the sauce, 25–30 min, then remove from the heat.

11 Add the salt. Adjust the seasoning if necessary.

12 Cool to room temperature over an ice bath.

13 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

This recipe yields a lot more than some of the others in this chapter, and the reason is simple. If you're going through the trouble of procuring all of these ingredients (some of them may be specialized) and spending the time to make the sauce, you might as well make a large batch and freeze the leftovers.

If you do not want to thicken the sauce with a roux, you can replace the butter and flour with 4.4 g (2½ tsp) low-acyl gellan gum. Sprinkle it on top of the cooled sauce base after adding the milk in step 6. Let it hydrate for 3–5 min, and then whisk it in. Bring the sauce base to a boil, whisking constantly. Season to taste with salt. Chill over an ice bath until fully set into a gel. Blend the set gel into a puree. The pureed sauce is best used at room temperature.

Artisan pizza with clam chowder sauce, steamed potato slices, sliced celery, clams, and fresh parsley

VEGETABLE- AND FRUIT-BASED SAUCES

The purees featured in the following pages can add bold flavor and provide the foundation for imaginative pizzas. We start with a general recipe for pressure-caramelized vegetable sauce that relies on a method that we developed when we were writing *Modernist Cuisine*. We also use purees to add flavor and color to a variety of pizza doughs on pages 186–191.

Vegetables are made up of cells with strong walls that soften at higher temperatures than the cells in meat do. Vegetables are composed mostly of water, however, and their temperature normally won't exceed the boiling point of water (100°C / 212°F) until they are dried out.

Cooking at elevated pressures gives us a way around this roadblock because the boiling point rises in step with the pressure. Even at 120°C / 250°F, vegetables in a fully pressurized cooker don't dry out because they quickly become tender. And because the air is sealed in, you don't need as much water, so juices are extracted without becoming diluted.

When we combine the effectiveness of a pressure cooker with our recipe for pressure-caramelizing vegetables, we obtain particularly rich results. The resulting sauce intensifies the caramelization of sugars and concentrates the flavors through the alkalinity of the baking soda and the heat buildup in the pressure cooker.

Other recipes included in this section span a variety of flavors and textures, from a curried onion sauce to a salsa verde. We'd have to write a separate book to include every type of vegetable- or fruit-based sauce. You'll find a selection of our favorites in the coming pages.

PRESSURE-CARAMELIZED VEGETABLE SAUCE

TOTAL TIME	YIELD
Active 5 min / Inactive 50 min–1 h	~575 g

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Vegetables, such as carrots or other root vegetables, broccoli, or cauliflower	500 g	varies	100
Unsalted butter	80 g	⅓ cup	16
Baking soda	2.5 g	½ tsp	0.5
Fine salt	5 g	1 tsp	1

PROCEDURE

1 Prepare your vegetables as you would for roasting (see page 361).

2 Melt the butter in the base of a pressure cooker over medium-high heat.

3 Add the vegetables and baking soda. Stir so that the baking soda is evenly incorporated and the butter coats all of the vegetables. Put the lid on the pressure cooker.

4 Pressure-cook at a gauge pressure of 1 bar / 15 psi for 50 min.

5 Depressurize the cooker quickly by running tepid water over the rim.

6 Blend the vegetables in the cooker with an immersion blender. Add half the salt and taste the sauce. Adjust the seasoning if necessary.

7 Cool to room temperature over an ice bath.

8 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

If the resulting puree is too thin, you can cook it in the same pot over medium heat to evaporate some of the moisture; stir frequently to prevent scorching at the bottom of the pot. If the puree is too thick, you can make it looser by adding water, heavy cream, or vegetable stock.

If using an instapot, set to Sauté. Follow steps 1–3. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 50 min. Lock the lid onto the pot and pressure-cook the vegetables. When the instapot has depressurized, proceed with steps 6–8.

One of our favorite vegetables to use for this method is carrots.

New York pizza with pressure-caramelized zucchini sauce, roasted green and yellow zucchini, browned butter, sage, and Parmigiano-Reggiano

PRESSURE-CARAMELIZED ZUCCHINI SAUCE

INSPIRED BY DRY

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Unsalted butter	100 g	½ cup	25
Zucchini, thinly sliced	400 g	4 cups	100
Baking soda	2 g	½ tsp	0.5
Fine salt	as needed		

TOTAL TIME	YIELD
Active 10 min / Inactive 30 min	~500 g

PROCEDURE

1 Melt the butter in the base of a pressure cooker over medium-high heat.

2 Add the zucchini and baking soda. Stir so that the baking soda is evenly incorporated and the butter coats all of the zucchini slices. Put the lid on the pressure cooker.

3 Pressure-cook at a gauge pressure of 1 bar / 15 psi for 25 min.

4 Depressurize the cooker quickly by running tepid water over the rim.

5 Transfer the contents of the pressure cooker to a blender, and puree until smooth.

6 Add the salt.

7 Cool to room temperature over an ice bath.

8 Store for up to 2 d in refrigeration. Do not freeze.

If using an instapot, set to Sauté. Follow steps 1–2. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 50 min. Lock the lid onto the pot and pressure-cook the sauce. When the instapot has depressurized, proceed with the remaining steps.

CURRIED ONION SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Yellow onions, thinly sliced	720 g	6 cups	100
Garlic, minced	20 g	2 Tbsp + 2 tsp	2.78
Ginger, minced	20 g	2 Tbsp + 2 tsp	2.78
Ghee	60 g	¼ cup	8.33
Curry spice mix	24 g	3 Tbsp + ¾ tsp	3.33
Fine salt	6 g	1⅛ tsp	0.83

TOTAL TIME	YIELD
Active 10–15 min	~825 g

If the resulting sauce is too thick to be spreadable, adjust the consistency with water.

PROCEDURE

1 Lightly sweat the onions, garlic, and ginger in the ghee in a large saucepot over medium heat, 8–10 min.

This recipe yields a lot more than some of the others in this chapter, and the reason is simple. If you're going through the trouble of procuring all of these ingredients (some of them may be specialized) and spending the time to make the sauce, you might as well make a large batch and freeze the leftovers.

2 Add the curry, and sweat until the ghee starts to separate from the mixture, 2–3 min.

3 Transfer to a blender, and puree until smooth. Add the salt, and adjust the seasoning if necessary.

4 Store for up to 4 d in refrigeration. Freeze for up to 3 mo.

FRENCH ONION SAUCE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Onions, sliced	575 g	4¾ cups	100
Garlic, minced	10 g	1 Tbsp	1.74
Olive oil	30 g	2 Tbsp	5.22
Fresh thyme leaves	1 g	1⅛ tsp	0.17
Brandy	105 g	½ cup	18.26
Fine salt	6 g	1⅛ tsp	1.04

TOTAL TIME	YIELD
Active 20–25 min / Inactive 10–15 min	~550 g

This delicious sauce mimics the flavors that you would find in French onion soup. We recommend pairing it with grated Gruyère and topping it with toasted Panko bread crumbs to fully flesh out the flavor profile.

PROCEDURE

1 Lightly brown the onions and garlic in the olive oil in a medium sauté pan over medium-high heat, stirring frequently, 10–15 min.

You can leave the sauce as is or make a smooth onion puree by blending it.

2 Add the thyme, and deglaze with the brandy. Reduce until dry.

3 Add the salt.

4 Cool to room temperature over an ice bath.

5 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

Artisan pizza with French onion sauce, toasted panko crumbs, and Parmigianno-Reggiano

SALSA VERDE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Tomatillos, husks removed	390 g	11 ea	100
White onions, quartered	260 g	2 ea	66.67
Jalapeños	65 g	5 ea	16.67
Olive oil	30 g	2 Tbsp + ½ tsp	7.69
Fine salt	5 g	¾ tsp + ⅛ tsp	1.28

TOTAL TIME	YIELD
Active 20-25 min	~650 g

PROCEDURE

1 Char the tomatillos, onions, and jalapeños on a hot flattop or large sauté pan over high heat. (Alternatively, place the vegetables on a wire rack set over a sheet pan, and char them using a blowtorch; see page 363.)

2 Stem and seed the jalapeños (you can leave the seeds in, but this will increase the spiciness).

3 Combine the tomatillos, onions, and jalapeños in a medium saucepot with the olive oil. Sweat over medium heat until tender.

4 Blend the sauce with an immersion blender until smooth.

5 Add the salt, and adjust the seasoning if necessary.

6 Cool to room temperature over an ice bath.

7 Store for up to 3 d in refrigeration. Freeze for up to 3 mo.

Artisan pizza with salsa verde, pizza cheese, huitlacoche confit, chorizo, and red peppers

CHAPTER 9

CHEESE

CHEESE

It's hard to think of pizza without thinking about cheese. Sure, there's one very famous and very traditional cheeseless pizza, the Marinara Pizza (see page 3:52), but most of the time, when we eat pizza, we're expecting cheese. People in the business of marketing pizza know this. That's why you see so many images of ooey-gooey cheese in pizza advertising. It's what immediately comes to mind when we're thinking about the classic New York pizza: biting into a slice and getting that stretchy and magnificent "cheese pull." While a cheeseless pizza is fine every once in a while, we like our cheese. It's got flavor. It's got texture. And it's very satisfying.

Cheeses can be classified in a number of different ways. The source of the milk is one way. Whether you use cow's, buffalo's, sheep's, goat's, or even camel's milk, it will play a big role in the flavor and texture of the finished cheese. Cheese can also be classified in terms of texture: very hard, hard, semihard, semisoft, or soft. Texture in cheese has a lot to do with moisture content, which is a very important consideration in pizza making. Cheeses can also be differentiated in terms of the coagulating agent used (rennet or acid) and their microflora. Some have internal mold, while others have surface mold; there may be surface yeasts and/or bacteria giving cheeses specific aroma and flavor. Some have propionic acid bacteria (which helps make the "eyes" in Swiss cheese). Cheeses can vary based on where they're produced, since different countries have different regulations for the cheese-making process. Following one set of rules versus another when it comes to virtually any decision at the farming, processing, and maturing levels can dramatically impact the finished product. While these variations exist in cheese, the recipes are more alike than they are different. And these small differences are what give cheeses their distinct characteristics. In this way, cheese is comparable to bread or wine, particularly since all involve microorganisms.

In pizza terms, we think there's another means of categorization: when the cheese is added to the pizza. Some cheeses are best added before the pizza goes in the oven and others work better when they're added after the bake, depending on whether or not (or how) the cheese melts. Misjudging the timing can affect how your pizza turns out. For example, you'd never put cold mozzarella onto a fully baked pizza (unless you are making Ohio Valley–style pizza; see page 1:105); it needs to be put on the pizza just before it's baked so it melts completely. Parmesan, on the other hand, can be grated onto a hot-from-the-oven pizza with lovely results, but it can also be added before baking and still turn out great. And cheeses like Taleggio or blue cheese should generally be applied after baking so that they don't melt and disappear into the pizza (we've developed a technique to prevent this, however, and created a blue cheese that'll melt like mozzarella; see page 332). We've included a table on page 304 that will help you get the amounts just right.

Alas, we don't cover *every* cheese in this chapter (there are far too many varieties, which entire books are devoted to). Here, we focus on the cheeses commonly used on pizzas, plus a few of our other favorites.

Over 5.1 billion pounds of Italian-style cheeses were produced in the United States in 2018, making it the top category in natural cheese production. According to the USDA, mozzarella, or what we call pizza cheese, was by far the largest share, at just under 4 billion pounds.

For pizza purposes, it makes the most sense to think about cheeses in terms of moisture content. The moisture content will dictate how it behaves in a hot oven, how long it can be in the heat, and whether it's best to apply it before or after baking.

For those who want to make cheese at home, the amount of milk needed to make a relatively small amount of cheese can be a hurdle (see page 287). Cheese makers typically raise their own cows for milk or have a special deal with a dairy farmer to make their production possible. This means it's tough to beat a professional operation cost-wise, but making cheese at home is fun and there are advantages.

NEW DISCOVERIES AND TECHNIQUES

MILK

Cows were first brought to the North American continent in 1525, at Veracruz, Mexico. The first cows arrived in what would become the United States in 1611 at the Jamestown Colony.

Farmhouse (or farmstead) cheeses are vertically integrated operations where the milk and cheese are made on site (usually by hand). They typically use traditional methods to make their cheeses and some cross the borders between standard cheese categorization.

Carotenoid pigments are part of the reason that butter from cow's milk is yellow and that goat's milk is so white. Goats and cows both obtain the pigments from their diet, but goats break down the carotenoids differently, so the pigments do not appear in their milk.

When we talk about milk from any other animal besides cows, we'll specify, say, sheep's milk or goat's milk. For example, we expressly say buffalo's milk mozzarella (or mozzarella di bufala) when we're talking about the milk to make that specific cheese.

In general conversation, when we say "milk," we're talking about cow's milk. Cow's milk can come from Holstein Friesian, Jersey, Brown Swiss, Guernsey, Ayrshire, Milking Shorthorn, or a number of other breeds. The milk that you buy at the grocery store is almost all from Holsteins, due to their high production. This is a little bit like if the only wine was Chardonnay. The generic milk market is itself homogeneous! Different breeds of cattle produce different milks (and different animals produce milk). Holstein milk is not well suited to cheese making, however. The majority of commercially produced cheeses are made from cow's milk.

In larger cheese-making operations, milk from different herds of cows, buffalo, goats, or sheep is blended to standardize the butterfat and casein content before starting cheese production. For smaller farmhouse cheese makers, which often make their cheeses from a single herd, the breed is more important because certain types of cows, like Ayrshire or Milking Shorthorn, produce milk that is better suited to making cheese (the ratio of butterfat to protein and the amount of lactic acid bacteria need to be within a certain range). Certain famous cheeses are even regulated by rules about the types of cow's milk that can be used to make the cheese, such as Comté, which must be made from the milk of Simmental or Montbéliarde cows. The breed is only one part of the equation, however. The farming practices used to raise the animals have a critical impact on the texture and melting profile of the resulting cheese because the fatty acid composition of cheese made from the milk of grass- or grain-fed animals can be radically different.

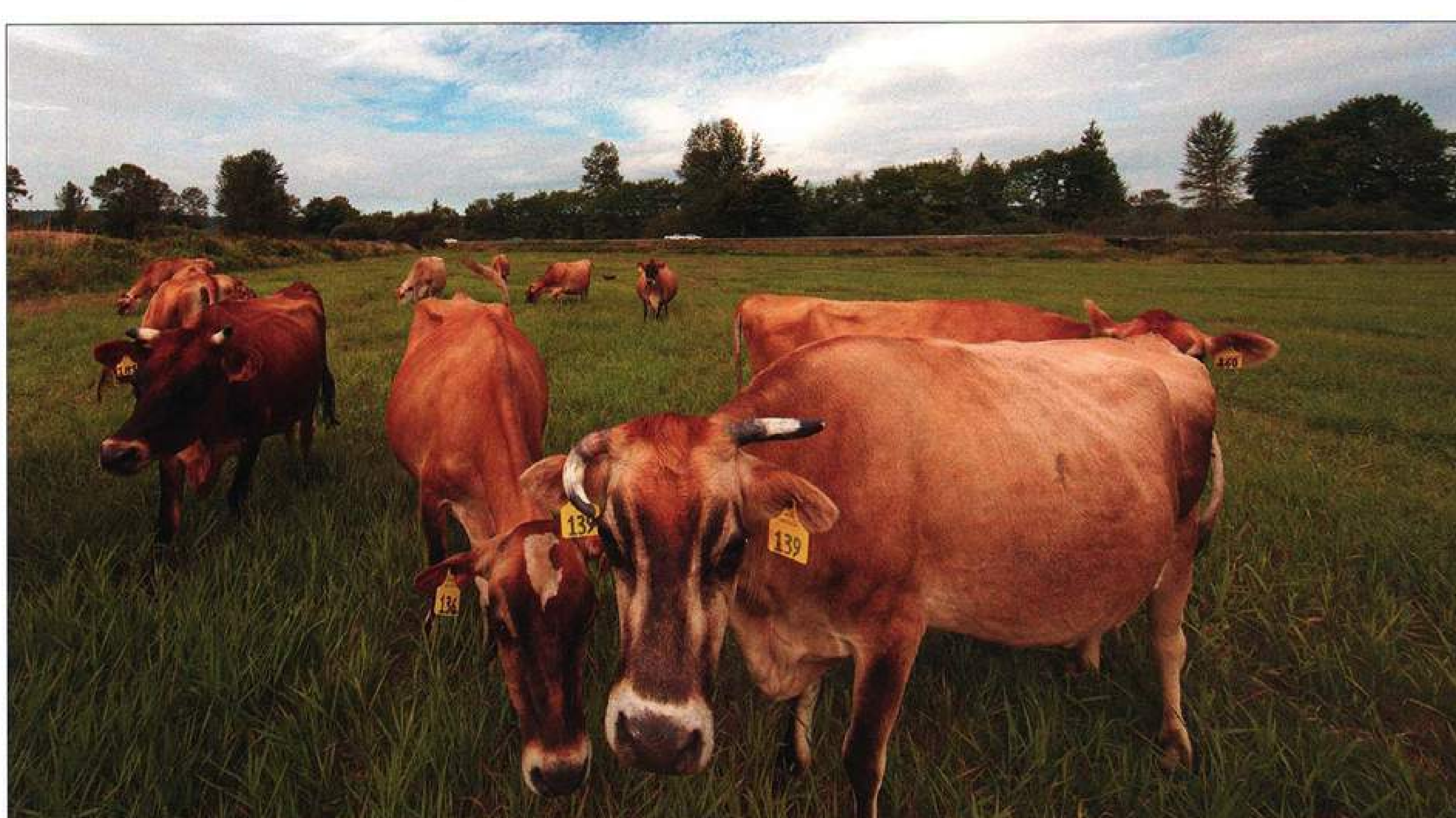
In some ways, the type of milk used isn't the key determinant of the final cheese result. You can buy mozzarella made from buffalo's milk or cow's milk (called fior di latte mozzarella), but we also successfully made a goat's milk mozzarella (see page 329). The flavors of these cheeses will be different, but they're still mozzarella. We've found that the type of milk used is far less important than the skill of the cheese maker and the process used.

Buffalo's milk contains roughly twice the milk fat of cow's milk, which makes it especially prized for cheese making (see page 290). Unlike cow's milk, buffalo's milk contains no beta-carotene since the buffalo have the ability to metabolize it into vitamin A. The higher fat content and larger fat globules of buffalo's milk also play a role in its color: they scatter light better, making it more opaque. When baked, the drained mozzarella di bufala showed almost no sign of browning.

THE COMPOSITION OF COW'S MILK

Milk is interesting stuff. It serves as a nutritionally complete meal to newborn mammals who often don't have the ability to eat solid foods for the first few months of their life. And due to its composition, you can transform liquid milk into solid matter. Depending on how you do it and what you use to do it, you can obtain hundreds of different results, all called cheese. (On average, it takes 1 kg of milk to make 100 g of cheese.)

Milk is approximately 87% water and 13% solids. These solids, on average, are made up of 25% fat. Whole milk contains no less than 3.25% milk fat. The milk fat is made up of individual fatty molecules (in



Jersey cows are known for producing high butterfat and protein in their milk, which makes it great for drinking and for making soft and semisoft cheeses (you'll also get more curds per gallon of milk).

the form of milk fat globules), the most common of which is called triglyceride (which, you guessed it, has three fatty acids). Milk also contains mono- and diglycerides, which are used as emulsifiers in certain foods, such as ice cream. Of all the edible fats, milk fat has the most complex composition, with over 400 individual fatty acids. Most of the pleasant flavors we identify in milk and dairy products come from these fatty acids.

Cow's milk is about 3.9% protein, though this amount can vary depending on the cow and what it eats. Feed can have an impact. Farmers have an old adage: breed for protein, feed for fat. (By "breed" they mean select the breed.) About 20% of the milk protein is whey (serum) and 80% is casein. (There are also tiny fractions of some minor proteins.) Casein is a key part of dairy cheese making. In acid-coagulated cheeses (though this method isn't used to make the majority of cheeses; see page 292), the casein protein coagulates at a pH of 4.6, and that coagulation forms the curd cheese makers use to make their product. The serum or whey proteins leave the curd with the whey in the cheese-making process.

There are carbohydrates in milk, too, and it's easiest to think of them as sugars. We've all heard the term "lactose"—that's the sugar in milk. Any browning that occurs in cheese is a Maillard reaction that involves these sugars. (The ending "-ose" indicates sugar.) Lactose is a disaccharide, which means each molecule is made up of two other sugar molecules stuck together (in this case galactose and glucose), and it's found dissolved in the whey part of milk. Some people are lactose intolerant and are unable to digest lactose. When you buy fat-free milk powder, you are mostly buying lactose and protein.

Milk contains a number of vitamins and minerals, including A, B, C, E, and K as well as folate and calcium. It's often fortified with vitamin D (originally added to help prevent rickets).

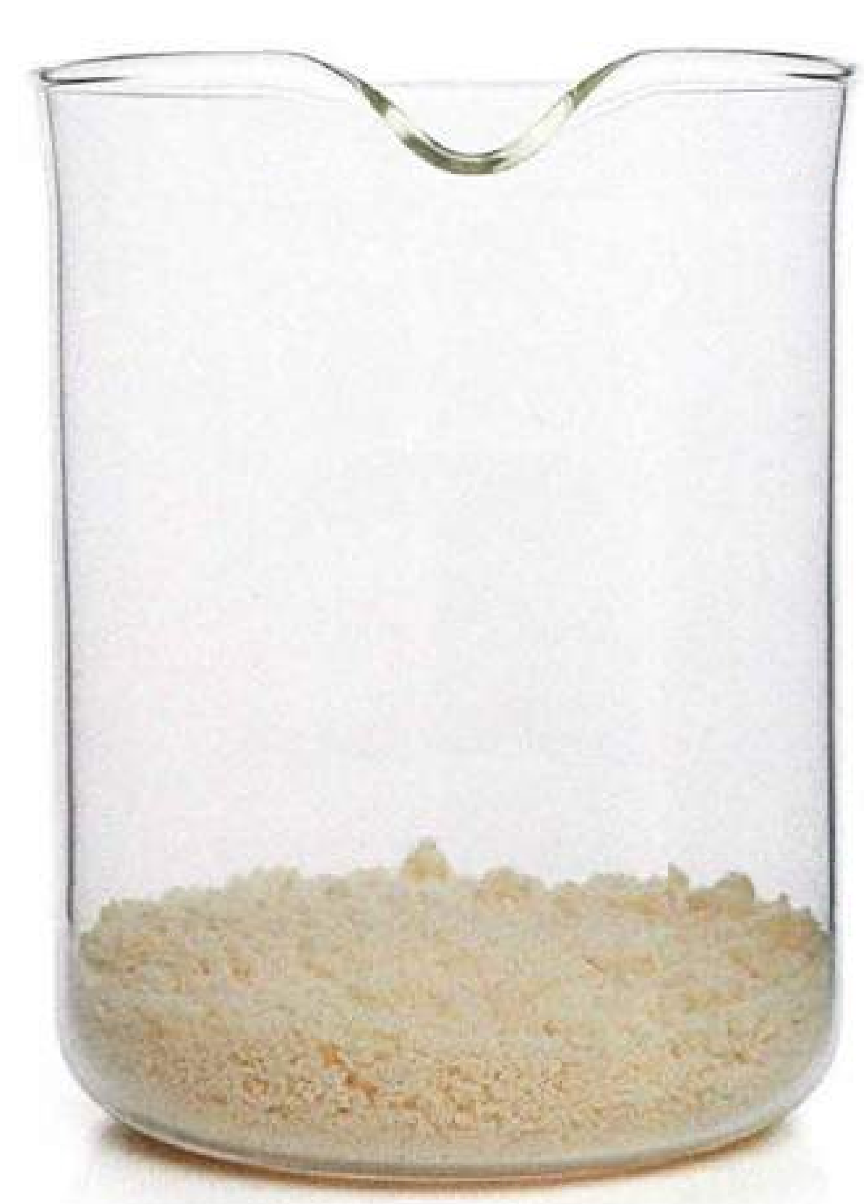
While some people worry about the fat content in milk due to caloric intake, what they should be thinking about more is the sugar (lactose) content in milk, which is close to 5%.

It takes 485 L / 128 gallons of milk to make a 30 kg / 66 lb wheel of Parmigiano-Reggiano (this is the minimum weight required for a single wheel).

Mozzarella di bufala
238 g / 8.4 oz

Fior di latte mozzarella
133 g / 4.69 oz

Pizza cheese
90 g / 3.17 oz



Parmigiano-Reggiano
60 g / 2.12 oz

Ever wondered why cheese is so much more expensive than milk? The images above show the amount of cheese you get from 1 L (34 oz) of milk (buffalo's milk for the mozzarella di bufala and cow's milk for the rest) to scale. Another factor that you have to consider is that some cheeses are aged for a significant amount of time (a minimum of 1 year in the case of Parmigiano-Reggiano, although most of that cheese is sold at 2-3 years old). In addition to not being able to turn a profit during the aging period, the cheese makers must give care and attention to make sure that the cheeses are aging correctly. It's fascinating to think that on a single pizza you can have cheese that's a day old or less and cheese that's years old, both made from the same ingredient.

RAW VERSUS PASTEURIZED MILK

When you buy cheese, you may notice the ingredient list indicating whether it was made with either pasteurized milk or raw milk, meaning it wasn't pasteurized. What's the difference? Advocates for raw milk say that pasteurizing the milk destroys some of its nutritional value and that raw milk simply tastes better. In addition, raw milk has a more diverse community of microbes, which contributes to a more complex flavor in the cheese. So why pasteurize? Because this heat-treatment step kills off any harmful bacteria in the milk (people with compromised immune systems and pregnant women are advised against drinking raw milk and eating cheese made from it). Before choosing your cheeses, it's worth learning a little more about the potential for contamination, as well as the differences between raw milk in fluid form and raw milk cheeses.

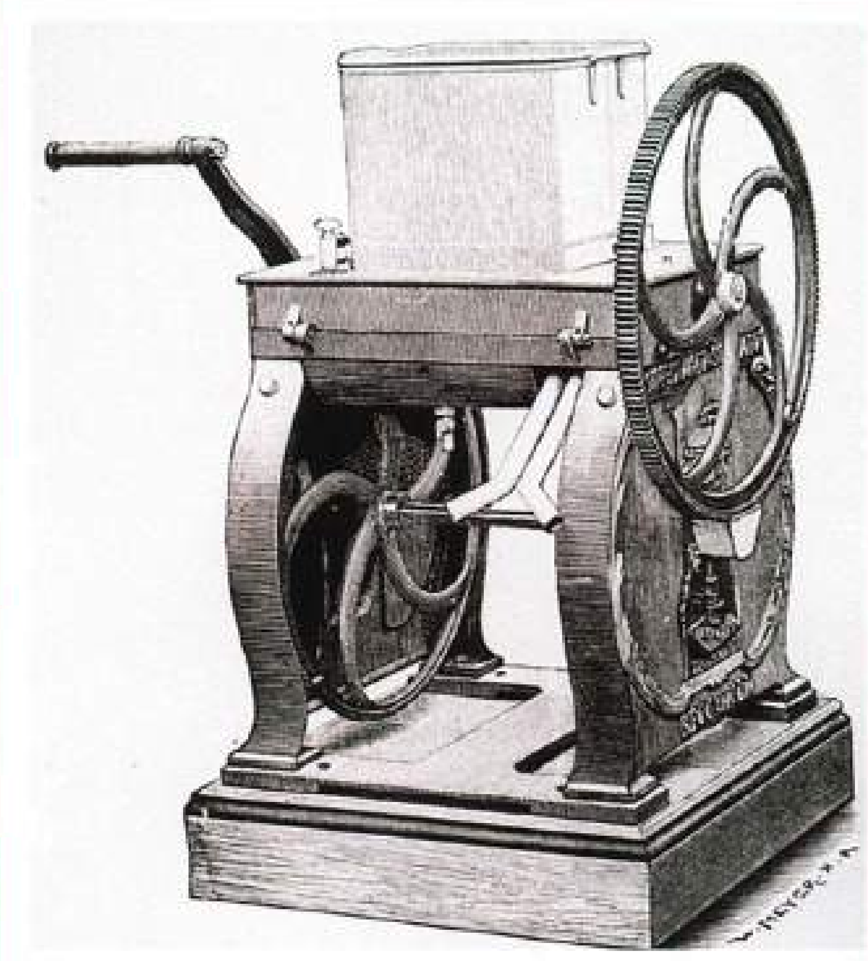
First, how does raw milk get contaminated in the first place? Human pathogens can live in the guts of the animals and in their manure. It's not too difficult for tiny amounts of manure to wind up in the milk. Sometimes, the pathogens can also be spread by secretions from the udder.

Contamination can happen during processing, too. The milk is first extracted from the animal, then quickly cooled and stored. Dairies and cheese-making facilities must keep everything

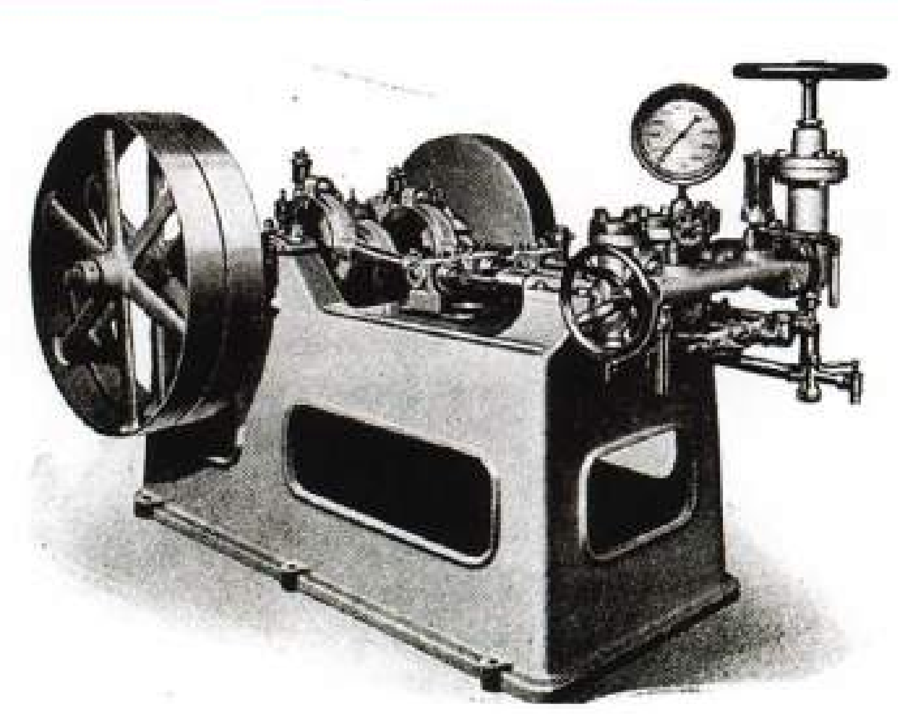
BREAKTHROUGHS IN MILK TECHNOLOGY THROUGHOUT HISTORY

Today, milk is positioned as a wholesome food, something that builds strong bones and nourishes children. But it wasn't always that way. In the mid-19th and early 20th centuries, contaminated milk sickened and even killed thousands of people. Over the years, inventions have helped reduce the chances of contaminants getting into milk. There have also been advances that made it easier to get milk to consumers. Here are some key moments in milk history.

1856
French scientist Louis Pasteur began experiments with killing bacteria in milk by boiling it. The process would come to be called pasteurization.



1878
A Swedish engineer named Gustaf de Laval invented a way to mechanically separate cream by centrifuge, replacing hand-skimming.



1899
Milk is mostly liquid, but it also contains fat, which would rise to the top of the container if the milk sat for a while. French inventor Auguste Gaulin came up with a way to prevent that separation. He patented a milk homogenizer that crushed the milk fat globules into droplets that were too small to float to the surface. No more separation.

1917
Milk pasteurization became mandatory in the United States. Before that, there were very few safeguards to prevent contamination. Pasteurization, in combination with refrigeration, was instrumental in the industrialization of milk.

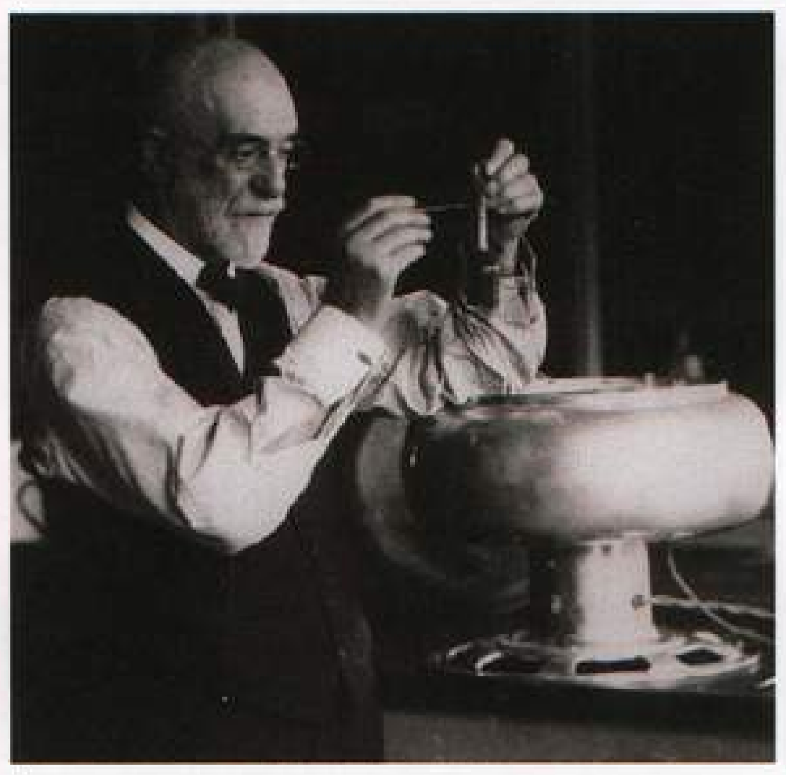
scrupulously clean—the equipment, the floors, the walls, the walk-ins. They do extensive testing for pathogens and keep records in case of an outbreak. But sometimes, equipment isn't properly sanitized. Without the pasteurization step, the bacteria can thrive and spread. In some cases, the bacteria can make people very sick. Serious illnesses or even death have been connected with contaminants such as *E. coli*, listeria, salmonella, tuberculosis, and brucella in unpasteurized milk.

At this point, you may be wondering whether it's worth the risk. First, understand that in most of these cases, people get sick not from cheeses made with raw milk but from drinking the milk in fluid form. Many cheeses are aged products, and most harmful bacteria do not survive during a long aging process. But different cheeses behave differently. The question then becomes how long any given cheese needs to age to minimize any risk. There are a number of different views on these questions, and the result is that the rules around raw milk cheeses vary by region.

In the United States, raw milk cheese may be sold as long as it's aged for 60 days. A 2016 FDA report sampled raw milk cheeses for a number of pathogens, including *E. coli*, salmonella, and listeria, and found that the overall contamination rates were less than 1%. For some, that's an acceptable risk. Other cheese makers skirt the whole problem and choose pasteurization.

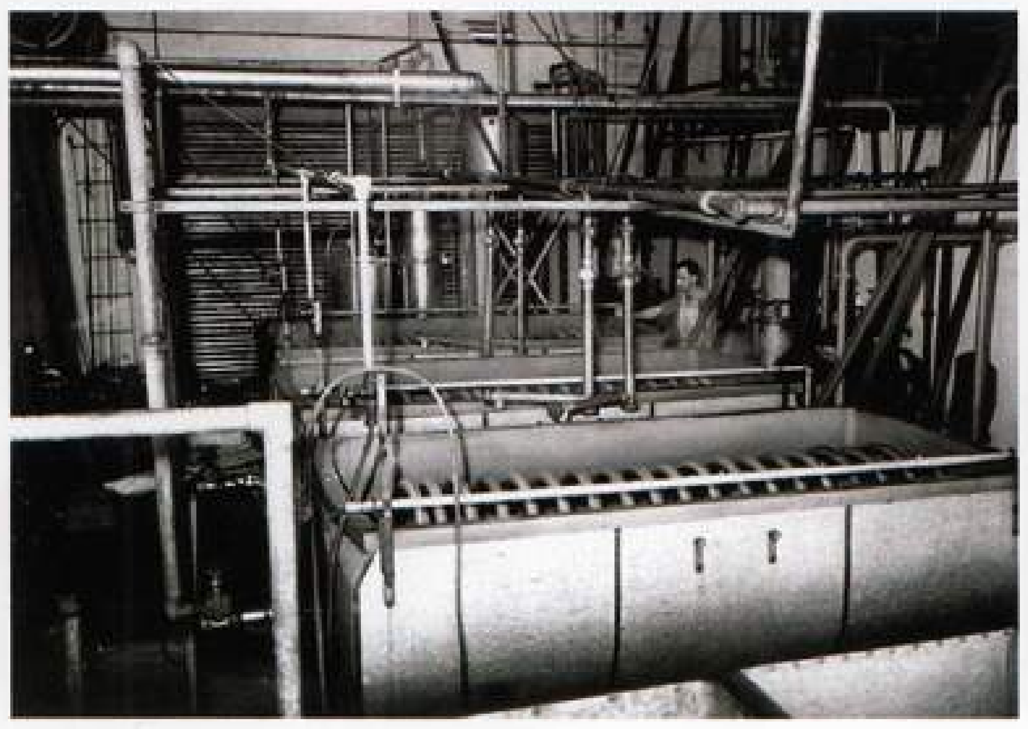
Buffalo's milk contains about twice as much fat as cow's milk does.

1884
An American druggist named Hervey D. Thatcher created the first milk bottle, allowing sanitary delivery of milk.



1890
University of Wisconsin-Madison chemist Stephen Babcock came up with way to measure the fat content of milk. The Babcock test was once the primary means of determining milk quality.

1895
Commercial pasteurization of milk began.



1930s
Dairy facilities began switching to the high-temperature/short-time (HTST) pasteurization method, which brings the milk up to 72° C / 162° F for 15 seconds, with a very quick cool-down to 4.4° C / 40° F.

1948
A faster method of pasteurization using ultra-high temperatures (UHT) was developed. The milk is brought up to 135° C / 275° F for 2-5 seconds and is then quickly cooled down to 4.4° C / 40° F or below. It took more than three decades for this process to catch on. UHT is only used for shelf-stable products in the US, but it's more common in milk products in Europe.

1981
UHT pasteurization began to be more widely implemented in the 1980s. Some people believe this heat step affects the flavor and nutritional value of the milk, and thus favor using raw milk. This, of course, does not come without its risks.

Both commercial cheese curds (top) and freshly made cheese curds (bottom) are typically stretched before using on pizza. When we baked mozzarella on a pizza without stretching the curd first, it was spongy, more browned, and lacked the cheese pull of stretched mozzarella (see page 319 for more on why this happens).

CHEESE MAKING

How does milk, a liquid, transform into cheese, a solid? And how does the flavor go from plain and slightly sweet to nutty, pungent, earthy, tangy, and all those other different flavors you find in the wide world of cheese? For most cheeses, there are a few basic steps. First, the milk is heated, and an ingredient is added that acidifies the milk—it could be a starter culture or something as simple as citric acid. The acidification both helps flavor develop and sets the stage for the next step, coagulation.

A coagulant, such as rennet, is typically added to help turn the casein protein in the liquid form into a solid gel. This gel or coagulum is then cut into small cubes or curds. These curds vary in size depending on the cheese. Some cheeses require curds to be cooked or washed to produce specific textures. Curds are then manipulated to form the desired shape, either by stretching (for pasta filata cheeses like mozzarella), cheddaring, or ladling into a form (like a wheel of gouda). Whey, the liquid by-product, is drained off as part of this process.

Many cheeses are pressed with weight to further aid in draining and acidification. As cheeses age, certain techniques can be utilized to encourage the growth of beneficial molds, yeasts, and bacteria. Cheese makers generally use the French term "affinage" to describe this practice.

There are endless possibilities for variation at each step. The milk of various animals has distinct flavors—goat's milk tastes different from cow's milk. Different starters produce different results. Rennet acts a little differently on milk than other coagulants. Different molds make different cheeses; for example, the growth of *Penicillium roqueforti* makes the veins you see in blue cheese, while *Penicillium candidum* is what helps to create the white rind on Brie (under the right conditions). Forming the cheese into different shapes can change the flavor and texture, as can molding or pressing it.

There are many resources available that provide details beyond the basic cheese-making steps described here. In this book, we focus on the aspects of cheese making that are pertinent to the two most common types of cheese that you might make for pizza: mozzarella and ricotta. Although you can easily purchase these cheeses in different forms, both are relatively simple to make. You can also create spectacular results when you vary the amount of fat (see page 334) or infuse the milk with different flavors (see page 336).

The important figure for cheese-making quality is the ratio of protein to fat. The protein is a determinant of the yield of cheese but not necessarily of the quality. Low-solids milk (the milk from the height of summer grazing) makes good cheese, just not very much of it for the volume of milk that you get.

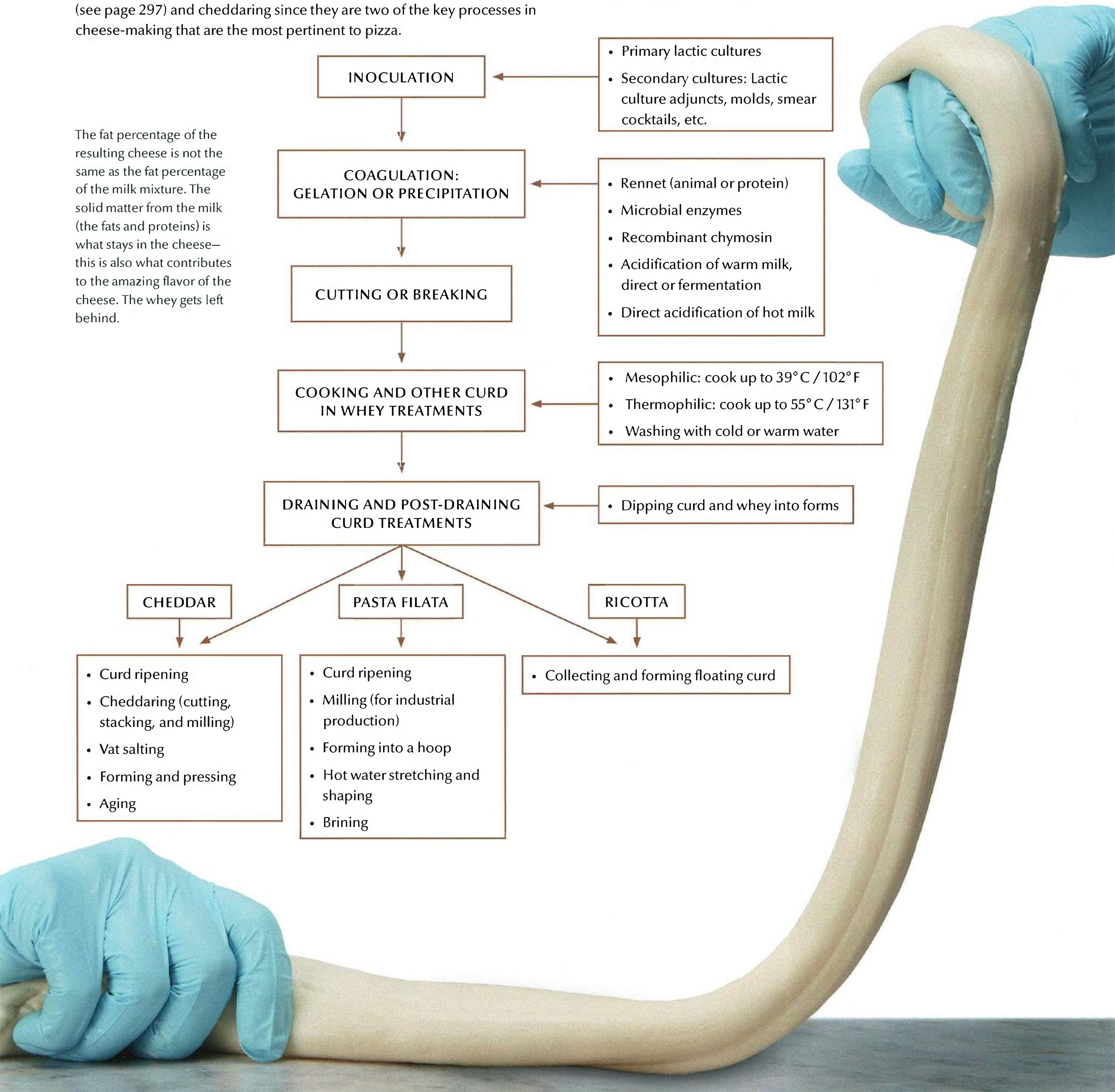
During our visit to Caseificio "Al Valico," we learned the ins and outs of making mozzarella from our gracious host Antonio Campanile (pictured at left).

THE BASIC CHEESE-MAKING PROCESS

The basic cheese-making process is very similar for all cheeses. Small changes in technique give us the huge range of cheeses. Cheeses can be made from raw or pasteurized milk (see page 288) that may be homogenized or standardized for protein and fat content. Some cheeses start with a combination of milk and skim milk, while others use milk that is enriched with heavy cream. All cheeses start by coagulating the milk. After that, the steps for making specific cheeses will differ depending on the type. The diagram below shows the overarching steps of the cheese making process from acidification through coagulation, draining, salting, shaping, and ripening. We highlight the process for pasta filata (see page 297) and cheddaring since they are two of the key processes in cheese-making that are the most pertinent to pizza.

The term "pasta filata" doesn't have anything to do with what you see as a course on a menu; it means "spun paste" in Italian. This category of cheeses includes some of those most commonly used for pizza, namely fresh mozzarella (fior di latte) and low-moisture mozzarella. The former is ubiquitous on margherita pizzas, while the latter is shredded and used on a variety of pizza styles. In fact, low-moisture mozzarella is so widely used that it is referred to as "pizza cheese," which is the term that we typically use in this book. Note that the popular string cheese snack is made by hot extruding low-moisture mozzarella and cutting it into lengths before packaging and selling it.

The fat percentage of the resulting cheese is not the same as the fat percentage of the milk mixture. The solid matter from the milk (the fats and proteins) is what stays in the cheese—this is also what contributes to the amazing flavor of the cheese. The whey gets left behind.



Protein content is by far the most important component of milk to consider when you're making cheese. If you don't have sufficient casein, you likely won't be able to make cheese.

The outside of cheese is called the rind; the inside is called the paste.

For mesophilic cultures, there is practically no acid production at temperatures under 20° C / 68° F. Growth is also severely inhibited above 39° C / 102° F. For thermophilic cultures, their optimal acid production occurs between 38° C / 100° F and 43° C / 110° F, depending on the culture. They can survive at temperatures higher than 55° C / 131° F, but don't perform well at those temperatures.

CULTURES

Milk left to sit out will be invaded by microorganisms. One class of these are lactic acid bacteria (LAB). They secrete acid that causes milk to thicken. The direct result of that is yogurt. Cultures, like LAB, are prepared inoculations of molds, bacteria, or yeast that are added to milk and cheese. They have two main purposes: to promote ripening and develop acidity. Many strands of LAB can acidify cheese as well as work to speed up ripening (other adjunct cultures like propionic acid bacteria are added for flavor). LAB for cheese making tolerate only low oxygen concentrations and are stored dormant in the freezer. There are thousands of strains of LAB specifically selected for their purpose.

Acid also forms the coagulation for a number of cheeses, including cream cheese, feta, cottage cheese, and some recipes for mozzarella. Acid causes the milk to thicken and ultimately the proteins to bind together, a process called coagulation, or curdling. (the lower the pH, the faster the coagulation). Those curds then begin to contract, pushing moisture out of the cheese and slowing the growth of bacteria and other pathogens, such as *Staphylococcus aureus*, *Listeria monocytogenes*, *salmonella*, and *E. coli*. It affects texture and flavor, too. The pH of milk is around 6.7. Examples of cheeses with a higher pH (close to that of milk) include blue cheese, Brie, and queso fresco. Cheeses with a lower pH (around 4.9–4.6) and higher acidity are softer; they have less calcium available because the acid dissolves it, which makes for a weaker protein matrix. Examples include cream cheese, feta, and cottage cheese.

LAB cultures can be grouped according to four criteria: what they produce (metabolites), their optimal growth temperature, the forms of inoculation, and the starter composition. In terms of metabolites, cultures can be classified as either homofermentative or heterofermentative. Homofermentative cultures mostly produce lactic acid. Heterofermentative cultures produce lactic acid, but they also produce carbon dioxide (which produces holes in some cheeses), acetaldehyde (a component of yogurt flavor), diacetyl (which determines the flavor of certain cheeses, like Havarti and gouda), and ethyl alcohol.

Cheese makers use specific strains of LAB to achieve specific results. These are a combination of coagulation of the cheese but also some of the flavor. These cultures also have characteristic temperatures that they like to be at. Thermophilic cultures like higher temperatures and mesophilic cultures like lower temperatures.

HOW TO Use a pH Meter

Make sure to buy a pH meter that's waterproof, preferably with the glass electrode housed in a probe that can be easily dipped into cheese. See our Resources section on pages 3:377–3:380 for information on where to buy a pH meter.

1 Calibrate your meter according to the manufacturer's instructions. We suggest recalibrating the meter once a week or so if you use it on a regular basis; if you rely on it only occasionally, calibrate it just before you use it. Always keep the tip of the pH meter (where the electrode is) submerged in a storage solution such as potassium chloride (KCl) when not in use; this helps keep it clean and also protects the electrode from damage. It is extremely sensitive and the reason why some pH meters aren't exactly cheap.

2 Before each use, rinse the glass-encased electrode with distilled water. Pat it dry with a lint-free tissue or towel. Don't overhandle it; just let the tissue absorb any excess moisture.

3 Insert the probe into the cheese. Wait a few seconds until the number it shows does not fluctuate. Note the reading.

4 Rinse the glass-encased electrode with more distilled water, and pat it dry with a lint-free tissue or towel. Return it to the storage solution until next use.

You can also test for pH using paper pH testing strips. They are less expensive but also less accurate.

Why do some cheeses melt while others don't? It has to do with pH. Cheeses that are either very high or very low in acid won't melt.

RENNET AND OTHER COAGULANTS

Somehow ancient cheese makers discovered that sheep intestines had an enzyme that made the milk coagulate more firmly than it would with acid and do so instantly. Subsequent science has shown this is due to an enzyme called rennet. Rennet is not found only in animal intestines. It's also produced from vegetable sources, notably from an extract of cardoon (*Cynara cardunculus*). In addition, there are other kinds of coagulants that are used. These days most rennet is produced from vegetables. There are also microbial coagulants, which are typically extracted from a fungus called *Rhizomucor miehei* (or sometimes *R. pusillus* or *Cryphonectria parasitica*). Coagulants made from the fungus *Aspergillus niger* or the yeast *Kluyveromyces lactis* can also be used.

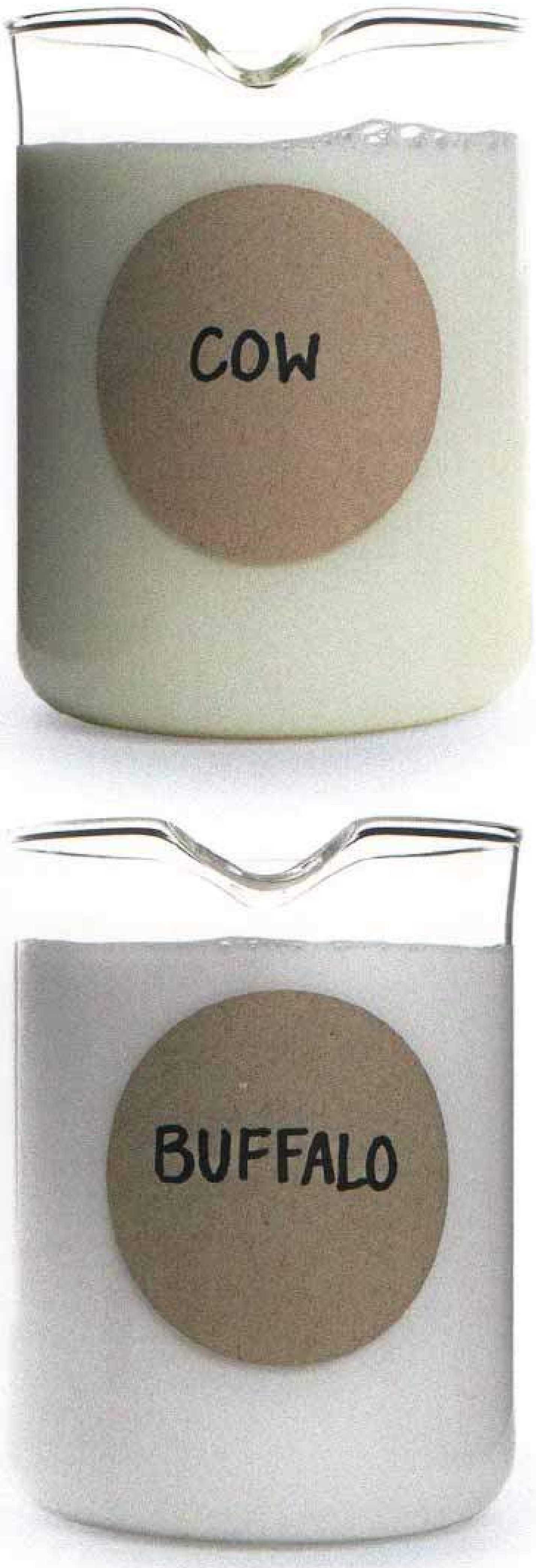
Ruminants are animals, such as cows, that have more than one stomach. The plant matter they eat is first fermented in a special stomach before it's digested.

AUTHENTICATING MOZZARELLA DI BUFALA

One of the traditional cheeses for making pizza in Campania is mozzarella di bufala, which is a cheese made from the milk of the Asian water buffalo. Buffalo's milk has roughly double the amount of fat as cow's milk, but shares a similar flavor. This results in a softer, richer mozzarella. The creamier milk from water buffalo has long been cherished and commanded a higher price than cow's milk. The Italian government had to officially define and recognize mozzarella made from water buffalo's milk in 1979 to protect the consumer from a common fraudulent practice of selling cow's milk mozzarella at the higher price of mozzarella di bufala. The latter became a DOP cheese (see page 213) in 1993, protected and regulated by the Consortium for the Protection of the Mozzarella di Bufala Campana. The cheese's origin and the traditional technology used to make it are guaranteed by a legal standard of identity. Only cheese made in specific areas in Italy with 100% water buffalo's milk can be distributed with the consortium's logo.

Fraud in the form of substituting a cheaper type of milk for one of a higher quality is not limited to buffalo's milk; it's common for other milk, such as sheep's and goat's, as well. What are the ways to trace back the origin of the milk in cheeses so that you don't get cheated? Given the importance of this task, several methods have been developed. Tests are constantly evolving to do this, including ones to test baked pizzas.

With no intention to deceive, we developed our enhanced fat mozzarella (see page 334) to see if we could make a cow's milk–based cheese that was as rich a mozzarella di bufala. The results are delicious.



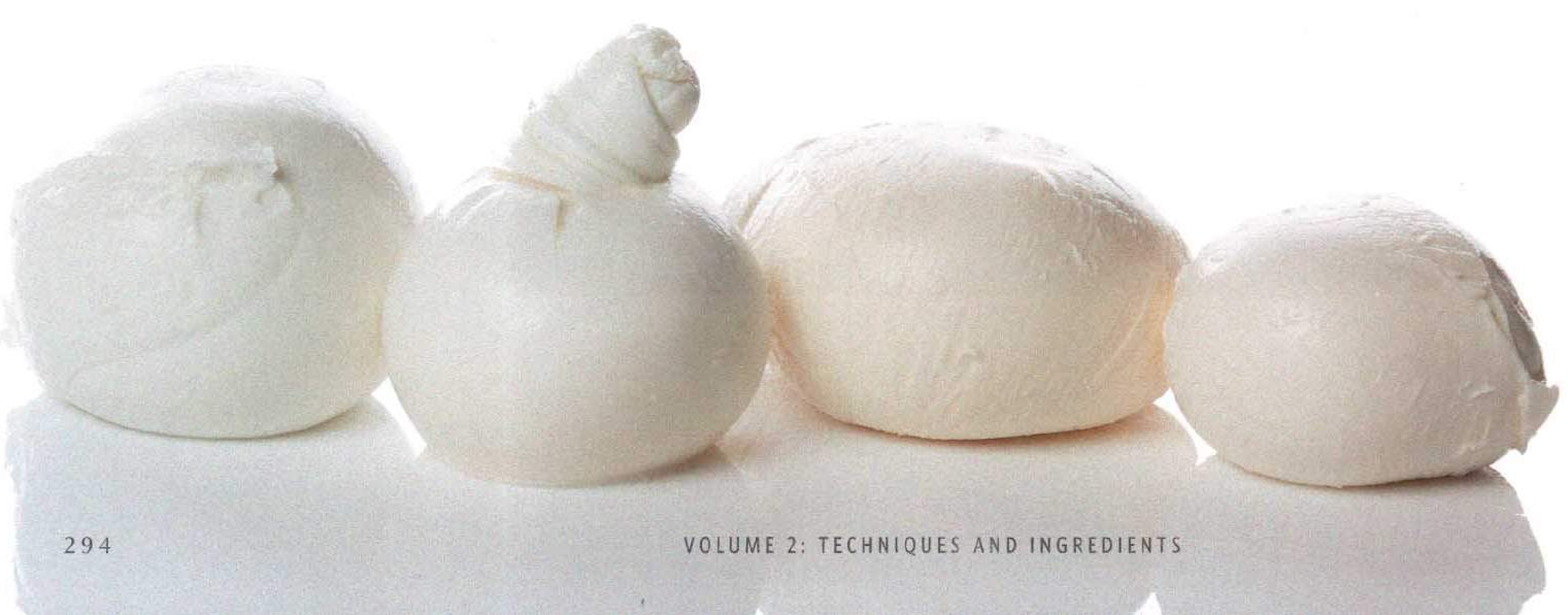
CHEESE CLASSIFICATION BY TEXTURE AND MOISTURE CONTENT

Cheese is often classified into categories. But the classification itself is a bit subjective. To put it plainly, one cheese maker's semihard is another's semisoft. For example, one book we consulted says that cheddar is a hard cheese. Another book says that Colby and Monterey Jack are forms of cheddar but calls them all semihard cheeses.

We focused on the most common cheese texture categories and the moisture content for the different varieties of cheese when available. The moisture and fat percentages tell you only so much about the nature of the cheese because the cheese-making process has such a big impact on the final product. For example, if you compare a ripe Camembert, which is 48% moisture, and a Comté, with 43% moisture, their moisture percentages aren't that far apart but their textures are completely different. The Comté is hard, but the Camembert will ooze because there is an enzyme causing it to be soft. The examples listed in the following table are by no means exhaustive; they are merely some of the most commonly found cheeses in each category that we would use on pizza.

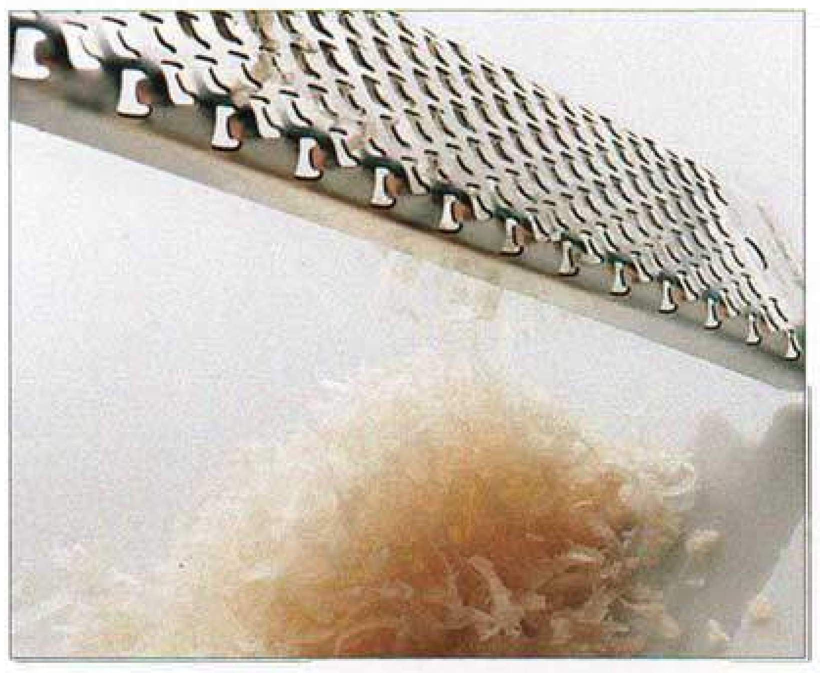
Classification	Examples	Moisture content %	Fat content %	Type of milk	Notes
Very hard/extra-hard cheeses (internal bacterial-ripened varieties)	Parmigiano-Reggiano	30.8	27	raw cow's milk in Italy; pasteurized cow's milk in the US	Parmigiano-Reggiano and others in the very hard category often have a DOP seal, meaning they're made under strict rules (see page 213). American cheeses of this style don't follow those rules and thus can't use the Parmigiano-Reggiano name, so they're just called Parmesan.
	Pecorino Romano	31	29	sheep	
	Grana Padano	32	28.4	cow	American Parmesan has a very different look and taste from DOP Parmigiano-Reggiano, and sometimes the quality isn't as high.
	Asiago (d'Allevo)	34	31	part-skim raw cow's milk	Pecorino Romano is slightly cheaper than DOP Parmigiano-Reggiano and can be used as a substitute. A grainy texture is desirable in some of the very hard cheeses; that's what the "Grana" in Grana Padano means.
Hard cheeses (internal bacterial-ripened varieties)	Comté	43.5	30	cow	All hard cheeses have more or less the same method for manufacture. They're all pressed during ripening to produce a hard, uniform, and closed-texture cheese with no holes.
	Idiazabal	33.2	37.8	sheep	
	Mahon	31.7	32.6	cow	
	Cheddar	36	33.8	cow	Cheddar is possibly the most important cheese in the hard cheeses group. There's even a step in making these cheeses called cheddaring, in which the curds are acidified and textured before they're milled and dry salted.
	Colby	38.2	32.11	cow	
	Gouda	41	28.5	cow, goat, or sheep	
	Monterey Jack	41.01	30.2	cow	
	Wisconsin brick cheese	40	30	cow	
	American muenster	41.77	30.04	cow	
Pasta filata cheeses (stretched curd)	Fior di latte mozzarella	54	18	cow	This group of cheeses is made by stretching curds before shaping the cheese (its name means "spun paste" in Italian). Fior di latte mozzarella can also be purchased smoked (the process and materials may vary).
	Mozzarella di bufala	58	21	water buffalo	
	Burrata	60–70	15–20	cow	
	Low-moisture mozzarella	47	23.7	cow	Low-moisture mozzarella is also called American mozzarella, pizza cheese, or part-skim mozzarella.
	Provolone	42.5	27	cow	
	Caciocavallo	35–40	25–30	cow	Provolone piccante is a variation made with a culture that gives it a stronger flavor. Regular provolone (provolone dolce) is made with rennet extract. Both can be purchase smoked.
	Scamorza	45–52	20–30	cow or water buffalo	

Left to right: mozzarella di bufala, burrata, and fior di latte mozzarella balls



Classification	Examples	Moisture content %	Fat content %	Type of milk	Notes
Semihard cheeses					
Cheeses with holes	Edam	43	24	cow or goat	The holes in these cheeses are called eyes.
	Gouda	41	28.5	cow, goat, or sheep	Other cheeses in this category are raclette (see our Raclette Slice on page 255), Beaufort, Appenzeller, and Jarlsberg, though they're less commonly used on pizza.
	Havarti	43.5	26.5	cow	
	Emmental	35.5	30.5	cow	Emmental is the cheese typically referred to as Swiss.
	Gruyère	43.5	30	cow	In addition to semihard gouda, there's also aged gouda, which would fall in the very hard category, and smoked gouda.
	Manchego	35.5	33.6	sheep	
	Aged fontina	37.92	31.14	cow	
High-salt cheeses	Feta	59.7	20.3	sheep	High-salt cheeses don't typically melt and if they do, they don't spread. Feta is brittle and will burn before it melts. Halloumi will hold its shape even under the broiler; you can grill it and it won't spread (in fact, it is prized for its ability to brown).
	Halloumi	43	24.7	sheep	
Semisoft mold-ripened cheeses					
Washed-rind and surface mold-ripened cheeses	Camembert	52.5	23	cow	These are typically very aromatic, piquant cheeses (the soft versions are usually more pungent than the semihard examples).
	Brie	48.6	26.9	cow	
	Époisses	55	22–25	cow	Surface mold-ripened cheeses have a soft, edible rind. Some prefer to remove it before eating but that's not necessary.
	Fontina	37.92	31.14	cow	
	Taleggio	45–50	48	cow	Fontina's texture changes through the aging process. It's semisoft at first, but as it ages it can firm up and fits more properly in the semihard category.
	French münster	43	29	cow	These cheeses spread a lot when they melt, so we add them just before the end or after baking so that they don't turn into a puddle.
Blue cheeses (internal mold-ripened varieties)	Roquefort	40	31	cow	These can be very aromatic (some blue cheeses are described as having a barnyard aroma). They don't stretch (unless you use our technique on page 332) and tend to melt into a puddle during baking, which is why we recommend adding them during or after baking. You can add them before baking if you nestle them in with the mozzarella, but you can't really see them on the pizza after it comes out of the oven.
	Stilton	38.3	33	cow	
	Cabrales	43–45	30	cow	
	Gorgonzola	48.4	31.2	cow	
Soft cheeses					
Acid-coagulated cheeses	Cream cheese	50	33.5	cow	These soft cheeses are usually added toward the end or after baking (or are included as part of the base sauce). Ricotta is used in combination with mozzarella on classic white pizzas. Don't confuse ricotta salata with ricotta; it's firm and drier, and it's made from sheep's milk.
	Quark	79	0.2	cow	
	Goat cheese (chèvre)	60.75	21.08	goat	
Heat/acid-coagulated cheeses	Ricotta	72	12.7	cow	
	Mascarpone	47.8	42	cow	
Processed cheeses	American cheese	43.12	24.46	cow	Processed cheese is not exactly cheese. Because of the way it's made, the word "processed" must be added to the label. It has a very low melting point and doesn't have the stretchy texture of a cheese like mozzarella. For some, this is a desirable characteristic. When you choose a slice from a whole pizza, the cheese tends to stay on the crust.
	Provel	n/a	n/a	cow	
	Catupiry	n/a	n/a	cow	

PREPARING YOUR CHEESE



You can functionally divide the types of cheeses that you use on pizza into two categories: the main melting cheese as a primary ingredient, and an accent cheese for flavor. The majority of the time (but not always), the main melting cheese has a milder flavor profile, like mozzarella, provolone, Monterey Jack cheese, or cheddar. Accent cheeses, such as Parmigiano-Reggiano or blue cheese, are usually more strongly flavored, used sparingly, and applied after baking.

For the majority of the main melting cheeses that you'll put on pizza, we can narrow down the key question to this: slice it or shred it? The key factors that go into the decision are the cheese itself, whether it's going on before or after baking, and its relationship to the sauce (whether it's going on underneath or on top of it). Of course, there are pros and cons for each. Slices give you a bit more control. It's easy to achieve consistency in terms of weight and also in terms of even distribution across the pizza. Place the slices so they slightly overlap each other, and your pizza will come out neat and orderly. (If you're going for an artisanal or rustic look, though, it might look a little too uniform.) Because slices are placed in a single layer, you might wind up with less cheese on your pizza than if you use shredded cheese. If you or your customers want more cheese, you can slice it a little thicker.

Shredded cheese, on the other hand, tends to be a bit harder to control by weight unless you portion it out ahead of time (see page 305). It takes a little practice, but soon you may find it faster and easier to use than sliced cheese. Pizza cheese, scamorza, caciocavallo, Monterey Jack, and provolone are all commonly use shredded (or sliced) on pizza. Many of the cheeses used on pizza are available preshredded, and they're designed to work best on pizza that takes 4–6 minutes to bake. If you're shredding your own cheese, use the largest grater size you can get (except if using very hard cheeses, as noted on page 297). Here are our recommendations for preparing different categories of cheese.

IDEAL CHEESES FOR PIZZAS

There is no single ideal cheese for pizza because there are lots of different styles of pizza, each with different qualities and baking criteria. Generally speaking, you want a cheese that melts well. That said, Parmesan and other hard cheeses can be delicious as a flavor accent but don't work well as the main melting cheese for a pizza.

Fresh mozzarella is the most iconic cheese and the only one you should use when making AVPN Neapolitan pizza, yet it's not perfect when you get it. You have to add a step to drain it before using, otherwise you will end up with a puddle of water in the middle of your pizza—a serious flaw in our minds (see page 1:113). Pizza cheese, or low-moisture mozzarella, is perfect for melting but is best suited to baking at lower temperatures.

Part-skim mozzarella, low-moisture mozzarella, American mozzarella, and pizza cheese are different names for basically the same thing. It's the kind of cheese you see on most New York pizza, and many other styles, too. We call it pizza cheese in this book.

VERY HARD CHEESES

Finely grate these cheeses with a cheese grater or Microplane. If you grate them ahead of time, keep them in an airtight container in refrigeration. Alternatively, you can grate very hard cheese directly onto the pizza (either before or after baking). It doesn't take too long and it avoids the problem of clumping, which sometimes happens if you store grated cheeses.

You can buy very hard cheeses pregrated, though their texture is actually more milled than grated. That's why the particles of store-bought grated Parmesan have a very different shape and size than if you grated Parmigiano-Reggiano; they are different cheeses and Parmesan will grind into more of a powder. Keep refrigerated in an airtight container.

Use a vegetable peeler or even a mandoline to create wider (but still very thin) slices or curls that are usually applied after baking. They're fragile, so it's best to do this to order rather than ahead of time. This technique is often used to make Parmigiano-Reggiano curls that are applied to arugula salad.

HARD AND SEMIHARD CHEESES

Use a cheese/meat slicer to thinly slice these cheeses between 2.5 mm and 4 mm / 0.1 in and 0.16 in thick. Place the slices in a single layer or, if you want to stack them, use parchment paper in between the slices to prevent them from sticking together. Keep the slices refrigerated. Room-temperature slices can soften and become difficult to handle since they stick together.

If you want to grate these cheeses, use the largest grater size. Grated cheeses should be kept in refrigeration or cold at all times. If not, the cheese will clump. Hand-cut or cubed cheese also must be kept cold.

PASTA FILATA CHEESES

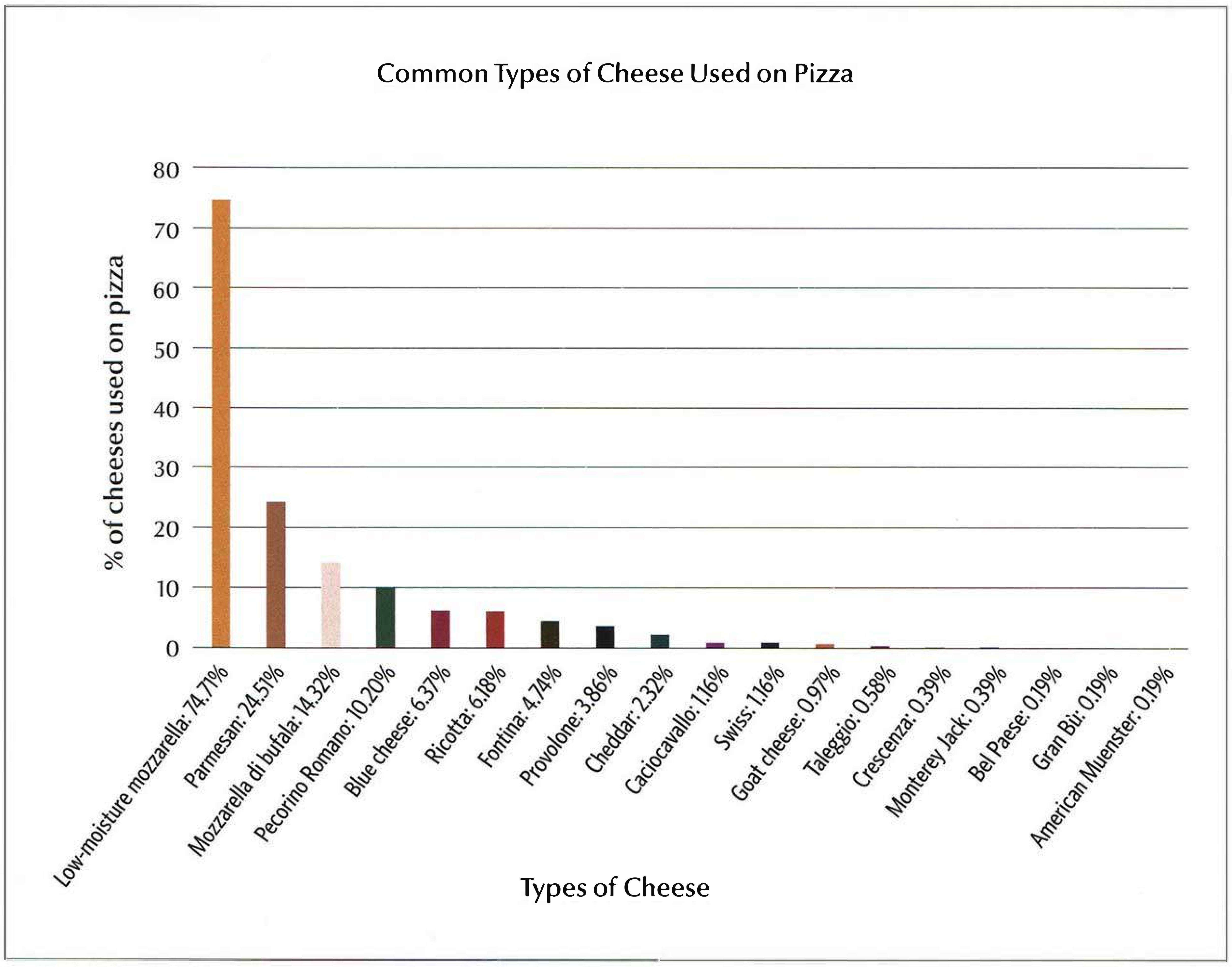
Pasta filata, Italian for "spun paste," is a technique for making cheese that includes a stretching step, giving the cheese a fibrous texture. Cheeses in this category that are often used on pizza include whole-milk fresh mozzarella, mozzarella di bufala, burrata, pizza cheese (also known as low-moisture mozzarella or American mozzarella), provolone, caciocavallo, and scamorza.

Fresh Pasta Filata Cheeses

Fior di latte mozzarella and mozzarella di bufala are typically sold in balls of various sizes. These cheeses have a high moisture content and are suspended in brine, so if you don't want a soupy pizza with a puddle in the middle, you'll need to drain off the brine before using (see page 298). Some pizzaioli like to tear the cheese ball apart to order. This helps with

It's a common practice to tear pieces of mozzarella by hand when assembling a margherita pizza. We prefer to cut our balls of mozzarella with a french fry cutter and drain them overnight to remove excess water and reduce the chances of a soupy pizza.

Some types of pasta filata cheeses are ripened, like provolone (ripened for 2–6 months at 12–14° C / 54–57° F) and caciocavallo (typically ripened for 3–4 months but sometimes up to 12 months, at 10° C / 50° F).



In the chart below, we gathered information from 518 pizza recipes that use cheese. The percentages represent the number of times a cheese was used, and since more than one cheese is often used on a pizza, the total percentages add up to over 100%. For example, Parmesan isn't used alone, but it is still represented widely in 24.5% of recipes.

We wondered if we could achieve a more uniform melt if we made the size of the cheese particles smaller. To get the small particles, we had to get the mozzarella cold, almost freezing. Then we grated it to 2–3 mm diameter. However, this did not dramatically change the result.

In certain regions of Italy where buffalo's milk is not used, the term "fior di latte" is reserved for cow's milk mozzarella acidified with lactic fermentation. The term differentiates between cow's milk mozzarella, which is made by direct acidification, and fior di latte mozzarella that is made by bacterial fermentation.

Fresh cheeses such as ricotta, quark, mascarpone, or crème fraîche don't really require any preparation and are typically spooned on after baking.

portion control, but there's a risk the pieces will be too wet. Other pizzaioli use a special food processor or french fry cutter to cut pieces about 1.25 cm / 0.5 in thick. Fresh mozzarella can be difficult to slice by hand but you can purchase it presliced.

The overall sizes of the slices will vary since the cheese starts off as a ball (although you can find logs of fresh mozzarella that are presliced into uniformly sized pieces). You'll need to drain these pieces before service to keep the cheese from leaking excess moisture onto the pizza. We line a colander or strainer with cheesecloth and place it over a large bowl, then leave it to drain for a few hours (or even overnight in refrigeration) before we use it. If you forget to do this step, and really only in cases of emergency (see page 321), you can press the cheese hard between two clean kitchen towels.

In addition to draining, you'll need to temper these cheeses. Placing cold cheese on the pizza dough will cool down the surface and slow down the baking, and the cheese won't melt properly. This is especially important for pizzas that bake for a short time at high temperatures, like Neapolitan pizzas. Some of the top Neapolitan pizzaioli, in fact, insist on keeping the cheese at room temperature throughout service while others rotate their tubs of drained mozzarella in and out of refrigeration. If you keep your fresh mozzarella at room temperature for service, you can store it this way for only up to 2 hours.

If you're making a lot of pizza, you'll need a schedule for tempering. The cheese should be taken out of refrigeration 2 hours before you'll use it—but if you keep it out for more than 2 hours (see page 3:329), you risk creating a food safety hazard. When we're baking a lot of pizza, we stagger the tempering step, removing cheese from refrigeration at 30-minute intervals, so we always have a batch ready at room temperature.

Burrata is half fior di latte mozzarella and half cream; it functions as a cheese and sauce at the same time. You don't want to drain it because you'd get rid of the delicious creamy part in the middle, but keep in mind that it's super wet. Don't use too much of this on Neapolitan pizzas or you'll get a soupy pizza. (One way to mitigate that is to use a thicker substance in place of the cream in the center; see page 331.) For other, longer-baking pizza styles, burrata works pretty well. The moisture has enough time to evaporate in the oven and become something of a sauce. As with other fior di latte cheeses, keep burrata refrigerated and then temper it 2 hours before baking.

Low-Moisture Mozzarella

Low-moisture mozzarella (either whole-milk or part-skim) is the most commonly used cheese on pizzas made outside of Italy (that's part of the reason why the term "pizza cheese" is frequently used to label this cheese). It's quite different from Italian fresh mozzarella. It's much lower in moisture,

Neapolitan pizza margherita with pizza cheese

Neapolitan pizza margherita with caciocavallo cheese

Neapolitan pizza margherita with scamorza cheese

During our travels, we observed many esteemed pizzaioli using low-moisture cheeses such as scamorza or caciocavallo on Neapolitan pizzas, either in combination with or instead of the standard fior di latte mozzarella or mozzarella di bufala. We decided to give those two low-moisture cheeses a try and compare them with the pizza cheese (low-moisture mozzarella) that we use on our New York pizza, among others. While many Italian pizzaioli that we talked to look down on pizza cheese with disdain, you can successfully bake scamorza, caciocavallo, and pizza cheese on Neapolitan pizza dough at Neapolitan pizza baking temperatures. All of the cheeses melted similarly and looked virtually the same, with minor differences in fat separation and browning. The pizza cheese and scamorza were closer in flavor, while the caciocavallo had a slightly more distinct saltiness and character due to the fact that caciocavallo is usually aged longer than scamorza.

so it doesn't need to be drained. You can buy it in log form, sliced, or shredded. Most pizzerias buy it shredded for convenience. Pizzaioli who want to control the size of the shred buy logs and shred it themselves. The logs are marginally cheaper, but remember, it takes labor to shred.

We like to use shredded cheese on most pizzas (primarily New York pizza but also Detroit-style and deep-dish), and we buy it preshredded. For New York or artisan pizza, you need less cheese than on a thin-crust pizza because it heats up faster. A round pizza is easier to cover with shredded cheese than with square slices because you'd have to overlap them.

We've found that sliced cheese works nicely on New York square pizzas because it gives you a nice even layer. Shredded cheese can be used but it takes longer to cover those pizzas. Shredded cheese can also fall in between the pan and dough and burn. We typically slice our pizza cheese about 3 mm / 0.12 in thick.

Some preshredded cheese comes tossed in cellulose (up to 4% is legally allowed) to prevent clumping (see page 302). This can make things easier during a busy service when you may store your cheese at room temperature for longer than 2 hours. Otherwise, we recommend keeping shredded pizza cheese refrigerated at all times.

SURFACE MOLD-RIPENED AND SURFACE SMEAR-RIPENED CHEESES

These cheeses are typically eaten as a cheese course. For that purpose, they're best enjoyed at room temperature, which will allow the interior to soften. Using them for pizza is a different story. Softer cheeses are hard to handle and tend to stick to everything, so if we're using them for pizza, we like to keep them in a wine fridge, which is a little warmer than a regular refrigerator (13°C / 55°F). This keeps them cool enough to handle without sticking to our hands but warm enough so that they won't cool down the pizza significantly when you put them on top. If you don't have a wine fridge, you can slice the cheese when it's cold and then keep it refrigerated.

These cheeses should be added after the pizza is baked (or a minute or two before the pizza comes

Low-moisture mozzarella and scamorza are so closely aligned they share the same specific standards in the FDA's Code of Federal Regulations.

Armenian string cheese, known as chechil, is a relative of the string cheese that has often been stuck into children's lunch boxes throughout history in the United States. Chechil is braided and studded with nigella seeds; one way to serve it is to pull apart all of the strands of the string cheese and place them on a large platter.

THE ORIGIN OF BURRATA

In name alone, burrata sounds like an old-world cheese, conjuring up images of the Italian countryside. Funny thing is, it's not so traditional at all. There are two origin stories for burrata, one dating from the 1920s and the other from the 1950s—which would mean it's about as old as the factory-made pizza cheese that you find in every grocery store.

The story makes the most sense after you know exactly what burrata is. A cow's milk cheese in the pasta filata family, it looks much like fresh mozzarella, and like that cheese, it's sold in balls. But if you cut into a ball of burrata, you'll find that the middle is hollowed out and filled, dumpling-like, with small strips of cheese and a rich cream. It's a lovely cheese.

It's also a great way to get rid of leftovers from the cheese-making process. According to the 1920s origin story, day-old fresh mozzarella tended to dry up, so an Apulian cheese maker decided to pull the balls into shreds, soak them in cream, and tuck them inside a new ball of fresh mozzarella—those became the strips inside of burrata, called stracciatella, meaning "rags."

The other origin story dates to 1956, and the details are mostly the same, though a little more specific. The inventor was said to be one Lorenzo Bianchino, who realized he could use scraps from the mozzarella-making process to make a new and richer kind of cheese. We offer our own version of burrata in the recipe on page 331.

out of the oven). You can either cut them to order or portion them ahead of time. If doing the latter, place them in a single layer over parchment paper on a sheet pan and cover with plastic wrap.

BLUE CHEESES

These cheeses are typically crumbled and then sprinkled on top of the pizza after baking. They're easiest to crumble when very cold. Use your hands (not a knife) and break into pieces no bigger than 1.25 cm / 0.5 in. Smaller crumbles will soften with the heat of the baked pizza and, hopefully, stay on when you eat it; larger pieces tend to roll off. If you like larger pieces, consider adding them when the pizza is halfway or two-thirds baked so they'll have a chance to melt a little. If you're doing a four- or five-cheese pizza, it is not out of the question to apply the blue-veined cheeses with the others before baking. They'll meld with the other cheeses and give a slight blue-gray hue.

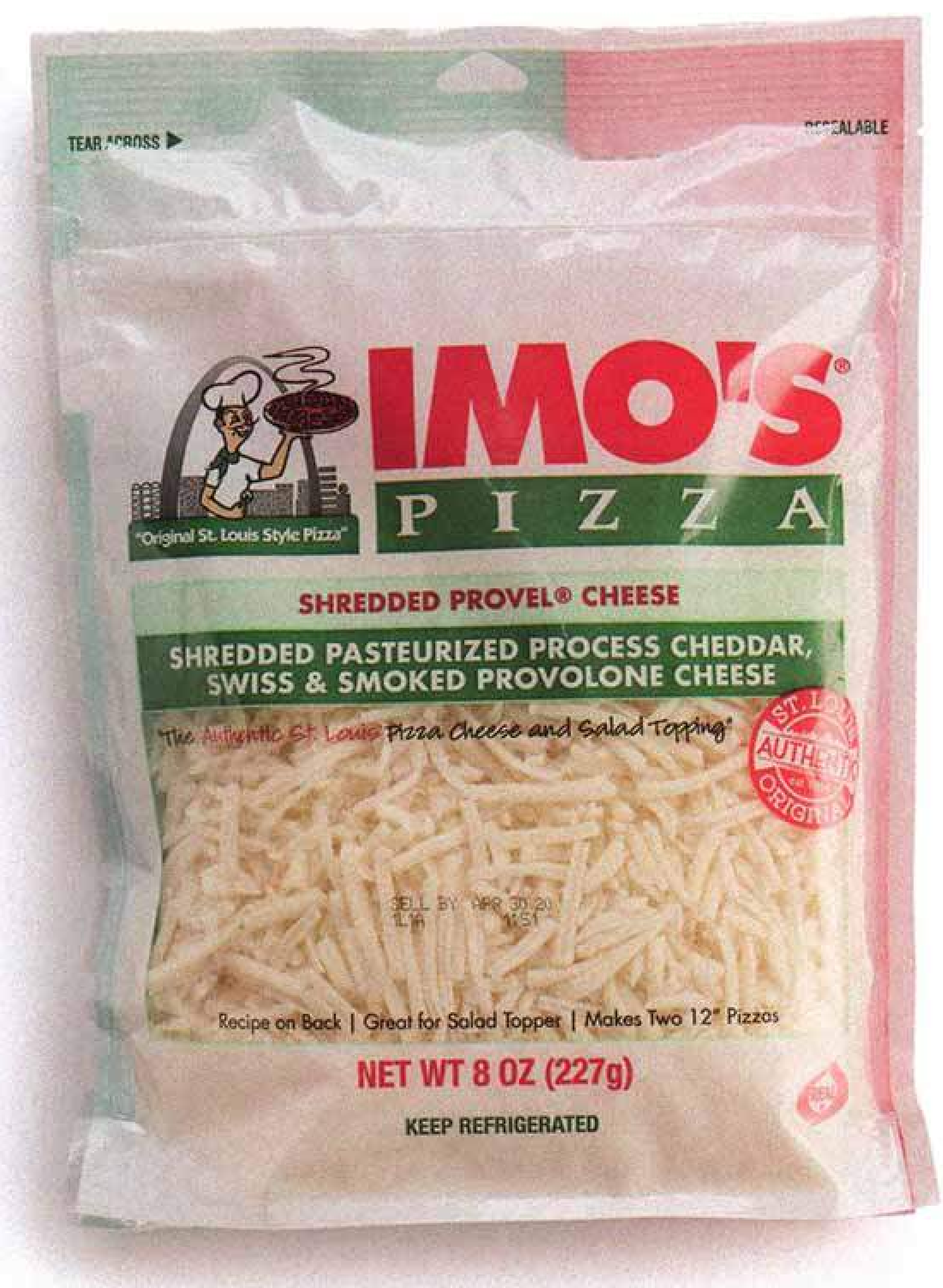
SOFT CHEESES

This category includes acid-coagulated cheeses like cream cheese and quark, heat/acid-coagulated cheeses like ricotta, goat cheese, and mascarpone, and heat/culture-coagulated dairy products like crème fraîche and sour cream. Keep them refrigerated in an airtight container and portion to order. Alternatively, keep them in a piping bag (in refrigeration when not in use), which can make portioning fast and easy.

If you're using these cheeses more as a sauce than a finishing topping, apply them to the pizza dough before baking (see page 303). With the high-fat spreads, such as mascarpone or crème fraîche, some of the fat will separate out in the oven. Apply in a thin layer. You can also try interspersing them with tomato sauce.

PROCESSED CHEESES

You can buy these cheeses in logs and slice them yourself, but we don't recommend it; they're hard to slice cleanly and tend to stick to the slicer. Instead, buy them presliced; the slices come already separated by plastic or parchment paper so they're ready to go. Provel, used on St. Louis–style pizza (see below), is also available in extruded strands that look like fresh spaghetti.



If you want to use a little cheese to act as a glue for toppings, you can just use some shredded pizza cheese.

Mexico's cuisine uses cheese abundantly and in many different forms. Some cheeses are similar to gouda cheese, others are paneer-like (queso cotija and queso fresco) or melt like pizza cheese (Chihuahua cheese). There are even pasta filata cheeses, such as Oaxaca string cheese. The latter is similar to its Neapolitan relative, fior di latte mozzarella, which is easy to tear apart, very white, and easy to melt.

In India, paneer is often made with buffalo's milk, which offers a far superior version of this cheese with a ton of flavor, unlike many that you find in other countries.

THE ORIGIN OF PROVEL CHEESE

Provel is a processed cheese that comes with some strong opinions. It's a blend of cheddar, Swiss, and smoked provolone, and is a standard component of St. Louis–style pizza (see page 3:22).

Aside from the flavor, a distinctive characteristic of Provel is its lack of stretchability. On the plus side, that means you can bite cleanly through it, so you're not going to accidentally pull off all the toppings in one big cheese stretch (as sometimes happens with pizza cheese). On the minus side, even its biggest proponents admit it's an acquired taste. Detractors use words like "waxy" to describe it. One called it "melted plastic from the '80s." But there are many die-hards who swear by the stuff.

John Sigillito, a downtown grocer who also acted as a distributor, introduced the cheese to St. Louis in the late 1940s, and the name was trademarked in 1950. We found a local newspaper ad from 1957 showing that it was a popular ingredient in both pizza and other Italian-style dishes, but it truly became synonymous with St. Louis–style pizza (see page 1:105) thanks to Imo's, a local pizzeria founded in 1964. (Although Provel was nowhere to be found on the original St. Louis pizza: it didn't exist then.) The locals loved the cracker-thin pizzas with Provel, and the chain now has more than 100 locations in Missouri, Illinois, and Kansas.

While the style hasn't caught on much outside that region, St. Louis–style pizza fans can order Provel, or even frozen Provel-topped pies, online. Provel is sold in blocks, shredded, and in an extruded form that looks like fresh pasta. It's also one of the thirteen styles featured at Tony's Pizza Napoletana in San Francisco, CA.

EQUIPMENT FOR CHEESE PREPARATION

When you're looking to shred or slice your cheese yourself, there are a number of equipment options to get the job done. The results will vary, however, and can impact how the cheese melts on your pizza. Be sure to refrigerate your prepared cheese until you are ready to temper it.

1. **Manual Cheese Grater:** There are many forms of manual cheese graters available. The most common is probably the box grater, which typically has four sides with options for shredding and grating cheese (some have up to eight sides with different purposes). Use the largest-size hole for shredding softer cheeses like pizza cheese and the smaller options for grating hard cheeses like pecorino Romano. Some graters are a single sheet of metal with holes punched in it that resembles a single side of a box grater with a handle. You can also purchase rotary cheese graters with interchangeable drums that produce various sizes of shredded or grated cheese. These typically can handle only small blocks of cheese at a time and can be difficult to clean.

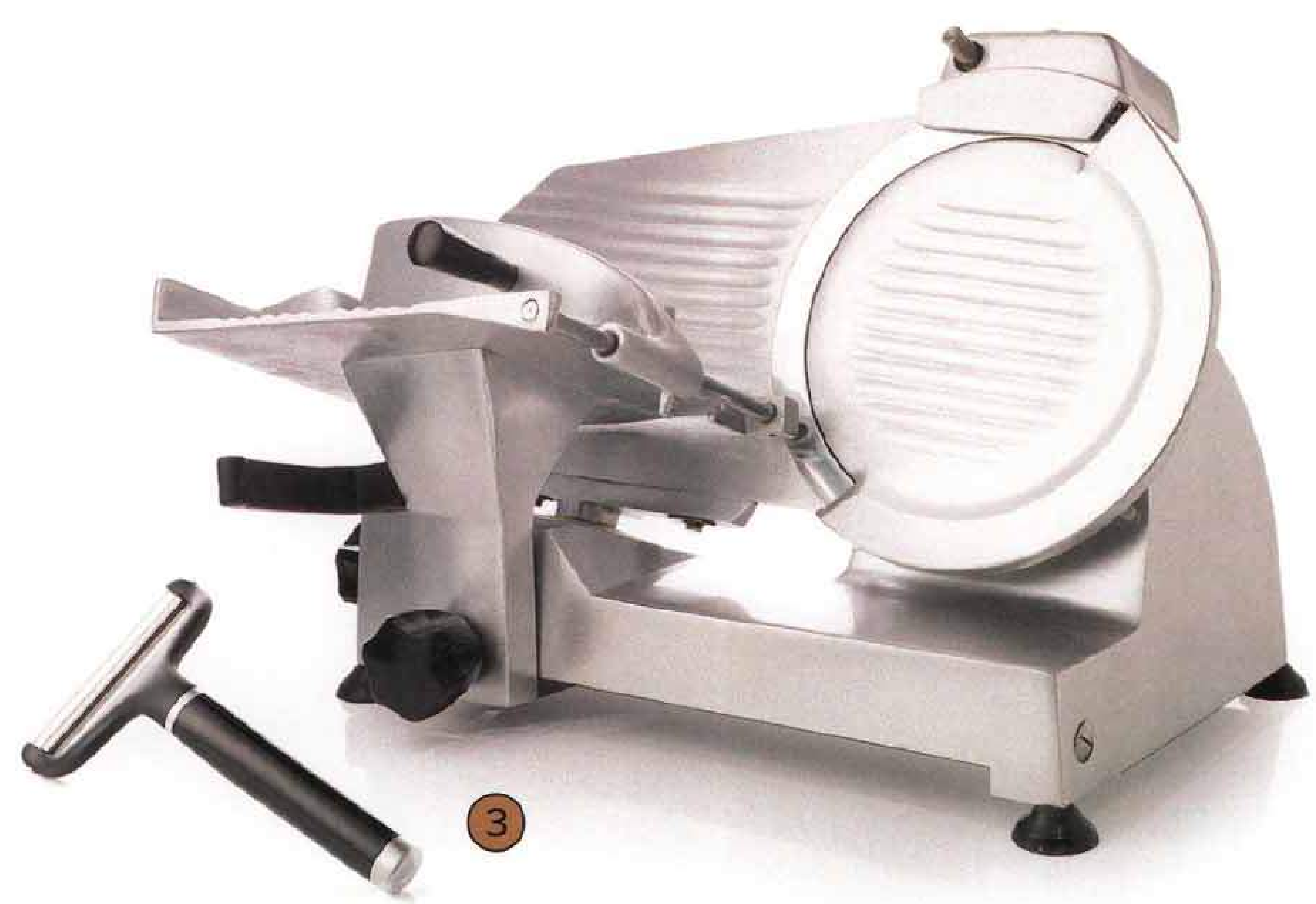
2. **Food Processor:** Most home food processors come with a shredder blade that sits atop the food processor bowl. You can push blocks of cheese through the feeder tube and the bowl will fill up with shredded cheese. Larger professional food processor models have a chute that allows the shredded cheese to fall out of the side of the machine into a receptacle of your choosing. The advantage to this style of food processor is that you aren't constrained by the size of the food processor bowl when it comes to how much cheese you can shred. You can continuously feed blocks of cheese into the food processor and then just change out the receptacle when it is full. The force needed to push down on the cheese can change with the height and strength of the pizza maker, which can change the thickness of the shred. There can be a greater usage of cheese when the cheese isn't pushed down hard enough and it has a thinner shred. Food processors usually work best with softer cheeses like pizza cheese, although some models can grate harder cheeses like Parmigiano-Reggiano.

3. **Cheese Slicer:** The most common machine used in this category is your standard deli slicer. It makes quick work of a log or brick of cheese and is handy because you can easily adjust the thickness of your slices. Other cheese-slicing machines include versions of the one we found at Tony Gemignani's Pizza Rock. A wire slicer is a simple cheese-slicing tool for home use. It provides uniform cheese slices but it will take longer to manually slice the cheese, and the slices might be thicker than you'd like (unless you have an adjustable version that allows you to cut any thickness that you want). You can also ask your local grocery store or deli to slice cheese to the specifications you need.

4. **French Fry Cutter:** Usually used for making french fries, as the name suggests, this is our favorite tool for cutting balls of fresh mozzarella. The resulting pieces are of different sizes because we start with a sphere rather than a rectangle, but the potato slicer makes 1.25 cm / ½ in pieces of mozzarella that we drain and then use on pizza.

5. **Microplane:** The Microplane company originally started out making wooden rasps before they began manufacturing the stainless steel graters that have become ubiquitous in professional and home settings alike. Microplanes come in a variety of widths and hole sizes and are typically used to finely grate foods from hard cheeses to lemon zest to chocolate. They also have a four-sided box grater.

6. **Vegetable Peeler:** We use a vegetable peeler to add shavings of hard cheeses after the pizza has come out of the oven.



ANTICAKING AGENTS IN SHREDDED MOZZARELLA CHEESE

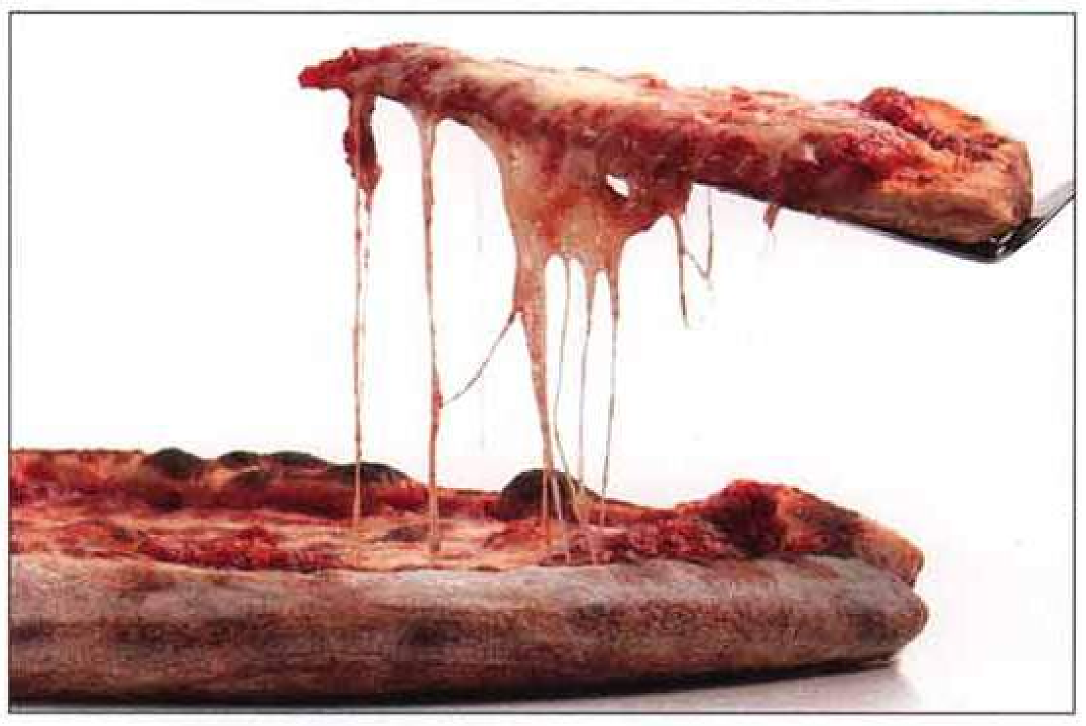
Some brands of low-moisture part-skim mozzarella cheese contain anticaking agents (such as cellulose and starch) to keep the cheese from clumping. We found ourselves asking a lot of questions: Do these cheeses melt or brown differently? Is there a taste difference? A stretch difference? And finally, are anticaking agents even necessary?

In the photos below, three different cheese brands were baked on New York pizzas for 5 minutes in a 315° C / 600° F deck oven. Within 30 seconds of removal from the oven, a slice was cut and pulled from each pizza to showcase the cheese stretch. It turned out that the cheese with dispersed cornstarch was inferior—in melting, browning, and stretching—to both the cheese without additives and the one with cellulose. After we tasted each pizza, the cornstarch cheese came out the loser again. It had a tougher texture than the others, and a less appetizing flavor.

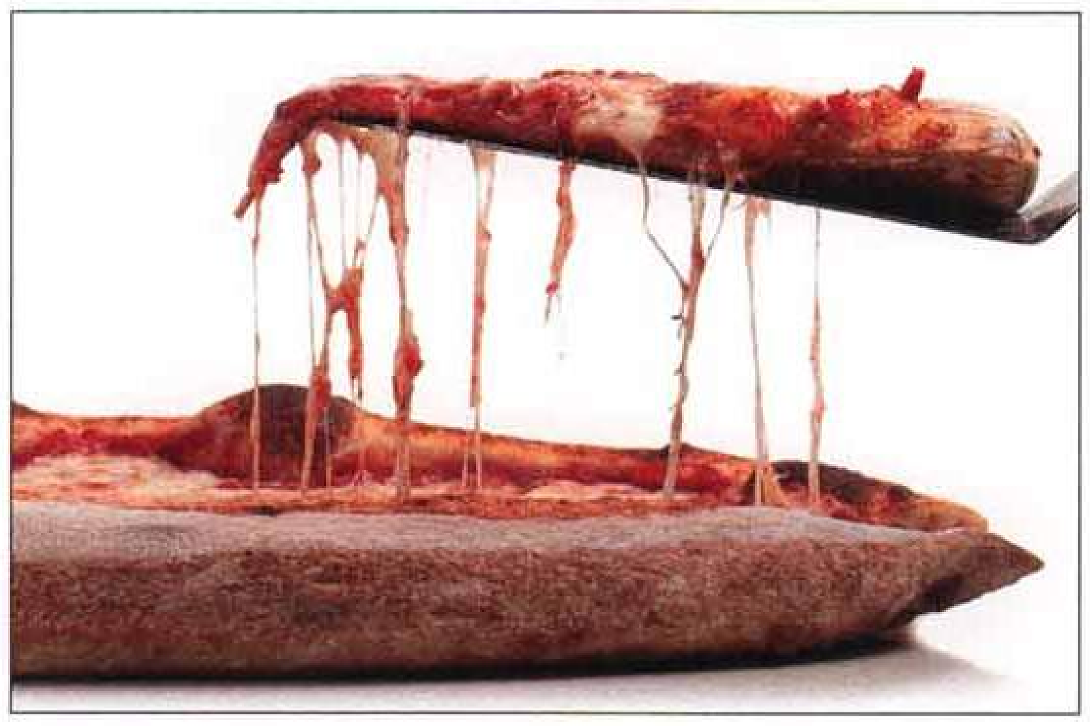
Since the shredded mozzarella with cellulose had similar results to the shredded mozzarella with no additives, we went on to further test whether the anticaking agent was even needed and, if so, the proper amount. We mixed shredded pizza cheese along with dispersed 1.5%, 3%, and 4% microcrystalline cellulose, and tested it against the control (without additives). Each sample was kept both cold (4° C / 39° F) and at room temperature (21° C / 70° F) for 3 hours. At cold temperatures, we observed no caking in any of the cheeses. At room temperature, the shredded mozzarella with no additive massed together, making it more difficult to scatter evenly. The cheeses dispersed with cellulose showed no signs of caking at room temperature. After baking each percentage of the dispersed anticaking agent, we preferred the option with 1.5% microcrystalline cellulose since the higher amounts didn't provide any added benefit.

When shredded pizza cheese is kept at room temperature, simply disperse 1.5% microcrystalline cellulose in the cheese or find a store-bought product containing the agent. If the cheese is held in cold conditions, a product without any additive is best for baking on pizza.

Pizza cheese with added cornstarch



Pizza cheese with added cellulose



Pizza cheese with no additives

DOES MOZZARELLA SHRED SIZE AFFECT PIZZA SURFACE COVERAGE AND MELTING?

When it comes to cheese—particularly the shape—we had a lot of questions. What's the optimal amount and size of cheese for a given pizza style? Will finely shredded cheese cover the same surface area as coarsely shredded cheese? Do you need to compensate for any differences between them? Does sliced cheese brown more quickly than shredded? We wanted answers!

We designed an experiment using a block of pizza cheese that we divided in four different shapes: sliced to a typical thickness of 3 mm / 0.12 in, and shredded to three different sizes—fine, medium, and coarse. Weighing out equal portions, we used each of the shapes to top individual New York pizzas. For the shredded cheeses, we made sure each pizza was covered completely, without any gaps. Then we baked the pizzas for the same time and at the same temperature (see photos below).

Regardless of the cheese size/shape we used, we got relatively similar results in terms of melting and browning. Turns out that cheese size—sliced or shredded—isn't really an issue so long as you're controlling for weight and baking conditions.

Fine

Medium

Coarse

APPLYING CHEESE TO YOUR PIZZA

Even though you can get good results whether you slice or shred your cheese, how you apply it to the pizza matters. If you want the cheese to completely melt and/or brown, it needs to be in an even layer. This brings us to one of our biggest pet peeves: asymmetrical pizzas. Sure, pizzas have a somewhat organic shape, but they're often shared. Who wants an under-cheesed slice? Even if it's a one-person pizza, you still don't want all the cheese on one side. Strive for consistency.

For sliced cheese, aim for a single layer, overlapping each slice slightly to prevent gaps. For shredded cheese, apply in an even layer and don't overdo it. It's okay to see some of the sauce. Typically, shredded cheese will melt and cover small gaps. Inexperienced pizza makers tend to add too much or too little cheese, which can affect the way the pizza bakes, customer satisfaction, and the bottom line (see The Importance of Portioning, page 305). Also, though it may seem hard to believe, there is such a thing as too much cheese. (See the Argentinian al molde pizzas on page 1:200.)

For hard cheese, grate it directly over the pizza and distribute it evenly. These cheeses are usually very flavorful, so you don't need much. They can be applied before, during, or after baking, depending on the flavor you're seeking. Using a vegetable peeler to slice strips of very hard cheeses directly onto the baked pizza can make for an elegant presentation.

Crumbled cheese (like blue cheese or feta) should be distributed evenly, too, but with a restrained hand. Remember, these tend to be strong in flavor; don't carpet your pizza with blue cheese.

When using hand-torn or shredded fresh mozzarella, distribute it evenly over the sauce, but you don't need to cover the entire surface. The cheese is only one-third of the Neapolitan margherita pizza experience. Make sure that even though these shapes are organic, you are distributing them evenly and symmetrically over the pizza.

Treat hand-cut or cubed cheese similarly to shredded cheese. Lay it on in an even layer, but not so heavily that you can't see the sauce or dough. When it melts, the pizza will be covered.

Use a vegetable peeler on hard cheeses to produce curls of cheese that you can apply to the pizza after it bakes.

RECOMMENDED CHEESE AMOUNT BY PIZZA STYLE

How much cheese is enough? We did experiments for each type of pizza to determine the optimal amount of cheese for each style. You'll see specific amounts in our assembled iconic recipes in chapter 12 on page 3:3 that may differ slightly from the amounts below, but here are some general guidelines. We don't include recommended amounts for al taglio pizza here since the amount varies so much depending on whether you are baking the cheese on the dough or applying after baking. See the Iconic Recipes chapter starting on page 3:3 for more info on al taglio pizza.

Pizza style	Dough weight	Pizza size	Recommended cheese type(s)	Recommended weight
Thin-Crust Pizza see page 3:19	275 g	40 cm / 16 in	Shredded pizza cheese	150 g
	370 g	50 cm / 20 in		270 g
Brazilian Thin-Crust Pizza see page 3:25	125 g	23 cm / 9 in	Shredded pizza cheese	175 g
	250 g	40 cm / 16 in		340 g
Deep-Dish Pizza see page 3:93	230 g	21 cm / 8½ in	Sliced skim low-moisture mozzarella	120 g
			Shredded pizza cheese	55 g
			Sliced provolone	160 g
	700 g	32 cm / 12½ in	Sliced pizza cheese	255 g
			Shredded pizza cheese	140 g
			Sliced provolone	255 g
Neapolitan Pizza see page 3:47	250 g	30 cm / 12 in	Fior di latte mozzarella or mozzarella di bufala	100 g
New York Pizza see page 3:71	400 g	35 cm / 14 in	Shredded pizza cheese	195 g
	600 g	40 cm / 16 in		290 g
	800 g	45 cm / 18 in		390 g
	1 kg	50 cm / 20 in		485 g
	1.1 kg	55 cm / 22 in		535 g
	1.2 kg	60 cm / 24 in		585 g
Artisan Pizza see page 3:77	360 g	35 cm / 14 in	Shredded pizza cheese	180 g
	400 g	40 cm / 16 in		270 g
	470 g	45 cm / 18 in		360 g
	500 g	50 cm / 20 in		450 g
	580 g	55 cm / 22 in		495 g
	620 g	60 cm / 24 in		540 g
New York Square Pizza see page 3:133	500 g	46 cm by 33 cm / 18 in by 13 in	Shredded pizza cheese	425 g
Detroit-Style Pizza see page 1:109	330 g	25 cm by 20 cm / 10 in by 8 in	Shredded pizza cheese	60 g
			Wisconsin brick cheese	115 g
	500 g	35 cm by 25 cm / 14 in by 10 in	Shredded pizza cheese	115 g
			Wisconsin brick cheese	225 g

Artisan pizza with New York / artisan pizza tomato sauce, braised short rib, sautéed mustard greens, and shredded mozzarella

THE IMPORTANCE OF PORTIONING

If you're making pizza at home, do you need to have precise portions of toppings? Not really, as long as you don't overdo it. Follow our common-sense steps in the chapter starting on page 3:3 and you'll be fine. If you own a pizzeria, though, it's a different story. Properly portioned toppings can be a big deal for three reasons: consistency, cost, and baking time.

Every restaurant wants repeat customers, and you better believe they're going to want their favorite pizza to look and taste the same every time. If the topping amounts vary, customers may begin to wonder what they're getting for their money. More cheese than usual generally doesn't result in complaints, but if there's less, you could have a problem. Some customers will bring it to your attention. Others just won't come back. Some might even tell their friends.

In terms of cost, occasionally putting an extra ounce of cheese on top of a pizza may not seem like a big deal. But if you make dozens or hundreds of pizzas a day, it quickly adds up. Among the three basic components of pizza (cheese, sauce, and dough), cheese can be the most expensive. If you're running a restaurant, your profit margins are already narrow. Don't set yourself back by giving away extra cheese. We recommend that you start with the outer rim, follow your sauce line, and then work your way into the middle when you add cheese to pizza. Everything tends to slide a little toward the middle as it bakes, which is why most cooks end up with a red ring along the perimeter with no cheese (the sauce then burns because it has no coverage and it looks like you burnt the pizza). The pizza is also weakest in the middle; if there is cheese built up in the middle, the pizza will be unintentionally soupy, or all the toppings will slide off when the customer tries to pick up a slice.

Using too much cheese can also impact production. When the amount of cheese on the pizza varies, so will its baking time. Keeping the weight of the cheese consistent helps you not only ensure each pizza is cooked all the way through, but also maximize output during busy service.

The first step is to identify how much cheese you want on each pizza (see previous page). After that, you can control portions in several different ways. The most precise is to pre-weigh all of the cheese into stackable airtight containers and keep them in refrigeration. This requires some upfront work, but once it is done, it's done. Another method is to assemble each pizza on a scale. This allows you to precisely control the weight of each ingredient you put on top. The downside is that it can be awkward. Some scales aren't big enough for larger pizzas like New York, and sliding a peel onto a scale can be cumbersome. To make using the scale easier, you can assemble the pizza on a mesh pizza screen. This allows you to easily slide it into the oven with no damage; unfortunately, this can be a little more time consuming.

Though we prefer weighing ingredients, portioning by volume is an option. First, decide on the weight of cheese you want on a specific style of pizza. Then find a volume measure that will fit the cheese with as much precision as possible. It can be a measuring cup or a soup bowl or whatever you have. It should be loosely packed; tight packing will make the cheese cluster. This method is the fastest and most efficient, but it's also the least accurate.

Some cheeses make portioning simple. Fresh fior di latte mozzarella, for example, comes in preportioned balls from the manufacturer. Many pizzerias use one regular-size ball of mozzarella for each Neapolitan pizza. No scales, no measuring cups, no guesswork. The downside to this is that the cheese will not be properly drained and may produce a soupy pizza.

CHOOSING YOUR OWN CHEESE ADVENTURE

We know cheese helps make pizza delicious and provides textural interest that adds to the pleasure. That's from the eater's perspective. But cheese has a functional perspective, too, and knowing that will help you understand how to build flavors and play with textures. Many classic pizzas, like a New York slice or a Neapolitan margherita, use a single type of cheese, but who says you have to use just one type? The key is knowing which cheeses combine well—that is to say, which cheeses melt at more or less the same rate. You can combine cheeses that don't melt at the same rate, too, but you'll have to add them to the pizza at different times. Here are our suggested combinations.

CHEESES THAT CAN BE ADDED DURING OR AFTER BAKING

Goat cheese (chèvre), Camembert, Brie, Époisses, fontina, Taleggio, French münster, Roquefort, Stilton, Cabrales, Gorgonzola, cream cheese, quark, ricotta, mascarpone, crème fraîche, Ekte Gjetost

The ricotta on the prebaked al taglio pizza on page 3:146 helps to affix the toppings to the pizza and is not baked again before serving.

CHEESES USED FOR FLAVOR

Parmigiano-Reggiano, pecorino Romano, Grana Padano, Asiago (d'Allevo), Manchego, Idiazabal, Mahon, any smoked cheese (gouda, provolone, mozzarella)

A combination of flavorful cheeses (Manchego and goat cheese) come together on our Artisan Pizza on page 3:77 and work to highlight the flavor of the figs and prosciutto.

BROWNING CHEESES THAT CAN BE BAKED IN ANY COMBINATION

Cheddar, Colby, Monterey Jack / Pepper Jack, Wisconsin brick cheese, American muenster, low-moisture mozzarella, provolone, caciocavallo, scamorza, Edam, gouda, Havarti, Emmental, Gruyère, Comté, aged fontina

The star of the Don't Hold the Mustard Pizza (see page 3:253) is the short rib pastrami, but the Gruyère plays an important supporting role in the flavor profile.

CHEESES USED AS THE MAIN CHEESE LAYER

Pizza cheese, mozzarella di bufala, fior di latte mozzarella, cheddar, provolone, Provel, Wisconsin brick cheese

One pizza that famously features cheese as the main layer is Detroit-style pizza (see page 3:109), which also has a frico crust made out of Wisconsin brick cheese and pizza cheese.

FLAVORFUL CHEESES THAT DON'T MELT WELL

Goat cheese, Camembert, Brie, Époisses, Taleggio, French münster, Roquefort, Stilton, Cabrales, Gorgonzola, cream cheese, Ekte Gjetost

Goat cheese is one of the main components that contributes to the spring flavor profile of the Get Your Goat Pizza on page 3:280.

CHEESES THAT CAN BE ADDED BEFORE OR AFTER BAKING

Parmigiano-Reggiano, pecorino Romano, Grana Padano, Asiago (d'Allevo), Manchego, Idiazabal, Mahon

Our One in Ten Is Spicy Pizza (see page 3:279) is finished with shaved Manchego but you could just as easily add the cheese before baking.

CHEESES THAT PERFORM WELL IN HIGH-TEMPERATURE OVENS

Mozzarella di bufala, fior di latte mozzarella, ricotta, mascarpone, crème fraîche

Fior di latte mozzarella or mozzarella di bufala are optimal choices for the classic Margherita Pizza (see page 3:47) that is typically baked in a 425–480°C / 800–900°F oven.

CHEESES THAT CAN DOUBLE AS A SAUCE

Quark, ricotta, mascarpone, crème fraîche, sour cream

Our Raclette Pizza (see page 3:243) uses crème fraîche as the sauce base in combination with creamy raclette, roasted fingerling potatoes, and caramelized onions.

THE FUNCTIONAL QUALITIES OF MELTED CHEESE

A cheese is melted when it no longer holds its original shape and the fat has softened. Not all cheeses melt. Some will keep their shape no matter how hot they get, like feta and Halloumi, while others will melt but will turn into a puddle, like Brie. So are there any universal principles for cheese on pizza?

In some ways, this is a tough question since the desired outcome depends on the type of cheese. For example, you wouldn't want ricotta to brown, but browning can be desirable with other cheeses (see page 319). Still, there are some aspects of cheese melting that can be quantified. The apparent viscosity will let you know how toothsome the cheese will be after melting. The flowability measures how much the cheese spreads while melting.

The melt time is crucial to know. If the cheese is shredded, it shouldn't hold a trace of its original shape when it melts and, on most pizzas, the cheese layer forms a homogeneous mass. (Pizzas like Neapolitan margheritas are an exception; in those, the cheese isn't going to cover the entire surface.)

As for browning, this is an interesting process. Cheese browns once the surface gets hot enough, which usually occurs well after the cheese has melted. First, the water has to evaporate, which occurs at 100°C / 212°F. Once enough moisture has evaporated to get the sugars and proteins on the surface hot, browning can begin (as an example of a Maillard reaction, see page 393).

And finally, the stretchability of a cheese is its ability to form cohesive strings when it is extended, as well as how long the strings can stretch before they break.

At Apollonia's Pizzeria in Los Angeles, CA, we indulged in some of the best Detroit-style pizza in the United States. This slice combined a lacy frico crust with mozzarella and fresh ricotta to make for a delicious combination of cheeses.

CHEESE MELTABILITY AND BROWNING

There's nothing more gratifying than a lovely cheese pull on pizza, but not all cheeses melt the same. Since choosing to bake the wrong cheese in the high heat of a pizza oven can potentially ruin your pizza, we experimented with different cheeses to better understand their melting and browning characteristics. We found that the browning of mozzarella depends a lot on the ingredients used and how the cheese is made (see page 319).

Cheese begins to melt at around 32° C / 90° F; the milk fat melts, and the cheese softens. The hydrophobic interactions between casein molecules increase in the presence of heat and these interactions force out water molecules. The space between casein molecules increases, allowing milk fat to escape. The temperatures necessary for the rest of the melting process depend on the specific type of cheese and its fat and moisture content.

A cheese with a higher moisture content will have more loosely packed milk proteins, which separate more easily when heated. We confirmed this by comparing the melting and browning of whole-milk fresh mozzarella and low-moisture mozzarella (or pizza cheese). The latter has less moisture to evaporate and browns more quickly on Neapolitan pizzas. A cheese with more moisture, like fresh mozzarella, is traditionally preferred on Neapolitan, since that cheese will take longer to lose its moisture, therefore taking longer to brown.

Another interesting observation is that overall, softer cheeses first melt, then the fat separates. (Although some cheeses, regardless of whether they are soft, don't melt well.) Harder cheeses do the opposite: the oil separates first (which is undesirable for pizza), then melting occurs. For example, Parmesan cheese has a great nuttiness and aged cheese flavor. When baked, however, this hard and dry cheese will become oily and greasy instead of creamy. In a hot oven it can brown significantly before the dough is properly baked. This is why it's more commonly used as a garnish after the pizza comes out of the oven.

Pizza cheese

Whole-milk fresh mozzarella

Cheese has to melt by typical mammal body temperature since cows have about the same body temperature as humans.

Parmigiano-Reggiano

COMMON CHEESE PROBLEMS

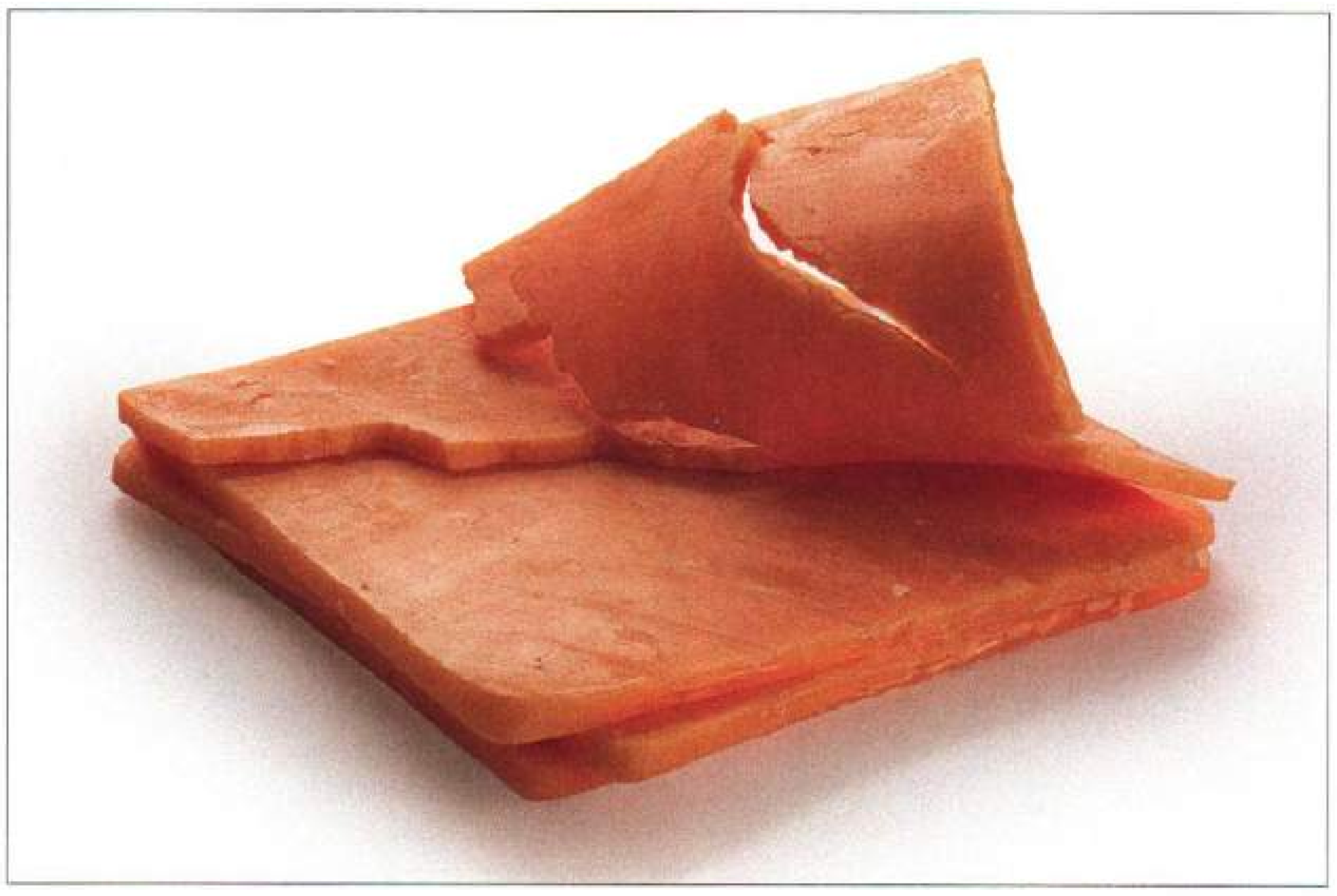
How you store your cheese will have a dramatic impact on how it behaves when you assemble a pizza as well as how it bakes in the oven. It can also promote the growth of unwanted molds. Keep your cheeses well wrapped (or covered if they are shredded or grated) and in the refrigerator when they are not being used in service.

Mold

Not all molds are bad. Some, in fact, are used for making cheese (and, for that matter, mold was key to the development of penicillin). Eating a little bit of unwanted mold on cheese isn't likely to cause problems in healthy people. Yet many people see a little bit of mold on their cheese and immediately throw it all away. With semihard, hard, and very hard cheeses, that's not necessary. Mold can't penetrate very deep into these cheeses, so just cut off the part that's molding, plus an extra margin of, say, 3-6 mm / ⅛-¼ in. The rest will be fine. Make sure the knife doesn't touch the mold so you don't accidentally spread it while you're cutting. On the other hand, for soft cheeses like mascarpone or crème fraîche, it's a good idea to just throw the whole thing away if you see mold. Mold is a clue that the product is past its prime quality and maybe no longer safe to consume.

Clumping

This typically happens with shredded cheeses when they're left out at room temperature for too long. Try to keep these cheeses cold at all times. If they've clumped from sitting out at room temperature and they've been out for less than 2 hours, chill them again and break the clumps apart by hand.



Slices Sticking Together

This occurs for the same reason as clumping. As the cheese softens, it will stick to whatever it contacts. If you're careful about keeping the slices in a single layer or placing parchment between slices when they're stacked, you shouldn't have a problem.

Sweaty Cheese

This occurs with very hard, hard, and semihard cheeses. When they sit out uncovered, they tend to sweat. This isn't a problem in and of itself, but it does mean you've left your cheese uncovered and it will eventually dry out. You should cover the cheese and keep it refrigerated. In the case of sliced cheeses, separate the slices with parchment paper to keep them from sticking.

VEGAN CHEESES

The quest for a flavorful, meltable, stretchable nondairy cheese has been ongoing for years. While there are foods that seem sort of cheeselike through a 21st century lens—fermented tofu, for example, which dates back at least to 16th century China—the development of this sector has largely been in the United States, according to the SoyInfo Center, which published a 567-page book on the subject, documenting every alternative cheese it has come across.

The earliest commercially available example was developed in 1896 by Dr. John Harvey Kellogg (of cereal fame), a member of the Seventh Day Adventist church, which promotes vegetarianism. Called Nuttose, it was made from peanuts. Throughout the early- and mid-20th century, many of the commercially available cheese alternatives were made by the Seventh Day Adventist community. Most of these "cheeses" were actually tofu. By the 1980s, more commercial products were coming out, but, unbeknownst to many consumers, many contained casein (see page 286), which gives cheese its melting properties but is made from milk, an animal product.

Many of the early products just couldn't match real cheese. They often had a waxy, chalky, and/or plastic-like texture, and didn't always taste great, either. In recent years, as consumers have become more interested in plant-based proteins, the quality and flavor have improved dramatically and the options have expanded. Now, you can find vegan cheeses made from many different sources: soy, almond, or rice milk; nuts; seeds; tapioca; soybeans; coconut oil; and more.

A big challenge is making these nondairy cheeses behave like cheese in the oven. To get around the casein problem, modern cheese makers use a blend of solids, fats, gums, and protein to try to replicate the melting qualities and mouthfeel of dairy cheese. We conducted a round of vegan cheese tests from 10 different brands with a total of 22 cheeses, including mozzarella, ricotta, cheddar, provolone, Parmesan, smoked provolone, smoked gouda, Pepper Jack, and American. We baked the cheeses on Neapolitan, New York, and Detroit-style pizzas.

The results ran the gamut. Some vegan cheeses didn't melt; others turned out slimy after baking. Some turned very grainy in texture, with a mouthfeel like grated Parmesan or cheese powder. Others leaked lots of oil. Some came out of the oven looking almost fluorescent. Flavors varied from neutral to, well, rather unusual. We have discerned coconut, spice, or floral notes in some of these cheeses; others taste distinctly of fermentation and acidity after baking.

With the vegan cheese market rapidly expanding (and additional plant-based cheeses being developed), we expect more delicious vegan cheeses to try in the future. These are our favorite vegan cheeses available where we live in the Pacific Northwest. We recommend trying a bunch of the brands locally available to you since we found the taste and texture varied widely from brand to brand.

Pizza styles	Recommended cheeses	When to apply	Notes
Neapolitan Pizza see page 3:47	Kite Hill ricotta	before baking	taste and appearance nicely mimic ricotta; good tangy flavor
	So Delicious mozzarella	before baking	good melt and browning; decent mouthfeel; an unusual floral flavor note
	Good Planet Foods mozzarella	before baking	nice melt; decent texture; neutral flavor
New York Pizza see page 3:71	Kite Hill ricotta	before baking	decent ricotta texture and flavor; no melt
	Daiya mozzarella	before baking	good flavor; slightly gummy texture
	Good Planet Foods mozzarella	before baking	nice melt; decent texture; neutral flavor
Detroit-Style Pizza see page 3:109	Kite Hill ricotta	after baking	good texture; good tangy flavor
	So Delicious cheddar and mozzarella mixture	before baking	good mimic of cheese; nice mouthfeel; tangy flavor
	Good Planet Foods mozzarella	before baking	nice melt; decent texture; neutral flavor

New York pizza with Daiya mozzarella

THE ORIGIN OF CATUPIRY CHEESE

Catupiry is a soft, bright white processed cheese from Brazil—imagine American cheese and Miracle Whip. It's in the "requeijão" or creamy cheese family, so it's spreadable rather than sliceable. It's often extruded onto pizza and is even sold in plastic piping bags or squeeze bottles just for that purpose. Because it's heat sensitive, Catupiry is typically applied after baking. It was invented in 1911 by an Italian immigrant named Mario Silvestrini. We had it for the first time on our trip to Brazil (see page 1:190). According to the makers, the name catupiry means "excellent" in the Tupí language spoken by the Tupinambá people of Brazil. Like American cheese and Provel, it's a processed cheese and thus can't legally be labeled "cheese" in the United States.

THE CONSEQUENCES OF FREEZING CHEESE

Although freezing works well to extend the shelf life of many foods, freezing cheese can present some problems, depending on the type of cheese and its moisture content. Ice crystals form in cheese when it's stored in the freezer, which affects both the flavor and texture of the cheese when it's thawed. Because water expands when it freezes and contracts as it thaws, the molecular structure of the cheese can break down when the cheese is removed from the freezer.

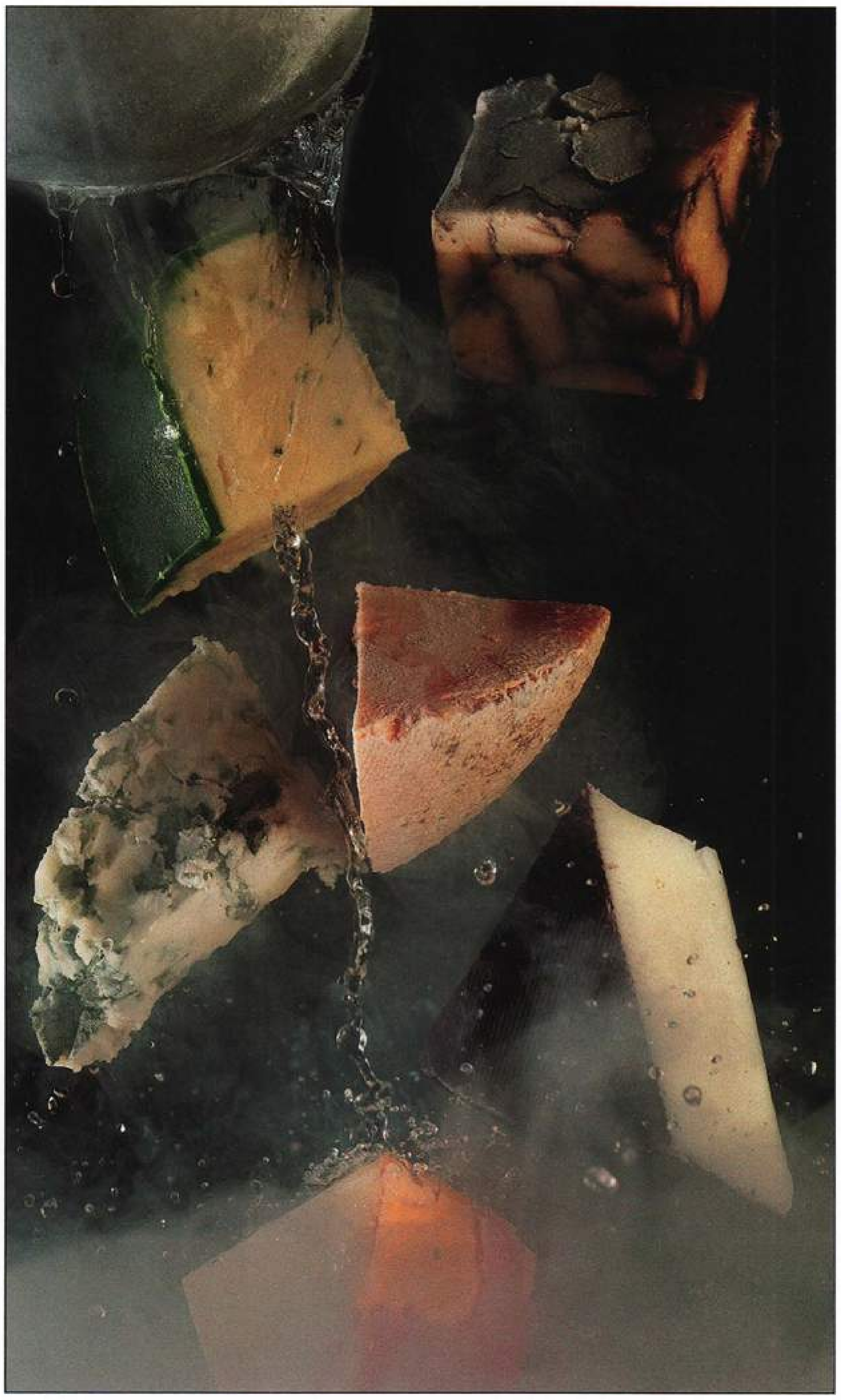
We wanted to experiment to see which cheeses were capable of withstanding freezer conditions. We tried freezing ricotta, fior di latte mozzarella, sliced whole-milk fresh mozzarella, sliced pizza cheese, shredded pizza cheese, sliced provolone, sliced cheddar, crumbled Gorgonzola, and grated Parmesan.

Sliced cheeses were portioned and wrapped well in plastic wrap before being placed in the freezer. Ricotta and fior di latte mozzarella were frozen in the containers they were purchased in, and the shredded pizza cheese, Gorgonzola, and Parmesan were portioned and placed in tightly sealed zip-top bags before freezing. All cheeses were assessed at 6 weeks and 12 weeks. At each time point, the cheeses were thawed in refrigeration for 1 day and then baked on pizzas.

After 6 weeks, the mozzarellas (other than fior di latte), provolone, cheddar, and Parmesan cheeses behaved fairly normally both when we tasted them raw and when we baked them. The soft cheeses—ricotta and fior di latte mozzarella—had noticeable differences in their raw texture compared to their texture before freezing. The ricotta was grainier and yellow in color, and the fior di latte mozzarella was tough and slightly crumbly when we tore it into pieces. Liquid seeped out of both soft cheeses during baking, which made for soggier pizzas.

By 12 weeks, both soft cheeses were grainy when we tasted them raw. Although they still wept some liquid, the liquid evaporated during baking in both cases. The semihard to hard cheeses (with the exception of Parmesan, which saw no obvious variation) performed well during baking. We did see evidence of oil separation, however, signifying a collapse of the protein matrix strength and its inability to hold on to the milk fat in the cheese. This "oiling off" is an undesirable result for most pizzas.

The upshot: freezing cheese is a way of prolonging its shelf life, but it comes at a price. It will likely change the cheese's desired properties if stored for an extended period of time. We don't recommend freezing softer cheeses like ricotta and fior di latte mozzarella. Semihard to hard cheeses hold up much better, and we recommend storing them for 6 to 12 weeks.



While you can freeze some of the cheeses commonly used on pizzas with limited success, freezing artisan specialty cheeses like those pictured above and then baking them on pizza would not work well (especially with the liquid nitrogen used to freeze the cheeses above).

MODIFIED ATMOSPHERE PACKAGING FOR CHEESE

You can keep food spoilage at bay in a number of ways. Refrigeration is the simplest because lower temperatures slow down the growth of most microbes. Pickling, curing with salt, or adding artificial preservatives works, too. To keep food fresh as long as possible without additives, modified atmosphere packaging (MAP) is often used. This type of packaging contains a carefully controlled mixture of natural gases that inhibit oxidation and the growth of microbes. Spoilage is reduced and shelf life is increased.

How does MAP work with cheese? We experimented with carbon dioxide, which is commonly used in packaging both fresh and shelf-stable foods. It acts by excluding oxygen from the atmosphere inside the storage container (called head-gas). When head-gas oxygen levels are dropped below 2%, undesirable oxidation reactions can be greatly decreased, resulting in longer shelf life.

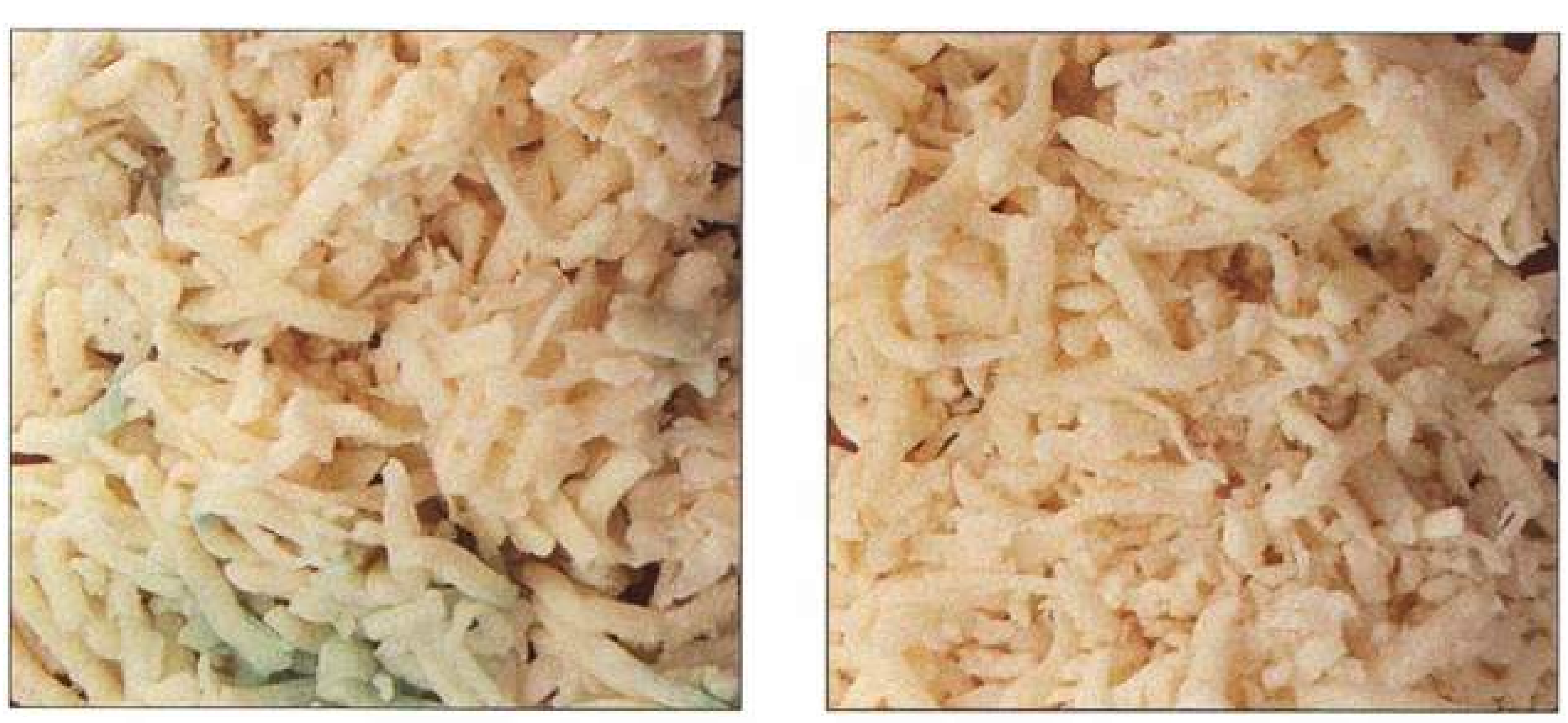
We tested ricotta, fior di latte mozzarella, sliced whole-milk fresh mozzarella, sliced pizza cheese, shredded pizza cheese, sliced provolone, sliced cheddar, crumbled Gorgonzola, and grated Parmesan. All of the cheeses were stored in the refrigerator with the exception of the fior di latte mozzarella and the sliced whole-milk fresh mozzarella. We observed them at room temperature because that's what the pizzaioli in Naples recommend for margherita pizzas. Because they weren't refrigerated, their shelf life was, of course, shorter.

Each cheese was removed from its original packaging, and samples were placed in three different sealed bags: one zip-top bag filled with air, one zip-top bag flushed with CO_2 from a whipping siphon, and one vacuum-sealing bag filled with CO_2 from a gas tank (using a chamber-style vacuum-packing machine, such as those used in delis or sous vide, which often has a feature to do a gas flush from a tank of CO_2). Cheeses under refrigeration were evaluated and baked on pizzas at 1-week intervals for 6 weeks, while the cheeses at room temperature were evaluated and baked on a pizza at 24-hour intervals for 4 days.

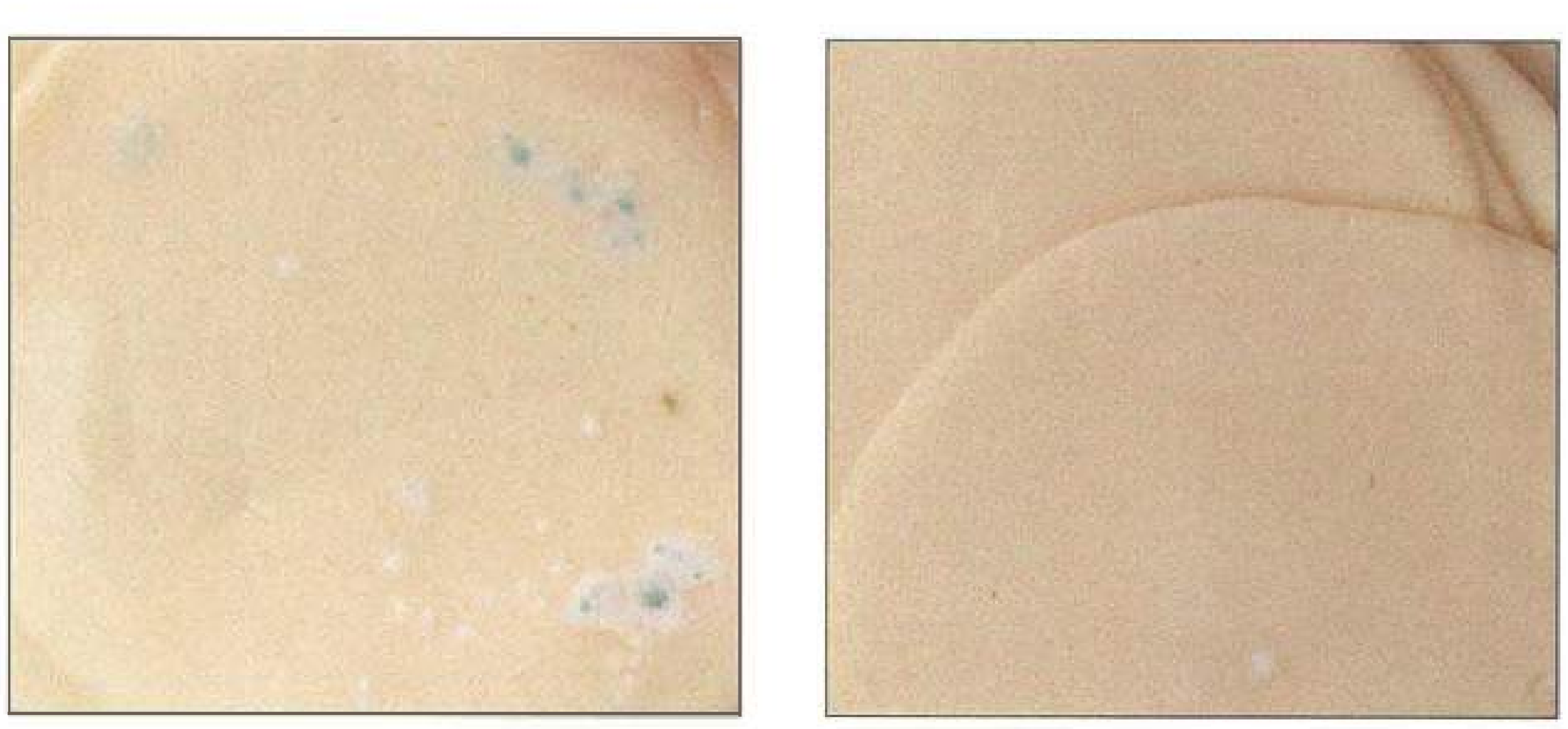
For the refrigerated cheeses, the zip-top bag with air gave the shortest shelf life. Most of the cheeses started to taste a little sour and began to mold once they hit 2 weeks. (The exceptions were ricotta and Parmesan, which were still acceptable at 4 weeks.) The zip-top bag flushed with CO_2 extended the shelf life for most of the cheeses further, to over 3 weeks. The exceptions were the cheddar and provolone, which started to show signs of mold right at the 3-week mark, and the shredded low-moisture mozzarella, which showed mold at 2 weeks. The Cryovac bag with CO_2 extended the shelf life even further—all of the cheeses lasted 5 weeks with no adverse effects during baking. At 6 weeks, we observed all of the cheeses breaking during baking, with an excess of oil separation. The breaking of the cheeses signified structural weakness, making them less than ideal.

The three types of packaging performed similarly for the two cheeses stored at room temperature—fior di latte mozzarella and whole-milk fresh mozzarella slices—though the time period was compressed. The zip-top bags with air lasted 2 days, although they were slightly sour smelling by the end of the second day. The zip-tops with CO_2 and Cryovac with CO_2 both extended the storage time at the same rate to 3 days. The Cryovac samples were better at maintaining the shape and freshness of the cheeses. The most interesting find was on day 4 with the Cryovac samples: both cheeses showed small bubbles of carbonation. Once they were baked on the pizzas, it was still evident that the cheeses were carbonated but it didn't give the pizza a bad flavor. We recommend keeping these cheeses at room temperature in a Cryovac bag for no more than 4 days.

Overall, these results confirmed previous scientific findings of extending storage time with the use of CO_2 and MAP. If your cheese comes in a block, you can also vacuum seal the block whole. If a vacuum sealer and CO_2 gas tank are not readily available to you, a zip-top bag with siphoned CO_2 is a great alternative when storing cheese.



3-week-old pizza cheese without and with CO_2 zip-top packaging



3-week-old provolone without and with CO_2 zip-top packaging

5-week-old Parmesan cheese with CO_2 vacuum-sealing packaging

MOZZARELLA

The very first mentions of pizza in Naples actually do not talk about cheese at all (see pages 1:10–11). Pizza in the late 1700s and early 1800s was more often topped with tomato or small fish; the first reference to cheese pizza dates to 1824. It's safe to say that since then mozzarella has become the most popular cheese used on pizza.

In the process of conquering the pizza world, mozzarella evolved into a variety of different forms. Today in Italy, it exists in several primary forms for the pizzaiolo. The most common is fior di latte mozzarella and mozzarella di bufala; there are also low-moisture varieties, however, such as scamorza, caciocavallo, and provolone (an aged pasta filata cheese). Fresh mozzarella and scamorza are also smoked to contribute a different flavor profile on pizza.

Mozzarella, as befits a cheese that possibly dates back to the 12th century (see page 316), can be made with no special equipment and in very small batches. It's a perfect cheese for small artisanal production. It's not surprising that fresh mozzarella was first manufactured in the United States by Italian immigrants over a hundred years ago in the Midwest.

As pizza became popular in the United States and manufacturers wanted to ship mozzarella across the country, the style changed and the most common cheese became low-moisture mozzarella. Anyone who tries low-moisture mozzarella, then fresh mozzarella will scarcely believe the two are same kind of cheese, yet the process to make them is very similar. And low-moisture mozzarella is itself very similar to scamorza and caciocavallo when it bakes (see page 298). Pizzaioli in Italy primarily use fresh mozzarella, though some use low-moisture cheese like scamorza and caciocavallo. The usage in the United States is the opposite; here, pizzaioli primarily use pizza cheese (low-moisture mozzarella), while some pizza makers use fresh mozzarella.

All of the aforementioned cheeses are part of a group known as pasta filata cheeses, or "spun paste" cheese. To make these cheeses, curds are heated in hot water or other liquids and then manually or mechanically stretched and kneaded (or spun). This creates the stringy cheese that everyone knows. There are basically two ways to make mozzarella from scratch: One is by direct acidification, in which the milk is mixed with rennet and citric acid, heated to form curds, and then stretched to form cheese. The second method also involves rennet, but instead of citric acid, a culture is used.

In all of our tests, we preferred the direct acidification method. The two approaches produced similar mozzarellas; direct acidification is simpler and takes a fraction of the time but doesn't melt as well as mozzarella made with cultures. We preferred using nonhomogenized whole cow's milk for fior di latte mozzarella (see page 324) and whole buffalo's milk for mozzarella di bufala (see page 328). Note that homogenized milk will not form curds. There's also a third method for making mozzarella that allows you to skip some of the initial steps: buy the curds and then shape the cheese (see page 319). This method, frankly, is the easiest and fastest of all.

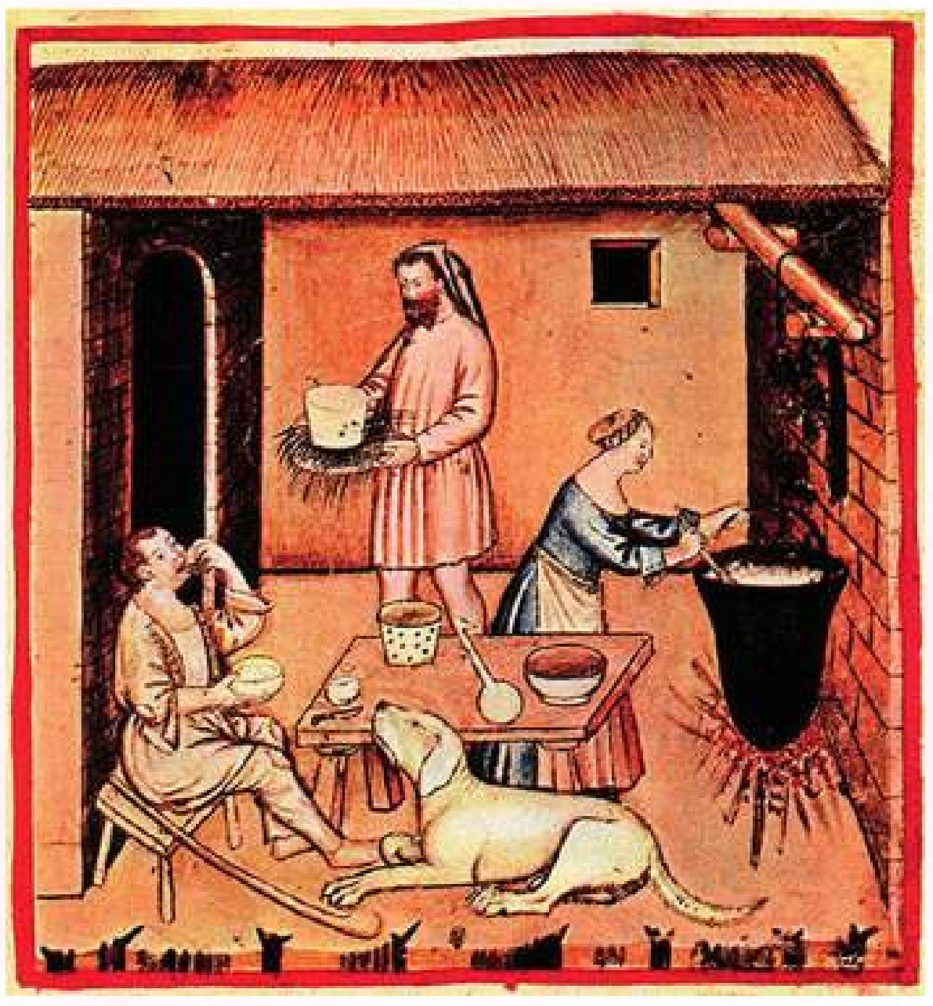
Low-moisture mozzarella is sometimes sold as "pizza cheese." This cheese is made with low-fat milk (about 1.8% fat) and a thermophilic starter that includes *Streptococcus thermophilus* and *Lactobacillus spp.* The curds are warmed to lower temperatures (70 °C / 158 °F) and the cheese is stretched and kneaded more extensively than fresh mozzarella. The result is a harder cheese that's molded into rectangular blocks while warm. The cheese is then brined in salt water (or, alternatively, it's salted during the stretching and kneading process). It's made in a way that's similar to making cheddar.

The word "mozzarella" derives from the Italian word mozzare, which means "to cut off." The name is apt. When making fresh mozzarella, the cheese maker uses the index finger and thumb to squeeze off pieces of the formed mozzarella, giving the portions a roundish shape.

Once we started researching, we found that many Italian mozzarellas have comparable forms in the United States. We grouped the common forms of mozzarella in Italy and the US, along with their moisture contents below.

MOZZARELLA THROUGH THE AGES

Mozzarella di bufala is considered by many to be the best cheese for making Neapolitan pizza, although how water buffalo arrived in Italy is a matter of speculation (see page 1:15). But mozzarella itself precedes the presence of water buffalo in Italy. It is, in fact, an ancient style of fresh, pressed cheese possibly dating back to the ancient Romans and made with the milk of cows, water buffalo, and even sheep.



CA. 50 CE

Lucius Junius Moderatus Columella wrote in *De Re Rustica* about a cheese-making technique in which hot water was added to curds and then the curds were molded by hand or placed in a wooden box.

12TH CENTURY

Documents specify that monks from the monastery of San Lorenzo in Capua offered "mozzarella or provatura with a piece of bread" to pilgrims who visited the church annually.

MID- TO LATE 15TH CENTURY

Provatura cheese made with buffalo's milk appeared in recipes for ravioli and two different tortes in *Il Cuoco Napoletano* (*The Neapolitan Recipe Collection*).

1816

The production of mozzarella and provole began in Acerra, Bisaccia, Cerignola, Aversa, and Cardito.

1824

The first description of savory pizza baked with oil, lard, mozzarella, and caciocavallo was found in the play *Le Ridicole Operazioni, o sia Pulcinella Vendicato*.

1847–1866

The first time mozzarella was mentioned with regard to pizza was in *Usi e costumi di Napoli* by Francesco de Bourcard.

1861

The *Tour de Monde*, a guidebook written in French, printed a description of a pizza that included herbs, anchovies, prosciutto, mozzarella, and spices. The German magazine *Globus* printed a similar description of garlic, vegetables, sardines, ham, mozzarella, and spices on the pizza.

1892

Pina and Francesco "Frank" Alleva opened Alleva Dairy, now the oldest cheese store in the United States, in Manhattan's Little Italy.

1918

The *Italian Chamber Bulletin* newspaper in Chicago included an early ad for buffali, or buffalo cheese, demonstrating the growing Italian community and the demand for Italian food products in the US.

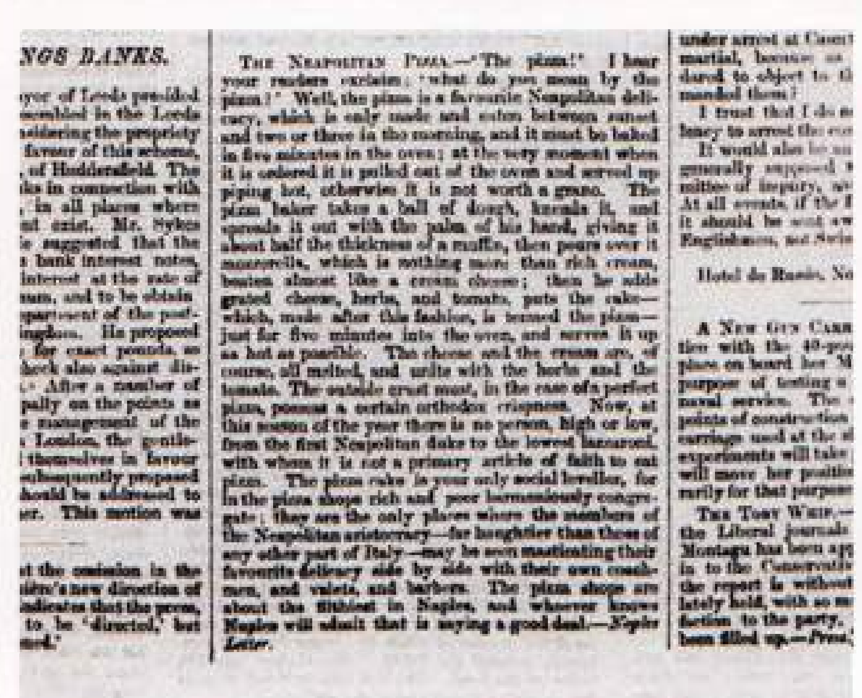
1524
Provatura appeared in recipes for a torte called picza figliata and for ravioli in the *Manoscritto Lucano*, a collection of recipes published in Nerola, outside of Rome.

1557
Cheese made from buffalo's milk was mentioned in *I Discorsi di M. Pietro*. It was called mozze in Naples and provature in Rome.

1570
The term "mozzarella" was used for the first time in *Opera di M. Bartolomeo Scappi*. The text differentiated between fresh mozzarella and neve di latte, today's fior di latte mozzarella. Scappi was the personal chef to two popes.

1726
The play *Delle Commedie di Giovanbattista de la Porta* provided a description of provatura, provola, and mozzarella.

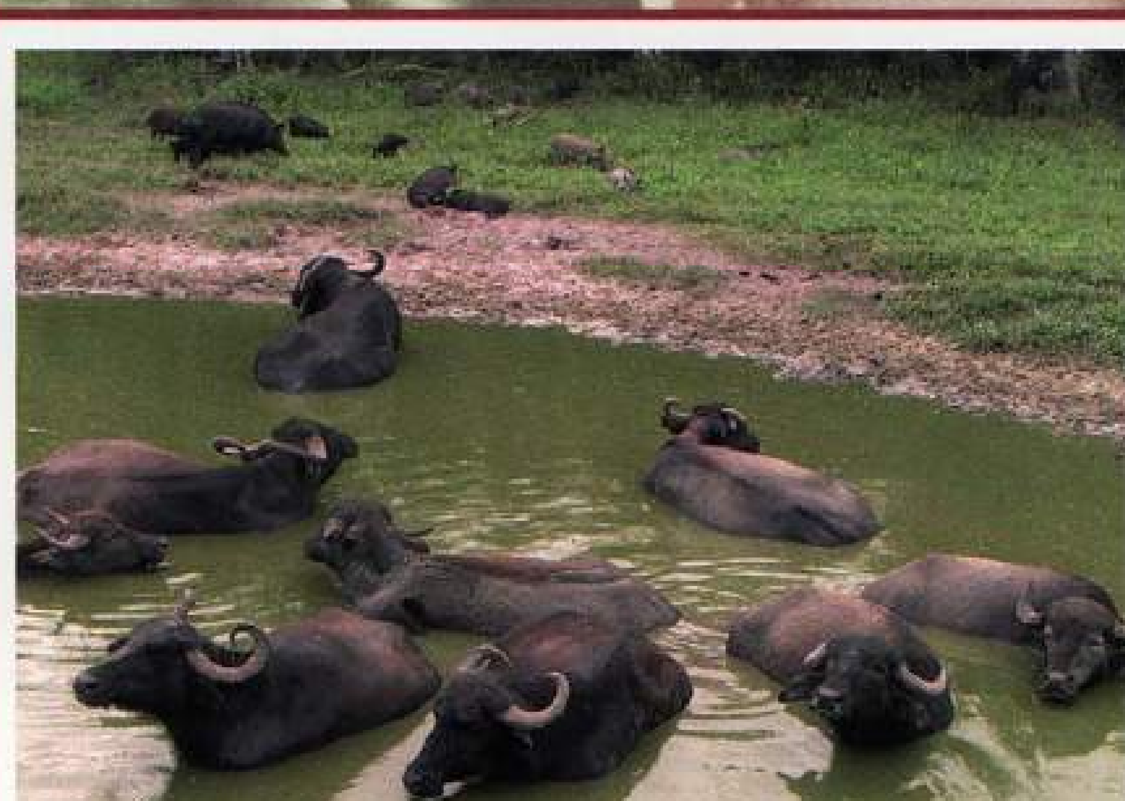
1848
The encyclopedia *L'Omnibus Pittoresco* first mentioned both tomato and mozzarella as ingredients on pizza.



1860
The London *Chronicle* published the first non-Italian description of Neapolitan pizza, complete with tomato and mozzarella (described as "nothing more than rich cream, beaten almost like a cream cheese") as ingredients.

1861
Italy became a country in 1861 following a long unification process, known as the Risorgimento, which consolidated the many different states of the Italian peninsula under a single government.

1861
After the unification of Italy, a wholesale market for mozzarella and ricotta known as the Taverna was formally established in Aversa.



1975
Dr. Hugh Popenoe, in a partnership with the University of Florida, established the first modern commercial herd of water buffalo in the country. At its peak, it counted 800 head of water buffalo that were used on and off for dairy production.

1996
Mozzarella di bufala received a DOP (Denominazione d'Origine Protetta [protected designation of origin]) designation from the Italian government. It is regulated by the Consorzio di Tutela della Mozzarella di Bufala Campana DOP.

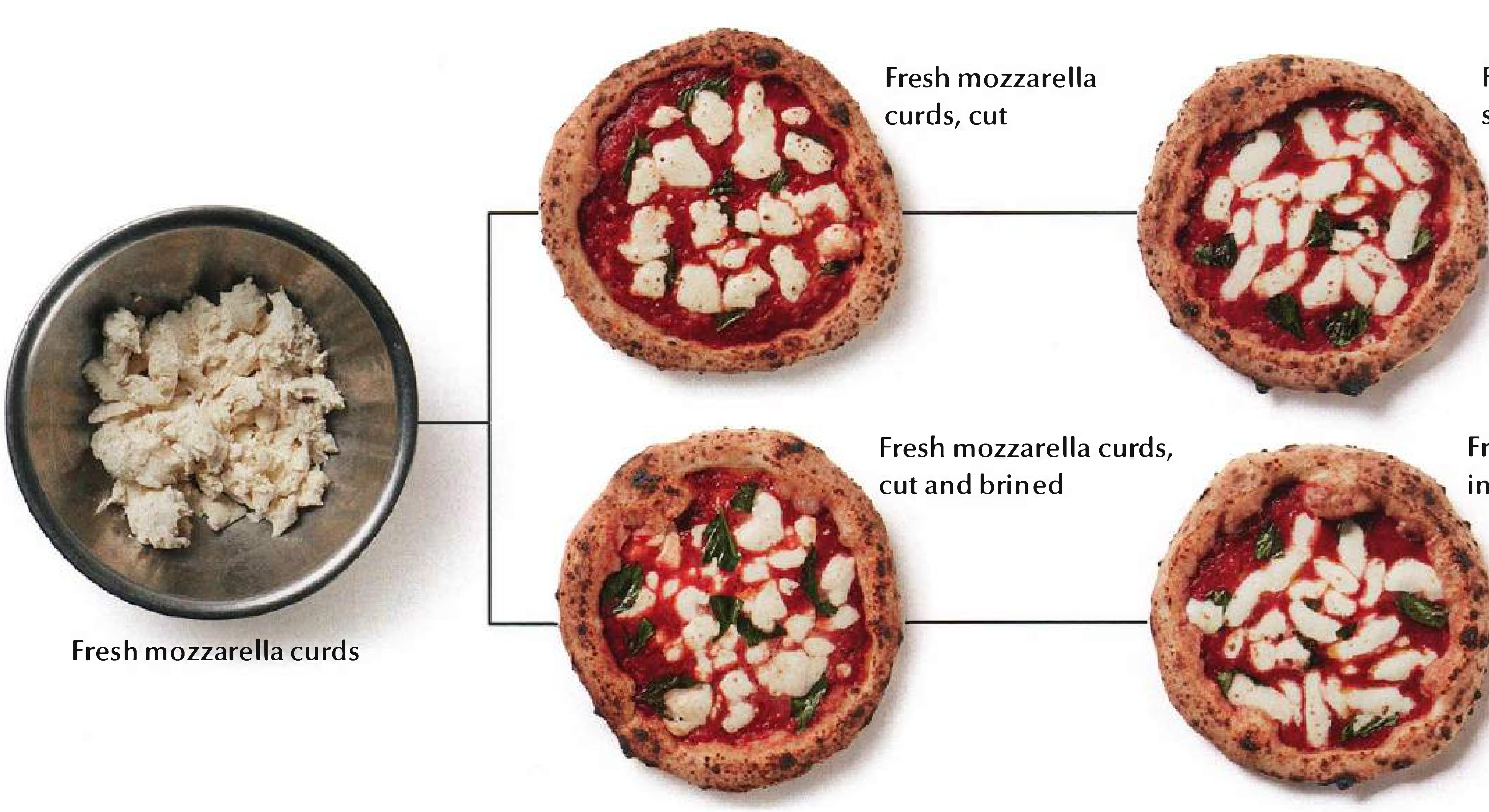
OPTIONS FOR USING FRESH MOZZARELLA ON PIZZA

You have a few options for manipulating your mozzarella before using it on pizza. We recommend that you stretch mozzarella curd because you'll get a better pizza, but you don't need to ball it. The table below outlines the different ways that you can treat mozzarella before you use it, in order of how long it takes to prepare the mozzarella before baking. This table assumes that you are using premade mozzarella curds, but we also provide a recipe for how to make your own (see page 324).

PREPARATION	NOTES
Mozzarella curds	
Use mozzarella curds on pizza	Store-bought or homemade curds can be put directly on the pizza, but note that curds brown more, have a bland flavor, and are spongy in texture.
Soak mozzarella curds in brine before using	Soak the curds in brine for 1–7 d to help improve the flavor. Drain the curds before use. Soaking the curds in brine, then draining will not only improve the flavor, but also transform the texture to have a smoother/more stretchy bite with much less browning during baking. This won't give you an identical result to pizzas made with stretched fresh mozzarella, but it is a good alternative.
Stretched mozzarella	
Cut premade mozzarella balls and drain	Many pizzerias buy mozzarella balls and then cut them or hand-tear them before using on pizza. You can purchase mozzarella balls in different weights and sizes. They are typically stored in whey or brine or in plastic (see page 320). Cut the balls and then drain overnight (or for at least 12 h). You can save significant time if you vacuum drain the mozzarella (see page 321)
Bulk stretch premade curds	Another option is to purchase mozzarella curd, stretch it in hot water, and then leave it as a whole mass rather than shaping it into balls. Before you use it on pizza, shred or cut it and then drain it.
Stretch premade curds and form into balls	Pizza makers sometimes want to stretch their own cheese (they are not making their own cheese from scratch, just stretching it). They purchase mozzarella curds, place them in hot water, stretch it, and then ball it. You have to shred or mechanically cut it and then drain it before using them on pizza.

Store-bought fresh mozzarella balls

Store-bought fresh mozzarella balls, cut and drained



Fresh mozzarella curds, cut

Fresh mozzarella curds, bulk stretched, cut, and drained

Fresh mozzarella curds, cut and brined

Fresh mozzarella curds, stretched into balls, cut, and drained

Fresh mozzarella curds

MAKING MOZZARELLA

Mozzarella curd is produced when milk is heated and acidified, either through fermentation with LAB cultures or directly with citric acid. Then rennet is added to cause coagulation. The pH will fall and, once it reaches a pH of 5.3–5.1 (see page 292), the curd may immediately be stretched into mozzarella (known as the filature step). The tangled mass of casein complexes that forms the curd is steeped in a bath of very hot whey or water. After a short period of time, the curds are kneaded within the water and the stretching begins, which forms the curd into a soft, elastic, stringy texture.

As we were experimenting and developing our mozzarella recipes, we asked ourselves a series of questions. Is stretching mozzarella curd worth the effort? Does balling the resulting cheese matter? Can we simply bake mozzarella curd on a pizza? Our experiments led to several interesting conclusions.

The first is that we highly recommend stretching mozzarella curd. Seasoned, drained curd can be used on pizza instead of mozzarella, but you need to manage your expectations. Baking the curd will increase browning moderately (this browning may bother some pizzaioli more than others) and the result will lack the nice stringy pull typically desired on the pizza. Furthermore, curds aren't commonly seasoned with salt, so they can be very bland. Could we troubleshoot both of these problems? Our procedure for brining the curd on the previous page can mitigate the browning issue and improve the flavor. But ultimately, we think that you should stretch your curds. We recommend limiting the stretching to two to three times, however, since overstretching can result in a tougher texture. As soon as a nice sheen has developed from stretching, your mozzarella is ready to use.

Contrary to popular practice, you don't need to ball mozzarella. As long as you stretch the curd, the shape you give to your cheese is not important. A ball is a traditional way of shaping mozzarella cheese, but it is by no means essential, especially if you plan to rip your cheese into pieces or cut it before using. If you are stretching large amounts of mozzarella, we recommend using our method for bulk-stretching mozzarella on page 326. There appears to be a predominantly American phenomenon where pizzerias buy the curd and then stretch and ball the mozzarella themselves. This certainly has a few practical aspects. It's simpler to do that than make it from scratch and the curd lasts longer.

Regardless of whether you are using curd or mozzarella, draining is a crucial step before baking to avoid ending up with a soupy pizza. Drain it for a minimum of 12 hours or overnight under refrigeration. If you are in a pinch, we suggest pressing a ball of mozzarella between paper towels or a clean kitchen towel to force out some of the moisture in the cheese, then tearing and placing it on a pizza just before baking. You can also save a bunch of time by vacuum-draining a batch of mozzarella and keeping it refrigerated. You'll always have ready-to-bake mozzarella if you use that method (see page 321).

Braiding stretched mozzarella makes for a beautiful presentation of fior di latte mozzarella. While this shaping method works well for appetizers and salads, it doesn't make sense for pizza because you end up just shredding and draining fresh mozzarella before baking.

When you need to warm your curds and whey to a specific temperature (see page 328), a yogurt incubator or sous vide machine would work well. Dehydrators can work if you turn them down very low and seal your bowl to prevent evaporation.

You'll have your hands in very hot water when you are stretching your mozzarella curd, so you might want to use thick kitchen gloves to protect yourself (the disposable ones don't work as well).

BAKING MOZZARELLA AT LOW TEMPERATURES

It is commonly assumed that only fresh mozzarella can be baked in Neapolitan-style ovens, which operate at 425–480° C / 800–900° F. Some pizzaioli also believe that this type of mozzarella doesn't function as well when it is baked at lower temperatures. We tested a number of mozzarella permutations on a variety of pizza styles that are baked at different temperatures . When baking at 288–315° C / 550–600° F, we saw no difference between store-bought mozzarella, the curd that was stretched and balled, and the curd that was stretched in bulk. If you would like to bake unstretched curd, soaking it in brine will improve its flavor and its melt.

Thin-crust pizza topped with curds, baked at 288°C / 550°F

Thin-crust pizza topped with mozzarella that was stretched, balled, and cut, baked at 288° C / 550° F

Thin-crust pizza topped with mozzarella that was stretched and then cut, baked at 288° C / 550° F

Thin-crust pizza topped with mozzarella that was balled and cut, baked at 288° C / 550° F

Thin-crust pizza topped with brined curds, baked at 288° C / 550° F

Our standard mozzarella brine contains 1% salt and 0.06% calcium lactate.

STORING MOZZARELLA

When we visited Italy, we heard mixed messages about the best temperature to store fresh mozzarella. Some pizzaioli claimed that you would ruin it if you put it in the refrigerator (likely lore that was passed down through the generations), while others drain their mozzarella under refrigeration and then temper only the amount that they'll need for service. Even in Naples, where dough isn't typically refrigerated (see page 88), the cheese almost always is. As Americans, we found this interesting since all imported mozzarella cheese comes to us refrigerated, so this is the only way we've experienced it. Local or domestic fresh mozzarella is also always refrigerated regardless of whether the cheese is for home or restaurant use.

As the cheese ages (whether at room temperature or not), it will become more sour as the lactic acid builds. There will be a variety of changes to the texture, the primary of which is that it will get softer. We discerned no advantages in taste or quality with storing mozzarella at room temperature when compared to storing it in refrigeration. Fresh mozzarella can withstand being stored at room temperature for up to 3 days (you can extend this to 4 days if you use our vacuum-sealing bag MAP technique on page 313). The shelf life for our homemade Uncultured Fior di Latte Mozzarella (see page 324) increases to 1 week in the refrigerator, which is why we suggest that you keep your mozzarella cold.

Another important decision to make is the storage environment. The three most common ways of storing whole fresh mozzarella are in plastic wrap, in brine, or in the mozzarella's own whey. After taking a closer look at the role these storage conditions play for our in-house fresh mozzarella, we observed a link between storage conditions and water within the cheese: storing mozzarella in liquids makes it swell over time, with brined mozzarella swelling more due to osmosis. The brined mozzarella also tends to release its moisture very reluctantly, which is likely due to the salt that's absorbed into the cheese.

If you have made your own mozzarella, we recommend brine for storing it and we have included this step in our mozzarella recipes. Just make sure to drain it overnight before baking or you'll get a soupy pizza (or you can vacuum drain it; see next page). Additionally, brining will give your cheese shelf stability by inhibiting bacterial growth. Remember: even a cheese produced with the greatest care will degrade quickly if it's not properly stored.

SEPARATING WHEY FROM FAT IN FRESH MOZZARELLA

Cheese is technically an emulsion (see page 259) of whey and butterfat, and this emulsion is unstable upon heating. If you've ever had a fondue party and not kept an eye on your fondue pot, you know exactly what this means: the emulsion breaks and the oil seeps out. This isn't typically a result you want, but curiosity got the better of us and a question arose within our team: Is there a way to get the butterfat out of the mozzarella without heating it? Brute-force methods immediately came to mind. Cheese is essentially composed of three types of particles based on density: heavier milk solids, whey (about 1 g / cm^3), and fat (about 0.9 g / cm^3). We were able to split them using the centrifugation principle. Furthermore, we were able to squeeze fat out of freeze-dried mozzarella using compressive force provided by a 20-ton heavy-duty hydraulic press.

Solids Fat Whey

READY-TO-BAKE FRESH MOZZARELLA

Our usual procedure for draining fresh mozzarella is to place the cheese on a lint-free paper towel, cover it, and let it rest 12 hours (or overnight) under refrigeration. Other methods that work well include placing the cut pieces of cheese in a cheese-cloth-lined strainer placed over a bowl or placing the cheese in a perforated hotel pan fitted over another same-sized unperforated hotel pan, which will collect the drained liquid. Both methods require 12 hours under refrigeration.

We wondered if there was another way to remove the moisture if you are in a hurry. It is possible to have either forgotten to drain the cheese or not drained enough of it (e.g., you run out mid-service). We found out there is an option that you can use in an emergency. You can wrap your mozzarella ball or rectangle in a clean kitchen towel or a lint-free paper towel and squeeze it to force out some of the moisture in the cheese. Then you just need to tear or cut it immediately after, directly over the sauced pizza, and it will bake with very good results (see photos below). This method is handy but not practical for preparing large amounts of drained fresh mozzarella cheese.

This led us to think about developing a method to quickly make a ready-to-bake fresh mozzarella. Which also led us to ask, had someone else thought of the idea of selling already cut-and-drained fresh mozzarella? We were not able to find any source that provides this very valuable service and we thought that there had to be a reason for it. It is a lot of work to cut large quantities of fresh mozzarella cheese and then drain it. After all, you can get shredded pizza cheese or you can get it in a whole log and shred it yourself, possibly using a machine to cut down on time and labor. So ready-to-bake mozzarella is not unheard of when it comes to low-moisture mozzarella cheese (and many pizzerias use it).

But our task was to develop a procedure for ready-to-bake fresh mozzarella. What we ended up doing consists of placing your cut mozzarella onto a liquid-absorbing pad (like the absorbent pads packed with a cut of meat), vacuum-packaging the bag, and then pulling a full vacuum. The pressure from sealing the cheese will push out the moisture and the meat pad absorbs the liquid coming off the cheese. You can then store your mozzarella under refrigeration until you are ready to bake (but not beyond its original expiration date). The results were fantastic. The cheese bakes exactly like traditionally cut and drained fresh mozzarella and the best part is that this method can easily be scaled up to large quantities of cheese.

Mozzarella di bufala is fresh mozzarella made with water buffalo's milk (not the milk of American bison/buffalo). It has a distinctive sour flavor, almost like unsweetened yogurt. Some pizzaioli use only this type of cheese, while others say that it's a waste to bake it on a pizza and instead use fior di latte mozzarella. It may be a taste preference or a matter of cost (mozzarella di bufala is more expensive), but we found that both beliefs are typically strongly held.

The amount of moisture that mozzarella loses during draining reduces over time. This characteristic aligns with our observation of increased homogeneity over time. The water migrates more evenly through the cheese as it ages.

Mozzarella drained as normal

Whole mozzarella ball squeezing with a towel ("emergency draining" procedure)

Pre-cut mozzarella vacuum-sealed using meat pads (ready-to-bake mozzarella)

As evidenced by these photos, the different methods for draining mozzarella produce very similar baked pizzas. The big difference is the time that it takes to drain the mozzarella; the vacuum-drained mozzarella saves you 12 hours.

THE EFFECTS OF AGING ON MOZZARELLA

Draining and aging have a two-pronged effect on mozzarella. Mozzarella softens as it ages, producing a better melt when baked on pizza. This happens sooner in drained mozzarella when compared to undrained mozzarella. We recommend using 10-day-old fior di latte mozzarella that has been drained overnight or 16-day-old mozzarella di bufala that has been drained overnight for your pizza. Keep in mind that these findings are separate from our storage recommendation, which is to keep the mozzarella in brine.

DRAINED

Day 5 | Day 10 | Day 16 | Day 24 | Day 30

The texture of mozzarella di bufala softens significantly over the course of 30 days.

UNDRAINED

Day 5 | Day 10 | Day 16 | Day 24 | Day 30

Note how the shape of mozzarella di bufala goes from nearly round (day 5-16) to oval (day 24-30). Not surprisingly, while the cheese softens over time, it also has the tendency to set and lose its shape under the effect of gravity.

Note that the texture of the melted mozzarella becomes more uniform over time.

AGED VS FRESH MOZZARELLA

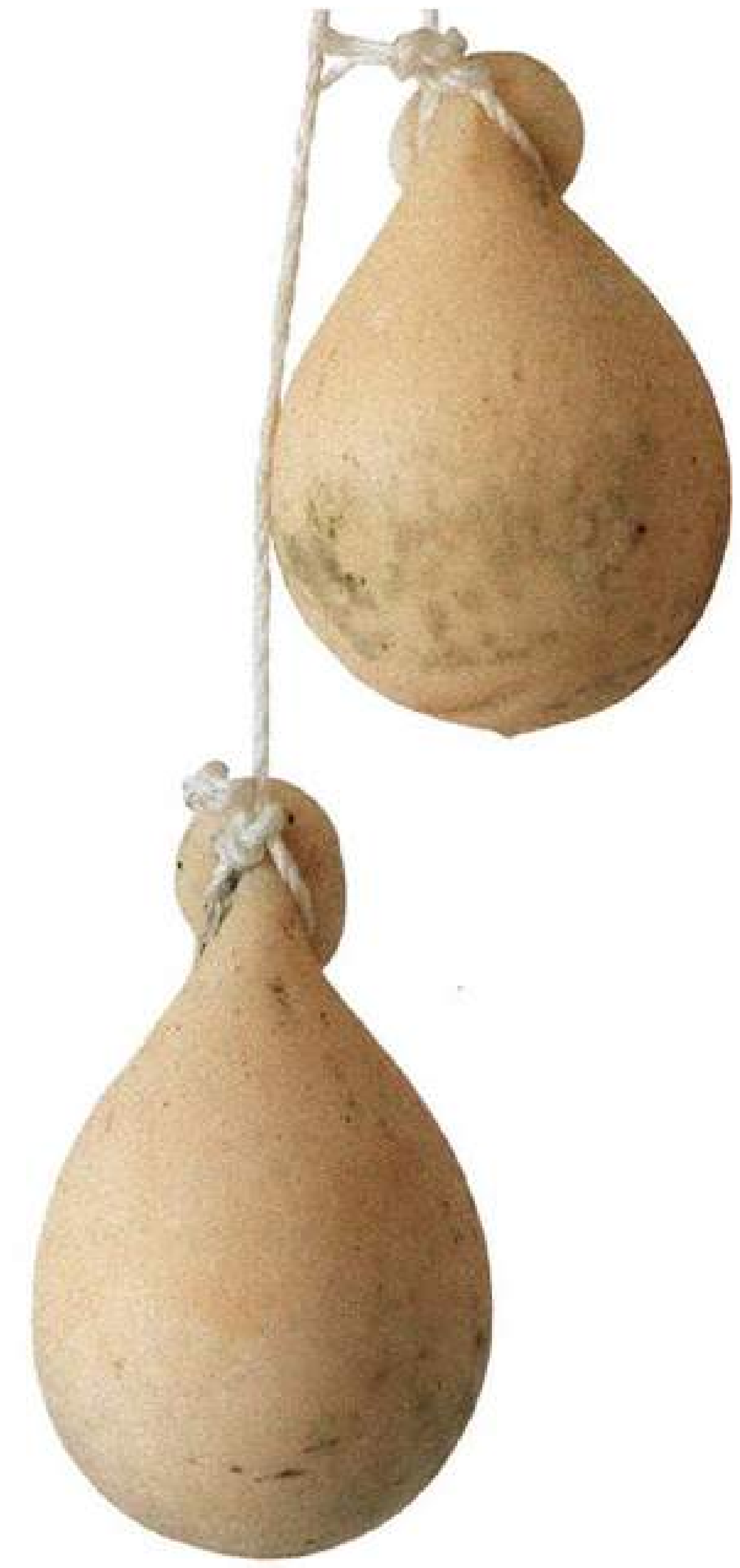
When you sample freshly made cheese at a mozzarella factory in Italy, the fresh mozzarella can have a squeaky feel when you bite into it (the sound when you eat it is kind of like sneakers on a basketball court). The stretching of the melted curd creates a fibrous texture that can rub together when you chew it. There is little, if any, sour/lactic acid taste. But if you taste a very fresh mozzarella side by side with a week-old one, you may notice a softer, more even texture as well as a more complex flavor in the aged cheese.

In his 2012 *New York Times Magazine* article, Sam Anderson describes mozzarella di bufala evocatively: "Buffalo mozzarella is the apotheosis of dairy: the golden mean between yogurt and custard and cottage cheese and heavy cream and ricotta. It lives (along with clouds and mercury and lava and photons and quicksand) on the mystical border between solid and liquid. Descriptions of it tend toward poetry." This is a fair, if a bit romantic, description of the mozzarella di bufala you can sample after it has traveled to the United States. Based on what we ate at the mozzarella manufacturers in Naples, this is not the flavor and texture that it has at its early stages. It's what fresh mozzarella di bufala will turn into eventually. But when, and how?

When we talked to pizzaioli in Naples about the age of their mozzarella, some were firm about using the freshest mozzarella (this is feasible because it's readily available to them). But many said that they didn't receive daily mozzarella deliveries. This inspired us to create a series of experiments to find out the storage window for fresh mozzarella that optimizes both flavor and texture. We have examined refrigerated fior di latte mozzarella, fior di latte mozzarella stored at room temperature, and refrigerated mozzarella di bufala, consuming a total of 77 balls of fresh mozzarella!

Our conclusions were thought-provoking. Whether you are using fior di latte mozzarella or mozzarella di bufala for your Neapolitan pizza, you'll get a softer, more uniform texture if you let the cheese mature. The flavor benefits as well; we prefer 7- to13-day old fior di latte mozzarella (our favorite pizza was made with 10-day-old cheese) and 16- to 24-day old mozzarella di bufala (our favorite pizza used 16-day-old cheese) over freshly made mozzarella. The cheese on these pizzas had a perfect pull, a cohesive melt, a softer structure, and a delicious flavor. Room-temperature storage has no notable advantages in our opinion, and it is limited to 3 days (see page 313). Draining is recommended in general for a better cheese melt: the photos on the previous page show that the drained mozzarella had a better consistent melt about a week sooner than undrained.

If you are importing mozzarella di bufala from Italy, which can take some time, or when you don't have access to the freshest mozzarella possible, this might actually be a blessing. We fully acknowledge that this opinion is contrary to what many pizza makers do in practice and that this result is based on our personal preference. We encourage you to give it a try and decide for yourself.



Mozzarella can be shaped into pieces that are just large enough for a single Neapolitan pizza; some pizzaioli use them for portion control in their restaurants. Larger pieces of mozzarella can be tied at one end and hung up to age in order to make the scamorza shown above. This process gives the mozzarella a firmer texture; scamorza is also often smoked.

UNCULTURED FIOR DI LATTE MOZZARELLA

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600 g curds

Why would you make something like mozzarella rather than buy it premade? One reason might be that you can't get it (or you can't get a product of the quality that you want). Another is that you want to do something different on your pizzas. We contend that it's fun to make cheese and making it lets you experience that ingredient on a whole new level. Once you do start making it, that gives you an opportunity to make something very different that you can't buy, like our infused mozzarella (see page 336) or higher fat mozzarella (see page 334).

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	60 g	¼ cup	1.56
Nonhomogenized whole cow's milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Liquid animal rennet	1.18 g	¼ tsp	0.03
For forming the mozzarella			
Water	3 kg	3 qt + 1 cup	100
Fine salt	150 g	½ cup + 2¾ tsp	5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2 g	½ tsp	0.06

For where to purchase cheese-making supplies, see Resources, page 3:377.

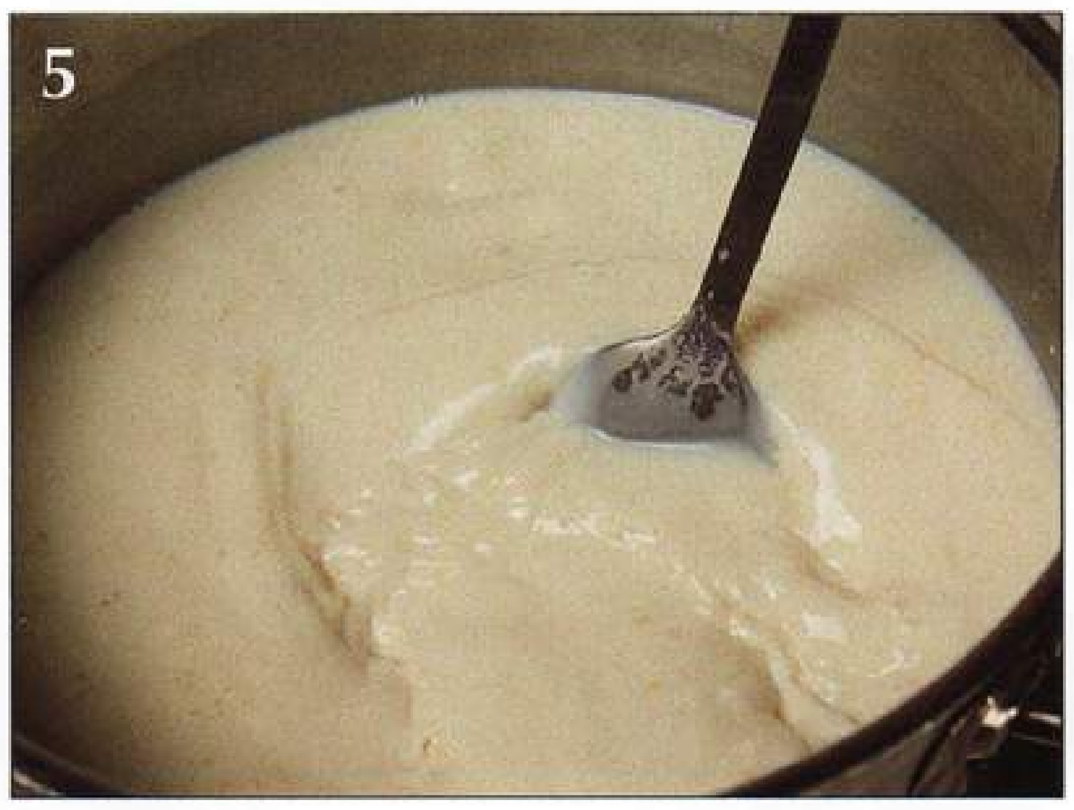
Overstretching the mozzarella (handling it too much) can result in a tougher final texture.

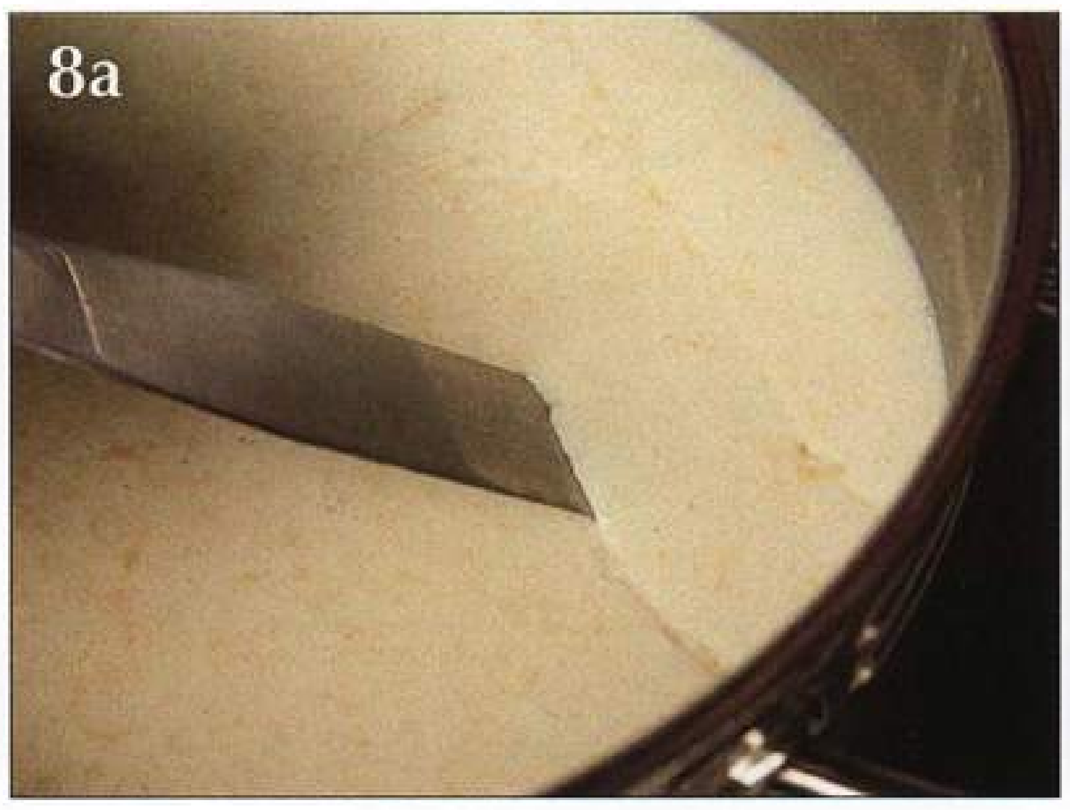
The water for the stretching process is quite hot, so either double up the gloves on your hands or purchase sugar-pulling gloves.

You'll notice that the method for shaping the mozzarella into balls is optional in step 18. We found that there is no qualitative difference in baking shaped mozzarella and you can save yourself the time and effort. We have a method for bulk stretching a large batch of mozzarella on page 326 that allows you to stretch the mozzarella and then cut and drain it for service.

HOW TO Make Fior di Latte Mozzarella

There are various ways of making mozzarella from scratch. We recommend making mozzarella by direct acidification (without culture) because it is the fastest method for making the cheese. You can also start from store-bought mozzarella curds. If you decide to use this method, start at step 11 in the following how-to. You can use this stretching method for cheddar curds as well, but keep in mind that your "cheddarella" will be a little firmer.





1 Dissolve the citric acid in the water in a large stainless steel saucepot.

2 Whisk in the milk gently.

3 Warm over medium-low heat to 32 °C / 90 °F, stirring occasionally.

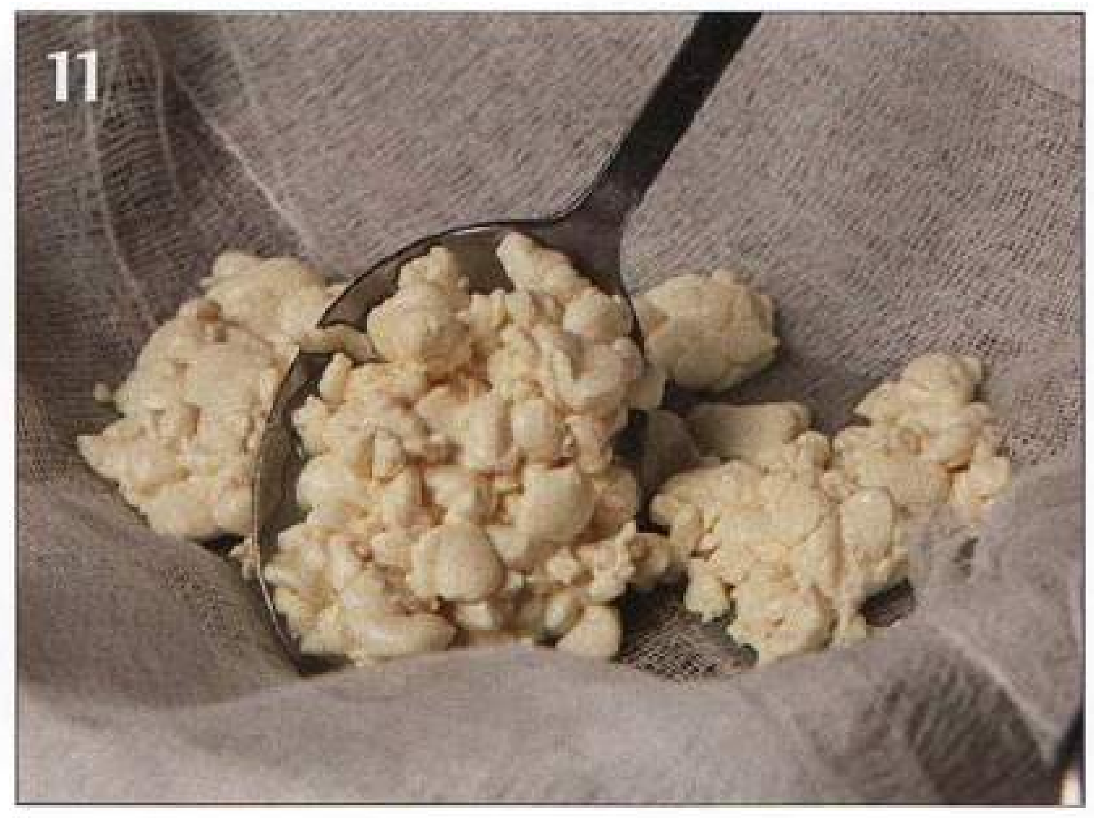
4 Remove the pot from the heat.

5 Gently stir in the rennet with an up-and-down motion, about 10 s.

6 Cover the pot and leave undisturbed for 5 min.

7 Check the curd for clear separation. If the curd has not separated easily from the whey, cover the pot and let it sit for an additional 5–10 min.

8 Cut the curd with a long knife or thin metal spatula into 1.25–2.5 cm / ½–1 in squares.



9 Return the pot to the stove and heat to 43° C / 110° F while gently stirring the curds.

10 Remove the pot from the heat and continue slowly stirring for 2–5 min.

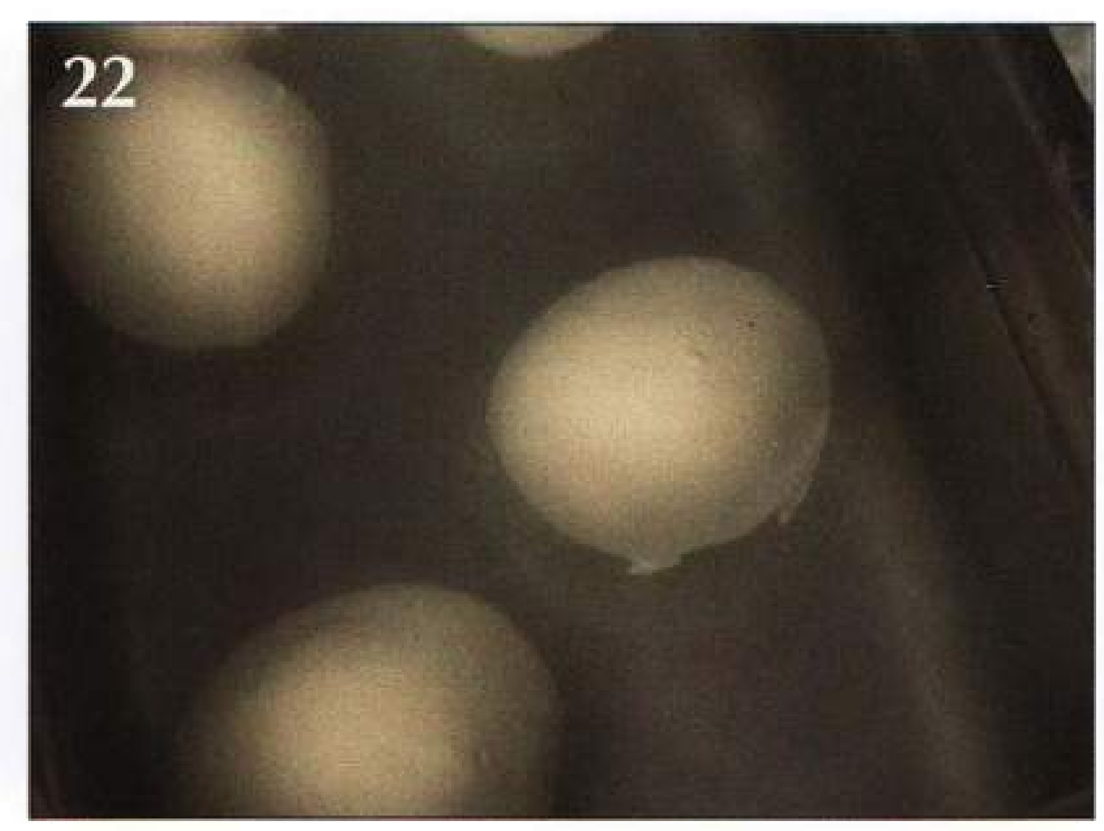
11 Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.

12 Drain the curds for 20 min.

13 For forming the mozzarella, heat the water to 88° C / 190° F in a medium saucepot. Add the salt. If not serving the mozzarella right away, prepare two water baths, one at 13° C / 55° F and one at 4.4° C / 40° F.

14 Place half of the strained curds (or whatever you feel comfortable with handling at one time) in a large stainless steel bowl.

15 Gently pour the hot salt water down the side of the bowl (not directly on top of the curds) until the curds are covered. Let sit undisturbed for 2 min.



16 Knead the mixture to form one large mass of mozzarella within the water.

17 Stretch the mozzarella 2–3 times. At each stretch pull the cheese about 60 cm / 2 ft in length, then place the two ends together and pull to stretch the cheese again. If the water becomes too cool and the mozzarella is not stretching easily, drain the bowl and replace with new hot water. The target curd temperature for a proper stretch is 57° C / 135° F.

18 Once a nice sheen has developed from stretching, form balls, if desired, by taking a stretched section of the curds and folding it underneath itself to about 5 cm / 2 in. in diameter, then with your index finger and thumb, pinch together one end and tear or cut off.

19 Place the mozzarella in the 13° C / 55° F water bath for 5 min.

20 Transfer the mozzarella to the 4.4° C / 40° F bath for 10 min to keep their shape.

21 For storing the mozzarella, stir together the water, salt, and calcium lactate in an airtight plastic container.

22 Place the chilled mozzarella in the storage bath.

23 Store for up to 1 wk in refrigeration.

Neapolitan pizza with smoked provolone, fior di latte mozzarella, pickled Peppadew peppers, and fresh basil

BULK STRETCHED FIOR DI LATTE MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
For forming the mozzarella			
Water	5 kg	5 qt + 1¾ cups	100
Salt	250 g	¾ cup + 3 Tbsp	5
Fior di latte mozzarella curds*	4.54 kg	4 qt + 3 cups	100
For storing the mozzarella			
Water	6 kg	6 qt + 2 cups	100
Salt	60 g	3 Tbsp + 1¾ tsp	1
Calcium lactate	3.6 g	1½ tsp	0.06

** Follow steps 1–12 of the Uncultured Fior di Latte Mozzarella recipe on page 324 if you want to make the mozzarella curds. You could also use store-bought curds.*

TOTAL TIME	YIELD
Active 20–30 min / Inactive 35–40 min	~4.54 kg curds

The water for the stretching process is quite hot, so either double up the gloves on your hands or purchase sugar-pulling gloves.

While many pizzerias shape their mozzarella into balls (often for portion control), it really isn't necessary. We store balled mozzarella and bulk mozzarella overnight, and then cut it, drained it, and baked it side by side on the pizza. There was absolutely no difference between the two cheeses.

PROCEDURE

1. For forming the mozzarella, heat the water to 77° C / 170° F in a large rondeau or stock pot. Add the salt.
2. For storing the mozzarella, stir together the water, salt, and calcium lactate in an airtight plastic container. Refrigerate until needed.
3. Prepare a 10–15 cm / 4–6 in deep full hotel pan with 6–7 L of ice water. Have a 10–15 cm / 4–6 in deep half hotel pan nearby for holding the shaped mozzarella.
4. Break apart any large chucks of curd and place all of the curds into the warm water.
5. Let sit for 5-10 minutes without stirring to soften.
6. Knead the mixture to form one large mass of mozzarella within the water. If the water becomes too hot to handle, you can turn the water down to 54–60° C / 130–140° F.
7. Stretch the mozzarella 3 times. At each stretch pull the cheese about 60 cm / 2 ft in length, then place the two ends together and rotate 90°. The mozzarella at this point should be in a rectangular shaped block. If the water becomes too cool and the mozzarella is not stretching easily, drain the bowl and replace with new hot water. The target curd temperature for a proper stretch is 57° C / 135° F.
8. Gently place the mozzarella into the half hotel pan place the pan into the ice bath for 20–25 min.
9. Place the chilled mozzarella in the storage bath.
10. Store for up to 1 wk in refrigeration. Do not freeze.

MODERNIST FIOR DI LATTE MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	180 g	¾ cup	4.69
Liquid animal rennet	1.18 g	¼ tsp	0.03
Nonhomogenized whole milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Sodium hexametaphosphate (SHMP)	19.2 g	1 Tbsp + ¾ tsp	0.5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2 g	½ tsp	0.06

For where to purchase cheese-making supplies, see Resources, page 3:377.

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600 g curds

Emulsifying salts, including sodium hexametaphosphate (SHMP), are commonly used in the production of processed cheeses to disperse proteins and lipids and create a more homogeneous product. Adding the emulsifying salt to the fresh curd allows it to retain more moisture during draining, and its melting was also improved while the browning was reduced.

PROCEDURE

1. Follow steps 1–12 of the Uncultured Fior di Latte Mozzarella recipe on page 324.
2. Prepare a double boiler with a medium saucepot and a medium bowl. Heat the water to 93° C / 200° F.
3. Toss the drained curds with the SHMP in a large bowl.
4. Place the curds in the double boiler.
5. Let the curds sit undisturbed for 2–5 min.
6. Knead the mixture to form one large mass of mozzarella.
7. Stretch the mozzarella 2-3 times. At each stretch pull the cheese about 30 cm / 1 ft, then place the two ends together and pull to stretch the cheese again.
8. Continue to follow steps 18–23 on page 325.

CHARCOAL FIOR DI LATTE MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Citric acid	7.5 g	1.5 tsp	0.2
Water, cool	230 g	1 cup	5.99
Nonhomogenized whole milk (~3.25% fat)	3.84 kg	1 gallon + ⅔ cup	100
Food-grade activated charcoal	19.2 g	⅓ cup + 1 Tbsp	0.5
Liquid animal rennet	1.18 g	¼ tsp	0.03
For forming the mozzarella			
Water	3 kg	3 qt + 1 cup	100
Fine salt	150 g	½ cup + 2¾ tsp	5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2 g	½ tsp	0.06

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600 g curds (six 100 g balls)

PROCEDURE

1 Dissolve the citric acid in the water in a large stainless-steel saucepot.

2 Whisk in the milk and charcoal gently.

3 Warm over medium-low heat to 32° C / 90° F, stirring occasionally.

4 Remove the pot from the heat.

5 Gently stir in the rennet with an up-and down motion, about 10 s.

6 Cover the pot and leave undisturbed for 5 min.

7 Check the curd for clear separation. If the curd has not separated easily from the whey, cover the pot and let it sit for an additional 5–10 min.

8 Cut the curd with a long knife or thin metal spatula into 1.25–2.5 cm / ½–1 in squares.

9 Return the pot to the stove and heat to 43° C / 110° F while gently stirring the curds.

10 Remove the pot from the heat and continue slowly stirring for 2–5 min.

11 Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.

12 Drain the curds for 20 min.

13 For forming the mozzarella, heat the water to 88° C / 190° F in a medium saucepot. Add the salt. If not serving the mozzarella right away, prepare two water baths, one at 13° C / 55° F and one at 4.4° C / 40° F.

14 Place half of the strained curds (or whatever you feel comfortable with handling at one time) in a large stainless-steel bowl.

15 Gently pour the hot salt water down the side of the bowl (not directly on top of the curds) until the curds are covered. Let sit undisturbed for 2 min.

16 Knead the mixture to form one large mass of mozzarella within the water.

17 Stretch the mozzarella 2–3 times. At each stretch pull the cheese about 60 cm / 2 ft in length, then place the two ends together and pull to stretch the cheese again. If the water becomes too cool and the mozzarella is not stretching easily, drain the bowl and replace with new hot water. The target curd temperature for a proper stretch is 57° C / 135° F.

18 Once a nice sheen has developed from stretching, form balls if desired, by taking a stretched section of the curds and folding it underneath itself to about 5 cm / 2 in. in diameter, then with your index finger and thumb, pinch together one end and tear or cut off.

19 Place the mozzarella in the 13° C / 55° F water bath for 5 min.

20 Transfer the mozzarella to the 4.4° C / 40° F bath for 10 min to keep their shape.

21 For storing the mozzarella, stir together the water, salt, and calcium lactate in an airtight plastic container.

22 Place the chilled mozzarella in the storage bath.

23 Store for up to 1 wk in refrigeration. Do not freeze.

15

16

17

For more on how to use this mozzarella, see The Dark Side Neapolitan Pizza on page 3:56

CULTURED FIOR DI LATTE MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole cow's milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
TA 61 thermophilic starter culture (Danisco)	0.26 g	⅛ tsp	0.007
Liquid animal rennet	1.18 g	¼ tsp	0.03
For forming the mozzarella			
Water	3 kg	3 qt + 1 cup	100
Fine salt	150 g	½ cup + 2¾ tsp	5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2 g	½ tsp	0.06

For where to purchase cheese-making supplies, see Resources, page 3:377.

TOTAL TIME	YIELD
Active 15–20 min / Inactive 4½–5 h	~600 g curds

If you'd like to make mozzarella di bufala with this method, simply replace the cow's milk with buffalo's milk.

This mozzarella has a similar flavor to the Uncultured Fior di Latte Mozzarella on page 324, but the texture can differ. This mozzarella will be a bit firmer the first couple of days after making it. There is a noticeable difference, when baking the two. When using the direct acidification method, the acid causes the casein micelles to attract to each other and aggregate together; that attraction means the cheese won't melt as well. With the mozzarella made with culture, the acid is less intense, which causes a better melt.

PROCEDURE

1 Warm the milk over medium-low heat to 38 °C / 100 °F in a large stainless steel saucepot, stirring occasionally.

2 Sprinkle the culture over the milk.

3 Let it sit for 2 min before stirring.

4 Let the milk ripen for 1 h, stirring occasionally.

5 Warm the milk back up to 38 °C / 100 °F if necessary.

6 Gently stir in the rennet with an up-and-down motion, about 10 s.

7 Let the milk sit undisturbed for 45 min.

8 Check the curd for clear separation and to see if the curd has firmed enough to cut. If the curd has not separated easily and/or is not firm enough, cover the pot and let it sit for an additional 10 min.

9 Cut the curds into 5 cm / 2 in cubes.

10 Let the curds sit undisturbed for 10 min.

11 Stir gently while breaking up the curds into 1.25–2.5 cm / ½–1 in pieces.

12 Let the curds settle to the bottom of the pot over the course of 1 h. Agitate the curds occasionally by gently stirring to keep them from clumping together.

13 Check the pH (see page 292). The target pH is 5.1–5.3.

14 Gradually heat the curds and whey to 32–38 °C / 90–100 °F. Within 30 min to 1 h, the target pH should be reached. The pH will drop quickly once it reaches 5.6. Be sure to check the pH every 5–10 min at this point.

15 Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.

16 Drain the curds for 10 min.

17 Continue with steps 13–23 of the Uncultured Fior di Latte Mozzarella recipe on page 325.

Neapolitan pizza with fior di latte mozzarella, yogurt/cultured cream sauce, whole grain mustard, sauerkraut, potatoes, bratwurst, and fresh parsley

MODERNIST GOAT'S MILK MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole goat's milk (~4.1% fat)	1.92 kg	2 qt + ⅓ cup	100
Micellar casein	48 g	¼ cup	2.5
TPF 5 thermophilic starter culture (Bioprox)	0.13 g	1⁄16 tsp	0.007
Liquid animal rennet	0.59 g	⅛ tsp	0.03
For forming the mozzarella			
Water	3 kg	3 qt + 1 cup	100
Fine salt	150 g	½ cup + 2¾ tsp	5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2 g	½ tsp	0.06

For where to purchase cheese-making supplies, see Resources, page 3:377.

TOTAL TIME	YIELD
Active 15–20 min / Inactive 5–5½ h	~300 g curds

Goat's milk curds are a bit softer than those made from cow's milk.

Goat's milk mozzarella is a little more delicate when you form the balls. After stretching the curds, quickly maneuver them into a ball shape and place in cool water.

We included a recipe for goat's milk ricotta in *Modernist Cuisine* and wanted to explore making mozzarella with goat's milk for this book. We initially thought that it would be simple to make, but it took a lot of experimentation and help from cheese makers to create this recipe. The goat flavor is pronounced and distinct in this cheese; we highly recommend that you try it.

PROCEDURE

1 Warm the milk over medium-low heat to 37 °C / 98 °F in a large stainless steel saucepot, stirring occasionally.

2 While maintaining 37 °C / 98 °F, gently whisk in the casein.

3 Cover, and let the milk sit undisturbed for 20 min.

4 Sprinkle the culture over the milk.

5 Let it sit for 2 min before stirring.

6 Let the milk ripen for 1 h, stirring occasionally.

7 Gently stir in the rennet with an up-and-down motion, about 10 s.

8 Cover, and let the milk sit undisturbed for 45 min.

9 Check the curd for clear separation and to see if the curd has firmed enough to cut. If the curd has not separated easily and/or is not firm enough, cover the pot and let it sit for an additional 10 min.

10 Cut the curds into 5 cm / 2 in cubes.

11 Let the curds sit undisturbed for 10 min.

12 Stir gently while breaking up the curds into 1.25–2.5 cm / ½ inch–1 in pieces.

13 Let the curds settle to the bottom of the pot over the course of 1 h. Agitate the curds occasionally by gently stirring to keep them from clumping together.

14 Check the pH (see page 292). The target pH is 5.1–5.3.

15 Gradually heat the curds and whey to 32–38 °C / 90–100 °F. Within 30 min to 1 h, the target pH should be reached. The pH will drop quickly once it reaches 5.6. Be sure to check the pH every 5–10 min at this point.

16 Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.

17 Drain the curds for 10 min.

18 Continue with steps 13–23 of the Uncultured Fior di Latte Mozzarella recipe on page 325.

Neapolitan pizza with goat's milk mozzarella, king oyster mushrooms, balsamic vinegar, pistachios, and fig preserves

MODERNIST BUTTERMILK MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole cow's milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Nonhomogenized whole buttermilk (~4.1% fat)	192 g	¾ cup	5
Liquid animal rennet	1.18 g	¼ tsp	0.03
For forming the mozzarella			
Water	3 kg	3 qt + 1 cup	100
Fine salt	150 g	½ cup + 2¾ tsp	5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2 g	½ tsp	0.06

For where to purchase cheese-making supplies, see Resources, page 3:377.

TOTAL TIME	YIELD
Active 15–20 min / Inactive 16½–22½ h	~600 g curds

Using buttermilk allows you to introduce a culture to mozzarella in a simple fashion. Much of the buttermilk at the grocery store is low-fat. We recommend using full-fat buttermilk as a way to increase the fat in the cheese and create a more full-flavored product. You can add 17 g (1 Tbsp + ½ tsp) heavy cream to low-fat buttermilk to increase the fat percentage.

PROCEDURE

1 Combine the milk and buttermilk in a container, cover, and let sit in refrigeration for 12–18 h.

2 Warm the mixture over medium-low heat to 38 °C / 100 °F in a large stainless steel saucepot, stirring occasionally.

3 Gently stir in the rennet with an up-and-down motion, about 10 s.

4 Cover, and let the milk sit undisturbed for 45 min.

5 Check the curd for clear separation and to see if the curd has firmed enough to cut. If the curd has not separated easily and/or is not firm enough, cover the pot and let it sit for an additional 10 min.

6 Cut the curds into 5 cm / 2 in cubes.

7 Let the curds sit undisturbed for 10 min.

8 Stir gently while breaking up the curds into 1.25–2.5 cm / ½–1 in pieces.

9 Let the curds settle to the bottom of the pot over the course of 1 h. Agitate the curds occasionally by gently stirring to keep them from clumping together.

10 Check the pH (see page 292). The target pH is 5.1–5.3.

11 Gradually heat the curds and whey to 32–38 °C / 90–100 °F. Within 30 min to 1 h, the target pH should be reached. The pH will drop quickly once it reaches 5.6. Be sure to check the pH every 5–10 min at this point.

12 Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.

13 Drain the curds for 10 min.

14 Continue with steps 13–22 of the Uncultured Fior di Latte Mozzarella recipe on page 325.

15 Store for up to 3 d in refrigeration.

Neapolitan pizza with Modernist buttermilk mozzarella, roasted leeks, broccolini, and fried brussels sprouts

BURRATA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Fior di latte mozzarella curds*	600 g	2½ cups	100
Heavy cream	200 g	¾ cup + 2 Tbsp	33.33
For forming the mozzarella			
Water	3 kg	3 qt + 1 cup	100
Fine salt	150 g	½ cup + 2¾ tsp	5
For storing the mozzarella			
Water	2 kg	2 qt + ⅔ cup	100
Fine salt	20 g	1 Tbsp + ½ tsp	1
Calcium lactate	1.2g	½ tsp	0.06

**Follow steps 1-12 of the Uncultured Fior di Latte Mozzarella recipe on page 324 if you want to make the mozzarella curds.*

TOTAL TIME	YIELD
Active 30-40 min / Inactive 1-1½ h	~800 g curds

PROCEDURE

1 Combine 200 g (¾ cup + 1½ Tbsp) curds and heavy cream in a bowl.

2 Separate the filling into 4 portions and set aside.

3 Cut butcher's twine into four 15 cm / 6 in lengths.

4 Follow steps 13-17 of the Uncultured Fior di Latte Mozzarella recipe on page 325 with the remaining curd.

5 Once a nice sheen has developed from stretching, tear off about 100 g of cheese and shape into a flat, round disc about 15-17.5 cm / 6-7 in. in diameter.

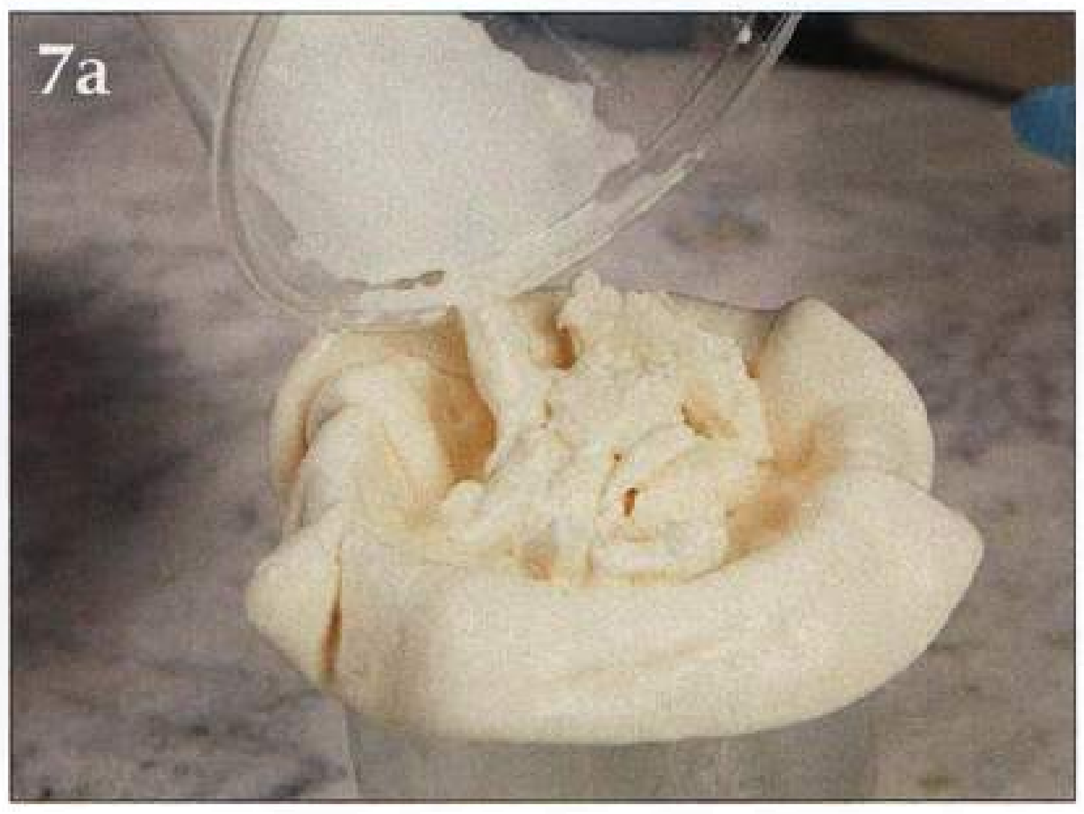
6 Working quickly, place the disc into a round container that is no more than 7.5 cm / 3 in. in diameter. Press the middle of the mozzarella disc into a bowl shape with some of the disc hanging over the sides of the container.

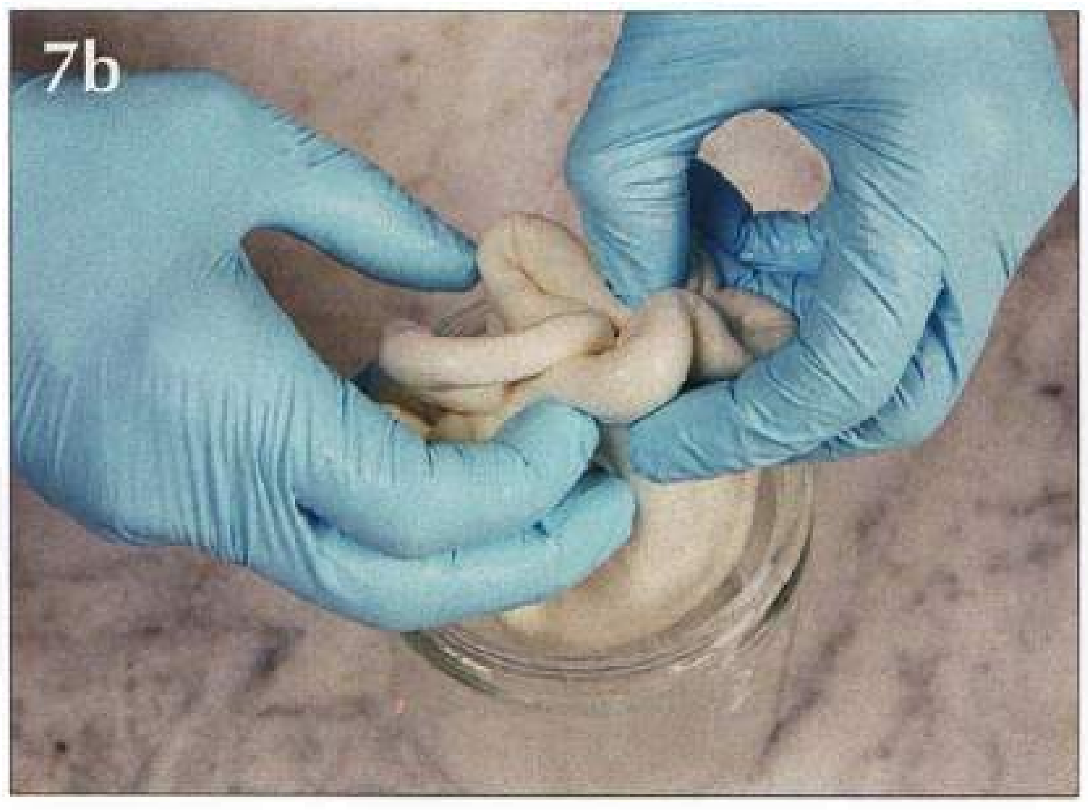
7 Add one portion of the filling to the center of the disc. Gently pull up the sides of the disc and pinch at the top to seal in the filling. Be sure to have a little cheese overhang (roughly 2 cm / ¾ in) above the seal. Tie one strand of twine around the seal.

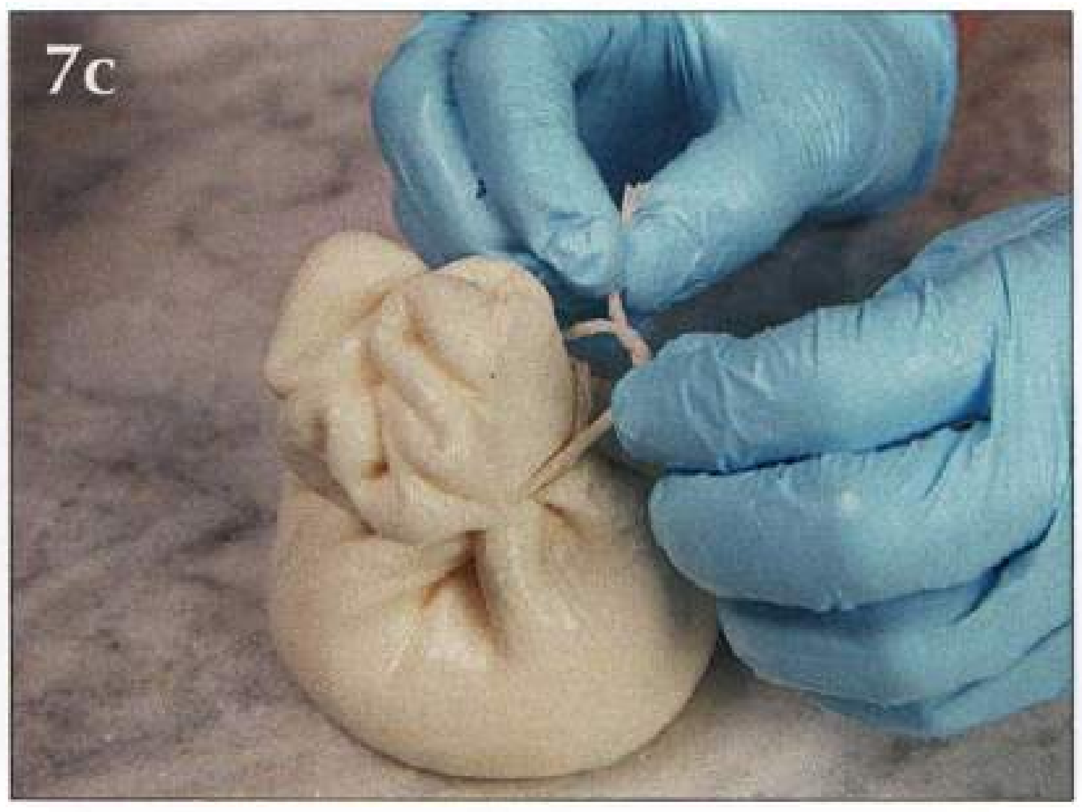
8 Serve immediately. Alternatively, prepare a water bath for storage by following steps 20-23 of the Uncultured Fior di Latte Mozzarella recipe on page 325.

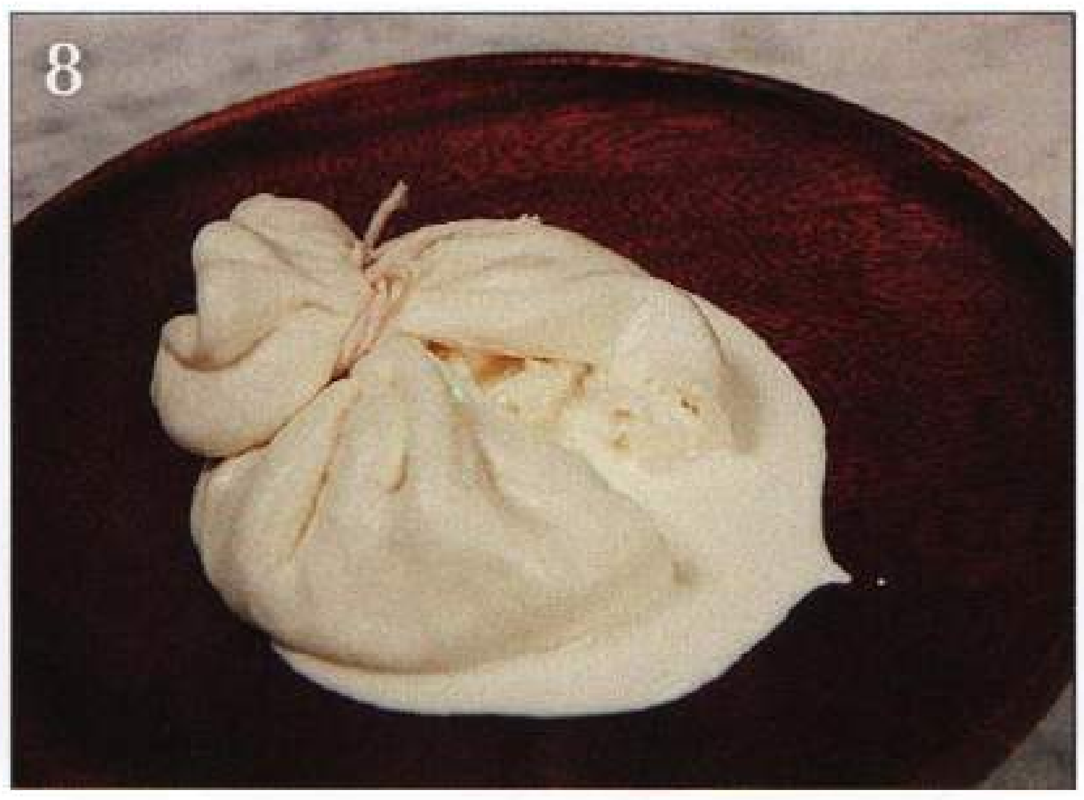
9 Repeat steps 5-8 to make the remaining burrata.

Other filling options are clotted cream, mascarpone, or ricotta (see page 338). In this case omit the heavy cream and steps 2-4. Use all of the curd to make 4 burrata with 100 g of your desired filling per burrata.









FRANKENCHEESES

Cheese comes in many shapes, textures, colors, and flavors. While many cheeses melt exceedingly well and brown slightly as the pizza dough bakes, others either do not melt at all or melt with noticeable fat separation. A good melt is achieved with the right combination of moisture content, fat content, and acidity in the cheese. When a cheese lacks this combination, its use for pizza is typically limited to applying after baking.

We wondered if we could manipulate these finishing cheeses using modern techniques and equipment to come up with a protocol for improving their melting qualities. Could we make certain cheeses melt as well as mozzarella? We hoped to gain the flexibility of adding these cheeses at any point during baking.

We looked at pairing up cheeses that don't normally melt well with cheeses that do in hopes that we could obtain the flavor of the former and the stretch and texture of the latter. We experimented with various cheese blends, and affectionately dubbed them Frankencheeses. Our first instinct was to start with the one cheese we know melts well on pizza: low-moisture mozzarella (or pizza cheese). Next was to identify the categories of finishing cheeses and a representative cheese from each of these categories. We selected very hard cheeses, blue-veined cheeses, washed-rind cheeses, and acid-coagulated cheeses: specifically Parmesan, blue cheese, Brie, and fresh goat cheese.

Based on the success of the technique we use in our Modernist Cheese Sauce recipe, which we updated from *Modernist Cuisine at Home* (see page 255), we had the notion that emulsifiers or emulsifying salts would help mesh the cheeses together. After several trials (and errors) with different cheeses and emulsifiers, we found that some cheeses blended better with 0.5% sodium hexametaphosphate (SHMP) while others blended best with 2% mono- and diglyceride flakes (MDG) and the addition of water.

Along with deciding on an emulsifier, we had to figure out the optimal ratio of pizza cheese to the cheese we wanted to blend. Each cheese-blend scenario was different; the cheeses with mild flavor, such as Brie or Taleggio, required higher amounts cheese in combination with the pizza cheese, while in the case of blue cheese, 20% was sufficient. In the end, we found the flavor of the washed-rind cheeses got lost when combined with the mozzerella. For some of the cheeses, we were able to bake them successfully at different temperatures. We could bake the goat cheese-based Frankencheese in both a 454 °C / 850 °F gas-fired pizza oven and a 315 °C / 600 °F oven). The advantages are clear (and this can be made with just a few ingredients) and offer a leap forward in the ways we can manipulate various cheeses on pizza so that you can keep the flavor while obtaining the ideal quality of the ever-popular pizza cheese.

FRESH GOAT CHEESE FRANKENCHEESE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Fresh goat cheese	200 g	½ cup + ⅓ cup	40
Pizza cheese, grated	300 g	3 cups	60
Sodium hexametaphosphate (SHMP)	2.5 g	½ tsp	0.5

TOTAL TIME	YIELD
Active 6–10 min / Inactive 3 h	~500 g

THERMOMIX METHOD

1 Place both cheeses in the Thermomix.

2 Sprinkle the sodium hexametaphosphate on top.

3 Mix on 2.5 speed at 38–43° C / 100–110° F for 2–3 min.

4 Scrape the blender if needed.

5 Mix on 3.5–4.5 speed at 49–54° C / 120–130° F until smooth and homogenous, 4–6 min.

6 Pour into an 11.5–12.5 cm by 2.5–3.75 cm / 4½–5 in by 1–1½ in mold.

7 Cover directly with plastic wrap and place in refrigeration to set completely, at least 3 h.

8 Shred or slice the cheese before using.

9 Store for up to 10 d in refrigeration.

The Thermomix is a device that combines several different appliances into one machine. It's a powerful high-speed blender that also has precise temperature control (it can heat but not cool). You can weigh directly into the cup of the machine and it comes with various different attachments. It's a single-appliance dinner and there are lots of recipe books and social media groups devoted to this device.

IMMERSION BLENDER METHOD

1 Place both cheeses in a 2–3 qt stainless steel saucepot.

2 Sprinkle the sodium hexametaphosphate on top.

3 Heat on low to 49° C / 120° F. As the cheeses melt, be sure to mix and stir with a silicone spatula frequently, 4–5 min.

4 Blend the cheeses using an immersion blender to help emulsify them. Blend until smooth and homogenous, 2–4 min.

5 Pour into an 11.5–12.5 cm by 2.5–3.75 cm / 4½–5 in by 1–1½ in mold.

6 Cover directly with plastic wrap and place in refrigeration to set completely, at least 3 h.

7 Shred or slice the cheese before using.

8 Store for up to 10 d in refrigeration.

While this technique allows you to use these cheeses in inventive ways, it's also worth noting that they work exceptionally well with the typical flavor profiles that you find on pizza.

BLUE CHEESE FRANKENCHEESE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Blue cheese	100 g	3½ Tbsp	20
Pizza cheese, grated	400 g	4 cups	80
Sodium hexametaphosphate (SHMP)	2.5 g	½ tsp	0.5

TOTAL TIME	YIELD
Active 6–10 min / Inactive 3 h	~500 g

Follow the Thermomix or immersion blender instructions for Fresh Goat Cheese Frankencheese above. Store for up to 2 wk in refrigeration.

The flavor will depend on the kind of blue cheese you are using (some are stronger than others). For example, Roquefort has a very different flavor than Stilton.

PARMESAN FRANKENCHEESE

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Parmesan, grated	250 g	2⅔ cups	50
Pizza cheese, grated	250 g	2½ cups	50
Water	50 g	¼ cup	10
Mono- and diglyceride flakes (MDG)	10 g	1 Tbsp + 2 tsp	2

TOTAL TIME	YIELD
Active 6–10 min / Inactive 3 h	~550 g

Follow the Thermomix or immersion blender instructions for Fresh Goat Cheese Frankencheese above. Replace the sodium hexametaphosphate with mono- and diglyceride flakes. Add the water with the mono- and diglyceride flakes. In step 5 of the Thermomix method, mix on 4–5 speed at 65° C / 150° F until smooth and homogenous, 4–6 min. In step 3 of the immersion blender method, heat on low to 63–65° C / 145–150° F. Store for up to 2 wk in refrigeration.

You can create flavorful variations of this cheese by replacing 2.5% of the total water with strongly flavored liquids such as fish sauce, Worcestershire sauce, or ponzu.

Mono- and diglyceride flakes dissolve in oil at 60° C / 140° F.

HIGHER-FAT FIOR DI LATTE MOZZARELLA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	180 g	¾ cup	4.69
Liquid animal rennet	1.18 g	¼ tsp	0.03
Nonhomogenized whole milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Additional fat options see table at right	425 g	*	11.07

**See table at right.*

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600–700 g curds

Follow steps 1–23 of the Uncultured Fior di Latte Mozzarella recipe on page 324. Stir the additional fat in with the milk in step 2.

Mozzarella di bufala is undeniably delicious; one of the reasons for this is that buffalo's milk has almost twice as much fat as cow's milk. We wondered why we couldn't make a fior di latte mozzarella that is closer to mozzarella di bufala, and it turns out you can. We increased the fat content of whole milk by adding about 11% cream to the milk to reach 6.6% fat in the milk. This, in turn, produced a mozzarella that has a higher overall fat content. Be sure to use heavy cream without any additives or thickeners.

Perhaps some enterprising cheese makers will start producing this commercially. It's that good!

PARAMETRIC RECIPE

ADDITIONAL FAT OPTIONS

Ingredients	Weight	Volume
Sour cream	425 g	1¾ cups + 1½ Tbsp
Mascarpone*	425 g	1 cup
Crème fraîche	425 g	1¾ cups + 1½ Tbsp
Heavy cream*	425 g	1¾ cups + 1½ Tbsp
Butter	425 g	1¾ cups + 1½ Tbsp
Ghee	425 g	1¾ cups + 1½ Tbsp
Olive oil	425 g	1¾ cups + 2 Tbsp

**These were some of our favorite mozzarella variations in the book.*

To assess how much fat is contained in these mozzarellas, we determined how much fat is lost to the whey by centrifuging it. Knowing the initial fat content of the milk and the weight of the final cheese, we were able to calculate the fat content of the mozzarella.

Neapolitan pizza with olive oil–infused fior di latte mozzarella, and fresh basil

HOW MUCH FAT ARE YOU ACTUALLY ADDING TO HIGHER FAT MOZZARELLA?

We loved the results we got when we increased the amount of fat in our fior di latte mozzarella (see page 324). This got us to thinking about how much actual fat is incorporated into the mozzarella. Knowing the initial fat content of the milk and the weight of the final cheese, we were able to calculate the fat content of the mozzarella by determining how much fat was lost to the whey by centrifuging it.

After making a batch of mozzarella with 1.92 kg of whole milk, the whey contained 10 g of fat (we centrifuged and weighed it). We calculated the theoretical total weight of fat in the milk (based on the nutrition facts from our dairy provider), subtracted 10 g, and obtained the amount of fat retained in the mozzarella. To calculate the fat percentage, we divided the amount of fat retained by the weight of the cheese. We found that our homemade mozzarella contained 17.5% fat, which is very similar to BelGioioso mozzarella (17.85% fat).

When using oil or other ingredients to incorporate fat and flavor in mozzarella, we added 11.1% of the ingredients to 100% milk before making our direct acidification mozzarella recipe on page 324. We then collected the fat from the whey by centrifuging it and calculated the fat percent in cheese in a similar fashion. We then baked pizzas with the resulting mozzarella to see how it behaved during baking and how it tasted to gather the recommendations in the table below.

Product*	% added to 100% milk	Overall % fat in the cheese	Notes
Heavy cream	11.07	36.5	This provided a richer flavor and creamier texture than mozzarella made with only whole milk. This was one of our favorite results of incorporating additional fats.
Olive oil	11.07	21.9	The olive oil flavor is much more apparent before baking; it loses its signature flavor once it's baked. It has a similar texture to the basic fior di latte mozzarella.
Unsalted butter, melted and cooled	11.07	**	Similar to olive oil mozzarella, the butter flavor is diminished after baking. Butter makes for an even richer and softer mozzarella than fior di latte mozzarella made with cream. Because of this, the cheese loses its structure at a faster rate, resulting in a shorter shelf life.
Ghee, melted and cooled	11.07	32.72	The overall flavor is very rich with a subtle ghee taste to the mozzarella. It becomes soft after 1 d and behaves like spreadable cheese. This makes for a shorter shelf life (2–3 d). This mozzarella is very easy to melt and has the least amount of browning during baking when compared to the other fats. Ghee mozzarella is very creamy in both raw and baked forms.
Crème fraîche	11.07	23.01	This addition made for a slightly tangier mozzarella that was also creamier than normal mozzarella.
Mascarpone	11.07	21.91	This provided a richer flavor and creamier texture than mozzarella made with only whole milk. This was also one of our favorite results of incorporating additional fats.
Sour cream	11.07	18.59	This addition did not add much creaminess in comparison to the control but brought in a tangier flavor.

**The scaling is from the addition of 11.1% product to 100% milk for each of the cheeses.*

***Since butter contains fat and water, and the water will partially evaporate during melting, we couldn't accurately calculate the amount of fat in the resulting cheese.*

HERB-INFUSED FIOR DI LATTE MOZZARELLA

TOTAL TIME	YIELD
Active 20–25 min / Inactive 13–17½ h	~600 g curds

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole milk (3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Fresh basil, parsley, or dill, hand torn	384 g	9¼ cups	10
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	180 g	¾ cup	4.69
Liquid animal rennet	1.18 g	¼ tsp	0.03

PROCEDURE

1 Steep the milk with the herbs overnight under refrigeration, 12–16 h.

2 Strain the milk.

3 Follow steps 1–22 of the Uncultured Fior di Latte Mozzarella recipe on page 324.

4 Store for up to 2–3 d in refrigeration.

PAPRIKA-INFUSED FIOR DI LATTE MOZZARELLA

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600 g curds

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Spanish paprika	38.4	⅓ cup	1
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	180 g	¾ cup	4.69
Liquid animal rennet	1.18 g	¼ tsp	0.03

PROCEDURE

1 Whisk together the milk and paprika.

2 Follow steps 1–23 of the Uncultured Fior di Latte Mozzarella recipe on page 324.

SAFFRON-INFUSED FIOR DI LATTE MOZZARELLA

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600 g curds

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Saffron	1 g	1 Tbsp + 2 tsp	0.03
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	180 g	¾ cup	4.69
Liquid animal rennet	1.18 g	¼ tsp	0.03

PROCEDURE

1 Bring 100 g (⅓ cup + 2 Tbsp) of the milk to a simmer with the saffron.

2 Cool, strain, and add to the remaining milk.

3 Follow steps 1–23 of the Uncultured Fior di Latte Mozzarella recipe on page 324.

FLAVORED OIL-INFUSED FIOR DI LATTE MOZZARELLA

TOTAL TIME	YIELD
Active 20–25 min / Inactive 1–1½ h	~600 g curds

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Nonhomogenized whole milk (~3.25% fat)	3.84 kg	1 gal + ⅔ cup	100
Flavored oil*	384 g	1¾ cups	10
Citric acid	7.5 g	1½ tsp	0.19
Water, cool	180 g	¾ cup	4.69
Liquid animal rennet	1.18 g	¼ tsp	0.03

**Suggestions include extra-virgin olive oil, lemon or citrus oils, garlic confit oil (see page 366), or herb-infused oils.*

PROCEDURE

1 Whisk together the milk and flavored oil.

2 Follow steps 1–23 of the Uncultured Fior di Latte Mozzarella recipe on page 324.

VACUUM-INFUSED FIOR DI LATTE MOZZARELLA

TOTAL TIME	YIELD
Active 5 min	~100 g

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Fior di latte mozzarella, cut or torn see page 324	100 g	⅓ cup + 1½ Tbsp	100
Wine or ponzu	30 g	2 Tbsp	30

PROCEDURE

1 Combine in a small, deep bowl.

2 Place the bowl in a chamber vacuum machine and pull the vacuum to 100%, making sure the liquid does not flow over the bowl.

3 Strain off any excess liquid.

4 This mozzarella is best used the day it is made.

You need to use very strong wine in order for the flavor to come through. You can try making a spicy version of this mozzarella by diluting hot sauce, such as tabasco, sriracha, gochujang, or chipotle in adobo sauce, to taste in 30 g (2 Tbsp) water in place of the wine.

Ricotta cheese was developed as a way to use the leftover whey that's a by-product of making other cheeses.

RICOTTA

Ricotta is a soft, unripened cheese that is commonly used on many kinds of pizzas. It was created as a way to make use of whey from other cheese making processes, such as mozzarella. In that case, almost all of the fat would go into making the mozzarella cheese curd, but you would still have a lot of protein in the whey. Coagulating that became a way to reuse the whey (in combination with milk). Many ricotta recipes use an acid such as lemon juice, vinegar, or buttermilk for coagulation. You can also make ricotta solely from whole milk, which provides a much creamier result because the fat is contained in the cheese.

In many ways, ricotta is the culmination of the beginning stages of cheese making (see page 290). You basically take the milk to the point of making curd, drain it, and call it a day; it's that simple. The milk or milk-whey blend is acidified directly using a food-grade acid (such as citric acid), a starter culture (although this is not very common because it takes longer to make), or acid whey powder (~25% is added). The mixture is brought to a pH between 5.9 and 6, and it is then heated to 80°C / 176°F. Other forms of acid can be added, such as vinegar, lemon juice, or even buttermilk. Even though the first couple steps are the same as making mozzarella, the result is totally different. The ricotta has a grainy texture and doesn't melt (although the high-fat ricotta will melt, in a fashion).

The USDA specifies three types of ricotta. Ricotta is made from whey, skim milk, or a combination of whey and skim milk. It has a moisture content of ~82.5% and a fat content of ~1%. Part-skim ricotta is made from reduce-fat milk and must have between 6% and 11% milk fat and 80% moisture content. Whole-skim ricotta is made from whole milk and should have a fat percentage above 11%.

Ricotta is applied to pizza either before or after baking, depending on the desired effect. It is soft enough to act as a sauce, depending on how freshly made it is. To us, there are few things as delicious as the taste of a smooth, just-made, and still slightly warm ricotta. You can also buy it, of course.

RICOTTA

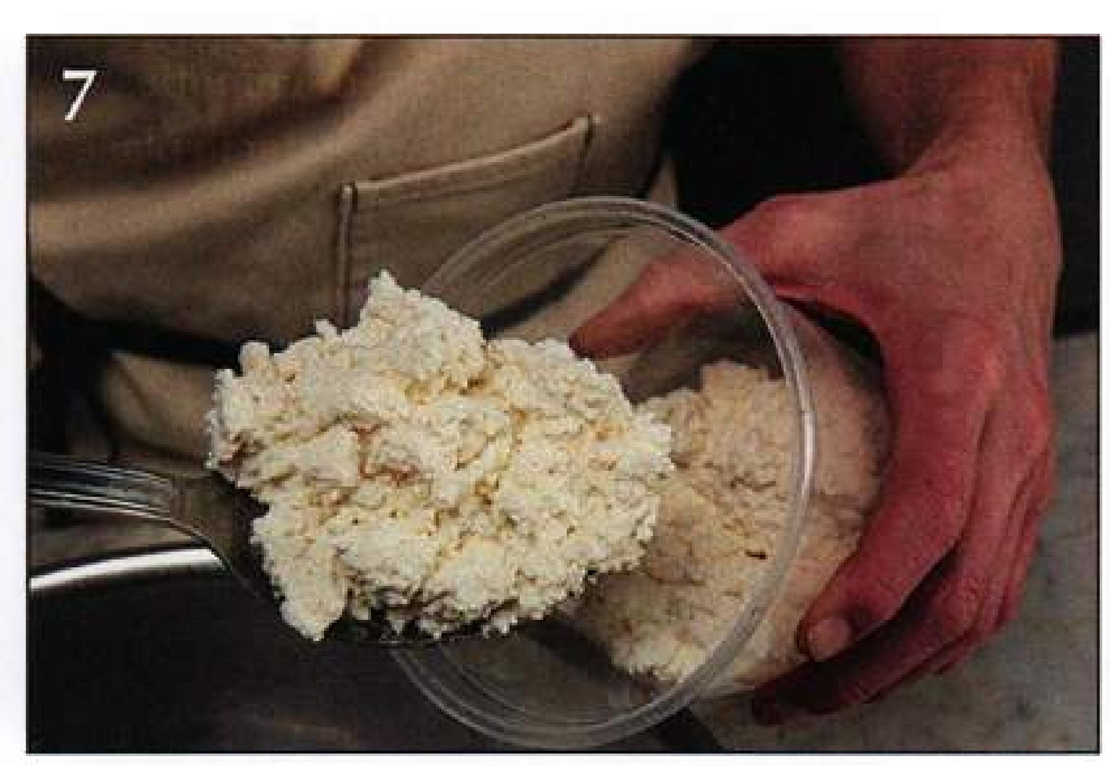
INGREDIENTS	WEIGHT	VOLUME	SCALING %
Whole milk	2 kg	2 qt + ⅔ cup	100
Citric acid	4 g	¾ tsp	0.2
Fine salt	as needed		

TOTAL TIME	YIELD
Active 7–10 min / Inactive 45 min–1 h	~400 g

PROCEDURE

1. Warm the milk over medium heat to 93°C / 200°F in a medium stainless steel saucepot, stirring occasionally.
2. Remove the pot from the heat and gently whisk in the citric acid.
3. Let it stand undisturbed for 10 min.
4. Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.
5. Drain the curds for 25–30 min.
6. Season with salt to taste. Start with 1% of the final weight of the ricotta and then adjust as needed.
7. Use immediately or store in an airtight container for up to 3 d in refrigeration.

You can replace the citric acid with 45 g (3 Tbsp) lemon juice or distilled white vinegar if you don't have citric acid on hand. The lemon juice will lend its flavor to the ricotta while the vinegar is much more neutral.



This ricotta is smooth, creamy, and perfect as a sauce on pizza or simply garnished with olive oil, herbs, salt, and pepper and enjoyed on its own.

RICOTTA WITH ADDED FAT

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Whole milk (~3.5% fat)	2 kg	2 qt + ⅔ cup	100
Mascarpone, crème fraîche, or heavy cream	225 g	1 cup	11.25
Citric acid	2 g	¼ + ⅛ tsp	0.1
Fine salt	as needed		

TOTAL TIME	YIELD
Active 7–10 min / Inactive 45 min	~500 g curds

We recommend starting with 1% added salt and then adjusting the seasoning to taste.

PROCEDURE

1 Warm the milk and additional dairy gradually in a medium saucepot over medium heat to 93°C / 200°F, stirring occasionally.

2 Continue with steps 2–7 of the Ricotta recipe on the previous page.

GOAT'S MILK RICOTTA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Whole goat's milk (~4.1% fat)	2 kg	2 qt + ⅔ cup	100
Citric acid	2 g	¼ tsp + ⅛ tsp	0.1
Fine salt	as needed		

Follow steps 1–7 of the Ricotta recipe on the previous page.

We recommend starting with 1% added salt and then adjusting the seasoning to taste.

TOTAL TIME	YIELD
Active 7–10 min / Inactive 45 min	~400 g curds

The texture of this cheese is a little drier than ricotta made with cow's milk.

BUTTERMILK RICOTTA

INGREDIENTS	WEIGHT	VOLUME	SCALING %
Buttermilk (~4.1% fat)	1 kg	1 qt + ⅓ cup	100
Whole milk	1 kg	1 qt + ⅓ cup	100
Fine salt	as needed		

TOTAL TIME	YIELD
Active 7–10 min / Inactive 45 min–1 h	~300 g

The buttermilk ricotta is drier and slightly more crumbly than our whole-milk ricotta recipe.

PROCEDURE

1 Warm the milk and buttermilk over medium heat to 85°C / 185°F in a medium stainless steel saucepot, stirring occasionally.

2 Hold at that temperature for 3–5 min. You will see the mixture starting to separate.

3 Remove the pot from the heat. Let it stand undisturbed for 10 min.

4 Gently transfer the curds to a fine-mesh sieve lined with cheesecloth.

5 Drain the curds for 25–30 min.

6 Season with salt to taste. Start with 1% of the final weight of the ricotta and then adjust as needed.

7 Use immediately or store in an airtight container for up to 3 d in refrigeration.

New York pizza with smoked mozzarella, ricotta, spicy Italian sausage, and sautéed Swiss chard

CHAPTER 10
TOPPINGS

TOPPINGS

When we talk about toppings, we mean everything that goes on pizza dough that isn't sauce or cheese. There are so many possible toppings to put on pizza, just choosing them can be daunting. Indeed, we suspect that in order to avoid the choice part altogether, some pizza makers pretty much just pile everything on and throw the pizza in the oven. There is a better way.

Our first rule for toppings boils down to two words: even distribution. It infuriates us to see a lopsided pizza, with more toppings on one side than the other. It's like getting a glazed doughnut that has sprinkles on only one side. No one wants that. And since pizza is often meant to be shared, it means someone's going to end up with a sad-looking slice.

Order of assembly is also important. Do all toppings have to go on the pizza before baking? Most do, but some toppings do best when added halfway through or even after baking. We'll share tips on how to apply toppings in each of these stages, but the overarching goal is to get thinking about the intended texture of your toppings and the eating experience you want your pizza to provide.

Biteability is key. Even though it's a made-up word, we're pretty sure you know what we mean: the ability to bite cleanly into a slice without dragging off all the toppings. Important, right? Certain toppings, such as thinly sliced prosciutto, are low on the biteability scale; you'll most likely drag off a whole slice with your first bite. But there are ways to solve biteability problems, and you'll find them here.

Payload is another big question in the topping department (as is the moisture content of the topping; this will determine if you need to precook the ingredient). How much can you put on a pizza without going overboard, creating a soggy pizza whose toppings slide off because they can't bind properly with the sauce and cheese? We'll walk you through how much is enough, so you'll know when to say when. Some people just eyeball it, but until you've made a lot of pizzas, nothing beats a scale for precision—and don't worry, we've got a table on page 348 with maximum payloads for all of our master pizza styles and sizes.

The majority of this chapter gives you the know-how to prepare pizza toppings. We'll give you an overview of our favorite basic cooking methods for vegetables and fruits since many of these ingredients need to be prepared in some way before putting them on top of pizza. These methods aren't meant to teach you how to cook but to give you simple guidelines. Because these methods will work for many types of vegetables and fruits (as well as meats), you'll need to tailor the methods for the different types of toppings. Our section on meat toppings focuses on preparing the common cured meats and fresh sausages that you find on pizza. We'll also give you information on finishing oils, which can add a nuanced flavor to your pizza. You'll find our favorite topping combinations in our Flavor Themes chapter on page 3:173.

NEW DISCOVERIES AND TECHNIQUES

Recommended topping weights for each pizza style (see page 348)

Our toppings database findings (see page 354)

Frico cheese crisps as a topping (see page 372)

Why does pepperoni curl? (see page 379)

This thin-crust pizza in the photo on the previous page topped with layered portobello mushrooms and garnished with chives and chervil after baking.

THE SCIENCE OF PIZZA TOPPINGS

No one would want a doughnut that's topped on only one side. Pizza is no different: toppings should be applied evenly and symmetrically.

All pizza toppings share some factors that are critical for which ingredients you choose to use as a topping, how much you use, and when you apply them. The ways that different toppings react to baking affect the whole eating experience, and we've noticed that careful attention to toppings is often the difference that makes one pizzeria better than others. Certainly dough, sauce, and cheese matter, but toppings can make or break an otherwise great pizza.

The first of these critical factors, and the most constraining, is heat. A topping that is applied to the pizza before baking, which is typical for most styles, has to be able to survive its time in the oven. Depending on the pizza style, that oven can be extremely hot.

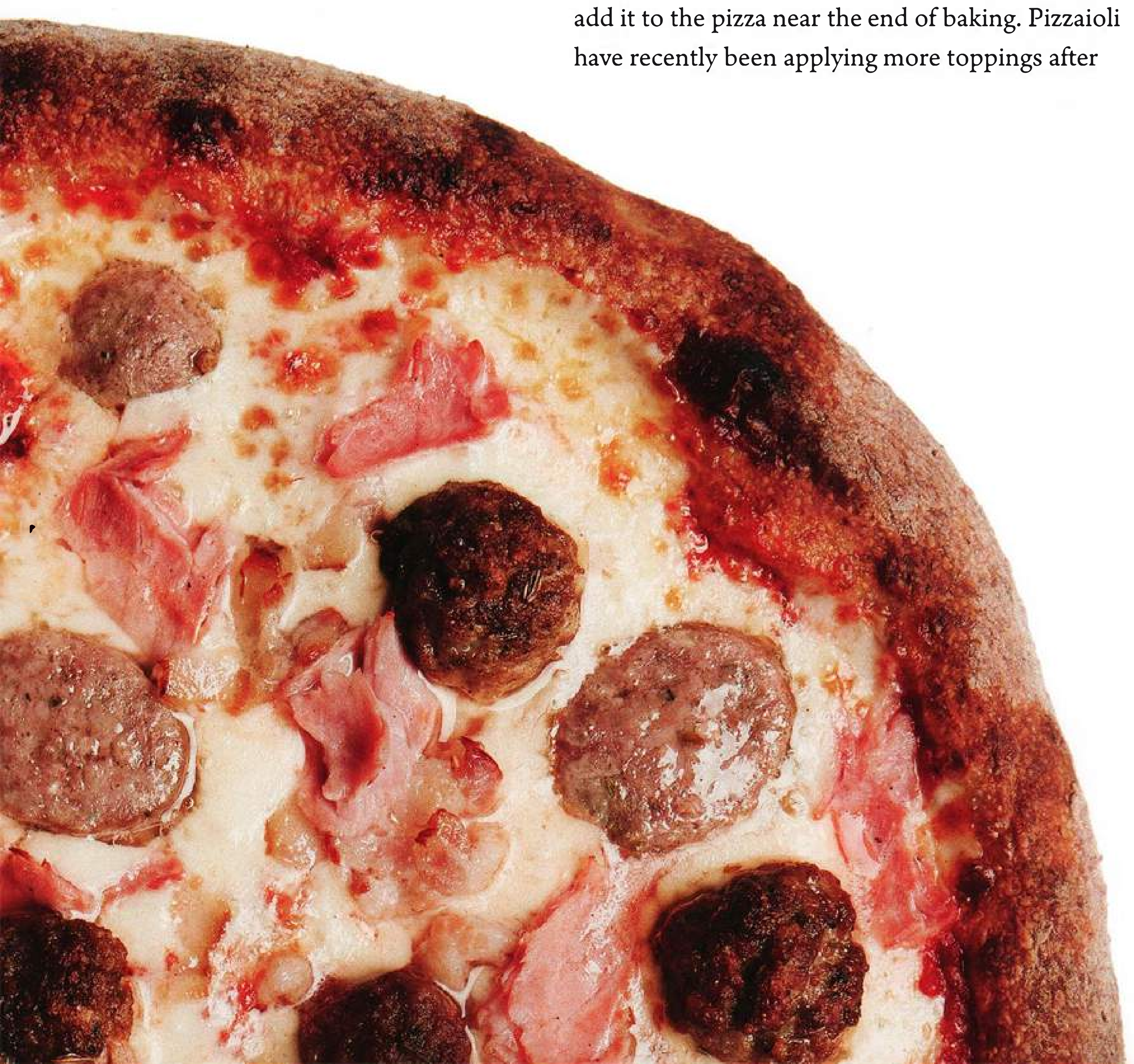
You want the toppings to cook properly but not burn. This is one of many reasons that you can't make a steak pizza by just throwing a piece of steak on top of a pizza—not only will it not cook properly in the time that it takes to bake the pizza, it won't be easy to eat. If you put raw sausage on a thin-crust pizza and it's exposed to the heat, it will probably cook through and brown, but if it's buried under a layer of sauce and cheese, as in the case of deep-dish pizza, it'll steam and won't be as tasty.

Similar consideration needs to be taken for delicate items, like basil, which can burn easily in a hot oven. Either you'll have to put the basil under the cheese if you apply it before baking, or you'll need to add it to the pizza near the end of baking. Pizzaioli have recently been applying more toppings after baking, especially ones that will be adversely affected by the baking process. You see this with all styles of pizza, including trendy styles like al taglio where the crust is often prebaked without any toppings at all (see page 3:130).

The next factor to consider is how the toppings "eat" with the rest of the pizza. Toppings that are too tough to bite through or are tough enough that they're a substantially different texture from the crust or other parts of the pizza are going to be a problem. Note that there is a difference between "eatability" (the overall eating experience) and "biteability" (how you bite through the topping). For example, you can technically bite through a soupy pizza but the overall eatability isn't great. The amount of toppings and how messy they are will also impact eatability. We found that the pizza makers in Argentina used an overwhelming amount of cheese on pizzas, which is why it is common to eat the slice with a knife and fork. They also put whole, unpitted olives on their pizzas as a decorative topping. Since the olives were unsliced, they would roll off. And if you were unlucky enough to get one, you might crack a tooth.

Moisture content is another issue. Toppings that release a lot of moisture when they heat up will lead to a soggy pizza. Certain items can release a significant amount of fat, which can puddle on the pizza. Some people don't like this; it's common to see people dabbing the fat off the top of the pizza with a napkin. If this is a problem for you or your customers, you can render items like bacon or high-fat sausage before it goes on the pizza. You should never do this with cupping pepperoni, however, since the little grease chalices are a big part of the eating experience. In general, it's hard for raw toppings to properly cook on a pizza and they often release a significant amount of water, which is why toppings are often precooked.

We provide topping suggestions in both the Iconic Recipes chapter on page 3:3 and the Flavor Themes chapter on page 3:173. If you are creating your own pizza rather than following the recipes (which we think is fantastic), use these guidelines when you are applying toppings that aren't covered in this book. You can also look for other similar toppings in the book and treat your toppings in the same fashion.



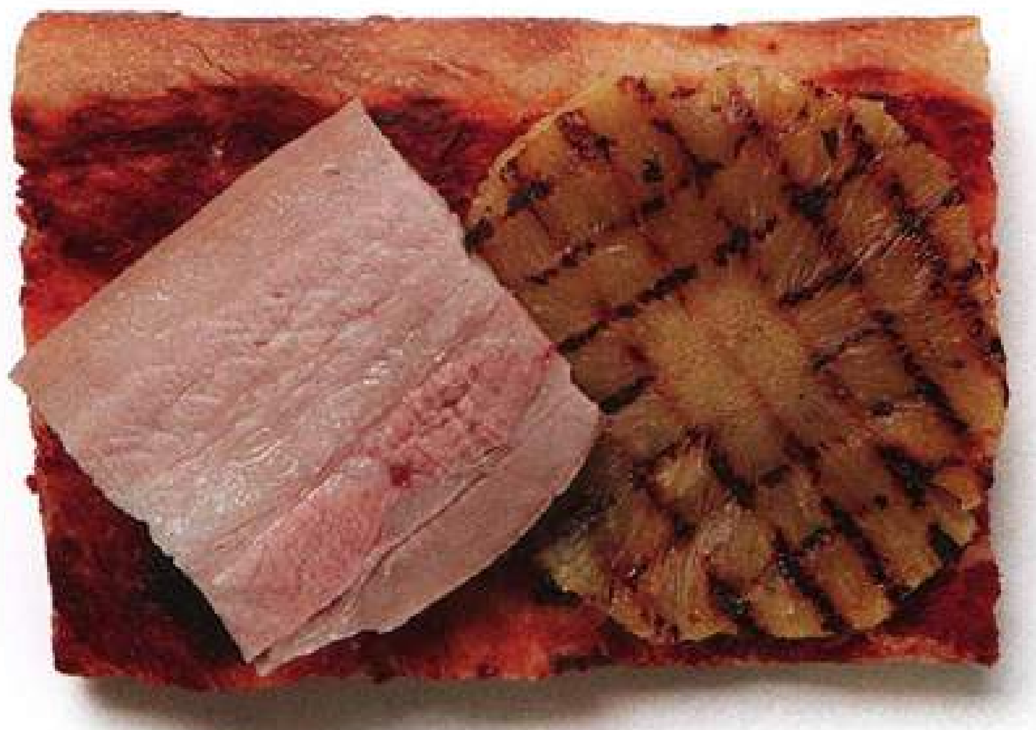
We recommend precooking any of the fresh sausages that you would use on pizza (see page 375) in order to get the benefits of browning. Meats that can be eaten outright, like smoked salmon or prosciutto, are different and don't need this additional cooking step.

COMMON TOPPING PROBLEMS

The best way to fix a problem is to avoid it in the first place. This list of common topping problems are all ones that are difficult to fix once your topped pizza goes into the oven, so consider these ahead of time, or learn from your mistakes and try again!

Problem	Solution
There is topping drag.	If toppings cover a surface area larger than a mouthful, the result is often topping drag. Cut or hand-tear these ingredients into smaller, bite-sized pieces before baking.
The toppings are tough.	Kale, meats with connective tissue (such as pork shoulder), and other tough ingredients should be partially or fully cooked before they're placed on a pizza and cut to appropriate sizes. If you have applied a topping and it's still tough after baking, you can't do much about it but take it off.
The toppings are burnt.	Apply the topping halfway or three-quarters of the way through baking rather than at the beginning. You can also make sure the topping is surrounded by moist ingredients to insulate and protect it from high heat exposure. Keep in mind that there are degrees of burnt. If it's just slightly charred, it can add to the overall positive experience of eating pizza. If it's black in a bunch of areas or if it smells burnt, it might not be pleasant to eat. You might be able to manually pick burnt bits out without disrupting the cohesiveness of the merged toppings. If not, remake the pizza.
The pizza has excessive toppings.	Weigh the amount of toppings based on our suggestions. Excess toppings typically leach a lot of water. The problem is particularly pronounced with vegetable-heavy pizzas or when using very moist toppings. The water has trouble evaporating by the time the crust is baked. Don't overload the pizza; alternatively, precook some or all of the ingredients.
The toppings fall off.	Toppings are held together by the melted cheese, but if you have a loose layer of too-wet toppings, the whole thing will slide off when you take a bite. Also, make sure your toppings aren't too big, as large toppings tend to fall off. In this case, you can suggest that the slice be eaten folded or with a fork and knife.

Topping drag



Tough toppings

Burnt toppings

Excessive toppings

Toppings fall off

TOPPING PAYLOAD

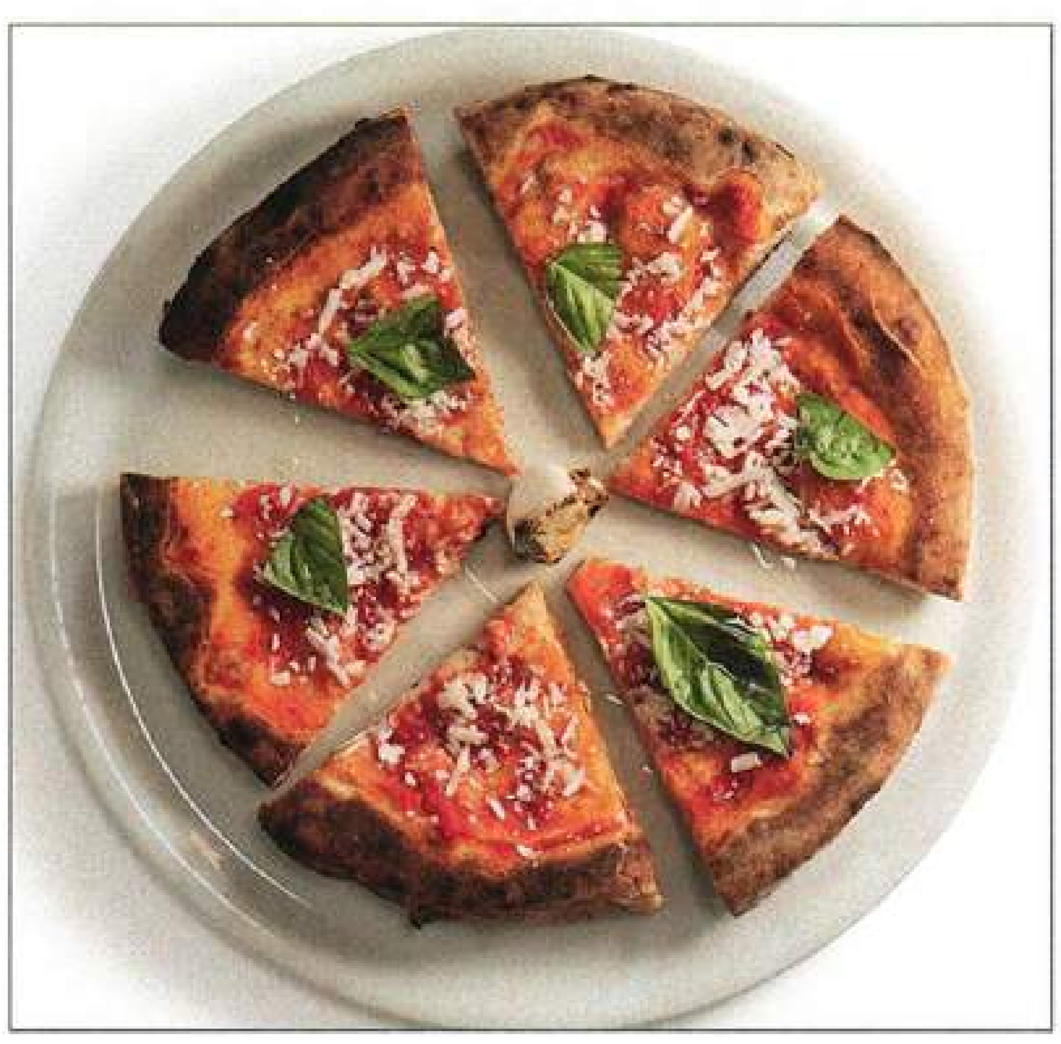
"Payload" is a term used in aviation and aerospace to describe the amount of "stuff" a vehicle can carry given the amount of fuel it has. In other words, payload is its capacity to carry the weight without compromising flight functions. We think the term also applies to pizza. How much stuff can I put on before all the toppings spill off or the slice buckles under its own weight?

Neapolitan-style pizza can't handle a lot of toppings. The dough is soft and the baking time is short, which prevents a firm crust from forming. Even a simple marinara pizza will sag at the tip. In fact, according to the AVPN (see page 3:43), tip sag is a positive quality attribute. While some tip sag is acceptable, that doesn't mean you can pile loads of toppings on a Neapolitan-style pizza. That approach simply doesn't work with this style.

Other pizzas, though, can hold a significant amount of toppings. But just because you can doesn't mean you should. If you're eating pizza with your hands, the toppings are likely to slide off if you've piled on too many. This can happen even if you fold the slice.

Pan-baked pizzas are significantly thicker and theoretically could handle a pile of toppings, especially if you're eating them with a fork and knife. But more toppings do not always translate to a better eating experience. You want to get the balance right. Too much weight on even the thickest of pizzas will hinder its expansion in the oven and produce a denser crumb than desirable.

We learned during *Modernist Bread* that bread can withstand up to 30% of dry weight in it and still expand to a good volume in the oven. This also applies to pizza, although pizza toppings aren't typically dry weight. Most, if not all, toppings contain some moisture, and this moisture can produce a very undesirable gum line (see page 1:370) between the dough and the sauce, cheese, and other toppings.



Undertopped

Overtopped

Topping slides off

Poor distribution

Uneven baking

Wet toppings

These photos, taken during our travels to pizzerias all over the globe, illustrate what can happen when you don't pay enough attention to how much and where you place the toppings on your pizza.

Undertopped

Properly topped

Overtopped

RECOMMENDED TOPPING WEIGHTS

Here are our recommendations for the optimal to maximum topping payload range for each style of pizza. These are admittedly subjective, and some styles of pizza, like the cheese-laden ones we sampled in Buenos Aires, far exceed these amounts. For practical purposes, this includes the sauce and cheese, so the numbers here are for the total payload. (The amount of cheese can vary from pizza to pizza, of course, but we've used the iconic assembly recipe amounts in the chapter that begins on page 3:3.) The maximum figure indicates the point just before quality aspects begin to suffer. When considering the amount of topping to put on, keep in mind both the volume and the flavor intensity of the ingredient. If you topped a small thin-crust pizza with 135 g of arugula after baking, it would engulf the pizza, and 135 g of anchovies would overwhelm the other flavors on the pizza. But adding 135 g of burrata would be reasonable in terms of both volume and flavor.

		1	2	3	4	5	6
Style of pizza	Pizza size	Sauce	Cheese	Toppings added before baking	Toppings added after baking	Total payload (sauce + cheese + toppings added before baking) (1 + 2 + 3)	Total payload (sauce + cheese + toppings added before and after baking) (4 + 5)
Thin-Crust Pizza see page 3:19	40 cm / 16 in	95 g	150 g	135–165 g	135–150 g	380–410 g	515–560 g
	50 cm / 20 in	170 g	270 g	250–300 g	250–275 g	690–740 g	940 g–1.01 kg
Brazilian Thin-Crust Pizza see page 3:25	23 cm / 9 in	100 g	175 g	165–210 g	95–135 g	440–485 g	535–620 g
	40 cm / 16 in	160 g	340 g	300–380 g	170–250 g	800–880 g	970 g–1.13 kg
Neapolitan Pizza* see page 3:47	30 cm / 12 in	120 g	100 g	125–150 g	180–210 g	345–370 g	525–580 g
New York Pizza see page 3:71	35 cm / 14 in	160 g	195 g	130–300 g	175–225 g	485–655 g	660–880 g
	40 cm / 16 in	240 g	290 g	195–450 g	260–335 g	725–980 g	985 g–1.31 kg
	45 cm / 18 in	320 g	390 g	260–600 g	350–450 g	970 g–1.31 kg	1.32–1.76 kg
	50 cm / 20 in	400 g	485 g	325–750 g	435–560 g	1.21–1.63 kg	1.64–2.19 kg
	55 cm / 22 in	440 g	535 g	355–825 g	480–615 g	1.33–1.8 kg	1.81–2.41 kg
	60 cm / 24 in	480 g	585 g	390–900 g	525–675 g	1.45–1.96 kg	1.97–2.63 kg
Artisan Pizza see page 3:77	35 cm / 14 in	145 g	180 g	170–300 g	110–320 g	495–625 g	605–945 g
	40 cm / 16 in	215 g	270 g	255–450 g	165–480 g	740–935 g	905 g–1.41 kg
	45 cm / 18 in	290 g	360 g	340–600 g	220–640 g	990 g–1.25 kg	1.21–1.89 kg
	50 cm / 20 in	360 g	450 g	425–750 g	275–800 g	1.23–1.56 kg	1.5–2.36 kg
	55 cm / 22 in	400 g	495 g	465–825 g	300–880 g	1.36–1.72 kg	1.66–2.66 kg
	60 cm / 24 in	435 g	540 g	510–900 g	330–960 g	1.48–1.87 kg	1.81–2.83 kg
New York Square Pizza see page 3:133	46 cm by 33 cm / 18 in by 13 in	225 g	425 g	800–900 g	700–800 g	1.45–1.55 kg	2.15–2.35 kg
Al Taglio Pizza see page 3:141	60 cm by 20 cm / 24 in by 8 in	200 g	300 g	550–600 g	350–575 g	1.05–1.1 kg	1.4–1.67 kg
	60 cm by 40 cm / 24 in by 16 in	400 g	600 g	1.1–1.2 kg	700 g–1.15 kg	2.1–2.2 kg	2.8–3.35 g
Detroit-Style Pizza see page 3:109	25 cm by 20 cm / 10 in by 8 in	75 g	170 g	185–210 g	175–200 g	430–455 g	605–655 g
	35 cm by 25 cm / 14 in by 10 in	150 g	340 g	375–425 g	350–400 g	865–915 g	1.21–1.31 kg

**These amounts are for margherita pizzas. For marinara pizzas, reduce the amounts by 40 g.*

TOPPING APPLICATION

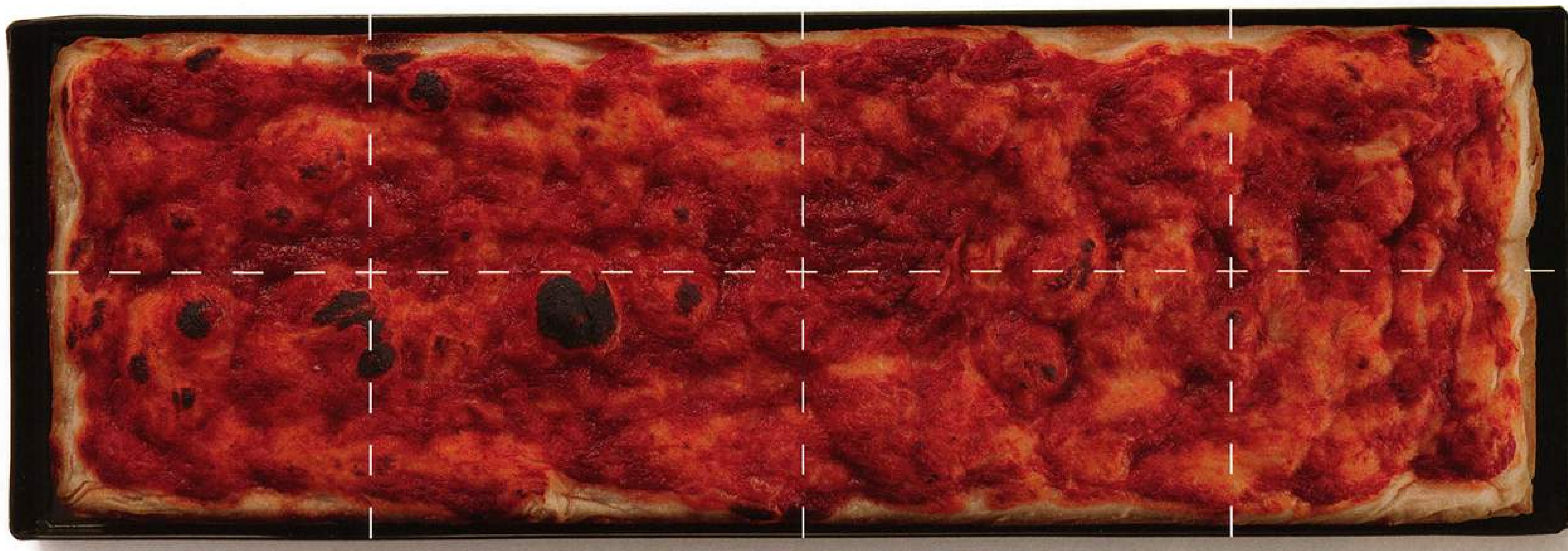
If you've watched pizza being made, it might seem like applying toppings is a no-brainer. How hard can it be? A little bit of sprinkling, a little bit of laying or layering, and that's the end of that. Right? The pros certainly make it look easy, but they've had a lot of practice not only making pizzas but making them efficiently and quickly.

Toppings need to be distributed evenly and symmetrically over the surface of the pizza. Envision each slice (triangles or quarters for round pizzas and quarters for rectangular pizzas) and try to apply roughly the same amount of toppings on each one. The toppings should not exceed the payload (the weight of the toppings the pizza can support). Less is often more when it comes to toppings. If you apply them evenly, you can probably get away with applying less. If you are sloppy with the topping application, you'll tend to apply more.

A peel can be used to test this. If you assemble your pizza on a work surface and then struggle to slide a peel under it before moving it to the oven, there's a good chance you've added too many toppings. (Some people choose to assemble their pizza on the peel, which could conceivably mitigate this problem, but there are pros and cons to each approach; see page 204.)

When you cut the baked pizza into slices, the toppings should stay in place, anchored down by sauce (and possibly cheese). The toppings provide flavors and textures that will harmonize or contrast with the other components. When you are preparing your toppings, you need to keep in mind how the seasoning will meld with the other flavors on the pizza. For example, we recommend seasoning your vegetables when roasting or sautéing them, but the level of seasoning may need to vary depending on the other components on the pizza. For example, finishing a pizza with shaved Parmesan curls could push a well-seasoned pizza into the realm of being overly salty.

Visually divide pizzas into slices and top them accordingly. In this case, the al taglio pizza is topped after baking but you should top pizzas symmetrically whether you are topping them before or after baking.



If you're a bread baker, it is worth noting that the way you prepare toppings isn't all that different from how you would prepare some inclusions for bread. Some toppings will need to be cooked before being added to a pizza, just like some inclusions. Others can be chopped and added without additional prep. The main difference is obvious: pizza toppings go on top of the dough and are baked in direct contact with external heat, while bread inclusions are baked inside the dough and are thus protected from direct heat. Unprotected, toppings can experience melting, evaporation, browning, and fat rendering, while inclusions won't necessarily experience all those changes, or at least not as dramatically.

Including raw sausage in your topping station can create a food safety issue. We recommend cooking your sausage ahead of time (see page 375), but if you prefer using uncooked sausage on your pizzas, take care in how you store it to avoid cross-contamination.

WHEN TO APPLY TOPPINGS

At the most basic level, the goal is for the toppings to meld together during baking. They'll merge with the other components, such as sauce and cheese, and form a cohesive and well-balanced pizza. In most cases, the simplest way to achieve this is to distribute the toppings evenly across the top of the unbaked pizza dough along with the other components. But we encourage you to consider how the topping placement will affect how the pizza bakes. What impact will it have if the toppings go under the cheese? Under the sauce? In between them? How will those things affect the eating experience?

One way to approach these questions is to think about what you want out of each topping. Take spinach, for example. Adding a pile of uncooked spinach to a pizza before it bakes is probably unwise. First, there's the volume problem; raw spinach cooks down to a fraction of its size. It also releases a bunch of water, which can make for soggy pizza. Then there's the fact that a pile of spinach leaves can prevent whatever is under them from melting or cooking (and may burn in the process). So it may be smarter to apply sautéed spinach under the cheese at the beginning of baking so it can meld with the cheese and sauce, or to apply it as a salad-like topping after the pizza comes out of the oven. Some of this comes down to personal preference as well, since you are the one who determines how you want your pizza to be served.

The time it takes for a pizza to bake is another factor to consider. Neapolitan pizzas bake quickly. Whatever you're putting on the pizza needs to meld with the sauce and cheese during that short time in the oven, so we generally recommend precooked toppings or toppings that cook quickly, like sliced garlic. Additionally, if you add something that has been significantly browned or charred, it will likely burn and be unpleasant to eat due to the high heat at which Neapolitan pizzas are baked. But you can alter the assembly of the pizza and, for example, intersperse caramelized onions with the sauce, whether it's Classic Neapolitan Pizza Tomato Sauce (see page 225) or something like cream or mascarpone, to protect the onions from the intense heat.

Likewise, it's not only acceptable but encouraged to apply certain toppings to pizza after baking. Temperature-sensitive ingredients such as salad greens are quite obviously going to wilt if they're baked, but others may not be so obvious. For instance, some cured meats are best added at the end of a bake rather than the start. If you bake a high-end Serrano ham or duck prosciutto on your pizza, you'll wind up with an unidentifiable leathery, salty crisp. Most of the flavors and textures we enjoy from cured meats such as these are at their peak at room temperature or slightly warm. Placing them on a hot pizza after baking gives them an ideal texture because they'll be quickly heated through and tender. Pepperoni, on the other hand, tastes best after a little time in the oven. The edges get crisp and the fat renders and pools onto the cheese. It's sometimes better to cut the baked pizza before placing toppings such as mortadella slices on, especially if they'll adversely affect the pizza's presentation.

A large pile of raw spinach added before baking will cook down to a soggy pile in the heat of the oven, preventing anything underneath from fully cooking. We suggest sautéing spinach and other hearty greens before adding so that the water has been released and you have better gauge on the amount.

Applying Toppings Before Baking

Before applying toppings, decide what flavor and textural role your particular topping(s) will play. Some will combine with the sauce and cheese, while others may crisp or brown. Consider that previously cooked toppings will cook further when exposed to the direct blast of heat in the oven. (This will occur only on the parts of the cooked topping that aren't surrounded by sauce, cheese, or other moist toppings that slow down browning.) We tend to like dark brown, crispy, slightly charred bits on our pizzas, but this is a matter of personal preference that you can decide for yourself.

Most pizza toppings are applied before baking so that the flavors can blend together and so that the toppings will meld with the sauce and cheese. This improves the eating experience because the toppings won't fall off when you bite into the slice. Some toppings, like sliced mushrooms, bell peppers, olives, or pepperoni, can be scattered raw on the pizza (usually in between the sauce and cheese layers) and they'll bake beautifully into a delicious pizza. Other toppings, like quince, winter squash, or tough cuts of meat, require advanced preparation before putting them on pizza. You can also use a combination of raw and precooked variations of the same ingredient (like sliced raw onions and caramelized onions or potato puree and fried shoestring potatoes) to provide flavor and textural contrasts in your pizza.

When possible, room-temperature toppings are preferable to cold. Cold toppings can cool down the dough, which can cool down the oven and prolong baking time. Some toppings, such as uncooked meats, must remain refrigerated, and you may need to adjust the baking times to accommodate the cold toppings. And although most cured meats are okay to sit out at room temperature for up to 2 hours, some, like thinly sliced prosciutto, are easier to separate when they're cold.

As you begin applying toppings, it helps to visually divide the pizza into evenly sized grids, whether they are triangles, rectangle, or squares. Your goal is to make those portions look more or less the same. Try to keep the same toppings similar in size so they'll bake and cook at about the same rate. It is crucial to apply the toppings more generously at the outer perimeter. The toppings will move toward the center during baking because the center is the weakest point of the pizza. The concentration of toppings in the middle, called center loading, must be avoided.

THE UBIQUITOUS SHAKERS THAT LET YOU CUSTOMIZE YOUR SLICE

Many pizzerias across the United States offer shakers of crushed red pepper, Parmesan, and dried oregano. They are so common, we got to wondering about this widespread practice. We didn't see this in Italy during our many visits.

Take the crushed red pepper, for example. Trying to shake out a few flakes can be an exercise in frustration. It turns out there's a reason for this. Most of those shakers have holes that are just big enough for the seeds and some flakes to come out. This prevents customers from accidentally dumping on too much, which could lead to (gasp!) not eating the slice or trying to pick off the spicy bits. Thankfully there's a more generous and better-designed shaker. The one shown at right has vent-like openings. It still controls the amount of flakes that come out, but it's more generous than the classic shaker.

When it comes to the Parmesan shakers, we're sorry to inform you that the cheese is not, and has never been, Parmigiano-Reggiano. Rather, it's Parmesan, a very different cheese. Parmigiano-Reggiano can be costly. It has a DOP protection (see page 213), which means it's made under strict regulation. Cheeses that aren't made to these specifications must be called something else, even if they're made in generally the same style.

In the United States, we refer colloquially to Parmigiano-Reggiano as Parmesan as well, which is why there might be some confusion. The Parmesan in the shakers is milled, not grated, which makes it closer to a powder and easy to shake out of the jar (a grated shape might get stuck or clogged in the shaker). Some pizzaioli add Parmesan to their pizza before baking, and with good reason. Parmesan (and Parmigiano-Reggiano) contains a high amount of naturally occurring MSG, which provides a lot of flavor without having to rely completely on salt. Whether you choose to add it after baking is a matter of personal preference.

Most of the dried oregano in pizzeria shakers is Greek oregano, also known as true oregano or Italian oregano. If you offer dried oregano in shakers in your establishment, be mindful of how old the dried herb is since the flavor can deteriorate over time.

Pizza makers will often apply dried oregano to their pizzas either before or after baking since the flavor complements the sauce and cheese so well. Some pizzaioli prefer a type of dried oregano that comes from the Calabria region in Italy; it comes in a dried bunch (instead of loose leaves), and it adds to the "show" to tap the dried bunch of oregano on a freshly baked pizza. Oregano is very aromatic, but even more so if it's slightly toasted, so you can really amplify the aroma if you add it before you bake the pizza rather than after.

Toppings like cheese, pepperoni, or thinly sliced onions can be applied easily before baking. Toppings like pistachios can be applied during baking while items like arugula, which are delicate, should be added to the pizza after baking.

Applying Toppings Halfway Through Baking

Some toppings, such as shellfish, chicken breast, or foie gras, might overcook, melt, or burn if they spend the entire baking time in the oven. While adding toppings halfway through baking is not as common as adding toppings before or after baking, it is a good option for certain items that benefit from some time in the oven but might burn if they're on for the entire bake. We also like to add toppings halfway through baking for thick-crusted pizzas such as al taglio pizza because the dough will get better oven spring without being weighed down by toppings before baking.

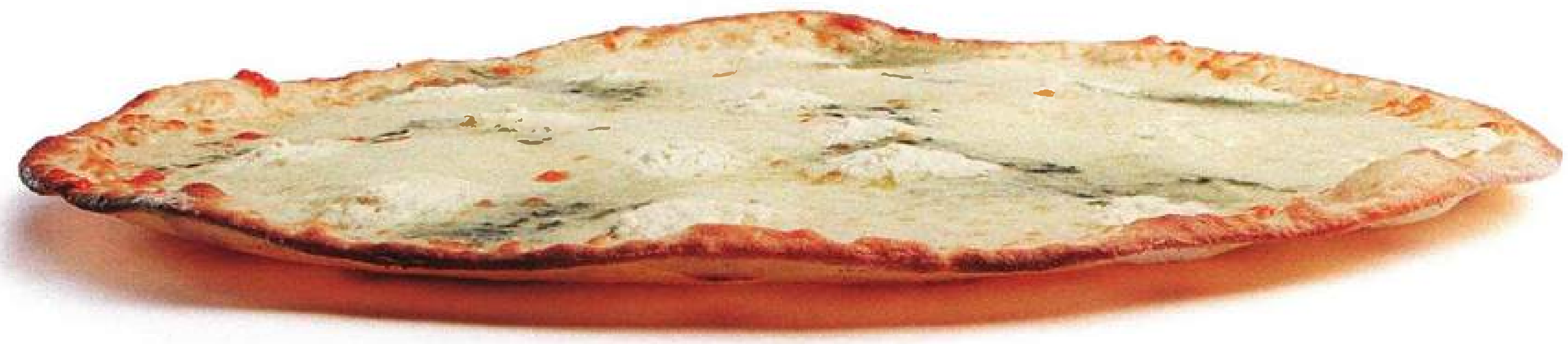
Don't get too tied to the literal halfway point. The spirit of this step is that you can apply toppings almost any time after baking has begun if the topping requires it. Whether that's three-quarters, halfway, or one-quarter into the baking time will depend on the type of topping and/or what texture, flavor, or color you're trying to get out of it.

The most important thing is to not burn yourself when applying toppings partway through baking. We suggest keeping the half-baked pizza on a peel as you're applying the toppings. Make sure the peel and pizza are steady and well balanced. Don't put the pizza on a surface that's temperature sensitive. Close the oven door to avoid a dramatic temperature drop and work quickly. Reset your timer, if necessary, after returning the pizza to the oven.

Applying Toppings After Baking

Some of the most common toppings to put on after baking are delicate salad greens, herbs, or thinly shaved vegetables, but those aren't the only things that you can add once the pizza is baked. Cured meats like mortadella or capocollo should be applied after baking so that they are only gently warmed and the integrity of the product isn't compromised. Certain sauces, such as aioli or ranch, are temperature sensitive. You can set aside these sauces and use them for dipping, but it's not out of the question to spoon or drizzle emulsified or dairy-based sauces onto a pizza after baking (see page 259). Eggs are another interesting option. Sometimes an egg is cracked at the center of a pizza the moment it comes out of the oven. The idea is that the pizza is hot

Certain cheeses, like blue cheeses, can melt into the pizza if applied before baking (see photos at left). That's why we recommend putting them on pizzas after baking or just at the end of baking to preserve their texture and visual appeal.



Blue cheese added before baking

Blue cheese added halfway through baking

Blue cheese added after baking

enough to cook the egg white just enough so it's not raw. The problem is, it's not always successful. We recommend not waiting until the end. Depending on the pizza, add the egg(s) a minute or two before the pizza comes out of the oven so the whites are set and the yolk is still runny. For Neapolitan pizzas, which have a bake time of 60–90 seconds, put the eggs on the pizza before baking. The high temperature will set the whites by the time the pizza is baked.

Slide the pizza onto a cutting board, serving tray, or platter when it's done baking. Depending on the topping, you may want to slice the pizza before adding it. For example, for mortadella and ricotta "rosettes," cut the pizza first into the desired number of slices, pipe the ricotta rosettes at the center of each slice, and fold a disc of mortadella on top of the ricotta. If you're simply drizzling olive oil on top, however, apply it first and then cut the pizza.

MATCHING TEXTURES WITH BITE STRATEGY

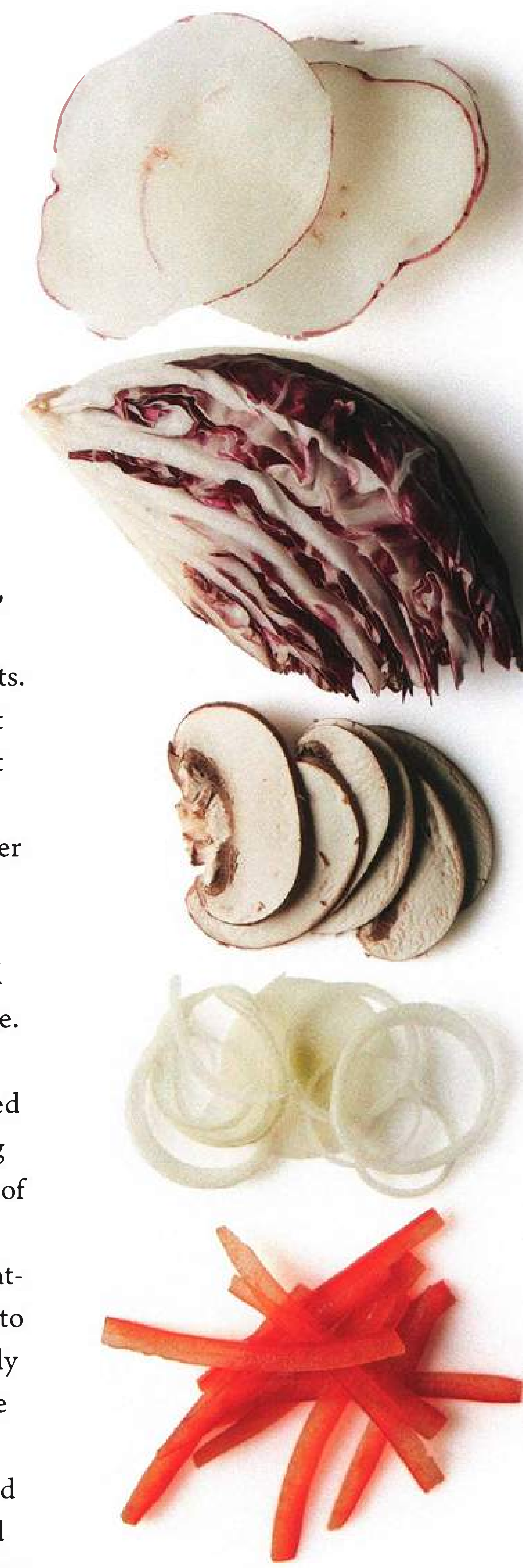
Have you ever tucked into a sandwich and had all the fillings drag out with the first bite? That's poor sandwich design. This culinary tragedy can also happen with pizza, and for the same reason: there was something on it that was too tough for your teeth to cut through cleanly. As you pull the pizza away from your mouth, everything connected to that impenetrable piece of topping comes along with it. It will land on your chin, chest, plate, the floor, or all of the above. If it happens to be molten-hot cheese, your misfortune is compounded.

Sliced cured meats are often the biggest culprits. It's not necessarily because they're tough; it's just that a slice of meat can cover a significant amount of surface area, which can make for an awkward eating experience. The simplest fix is to use smaller or even bite-sized pieces (see page 345). Tearing the slices is the easiest way to accomplish this. When you cut cured meats with a knife, they tend to stick to each other and become hard to separate.

Cured meats aren't the only culprits. We've seen it with eggplant parmigiana and with roasted whole radicchio leaves. Pretty much any topping that can cover a surface area larger than the size of a bite can become a biteability nightmare.

Don't consider just surface area; thickness matters, too. A very thick topping (like a slice of potato or roasted squash), even if it's bite-sized, will likely slide off your slice. The simple solution is to make sure that your toppings are thinly sliced. You can go high with some things, like salad greens applied to pizza after baking, but you'll have to either fold these pizzas to keep everything in place or eat them with a fork and knife.

We're not saying all of the textures need to be exactly the same. On the contrary, textural contrast is a wonderful thing on pizza. But we encourage you to take these considerations in mind beforehand.

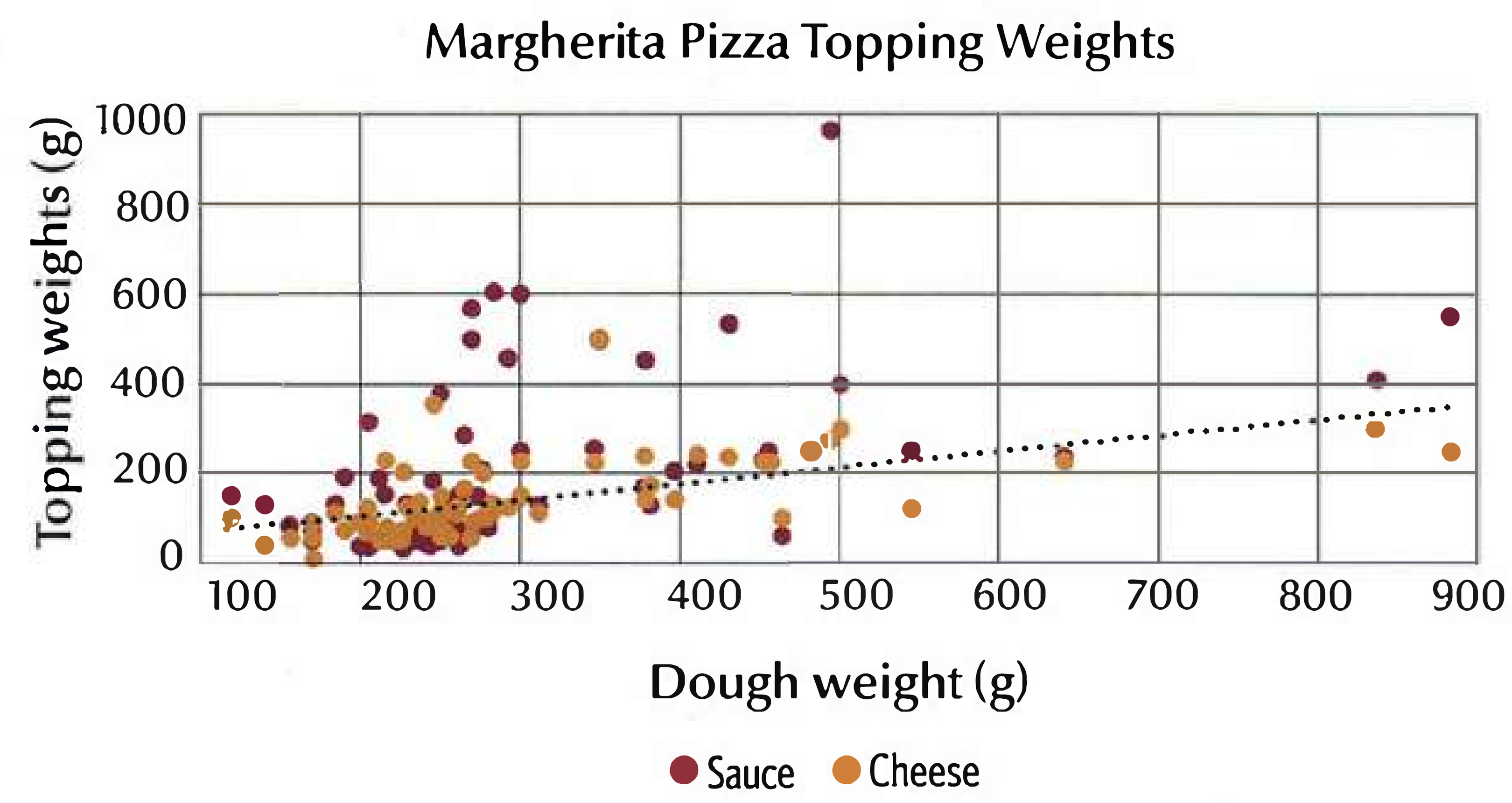


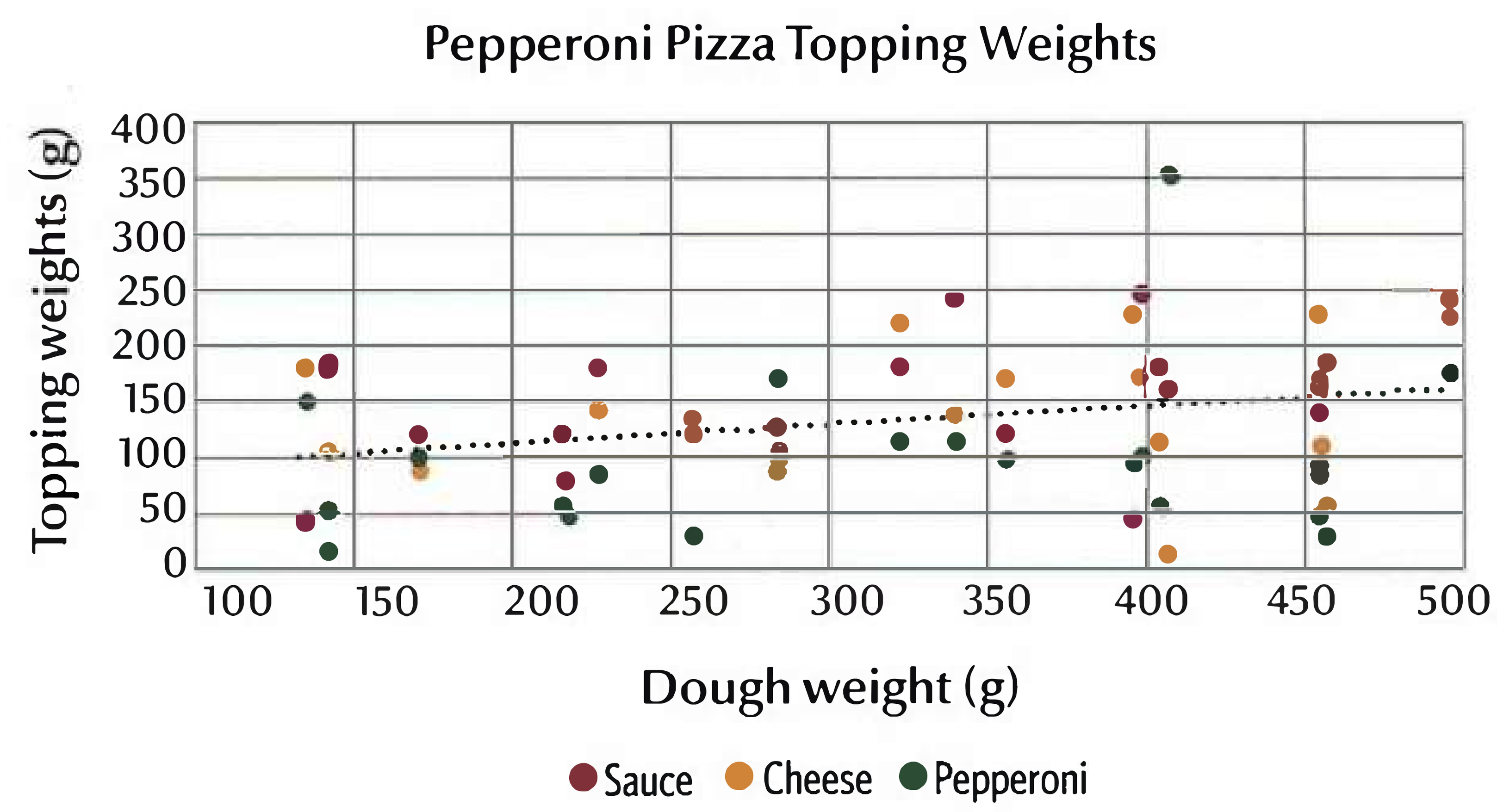
Be sure to prepare your toppings so that they have the desired biteability on the finished baked pizza (see page 344). Thinly slicing the ingredients will almost always guarantee that they will bake properly on the pizza. Try to make the toppings more or less the same size so that they cook at the same rate.

OUR TOPPINGS DATABASE FINDINGS

When we started this book, we compiled pizza recipes from over 370 books from all over the world, old and new, written in many different languages (see page 1:320). Creating this database was an integral part of our research because it helped us to determine if certain pizza styles had baseline characteristics and standards for ingredients. When we looked at the toppings section of our database, it helped us appreciate how vast the variety of pizza toppings is. We recorded the pizza topping data as a percentage of total weight of the dough. There are also subcategories within to separate major toppings like sauce—alone—and cheese—alone—in comparison to the total dough weight. The charts on the right compare the topping weights of two of the most popular topping combinations, margherita pizzas and pepperoni pizzas. Both charts plot the topping weights in relation to the base weights of the dough showing the wide ranges of both recipe sets. The toppings component of margherita pizzas in this graph includes a small variety of ingredients and garnishes. The data is clustered around what is considered to be the standard size (made from roughly 250 g of dough with 300 g or less of sauce, cheese and toppings) for a Neapolitan pizza. There are several outlier recipes in this category that use tomatoes as a topping alongside tomato sauce.

For the pepperoni category, we see the toppings weights more evenly distributed across the range of the dough weights. Several recipes have an extra finishing ingredients incorporated into the recipes.





COMMON PIZZA TOPPINGS AROUND THE WORLD

Don't discount a topping just because it might seem unusual to you. After our travels, we've concluded that just about any food can be fair game as a pizza topping. Toppings often reflect cultural tastes and local availability. Many pizza chains, like Pizza Hut, Mr. Pizza, and Domino's, have outposts around the world, and their menus reflect some traditional ingredient, flavor, or famous dish from the region (see page 1:145). Those particular topping combinations may not catch on worldwide, but they satisfy their all-important local customer base. Here are some popular toppings from around the world.

Country	Topping
Argentina	anchovies, Fainá (see page 1:40), whole green and black olives, ham, roasted red peppers, sliced fresh tomatoes, sweated onions
Australia	prawns, chicken, ham, barbecue sauce, pineapple, kangaroo
Brazil	canned tuna, Calabrese sausage, Catupiry (see page 312), hard-boiled eggs, hearts of palm, olives, shrimp
Canada	Hawaiian pizza includes: Canadian bacon and pineapple
France	bacon, fresh cream, onion, raw egg
India	butter chicken, chicken curry, kheema masala, palak paneer
Italy	anchovies, basil, garlic, mozzarella, tomatoes
Japan	mayo jaga pizza includes: mayonnaise, potato, and bacon
Kenya	beef ham, mushrooms, peri peri chicken
Mexico	hot sauce/salsa, maggi sauce, squeeze of lime juice
Nigeria	tropical pizza includes: sliced banana, Philly steak, mushrooms, and red chilies
Russia	moskva pizza includes: sardines, tuna, mackerel, onion, salmon, and red herring; sometimes served cold
South Africa	boerewors sausage, peri peri sauce
South Korea	blueberries, corn, cream cheese, fried chicken, kimchi, shrimp, sweet potato
Sweden	kebab meat, pepperoncini peppers, ham, bananas, pineapple
United States	green bell peppers, mushrooms, olives, onions, pepperoni, sausage, tomatoes

From top left, to right: Peri peri sauce, mackerel, mushrooms, pineapple, pepperoni, chicken curry, raw egg, kimchi, catupiry, red chilies, mayonnaise, and prawns

FRUITS AND VEGETABLES

Although it's not common to see additional starch used as a topping on a pizza (the logic being that the crust already provides a starchy base), it's not out of the question. In our experience, mashed potatoes, roasted potatoes, and fried potatoes work really nicely on a pizza. Our Gazpacho Pizza on page 3:266 utilizes croutons as a garnish and the Pixelated Pizza on page 3:98 incorporates pasta tubes as an integral part of the deep-dish pizza. The key is to use different forms of starch rather than additional dough and to not use an overwhelming amount.

While not technically vegetables (they're a fungus), truffles are amazing on pizza, whether they're black or white. They should be sliced to order directly over the pizza when it comes out of the oven—or, better yet, in front of the diners so they can get the full aromatic impact.

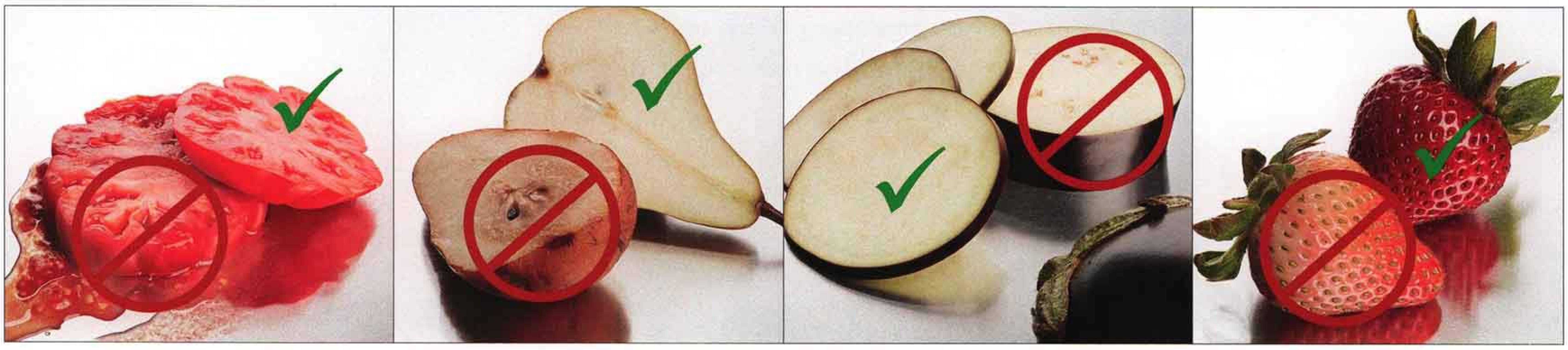
Fruit isn't the most common pizza topping you'll see, but it isn't unusual to find fruits such as nectarines or blueberries on artisan-style pizzas (and pineapple on the infamous Hawaiian pizza, of course). Typically, your best bet is to use fresh fruit, and it will be tastiest (and cheapest) when it's in season. It's important to consider the amount of moisture in the fruit and how that might affect your pizza. Fruits with high moisture content may need to be cooked before you put them on a pizza; roasting is a common method used to drive off excess water and concentrate flavor (see page 360). Frozen fruits release a lot of moisture when they thaw. Some fruits, like berries, also tend to break down when frozen and become mushy when thawed. Fruits can be thinly sliced or cut into bite-sized pieces and are usually applied partway through baking or after baking so that they don't break down too much during baking.

Dried fruits aren't often seen in the world of pizza, but it's possible to use them creatively, especially if the pizza includes artisan cheese, foie gras, or cured meats, which harmonize well with dried fruit. Some options are dates, figs, persimmons, prunes, or raisins. We recommend mixing dried fruits into the dough as an inclusion (see page 1:331) instead of using them as a topping. The challenge is that dried fruits are very low in moisture and can easily burn, even when used as a dough inclusion. To resolve this, you can plump the dried fruits in very hot water (or flavorful liquid) for a few hours. This way, they'll be pleasant to eat and won't burn in the oven.

Many vegetable toppings can be applied before baking. Vegetables tend to be firmer than fruits, which is why we often suggest a precooking step for things like broccoli rabe, eggplant, or potatoes. Other vegetables are better applied to pizza when they're raw, and often just after the pizza comes out of the oven. Tender salad greens are an obvious example. Simply trim, rinse well in cold water, and pass through a salad spinner to remove excess water. Keep covered in refrigeration. Other examples of raw vegetable pizza toppings include thinly sliced carrots, celery, cucumbers, radishes, or fennel (although carrots or fennel could be applied before baking as well). We recommend holding these in ice water during service.

COMMON FRUIT AND VEGETABLE PROBLEMS

Problem	Solution
The pizza gets soggy or doesn't bake because the fruit or vegetable is too wet.	Avoid applying raw fresh fruits and vegetables with a high moisture content before baking because they can make the pizza soggy. Precooking the toppings can remove some of the moisture and help mitigate this problem.
The fruit or vegetable is too soft and ripe.	This is a matter of personal preference. Consider pureeing the fruit or vegetable and adding it to the dough or using it as a sauce. You can also do this with overcooked fruits and vegetables.
The fruit or vegetable slides off the slice.	Always slice or cut the topping down to bite-sized pieces (ideally before it's cooked).
The fruit is underripe.	If you cannot wait for fruit to ripen, your best option is to poach it until tender. This will soften it, but the fruit may still lack flavor. Consider poaching the unripe fruit with a dried version of the fruit, which can add sufficient flavor.



Too wet — Too soft — Too thick — Not ripe

FRUIT AND VEGETABLE PREPARATIONS

This table doesn't encompass every kind of fruit or vegetable (or all the cooking methods that you can use to prepare them), but it does offer our recommendations for some of the most common pizza toppings. We outline basic cooking methods following this table. Regardless of the cooking method, you'll need to cut your ingredient into bite-sized pieces. We recommend small or medium dice for most fruits and vegetables, but things like broccoli and cauliflower would make more sense cut into florets while baby artichokes could be cut into quarters or eighths, depending on the size. For nearly all of the items listed below, we recommend adding them to the pizza before baking; the exception is raw salad greens, which are applied to the pizza after baking. You can experiment with adding dried fruits and vegetables to your pizza before or after baking, but we recommend reconstituting them in a flavorful liquid before using.

Fruit / Vegetable	Use fresh?	Recommended cooking method (if not using fresh)
Apples, pears, or Fuyu persimmons*	yes; core, then slice thinly on a mandoline (slice thicker if cooking)	roast sauté sous vide grill
Baby artichoke hearts	no; a precooking step is necessary before using	roast grill steam poach
Berries (blueberries, blackberries, raspberries, strawberries) or currants	yes; although they might pop and make the top of the pizza a bit wetter than desirable	sauté
Broccoli florets	yes; toss in olive oil and season with salt and pepper	steam roast
Broccoli rabe	no (the stems are too tough)	roast sauté
Cauliflower florets	yes; toss in olive oil and season with salt and pepper	roast deep-fry sauté steam
Corn kernels	yes	roast char sauté
Eggplant	no	roast sauté sous vide
Figs	yes; trim the stems and cut into quarters, eighths, or coins	roast poach grill
Garlic	yes; slice thinly or mince, then toss in olive oil and season with salt	roast confit sauté
Gourds (pumpkin, butternut squash, delicata squash)	no	roast sauté sous vide
Greens (spinach, kale, arugula, escarole)	yes; use after baking	sauté
Mushrooms	yes; toss in olive oil and season with salt and pepper	roast sauté

Fruit / Vegetable	Use fresh?	Recommended cooking method (if not using fresh)
Olives	yes (technically they are brined and are never available raw)	roast
Onions	yes; slice thinly, then toss in olive oil and season with salt	roast char sauté confit
Peppers (all fresh varieties including hot)	yes; toss in olive oil and season with salt and pepper	roast char
Pineapple	yes; cut into bite-sized pieces	roast grill sauté
Potatoes	no	roast confit deep-fry
Quince	no	roast poach steam pressure-caramelize
Radicchio	yes; thinly slice or tear into bite-sized pieces after baking	sauté
Rhubarb	no	roast poach
Stone fruits	yes; pit, then slice thinly or cut into halves, quarters, or eighths	roast sauté poach
Summer squash (zucchini and yellow squash)	yes; cut into batons, slices, or bite-sized pieces	roast sauté
Sunchokes	no	roast
Tomatoes	yes; cut into halves, quarters, or eighths	roast concasse

**Hachiya persimmons are too mushy to use when ripe.*

Not all apple varieties work well for cooking. We recommend Granny Smith, Golden Delicious, Ginger Gold, Jonagold, Empire, Cameo, Gala, McIntosh, Braeburn, and Cortland.

We don't include citrus fruits because they can make a pizza soggy. We highly recommend using the flavorful zest, however. Zest citrus peel directly over the pizza after baking. Tossing fruits and vegetables in citrus juice can also add flavor. You can also grill or fry thinly sliced citrus fruits and put them on top of pizza after baking.

When we visited Italy, we noticed a trend of slicing garlic to order, especially when topping marinara pizzas, with the same narrow spatula that they use to lift the dough balls out of the proofing tubs. The spatula is not sharp, but it's a practical way to cut the garlic into thick slices. We also saw this in Tokyo, but we have found that there are other ways of cutting the garlic, including a garlic slicer (see page 13), which cuts very thin slices. We also recommend slicing the garlic ahead of time and letting it sit in olive oil during service. You get the benefit of flavored oil and you save time by adding both the oil and garlic in the same step.

Zucchini blossoms are fantastic on pizza; they should be put on the pizza before baking or halfway through baking if you don't want to them to wilt too much. They can also be stuffed with cheese, battered, and deep-fried to be added to pizza after baking.

To roast olives, drain them and toss them in olive oil along with any combination of herbs and spices that will complement your pizza's flavor profile. Roast them in a 260 °C / 500 °F oven for 10–15 minutes, or until aromatic and slightly dry. This technique both concentrates the flavor and removes some of the moisture that could leak out onto the pizza. Just be mindful that they'll be baked a second time, so don't dry them out so far that they burn when they are baked on the pizza.

Ingredients like canned artichokes or pineapple and jarred peppers are great topping options. They do not need additional prep, aside from draining, before using on pizza since they are typically cooked before canning.

For more on how to concasse tomatoes, see page 226.

Sous vide

Grilled

PRECOOKING TECHNIQUES

Here are some of our go-to techniques for cooking fruits and vegetables to prepare them as pizza toppings. While not a comprehensive list, these are the methods used most commonly for fruits and vegetables.

ROASTING

The main goal in roasting fruits and vegetables is to remove as much water as possible, thereby concentrating the flavor—and avoiding a soggy pizza. This slow-cooking method relies on hot air, so the food loses a large amount of water, especially from its surface. This surface-water loss, in combination with heat, sugars, and proteins, will produce browning via the Maillard reaction (see page 393). When roasting, consider the time it will take for the oven's heat to penetrate whatever you're cooking all the way to the core. If you want your food to cook faster, cut it into smaller pieces. Roasting in a convection oven will speed things up even more because there's constant, even heat blowing directly on the surface of the food. Once the fruit or vegetable is cooked, let it cool completely before you apply it to a pizza. Roasted fruits and vegetables can be refrigerated or frozen for later use.

For fruit, the best results are achieved with fruits that can retain their shape and texture while roasting rather than turning to mush. Although unripe fruits are firmer, we recommend using ripe fruits because their flavor will be sweeter and more pronounced. When preparing fruit for roasting, you may optionally also toss the fruit in 20% of its weight in sugar. This will sweeten the fruit lightly if needed and pull some moisture out of the fruit to help it roast faster. If you perform this step, toss the cut fruit pieces with the sugar, allow the fruit to sit in the bowl for 30–45 minutes, then place the fruit in a colander to drain excess moisture. Reserve this sweetened liquid for other purposes.

Vegetables tend to be tougher than fruits and can withstand higher roasting temperatures. We recommend coating vegetables in olive oil not only to conduct heat to the ingredient more quickly but also to help adhere any seasoning. If you want to achieve even more browning on your vegetables, you can roast them at a higher temperature. Just keep in mind that they'll be subjected to a hot oven when the pizza is baking, so you don't want them to be so browned that they'll burn when they are baked again.

HOW TO Roast Fruits

1. Preheat a deck or home oven to 135 °C / 275 °F or a convection oven to 120 °C / 250 °F with the fan on low speed.
2. Trim and cut the fruit as needed. You can add spices and herbs to the fruit before roasting.
3. Line a sheet pan with aluminum foil.
4. Place a wire rack on top of the foil-lined sheet pan.
5. Spray the wire rack with a light mist of cooking oil.
6. Place the fruit on the wire rack in a single layer, if possible. Do not overcrowd or it will steam rather than roast.
7. Place the pan in the oven; leave the vent open or the door slightly ajar so that water evaporating from the fruit can escape.
8. Roast the fruit until it is just tender, not mushy. It may take on some color (browning on the edges) from cooking.
9. Remove the pan from the oven and let the fruit cool on the wire rack.
10. The fruit can be used to top a pizza or stored in an airtight container in the refrigerator for up to 3 d or in the freezer for up to 3 mo. If refrigerated, warm slightly before using. If you freeze it, once it thaws, it will release water; thaw it in a colander or on a perforated surface so that the excess water drips off.

HOW TO Roast Vegetables

1 Preheat a deck or home oven to 205°C / 400°F or a convection oven to 190°C / 375°F with the fan on low speed.

2 Trim and cut the vegetable as needed. Toss with olive oil to coat completely, and season as desired.

3 Place the vegetable on a sheet pan (nonstick or lined with aluminum foil) cut-side down in a single layer, if possible. Do not overcrowd or it will steam rather than roast.

4 Roast the vegetable until it is cooked through.

5 Remove the pan from the oven and let the vegetable cool. If you roasted the vegetables whole, cut them into smaller pieces.

6 The vegetable can be used to top a pizza or stored in an airtight container in the refrigerator for up to 3 d or in the freezer for up to 3 mo. If refrigerated, warm slightly before using. If you freeze it, once it thaws, it will release water; thaw it in a colander or on a perforated surface so that the excess water drips off.

The roasting time will vary from oven to oven and depending on the kind of fruit or vegetable that you are cooking. Always check for doneness by touching the fruit or vegetable or sliding a wooden skewer or fork through the flesh (never a knife, which is sharp and will slide easily into many foods whether they're cooked or not). If the utensil slides in and out easily, the item is ready to come out of the oven. If not, let it continue to roast and check every 3 to 5 minutes. It's not possible to use the core temperature to gauge for doneness; a thermometer is too big to insert into most pieces of fruits or vegetables.

If you want, you can season vegetables with salt, pepper, spices, and/or herbs. We suggest seasoning vegetables prior to roasting them, after tossing them with olive oil.

New York pizza with New York tomato sauce, pizza cheese, roasted red peppers, roasted eggplant, green olives, pine nuts, and fresh basil

If you want, you can season your sautéed vegetables with salt, pepper, and/or other spices. For some vegetables, such as spinach, kale, or escarole, we suggest doing this once the vegetable is close to being cooked or completely cooked because it will lose so much volume once cooked. If you season it at the start, you might overseason since it looks like much more than what you end up with.

You can combine a sautéed vegetable with other ingredients, such as garlic or onions, to complement its flavor. Combine vegetables in the sauté pan only if you are sure they will cook at the same time. You can also add an herb to the mix, as well as other ingredients, such as cured meats like bacon or chorizo.

SAUTÉING

Sautéing is the technique of cooking food in a small amount of fat in a shallow pan. It sounds simple enough, but the method requires special care and attention. The goal is to cook the food quickly, but the speed hinges on how high the heat is and how long it takes that heat to penetrate to the food's core. As the surface of the food dries in contact with the pan, browning via the Maillard reaction will shortly follow.

Remember that the smaller the mass of the food you're cooking, the higher the heat you'll use to cook it. For instance, thinly sliced potatoes or onions will benefit from a blazing-hot pan to cook them quickly, while high heat may cause thicker pieces of food, such as cauliflower florets, to burn on the outside before they cook at the core. Fat (oil, butter, lard, or shortening) is typically used to conduct heat and to keep food from sticking to the pan.

Be sure to allow plenty of space in the pan. This will help the water in the food evaporate rather than accumulate, which would cause the food to steam and overcook before it browns. The pan should be large enough to easily accommodate all the sliced fruits or vegetables and make stirring easy; you can work in batches if you don't have a pan large enough or have a large amount of fruits and vegetables to cook. Unlike other vegetables, leafy greens such as spinach should be piled into the pan since they lose a lot of volume during cooking.

HOW TO Sauté Fruits and Vegetables

1 Trim and cut the fruit or vegetable as needed.

2 Heat the fat in a sauté pan over medium-high heat.

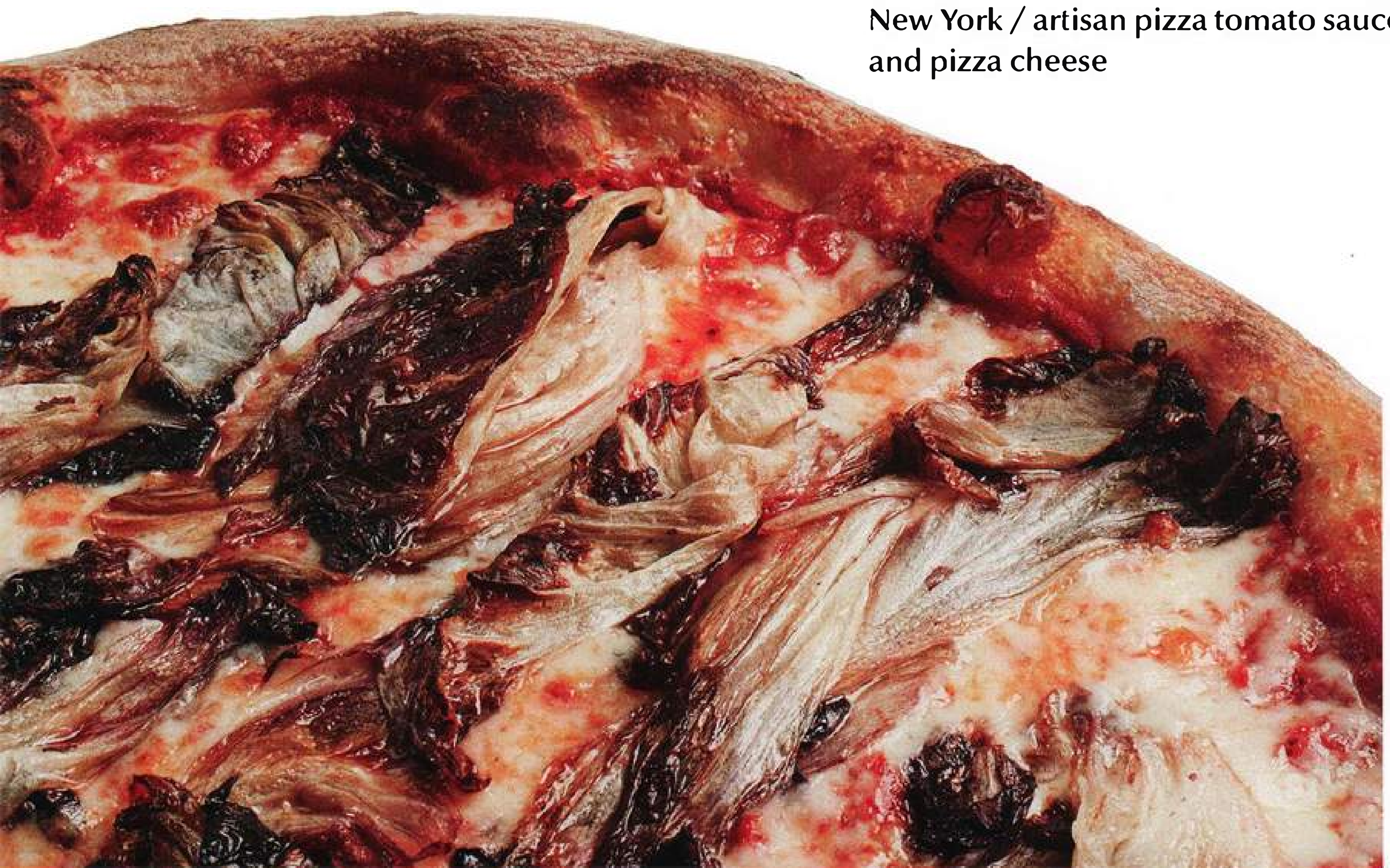
3 When the fat begins to bubble (or the oil is just about ready to smoke), add the fruit or vegetable and stir well to coat. Season if desired.

4 Lower the heat to medium if you are sautéing thicker pieces of food. Otherwise, maintain the medium-high heat.

5 Stir every 2–3 min with a wooden spoon or silicone spatula so that the ingredient cooks evenly. Do not leave the pan unattended. If the ingredient is starting to char in some spots but is not cooking evenly, add some water to the pan and continue to cook.

6 Once the item has turned a deep brown and is soft, remove the pan from the heat and allow it to cool.

7 When cool, the ingredient can be used to top a pizza or refrigerated in an airtight container for up to 5 d. If refrigerated, warm slightly or temper for a few hours before using.



Artisan pizza with sautéed radicchio, New York / artisan pizza tomato sauce, and pizza cheese

Lightly sautéing vegetables will sweat them and make them just tender. If you sauté certain vegetables, like onions, for a prolonged period, they will caramelize. If you want the ingredients to brown, do not stir them as often during cooking.

If you want to incorporate a fried topping onto your pizza but you don't have a deep fryer (see page 368) or you don't want to invest in using a lot of oil, you can use the shallow frying technique. This method uses the same basic steps of sautéing, but you need to increase the amount of oil in the pan. It should come one-third to halfway up the food that you are frying. Heat the oil to 175° C / 350° F (check the temperature of the oil if you are frying multiple batches to make sure that the oil temperature has recovered). Place the item in the pan and fry it until it is golden brown on one side. Flip it and brown the other side. Transfer the fried ingredient to a sheet pan lined with paper towels to drain the excess oil. It is just as important that you not overcrowd the pan so that the toppings don't steam and become limp and pale. You can coat your toppings with the Tempura Batter on page 3:281 if you'd like.

STEAMING

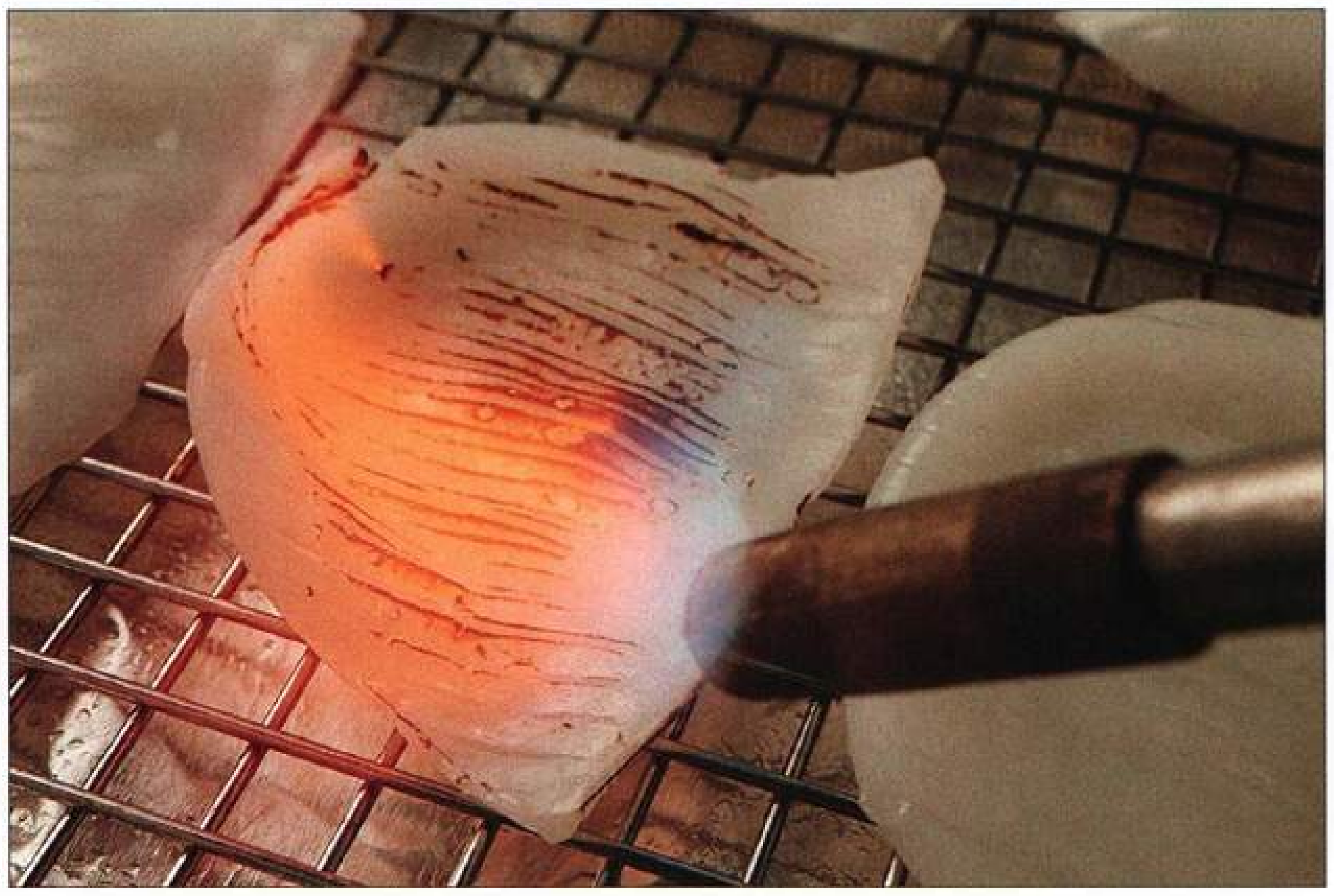
Steaming is among the fastest ways to cook food. The point is to create an enclosed 100°C / 212°F environment of constant heat in contact with the food. When water vapor condenses on the cool surface of a piece of food, it releases its stored energy and heats the food; this is called the latent heat of vaporization. Think of it as energy stored in the water vapor. Because the transition from liquid to vapor requires so much energy, steam contains far more energy than boiling water does, which is why it takes less time to cook food by steaming than by boiling. To check steamed vegetables for doneness, slide a toothpick or skewer into the thickest part of the food. It should slide in and out easily. For green vegetables, the color should still be vibrant.

HOW TO Steam Fruits and Vegetables

1. Trim and cut the fruit or vegetable as needed.
2. Prepare an ice bath (equal parts water and ice) with sufficient water and ice to fully submerge the item once it is cooked.
3. Fill a pot with 1.25 cm / ½ in of water and place a steaming basket over it. The pot and the basket should be large enough to fit all of the items and still allow the lid to be placed on top.
4. Cover the pot with a lid.
5. Bring the water to a boil over high heat.
6. Put the ingredient in the basket and immediately replace the lid.
7. Check for doneness after 5 min; if the ingredient isn't done, check at 2-min intervals.
8. Shock the steamed ingredient in the ice bath.
9. Drain the water. The ingredient can be used to top a pizza or refrigerated in an airtight container for up to 5 d. If refrigerated, warm slightly or temper for a few hours before using.

CHARRING TOPPINGS

To char a food, we lightly burn its surface (without necessarily cooking the food through), often using a flame from a torch, broiler, or salamander. You can also char foods over an open gas flame if you prefer. The goal is to blacken the surface, which lends a lightly grilled flavor. You can use this method to char peppers and remove the skins (after charring, place the peppers in a bowl and cover them with plastic, which softens the skin and makes them easier to peel) or onions or shucked corn to add another flavor dimension to your pizza. We recommend cutting large calamari into bite-sized pieces (after removing the skin), scoring them, and charring them with a torch or grill. It seems obvious to say, but don't ever try this technique over a flammable surface. We usually place a wire rack on a sheet pan, place the food on top, and then apply the heat.



Another cooking method that involves submerging food in water is poaching. You simply submerge the food in liquid that is just below a simmer, at 60–82°C / 140–180°F. Make sure that the poaching liquid is very flavorful. You can also simmer or boil fruits or vegetables; this takes less time but the cooking method is more aggressive and may not be suitable for more delicate fruits or vegetables.

COOKING SOUS VIDE

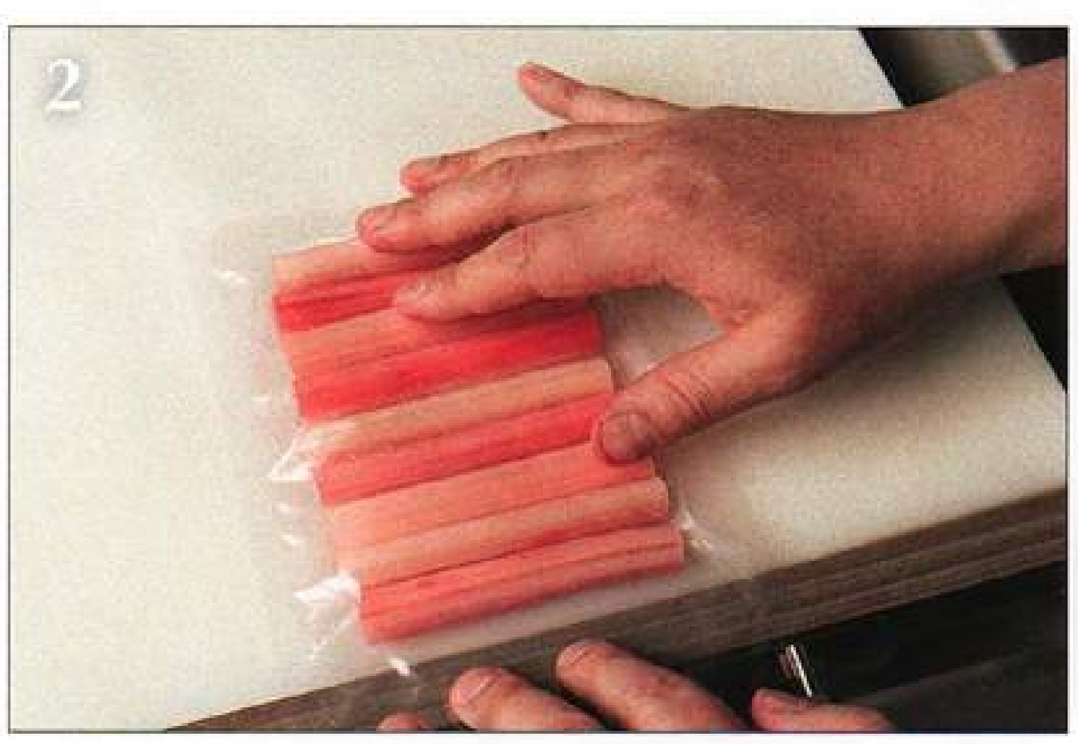
One of the benefits of cooking sous vide is that it greatly reduces anxiety about cooking times and temperatures. If you leave the food in for a little more time than the recipe suggests, the consequences aren't nearly as perceptible as they are when you cook on a stove top or in a hot oven. While it employs some special equipment and know-how, it takes a lot of the guesswork out of cooking and allows you to achieve consistent results, which is especially helpful in commercial settings like pizzerias. The four basic steps in cooking sous vide are preparing, packaging, cooking, and finishing. Most recipes call for cooking an ingredient (especially meats) to a specific core temperature, meaning that you remove the food from the bath as soon as the temperature of its thickest part hits the target. If you set the temperature of the water bath or oven to just a degree or two higher than the target temperature, you won't have to worry about overcooking. This approach works well for tender red meats, poultry, fish and other seafood, and certain fruits and vegetables. Tough meats, however, are cooked at lower temperatures and often take a significant amount of time to tenderize.

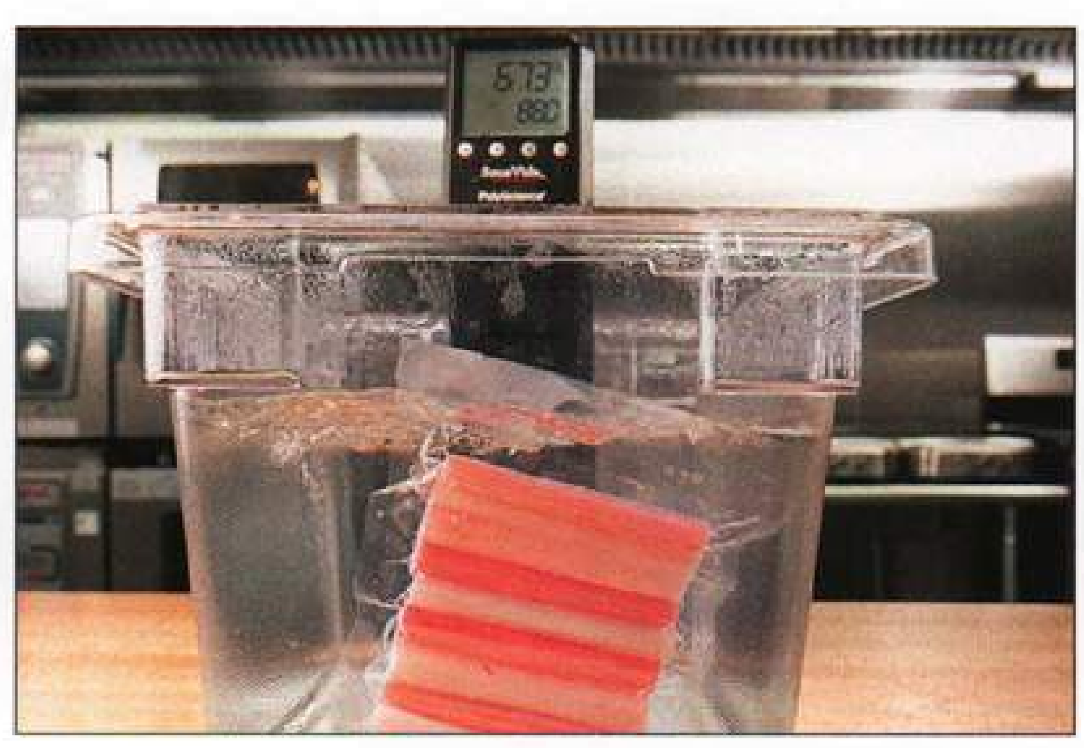
Prepare and organize the ingredient for cooking sous vide much as you would for any other technique. Make the pieces as similar in thickness and size as possible so that when cooked together, they are all done at the same time. You can add flavors by seasoning, marinating, brining, or curing before cooking. You can also change the color or texture of certain ingredients by searing or blanching them before cooking sous vide.

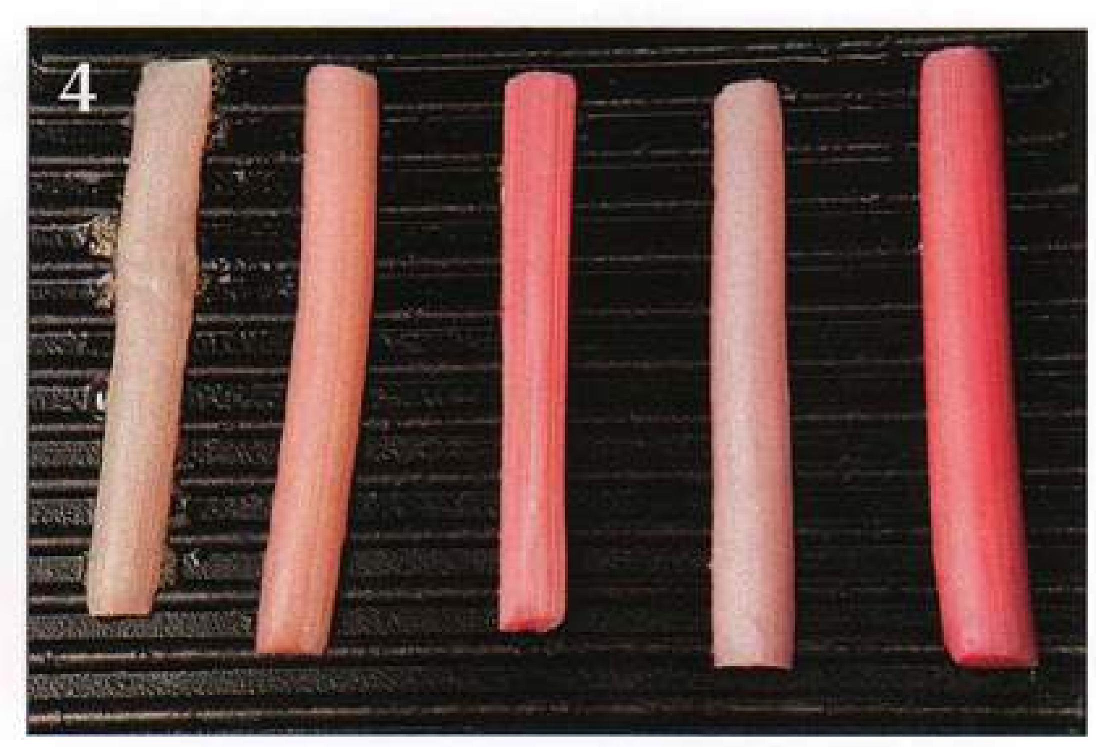
Food is usually packaged before cooking in a water bath (the most common method); if you just put the food directly in the water bath (e.g., poaching), some of the flavor and juices could wash away. Restaurants and caterers who cook sous vide vacuum-seal the food in special plastic bags. Vacuum-sealed bags are less likely to float, and they allow cooked food to keep longer in the refrigerator after cooking, which is handy.

Home vacuum sealers are now widely available and easy to use, but you don't need to vacuum-pack food to cook it sous vide. Zip-top bags work fine, except when cooking foods for a very long time.

HOW TO Sous Vide Fruits and Vegetables







1 Trim and cut the ingredient. The pieces should be roughly similar in size and thickness.

2 To vacuum seal, place portions of the ingredient in separate sous vide bags, optionally add water or oil, and seal. You can also use zip-top bags or canning jars.

3 Cook the food to the set temperature in a water bath or combi oven. If the bags are floating in a water bath, use binder clips or a water rack to hold them under water; the food should be fully submerged.

4 Sear the food in a pan, on a grill, in a deep fryer, or with a blowtorch, if desired.

5 When cool, the ingredient can be used to top a pizza or refrigerated in an airtight container for up to 5 d. If refrigerated, warm slightly before using.

Canning jars offer another convenient alternative in many situations. If you use a combi oven rather than a water bath to cook sous vide, you don't need any packaging at all—simply put the food in an open pan, and stick it in the oven.

Both water baths and combi ovens require preheating, which usually takes 15–30 minutes, before the food goes in. The bath or oven temperature that you select will depend on the type of food and the degree of doneness you prefer. We offer extensive tables and recipes in both *Modernist Cuisine* and *Modernist Cuisine at Home* that can serve as a starting point.

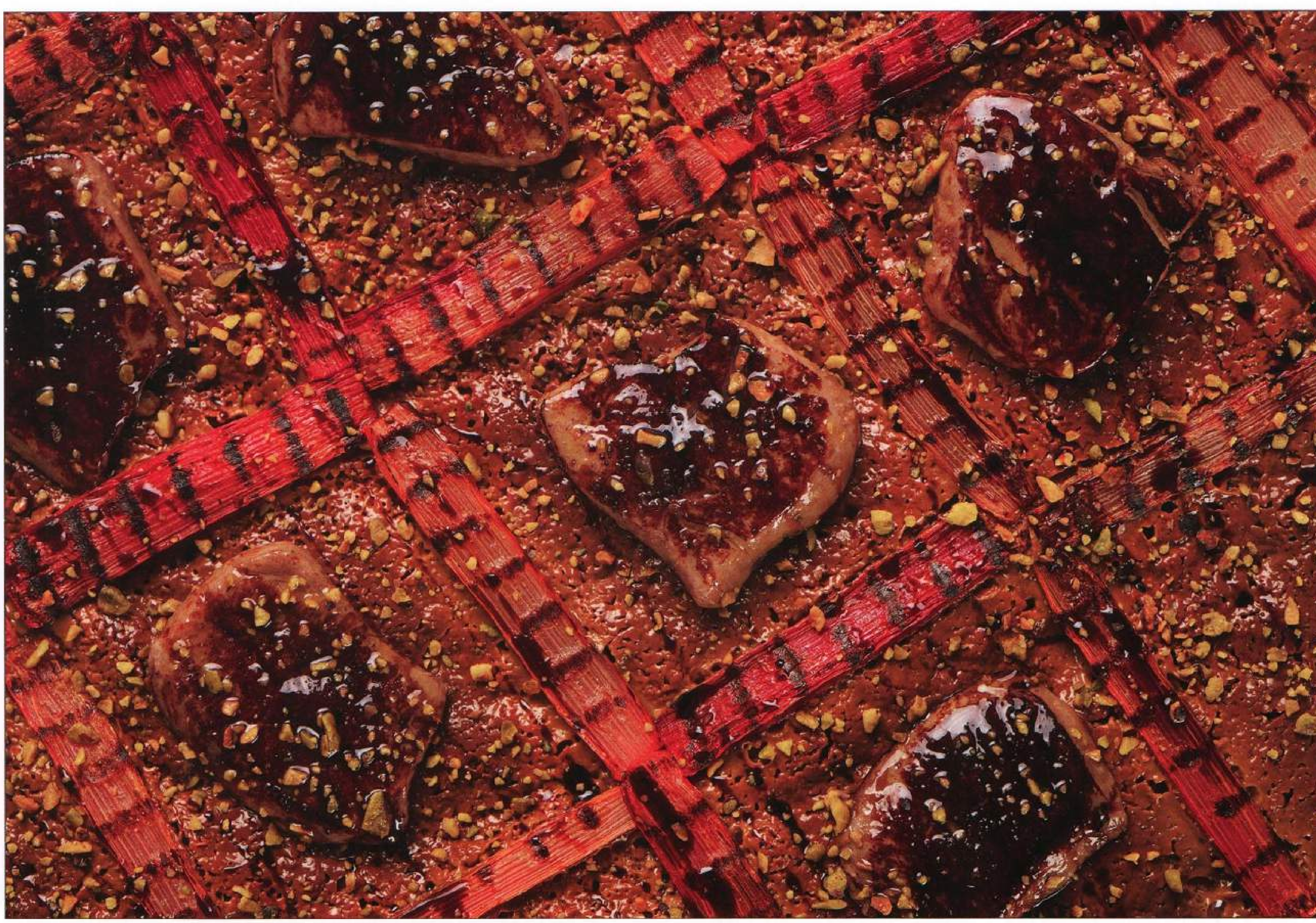
When cooking to a target core temperature given in a recipe or table, set the water bath 1–2° C / 2–3° F hotter than the target temperature. (Although setting the bath much hotter does accelerate cooking, it makes timing trickier, so we don't recommend it.) Use a probe thermometer to keep tabs on the internal temperature until you gain confidence in knowing how long particular foods of a given thickness take to cook this way.

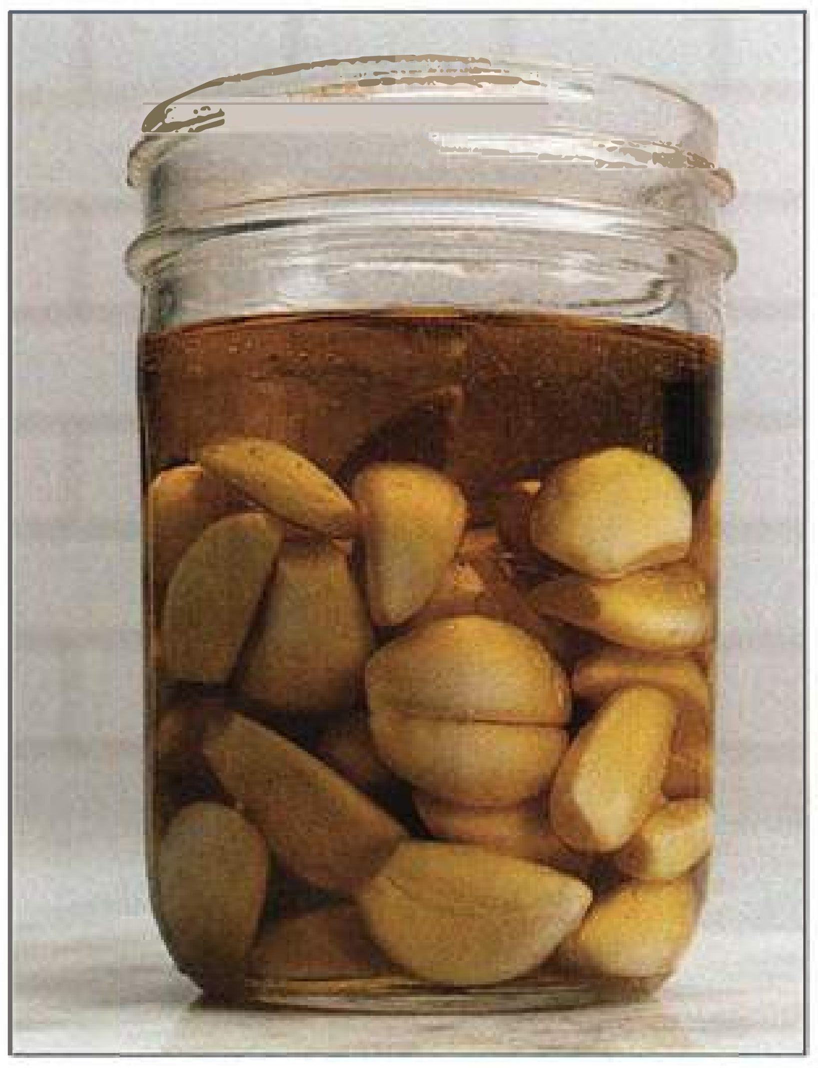
The cooking time required varies as a function of both the kind of food and the thickness. As a rough rule, doubling the thickness of the food quadruples the cooking time. Note, however, that you don't need to adjust holding times (the time you can hold it in the water bath after the core temperature is reached); once the core has hit the target temperature, the holding time doesn't vary with the thickness of the food. You can experiment with longer or shorter holding times, however, to achieve different textures. Each kind of food responds differently as cooking continues.

Food cooked sous vide takes on a texture and appearance similar to that of food that has been poached or steamed (see page 363). If that's acceptable, simply open the bag, and prep the ingredient for topping your pizza. Some foods, however, look and taste much better if you give them a seared crust. Searing not only browns the food but also generates flavorful compounds that form only at high temperatures. Because the interior of the food is cooked to perfection, you want to use very high heat to quickly sear only the exterior of the food. Pan-searing is perhaps the easiest method, but you can instead use a blowtorch, grill, or deep fryer (see page 368).

Cooking certain toppings sous vide, especially delicate items or tough meats, before using them on a pizza will ensure that they have the proper texture when you are eating the finished pizza.

We cooked rhubarb sous vide to top a pizza with foie gras and pistachios.





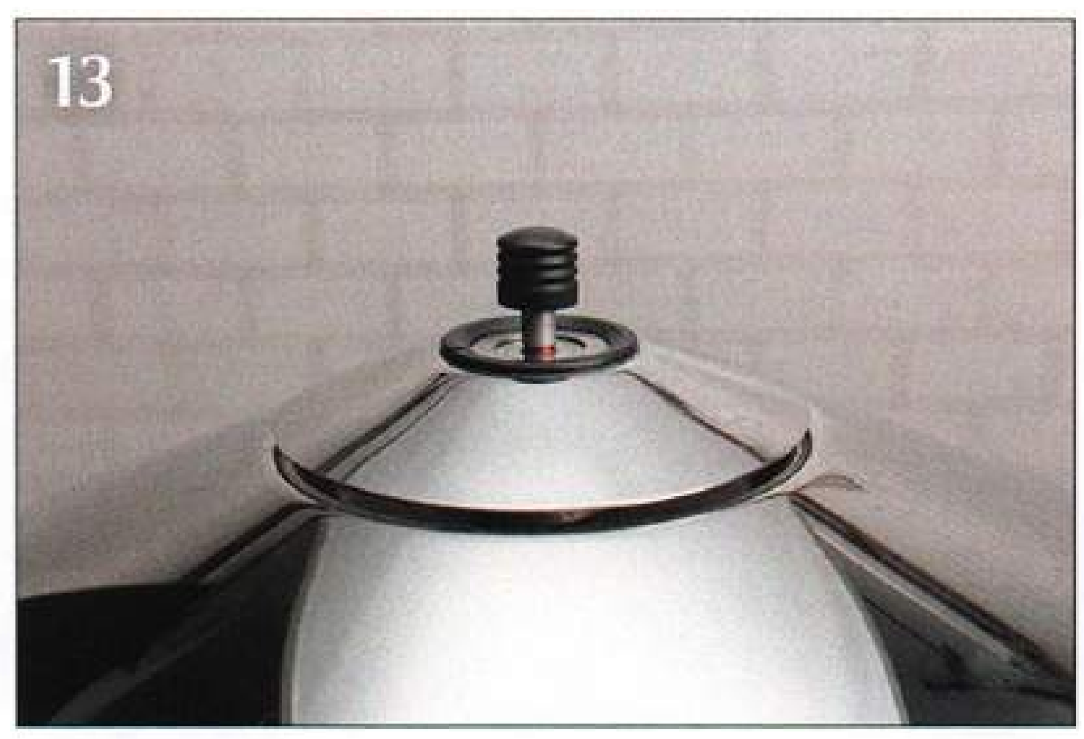
COOKING FOOD SUBMERGED IN OIL (CONFIT)

Although cooking confit is similar to frying (see page 368), there are key differences—namely, whatever you confit is cooked in fat at much lower temperatures and for much longer. A few methods for confit toppings are detailed below: pressure cooker, low-temperature oven, and stove top. The first method is best suited for home cooks while the other two can be used by professionals and home cooks alike.

We don't recommend cooking most fruits in oil, although we've had success cooking quince, cherries, dates, and Granny Smith apples in clarified butter. Mangoes, guavas, and pineapples can work when cooked in coconut oil (as can coconuts).

All three methods below can also be applied to meats. For larger pieces of meat that won't fit in a jar in the pressure cooker method, skip steps 1–5. You'll have to add enough fat to the pot to completely cover the meat being confited. Depending on the size of your pressure cooker, you may need to add more than what renders from the meat itself. For step 11, the ingredients and fat can be transferred to an airtight container and kept in refrigeration for up to 3 months. Make sure the confited ingredient is completely submerged in the fat.

HOW TO Confit in a Pressure Cooker



1 Trim and cut the ingredient. The pieces should be roughly similar in size and thickness.

2 Fill a mason jar two-thirds of the way with the ingredient to be confited.

3 Fill the rest of the jar with the chosen fat.

4 Close the jar's lid but not too tightly (not too loosely, either).

5 Fill the pressure cooker with about 2.5 cm / 1 in of water.

6 Place a trivet in the pressure cooker.

7 Place the jar on the trivet.

8 Bring the water to a simmer over high heat without the lid on the pressure cooker.

9 Once the water reaches a simmer, close the lid securely on the pressure cooker.

10 Turn the heat to medium.

11 Bring the pressure to 1 bar / 15 psi (about 117° C / 243° F) inside the cooker.

12 Cook for 1½ h, adjusting the heat as needed to maintain steady pressure inside the pot.

13 Allow the pressure cooker to cool completely at room temperature before opening the lid.

14 Remove the jars and let them cool to room temperature.

15 Drain the fat from the jar before placing the confit ingredient on top of the pizza, or close the jar and refrigerate for up to 3 mo. If refrigerated, warm the jar under hot water and drain the fat before using the topping.

To use an instapot, follow steps 1–7 of the method above. Set the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 1 h. Lock the lid onto the pot and confit the ingredients. When the instapot has depressurized, cool the contents. Proceed with step 14 in the pressure cooker instructions above.

The term "confit" is used to describe cooking something in oil, but it is a misnomer in most cases since the true meaning is cooking and preserving something in its own fat.

It's important to realize that overpressurizing the cooker doesn't make the temperature inside any higher—it merely causes the safety valve to release steam, which allows the water inside to resume boiling. Repeated overpressurization can ruin both the flanges and the seal around the lid.

HOW TO Confit in a Low-Temperature Oven

1. Trim and cut the ingredient. The pieces should be roughly similar in size and thickness.
2. Preheat the oven to 120° C / 250° F (if convection, turn off the fan or set it at the lowest speed possible).
3. Fill a hotel pan or deep baking pan two-thirds of the way with the ingredient.
4. Pour the chosen fat over the ingredient so that it is completely submerged. Cover with foil.
5. Place the pan in the warm oven and allow the ingredient to cook until tender, 3–4 h (check every hour).
6. Cool the pan completely at room temperature.
7. Drain the fat from the pan before placing the confit ingredient on top of the pizza, or transfer the ingredient along with the fat to an airtight container and refrigerate for up to 3 mo. If refrigerated, warm the container under hot water and drain the fat before using the topping.

HOW TO Confit on the Stove

1. Trim and cut the ingredient. The pieces should be roughly similar in size and thickness.
2. Fill a saucepot two-thirds of the way with the ingredient.
3. Pour the chosen fat over the ingredient so that it is completely submerged. Cover with a lid.
4. Place the pan over the lowest possible heat and allow the ingredient to cook until tender, 2–3 h (check every hour).
5. Cool the pan completely at room temperature.
6. Drain the fat from the pan before placing the confit ingredient on top of the pizza, or transfer the ingredient along with the fat to an airtight container and refrigerate for up to 3 mo. If refrigerated, warm the container under hot water and drain the fat before using the topping.

Artisan pizza with heavy cream, ricotta, Swiss cheese, cheddar cheese, braised trotters, sweated onion, potato confit, and garlic confit

Topping the pizza with crispy deep-fried items towards the end of baking or after baking will add another level of texture to the finished pizza.

However you choose to cut the vegetables, it is very important that you try to keep them about the same size so that they will cook and fry in the same amount of time.

DEEP-FRYING

When food comes in contact with hot oil, the oil affects only the surface of the food. Below the surface, the food behaves no differently than if the heat was coming from hot air or water. The heat from frying, however, is much higher than from water or steam, and much more efficient at conducting heat than air. The hot fat used for frying becomes an ingredient, as some of it permeates the surface of the food; it therefore can contribute some flavor, but it will only minimally be absorbed by the surface. Cooking food in oil has the same effect whether you're submerging it completely in very hot fat, shallow frying it, or cooking it at a lower temperature, as with confit (see page 366); the only difference is how long it takes the food to cook.

Fat can only get so hot before it begins to burn. This is called the smoke point, a self-explanatory term for the temperature at which the oil begins to smoke. That temperature varies from fat to fat. Most fats reach their smoke point long before they combust, so it may be tempting to inch the oil temperature up as high as possible. This isn't recommended. In general, 175–190° C / 350–375° F is a good range for frying most foods; you typically don't want to fry at a temperature higher than 190–200° C / 375–390° F because the outside could burn before the interior of the food is cooked. Vegetables that fry well with the direct method (without a batter or starch coating) are brussels sprouts, potatoes, shallots, eggplant, zucchini, and leeks.

Alternatively, you can dip the vegetable in a batter or coat it in a starch to make it extra crispy on the outside. If you are simply going to coat the vegetable in starch, it needs to be slightly moistened on the surface for the starch to attach itself to it. Some starches are better than others for producing a crispy surface. Some vegetables that work well for batter frying are potatoes, sweet potatoes, squashes and gourds, cauliflower or broccoli, onions, pickles, green tomatoes, and green beans. And, of course, battered fried chicken is delicious on pizza.

Because of the way pizza is baked, it's not very common for a topping to be crispy unless it's been added after baking. Anything battered and fried (or shallow fried, like crispy bacon) becomes soft and soggy if baked with the other toppings (including cheese and sauce). But when added after baking, it will stay crisp for much longer. The only downside is it has nothing binding it to the slice and thus might roll off easily. Fried toppings need to be strategically placed on the pizza so they can be held inside a folded slice. We include two types of crispy toppings, rösti potatoes and frico (cheese crisps), that can cover the pizza in its entirety, which means that there will be a crispy texture in every bite.

HOW TO Deep-Fry Directly

1 Preheat the fryer to 175° C / 350° F.

2 Trim and cut the ingredient. The pieces should be roughly similar in size and thickness.

3 Place the ingredient in a frying basket and cook until browned and cooked through (the time will depend on the ingredient and the size of the batch).

4 Transfer the fried ingredient to a sheet pan lined with paper towels to drain the excess oil.

5 Place the topping on the baked pizza and serve immediately.

The pizza on the next page features deep-fried baby artichokes as a crunchy textural component to the finished pizza.

RÖSTI POTATOES

INGREDIENT	WEIGHT	VOLUME	SCALING %
Russet potatoes, peeled	800 g	3-4 ea	100
Butter, melted	150 g	⅔ cup	18.75
Fine salt	7 g	1¼ tsp	0.88

TOTAL TIME	YIELD
Active 25 min / Inactive 40-45 min	one 20 cm / 8 in discs

PROCEDURE

1 Preheat a convection oven to 190° C / 375° F or a home oven to 205° C / 400° F.

2 Using the smallest shredding attachment on a mandolin (1.5 mm / 0.06 in), slice the potatoes into long thin strips. Store the potatoes in water while working to prevent oxidation. This should yield about 650 g (6½ cups) shredded potatoes.

3 Transfer the shredded potatoes to a container filled with ice water and agitate to rinse off the starch; alternatively, rinse under running water.

4 Spread the potatoes out on a sheet pan lined with kitchen towels or paper towels, and pat dry.

5 Transfer the potatoes to a bowl.

6 Pour the butter over the potatoes and add the salt. Mix well to coat.

7 Heat a 25 cm / 10 in oven-safe nonstick skillet over medium high heat.

8 When the pan is hot, add the potatoes, tamping down with a rubber spatula or wooden spoon to form a disk that is roughly the same size as the skillet.

9 Cook over medium-high heat until the potatoes have begun to stick together and color slightly on the bottom, about 5 min.

10 Transfer the pan to the oven and cook until the top is slightly golden brown, about 10 min in a convection oven or 15 min in a home oven.

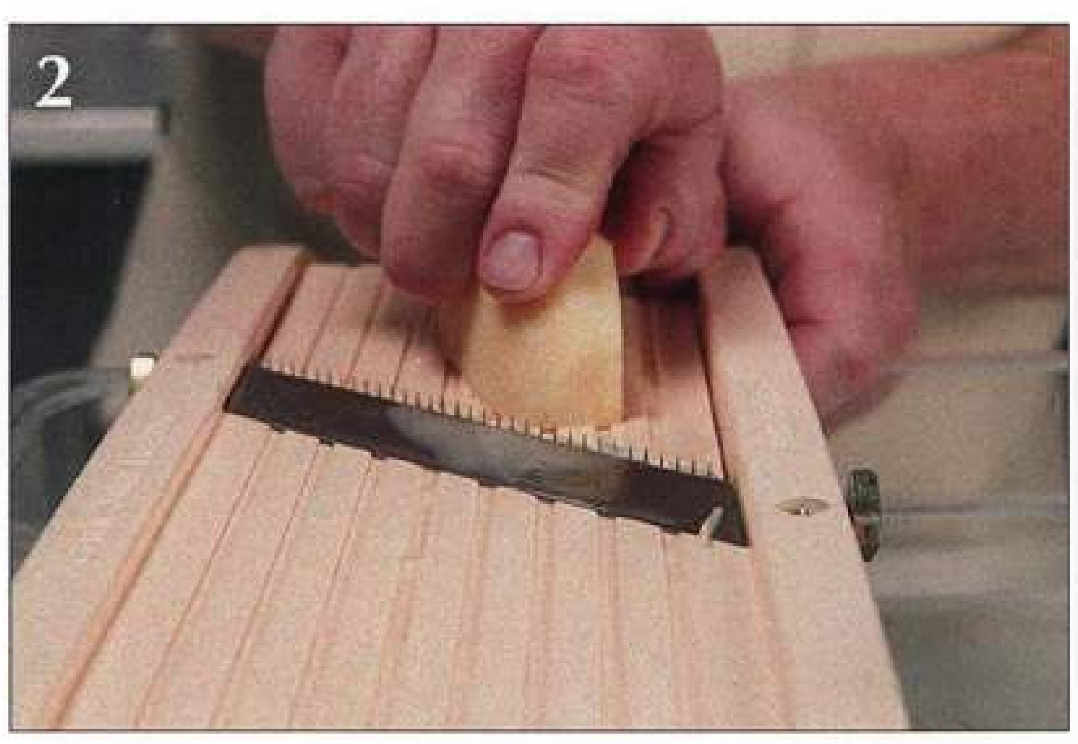
11 Quickly and carefully invert the rösti onto a rimless plate, and then slide back into the hot pan.

12 Bake until golden brown and cooked through, about 15 min in a convection oven or 20 min in a home oven.

13 Transfer the rösti to a sheet pan lined with a wire rack to cool.

14 Re-crisp and reheat the rösti for 5-7 minutes at 190° C / 375° F in a convection oven or 205° C / 400° F in a home oven.

15 Cut the rösti into the same number of slices as you will be cutting the pizza and place one wedge on top of each slice of pizza.



It is crucial to the success of this preparation that the potatoes be cut into a uniform thickness so that they cook at the same time; their length matters less.

We would use this size rösti on a 30 cm / 12 in pizza since we do not want it to cover the crust. Making a larger rösti for a larger pizza is possible; you will need a larger pan, of course, and turning it over gets a little more complicated due to the size, so be careful.

If you really want to go the extra mile, cut the rösti into the same number of slices you plan on cutting the pizza into. Deep-fry them in a fryer or pot filled with 175° C / 350° F oil for 2-3 min. Blot the excess oil on paper towels, and then place one on each slice of the just-baked pizza.

Rösti is typically topped with sour cream or crème fraîche and chives; we highly recommend this addition if it fits in with the flavor profile of your pizza.

You can julienne the potatoes in three different ways. Use a mandoline to slice the potatoes very thinly, 1.5 mm / 0.06 in thick. Stack 8-10 slices into a pile, and cut into 1.5 mm / 0.06 in wide pieces. Alternatively, use a mandoline that has a julienne blade attachment or use a turning vegetable slicer with the julienne blade attachment.

FRICO (CHEESE CRISPS)

INGREDIENT	WEIGHT	VOLUME	SCALING %
Hard cheese (Parmigiano-Reggiano, Grana Padano, Asiago, aged gouda), finely grated	200 g	2 cups	100

TOTAL TIME	YIELD
Active 8-10 min / Inactive 10 min	twenty-five 7.5 cm / 3 in squares

PROCEDURE

1 Preheat an oven to 205° C / 400° F.

2 Line a sheet pan with a silicon baking mat.

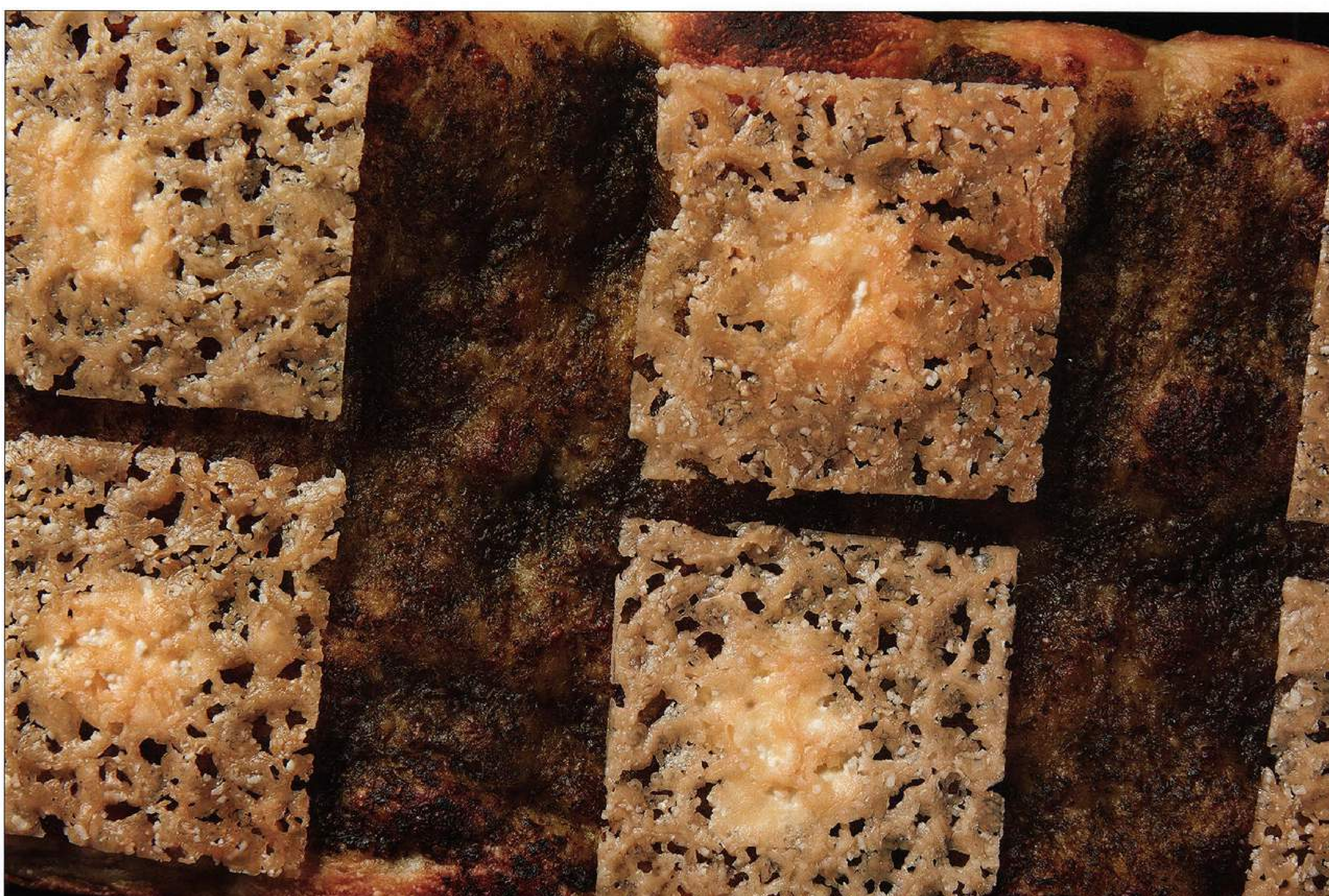
3 Spread the cheese in a single layer.

4 Bake until golden brown, about 10 min.

5 Once ready, cut into square pieces using a pizza cutter, or break into square size pieces by hand.

6 Store in an airtight container lined with clean paper towels for up to 2 wk.

We were inspired by how delicious this topping is on pizza and decided to try wrapping slices of baked pizza in frico. The method allowed us to give new life to leftovers (see page 3:283).



PRESSURE-CARAMELIZING

When we were writing *Modernist Cuisine*, we developed a method for caramelizing food under pressure using baking soda to accelerate the process. This produces particularly flavorful results, intensifying the caramelization of sugars (in both the food and the additional sugar itself) and concentrating the flavors through the alkalinity of the baking soda combined with the heat buildup at 120° C / 250° F in the pressure cooker.

INGREDIENT	WEIGHT	VOLUME	SCALING %
Main ingredient(s)	200 g	varies	100
Butter, melted	60 g	¼ cup	30
Sugar	40 g	¼ cup	20
Baking soda	1 g	⅛ tsp	0.5

To use an instapot, set the instapot to Sauté. Melt the butter in the cooker. Add the main ingredient(s), sugar, and baking soda. Stir well to combine. Switch the instapot to Pressure Cook mode. Select 12 psi (High) and set the time for 1 h. Lock the lid onto the pot and pressure-caramelize the ingredients. When the instapot has depressurized, cool the contents before using on a pizza.

PROCEDURE

1 Combine all the ingredients well in a bowl.

2 Spoon the ingredients into canning jars; close the lids but not too tightly (not too loosely, either).

3 Place a trivet in the pressure cooker.

4 Place the jars on the trivet.

5 Fill the pressure cooker with enough water to reach halfway up the jars.

6 Bring the water to a simmer over high heat without the lid on the pressure cooker.

7 Once the water reaches a simmer, close the lid securely on the pressure cooker.

8 Bring the pressure to 1 bar / 15 psi (about 117° C / 243° F) inside the cooker.

9 Cook for 1 h, adjusting the heat as needed to maintain steady pressure inside the pot.

10 Allow the pressure cooker to cool completely at room temperature before opening the lid.

11 Remove the jars and let them cool to room temperature.

12 Once cool, the caramelized ingredient is ready to top a pizza. Store for up to 3 mo under refrigeration.

It's important to realize that overpressurizing the cooker doesn't make the temperature inside any higher—it merely causes the safety valve to release steam, which allows the water inside to resume boiling. Repeated overpressurization can ruin both the flanges and the seal around the lid.

Thin-crust pizza with curry cream sauce, paneer, pizza cheese, fried chickpeas, fried curry leaves, and pressure-caramelized carrots

MEATS

Pizzas are commonly topped with fresh or cured meats, with pepperoni and sausage being two of the most popular examples from these categories. Cured meats make great toppings for pizza and are more commonly used than raw meat since they are more shelf stable and practical for most pizzerias. These types of meat tend to be highly seasoned and bring special flavors to the pizza. Cured meats are often very hard, so they need to be sliced super thin or they are difficult to eat and could pull off the slice.

Some cured meats are best placed on the pizza before baking, while others should go on after baking (see our recommendations in the table on page 377). Higher-fat cured meats like pepperoni benefit from baking since some of their fat will render out and crisp them up. Other cured meats fare poorly if cooked—like prosciutto, which will render into a salty flavorless crisp—and are thus best applied after baking.

Some pizza makers put raw fresh pork sausage on pizza before baking it, but we prefer to precook it for several reasons. The first is that this gives you the opportunity to brown the sausage, which adds flavor. Another important reason is that this will ensure that the sausage is cooked through, especially for pizzas like deep-dish, which have a plethora of toppings and take a long time to bake through. Alternatively, you can put raw fresh sausage on thin-crust or medium-crust pizzas before baking if it's in very small pieces, which will cook completely in the oven.

There's also a large set of pork and beef sausages called emulsified sausages that includes things like mortadella, bratwurst, and hot dogs, among others. In general, these can be a challenge to use on pizza. Mortadella is commonly used on pizza but it's added after baking because it burns easily and baking doesn't improve its flavor. Hot dogs can be put on pizza but you have to make sure they are precooked before slicing and adding them to your pizza. Most other types of emulsified sausages aren't going to do very well in the heat of the oven without burning, but it's possible to use them if you find them in a raw form and parcook them.

When you make sausages, especially in the case of emulsified sausages like hot dogs, you need to use really finely ground spices. In fact, you can

Not all meats will stick together when sliced. Ham, for example, may not stick to other slices of ham when placed on parchment paper, but prosciutto certainly will. Unsticking slices of meat during a busy service (or even in your own home) is not a problem you want to contend with. Some meats, like pepperoni, don't require much care since they won't stick to each other; you can just slice them into a pile in a tub or other container (although most pizza makers buy presliced pepperoni).

A meat slicer is the ideal tool for slicing cured meats, followed by buying meat already sliced from a deli or even the grocery store. One of the main concerns with slicing most whole cured meats (as opposed to meats that are made of ground components, like salami) is to make sure to slice against the grain. This makes these meats easy to bite into and will help prevent topping drag (see page 345). Slicing by hand is not recommended unless you have excellent cutting skills and a very sharp knife.

order “sausage spices” from companies that come preground to the correct fineness. If your homemade pork sausage becomes too cohesive and tough when you cook it, that’s almost always because you’ve salted it too much or too far ahead of time and let it sit. If you don’t bind the sausage properly and put it in a casing, when you cut the sausage, little grains of meat will pour out. This is typically caused by the grinder getting too hot. It cooks the exterior of the tiny pieces of meat just enough so that they won’t bind (it’s almost as if it cauterizes the granules of meat). This is why you should start with really cold meat and equipment.

There are certainly other animal products you can use as toppings, including beef, poultry, fish, and shellfish. While fresh sausage is popular, you don’t typically see a lot of cuts of fresh meat used on pizza, such as steak or chicken. These forms of meat can be expensive and putting them on pizza might diminish their quality because they typically won’t cook properly. These types of meat also need to be very thinly sliced so that they easily eaten on the pizza; these thin slices have a chance of overcooking while the pizza bakes, however. One solution is to properly cook fresh meat, slice it, store it in refrigeration until you are ready to use it, and then put it on the pizza toward the end of baking so that it just warms up.

Another important factor is when you put the meat on the pizza so it has sufficient time to fully cook (without overcooking). Seafood is problematic because the pizza oven is vastly hotter than most seafood likes to be. Octopus, which has been precooked for a long time can be applied to the pizza before baking. Shellfish like oysters or clams can be put on before or during baking (just be sure that they don’t become rubbery). For smoked fish or shellfish, you’ll want to put it on after baking to preserve the flavor and texture. Chicken breast, thighs, and legs can be roasted, sautéed, or poached and put on before baking, but make sure to surround or cover them with cheese and sauce to prevent overcooking. We focus on cured meats and fresh sausage in this chapter but encourage you to experiment with a wide variety of meats as toppings for your pizza.

Some of the most popular meats to use on pizza, like pepperoni and sausage, are both highly seasoned and cheaper than whole cuts of meat. Because these meats are highly seasoned, you don’t have to use very much but note that using meat sparingly is also in keeping with pizza’s history as a cheap food for the poor (see page 1:16).

Italian prosciutto, like most European hams, is a raw product cured with salt for months. That ham is also sold in the US as cured ham (Smithfield is an example). In the US, ham without a modifier will refer to cooked ham, which is usually precooked, cured pork leg that has a much higher moisture content than a cured ham.

We couldn’t find “Italian” sausage as we know it when we visited Italy. We found some pizzerias using fresh pork sausage but it didn’t have the same flavor profile that you find in the United States. It’s worth noting that both sweet Italian and hot Italian sausages have sugar; the hot Italian just has additional spices.

In Chicago, arguably the place where sausage is the most popular meat topping for pizza, we saw almost all of the pizza makers putting their sausage on loose and raw (usually by pinching off small pieces and scattering them across the pizza). One exception was at Gino’s East, which uses a sausage puck that is the same diameter as the deep-dish pizza as one of their filling layers.

When we visited the San Telmo market in Buenos Aires, Argentina, we found a multitude of cured sausages that could be used on pizza. Like in Italy (see page 378), we saw that these were used in limited amounts on pizza.

PREPARING CURED MEATS

If you don't find a specific type of cured meat here, find the one that looks closest to it from the list below. All cured meats should be refrigerated until they're needed. Sliced cured meats can burn if exposed while baking; to avoid this, coat the meat with a melting cheese like mozzarella, or place it on the dough after it has baked halfway.

TYPE OF MEAT	HOW TO PREPARE
Apply before baking	
Bacon, slab	slice thick (6 mm / ¼ in) and cut into batons to make lardons; render fat out
Guanciale	slice thick (6 mm / ¼ in) and cut into batons; render fat out
Pancetta	slice thin cut into lardons to add before baking, render fat out halfway to add after baking, render fat out completely and crisp in an oven or sauté pan
Blood sausage	remove from casing, pinch pieces onto pizza
Mexican chorizo	cook before topping pizza
Italian sausage (spicy or mild)	cook before topping pizza unless using very small pieces
Pepperoni	slice thin slice thin and julienne
Salami	slice thin or thick, depending on desired outcome slice thin slice thin and julienne
Hot dogs	leave whole (if Vienna sausage size) slice into 1 cm / ⅜ in pieces slice into discs
Spam	slice thin slice thick (6 mm / ¼ in) and cut into batons to make lardons; render fat out cut into 6 mm / ¼ in dice
Non-aged ham (also called cooked ham)*	slice thin slice thin and julienne slice thin and shred by hand
Apply after baking	
Prosciutto, Serrano ham, Ibérico ham	slice thin and tear by hand slice thin and julienne
Mortadella	slice thin slice thin and shred by hand
Coppa, duck breast prosciutto, speck, bresaola, lardo	slice thin
Pastrami	slice thin slice thin and julienne slice thin and shred by hand
Apply before or after baking	
Bacon, sliced	leave whole or cut into small squares, lardons, or julienne to add before baking, render fat out halfway to add after baking, render fat out completely and crisp in an oven or sauté pan
Tasso ham, Spanish cured chorizo	slice thin slice thin and shred by hand slice thin and julienne

**If using very high-quality ham, add after baking*

When you slice hot dogs into discs and bake them, their casing makes them cup like pepperoni (see page 379).

THE PEPPERONI THAT SET THE STANDARD

Pepperoni is an American innovation and is unlike any other sausage in Italy. It's classified as semicured and fermented for a short while to add flavor. Some pepperoni is smoked. It's soft, which is part of the reason it works so well on pizza. Have you ever made your own pepperoni? Yeah, probably not. And if you did, you might have been disappointed because it probably didn't taste like what you were expecting. The standard flavor of pepperoni was established not in Italian salumerias but by large American food-processing companies, notably Hormel Foods, which started making the ubiquitous red pizza sausage more than 100 years ago (see page 1:52). By 1920, Armour & Company was also cranking it out using a large-scale automated production process.

Old-fashioned Hormel pepperoni, in particular, is such a standard-bearer that other pepperoni can look strange by comparison. When the website Serious Eats did a taste test, they praised a Hormel offering (which gets its red color from cherry powder) for its "classic pepperoni flavor" and declared it the "clear winner" compared to other brands in the pizza topping category.

Today, an estimated 36 percent of pizzas sold in the United States have pepperoni on top. It's the number one topping choice in every state except Hawaii, according to analysis of delivery orders through the app Slice. Most pizza advertisements show a pepperoni pie. Even back in the 1940s, grocers were advertising their frozen pepperoni pizzas.

Hormel Foods dominates the pepperoni market and owns some of the smaller brands, too. That's not to say there isn't other good pepperoni. We've tried and enjoyed several brands, and even prefer some of them to the classic. But in our minds, we have to fight the urge to compare them to the mass-produced stuff.

A Hormel Foods delivery truck from 1927

Pepperoni being made at Hormel Foods in the 1930s

When we traveled to Italy, we found an almost universal staunch opposition to using pepperoni on pizza. We don't know why since this partially cured spicy sausage renders so well, the red oil that it produces is so delicious, and it acquires additional flavors when it browns in the oven. We were also somewhat surprised by this attitude since there are spicy cured Italian sausages that have the potential to work well on pizza. Despite the resistance to using pepperoni in Italy, we can tell you that it works beautifully on Neapolitan pizzas, even when it is baked at very high temperatures.

A Hormel Foodservice ad, from 1988, praising how its product doesn't cup in the heat of the oven

Popular Hormel Foodservice pepperoni product

Although cupping pepperoni is trendy now, it's actually old school. All pepperoni used to have collagen casings. Manufacturers eventually switched to paper-based casings, and it became such a distant memory that many pizza aficionados think cupping pepperoni is a new trend.

EXPERIMENT

WHY DOES PEPPERONI CURL?

Cupping pepperoni is all the rage these days. Pizzerias and social media accounts sing the praises of these grease-filled "roni" cups. But why do some pepperoni slices curl while others don't? We suspected it was the casing, so we came up with an experiment. We used a pepperoni brand specifically marketed as "cupping" pepperoni with a collagen-based casing. We tried heating the pepperoni slices both with and without this casing and then compared the results to non-cupping pepperoni.

Our hunch about the curling being related to the casing was correct. When we used a ring cutter to cut away the casing from the cupping pepperoni, the pepperoni still cupped, but much less so. And when we heated just the casing ring, it contracted very quickly. Standard non-cupping pepperoni didn't cup at all, as expected.

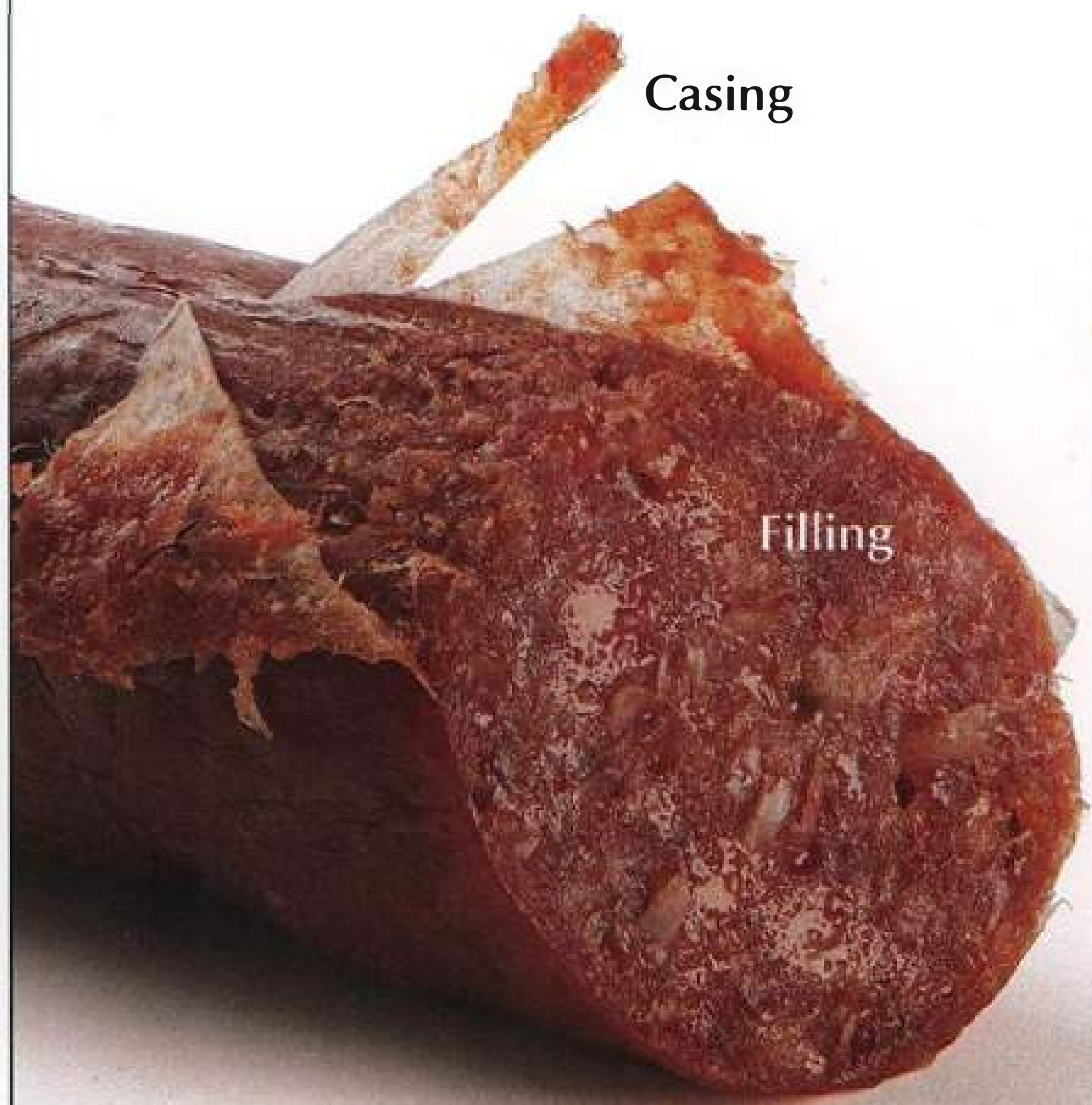
It also turns out that cupping pepperoni always curls toward the dominant heat source. When we heated the pepperoni using bottom heat only, the pepperoni curled down. When we subjected it to top heat only, which is what happens on a pizza since the sauce and cheese the pepperoni sit on is cold and the oven is hot, the pepperoni cupped up. To test this further, we stacked two pieces of pepperoni on top of each other and cooked them with simultaneous bottom and top heat. Lo and behold, the bottom one cupped down and the top one cupped up. Differential heating dictates which direction it cups.

We wanted to see if these results would be repeated when we baked the pepperoni on an actual pizza. We used a ring cutter to cut off about 1.5 mm / 0.06 in from the thinly sliced cupping pepperoni discs to remove the casing. We topped half of a pizza with the uncut cupping pepperoni and the other half with the casing-free pepperoni. As you can see in the photos below, the ones without the casing did not cup as much. We then baked cupping pepperoni alongside store-bought casing-less pepperoni on a pizza. This shows more than anything the vast difference between one and the other.

One reason people like cupping pepperoni is that as the fat from the sausage melts in the oven's heat, it accumulates in the tiny pepperoni cup, forming a delicious pool. Also, the rim of the pepperoni gets darker because it's unprotected from the direct heat. The rim becomes crispier than the remainder of the pepperoni, providing a very pleasant textural contrast.

Cupping pepperoni (left) and non-cupping pepperoni (right) inhabiting the same pizza.

Cupping pepperoni (left) and cupping pepperoni without casing (right)



Cupping pepperoni with casing

Cupping pepperoni without casing

Non-cupping pepperoni

ITALIAN SAUSAGE

INGREDIENT	WEIGHT	VOLUME	SCALING %
Pork shoulder, cut into 5 cm / 2 in cubes and chilled or very cold	1 kg	n/a	100
Pork fatback, cut into 5 cm / 2 in cubes and chilled or very cold	300 g	n/a	30
Fine salt	20 g	1 Tbsp + 1¾ tsp	2
Sugar	20 g	1 Tbsp + 2½ tsp	2
Hungarian paprika	17 g	2 Tbsp + 1½ tsp	1.7
Fresh basil, finely minced	17 g	6 Tbsp	1.7
Fresh oregano, finely minced	17 g	2 Tbsp + 2½ tsp	1.7
Fennel seeds, toasted and ground to a fine powder	11 g	1 Tbsp + 2½ tsp	1.1
Coriander seeds, toasted and ground to a fine powder	6 g	1 Tbsp + 1 tsp	0.6
Crushed red pepper flakes	2 g	1¼ tsp	0.2
Black peppercorns, coarsely ground	1 g	¼ + ⅛ tsp	0.1
Ice water	140 g	½ cup + 2 Tbsp	14

TOTAL TIME	YIELD
Active 15–20 min / Inactive 2 h	1.8 kg

Although we recommend precooking most sausages, if you portion fresh sausage into 2.5 cm / 1 in pieces, it should cook through and the resulting fat will be released into the pizza, which adds extra flavor.

PROCEDURE

1 Chill the meat grinder parts, including the coarse grinder die (1 cm / ⅜ in), in ice water for 1 h. Chill the extruder bowl in the freezer.

2 Remove the grinder parts from the ice bath, pat dry, and assemble.

3 Grind the pork shoulder and fatback separately through the chilled die into the chilled bowl.

4 Fold the ground meat and fat together, and grind once more. Keep the forcemeat chilled.

5 In a bowl, combine the salt, sugar, paprika, basil, oregano, fennel, coriander, red pepper, and peppercorns.

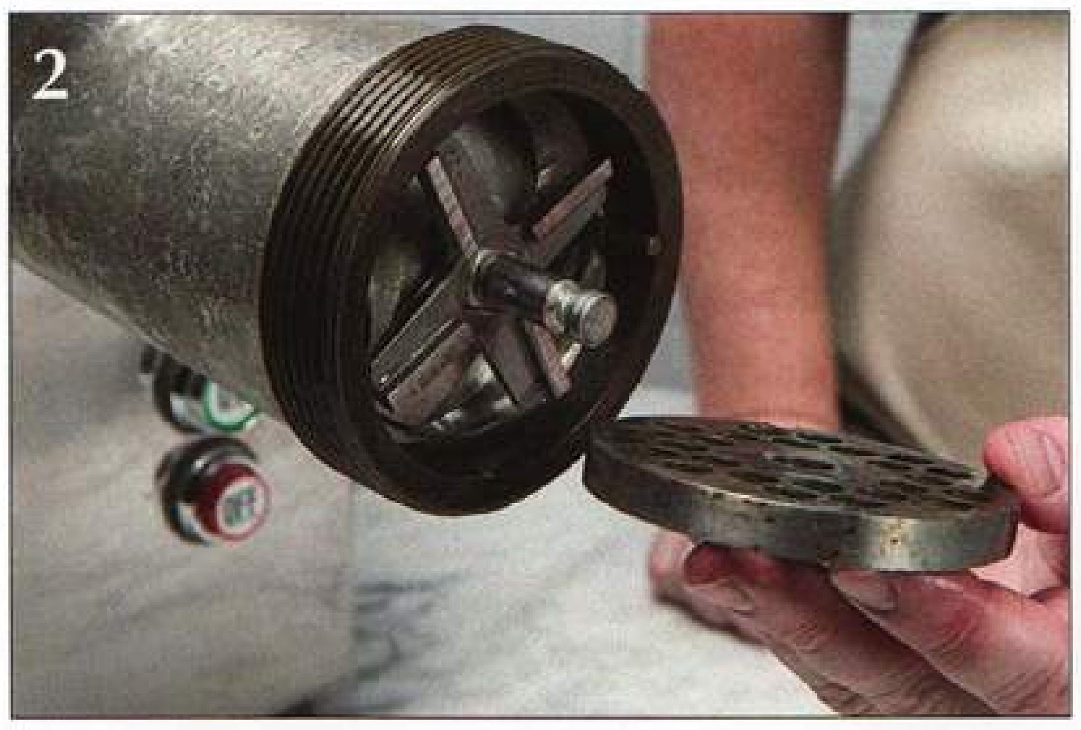
6 Stir in the ice water.

7 Fold the mixture into the forcemeat.

8 Transfer the forcemeat to a stand mixer fitted with a paddle attachment. Mix on low speed to ensure that the water and seasonings are evenly distributed, 2–3 min.

9 Refrigerate the sausage for at least 1 h before using.

10 Store for up to 1 wk in refrigeration. Freeze for up to 3 mo.


2


3


4


5


6


8

We made this a loose sausage since that is what is generally used as a pizza topping. You can put this sausage in a casing, but there's a lot more technique involved and you'd have to parcook it and slice it before you could put it on your pizza.

In Chicago, we found that the fresh sausage was frequently seasoned with garlic rather than fennel. If you'd like to make a garlic variation of this sausage, replace the combined weight of the paprika, oregano, fennel, coriander, crushed red pepper, and black peppercorns with peeled fresh garlic cloves. Add the whole cloves in with the pork before you grind it.

FINISHING YOUR PIZZA

The popularity of dipping sauces has grown considerably in recent years. There has been somewhat of a backlash, however, with many pizzerias refusing to serve their pizza with a side of ranch.

You can also finish a pizza with grated hard cheeses, herbs and spices, or even toppings like salmon furikake, pork floss, bonito flakes, or grated bottarga.

Finishing sauces are liquid condiments that can be drizzled over a baked pizza. Some culinary flavors are fat soluble so those will always be carried better by an oil than a water-based liquid. They can be homemade or commercially prepared, and the options are endless. Some of our favorites include sriracha, Maggi sauce, any and every form of hot sauce, hoisin sauce, teriyaki sauce, barbecue sauce (see page 267), vinegars in all forms, and flavored oils. Other highlights include ranch or blue cheese dressing, chimichurri, yogurt sauce, tapenade, caponata, or even mustard. We include a wide array of recipes in our chapter on sauces (see page 259 for those that can be applied after baking, including Aioli and Sous Vide Hollandaise). The sky is truly the limit in terms of the flavors that you can add to your pizzas. Shop your local markets or scour the internet to find interesting condiments to add to your flavor profiles.

FLAVORED OILS

We recommend applying these to the pizza after baking since the flavor is more pronounced, but you can add before baking if you prefer.

Flavored oil	Ingredients	Scaling %	Notes
Boquerones or anchovy oil	Boquerones or anchovies in oil (canned)	100	Drain the boquerones or anchovies and reserve both the oil and fish in refrigeration.
Butter or ghee	Butter or ghee	100	Use purchased as is, or infuse with a variety of flavors. Citrus zest, herbs, or spices are common additions.
Chili oil	Calabrian or Szechuan chilis	20	Toast the chilis (they can be whole or crushed) in a sauté pan over medium-high heat. Stir frequently so they get completely toasted throughout. Once aromatic, add the oil and bring the oil up to 150° C / 300° F. Turn off the heat and cool to room temperature before using. Straining is optional.
	Vegetable oil	100	
Chorizo oil	Spanish cured chorizo	100	Render the fat out of the chorizo by cutting it into small dice and then cooking it in a hot sauté pan. Once the fat has leached from the chorizo and the chorizo has browned, take the pan off the heat. Drain the resulting fat and reserve it warm for service so it stays fluid. Otherwise, refrigerate. Use the cooked chorizo as a topping for pizza.
Curry-infused oil	Curry mix of your choice	5	Toast the curry spices in a sauté pan over medium-high heat, stirring constantly. Once aromatic, add the oil and bring the oil up to 150° C / 300° F. Turn off the heat and cool to room temperature before using. If using whole spices, strain out the spices. If using a curry spice powder, it's not worth straining.
	Vegetable oil	100	
Saffron-infused oil	Saffron threads	0.1	Combine the ingredients in a pot and bring up to 150° C / 300° F over medium-high heat. Turn off the heat and cool to room temperature before using. Straining is optional.
	Vegetable oil	100	

Some oils are flavorful enough to use on their own. Extra-virgin olive oil is the most commonly used, especially on Neapolitan pizza. Argan oil; hazelnut, macadamia, and pistachio oils; pumpkin seed oil; toasted sesame oil, and truffle oil all work well as finishing oils for pizzas.

The chili oil that is being drizzled on this pizza adds both spiciness and flavor to the finished pizza.

THE STATE OF OLIVE OIL

In horticultural terms, olives are the fruit of the olive tree, which makes olive oil a kind of fruit juice. But the juice of this fruit isn't a sweet syrup; it's a pleasantly fruity fat.

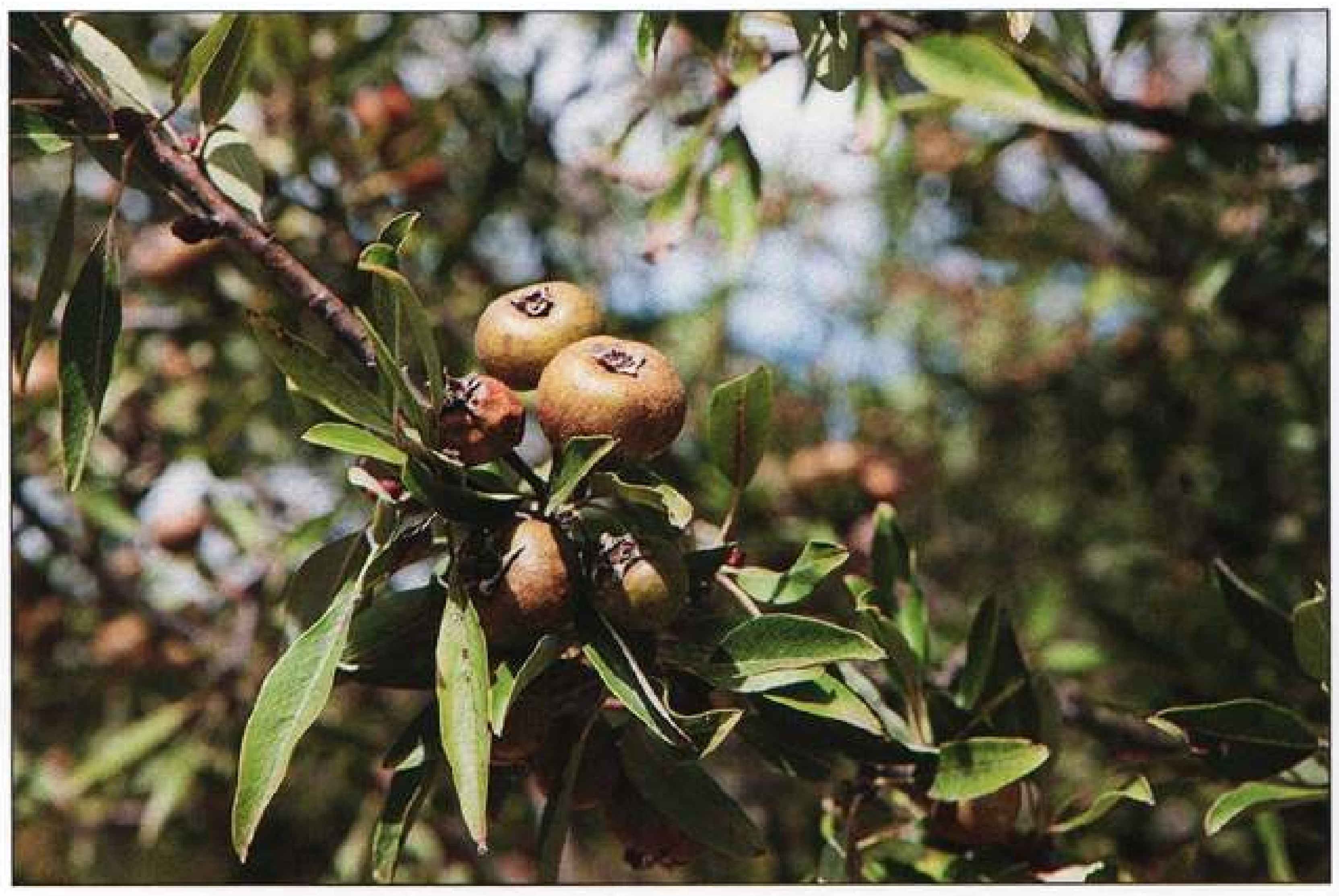
After harvesting, the olives are washed and crushed into a paste. The paste is mechanically mixed and then centrifuged to separate the solids from the liquids. The liquids are further processed to separate water from oil.

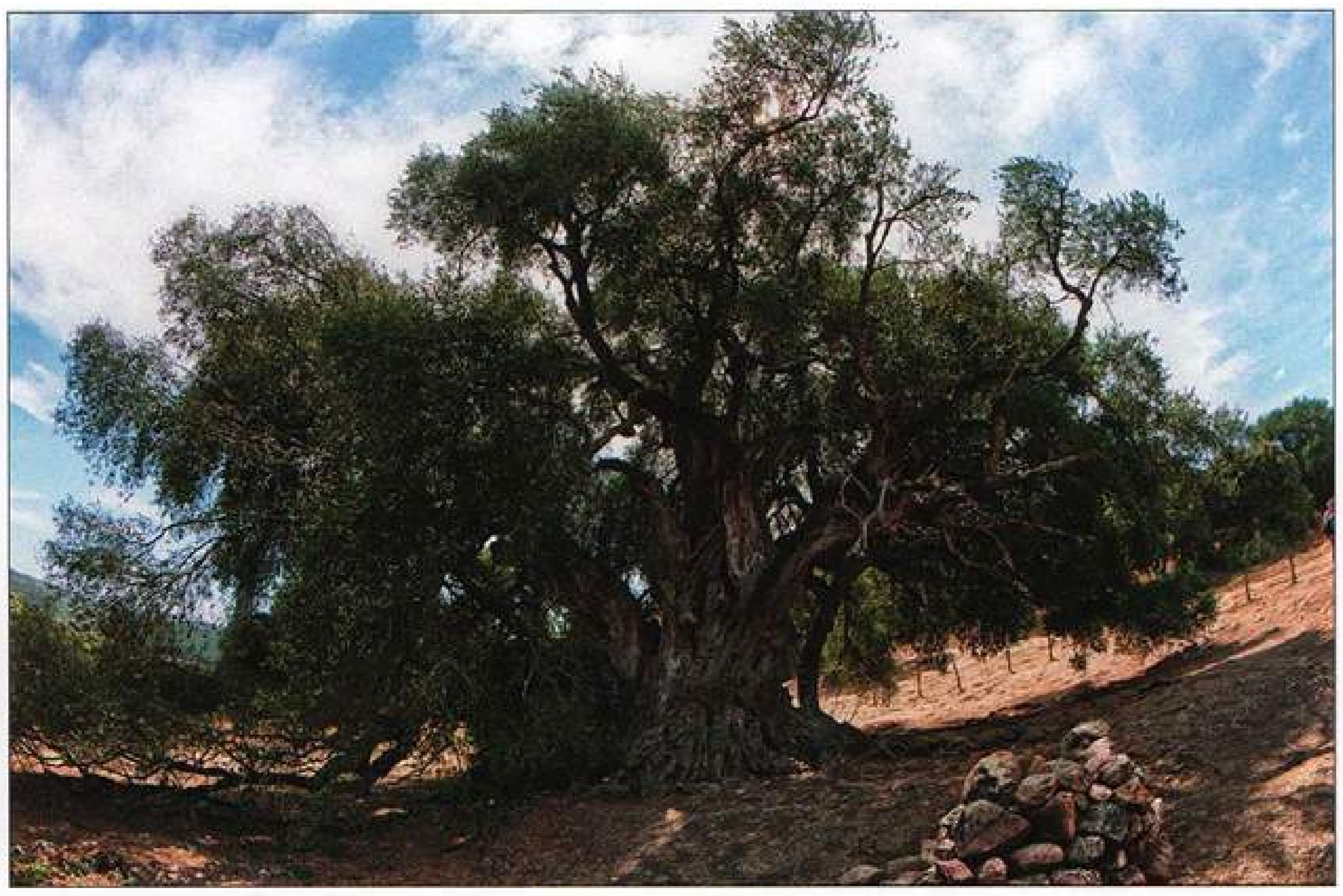
The oil's flavor can vary depending on the type of olive, where the olives are grown, how long they mature on the tree before harvesting, how long they sit before processing, and the way they're processed.

Olive oils come in different grades. Under international standards, "virgin" olive oils are processed mechanically (as opposed to chemically); oils labeled "extra-virgin" are expected to have fewer flavor defects than those that simply have the "virgin" designation. Refined olive oil, also called "pure olive oil," "light olive oil," or just plain "olive oil," goes through additional processing that can include heat and chemicals. The processing is designed to overcome flaws in the olives themselves or those caused by poor handling, but it winds up removing desirable flavors as well. For that reason, it's often mixed with stronger oils to return some of that flavor.

Various governing bodies, including the International Olive Council and the Olive Oil Commission of California, have defined parameters for the different types of oils—for example, the maximum percentage of free fatty acids they may contain—but those standards vary from region to region. And they're not always followed, anyway. As it turns out, even if it says "extra-virgin" or "Italian" on the label, that might not be what's in the bottle. In a study by the University of California-Davis, nearly three-quarters of samples obtained from bottles of top-selling brands failed to meet international standards for flavor and aroma. Those flaws, which included rancidity, were an indicator that oils were oxidized, adulterated with cheaper oils, improperly processed, or made with poor-quality or damaged olives. Many samples failed chemical tests, too. The findings were in keeping with other research that found rampant problems, including outright fraud, in olive oil production and labeling.

So how do you know if you're buying a good olive oil? One simple step is to check the harvest, production, and bottling dates. The shorter the time between each of the steps, the better. Also, if the oil is more than two years old, don't bother. Small bottles are better if you're not going to finish a large bottle within two years. Store away from light, at under 27° C / 80° F. Producers, grocers, and importers can also employ testing companies, like Agbiolab in California, to assess key attributes, such as ultraviolet absorbency (an indicator of secondary oxidation), peroxide value (an indicator of improper handling), and free acidity (an indicator of poor fruit quality or improper handling).





These olive trees at Olivastri Millenari in Sardinia, Italy, have lived for thousands of years. The oldest is said to be 3,000 years old.

CHAPTER 11
BAKING PIZZA

BAKING PIZZA

You'll find that understanding the basic science of how baking works makes the practice of baking your pizza easier and more interesting (see The Physics of Dough and Sauce, page 1:362). After all, turning dough into a successful pizza is the result of a series of steps: properly proofing the dough, stretching it to the right thickness, and safely transferring it to a hot oven (hopefully one that's well-suited to your specific pizza style) to bake.

When you bake a pizza, heat energy moves from the oven into the dough mixture, transforming it. The water in the dough boils into steam, which further inflates bubbles created by the carbon dioxide and ethanol released by yeast during fermentation and causes the final "oven spring" of the rising process. In the interior crumb, proteins unravel in the heat and stick together to form a stretchy web. On the surface, starch heated in the presence of water gels, and then the starch gel can solidify, which is called a starch "glass." This crisp state of starch is what's responsible for crispiness in everything from potato chips to pizza crust.

It's also important to understand the fundamentals of the way that your oven works when it bakes a pizza. Thin-crust and medium-crust pizzas, such as thin-crust or Brazilian thin-crust pizza, Neapolitan pizza, and New York pizza, are baked with infrared light, especially in the case of a wood-burning pizza oven (see page 1:357). The heat in these types of ovens is asymmetric (and the temperature is typically very high), so pizzaioli have to contend with moving the pizzas around the oven to bake them evenly. The top is baked almost entirely by radiation—the air temp does not make much contribution. That's not true in a combi, home, impinger, or convection oven where the air temperature is a primary heat transfer mechanism.

When it comes to ovens that are used at lower temperatures, like deck ovens, the temperature of the air plays a more important role. And it's key to note that the bottom of the pizza is always baked by conduction, whether the pizza sits directly on the oven floor or it's in a pan. The top is baked by radiation (broiled, if you will)—this is true for all types of ovens except for combi, home, and convection ovens. This means that when you cook in a home oven, you have a problem and you need to improvise (see page 1:393).

Choosing an oven for baking your pizza can have serious implications because the capabilities of the oven determine to a great extent the kinds and quality of the pizzas you can bake in it. The oven is the primary difference between a home maker and a pizzeria for some kinds of pizza. (It depends on the kind of pizza though. There are types where there really isn't a difference.) The fundamental problem is that many of the ovens we use don't give you what you need. A good oven will have a steady source of heat and recover quickly after it's loaded (see page 1:375). Some ovens, such as impinger or deck ovens, work well for a variety of different pizza styles. Others, such as wood-fired ovens, are specialized. Home ovens, meanwhile, are just plain difficult to work around. Not to worry, though. Your pizza isn't going to jump out of the oven in protest if you don't have the right kind. A little bit of finessing and hacking will make your results even better than expected.

In our chapter on the science of baking and pizza ovens on page 1:345, we cover how each oven functions in detail. This chapter will give you the practical know-how to confidently bake your pizza. We'll break down the methods for loading each different style of pizza into the oven so that your pizza doesn't stick to your peel and spoil the work that you put in up to that point. We'll share detailed methods for how to bake pizza in a wide variety of ovens and explain which styles work best in each oven. We'll also give you the tools to make pizza in unconventional ovens such as a grill, a fryer, or a portable oven. Many readers might not have professional pizza ovens at their disposal, but we'll show you ways to make the most out of the oven you have. We strongly believe that a good pizzaiolo can make delicious pizza in any oven.

Even with a really great oven, you'll need to rotate your pizza at least once (or many times with Neapolitan pizzas). Rotating helps prevent the bottom from scorching and is the secret to even baking.

For more on the specific mechanics of how ovens work, see page 1:346.

NEW DISCOVERIES AND TECHNIQUES

We always fully prebake our al taglio pizzas (see photo, previous page), either with or without sauce. Prebaking (see page 419) helps to mitigate the formation of a gel layer.

TRANSFERRING YOUR DOUGH

Pizza screen

You're ready to bake a pizza. This is the moment when everything you've done beforehand will pay off . . . if you can actually get the pizza into the oven without incident. Pan-baked pizzas proof in the pans they bake in, making transferring them into the oven very easy. We cover the transferring and baking steps for pan-baked pizzas on page 409 of this chapter. Doughs that are proofed in a ball and require shaping before baking are more of a challenge.

Once the dough ball has been shaped, sauced, and topped, your mission is to get that pizza into the oven without distorting the shape or losing toppings to the oven floor. If you're too aggressive, you risk knocking toppings out of place. If you're too hesitant, the dough might not even slide off the peel. You'll need to handle the dough gently but with confidence.

Chris Bianco (see page 1:267) removes this marinara pizza with a metal peel that is commonly used with wood-fired or gas-fired pizza ovens. When making Neapolitan pizzas in these ovens, pizzaioli usually use a wooden peel to load the pizza and a smaller metal peel to spin the pizza while it bakes and to take the pizza out of the oven.

PIZZA SCREENS

Although not as commonly used as peels in pizzerias, pizza screens consist of a fine wire mesh surrounded by a metal ring. They come in a number of different diameters, from 20 cm / 8 in to 60 cm / 24 in. Depending on your perspective, using a screen is either a godsend or it's cheating. Screens are useful if you don't have experience making pizza, because you can consistently shape a round pizza that is the exact size that you need. We find screens useful for certain styles of pizza and types of ovens.

We always spray the screens with oil just before placing the dough on top, then apply the sauce, cheese, and toppings as needed. The screen makes it easy to move the pizza from worktable to oven. It's extremely practical for impinger ovens since all you have to do is place the pizza-loaded screen onto the conveyor belt and walk away. (Depositing a pizza directly on a conveyor belt without losing its shape is a challenge, to say the least.) Since impinger ovens blow hot air from above and below, the screen allows the heat to pass through easily. For home pizza makers, it also helps to assemble the pizza on the screen and then place it on a baking steel or stone so that you don't have to worry about the pizza sticking to a peel when you are loading it into the oven.

Large screens also make it easier to handle bigger pizzas, which often need extra attention to crisp up on the bottom. After about 2 minutes of baking the pizza on the screen, we slide a thin metal peel between the screen and pizza and move the pizza to a new hot spot in the oven. This eliminates any possibility of a soft or underbaked bottom crust.

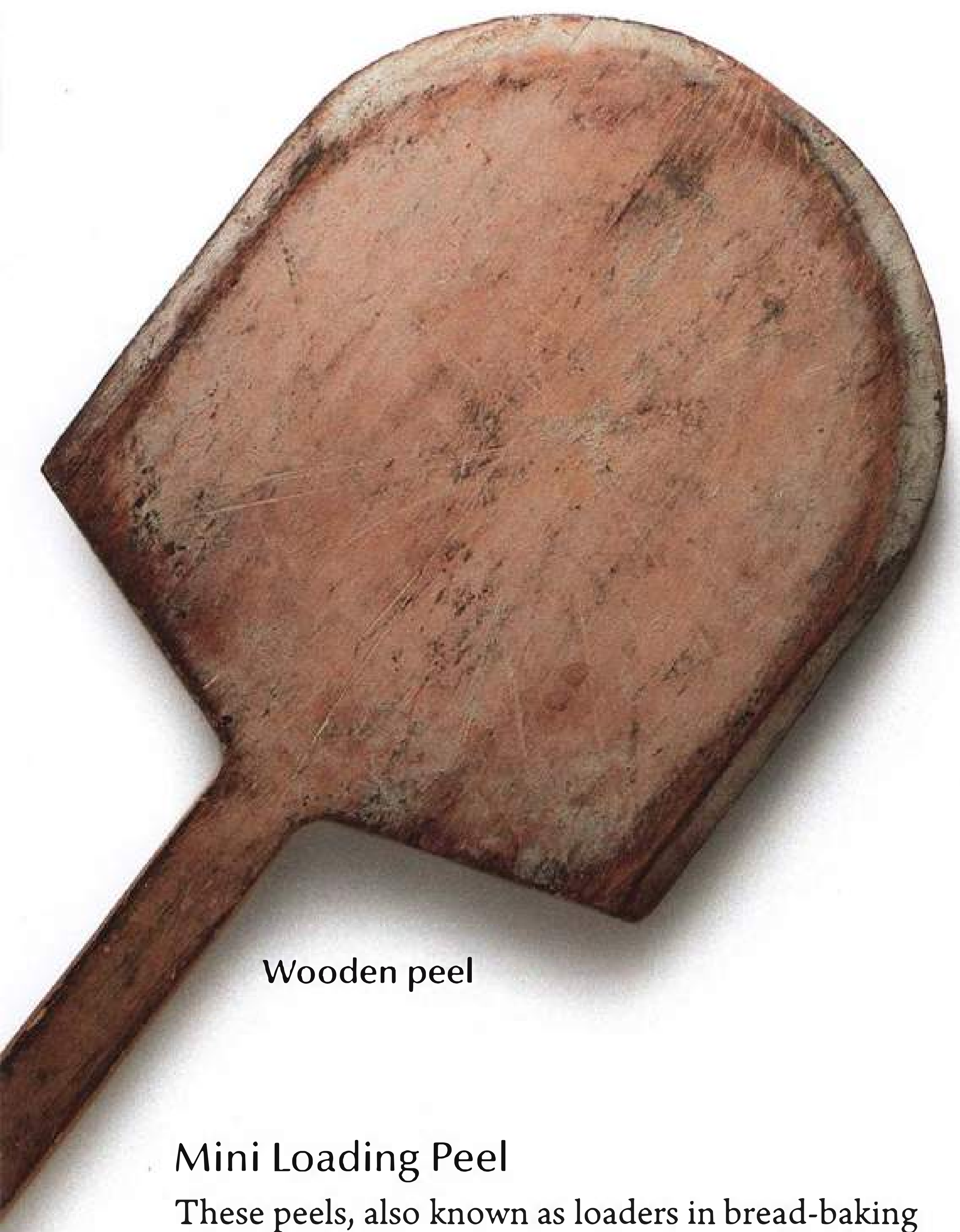
PEELS

For doughs baked without pans, peels are indispensable. They come in many different paddle sizes, lengths, and materials (wood, metal, and cloth). Some other kitchen tools can be used in a pinch. The purpose, of course, is to transport the dough from point A to point B without damaging anything. This simple operation will take some finesse. Hesitation won't get you there. Nor will working too slowly. Even being excessively careful can be a detriment. Gentle but assertive motions—and practice—are key.

Note that peels are mostly necessary for pizzas that are baked directly on a hot surface (the oven floor or a baking stone or steel). For pan-baked pizzas, you can push the pan around in the oven with a peel, but it won't work for pulling it out. For that, use oven mitts, clean kitchen towels, or baking pan grippers or pliers.

Wooden Peels

The earliest peels were made of wood, and some traditionalists still prefer wooden peels over metal. Wooden peels are generally thicker than metal, and that thickness presents some challenges. It means the pizza has a longer distance to drop from peel to oven floor, and using a wooden peel requires a lot more skill than a metal one. Wooden peels also tend to split and splinter after heavy use. If tradition is more important than efficiency, you may prefer a wooden peel, but otherwise, we don't see a good argument in favor of using it.



Wooden peel

Mini Loading Peel

These peels, also known as loaders in bread-baking vernacular, aren't practical for large-scale use, but the smaller versions can make the home pizza maker's life a whole lot easier. The dough is shaped and placed on the loader, then sauced, cheesed, and topped. There's a rolling cloth mechanism that allows you to slowly and gently drop the pizza onto the hot baking steel or stone with minimal effort.

Metal Peels

Metal peels are typically made of stainless steel or aluminum and come in a variety of shapes and sizes to fit almost any kind of pizza or oven. One of the simplest but greatest improvements on the original solid metal peels is the perforated peel, which has two benefits. The perforations reduce the chances the dough will stick, making it easier to release the dough into the oven. The holes also let excess flour fall off before reaching the oven floor, where it might burn onto the dough. Metal peels tend to be much lighter and thinner than wood, so there won't be a big jolt as the pizza drops from peel to oven floor. This can make a difference to someone manning the oven all day. You'll need to work quickly if you are dressing the pizza on a metal peel because the dough has a tendency to stick more to metal than to wood. If you dress the pizza on a perforated metal peel, there is a chance that the dough will press into the holes, so you can't press too hard when shaping the dough.

If you're making Neapolitan pizzas, you'll likely need two different peels: a 30 cm / 12 in peel to load the pizza into the oven, and a much smaller peel, also known as a turning peel, to spin the pizza around on the oven floor to help it bake evenly and prevent scorching.

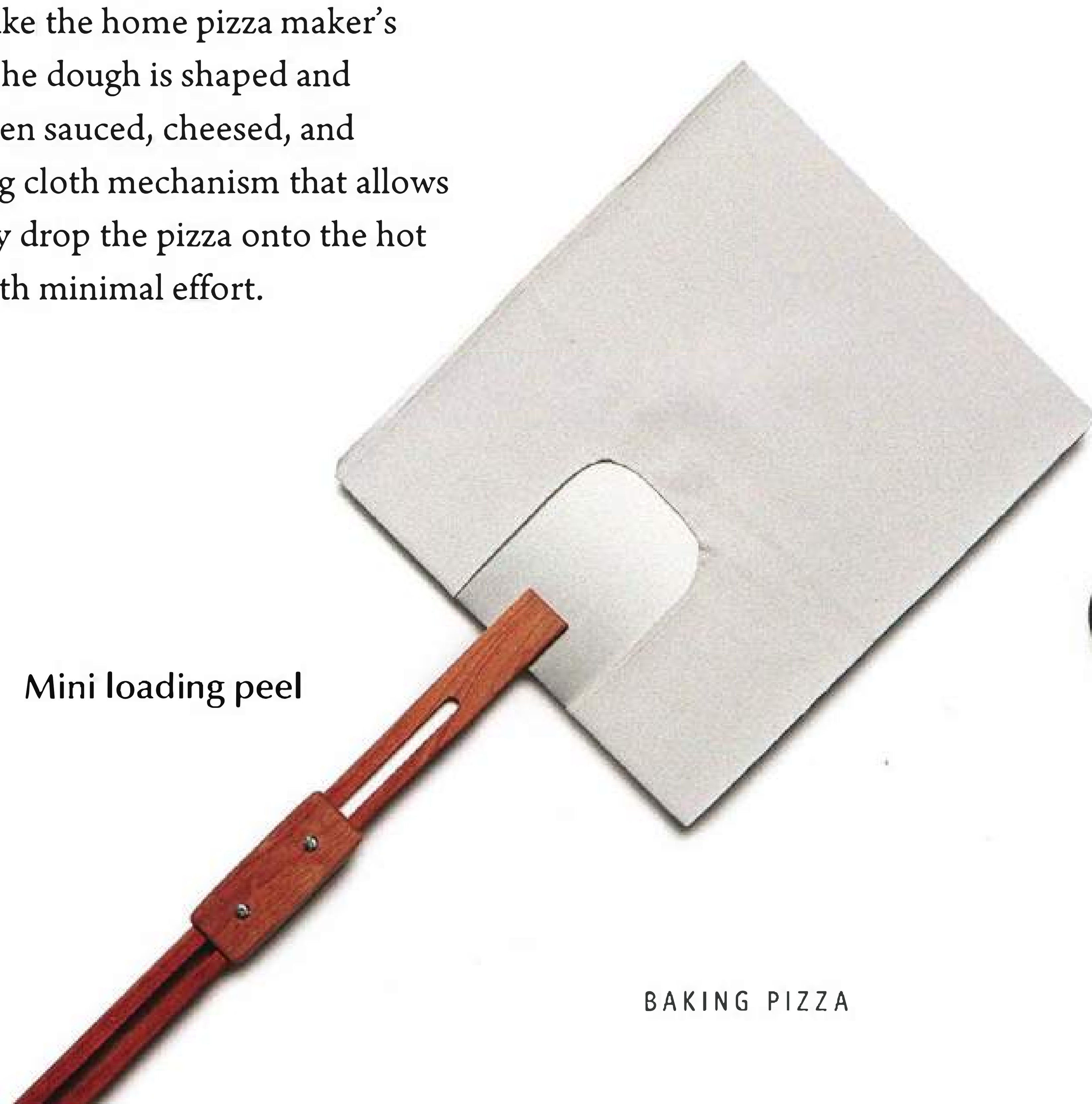
Improvised Peels

Most flat, thin surfaces can work as an improvised peel, so long as they're large enough to fit the whole pizza (with a little wiggle room if possible). They should be thin enough to prevent the pizza from having a big drop-off when it's slid onto the baking surface. An upside-down half sheet pan, a piece of sturdy cardboard, or a large cake board can work. An upside-down sheet pan can be used in combination with parchment paper.

Pizzaioli generally use peels made from either wood or metal, depending on their preference and the style of pizza they are making. These peels come in a number of shapes and sizes; some metal peels are perforated (we prefer these). If you don't have a peel at home, you can flip a sheet pan upside down and use it to load pizzas into your oven (putting a piece of parchment paper on top makes it even easier).

Metal peels

Improvised peel

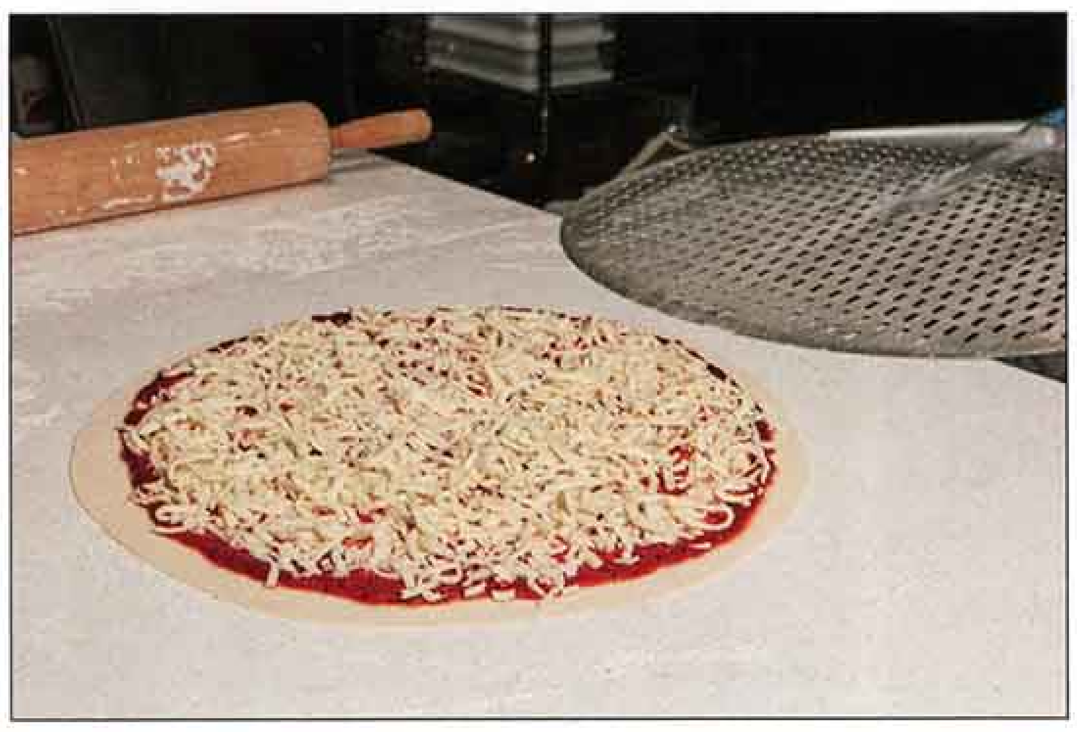


Mini loading peel

HOW TO Transfer Pizza Dough Using a Peel

There are five methods for transferring floor-baked pizza dough into any oven, each requiring a peel or a stand-in. They all hinge on a jerk-back motion, which requires some practice. You have to be quick, otherwise the dough might stick to the peel. When you use a peel, finish the transfer by following the three steps for loading floor-baked pizzas into the oven.

OUR PREFERRED METHOD FOR THIN-CRUST, BRAZILIAN THIN-CRUST, NEW YORK, AND ARTISAN PIZZA



1 Place the peel close to the assembled pizza; make sure it's steady and will stay in place.

2 Slide the peel under the pizza in a quick-jerk-back-and-forth motion (inertia is your friend). Reshape as needed.

3 Slide the pizza into the oven.

OUR PREFERRED METHOD FOR NEAPOLITAN PIZZA

1 Place the peel close to the assembled pizza; make sure it's steady and will stay in place.

2 Slide the pizza onto the peel with your hands. Reshape as needed.

3 Slide the pizza into the oven.

OUR PREFERRED METHOD FOR LOADING PIZZAS ASSEMBLED ON A PEEL

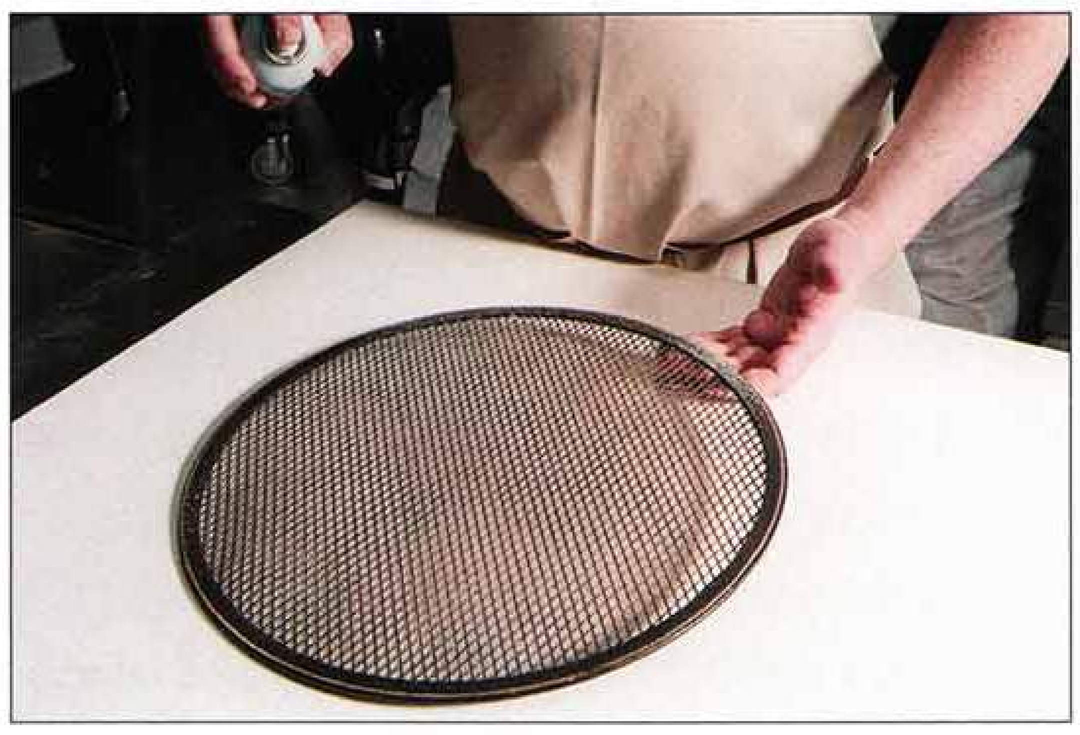
1 Flour your metal or wooden peel.

2 Shape the dough on a generously floured surface and then place it on the floured peel (you can use less flour as you gain experience). Reshape as needed.

3 Apply sauce, cheese, and toppings. Do this as quickly as possible; the longer this takes, the higher the chances the dough will stick to the peel (the dough can also stick if you press too hard while assembling the pizza).

4 Slide the pizza into the oven.

OUR PREFERRED METHOD FOR IMPINGER OVENS OR DOUGHS BAKED ON SCREENS



1 Coat a pizza screen with a light layer of cooking spray.

2 Shape the dough on a generously floured surface and then place it on the screen. Reshape as needed.

3 Apply sauce, cheese, and toppings.

4 Slide the pizza into the oven with the screen.

TRANSFERRING FLOOR-BAKED PIZZAS WITH PARCHMENT PAPER

1 Shape your dough and place it on the parchment paper. Apply sauce, cheese, and toppings.

Cut your parchment paper slightly larger than your pizza. For a 30 cm / 12 in or 35 cm / 14 in pizza, cut a 38 cm / 15 in round or square piece.

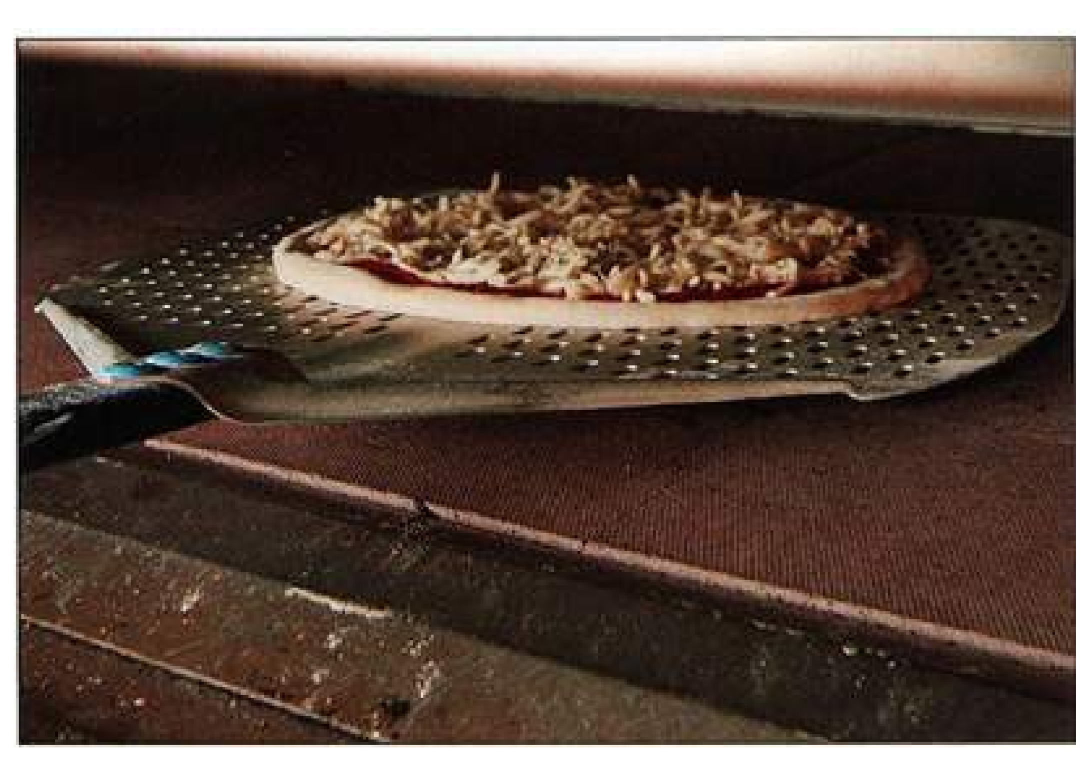
2 Transfer the pizza onto a peel or the back of an upside-down sheet pan or cookie sheet

This method is meant to be used for pizzas baked in a home oven, either on a baking stone or a baking steel. Do not use this method for Neapolitan pizzas because they are baked at high temperatures and the parchment paper can burn in a wood-fired oven.

3 Slide the pizza into the oven.

LOADING FLOOR-BAKED PIZZAS INTO THE OVEN

1 Position the peel where you want the pizza to go in the oven.



2 Tilt the handle of the peel up only a few degrees.

3 Pull the peel back in a series of quick jerk-back motions. These quick motions use inertia to make the dough slide off. It may take several jerked-back-and-forth motions to fully release the pizza, especially if it's large.

TRANSFORMING DOUGH INTO PIZZA

Alveoli are the small holes, or air pockets, in a pizza's crumb. They are first formed during mixing and expand during fermentation and baking.

The increase in size in the crust is called oven spring by bread bakers.

High heat is the main element required to convert dough into pizza crust, with different phenomena occurring as the dough's temperature rises. During baking, yeasts start to die off at 50–60°C / 122–140°F. Enzymes, the compounds that unleash the process of gluten formation and fermentation, will also be rendered inactive once the dough reaches this temperature. As water in the dough vaporizes, the bubbles within expand because of heat and accelerated fermentation, increasing in size until they burst. This steam is what inflates the pizza. It transforms the millions of bubbles within the dough into a few interconnected ones.

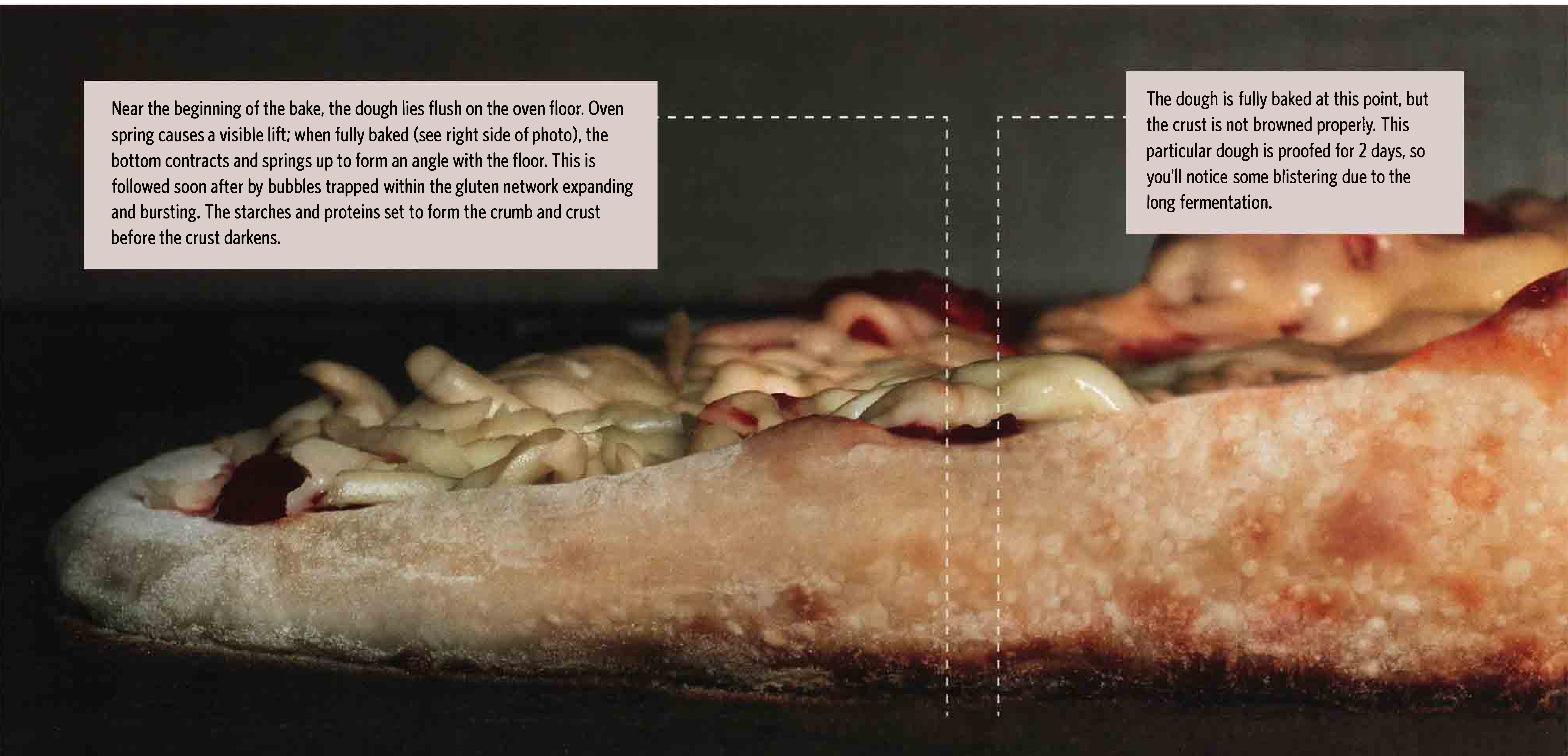
As the water evaporates during baking, it also contributes to the dough's expansion. Pan-baked pizzas can even double in size. In stretched doughs baked directly on the oven floor, the expansion occurs mostly in the rim (see page 1:362).

The two phenomena controlling crumb formation are the coagulation of the proteins and the gelatinization of the starches. Protein coagulation involves the irreversible bonding of the proteins to form a solid network. Gelatinization means that the starch has gotten hot enough to form a set gel. Between 55 and 65°C / 131 and 149°F, starch granules begin to swell with water, which migrates from the proteins, and the amylose within the starch starts seeping out. Gas expansion increases the pressure within the dough, forcing the bubbles to coalesce. This pressure is partly responsible for determining the structure of the crumb and the alveolar pattern.

The temperature at which protein coagulation and starch gelatinization are complete depends on the type of flour used and the hydration of the dough; for doughs made with bread flour, this temperature is 60°C / 140°F. Doughs that contain a large proportion of rye flour and/or a low percentage of water may not undergo complete starch gelatinization until 90°C / 194°F. This is because there's less conductivity in denser doughs; therefore, gelatinization and coagulation take more time, and such doughs may require lower baking temperatures to avoid burning the crust.

Our highest-hydration pizzas are all thick crusted, or bread-like, so they take longer to bake. In general, these doughs are baked at lower temperatures than thin-crust pizzas because higher temperatures would lead to scorching. The longer baking times also mean that in many professional settings most of the bread-like pizzas are prebaked (see page 419) and then reheated (with the exception of Detroit-style pizzas; see page 3:109). This way, the customer can get their pizza faster. Also, a lot of these styles are sold by the slice because they can be quickly reheated or finished and served. The increased moisture in the crusts also means that they reheat very well without drying out too much. Doughs that have oil as an ingredient retain moisture in the crust and crumb and reheat better.

The type and temperature of the oven also influence the rate at which heat flows into the dough. The rim of a medium-crust pizza can be baked at a higher temperature because the heat transfer



Near the beginning of the bake, the dough lies flush on the oven floor. Oven spring causes a visible lift; when fully baked (see right side of photo), the bottom contracts and springs up to form an angle with the floor. This is followed soon after by bubbles trapped within the gluten network expanding and bursting. The starches and proteins set to form the crumb and crust before the crust darkens.

The dough is fully baked at this point, but the crust is not browned properly. This particular dough is proofed for 2 days, so you'll notice some blistering due to the long fermentation.

happens quickly enough that the interior cooks through before the surface burns. The extreme version of this is a Neapolitan pizza, which can bake in as little as 60–90 seconds.

Crust formation occurs early on, and the surface of the dough begins to take on color as the bake progresses, becoming darker and darker. By the time the core temperature reaches between 91 and 93° C / 195 and 200° F, the crumb structure is set, but the color of the crust should be the determining factor in when to remove it from the oven.

The texture of the baked crust will vary depending on the style. Most pizzas that are baked on the oven floor are firmer and able to hold a plank pretty well if they are properly baked and aren't overloaded with toppings. Neapolitan pizza is an exception, however. It's baked at higher temperatures than our other styles, but it's only in the oven for 60–90 seconds, so it doesn't have enough time to form a crispy crust. These pizzas have a serious case of tip sag (see page 6), but that's intentional. Crispiness and the ability to hold a plank are made possible by moisture evaporation during baking. The 90-second bake for a Neapolitan pizza is generally not long enough to evaporate moisture and lend structural strength to the dough. Pan-baked pizzas rarely sag unless the dough is very soft or underbaked. They're thick to begin with and can therefore support more weight on top.

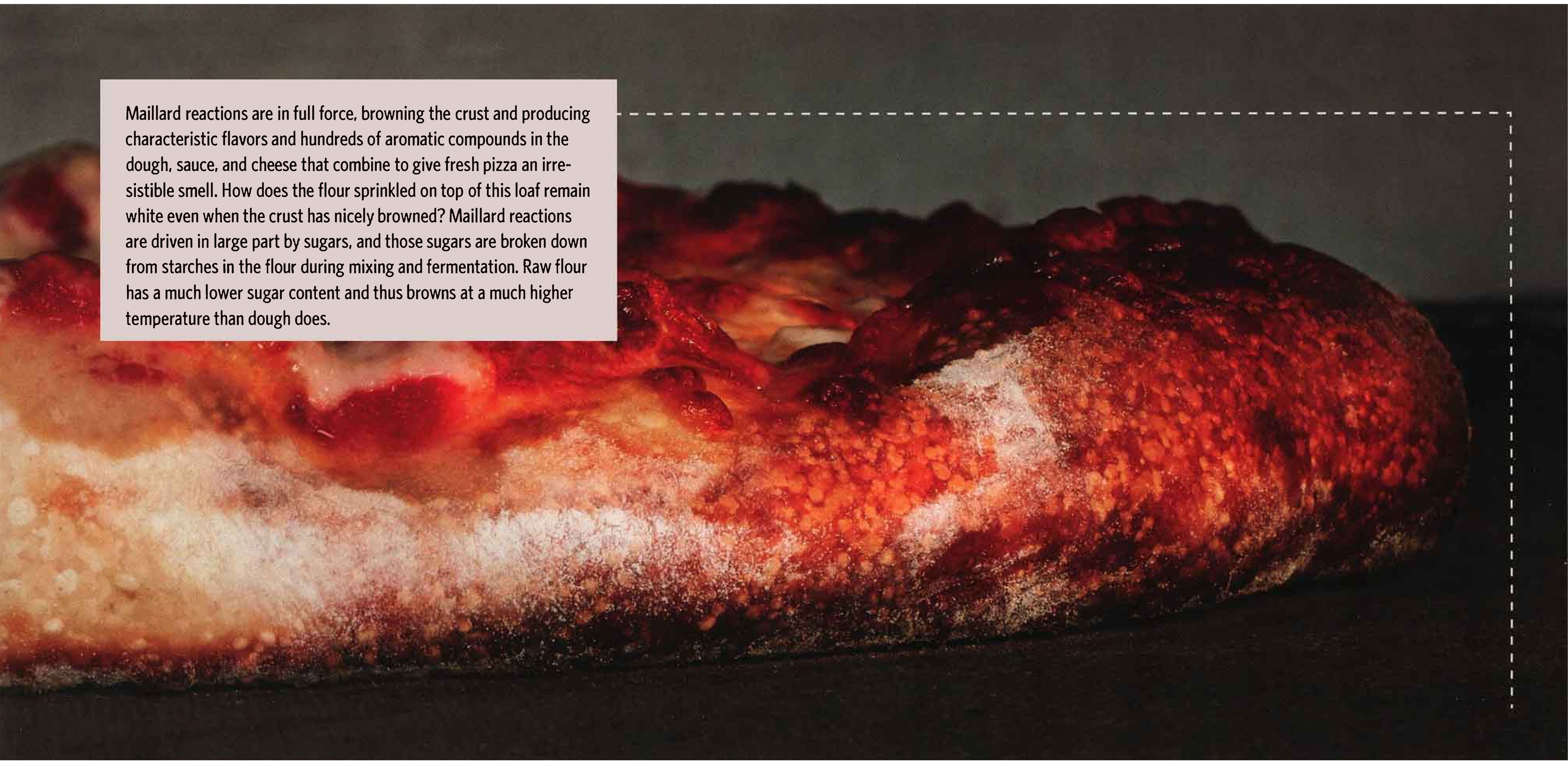
GEL LAYER FORMATION

Different styles of pizza have different properties of their under crust, too. Some styles suffer from a significant gel layer or gum line (see page 1:370). This happens when the sauce and cheese unknowingly conspire to keep the dough underneath from baking properly. The sauce (and, to a lesser extent, the cheese) creates a moisture barrier between the hot air in the oven and the surface of the dough, leaving the covered part of the dough gummy. It can happen in thin-crust pizza, too, but you'll notice it less—the thicker the pizza, the thicker the gum line seems to be. To remedy or reduce gumminess, you can place the cheese on first and variegate it with the sauce (see page 207). For some bread-like pizzas, you can prebake the dough completely, turn it over in the pan, and then apply sauce and cheese and bake it again, as we do with our New York Square Pizza (see page 3:133). It's an extra step that not everyone wants to take, but it will completely eliminate the gel layer.

Deep-dish pizza suffers from a similar fate because the under crust is submerged in wet stuff; in this case even prebaking the crust doesn't completely solve the problem. Although you should wait a few minutes after taking it out of the oven before you eat it (see page 3:295), you'll still need to manage your expectations because the crust won't be very crisp. This lack of crispiness isn't as noticeable in deep-dish pizza, though, because you have very little dough when you compare it to the amount of toppings in the pizza. Since the dough has a lower hydration than many others, it doesn't tend to feel as gummy as thicker, higher-hydration pizza doughs.

When the pizza crust's surface temperature exceeds roughly 130° C / 265° F, Maillard reactions start to occur rapidly. Sugars react chemically with amino acids and other protein fragments to produce brown pigments, complex flavor compounds, and a stiff, brittle surface—all crucial elements in the majority of pizza crusts. The notable exception to this is the Neapolitan pizza, which has a soft crust.

This compilation of time lapse photos illustrates how this artisan pizza changes during baking. Oven spring increases the volume of the pizza dough during the early stages of baking and the crust goes from pale white to a rich mahogany brown.



Maillard reactions are in full force, browning the crust and producing characteristic flavors and hundreds of aromatic compounds in the dough, sauce, and cheese that combine to give fresh pizza an irresistible smell. How does the flour sprinkled on top of this loaf remain white even when the crust has nicely browned? Maillard reactions are driven in large part by sugars, and those sugars are broken down from starches in the flour during mixing and fermentation. Raw flour has a much lower sugar content and thus browns at a much higher temperature than dough does.

PIZZA BAKING METHODS

Not every oven is good for every type of pizza (see our recommendations in the Pizza Ovens chapter, page 1:345). The pizza deck oven is the most versatile and is recommended for all of our styles except Neapolitan. The wood-burning oven is the hardest to use; you can get a superior result only if you're really skilled. We found an interesting correlation between the number of skilled minutes you spend making the dough and baking it: Neapolitan pizza dough is among the easiest to make but requires the highest degree of baking skills, while al taglio pizza has dough that is harder to handle but easier to shape and bake. If the idea of a traditional-looking domed pizza oven appeals to you, consider a gas-fired version, which is easier to use and produces more consistent temperatures (see page 1:356).

Forced-air convection ovens are less than ideal for most (if not all) pizzas because the hot circulating air sets the crust too quickly, and the volume takes a hit. We recommend turning the fan down as much as possible. Another problem is they don't have a floor that can radiate heat directly into the pizza or its baking pan. To get a crispy bottom crust, we recommend using a baking steel or baking stone.

If you're a home pizza maker, the only thing standing between you and pizza greatness is your oven. We provide a few solutions and work-arounds, but know that if your intent is to bake Neapolitan pizza, you're not going to get true Naples-style results in a home oven. It just doesn't have enough juice to reach the super-high temperatures you need. However, there are some appliances that can do that and some small outdoor units that can get ripping hot (see page 1:394).

When you remove a pizza from the oven, the spot where it baked will be cooler than the rest of the oven floor. The oven needs time to recover its temperature. Keep a visual map of where you've been, where you are, and where you're going next (see page 1:385). It helps to follow a pattern. Assign each corner a number and keep it that way; eventually it will become second nature. Similarly, watch for hot spots in your oven (see page 1:385).

Pizzas baked directly on the oven floor will also need to be tended and rotated. If you're baking in a home oven, we highly recommend using a baking steel or stone in combination with the broiler for the best results. We also recommend using a baking steel or stone in combi or convection ovens to get a crispy bottom. In the following pages, we'll provide additional practical tips to get the best pizza out of each type of oven, as well as a list of styles that are recommended for each oven type. We also have a set of how-tos for some alternative ways to make a pizza, such as grilling and frying.

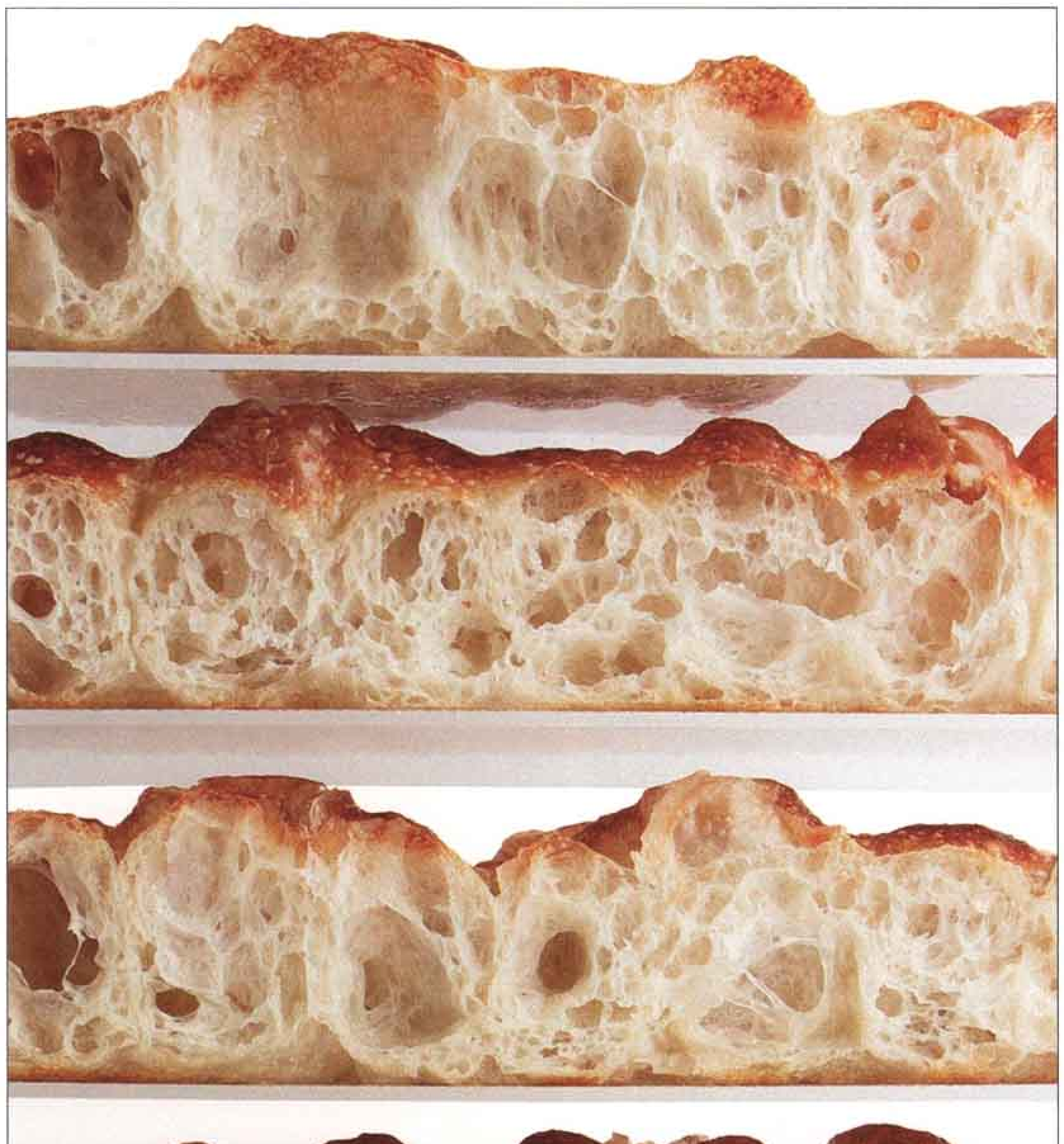
For more on pizza ovens, see the Pizza Ovens chapter starting on page 1:345.

The baking stone shown on the grill below is a valuable tool you can use at home to try to re-create the even heat of the hearth of a wood-fired oven with gas assist (shown on the previous page). The baking stone won't make an exact replica of the margherita pizza being baked on the brick hearth because it can't get to the same high temperatures (but it'll still be delicious).

EXPERIMENT

DOES ANY ONE FACTOR MATTER WHEN BAKING PIZZA?

We work with living dough when we make pizza, which translates to differences in the baked end result. But does it differ from pizza to pizza as much as we think? Variation is intrinsic to any recipe. As a matter of fact, the innate variations in quality of ingredients, human handling, the "living" fermentation process (especially for doughs containing levain), and the temperature can all vary from day to day. When we achieve a superior result in a certain set of circumstances, this naturally (and erroneously) leads us to believe that we have to maintain this routine in order to make great pizza every time. How can we avoid this pitfall?



Different slices from the same focaccia

In regulated scientific environments, processes are repeated tens to hundreds of times to assess the process variation leading to a product's quality attributes. This allows for the establishment of a statistical range of variation for different criteria that would characterize the product. Once a range is established, a product's critical quality attributes (CQAs) would require any newly made batch to either be in range of the statistical variation, or to be dismissed for failing the quality criteria. In other words, a product would be considered different from the desired result if it falls outside the range of the established statistical variation.

When comparing baking techniques and conditions, our goal is to determine if the difference that we see is statistically significant. We did this by measuring volume in our bread-like pizzas that have high-hydration ranges (70%–87% hydration). The expected variation in these thicker doughs will be higher than that of lower-hydration dough, which doesn't rise as much, so its variation will be smaller and its volume more undeviating. Although volume isn't the only factor in determining pizza quality, it is one that is easy to objectively measure, unlike taste (see How to Set Up the Triangle Test on page 9). And volume is a key quality attribute that pizza makers look for in pizza.

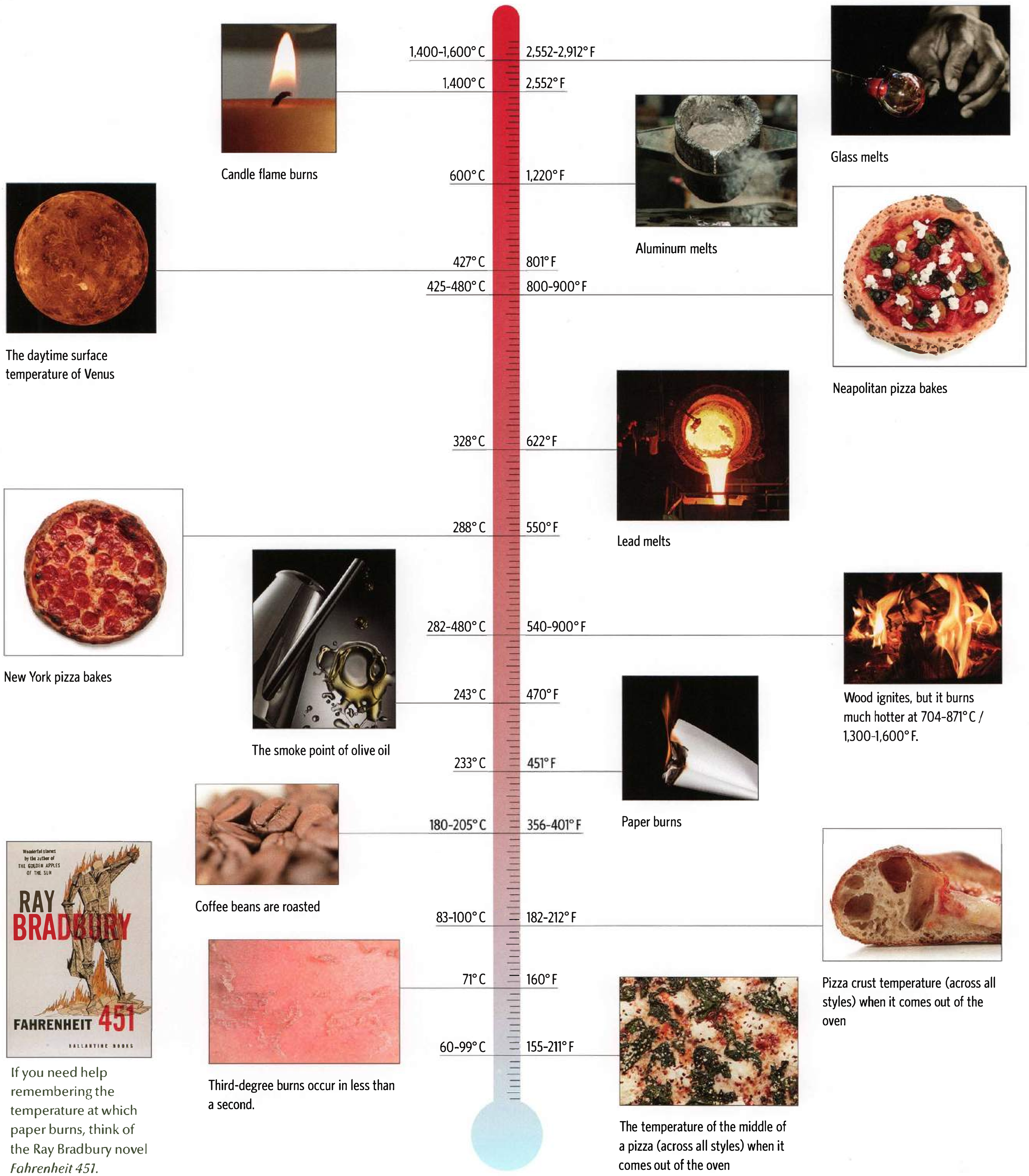
We started the experiment with focaccia. We prepared 20 versions of the master recipe in four batches over the course of 4 days. Each batch resulted in five pizzas baked at the same time. The focaccias were stippled by a custom-prepared stippler to remove the element of human hands causing variation. We established our standard deviation based on the resulting volume measurements and then repeated this procedure for New York square, al taglio, and Detroit-style pizzas to obtain their volume ranges. Three standard deviations would cover 99% of "control" pizzas—pizzas prepared according to our master recipe at the Modernist Cuisine facility by our chefs; two standard deviations would cover 95%. The percent standard deviation (called CV for Coefficient of Variation) is defined as standard deviation divided by mean value and multiplied by 100: % Relative Std Dev (CV) = STDx100/Mean.

The photos at left show the volumes of five focaccias baked on the first day, and equally divided in six slices using a ruler. The first focaccia is a good illustration of the concept of slice to slice variation. It has a very thin first slice and a much thicker last slice, which is quantitatively confirmed by the volume measurements (the smaller slice has a volume of 501.94 cm^3 and the bigger slice has a volume of 857.61 cm^3). The difference between the two slices is as high as 52%. Even within the same pizza, the slices can vary so much that it looks like they came from two different pieces of baked dough.

With open-crumb crusts, there's natural variation from one pizza to the next, and you can usually mitigate any differences with experience and pizza-making techniques. With all their efforts to be consistent, a working pizzeria will always provide products that vary day to day and, within the same day, from batch to batch. If making a change to your ingredients or technique results in a pizza that falls within the standard deviation range, then that change is producing virtually the same pizza and doesn't need to be made. We think this is probably why there are some amazingly complicated dough recipes, but it's very hard to believe those things actually matter.

SOME LIKE IT HOT

The temperature of a wood-fired oven can get up to a blistering 425–480°C / 800–900°F, which is well-suited for baking Neapolitan pizzas. We bake other pizza styles at a more modest 245–285°C / 475–550°F. Of course, the temperature of the pizza itself doesn't get close to those baking temperatures (unless they are burnt). You might be surprised to learn what happens to other materials at similar temperatures. For example, a Neapolitan pizza bakes at temperatures hotter than molten lead.



DONE VERSUS OVERDONE

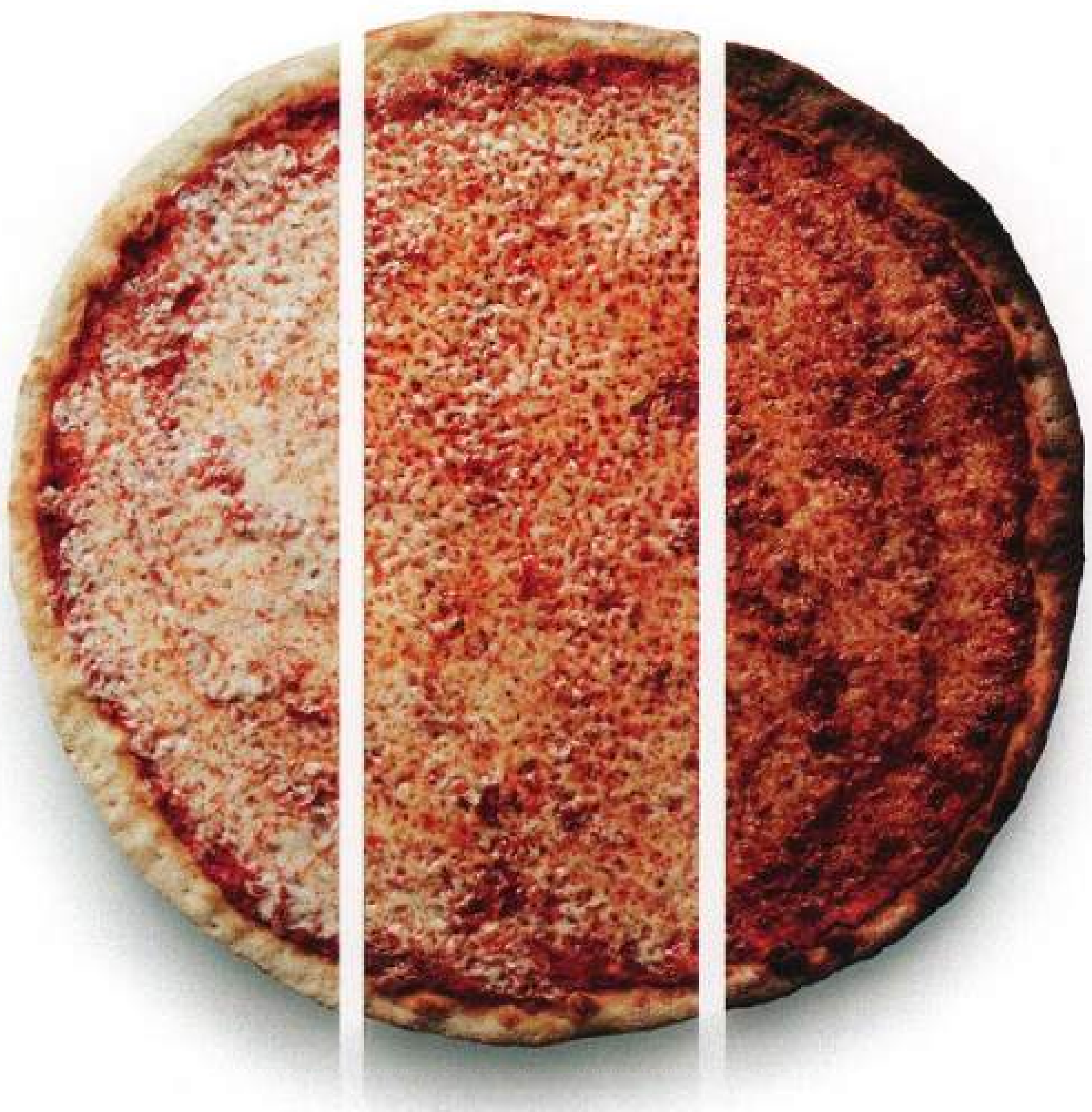
You've probably seen mouthwatering pictures of pizza your entire life. You can imagine the perfect slice of New York pizza, glistening with slightly charred pepperoni and a golden-brown rim ready to be folded and eaten as you walk down the street. In real life, you've probably also seen some pale pizza with an underdone gummy crust. Or, in the other direction, a burnt crust and toppings.

When it comes to doneness, there are different schools of thought, depending largely on the preference of the pizzaiolo. Many pizza makers prefer a golden-brown pizza while others like to bake their pizzas a little darker, especially in the cases of Neapolitan or artisan pizzas (although we found some styles, like New Haven pizza, to be burnt the majority of the time; see page 1:97).

We want to be clear that there is a difference between pizzas that are dark brown (this is called bien cuit in bread circles) and pizzas that are burnt. The leoparded spots that you see on Neapolitan pizzas are scattered across the surface of just-baked dough (see page 1:366). You'll get contrasting textures and flavors in these crusts. When you see crusts where the majority of the surface is black and carbonized, the crust will taste acrid with off-flavors (burnt foods have also been linked to carcinogens). We're all for serving a pizza with a crispy crust, but it shouldn't be burnt.

These photos show you the baking gradient for nine of our master pizza doughs so that you can see what each crust looks like from underdone to brown to slightly charred to burnt; what the cheese looks like when it's properly melted (and possibly browned); and what the sauce looks like when it is too wet, the perfect consistency, and overdone.

THIN-CRUST PIZZA



underdone / properly baked / overbaked

NEAPOLITAN PIZZA

underdone / properly baked / overbaked

NEW YORK PIZZA

underdone / properly baked / overbaked

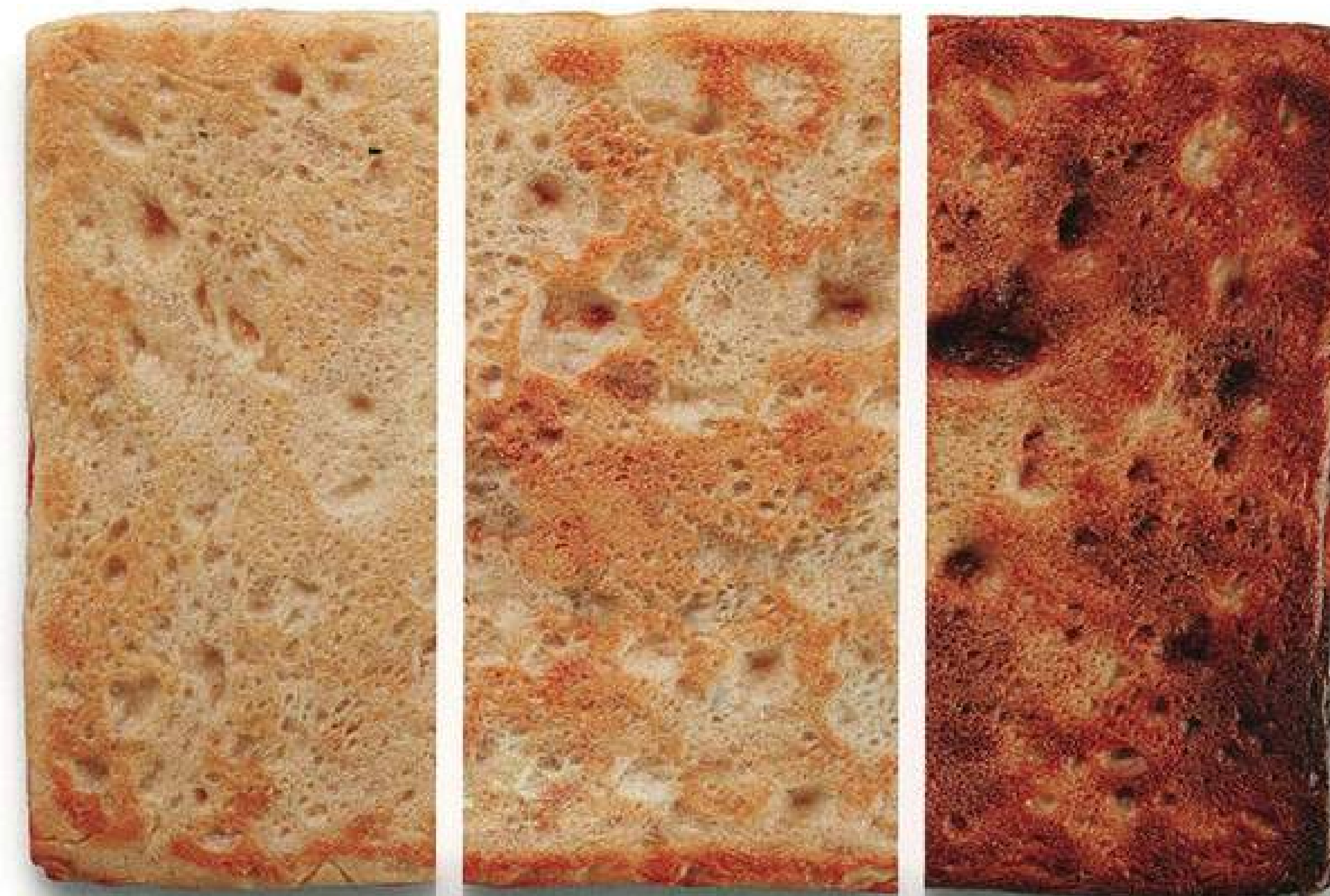
ARTISAN PIZZA

underdone / properly baked / overbaked

FOCACCIA

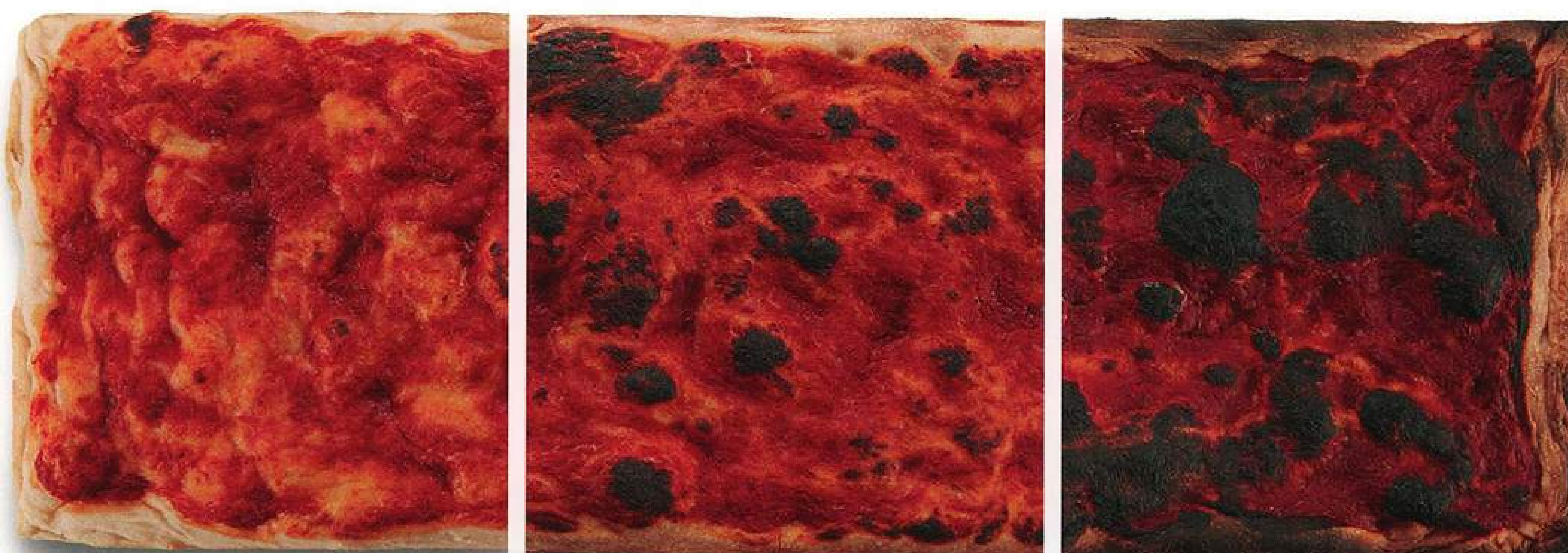
underdone / properly baked / overbaked

NEW YORK SQUARE
(prebaked bottom)



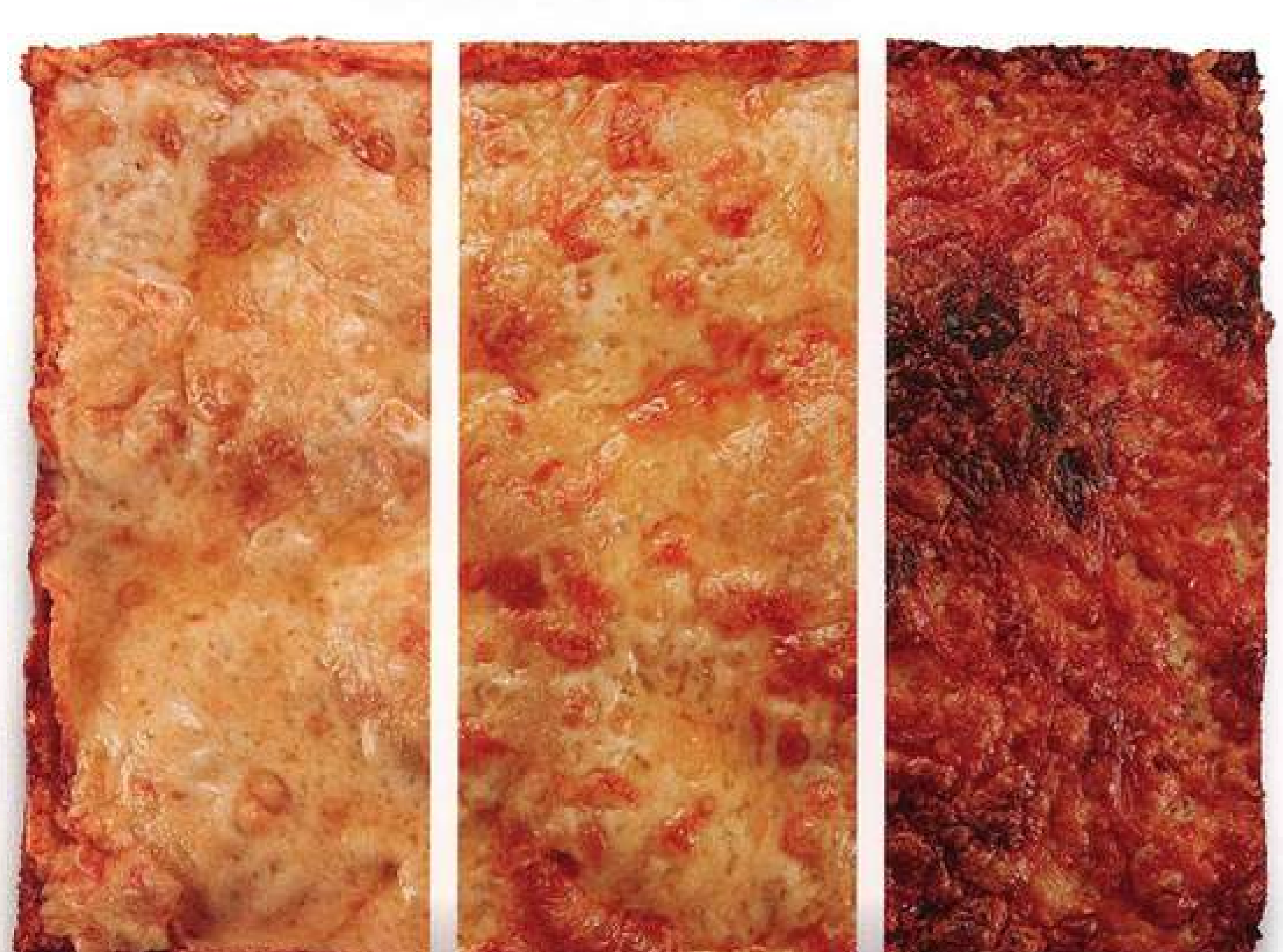
underdone / properly baked / overbaked

AL TAGLIO PIZZA
(after baking, before topping)



underdone / properly baked / overbaked

DETROIT-STYLE PIZZA



underdone / properly baked / overbaked

DEEP-DISH PIZZA

underdone / properly baked / overbaked

COMMON PIZZA BAKING PROBLEMS

Multiple factors can impact pizza as it bakes. Your dough, sauce, and cheese are all baking at different rates (see The Pizzaiolo Equation, page 1:372). You have to contend with oven temperature recovery and monitoring your pizza to ensure even baking. We outline some key problems below, along with solutions.

FIXABLE

Problem	Solution
The pizza has a soupy center.	Bake the pizza for a little longer or at a lower temperature. You could also use a thicker sauce or less of it. Try precooking toppings like mushrooms that release a lot of water during cooking.
There is unmelted cheese on the pizza.	Temper your ingredients so everything bakes at the same rate. The pizza might be too densely topped. The oven temperature may be too low. You might need to bake the pizza longer if the crust is pale too.
The crumb of the crust is gummy.	Try baking the pizza for longer. If it's only slightly gummy, place it near the mouth of the oven, where it is cooler, to finish baking.
Baking is taking longer than normal.	Let your oven recover between baking in certain spots.
The top of the pizza is underdone.	If the rest of the pizza is baked, lift the pizza off the floor with a peel and raise it toward the top heat of the oven (this is generally done with Neapolitan pizzas). You can also torch the top of the pizza with a heat gun if top heat is not available in your oven.

Soupy center

Pizza is underdone

Gummy crumb

Slow baking

Undermelted cheese

WHAT TO DO NEXT TIME

Problem	Solution
The pizza is burnt on the bottom.	The pizza is getting too much heat from the bottom. You could lower the temperature of the floor of the oven if that's an option. You can also lift the pizza up on the peel briefly to keep it from burning or move it to the mouth of the oven, where it's cooler (this generally applies just to Neapolitan pizza).
The pizza is burnt on one side.	Rotate the pizza as it's baking.
There are burnt ingredients on the pizza.	Try assembling the pizza differently so that delicate ingredients are protected from the heat by sauce or cheese. You can also add those toppings after the pizza is baked. If the crust is also burnt, lower the oven temperature.
Flour is caking or burnt in spots on the bottom of the pizza.	There's too much flour on the dough before you load it in the oven. If you're using semolina to dust your peel, sweep the soot off the oven floor because semolina tends to burn.

Burnt on the bottom

Burnt on one side

Burnt ingredients

Caked/burnt flour

HOW TO Bake Pizza in a Pizza Deck Oven

Recommended doughs: thin-crust, Brazilian thin-crust, deep-dish, New York, artisan, focaccia, New York square, high-hydration al taglio, Detroit-style

1 Set the oven temperature and open the vent halfway. If you have both a top and bottom thermostat, set them to the same temperature. If you have a temperature distribution button, see the Strategies for Pizza Ovens on page 1:380 for specific protocols.

2 Shape the pizza dough and apply sauce, cheese, and toppings (see page 3:3).

3 Load the pizza in the oven (see page 390). If baking more than one pizza at a time, always place the first pizza in the back of the deck floor, then the second one next to it.

4 Set the timer and bake for the recommended time. Rotate the pizza as instructed in the recipe. The lower the baking temperature, the less frequently you have to rotate it. Most pan-baked pizzas require rotating only once, 180°. For oven-floor-baked pizzas, depending on the size, rotate once or up to 4 times (rotate 90° each time).

5 Remove the pizza from the oven with a peel.

HOW TO Bake Pizza in a Bread Deck Oven

Recommended doughs: thin-crust, Brazilian thin-crust, deep-dish, New York, artisan, focaccia, New York square, high-hydration al taglio, Detroit-style

1 Set the oven temperature. If you have both a top and bottom thermostat, set them to the same temperature.

2 Shape the pizza dough (as needed) and apply sauce, cheese, and toppings (see page 3:3).

3 Load the pizza in the oven (see page 390). If baking more than one pizza at a time, always place the first pizza in the back of the deck, then the second one next to it.

4 Set the timer and bake for the recommended time. Rotate the pizza as instructed in the recipes. The lower the baking temperature, the less frequently you have to rotate it. Most pan-baked pizzas require rotating only once, 180°.
For oven-floor-baked pizzas, depending on the size, rotate once or up to 4 times (rotate 90° each time).

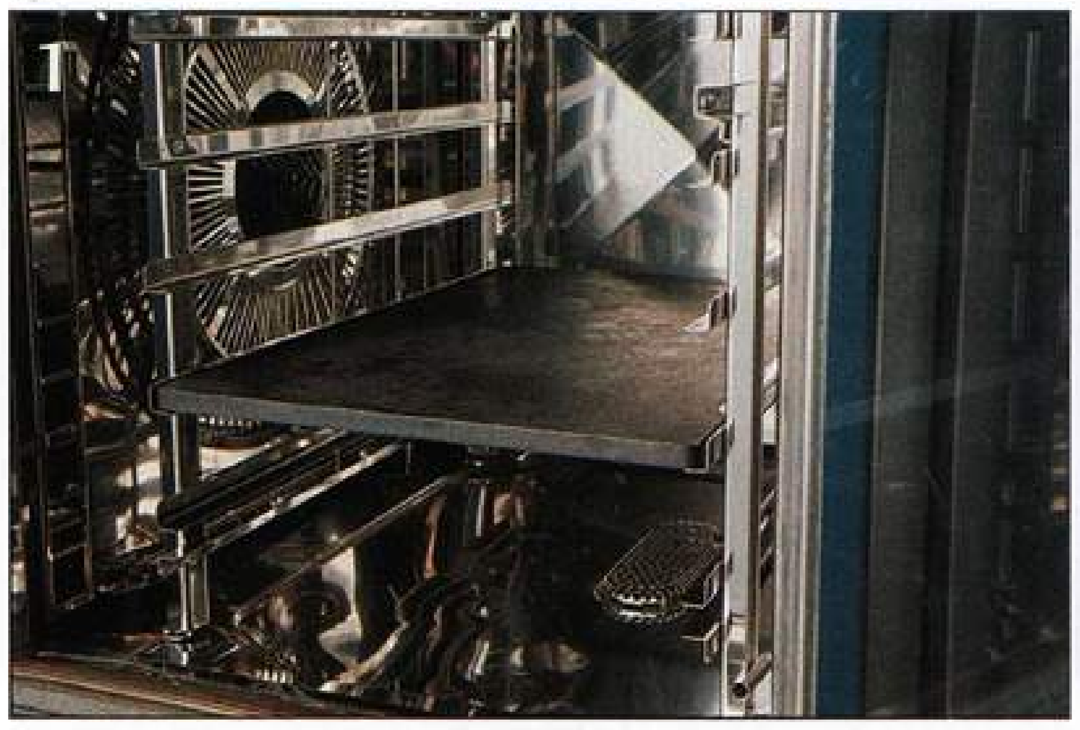
5 Remove the pizza from the oven with a peel.

These al taglio pizzas from Panificio Davide Longoni in Milan are baked in a bread deck oven.

HOW TO Bake Pizza in a Combi Oven

FOR FLOOR-BAKED PIZZAS

Recommended doughs: thin-crust, Brazilian thin-crust, New York, artisan



1 For a half-sheet-pan-size combi oven, use a custom-cut baking steel. For a full-sheet-pan-size combi oven, place baking stones or a full-size baking steel inside.

2 Preheat the oven to 285–300° C / 550–575° F for at least 10–15 min before baking to get the steel or baking stones hot enough.

3 Turn the fan to the lowest speed.

4 Shape the pizza dough and apply sauce, cheese, and toppings (see page 3:3).

5 If using a peel, slide the peel's front end to almost meet the farthest end of the baking stone or steel. With quick-jerk-back-and-forth motions, drop the pizza onto the hot surface.

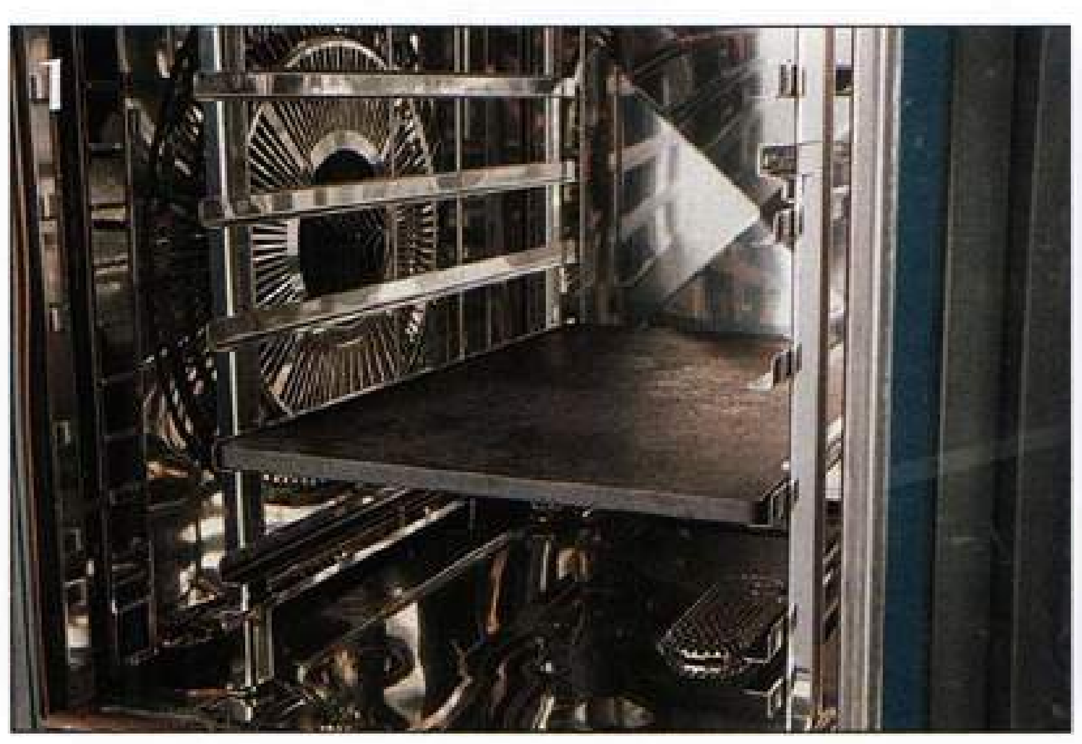
6 Set the timer and bake for the recommended time. Rotate the pizza as instructed in the recipe.

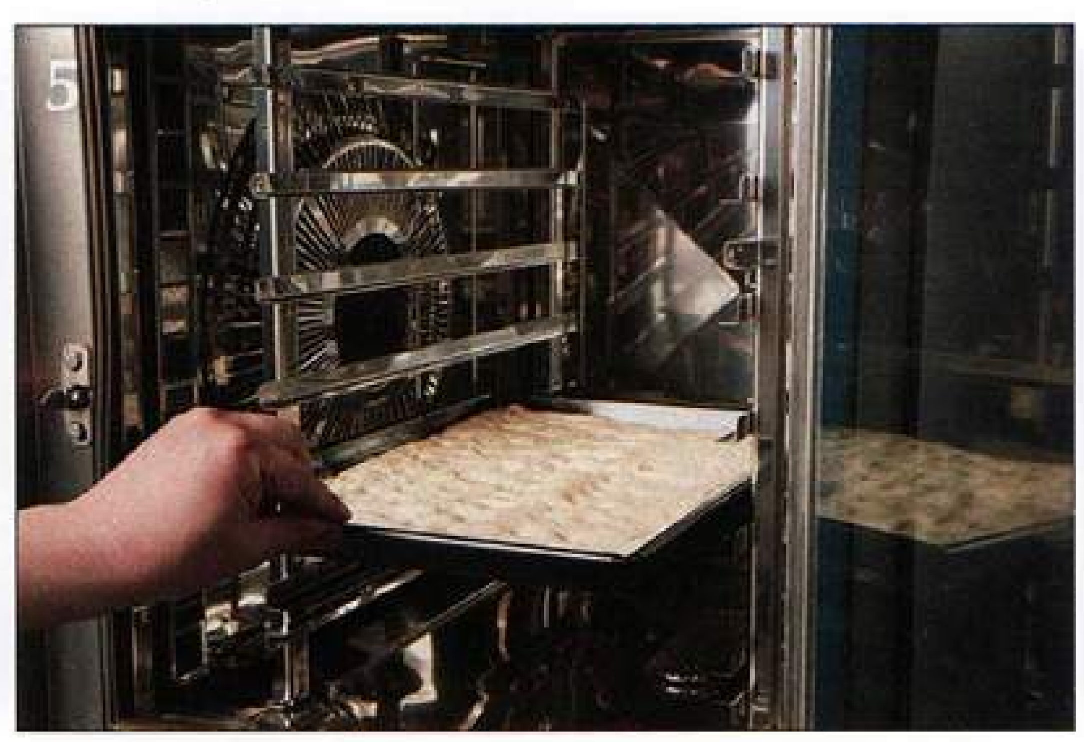
7 Remove the pizza from the oven with a peel.

Combi ovens do not get hot enough to bake Neapolitan-style pizzas. The highest temperature that you can get to is 300° C / 575° F, and it won't hold that temperature for long. You can preheat at this temperature but then turn it down to 285° C / 550° F.

FOR PAN-BAKED PIZZAS

Recommended doughs: deep-dish, focaccia, New York square, Detroit-style





1 For a half-sheet-pan-size combi oven, use a custom-cut baking steel. For a full-sheet-pan-size combi oven, place baking stones or a full-size baking steel inside.

2 Preheat the oven to 285–300° C / 550–575° F for at least 10–15 min before baking to get the steel or baking stones hot enough. The exception is focaccia, which is baked at 245° C / 475° F.

3 Turn the fan to the lowest speed.

4 Once the dough has proofed in the pan, apply the sauce, cheese, and toppings (see page 3:3).

5 Slide the pizza directly onto the preheated baking stone or steel.

6 Set the timer and bake for the recommended time. Rotate the pizza as instructed in the recipes.

7 Remove the pizza pan from the oven using dry kitchen towels, oven mitts, stainless steel pliers, or grippers.

HOW TO Bake Pizza in a Convection Oven

Recommended doughs: thin-crust, Brazilian thin-crust, deep-dish, New York, artisan, focaccia, New York square, high-hydration al taglio, Detroit-style

1 Preheat the oven to 245° C / 475° F for at least 15–20 min before baking to get the steel or baking stones hot enough.

2 Follow steps 3–7 in How to Bake Pizza in a Combi Oven above.

HOW TO Prepare a Wood-Fired Pizza Oven

Decide what side of the oven you'll use for burning wood. This is a matter of personal preference and has nothing to do with dexterity, but the wood needs to be on the left, center, or right of the oven floor, not in the back (you can build the initial fire there, but it will need to be moved to one side or the other during service).

1 Choose your wood to get the fire started (see notes below). It should not be too large (ideally 10–20 cm / 4–8 in wide).

2 Make a crisscross pattern of similarly sized logs, making sure they have enough space in between so that oxygen can flow through and help the fire burn easily. Use larger logs only once the oven is already at temperature; bigger logs will burn longer, so they don't need to be replaced as frequently.

You'll need to get kiln-dried wood, preferably a hardwood. Oak is the most common in Italy, but beech, applewood, hickory, mesquite, and almondwood are also used. Soft woods tend to burn very quickly, but we noticed in Brazil that compressed eucalyptus was the most commonly used wood. We don't recommend pine, redwood, spruce, or cedar.

Small rounded logs can be hard to stack since they roll off each other quite easily. Instead, we suggest smaller log pieces cut from a large log; they have two flat sides, which helps keep them in place.

3 We like to place both a rolled-up piece of newspaper and some wood shavings, kindling, or sawdust between several of the logs to get things going. You can also shoot a stream of lighter fluid over the whole thing, but be careful when you reach in to light things up, so you don't burn yourself.

4 Light a long rolled-up piece of newspaper and use it to light the pieces of newspaper in the oven. Start from the back of the log pile and move toward the front. The lit paper should light the wood shavings, which will then light the logs. If the logs don't light easily but the wood shavings are burning, add more rolled-up newspaper to the mix. Use a pair of long tongs to help place the paper rolls strategically; don't just throw in the paper and hope for the best. Use a peel or shovel to drop wood shavings over the area that's already lit; they'll help intensify the fire because they light quickly.

5 Now you have the logs lit, but the oven still isn't ready. It still needs to get hot enough to cook the pizzas. The time will vary from oven to oven, but if you start from a cold oven, it can take a few hours. At closing time in some pizzerias, they let the fire burn to embers and close the oven door to keep it as warm as possible. This way, the oven will take less time to come up to temperature the next day.

6 During pizza baking, make sure to keep feeding logs on the fire, or alternate logs with wood chips to keep the fire placement (see page 1:354) and desired temperature consistent. You should regularly sweep ash and spent embers from the oven floor so they don't stick to the bottom of the pizza.

If you built the fire in the center of the oven, move it to one side using a metal shovel and sweep the oven floor to remove any soot.

You can use a metal peel to help tend the fire if the burning logs start to roll toward where the pizza is baking.

HOW TO Bake Pizza in a Wood-Fired Pizza Oven

Recommended doughs: Neapolitan, thin-crust, Brazilian thin-crust, New York, artisan

1 Prepare a fire to get the oven up to temperature (see previous page). Our preferred temperature is 455° C / 850° F since we typically use this type of oven for Neapolitan pizzas. You can use it at much lower temperatures for other styles of pizza; you will simply need to use less wood or add logs less frequently.

2 Shape the pizza dough and apply sauce, cheese, and toppings (see page 3:3).

3 Load the pizza into the oven (see page 390).

4 As soon as you begin to see browning and blistering on the rim, slide a small peel under the pizza and begin to rotate it (see page 406).

5 Lift the pizza by one end with the peel while it's still inside the oven to check the under crust. It should be pocked with small blister marks in an irregular pattern but not have too many dark blisters.

6 Pull the pizza closer to you and check to see if the sauce and moisture from the cheese have evaporated enough. If not, "dome" the pizza by lifting it toward the domed top of the oven for 5–10 s. Remove the pizza from the oven with a peel.

7 If you're baking a second pizza right away, make sure you place it in a new spot to avoid the area of the oven floor that will have cooled down from the previous pizza.

8 Keep track of the oven temperature while you're baking. Add more wood, wood shavings, or sawdust when the temperature starts to drop more than 14° C / 25° F.

You'll find a lot of information about wood-fired ovens in this chapter, including how to prepare the oven and how to successfully bake a pizza and avoid burning the crust. We want to emphasize that even though wood-fired ovens are popular in artisan pizzerias, there are better ways to get a consistently good pizza (see page 1:354), especially if you haven't worked with these oven extensively.

The best pizzaioli we have met can bake three pizzas at a time, but this takes a lot of practice. Two at a time is more manageable, but we recommend that you bake only one at a time until you've had plenty of practice.

As the wood burns down, use a third, much sturdier peel to move the wood and excess embers before adding more fuel to the fire.

The main reason to "dome" (or cook only the top by lifting it up) is to help evaporate any extra water on the surface of the pizza if the rest of it is already baked. If you have a very wet sauce, it can help eliminate the excess moisture. Once you have more experience, however, you won't need to dome your pizza.

HOW TO Bake Pizza in a Gas-Fired Pizza Oven

Recommended doughs: Neapolitan, thin-crust, Brazilian thin-crust, New York, artisan

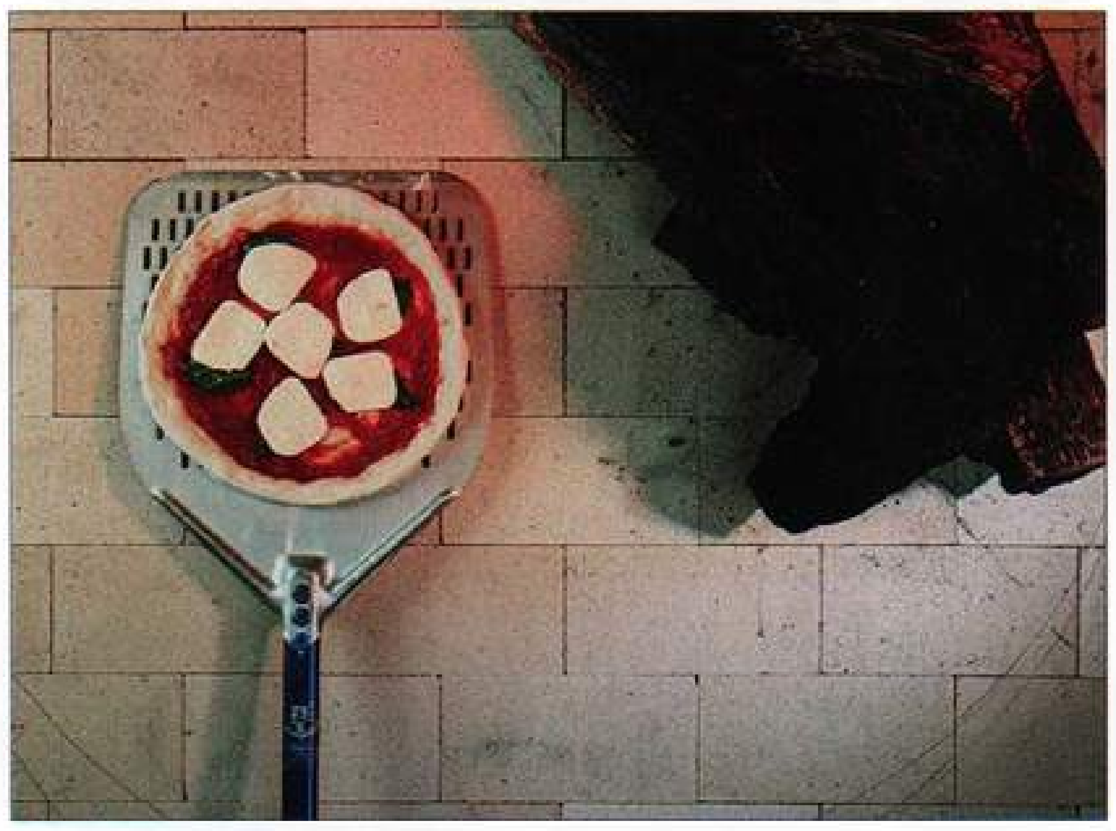
1 Preheat the oven to 455° C / 850° F for 1½–2 h before you start baking.

2 Proceed with steps 2–5 of How to Bake Pizza in a Wood-Fired Oven (see above).

3 Remove the pizza from the oven with a peel.

PEEL GYMNASTICS IN WOOD-FIRED AND GAS-FIRED PIZZA OVENS

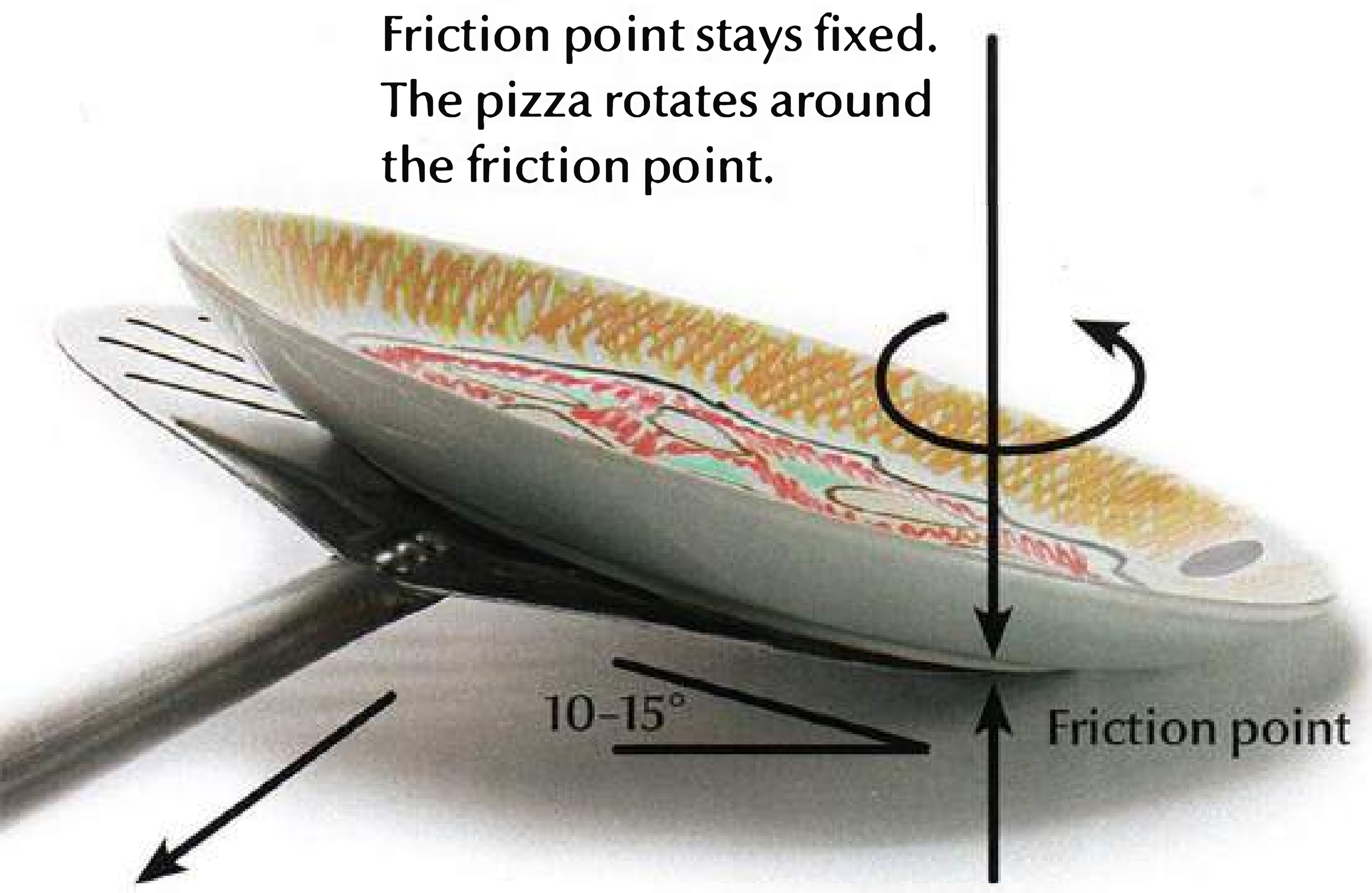
One of the hardest skills to master in a wood-fired or gas-fired pizza oven is manipulating the pizza in the oven. You need two types of peels, one to load the pizza and another smaller peel to spin the pizza while it's in the oven so that it'll bake evenly. The basic motion for handling the pizza while it is in the oven is the same for both types of ovens, although some pizziaoli will spin their pizza using a quarter-turn motion (see page 405), while others spin their pizza continuously (the latter takes a significant amount of experience). The more you spin it, the more evenly the pizza will bake. It's important to spin the pizza in the same spot, wherever you placed it in the oven. Keep in mind that if you are making two pizzas, you'll have to babysit both, which is why we recommend baking only one pizza at a time until you've gotten some practice under your belt.



Load the pizza into the oven. Place it in a spot where you didn't just bake a pizza.

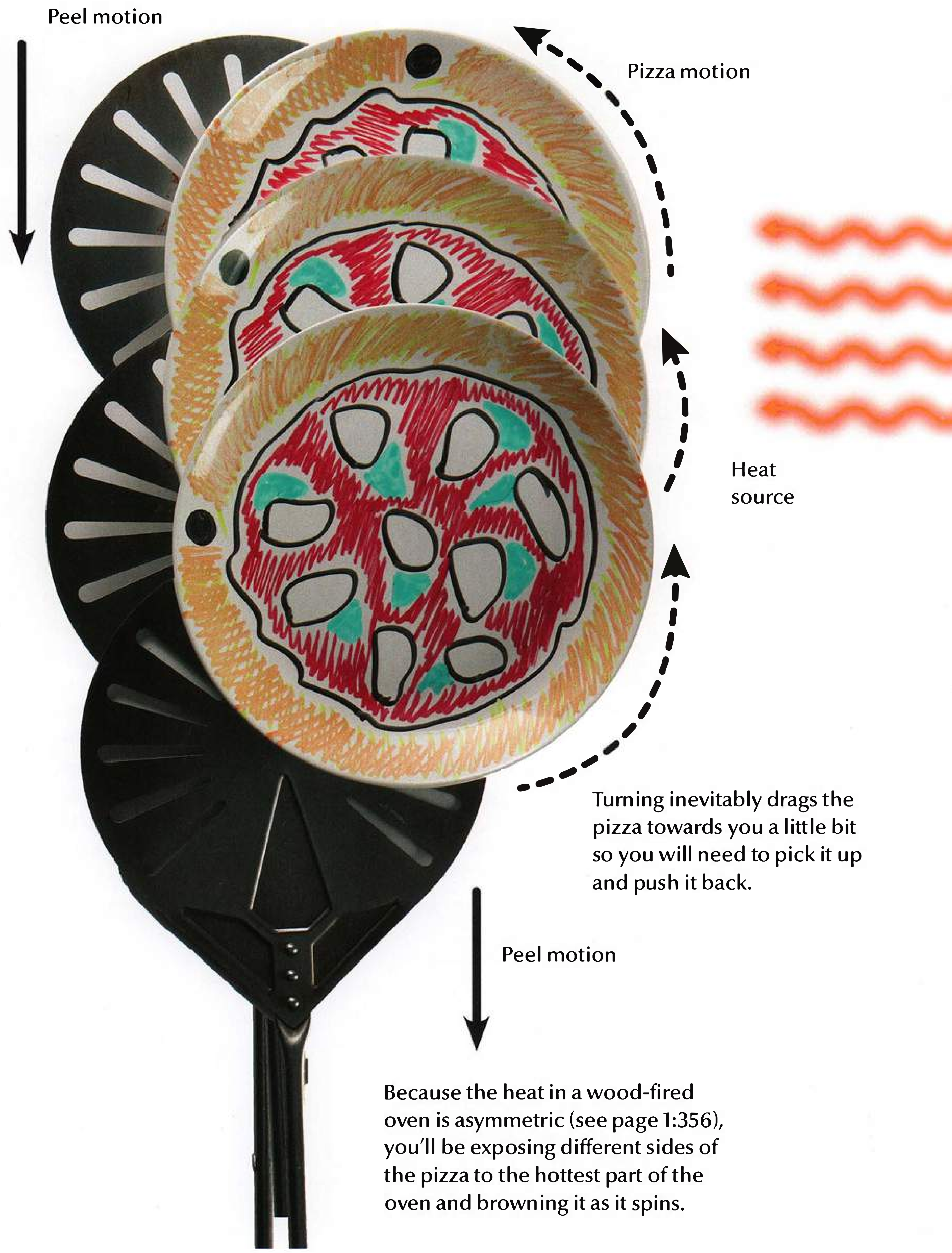
Some pizzaioli spin the pizza constantly rather than doing quarter turns. Rather than pulling the pizza back and forth, they are moving it constantly with a motion that traces the pattern of an oblong oval.

Friction point stays fixed. The pizza rotates around the friction point.



Place the peel under one side of the pizza, not in the middle. Tilt the peel up 10–15°. The gravity of the untilted side will help keep the pizza in place on the peel.

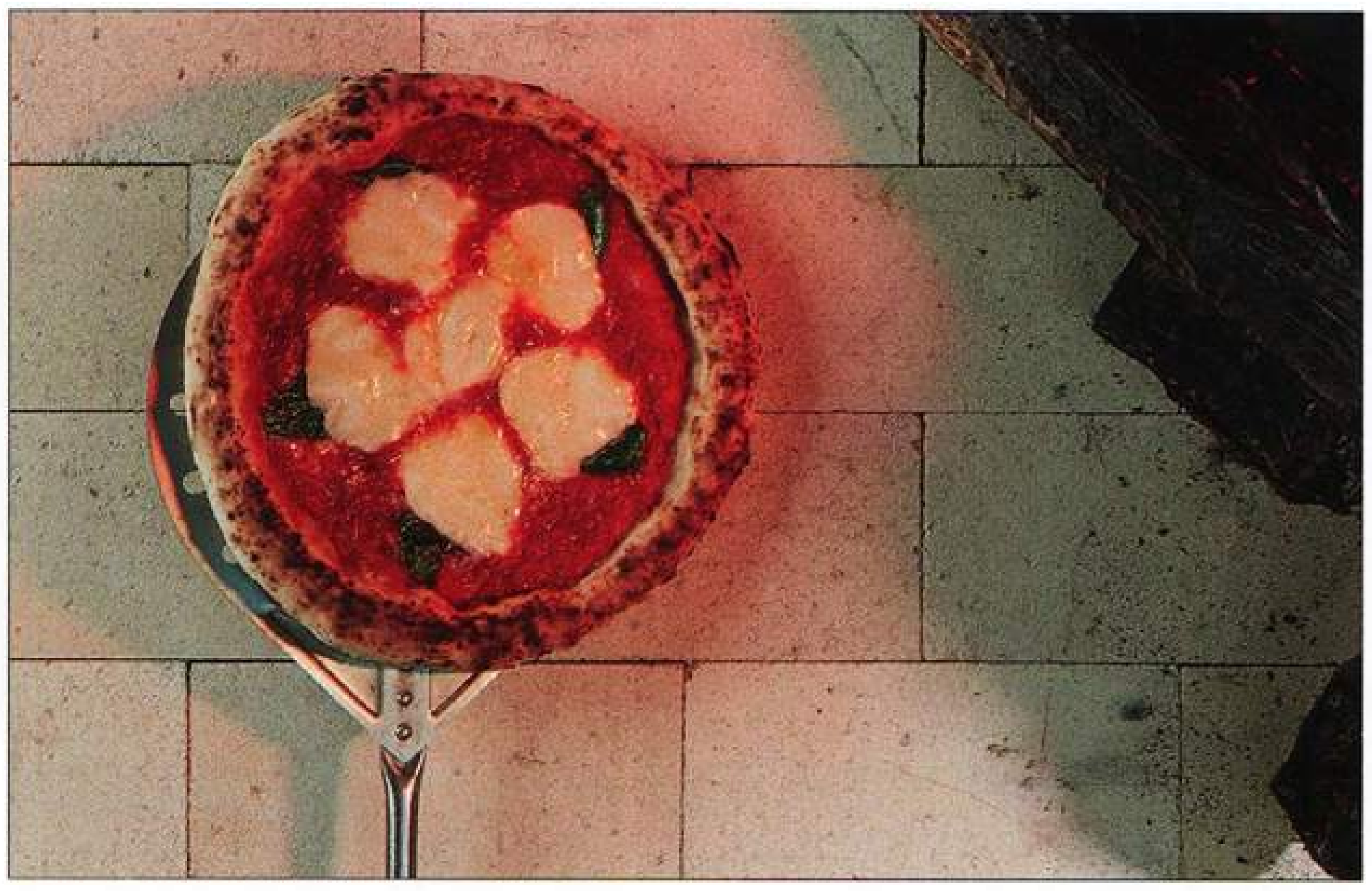
The next best thing to spinning a real pizza in the oven is to practice with a plate (we initially tried this with a paper plate, but it was too light). Pick a plate that weighs between 350 and 400 g; if it's a little heavier, that's fine. Mark one spot with a dry erase marker and practice spinning the pizza according to the instructions above.



Because the heat in a wood-fired oven is asymmetric (see page 1:356), you'll be exposing different sides of the pizza to the hottest part of the oven and browning it as it spins.

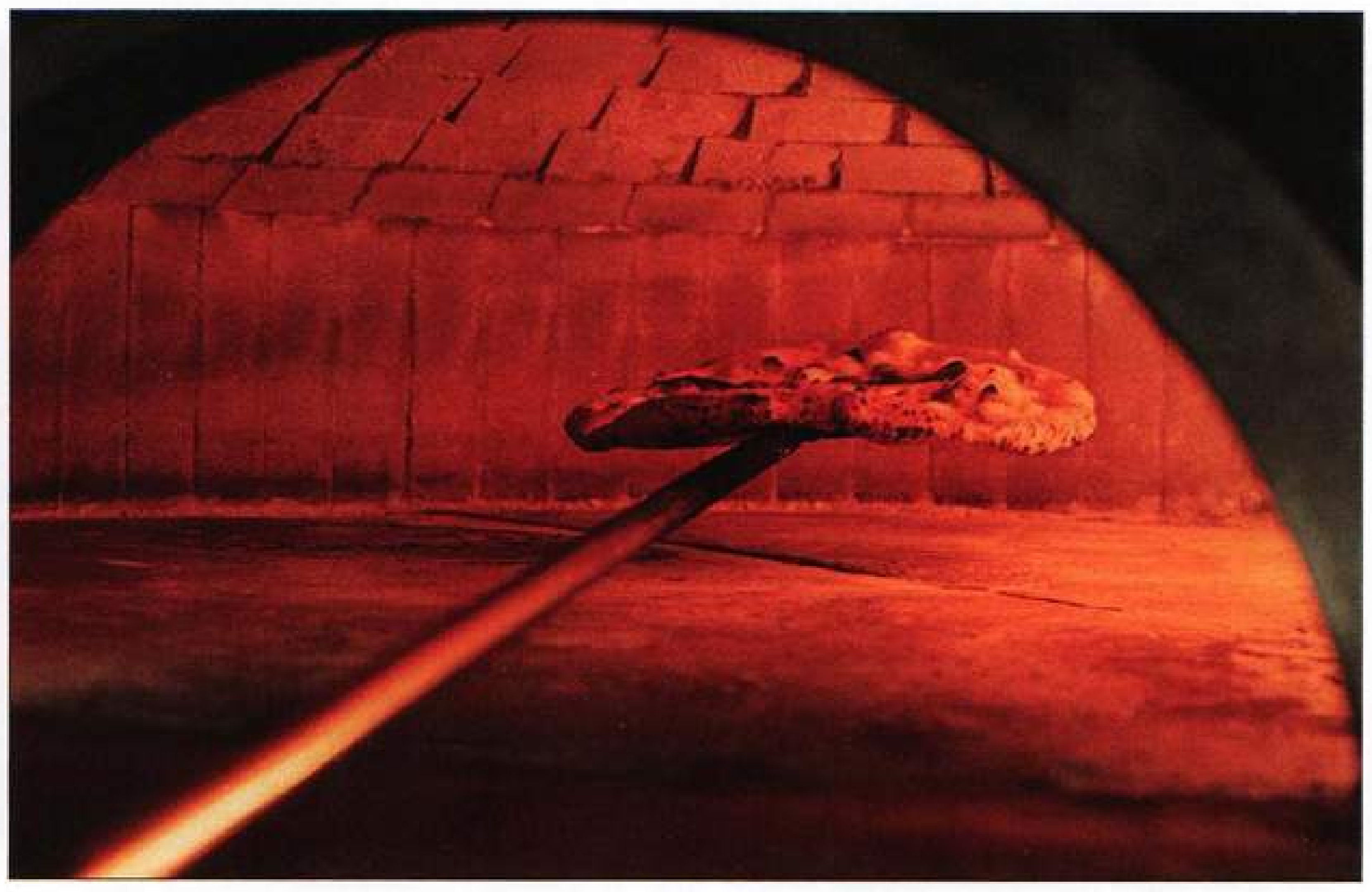
Pull back toward you slightly and then push the pizza back in place, spinning it 90°. Count to 10 and spin it another 90°. Continue giving the pizza quarter turns until it is baked.

When the pizza just starts to blister, slide the spinning peel underneath it.



After you spin the pizza, place it on the center of the peel and return it to the original spot where it was baking.

Check the bottom of your pizza for doneness when you get close to the end of baking.



If your pizza crust is evenly browned but the toppings aren't cooked to your liking, you can dome the pizza by simply putting it close to the oven ceiling for a few seconds.

THE BENEFITS OF THE GAS-FIRED PIZZA OVEN

Even heat is the key to baking high-quality pizzas consistently. While it is widely known that all ovens have hot spots (see page 1:385), we were surprised to learn how differently the heat is distributed in a wood-fired versus a gas-fired pizza oven. Even though you use the two ovens in similar ways, and they may appear superficially to be the same, the heat is much more asymmetrical in a wood-fired pizza oven (see page 1:356).

A gas-fired pizza oven is going to give you a much more accurate oven temperature, not only in the way that it heats but also because the heat source is constant. As the wood burns down and is replenished, the temperature fluctuates and is inconsistent. We noticed this pattern when we visited pizzerias that used wood-burning ovens. Although the pizzaioli told us that their oven was a certain temperature, when we checked the temperature with an infrared thermometer, it was almost always different (and sometimes wildly different) than what they claimed. Their expertise is what allows them to make great pizza despite the oven being at the wrong temperature. You'll also need a good deal of practice before you know how much wood you'll need to burn to achieve a certain temperature. It's an additional step in the realm of learning how to make Neapolitan pizzas, which is already difficult.

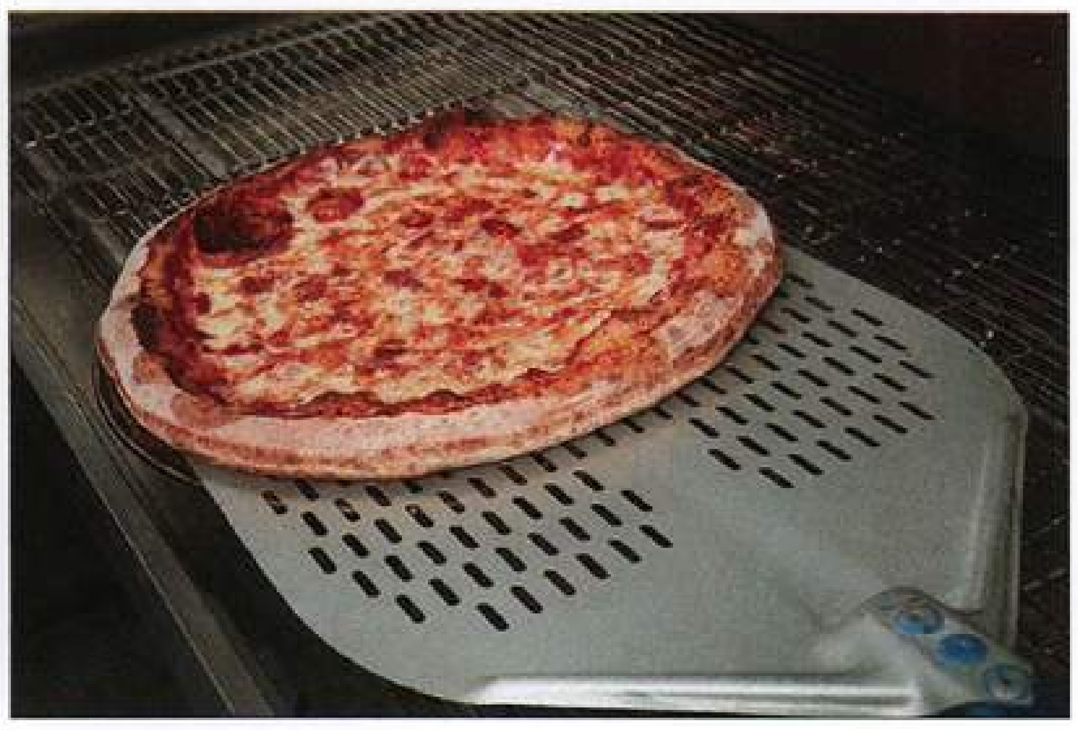
There is also an argument to be made that a gas-fired pizza oven burns cleaner and is more environmentally friendly than a wood-fired

oven. Many cities around the world do not allow or strictly regulate wood-burning ovens because of the emissions they cause. Gas-fired ovens are also cleaner. (A cleaner and more even approach is an electric oven, see page 1:383.) You also have to be aware of where and how you store wood in your kitchen since it's virtually certain the wood will have insects on it.

HOW TO Bake Pizza in an Impinger Oven

FOR FLOOR-BAKED PIZZAS

Recommended doughs: thin-crust, Brazilian thin-crust, Neapolitan, New York, artisan



1 Set the speed of the conveyor belt and the oven temperature.

2 Lightly spray a pizza screen with oil on both sides. It should be the same diameter as the finished pizza.

3 Shape the pizza dough and place it directly on the screen. Adjust the shape if needed.

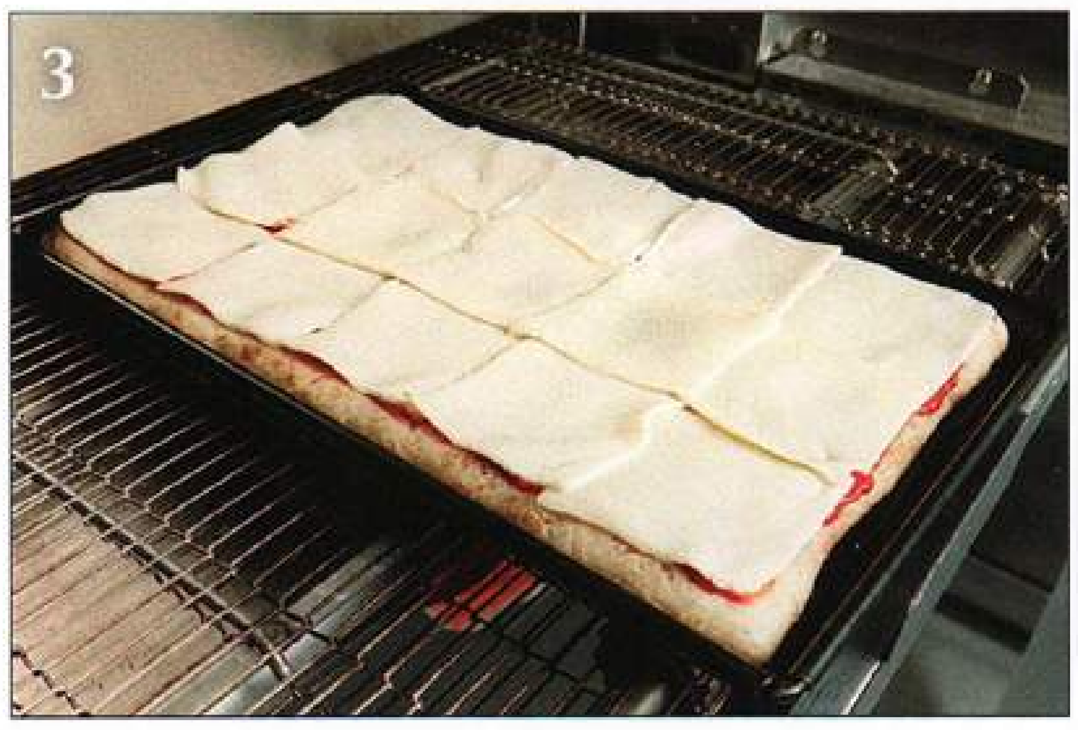
4 Apply sauce, cheese, and toppings (see page 3:3) and place the pizza on the conveyor belt with the screen.

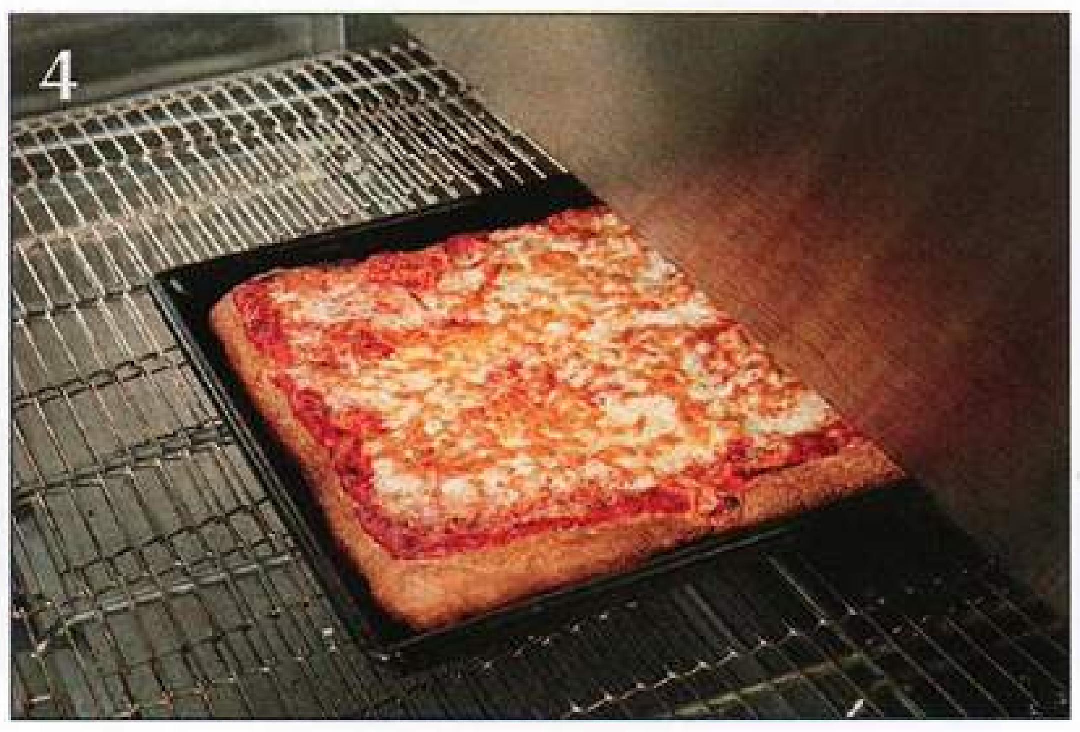
5 When the pizza comes out on the other end, remove it from the conveyor belt with dry kitchen towels, oven mitts, or a peel.

We include impinger oven temperatures in the baking tables in the Iconic Recipes chapter, starting on page 3:3.

FOR PAN-BAKED PIZZAS

Recommended doughs: deep-dish, focaccia, New York square, high-hydration al taglio, Detroit-style





1 Set the speed of the conveyor belt and the oven temperature.

2 Once the dough has proofed in the pan, apply the sauce, cheese, and toppings (see page 3:3).

3 Place the pan on the conveyor belt.

4 When the pizza comes out on the other end, remove it from the conveyor belt with dry kitchen towels, oven mitts, or a peel.

5 Remove the pizza from the pan and place on a cooling rack.

For thin- and medium-crust pizzas, we highly recommend using a lightly oiled fine-mesh pizza screen or rack when baking in an impinger oven. They come in a number of sizes and are extremely helpful in maintaining the pizza's round shape, as well as moving the dough from the table to the oven without damaging it.

For pizzas baked in a pan, make sure your oven is large enough and long enough to fit the pan completely, especially for Roman al taglio pizza pans, which are rather long.

We use a long bench knife (see page 10) or an offset spatula to remove pan-baked pizzas from the oven.

Impinger ovens can be found in pizzerias both large and small, including the one below at Imo's that is being used to make St. Louis-style pizza (see page 1:66).

HOW TO Bake Pizza in a Home Oven

FOR FLOOR-BAKED PIZZAS

Recommended doughs: thin-crust, Brazilian thin-crust, New York, artisan

1. Place a baking steel or stone on an oven shelf 10 cm / 4 in from the broiler. Preheat to 285° C / 550° F for 30 min before baking.
2. Shape the pizza dough and apply sauce, cheese, and toppings (see page 3:3).
3. If using a peel, slide the peel's front end to almost meet the farthest end of the baking stone or steel. With quick-jerk-back-and-forth motions, drop the pizza onto the hot surface.
4. Set the timer and bake for the recommended time. Rotate the pizza as instructed in the recipe.
5. Remove the pizza from the oven with a peel.

Neapolitan pizzas can't be baked in home ovens since they cannot reach the high temperatures needed for this style of pizza.

Most home ovens' highest temperature setting is between 275–285° C / 525–550° F. Go as high as you can.

Make sure your pan fits inside the oven before you begin; ideally it will fit evenly on top of the baking steel or baking stone.

To transfer dough using parchment paper, shape your pizza and place it on a square of parchment paper that is about 5 cm / 2 in wider than the diameter of your pizza. Apply sauce, cheese, and toppings (see page 3:3) and place the parchment paper onto a peel or an upside-down sheet pan. Slide the pizza onto the hot surface.

FOR PAN-BAKED PIZZAS

Recommended doughs: deep-dish, focaccia, New York square, high-hydration al taglio, Detroit-style

1. Place a baking steel or stone on an oven shelf 10 cm / 4 in from the broiler. Preheat to 285° C / 550° F for 30 min before baking.
2. Once the dough has proofed in the pan, apply the sauce, cheese, and toppings (see page 3:3).
3. Slide the pan directly onto the preheated baking stone or steel.
4. Set the timer and bake for the recommended time.
5. Remove the pizza pan from the oven using dry kitchen towels, oven mitts, or stainless steel pliers.

IMPROVING THE PERFORMANCE OF A NON-PIZZA OVEN

Pizza ovens have a hearth floor that gets extremely hot and retains a substantial amount of heat when it is preheated. So, when you put a pizza on it, there's significant heat transfer from conduction. Ovens that are not specifically designed to bake pizzas can present some challenges to the pizza maker. The ovens that are toughest to produce good pizza in are home ovens (with or without convection), professional convection ovens, and combi ovens.

If you have one of those, what can you do to make it work better? The answer varies slightly from oven to oven, but the most important factors are providing a direct heat source to the bottom of the pizza and getting the oven as hot as possible. (Pizza ovens are built to do both, with varying degrees of success; see page 1:375.) Keep in mind that these are the key factors regardless of the style of pizza. Thin-crust and medium-crust pizzas need the high heat for their crust development but even pan-baked pizzas benefit from the heat in order to achieve a crispy bottom crust.

In a traditional pizza oven, the ambient temperature of the air is vastly higher and air makes much less of a contribution (see page 1:354). By contrast, home ovens work by heating the air within the oven. Because home ovens operate at temperatures that are hundreds of degrees colder than a pizza oven, heat transfer from the air is important. If a home oven has convection heat, the oven has a fan that blows the heat around the oven. This speeds up the cooking time, but it can set the pizza crust too quickly and contribute to a reduction in volume. When you load the pizza into a home oven and close the door, the oven will take some time to recover. Combi and convection ovens will take less time to do so since the circulating hot air makes the oven come up to temperature faster than in a still oven.

Additionally, a home oven doesn't have a floor like a pizza oven, and the thin metal walls don't help the situation because they don't hold enough heat. We tried using a baking stone to mimic the hearth of a pizza oven. The problem is that the stone in a pizza oven is much thicker and gets much hotter, so even though the material is the same, using a baking stone isn't that great at improving the performance of a non-pizza oven.

The best way to try to replicate the floor of a pizza oven in a non-pizza oven is to preheat your oven with a baking steel or baking stone for 10–20 minutes (home ovens benefit from a 30-minute preheat). For most pizza styles, we recommend the you place the steel on a shelf 10 cm / 4 in from the broiler in combi, convection, or still electric or gas ovens. Sometimes, we recommend turning on the broiler at some point during baking (see the individual recipes for specific recommendations). Make sure that your oven is calibrated and that you use an oven thermometer to verify the temperature of the oven (see page 1:392).

You can also stack two baking steels on top of each other to retain and radiate heat more evenly. Or you can separate them and cook more pizzas at the same time. If you are making pizzas frequently in these ovens, it might be worth investing in two steels. Keep in mind, however, that some oven racks can't support the weight of two steels and the racks can bend and fall in the oven. Most baking steels won't fit exactly on the shelves of a combi or convection oven, so you might consider getting a custom-cut steel if you will be making pizza often, we recommend 1.25 cm / ½-in thick-cut steel or 2.5 cm / 1-in thick-cut aluminum.

The next best thing to a baking steel is a baking stone. This functions in much the same way but doesn't retain heat as well as the steel. You can use untreated paving tiles to replicate a baking stone but you'll likely need to put a grid of them in your oven to create an area large enough to bake a pizza on, which can be unwieldy. Paving tiles fit nicely in toaster ovens and can be used to improve pizzas that you bake or reheat in them.

Another great alternative to using a baking steel is making pizza in a cast-iron skillet or griddle either in the oven or on a stove top. You want to use something that is flat, shallow, and large enough to cook your pizza. We prefer round cast-iron skillets to rectangular griddles but either will do (round cast-iron griddles with handles, similar to what sizzling fajitas are served on, work well). Be sure to preheat the cast iron to the temperature indicated in the recipe before making your pizza.

While cast-iron skillets provide consistent bottom heat to the pizza, they aren't capable of giving you top heat. We like to use them in conjunction with a heat gun for the stove top or a high-heat broiler in the oven to bake the cheese and toppings to the perfect doneness. We tried using a blowtorch to brown the top of the pizza but it was less successful than the heat gun. The other benefit to using cast-iron skillets that is worth mentioning is that they are multipurpose. As a last resort, you can preheat a stack of three or four upside-down sheet pans to try to provide extra bottom heat to the pizza as it bakes.

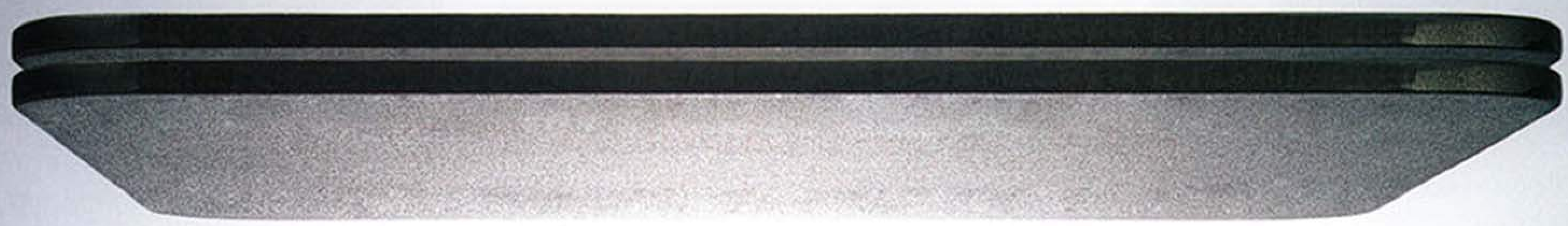
For home ovens, you can preheat the oven 15 °C / 25 °F higher than the recipe's baking temperature calls for, if your oven allows. This is so that the temperature drop from opening the oven door isn't so dramatic. Make sure that when you do close the door and the oven goes back to the desired temperature, you set the oven to the correct temperature in the recipe.

For more on the reasons why you should use a baking steel or stone, see page 1:391.

Keep in mind that you need to maintain your baking steel (in much the same way as cast iron). Before using the baking steel, season it with oil and burn it off. Don't wash your baking steel. If something gets crusted on it, scrub it with salt to clean it. Rub the steel with coats of oil in between uses so that it doesn't rust.

Using a pizza screen (see page 388) makes it easier to load the pizza into the oven. Be sure to coat the screen with spray oil before using. Remove the pizza from the screen a couple of minutes after it goes into the oven so that the bottom of the pizza can brown properly. Slide a peel in between the pizza and the screen and then take the screen out of the oven with tongs or a kitchen towel.

Single baking steel

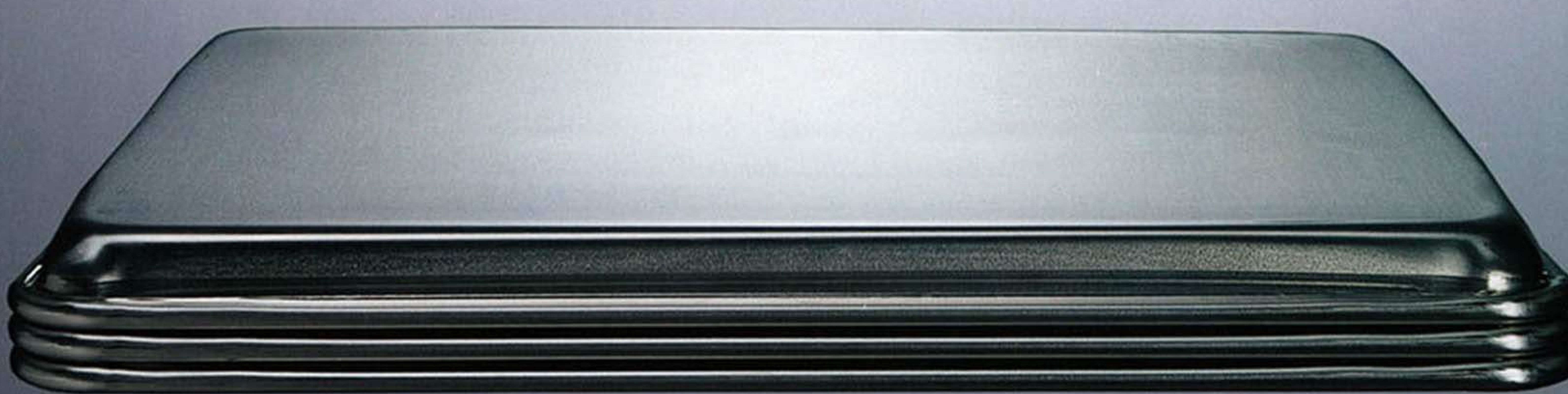


Two baking steels (used alone or in combination)

Shallow cast-iron pan

These pieces of equipment can improve a non-pizza oven, starting with our highest recommendation at the top.

Baking stone



Stack of 3 or 4 sheet pans

HOW TO Cook Pizza on the Stove

Recommended doughs: thin-crust, Brazilian thin-crust, Neapolitan, New York, artisan


3


5a


5b

1 Preheat a grill pan or cast-iron pan to 220°C / 425°F.

2 Shape the dough according to its master recipe. Spray the surface of the dough with olive oil.

3 Place the dough oiled side down in the pan and cook for 2–2½ min. While the pizza is cooking, spray the top surface with olive oil.

4 Remove the dough from the pan and flip it over on a plate or cutting board with the baked side facing up. Apply sauce, cheese, and toppings (see notes below).

5 Return the pizza to the pan and cook for about 3 min. As the pizza is cooking, use a heat gun on the toppings and crust of the pizza to help with heating and browning.

6 Remove the pizza from the pan.

You can use a flat cast-iron skillet or a cast-iron pan with a grill texture. We recommend using the shallow portion of a 30 cm / 12 in cast-iron combi cooker.

If you are making Brazilian thin-crust pizza, it's very important that you replace the flour in the recipe with high-gluten flour (we recommend King Arthur Sir Lancelot High Gluten Flour). Follow the master recipe just until it's time to divide it. You'll divide the dough into 150 g pieces and shape into balls before proofing for the recommended time. You may be able to divide the dough into 175 g pieces, if desired, but you run the risk of the pizza being too big for the pan.

Keep your sauce, cheese, and other toppings at room temperature so they get hot and/or melt faster.

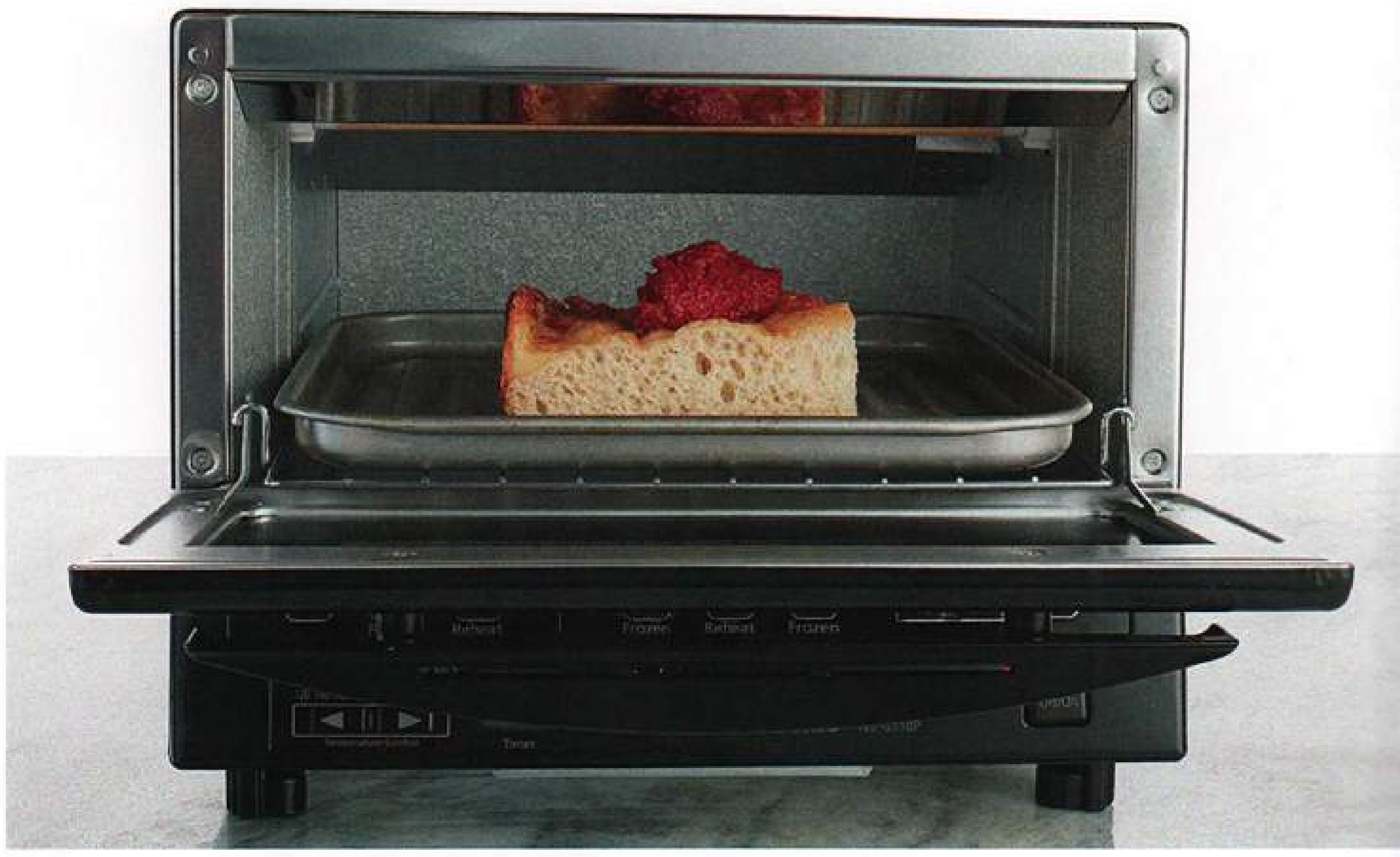
Don't overcrowd the pizza with toppings. The more you put on top, the less hot the toppings will get.

We recommend using a medium-thick sauce, such as the New York / Artisan Pizza Tomato Sauce (see page 227). Spread it evenly across the top of the pizza, leaving a border for the rim.


6

CAN YOU MAKE PIZZA IN A TOASTER OVEN?

The toaster oven isn't exactly your best option for making pizza. It's not the worst, either, but it helps to understand its limitations beforehand. It usually has a very small capacity, so you can make only small pizzas. Most won't even fit a 30 cm / 12 in pizza. And most of them top out at 230°C / 450°F. There are no baking stones or steels on the market that will fit inside these ovens. Most toaster ovens come with small sheet pans that are just the right size to fit inside. Use this sheet pan if you're trying to make a pan-baked pizza. A half-size Detroit style pizza pan will fit in most toaster ovens and will actually produce a reasonably good result. Some casserole pans can also be used, but they don't really produce a crisp bottom. Pie tins will work as well, but we suggest using nondisposable tins because disposable pie tins are very flimsy. We also found that toaster ovens work well for crisping up the surface of our pizza gourmet dough and, of course, they do a fine job of reheating pizza (see page 3:313).



HOW TO Bake in a Breville Pizzaiolo Pizza Oven

1 Preheat the oven for 10–15 min by turning the temperature and darkness all the way up.

You have very little wiggle room in the oven when it comes to the size of the pizza. You can assemble the pizza on the peel to ensure the correct size, but it should be properly floured and you need to work quickly.

2 Shape your pizza with the peel next to it so that you can make sure that it is the right size.

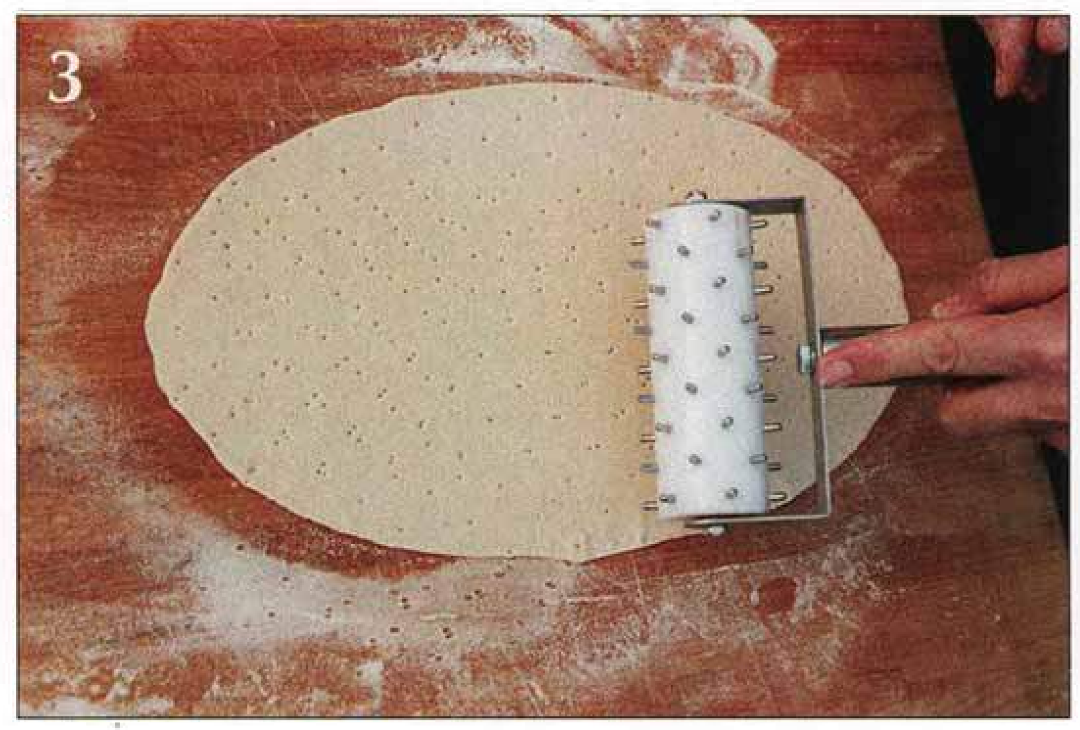
When testing consumer countertop pizza ovens, we found the Breville to be the one that was the easiest to use and that gave you the high heat you need to make top-notch pizzas.

3 Apply sauce, cheese, and toppings.

4 Slide the pizza into the oven and set a timer. It'll take 2–2½ min to bake. Rotate it once while it's in the oven.

HOW TO Grill Pizza

FOR A 55 CM / 22 IN CHARCOAL GRILL
Recommended dough: Brazilian thin-crust



1 Prepare a charcoal grill. Once the coals are ready, move them so they're on only half of the grill. You're aiming for temperatures that are above 480° C / 900° F on the charcoal side and about 205° C / 400° F on the non-charcoal side.

2 Roll out the dough with a rolling pin to an oval/rectangular shape. It should be 30–35 cm long by 10–15 cm wide by 6 mm thick / 12–14 in long by 4–6 in wide by ¼ in thick.

3 Dock the dough (see page 3:12) and spray the surface with olive oil.

4 Place on the non-charcoal side of the grill. Close the lid and cook for 45 s–1 min.

5 Remove the dough from the grill.

6 Flip the dough over so that the baked side is facing up and apply sauce, cheese, and toppings (see notes on the next page).

7 Place the topped pizza back on the grill, off-center toward the charcoal side.

8 Keeping the lid up, cook for 1 min, then rotate the pizza 180° and cook for 1 min more. If the toppings still need additional time, move the pizza to the cooler side and close the grill lid for no more than 30 s at a time.

9 Remove the pizza from the grill using a peel.

Grilled Brazilian thin-crust pizza with thin-crust tomato sauce, provolone, 'nduja, and arugula

FOR A GAS GRILL

Recommended doughs: thin-crust, Brazilian thin-crust, Neapolitan, New York, artisan

1. Prepare a gas grill by turning all the heat settings to high.
2. Once the grill has reached 370–425° C / 700–800° F, turn off one side of the grill and keep the other side on high heat.
3. Shape the dough according to its master recipe. Dock the dough (see page 3:12) and spray the surface with olive oil.
4. Place the dough oiled side down on the high-heat side of the grill and cook for 1 min. While the pizza is cooking, spray the top surface with olive oil.
5. Flip the dough over and cook for 1 min.
6. Remove the dough from the grill and apply sauce, cheese, and toppings (see notes below).

7. Place the topped pizza on the nonheated side of the grill (it should be around 150° C / 300° F). Close the lid. Cook for 6 min, checking the pizza every 2 min.
8. If the pizza still feels a little flabby after 6 min, move to the high-heat side for an additional 30–90 s, keeping the grill lid up to crisp the pizza.
9. Remove the pizza from the grill using a peel.

We tested a number of doughs for grilling pizza, and our favorite recipe was our Brazilian Thin-Crust Pizza Dough (see page 114) since it can be rolled out very thin, is easy to handle, and gets nicely crisp after grilling. (In fact, we had grilled Brazilian thin-crust pizza when we visited São Paulo; see page 1:190.) It's very important that you replace the flour in the recipe with high-gluten flour (we recommend King Arthur Sir Lancelot High Gluten Flour). Follow the master recipe just until it's time to divide it. You'll divide the dough into 150 g pieces and shape into balls before proofing for the recommended time.

Keep your sauce, cheese, and other toppings at room temperature so they get hot and/or melt faster.

Don't overcrowd the pizza with toppings. The more you put on top, the less hot the toppings will get.

We recommend using a medium-thick sauce, such as the New York / Artisan Pizza Tomato Sauce (see page 227). Spread it evenly across the top of the pizza, leaving a border for the rim.

Don't grill pizza side by side with meat or anything that might cause flare-ups.

Grilled thin-crust pizza with thin-crust tomato sauce, pizza cheese, Italian sausage, gorgonzola, and toasted pine nuts

COOKING PIZZA IN PORTABLE OVENS

Although you can typically find individual grills at campsites (or communal grills in some cases), sometimes you want to take your outdoor adventure to the next level. Fortunately, there is a class of portable ovens that will allow you to do just that. While some of these ovens offer the option of heating with wood chips, we prefer to use propane because it gets hotter and maintains a more consistent temperature.

When making pizza outside, keep your portioned dough(s) in a cooler in a lightly oiled plastic container. Even though we don't recommend oiling all of our pizza doughs when you are working in a kitchen, we do in this case because it'll make it much easier to transport and use. Once you get to your destination, take the dough, sauce, cheese, and toppings out of the cooler 2 hours before you want to eat (if it's hot out, the dough might need less time to proof). Preheat the oven 30–45 minutes before you bake the pizza.

Bring a 30–33 cm / 12–13 inch cutting board with you, for both assembling the pizza and cutting it after it is baked. (You can assemble the pizza on the peel but you must be quick so it doesn't stick.) Load the pizza into the oven. Rotate the pizza two to three times to make sure that it bakes evenly. The portable ovens that we tried recovered pretty quickly, so you can continue to make pizzas as long as you want.

When you are done baking pizzas, be sure that the oven is completely cool before putting it away. The propane tank should be shut off and disconnected. If you used wood chips, they need to be completely extinguished and disposed of responsibly.

Using a pizza screen (see page 388) makes it easier to load the pizza into the oven. Be sure to coat the screen with spray oil before using. Keep the pizza on the screen the entire time that it bakes and rotate it. You can also assemble and bake the pizza on parchment paper (see page 391) but not if you are using wood chips to heat the oven because it will burn.

HOW TO Bake Pizza in a Portable Oven

1 Quickly assemble the pizza on the peel so that it doesn't stick. Reshape the pizza, if necessary, before loading it in the oven.

2 Load the pizza into the oven.

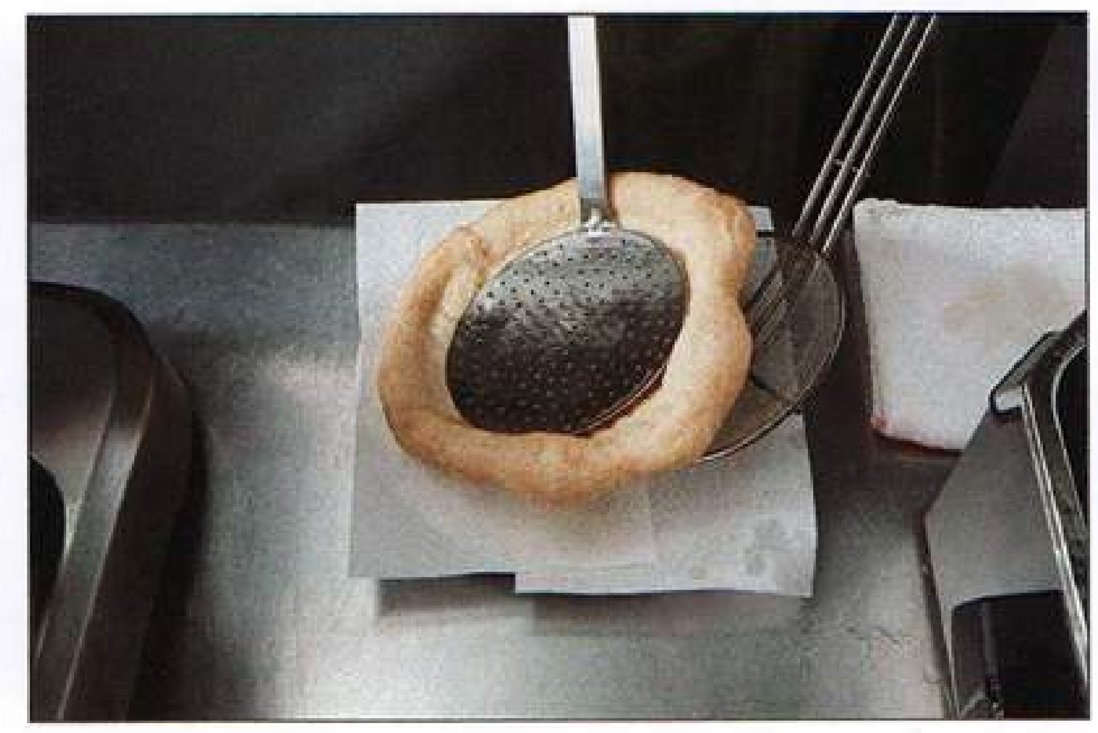
3 Once the rim starts to blister and brown, rotate the pizza.

4 Spin the pizza as needed to ensure that it bakes evenly.

HOW TO Fry Pizza

FOR A STANDARD FRYER

Recommended doughs: Neapolitan, New York, artisan



1 Make sure the dough ball weighs no more than 150–175 g for a 30 cm / 12 in pizza.

2 Heat the oil in the fryer to 175–190° C / 350–375° F.

3 Place the shaped pizza in the fryer (for pizza style–specific tips, see page 3:157).

4 Submerge the pizza after 10–20 s or allow the bottom side to get golden brown and then gently turn the pizza over.

5 Once both sides are the same color, lift the pizza out of the fryer, and drain in a colafritto or place it on a sheet pan or plate lined with paper towels to drain any excess oil.

Electric and gas fryers are a common sight in many professional kitchens. They're not as common at home due to size and the space they require. Electric and gas fryers are convenient because their temperature can be regulated. While vastly cheaper, a pot of oil on the stove needs to be constantly monitored for temperature fluctuations.

Use a high-quality flavorless frying oil with a high smoke point. Don't use extra-virgin olive oil of any kind for deep-frying because it will burn before it reaches an adequate frying temperature. Canola, peanut (be careful of peanut allergies), vegetable, safflower, corn, cottonseed, and sunflower oils are all good options.

We use this method to make pizza montanara, a pizza made with fried dough (see page 3:157), but you can also use this method for pizza fritta (see page 3:159) and calzone.

Most oils need to be changed every day or two; old oil makes everything taste bad. When you fry things like pizza that likely have flour on the outside, that flour will come off in the fryer and sink to the bottom, eventually burning. This burnt flavor will attach itself to whatever you fry next. Some fryers have filtering systems, but these are more of an investment.

When shaping the dough, use very little flour so that the excess flour doesn't burn in the fryer.

You can fry pizza montanara in a regular gas or electric fryer, but you can also get a gas or electric montanara pizza fryer. Or you can go low-tech and use a regular pot with a round basket that can be used to submerge the pizza in the oil and lift it out.

A colafritto allows steam to escape from the bottom of the pizza through the holes so that the crust doesn't get soggy.

FOR AN IMPROVISED SHALLOW FRYER

Recommended doughs: Neapolitan, New York, artisan

1 Make sure the dough ball weighs no more than 150–175 g maximum for a 30 cm / 12 in pizza.

2 Heat 1.25 cm / ½ in oil to 190° C / 375° F in a 36 cm / 14 in sauté or cast-iron pan over medium-high heat. Insert a thermometer into the oil occasionally to keep track of the temperature and adjust the heat as needed.

3 Shape the dough according to its master recipe (see page 3:3).

4 Carefully place the dough in the oil. Fry for 5 min, using a spider to press down on the center of the dough to keep it submerged in the oil.

5 Halfway through frying, carefully flip the dough.

6 Remove the pizza from the pan, and place it on a sheet pan or plate lined with paper towels to drain any excess oil.

7 Apply sauce, cheese, and toppings.

8 To finish the topped pizza, there are two options:

8a Place the pizza in a pie pan or a similarly sized pan. Put in a 285° C / 550° F oven or under the broiler for 1–2 min until the cheese melts.

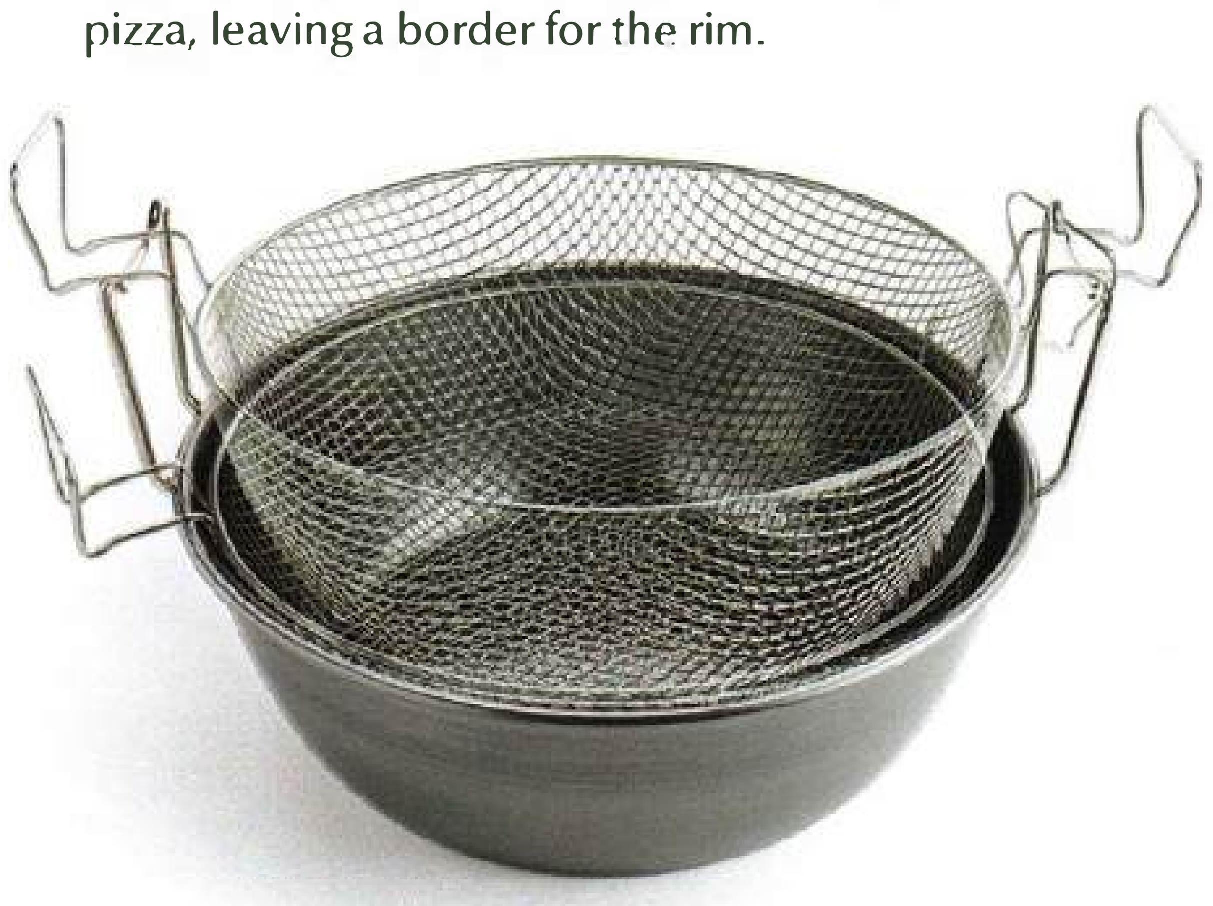
8b Alternatively, use a heat gun to apply heat to the toppings and crust of the pizza to help with browning and heating. This will also brown the cheese and scorch the crust slightly, giving it a Neapolitan pizza look (see photo below).

For home cooks, there aren't many choices for deep fryers that would be large enough to hold even the smallest 30 cm / 12 in pizza. Even if there were, it takes a lot of oil to fill it, and few home kitchen hoods work well enough to keep your house from smelling like a fast-food restaurant. We came up with this improvised shallow fryer option to allow you to more easily make fried pizza at home.

Keep your sauce, cheese, and other toppings at room temperature so they get hot and/or melt faster.

Don't overcrowd the pizza with toppings. The more you put on top, the less hot the toppings will get.

We recommend using a medium-thick sauce, such as the New York / Artisan Pizza Tomato Sauce (see page 227). Spread it evenly across the top of the pizza, leaving a border for the rim.



This basic fryer setup consists of an aluminum pot with a pair of baskets that will allow you to sandwich dough between them and fry it to create a montanara pizza. If you don't have one of these fryers, using a spider to create the depression in the center of the dough works just fine (see page 417).

If you're making fried pizza in a professional setting and baking the topped pizza using Neapolitan baking temperatures, it won't take very long. We suggest keeping the pan close to the mouth of the oven and rotating it frequently so the cheese melts and the dough doesn't burn. Other lower-temperature professional ovens are gentler and will take longer to melt the cheese with less babysitting on your part, but keep an eye on it anyway. Remember that the dough is already cooked completely at this point and thus can only get darker.

This method is a different way of making a montanara. It's also drafting on the traditions among Native American fry bread, Mexican sopaipillas, and Scottish bannock.

Montanara pizza with ricotta, pizza cheese, prosciutto, artichoke, and caper berries

PARBAKING AND PREBAKING PIZZA

The term "parbaking" is used a lot in the baking industry. It's a process that involves baking bread until it's about 90% done, allowing it to cool, then finishing the baking later. The initial baking period is enough to deactivate the yeasts and enzymes and set the structure of the crust and crumb (so the loaf can maintain its shape as it cools), but not enough to fully brown the crust. Technically, the bread is edible after parbaking, but it isn't appetizing. Even if you haven't parbaked bread yourself, you've seen the technique numerous times. You know those pale baguettes in the grocery store that you take home and pop in the oven to warm and brown? Parbaked. It can work quite well—for bread, anyway.

But what about parbaking pizza? Does it work the same as bread? More importantly, does it deliver the same glorious results that you get when you bake your pizza normally? In some cases, it does work well (see page 420). For example, if you are selling frozen pizza or if you are a caterer and you have an off-site event, you can parbake your pizzas two-thirds to three-quarters of the way, freeze them, and then finish baking them later. We also found that parbaking works well for thin-crust pizzas and medium-crust pizzas (especially if you're freezing them).

We decided to test another technique that lets you do part of the work in advance: prebaking. In prebaking, the pizza is cooked all the way through

When we traveled to Chicago, we ran into many deep-dish pizzas that had the same problem: excessive gel layer (see page 1:370). When we suggested prebaking the pizza shells to mitigate this problem, many pizzaioli scoffed at the idea. We wish that there wasn't such a stigma surrounding prebaking deep-dish pizza. It would make for a better slice!

For more on the gel layer problem, see page 1:370.

Al taglio pizza with artichoke, cherry tomatoes, green olives, and arugula

At Panificio Menchetti in Arezzo, Italy, they make al taglio-style pizza bases that are later topped and served. We recommend fully prebaking al taglio pizza in order to prevent a gum line (see page 1:370).

A dough press is technically a prebaking, as well as shaping, method, but it works well only for thin-crust pizzas (see page 3:14).

and can be reheated later. If you're in the pizza business—or even if you're throwing a pizza party at home; see next page—the ability to prebake can help organize the workflow because you do most of the baking ahead of time.

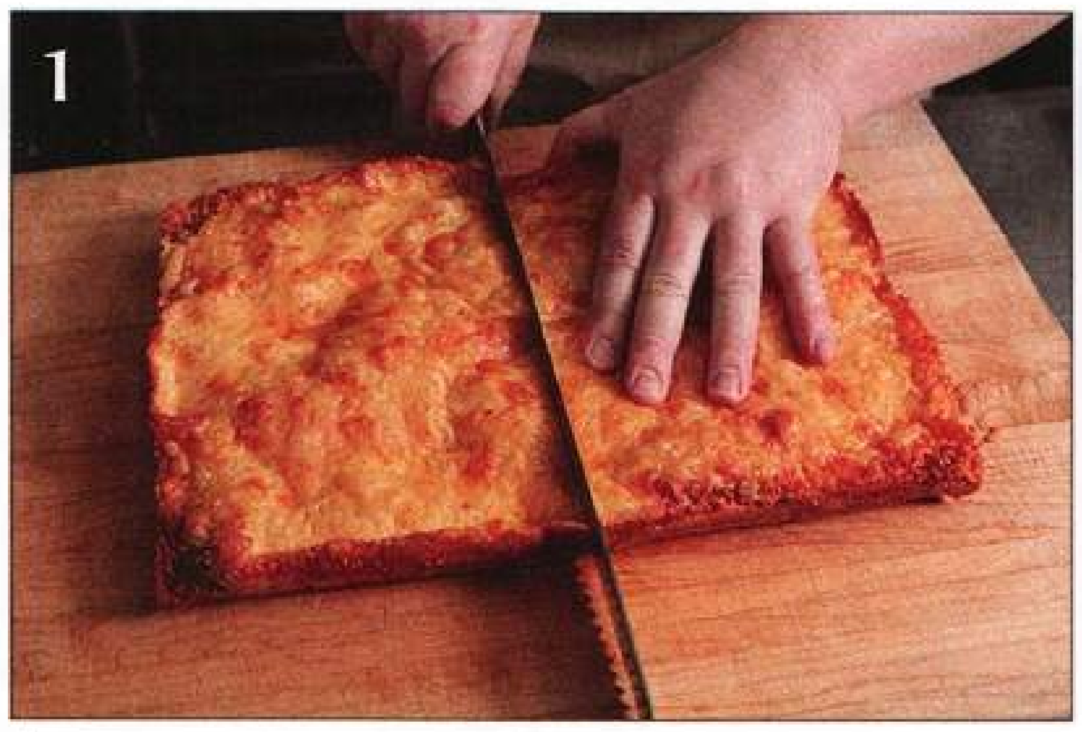
Prebaking is part of the standard process when you're making a New York square pizza (see page 3:133). This pizza is baked and cooled, then sauced and topped later if you are using it as the foundation of a pizza. Prebaking is how we make the pizza gourmet style on page 3:151. Al taglio pizzas are also prebaked, sometimes with sauce and sometimes just the dough alone. Then they're cooled, and additional toppings can be added later and the pizza can be heated again in the oven.

We wondered if prebaking could streamline the process for other kinds of pizza, too. The answer is yes—for some styles of pizza. You may, however, prebake thin-crust and medium-crust pizzas for the purpose of freezing (see table on page 3:331). In those cases, the pizzas are prebaked with sauce and cooled. We recommend adding cheese just before baking. (Adding the cheese before baking on a prebaked pizza will influence the cheese's complex melt rheology and textural attributes.) When you're ready to eat, you don't even need to defrost; you can bake it straight from its frozen form (see the tables on page 3:324 for more guidance).

For a few pizza styles, we found another big benefit of prebaking: it helps eliminate the gel layer (see page 1:370). That's the pale, gooey layer of underbaked dough we found in nearly every deep-dish or square pizza slices we ate during our travels (see page 1:101). We found that by prebaking the dough alone, the gel layer can be eliminated. Sauce, cheese, and toppings are added later, then the pizza is reheated. You'll notice that our New York square and al taglio pizzas specifically call for prebaking. You can also prebake Detroit-style pizzas, although it's not necessary because you don't get a gum line. We have extensive information on holding, freezing, storing, and reheating pizzas in the chapter beginning on page 3:293.

Prebaked sauced al taglio pizza wrapped for freezing

HOW TO Make Pizza for a Crowd



1 Once the pizzas have been baked and cooled, cut them into portions using a serrated knife.

2 Place the sliced pizzas back in their baking pans, cover, and set aside until you're ready to reheat.

3 About 1 h before you're ready to serve the pizzas, place one or ideally two baking stones or baking steels stacked in the oven. Preheat the oven to 230 °C / 450 °F.

4 To reheat the pizzas, uncover them and simply slide the pans onto the hot baking steels or baking stones. They'll take 5–7 min to reheat and recrisp the bottom.

5 For Detroit-style pizza, apply the hot tomato sauce over each hot slice, plus any other post-bake toppings. For al taglio pizza, apply any heat-sensitive toppings, like arugula, blue cheese, or tapenade, after baking.

6 Transfer to a serving platter.

THE LOGISTICS OF COOKING FOR A CROWD

When you think of cooking for many people, you might envision a vast event space with a caterer whipping up hundreds of plates of food behind the scenes (or in front of the guests if they have interactive stations). Although pizza is extremely popular and might be tempting to serve at one of these events, it comes with some risks, depending on the type of pizza that you choose to serve. If you go with a Neapolitan or artisan pizza, you'll be able to serve only one guest at a time, you'll need a special oven to do the job right, and it'll require someone with a high level of expertise to make the pizza. And this assumes that you are making the pizzas a la minute in front of the guests because these styles of pizzas won't hold for longer than a few minutes (see page 3:295). You could opt to make larger New York pizzas that will feed multiple people and reheat well (this is, after all, the business model for countless slice shops across the United States). But we don't think that it's the absolute best solution. We'll come to that in a minute.

Another scenario that may have you cooking for a crowd is that you've decided to have a pizza party at home. It can be a very fun occasion if you plan it correctly and choose the right pizzas. Your guests want to see you (presumably!), so it's not ideal to be stuck in the kitchen the whole time. If you have an outdoor wood-fired or propane-fueled oven, you can bake pizzas while your guests hang out around you or even help. Indoors, the spaces are tighter, the ovens are generally smaller, and you can bake only so many pizzas at a time.

Our recommended solution for both cases is to choose to make pizzas that reheat very well and can be made well in advance: New York Square Pizza (see page 3:133), Detroit-Style Pizza (see page 3:109; shown at right), or Al Taglio Pizza (see page 3:141). You can make the pizza crusts ahead of time, cool them down, wrap them in plastic wrap, and freeze them for up to 6 months. In the case of catering, you can bake them offsite, freeze them (if you'd like), and transport them to the event. You don't even need to defrost them. We have detailed instructions on reheating pizzas in a commercial environment and at home on pages 3:315–3:327. You can reheat whole pans or slices. You can slice ahead of time too.

You might want to have a toppings station. Your guests can either tell the event staff what they want on their pizzas or, if you are entertaining at home, they can build their own pizzas using the naked prebaked pizzas. This will let you spend less time alone in the kitchen and more time with your guests.

INDEX

C

D

E

J

K

L

M

N

W

X

Y

Z