Introduction to Baking

Chapter Objectives

1. Explain the importance of accuracy in the bakeshop and how it is achieved.

2. Differentiate between volumetric and weight measurements and specify when each should be used.

3. Differentiate between metric and U.S. common units.

4. Introduce the concept of baker's percentages.

5. Explain the importance of controlling ingredient and oven temperatures.

Introduction

Those who enter the fields of baking and pastry arts do so for a variety of reasons. For some, it is the joy of working with their hands, of creating edible works of art from a few basic ingredients. For others, it is the rush they get from the fast pace of the bakeshop or from its satisfying sights and smells. Still others like the challenge of pleasing and surprising customers. No matter the reason, the decision to work in the field is usually grounded in a love of food, and maybe past experience in a bakeshop or a home kitchen.

Working in a professional bakeshop is different from baking at home, however. Production in a bakeshop is on a larger scale. It takes place day in and day out, sometimes under severe time pressures, in uncomfortably hot and humid conditions, and over long hours. Despite the discomforts and pressures, product quality must remain consistently high, because that is what the customer expects.

It takes specialized knowledge and practiced skills to accomplish these goals successfully. It helps to be attentive to the sights, sounds, and smells of the bakeshop. Experienced bakers and pastry chefs, for example, listen to the sound of cake batter being beaten in a bowl, knowing that changes in sound accompany changes to the batter itself. They push and pummel bread dough to feel how it responds. They use smells from the oven to judge when baking is nearly complete, and they sample their finished products before presenting them to the customer.

Experienced bakers and pastry chefs rely, too, on tools like timers and thermometers, because they know how time and temperature affect product quality. They also rely heavily on accurate scales.

The Importance of Accuracy in the Bakeshop

Most bakery items are made of the same ingredients: flour, water, sugar, eggs, leavening agents, and fat. Sometimes the difference between two products is simply the method of preparation used in assembling the ingredients. Other times the difference is the proportion or amount of each ingredient in a formula. Because small differences in method and in proportion of ingredients can have a large effect on the quality of baked goods, it is crucial that bakers and pastry chefs follow methods of preparation carefully and measure ingredients properly. Otherwise, a product may turn out unexpectedly, or worse, may turn out unacceptable or inedible.

For example, if too much shortening and too few eggs are added to a formula for moist, chewy oatmeal cookies, the cookies will likely turn out crisp and dry. If the same error is made with cake batter, the result will likely be a complete failure, since eggs provide structure and volume. In fact, bakers and pastry chefs require a higher degree of accuracy when measuring ingredients than do culinary chefs in the kitchen.

When the kitchen chef prepares a pot of soup, it doesn't really matter if a little less celery is added or an extra onion is included. The chef still has a pot of soup, and if the flavor is off, adjustments can be made along the way. Bakers and pastry chefs cannot make adjustments along the way. If too little salt is added to bread dough, it will do no good to sprinkle salt onto the bread once it is baked. Instead, ingredients must be weighed and measured accurately at the beginning.

This means that, more so than kitchen chefs, bakers and pastry chefs are chemists in the kitchen. As with chemists, creativity and skill are important for success, but so is accuracy. If a formula calls for two pounds of flour, it doesn't mean around two pounds, more or less. It means two pounds.

Balances and Scales

Formulas used in the bakeshop are in some ways like recipes in the kitchen. Formulas include a list of ingredients and a method of preparation (MOP). Unlike recipes used by the kitchen chef, however, formulas include exact measurements for each ingredient, and these measurements are usually given in weights. The process of weighing ingredients is called *scaling* because pastry chefs use scales to weigh ingredients.

> **HELPFUL HINT**
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> *Baker's scales and their accessories (scoops and weights) must be cared for if they are to remain in balance. They should be wiped regularly with a damp cloth and mild detergent, and they should not be banged or dropped. These precautions are necessary to keep the scale reading accurately.*
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> *To determine if a scale is in balance, empty both platforms and move the ounce weight indicator to the far left (that is, to zero). With the scale at eye level, determine whether the platforms are at the same height. If they are not, adjust the weights located beneath the platforms as needed. Repeat this test with a scoop on the left platform and a counterweight on the right. If balancing is needed, do so by adding or removing weight from the counterweight.*

The traditional scale used in the bakeshop is a baker's balance scale. It measures ingredients mechanically by balancing them against known weights. It is an investment that should be selected for its durability and its precision. A good baker's scale can weigh amounts as large as 8 pounds (4 kilograms) or more and as small as ¼ ounce (0.25 ounce or 5 grams). This provides the precision needed for most quantity food preparation.

Bakers and pastry chefs sometimes use digital electronic scales. While many affordable electronic scales provide the same or better precision as baker's scales, it is not necessarily the case. The precision of a scale—either mechanical baker's scale or electronic scale—depends entirely on the scale's design and construction, how well the scale is maintained, and whether it has been properly calibrated.

Most digital electronic scales provide information about their precision and capacity on their front or back panels. For example, a scale that is marked *4.0 kg × 5 g* has a capacity of 4 kilograms, meaning it can measure quantities as large as 4 kilograms (about 8.8 pounds). The *readability* of this scale, 5 grams, is the smallest quantity that the scale will display on its digital readout. Readability, sometimes represented as *d* on a scale, is a reasonable indicator of the precision of a scale. Generally, the smaller the readability of the scale, the better it will be at weighing small amounts. Five grams is equivalent to just under 0.2 ounce, which is similar to the 0.25-ounce precision of a good baker's scale.

Consider another electronic scale, one marked *100 oz. × 0.1 oz.* This scale has a capacity of 100 ounces (6.25 pounds or 2.84 kilograms) and a readability of 0.1 ounce (3 grams). The smaller value for readability indicates that this scale likely provides better precision than a typical baker's scale, making it useful for weighing small quantities of spices or flavorings.

More on Scale Readability

The abbreviation for the readability of a scale, *d*, stands for scale division. Readability represents the increments that the scale's weight capacity is divided into. This means that when an item is placed on a scale, the reading on the scale's display panel will be in increments represented by the readability. As weight is added onto a scale with a readability of 5 grams, for example, the reading on the display panel will change from 0 grams, to 5 grams, to 10, 15, 20, and so on. No matter the weight of the ingredient, the scale displays the weight in increments of 5 grams. If a sample in fact weighs 6 grams, the display will read 5 grams. If it weighs 8.75 grams, the display will read 10 grams.

Sometimes a scale fluctuates between readings. Let's say, for example, that the scale in the previous example fluctuates between 5 grams and 10 grams. It is likely that the sample actually weighs about 7.5 grams, which is halfway between 5 grams and 10 grams.

While a scale's readability is an indication of the smallest amount that can be weighed on a scale, it is not the same as the smallest amount that *should* be weighed on a scale. As the amount that you place on a scale approaches the readability of that scale, the uncertainty in the reading increases. A good rule of thumb is that a scale is acceptable for weighing an ingredient as long as the readability of the scale is 10 percent or less than the amount to be weighed. Stated another way as a workable formula:

Smallest quantity to be weighed =
scale readability × 10

Consider a scale where the readability is 0.25 ounce (7 grams). This scale could appropriately weigh quantities as small as 2.5 ounces (70 grams). Likewise, a scale with a readability of 0.1 ounce (3 grams) could adequately weigh quantities as small as 1 ounce (30 grams).

Figure 1.1 Check your scale daily with a known weight to confirm that it is properly calibrated.

Just as baker's scales need to be checked periodically for accuracy, so too must digital scales. Digital scales typically come with a brass weight calibrated for accuracy. Check your scale daily with the brass weight (Figure 1.1). If the scale's reading does not match the mass of the brass weight, follow the manufacturer's instructions to adjust the scale. Because a scale is an important piece of equipment in a bakeshop, it is best to also occasionally check its calibration at two or more different weights (200 grams and 2,000 grams, for example). The scale will need adjustment or repair if either of these two readings is off.

How an ingredient is added to a digital scale can sometimes make a difference in the accuracy of the reading. For example, multiple small additions will sometimes read lower than the identical amount added all at once. This can happen because scales are generally designed so that they don't fluctuate excessively with air movement, and scales cannot necessarily differentiate a very small amount of product from air movement.

HELPFUL HINT

Follow these precautions when using digital electronic scales, especially when weighing very small quantities.

- *Place the scale on a sturdy work surface to avoid vibrations that may cause your readings to fluctuate.*
- *Place the scale away from equipment that generates strong electromagnetic waves, such as induction burners.*
- *Avoid hot or cold drafts, which could cause readings to fluctuate.*
- *If samples are very hot or very cold, first place a plate on the weighing platform and tare (rezero) the scale. This will insulate the scale from an extreme temperature that could cause readings to drift.*
- *Avoid using plastic containers to weigh ingredients, especially if the air is dry. Plastic holds static electricity, which can affect the functioning of electronic scales.*

Units of Measure

Digital and baker's scales measure in either standard U.S. common units (pounds and ounces; also called imperial units in Canada) or in metric units (kilograms and grams). Some versatile digital scales switch at the touch of a button from U.S./imperial units to metric units. Most countries throughout the world have adopted the metric system. This provides a means of sharing formulas more easily across national borders. More importantly, the metric system is simpler to use once you become familiar with it. With the metric system, for example, fewer math calculations are needed when converting a formula to a new batch size. Since 1 kilogram in metric equals 1,000 grams, you simply move decimal points to convert from one size unit to another. For example, 1.48 kilograms is equal to 1,480 grams, and 343 grams is equal to 0.343 kilograms. Try converting as quickly from pounds to ounces, or ounces to pounds! This ease of use is probably the main reason why more bakers and pastry chefs in North America are adopting the metric system for use in the bakeshop.

Using the metric system consistently, for the most part, does not require tedious math conversions from ounces to grams or pounds to kilograms. This makes it much easier to use the metric system than most people believe. Table 1.1 lists the metric equivalents of a few U.S. common/imperial units, for those times when you do need to convert from one system to another.

It is a common misconception that metric units provide better precision than U.S./imperial units. In fact, metric units are not necessarily more precise, although they are simpler to use. Once again, the precision of measurements depends on the design and construction of the scale, not on the units used.

TABLE 1.1 EQUIVALENCIES BETWEEN U.S. COMMON/IMPERIAL AND METRIC UNITS

WEIGHT	
1 ounce	= 28.4 grams
1 pound	= 454 grams
VOLUME	
1 teaspoon	= 5 milliliters
1 quart	= 0.95 liters

Weight and Volume Measurements

Home cooks in North America use volumetric measurements—measuring cups and measuring spoons—for all ingredients, including dry ingredients. This is a problem when measuring certain ingredients. For example, flour settles over time. When flour settles, there is less air between particles. With less air, density is greater and more flour is needed to fill a container. On the other hand, if flour is sifted before it is measured, there is more air between particles. Density is lower, and less flour is needed to fill a cup (Figure 1.2).

How Can an Ounce Scale Provide the Precision of a Gram Scale?

One gram is a much smaller unit than one ounce (there are 28.35 grams in an ounce), so how is it possible for an ounce scale to provide the same or better precision than a gram scale?

Certainly if the gram scale has a readability of 1 gram and the ounce scale has a readability of 1 ounce, the gram scale will measure more precisely than the ounce scale. But this is rarely the case.

Take, for example, the description of the two electronic scales given earlier. The first scale is a gram scale, with a readability of 5 grams, or 0.2 ounce (5 grams divided by 28.35 grams per ounce). The second scale is an ounce scale with a readability of 0.1 ounce (3 grams). In this particular example, the ounce scale weighs more precisely than the gram scale, because the design and construction of the scale allows it to read smaller amounts.
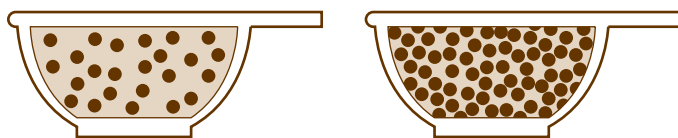
Figure 1.2 A cup filled with sifted flour **(left)** will have fewer flour particles and a lower weight per cup while a cup filled with unsifted flour **(right)** will have more flour particles and a higher weight per cup.

To avoid these inconsistencies, pastry chefs and bakers do not use volumetric measurements for flour and other dry ingredients. Instead, they weigh dry ingredients—and most liquid ingredients—for accuracy. The amount of air in a product or its density does not affect weight measurements the way it affects volume measurements. A pound of sifted flour weighs the same as a pound of unsifted flour, regardless of the density. They both weigh 1 pound!

While some pastry chefs and bakers weigh all ingredients using a scale, others measure some liquids volumetrically, for convenience. They use measuring containers for water and for liquids that have about the same density as water, using one pint of liquid for every pound (or one half-liter for every 500 grams) called for in a formula. While practices vary from one bakeshop to another, ingredients that are often measured volumetrically include milk, cream, and eggs. Table 1.2 indicates why. Notice that the weights per pint (or per half-liter) of cream, milk, and eggs are around the same as that of water. While these ingredients do not weigh exactly 1 pound per pint, they are approximately so (notice, however, that in the metric system, 1 half-liter—500 milliliters—of water at room temperature does weigh exactly 500 grams. This is not a coincidence). Many other liquids, including honey, corn syrup, and oil, have densities much different from water. These liquids are weighed, because 1 pint does not weigh 1 pound.

TABLE 1.2 A COMPARISON OF THE APPROXIMATE WEIGHTS OF 1 PINT AND 1 HALF-LITER OF VARIOUS INGREDIENTS

INGREDIENT	APPROXIMATE WEIGHT PER U.S. PINT (2 CUPS), IN WEIGHT OUNCES	APPROXIMATE WEIGHT PER HALF-LITER (500 ML), IN GRAMS
Splenda	4.0	120
Ginger, ground	6.0	180
Flour, sifted	8.2	245
Flour, unsifted	9.2	275
Sugar, granulated	14.1	420
Oil, vegetable	14.8	445
Cream, heavy	16.4	490
Water	16.7	500
Milk, whole	17.0	510
Eggs, whole	17.2	515
Orange juice	17.4	520
Coffee liqueur	17.5	525
Simple syrup (equal parts sugar and water)	20.6	615
Honey, molasses, and glucose corn syrups	23.0	690

The Difference Between Weight Ounces and Fluid Ounces

Refer to Table 1.3, which lists conversions between U.S. common volumetric measurements. Notice that there are 16 ounces in a pint (2 cups). Recall that there are 16 ounces in a pound. Why, then, did we see from Table 1.2 that a pint does not weigh 1 pound for all ingredients? Likewise, how can there be 16 tablespoons in a cup and 8 ounces in a cup, but 16 tablespoons does not necessarily weigh 8 ounces? These are the problems that result when one word—ounce—is used to represent two different concepts.

The term *ounce* represents a unit of weight or mass. It can also represent volume or capacity. That is, there are weight ounces that measure weight, and there are fluid ounces that measure volume. Notice that Table 1.3 specifies fluid ounces, not weight ounces, in each conversion. While 1 fluid ounce sometimes does weigh 1 ounce, it is not necessarily always so.

Consider feathers and bullets. No one expects 1 cup of feathers to weigh the same as 1 cup of bullets. Likewise, food ingredients vary in how much they weigh per cup. Refer back to Table 1.2, which lists several ingredients—arranged from less dense to more dense—and their weights per pint (2 cups) and per half-liter (500 milliliters). Notice the large range in values. This shows that the expression "a pint's a pound the world 'round" is not only false for feathers and bullets, but it is also false for many common bakeshop ingredients. It is approximately true for water and for ingredients with the same density as water. Because 1 fluid ounce of water (and ingredients with the same density as water) weighs about 1 ounce, and 1 milliliter of water weighs 1 gram, for practical purposes it doesn't matter whether water is weighed on a scale or measured volumetrically.

> **HELPFUL HINT**
>
> *If a formula includes measurements in ounces, be sure to check carefully to determine for each ingredient whether it is to be measured using fluid or weight ounces. Unless you know the density of an ingredient, do not interchange weight measurements with volumetric measurements or vice versa.*

TABLE 1.3   VOLUMETRIC CONVERSIONS FOR U.S. COMMON UNITS

1 tablespoon	= 3 teaspoons
	= 0.5 fluid ounce
1 cup	= 48 teaspoons
	= 16 tablespoons
	= 8 fluid ounces
1 pint	= 16 fluid ounces
	= 2 cups
1 quart	= 32 fluid ounces
	= 4 cups
	= 2 pints
1 gallon	= 128 fluid ounces
	= 16 cups
	= 8 pints
	= 4 quarts

The Difference Between Density and Thickness

Density is a measure of the compactness of particles or molecules in a liquid or solid. If the particles or molecules are loosely packed, the liquid or solid is not dense, and the weight per cup or per liter of that ingredient is low. If the particles or molecules are closely packed, the liquid or solid is dense, and the weight per cup or weight per liter of that ingredient is high. Worded another way, a given weight of a less dense ingredient takes up more space than the same weight of a denser ingredient. Figure 1.3 shows the different volumes taken up by equal weights (7 ounces or 200 grams) of glucose corn syrup, sifted pastry flour, and water. Notice that 7 ounces (200 grams) of glucose corn syrup takes up much less space than the same weight of sifted pastry flour.

Figure 1.3 Equal weights of **(left to right)** glucose corn syrup, sifted pastry flour, and water take up different volumes.

> **HELPFUL HINT**
>
> *Do not judge the density of a liquid by its appearance. Unless you know for sure that the density of a liquid is close to that of water, assume that it is not; assume that it must be weighed. That is, assume that 1 fluid ounce does not necessarily weigh 1 ounce, and that 1 milliliter does not necessarily weigh 1 gram.*

Viscosity or consistency is a measure of how easily a liquid flows. If a liquid's particles or molecules slide past each other easily, the liquid flows easily and is considered thin. If the particles or molecules bump or tangle with each other, the liquid will not flow easily and is thick. This is the case with fruit purees. Tiny pulp pieces in fruit purees bump and tangle with one another, preventing water and pulp particles from flowing easily past one another. This makes the puree thick.

Some common liquids—honey and molasses, for example—are both dense and thick. The molecules are close together, making these liquids dense, and the molecules do not slide easily past each other, making the liquids thick (Figure 1.4). On the other hand, vegetable oil is thicker than water, yet it is less dense than water, which is why oil floats on water. Notice that the density of a liquid cannot be judged by its appearance.

**Figure 1.4** Molasses is thick because molecules do not slide past each other easily.

Honey, molasses, and glucose corn syrups are all quite dense, weighing about 23 ounces per pint (690 grams per half-liter). Why are these liquids so much denser than either sugar or water alone?

Consider, first, a cup of sugar and a cup of water. It is easy to see that dry sugar crystals are separated by empty space, lowering the density of a cup of sugar. What's less obvious is that the molecules that make up water are also separated by empty space. The empty spaces are not visible to the naked eye.

If a cup of sugar is stirred into a cup of water, there is an instant attraction between the sugar and water molecules. This attraction pulls apart the crystals as the sugar dissolves, and the individual sugar molecules fill the empty spaces between water molecules. Because there is less empty space between molecules in a sugar syrup, the syrup is dense. In fact, the cup of sugar and the cup of water, when combined, take up only about 1⅔ cups.
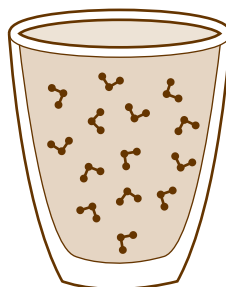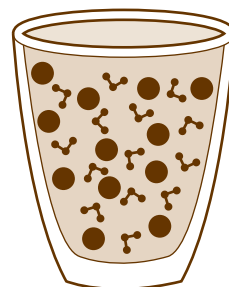
Water   Sugar Dissolved in Water

Baker's Percentages

Formulas, especially bread formulas, are sometimes expressed in terms called *baker's percentages*. With baker's percentages, each ingredient is expressed as the amount of an ingredient compared to the total amount of flour in the formula. Flour is used as the basis for baker's percentages because it is typically the predominant ingredient in most baked goods. Since the total amount of flour is designated as 100 percent, the percentages of all ingredients add up to more than 100 percent. Table 1.4 provides an example of a bread formula expressed in weight and in baker's percentages. Notice that more than one type of flour is included in this formula, but that together the weight of the flours adds up to 100 percent.

TABLE 1.4   WHOLE WHEAT BREAD FORMULA EXPRESSED IN WEIGHT AND IN BAKER'S PERCENTAGES

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	6		3,000	60%
Flour, whole wheat	4		2,000	40%
Water	5	10.0	2,800	56%
Yeast, compressed		6.0	190	4%
Salt		3.0	95	2%
Total	**16**	**3.0**	**8,085**	**162%**

Note: Metric measures in this table and throughout the text are not necessarily exact conversions of U.S./imperial measures. This is done to avoid the use of awkward numbers. Baker's percentages remain approximately the same regardless of the unit of measure.

For formulas that do not contain flour, each ingredient is expressed relative to the predominant and characteristic ingredient. In the case of a date filling, for example, each ingredient is expressed relative to the amount of dates (Table 1.5). For baked custard, each ingredient is expressed relative to the dairy ingredients—milk and cream.

Baker's percentage—sometimes called *formula percentage* or indicated as "on flour weight basis"—is different from the percentages commonly taught in math classes. Baker's percentages are actually ratios of the amount of an ingredient to the amount of flour. In the more common type of percentage, each ingredient is expressed as a certain percentage of the total batch size. In this case, ingredient percentages add up to 100 percent. Table 1.6 shows the bread formula from Table 1.4, this time expressed as a percentage of the total batch.

Baker's percentages have an advantage over percentages based on total batch size. Baker's percentages require fewer calculations when adding or changing the amount of one ingredient. If percentages used are based on total batch size, then every ingredient percentage will have to be recalculated when any one ingredient is changed, since the total batch size would also change. Needless to say, this is complicated and time consuming and thus, baker's percentages are preferred by some bakers.

Why bother expressing formulas in percentages at all? Percentages allow formulas to be compared easily. Table 1.7 illustrates this point. Compare the two bread formulas in Table 1.7 by looking at the weights of each ingredient. Can you tell quickly which formula is saltier? Before you conclude that Bread #2 is saltier because it contains 6 ounces (190 grams) of salt compared with 3 ounces (95 grams) in Bread #1, notice that the formula for Bread #2 also yields a larger quantity of dough. Unless this difference in yield or batch size is accounted for, weights alone won't reveal which bread is saltier.

When baker's percentages instead of weight are used to compare the two formulas, however, the difference in batch size is accounted for, and it becomes clear that the formula for Bread #1 is saltier. The amount of salt in the formula for Bread #1 is about 2 percent of the weight of the flours compared with 1 percent in Bread #2.

TABLE 1.5 DATE FILLING FORMULA EXPRESSED IN WEIGHT AND IN BAKER'S PERCENTAGES

INGREDIENT	POUNDS	GRAMS	BAKER'S PERCENTAGE
Dates	6	3,000	100%
Sugar	1	500	17%
Water	3	1,500	50%
Total	**10**	**5,000**	**167%**

TABLE 1.6 WHOLE WHEAT BREAD FORMULA EXPRESSED IN WEIGHT AND IN PERCENTAGE OF TOTAL BATCH

INGREDIENT	POUNDS	OUNCES	GRAMS	PERCENTAGE OF TOTAL BATCH
Flour, bread	6		3,000	37%
Flour, whole wheat	4		2,000	25%
Water	5	10.0	2,800	35%
Yeast, compressed		6.0	190	2%
Salt		3.0	95	1%
Total	**16**	**3.0**	**8,085**	**100%**

BREAD #1

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	6		3,000	60%
Flour, whole wheat	4		2,000	40%
Water	5	10	2,800	56%
Yeast, compressed		6	190	4%
Salt		3	95	2%
Total	**16**	**4**	**8,085**	**162%**

BREAD #2

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	22		10,000	60%
Flour, whole wheat	15		6,800	40%
Water	21		9,550	57%
Yeast, compressed		18	500	3%
Salt		6	190	1%
Total	**59**	**8**	**26,965**	**161%**

The Importance of Controlling Ingredient Temperatures

The finest ingredients can be selected, and they can be accurately weighed and properly mixed, but if temperatures are not carefully controlled, there is still a chance for failure. Why? Many ingredients change properties with temperature. Think of fat, especially fats that melt easily, such as butter. Butter must remain within a narrow temperature range (65°–70°F or 18°–21°C) as it is spread onto croissant dough. If it is too cold, it will not spread properly; if it is too warm, it melts into the dough and flakiness is compromised.

Often, ingredients that are at widely different temperatures must be carefully combined to avoid damaging one ingredient with the shock of the heat—or cold—of another. In making vanilla custard sauce, for example, cold yolks cannot be added directly to hot milk, or the yolks could curdle. Instead, in a technique called *tempering*, small amounts of hot milk are stirred into the yolks, diluting and warming them. The tempered yolks can now be safely added to the bulk of the hot liquid.

Tempering is also necessary when stabilizing whipped cream with a gelatin solution. Warmed gelatin hardens into tiny rubbery balls if it is added too quickly to a cold ingredient like whipped cream. The addition of a small amount of whipped cream to the warm gelatin dilutes and slightly cools the gelatin, so it can be added safely to the bulk of the cold whipped cream.

Notice that in the first example of tempering, a small amount of the hot ingredient is added to the cold ingredient, to prevent damage to the cold ingredient. In the second example, a small amount of the cold ingredient is added to the warm ingredient, to prevent damage to the warm ingredient.

Many other examples demonstrate the need for controlling ingredient temperatures and for carefully tempering ingredients. Look for them throughout the text.

The Importance of Controlling Oven Temperatures

Chapter 2 is all about heat transfer and how to control it. Yet the information in the next chapter is of little use if an oven is not calibrated properly. Nor is it of any use if an oven is not allowed to preheat fully before product is added, or if an oven door is opened too often and for too long. Paying attention to these simple points can go far in assuring that products coming from your bakeshop are of consistently high quality.

It is particularly important that oven temperatures be controlled if products are to rise properly. Figure 1.5 shows puff pastry baked at two different oven temperatures. Notice that the puff pastry baked at the lower temperature rose less than the pastry baked at the higher temperature, where a fast burst of steam allowed for more leavening.

Figure 1.5 Puff pastry baked at different oven temperatures: **Left:** puff pastry baked at 350°F (175°C); **right:** the same pastry baked at 400°F (200°C)

High-ratio liquid shortening cakes are characterized by high ratios, or baker's percentages, of liquid and sugar to the amount of flour. They are formulated to be mixed in a single step that whips large amounts of tiny air bubbles into the batter. While generally considered to be foolproof, things can go wrong if the oven temperature is off.

When the oven temperature is low, for example, a cake's structure sets later than it should. In the meantime, the batter slowly warms and as it does, it thins out. Air bubbles can rise easily through the thin batter to the surface of the cake, while starch in the flour can sink to the bottom. If the oven temperature is quite low, the baked cake will have a thick rubbery layer of gelatinized starch along the bottom and a low volume overall. Or it could have a series of thin tunnels running from bottom to top, tunnels that follow the trail of escaping bubbles.

Questions for Review

1 Why do bakers and pastry chefs require better accuracy in measuring ingredients than do kitchen chefs?

2 What does it mean for a baker's scale to be out of balance? Describe how to check and adjust a baker's scale for proper balancing.

3 An electronic scale has the following printed on its front display panel: 500 g × 2 g. What does each number refer to?

4 What is the smallest amount that should be weighed on a scale that has 500 g × 2 g on its display panel? (Use the value for the scale's readability in calculating the smallest quantity to be weighed.)

5 What is the main advantage of metric weight measurements (grams and kilograms) over U.S. common or imperial measurements (ounces and pounds)?

6 Explain why weighing ingredients in grams is not necessarily more accurate than weighing in ounces.

7 Why do bakers and pastry chefs prefer weight measurements to volume measurements? (Use flour as an example when answering this question.)

8 When weighing flour to be sifted, does it matter whether the flour is sifted before or after it is weighed? Why or why not?

9 What are the two meanings of the word *ounce*? For which ingredients are they approximately equal?

10 List three ingredients that are sometimes measured using volumetric measures (pints, liters, tablespoons, or milliliters).

11 Why is honey denser than water; that is, why does it weigh more per cup? Why is it thicker?

12 What is the main advantage of using formulas that are expressed in percentages?

13 What is an advantage of baker's percentages over percentages based on total yield?

14 What does it mean to temper ingredients?

15 Explain how to temper hot milk and egg yolks.

Questions for Discussion

1 A friend is preparing a 1-2-3 short dough (which contains, for example, 1 pound sugar, 2 pounds butter, 3 pounds flour, and three eggs). Instead of weighing the ingredients, however, your friend uses measuring cups, measuring 1 cup sugar, 2 cups butter, and 3 cups flour. Why is it unlikely that the cookie dough will turn out properly?

2 You are preparing an orange sauce that calls for 32 fluid ounces of orange juice and 1 ounce of starch. You decide to weigh the 32 ounces on a scale. Using the information from Table 1.2, explain whether you will be adding more or less orange juice than actually required. Will your orange sauce turn out slightly too thick or too thin?

3   Use the information from Table 1.2 to identify which ingredient in each of the following pairs is denser: heavy cream or whole milk; whole eggs or orange juice; oil or water; water or honey. Next, based on your experience, identify which ingredient in each pair is typically thicker. In which pairs of ingredients, if any, were the thicker samples also denser? What do you conclude from this; that is, can the relative weight of an ingredient always be properly judged by its thickness?

4   Explain why whipping air into a custard sauce might make it thicker. Explain what effect the added air will have on the density of the sauce.

5   Explain how to combine warmed melted chocolate and chilled whipped cream together, to prevent bits of chocolate from solidifying into small chips in the cold cream.

Exercises and Experiments

❶ Exercise: Rye Bread Formulas

Use information from these two formulas to answer the questions on page 16.

FORMULA 1

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	8		3,000	60%
Flour, white rye	2		2,000	40%
Water	6		2,800	56%
Yeast, compressed		6	190	4%
Salt		3	95	2%
Caraway seeds		2.4	75	1.5%
Total	**16**	**11.4**	**8,160**	**163.5%**

FORMULA 2

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	22		10,000	60%
Flour, white rye	15		6,800	40%
Water	21		9,550	57%
Yeast, compressed		15	425	2.5%
Salt		9	260	1.5%
Caraway seeds		4.75	135	0.8%
Total	**59**	**12.75**	**27,170**	**161.8%**

1 Based on the amount of caraway seeds added to each, which would you expect to have a stronger caraway flavor? Explain your answer.

_____

_____

_____

2 Based on the amount of yeast added to each, which would you expect to rise faster and possibly have a stronger yeast flavor? Explain your answer.

_____

_____

_____

❷ Exercise: Calculating Baker's Percentages

Calculate baker's percentages for the formula below. (Hint: complete the exercise using the metric weights provided; the math is easier and the answers are the same.) Remember that a baker's percentage is really the ratio of the weight of the ingredient divided by the total weight of flour. Use the following formula to complete the exercise. The first two are done for you.

Baker's percentage = 100% × (weight of ingredient) ÷ (total weight of flour)

BROWN SUGAR SPICE COOKIES

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, pastry	2	8	1,200	= 100% × 1200 ÷ 1200 = 100%
Brown sugar, dark	1	4	600	= 100% × 600 ÷ 1200 = 50%
Butter	1		500	
Eggs		4	125	
Cinnamon		0.7	20	
Salt		0.25	8	
Total	5	4.95	2,453	

❸ Experiment: Density and Thickness in Volumetric Measurements

Objectives

- Show how thick samples are not necessarily denser than thin samples.
- Show how different methods of adding flour and other dry ingredients affect density.

Materials and Equipment

- Flour (any type)
- Any starch, such as cornstarch
- Small spoon or scoop
- Dry measuring cup
- Sieve
- Scale

Procedure

1   Prepare a thickened starch solution by cooking any starch with water (about 25 grams cornstarch into 400 grams water) until noticeably thick; cool to room temperature. Or add instant starch to water until noticeably thick, being careful to avoid whisking air into the mixture. *Do not pre-blend instant starch with sugar;* this will increase the density of the solution and alter the results of the experiment.

2   Measure out 1 level cup (250 ml) of each of the following ingredients, then weigh each sample on a scale:
    - Flour lightly spooned into the cup
    - Flour spooned into the cup but shaken after every few spoonfuls to allow flour to settle
    - Flour sifted first, then lightly spooned into the cup
    - Water (room temperature)
    - Thickened starch solution (room temperature)

Results

Record weights for each of the 1 cup samples in the Results Table. Be sure to indicate your units of measure—grams or ounces—in the table.

RESULTS TABLE   DENSITY MEASUREMENTS

PRODUCT	WEIGHT PER CUP
Flour, spooned	
Flour, spooned and shaken	
Flour, sifted then spooned	
Water	
Starch-thickened solution	

Sources of Error

List any sources of error that might make it difficult to draw the proper conclusions from your experiment. In particular, consider if air was trapped in the starch solution as it was prepared and cooled; if cups were properly leveled with a straight-edge; if samples were at room temperature; if scale was used properly.

_____

_____

_____

State what you could do differently next time to minimize or eliminate each source of error.

_____

_____

_____

Conclusions

1 Rank the flour samples—spooned, spooned and shaken, or sifted then spooned—from least dense to densest.

_____

_____

_____

Based on these results, explain why weight, not volume, is best for measuring flour and other dry ingredients.

_____

_____

_____

2 How did the density (weight per cup) of the starch-thickened solution compare with the density of water? How might you explain these results?

_____

_____

_____