

chapter six

Baking formulas and bakers' percentages

a

baker or pastry chef needs to perform a number of key calculations in order to have consistently successful results and work efficiently. This chapter provides a brief overview of some of the basic mathematical formulas and calculations used in the bakeshop and pastry kitchen to create standardized production formulas, increase or decrease a formula's yield (a technique known as scaling), and adjust to different production needs.

Baking formulas

Always read through any formula completely before you start. The formula may require a special piece of equipment or a component made separately. Or perhaps the formula makes only ten servings and you need to make fifty. In that case, you will have to scale the formula (see “Formula Calculations,” page 90). In increasing or decreasing a formula, you may discover that you need to make equipment modifications as well.

Once you have read through and evaluated or modified the formula, assemble your equipment and ingredients—the baker’s *mise en place*. In many formulas, the ingredients list will indicate how the ingredient should be prepared (for example, sifted, melted, or cut into pieces of a certain size) before the actual mixing or assembling begins.

Scaling with precision

Ingredients are purchased and used following one of three measuring conventions: count, volume, or weight. They may be purchased according to one system but measured in another for use in a formula.

Count is a measurement of whole items. The terms *each*, *bunch*, and *dozen* all indicate units of count measure. If an individual item has been processed, graded, or packaged according to established standards, count can be a useful, accurate way to measure that ingredient. It is less accurate for ingredients requiring some preparation before they are added to the formula or for those without any established standards for purchasing. Apples illustrate the point well. If a formula calls for ten apples, then the yield, flavor, and consistency of the item will change

Accurate scaling is vital for the best and most consistent results.

depending upon whether the apples you use are large or small.

Volume is a measurement of the space occupied by a solid, liquid, or gas. The terms *teaspoon (tsp)*, *tablespoon (tbsp)*, *fluid ounce (fl oz)*, *cup*, *pint (pt)*, *quart (qt)*, *gallon (gal)*, *milliliter (mL)*, and *liter (L)* all indicate units of volume measure. Graduated containers (measuring cups) and utensils with a precise volume (such as a 2-ounce ladle or a teaspoon) are used to measure volume. Volume measurements are best suited to liquids, though they are also used for dry ingredients, such as spices, in small amounts. Keep in mind that tools used for measuring volume are not always as precise as they should be. Volume measuring tools need not conform to any regulated standards, so the amount of an ingredient measured with one set of spoons, cups, or pitchers could be quite different from the amount measured with an-



other set. (To learn more about converting volume measures to weight measures, see the table “Converting to a Common Unit of Measure,” page 91.)

Weight is a measurement of the mass or heaviness of a solid, liquid, or gas. The terms *ounce (oz)*, *pound (lb)*, *gram (g)*, and *kilogram (kg)* all indicate units of weight measure. Scales are used to measure weight, and they must meet specific standards for accuracy regulated by the U.S. National Institute of Standards and Technology’s Office of Weights and Measures. (See “Scales” in Chapter 3, page 36, for more about using scales.) In professional kitchens, weight is usually the preferred type of measurement because it is easier to be accurate with weight than with volume measurements.

Standardized formulas

The formulas used in a professional baking and pastry setting must be standardized. Unlike published formulas meant to work in a variety of settings for a wide audience, standardized formulas suit the specific needs of an individual pastry kitchen or bakeshop. Preparing well-written and accurate standardized formulas is a big part of the professional pastry chef’s or baker’s work, as these are records that include much more than just ingredient names and preparation steps. Standardized formulas establish overall yields, serving sizes, holding and serving practices, and plating information. They set standards for equipment as well as temperatures and times for cooking or baking. These standards help to ensure consistent quality and quantity, and they permit pastry chefs and bakers to gauge the efficiency of their work and reduce costs by eliminating waste as appropriate.

In addition, the wait staff must be familiar enough with an item or plated dessert to be able to answer any questions a customer might have. For example, the type of nuts used in an item may matter very much to an individual who has a nut allergy.

Standardized formulas can be handwritten or stored on a computer, using a formula management program or other such database or program. The formulas should be written in a consistent, clear, easy-to-follow format and be readily accessible to the entire staff. The pastry chef or baker should instruct pastry kitchen or bakeshop staff to follow standardized formulas to the letter unless otherwise instructed, as well as encourage service staff to refer to standardized formulas when a question arises about ingredients or preparation methods.

As you prepare a standardized formula, be as precise and consistent as possible. Include as many of the following elements as necessary:

NAME or **TITLE** of the food item or dish

YIELD for the formula, expressed as one or more of the following: total weight, total volume, or total number of servings

PORTION INFORMATION for each serving, expressed as one or more of the following: number of items (count), volume, or weight

INGREDIENT NAMES, expressed in appropriate detail (specifying variety or brand as necessary)

INGREDIENT MEASURES, expressed as one or more of the following: count, volume, or weight

INGREDIENT PREPARATION INSTRUCTIONS, sometimes included in the ingredient name, sometimes included in the method as a separate step



A variety of volume measuring tools are useful when adapting formulas originally written in common household measures.

EQUIPMENT INFORMATION for preparation, cooking, storing, holding, and serving

PREPARATION STEPS detailing mise en place, mixing, cooking or baking, and temperatures for safe food handling (see also “Hazard Analysis Critical Control Points [HACCP],” page 78)

SERVICE INFORMATION, including how to finish and plate the dessert; sauces and garnishes, if any; and proper service temperatures

HOLDING AND REHEATING PROCEDURES, including equipment, times, temperatures, and safe storage

CRITICAL CONTROL POINTS (CCPs) at appropriate stages in the formula, to indicate temperatures and times for safe food-handling procedures during storage, preparation, holding, and reheating (to learn more about CCPs, see “Identify the Critical Control Points,” page 79)

Formula calculations

Often you will need to modify a formula. Sometimes the yield must be increased or decreased. You may be adapting a formula from another source to a standardized format, or you may be adjusting a standardized formula for a special event, such as a banquet or a reception. You may need to convert from volume measures to weight, or from metric measurements to the U.S. system. Or you may want to determine how much the ingredients in a particular formula cost.

The formula conversion factor (FCF)

To increase or decrease the yield of a formula, you need to determine the *formula conversion factor*. Once you know that factor, you then multiply all the ingredient amounts by it and convert the new measurements into appropriate formula units for your pastry kitchen or bake-shop. This may require converting items listed by count into weight or volume measurements, or rounding measurements to reasonable quantities. And in some cases you will have to make a judgment call about those ingredients that do not scale up or down exactly, such as spices, salt, thickeners, and leaveners.

$$\frac{\text{Desired yield}}{\text{Original yield}} = \text{Formula conversion factor (FCF)}$$

The desired yield and the original yield must be expressed in the same way before you can use the formula; that is, both must be in the same unit of measure. For example, if the original formula

gives the yield in ounces and you want to make 2 quarts of the sauce, you will need to convert quarts into fluid ounces. Or, if your original formula says that it makes five servings and does not list the size of each serving, you may need to test the formula to determine serving size.

Converting to a common unit of measure

To convert measurements to a common unit (by weight or volume), use the following chart. This information can be used both to convert scaled measurements into practical and easy-to-use formula measures and to determine costs.

For some ingredients, straightforward multiplication or division is all that is needed. To increase a formula for poached pears from five servings to fifty, for example, you would simply multiply five pears by ten; no further adjustments are necessary. But once you have converted them, some other ingredient amounts may need some fine-tuning. You may need to round off a result or convert it to the most logical unit of measure. And measures for ingredients such as thickeners, spices, seasonings, and leavenings, for example, should not always be simply multiplied or divided. If a formula that makes six 6-in/15-cm cakes requires ½ oz/14 g of baking powder, it is not necessarily true that you will need 3 oz/84 g of baking powder to leaven six times the amount of the same batter if you are mixing it all in one batch. In such cases, the only way to be sure is to test the new formula and adjust it until you are satisfied with the result.

Other considerations when converting formula yields include the equipment you have, the production issues you face, and the skill level of your staff. Rewrite steps as necessary to suit the realities of your establishment at this point. It is important to do this now, so you can discover any further changes to the ingredients or methods that the new yield might cause. For instance, to mix enough bread dough to make ten 1-lb/454-g loaves of bread requires a large mixer, but if you only want to make two 1-lb/454-g loaves, you need a much smaller mixing bowl. The smaller batch of dough would fit in the large mixing bowl, but there would not be enough dough for the mixer to be able to mix and develop the structure for the bread properly.

FORMULA MEASURE	COMMON CONVERSION TO VOLUME	COMMON UNIT (U.S.)	COMMON UNIT (METRIC)
1 pound (lb)	N/A*	16 ounces (oz)	454 grams (g)
1 tablespoon (tbsp)	3 teaspoons (tsp)	½ fluid ounce (fl oz)	30 milliliters (mL)
1 cup	16 tablespoons (tbsp)	8 fluid ounces (fl oz)	240 milliliters (mL)
1 pint (pt)	2 cups	16 fluid ounces (fl oz)	480 milliliters (mL)
1 quart (qt)	2 pints (pt)	32 fluid ounces (fl oz)	960 milliliters (mL)
1 gallon (gal)	4 quarts (qt)	128 fluid ounces (fl oz)	3.75 liters (L)
* Most liquids convert uniformly from weight to volume; different solids and semisolids convert differently from weight to volume.			

Converting for a different number of servings

Sometimes you need to modify the total yield of a formula to obtain a different number of servings.

$$\text{Number of servings} \times \text{Serving size} = \text{Total yield}$$

For instance, you may have a sauce formula that makes four servings of 2 fl oz/60 mL each, but you want to make forty servings of 2 fl oz/60 mL each. To make the conversion:

First determine the total original yield of the formula and the total desired yield.

$$4 \times 2 \text{ fl oz} = 8 \text{ fl oz (total original yield)}$$

$$40 \times 2 \text{ fl oz} = 80 \text{ fl oz (total desired yield)}$$

Then determine the formula conversion factor.

$$\frac{80 \text{ fl oz}}{8 \text{ fl oz}} = 10 \text{ (the formula conversion factor or FCF)}$$

Modify the formula as described above by multiplying formula measures by 10.

Converting for a different serving size

Sometimes you need to modify the total yield of a formula to obtain a different number of servings of a different size.

For instance, you may have a sauce formula that makes four servings of 2 fl oz/60 mL each, but you want to make twenty 3-fl oz/90-mL servings. To make the conversion:

First determine the total original yield of the formula and the total desired yield.

$$4 \times 2 \text{ fl oz} = 8 \text{ fl oz (total original yield)}$$

$$20 \times 3 \text{ fl oz} = 60 \text{ fl oz (total desired yield)}$$

Then determine the formula conversion factor.

$$\frac{60}{8} = 7.5 \text{ (the formula conversion factor or FCF)}$$

Modify the formula as described above by multiplying formula measures by 7.5.

Volume versus weight measure

In the professional bakery or pastry shop, most ingredients are measured by weight. When creating standardized formulas for common use, consistency of quality and flavor is the most important objective. Weight is more accurate, leaving less room for error. If a formula is found or developed in volume measurements it should be converted to weight for professional use.

Converting volume measures to weight

Confusion often arises between weight and volume measures when ounces are the unit of measure. It is important to remember that weight is measured in ounces (oz) and volume is measured in *fluid* ounces (fl oz). A standard volume measuring cup is equal to 8 fl oz, but the contents of the cup may not always weigh 8 oz/227 g. One cup (8 fl oz/240 mL) of shredded fresh coconut weighs just under 3 oz/84 g, but 1 cup (8 fl oz/240 mL) of peanut butter weighs 9 oz/255 g. Since measuring dry ingredients by weight is much more accurate, it is the preferred and most common method used for measuring dry ingredients in professional kitchens and bakeshops.

Water is the only substance for which it can be safely assumed that 1 fl oz/30 mL (a volume measure) equals 1 oz/28 g by weight. But you can convert the volume measure of another ingredient into a weight if you know how much a cup of the ingredient (prepared as required by the formula) weighs. This information is available in a number of charts or ingredients databases. You can also calculate and record the information yourself:

- Record a description of the ingredient, and the way it is received (whole, frozen, chopped, canned, etc.).
- Prepare the ingredient as directed by the formula (sift flour, roast nuts, chop or melt chocolate, drain items packed in syrup, and so on). Record this advance preparation, too.
- Measure the ingredient carefully according to the formula, using nested measures for dry ingredients or liquid cups or pitchers for liquid ingredients (see “Volume Measures” in Chapter 3, page 37, for measuring techniques).
- Set up your scale and set it to tare (see “Scales” in Chapter 3, page 36).
- Weigh the ingredient.
- Finally, record the weight of the ingredient, noting all the advance preparation steps involved (sifting, melting, chopping, and so forth).

Converting between U.S. and metric measurement systems

The metric system used throughout the rest of the world is a decimal system, meaning that it is based on multiples of ten. The gram is the basic unit of weight, the liter the basic unit of volume, and the meter the basic unit of length. Prefixes added to the basic units indicate larger or smaller units.

The U.S. system uses ounces and pounds to measure weight, and teaspoons, tablespoons, fluid ounces, cups, pints, quarts, and gallons to measure volume. Unlike the metric system, the U.S. system is not based on multiples of a particular number, so it is not as simple to increase or decrease quantities. Rather, the equivalencies of the different units of measure must be memorized or derived from a chart.

Most modern measuring equipment is capable of measuring in both U.S. and metric units. If, however, a formula is written in a system of measurement for which you do not have the proper measuring equipment, you will need to convert to the other system.

TO CONVERT OUNCES AND POUNDS TO GRAMS:

Multiply ounces by 28.35 to determine grams; divide pounds by 2.2 to determine kilograms.

TO CONVERT GRAMS TO OUNCES OR POUNDS:

Divide grams by 28.35 to determine ounces; divide grams by 454 to determine pounds.

TO CONVERT FLUID OUNCES TO MILLILITERS:

Multiply fluid ounces by 30 to determine milliliters.

TO CONVERT MILLILITERS TO FLUID OUNCES:

Divide milliliters by 30 to determine fluid ounces.

Metric Prefixes

kilo (k) = 1,000; 1 kg = 1,000 g

hecto = 100

deka = 10

deci = $\frac{1}{10}$ or 0.1

centi = $\frac{1}{100}$ or 0.01

milli = $\frac{1}{1000}$ or 0.001

TO CONVERT CELSIUS TO FAHRENHEIT: Multiply the degrees Celsius by 9, divide the result by 5, and add 32 to get the Fahrenheit equivalent:

$$\frac{^{\circ}\text{C} \times 9}{5} + 32 = ^{\circ}\text{F}$$

To convert Fahrenheit to Celsius: Subtract 32 from the degrees Fahrenheit, multiply the result by 5, and divide the result by 9 to get the Celsius equivalent:

$$\frac{(^{\circ}\text{F} - 32) \times 5}{9} = ^{\circ}\text{C}$$

Calculating as-purchased cost per unit (APC)

Most food items purchased from suppliers are packed and priced by wholesale bulk sizes (crate, case, bag, carton, and so on). In kitchen production, the packed amount is generally broken down and often used for several different items. Therefore, in order to assign the correct prices to the formula being prepared, it is necessary to convert purchase pack prices to unit prices, expressed as price per pound, per single unit, per dozen, per quart, and the like.

To find the cost of a unit in a pack with multiple units, divide the as-purchased cost of the pack by the number of units in the pack.

$$\frac{\text{Total cost}}{\text{Number of units}} = \text{Cost per unit (APC)}$$

$$\text{Number of units} \times \text{Cost per unit} = \text{Total Cost}$$

Calculating yield percentage of fresh fruits and vegetables

For many food items, trimming is required before the items are used. In order to determine an accurate cost for such items, trim loss must be taken into account. The yield percentage is important in determining the quantity to order.

$$\frac{\text{Edible-portion quantity}}{\text{As-purchased quantity}} = \text{Yield percentage}$$

First, record the as-purchased quantity (APQ).

$$\text{APQ} = 5 \text{ lb lemons} = 80 \text{ oz}$$

Trim the item(s), saving unusable trim loss and edible-portion quantity (EPQ) in separate containers. Weigh each separately and record their weights.

$$\text{EPQ} = 36.5 \text{ oz lemon juice}$$

$$\text{Trim loss} = 43.5 \text{ oz}$$

Divide the EPQ by the APQ to determine the yield percentage.

$$\frac{36.5}{80} = 0.456 \times 100 = 45.6\%$$

$$\text{Yield percentage} = 45.6\%$$

This calculation can also be used to determine the yield percentage of meat, fish, poultry, and other types of ingredients that might be used trimmed.

Calculating as-purchased quantity (APQ) from formula measure

Because many formulas assume the ingredients listed are ready to cook, it is necessary to consider trim loss when purchasing items. In such cases, the edible-portion quantity must be converted to the as-purchased quantity that will yield the desired formula measure.

$$\frac{\text{EPQ}}{\text{Yield percentage}} = \text{APQ}$$

EXAMPLE

A formula requires 20 lb peeled and diced potatoes. The yield percentage for potatoes is 78 percent (0.78). Therefore, 20 lb divided by 78 percent will equal the amount to purchase.

$$\frac{20 \text{ lb}}{0.78} = 25.65 \text{ lb APQ}$$

Generally, the as-purchased quantity obtained by this method is rounded up (in this example, to 26 lb), since the yield percentage is, by its nature, an estimate.

It should be kept in mind that not all foods, of course, have trim loss. Many pastry and bakeshop ingredients, such as sugar, flour, and spices, are processed or refined foods that have 100 percent yield. Other foods have a yield percentage that depends on how they are to be served. If, for example, the ingredient is to be served by the piece (1 poached pear), or if a formula calls for it by count (15 strawberries), there is no need to consider the yield percentage; the correct number of items is simply purchased to create the desired number of servings. However, if you are making fruit tartlets and the formula calls for 2 oz sliced pineapple and 1 oz sliced strawberries per serving, you must consider the yield percentage when ordering.

Calculating edible-portion quantity (EPQ)

Sometimes it is necessary to determine how many servings can be obtained from raw product, which is known as edible-portion quantity (EPQ). For example, if you have a case of fresh kiwis that weighs 10 lb and you want to know how many 4-oz servings the case will yield, you first need to determine the yield percentage, either by referring to a list of yield percentages or by performing a yield test. (See “Calculating Yield Percentage of Fresh Fruits and Vegetables,” page 94.)

$$\text{APQ} \times \text{Yield percentage} = \text{EPQ}$$

Once you know the yield percentage, you can compute the weight of the kiwis after trimming.

$$10 \text{ lb} \times 0.85 = 8.5 \text{ lb}$$

The second step is to compute how many 4-oz servings the edible-portion quantity, 8.5 lb, will yield.

$$\frac{\text{EPQ}}{\text{Serving size}} = \text{Number of servings}$$

$$4 \text{ oz} = \frac{1}{4} \text{ lb} = 0.25\text{-lb}/113\text{-g serving size}$$

$$\frac{8.5 \text{ lb}}{0.25 \text{ lb}} = 34 \text{ or } \frac{3859 \text{ g}}{113 \text{ g}} = 24 \text{ kiwis}$$

NOTE If you do not get a whole number as your result from a similar calculation, you should round down the number of servings, since it would not be possible to serve a partial serving.

Calculating edible-portion cost (EPC)

As discussed earlier, formulas often assume that ingredients are ready to cook. When it comes to costing a formula, the edible-portion cost (EPC) per unit can be calculated from the as-purchased cost (APC) per unit.

$$\frac{\text{APC}}{\text{Yield percentage}} = \text{EPC}$$

EPC can then be used to calculate the total cost of an ingredient in a formula, as long as EPQ and EPC are expressed for the same unit of measure.

$$\text{EPQ} \times \text{EPC} = \text{Total cost}$$

Bakers' percentages

Bakers' percentages have two basic functions. First, when a formula is expressed in bakers' percentages, it is easy to see and evaluate the relationships among the different ingredients. An understanding of the relationships between ingredients will help the baker or pastry chef to recognize a faulty formula, and to prepare basic products without the aid of written formulas, if necessary.

The second function of bakers' percentages is to make it easy to use a formula in the bakeshop or pastry kitchen. When a formula is expressed in bakers' percentages, it is easy to scale it up or down.

A percentage is a part of a whole (100 percent). In bakers' percentages, the whole is always the flour; *that is, the flour is always 100 percent*. If there are two or more types of flour, their sum must equal 100 percent. The percentages for all other ingredients are derived from the flour. Because the whole is the flour, and not the sum total of all the ingredients, the sum of all the ingredients will always exceed 100 percent. Occasionally the percentage of another ingredient may exceed 100 percent, if it is required in a greater amount than the flour.

Calculating the percentage value for an ingredient

To determine the percentage value for each ingredient in a formula, simply divide the weight of the ingredient by the weight of the flour and then multiply the result by 100.

$$\frac{\text{Total weight of ingredient}}{\text{Total weight of flour}} = \text{Decimal value} \times 100 = \text{Percent value of ingredient}$$

EXAMPLE

A bread formula calls for 5 lb of flour and 3 lb of diced potato. To calculate the percentage value for the diced potato, divide its weight by the weight of the flour (which is always 100 percent) and then multiply the result by 100.

$$\frac{3 \text{ lb diced potato}}{5 \text{ lb flour}} = 0.60 \times 100 = 60$$

The resulting percentage value is 60 percent.

NOTE Remember that when making any calculations, numerical values must be expressed in the same unit of measure (e.g., pounds, ounces, grams, kilograms); if necessary, convert any values before beginning the calculation.

Calculating the weight of an ingredient when the weight of flour is known

Divide the percentage value of the ingredient by 100 to get its decimal version, then multiply by the weight of the flour.

$$\text{Decimal value of ingredient} \times \text{Total weight of flour} = \text{Total weight of ingredient}$$

EXAMPLE

A bread formula lists the ingredient values only in percentages. You want to make a batch of dough using 5 lb flour. You need to calculate the weight for the potatoes, which are valued at 60 percent, so you can prep them for making the dough the next day.

$$\frac{60}{100} = 0.6 \text{ decimal value}$$

$$0.6 \times 5 \text{ lb flour} = 3 \text{ lb potatoes}$$

Desired dough temperature

The desired dough temperature (DDT) is the ideal average temperature of a dough while you are working with it. For lean doughs, this temperature is typically 75° to 80°F/24° to 27°C. Working with a lean dough at this temperature will help to keep the gluten strands relaxed. The ideal DDT for enriched doughs is slightly higher, as it is important to keep the fats that have been added to the dough soft while it is being worked. (To learn more about DDT, see “Desired Dough Temperature and British Thermal Units” in Chapter 7, page 106.)

Calculating water temperature from DDT

The DDT, the total temperature factor (TTF), and the sum of the other known temperatures that will influence the DDT are used to calculate the temperature the water should be when it is added to the ingredients so that after mixing the dough will be at or very near the DDT.

To make this calculation, first calculate the TTF. To find the TTF, multiply the DDT by the number of temperature factors to be considered. For a straight mix dough, there are three factors to be considered. For a sourdough or a dough that uses a pre-ferment, there are four or sometimes five factors, depending on the number of elements that are going to be added. These elements include the temperature of the flour, soaker pre-ferment, butter, eggs, really any ingredient that is over 20 percent. Also to be factored in are the ambient temperature and friction created by the mixer.

After you have found the TTF, subtract the sum of the known temperatures from it to give the ideal temperature for the water. The known temperatures are the temperature of the flour and the room. You also need to know the amount of friction the dough will undergo in the mixer.

EXAMPLE

You are making an enriched straight mix dough. The flour temperature is 65°F, the room temperature is 75°F, and the dough will be mixed for a total of 12 minutes.

First, calculate the TTF.

$$\text{DDT} \times \text{TTF factor} = \text{TTF}$$

$$80 \times 3 = 240$$



The flour's temperature is one of the known elements in calculating desired dough temperature (DDT).

Then find the value for the mixer friction. In this example, the number 2 is used for the friction factor, but this number may be higher or lower depending on batch size, speed, and type of mixer.

$$\begin{aligned} \text{Number of minutes mixing} \times \text{Friction factor} &= \text{Mixer friction} \\ 12 \times 2 &= 24 \end{aligned}$$

Then find the sum of all the known temperature factors.

$$\begin{aligned} \text{Flour temperature} + \text{Room temperature} + \text{Mixer friction} &= \text{Sum of known} \\ \text{temperature factors} & \\ 65 + 75 + 24 &= 164 \end{aligned}$$

Finally, find the water temperature.

$$\begin{aligned} \text{TTF} - \text{Sum of the known temperature factors} &= \text{Water temperature} \\ 240 - 164 &= 76^\circ\text{F} \end{aligned}$$

In warmer climates, it may be advisable to have a colder DDT. If necessary, ice can be used to lower the temperature of the water.

For example, if the calculated water temperature for 40 lb of water is 45°F, but the temperature of the water is 60°F, ice can be used to lower the temperature of the water. To calculate how much ice to use, an “ice Btu factor” (the amount of British thermal units it takes to melt 1 pound of ice) must be determined, using the following equation:

$$\frac{(\text{Total weight of water}) \times (\text{Water temperature} - \text{Desired water temperature})}{144} = \text{Weight of ice}$$

First subtract the actual water temperature from the desired water temperature to find the “degree difference.”

$$60^\circ\text{F} - 45^\circ\text{F} = 15^\circ\text{F}$$

Next, multiply the total weight of water by the “degree difference.”

$$40 \text{ lb} \times 15^\circ\text{F} = 600$$

Finally, divide the result by 144, the Btu factor.

$$\frac{600}{144} = 4.16 \text{ lb}$$

The result is the number of pounds of ice needed to achieve the desired water temperature and, ultimately, the DDT. Subtract the number of pounds of ice needed from the total weight of water needed to see how much water you need when adding ice to the formula.

$$40 \text{ lb} - 4.16 \text{ lb} = 35.9 \text{ lb}$$

In this formula, you will need to reduce the water to 35.9 lb to compensate for the 4.16 lb of ice. If you round the numbers so they can be measured easily, you will need 36 lb of water and 4 lb of ice.

part two

Yeast-raised breads and rolls



CLOCKWISE FROM TOP LEFT: Craquelin (page 187),
Brioche Loaf (page 186), Chocolate and Pecan Babka
(page 189), Brioche Loaf slices, Brioche à Tête (page 138)