4

INGREDIENTS

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO:

1. **Describe the characteristics and functions of wheat flours.**
2. **Describe the characteristics and functions of other flours, meals, and starches.**
3. **Describe the characteristics and functions of sugars.**
4. **Describe the characteristics and functions of fats.**
5. **Describe the characteristics and functions of milk and milk products.**
6. **Describe the characteristics and functions of eggs.**
7. **Describe the characteristics and functions of leavening agents.**
8. **Describe the characteristics and functions of gelling agents.**
9. **Describe the characteristics and functions of fruits and nuts.**
10. **Describe the characteristics and functions of chocolate and cocoa.**
11. **Describe the characteristics and functions of salt, spices, and flavorings.**

THE INTRODUCTION TO baking ingredients provided in this chapter is necessarily simplified. Hundreds of pages could be—and have been—written on wheat flour alone. Much of this information is, however, of a technical nature and of concern primarily to large industrial bakers. In contrast, this chapter covers the information you will need to produce a full range of baked items in a small bakeshop or a hotel or restaurant kitchen.

WHEAT FLOUR

WHEAT FLOUR IS the most important ingredient in the bakeshop. It provides bulk and structure to most of the baker's products, including breads, cakes, cookies, and pastries. Unlike the home cook who depends almost entirely on a product called *all-purpose flour*, the professional baker has access to a wide variety of flours with different qualities and characteristics. To select the proper flour for each product, and to handle each correctly, you need to understand the characteristics of each type of flour and how it is milled.

Wheat Varieties

The characteristics of a flour depend on the variety of wheat from which it is milled, the location where it is grown, and its growing conditions. The most important fact the baker needs to know is that some wheats are *hard* and some are *soft*. ***Hard wheats*** contain greater quantities of the proteins called *glutenin* and *gliadin*, which together form gluten when the flour is moistened and mixed. The subject of gluten is discussed in more detail later in this chapter and in Chapter 5.

Gluten development, as you will learn, is one of the baker's major concerns when mixing doughs and batters. ***Strong flours***—that is, flours from hard wheats with high protein content—are used primarily to make breads and other yeast products. ***Weak flours***—that is, flours from ***soft wheats*** with low protein content—are important in the production of cakes, cookies, and pastries.

Six principal classes of wheat are grown in North America:

1. **Hard red winter.** This wheat is grown in large quantities. It has a moderately high protein content (see the Protein Content of North American Wheat Varieties table) and is used primarily for *bread flours*. The word "red" in the name refers to the dark color of the bran and husk layers of the wheat berry, not the interior of the grain, which is white.
2. **Hard red spring.** This wheat has the highest protein content of North American wheats and is an important component of strong bread flours. It is often blended with flours from other wheat varieties to make bread flour. Flour made only from hard red spring wheat contains gluten proteins that are often too strong and difficult to stretch for making hand-shaped breads.
3. **Hard white.** This high-protein winter wheat is grown in small quantities for bread flours. One interesting use for this wheat is to make whole wheat flours that are lighter in color and not as strong in flavor as whole wheat flours made from red wheat.
4. **Soft white.** This is a low-protein wheat useful for pastries, cakes, crackers, and other products in which a softer wheat is required.
5. **Soft red winter.** This is another low-protein wheat used for cake and pastry flours.
6. **Durum.** This hard wheat is used primarily for spaghetti and other macaroni products.

Different wheat varieties are grown in Europe. For example, four principal wheat strains grown in France—Recital, Scipion, Soissons, and Textel—are softer—that is, lower in protein—than most North American varieties.

PROTEIN CONTENT OF NORTH AMERICAN WHEAT VARIETIES

WHEAT VARIETY	PROTEIN CONTENT
Soft winter wheat (red and white)	8–11%
Hard winter wheat (red and white)	10–15%
Hard red spring wheat	12–18%
Durum wheat	14–16%

Composition of Wheat

The wheat kernel consists of three main parts:

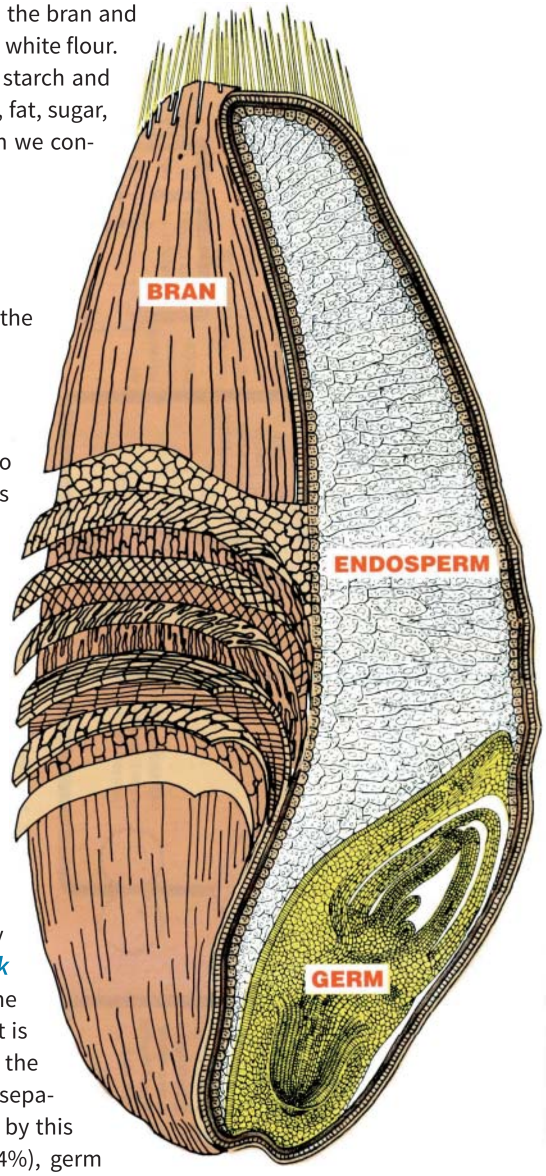
1. The ***bran*** is the hard outer covering of the kernel. Darker in color than the interior of the grain, bran is present in whole wheat flour as tiny brown flakes, but is removed in the milling of white flour. (In the case of whole wheat flour made from white wheat, the bran flakes are a much lighter, creamy white color.)

   Bran is high in dietary fiber and contains B vitamins, fat, protein, and minerals.

2. The ***germ*** is the part of the kernel that becomes the new wheat plant if the kernel is sprouted. It has a high fat content that can quickly become rancid. Therefore, whole wheat flour containing the germ has poor keeping qualities.

   Wheat germ is high in nutrients, containing protein, vitamins, and minerals, as well as fat.

3. The ***endosperm*** is the white, starchy part of the kernel that remains when the bran and germ are removed. This is the portion of the wheat kernel that is milled into white flour. Depending on its source, the wheat endosperm contains about 68 to 76% starch and 6 to 18% protein. The endosperm also contains small amounts of moisture, fat, sugar, minerals, and other components. These are discussed in more detail when we consider the composition of flour in a later section.



Kernel of wheat.

Provided by the Wheat Foods Council.

The Milling of Wheat

The purpose of milling wheat is twofold: (1) to separate the endosperm from the bran and germ; and (2) to grind the endosperm to a fine powder.

Stone Grinding

Until modern roller milling (described next) was invented, wheat was made into flour by grinding it between two large stones. Once the grain was ground, it was sifted to remove some of the bran. This sifting is called ***bolting***. Bolted flour is lighter in color and finer in texture than whole wheat flour. However, some of the flavor and nutrients are removed along with the bran and germ. In specialty markets, one can still find stone-ground flour, especially unbolted whole wheat flour, and other stone-ground meals, such as cornmeal.

Stone-grinding is laborious and time-consuming, and it does not produce a product that is easy to separate into the precise grades of flour demanded by modern baking. It wasn't until the break system was invented in the nineteenth century that the full range of flour grades in use today became available.

Roller Milling and the Break System

Modern milling of wheat into flour is accomplished by a fairly complex and highly refined system that uses grooved steel rollers. In what is called the ***break system***, the rollers are set so the space between them is slightly smaller than the width of the kernels, and the rollers rotate at different speeds. When the wheat is fed between them, the rollers flake off the bran layers and germ and crack the endosperm into coarse pieces. By sifting the broken grains, the parts can be separated. Approximately 72% of the wheat kernel can be separated as endosperm by this process and milled into flour. The remaining 28% consists of bran (about 14%), germ (about 3%), and other outer portions called *shorts* (about 11%).

To further understand how milling works, you must understand that the outer parts of the endosperm—that is, the parts closest to the bran—are higher in protein than the inner parts. When the grain is cracked in the mill, the outer parts break into larger pieces and the inner parts into smaller pieces. In addition, the parts closest to the bran are darker in color than the creamy white interior of the endosperm.

Sifting separates the flour into ***streams***. This means the grain is passed through the rollers many times, with the rollers closer together each time. After each pass through the rollers, part of the endosperm is fine enough to be sifted off as flour. The first streams come from the interior of the kernels. Later streams consist of the outer portions of the endosperm. By repeated sifting and breaking, different grades of flour can be obtained from one type of wheat. These grades are described in the following section.

Flour Grades

As just described, different grades of flour come from different portions of the endosperm. Modern milling processes were developed to separate these portions.

PATENT FLOUR

Flour from the interior of the endosperm, extracted during the first streams of milling, is considered the highest grade of flour and is called ***patent flour***. It is fine in texture because the granules from the interior of the grain are the smallest. It is also whiter in color than other grades and has high-quality protein. It is nearly completely free of any trace of bran or germ.

Different grades of patent flour are available, depending on the amount of endosperm extracted. Fancy patent, also called *extra short*, is made from only the inner 40 to 60% of the endosperm. Short patent may contain up to 80% of the endosperm, while long patent consists of up to 95% of the endosperm.

Most bakers use the term *patent flour* to mean strong patent flour used for breads. However, any flour made from the interior of the endosperm is patent flour, even if made from soft wheat. Cake flour and pastry flour are also patent flours. You should be aware of these two uses of the term to avoid confusion.

CLEAR FLOUR

The portion of the endosperm left after the patent flour has been removed is called ***clear flour***. This flour comes from the outer parts of the endosperm and thus is darker in color and higher in protein. Clear flour is usually separated into more than one grade. *First clear* is a dark flour, tan in color, that is often used in rye breads, where its dark color is not noticed and its high protein content contributes much-needed gluten. Even though it is dark, first clear is lighter in color than *second clear*, which is a low-grade flour not usually used in food production.

It was stated earlier that the outer parts of the endosperm are higher in protein than the interior. Thus, for each type of wheat, clear flour is higher in protein than patent flour. However, the quality of the protein in patent flour is better. This means that the gluten that is formed from these proteins stretches well and makes a strong, elastic film.

STRAIGHT FLOUR

Straight flour is made by combining all the streams of the milling process. In other words, it is made from the entire endosperm. Because it contains the darker parts of the grain as well as the whiter interior, straight flour is darker in color than patent flour. In addition, it contains small amounts of bran and germ that weren't separated during milling.

Straight flour is not often used in North American baking. Some European flours are straight flours.

EXTRACTION

Extraction refers to the amount of flour milled from a given amount of grain. It is expressed as a percentage of the total amount of grain. For example, whole wheat flour is said to be 100% extraction because if you start with 100 pounds of grain, you end up with 100 pounds of whole wheat flour. As a second example, if a grade of flour is described as 60% extraction, this means it would take 100 kilograms whole grain to produce 60 kilograms of this grade of flour. The remaining 40% is bran, germ, shorts, and darker, lower grades of flour. Patent flour is a low-extraction flour, while straight flour is a high-extraction flour.

Composition of Flour

White flour consists mostly of starch. This starch supplies the bulk in baked goods such as breads. Yet the other components of flour, especially protein, are of greatest concern to the baker because of the way they affect the dough-making and baking processes. This section describes each of the major components of white flour.

STARCH

White flour consists of about 68 to 76% starch. Starches are complex carbohydrates whose molecules consist of long chains of simpler sugars bound together. The starches in flour are contained in tiny granules. Most of these remain intact until they come in contact with water during the mixing process, at which time they absorb water and swell in size. Starch can absorb from one-quarter to one-half its weight in water.

A very small amount of the starch is broken down into sugars during milling or storage. This sugar is available as food for yeast.

PROTEIN

About 6 to 18% of white flour is protein, depending on the variety of wheat. Proteins act as binding agents that hold the starch granules together in the endosperm.

About 80% of the proteins in flour are called *glutenin* and *gliadin*. These two proteins, when combined with water and mixed in a dough, form an elastic substance called ***gluten***. Controlling the development of gluten, as you will learn in the next chapter, is one of the primary concerns of the baker. Without gluten, it is impossible to make familiar yeast-raised breads, because gluten provides their structure. Gluten proteins can absorb about two times their weight in water.

Other proteins present in white flour are enzymes, most importantly ***amylase***, also called ***diastase***. This enzyme breaks down starch into simple sugars, which is important for yeast fermentation. Yeast is able to ferment sugars but not starch; amylase makes fermentation possible even in bread doughs with no added sugar.

MOISTURE

The moisture content of flour in good condition ranges from 11 to 14%. If it becomes higher than this, spoilage is likely to occur. For this reason, flour should always be stored covered in a dry place.

GUMS

Like starches, *gums* are forms of carbohydrate. Gums make up 2 to 3% of white flour. The most important gums are called ***pentosans***. They are significant because they have a much greater capability to absorb water than either starches or proteins. Pentosans absorb 10 to 15 times their weight in water, so even though they are present in small quantities, they have an important effect on dough formation.

Gums also serve as a source of dietary fiber.

FATS

Fats and fatlike substances (*emulsifiers*) comprise only about 1% of white flour, but it is necessary to be aware of them. First, they are important for gluten development. Second, they spoil easily, giving flour an “off” flavor. For this reason, flour has a limited shelf life and should be used in a timely manner.

ASH

Ash is another term for the mineral content of flour. When bakers are buying flour, they look at two important numbers in the flour’s description: the protein content and the ash content. The ash content is determined by burning a sample of flour in a controlled environment. The starch and protein, when burned completely, turn to carbon dioxide gas, water vapor, and other gases, but the minerals do not burn and are left as ash. In general, the higher the ash content, the darker the flour. This is because the bran and the outer parts of the endosperm contain more minerals than the whiter, inner portions of the endosperm. Similarly, whole-grain flour is higher in ash than white flour. In conventional baking, bakers like a relatively low ash content because it makes whiter breads. Today, many artisan bakers of handmade breads look for darker flour with a higher ash content because it makes breads with a more robust wheat flavor.

Ash content for wheat flours ranges from about 0.3% for white cake flour to about 1.5% for whole wheat flour.

PIGMENTS

Orange-yellow pigments called ***carotenoids*** are present in flour in tiny amounts. Because of these pigments, unbleached flour is creamy in color rather than pure white. As flour ages after it is milled, oxygen in the air bleaches some of these pigments, turning the flour somewhat whiter in color.

KEY POINTS TO REVIEW

- What are the three main parts of the wheat kernel?
- How is flour milled, using the roller milling system?
- What is meant by *extraction*?
- What are the three main grades of flour as produced by the roller milling process? Describe them.

Absorption

Absorption refers to the amount of water a flour can take up and hold while being made into a simple dough, based on a predetermined standard dough consistency or stiffness. It is expressed as a percentage of the weight of flour. Thus, if the absorption ratio of a certain grade of flour is described as 60%, this means 60 pounds water combined with 100 pounds flour would yield a dough of standard consistency.

What accounts for differences in absorption ratio of different flours? Remember that the starch, protein, and pentosan gums in flour all absorb water (pp. 56–57). Consider these facts:

- Because starch is the largest component of flour, it absorbs most of the water. However, it absorbs only one-quarter to one-half its weight in water, so a small variation in starch content results in a small variation in absorption.
- Pentosan gums absorb 10 to 15 times their weight in water, but because they are present in such tiny quantities, they don't account for much variation in absorption ratios.
- Proteins are present in significant amounts and absorb up to twice their weight in water. Thus, variations in the absorption ratio of different flours are caused primarily by variations in protein content.

For all practical purposes, the absorption ratio of water by flour is a function of the protein content. *The higher the protein content of the flour, the more water it can absorb*. Obviously, this is an important consideration for bakers. They will have to adjust the water in their bread formulas if they start using flour of a different protein content.

Flour Treatments and Additives

Millers may add small amounts of various compounds to improve the dough-making and baking qualities of flour. All additives must be indicated on the product label. Bakers also may purchase additives and add them to flour as needed.

ENZYMES

As described above, the enzyme amylase, more commonly called *diastase* by bakers, is naturally present in flour, but usually in too small a quantity to be helpful for yeast. Malt flour (described on p. 66) is high in diastase. It may be added by the miller, or the baker may add it in the bakeshop.

AGING AND BLEACHING

Freshly milled flour is not good for bread making. The gluten is somewhat weak and inelastic, and the color may be yellowish. When the flour is aged for several months, the oxygen in the air matures the proteins so they are stronger and more elastic, and it bleaches the color slightly.

Aging flour is costly and haphazard, however, so millers may add small quantities of certain chemicals to accomplish the same results quickly. Bromates, specifically potassium bromate, added to bread flours mature the gluten but do not bleach the flour a great deal. Bromate use is decreasing because of concerns about its safety, and it is not used at all in Canada and Europe. Other additives, such as ascorbic acid (vitamin C), are used instead.

Chlorine is added to cake flour for two reasons: as a maturing agent, and to bleach the flour to pure white.

NUTRIENTS

Enriched flour is flour to which vitamins and minerals (primarily iron and B vitamins) are added to compensate for the nutrients lost when the bran and germ were removed. Most white flour used in North America is enriched.

DOUGH CONDITIONERS

Dough conditioners, also called *dough improvers*, are sometimes added by the baker for the production of yeast products. They contain a variety of ingredients that improve gluten development, aid yeast fermentation, and delay staling. The use of dough conditioners is regulated by law in Canada and the United States, so it is important not to use too much. Also, adding too much to yeast doughs decreases bread quality.

VITAL WHEAT GLUTEN

Vital wheat gluten is wheat gluten in a concentrated form, usually about 75% by weight. It is added to flour to improve the quality of yeast-raised doughs. It can increase the volume of yeast breads and aid in the development of gluten during mixing.

Types of Patent Flour

Bakers generally use the term *patent flour* to mean *patent bread flour*. Technically, all white flour except clear flour and straight flour is patent flour, including cake and pastry flours.

Bread Flour

Patent flour made from hard wheat has enough good-quality gluten to make it ideal for yeast breads. Patent bread flours typically range from 11 to 13.5% protein and 0.35 to 0.55% ash. They are available bleached or unbleached. ***Bread flour*** with added malt flour to provide extra diastase enzymes is also available.

In North America, most patent bread flour is formulated for large commercial bakeries. Thus, its gluten proteins are strong enough to tolerate machine handling and molding. Protein content of up to 13.5% is suitable for highly mechanized bakeries. Hand-made artisan breads, on the other hand, generally require a somewhat softer flour, because stronger flours make doughs that are difficult to make up by hand. Look for flour with a protein content of 10.5 to 12%.

Bread flour.

High-Gluten Flour

Flour with an especially high protein content is sometimes used in hard-crusted breads and in such specialty products as pizza dough and bagels. It is also used to strengthen doughs made from flours that contain little or no gluten. See, for example, the formula for Chestnut Bread on page 137. (The name of this flour is slightly misleading, as the flour is high not in gluten but in gluten-forming proteins. There is no gluten in flour until certain proteins absorb water and a dough is mixed.)

A typical high-gluten flour has 14% protein and 0.5% ash.

Cake flour.

Cake Flour

Cake flour is a weak or low-gluten flour made from soft wheat. It has a soft, smooth texture and a pure white color. Cake flour is used for cakes and other delicate baked goods that require low gluten content.

Protein content of cake flour is approximately 8%, and ash content is approximately 0.3%.

Pastry Flour

Pastry flour is also a weak or low-gluten flour, but it is slightly stronger than cake flour. It has the creamy white color of patent flour rather than the pure white of cake flour. Pastry flour is used for pie doughs and for some cookies, biscuits, and muffins.

Pastry flour has a protein content of about 9% and an ash content of about 0.4 to 0.45%.

Pastry flour.

European Flour Types

In much of Europe, a flour grading system based on ash content is dominant. For example, the French grades T45 and T55 are white wheat flours with low ash, for breads and pastries. T65 includes high-gluten flours, and T80, T110, and T150 are whole wheat flours of increasing darkness. Other flours are included in this grading system. For example, T170 is dark rye flour.

Bread flours from European wheats are generally lower in protein than North American bread flours. Typically, they have a protein content of around 11 to 11.5%. Some North American mills have begun supplying similar flour to artisan bread bakers seeking to imitate classic European breads.

TYPES OF FLOUR

FLOUR	PROTEIN	ASH
Straight flour	13–15%	0.4–0.45%
Patent bread flour	11–13.5%	0.35–0.55%
Clear flour	17%	0.7–0.8%
High-gluten flour	14%	0.5%
Cake flour	8%	0.3%
Pastry flour	9%	0.4–0.45%
All-purpose flour	10–11.5%	0.39–4.4%

HAND TEST FOR FLOUR STRENGTH

A typical small bakery keeps three white wheat flours on hand: cake flour, pastry flour, and a bread flour such as patent. You should be able to identify these three by sight and touch, because sooner or later someone will dump a bag of flour into the wrong bin or label it incorrectly, and you will need to be able to recognize the problem.

- Bread flour feels slightly coarse when rubbed between the fingers. If squeezed into a lump in the hand, it falls apart as soon as the hand is opened. Its color is creamy white.
- Cake flour feels very smooth and fine. It stays in a lump when squeezed in the hand. Its color is pure white.
- Pastry flour feels smooth and fine, like cake flour, and can also be squeezed into a lump. However, it has the creamy color of bread flour, not the pure white color of cake flour.

Hand test for flour strength (from left to right): bread flour, pastry flour, cake flour.

Other Wheat Flours

Other wheat flours you should be familiar with include the following:

All-purpose flour, commonly found in retail markets, is less often found in bakeshops, although it is often used as a general-purpose flour in restaurants, where it is purchased under the name *restaurant and hotel flour*. This flour is formulated to be slightly weaker than bread flour so it can be used for pastries as well. All-purpose flour has a protein content of about 10 to 11.5%.

Durum flour is made from durum wheat, a high-gluten wheat of a different species than those used for most flour. It is used primarily to make spaghetti and other dried pasta. In the bakeshop, it is occasionally used in specialty products, such as Italian semolina bread (*semolina* is another name for durum flour or durum meal). Durum flour has a protein content of 12 to 16%.

Self-rising flour is a white flour to which baking powder and, sometimes, salt has been added. Its advantage is that the baking powder is blended in uniformly. However, its use is limited by two factors. First, different formulas call for different proportions of baking powder. No single blend is right for all purposes. Second, baking powder loses its aerating, or leavening, power with time, so the quality of baked goods made from this flour can fluctuate.

Whole wheat flour.

Whole wheat flour is made by grinding the entire wheat kernel, including the bran and germ. The germ, as you have learned, is high in fat, which can become rancid, so whole wheat flour does not keep as well as white flour.

Because it is made from wheat, whole wheat flour contains gluten-forming proteins, so it can be used alone in bread making. (Protein content is typically 12 to 13%.) However, bread made with 100% whole wheat flour is heavier than white bread because the gluten strands are cut by the sharp edges of the bran flakes. Also, the fat from the wheat germ may contribute to the shortening action. This is one reason why most whole wheat breads are strengthened with white flour. Another reason is that the flavor of 100% whole wheat is stronger than many people care for, and the lighter flavor imparted by a blend of flours is often preferred by customers.

Bran flour is flour to which bran flakes have been added. The bran may be coarse or fine, depending on specifications.

Cracked wheat is not a flour but a type of meal, in which the grains are broken into coarse pieces. It is used in small quantities to give texture and flavor to some specialty breads.

OTHER FLOURS, MEALS, AND STARCHES

WHEAT FLOUR IS the only flour with gluten of sufficient quantity and quality for making regular yeast breads. Some other grains, primarily rye and spelt, also contain gluten proteins, a fact important to people with gluten sensitivity or celiac disease. Unfortunately, the proteins do not form a good, elastic gluten useful for bread making. With the exception of a few specialty baked goods, these other flours and meals are mixed with wheat flour for most baking purposes.

Rye

Next to white and whole wheat, rye is the most popular flour for bread making. Although ***rye flour*** contains some proteins, these do not form gluten of good quality. This is because although it contains enough gliadin, rye flour does not contain enough glutenin. Therefore, breads made with 100% rye flour are heavy and dense. To make a lighter rye loaf, it is necessary to use a mixture of rye and hard wheat flours. Typical formulas call for 25 to 40% rye flour and 60 to 75% hard wheat flour.

Rye flour is also high in pentosan gums—about four times as much as wheat flour. The gums give some structure to rye breads, but they also interfere with gluten development and make rye doughs stickier than wheat doughs.

Rye flour is milled much like wheat flour. The lightest rye flours, from the inner part of the kernel, have a low extraction rate, corresponding to patent flour. The following grades and types are generally available:

Light rye. The lightest is nearly white. It has a very fine texture and a high percentage of starch, with little protein.

Medium rye. This is a straight flour, milled from the whole rye grain after the bran is removed. Thus, it is darker than light rye and has a higher protein content.

Dark rye. Like clear flour milled from wheat, dark rye comes from the part of the rye grain closest to the bran. Thus, it is darker than other rye flours and has a lower percentage of fine starch particles.

Whole rye flour. This product is made from the whole rye kernel, including the bran and germ.

Rye meal or pumpernickel flour. ***Rye meal*** is a dark, coarse meal made from the entire rye grain, including the bran and germ. Products labeled *pumpernickel* are sometimes cut into flakes rather than ground into coarse meal. Rye meal is used for pumpernickel bread and similar specialty products.

Rye blend. This is a mixture of rye flour (generally 25 to 40%) and a strong wheat flour, such as clear flour.

Dark rye flour.

Corn

Wheat and rye account for the great majority of the grain flours and meals used in the bakeshop. Other grains are used mainly to add variety to baked goods. Of these other grains, corn is perhaps the most important. (*Note:* In Great Britain, corn is referred to as *maize*, while the word *corn* simply means "grain.")

Corn contains no gluten-forming proteins, although it does contain significant quantities of other proteins, and is therefore important in vegetarian diets.

Corn is most often used by the baker in the form of yellow cornmeal. Blue cornmeal is also available. Most cornmeal is made from only the endosperm, because the oil in the germ becomes rancid quickly. However, whole-grain cornmeal is also available. Cornmeal is available in grinds from fine to coarse. Coarse cornmeal produces a crumbly, somewhat gritty texture in cornbreads, a quality that is desirable in some products.

Other important corn products are discussed on page 63 in the section on starches.

Yellow cornmeal.

Spelt

Spelt is considered an ancestor of modern wheat. Like wheat, it contains gluten proteins, but they form a rather weak gluten structure that can't withstand much mixing. Spelt has a lower absorption ratio than wheat.

Spelt was unheard of by most bakers until not long ago. More recently, it has enjoyed increased popularity, partly because of increased interest in vegetarian diets and the desire for greater variety in dietary sources of protein. It is found increasingly as an ingredient in specialty breads.

Oats

Long familiar as breakfast porridge, oats in various forms also find uses in the bakeshop. Although rich in protein, including enough gluten proteins to make them off-limits for people allergic to gluten, oats do not form a gluten structure when mixed into a dough. Oats are high in gums, which supply dietary fiber. The gum content accounts for the gummy or gluey texture of oatmeal porridge.

Rolled oats, commonly used for porridge, are made by steaming oat grains to soften them and then flattening them between rollers. They are used to give textural interest to multigrain breads, as toppings for specialty loaves, and as an ingredient in some cookies.

Steel-cut oats are whole grains that have been cut into small pieces. They are occasionally used in small quantities in specialty breads. They have a long cooking time and a chewy texture.

Oat flour is whole-grain oats ground into fine flour, which can be mixed with wheat flour in small quantities for specialty breads.

Oat bran is a good source of dietary fiber that is often used as a muffin ingredient.

Buckwheat

Buckwheat is technically not a grain because it is the seed not of a grass but of a plant with branched stems and broad, arrow-shaped leaves. Whole buckwheat is often ground into a dark, strong-tasting flour, while buckwheat endosperm alone is ground into a lighter-colored flour with a somewhat milder taste. When the grains are crushed into small pieces, they are called *buckwheat groats* and can be cooked like rice.

Buckwheat flour is most commonly used for pancakes and crêpes, but it can also be used in small quantities in specialty breads and multigrain products.

Soy

Soy is not a grain; it is a bean, or legume. Nevertheless, it may be ground into a flour like a grain. Unlike regular grains, however, it is low in starch. It is also high in fat and protein, although it contains no gluten proteins. The rich protein content makes it valuable in vegetarian diets.

Soy flour used in baking usually has had part of the fat removed. Raw soy flour contains enzymes that make it useful in baking. These enzymes aid yeast action and bleach the pigments in wheat flour. Raw or untoasted soy flour should be used in small quantities in yeast breads, generally about 0.5%. Higher quantities give an unpleasant beany flavor to breads and produce poor texture.

When soy flour is toasted, the enzymes are destroyed and the flour has a pleasanter flavor. Toasted soy flour can be used to add flavor and nutritional value to baked products.

Rice

Rice flour is smooth white flour milled from white rice. It has a small amount of protein but no gluten, so it is often used in gluten-free baked products.

Other Grains and Flours

Many other grains, such as amaranth, millet, teff, and barley, have limited used in the bakeshop, either as flour or as whole grains. Other starchy nongrain foods, such as potatoes and chestnuts, can be dried and ground into flour for special products. See, for example, the formula for Chestnut Bread on page 137. Cooked potato starch is sometimes added to yeast breads, because the starch is easily broken down by diastase enzymes into forms of sugar that yeast can use.

Starches

In addition to flours, other starch products are used in the bakeshop. Unlike flour, they are used primarily to thicken puddings, pie fillings, and similar products. The three most important starches in dessert production are as follows:

1. *Cornstarch* has a special property that makes it valuable for certain purposes. Products thickened with cornstarch set up almost like gelatin when cooled. For this reason, cornstarch is used to thicken cream pies and other products that must hold their shape.
2. *Waxy maize* is made from a different type of corn. It is almost always manufactured into a form called *modified food starch*. Waxy maize and other modified starches have valuable properties. Because they do not break down when frozen, they are used for products that are to be frozen. Also, they are clear when cooked and give a brilliant, clear appearance to fruit pie fillings.

   Waxy maize does not set up firm like cornstarch but rather makes a soft paste that has the same consistency hot and cold. Thus, it is not suitable for cream pie fillings.
3. *Instant starches* are precooked or pregelatinized so they thicken cold liquids without further cooking. They are useful when heat will damage the flavor of the product, as in fresh fruit glazes such as strawberry.

AMYLOSE AND AMYLOPECTIN STARCHES

Starch molecules fall into two principal categories. Amylose molecules are long, straight chains, while amylopectin molecules have many branches. Most grain starches are high in amylose starches; starches from roots and tubers, such as potatoes and arrowroot, are high in amylopectin starches. The differences between the two types can be summarized as follows:

- Amylose starches, after cooking, get thicker and cloudier as they cool. They form a firm gel when cooled. They tend to break down and release liquid after long storage or after freezing.
- Amylopectin starches do not get thicker as they cool, and they remain fairly clear. They also remain stable when frozen and do not release liquid in storage or after freezing.

KEY POINTS TO REVIEW

- What is meant by *absorption*? Why is it important?
- What are the most important characteristics of bread flour, high-gluten flour, pastry flour, and cake flour?
- What are the main types of rye flour?

SUGARS

SUGARS OR SWEETENING agents have the following purposes in baking:

- They add sweetness and flavor.
- They create tenderness and fineness of texture, partly by weakening the gluten structure.
- They give crust color.
- They increase keeping qualities by retaining moisture.
- They act as creaming agents with fats and as foaming agents with eggs.
- They provide food for yeast.

We customarily use the term *sugar* to refer to regular refined sugars derived from sugarcane or beets. The chemical name for these sugars is ***sucrose***. However, other sugars of different chemical structure are also used in the bakeshop.

Sugars belong to a group of substances called ***carbohydrates***, a group that also includes starches. There are two basic groups of sugars: ***simple sugars*** (or *monosaccharides*, which means “single sugars”) and ***complex sugars*** (or *disaccharides*, meaning “double sugars”). Starches, or *polysaccharides*, have more complex chemical structures than sugars. Sucrose is a disaccharide, as are maltose (malt sugar) and lactose (the sugar found in milk). Examples of simple sugars are glucose and fructose.

DEXTROSE AND LEVULOSE

The names for the two sugars that make up invert sugar mean, literally, "right sugar" and "left sugar." To put it simply, this is because their molecules contain the same numbers of atoms and have the same basic structure, but they are mirror images of each other. If one can be said to coil to the right, the other coils to the left.

Another name for dextrose is *glucose*. This is the name it is usually known by in the bakeshop, except when it is purchased as a dry powder.

All these sugars have different degrees of sweetness. For example, lactose is much less sweet than regular table sugar (sucrose), while fructose (or fruit sugar, one of the sugars in honey) is much sweeter than sucrose.

All sugars share one characteristic that is important for bakers and pastry chefs to understand: They are *hygroscopic*. This means they attract and hold water. Some sugars are more hygroscopic than others. Fructose, found in honey, is much more hygroscopic than sucrose, or table sugar.

For some purposes, this characteristic is desirable. For example, baked goods containing sugar stay moist longer than those with little or no sugar. For other purposes, this is undesirable. For example, spun sugar (p. 663) can be held for only a limited time, because it attracts moisture from the air and becomes sticky. Sugar used for dusting can attract moisture and dissolve.

Invert Sugar

When a sucrose solution is heated with an acid, some of the sucrose breaks down into equal parts of two simple sugars, dextrose and levulose. A mixture of equal parts of dextrose and levulose is called ***invert sugar***. It is about 30% sweeter than regular sucrose.

Invert sugar has two properties that make it interesting to the baker. First, it holds moisture especially well—that is, it is very hygroscopic—and, therefore, helps keep cakes fresh and moist. Second, it resists crystallization. Thus, it promotes smoothness in candies, icings, and syrups. This is why an acid such as cream of tartar is often added to sugar syrups. The acid inverts some of the sugar when it is boiled, preventing graininess in the candy or icing.

Invert sugar is produced commercially and is available as a syrup. It is also present in honey.

Regular Refined Sugars, or Sucrose

Refined sugars are classified by the size of the grains. However, there is no standard system of labeling, so the names of the granulations vary depending on the manufacturer.

Granulated Sugar

Solid sugars (clockwise from top left): 10X sugar, brown sugar, regular granulated sugar, superfine granulated sugar.

Regular granulated sugar, also called *fine* ***granulated sugar*** or table sugar, is the most familiar and the most commonly used.

Very fine and **ultrafine sugars** (also called *caster sugar*) are finer than regular granulated sugar. They are prized for making cakes and cookies because they produce a more uniform batter and can support higher quantities of fat.

Sanding sugars are coarse and are used for coating cookies, cakes, and other products.

Pearl sugar is a type of sanding sugar. It consists of opaque, white grains and does not easily dissolve in water. This characteristic, as well as its appearance, makes it useful for decorating sweet dough products. Pearl sugar is also called *sugar nibs*.

In general, finer granulations are better for mixing into doughs and batters because they dissolve relatively quickly. Coarse sugars are likely to leave undissolved grains, even after long mixing. These show up after baking as dark spots on crusts, irregular texture, and syrupy spots. Also, fine sugars are better for creaming with fats because they create a finer, more uniform air cell structure and better volume.

Coarse sugar, on the other hand, can be used in syrups, where its mixing properties are not a factor. Even a very coarse sugar dissolves readily when boiled with water. In fact, coarse crystalline sugar is often purer than fine sugar and makes a clearer syrup.

Confectioners' or Powdered Sugars

Confectioners' sugars are ground to a fine powder and mixed with a small amount of starch (about 3%) to prevent caking. They are classified by coarseness or fineness.

10X is the finest sugar. It gives the smoothest texture in icings.

6X is slightly coarser in texture than 10X. For this reason, it is less likely to form lumps or to dissolve in moisture. It is used mostly for dusting the tops of desserts.

Coarser types (XXXX and XX) are used for dusting and whenever 6X or 10X are too fine.

Confectioners' sugar is also known as *icing sugar* because of its importance in making many kinds of icing.

Dehydrated Fondant

Dehydrated fondant, also known as *fondant sugar*, is a dried form of fondant icing. It is different from confectioners' sugar in that it is much finer than even 10X, and it does not contain any starch to prevent caking.

During the manufacture of fondant, part of the sucrose is changed to invert sugar. This helps keep the sugar crystals tiny, which makes for a very smooth, creamy icing with a good shine.

Fondant is discussed with other icings in Chapter 17.

Brown Sugar

Brown sugar is mostly sucrose (about 85 to 92%), but it also contains varying amounts of caramel, molasses, and other impurities, which give it its characteristic flavor and color. The darker grades contain more of these impurities. Basically, brown sugar is regular cane sugar that has not been completely refined. However, it can also be made by adding measured amounts of these impurities to refined white sugar.

Brown sugar was, at one time, available in 15 grades that ranged from very dark to very light. Today, only two to four grades are generally available.

Because it contains a small amount of acid, brown sugar can be used with baking soda to provide some leavening (see p. 79). It is used in place of regular white sugar when its flavor is desired and its color will not be objectionable. Of course, it should not be used in white cakes.

Keep brown sugar in an airtight container to prevent it from drying out and hardening.

Demerara sugar is a crystalline brown sugar. It is dry rather than moist like regular brown sugar. Demerara sugar is sometimes used in baking, but it is more often served as a sweetener with coffee and tea.

Nonnutritive Sweeteners

Also known as *sugar substitutes*, these products are discussed together with other dietary issues in Chapter 26.

Syrups

Syrups consist of one or more types of sugar dissolved in water, often with small amounts of other compounds or impurities that give the syrup flavor. The most basic syrup in the bakeshop, called ***simple syrup***, is made by dissolving sucrose in water. ***Dessert syrup*** is simple syrup with added flavorings. These sucrose syrups are discussed in more detail in Chapter 12.

Molasses

Molasses is concentrated sugarcane juice. Sulfured molasses is a byproduct of sugar refining. It is the product that remains after most of the sugar is extracted from cane juice. Unsulfured molasses is not a byproduct but a specially manufactured sugar product. It has a less bitter taste than sulfured molasses.

Molasses contains large amounts of sucrose and other sugars, including invert sugar. It also contains acids, moisture, and other constituents that give it its flavor and color. Darker grades are stronger in flavor and contain less sugar than lighter grades.

Molasses retains moisture in baked goods and therefore prolongs freshness. Crisp cookies made with molasses can soften quickly because the invert sugars absorb moisture from the air.

Liquid sugars (clockwise from top left): molasses, honey, low-conversion glucose syrup, corn syrup.

Glucose Corn Syrup

Glucose is the most common of the simple sugars (monosaccharides). In syrup form, it is an important bakeshop ingredient. Glucose is usually manufactured from cornstarch. Starch, as explained on page 63, consists of long chains of simple sugars bound together in large molecules. The manufacturing process breaks these starches into glucose molecules.

Not all the starch is broken into simple sugars during the process. In low-conversion syrups, only one-fourth to one-third of the starch is converted to glucose. As a result, these syrups are only slightly sweet. They are also very thick, because there are many larger molecules in the solution. Low-conversion syrups are less likely to burn or caramelize. They are useful for icings, candies, and sugar pieces, such as pulled sugar.

Regular, all-purpose ***corn syrups*** are medium-conversion glucose syrups in which nearly half the starch is converted to glucose. Corn syrup is useful for imparting moistness and tenderness to baked goods.

Dark corn syrup is regular corn syrup with added flavorings and colorings. In bakeshop usage, it is considered similar to a very mild molasses.

Invert Sugar Syrup

As explained on page 64, invert sugar is available as a syrup. It is often used in cakes and other products for its moisture-retaining properties. Bakers often refer to invert sugar syrup as *trimoline*, which is the brand name used by one of its manufacturers.

Honey

Honey is a natural sugar syrup consisting largely of the simple sugars glucose and fructose, plus other compounds that give it its flavor and color. Honeys vary considerably in flavor and color, depending on their source. Flavor is the major reason for using honey, especially as it can be expensive.

Because honey contains invert sugar, it helps retain moisture in baked goods. Like molasses, it contains acid, which means it can be used with baking soda as a leavening.

Malt Syrup

Malt syrup, also called *malt extract*, is used primarily in yeast breads. It serves as food for the yeast and adds flavor and crust color to the loaves. Malt is extracted from barley that has been sprouted (malted) and then dried and ground.

There are two basic types of malt syrup: *diastatic* and *nondiastatic*. Diastatic malt contains a group of enzymes called *diastase*, which breaks starch into sugars that can be acted on by yeast. Thus, diastatic malt, when added to bread dough, is a powerful food for yeast. It is used when fermentation times are short. It should not be used when fermentation times are long because too much starch will be broken down by the enzyme. This results in bread with a sticky crumb.

Diastatic malt is produced with high, medium, or low diastase content.

Nondiastatic malt is processed at high temperatures that destroy the enzymes and give the syrup a darker color and stronger flavor. It is used because it contains fermentable sugar and contributes flavor, crust color, and keeping qualities to breads.

Whenever malt syrup is called for in formulas in this book, nondiastatic malt is intended. Only one formula (Bagels, p. 136) requires diastatic malt. If malt syrup is not available, you may substitute regular granulated sugar.

Malt is available in two other forms. *Dried malt extract* is simply malt syrup that has been dried. It must be kept in an airtight container to keep it from absorbing moisture from the air. *Malt flour* is the dried, ground, malted barley that has not had the malt extracted from it. It is obviously a much less concentrated form of malt. When used in bread making, it is blended with the flour.

KEY POINTS TO REVIEW

- What are the six functions of sugars in baked goods?
- What forms of sucrose are used in the bakeshop?
- What are the main syrup products used in the bakeshop?

FATS

THE MAJOR FUNCTIONS of fats in baked items are:

- To add moistness and richness.
- To increase tenderness by shortening gluten strands.
- To increase keeping quality.

- To add flavor.
- To assist in leavening when used as a creaming agent, or to give flakiness to puff pastry, pie dough, and similar products.

Many fats are available to the baker. Each has distinctive properties that make it suitable for different purposes. Among the properties a baker must consider when selecting a fat for a specific use are its melting point, its softness or hardness at different temperatures, its flavor, and its ability to form emulsions (described later in this section).

Saturated and Unsaturated Fats

Some fats are solid at room temperature, while others are liquid. The liquid fats we usually refer to as ***oils***. Whether the fats are solid or liquid depends on the fatty acids that make up the fat molecules (see the Lipids sidebar).

Fatty acids consist primarily of long chains of carbon atoms to which hydrogen atoms are attached. If a fatty acid chain contains as many hydrogen atoms as it can possibly hold, it is called a ***saturated fat***. If the chain has empty spaces that could hold more hydrogen, it is called an ***unsaturated fat***. (One or more places along the carbon chain may lack hydrogen atoms.) Saturated fats are solid at room temperature, while unsaturated fats are liquid.

Natural fats consist of a mixture of many fat compounds. The more saturated fats there are in the mixture, the more solid the fat. The more unsaturated fats there are in the mixture, the softer it is.

To produce solid, pliable fats for the bakeshop, manufacturers submit oils to a treatment called ***hydrogenation***. This process bonds hydrogen atoms to the empty spaces in fatty acid chains, changing them from unsaturated to saturated. By controlling the process, the manufacturer can give the fat exactly the desired blend of saturated and unsaturated fats to produce a shortening with the exact characteristics desired, such as softness, moldability, and melting point.

LIPIDS

Fats are members of a larger group of compounds called *lipids*. Lipids are organic compounds that are not soluble in water. Other lipids include cholesterol and emulsifiers, such as lecithin.

Technically, fats are *triglycerides*, which are molecules made up of three fatty acid chains attached to the three carbon atoms of a glycerin molecule. The physical characteristics of each fat are determined by the kind of fatty acid chains that make up the compound.

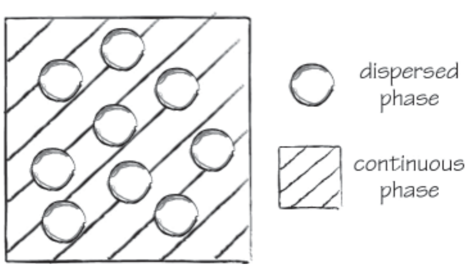
HYDROGENATION AND FAT STABILITY

As explained in the text, one purpose of hydrogenation is to produce fats with desired physical characteristics. A second reason is to reduce the tendency of the fat to spoil, or become *rancid*, by reacting with the oxygen in the air. The more unsaturated a fat is, the more likely it is to become rancid. Saturated fats are more stable, because all the places along the carbon chain are filled by hydrogen atoms, which gives oxygen less opportunity to react with the fat.

Fat Emulsions

Most bakery ingredients mix easily with water and other liquids and actually undergo a change in form. For example, salt and sugar dissolve in water; flour and starch absorb water, and the water becomes bound up with the starch and protein molecules. Fat, on the other hand, does not change form when it is mixed with liquids or other bakery ingredients. Instead, it is merely broken down into smaller and smaller particles during mixing. These small fat particles eventually become more or less evenly distributed in the mix.

A uniform mixture of two normally unmixable substances, such as a fat and water, is called an ***emulsion***. Mayonnaise is a familiar example of an emulsion from outside the bakeshop—in this case, an emulsion of oil and vinegar. There are also emulsions of air and fat, such as that formed when shortening and sugar are creamed together in the production of cakes and other products (see p. 80).



In an emulsion, droplets of one substance (called the *dispersed phase*) are evenly mixed in another substance (called the *continuous phase*).

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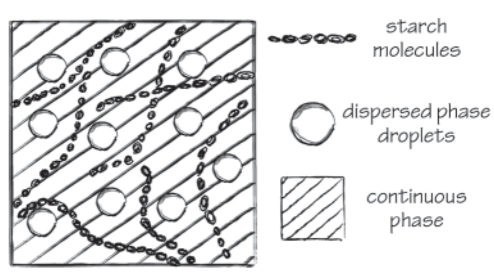

Particles (such as starch) in the continuous phase stabilize an emulsion by helping keep droplets of the dispersed phase from coming together and merging.

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Fats have differing abilities to form emulsions. For example, if the wrong shortening is used in certain cakes, the emulsion may fail because the batter contains more water than the fat can hold. We then say that the batter curdles, or breaks.

Shortenings

Any fat acts as a shortening in baking because it shortens gluten strands and tenderizes the product. However, we generally use the word ***shortening*** to mean any of a group of solid fats, usually white and tasteless, that are especially formulated for baking. Shortenings generally consist of nearly 100% fat.

Shortenings may be made from vegetable oils, animal fats, or both. During manufacturing, the fats are hydrogenated. This process turns liquid oils into solid fats. Shortenings are used for many purposes, so manufacturers have formulated different kinds of fats with various properties. There are three main types: regular or all-purpose (AP) shortenings, high-ratio plastic shortenings, and high-ratio liquid shortenings.

REGULAR SHORTENINGS

Regular shortenings, or all-purpose shortenings, have a fairly tough, waxy texture, and small particles of the fat tend to hold their shape in a dough or batter. They are called *plastic* shortenings, which means they are moldable at room temperature. Regular shortenings can be manufactured to varying degrees of hardness. They have a good creaming ability. This means that a good quantity of air can be mixed into them to give a batter lightness and leavening power (see p. 80). Also, this type of shortening melts only at a high temperature.

Fats (from left): lard, butter, margarine, shortening.

Because of their texture, regular shortenings are used for flaky products such as piecrusts and biscuits. They are also used in many other pastries, breads, and products mixed by creaming, such as certain pound cakes, cookies, and quick breads.

Unless another shortening is specified in a formula, regular shortening is generally used.

HIGH-RATIO PLASTIC SHORTENINGS

These are soft shortenings that spread easily throughout a batter and quickly coat the particles of sugar and flour. They are called *high-ratio* because they were devised for use in cake batters that contain a high ratio of sugar and liquid to flour. They also contain added emulsifying agents, so they can hold a larger quantity of liquid and sugar than regular shortenings. Thus, they give a smoother and finer texture to cakes, and make them moister. Because of the added emulsifiers, this shortening is also commonly referred to as ***emulsified shortening***.

On the other hand, high-ratio shortening does not cream well. When recipe instructions call for creaming shortening and sugar, regular shortening rather than high-ratio shortening should be used.

When emulsified shortening is used to make high-ratio cakes—cakes with a high ratio of sugar and liquid to flour—a simpler mixing method can be used because this shortening spreads so well (see Chapter 16). In addition, high-ratio shortening is often used in icings because it can hold more sugar and liquid without curdling.

The term *emulsified shortenings* is not, strictly speaking, an accurate one. Pure fat cannot be emulsified, because an emulsion is a mixture of at least two substances. It would, perhaps, be more accurate to call them *emulsifier* or *emulsifying* shortenings. However, the term *emulsified shortenings* is the more widely recognized and commonly used term.

HIGH-RATIO LIQUID SHORTENINGS

High-ratio liquid shortenings, also called *liquid cake shortenings*, are less hydrogenated than plastic shortenings, making them liquid and pourable, although they are thick and cloudy or opaque in appearance. They contain more emulsifiers than high-ratio plastic shortenings, and are effective shortenings in high-ratio cakes. The emulsifiers make the cakes moist and fine-textured. Also, because air is incorporated so easily during mixing, these shortenings increase the volume and tenderness of cakes.

High-ratio liquid shortenings, because they spread through the batter so well, simplify mixing. Also, the quantity of shortening in a batter can often be reduced because the shortening is so effective. For example, in the formula for Yellow Cake batter on page 400, the shortening quantity can be reduced to 50% with only a small change in quality; the cake will be only slightly drier and firmer.

Butter

Fresh butter in North America consists of about 80% fat, about 15% water, and about 5% milk solids. Most North American butter is made from sweet cream. Many European butters have a higher fat content—about 82%, or even more—and a lower moisture content. In addition, they are more likely to be made from cultured cream (crème fraîche, p. 71, and sour cream are examples of cultured cream used in the kitchen), which gives them a somewhat fuller flavor.

Butter is graded according to U.S. Department of Agriculture (USDA) standards, although grading is not mandatory. Grades are AA, A, B, and C. Most operations use grades AA and A because flavors of the lower grades may be off. In Canada, grades are Canada 1, Canada 2, and Canada 3.

Butter is available salted and unsalted. Unsalted butter is more perishable, but it has a fresher, sweeter taste and is thus preferred in baking. Also, salt masks flavors that might be absorbed during storage, making it is harder to tell if salted butter has foreign flavors that might detract from the finished baked goods. If salted butter is used, the salt in the formula may have to be reduced. It is difficult to know for sure, however, how much to reduce the salt content, because salted butters vary in their composition.

Shortenings are manufactured to have certain textures and levels of hardness to suit them for particular uses. Butter, on the other hand, is a natural product that doesn't have this advantage. It is hard and brittle when cold, very soft at room temperature, and it melts easily. Consequently, doughs made with butter are much harder to handle. Also, butter is more expensive than shortening.

On the other hand, butter has two major advantages:

1. **Flavor.** Shortenings are intentionally flavorless, but butter has a highly desirable flavor.
2. **Melting qualities.** Butter melts in the mouth. Shortenings do not. After eating pastries or icings made with shortening, one can be left with an unpleasant film of shortening coating the mouth.

For these reasons, many bakers and pastry chefs feel the advantages of butter outweigh its disadvantages for many purposes. Shortening is not often used in fine French pastries, for example. Frequently, you may blend 50% butter and 50% shortening to get both the flavor of butter and the handling qualities of shortening.

Margarine

Margarine is manufactured from various hydrogenated animal and vegetable fats, plus flavoring ingredients; emulsifiers; coloring agents; and other ingredients. It contains 80 to 85% fat, 10 to 15% moisture, and about 5% salt, milk solids, and other components. Thus, it may be considered a sort of imitation butter consisting of shortening, water, and flavoring.

Unlike the margarines sold by retail grocers, baker's margarines are formulated in different ways for different purposes. Following are the two major categories.

Cake and Baker's Margarines

These types of margarine are soft and have good creaming ability. They are used not only in cakes but also in a wide variety of other products.

Pastry Margarines

These margarines, also called *roll-in compounds*, are tougher and more elastic than cake margarines and have a waxy texture. They are especially formulated for doughs that form layers, such as Danish dough and puff pastry.

Puff pastry margarine, the toughest of these fats, is sometimes called *puff pastry shortening*. Puff pastry made with this margarine generally rises higher than pastry made with butter.

However, as the fat doesn't melt in the mouth like butter, many people find the pastry unpleasant to eat.

Roll-in margarine is somewhat softer in texture than puff pastry margarine and has a lower melting point. It can be used in Danish pastries, croissants, and puff pastry.

Oils

Oils are liquid fats. They are not often used as shortenings in baking because they spread through a batter or dough too thoroughly and shorten too much. Some breads and a few cakes and quick breads use oil as a shortening. Beyond this, the usefulness of oil in the bakeshop is limited primarily to greasing pans, deep-frying doughnuts, and serving as a wash for some kinds of rolls.

KEY POINTS TO REVIEW

- What are the four functions of fats in baked goods?
- What is an emulsion?
- What types of shortenings are used in the bakeshop?
- What is the composition of butter? What are the advantages and disadvantages of using butter in baked goods?

Lard

Lard is the rendered fat of hogs. Because of its plastic quality, it was once highly valued for making classic American flaky piecrusts and biscuits—and it is still sometimes used for these products. Since the development of modern shortenings, however, it is not often used in the bakeshop.

Storage of Fats

All fats become rancid when exposed to the air too long. Also, they tend to absorb odors and flavors from other foods. Highly perishable fats, such as butter, should be stored, well wrapped, in the refrigerator. Other fats and oils should be kept in tightly closed containers in a cool, dry, dark place.

MILK AND MILK PRODUCTS

NEXT TO WATER, milk is the most important liquid in the bakeshop. As we will discuss in Chapter 5, water is essential for the development of gluten. Fresh milk, being 88 to 91% water, fulfills this function. In addition, milk contributes to the texture, flavor, crust color, keeping quality, and nutritional value of baked products.

In this section, we discuss milk products in two parts: first, an explanation and definition of the available products; and second, guidelines for using milk products in baking.

The Composition of Milk Products table on page 71 lists the water, fat, and milk solids content of the most important milk products. Milk solids include protein, lactose (milk sugar), and minerals.

Categories and Definitions

When we talk about milk and cream used in food service, we are nearly always talking about milk from cows. Milk from other animals, including goats, sheep, and water buffaloes, is used to make some cheeses, but most of the liquid milk we see, except for a small amount of goat milk, is milk from dairy cattle.

Milk is used as a beverage and in cooking. Similarly, other milk products, including cream, butter, and cheese, are eaten as purchased and used in cooking.

Pasteurization

Liquid milk, directly as it comes from the cow and before it has had anything done to it, is called *raw milk*. Because raw milk may contain disease-causing bacteria or other organisms, it is almost always ***pasteurized*** before being sold or before being processed into other products. Pasteurized milk has been heated to 161°F (72°C), held at this temperature for 15 seconds to kill disease-causing organisms, and then quickly chilled. By law, all Grade A liquid milk and cream must be pasteurized. (Grades B and C are used in food processing and industrial uses and are rarely seen in food service or in the retail market.)

Even after pasteurizing, milk and cream are highly perishable products. Some cream products are ***ultrapasteurized*** or ***UHT pasteurized*** (ultra-high temperature or ultra-heat treated) to extend their shelf life. Heating the product to a much higher temperature (275°F/135°C) for one to three seconds kills not only disease-causing bacteria but nearly all organisms that cause spoilage. If packed in sterile conditions, UHT milk keeps at room temperature until opened, but then must be refrigerated.

UHT milk has a somewhat cooked taste and is better suited to cooking than for drinking.

Fresh Milk Products

Whole milk is fresh milk as it comes from the cow, with nothing removed and nothing (except vitamin D) added. It contains about 3½% fat (known as ***milk fat*** or ***butterfat***), 8½% nonfat milk solids, and 88% water.

Skim or ***nonfat milk*** has had most or all of the fat removed. Its fat content is 0.5% or less.

Low-fat milk has a fat content of 0.5 to 2%. Its fat content is usually indicated, usually 1% and 2%.

Fortified nonfat or low-fat milk contains added substances that increase its nutritional value, usually vitamins A and D and extra nonfat milk solids.

Except, of course, for nonfat milk, natural liquid milk contains fat, which, because it is lighter than water, will gradually separate and float to the top in the form of cream. ***Homogenized milk*** has been processed so the cream doesn't separate. This is done by forcing the milk through very tiny holes, which breaks the fat into particles so small they stay distributed in the milk. Nearly all liquid milk on the market has been homogenized.

COMPOSITION OF MILK PRODUCTS

	WATER (%)	FAT (%)	MILK SOLIDS (%)
Fresh, whole	88	3.5	8.5
Fresh, skim	91	Trace	9
Evaporated, whole	72	8	20
Evaporated, skim	72	Trace	28
Condensed, whole[1]	31	8	20
Dried, whole	1.5	27.5	71
Dried, skim	2.5	Trace	97.5

[1] Condensed milk also contains 41% sugar (sucrose).

Fresh Cream Products

Whipping cream has a fat content of 30 to 40%. Within this category, you may find light whipping cream (30 to 35%) and heavy whipping cream (36% or more). Extra-heavy cream, also called *manufacturer's cream*, has a fat content of 38 to 40% or more and is generally available only on the wholesale market. Whipping cream labeled *ultrapasteurized* keeps longer than regular pasteurized cream. Pure ultrapasteurized cream does not whip as well as regular pasteurized cream, so additives such as vegetable gums are added to make it more whippable.

Light cream, also called *table cream* or *coffee cream*, contains 18 to 30% fat, usually about 18%.

Half-and-half has a fat content of 10 to 18%, too low to be called *cream*.

Fermented Milk and Cream Products

Sour cream has been cultured or fermented by added lactic acid bacteria, which makes it thick and slightly tangy in flavor. It has about 18% fat.

Crème fraîche (krem fresh) is a slightly aged, cultured heavy cream. It is widely used for sauce making in Europe because of its pleasant, slightly tangy flavor and its ability to blend easily into sauces. Unlike regular heavy cream, it usually doesn't require tempering and can be added directly to hot sauces. It is available commercially but is expensive. A close approximation can be made by warming 1 quart (1 L) heavy cream to about 100°F (38°C), adding 1½ ounces (50 mL) buttermilk, and letting the mixture stand in a warm place until slightly thickened, about 6 to 24 hours.

Buttermilk is fresh, liquid milk, usually skim milk, which has been cultured or soured by bacteria. It is usually called *cultured buttermilk* to distinguish it from the original buttermilk, which was the liquid left after butter making. Buttermilk is used in recipes calling for sour milk.

Yogurt is milk (whole or low-fat) cultured by special bacteria. It has a custardlike consistency. Most yogurt has additional milk solids added, and some of it is flavored and sweetened.

Milk Products with Water Removed

Evaporated milk is milk, either whole or skim, with about 60% of the water removed. It is then sterilized and canned. Evaporated milk has a somewhat cooked flavor.

Condensed milk is whole milk that has had about 60% of the water removed and is heavily sweetened with sugar. It is available canned and in bulk.

Dried whole milk is whole milk that has been dried to a powder. **Nonfat dry milk** is skim milk that has been dried in the same way. Both are available in regular form and in instant form, which dissolves in water more easily.

Baker's cheese.

Cream cheese.

Cheese

Two types of cheese are used in the bakeshop, primarily in the production of cheese fillings and cheesecakes.

Baker's cheese is a soft, unaged cheese with a very low fat content. It is dry and pliable and can be kneaded somewhat like a dough. Generally available in 30-pound (13.6-kg) and 50-pound (22.6-kg) packs, it can be frozen for longer storage.

Cream cheese is also a soft, unaged cheese, but it has a higher fat content, about 35%. It is used mainly in rich cheesecakes and in a few specialty products.

Two other cheeses are occasionally used for specialty products. *Mascarpone* is a type of Italian cream cheese with a tangier flavor than American-style cream cheese. It is used to make the filling for tiramisù (p. 467). Another Italian cheese, *ricotta*, was originally made from the whey left over from making cheese from cow's milk or sheep's milk, although now it is more often made from whole milk than from whey. It has many uses in the kitchen and bakeshop. A smooth, relatively dry ricotta called *ricotta impastata* is used to make a filling for cannoli (p. 239). Regular ricotta has too much moisture for this purpose.

Mascarpone.

Ricotta.

Ricotta impastata.

Artificial Dairy Products

A wide variety of imitation cream and dessert topping products are made from various fats and chemicals, which are listed on the label. They are used in some institutions because they keep longer and are generally less expensive than dairy products. Some people feel they are acceptable, but many find their flavors objectionable.

Guidelines for Using Milk Products in Baking

Fresh Liquid Milk

Whole milk contains fat, which must be calculated as part of the shortening in a dough. For this reason, whole and skim milk are not interchangeable in a formula unless adjustments are made for the fat. (Refer to the Composition of Milk Products table on page 71 for the fat content of milk products.)

Acid ingredients, such as lemon juice, cream of tartar, and baking powder, normally should not be added directly to milk, as they will curdle it.

Fresh liquid milk, even regular pasteurized milk, contains an enzyme that can be harmful to gluten formation. For this reason, bakers often heat milk to just below the boiling point (called *scalding*) and cool it again to room temperature before incorporating it in yeast doughs. If you find you have difficulty properly developing doughs containing fresh milk, you might try scalding the milk to see if this solves the problem. Alternatively, use ultrapasteurized or UHT milk, which has been processed at higher temperatures.

Buttermilk

When buttermilk is produced, the lactose in the milk is converted to lactic acid. When buttermilk is used in place of regular milk in baked goods such as cakes or muffins, this acidity must, in most cases, be neutralized by adding baking soda to the formula. Then, because the soda and acid together release carbon dioxide, this extra leavening power must be compensated for by reducing the baking powder, as follows:

For each quart (2 lb) buttermilk:

1. Add 0.5 oz baking soda.

2. Subtract 1 oz baking powder.

For each liter (1 kg) buttermilk:

1. Add 15 g baking soda.

2. Subtract 30 g baking powder.

Substituting plain milk for buttermilk requires a different calculation. If a formula includes buttermilk and baking soda, you must add another acid to react with the soda when you substitute plain milk. Adding cream of tartar is usually the simplest method of supplying acid. For each teaspoon (5 mL) baking soda, add 2 teaspoons (10 mL) cream of tartar to make up for the lost acid of the buttermilk.

Cream

Cream is not often used as a liquid in doughs and batters, except in a few specialty products. In these instances, because of its fat content, cream functions as a shortening as well as a liquid.

Cream is more important in the production of fillings, toppings, dessert sauces, and cold desserts such as mousses and Bavarian creams. For detailed instructions on whipping heavy cream into a foam, see Chapter 12, page 255.

Dried Milk

Dried milk is often used because of its convenience and low cost. In many formulas, it is not necessary to reconstitute it. The milk powder is included with the dry ingredients and water is used as the liquid. This practice is common in bread making and in no way reduces quality. Unlike fresh liquid milk, which must be heated to destroy enzymes that can be harmful to bread doughs, dried milk contains no active enzymes and can be used without further preparation.

Proportions for reconstituting dry milk can be calculated from the Composition of Milk Products table on page 71. For convenience, the equivalents in the Substituting Dry Milk for Liquid Milk table can be used.

Heat-treated dry milk, not low-heat-processed dry milk, should be purchased by the bakeshop. In the heat-treated product, certain enzymes that can break down gluten have been destroyed.

SUBSTITUTING DRY MILK FOR LIQUID MILK

TO SUBSTITUTE FOR	USE
1 lb skim milk	14.5 oz water + 1.5 oz nonfat dry milk
1 lb whole milk	14 oz water + 2 oz dried whole milk
1 lb whole milk	14 oz water + 1.5 oz nonfat dried milk + 0.5 shortening or 0.7 oz butter
1 kg skim milk	910 g water + 90 g nonfat dry milk
1 kg whole milk	880 g water + 120 g dried whole milk
1 kg whole milk	880 g water + 90 g nonfat dry milk + 30 g shortening or 40 g butter

Storage of Milk Products

Fresh milk and cream, buttermilk and other fermented milk products, and cheese must be kept refrigerated at all times.

Evaporated milk in unopened cans may be kept in a cool storage area. After opening, however, it must be stored in the refrigerator.

Condensed milk in large containers keeps for a week or more after opening if kept covered and in a cool place. The sugar acts as a preservative. Stir before using because the sugar tends to settle to the bottom and sides.

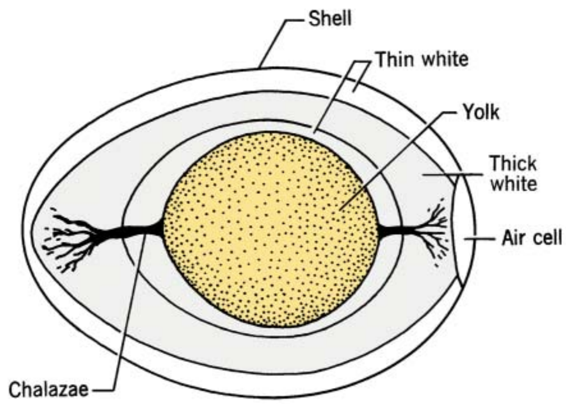
Dried milk does not need refrigeration, but should be kept in a cool, dark place, well away from ovens and other heat sources. Keep the container tightly closed, to prevent the milk from absorbing moisture from the air.

EGGS

EGGS SHOULD BE well understood by the baker because they are used in large quantities in the bakeshop and are more expensive than many of the other high-volume ingredients, such as flour and sugar. For example, half or more of the ingredient cost of the average cake batter is for the eggs.

Composition

A whole egg consists primarily of a yolk, a white, and a shell. In addition, it contains a membrane that lines the shell and forms an air cell at the large end, and two white strands called *chalazae* that hold the yolk centered.



The parts of an egg. The diagram shows, in simplified form, the location of the parts of an unbroken egg, as described in the text.

Courtesy of USDA.

- The yolk is high in both fat and protein, and contains iron and several vitamins. Its color ranges from light to dark yellow, depending on the diet of the chicken.
- The white is primarily albumin protein, which is clear and soluble when raw but white and firm when coagulated. The white also contains sulfur.
- The shell is *not* the perfect package, in spite of what you may have been told. It is not only fragile but also porous, allowing odors and flavors to be absorbed by the egg and allowing the egg to lose moisture even if unbroken.

The Average Composition of Fresh Liquid Eggs table lists the average water, protein, and fat content of whole eggs, whites, and yolks.

AVERAGE COMPOSITION OF FRESH LIQUID EGGS

	WHOLE EGGS (%)	WHITES (%)	YOLKS (%)
Water	73	86	49
Protein	13	12	17
Fat	12	—	32
Minerals and other components	2	2	2

Grades and Quality

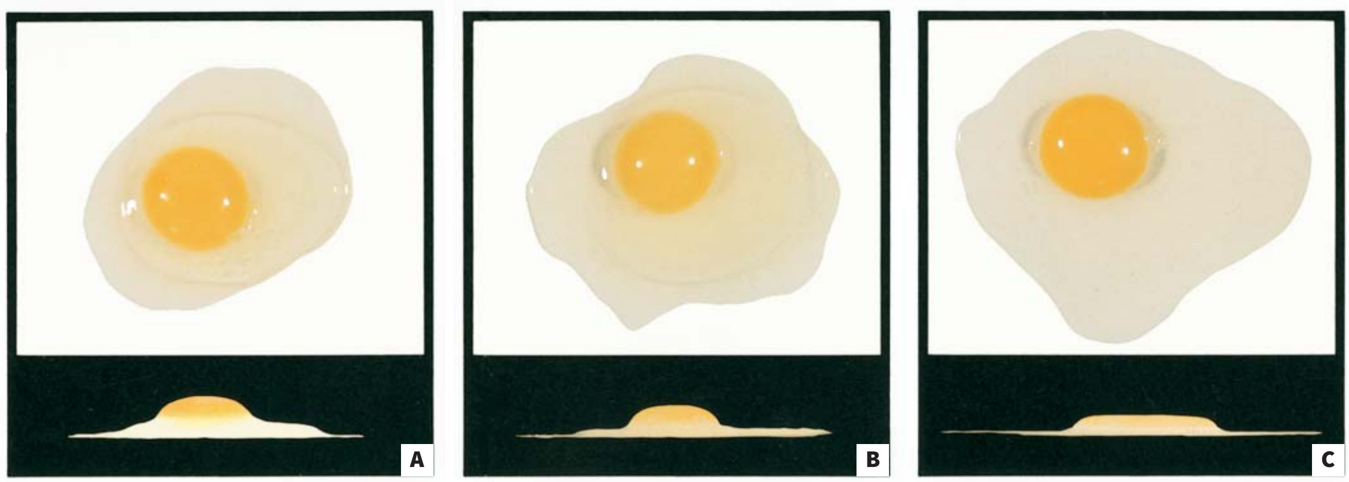
Grades

In the United States, eggs are graded for quality by the USDA. There are three grades: AA, A, and B. The best grade (AA) has a firm white and yolk that stand up high when broken onto a flat surface and do not spread over a large area.

As eggs age, they become thinner and are graded lower. The figure on page 75 shows the differences among U.S. grades AA, A, and B.

In Canada, there are four egg grades: A, B, C, and Canada Nest Run.

As a baker, you will not be concerned so much with the firmness of yolks and whites. Rather, you will want eggs that are clean and fresh-tasting, free of bad odors and tastes caused by spoilage or absorption of foreign odors. One bad-smelling egg can ruin an entire batch of cakes.



Egg grades: (a) Grade AA, (b) Grade A, and (c) Grade B, as seen from the top and side. Note how the white and yolk lose thickness and spread more in the lower grades.

Maintaining Quality

Proper storage is essential for maintaining egg quality. Eggs keep for weeks when held at 36°F (2°C) but lose quality quickly when held at room temperature. In fact, they can lose a full grade in one day at warm bakeshop temperatures. There's no point in paying for Grade AA eggs if they are Grade B by the time you use them. Store eggs away from other foods that might pass on undesirable flavors or odors.

Size

Eggs are also graded by size. The Egg Size Classifications table gives the minimum weight per dozen (including shell) of each size category. Note that each size differs from the next by 3 ounces (85 g) per dozen. European eggs are also graded by size, with size 1 being the largest (70 g each, or about 2.5 oz) and 7 being the smallest (45 g each, or about 1.6 oz). This weight includes the shell.

Large eggs are the standard size used in baking and in food service. Shelled large whole eggs, yolks, and whites have the following approximate weights.

Average Large Eggs: Approximate Weights without Shell

One whole egg = 1.67 oz	47 g
One egg white = 1 oz	28 g
One yolk = 0.67 oz	19 g
9½ whole eggs = 1 lb	21 whole eggs = 1 kg
16 whites = 1 lb	36 whites = 1 kg
24 yolks = 1 lb	53 yolks = 1 kg

To measure small quantities or odd quantities of whole egg, such as 0.5 oz or 15 g, beat the whole egg or eggs and then measure by weight.

EGG SIZE CLASSIFICATIONS

	MINIMUM WEIGHT PER DOZEN	
SIZE	U.S.	METRIC
Jumbo	30 oz	850 g
Extra large	27 oz	765 g
Large	24 oz	680 g
Medium	21 oz	595 g
Small	18 oz	510 g
Peewee	15 oz	425 g

Market Forms

1. **Fresh eggs** or **shell eggs.**
2. **Frozen eggs.** Frozen eggs are usually made from high-quality fresh eggs and are excellent for use in baking. They are pasteurized and usually purchased in 30-pound (13.6-kg) tins.

   To thaw, place them unopened in the refrigerator and hold for two days, or place in a defrosting tank containing running water at 50° to 60°F (10° to 15°C) for about six hours. Do not defrost at room temperature or in warm water. Stir well before using.

   The following egg products are available frozen:

   Whole eggs
   Whole eggs with extra yolks
   Whites
   Yolks

   Frozen yolks usually contain a small amount of sugar (usually about 10%; check the label) to keep the components from separating while frozen. When sugared yolks are used in products such as cakes, you should allow for their sugar content by reducing the sugar in the formula by the same amount. For example, if you are using 20 ounces of yolks with 10% sugar, subtract 2 oz (20 oz × .10) from the sugar in the formula.
3. **Dried eggs.**

   The following egg products are available dried:

   Whole eggs
   Yolks
   Whites

   Dried eggs are sometimes used in the bakeshop, though less often than frozen eggs. The whites are frequently used for making meringue powders. Dried egg products are also used by commercial manufacturers of cake mixes.

   Dried eggs are incorporated in baked goods in two ways: by reconstituting them with water to make liquid eggs, or by mixing them with the dry ingredients and adding the extra water to the liquid portion of the formula.

   It is important to follow manufacturers' instructions for the ratio of egg to water because egg products vary. After mixing, let the eggs stand to allow time for the water to be absorbed. This takes an hour for whole eggs and yolks, and sometimes three hours or more for whites. Mix again before using. The following are typical ratios for reconstituting eggs:

Product	Ratio of Egg to Water by Weight
Whole eggs	1:2.5
Yolks	1:1 to 1:1.5
Whites	1:5.5 to 1:6

Unlike most dried products, dried eggs do not keep well. Keep refrigerated or frozen, tightly sealed.

Pasteurized Eggs and Sanitation

In recent years, cases of salmonella food poisoning have been caused by raw or undercooked eggs. As a result, cooks have been made more aware of sanitation concerns with respect to eggs. Pasteurized egg products are used in more operations. For a more detailed discussion of eggs and food safety, see Appendix 6, page 738.

Functions

Eggs perform the following functions in baking:

1. **Structure.** Like gluten protein, egg protein coagulates to give structure to baked products. This is especially important in high-ratio cakes, in which the high content of sugar and fat weakens the gluten.

   If used in large quantities, eggs make baked products more tough or chewy unless balanced by fat and sugar, which are tenderizers.

2. **Emulsifying of fats and liquids.** Egg yolks contain natural emulsifiers that help produce smooth batters. This action contributes to volume and to texture.
3. **Leavening.** Beaten eggs incorporate air in tiny cells, or bubbles. In a batter, this trapped air expands when heated and aids in leavening.
4. **Shortening action.** The fat in egg yolks acts as a shortening. This is an important function in products that are low in other fats.
5. **Moisture.** Eggs are mostly water (see the Average Composition of Fresh Liquid Eggs table on p. 74). This moisture must be calculated as part of the total liquid in a formula. If yolks are substituted for whole eggs, for example, or if dried eggs are used, adjust the liquid in the formula to allow for the different moisture content of these products.
6. **Flavor.**
7. **Nutritional value.**
8. **Color.** Yolks impart a yellow color to doughs and batters. Also, when baked in doughs, eggs brown easily and contribute to crust color.

KEY POINTS TO REVIEW

- What are the main types of milk and cream products used in the bakeshop?
- What types of egg products are used in the bakeshop?
- Why are pasteurized eggs used for many preparations?
- What are the eight functions of eggs in baked goods?

LEAVENING AGENTS

UNLIKE LIQUIDS AND solids, gases expand greatly when they are heated. ***Leavening*** is the production or incorporation of gases in a baked product to increase volume and produce shape and texture. These gases must be retained in the product until the structure is set enough (by the coagulation of gluten and egg proteins and the gelatinization of starches) to hold its shape.

The three main gases that leaven baked goods are carbon dioxide, steam, and air. Two of these gases, steam and air, are present in all baked goods.

An essential part of the leavening process is the formation of *air cells* during mixing. Even if a properly mixed dough or batter appears dense and compact, it actually contains millions of tiny air cells. Leavening gases are trapped in these air cells, which expand as they fill with gases and as the gases are heated. The walls of the cells are formed largely from gluten proteins and sometimes egg proteins. They hold the gases and form the structure of the baked item. More details of the leavening process are discussed in Chapter 5. In this section, we discuss the most important ingredients or agents that supply gases for leavening.

Exact measurement of leavening agents is important because minor changes can produce major defects in baked products.

Yeast

Yeast is the leavening agent in breads, dinner rolls, Danish pastries, and similar products. This section describes the characteristics of yeast. The handling of yeast and its use in yeast doughs are discussed in Chapter 6.

Yeast Fermentation

Fermentation is the process by which yeast acts on sugars and changes them into carbon dioxide gas and alcohol. This release of gas produces the leavening action in yeast products. The alcohol evaporates completely during and immediately after baking.

Fermentable sugar in bread dough comes from two sources:

1. It is added to the dough by the baker.
2. It is produced from flour by enzymes that break down the wheat starch into sugar. These enzymes are present in the flour and/or are added by the baker in the form of diastatic malt (see p. 66).

Yeast is a microscopic plant that accomplishes this fermentation process by producing enzymes. Some of these enzymes change complex sugars (sucrose and maltose) into simple sugars. Others change the simple sugars into carbon dioxide gas and alcohol. The following formula describes this reaction in chemical terms:

$$\underset{\text{simple sugar}}{C_6H_{12}O_6} \rightarrow \underset{\text{carbon dioxide}}{2CO_2} + \underset{\text{alcohol}}{2C_2H_5OH}$$

Because yeast is a living organism, it is sensitive to temperature, as shown here.

34°F (1°C)	Inactive (storage temperature)
60° to 70°F (15° to 20°C)	Slow action
70° to 90°F (20° to 32°C)	Best growth (fermentation and proofing temperatures for bread doughs)
Above 100°F (38°C)	Reaction slows
140°F (60°C)	Yeast is killed

In addition to leavening gases, yeast also contributes flavor to bread doughs. Flavor molecules are produced by the yeast during fermentation. For this reason, breads produced by long fermentations usually have more flavor than short-fermentation products.

Types of Yeast

The yeast added to bread dough by the baker may be a commercially produced yeast or a wild yeast culture that is present in *sourdough starter*. The preparation, use, and handling of sourdough starters is discussed in Chapter 8.

Commercial yeast is available in three forms:

Fresh yeast.

Active dry yeast; instant dry yeast.

1. ***Fresh yeast***, also called ***compressed yeast***, is moist and perishable. Before the development of instant yeast (see number 3), it was the preferred form of yeast for most baking purposes and is still widely used by professional bakers. It is usually purchased in 1-pound (454-g) cakes. Under refrigeration and carefully wrapped to avoid drying, fresh yeast lasts up to two weeks. For longer storage (up to four months), it may be frozen. Avoid using fresh yeast that has discolored or become moldy.

   Some bakers crumble compressed yeast and add it directly to the dough in a straight-dough procedure. However, the yeast is mixed more evenly into the dough if it is first softened in twice its weight of warm (100°F/38°C) water. See Chapter 6 for information on mixing procedures.

2. ***Active dry yeast*** is a dry, granular form of yeast. It must be rehydrated in four times its weight of warm water (105°F/41°C) before use. When using active dry yeast in a bread formula, use part of the water in the formula to dissolve the yeast. Do not add additional water.

   About 25% of the yeast cells in active dry yeast are dead, due to the harsh conditions of the drying process. The presence of the dead cells can have a negative effect on dough quality. For this reason, active dry yeast has never been popular with professional bakers.

3. ***Instant dry yeast***, sometimes called *rapid-rise* or *quick-rise* yeast, is a fairly new product (it was invented in the 1970s). Like active dry yeast, it is also a dry granular form of yeast, but it does not have to be dissolved in water before use. (As the illustration shows, instant yeast is nearly identical in appearance to active dry yeast. You must rely on the packaging for proper identification.) It can be added in its dry form because it absorbs water much more quickly than regular dry yeast. In fact, the preferred way of incorporating it in a bread formula is to mix it with the dry flour.

   Unlike active dry yeast, instant yeast contains very little dead yeast, so less of it is needed. In general, you need only 25 to 50% as much instant yeast as fresh compressed yeast, or about 35% on average.

   Instant yeast also produces more gas, and produces it more quickly than regular dry yeast. This characteristic makes it appropriate for short fermentations or no-time doughs (explained on p. 120). For long fermentations and pre-ferments (see p. 156), fresh yeast may be a better choice. Fermentation times for instant yeast must be carefully monitored to avoid overfermentation or overproofing.

   In doughs with a high sugar content, a special type of instant yeast called ***osmotolerant yeast*** is often indicated in the formula, as this yeast performs better in sweet doughs (see the Osmotolerant Yeast sidebar). If osmotolerant yeast is called for in the formula and you have only regular instant yeast, increase the quantity of yeast by 30%.

OSMOTOLERANT YEAST

In small quantities, sugar helps yeast to ferment by providing food for the yeast. When the quantity of sugar becomes high, however, as in many sweet dough products, sugar inhibits fermentation. This is because the sugar attracts a lot of water to itself and makes it unavailable to the yeast, thus slowing fermentation. The scientific explanation is that the sugar creates *osmotic pressure*.

Special strains of yeast are available that can tolerate this osmotic pressure and be more active when sugar levels are high. These are called *osmotolerant yeasts*.

Most formulas in this book specify either instant yeast or fresh yeast when yeast is required. To substitute another type of yeast for the one specified, follow these guidelines. And for information on how to add each type of yeast during the mixing process, refer to the previous discussion.

- To convert fresh yeast to regular active dry yeast, multiply the quantity by 0.5. For example, if the formula calls for 1.5 ounces fresh yeast, multiply by 0.5 to get 0.75 ounces active dry yeast.
- To convert fresh yeast to instant dry yeast, multiply the quantity by 0.35. For example, if the formula calls for 40 grams fresh yeast, multiply by 0.35 to get 14 grams instant yeast.
- To convert instant dry yeast to fresh yeast, multiply the quantity by 3. For example, if the formula calls for 0.5 ounces instant yeast, multiply by 3 to get 1.5 ounces fresh yeast.
- To convert instant dry yeast to active dry yeast, multiply the quantity by 1.4. For example, if the formula calls for 30 grams instant yeast, multiply by 1.4 to get 42 grams active dry yeast.

Chemical Leaveners

Chemical leaveners are those that release gases produced by chemical reactions.

Baking Soda

Baking soda is the chemical ***sodium bicarbonate***. If *moisture* and an *acid* are present, soda releases carbon dioxide gas, which leavens the product.

Heat is not necessary for the reaction to take place (although the gas is released faster at high temperatures). For this reason, products leavened with soda must be baked at once, or gases will escape and leavening power will be lost.

Acids that react with soda in a batter include honey, molasses, brown sugar, buttermilk, sour cream, yogurt, fruit juices and purées, chocolate, and natural cocoa (not Dutch-processed). Sometimes cream of tartar is used for the acid. The amount of soda used in a formula is generally the amount needed to balance the acid. If more leavening power is needed, baking powder, not more soda, is used.

Baking Powders

Baking powders are mixtures of baking soda plus one or more acids to react with it. They also contain starch, which prevents lumping and brings the leavening power down to a standard level. Because baking powders do not depend for their leavening power on acid ingredients in a formula, they are more versatile.

- ***Single-acting baking powders*** require only moisture to release gas. Like baking soda, they can be used only if the product is to be baked immediately after mixing. For all practical purposes, no single-acting baking powders are sold today, although you can make one yourself, as explained in the Making Single-Acting Baking Powder sidebar. Practically, single-acting baking powders release gas too quickly to be useful for most products.
- ***Double-acting baking powders*** release some gas when cold, but they require heat for complete reaction (see the Acid Salts sidebar). Thus, cake batters made with these can incorporate the leavening agent early in the mixing period and then stand for some time before being baked.

Do not include more baking powder than necessary in a formula, because undesirable flavors may be produced. Also, excess

MAKING SINGLE-ACTING BAKING POWDER

A simple, homemade baking powder may be made by mixing the following ingredients in the proportions indicated (using volume measure rather than weight).

Baking soda	1 tbsp	15 mL
Cornstarch	1 tbsp	15 mL
Cream of tartar	2 tbsp	30 mL
Yield:	4 tbsp	60 mL

ACID SALTS

Technically, the ingredients in baking powder are not acids but acid salts. This means they do not release an acid or act like an acid until they are dissolved in water. For simplicity, however, we refer to these compounds as acids.

Different baking powders contain varying combinations of acid salt that react at different speeds. How they react is referred to as their *dough reaction rate*, or DRR. Fast-acting baking powders release about two-thirds of their gases during mixing and one-third during baking. Slow-reacting powders release about one-third of their gases during mixing and two-thirds during baking.

Release of some gases during mixing helps create the air cells needed for leavening, as explained previously. However, it is important that some gases are also released during baking for proper leavening to occur.

Fast-acting acids include cream of tartar (potassium acid tartrate) and monocalcium phosphate (MCP). Slow-acting acids include sodium aluminum sulfate (SAS) and sodium acid pyrophosphate (SAPP).

leavening may create an undesirably light, crumbly texture. Cakes may rise too much and then fall before they become set.

Baking Ammonia

Baking ammonia is a mixture of ammonium carbonate, ammonium bicarbonate, and ammonium carbamate. It decomposes rapidly during baking to form carbon dioxide gas, ammonia gas, and water. Only heat and moisture are necessary for it to work. No acids are needed.

Baking ammonia decomposes completely, leaving no solid residue that could affect flavor when it is properly used. However, it can be used only in small products that are baked until dry, such as cookies. Only in such products can the ammonia gas be completely driven off.

Because ammonia releases gases very quickly, it is sometimes used in products in which rapid leavening is desired, such as cream puffs. Use of ammonia enables the baker to lower the cost of such products by reducing the quantity of eggs. However, the quality of the resulting goods is lowered as well.

Storage of Chemical Leaveners

Baking soda, powder, and ammonia must always be kept tightly closed when not in use. If left open, they can absorb moisture from the air and lose part of their leavening power. They must be stored in a cool place, because heat also causes them to deteriorate.

Air

Air is incorporated into all doughs and batters during mixing. The formation of air cells is important even in products leavened by yeast or baking powder because the air cells collect and hold the leavening gases.

Some products are leavened mostly or entirely by air. In these products, air is incorporated into the batter primarily by two methods: creaming and foaming. This air expands during baking and leavens the products.

1. ***Creaming*** is the process of beating fat and sugar together to incorporate air. It is an important technique in cake and cookie making. Some pound cakes and cookies are leavened almost entirely by this method.
2. ***Foaming*** is the process of beating eggs, with or without sugar, to incorporate air. Foams made with whole eggs are used to leaven sponge cakes, while angel food cakes, meringues, and soufflés are leavened with egg-white foams.

KEY POINTS TO REVIEW

- What three gases are responsible for leavening baked goods?
- What types of yeast are used in the bakeshop?
- What calculations can you do to substitute one type of yeast for another?
- At what temperatures is yeast active? At what temperatures is it inactive or killed?
- What kinds of chemical leaveners are used in the bakeshop?

Steam

When water turns to steam, it expands to 1,100 times its original volume. Because all baked products contain some moisture, steam is an important leavening agent.

Puff pastry, cream puffs, popovers, and piecrusts use steam as their primary or only leavening agent. If the starting baking temperature for these products is high, steam is produced rapidly and leavening is greatest.

GELLING AGENTS

THE TWO INGREDIENTS discussed in this section are chemically and nutritionally unrelated. Gelatin is a protein, and pectin is a soluble fiber, a type of carbohydrate that is not absorbed by the body. However, they both are used to thicken or to solidify (gel) soft or liquid foods.

Other thickening and gelling agents include starches, discussed on page 63.

Gelatin

Gelatin is a water-soluble protein extracted from animal connective tissue. When a sufficient quantity of gelatin is dissolved in hot water or other liquid, the liquid will solidify when cooled or chilled. When used in smaller quantities, the liquid will thicken but not solidify.

Gelatin thickens and gels because of the nature of its proteins, which form long strands. When present in small quantities, the strands get tangled with one another, so the liquid does not flow as freely. When present in large enough quantities, the strands bond with one another to form a network that traps the liquid to keep it from flowing at all.

BLOOM

When used in connection with gelatin, the term *bloom* has two meanings:

1. The process of softening gelatin in water is called *blooming*. To bloom gelatin, combine it with water or other liquid according to the procedures explained in the text.
2. The *bloom rating* is a measure of the strength of the gel formed by the gelatin. The higher the number, the stronger the gel. Gelatins with higher bloom ratings set faster and have less taste to detract from the main ingredients.

Powdered gelatin usually has a bloom rating of about 230.

Sheet gelatin varies in bloom rating, but sheets with lower bloom rating weigh more, so the gelling power per sheet is the same no matter the bloom rating. Typically, manufacturers label sheet gelatin “gold,” “silver,” and “bronze,” as follows:

Gold	200 bloom	2 g per sheet	0.07 oz per sheet
Silver	160 bloom	2.5 g per sheet	0.09 oz per sheet
Bronze	130 bloom	3.3 g per sheet	0.12 oz per sheet

Gelatin Forms

Culinary gelatin is available in powdered form and in sheets. Powdered gelatin is most widely available to North American kitchens, although sheet gelatin, also called *leaf gelatin*, is also available and often preferred by pastry chefs. The sheet form is especially easy to use because it is premeasured (the sheets are of uniform weights). Also, when using sheet gelatin, it is not necessary to measure the liquid for soaking it. This is explained below.

As explained in the Bloom sidebar, equal weights of powdered and sheet gelatin do not have the same gelling power. The following equivalents are useful:

- 10 teaspoons powdered gelatin equal 1 ounce.
- 1 ounce (30 g) powdered gelatin has the same gelling power as 20 sheets of sheet gelatin.
- 1 teaspoon powdered gelatin weighs about 2.8 grams or 1⁄10 ounce.
- 1 teaspoon powdered gelatin has the same gelling power as 2 sheets of gelatin.

The Weight-Volume Equivalents table lists volume equivalents for a range of weights of gelatin.

Sheet gelatin is available in sizes ranging from 1.7 grams to 3.3 grams (see the Bloom sidebar).

Powdered gelatin and sheet gelatin can be used interchangeably, but they are handled differently. Guidelines for handling the two products and for substituting one for the other are described next.

Sheet and granulated gelatin.

WEIGHT-VOLUME EQUIVALENTS FOR POWDERED GELATIN

U.S.		METRIC	
WEIGHT	APPROXIMATE VOLUME	WEIGHT	APPROXIMATE VOLUME
0.1 oz	1 tsp	1 g	1.75 mL
0.12–0.13 oz	1¼ tsp	2 g	3.5 mL
0.16–0.17 oz	1⅔ tsp	3 g	3 mL
0.2 oz	2 tsp	4 g	7 mL
0.25 oz	2½ tsp	6 g	10 mL
0.33 oz	3⅓ tsp	8 g	14 mL
0.4 oz	4 tsp	10 g	18 mL
0.5 oz	5 tsp	12 g	21 mL
0.75 oz	7½ tsp	14 g	25 mL
1 oz	10 tsp	16 g	28 mL
		20 g	36 mL
		30 g	54 mL

Using Gelatin in Formulas

Using gelatin in a formula requires three main steps:

1. The gelatin is softened in water or other liquid. It absorbs five times its weight in water.
2. The softened gelatin is added to hot ingredients, or is heated with other ingredients, until it dissolves.
3. The mixture is chilled until it sets.

Most of the formulas in this book that require gelatin were developed using powdered gelatin (the remainder were developed using sheet gelatin). The following guidelines will help you use recipes requiring gelatin:

- When a formula was developed using sheet gelatin, no soaking liquid is indicated in the ingredient list. In the procedure, the instructions direct you to soften the gelatin in cold water. To use sheet gelatin, add the indicated weight of gelatin to a generous quantity of cold water and soak until soft. Remove the soaked sheets from the water, drain well, and incorporate into the formula. (See p. 264 for an illustration of using sheet gelatin to make Chiboust Cream.)
- Always use very cold water to soak sheet gelatin. If the water is warm, some gelatin will dissolve and be lost.
- To substitute powdered gelatin when no quantity of soaking liquid is given, measure the gelatin, then add five times its weight of cold water. Let stand until the water is absorbed.
- When a formula was developed using powdered gelatin, the quantity of water for soaking is usually indicated. Either powdered gelatin or sheet gelatin can be used in these formulas. Add the measured gelatin to the measured water and soak. Then add the gelatin and the soaking liquid to the mixture in the formula.

For an example of a formula developed using sheet gelatin but indicating no soaking liquid in the ingredient list, see Fruit Glaçage, page 428. For an example of a formula developed using powdered gelatin and for which the quantity of soaking liquid is indicated, see Vanilla Bavarian Cream, page 528.

Bavarian creams, chiffon pie fillings, and many mousses depend on gelatin for their texture. More information on the use of gelatin in these products is included in Chapter 13.

Pectin

Vegetable gums are carbohydrates that consist of molecules in long chains, somewhat like starches. They can absorb a great deal of water, which makes them useful for thickening or gelling liquids.

Pectin is perhaps the most familiar of these gums. It is present in many fruits. In general, unripe fruits have more pectin than ripe fruits. One of the reasons fruits get softer as they ripen is that the pectin breaks down.

VEGETABLE GUMS

In addition to pectin, several other gums are used in food production. Most of these are used by manufacturers and are not likely to be found in the bakeshop. The following three gums, however, are sometimes used by pastry chefs and retail bakers:

Agar-agar, also known simply as *agar* or *kanten* (its Japanese name) is derived from seaweed and sold in the form of dry strands or powder. It is used much like gelatin, except it does not need to be refrigerated in order to gel. This makes it especially good for use in warm weather and for products that will not be refrigerated. Unlike gelatin, which is an animal product, agar-agar can be used on vegetarian menus.

As a rule of thumb, 1 part agar by weight has as much gelling power as 8 parts gelatin.

Gum tragacanth, often called *gum trag*, is extracted from a bush native to the Middle East. It is used by pastry chefs to make gum paste, a decorative product similar to pastillage (p. 653).

Xanthan gum (ZAN than) is often used to provide structure in gluten-free formulas (see p. 694).

Pectin is extracted from fruits and used to thicken or gel fruit preserves, jams, and jellies. It can also be used to make fruit glazes, because the pectin thickens or sets fruit juices and purées. An important advantage of pectin over an ingredient such as cornstarch is that it makes a clear, not cloudy, gel.

Pectin alone, when added to a liquid, thickens but does not solidify or gel. For pectin to gel, an acid (such as fruit juice) and a high sugar content are necessary. This is one reason jams and jellies contain so much sugar.

Fruits high in pectin will gel naturally, without needing additional pectin. Such fruits include cranberries, apples, and plums. Citrus peels also contain pectin; this characteristic is useful in the production of marmalade.

For making jellies, the amount of pectin you need to add varies with the fruit. As a rule of thumb, 1.75 ounces (50 g) powdered pectin gels 2 quarts (2 L) fruit juice or fruit pulp.

Several fruit preparations in Chapter 21 require the use of pectin.

KEY POINTS TO REVIEW

- What forms of gelatin are used in the bakeshop?
- What are the three basic steps in using gelatin in a formula?
- What are the blooming or soaking procedures for powdered gelatin and sheet or leaf gelatin?

FRUITS AND NUTS

Fruit Products

Nearly any kind of fresh fruit can be used in the production of desserts. In addition, a wide variety of dried, frozen, canned, and processed fruit products are important ingredients in the bakeshop. The lists here specify a number of the most important fruit products, in five categories. You will learn how to use these products in appropriate chapters throughout the book. For more detailed information on fresh fruits, turn to Chapter 21.

Fresh

- apples
- apricots
- bananas
- berries
- cherries
- figs
- grapefruit
- grapes
- kiwi
- kumquats
- lemons
- limes
- mangoes
- melons
- nectarines
- oranges
- papayas
- passion fruit
- peaches
- pears
- pineapples
- plums
- rhubarb (actually, not a fruit but a stem)

Canned and Frozen

- apples, sliced
- apricots, halves
- blueberries
- cherries, sour and sweet
- peaches, slices and halves
- pineapple, rings, chunks, nibs, crushed, juice
- strawberries

Dried

- apricots
- currants (actually, very small raisins)
- dates
- figs
- raisins, light and dark
- prunes

Candied and Glace

- cherries
- citron
- figs
- fruitcake mix
- lemon peel
- orange peel
- pineapple

Other Processed Fruits

- apricot glaze or coating
- jams, jellies, and preserves
- prepared pie fillings
- fruit purées and fruit compounds, usually frozen (widely used for such products as fruit Bavarians, sauces, soufflés, and other desserts)

Nuts

Most nuts are available whole, halved, or broken or chopped. Because they are high in oil, all nuts can become rancid. Store them, tightly closed, in a cool, dark place. The most common types of nuts found in the bakeshop are these:


Almonds.


Brazil nuts.


Cashews.


Hazelnuts.


Macadamia nuts.


Pecans.


Pine nuts, or pignoli.


Pistachios.


Walnuts.

Almonds. The most important nut in the bakeshop. Available natural (skin on) and blanched (skin off) in many forms: whole, split, slivered, chopped, and ground (almond flour).

Brazil nuts.

Cashews.

Chestnuts. Must be cooked. Forms used in bakeshops are purée and glacé (in syrup).

Coconut. Sweetened coconut is used primarily for cake decoration. Unsweetened coconut is used as an ingredient in a wide variety of goods, such as cookies, macaroons, cakes, and fillings. Many types are available, based on the size of the individual grains, flakes, or shreds. The smallest types are extra-fine, about the texture of granulated sugar, and macaroon, close to the texture of cornmeal. Large sizes include short and long shred, chip, and flake.

Hazelnuts. Best if toasted before use. Also available ground (hazelnut flour or meal). One of the most important nuts in the bakeshop, along with almonds and walnuts.

Macadamia nuts.

Pecans. More expensive than walnuts. Used in premium goods.

Peanuts.

Pine nuts, or pignoli. Small kernels that are usually toasted to enhance flavor. Especially important in Italian pastries.

Pistachios. Often used in decorations because of the attractive green color of the kernel.

Walnuts. One of the most important nuts in the bakeshop, along with almonds and hazelnuts.

Nut Products

These seven nut products are standard bakeshop ingredients:

Almond paste. An expensive but highly versatile nut paste, used in a variety of cakes, pastries, cookies, and fillings. It is made from two parts finely ground almonds and one part sugar, plus enough moisture to bring it to the proper consistency.

Kernel paste. A product similar to almond paste, but less expensive. It is made from apricot kernels, which have a strong almondlike flavor.

Macaroon paste. This product stands between almond paste and kernel paste in that it is made from a blend of almonds and apricot kernels.

Marzipan. Essentially a sweetened almond paste, used in decorative and confectionery work. This product can be purchased or made in the bakeshop from almond paste.

Pistachio paste. Similar to almond paste, but made with pistachios.

Praline paste. A confectionery paste made from almonds and/or hazelnuts and caramelized sugar, all ground to a paste. It is used as a flavoring for icings, fillings, pastries, and creams.

Nut flours. Nuts ground to a powder but not so fine as to turn to a paste. Almond flour is the most widely used. Nut flours are often used in fine pastries.

CHOCOLATE AND COCOA

CHOCOLATE AND COCOA are derived from cocoa or cacao beans. When the beans are fermented, roasted, and ground, the resulting product is called ***chocolate liquor***, which contains a white or yellowish fat called ***cocoa butter***.

Much more information on the characteristics of chocolate and on handling chocolate can be found in Chapter 23, which is devoted to this specialty. The brief summary of chocolate products in this chapter offers an overview of those used in the bakeshop.

Cocoa

Cocoa is the dry powder that remains after part of the cocoa butter has been removed from chocolate liquor. ***Dutch process cocoa***, or *dutched cocoa*, is processed with an alkali. It is slightly darker, smoother in flavor, and more easily dissolved in liquids than natural cocoa.

Natural cocoa.

Dutched cocoa.

Natural cocoa is somewhat acidic. When it is used in such products as cakes, it is possible to use baking soda (which reacts with acid) as part of the leavening power.

Dutched cocoa, on the other hand, is generally neutral or even slightly alkaline. Therefore, it does not react with baking soda (see the Baking Soda Needed to Balance the Acidity of Typical Cocoa Products table). Instead, baking powder is used as the sole leavening agent. If you are substituting dutched for natural cocoa, you must increase the baking powder by 1 ounce (30 g) for each ½ ounce (15 g) soda omitted.

If not enough soda is used in chocolate products, the color of the finished product may range from light tan to dark brown, depending on the quantity used. If too much is used, the color will be reddish brown. This color is desired in devil's food cakes but it may not be wanted in other products. When switching from one kind of cocoa to another, you may have to adjust the soda in your recipes.

SAVORY INGREDIENTS

The ingredients listed in this chapter by no means comprise all those used by bakers or by any worker preparing a dough product. Pizza is only one example of a yeast dough product that may include nearly any food ingredient in the kitchen. Even simpler yeast breads may contain ingredients such as olives, aged cheeses, or meat products. Herbs, both fresh and dried, are used in many savory bread items, such as the Herb Focaccia on page 167. In fact, the number of ingredients the baker can call upon to exercise his or her creativity is limitless.

BAKING SODA NEEDED TO BALANCE THE ACIDITY OF TYPICAL COCOA PRODUCTS

	AMOUNT OF BAKING SODA PER LB	AMOUNT OF BAKING SODA PER KG
Natural cocoa	1.25 oz	80 g
Dutched cocoa	0	0
Unsweetened chocolate	0.8 oz	50 g
Sweet chocolate	0.4 oz	25 g

Unsweetened or Bitter Chocolate

Unsweetened chocolate is straight chocolate liquor. It contains no sugar and has a strongly bitter taste. Because it is molded in blocks, it is also referred to as *block cocoa* or *cocoa block*. It is used to flavor items that have other sources of sweetness.

Unsweetened chocolate is also known as *bitter chocolate*. Do not confuse this product with *bittersweet chocolate*, which is a category of sweetened chocolate with a low sugar content.

In some less expensive brands of unsweetened chocolate, some of the cocoa butter may be replaced by another fat.

Sweetened Dark Chocolate

Sweetened dark chocolate is bitter chocolate with the addition of sugar and cocoa butter in varying proportions. Based on the amount of sugar added, dark chocolate is divided into the following categories:

- *Sweet chocolate* has the highest percentage of sugar and the lowest percentage of chocolate liquor. A product labeled sweet chocolate may contain as little as 15% chocolate liquor, although it may contain as much as 50%. Because of the low cocoa content, this product is used primarily in inexpensive candies, not in the finest chocolate work.
- *Semisweet chocolate* must contain a minimum of 35% chocolate liquor, but it usually contains about 50 to 65%. It is widely used in confectionery, pastry, and dessert products.
- *Bittersweet chocolate* contains the highest proportion of chocolate liquor, usually from 65 to 85%. Products at the upper end of this range are sometimes labeled *extra bittersweet*. Because of its higher cocoa content, bittersweet chocolate is used in the finest baked goods, pastries, desserts, and confections.

Note: According to government regulations, there is no difference between semisweet and bittersweet chocolate. Both have a minimum chocolate liquor content of 35%. However, most manufacturers use the term *bittersweet* for their products with higher cocoa content.

In this book, when a sweetened dark chocolate is required in a formula, semisweet chocolate is usually specified. Bittersweet chocolate is specified when a good grade of chocolate with a high chocolate liquor content is essential for the best results.

Because sweetened chocolate has, on average, only half the chocolate content of bitter (unsweetened) chocolate, it is usually not economical to add to products that are already highly sweetened, because twice as much will be needed. For example, it is better to use bitter chocolate when making chocolate fondant from plain white fondant.

Good-quality chocolate products—including not only dark chocolate but also milk chocolate and white chocolate (see below)—are often called ***couverture***, which means “coating” in French. When couverture is used to coat candies, cookies, and other products, the chocolate must be prepared by a process called ***tempering***. This involves carefully melting the chocolate without letting it get too warm, then bringing the temperature back down to a certain level. The process requires a fair amount of skill (see p. 627).

Coating Chocolate

Less expensive chocolates, which have part of the cocoa butter replaced by other fats, are easier to handle and don’t require tempering. However, they do not have the flavor and eating qualities of good chocolate. These products are sold under such names as *cookie coating*, *cake coating*, *baking chocolate*, *coating chocolate*, and *compound chocolate*. Do not confuse coating chocolate with couverture. These two products are entirely different, even though *couverture* means “coating.” It would be less confusing if this lower-quality chocolate were referred to only as *baking chocolate*, without using the word *coating*.

Milk Chocolate

Milk chocolate is sweet chocolate to which milk solids have been added. It is usually used as a coating chocolate and in various confections. Milk chocolate is seldom melted and then incorporated in batters because it contains a relatively low proportion of chocolate liquor.

FAT CONTENT OF COCOA

When chocolate liquor is pressed to remove cocoa butter from cocoa solids, not all the cocoa butter is pressed out. Therefore, cocoa powder contains some fat in the form of cocoa butter. In Canada and the United States, a product labeled cocoa contains a minimum of 10% cocoa butter. Regular cocoa has a fat content of 10 to 12% and is known as 10/12 cocoa. High-fat cocoa has a fat content of 22 to 24% and is known as 22/24 cocoa. Both types are used in the bakeshop. For hot cocoa beverage, 22/24 cocoa is more often used. European cocoa usually has a fat content of 20 to 22% and is called 20/22 cocoa.

Low-fat cocoa, with a fat content below 10%, must be specially labeled and is more difficult to manufacture. It is expensive and not generally used in the bakeshop.

Cocoa Butter

Cocoa butter is the fat pressed out of chocolate liquor when cocoa is processed. Its main use in the bakeshop is to thin melted couverture to a proper consistency.

White Chocolate

White chocolate consists of cocoa butter, sugar, and milk solids. It is used primarily in confectionery. Technically, it should not be called chocolate, because it contains no cocoa solids. However, the name white chocolate is in common use. Some inexpensive brands, in which another fat is substituted for the cocoa butter, not only contain no cocoa solids, but none of the other components of chocolate either. These products don't deserve the name *chocolate* at all.

Substituting Cocoa and Chocolate

Cocoa, remember, is the same as bitter (unsweetened) chocolate, but with less cocoa butter. Therefore it is often possible to substitute one product for the other in baked goods. Shortening is usually used to take the place of the missing fat. It's important to keep in mind, however, that different fats behave differently in baking. Regular shortening, for example, has about twice the shortening power of cocoa butter, so only half as much is needed in many products, such as cakes. The procedures given here take this difference into account.

Because of these varying factors, as well as the different baking properties of cakes, cookies, and other products, it is recommended that you test-bake a small batch when making a substitution in a formula. You can then make additional adjustments, if necessary. *No single substitution ratio is adequate for all purposes.*

PROCEDURE: Substituting Natural Cocoa for Unsweetened Chocolate

1. Multiply the weight of the chocolate by $\frac{5}{8}$. The result is the amount of cocoa to use.
2. Subtract the weight of the cocoa from the original weight of chocolate. Divide this difference by 2. The result is the amount of shortening to add to the formula.

Example: Replace 1 lb chocolate with natural cocoa.

$$\frac{5}{8} \times 16 \text{ oz} = 10 \text{ oz cocoa}$$

$$\frac{16 \text{ oz} - 10 \text{ oz}}{2} = 3 \text{ oz shortening}$$

PROCEDURE: Substituting Unsweetened Chocolate for Natural Cocoa

1. Multiply the weight of the cocoa by $\frac{8}{5}$. The result is the amount of chocolate to use.
2. Subtract the weight of cocoa from the weight of chocolate. Divide by 2. Reduce the weight of shortening in the mix by this amount.

Example: Substitute bitter chocolate for 1 lb natural cocoa.

$$\frac{8}{5} \times 16 \text{ oz} = 26 \text{ oz chocolate (rounded off)}$$

$$\frac{26 \text{ oz} - 16 \text{ oz}}{2} = \frac{10}{2} = 5 \text{ oz less shortening}$$

Starch Content of Cocoa

Cocoa contains starch, which tends to absorb moisture in a batter. Consequently, when cocoa is added to a mix—for example, to change a yellow cake to a chocolate cake—the quantity of flour is reduced to compensate for this added starch. Exact adjustments will vary depending on the product. However, the following may be used as a rule of thumb:

> Reduce the flour by ⅜ (37.5%) of the weight of cocoa added. Thus, if 1 pound cocoa is added, the flour is reduced by 6 ounces. Or, if 400 grams cocoa is added, reduce the flour by 150 grams.

Chocolate, of course, also contains starch. When melted chocolate is added to fondant, for example, the fondant gets stiffer because of this starch and usually requires thinning. Often, however, the drying effect of the starch is balanced by the tenderizing effect of the cocoa butter. Methods of incorporating both chocolate and cocoa in various products are discussed in appropriate chapters.

SALT, SPICES, AND FLAVORINGS

Salt

Salt plays an important role in baking. More than just a seasoning or flavor enhancer, it has these other functions:

- Salt strengthens gluten structure and makes it more stretchable. Thus, it improves the texture and grain of breads. When salt is present, gluten holds more water and carbon dioxide, allowing the dough to expand more while holding its structure.
- Salt inhibits yeast growth. It is therefore important for controlling fermentation in bread doughs and preventing the growth of undesirable wild yeasts.

For these reasons, the quantity of salt in a formula must be carefully controlled. If too much salt is used, fermentation and proofing are slowed. If not enough salt is used, fermentation proceeds too rapidly. The yeast uses too much of the sugar in the dough and, consequently, the crust doesn't brown well. Other results of overfermentation are described in Chapter 6. Because of the effect of salt on yeast, never add salt directly to the water in which yeast is softened.

Spices

Spices are plant or vegetable substances used to flavor foods. Plant parts used as spices include seeds, flower buds (such as cloves), roots (such as ginger), and bark (such as cinnamon). Spices are generally available whole or ground. Ground spices lose their flavor rapidly, so it is important to have fresh spices always on hand. Keep them tightly sealed in a cool, dark, dry place.

A small amount of spice usually has a great deal of flavoring power, so it is important to weigh spices carefully and accurately. A quarter ounce too much of nutmeg, for example, could make a product inedible. In most cases, it is better to use too little than too much.

The following are the most important spices and seeds in the bakeshop:

Allspice.

Anise.

Caraway.


Cardamom.

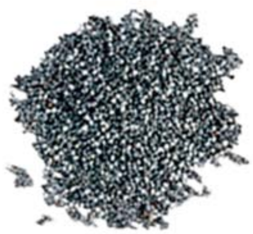

Cinnamon.


Cloves.


Ginger.


Mace.


Nutmeg.


Poppy seeds.


Sesame seeds.


Zest of lemon and orange (the outer colored part of the peel).

Vanilla

Vanilla is the most important flavoring in the pastry shop. The source of the flavor is the ripened, partially dried fruit of a tropical orchid. This fruit, called *vanilla bean* or *vanilla pod*, is readily available, but at a high price. In spite of their cost, vanilla beans are valued by pastry chefs for making the finest-quality pastries and dessert sauces and fillings.


Vanilla beans.

There are several ways to flavor products directly with vanilla beans. The simplest is simply to add one to a liquid when the liquid is heated, allowing the flavors to be extracted. Then remove the bean. For a stronger flavor, split the bean lengthwise before adding it. Then, after removing the bean, scrape out the tiny black seeds from inside the pod (see p. 261) and return them to the liquid.

Vanilla beans can also be used to flavor items that are not heated, such as whipped cream. Simply split the bean lengthwise, scrape out the seeds, and add them to the preparation.

A more common and economical way of flavoring with vanilla is to use vanilla extract. Vanilla extract is made by dissolving the flavoring elements of vanilla beans in an alcohol solution. To use, simply add the indicated quantity of the liquid as directed in the recipe.

If a formula calls for vanilla beans, there is no exact equivalent if you must substitute vanilla extract. This is because the strength of the flavor extracted from the bean depends on many factors, such as how long it was left in the liquid, whether or not it was split, and so on. However, a rule of thumb is to substitute ½ to 1 teaspoon (2.5 to 5 mL) extract for each vanilla bean.

Pure natural vanilla powder also is available. Pure white in color, it can be used to give a good vanilla flavor to white products, such as flat icing or whipped cream, without discoloring them.

Extracts and Emulsions

Extracts are flavorful oils and other substances dissolved in alcohol. These include vanilla, lemon, bitter almond, cinnamon, and coffee. Coffee extract can be approximated if it is not available. Dissolve 5 ounces (150 g) instant coffee powder in 12 ounces (360 g) water.

Emulsions are flavorful oils mixed with water with the aid of emulsifiers such as vegetable gums. Lemon and orange are the most frequently used emulsions. Their flavor is strong. For example, it takes less lemon emulsion than lemon extract to give the same flavor.

Flavorings in general may be divided into two categories: natural and artificial. Natural flavorings are usually more expensive but have a superior flavor. Artificial vanilla, for example, is a compound called *vanillin*, widely used in industrially made baked goods but lacking the rich, complex flavor profile of natural vanilla. Because flavorings and spices are used in small quantities, it is not much more expensive to use the best quality. Trying to save a few pennies on a cake by using inferior flavorings is false economy.

Alcohols

Various alcoholic beverages are useful flavoring ingredients in the pastry shop. These include sweet alcohols, often called *liqueurs*, nonsweet alcohols, and wines.

Many liqueurs are fruit-flavored. The most important of these are orange (including Cointreau, Grand Marnier, and Triple Sec) and cassis or blackcurrant. Other important flavors are bitter almond (amaretto), chocolate (crème de cacao), mint (crème de menthe), and coffee (crème de café, Kahlúa, Tía Maria).

Nonsweet alcohols include rum, cognac, Calvados (a brandy made from apples), and kirschwasser (a colorless brandy made from cherries; see p. 576).

The two most important wines are both sweet wines: Marsala (from Sicily) and Madeira (from the Portuguese island of the same name).

KEY POINTS TO REVIEW

- What are the components of unsweetened chocolate?
- What are the main types of sweetened chocolate used in the bakeshop? Describe them.
- What are the functions of salt in baked goods?

TERMS FOR REVIEW

hard wheat
strong flour
weak flour
soft wheat
bran
germ
endosperm
bolting
break system
stream
patent flour
clear flour
straight flour
extraction
gluten
amylase
diastase
pentosan
ash
carotenoid
absorption
enriched flour
dough conditioner
vital wheat gluten
bread flour
cake flour
pastry flour
all-purpose flour
durum flour
self-rising flour
whole wheat flour
bran flour
cracked wheat
rye flour
rye meal
sucrose
carbohydrate
simple sugar
complex sugar
invert sugar
granulated sugar
confectioners' sugar
brown sugar
syrup
simple syrup
dessert syrup
molasses
glucose
corn syrup
malt syrup
oil
saturated fat
unsaturated fat
hydrogenation
emulsion
shortening
regular shortening
emulsified shortening
margarine
pasteurized
ultrapasteurized
UHT pasteurized
whole milk
milk fat
butterfat
skim milk
nonfat milk
low-fat milk
fortified nonfat or low-fat milk
homogenized milk
whipping cream
light cream
half-and-half
sour cream
crème fraîche
buttermilk
yogurt
evaporated milk
condensed milk
dried whole milk
nonfat dry milk
baker's cheese
cream cheese
leavening
fermentation
fresh yeast
compressed yeast
active dry yeast
instant dry yeast
osmotolerant yeast
chemical leavener
sodium bicarbonate
single-acting baking powder
double-acting baking powder
baking ammonia
creaming
foaming
gelatin
pectin
chocolate liquor
cocoa butter
cocoa
dutch process cocoa
couverture
tempering
extract

QUESTIONS FOR REVIEW

1. Why is white wheat flour used in rye breads? In whole wheat breads? Some bakeries in Europe produce a kind of pumpernickel bread with 100% rye flour. What would you expect its texture to be like?
2. Describe how to distinguish bread, pastry, and cake flours by touch and sight.
3. Why does white flour have better keeping qualities than whole wheat flour?
4. What is the importance of aging in the production of flour? How is this accomplished in modern flour milling?
5. What is clear flour? What products is it used for?
6. List five functions of sugars in baked foods.
7. What is invert sugar? What properties make it useful in baking?
8. True or false: 10X sugar is one of the purest forms of sucrose. Explain your answer.
9. What is the difference between regular and emulsified shortening? Between cake margarine and pastry margarine?
10. What are some advantages and disadvantages in using butter as the fat in pie dough?
11. List eight functions of eggs in baked goods.
12. What is the difference between single-acting and double-acting baking powders? Which is most frequently used, and why?
13. Explain how to use sheet gelatin in a recipe. Explain how to substitute powdered gelatin for sheet gelatin.