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The Baking Profession

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO:

1. **Describe the major events in the history of baking, from prehistoric times to the present.**
2. **Name the principal career positions in modern food service and bakery operations.**
3. **Name and discuss four attitude characteristics possessed by successful bakers and pastry cooks.**

BAKING IS ONE of the oldest occupations of the human race. Since early prehistoric human beings made the transition from nomadic hunters to settled gatherers and farmers, grains have been the most important foods to sustain human life, often nearly the only foods. The profession that today includes baking artisan sourdough breads and assembling elegant pastries and desserts began thousands of years ago with the harvesting of wild grass seeds and the grinding of those seeds between stones.

Today, the professions of baker and pastry chef are growing quickly and changing rapidly. Thousands of skilled people are needed every year. Baking offers ambitious men and women the opportunity to find satisfying work in an industry that is both challenging and rewarding.

Before you start your practical studies, which are covered in this book, it is good to first learn a little about the profession you are entering. Therefore, this chapter gives you a brief overview of baking professions, including how they got to where they are today.

BAKING: HISTORICAL BACKGROUND

GRAINS HAVE BEEN the most important staple foods in the human diet since prehistoric times, so it is only a slight exaggeration to say that baking is almost as old as the human race.

The First Grain Foods

Before human beings learned to plant, they gathered wild foods. The seeds of various wild grasses, the ancestors of modern grains, were rich in nutrients and valued by prehistoric peoples as important foods. These seeds, unlike modern grains, had husks that clung tightly to them. People learned that by toasting the seeds, probably on hot rocks, they could loosen the husks and then remove them by beating the seeds with wooden tools.

The early development of grain foods took place mostly in the eastern Mediterranean regions, where, it seems, wild grains were especially abundant.

Few cooking utensils were in use at this point in human history, so it is probable that the earliest grain preparation involved toasting dry grains, pounding them to a meal with rocks, and mixing the meal to a paste with water. The grains had already been cooked by toasting them, to remove the husks, so the paste needed no further cooking. Later, it was discovered that some of this paste, if laid on a hot stone next to a fire, turned into a flatbread that was a little more appetizing than the plain paste. Unleavened flatbreads, such as tortillas, are still important foods in many cultures. Unleavened flatbreads made from grain pastes are the first stage in the development of breads as we know them.

To understand how breads evolved, you must also understand a little about how grains developed. As you will learn in Chapter 4, modern yeast breads depend on a combination of certain proteins to give them their structure. For all practical purposes, only wheat and its relatives contain enough of these proteins, which form an elastic substance called *gluten*. A few other grains also contain gluten proteins, but they do not form as strong a structure as wheat gluten.

Further, the proteins must be raw in order to form gluten. Because the earliest wild grains had to be heated to free them from their husks, they could be used only to make grain pastes or porridges, not true breads. Over time, prehistoric people learned to plant seeds; eventually, they planted only seeds of plants whose seeds were easiest to process. As a result, hybrid varieties emerged whose husks could be removed without heating the grains. Without this advancement, modern breads could not have come about.

Ancient Leavened Breads

A grain paste left to stand for a time sooner or later collects wild yeasts (microscopic organisms that produce carbon dioxide gas) from the air, and begins to ferment. This was, no doubt, the beginning of leavened (or raised) bread, although for most of human history the presence of yeast was mostly accidental. Eventually, people learned they could save a small part of the current day's dough to leaven the next day's batch.

Small flat or mounded cakes made of a grain paste, whether leavened or unleavened, could be cooked on a hot rock or other hot, flat surface, or they could be covered and set near a fire or in the embers of a fire. The ancient Egyptians developed the art of cooking leavened doughs in molds—the first loaf pans. The molds were heated and then filled with dough, covered, and stacked in a heated chamber. These were perhaps the first mass-produced breads. Breads made from wheat flour were costly and so affordable for only the wealthy. Most people ate bread made from barley and other grains.

By the time of the ancient Greeks, about 500 or 600 BCE, true enclosed ovens were in use. These ovens were preheated by building a fire inside them. They had a door in the front that could be closed, so they could be loaded and unloaded without losing much heat.

Still, for the most part, the breads baked in these ovens were nothing more than cakes of baked grain pastes mixed with a little of the paste from the day before to supply wild yeasts for leavening. Such flat or slightly mounded breads were called *maza*. Maza, especially those made of barley, were the staple food of the time. In fact, in ancient Greece, all foods were divided into two categories, maza and *opson*, meaning things eaten with maza. Opson included vegetables, cheese, fish, meat, or anything else except bread. Often the opson was placed on top of the flat bread, forming the ancestors of modern pizzas.

Writings from ancient Greece describe as many as 80 kinds of bread and other baked grain products originated by professional bakers. Some of these could be called true breads, rather than flatbreads or maza, because they were made with kneaded doughs containing wheat flour, which provided gluten proteins.

Several centuries later, the ancient Romans were slow to develop breads. Not until master bakers arrived from Greece did grain foods advance much beyond porridges and simple flatbreads. By the latter period of the Roman Empire, however, baking was an important industry. Bakeshops were often run by immigrant Greeks.

An important innovation in Roman baking was introduced by the Gauls, a European people who had been conquered by the Romans. The Gauls, the ancestors of the modern French, had invented beer making. They discovered that adding the froth from beer to bread dough made especially light, well-leavened breads. The froth contained yeast from beer fermentation, so this process marked the beginning of the use of a controlled yeast source for making bread doughs.

Many of the products made by Roman bakers contained quantities of honey and oil, so these foods might more properly be called pastries rather than breads. That the primary fat available was oil placed a limit on the kinds of pastries that could be made, however. Only a solid fat such as butter enables the pastry maker to produce the kinds of stiff doughs we are familiar with today, such as pie doughs and short pastries.

Baking in the Middle Ages

After the collapse of the Roman Empire, baking as a profession almost disappeared. Not until the latter part of the Middle Ages did baking and pastry making begin to reappear as important professions in the service of the nobility. Bread baking continued to be performed by professional bakers, not homemakers, because it required ovens that needed almost constant tending. And because of the risk of fire, baking ovens were usually separated from other buildings, and often outside city walls.

In much of Europe, tending ovens and making bread dough were separate operations. The oven tender maintained the oven, heated it properly, and supervised the baking of the loaves that were brought to him. In early years, the oven may not have been near the workshops of the bakers, and one oven typically served the needs of several bakers. It is interesting to note that in many bakeries today, especially in the larger ones, this division of labor still exists. The chef who tends the ovens bakes the proofed breads and other products that are brought to him or her and may not have any part in the mixing and makeup of these products.

Throughout the Middle Ages, one of the bread maker's tasks was sifting, or *bolting*, the whole-grain flour that was brought to him by customers. Sifting with coarse sieves removed only part of the bran, while sifting with finer sieves removed most or all of the bran and made whiter flour. More of the grain is removed to make white flour, so the yield was lower and, thus, white bread was more expensive, putting it out of reach of ordinary people. Not until around 1650 CE did bakers start buying sifted flour from mills.

Because bread was the most important food of the time, many laws were passed during this period to regulate production factors such as bolting yields, bread ingredients, and loaf sizes. It was also in the Middle Ages that bakers and pastry chefs in France formed guilds to protect and advance their art. Regulations prohibited all but certified bakers from baking bread for sale, and the guilds had the power to limit certification to their own members. The guilds, as well as the apprenticeship system, which was well established by the sixteenth century, also provided a way to pass the knowledge of the baker's trade from generation to generation.

To become master bakers, workers had to go through a course of apprenticeship and obtain a certificate stating they had gained the necessary skills. Certified master bakers could then set up their own shops. Master bakers were assisted by apprentices, who were learning the trade and so were not paid, and by journeymen, who were paid servants and who may have completed an apprenticeship but had not gained a master baker's certificate.

Sugar and Pastry Making

Bakers also made cakes from doughs or batters containing honey or other sweet ingredients, such as dried fruits. Many of these items had religious significance and were baked only for special occasions, such as the Twelfth Night cakes baked after Christmas. Such products nearly always had a dense texture, unlike the light confections we call cakes today. Nonsweetened pastry doughs were also made for such products as meat pies.

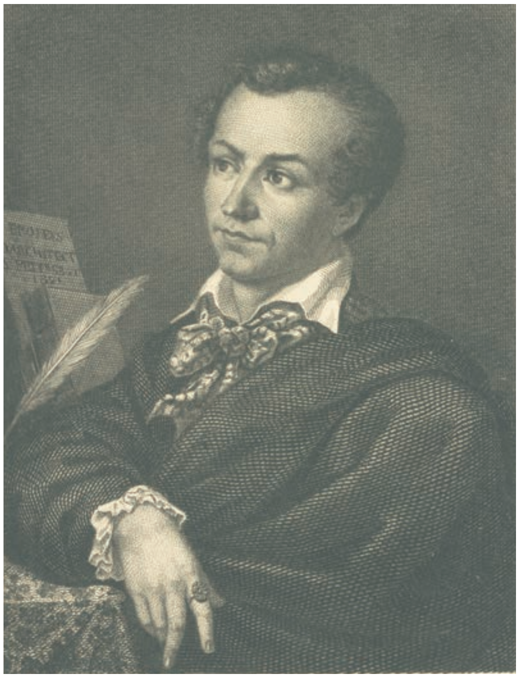
In the 1400s, pastry chefs in France formed their own corporations and took control over pastry making from bakers. From this point on, the profession of pastry making developed rapidly, and bakers invented many new kinds of pastry products.

Honey was the most important sweetener at the time because, for Europeans, sugar was a rare and expensive luxury item. Sugarcane, the source of refined sugar, was native to India and grown in southern regions of Asia. To be brought to Europe, sugar had to pass through many countries, and each overland stop added taxes and tolls to its already high price.

The European arrival in the Americas in 1492 sparked a revolution in pastry making. The Caribbean islands proved ideal for growing sugar, which led to increased supply and lower prices. Cocoa and chocolate, native to the New World, also became available in the Old World for the first time. Once these new ingredients became widely accessible, baking and pastry became more and more sophisticated, and many new recipes were developed. By the seventeenth and eighteenth centuries, many of the basic pastries we know today, including laminated or layered doughs like puff pastry and Danish dough, were being made. Also in the eighteenth century, processors learned how to refine sugar from sugar beets. At last, Europeans could grow sugar locally.

From the First Restaurants to Carême

Modern food service is said to have begun shortly after the middle of the eighteenth century. Just as bakers and pastry cooks had to be licensed, and became members of guilds, which controlled production, so too did caterers, roasters, pork butchers, and other food workers become licensed members of guilds. For an innkeeper to be able to serve meals to guests, for example, he had to buy the various menu items from those operations that were licensed to provide them. Guests had little or no choice. They simply ate what was offered for that meal.



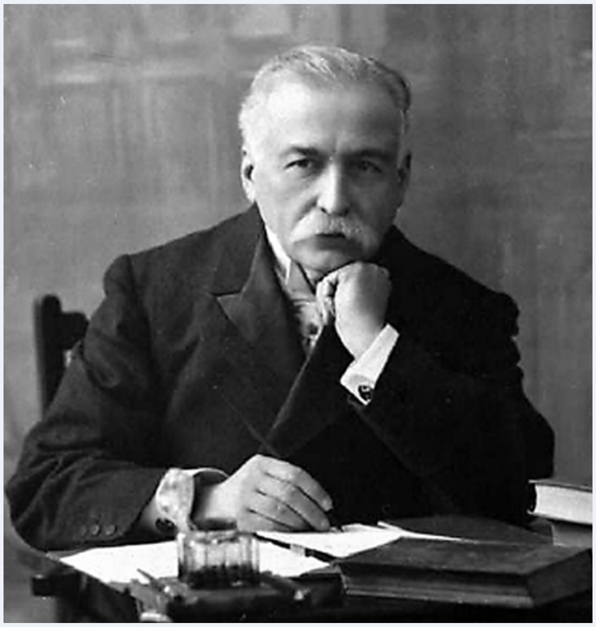
Portrait of Marie-Antoine Carême, from M.A. Carême. *L'art de la cuisine française au dix-neuvième siècle. Traité élémentaire et pratique*, 1833. Division of Rare and Manuscript Collections, Cornell University Library.

GEORGES-AUGUST ESCOFFIER

Georges-August Escoffier (1847–1935), the greatest chef of his time, is still revered by chefs and gourmets as the father of twentieth-century cookery. His main contributions were: (1) the simplification of the classical menu; (2) the systematizing of cooking methods; and (3) the reorganization of the kitchen.

Escoffier's books and recipes remain important reference works for professional chefs. The basic cooking methods and preparations we study today are based on his principles. Escoffier's *Le guide culinaire*, which is still widely used, arranges recipes in a system based on the main ingredient and cooking method, greatly simplifying the more complex system handed down from Carême. Learning classical cooking, according to Escoffier, begins with mastering a relatively few basic procedures and understanding essential ingredients.

Although Escoffier didn't work as a bread baker, he applied the same systems to the production of desserts that he did to savory food. Several of the desserts he invented, such as peach Melba, are still served today.



Georges-August Escoffier.

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In 1765, a Parisian named ***A. Boulanger*** (whose name, incidentally, means "bread baker") began advertising on his shop sign that he served soups, which he called "restaurants," or "restoratives." (The word "restaurant" comes from the French *restaurer*, "to restore.") According to the story, one of the dishes he served was sheep's feet in a cream sauce. The guild of stew makers challenged him in court, but Boulanger won by claiming he didn't stew the feet *in* the sauce but served them *with* the sauce. In challenging the rules of the guilds, Boulanger changed the course of food service history.

For the bread baker, two important events during this period were the publication of the first major books on bread making: *L' art du meunier, du boulanger et du vermicellier* (*The Art of the Miller, the Bread Baker, and the Pasta Maker*) by Paul-Jacques Malouin in 1775, and *Le parfait boulanger* (*The Perfect Bread Baker*) by Antoine-Augustin Parmentier in 1778.

The nineteenth century saw not just a revolution in food service but also in the development of modern baking as we know it. After the French Revolution in 1789, many bakers and pastry cooks who had been servants in the houses of the nobility started independent businesses. Artisans competed for customers with the quality of their products, and the general public—not just aristocrats and the well-to-do—were able to buy fine pastries. Some of the pastry shops started during this time are still serving Parisians today.

An invention in the eighteenth century forever changed the organization of the commercial kitchen, which to date had been centered round an open cooking fire. This invention was the stove, which provided a more controllable heat source. In time, commercial kitchens were divided into three departments, each based on a piece of equipment: the stove, run by the cook, or ***cuisinier***; the rotisserie, run by the meat chef, or ***rôtisseur***; and the oven, run by the pastry chef, or ***pâtissier***. The pastry chef and the meat chef reported to the cuisinier, who was also known as ***chef de cuisine***, which means "head of the kitchen." Although the stovetop was a new feature of this reorganized kitchen, the baker's oven was still the wood-fired brick oven that had long been in use.

The most famous chef of the early nineteenth century was ***Marie-Antoine Carême***, also known as Antonin Carême, who lived from 1784 to 1833. His spectacular constructions of sugar and pastry earned him great fame, and he elevated the professions of cook and pastry chef to respected positions. Carême's book, *Le pâtissier royal*, was one of the first systematic explanations of the pastry chef's art.

Ironically, most of Carême's career was spent in the service of the nobility and royalty, in an era when the products of the bakers' and pastry chefs' craft were becoming more widely available to average citizens. Carême had little to do with the commercial and retail aspects of baking.

In spite of his achievements and fame as a pastry chef, Carême was not primarily a baker, but a chef de cuisine. As a young man, he learned all the branches of cooking quickly, and he dedicated his career to refining and organizing culinary techniques. His many books contain the first systematic account of cooking principles, recipes, and menu making.

Modern Baking and Modern Technology

The nineteenth century was a time of great technical progress in the baking profession. Automated processes enabled bakers to do many tasks with machines that once required a great deal of manual labor. The most important of these technological advances was the development of *roller milling*. Prior to this time, flour was milled by grinding grain between two stones. The resulting flour then had to be sifted, or bolted, often numerous times, to separate the bran. The process was slow. Roller milling, described in Chapter 4 (see page 57), proved to be much faster and more efficient. This was a tremendous boost to the baking industry.

Another important development of the period was the availability of new flours from the wheat-growing regions of North America. These wheat varieties were higher in protein than those that could be grown in northern Europe, and their export to Europe promoted the large-scale production of white bread.

In the twentieth century, advances in technology, from refrigeration to sophisticated ovens to air transportation that can carry fresh ingredients around the world, contributed immeasurably to baking and pastry making. Similarly, preservation techniques have helped make available and affordable some ingredients that were once rare and expensive. Also, thanks to modern food preservation technology, it is now possible to do some or most of the preparation and processing of foods before shipping, rather than in the bakeshop or food service operation itself. Thus, convenience foods have come into being. Today, it is feasible to avoid many labor-intensive processes, such as making puff pastry, by purchasing convenience products.

Modern equipment, too, has helped advance production techniques and schedules. For example, dough sheeters speed the production of laminated doughs, such as Danish dough, while at the same time producing a more uniform product. Retarder-proofers hold yeast doughs overnight and then proof them so they are ready to bake in the morning. It is now possible to prepare some foods farther in advance and in larger quantities, maintaining them in good condition until ready for finishing and serving.

Modern Styles

All these developments have led to changes in cooking styles and eating habits. The evolution in cooking and baking, which has been going on for hundreds of years, continues to this day. It is helpful to explore the shifts in restaurant cooking styles, because those in baking and pastry have followed a similar course.

A generation after *Escoffier*, the most influential chef in the middle of the twentieth century was Fernand Point (1897–1955). Working quietly and steadily in his restaurant, La Pyramide, in Vienne, France, Point simplified and lightened classical cuisine. His influence extended well beyond his own lifetime.

Many of Point's apprentices, such as Paul Bocuse, Jean and Pierre Troisgros, and Alain Chapel, went on to become some of the greatest stars of modern cooking. They, along with other chefs of their generation, became best known in the 1960s and early 1970s for a style of cooking called *nouvelle cuisine*. They took Point's lighter approach even further, by urging the use of simpler, more natural flavors and preparations, with lighter sauces and seasonings and shorter cooking times. In traditional classical cuisine, many dishes were plated in the dining room by waiters. Nouvelle cuisine, in contrast, emphasized artful plating presentations done by the chef in the kitchen. In the pastry chef's department, this practice marked the beginning of the modern plated dessert.

A landmark event in the history of modern North American cooking was the opening of Alice Waters' restaurant, Chez Panisse, in Berkeley, California, in 1971. Waters' philosophy is that good food depends on good ingredients, so she set about finding dependable sources of the highest-quality vegetables, fruits, and meats, and preparing them in the simplest ways.

Alice Waters of Chez Panisse.

Courtesy of Chez Panisse.

Over the next decades, many chefs and restaurateurs followed her lead, seeking the best seasonal, locally grown, organically raised food products.

During the latter part of the twentieth century, as travel became easier, and more immigrants began arriving in Europe and North America from around the world, awareness of and taste for regional dishes grew. To satisfy these expanding tastes, chefs became more knowledgeable, not only about the traditional cuisines of other parts of Europe but also of Asia, Latin America, and elsewhere. Many of the most creative chefs today are inspired by these cuisines and use some of their techniques and ingredients. Master pastry chefs such as Gaston Lenôtre have revitalized the art of fine pastry and inspired and taught a generation of professionals.

The use of ingredients and techniques from more than one regional cuisine in a single dish has become known as *fusion cuisine*. Fusion cuisine can, however, produce poor results because it is not true to any one culture and becomes too mixed up. This was especially true in the 1980s, when the idea of fusion cuisine was new. Cooks often mixed ingredients and techniques without a true understanding for how everything worked together. The result was sometimes a jumbled confusion of tastes. Fortunately, since the early days of fusion, those chefs who have taken the time to study in depth the cuisines and cultures they borrow from have brought new excitement to cooking and restaurant menus. In the pastry department specifically, ingredients such as passion fruit, mangoes, and lemongrass, once thought strange and exotic, are now commonly found.

Reactions to Technology and the Evolution of Modern Bread

The progression of bread baking since the nineteenth century is an interesting example of how technology has affected our food production. Two developments changed how bread was made, and for the first time made possible the mass production of bread: the widespread use of mixers and the development of modern yeast. Mixing machines, though invented decades earlier, didn't really become popular until the 1920s. Within a few years, stronger commercial yeasts became available, meaning that bakers no longer had to depend on slow-fermenting sponges and sourdough starters to leaven their breads. Now, large quantities of breads could be mixed, fermented, and baked in just a few hours.

By the 1950s and 1960s, most bread was being mass produced. Unfortunately, most of it was boring and flavorless. To compensate for the rapid mixing and production processes, bakers had to add dough conditioners and other additives to their products. But much of the flavor of good bread comes from long yeast fermentation, so the new mixing and leavening procedures meant sacrificing flavor for speed. As a result, bread became little more than a vehicle to hold sandwich fillings or to convey butter and jelly to the mouth. Even in France, the baguette had become bland and uninteresting.

Perhaps the most important figure in the bread revolution of the twentieth century was the Frenchman Professor Raymond Calvel. Calvel did extensive research on flour composition, fermentation, and other aspects of bread making for the purpose of restoring character and flavor to bread and to produce bread with only natural ingredients. His work stimulated a return to older-style flours and more traditional mixing techniques. More than this, he developed new techniques, such as autolyse (explained on page 135), that enabled bakers to produce flavorful artisanal breads without resulting in a return to the 12- to16-hour days of heavy labor required of bakers in earlier times. (More information on the bread revolution launched by Calvel is detailed in the Bread Mixing: A Historical Perspective sidebar in Chapter 6 on page 110.) Calvel's book *Le Goût du Pain* (translated as *The Taste of Bread*) is today one of the most important reference books for artisan bakers.

This effort to recapture in bread lost flavors of times gone by has carried over to other baked goods, including pastries and desserts of all kinds. The same artisan bakeries selling flavorful old-style breads are also now enticing customers with higher-quality Danish, brioche, and croissants, made with many of these rediscovered techniques. On restaurant dessert menus, this trend can be seen in the home-style desserts made with the best ingredients, which sit comfortably side by side with ultramodern pastry presentations.

KEY POINTS TO REVIEW

- Why is wheat the most important grain in the development of baked goods?
- How have new technologies changed the baking industry since the nineteenth century?

LIONEL POILÂNE

A generation younger than Raymond Calvel, the Parisian baker Lionel Poilâne expanded the baking business he inherited from his father into one of the world's most famous boulangeries, shipping his signature 2-kg round sourdough loaves around the world. Except for the use of mixing machines, he relied on traditional techniques and ingredients, such as stone-ground flour, wood-burning ovens, and sourdough fermentation, to produce his intensely flavorful breads. Sadly, Poilâne was tragically killed in a helicopter crash in 2002, but his daughter Apollonia carries on the business today.

BAKING AND PASTRY CAREERS

SINCE THE BEGINNING of the twenty-first century, the popularity of fine breads and pastries has been growing faster than new chefs can be trained to support it. Those entering careers in baking or pastry making today will find opportunities in many areas, from small bakeshops and neighborhood restaurants to large hotels and wholesale bakeries.

Restaurant and Hotel Food Service

As you learned earlier in this chapter, one of Escoffier's important achievements was the reorganization of the kitchen. He divided the kitchen into departments, or stations, based on the kinds of foods they produced. A station chef was placed in charge of each department. This system, with many variations, is still in use today, especially in large hotels offering traditional kinds of food service. In a small operation, the station chef may be the only worker in the department. But in a large kitchen, each station chef might have several assistants.

Station chefs in large kitchens include the sauce chef (*saucier*), who is responsible for sauces and sautéed items; the fish chef (*poissonier*); the roast chef (*rôtisseur*); and the pantry chef (*chef garde manger*). Desserts and pastries are prepared by the pastry chef (*pâtissier*). Station chefs report to the executive chef, or ***chef de cuisine***, who is in charge of food production. In the largest kitchens, the duties of the executive chef are mostly managerial. The executive chef may, in fact, do little or no cooking personally. The *sous chef* assists the executive chef and is directly in charge of the cooking during production.

The pastry department is usually separated physically from the hot kitchen, for at least two important reasons. First, and most obvious, is that many desserts and confections must be prepared in a cool environment. Second, the division helps prevent creams, icings, and batters from absorbing the aromas of roasted, grilled, and sautéed foods.

In a small to medium-size restaurant, the pastry chef may work alone, preparing all the dessert items. Often he or she starts work early in the morning and finishes before the dinner service starts. Another cook or the dining room staff then assembles and plates the desserts during service.

In large restaurants and hotels, the chef in charge of baking and desserts is the executive pastry chef.This is a management position comparable to the executive chef in the hot kitchen. The executive pastry chef supervises workers in the department, including specialists such as the bread baker (*boulanger*), who prepares yeast goods including such breakfast items as brioche, croissants, and Danish pastry; the ice cream maker (*glacier*), who makes frozen desserts; the confectioner or candy maker (*confiseur*); and the decorator (*décorateur*), who prepares showpieces, sugar work, and decorated cakes.

In hotels, the work of the baking and pastry department can be extensive, including preparing not only desserts and breads for all the on-premise restaurants, cafés, and room service, but also breakfast breads and pastries and all baked goods, including specialty cakes and decorative work, for the banquet and catering departments. Such large operations provide many opportunities for the baker wishing to gain a wide range of experience.

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Caterers, institutional volume-feeding operations (e.g., schools, hospitals, employee lunchrooms), executive dining rooms, and private clubs may also require the services of bakers and pastry chefs. The required skills vary from one establishment to another. Some prepare all their baked goods in-house, while others rely on convenience products and finished wholesale bakery foods.

Bakeries

Retail bakeries include independent bakeshops as well as in-store bakery departments in grocery stores and supermarkets. High-end supermarkets, in particular, have opened many new opportunities for creative bakers and pastry chefs. A few grocery stores have even installed wood-burning hearth ovens for baking handcrafted artisan breads.

The *head baker* is the professional in charge of the production in a retail bakery. He or she is in charge of a staff that may range from a few bakers who share most tasks to, in a larger bakery, many specialists who work in different departments, such as breads and yeast goods, cakes, and decorated items. Even bread-making tasks may be divided among different workers, with some mixing, proofing, and making up the doughs, and others baking the items and managing the ovens.

Although most independent bakeshops offer a full range of products, from breads to cakes and pastries, some make their reputations on one or two specialty items, such as cupcakes or artisan breads, and concentrate on those products. More specialized yet are shops whose entire business consists of preparing and decorating celebration cakes, such as for weddings, birthdays, and the like.

Wholesale bakeries accomplish the same tasks as retail bakeries, but their production facilities may be more automated and industrialized. In them, equipment such as mixers and ovens handle large volumes of doughs and baked goods. In addition to finished items, wholesale bakeries may produce unfinished products such as cake layers, cookie dough, and puff pastry dough for sale to restaurants, hotels, caterers, supermarkets, and other food service operations.

Professional Requirements

What does it take to be a qualified baker or pastry chef?

The emphasis of a food service education, whether in baking and pastry or in the hot kitchen, is on learning a set of skills. But in many ways, *attitudes* are more important than skills because a good attitude will help you not only learn skills but also to persevere and overcome the difficulties you may face in your career.

Mastery of skills is, of course, essential to success. There are, in addition, a number of general personal qualities that are equally important for the new pastry chef or baker just graduated from school who wants to advance in the industry. The following sections describe a few of these important characteristics.

Eagerness to Work

Baking professionally is demanding, both physically and mentally. By the time students graduate, they realize that those of their fellow students who have been the hardest working—especially those who sought extra work and additional opportunities to learn—are the most successful. Once they have graduated, bakers and chefs who continue to give the greatest effort are the ones who advance the fastest.

One of the most discouraging discoveries for new culinarians is how repetitive the work is. They must do many of the same tasks over and over, day in and day out, whether it's making up hundreds of dinner rolls a day or thousands of cookies for holiday sales. Successful bakers and chefs approach repetition as an opportunity for building skills. Only by doing a cooking task over and over can you really master it, really understand every nuance and variable.

Stress is another issue caused by repetitive hard work. Overcoming stress requires a sense of responsibility and a dedication to your profession, to your coworkers, and to your customers or clients. Dedication also means staying with a job, resisting the urge to hop from kitchen to kitchen every few months. Sticking with a job for at least a year or two shows prospective employers you are serious about your work and can be relied on.

Commitment to Learning

A strong work ethic is empowered by knowledge, so it is important that you, as a baking professional, make a commitment to your ongoing education: Never stop learning. Read. Study. Experiment. Take continuing education courses. Network with other chefs. Share information. Join appropriate professional associations, like the American Culinary Federation or the Retail Bakers of America. Join the alumni association of your school and stay in touch with your fellow graduates. Enter competitions, to hone your skills and to learn from your competitors. Learn management and business skills. Keep up with the latest developments in technology, baking techniques, and food trends while you refresh your basic skills. Remember that learning to bake and cook and manage a kitchen is a lifelong process.

In return, help others learn. Share your knowledge. Be a mentor to a student. Teach a class. Help a coworker. Judge a competition. Contribute to professional workshops and seminars. Do what you can to raise the skill level of the profession.

Dedication to Service

Food service, as its name implies, is about serving others. Baking and cooking professionally mean bringing enjoyment and a sense of well-being to your guests. Providing good service requires sourcing high-quality ingredients and handling them with care and respect; guarding the health of guests and coworkers, paying full attention to food safety and sanitation; treating others with respect; making guests feel welcome and coworkers feel valued; and maintaining a clean, attractive work environment. Look after others, and your own success will follow.

Professional Pride

Professionals take pride in their work, and want to make sure it is something they can be proud of. A professional cook maintains a positive attitude, works efficiently, neatly, and safely, and always aims for high quality. Although it may sound like a contradiction, professional pride should be balanced with a strong dose of humility, for it is humility that leads chefs to dedicate themselves to hard work, perpetual learning, and commitment to service. A professional who takes pride in his or her work recognizes the talent of others in the field and is inspired and stimulated by their achievements. A good baker or pastry chef also demonstrates pride by, in turn, setting a good example for others.

KEY POINTS TO REVIEW

- What are the major baking and pastry career positions in food service? In retail and wholesale bakeries?
- What are the personal characteristics that are important to the success of bakers and pastry chefs?

TERMS FOR REVIEW

gluten	chef de cuisine	fusion cuisine	boulanger
A. Boulanger	Marie-Antoine Carême	saucier	glacier
cuisinier	roller milling	poissonier	confiseur
rôtisseur	George-August Escoffier	chef garde manger	décorateur
pâtissier	nouvelle cuisine	sous chef	head baker

QUESTIONS FOR DISCUSSION

1. What characteristic of modern wheat flour makes it possible to produce an elastic, yeast-fermented dough? Why was it not possible for prehistoric people to make such doughs from the earliest wild grains?
2. What historical event did the most to make sugar widely available? How so?
3. What contribution did beer production make to the process of bread making?
4. Briefly describe how commercial kitchens were organized after the invention of the stove in the eighteenth century.
5. What is nouvelle cuisine? How did nouvelle cuisine affect the style of desserts served in restaurants?
6. Describe the organization of a large, modern hotel kitchen. Name and describe specialty positions that may be found in large bakeries.

2

Basic Professional Skills:

BAKESHOP MATH AND FOOD SAFETY

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO:

1. **Describe the problems and limitations of written formulas.**
2. **Describe the two basic functions of standardized formulas.**
3. **Explain the importance of weighing baking ingredients.**
4. **Use a baker's balance scale.**
5. **Calculate raw fruit yields based on trimming losses.**
6. **Use formulas based on baker's percentages.**
7. **Convert formulas to different yields.**
8. **Calculate edible portion (EP) unit costs.**
9. **Calculate formula costs.**
10. **Describe steps to prevent foodborne diseases in the areas of personal hygiene and food-handling techniques.**

RECIPES AND FORMULAS are fundamental tools of the kitchen and bakeshop. They indicate ingredients to be purchased and stored. They give measuring and preparation instructions for the items to be produced. And they are the focus of other management tools and techniques, including modifying quantities and determining costs.

In this chapter, you are introduced to basic bakeshop production, through a discussion of the kinds of measurements and mathematical calculations necessary for baking and of the basic processes common to nearly all baked goods.

The final portion of this chapter gives you a brief overview of another critically important issue in running a successful bakeshop: sanitation.

FORMULAS AND MEASUREMENT

A SET OF instructions for producing a certain dish is called a *recipe*. In order to duplicate a desired preparation, it is necessary to have a precise record of the ingredients, their amounts, and the way in which they are combined and cooked. This is the purpose of a recipe.

Bakers generally talk about *formulas* rather than recipes. If this sounds to you more like the lingo of a chemistry lab than a food production facility, it is with good reason. The bakeshop is very much like a chemistry laboratory, both in terms of the scientific accuracy required of the procedures and of the complex reactions that take place during mixing and baking.

Note there are no exact rules for using the word ***formula*** in the context of baking (see the Formulas and MOPs sidebar). Some bakers use the term to refer to flour goods only, while using the word ***recipe*** when talking about such items as pastry cream, fruit fillings, and dessert mousses. Other bakers are in the habit of calling all recipes ***formulas***. Still others consistently use the word ***recipe***. In this book, we use the word ***formula*** for most products, although you will also see the word ***recipe*** used occasionally.

The primary function of a formula is, of course, to give a set of ingredients and quantities for making a product. But a formula is also useful for related purposes. A written formula provides a means of modifying quantities and yields and determining costs. These functions require the use of math. Procedures for working with formula math are the main focus of this section.

FORMULAS AND MOPS

Strictly speaking, the term *formula* refers only to the list of ingredients and quantities. The directions for using those ingredients, referred to in this book as the *procedure*, is known by many chefs as the *method of preparation*, or MOP. There are relatively few MOPs, or basic procedures, and these are applied to nearly all the products of the bakeshop. To a trained baker, these MOPs are so well understood that they need not be repeated with every formula, as explained in the text.

One of the major purposes of this book is to familiarize you with the principal procedures used in the bakeshop so you too can make use of professional formulas.

Uses and Limitations of Formulas and Recipes

In spite of their importance, written formulas and recipes have many limitations. No matter how detailed a formula is, it assumes you already have certain knowledge—that you understand the terminology it uses, for example, and that you know how to measure ingredients.

Before talking specifically about baking formulas, let's briefly consider recipes in general. Many people believe that learning how to cook simply means learning recipes. A professional cook, on the other hand, learns to work by mastering a set of basic procedures. A recipe is a way of applying basic techniques to specific ingredients.

The main purpose of learning basic cooking principles is not to be able to cook without recipes but rather to understand the recipes you use. As we just said, every recipe assumes you have certain knowledge, so you can understand the instructions and follow them correctly.

If you have leafed through this book, you know it is made up of more than formulas and recipes. Although it does contain hundreds of formulas, they make up only part of its contents. Its main concern is to teach you the basic techniques and procedures so that you can apply them to any formula.

Bakers use a relatively small number of basic mixing techniques to prepare doughs and batters. For this reason, a baker's formula may consist only of a list of ingredients and quantities and the name of the mixing method. A trained baker can produced a finished product with this information alone. In fact, often the name of the mixing method isn't even necessary because the baker can tell from the ingredients and their proportions which mixing method is needed. To accustom you to this way of working, and to emphasize the importance of learning basic mixing methods well, most of the formulas in this book indicate the name of the required mixing method without repeating the steps for each formula. In each case, you should review the basic procedures as needed before using a formula.

Some recipes supply very little information; others supply a great deal. But no matter how detailed it is, a written recipe can't tell you everything, and some judgment by the cook is always required. This is especially true in the hot kitchen, where cooks must always make adjustments for ingredient product variation—some carrots are sweeter than others, for example, some oysters are saltier than others, and so on.

In the bakeshop, there is less product variation. Specifically, flour, yeast, sugar, butter, and other basic ingredients are pretty consistent, especially when purchased from the same source. Nevertheless, many other factors can't be accounted for when writing a recipe. To name just two:

- Equipment varies from bakeshop to bakeshop. For example, different mixers as well as different-size mixers process dough differently, and ovens vary in their baking properties.
- It is impossible to give exact instructions for many processes. For example, a bread formula may indicate a mixing time, but the exact time needed for a particular batch will vary. The baker must be able to judge by the feel and texture of the dough when it has developed properly.

Standardized Recipes and Formulas

A *standardized formula* or ***recipe,*** is a set of instructions describing the way a particular establishment prepares a particular item. In other words, it is a customized recipe developed by an operation for the use of its own cooks, pastry chefs, and bakers, using its own equipment, to be sold or served to its own patrons.

Formula formats differ from operation to operation, but nearly all of them try to include as much precise information as possible. The following details may be listed:

- Name of the recipe
- Yield, including total yield, number of portions, and exact portion size
- Ingredients and exact amounts, listed in order of use
- Equipment needed, including measuring equipment, pan sizes, portioning equipment, and so on
- Directions for preparing the dish—kept as simple as possible
- Preparation and cooking times
- Directions for holding the product between preparation and service
- Directions for portioning, plating, and garnishing
- Directions for storing leftovers

As you can tell, some of these points apply more to the pastry or dessert station in a restaurant than they do to retail bakeries. Bread recipes don't require instructions for plating and garnishing, for example. Nevertheless, the basic principles apply to bakeries, as well as to restaurant kitchens.

FUNCTIONS OF STANDARDIZED FORMULAS

An operation's own recipes are used to control production. They do this in two ways:

- *They control quality*. Standardized formulas and recipes are detailed and specific. This is to ensure the product is the same every time it is made and served, no matter who cooks it.
- *They control quantity*. First, they indicate precise quantities for every ingredient and how to measure that quantity. Second, they indicate exact yields and portion sizes and how to measure and serve those portions.

LIMITATIONS OF STANDARDIZED FORMULAS

Standardized formulas have the same problems as all recipes—those discussed earlier regarding variations in ingredients, equipment, and vagueness of instructions. These problems can be minimized by writing the recipe carefully, but they cannot be eliminated. Even if an operation uses proven, standardized recipes, a new employee making a dish for the first time usually requires some supervision to make sure he or she interprets the instructions the same way as the rest of the staff. These limitations don't invalidate standardized recipes. If anything, they make exact directions even more important. But they do show that experience and knowledge are still very important.

Instructional Recipes and Formulas

The formulas in this book are *not* standardized. Remember that a standardized formula is custom-made for a particular operation. The formulas in this book, obviously, are not.

The purpose of a standardized formula is to direct and control the production of a particular food item. Directions must be as complete and exact as possible. In contrast, the purpose of the instructional formulas in this book is to teach basic baking and cooking techniques. They provide an opportunity for you to practice, with specific ingredients, the general procedures you have learned.

If you glance at any of the formulas in this book, you will see they do not contain all the features of standardized formulas, as described in the previous section. In particular, you will see the following differences:

1. **Instructions for preparation.** In most cases, formulas in this book follow a discussion of a basic procedure. The formulas are examples of the general procedure, to give you experience in applying what you have learned. The information you are given in the formula instructions is intended primarily to encourage you to think and to learn a technique, not just to turn out a product. You should consult your instructor when you have a question about a procedure.

2. **Variations and optional ingredients.** Many formulas are followed by variations. These are actually whole formulas given in abbreviated terms. It is possible to write them out as separate, full-length formulas. (You are encouraged to do this before preparing a variation, as a learning experience.)

   Giving formulas as variations rather than as separate formulas helps you to see the patterns behind each. Again, you are learning techniques, not just formulas. You develop greater understanding of what you are doing when you see, for example, coconut cream pie and chocolate pudding as variations of the same basic techniques rather than as separate, unrelated formulas.

   Your instructors may have their own variations, or they may wish to make changes in the basic formulas in order to teach you certain points. Unlike standardized formulas, instructional formulas are not engraved in stone.

Reading Formulas and Recipes

Before starting production, you must read the entire recipe carefully and completely. The following are some of the tasks you must carry out as you read the recipe and get ready for production. Chefs call these advance preparations their *mise en place* (MEEZE on plahss; French for "put in place"). A good mise en place is essential for efficient operation of a bakeshop or kitchen.

Formula Modifications

- Determine the yield of the printed recipe and decide whether it needs modification. If you need to convert the recipe to a different yield (discussed later in this chapter), do all the math beforehand.
- Determine whether any other changes are needed, such as ingredient substitutions, to get the desired result. Write them down.

Ingredients

- Assemble and measure all ingredients. If all ingredients are scaled in advance, production can go quickly and without interruption. Also, it's better to find out in advance that you don't have enough of an ingredient so you can get more before starting production.
- Prepare all ingredients as necessary, such as sifting flour, separating eggs, and bringing butter to room temperature. Many of these steps are indicated in the recipe, but others may not be. Professional formulas often assume that the experienced baker knows, for example, that butter should be removed from the refrigerator in advance so it is soft enough to be used in creaming-method cake batters.

Procedures

- Read the entire procedure or method of preparation carefully, and make sure you understand it.
- If a mixing method is indicated only by name, such as creaming method, look up and

review the procedure if you need to refresh your memory. Make sure you understand each step of the general procedure and how to apply it to your specific formula.

- Look up any terms or key words you don't know.

Tools and Equipment

- Determine what equipment you need. Required equipment is generally listed in standardized recipes but not in those from other sources. Read every step of the procedure and write down which tools and equipment you need in each step.
- Assemble all tools and equipment.
- Prepare equipment as needed. For example, line sheet pans with parchment, grease cake pans, preheat ovens.

KEY POINTS TO REVIEW

- Is this statement true?: "If you have a good formula, you don't need to know how to bake, because the formula tells you what to do." Explain.
- What are standardized recipes? How are they used?

Measurement

One of the primary functions of a formula is to indicate the ingredients and their correct quantities or measurements to be used to make a product.

Ingredients are almost always weighed in the bakeshop, rather than measured by volume, because measurement by weight is more accurate. (There are some exceptions, noted below.) Accuracy of measurement, as we have said, is essential in the bakeshop. Unlike home baking recipes, a professional baker's formula will not call for 6 cups flour, for example.

To demonstrate to yourself the importance of weighing rather than measuring by volume, measure 1 cup flour in two ways: (a) Sift some flour and lightly spoon it into a dry measure. Level the top and weigh the flour. (b) Scoop some unsifted flour into the same measure and pack it lightly. Level the top and weigh the flour. Note the difference. No wonder home recipes, which usually indicate volume measures of dry ingredients, can be so inconsistent!

The baker's term for weighing ingredients is *scaling*.

The following ingredients, and *only* these ingredients, may sometimes be measured by volume, at the ratio of 1 pint per pound or 1 liter per kilogram:

- Water
- Milk
- Eggs

Volume measure is often used when scaling water for small or medium-sized batches of bread. Results are generally good. However, whenever accuracy is critical, it is better to weigh. This is because 1 pint water actually weighs slightly more than 1 pound, or approximately 16.7 ounces. (This figure varies with the temperature of the water.)

For convenience, volume measures of liquids are frequently used when products other than baked flour goods—such as sauces, syrups, puddings, and custards—are being made.

Units of Measure

The system of measurement used in the United States is complicated. Even people who have used it all their lives sometimes have trouble remembering factors such as how many fluid ounces are in a quart and how many feet are in a mile.

The Units of Measure: U.S. System table lists equivalents among the units of measure used in the bakeshop and kitchen. You should memorize these now so you don't lose time in the future making simple calculations. The Abbreviations for U.S. Units of Measure Used in This Book table lists those used in this book.

UNITS OF MEASURE: U.S. SYSTEM

WEIGHT		
1 lb	=	16 oz
VOLUME		
1 gal	=	4 qt
1 qt	=	2 pt *or* 4 cups *or* 32 (fl) oz*
1 pt	=	2 cups *or* 16 (fl) oz
1 cup	=	8 (fl) oz
1 fl oz	=	2 tbsp
1 tbsp	=	3 tsp
LENGTH		
1 ft	=	12 in.

*NOTE: One fluid ounce (fl oz)—often simply called ounce—of water weighs 1 ounce. One pint of water weighs approximately 1 pound.

ABBREVIATIONS FOR U.S. UNITS OF MEASURE USED IN THIS BOOK

Pound	lb
Ounce	oz
Gallon	gal
Quart	qt
Pint	pt
Fluid ounce	fl oz
Tablespoon	tbsp
Teaspoon	tsp
Inch	in.
Foot	ft

The Metric System

The United States is the only major country that uses the complex system of measurement we have just described. Other countries use a much simpler system called the *metric system*, detailed here.

BASIC UNITS

In the metric system, there is one basic unit for each type of measurement:

The *gram* is the basic unit of weight.

The *liter* is the basic unit of volume.

The *meter* is the basic unit of length.

The *degree Celsius* is the basic unit of temperature.

Larger or smaller units are made simply, by multiplying or dividing by 10, 100, 1000, and so on. These divisions are expressed by prefixes. The ones you need to know are:

kilo- = 1000

deci- = 1⁄10, or 0.1

centi- = 1⁄100, or 0.01

milli- = 1⁄1000, or 0.001

Once you learn these basic units, you will not need complicated tables such as the first one on page 19. The Metric Units table summarizes the metric units you need to know in the bakeshop.

CONVERTING TO METRIC

Most Americans think the metric system is much harder to learn than it really is. This is because they think about metric units in terms of U.S. units. They read, for example, that there are 28.35 grams in 1 ounce and are immediately convinced they will never be able to learn metrics.

Most of the time, you will not need to worry about converting U.S. units into metric units, and vice versa. This is a very important point to remember, especially if you think the metric system might be hard to learn. The reason is simple: You will usually be working in either one

METRIC UNITS

BASIC UNITS		
Quantity	**Unit**	**Abbreviation**
Weight	Gram	g
Volume	Liter	L
Length	Meter	m
Temperature	degree Celsius	°C
DIVISIONS AND MULTIPLES		
Prefix/Example	**Meaning**	**Abbreviation**
kilo-	1000	k
Kilogram	1000 grams	kg
deci-	1⁄10	d
Deciliter	0.1 liter	dL
centi-	1⁄100	c
Centimeter	0.01 meter	cm
milli-	1⁄1000	m
Millimeter	0.001 meter	mm

system or the other, and you will rarely have to convert from one to the other. Many people today own imported cars and repair them with metric tools without worrying about how many millimeters are in 1 inch. Occasionally, you might find a metric formula you want to try in a U.S. kitchen. Even then, much modern equipment, such as digital scales, measures in both metric and U.S. units, so conversion isn't needed. When it is necessary to convert, you can refer to a table such as the one in Appendix 2, Metric Conversion Factors, without having to memorize exact conversion factors. For most purposes, all you have to remember is the information in the table on this page.

To become accustomed to working in metric units, it is helpful to have a feel for how large the units are. Use the following rough equivalents to help you visualize metric units. These are *not* exact conversion factors; when you need exact conversion factors, see Appendix 2.

A *kilogram* is slightly more than 2 pounds.

A *gram* is about 1/30 ounce. A half-teaspoon of flour weighs a little less than 1 gram.

A *liter* is slightly more than 1 quart.

A *deciliter* is slightly less than ½ cup.

A *centiliter* is about 2 teaspoons.

A *meter* is slightly longer than 3 feet.

A *centimeter* is about ⅜ inch.

0°C is the freezing point of water (32°F).

100°C is the boiling point of water (212°F).

An increase or decrease of 1 degree Celsius is equivalent to about 2 degrees Fahrenheit.

METRIC FORMULAS AND RECIPES

American industry will probably adopt the metric system someday. Many recipe writers are getting a head start by including metric equivalents. As a result, you will see recipes calling for, for example: 454 g flour, 28.35 g butter, or a baking temperature of 191°C. No wonder some people are afraid of the metric system!

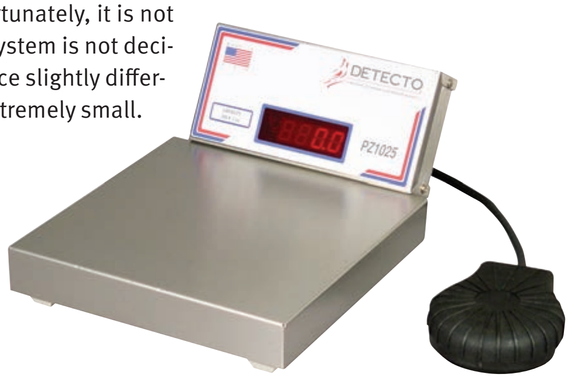
Kitchens in countries that use the metric system do not work with such impractical numbers any more than we normally use figures like 1 lb 1¼ oz flour, 2.19 oz butter, or a baking temperature of 348°F. That would defeat the purpose of the metric system, which is to be simple and practical. If you have a chance to look at a French cookbook, you will see nice, round numbers such as 1 kg, 200 g, and 4 dL.

The metric measures in the formulas in this book are NOT equivalent to the U.S. measures given alongside them. When working with a formula, do not measure some ingredients in ounces and others in grams. You should think of the metric portion of the formulas as separate formulas with yields that are close to but not the same as the yields of the U.S. formulas. To give exact equivalents would require using awkward, impractical numbers. If you have metric equipment, use the metric units; if you have U.S. equipment, use the U.S. units. As noted earlier, rarely should you have to worry about converting between the two.

For the most part, the total yield of the metric formulas in this book is *close* to the yield of the U.S. formulas, while keeping the ingredient proportions the same. Unfortunately, it is not always possible to keep the proportions exactly the same because the U.S. system is not decimal-based like the metric system. In some cases, the metric quantities produce slightly different results due to the varying proportions, but these differences are usually extremely small.

Measuring by Weight

A good balance scale should be accurate to ¼ oz (0.25 oz) or, if metric, to 5 g. Dry ingredients weighing less than ¼ oz can be scaled by physically dividing larger quantities into equal portions. For example, to scale 1/16 oz (0.06 oz), first weigh out ¼ oz, then divide this into four equal piles using a small knife.



Digital professional scale.

Courtesy of Cardinal Detecto.

For fine pastry work, a small battery-operated digital scale is often more useful than a large balance scale. A good digital scale is relatively inexpensive. It can instantly measure quantities to the nearest ⅛ oz or the nearest 2 g. Even more sensitive scales are available at a

SCONE FLOUR

British bakers have a convenient method for measuring baking powder when small quantities are needed. They use a mixture called *scone flour*. To make 1 lb scone flour, combine 15 oz flour and 1 oz baking powder; sift together three times. One oz (1/16 lb) scone flour thus contains 1/16 (0.06 oz) baking powder. For each 1/16 oz baking powder you need in a formula, substitute 1 oz scone flour for 1 oz of the flour called for in the formula.

somewhat higher price. Most digital scales have a zero, or *tare*, button that sets the indicated weight to zero. For example, you may set a container on the scale, set the weight to zero, add the desired quantity of the first ingredient, again set the weight to zero, add the second ingredient, and so on. This speeds the weighing of dry ingredients to be sifted together, for example. Be careful, however, when using this method, as opposed to weighing ingredients one at a time. If you add too much of one ingredient, you will likely have to discard the whole mixture and start again.

When very small quantities of items such as spices are required in formulas in this book, an approximate volume equivalent (usually in fractions of a teaspoon) is also included. However, remember that careful weighing on a good scale is more accurate. Approximate volume equivalents of selected ingredients are given in Appendix 4.

To make formula conversions and calculations easier, fractions of ounces that appear in the ingredient tables of the formulas in this book are written as decimals. Thus, 1½ oz is written as 1.5 oz, and ¼ oz is written as 0.25 oz. A list of decimal equivalents is included in Appendix 3.

AP Weight and EP Weight

In the hot kitchen, cooks are regularly concerned with the trimming yield of vegetables, fruits, meats, and other ingredients. For example, 1 lb raw, whole turnips yields much less than 1 lb trimmed, peeled turnips. In the bakeshop, bakers need not be concerned with trimming yield of the ingredients they use most: flour, sugar, fats, and so on. However, it is important to be able to make the proper yield calculations when working with fresh fruits. How many pounds of whole apples must the baker order, for example, if 5 lb peeled, sliced apples are needed?

The percentage yield of a fruit or vegetable indicates, on the average, how much of the *AP weight* (as purchased weight) is left after trimming to produce the ready-to-cook item, or *EP weight* (edible portion weight).

PROCEDURE: Using a Baker's Balance Scale

The principle of using a baker's scale is simple: The scale must balance before setting the weights, and it must balance again after scaling. The following procedure applies to the most commonly used type of baker's scale.

1. Set the scale scoop or other container on the left side of the scale.
2. Balance the scale by placing counterweights on the right side and/or by adjusting the ounce weight on the horizontal bar.
3. Set the scale for the desired weight by placing weights on the right side and/or by moving the ounce weight.

   For example, to set the scale for 1 lb 8 oz, place a 1-lb weight on the right side and move the ounce weight to the right 8 oz. If the ounce weight is already over 8 oz, so you cannot move it another 8, add 2 lb to the right side of the scale and subtract 8 ounces by moving the ounce weight 8 places to the left. The result is still 1 lb 8 oz.
4. Add the ingredient being scaled to the left side until the scale balances.

Courtesy of Cardinal Detecto.

To determine the percentage yield of a fruit, follow these steps:

1. Weigh the item before trimming. This is the AP weight.
2. Trim and peel the item as necessary to get the edible portion.
3. Weigh the trimmed item. This is the EP weight.
4. Divide the EP weight by the AP weight. For example,

$$5 \text{ lb trimmed (EP)} \div 10 \text{ lb before trimming (AP)} = 0.5.$$

5. Multiply this number by 100 to get the percentage. For example,

$$0.5 \times 100 = 50\%.$$

The most accurate yield percentages are the ones you calculate yourself, because they are based on the items you actually use in your bakeshop. For approximate or average yield percentages of most commonly used fruits, refer to the section on fruits in Chapter 22, page 578.

Once you have a yield percentage for an item, save this number to refer to as necessary. You can use this figure to do two basic calculations.

1. **Calculating yield.** Example: You have 10 lb AP apples. Yield after trimming is 75%. What will the EP weight be?
   a. First, change the percentage to a decimal number by moving the decimal point two places to the left.

   $$75\% = 0.75$$

   b. Multiply the decimal by the AP weight to get EP yield.

   $$10 \text{ lb} \times 0.75 = 7\tfrac{1}{2} \text{ lb or } 7 \text{ lb } 8 \text{ oz}$$

2. **Calculating amount needed.** Example: You need 10 lb EP apple slices. What amount of untrimmed fruit do you need?
   a. Change the percentage to a decimal number.

   $$75\% = 0.75$$

   b. Divide the EP weight needed by this number to get the AP weight.

   $$\frac{10 \text{ lb}}{0.75} = 13.33 \text{ lb or } 13 \text{ lb } 5\tfrac{1}{3} \text{ oz}$$

KEY POINTS TO REVIEW

- How are most formula ingredients measured?
- In the metric system, what are the units of measure for weight, volume, and length?
- What are the steps in the procedure for using a baker's balance scale?
- What are AP quantities and EP quantities? Explain how to perform yield calculations.

Baker's Percentages

The most important information conveyed by a baker's formula is the *ratios* of the ingredients to each other. For example, if you know a particular bread dough requires exactly two-thirds as much water as flour, you can always determine the exact amount of water to add to the flour, whether you are making a large or a small quantity. *Ratios are the simplest and most basic way of expressing a formula.*

Bakers use a simple but versatile system of percentages for expressing their formulas. *Baker's percentages* indicate the amount of each ingredient used as a percentage of the amount of flour used. Flour is used as the basis of baker's percentages because it is the main ingredient in nearly all baked goods.

PERCENT

A little math review may be in order. What does *percent* mean?

The word percent literally means "per hundred." 100%, then, could also be written 100⁄100. Similarly, 10%, for example, is the same as 10⁄100. This same fraction, written in decimals, is 0.1.

Whenever you need to work with a percentage in a math problem, you must first change it to a fraction, as we did above. To do this, simply move the decimal point two places to the left. For example

15% = 0.15

80% = 0.80 or, more simply, 0.8

100% = 1.00

150% = 1.5

To put it differently, the percentage of each ingredient is its total weight divided by the weight of the flour, multiplied by 100%, or:

$$\frac{\text{total weight of ingredient}}{\text{total weight of flour}} \times 100\% = \%\text{ of ingredient}$$

Thus, flour is always 100%. If two kinds of flour are used, their total is 100%. Any ingredient that weighs the same as the amount of flour used is also given as 100%. The cake formula ingredients listed on page 26 illustrate how these percentages are used. Check the figures with the above equation to make sure you understand them.

Please remember these numbers do not refer to the percentage of the total yield. They are simply a way of expressing *ingredient proportions.* The total yield of these percentage numbers will always be greater than 100%.

Baker's percentages make it easy to see at a glance the ingredient ratios and, therefore, the basic structure and composition of the dough or batter. In addition, they make it easy to adapt the formula for any yield, as you will see in a later section. A third advantage is that single ingredients may be varied, and other ingredients added, without changing the whole formulation. For example, you can add raisins to a muffin mix formula while keeping the percentages of all the other ingredients the same.

Using baker's percentages is the most basic way of expressing a formula, so they are also a useful tool for developing new formulas. When devising a new formula, a baker thinks about the best ratio of ingredients, as indicated by percentages. Once the proper ratios are established, the baker can then translate them into weights, so that the formula can be tested. Most of the formulas in this book were devised this way.

Clearly, a percentage system based on the weight of flour can be used only when flour is a major ingredient, as in breads, cakes, and cookies. However, the principle can be used in other formulas, as well by selecting a major ingredient and establishing it as 100%. Many bakers use the percentage system for flour goods only (doughs and batters), but it is helpful to extend the benefits of this system to other products. In this book, *whenever an ingredient other than flour is used as the base of 100%, this is indicated at the top of the formula above the percentage column.* See, for example, the formulas for Almond Filling on page 199. These recipes indicate "almond paste at 100%," and the weights of the sugar, eggs, and other ingredients are expressed as percentages of the weight of the almond paste. (In some formulas in this book, especially those without a predominant ingredient, percentages are not included.)

Formula Yields

Yields for the formulas in this book are indicated in one of two ways. In most cases, the yields are given as a total of the ingredient quantities. For example, in the sample formula on page 26, the yield tells us how much cake batter the formula makes. This is the figure we need to know for the purpose of scaling the batter into pans. The actual weight of the baked cake will vary, depending on pan size and shape, oven temperature, and so on.

Other formulas of this type, in which the yield is the total weight of the ingredients, include formulas for bread doughs, coffee cake fillings, pastry doughs, and cookie doughs.

In some formulas, however, the yield is not the same as the total weight of ingredients. For example, see the recipe for French Buttercream, page 425. When sugar and water are boiled to make a syrup, about half the water evaporates. Thus, the actual yield is less than the total weight of the ingredients.

In this book, when the yield is not the same as the total weight of the ingredients, the yield is indicated *above* the ingredients list rather than below it.

Also, please note that all yields, including percentage totals, are rounded off to the next lower whole number. This eliminates insignificant fractions and makes reading easier.

Basic Formula and Recipe Conversion

Unless you are working in an operation that uses only its own standardized formulas, you frequently will be required to convert formulas to different quantities. For example, you may have a formula for 20 lb dough but need only 8 lb.

Knowing how to convert formulas and recipes is an important skill. You will no doubt need to use it many times, not only in this book but also during your career.

There is no “best” yield to write recipes for, as every operation, every school, and every individual has different needs. This section explains two methods for converting recipe yields. The first, using a conversion factor, can be applied to nearly all recipes, not just those for baking. The second method uses baker’s percentages and is appropriate for most of the formulas in this book.

CONVERSION CALCULATIONS USING CONVERSION FACTORS

Nearly everyone can, instinctively, double a formula or cut it in half. It seems more complicated, though, to change a formula from, say, 10 to 18 kg, say, or from 20 to 12 qt. Actually, the principle is exactly the same: You multiply each ingredient by a number called a *conversion factor*, as in the procedure given here.

The procedure is a general one. It is also used for recipes in the hot kitchen.

CONVERSION CALCULATIONS USING PERCENTAGES

Using baker’s percentages simplifies formula and ingredient calculations. The two procedures that follow are used regularly in the bakeshop.

PROCEDURE: Calculating Conversion Factors

There is only one step in this procedure:

1. Divide the desired yield by the yield stated on the recipe. This formula may be written like a mathematical calculation, as on a calculator, or as a fraction:

$$\text{Mathematical Calculation: New yield} \div \text{Old yield} = \text{Conversion factor}$$

$$\text{Fraction: } \frac{\text{New yield}}{\text{Old yield}} = \text{Conversion factor}$$

Example 1: You have a recipe with a yield of 8 portions and you want to make 18 portions.

$$18 \div 8 = 2.25$$

Your conversion factor is 2.25. If you multiply each ingredient in your recipe by 2.25, you will prepare 18 portions, not the 8 of the original recipe.

Example 2: You have a recipe that makes 4 liters of sauce, and you want to make 1 liter.

$$1 \div 4 = 0.25$$

Your conversion factor is 0.25. That is, if you multiply each ingredient by 0.25, you will prepare only 1 liter.

Notice in the second example the conversion factor is a number less than 1. This is because the recipe yield is decreased. You are making the recipe smaller. This is a good way to check your math. Decreasing the recipe yield will involve a conversion factor less than 1. Increasing the yield of a recipe will involve a conversion factor larger than 1.

PROCEDURE: Calculating the Weight of an Ingredient When the Weight of Flour Is Known

1. Change the ingredient percentage to decimal form by moving the decimal point two places to the left.
2. Multiply the weight of the flour by this decimal figure to get the weight of the ingredient.

   Example: A formula calls for 20% sugar and you are using 10 lb flour. How much sugar do you need?

   $$20\% = 0.20$$
   $$10 \text{ lb} \times 0.20 = 2 \text{ lb sugar}$$

   Note: In the U.S. system, weights normally must be expressed all in one unit, either ounces or pounds, in order for the calculations to work. Unless quantities are very large, it is usually easiest to express weights in ounces.

Example (U.S.): Determine 50% of 1 lb 8 oz.

$$1 \text{ lb } 8 \text{ oz} = 24 \text{ oz}$$
$$0.50 \times 24 \text{ oz} = 12 \text{ oz}$$

Example (metric): A formula calls for 20% sugar and you are using 5000 g (5 kg) flour. How much sugar do you need?

$$20\% = 0.20$$
$$5000 \text{ g} \times 0.20 = 1000 \text{ g sugar}$$

PROCEDURE: Converting a Formula to a New Yield

1. Change the total percentage of the formula to a decimal form by moving the decimal point two places to the left.
2. Divide the desired yield by this decimal figure to get the weight of flour needed.
3. If necessary, round off this number to the next highest figure. This will allow for losses in mixing, makeup, and panning, and it will make calculations easier.
4. Use the weight of flour and remaining ingredient percentages to calculate the weights of the other ingredients, as in the previous procedure.

Example: In the sample cake formula in the table below, how much flour is needed if you require 6 lb (or 3000 g) cake batter?

$$377.5\% = 3.775$$
$$6 \text{ lb} = 96 \text{ oz}$$

$$96 \text{ oz}/3.775 = 25.43 \text{ oz; or, rounded off, } 26 \text{ oz } (1 \text{ lb } 10 \text{ oz})$$
$$3000 \text{ g}/3.775 = 794.7 \text{ g; or, rounded off, } 800 \text{ g}$$

INGREDIENTS	U.S. WEIGHT	METRIC WEIGHT	%
Cake flour	5 lb	2500 g	100
Sugar	5 lb	2500 g	100
Baking powder	14 oz	125 g	5
Salt	12 oz	63 g	2.5
Emulsified shortening	2 lb 18 oz	1250 g	50
Skim milk	3 lb	1500 g	60
Egg whites	3 lb	1500 g	60
Total weight:	***18 lb 14 oz***	***9438 g***	***377.5%***

Problems in Converting Formulas

For the most part, converting baking formulas to different yields works well. As long as ingredient ratios stay the same, you are making the same dough or batter. But when you make very large conversions—say, from 2 lb dough to 100 lb—you may encounter problems. In general, the major pitfalls are in one of the following categories.

SURFACE AND VOLUME

If you have studied geometry, you may remember that a cube with a volume of 1 cubic foot has a top surface area of 1 square foot. But if you double the volume of the cube, the top surface area is not doubled but is in fact only about 1½ times as large.

What in the world, you ask, does this have to do with cooking? Consider the following example.

Suppose you have a good recipe for ½ gallon of dessert sauce, which you normally make in a small saucepan. But now you want to make 16 gallons of sauce, so you multiply all ingredients by a conversion factor of 32 and make the sauce in a steam kettle. To your surprise, not only do you end up with more sauce than you expected, but it turns out rather thin and watery. What happened?

Your converted recipe has 32 times as much volume to start, but the amount of surface area has not increased nearly as much. Because the ratio of surface area to volume is less, evaporation is less. This means less reduction and less thickening occur, and the flavors are not as concentrated. To correct this problem, you would have to either simmer the sauce longer or use less liquid.

The surface/volume problem shows up in the difference between making a single loaf of bread at home and making a large quantity of bread in the bakery. The home bread baker uses warm water to make a bread dough, and must find a way to keep the dough warm enough so it ferments properly. The ratio of surface area to volume in a small amount of dough is so high the dough cools quickly. The commercial baker, in contrast, often uses ice water when making bread dough to ensure the dough doesn't become too warm (see p. 122). The ratio of surface to volume is low, and the dough retains the heat generated by mixing.

When making large adjustments in formula yields, you must also determine whether adjustments in procedure or ingredient percentages are needed.

EQUIPMENT

When you change the size of a formula, you must often use different equipment, too. This often means the recipe does not work in the same way. Bakers and cooks must be able to use their judgment to anticipate these problems and modify their procedures to avoid them. The example just given, of cooking a large batch of dessert sauce in a steam kettle, is among the kinds of problems that can arise when you change cooking utensils.

Other problems may arise because of mixers or other processing equipment. For example, if you break down a dough formula to make only a small quantity, you might find there is so little dough in the mixing machine that the beaters don't blend the ingredients properly.

Or you might have a recipe for a muffin batter you usually make in small quantities, mixing the batter by hand. When you increase the recipe greatly, you find you have too much to do by hand. Therefore, you use a mixer but keep the mixing time the same. Because the mixer does the job so efficiently, you overmix the batter and end up with poor-quality muffins.

Many mixing and stirring jobs can be done only by hand. This is easy with small quantities but difficult with large batches. The result is often an inferior product. On the other hand, some handmade products are better when they are produced in large batches. It is hard, for example, to make a small batch of puff pastry because the dough cannot be rolled and folded properly.

Selection of Ingredients

In addition to measuring, there is another basic rule of accuracy in the bakeshop: Use the exact ingredients specified.

As you will learn in Chapter 4, different flours, shortenings, and other ingredients do not function alike. Baker's formulas are balanced for specific ingredients. For example, do not substitute bread flour for pastry flour or regular shortening for emulsified shortening. They won't work the same way.

Occasionally, a substitution may be made, such as instant dry yeast for fresh yeast (see p. 80), but not without adjusting the quantities and rebalancing the formula.

Cost Calculations

Food service operations are businesses. Chefs and bakers must be aware of the basics of food cost calculations, even if they aren't responsible for the management of budgets, invoices, and expenses. This section discusses the most basic calculations.

Ingredient Unit Costs

The first simple calculation you need for all further calculations is for ***unit cost.*** Often, the purveyor's invoice indicates unit cost; for example, 10 lb apricots at $2.00 per pound, totaling $20.00 (10 × $2.00 = $20.00). In other cases, you must make this calculation, using the following formula:

Total cost ÷ Number of units = Unit cost

Example 1: A case of mangoes weighing 15 lb costs $25.00. What is the cost per pound?

$25.00 ÷ 15 lb = $1.67 per lb

Example 2: A 45-kg sack of patent flour costs $20.00. What is the cost per kilogram?

$20.00 ÷ 45 kg = $0.45 per kg (rounded up)

EP Unit Costs

Calculation of AP and EP quantities, as discussed on pages 22–23, is necessary not only for determining quantities needed for preparing formulas and recipes but also for determining costs. After all, when you buy fresh fruit by weight, for example, you are paying for the entire fruit, even if you discard peels, cores, and pits.

In the first example above, you determined that you are paying $1.67 per AP pound of mangoes. But you discard the peel and pit, so the cost per EP pound is greater than $1.67. You use the following formula to calculate the yield cost, or EP unit cost:

AP unit cost ÷ Yield percentage = EP unit cost

Using a yield percentage of 75% (see p. 23), you can calculate the cost of our peeled, pitted mangoes using this formula. First you convert the percentage to a decimal by moving the decimal point two places to the left:

75% = 0.75

$1.67 ÷ 0.75 = $2.23 per EP lb

Formula Costs

To determine the cost of preparing a formula or recipe, you first determine the cost of each ingredient. Then you add the costs of all the ingredients to get the total cost of the formula.

When you have calculated the total cost, you can then determine the unit cost of the finished product. Units may be any measure you require: per ounce, per kilogram, or per serving portion (portion cost).

For the most accurate costing, you should determine the number of units actually sold, rather than the unit yield of the formula. Keep in mind that ingredients or product lost through spillage or other waste must still be accounted and paid for. Using units sold or served accounts for these costs.

The general procedure on page 29 explains the basic steps in calculating formula cost.

PROCEDURE: Calculating Formula Costs

1. List all ingredients and quantities of the formula as prepared.
2. Determine the EP unit cost of each ingredient (see p. 28).
3. Convert the quantities in the formula to the same units used for the EP costs. (For example, to convert ounces to pounds, divide by 16, as in the example below.)
4. Calculate the total cost of each ingredient by multiplying the EP unit cost by the number of units needed. Round up fractions of a cent to the next highest cent.
5. Add the ingredient costs to get the total formula cost.
6. To get unit costs, divide the total formula cost by the number of units produced (or, for better accuracy, the number of units actually sold, as explained in the text). Round up fractions of a cent to the next highest cent.

EXAMPLE: COSTING A FORMULA ITEM: BISCUIT DOUGH

Ingredients (Step 1)	Amount	Amount in Converted Units (Step 3)	EP Unit Cost (Step 2)	Total (Step 4)
Bread flour	1 lb 4 oz	1.25 lb	$0.40/lb	$0.50
Pastry flour	1 lb 4 oz	1.25 lb	$0.38/lb	$0.48
Salt	0.75 oz	0.05 lb	$0.48/lb	$0.03
Sugar	2 oz	0.125 lb	$0.55/lb	$0.07
Baking powder	2.5 oz	2.5 oz	$0.18/oz	$0.45
Butter	14 oz	0.875 lb	$2.80/lb	$2.45
Whole milk	1 lb 10 oz	1.625 lb	$0.40/lb	$0.65

Total cost (Step 5)	$4.63

Quantity produced (Step 6)	5.3 lb or 85 oz
Cost per unit	$0.88 per lb or $0.06 per oz

KEY POINTS TO REVIEW

- What are baker's percentages?
- Using baker's percentages, what is the procedure for calculating the weight of an ingredient when the weight of flour is known?
- Using baker's percentages, what is the procedure for converting a formula to a new yield?
- What is the procedure for calculating formula costs?

FOOD SAFETY AND SANITATION

IN CHAPTER 1 we discussed some of the requirements for success in the food service industry, including professional pride. One of the most important ways of demonstrating professional pride is in the area of sanitation and safety. Pride in quality also is reflected in your personal appearance and work habits. Poor hygiene, grooming, and personal care, and sloppy work habits are nothing to be proud of.

In addition, poor sanitation can cost a lot of money. Poor food-handling procedures and unclean kitchens cause illness and unhappy customers, and may even result in fines, summonses, and lawsuits. Food spoilage raises food costs. Finally, poor sanitation and safety habits show lack of respect for your customers, your fellow workers, and yourself.

This section briefly outlines the guidelines for food safety and sanitation in the bakeshop, presenting enough information to build basic awareness. Be aware, however, that entire books and courses of study are devoted to food safety and sanitation. Consult the bibliography at the end of this book to find sources of more detailed information on these important subjects.

Food Hazards

Preventing foodborne illness is one of the most critical challenges facing every food service worker. To prevent illness, a food worker must begin by recognizing and understanding the sources of foodborne disease.

Most foodborne illness is the result of eating food that has been *contaminated*. To say that a food is contaminated means it contains harmful substances that were not present originally in the food. In other words, contaminated food is food that is not pure.

We begin this section by discussing the substances that can contaminate food and cause illness. Next, we consider how these substances get into food to contaminate it and how food workers can prevent contamination and avoid serving contaminated food.

Any substance in food that can cause illness or injury is called a *hazard*. Food hazards are of three types:

1. Biological
2. Chemical
3. Physical

Biological Hazards

The most important kinds of biological hazard to consider are microorganisms. A *microorganism* is a tiny, usually single-celled organism that can be seen only with a microscope. A microorganism that can cause disease is called a *pathogen*. Although these organisms sometimes occur in clusters large enough to be seen with the naked eye, they are not usually visible. This is one reason why they can be so dangerous. Just because food looks good doesn't mean it is safe.

Four kinds of microorganisms can contaminate food and cause illness: ***bacteria, viruses, fungi,*** and ***parasites***. Most foodborne diseases are caused by bacteria, and these are the pathogens we focus on here. Many of the measures we take to protect food from bacteria also help prevent the other three kinds of microorganisms.

BACTERIAL GROWTH

Bacteria multiply by splitting in half, repeatedly. Under ideal conditions for growth, they can double in number every 15 to 30 minutes. This means a single bacterium can multiply to 1 million in less than 6 hours! The following conditions are needed for bacterial growth:

1. **Food.** Bacteria require food in order to grow. They like many of the same foods we do. Foods with sufficient amounts of protein are best for bacterial growth. These include meats, poultry, fish, dairy products, and eggs, as well as some grains and vegetables.
2. **Moisture.** Bacteria require water in order to absorb food. Dry foods do not support bacterial growth. Foods with a very high salt or sugar content are also relatively safe, because these ingredients make the bacteria unable to use the moisture present.

3. **Temperature.** Bacteria grow best at warm temperatures. Those between 41°F (5°C) and 135°F (57°C) promote the growth of disease-causing bacteria. This temperature range is called the *Food Danger Zone*.
4. **Acidity or alkalinity.** In general, disease-producing bacteria thrive in a neutral environment, neither too acidic nor too alkaline. The acidity or alkalinity of a substance is indicated by a measurement called *pH*. The scale ranges from 0 (strongly acidic) to 14 (strongly alkaline). A pH of 7 is neutral. Pure water has a pH of 7.
5. **Oxygen.** Some bacteria require oxygen to grow. These are called *aerobic*. Other bacteria are *anaerobic*, which means they can grow only if no air is present, such as in metal cans. Botulism, one of the most dangerous forms of food poisoning, is caused by anaerobic bacteria. A third category of bacteria can grow either with oxygen or without it. These bacteria are called *facultative*. Most bacteria in food that cause disease are facultative.
6. **Time.** When bacteria are introduced to a new environment, they need time to adjust to their surroundings before they start growing. This time is called the *lag phase*. If other conditions are good, the lag phase may last about an hour or somewhat longer.

   If it weren't for the lag phase, foodborne disease would be much more common than it is. This time delay makes it possible to maintain foods at room temperature *for very short periods* in order to work on them.

PROTECTION AGAINST BACTERIA

Because we know how and why bacteria grow, we should be able to keep them from multiplying. Likewise, because we know how bacteria get from place to place, we should know how to prevent them from getting into our food.

There are three basic principles of protecting food against bacteria. These principles are the reasons behind nearly all the sanitation techniques we discuss in the rest of this chapter.

1. **Keep bacteria from spreading.** Don't let food touch anything that may contain disease-producing bacteria, and protect food from bacteria in the air.
2. **Stop bacteria from growing.** Take away the conditions that encourage bacteria to grow. In the kitchen, our best weapon is temperature. *The most effective way to prevent bacterial growth is to keep foods below 41°F (5°C) or above 135°F (57°C).* These temperatures won't necessarily kill bacteria; they'll just slow down their growth greatly.
3. **Kill bacteria.** Most disease-causing bacteria die when they are subjected to a temperature of 170°F (77°C) for 30 seconds, or higher temperatures for shorter periods. This enables us to make food safe by cooking and to sanitize dishes and equipment with heat. The term *sanitize* means to kill disease-causing bacteria. Certain chemicals also kill bacteria. These may be used for sanitizing equipment.

OTHER BIOLOGICAL HAZARDS

Viruses are even smaller than bacteria. They consist of genetic material surrounded by a protein layer. Viruses cause disease when they multiply inside the body. They do not grow or multiply in food, as bacteria do. Therefore, foodborne viral diseases are usually caused by direct contact with contaminated people, food contact surfaces, or water.

Parasites are organisms that can survive only by living on, with, or inside another organism. They take their nourishment from the organism they are living in, with, or on. Human parasites are usually very small, but they are larger than bacteria. Most foods that can carry parasites are found in the hot kitchen rather than the bakeshop, although raw fruits and milk may be contaminated.

Molds and yeasts are examples of *fungi* (singular form: fungus). These organisms are usually associated with food spoilage rather than foodborne disease. Certain fungi, like bread yeasts, are valuable to us. Some molds, however, produce toxins that can cause disease. Peanuts, tree nuts, corn, and milk can carry a serious mold-produced toxin that can be fatal to some people.

Some plants are naturally poisonous because they carry *plant toxins*. The best-known plant toxins are those found in certain wild mushrooms. The only way to avoid plant toxins is to avoid the plants in which they occur, as well as products made with those plants. In some cases, the toxins can be transferred in milk from cows that have eaten the plant (such as jimsonweed and snakeroot) or in honey from bees that have gathered nectar from the plants (such as mountain laurel). Other toxic plants to avoid are rhubarb leaves, water hemlock, apricot kernels, and nightshade.

An *allergen* is a substance that causes an allergic reaction. Allergens affect only some people, and these people are said to be *allergic* to that specific substance. Not all allergens are biological hazards, but the most important ones are, so we discuss them together in this section.

Foods to which some people are allergic include wheat products, soy products, peanuts and tree nuts, eggs, milk and dairy products, fish, and shellfish. Nonbiological allergens include food additives such as nitrites, used in cured meats, and monosodium glutamate (MSG), often used in Asian foods. These products are common and perfectly safe for most people, so it is difficult to avoid serving them. Nevertheless, for the sake of people who are sensitive to these foods, food service personnel, especially dining room staff, must be well informed of the ingredients in all menu items so they can inform customers, as needed.

Chapter 27 includes more detailed information on eliminating not only allergens but also other food compounds that some people can't tolerate in their diets.

Chemical and Physical Hazards

Specific kinds of chemical poisoning are caused by the use of defective or improper equipment, or equipment that has been handled improperly. The following toxins (except lead) produce symptoms that appear quickly, usually within 30 minutes of eating poisoned food. By contrast, symptoms of lead poisoning can take years to appear. To prevent these diseases, do not use the materials that cause them.

1. **Antimony.** Caused by storing or cooking acid foods in chipped gray enamelware.
2. **Cadmium.** Caused by cadmium-plated ice-cube trays or containers.
3. **Cyanide.** Caused by silver polish containing cyanide.
4. **Lead.** Caused by lead water pipes, solder containing lead, or utensils containing lead.
5. **Copper.** Caused by unclean or corroded copper utensils, acid foods cooked in unlined copper utensils, or carbonated beverages that come in contact with copper tubing.
6. **Zinc.** Caused by cooking foods in zinc-plated (galvanized) utensils.

Other chemical contamination can result from exposure of foods to chemicals used in commercial food service establishments. Examples include cleaning compounds, polishing compounds, and insecticides. Prevent contamination by keeping these items physically separated from foods. Do not use them around food. Label all containers properly. Rinse cleaned equipment thoroughly.

Physical contamination is contamination of food by objects that may not be toxic but may cause injury or discomfort. Examples include pieces of glass from a broken container, metal shavings from an improperly opened can, stones from poorly sorted dried beans, soil from poorly washed fruits, insects or insect parts, and hair. Proper food handling is necessary to avoid physical contamination.

KEY POINTS TO REVIEW

- What are the six conditions necessary for bacterial growth?
- What are three ways to protect against bacteria?
- Besides bacteria, what other hazards can make foods unsafe?

Personal Hygiene and Safe Food Handling

Earlier in this section, we said that most foodborne disease is caused by bacteria. Now we expand that statement slightly to say that *most foodborne disease is caused by bacteria spread by food workers*.

Cross-Contamination

At the beginning of this section, we defined ***contamination*** as harmful substances not present originally in the food. Some contamination occurs before we accept delivery of food, which means that proper purchasing and receiving procedures are important parts of a sanitation program. But most food contamination occurs as a result of ***cross-contamination***, which may be defined as the transfer of hazardous substances, mainly microorganisms, to a food from other foods or surfaces, such as equipment, worktables, or hands.

Personal Hygiene

For the food worker, the first step in preventing foodborne disease is good personal hygiene. Even when we are healthy, we have bacteria all over our skin, in our nose and mouth, and in our eyebrows and eyelashes. Some of these bacteria, if given the chance to grow in food, will make people ill. To lower the chance of this occurring:

1. Do not work with food if you have any communicable disease or infection.
2. Bathe or shower daily.
3. Wear clean uniforms and aprons.
4. Keep hair neat and clean. Always wear a hat or hairnet.
5. Keep mustaches and beards trimmed and clean. Better yet, be clean-shaven.
6. Remove all jewelry: rings, low-hanging earrings, watches, bracelets. Avoid facial and/or body piercings; if you have them, don't touch them when you are at work.
7. Wash hands and exposed parts of arms before work and as often as necessary during work, including:
   - After eating, drinking, or smoking
   - After using the toilet
   - After touching or handling anything that may be contaminated with bacteria
8. Cover your mouth when you cough or sneeze, then wash your hands.
9. Keep your hands away from your face, eyes, hair, and arms while handling food.
10. Keep your fingernails clean and short. Do not wear nail polish.
11. Do not smoke or chew gum while on duty.
12. Cover cuts or sores with clean bandages.
13. Do not sit on worktables.

USE OF GLOVES

When used correctly, gloves can help protect foods against cross-contamination. When used incorrectly, they can spread contamination just as easily as bare hands. Health departments in some localities require the use of some kind of barrier between hands and foods that are ready to eat—that is, foods that will be served without further cooking. Gloves, tongs, and other serving implements, and bakery or deli tissue all can serve as barriers. To be sure to use gloves correctly, observe the following guidelines.

PROCEDURE: Washing Hands

1. Wet your hands with hot running water. Make the water as hot as you can comfortably stand, but at least 100°F (38°C).
2. Apply enough soap to make a good lather.
3. Rub hands together thoroughly for 20 seconds or longer, washing not only the hands but the wrists and the lower part of the forearms.
4. Using a nail brush, clean beneath the fingernails and between the fingers.
5. Rinse hands well under hot running water. If possible, use a clean paper towel to turn off the water to avoid contaminating the hands by contact with soiled faucets.
6. Dry hands with clean single-use paper towels or a warm-air hand dryer.

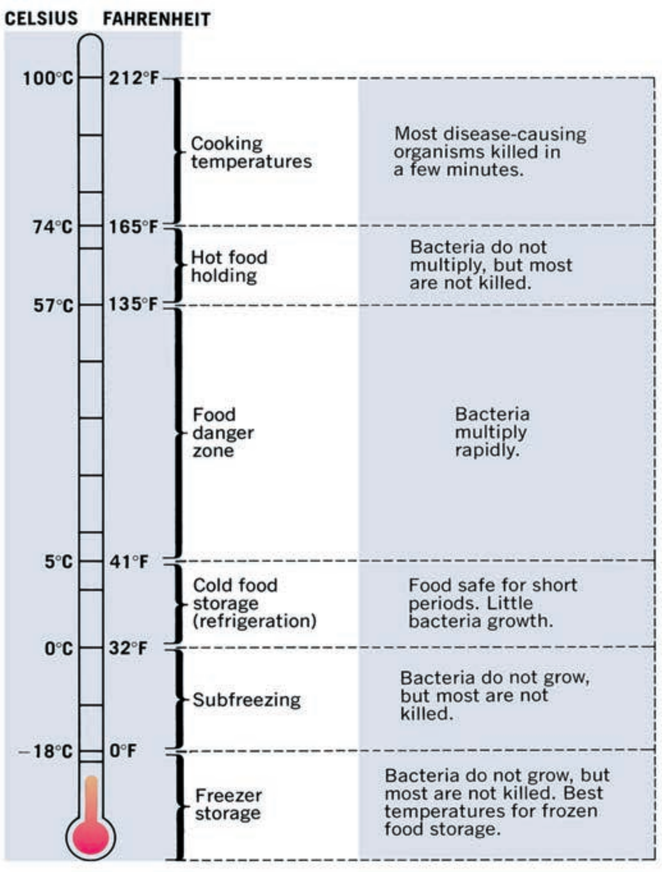
GUIDELINES: Using Disposable Gloves

1. Wash hands before putting on gloves or when changing to another pair. Gloves are not a substitute for proper handwashing.
2. Remove and discard gloves, wash hands, and change to a clean pair of gloves after handling one food item and before starting work on another. In particular, never to fail to change gloves after handling raw meat, poultry, or seafood. Gloves are for single use only. Remember that the purpose of wearing gloves is to avoid cross-contamination.
3. Change to a clean pair of gloves whenever gloves become torn, soiled, or contaminated by contact with an unsanitary surface.

Food Handling and Preparation

We face two major sanitation problems when handling and preparing food. The first is *cross-contamination*, just discussed. The second is that while we are working on food, it is usually at a temperature between 41°F (5°C) and 135°F (57°C), or in the Food Danger Zone. The lag phase of bacteria growth (p. 31) protects us a little, but to be safe, we must keep foods out of the danger zone whenever possible. Here's how:

1. Start with clean, wholesome foods from reputable purveyors. Whenever applicable, buy government-inspected dairy and egg products.
2. Handle foods as little as possible. Use tongs, spatulas, or other utensils instead of hands when practicable.
3. Use clean, sanitized equipment and worktables.
4. Clean and sanitize cutting surfaces and equipment after handling raw foods and before working on another food.
5. Clean as you go. Don't wait until the end of the workday.



Important temperatures in food sanitation and preparation.

6. Wash raw fruits thoroughly.
7. When bringing foods out of refrigeration, do not take out more than you can process in an hour.
8. Keep foods covered unless in immediate use.
9. Limit the time foods spend in the Food Danger Zone.
10. Taste foods properly. Using a ladle or other serving implement, transfer a small amount of the food to a small dish. Then taste this sample using a clean spoon. After tasting, do not use the dish and spoon again. Send them to the ware-washing station; or, if using disposables, discard them.
11. Don't mix leftovers with freshly prepared foods.
12. Cool and chill foods quickly and correctly, as explained in the following Guidelines for Cooling Foods. Chill custards, cream fillings, and other hazardous foods as quickly as possible by pouring them into shallow, sanitized pans, covering them, and refrigerating. Do not stack the pans.

GUIDELINES: Cooling Foods

1. Never put hot foods directly into the cooler. Not only will they cool too slowly but they will also raise the temperature of other foods in the cooler.
2. If they are available, use quick-chill units or blast chillers to cool foods quickly before transferring them to cold storage.
3. Use ice-water baths to bring down temperatures of hot foods quickly.
4. Stir foods as they are cooling to redistribute the heat in the food and help it cool more quickly.
5. Divide large batches into smaller batches. This increases the amount of surface area for the volume of food and helps it cool more quickly. Pouring foods into flat, shallow pans also increases surface area and cooling speed.

KEY POINTS TO REVIEW

- What is cross-contamination?
- What are the important rules of personal hygiene? List as many as you can.
- What is the Food Danger Zone?

The HACCP System

Once you have learned the principles of food safety, you must apply them in the bakeshop or kitchen. Many food service operations have designed food safety systems that enable food workers to keep a close check on food items whenever there is a risk of contamination or of the growth of pathogens. One effective food safety system is called the *Hazard Analysis and Critical Control Point* system, or *HACCP*. Versions of this system have been widely adopted throughout the food service industry.

The following is a brief introduction to the basic concepts of HACCP. For a more detailed explanation, refer to other published material listed in the Bibliography (p. 755). The discussion here is based on information presented in those books and applies to all food service work, not just the bakeshop.

The Steps of the HACCP System

The purpose of the HACCP system is to identify, monitor, and control dangers of food contamination. It has seven steps:

1. Assess hazards.
2. Identify critical control points (CCPs).
3. Set up standards or limits for CCPs.
4. Set up procedures for monitoring CCPs.
5. Establish corrective actions.
6. Set up a recordkeeping system.
7. Verify that the system is working.

These steps are the basis of the following discussion.

The Flow of Food

HACCP begins with a concept called the *flow of food*. This term refers to the movement of food through a food service operation, from receiving through the stages of storage, preparation, and service, until it is served to the consumer.

The flow of food is different for each item prepared. Some menu items involve many steps, including receiving of ingredients, storing ingredients, preparing ingredients (such as trimming fruit), cooking, holding, serving, cooling, storing leftovers, reheating leftovers, and so on. Even the simplest items undergo several steps. For example, a cake that is bought already prepared from a commercial baker and served as dessert goes through at least three steps on its way to the customer: (1) receiving, (2) storing, (3) serving.

Assessing Hazards

At each step in the flow of foods through the operation, risks may arise that can lead to dangerous conditions, or *hazards*. Assessing hazards is the process of identifying which of these dangerous conditions may occur at every step of the process. These hazards can be divided into three categories:

1. *Contamination*, such as cross-contamination from a soiled cutting surface, torn packaging that permits insect infestation, a worker handling food without washing hands, or spilling cleaning chemicals on food.
2. *Growth of bacteria and other pathogens* due to such conditions as inadequate refrigeration or storage and holding hot foods below 135°F (57°C).
3. *Survival of pathogens or the continued presence of toxins*, usually because of inadequate cooking or heating or inadequate sanitizing of equipment and surfaces.

Note these hazards correspond to the sanitation techniques discussed on page 31: keep bacteria from spreading, stop bacteria from growing, kill bacteria. The important difference is that the hazards addressed by HACCP include chemical and other hazards, in addition to disease-causing organisms. Naturally, however, most of the hazards we are concerned with are those that affect potentially hazardous foods.

Identifying Critical Control Points

Once the potential hazards are identified, the next step is to decide at which stages a worker can control the hazards, called control points. For any given hazard there may be several control points, or several opportunities to control the hazard. The last control point at which a worker can control a particular hazard is especially important to determine because this is the last chance to prevent a possible danger. These control points are called *critical control points (CCPs)*. Identifying CCPs is the second step in a HACCP program.

In simple language, setting up a HACCP system starts with reviewing the flow of food to figure out where something might go wrong, and then deciding what can be done about it. In the language of HACCP, these steps are called *assessing the hazards* and *identifying critical control points*.

Setting Standards or Limits for CCPs

The next step in designing a HACCP food safety system is setting up procedures for CCPs. At each such point, food workers need to know which standards must be met, which procedures to follow to meet the standards, and what to do if they aren't met. To reduce the chances for making mistakes, these standards and procedures are written out. Whenever possible, they should be included in the operation's recipes.

Some procedures are general and include the sanitation rules discussed earlier in this chapter. For example: Wash hands before handling food and after handling raw foods; hold foods above 135°F (57°C) or below 41°F (5°C). Others apply to specific items. For example: Cook a beef roast to an internal temperature of at least 145°F (63°C) and ensure it stays at that temperature at least three minutes.

Setting Up Monitoring Procedures

Careful observation is needed to verify when standards are met. This often involves measuring. The only way to know, for example, that a roast has reached the required internal temperature is to measure it, using a clean, sanitized thermometer.

Managers must ensure that all employees are trained to follow procedures and have the equipment needed to do the job.

Establishing monitoring procedures includes determining how a CCP is to be monitored or measured, when it is to be monitored, who is responsible for doing the measuring, and what equipment is needed to do the monitoring.

Taking Corrective Action

A *corrective action* is a procedure that must be followed whenever a critical limit is not met. Corrective actions should be identified in written procedures that clearly tell the worker what must be done in each situation.

For example, a monitoring procedure might show the internal temperature of a roast turkey just out of the oven is 155°F (68°C). But the critical limit for roast turkey is 165°F (74°C). The corrective action might be to return the turkey to the oven until the temperature reaches the critical limit.

Other corrective actions might be more complicated, but the written procedure should describe clearly what steps must be taken and who must take them.

Setting Up a Recordkeeping System

Keeping records of all the procedures described above is important for a HACCP system to succeed. Time and temperature logs, records of corrective actions taken, and documentation of when and how measuring devices were calibrated are examples of the kinds of records that enable an establishment to ensure food safety. Each establishment should develop clear, easy-to-use forms for entering all needed information.

Verifying the System Works

Accurate records enable you to make sure a HACCP system is working as intended. Review records regularly to check that all CCPs are being correctly monitored and that corrective actions are taken according to the proper procedures and adequate to control hazards. Revise procedures as necessary.

Accurate records also demonstrate to health inspectors that your operation is following correct safety procedures. In addition, records will help you determine what went wrong if a foodborne illness does occur.

To maintain accuracy of your establishment's records, whenever purchasing specifications are changed, new items are added to the menu, or new equipment is put into use, you must review procedures and revise them if needed. For example, if an operation starts buying larger beef steamship rounds for roasting, the internal temperature of the roasts will not meet critical limits unless the roasting time allowed for the beef is increased.

As this brief introduction to HACCP implies, establishing such a system to control all aspects of food production requires more information than this chapter can cover, so refer to the Bibliography for more detailed information.

Learning More about Food Safety

It is important to understand that food safety and sanitation are large and complex topics, so you should regard the second half of this chapter as only an introduction to them. To advance in a food service career, you will be required to demonstrate a detailed knowledge of the subject, well beyond what can be presented in such a limited space.

You will find entire textbooks devoted to kitchen sanitation and safety. Many organizations, including local and regional health departments and organizations such as the National Restaurant Association (in the United States) sponsor training programs leading to certificates of competency in food safety. Food-service employees in supervisory positions in the United States may be required to hold such a certificate by state or local law. In Canada, many provinces have their own safety regulations, and food-service operators should be familiar with these, as well as with federal regulations. The health and safety of your clientele depend on your diligent study of these important topics.

KEY POINTS TO REVIEW

- What does the term *flow of food* mean?
- What does the term *critical control point* refer to?
- What are the seven steps of the HACCP system?

TERMS FOR REVIEW

recipe	kilo-	hazard	parasite
formula	deci-	microorganism	fungus
standardized formula	centi-	pathogen	plant toxin
scaling	milli-	Food Danger Zone	allergen
metric system	scone flour	aerobic	cross-contamination
gram	AP weight	anaerobic	HACCP
liter	EP weight	facultative	flow of food
meter	baker's percentage	lag phase	critical control point
degree Celsius	contaminated	virus	corrective action

QUESTIONS FOR DISCUSSION

1. Below are ingredients for a white cake. The weight of the flour is given, and the proportions of other ingredients are indicated by percentages. Calculate the weights required for each.

Cake flour	3 lb (100%)
Baking powder	4%
Shortening	50%
Sugar	100%
Salt	1%
Milk	75%
Egg whites	33%
Vanilla	2%

2. In the formula in question 1, how much of each ingredient is needed if you want a total yield of 4½ lb batter?
3. Why are baking ingredients usually weighed, rather than measured by volume?
4. Make the following conversions in the U.S. system of measurement:

   3½ lb = ___ oz
   6 cups = ___ pt
   8½ qt = ___ fl oz
   ¾ cup = ___ tbsp
   46 oz = ___ lb
   2½ gal = ___ fl oz
   5 lb 5 oz divided by 2 = ____
   10 tsp = ___ fl oz

5. Make the following conversions in the metric system:

   1.4 kg = ___ g
   53 dL = ___ L
   15 cm = ___ mm
   2590 g = ___ kg
   4.6 L = ___ dL
   220 cL = ___ dL

6. Which foods can become contaminated by disease-causing organisms?

   chocolate éclairs
   dinner rolls
   baked custard
   biscotti cookies
   crisp baked meringues
   breadsticks
   chocolate bars

7. How often should you wash your hands when working on food?
8. Why is temperature control an effective weapon against bacterial growth? What are some important temperatures to remember?