6

BASIC PRINCIPLES OF COOKING AND FOOD SCIENCE

No written recipe can be 100 percent accurate. No matter how carefully a recipe is written, the judgment of the cook is still the most important factor in a preparation turning out well. A cook's judgment is based on experience, on an understanding of the raw materials available, and on knowledge of basic cooking principles and food science.

Ever since Carême began to define the principles and methods that lie behind the recipes we use (p. 3), professional cooking has been based on procedures and methods rather than only on recipes. In the twenty-first century, chefs have improved their knowledge not just of cooking theory but also of the science behind it.

This chapter deals with basic principles. You will learn about what happens to food when it is heated, about how food is cooked by different methods, and about rules of seasoning and flavoring. It is important to understand the science of food and cooking so you can successfully use these principles in the kitchen.

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO

1. Describe what happens to the major components of foods when they are heated or cooked.
2. Describe the ways in which heat is transferred to foods during cooking and the ways in which this heat transfer can be controlled to produce desired results.
3. Describe each basic cooking method used in the commercial kitchen.
4. Explain the composition of temporary and permanent emulsions.
5. Describe the ways to build flavor profiles in foods through the selection and use of primary flavors as well as seasoning and flavoring ingredients.

HEAT AND FOOD

To cook food means to heat it in order to make certain changes in it. Skillful cooks know exactly what changes they want to make and what they have to do to get them right. To learn these cooking skills, it is important for you to know why foods behave as they do when heated. For this, you have to study the theory.

Perhaps not all of this section will make sense to you at first. But the ideas should become clearer to you after you think about them in relation to specific techniques, as demonstrated by your instructor. Later in your studies, when you are learning about cooking meats, fish, and vegetables, making sauces, and creating salad dressings, review this section from time to time. Not only will you understand it better but also it should help you make more sense of the procedures you are learning and practicing.

WHAT IS HEAT?

Heat is a form of energy associated with the motion of atoms or molecules. When a substance absorbs heat, its molecules move faster. In liquids and gases, the molecules move more quickly from place to place and bounce off each other more frequently. In solids, the molecules stay mostly in place, but they vibrate with more energy. ***Temperature*** can be defined as a measure of this molecular activity. The higher the temperature, the faster the molecules are moving.

When fast-moving molecules in hot substances come in contact with slower molecules in cold substances, the fast molecules bump into the slower ones and transfer some of their energy, making the slower molecules move faster, or heat up. Thus, as heat is transferred, the hot substance loses energy and the colder substance gains energy.

The moving molecules in a liquid such as water sometimes move to the surface with enough energy to break through and escape to become a gas. This is called ***evaporation***. When the molecules in the liquid move faster, more of them can escape in a shorter time. This is why hot water evaporates more quickly than cold water.

When we add enough heat to foods, the molecules may move so fast the structure of the food changes. For example, sucrose (regular sugar) may break apart and form new molecules that happen to have a brown color and the taste of caramel. Or protein molecules may break apart and reform with a different structure. Creating these molecular changes is called **cooking**.

EFFECTS OF HEAT ON FOODS

Foods are composed of proteins, fats, carbohydrates, and water, plus small amounts of other compounds such as minerals (including salt), vitamins, pigments (coloring agents), and flavor elements. It is important to understand how these components react when heated or mixed with other foods. You will then be better equipped to correct cooking faults when they occur and to anticipate the effects of changing cooking methods, cooking temperatures, or ingredient proportions.

In other words, when you know why foods behave as they do, you can understand how to get them to behave as you want them to.

The following discussion is concerned with the physical and chemical reactions that affect the components of food. The nutritional aspects of these components are discussed in Chapter 5.

Carbohydrates

Starches and sugars are carbohydrates. Both compounds are present in foods in many forms. They are found in fruits, vegetables, grains, beans, and nuts. Meats and fish also contain a small amount of carbohydrate.

Caramelization

Sugars are simpler compounds than starches (see sidebar). For the cook, the most important change in sugar caused by cooking is **caramelization**, which can be defined as the browning of sugar caused by heat. The browning of sautéed vegetables is an example of caramelization. The browning of the crusts of baked goods, especially sweet doughs, is caused in part by caramelization and in part by another reaction called the Maillard reaction (discussed under Proteins, p. 114).

Different kinds of sugars caramelize at different temperatures. Regular sucrose (table sugar) begins to melt at 320°F (160°C). When it reaches approximately 338°F (170°C) it begins to turn golden brown.

POLYSACCHARIDES

Sugars are fairly simple compounds consisting of one or two rings of carbon atoms with hydrogen and oxygen atoms attached. Glucose, consisting of 6 carbon atoms, is the sugar that provides most of the food energy to most living things.

Starches consist of long chains of sugar molecules bound together. For this reason, starches are called *polysaccharides*, which means "many sugars." Starch molecules are too complex for our cells to use directly. When we eat and digest starches, our bodies break the long chains down into simple sugars so that our cells can absorb them and use them for energy.

As sugar is heated, its molecules break down into many new compounds. These compounds, in combination, have the typical flavor and brown color of caramel. The more the sugar is heated, the more the compounds break down, resulting in a darker color and a bitter flavor. Heavily caramelized sugar is less sweet than lightly caramelized sugar, because more of the sugar molecules are destroyed.

Gelatinization

Starches are important to cooks because of their function as thickeners for sauces and other liquids, and they are important to bakers because they supply most of the bulk of breads and other baked goods.

As described in the sidebar, starch molecules consist of long chains. In their raw form, these molecules are packed into tiny bundles called ***starch granules***. These granules change form in the presence of water and heat.

To demonstrate how starches behave when heated, first mix a little cornstarch with cold water and let it stand. You will see that the starch settles to the bottom. It does not dissolve in water as sugar does.

When mixed with cold water, starch granules absorb very little water. As the water is heated, the individual granules absorb water and swell to a much larger size (although they are still too small to be seen except with a microscope). The granules become so big that they bump into each other when the liquid is stirred or poured, and this slows down the flow. Thus, the liquid becomes thicker.

As the temperature gets close to boiling, some of the granules break open and release long starch chains. These chains connect with each other and form a network that blocks the flow of water and large starch granules. At this point, the starch has its greatest thickening effect.

This thickening process just described is called **gelatinization**.

As the thickened liquid is cooled, more reactions take place. Remember that molecules in a hot substance move faster than in a cold substance. So as the liquid cools, the water molecules slow down and are less able to resist the network created by the starch. This means that the liquid gets even thicker. If there is enough starch in the liquid, the mixture will form a solid gel and not flow at all. The formation of a solid gel is called ***gelation***.

Cooks should always keep in mind that sauces get thicker as they cool. The consistency of a sauce simmering on the range should be thinner than you want it to be when served. Remember that by the time the sauce is plated and brought to the customer, it will be cooler than it was on the stove. Test the consistency of a sauce by ladling a small amount onto a plate and letting it cool for a few moments.

Acids make sauces thinner because they break apart some of the starch chains. If you will be adding an acid to a sauce, you may need to make the base sauce a little thicker than usual. For best results, don't add acids to sauces until the gelatinization or thickening is complete.

Dextrinization

In Chapter 8 you will learn how to make roux to thicken sauces. You will learn that roux can be cooked lightly to be kept white or cooked more heavily to a brown color.

When starches are heated dry (that is, with no water but with or without fat), some of the long starch chains are broken down into simpler compounds called ***dextrins***, which give the starch a golden or a brown color. This process is called ***dextrinization***. Because dextrins have less thickening ability than starches, a brown roux has less thickening power than a white roux.

Fruit and Vegetable Fiber

Fiber is the name for a group of complex substances that give structure and firmness to plants. Fiber cannot be digested.

The softening of fruits and vegetables in cooking is, in part, the breaking down of fiber.

Sugar makes fiber firmer. Fruit cooked with sugar keeps its shape better than fruit cooked without sugar.

Baking soda (and other alkalis) makes fiber softer. Vegetables should not be cooked with baking soda because they become mushy and lose vitamins.

Proteins

Protein is a major component of meats, poultry, fish, eggs, milk, and milk products. It is present in smaller amounts in nuts, beans, and grains.

Coagulation

Proteins consist of long chains of components called amino acids. These chains normally form tight coils. As proteins are heated, the coils gradually unwind. At this point, the protein is said to be **denatured**.

For the cook, the important fact about denaturing is that, when the protein coils unwind, they become attracted to each other and form bonds. This bonding is called **coagulation**. The coagulated proteins form a solid network of bonds and become firm. As the temperature increases, the proteins shrink, become firmer, and lose more moisture. Exposure of proteins to excessive heat toughens them and makes them dry. Most proteins complete coagulation or are cooked at 160°–185°F (71°–85°C).

Maillard Reaction

Many protein foods, such as meats, contain small quantities of carbohydrate. When proteins are heated to about 310°F (154°C), the amino acids in the protein chains react with the carbohydrate molecules and undergo a complex chemical reaction. The result is that they turn brown and develop richer flavors. This reaction is called the **Maillard reaction**. It is what happens when meat browns. Because of the high temperature it requires, the Maillard reaction takes place only on the dry surface of the food. Because of its water content, the interior of the meat cannot get this hot.

Connective Tissue

Connective tissues are special proteins present in meats. Meats with a great deal of connective tissue are tough, but some connective tissues are dissolved when cooked slowly with moisture. Cooking tough meats properly, therefore, makes them more tender. These techniques are explained in Chapter 15.

Acids and Proteins

Acids, such as lemon juice, vinegar, and tomato products, have two effects on proteins:

- They speed coagulation.
- They help dissolve some connective tissues.

Fats

Fats are present in meats, poultry, fish, eggs, milk products, nuts, whole grains, and, to a lesser extent, vegetables and fruits. Fats are also important as cooking mediums, as for frying.

Fats can be either solid or liquid at room temperature. Liquid fats are called oils. When solid fats are heated, they melt, or change from solid to liquid. The melting point of solid fats varies.

When fats are heated, they begin to break down. When hot enough, they deteriorate rapidly and begin to smoke. The temperature at which this happens is called the **smoke point**, and it varies by type of fat. A stable fat—one with a high smoke point—is an important consideration in deep-fat frying.

Many flavor compounds dissolve in fat, so fats are important carriers of flavor. When fats melt and are lost from food, some flavors, as well as some vitamins, are lost with them.

For the functions of fats in baked goods, see page 911. For the functions of fats in emulsions, see page 125.

Minerals, Vitamins, Pigments, and Flavor Components

Minerals and vitamins are important to the nutritional quality of the food. Pigments and flavor components are important to a food's appearance and taste and may determine whether the food is appetizing enough to eat. So it is important to preserve all these elements.

Some of these components are soluble in water, and others are soluble in fats. All of these components may be leached out, or dissolved away, from foods during cooking.

Vitamins and pigments may also be destroyed by heat, by long cooking, and by other elements present during cooking.

It is important, then, to select cooking methods that preserve, as much as possible, a food's nutrients, taste, and appearance. This is addressed whenever cooking techniques are explained in the remainder of this book.

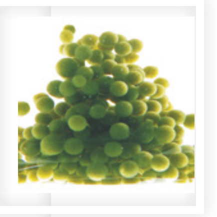
Water

Nearly all foods contain water. Dried foods may contain as little as a fraction of 1 percent water, but fresh meats, fish, vegetables, and fruits consist mostly of water.

Water exists in three states: solid (ice), liquid, and gas (water vapor or steam). At sea level, pure liquid water becomes solid, or freezes, at 32°F (0°C) and turns to steam at 212°F (100°C). When water molecules turn to steam and energetically escape into the atmosphere, water is said to be ***boiling***.

Water can also turn from liquid to gas at lower temperatures. When water turns to gas at any temperature, the process is called **evaporation**. Evaporation occurs more slowly the lower the temperature is. Evaporation is responsible for the drying of foods. The drying of food surfaces as they are cooked enables them to be browned.

Many minerals and other compounds dissolve in water, so water can be a carrier of flavor and of nutritional value. When water carries dissolved compounds, such as salt or sugar, its freezing point is lowered and its boiling point is raised.



KEY POINTS TO REVIEW

- What is caramelization? gelatinization? dextrinization? coagulation?
- What is the Maillard reaction?

HEAT MANAGEMENT

In order for food to be cooked, heat must be transferred from a heat source (such as a gas flame or an electric element) to and through the food. Understanding the ways in which heat is transferred and the speed at which it is transferred helps the cook control the cooking process.

HEAT TRANSFER

Heat is transferred in three ways: conduction, convection, and radiation. It is important to remember that, during a cooking process, more than one of these methods of transfer may be happening at the same time. For example, food on a grill may be heated by conduction from the hot metal grill, by convection from hot air rising from the burner or charcoal, and by radiation from the glowing burner or coals.

Conduction

Conduction occurs in two ways:

1. When heat moves directly from one item to something touching it—for example, from the top of the range to a soup pot placed on it, from the pot to the broth inside, and from the broth to the solid food items in it.
2. When heat moves from one part of something to an adjacent part of the same item—for example, from the exterior of a roast to the interior, or from a sauté pan to its handle.

Different materials conduct heat at different speeds. Heat moves rapidly through copper and aluminum, more slowly in stainless steel, more slowly yet in glass and porcelain. Air is a poor conductor of heat.

Convection

Convection occurs when heat is spread by the movement of air, steam, or liquid (including hot fat). There are two kinds of convection:

1. **Natural.**
   Hot liquids and gases rise, while cooler ones sink. Thus, in any oven, kettle of liquid, or deep-fat fryer a constant, natural circulation distributes heat.
2. **Mechanical.**
   In convection ovens and convection steamers, fans speed the circulation of heat. Thus, heat is transferred more quickly to the food, and the food cooks faster.

Stirring is a form of mechanical convection. Thick liquids cannot circulate as quickly as thin ones, so the rate of natural convection is slower. This explains, in part, why it is so easy to scorch thick soups and sauces. The heat is not carried away from the bottom of the pan quickly enough, so it stays concentrated on the bottom and scorches the food. Stirring redistributes the heat and helps prevent this. (Using heavy pots made of a material that conducts heat well also helps prevent scorching because the pot conducts the heat more quickly and evenly across the bottom and up the sides.)

Convection is the process that carries the heat from the heat source to the food. Once the carrier of the heat (air or liquid) comes in contact with the food, the heat is transferred from the carrier to the food by conduction.

Radiation

Radiation occurs when energy is transferred by waves from a source to the food. The waves themselves are not actually heat energy but are changed into heat energy when they strike the food being cooked. (Light waves, radio waves, and X-rays are examples of radiation not used for cooking.)

Two kinds of radiation are used in the kitchen:

1. **Infrared.**
   Broiling is the most familiar example of infrared cooking. In a broiler, an electric element or a ceramic element heated by a gas flame becomes so hot it gives off infrared radiation, which cooks the food. High-intensity infrared ovens are designed to heat food rapidly.
2. **Microwave.**
   In microwave cooking, the radiation generated by the oven penetrates partway into the food, where it agitates the molecules of water. Recall from our earlier discussion (p. 112) that heat is the motion of molecules. Thus, as the molecules move faster, the temperature of the food rises and the food is cooked.
   - Because microwave radiation affects only water molecules, a completely waterless material will not heat in a microwave oven. Plates become hot only when heat is conducted to them by hot foods.
   - Because most microwaves penetrate no more than about 2 inches (50 mm) into foods, heat is transferred to the center of large pieces of food by conduction, just as in roasting.

   Cooking with microwaves is discussed in more detail later in this chapter.

DONENESS AND COOKING TIMES

The final temperature to which we cook a food ranges from about 120°F (49°C) for rare meats and fish to about 400°F (200°C) for the crisp exterior of such foods as breads and seared meats. The boiling point of water, 212°F (100°C), falls within this range. Notice, however, the heat sources we use in the kitchen, from electric elements to gas flames, are much hotter than this temperature. Managing the heat to cook foods to the desired degree is an important part of cooking.

In the discussion that follows, we first consider cooking time—that is, the time it takes to heat food until it changes to a condition that we call ***done***. We then look at other problems with controlling heat in cooking.

We say a food is "done" when two things have happened:

1. **The interior temperature has risen to the desired degree.**
   Interior temperature is the most important factor when we are cooking tender meats. The difference between rare, medium, and well done (p. 481) is a difference in temperature, and we can measure this doneness with a thermometer. Interior temperature is also important for food safety, as we learned in the discussion of minimum internal cooking temperatures on page 29.
2. **The desired changes have taken place in the food.**
   Earlier in this chapter, we discussed the changes that take place in foods as they are heated. These changes include gelatinization of starches, coagulation of proteins, breaking down of connective tissues, caramelization of sugars, and Maillard browning.

   In many foods, creating these changes is more important than simply heating the interior to a desired temperature. For example, the inside of a small piece of stew meat quickly becomes just as hot as the liquid in which it is simmering. However, we don't say it is "done" until enough connective tissue has broken down so it has a tender texture. It's not enough just to heat it to the desired degree.

   Similarly, the inside of a strand of spaghetti quickly rises to the temperature of boiling water, but it is not done until enough starch has absorbed water and gelatinized, so it has the desired texture.

Standards of doneness are different for every type of food and for every cooking method. As we discuss individual foods throughout the remainder of this book, we learn more about doneness in meats, poultry, fish, vegetables, starches, and other foods.

The time it takes to achieve doneness is affected by three factors:

1. **Cooking temperature.**
   This means the temperature of the air in the oven, the fat in the fryer, the surface of a griddle, or the liquid in which a food is cooking.
2. **The speed of heat transfer.**
   Different cooking methods transfer heat at different rates, as shown by these examples:
   Air is a poor conductor of heat, while steam is much more efficient. A jet of steam (212°F/100°C) will easily burn your hand, but you can safely reach into an oven at 500°F (260°C). This is why it takes longer to bake potatoes than to steam them.
   A convection oven cooks faster than a conventional oven, even if both are set at the same temperature. The forced air movement transfers heat more rapidly.
3. **Size, temperature, and individual characteristics of the food.**
   For example:

   A small beef roast cooks faster than a large one.

   A chilled steak takes longer to broil than one at room temperature.

   Fish items generally cook more quickly than meats.

   Beef shank, which has a lot of connective tissue, takes longer to cook than beef tenderloin.

Because there are so many variables, it is difficult or even impossible to determine exact cooking times in most recipes. Individual ovens, fryers, and steamers, for example, may transfer heat more or less efficiently or have different recovery times. Roasting charts that give cooking times for various cuts of meat can be used only as guidelines, and the cook must use his or her judgment to make the final determination of doneness. Cooking times are discussed again in the next chapter.

CONTROLLING HEAT ON THE STOVETOP

To control cooking, we must control how heat is transferred. The kitchen contains dozens of kinds of heat sources as well as a great array of pots, pans, and other cooking tools. Controlling cooking with so many options is a skill a cook gains with experience, by performing cooking tasks over and over.

It's a common joke that boiling water is a cooking skill many noncooks have never learned. However, boiling water is a little more complex than such quips suggest. There is more to boiling water than just putting a pot on the stove.

To bring water to a boil on a cooktop, we apply heat to the bottom of a pot containing the water. The heat is transferred to the water, raising its temperature. Some of this heat energy quickly escapes from the top of the pot. If the pot is covered, much of the heat is trapped inside, and the water comes to a boil much more quickly. To raise the temperature of 1 gram of water 1 degree Celsius takes only 1 calorie of heat energy. But to turn 1 gram of boiling water to steam takes 539 calories. When the steam escapes, it takes this energy with it. A lot of energy is lost from an uncovered pot. By covering it, we save energy and shorten heating times.

After a liquid has come to a boil, keeping the pot covered can still be helpful. You have probably had the experience of removing the lid from a pot simmering over a low flame and seeing the bubbling slow down as soon as the lid is off. This is because so much heat escapes as soon as the cover is removed. By keeping the pot covered, you can maintain the desired cooking temperature using a lower burner setting.

Although covering pots is a more efficient use of energy, sometimes you must keep them uncovered:

- ***When evaporation is desired.*** In many cooking operations, one of the goals is to evaporate moisture to concentrate flavors or change textures. Keep the pot uncovered to speed evaporation.
- ***When the contents must be visually monitored.*** In some cases, you must keep an eye on the food as it simmers or boils, if only to make sure it continues to simmer at the proper rate, not too fast or too slow.
- ***When green vegetables are cooked.*** Plant acids that destroy green pigments must be allowed to escape, as explained on page 277.

BOILING OIL

The term *boiling oil* is commonly heard, but oil doesn't boil, at least in the way water does. The bubbling of boiling water, as the text explains, occurs when heated molecules of liquid water turn to gas—that is, steam—and rise to the surface. Oil that is free of water does not boil at normal cooking temperatures. The bubbling we see in cooking fat, such as that in deep fryers, is caused by water in submerged foods turning to steam. It's not the oil that is boiling.

Water boils at 212°F (100°C) at sea level and at standard atmospheric pressure. When water is boiling, any additional heat is used to turn water to steam, which then carries the heat away. No matter how high you turn the heat, the water can never rise above 212°F (100°C). In other words, turning up the heat under a pot that is already boiling is a waste of energy and does not decrease cooking time. Furthermore, the increased agitation of rapidly boiling water does more damage to delicate foods. Remember, a rapid boil is no hotter than a slow boil.

COOKING TO THE CENTER

As we read earlier, heat is transferred from the outside of food to the inside by conduction. Conduction takes time, so cooking takes time.

Think of a steak cooking on a grill. Let's say we want to cook the steak to an interior temperature of 140°F (60°C), for medium doneness. When we first put the steak on to cook, the interior temperature is room temperature, or possibly refrigerator temperature. The outside, however, rises to perhaps 400°F (200°C) very soon after we place it on the grill. Gradually, this heat moves to the center. By the time the center reaches the target temperature, the outside is much hotter. If we cut the steak through the center, we see a gradation from very well done at the outside to medium done in the middle.

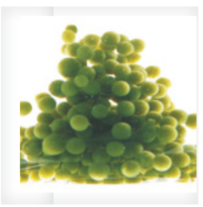
Often this is just what we want. This is how people are used to eating steaks, so a person might be surprised to get a steak that was a uniform medium done all the way through.

By contrast, if we cook the steak at a low temperature, there is less temperature difference between the outside and inside, so the doneness of the meat is more uniform from outside to inside.

The same is true of large roasts. Roasting at a high temperature produces a strong gradation of doneness, from well done on the outside to less done in the center. Roasting at a low temperature gives more uniform doneness throughout. The roasting temperature we use depends on the results we want.

Of course, cooking at a low temperature doesn't create the well-browned crust most diners desire. We have two options to solve this problem:

- Brown the exterior with high heat, then cook to doneness at lower heat.
- Cook to doneness at low heat, then brown the exterior with a quick blast of high heat.



KEY POINTS TO REVIEW

- What are the three ways in which heat energy is transferred to foods?
- What do we mean when we say a cooked food is "done"? What factors affect how long it takes to cook a food until it is "done"?
- When you are cooking food in a saucepan, when would you cover it, and when would you keep it uncovered?
- How does cooking temperature affect the doneness of foods such as roasts?

COOKING METHODS

Now that we understand the three basic methods of heat transfer—conduction, convection, and radiation—we can explore the basic techniques that cooks use to apply heat to food. These techniques are known as ***cooking methods***.

Cooking methods are classified as moist heat or dry heat.

Dry-heat methods are those in which the heat is transferred without moisture—that is, by hot air, hot metal, radiation, or hot fat. We usually divide dry-heat methods into two categories: without fat and with fat.

Moist-heat methods are those in which the heat is transferred to the food product by water or water-based liquids such as stock and sauces, or by steam.

Different cooking methods are suited to different kinds of foods. For example, some meats are high in connective tissue and are tough unless this tissue is broken down slowly by moist heat. Other meats are low in connective tissue and naturally tender. They are at their best and juiciest when cooked with dry heat to a rare or medium-done stage.

Many other factors must be considered when choosing cooking methods for meats, fish, and vegetables, such as the flavor and appearance imparted by browning, the flavor imparted by fats, and the firmness or delicacy of the product. These factors are discussed in later chapters with respect to individual foods.

In the following discussion, we begin with the conventional or traditional dry-heat and moist-heat cooking methods. Introduced here with brief definitions, these methods are discussed in greater detail in Chapter 12, as they are applied to vegetables, and again in Chapter 15, as they are applied to meats, poultry, and fish. In Chapter 15, each method is illustrated by a core recipe that gives you an opportunity to practice the technique in its most basic form before proceeding to the recipes in the chapters that follow.

Following the definitions of the conventional cooking methods, we proceed to explanations of microwave cooking, sous vide cooking, and specialized avant garde cooking techniques.

DRY HEAT METHODS

Roast and Bake

To **roast** and to **bake** both mean to cook foods by surrounding them with hot, dry air, usually in an oven. Cooking on a spit in front of an open fire may also be considered roasting.

The term ***roasting*** usually applies to meats and poultry. The term ***baking*** usually applies to breads, pastries, vegetables, and fish. It is a more general term than roasting, although, in practice, there is little or no difference in actual technique, and the terms are often interchangeable (except for breads and pastries).

Cooking uncovered is essential to roasting. Covering holds in steam, changing the process from dry-heat to moist-heat cooking, such as braising or steaming.

Barbecue

To **barbecue** means to cook with dry heat created by the burning of hardwood or by the hot coals of this wood. In other words, barbecuing is a roasting technique requiring a wood fire or wood smoke.

Broil

To **broil** means to cook with radiant heat from above.

Note: The terms ***broiling***, ***grilling***, and ***griddling*** are sometimes confused. Grilling (see following) is often called ***broiling***, and griddling is called ***grilling***. This book uses the terms that refer to the equipment involved. Thus, broiling is done in an overhead broiler, grilling on a grill, and griddling on a griddle.

Broiling is a rapid, high-heat cooking method used mainly for tender meats, poultry, fish, and a few vegetable items.

Grill, Griddle, and Pan-Broil

Grilling, griddling, and pan-broiling are all dry-heat cooking methods that use heat from below.

Grilling is done on an open grid over a heat source, which may be charcoal, an electric element, or a gas-heated element. Cooking temperature is regulated by moving the items to hotter or cooler places on the grill. Grilled meats should be turned to achieve desired grill marks, just as in broiling.

Griddling is done on a solid cooking surface called a griddle, with or without small amounts of fat to prevent sticking. The temperature is adjustable and much lower (around 350°F/177°C) than on a grill. In addition to meats, items such as eggs and pancakes are cooked on a griddle.

Pan-broiling is like griddling except it is done in a sauté pan or skillet instead of on a griddle surface. Fat must be poured off as it accumulates, or the process becomes pan-frying. No liquid is added, and the pan is not covered, or else the item would steam.

DRY-HEAT METHODS USING FAT

Sauté

To **sauté** means to cook quickly in a small amount of fat. High heat is required, and the procedure is most often done in a broad, flat pan called a ***sauté pan*** (p. 55) or ***sauteuse***.

Pan-Fry

To **pan-fry** means to cook in a moderate amount of fat in a pan over moderate heat. Pan-frying is similar to sautéing except more fat is used, the heat is lower, and the cooking time is longer. The method is used for larger pieces of food, such as chops and chicken pieces, and the items are not tossed by flipping the pan, as they often are in sautéing.

Deep-Fry

To **deep-fry** means to cook a food submerged in hot fat. The equipment most often used for this cooking method is the deep-fryer (p. 47), which is equipped with a thermostat to control the temperature of the fat, and with baskets to lower food into the fat and to remove and drain them when fried.

Many foods are given a coating of breading or batter before being deep-fried. These procedures are explained on pages 154–155.

MOIST-HEAT METHODS

Poach, Simmer, and Boil

Poaching, ***simmering***, and ***boiling*** all involve cooking a food in water or a seasoned or flavored liquid. The temperature of the liquid determines the method.

To **boil** means to cook in a liquid that is bubbling rapidly and greatly agitated. Water boils at 212°F (100°C) at sea level. No matter how high the burner is turned, the temperature of the liquid will go no higher.

To **simmer** means to cook in a liquid that is bubbling gently at a temperature of about 185°F to 200°F (85°C to 94°C).

To **poach** means to cook in a liquid, usually a small amount, that is hot but not actually bubbling. Temperature is 160°–185°F (71°–85°C).

Steam

To **steam** means to cook foods by exposing them directly to steam. In quantity cooking, this is usually done in special steam cookers. Steaming can also be done on a rack above boiling water.

Braise

To **braise** means to cook covered in a small amount of liquid, usually after preliminary browning. In almost all cases, the liquid is served with the product as a sauce.

Braising is sometimes referred to as a ***combination cooking method*** because the product is first browned, using dry heat, before it is cooked with a liquid. Nevertheless, in most cases, moist heat is responsible for most of the cooking process, and the browning may be thought of as a preliminary technique. The purpose of the browning step is not so much to cook the item as to develop color and flavor.

Some references describe braising and **stewing** as two different cooking methods. The term ***braising*** is used for large cuts of meat, and ***stewing*** is used for smaller items. In this book, however, we use the term ***braising*** for both methods because the basic procedure in both cases is the same—first browning with dry heat, then cooking with moist heat. (Note that the term ***stewing*** is also used for simmering in a small amount of liquid without preliminary browning.)

MICROWAVE COOKING

Microwave cooking refers to the use of a specific tool rather than to a basic dry-heat or moist-heat cooking method. The microwave oven is used mostly for heating prepared foods and for thawing raw or cooked items. However, it can be used for primary cooking as well.

Microwave oven models range in power from about 500 watts up to about 2,000 watts. The higher the wattage, the more intense the energy the oven puts out and the faster it heats foods. Most models have switches that allow you to cook at different power levels.

One of the most important advantages of the microwave oven in à la carte cooking is that it enables you to heat individual portions of many foods to order quickly and evenly. Instead of keeping such foods as stews hot in the steam table, where they gradually become overcooked, you can keep them refrigerated (either in bulk or in individual portions) and reheat each order as needed. This is perhaps the main reason why most restaurants have one or more microwave ovens, even though they may not use them for primary cooking.

Because the microwave oven is a unique tool in food service, the cook should observe the following special points regarding its use:

1. Small items will not brown in a standard microwave. Large roasts may brown somewhat from the heat generated in the item itself. Some models have browning elements that use conventional heat.

2. Watch timing carefully. Overcooking is the most common error in microwave use. High energy levels cook small items very rapidly.
3. Large items should be turned once or twice for even cooking.
4. An on/off cycle is often used for large items to allow time for heat to be conducted to the interior.
5. If your equipment has a defrost cycle (which switches the oven to lower power), use this cycle rather than full power to thaw frozen foods. Lower power enables the item to thaw more evenly, with less danger of partially cooking it. If your oven does not have this feature, use an on/off cycle.
6. Sliced, cooked meats and other items that are likely to dry out in the microwave should be protected either by wrapping them loosely in plastic or wax paper or by covering them with a sauce or gravy.
7. Because microwaves act only on water molecules, foods with high water content, such as vegetables, heat faster than denser, drier foods, such as cooked meats.
8. Foods at the edge of a dish or plate heat faster than foods in the center because they are more directly exposed to the oven's rays. Therefore:
   - Depress the center of casseroles so the food is not as thick there as at the edges. This will help it heat more evenly.
   - When you are heating several foods at once on a plate, put the moist, quick-heating items like vegetables in the center and the denser, slower-heating items at the edges.
9. Because microwaves do not penetrate metal, aluminum foil and other metals shield foods from the radiant energy. For example, a potato wrapped in foil will not cook in a microwave oven.

   With older machines, it was a general rule not to put any metal in the oven, as the radiation could bounce off the metal and damage the magnetron (the oven's generator). With newer machines, it is possible to heat foods in foil pans and to shield certain parts of the food by covering them with pieces of foil so they do not overheat. Do not place two pieces of metal close to one another, because sparks may be generated, causing a fire. Follow the procedures recommended by the manufacturer of the oven.

Because microwaves cook so rapidly, they will not break down the connective tissues of less tender meats. Slow, moist cooking is necessary for dissolving these connective tissues.

The more food placed in a microwave at once, the longer the cooking time. Thus, the primary advantage of microwave cooking—speed—is lost with large roasts and other large quantities.

COOKING SOUS VIDE

A new technology that has had a rapid growth in popularity among the world's top chefs is **sous vide** (soo veed) cooking. French for "under vacuum," the term is applied to cooking foods that have been vacuum-sealed in plastic bags.

In simplest terms, this food preparation technique is a two-step process:

1. Vacuum-pack the food item, plus any seasonings or marinades, in an appropriate plastic bag.
2. Cook the food item, while in the bag, at a constant low temperature, usually in a special water bath.

Precision Cooking

Although the name of the technique refers to the vacuum packing, the heart of sous vide cooking—and the reason many chefs are so excited about it—is the precise temperature control it permits.

As an example, think of roasting a boneless loin of lamb. On the one hand, we could place the meat in an oven at 400°F (200°C) and roast it until the center reaches a temperature of 140°F (60°C) for medium doneness. As we discussed on p. 118, however, the lamb will be medium done only in the center and more done everywhere else. In addition, we would have to monitor the cooking closely to make sure we remove it from the oven at the right time.

On the other hand, we could vacuum-pack the lamb loin in plastic and place it in a water bath heated to an exact 140°F (60°C). The temperature of the lamb would never go above that temperature, no matter how long we left it in the water bath. And it would be at exactly the same doneness from outside to center.

Because we like a browned exterior on the lamb, we could then remove it from the bag, brown it quickly in a hot sauté pan, and serve it immediately.

Sous Vide Applications

Sous vide cooking is such a new science that chefs are only beginning to explore its possibilities. Techniques will surely evolve and change in years to come.

Some of the main applications of sous vide cooking as it is practiced today are detailed below. Please note temperature ranges are approximate. Immersion circulators (p. 52) are extremely accurate, and chefs may specify temperatures to within a fraction of a degree to get the precise results they want. Although not as precise as immersion circulators, combi ovens (p. 45) are also used for some sous vide cooking.

Basic sous vide procedures for meat, poultry, and seafood are explained in Chapter 15, and additional recipes are included in following chapters.

Vegetables can benefit from sous vide techniques, especially those that discolor when exposed to air, such as artichokes. See Chapter 12 for further information on sous vide techniques for vegetables.

Tender Meats and Poultry

Tender meats and poultry are usually cooked in a water bath heated to the exact doneness temperature desired. The lamb loin described above is a typical example. Cooking temperatures usually range from 140° to 149°F (60° to 65°C), although higher or lower temperatures are also used, and cooking times may range from 20 to 60 minutes, or sometimes longer.

Remember that if the cooking temperature is within the Food Danger Zone (p. 17), cooking time must be counted as part of the four-hour rule (p. 26). For this reason, tender meats and poultry are almost always finished and served immediately after cooking and not chilled and stored for later use.

Tough Meats

Tough meats can be cooked to tenderness while retaining more moisture than if they were braised or simmered. Cooking temperatures range from 149° to 158°F (65° to 70°C). These temperatures are much lower than usual braising temperatures, but they are high enough to break down connective tissue. At the higher end of this range, meats become falling-apart tender, while at the lower end they retain more of their shape and have a firmer texture while still being tender and juicy.

Because it takes time to break down connective tissue, often 12–48 hours, tough meats are usually cooked to doneness, then immediately chilled and refrigerated for later use.

Because of the long cooking times, avoid cooking temperatures below 149°F (65°C). Higher temperatures provide more safety from bacterial growth.

Fish and Seafood

Fish are naturally tender and have even more delicate connective tissue than tender meats. Cooking procedures are similar to those for tender meats, but often with even lower temperatures and/or shorter cooking times. Typical cooking temperatures may range from 122° to 140°F (50° to 60°C), or sometimes higher, with cooking times as short as 10–15 minutes. Use only the freshest, cleanest fish, and finish and serve it immediately after cooking.

Shellfish such as lobster and shrimp can be toughened by the higher heat of traditional cooking techniques, so sous vide cooking can be a benefit. Cooking temperature for these items is typically around 140°F (60°C).

Vegetables

Vegetables can benefit from sous vide techniques, especially those that discolor when exposed to air, such as artichokes. Vegetables are usually cooked at 185°F (85°C).

Safety Factors

Working with vacuum-packed foods increases the health dangers caused by anaerobic and facultative bacteria (p. 18)—that is, bacteria that can grow without oxygen. Because cooking temperatures are so low, there is danger that bacteria will not be killed if cooking is not carefully done. Salmonella, *E. coli*, listeria, and botulism bacteria are the most serious risks.

For these reasons, chefs and health officials are especially cautious about sous vide cooking and have instituted strict guidelines. The following steps summarize the most important aspects of these safety rules:

1. Know the rules for sous vide set up by your local health department, and follow them carefully. Health departments usually require that you establish a HACCP system (p. 33) for sous vide cooking. To satisfy HACCP requirements, you must keep detailed records of every step in the production process for each item, including cooking and storage times and temperatures.
2. Use only the freshest, most wholesome foods from reputable purveyors.
3. Chill all foods thoroughly before vacuum packing. If you sear a food item before packing, chill it after searing and before packing.
4. After packing, cook the food at once, or immediately refrigerate it at 38°F (3.3°C) or lower—or, even better, freeze it.
5. After cooking, serve the food immediately, or chill it as quickly as possible in an ice bath or a blast chiller.
6. Thaw cooked food frozen in its package in the refrigerator.

Sous vide cooking involves complex procedures, and the above summary is only a short introduction to its techniques and safety factors. Entire books have been written on the subject, some of which are listed in the Bibliography. Later in this text, you will find recipes illustrating some of these techniques, including a recipe for long cooking of a tough meat (p. 454), for short cooking of fish (p. 659), meat (p. 523), and poultry (p. 584), and for cooking vegetables (pp. 323 and 324). Once again, these are only examples that can help you begin to understand the nature of sous vide.

Finally, using the proper equipment, especially a chamber vacuum packager and an immersion circulator (described on p. 52), is important. Home-style vacuum packers might be useful for experimenting, but only a chamber packer can achieve the vacuum pressures chefs find they need. Furthermore, home machines are not able to pack liquids, so they can't pack meats with marinades. Most important, precise temperature control is critical when you are cooking at such low temperatures, and you need appropriate equipment for cooking sous vide.

AVANT-GARDE TECHNIQUES

The approach to cooking first known as **molecular gastronomy**, introduced on page 7, is an effort by creative chefs to find new ways of preparing and presenting food. In the last few years, as these efforts have become more mainstream, we hear the term "molecular gastronomy" less often. Terms like *avant-garde cuisine* are more often used (see sidebar). (We'll use both terms in this discussion.)

We can define molecular gastronomy or avant-garde cuisine as the manipulation of food ingredients in new ways by the use of technology.

However, this description is misleading, because it suggests to many people that the technology is the most important part of this way of cooking. Even the name, molecular gastronomy, suggests scientists making artificial food in test tubes.

It is a challenge, in a short space, to describe molecular gastronomy because it consists of so many unrelated techniques. Also, every chef has his or her own style of cooking and uses a different set of favorite techniques and plating styles. Furthermore, it is important to understand that many or even most items on an avant-garde chef's menu are made with traditional techniques. The chef uses whatever cooking methods he or she feels are appropriate to the dish, whether a traditional technique or a molecular-gastronomy technique. You shouldn't think that such a menu is composed entirely of foams, bubbles, powders, and gels. In the definition in the preceding paragraph, the word ***selective*** is used to mean the chef selects a nonstandard technique when, and only when, it helps intensify a flavor or aroma or in another way to improve the dining experience.

The chef may use these techniques to change familiar foods into unfamiliar forms, to make unexpected combinations of foods, or to make one food look like another. Tricking the diner's expectations is another way the chef draws attention to flavors and aromas. One does not eat this food absentmindedly. Every bite is intended to be an exploration or an adventure.

In this style of cooking, using the best ingredients is necessary. Because the techniques are used to focus attention on flavors, colors, textures, and aromas, only the freshest foods have the quality to work in these dishes.

Chefs use countless individual techniques to create their versions of molecular gastronomy, and new ones are invented all the time. Just a few of the better-known and most talked-about of

AVANT-GARDE CUISINE

The term *avant garde* means "advance guard," and it was originally used to indicate the front ranks of an army advancing into battle. Today the term is used to describe any group that pushes the boundaries of a discipline beyond what is considered normal. The term is used most often in the arts and culture. Members of an avant-garde group experiment with and invent new techniques and new ways of applying new as well as old techniques.

For the best chefs in the field, molecular gastronomy is not so much a culinary movement as a new collection of tools for their toolkit. Their focus is still the food and the dining experience, and they use all their judgment and skills, including their training in classical techniques, to put good food on the plate. In the hands of great chefs, what could be nothing more than clever stunts with food becomes a great dining experience.

With this in mind, we can offer a second definition of *molecular gastronomy*: the selective use of technology and nonstandard ingredients to help enhance the flavors, aromas, appearance, and textures of natural foods.

these techniques are described below. Following this list is a description of some of the ingredients used to achieve these effects.

- **Nontraditional thickeners.** In addition to the traditional starches, chefs have new ways to thicken sauces and to change the texture of liquids. Some of these thickening agents work without heating and are simply blended with the cold liquid. This allows the chef to create sauces and other liquids with a fresh, uncooked taste.
- **Foams, froths, and bubbles.** For many years, chefs have made foamy sauces by whipping or blending a sauce just before plating. These foams collapse quickly, however. Avant-garde chefs stabilize foams with gelatin, lecithin, and other ingredients. A well-made foam adds an additional flavor dimension to the plate without adding bulk.
- **Gels.** Turning a liquid, such as a vegetable juice, into a solid not only gives it a different texture but also enables the food to be cut into many shapes, allowing the chef to create different visual presentations. Chefs use regular gelatin as well as other jelling agents, such as agar-agar, which is derived from seaweed.
- **Drying and powdering.** Drying a food intensifies its flavor and, of course, changes its texture. Eating a cauliflower floret that was deep-fried and then dehydrated until crisp is a much different experience than eating steamed, buttered cauliflower. If the dehydrated food is powdered, it becomes yet another flavor and texture experience.
- **Spherification.** This technique creates spheres of liquid contained inside a thin gel wall. In the standard method, the liquid is mixed with a hydrocolloid (p. 208) called sodium alginate. In a separate container is a water bath containing calcium. When the liquid is dropped into the calcium bath, the alginate and the calcium react to form a thin wall of gel surrounding a liquid center. The chef can make tiny spheres by using an eye dropper or larger ones by freezing the liquid in a mold before dropping it into the calcium bath.

  The opposite method is to dissolve the calcium in the flavorful liquid and drop it in an alginate bath. This is called ***reverse spherification***.

To give you a sense of how some of these ingredients and techniques are used, several recipes are included in Chapter 9 (pp. 224–228), Chapter 10 (p. 239), and Chapter 12 (pp. 325 and 326). Understand, however, this material gives you only a brief introduction to molecular gastronomy. To help you get a fuller sense of the subject, further references are included in the Bibliography (p. 1041).

SUMMARY OF COOKING TERMS

The following is an alphabetical list of terms that describe ways of applying heat to foods. Basic cooking methods described earlier are included, as are more specific applications of these basic methods.

bake. To cook foods by surrounding them with hot, dry air. Similar to **roast**, but the term bake usually applies to breads, pastries, vegetables, and fish.

barbecue. (1) To cook with dry heat created by the burning of hardwood or by the hot coals of this wood. (2) Loosely, to cook over hot coals, such as on a grill or spit, often with a seasoned marinade or basting sauce.

blanch. To cook an item partially and very briefly in boiling water or in hot fat. Usually a pre-preparation technique, as to loosen peels of vegetables, fruits, and nuts, to partially cook French fries or other foods before service, to prepare for freezing, or to remove undesirable flavors.

boil. To cook in water or other liquid that is bubbling rapidly, about 212°F (100°C) at sea level and at normal pressure.

braise. (1) To cook covered in a small amount of liquid, usually after preliminary browning. (2) To cook certain vegetables slowly in a small amount of liquid without preliminary browning.

broil. To cook with radiant heat from above.

deep-fry. To cook submerged in hot fat.

deglaze. To swirl a liquid in a sauté pan, roast pan, or other pan to dissolve cooked particles of food remaining on the bottom.

dry-heat cooking methods. Methods in which heat is conducted to foods without the use of moisture.

fry. To cook in hot fat.

glaze. To give shine to the surface of a food by applying a sauce, aspic, sugar, or icing, and/or by browning or melting under a broiler or salamander or in an oven.

griddle. To cook on a flat, solid cooking surface called a griddle.

grill. To cook on an open grid over a heat source.

moist-heat cooking methods. Methods in which heat is conducted to foods by water or other liquid (except fat) or by steam.

pan-broil. To cook uncovered in a skillet or sauté pan without fat.

pan-fry. To cook in a moderate amount of fat in an uncovered pan.

(en) papillote. Wrapped in paper (or sometimes foil) for cooking so the enclosed food is steamed in its own moisture.

parboil. To cook partially in a boiling or simmering liquid.

parcook. To cook partially by any method.

poach. To cook gently in water or other liquid that is hot but not actually bubbling, 160°–180°F (71°–82°C).

reduce. To cook by simmering or boiling until the quantity of liquid is decreased, often to concentrate flavors.

roast. To cook foods by surrounding them with hot, dry air in an oven or on a spit in front of an open fire.

sauté. To cook quickly in a small amount of fat, usually while mixing or tossing the foods by occasionally flipping the pan.

sear. To brown the surface of a food quickly at a high temperature.

simmer. To cook in water or other liquid that is bubbling gently, 185°–205°F (85°–96°C).

smoke-roast. To cook with dry heat in the presence of smoke, as on a rack over wood chips in a covered pan.

sous vide. Vacuum-packed. Refers to techniques for cooking foods that are packaged under vacuum in plastic bags.

steam. To cook by direct contact with steam.

stew. To simmer or braise a food or foods in a small amount of liquid, which is usually served with the food as a sauce.

stir-fry. To cook quickly in a small amount of fat by tossing cut-up foods in a wok or pan with spatulas or similar implements. Similar to sauté, except the pan is stationary.

sweat. To cook slowly in fat without browning, sometimes under a cover.

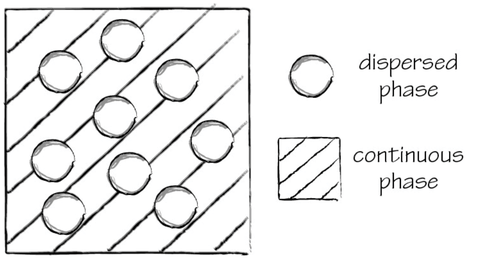


FIGURE 6.1 In an emulsion, droplets of one substance (called the *dispersed phase*) are evenly mixed in another substance (called the *continuous phase*).

EMULSIONS

An **emulsion** is a uniform mixture of two substances that are normally unmixable. A familiar example of an emulsion in the kitchen is mayonnaise, which is a mixture of oil and vinegar. Most of the emulsions we are concerned with in the kitchen are mixtures of fat and water. However, emulsions can be mixtures of any two substances. For example, when we cream together butter and sugar until light and fluffy, we create an emulsion of fat and air.

In an emulsion of two liquids, one of the liquids is said to be in ***suspension*** in the other. This means that one of the liquids is broken into tiny droplets and mixed evenly throughout the other liquid. The liquid that is broken into droplets is called the ***dispersed phase***, while the liquid it is mixed in is called the ***continuous phase*** (Figs. 6.1 and 6.2).

Depending on how we mix the two liquids, we can create a water-in-oil emulsion (in which water droplets are suspended in oil), or an oil-in-water emulsion (in which oil droplets are suspended in water). A vinaigrette is an example of a water-in-oil emulsion. Mayonnaise is an example of an oil-in-water emulsion.

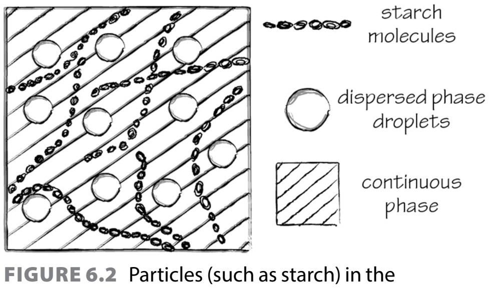


FIGURE 6.2 Particles (such as starch) in the continuous phase stabilize an emulsion by helping keep droplets of the dispersed phase from coming together and merging.

STABILIZERS AND EMULSIFIERS

As the text explains, some ingredients in a vinaigrette help the vinegar stay suspended in the oil longer. Such ingredients are called *stabilizers*. When a stabilizer is suspended throughout a vinaigrette, its tiny particles get between the droplets of vinegar and help keep them from bumping into each other and recombining. Thus, the vinegar droplets stay suspended longer. Given enough time, however, the vinaigrette will gradually separate.

One of the most useful and effective stabilizers for vinaigrettes is mustard. Any other ingredients, such as spices and finely chopped herbs, that form small particles can also help stabilize a temporary emulsion by getting between droplets.

To make a permanent *emulsion*, a true emulsifier is needed. Lecithin, a component of egg yolks, is a powerful emulsifier that makes possible the production of mayonnaise.

In mayonnaise, the oil is broken into tiny droplets and suspended in the vinegar. Lecithin is a long molecule with an unusual characteristic. The long chain of the molecule dissolves in oil, while one end of the molecule has an electrical charge that makes it attracted to water and repulsive to oil. The long tails dissolve in the droplets of oil, while the charged ends stick out and attract the water in the vinegar and also push away other oil droplets. Thus, each droplet of oil has a coating of water around it that is kept in place by the lecithin. Because of this arrangement, the oil droplets can't bump into each other and recombine, so the emulsion is permanent.

TEMPORARY EMULSIONS

A simple oil-and-vinegar dressing is called a **temporary emulsion** because the two liquids always separate after being shaken or beaten together. In a standard vinaigrette, the vinegar is broken into tiny droplets. These droplets are mixed evenly, or ***suspended***, throughout the oil.

The harder the mixture is beaten or shaken, the longer it takes for it to separate. This is because the vinegar is broken into smaller droplets, so the droplets take longer to recombine with each other and separate from the oil. When a mixture of oil and vinegar is mixed in a blender, the resulting mixture stays in emulsion considerably longer.

Some ingredients act as stabilizers (see sidebar). For example, when mustard is added to the mixture, the vinaigrette stays emulsified longer. Other ingredients that work this way include vegetable purées and stocks with a good gelatin content. Even these mixtures, however, will separate when they stand long enough. They should be mixed again before use.

PERMANENT EMULSIONS

Mayonnaise is also a mixture of oil and vinegar—in this case, an oil-in-water emulsion—but the two liquids do not separate. This is because the formula also contains egg yolk, which is a strong emulsifier. A substance in the egg yolk called lecithin forms a layer around each of the tiny oil droplets and holds them in suspension so that they do not recombine (see sidebar for more complete explanation).

The harder the mayonnaise is beaten to break up the droplets, the more stable the emulsion becomes. All emulsions, whether permanent or temporary, form more easily at room temperature, because chilled liquid is harder to break up into small droplets.

Other stabilizers are used in some preparations. Cooked dressing uses starch in addition to eggs. Commercially made dressings may use such emulsifiers as gums, starches, and gelatin.

EMULSIONS IN THE BAKESHOP

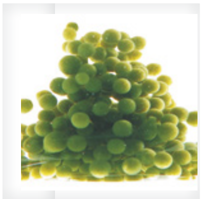
In the first paragraph of this section, we mention emulsions of fat and air that are created in certain batters. In fact, emulsions created in such products as cake batters are even more complex than this. Think of the main ingredients used in the bakeshop: solids such as flour, sugar, and butter; liquids such as water, milk, and eggs. In addition, doughs and batters contain air cells, large or small, distributed throughout. A successful product must have all these ingredients combined into a uniform mixture.

In a creaming-method cake batter, for example, the emulsion of solid fat and air is created in the first stage of the mixing process. In later stages, liquids such as water, milk, and eggs are also added. A finished cake batter is a complex emulsion of solids, liquids, and air. For this reason, following precise mixing procedures is necessary to successfully create a batter. Adding ingredients too fast or in the wrong order or having the ingredients at the wrong temperature can result in a broken emulsion.

SAUSAGES

In Chapter 28 we discuss a type of sausage called *emulsified sausage*. These include products such as bologna and frankfurters, which consist of a smooth, uniform mixture of meat, fat, and water or other liquid. (Technically, all sausages are emulsions, because they all contain solid fat and liquid such as meat juices, but in emulsified sausages, the emulsion is especially important to the structure of the finished product.)

Emulsified sausages have a high fat content, but if they are puréed and mixed properly, they can hold a lot of liquid in emulsion. This liquid content helps give the sausages their smooth, juicy texture. However, if too much liquid is added or if the ingredients are not cold enough when mixing, the emulsion can break, and the sausage will be dry and grainy rather than smooth and moist.



KEY POINTS TO REVIEW

- What cooking methods are classified as dry-heat methods? What methods are dry-heat methods with fat? What methods are moist-heat methods? Define each of these cooking methods.
- What are the two main steps in sous-vide cooking? List six safety guidelines to observe when cooking sous vide.
- What is an emulsion? How do stabilizers work in a temporary emulsion? How is a permanent emulsion formed?

BUILDING FLAVOR

People eat because they enjoy the flavors of good food, not just because they must fill their stomachs to stay alive. Appearance, texture, and nutrition are important, too, but good taste is the first mark of good cooking. Enhancement and adjustment of flavors are among a cook's most critical tasks, requiring experience and judgment.

The most important flavors of a given preparation are those of its main ingredients. A grilled beef tenderloin steak should taste like beef, green beans should taste like green beans, tomato soup should taste primarily of tomato. Plain, unseasoned foods, however, usually taste a little bland and one-dimensional, so it is the cook's job to add interest by combining ingredients to build depth of flavor. The harmony of ingredient flavors and aromas the cook creates by combining ingredients skillfully is sometimes called a **flavor profile**.

Foods offer complex experiences for the senses. When composing a new dish, a cook must first of all understand that more than just taste should be considered. The senses of sight, smell, taste, and touch all come into play. The fifth sense, hearing, also plays a role, as when we react to the sizzle of a steak or the crunch of a potato chip, but this sense is less of a concern for the cook than the other four. Consider how we perceive these characteristics of a dish:

- Appearance (color and color contrast, shape, shine, arrangement on the plate)
- Aroma
- Taste
- Mouthfeel (texture, moistness or dryness, softness or crispness) and temperature

All of these factors are important to making a dish appealing to the diner. The discussion in this section, however, is concerned mostly with aroma and taste. Why not just taste? Taste buds on the tongue perceive only four basic sensations: salty, sweet, bitter, and sour (but see sidebar). What we think of as flavor is a combination of taste and aroma. When the sense of smell is lacking, such as when you have a cold, foods seem to have little flavor.

The flavors in a dish can be thought of as primary flavors and supporting, or secondary, flavors. The primary flavors are the flavors of the main ingredients. For example, in blanquette of veal (p. 518) the **primary flavor** is veal; the primary flavors in calf's liver lyonnaise (p. 515) are liver and onions; and the primary flavors in Irish lamb stew (p. 519) are lamb, onions, leeks, and potatoes. These are the flavors that predominate. When you taste each of these dishes, the first tastes you encounter are the main ingredients. Other flavors, which we can call **supporting flavors**, support and enhance the primary flavors of the main ingredients.

Examining how a flavor profile is built in a single classic and fairly simple recipe can help you begin to understand the general principles involved.

UMAMI

Although European and North American tradition recognizes four basic tastes—salty, sweet, bitter, and sour—food authorities have recently identified a fifth, called **umami**, which has long been recognized by Asian cultures. Sense receptors on the tongue react to certain amino acids (p. 100). Because amino acids are components of proteins, this taste is strong in foods high in protein. In fact, umami is often translated as "meatiness." Beef, lamb, certain cheeses, and soy sauce are especially high in umami. The food additive monosodium glutamate (MSG), used as a seasoning or flavor enhancer in some Asian cuisines, produces strong umami.

AN EXAMPLE OF FLAVOR BUILDING

Let's look more closely at the recipe for blanquette of veal. Veal, by itself, does not have a strong or pronounced flavor. Unlike meats such as beef or venison, veal has a mild, subtle flavor. In this recipe, the veal is simmered, so the flavor is even milder than it would be if the meat were browned by roasting, sautéing, or braising. For this reason, when choosing seasonings and other supporting flavors, we want to avoid strong flavors that will mask the delicate flavor of the veal. Using white veal stock as a cooking medium reinforces and strengthens the primary flavor. We could use water, but the result would be a less flavorful dish. Brown stock would be too strong for our purpose and would completely change the character of the dish. White chicken stock might be an acceptable substitute, but it wouldn't reinforce the veal flavor as well. The onion and bouquet garni are added to the stock to give it more depth and fullness of flavor.

Continuing to the finishing ingredients, we find roux, a cream-and-egg liaison, lemon juice, nutmeg, and white pepper. The roux functions as a thickener and contributes primarily to texture, although the butter in the roux also gives some richness to the flavor. The liaison is used for both texture and flavor, adding richness and creaminess. The cream and the simmered veal are a classic marriage of flavors that work well together in many dishes. However, too much richness, combined with the mildness of the veal, could make the dish cloying. The acidity of the lemon juice cuts through the richness of the cream and egg yolks, gives a more balanced flavor, and perks up the taste buds. Just enough lemon is used to balance the richness of the cream and egg, not so much as to make the dish taste lemony. Finally, the smallest amount of nutmeg and white pepper gives a pleasing complexity to the finished taste without adding identifiable flavors. If one of the first things you taste is nutmeg, then too much nutmeg has been used.

If the dish is well composed, all of these flavors, primary and supporting, combine to form a complex but unified whole we identify as the taste of veal blanquette.

GENERAL CONCEPTS IN FLAVOR BUILDING

There are no fixed rules for combining flavors, but the example just discussed suggests some general principles. When you are developing or modifying a recipe, think about the following points.

Every ingredient should have a purpose. Start with the main ingredients, and then think about what will work with them. Continue to build the flavor, using just the ingredients you need.

Ingredients can work together by harmonizing or by contrasting. In the example above, the rich taste of the liaison and the mild taste of the veal harmonize, and the tartness of the lemon contrasts with the cream.

When two ingredients contrast, be sure they balance. For example, add just enough lemon juice to the blanquette to balance the cream, not too much or too little.

Consider not only the components of the single recipe but also the other items that will be served with it on the plate. For example, think of how we use lemon to balance the richness or fattiness of the cream in the blanquette. We can use the same idea to balance the fattiness of a pork pâté or sausage by serving it with a tart mustard or chutney on the side. In other words, think of building the flavor profile of the entire plate. Plan sauces, accompaniments, and garnishes to balance, enhance, and contrast with the main item and with each other, just as the flavors in an individual recipe do.

CLASSIC FLAVORING COMBINATIONS

These are just a few of the many traditional flavoring combinations from around the world. Keep in mind that, although only one or two combinations are given for each country or region mentioned, they are not the only combinations used there. These are merely examples to stimulate your thinking.

- Sour cream, paprika, caraway (Hungary)
- Sour cream or mustard, dill (Scandinavia)
- Caraway, onion, vinegar (Germany)
- Apples, apple cider or apple brandy, cream (France—Normandy)
- Shallot, garlic, parsley (France—Burgundy)
- Tomato, basil, olive oil (Italy)
- Olive oil, garlic, anchovy (Italy)
- Lemon, oregano (Greece)
- Cinnamon, nuts, honey (eastern and southern Mediterranean, Middle East)
- Ginger, onion, garlic (India)
- Fish sauce (nam pla), lemongrass, chiles (Thailand)
- Ginger, soy sauce (Japan)
- Soy sauce, sake or mirin, dried bonito (Japan)
- Ginger, garlic, scallion (China)

Simplicity and Complexity

Simpler is usually better. Some cooks mistakenly think that adding more ingredients is always preferable to adding fewer. But the more flavors you combine, the harder you have to work to balance them all. Further, the more competing flavors you have, the more you have to take care that the primary flavors of the main ingredients aren't lost.

This is true whether you are planning the ingredients in a single recipe or the components on a plate. Some cooks are tempted to put too many things on a plate. When you have a meat item perched on layers of three or four vegetables and starches, with additional garnishes and two or three sauces, the result is often a confused jumble.

It would be incorrect, however, to say that simpler is ***always*** better. Classic dishes from many of the world's regions have complex flavor profiles. Look through any collection of recipes from India, China, or Mexico, and you will find dishes that use a large number of spices and other flavoring ingredients. The recipe for Mole Poblano on page 583 is an example. When these dishes work, all the ingredients blend well. In a good curry, for example, it is difficult, if not impossible, to taste each of the individual spices.

Classic Flavor Profiles

How do you know what flavors work together? Perhaps the best place to start is to study traditional recipes from around the world as well as from the classical cuisine passed down to us through Escoffier. These are dishes that have stood the test of time. We know the flavor combinations work because they have been used over and over for decades or even centuries.

We have already seen some classic flavor combinations in our discussion of veal blanquette. The combination of white meat, cream, lemon, and a hint of nutmeg is a quartet of flavors you will find repeatedly in classic and regional dishes.

International or ethnic dishes provide other examples. In northern India, many dishes are based on a mixture of onion, garlic, and fresh ginger puréed together and fried in a little oil. Studying these recipes suggests to us that these three flavors might be used together in new dishes as well. Similarly, the combination of ginger and soy sauce from Japan, paprika and cured ham from Spain, garlic, tomato, and parsley from Provence, and olives and anchovies from around the Mediterranean are all successful flavor mixtures we learn to use when we study classic dishes.

For chefs who want to create their own dishes, studying classic recipes is a good place to start.

SEASONING AND FLAVORING INGREDIENTS

The preceding discussion of flavor building concerns all ingredients that add flavor to or change the flavor of a dish. These include the primary ingredients and the supporting or secondary ingredients. The remainder of this chapter is concerned primarily with herbs and spices as well as common flavoring ingredients such as onion, garlic, and mustard.

To repeat the most important concept of flavoring, the main ingredients are the primary sources of flavor. Use good-quality main ingredients, handle all foods with care, and employ correct cooking procedures. Remember that herbs and spices play only a supporting role. Badly prepared foods can't be rescued by a last-minute addition of herbs and spices.

Although chefs do not always use the terms this way, it might be said there is a difference between seasoning and flavoring. **Seasoning** means enhancing the natural flavor of a food without significantly changing its flavor. Salt is the most important seasoning ingredient. **Flavoring** means adding a new flavor to a food, thus changing or modifying the original flavor.

The difference between seasoning and flavoring is often one of degree. For example, salt is usually used only to season, not to flavor. But in the case of potato chips or pretzels, the salt is so predominant it can be considered an added flavoring. By contrast, nutmeg is normally used for its distinctive flavor, but just a dash can perk up the flavor of a cream sauce without being detectable by most people.

Seasoning

1. The most important time for seasoning liquid foods is at the end of the cooking process.

   The last step in most recipes, whether written or not, is "adjust the seasoning." This means you have to first taste and evaluate the product. Then you must decide what should be done, if anything, to improve the taste. Often, a little salt in a stew or a dash of fresh lemon juice in a sauce is enough.

   The ability to evaluate and correct flavors takes experience, and it is one of the most important skills a cook can develop.
2. Salt and other seasonings are also added at the beginning of cooking, particularly for larger pieces of food, when seasonings added at the end would not be absorbed or blended in but just sit on the surface.
3. Adding some of the seasoning during the cooking process aids in evaluating the flavor along the way.
4. Do not add much seasoning if it will be concentrated during cooking, as when a liquid is reduced.

Flavoring

Flavoring ingredients can be added at the beginning, middle, or end, depending on the cooking time, the cooking process, and the flavoring ingredient.

1. Only a few flavorings can be added successfully at the end of cooking. These include fresh (not dried) herbs, sherry or flamed brandy, and condiments like prepared mustard and Worcestershire sauce.
2. Most flavorings need heat to release their flavors and time for the flavors to blend. Whole spices take longest. Ground spices release flavors more quickly and thus don't require as long a cooking time.
3. Too much cooking results in loss of flavor. Most flavors, whether in spices or in main ingredients, are **volatile**, which means they evaporate when heated. That is why you can smell food cooking.

We can conclude that herbs and spices should cook with the foods long enough to release their flavors but not so long that their flavors are lost. If cooking times are short, you can generally add spices and herbs at the beginning or middle of cooking time. If cooking times are long, it is usually better to add them in the middle or toward the end of cooking time.

Note: Food safety experts recommend adding dried spices and herbs at least 30 minutes before the end of cooking so any microorganisms they might carry are destroyed.

Common Seasoning and Flavoring Ingredients

Any food product can be used as a flavoring ingredient, even meat (as when crumbled bacon is added to sautéed potatoes or diced ham is included in a mirepoix). Sauces, which are complex preparations containing many flavoring ingredients, are themselves used as flavorings for meat, fish, vegetables, and desserts. The term **condiment** means any edible substance that can be added to a food to contribute flavoring. Clearly, the list of condiments is nearly limitless.

We obviously cannot treat all possible flavoring ingredients here, but we discuss some of the most important. A survey of herbs and spices is provided in Table 6.1. Ingredients used primarily in the bakeshop are discussed in Chapter 31.

TABLE 6.1 Herbs, Spices, and Spice Blends

Product	Market Forms	Description	Examples of Use
Allspice	Whole, ground	Small brown berry; flavor resembles blend of cinnamon, cloves, and nutmeg	Sausages and braised meats, poached fish, stewed fruits, pies, puddings
Anise seed	Whole, ground	Small seed; licorice flavor	Cookies, pastries, breads
Annatto (Spanish name: achiote)	Whole seed	Small, deep red, very hard seeds; very mild, slightly peppery flavor; imparts strong yellow or yellow-orange color to foods	Used primarily for coloring some Latin American dishes, including rice, soups, stews, and sauces
Asafetida	Powdered or lump	Dried sap of an Asian herb; strong aroma.	Dropped into hot oil so that it toasts and foams up slightly; the flavored oil then used in Indian and Middle Eastern dishes
Basil	Fresh and dried leaves	Aromatic leaf; member of mint family	Tomatoes and tomato dishes, pesto (Italian basil sauce), egg dishes, lamb chops, eggplant, peas, squash
Bay leaf	Whole	Stiff, dark green, oblong leaves; pungent aroma	One of the most important herbs for stocks, sauces, stews, braised meats
Caraway seed	Whole	Dark brown, curved seeds; familiar rye bread seasoning	Rye bread, cabbage, sauerkraut, pork, cheese spreads, Eastern European dishes
Cardamom	Whole pod, ground seed	Tiny brown seeds inside white or green pod; sweet and aromatic; expensive	Pickling, Danish pastries, curries
Cayenne (red pepper)	Ground	Ground form of hot red chile; looks like paprika but is extremely hot	In small amounts in many sauces, soups, meat, fish, egg, and cheese dishes (p. 133)
Celery seed	Whole, ground, ground mixed with salt	Tiny brown seeds with strong celery flavor	Salads, coleslaw, salad dressings, tomato products
Chervil	Fresh and dried leaves	Herb with mild flavor of parsley and tarragon	Soups, salads, sauces, egg and cheese dishes
Chili powder	Ground blend	Blend of spices including cumin, chiles, oregano, garlic	Chili and other Mexican dishes, egg dishes, appetizers, ground meat
Chive	Fresh, dried, frozen	Grasslike herb with onion flavor	Salads, egg and cheese dishes, fish, soups
Cilantro (fresh coriander, Chinese parsley)	Fresh leaves	The plant that produces coriander seeds; delicate texture; assertive, herbaceous aroma and flavor; leaves resemble flat parsley	Widely used in Asian and Southwestern cooking and in dishes with various ethnic influences
Cinnamon	Sticks, ground	Aromatic bark of cinnamon or cassia tree	Pastries, breads, desserts, cooked fruits, ham, sweet potatoes, hot beverages

Product	Market Forms	Description	Examples of Use
Clove	Whole, ground	Dried flower buds of a tropical tree; pungent, sweet flavor	Whole: marinades, stocks, sauces, braised meats, ham, pickling; ground: cakes, pastries, fruits
Coriander	Whole, ground	Round, light brown, hollow seed, slightly sweet, musty flavor	Pickling, sausage, pork, curried dishes, gingerbread
Cumin seed	Whole, ground	Small seed resembling caraway, but lighter in color	Ingredient of curry and chili powders, sausages and meats, egg and cheese dishes
Curry powder	Ground blend	A mixture of 16–20 spices, including chile, turmeric, cumin, coriander, ginger, cloves, cinnamon, black pepper; brands vary greatly in flavor and hotness	Curried dishes, eggs, vegetables, fish, soups, rice
Dill	Fresh and dried leaves (called dill weed), whole seed	Herb and seed with familiar dill pickle flavor; seed is more pungent than the herb	Seed: pickling, sauerkraut, soups; herb: salads, cheese dishes, fish and shellfish, some vegetables
Epazote	Fresh and dried leaves	A pungent herb with coarse-textured leaves	Used in Mexican cooking; often cooked with beans
Fennel	Whole seed	Greenish-brown seeds similar in flavor to anise, but larger in size	Italian sausage, tomato sauce, fish
Fenugreek	Whole and ground seed	Small, hard, light-brown seed; pungent, bittersweet aroma	Curries and other Indian dishes
Filé powder	Ground	From the dried leaf of the sassafras tree; acts as thickener as well as flavoring.	Gumbos and other creole and Cajun dishes. Texture becomes stringy if boiled, so add at end of cooking.
Five-spice powder, Chinese	Ground	Blend of star anise, cinnamon, Sichuan pepper, cloves, fennel seed	Chinese dishes
Garam masala	Blend of ground or whole toasted spices (usually ground before using)	Variable blend of spices similar to curry powder but without turmeric and often without chiles. May contain pepper, cinnamon, cloves, nutmeg, cumin, cardamom, coriander	Indian dishes: vegetables, meat, poultry, fish, sauces, soups
Garlic	Fresh: whole bulbs; dried: granulated, powder, and mixed with salt	Strong, aromatic member of onion family; fresh bulbs composed of many small cloves	Wide variety of foods
Ginger	Whole, ground (also fresh and candied or crystallized)	Light brown, knobby root of ginger plant	Baked goods and desserts, fruits, curried dishes, braised meats; fresh in Chinese and other Asian dishes
Juniper berry	Whole	Slightly soft, purple berries with piney flavor; principal flavoring of gin	Marinades, game dishes, sauerkraut
Lemongrass	Fresh stalks	A tropical grass with a slightly bulbous base and an aroma of lemon	Used in Southeast Asian dishes and in dishes influenced by Asian cuisine
Mace	Whole (blade), ground	Orange outer covering of nutmeg; similar flavor, but milder	Baked goods, desserts, fruits, sausages, pork, fish, spinach, squash, other vegetables
Marjoram	Fresh and dried leaves	Gray-green herb with pleasant aroma and slightly minty flavor, similar to oregano, but much milder	Pâtés and ground meats, braised meats, sauces, roast lamb, poultry and poultry stuffings
Mint	Fresh leaves	Aromatic herb with familiar cool flavor; two varieties: spearmint and peppermint	Lamb, fruits, tea and fruit beverages, peas, carrots, potatoes
Mustard seed	Whole, ground (also prepared mustard; see p. 133)	Very pungent seed in white or yellow and brown varieties—brown is stronger	Cheese and egg dishes, pickling, meats, sauces and gravies
Nutmeg	Whole, ground	Sweet, aromatic kernel of nutmeg fruit	Soups, cream sauces, chicken, veal, many vegetables (spinach, mushrooms, squash, potatoes), desserts, custards, breads, pastries

(Continued)

TABLE 6.1 Herbs, Spices, and Spice Blends *(Continued)*

Product	Market Forms	Description	Examples of Use
Oregano	Fresh and dried leaves, whole and ground	Pungent herb known as the "pizza herb"	Italian and Mexican dishes, tomato products
Paprika	Ground	Ground form of a dried, sweet red chile. Spanish variety (pimento) is often smoked; Hungarian is darker and more pungent	Spanish: used as flavoring in stewed dishes and as garnish on light-colored foods; Hungarian: goulash, braised meats and poultry, sauces
Parsley	Fresh: whole sprigs, in bunches; dried: in flakes	Most widely used herb; dark green curly or flat leaves with delicate, sweet flavor	Almost all foods
Pepper, black and white	Whole (peppercorns); ground fine, medium, or coarse	Small black or creamy white hard berry; pungent flavor and aroma	Most widely used spice (p. 133)
Pepper, red	(see Cayenne)		
Peppercorn, pink	Whole	Bright pink dried seed or berry; pungent, floral taste; unrelated to black pepper	Limited uses in meat, poultry, and fish dishes; sauce garnish; used in peppercorn mixtures
Poppy seed	Whole	Tiny blue-black seeds with faint but distinctive flavor	Garnish for breads and rolls, buttered noodles; ground: in pastry fillings
Quatre épices	Ground	French name means "four spices." Blend may include white or black pepper, nutmeg, cloves, cinnamon, ginger, allspice	Soups, stews, vegetables, sausages and other charcuterie (p. 853)
Rosemary	Fresh and dried leaves	Light green leaves resembling pine needles	Lamb, braised meats and poultry, soups, tomato and meat sauces
Saffron	Whole (thread)	Red stigma of saffron crocus; gives bright yellow color to foods; mild, distinctive flavor; very expensive	Steeped in hot liquid before use; rice dishes, poultry, seafood, bouillabaisse, baked goods
Sage	Fresh leaves; dried whole and rubbed (finer consistency than whole leaves), ground	Pungent gray-green herb with fuzzy leaves	Pork, poultry, stuffings, sausage, beans, tomatoes
Savory	Fresh and dried leaves	Fragrant herb of mint family; summer savory is preferred to winter	Many meat, poultry, fish, egg, and vegetable dishes
Sesame seed	Whole (hulled or unhulled)	Small yellowish seed with nutlike taste; familiar hamburger bun garnish; high oil content	Bread and roll garnish
Sichuan peppercorn	Whole	Brown seed pod, usually partially opened; spicy, peppery flavor, but unrelated to black peppercorns	Spicy meat and poultry dishes
Star anise	Whole or broken	Dried, star-shaped seed pod with an aniselike flavor (but unrelated to anise) but more aromatic	Braised Chinese dishes
Tarragon	Fresh and dried leaves	Delicate green herb with flavor both minty and licoricelike	Béarnaise sauce, tarragon vinegar, chicken, fish, salads and dressings, eggs
Thyme	Fresh leaves; dried leaves: whole and ground	Tiny brownish-green leaves; very aromatic	One of the most important and versatile of herbs; stocks, soups, sauces, meats, poultry, tomatoes
Turmeric	Ground	Intense yellow root of ginger family; mild but distinctive peppery flavor	A basic ingredient of curry powder; pickles, relishes, salads, eggs, rice
Wasabi	Fresh root, dried powder; paste (in tubes)	A type of Japanese horseradish; pungent horseradish flavor (dried wasabi and paste are often regular horseradish tinted green)	Basic seasoning or condiment with sushi and sashimi; Asian-style dishes. Mix powder with water to form thick paste.
Zaatar	Powdered spice blend	Blend of herbs and spices including oregano, thyme, marjoram, sesame seeds, dried sumac berries, and salt	Arabian dishes

1. ***Salt*** is the most important seasoning ingredient. Don't use too much. You can always add more, but you can't take it out.
   - Table salt has a fine granulation. It may contain iodine as a dietary additive. Table salt also may contain other additives to prevent caking.
   - Kosher salt is prized in the kitchen because of its purity. Unlike table salt, it contains no additives. Because of its coarse or flaky granulation, it does not dissolve as quickly as table salt, but it is easier to use when added to foods by hand, so many chefs prefer it to table salt at their cooking stations.
   - Sea salts of many origins and types are available. Many of them have colors ranging from gray to green to red, from various minerals and other impurities. These impurities also add subtle flavors to the salt. In addition, their coarse granulation gives them a pleasant mouthfeel. More expensive than other salts, sea salts are used primarily as garnishes for plated foods.
2. ***Pepper*** comes in three forms: white, black, and green. All three are actually the same berry, but processed differently. Black pepper is picked unripe; white is ripened and the hull is removed; green peppercorns are picked unripe and preserved before their color darkens.
   - Whole and crushed ***black pepper*** are used primarily in seasoning and flavoring stocks and sauces and, sometimes, red meats. Ground black pepper is used in the dining room by the customer.
   - Ground ***white pepper*** is more important as a seasoning in the food-service kitchen. Its flavor is slightly different from that of black pepper, and it blends well (in small quantities) with many foods. Its white color makes it visually undetectable in light-colored foods.
   - ***Green peppercorns*** are fairly expensive and are used in special recipes. The types packed in water, brine, or vinegar (those in water and in brine have better flavor) are soft. Wet-pack peppercorns are perishable. Water-packed peppercorns keep only a few days in the refrigerator after they are opened, while the others keep longer. Dried green peppercorns are also available.
3. ***Red pepper*** or ***cayenne*** is completely unrelated to black and white pepper. It belongs to the same family as chiles, paprika, and fresh sweet bell peppers. Used in tiny amounts, it gives a spicy hotness to sauces and soups without actually altering the flavor. In larger amounts, it gives both heat and flavor to many spicy foods, such as those of Mexico and India.
4. ***Lemon juice*** is an important seasoning, particularly for enlivening the flavor of sauces and soups.
5. ***Fresh herbs*** are almost always superior to dried herbs. They should be used whenever cost and availability permit. Not long ago, the only fresh herbs generally available in many areas of North America were parsley, chives, and sometimes mint and dill. Now, however, most herbs are available fresh. The accompanying photos illustrate the most commonly used fresh herbs as well as some unusual fresh flavoring ingredients.
6. ***Onion, garlic, shallots***, and other members of the onion family, as well as carrots and celery, are used as flavorings in virtually all stations of the kitchen and even in the bakeshop. Try to avoid the use of dried onion and garlic products, except as a component of spice blends. They have less flavor, and the fresh product is always available.
7. Grated ***lemon*** and ***orange rind*** is used in sauces, meats, and poultry (as in duckling à l'orange) as well as in the bakeshop. Only the colored outer portion, called the ***zest***, which contains the flavorful oils, is used. The white pith is bitter.
8. ***MSG***, or ***monosodium glutamate***, is a flavor enhancer widely used in Asian cooking. MSG doesn't actually change the flavor of foods, but it acts on the taste buds. It has a reputation for causing chest pains and headaches in some individuals.
9. ***Wine***, ***brandy***, and other alcoholic beverages are used to flavor sauces, soups, and many entrées. Brandy should be boiled or flamed to eliminate the high percentage of alcohol, which would be unpleasant in the finished dish. Table wines usually need some cooking or reduction (either separately or with other ingredients) to produce the desired flavors. Fortified wines like sherry and Madeira, on the other hand, may be added as flavorings at the end of cooking.
10. ***Prepared mustard*** is a blend of ground mustard seed, vinegar, and other spices. It is used to flavor meats, sauces, and salad dressings and as a table condiment. For most cooking purposes, European styles such as Dijon (French) or Dusseldorf (German) work best, while the bright yellow American ballpark style is more appropriate as a table condiment than as a cooking ingredient. A coarse, grainy style is sometimes called for in specialty recipes.

Basil

Chervil

Chives

Garlic chives

Cilantro

Dill

Epazote


Regular ginger and green ginger

11. ***Vinegars*** consist of acetic acid, water, and various flavoring compounds, depending on the source. They are made by bacterial fermentation of wine, hard apple cider, grain alcohol, and other liquids containing alcohol. Vinegars are discussed in more detail in Chapter 22.
12. ***Soy sauce*** is a thin, dark brown, earthy, salty liquid made by fermenting soy beans and sometimes other grains, especially wheat, with water and various mold cultures. Widely used in Asian cuisines, it is available in various strengths from light to dark. A low-salt version is also available, but it is still salty. Japanese soy sauces are generally lighter in flavor than Chinese soy sauces. ***Tamari*** is a special kind of dark, rich Japanese soy sauce made with little or no wheat. Other Asian soy sauces include Indonesian, Korean, Burmese, Vietnamese, and Malaysian.
13. ***Fish sauce*** (also called ***nam pla***, ***nuoc mam***, and ***nuoc nam***) is a thin, salty liquid with a pungent aroma, made from raw or dried fish or shellfish. It is widely used in Southeast Asian cuisines.


Lemongrass


Marjoram


Mint


Oregano


Parsley, curly


Parsley, flat


Rosemary


Tarragon


Sage


Thyme

USING HERBS AND SPICES

Definitions

Herbs are the leaves of certain plants that usually grow in temperate climates.

Spices are the buds, fruits, flowers, bark, seeds, and roots of plants and trees, many of which grow in tropical climates.

The distinction is often confusing, but it is not as important to know which flavorings are spices and which are herbs as it is to use them skillfully.

Table 6.1 is not a substitute for familiarity with the actual products. Eventually, you should be able to identify any spice on your shelf by aroma, taste, and appearance without looking at the label. The accompanying photos illustrate a number of whole spices.

Top row, left to right: black peppercorns, green peppercorns, pink peppercorns. Bottom row, left to right: white peppercorns, Sichuan peppercorns

Top row, left to right: cloves, nutmeg, allspice, cinnamon sticks. Bottom row, left to right: juniper berries, cardamom, saffron, star anise

Top row, left to right: celery seed, dill seed, coriander seed, caraway seed. Bottom row, left to right: fennel seed, cumin seed, anise seed

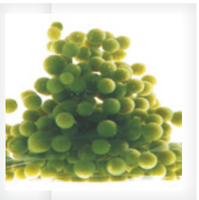
Evaluating Herbs and Spices

Fresh herbs should look fresh, not wilted, with good color and no yellowing, browning, or rotting, and no insect damage. Look for a fresh aroma characteristic of the particular herb.

Dried herbs and ground spices lose much flavor and aroma after six months. Buy properly sealed containers from reputable purveyors. Freshly opened spices and herbs should have a good aroma. Lack of aroma indicates staleness and lack of flavor. For freshest flavor, buy whole spices and grind them as needed.

GUIDELINES for Using Herbs and Spices

1. Be familiar with each spice's aroma, flavor, and effect on food. Looking at a spice chart, including the one in this book, is no substitute for familiarity with the actual product.
2. Store dried herbs and spices in a cool place, tightly covered, in opaque containers. Heat, light, and moisture cause herbs and spices to deteriorate rapidly.
3. Don't use stale spices and herbs, and don't buy more than you can use in about 6 months. Whole spices keep longer than ground, but both lose much flavor after 6 months. For maximum flavor, grind spices just before use.
4. Be cautious after you have replaced old spices. The fresher products are more potent, so the amount you used before might now be too much.
5. Use good-quality spices and herbs. It doesn't pay to economize here. The difference in cost is only a fraction of a cent per portion.
6. Whole spices take longer to release flavors than ground spices, so allow for adequate cooking time.
7. Whole herbs and spices for flavoring a liquid are tied loosely in a piece of cheesecloth (called a sachet) for easy removal.
8. When in doubt, add less than you think you need. You can always add more, but it's hard to remove what you've already added.
9. Except in dishes like curry or chili, spices should not dominate. Often, they should not even be evident. If you can taste the nutmeg in the creamed spinach, there's probably too much nutmeg.
10. Herbs and spices added to uncooked foods such as salads and dressings need several hours for flavors to be released and blended.
11. Taste foods before serving whenever possible. How else can you adjust the seasoning?



KEY POINTS TO REVIEW

- How do chefs use the idea of flavor balance to combine a variety of ingredients into a single dish?
- What is the difference between seasoning and flavoring?
- What guidelines are used for correctly adding herbs and spices to foods?

TERMS FOR REVIEW

cooking
caramelization
gelatinization
fiber
denature
coagulation
Maillard reaction
connective tissues
smoke point
evaporation
conduction
convection
radiation
infrared
microwave
dry-heat methods
moist-heat methods
roast
bake
barbecue
broil
grilling
griddling
pan-broiling
sauté
pan-fry
deep-fry
boil
simmer
poach
steam
braise
stewing
sous vide
molecular gastronomy
emulsion
temporary emulsion
flavor profile
umami
primary flavor
supporting flavor
seasoning
flavoring
volatile
condiment
herbs
spices

QUESTIONS FOR DISCUSSION

1. Your broiler cook has just broiled a codfish fillet that turned out dry, rubbery, and shrunken. Explain what happened to it.
2. Why might adding some tomato product to a beef stew help make the meat more tender?
3. You are roasting a large quantity of ducklings and must use both your conventional ovens and your convection oven. You set all the ovens at the same temperature, but find the ducklings in the convection oven are done first. Why did this happen?
4. You are roasting two beef tenderloins of the same size, one in an oven set at 450°F (230°C), and the other in an oven at 250°F (120°C). You remove both of them from the oven when the temperature at the center is 135°F (57°C). Describe the doneness of each tenderloin from outside to inside.
5. Arrange the following cooking methods in three groups, depending on whether they are moist-heat methods, dry-heat methods without fat, or dry-heat methods with fat: braising, roasting, deep-frying, sautéing, poaching, steaming, broiling, pressure frying, grilling, simmering.
6. A cook in your restaurant is roasting several pans of chickens. He thinks they are browning too fast, and he covers the pans with foil to keep the chickens from browning much more. What is wrong with this?
7. What food safety problems are posed by the vacuum packaging and the low cooking temperatures of sous vide cooking?
8. Describe the difference between ***primary flavor*** and ***supporting flavor***. Select a favorite recipe and explain the function of each ingredient, indicating which are primary flavors and which are secondary flavors.
9. What is meant by the phrase "adjust the seasoning"?
10. What is wrong with adding whole caraway seed to a portion of goulash just before serving?