4 Following the Food Product Flow

Coleslaw Linked to Shiga Toxin-producing Escherichia coli *Outbreak*

Twenty-seven people suffered from Shiga toxin-producing Escherichia coli *when they ate contaminated coleslaw at a food establishment near Indianapolis, Indiana. According to a health department report, employees at the establishment made a 100-pound batch of coleslaw using cabbage that was soft, heavily soiled, and had rotten leaves. The food establishment's standard operating procedure was for workers to remove the outer leaves from the heads of cabbage and then wash the heads before processing. However, workers at the establishment reported that the heads of cabbage that were used in the suspect batch of coleslaw had not been washed.*

The unwashed heads of cabbage were cut into 4 pieces. The cabbage, carrots, and onions for the coleslaw were shredded and placed in a sanitized plastic tub. The shredded vegetables were mixed with prepackaged commercial dressing. Workers mixed the coleslaw by hand, wearing elbow-length disposable gloves.

The coleslaw was dispensed into 6- and 16-ounce containers. It was also sold on the lunch buffet table. Leftover coleslaw was stored in the plastic tub in the walk-in cooler. It was used as needed. The batch of coleslaw implicated in this outbreak was used for 2-1/2 days. Leftover coleslaw was not mixed with fresh portions.

Learning Objectives

After reading this chapter, you should be able to:

- Recognize codes and symbols used to designate food products that have been inspected by governmental agencies
- Apply purchasing and receiving procedures that enhance the protection of food products

- Evaluate equipment used to transport food products to food establishments
- Use approved devices to measure temperatures in food products safely and accurately
- Recognize product defects and refuse acceptance of products that do not meet established food safety criteria
- Identify product temperatures required at receiving and storage
- Discuss safe methods to thaw frozen foods
- Identify internal temperature requirements for cooking foods
- Explain the proper methods used to cool foods
- Discuss the importance of employee health and hygiene related to food flow
- Employ measures to prevent contamination and cross contamination of foods.

Essential Terms

Aseptic packaging	Irradiation
Cold-holding	Modified Atmosphere Packaging (MAP)
Cooking	Pasteurization
Cooling	Reheating
First In, First Out (FIFO)	Reduced oxygen packaging (ROP)
Grade standards	Sensory evaluation
Hermetic packaging	Sous-vide
Hot-holding	Wholesome
Inspection for wholesomeness	

A Sound Food Supply

Effective purchasing paves the way for a successful food service operation. Purchasing is a highly skilled activity requiring knowledge of products and market conditions.

The main objectives of an effective purchasing program are to:

- Buy the product that is best suited for the job
- Buy the proper quantity of the item
- Pay the right price for the item
- Deal with only reputable and dependable suppliers.

Purchasing techniques include comparative shopping, evaluation of new products, wise judgment in timing large purchases of seasonal items, and selection of the most efficient supplier. In addition, a buyer must understand foods, specifications, formulations, and be able to evaluate these in terms of price and quality.

Purchase specifications are important to both buyer and management. They are the guidelines that detail the characteristics of a product, including such properties as:

- Quality grade
- Weight
- Count
- Contents
- Packaging.

Specifications make the task of comparison shopping easier, since the characteristics of a product are expressed in a common language and can be used as a basis for evaluation.

Buying from Approved Sources

You should always purchase food that is safe and **wholesome**. Something is wholesome if it is favorable to or promotes health. Food must come from an approved source that complies with all applicable local, state, and federal food laws.

Reputable suppliers deliver food products in vehicles that are clean and in good repair. These vehicles will also keep perishable foods at safe temperatures during transport. Reputable suppliers keep food products separate from general supplies (such as sanitizers or cleaning agents) during shipping. They also protect food packages from becoming damaged or torn. Receiving clerks should be instructed to inspect delivery vehicles. During these inspections, the clerk should check for:

- Cleanliness of the cargo area in the delivery vehicle
- Temperature of refrigerated and frozen storage areas (if applicable)

- Proper separation of food and non-food items
- Signs of insect, rodent, or bird infestation.

Foods prepared in a private home are not considered to be from an approved source. They must not be used or offered for sale in a retail food establishment. Aunt Lou may make the best brownies in town, but unless the health department inspects and approves her kitchen, her homemade products may not be used, or offered for sale, in a food establishment. The use of "home-canned" food is prohibited because of a higher risk for foodborne illness.

In the United States, government agencies closely monitor and regulate food supplies to protect the public from foodborne illness. These agencies at the federal, state, and local levels are concerned with the protection of the food supply available to consumers. The fundamental concern of all these agencies is the safety and wholesomeness of the food supply as it reaches the customers. These agencies work in close cooperation with each other and the food industry. Additional information about these governmental agencies will be provided in Chapter 11, Food Safety Regulations.

Strategies for Determining Food Quality

Sensory evaluation is a commonly used method for making routine quality determinations on foods received at retail food establishments. This type of evaluation involves using the senses of smell, touch, sight, and sometimes taste.

As a first step, foods should be observed for color, texture, and visual evidence of spoilage. Quite often, spoilage is easily seen, as slime formation, mold growth, and discoloration. Product containers should also be checked for tears, punctures, dents, or other signs of damage.

Flavor is a combination of smell and taste. Spoiled foods frequently give off foul odors indicative of compounds such as ammonia and hydrogen sulfide (the smell of rotten eggs). These odors, caused by the breakdown of proteins through bacterial action, are usually very easy to smell (Figure 4.1).

The flavor of spoiled foods can range from loss of good characteristic tastes to the development of objectionable tastes. Spoilage due to yeasts produces bubbles and an alcoholic flavor or smell. Milk develops an acidic taste and is often bitter when it spoils.

Figure 4.1 When in Doubt, Throw It Out!

The feel of spoiled foods is frequently determined by the type of food and the spoilage organism involved. Some foods feel slimy, whereas others may feel mushy.

The quality and safety of a food are affected by many factors. A food that shows no signs of spoilage may not always be safe. Spoilage cannot be used as an indicator of food safety.

Measuring Temperatures at Receiving and Storage

Maintaining safe product temperature is a critical part of your food safety system. According to foodborne disease investigations, improper temperature control during food preparation and service is one of the leading contributors to foodborne illness. Temperature-measuring devices are used in food establishments to measure temperatures of food, water, and the air of food storage areas (refrigerators, ovens, etc.).

You can measure the approximate temperature of packaged foods without opening the package. Place the probe of the thermometer or thermocouple between 2 packages of food or fold the package around

the stem or probe to make good contact with the packaging. The photographs in Chapter 3, Figure 3.5, illustrate ways to measure the temperature of packaged and prepared foods.

To measure the temperature of an unpackaged food, insert the sensing element of the thermometer or thermocouple into the thickest part of the food. To avoid cross contamination of food items, be sure to wash, sanitize, and air-dry the probe of the thermometer before going from a raw food to a cooked food.

Cold- or hot-holding equipment used for potentially hazardous foods must be equipped with an indicating or recording thermometer to measure the temperature of the storage environment. Equipment thermometers are either built into a piece of equipment or are fastened onto shelving or other apparatus. Position them where they can be easily read. **Place the sensor portion of the thermometer in the warmest part of a refrigeration unit or in the coolest part of a hot food storage unit.**

Following the Flow of Food

The flow of food on site begins with receiving and storage. From storage, food products move into the preparation and service phases, which can involve 1 or more steps. A simple diagram showing the flow of food is presented in Figure 4.2.

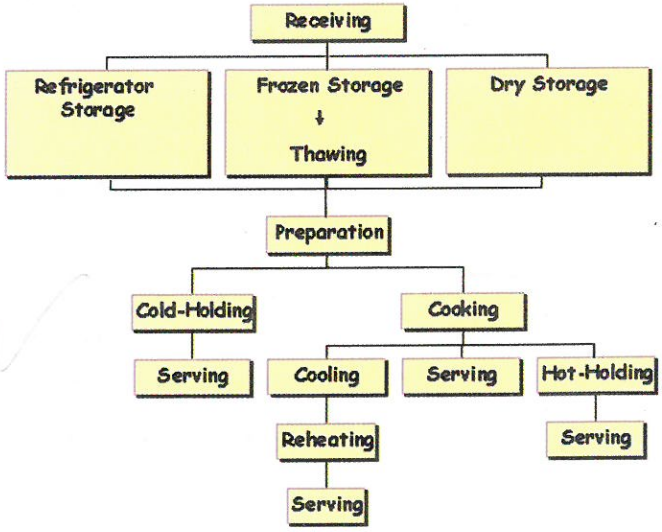


Figure 4.2 Food Flow Diagram

Receiving

Employees responsible for receiving products must carefully inspect all incoming food supplies to make sure they are in sound condition, free from filth or spoilage, and are at the proper temperatures.

As a first step, observe foods for color, texture, and visual evidence of spoilage. Quite often, spoilage is easily visible as in the case of slime formation, mold growth, and discoloration. Check the product containers for tears, punctures, dents, or other signs of damage.

Proper receiving requires a knowledgeable person who follows specific guidelines. Poor receiving procedures increase the chance of:

- Theft
- Acceptance of underweight merchandise
- Contamination
- Waste
- Acceptance of products that do not meet specifications.

Anticipate the arrival of deliveries and make sure enough space is available to receive them. These are 2 critical elements of receiving. Schedule deliveries to avoid peak periods of the day. Employees need to receive and store incoming shipments as soon as they arrive. Always make certain that food products are delivered in clean, well-maintained vehicles that protect the food from contamination and maintain proper product temperature.

Products that are damaged, spoiled, or otherwise unfit for sale or use in a food establishment must be properly disposed of or held by the establishment for credit, redemption, or return to the distributor. It is important that these products not be mistaken for safe and wholesome products and/or cause contamination of other foods, equipment, utensils, linens, or single-service or single-use articles. To prevent this from happening, these products must be segregated and held in designated areas that will keep them separate from food, equipment, utensils, linens, and single-service and single-use articles.

Whatever the size of the food establishment, receiving requires:

- Prompt handling
- Exacting quality control procedures

- Trained staff who have good judgment and experience in interpreting:
  - Product specifications
  - Coding
  - Temperature measurement
  - Proper disposition of distressed merchandise.

Packaged Foods

Heat processing is a common method for preserving foods. Potentially hazardous foods are frequently processed to destroy disease-causing organisms and then placed in a container that is sealed with a hermetic seal. The term **hermetic packaging** refers to a container sealed completely to prevent the entry and loss of gases and vapors. Such a container, since it remains intact, also stops the entry of bacteria, yeasts, molds, and other types of contamination. The most common hermetic containers are rigid metal cans and glass bottles.

Always check cans for:

- Leaks
- Bulges
- Dents
- Broken seals
- Damage along seams
- Rust
- Missing labels.

Do not accept cans if they leak or bulge at either end. Swollen ends on a can indicate that gas is being produced inside. This gas may be caused by a chemical reaction between the food and the metal in the container, or it may be caused by the growth of microbes inside the can.

Dents in cans do not harm the contents unless they have actually penetrated the can or sprung the seam. This damage can cause "pinhole" leaks that allow microbes to enter. Shipments with many dented cans or torn labels indicate poor handling and storage procedures by the supplier. Figure 4.3 shows some common defects found in cans.

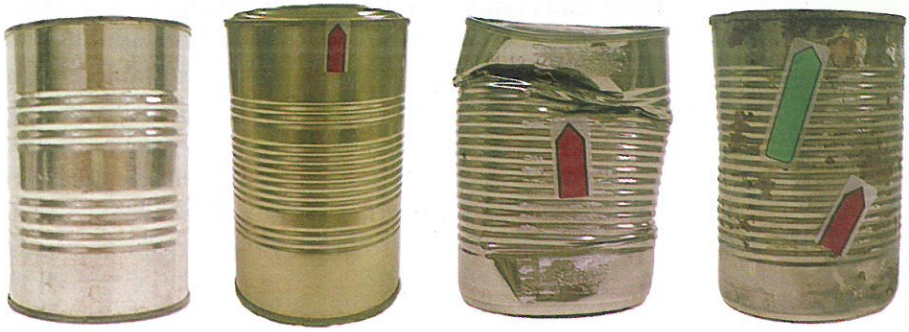


Figure 4.3 Normal and Defective Cans

(Courtesy Damage Recovery Systems, Inc.)

Modified Atmosphere Packaging (MAP) is a process whereby foods are placed in containers and air is removed from the package (Figure 4.4). Different gases, such as nitrogen and carbon dioxide, are then added to the packaged food to preserve it. This technique allows centralized processing and packaging of retail cuts of meat and poultry, thus eliminating entirely the need for processing at the food establishment.

Sous-vide is the French term for "without air." Processors of sous-vide foods seal raw ingredients, often entire recipes, in plastic pouches and then vacuum out the air. They then minimally cook the pouch under precise conditions and immediately refrigerate it. Some processors replace some of the air in the pouches with nitrogen or carbon dioxide. Processing food in this manner eliminates the need for the extreme cold of freezing and the intense heat of canning, thus better preserving taste.

a. Pre-Cut Salad Items **b. Vacuum Packaged Meat**

Figure 4.4 Examples of MAP Foods

Potentially hazardous foods processed using the sous-vide technique must be kept out of the food temperature danger zone. The lack of oxygen inside the package provides a suitable environment for the growth of *C. botulinum*. **The sous-vide process may not destroy these harmful bacteria and does not destroy spores.** If the food is not refrigerated and kept out of the temperature danger zone, the spores may germinate and form vegetative bacterial cells. The botulism bacteria can produce toxins that may be fatal if eaten.

The FDA recommends that sous-vide foods be:

- Used by the expiration date printed on the package
- Refrigerated constantly [safe cold storage temperatures may need to be below 41 °F (5°C)]
- Be heated according to the time and temperature provided on the package directions.

Food **irradiation** is a preservation technique used by some food processing industries. This process involves exposing food to ionizing radiation in order to destroy disease-causing microbes and delay spoilage. The FDA has approved food irradiation for a variety of foods including fruits, vegetables, grains, spices, poultry, pork, lamb, and, more recently, ground beef.

The acceptance of irradiated foods has been limited due to consumer fears. However, contrary to many myths, irradiated food is not radioactive and does not pose a risk to consumers. Foods that are processed with irradiation are just as nutritious and flavorful as other foods that have been cooked, canned, or frozen.

Federal law requires that all irradiated food must be labeled with the international symbol for irradiation called a "radura" (Figure 4.5). This symbol must be accompanied by the words "Treated with Irradiation" or "Treated with Radiation."

Irradiation of food can effectively reduce or eliminate pathogens and spoilage microbes while maintaining the quality of most foods. This is a technology that has been proven safe and should be welcomed by consumers as an effective food preservation technique.

Figure 4.5 Radura

Red Meat Products

Primarily red meat and meat products come from cattle (beef), calves (veal), hogs (ham, pork, and bacon), sheep (mutton), and young sheep (lamb). These products are inspected for wholesomeness by officials of the U.S. Department of Agriculture (USDA) or state agencies. Animals must be inspected prior to and after slaughter to make certain they are free of disease and unacceptable defects. *The USDA also offers voluntary meat grading services. Grade standards for meat represent the quality or palatability of the meat and are not measures of product safety.* Figure 4.6 contains examples of inspections and grading stamps applied to products approved for use.

Meat and meat products are obtained in several forms such as fresh, frozen, cured, smoked, dried, and canned. **Since meats are potentially hazardous foods, never accept them if there is any sign of contamination, temperature abuse, or spoilage.**

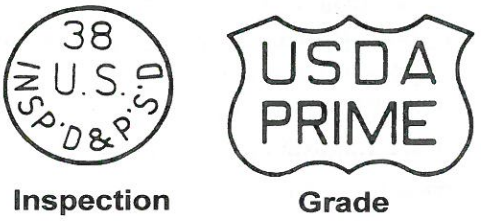


Figure 4.6 USDA Inspection and Grade Stamps for Beef, Veal, and Lamb

Never accept fresh meat if the product temperature exceeds 41°F (5°C) at delivery. Fresh meat should be firm and elastic to the touch and have characteristic aromas. "Off" odors are frequently an indicator of spoilage. Sliminess is another characteristic of spoilage and is caused by bacterial growth on the surface of meat. Control of factors that cause spoilage and sliminess also extends the shelf life of meat products.

Frozen meats should be solidly frozen when they arrive at the food establishment. Look for signs of freezing and thawing and refreezing such as frozen blood juices in the bottom of the container or the presence of large ice crystals on the surface of the product. Frozen meats should be packaged to prevent freezer burn. Move these products quickly from the delivery truck to the freezer for storage.

Game Animals

Game animals are not allowed to be sold or served in retail food establishments unless they meet federal code regulations. This ban does not apply to commercially raised game animals approved by regulatory agencies, field dressed game allowed by state codes, or exotic species of animals that must meet the same standards as those of other game animals.

Game animals that are commercially raised for food must be raised, slaughtered, and processed according to standards used for meat and poultry. Common examples of animals raised away from the wild and used for food are farm-raised buffalo, ostrich, and alligator. The USDA inspects the slaughter and processing of this meat in the usual manner.

Some states permit game animals, such as deer, bear, and elk, that have been killed and dressed in the field, to be used in food establishments. Game meat must be dressed soon after the kill to prevent rapid growth of bacteria already present in the meat. Next, the meat must be chilled rapidly, transported in a sanitary manner, and processed in an approved facility. Veterinarians are frequently appointed to inspect meat for contamination that would harm humans.

Some people consider exotic species of animals a delicacy. A distributor providing this type of product (elephant, tiger, monkey, etc.) must meet the same standards as those for domestic wild game. Endangered species may be prohibited by law from being used for food.

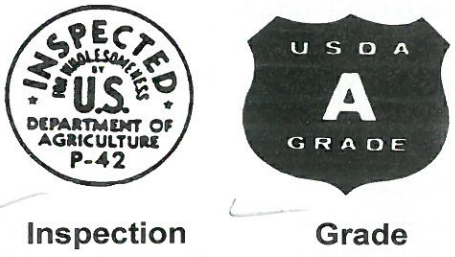
Poultry

Poultry is a very popular food item in America. Chicken, turkey, duck, geese, and other types of poultry are used all year long for roasting, frying, broiling, grilling, and stewing.

All poultry products must be inspected for wholesomeness by the USDA or state inspectors. **Inspection for wholesomeness** involves an examination of the poultry to make certain it is wholesome and is not adulterated. The poultry is examined live before slaughter, during evisceration (removal of the internal organs), and during or after packaging. Inspected poultry products carry a USDA seal for wholesomeness on the individual package or on bulk cartons. Examples of inspection and grade stamps for poultry are shown in Figure 4.7.

Usually poultry is graded also for quality. Top quality birds receive a Grade A rating. To earn a Grade A rating, the poultry must have good

overall shape and appearance, be meaty, practically free from defects, and have a well-developed layer of fat in the skin.



Inspection Grade

Figure 4.7 USDA Inspection and Grade Stamps for Poultry

Poultry products support the growth of disease-causing and spoilage microorganisms. The intestinal tract and skin of poultry may contain a variety of foodborne disease bacteria, including *Salmonella spp.* and *Campylobacter jejuni.* The near neutral pH, high moisture, and high protein content of poultry make it an ideal material for bacteria to grow in and on (Figure 4.8).

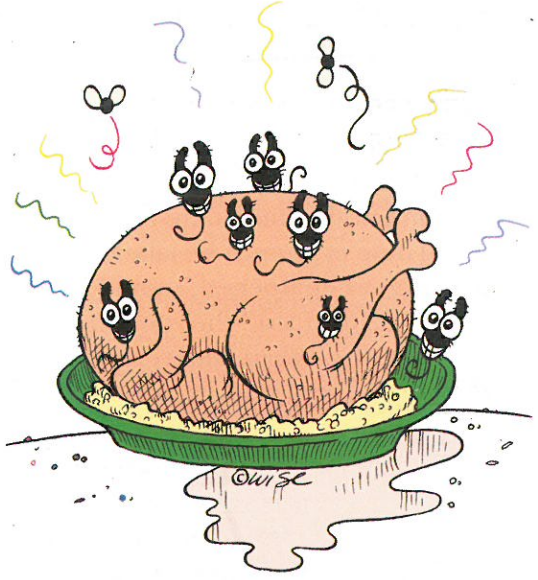


Figure 4.8 Spoiled Poultry

Poultry products are also vulnerable to spoilage caused by enzymes and spoilage bacteria.

Most spoilage bacteria come from the live bird's skin or intestinal tract. The bacteria grow on the skin of slaughtered birds and inside the birds' carcasses. Spoilage is indicated by meat tissue that is soft, slimy, and has

an objectionable odor. Stickiness under the wings is another sign of poultry spoilage. Darkened wing tips on poultry are caused by drying or exposure to freezing temperatures. Poultry that is discolored or has darkened wing tips or sticky skin should be rejected. At the time of delivery, poultry should be packaged on a bed of ice that drains away from the meat as it melts and held at or below 41°F (5°C).

Eggs

Most food establishments, regardless of their size or menu, use eggs in 1 form or another. Eggs are usually purchased by federal grades, the most common being AA, A, and B (Figure 4.9). Grades for eggs are based on exterior and interior conditions of the egg. Eggs cannot receive a grade when they are dirty, cracked, or broken.

The USDA reports that approximately 50 billion eggs are sold in the United States each year. *Salmonella enteritidis* bacteria are present in about 1% (approximately 500 million) of the eggs sold. This bacteria enters the yolk of the egg as it is formed inside the hen. The egg shell surface may contain *Salmonella spp.* bacteria, especially if the shell is soiled with chicken droppings. Even if the shell is not cracked, bacteria can enter through the pores in the egg's shell. Raw shell eggs should be clean, fresh, free of cracks or checks, and refrigerated at 45°F (7°C) or below when delivered. Shell eggs that have not been treated to destroy all viable *Salmonella* should be immediately placed in refrigerated equipment that maintains an ambient air temperature of 45°F (7°C) or less. These eggs must be labeled to include safe-handling instructions. The egg, when opened, should have no noticeable odor, the yolk should be firm, and the white should cling to the yolk. Reject eggs that are dirty or cracked, and remember that washing eggs only increases the possibility of contamination.

Figure 4.9 USDA Inspection and Grade Stamps for Eggs

An egg product is defined as an egg without its shell. As a safeguard against *Salmonella spp.*, the FDA requires that all egg products, such as

liquid, frozen, and dry eggs, be pasteurized to render them *Salmonella*-free. Pasteurized egg products should be in a sealed container and kept at 41°F (5°C). Egg containers should carry labels that verify that the contents have been pasteurized.

New techniques have been developed to pasteurize whole shell eggs. These products are well suited for facilities that offer food to people in high risk groups.

The shelf life of eggs is limited. Only buy the quantity of eggs the establishment will use in a 1- or 2-week period.

Fluid Milk and Milk Products

This food group includes milk, cheese, butter, ice cream, and other types of milk products. When receiving milk and milk products, make certain they have been pasteurized. **Pasteurization** destroys all disease-causing microorganisms in the milk and reduces the total number of bacteria, thus increasing shelf life. All market milk must be Grade A quality. Pasteurization also destroys natural milk enzymes that might shorten the shelf life of the products.

Milk that is marked "UHT" is pasteurized using ultra-high temperatures and is placed in **aseptic packaging**. UHT products can be stored safely for several weeks if kept under refrigeration. No refrigeration is required for short storage periods (Longrèe and Armbruster, 1996). Individual creamers are sometimes processed in this manner.

Fluid Milk

Fluid milk is a potentially hazardous food that must be received cold and refrigerated immediately upon delivery. Keep containers of fluid milk and dairy creamers at 41°F (5°C) or below. Individual containers of milk should be clearly marked with an expiration date and the name of the dairy plant that produced it. Check the expiration date of all dairy products before using them.

Cheese

Cheese should be received at 41°F (5°C). It should be inspected to make certain it possesses the proper color, flavor, and moisture content. Cheese should be rejected if it contains mold that is *not* a normal part of the cheese or if the rind or package is damaged.

Butter

Butter is made from pasteurized cream. Since disease-causing and spoilage bacteria and mold may grow in butter, handle the product as a

perishable item. The most common type of deterioration in butter is the development of a strong odor and flavor. Check to see that butter has a firm texture, even color, and is free of mold. The package should be intact and provide protection for the contents.

Staphylococcus aureus toxin has been the cause of foodborne disease outbreaks where butter and cheese were involved. *Staphylococcus aureus* does not require as much moisture as other pathogens and can thrive in salty foods which would inhibit other pathogens. Therefore, cheese and butter must be handled carefully and kept out of the temperature danger zone, except as required during production.

Fish

Fish includes finfish that are harvested from saltwater and freshwater and seafood that comes mainly from saltwater. Catfish and trout are two of the most popular types of freshwater finfish. Tuna, snapper, and flounder are saltwater finfish that are very popular with American consumers. Seafood consists of molluscan shellfish and crustaceans. Molluscan shellfish include oysters, clams, mussels, and scallops. Crustaceans include shrimp, lobster, and crab. Oysters, shrimp, catfish, salmon, and a few other types of finfish and seafood are being raised on fish farms using a technique called "aquaculture".

Fish and seafood are generally more perishable than red meats, even when stored in a refrigerator or freezer. Fish and seafood are typically packed on self-draining ice to prevent drying and to maximize the shelf life of the product. The slime covering fish and shellfish contains a variety of bacteria that makes them highly susceptible to contamination and microbial spoilage. Fish are also rich in unsaturated fatty acids which are susceptible to oxidation and the development of off-flavors and rancidity.

The quality of fish and seafood is measured by smell and appearance. Fresh finfish should have a mild, pleasant odor and bright, shiny skin with the scales tightly attached. Fish with the head intact should have clear, bulging eyes and bright red, moist gills. The flesh of fresh fish should be firm and elastic to the touch.

Fish must be commercially and legally caught or harvested, except when caught recreationally and approved for sale by the regulatory authority. Ready-to-eat raw, marinated, or partially cooked fish other than molluscan shellfish must be frozen throughout to a temperature of -4°F (-20°C) or below for 7 days in a freezer, or -31°F (-35°C) or below for 15 hours in a blast freezer, before service or sale. Records must be retained that show how the product was handled.

Shellfish must be purchased from sources approved by the Food and Drug Administration and the health departments of states located along the coastline where the shellfish is harvested. Shellfish transported from one state to another must come from sources listed in the *Interstate Certified Shellfish Shippers List.* The reason for requiring tight control over molluscan shellfish is to reduce the risk of infectious hepatitis and other foodborne illnesses that may result from eating raw or insufficiently cooked forms of this product.

When received by a food establishment, molluscan shellfish should be reasonably free of mud, dead shellfish, and shellfish with broken shells. Damaged shellfish must be discarded.

Molluscan shellfish must be purchased in containers that bear legible source-identification tags or labels (Figure 4.10) that have been fastened to the container by the harvester and each dealer that shucks, ships, or reships the shellstock. Molluscan shellfish tags must contain the following information:

- The harvester's identification number
- The date of harvesting
- The harvesting site
- The shellfish type and quantity
- A statement about leaving the tag on the container until the shellfish is used
- Instructions to keep the tag on file for ninety (90) days.

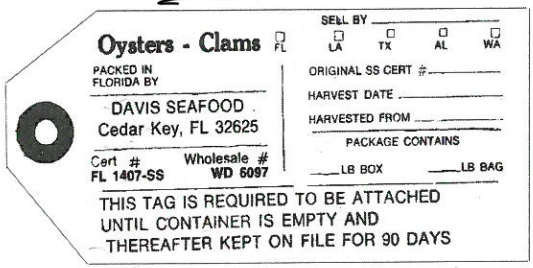


Figure 4.10 Example of Shellfish Tag

A shellstock tag must remain attached to the original container until the container is empty. These tags must be held for at least 90 days after the container is emptied. If seafood is suspected of being the source of foodborne illness, the investigating team can use the tags to determine where and when the product was harvested and processed.

Do not remove shellstock from the shipping container until right before sale or preparation for service, unless it is held on drained ice or in a display case that protects it from contamination. When it is necessary to remove the shellfish from the original, tagged container, only 1 container of shellfish should be used at a time. Molluscan shellfish caught recreationally *may not* be used or sold in food establishments.

Vegetables and Fruits

Most fruits and vegetables spoil very rapidly. They continue to ripen even after they are picked. Therefore, they may become too ripe if not properly handled. Microorganisms found in water and soil can also cause fruits and vegetables to spoil. Fruits and vegetables hold their top quality for only a few days.

Some products, like wild mushrooms, may only be used if they have been inspected and approved by a mushroom-identification expert who is approved by the regulatory authority. Beware of fresh mushrooms that are packaged in styrofoam trays and covered with plastic shrink wrap. Mushrooms have a high rate of respiration which will quickly use up the oxygen inside the package. Unless holes are poked in the plastic wrap that covers the package to permit oxygen inside, oxygen-free conditions may occur that are favorable for the growth of *Clostridium botulinum* bacteria.

Fresh fruits and vegetables are usually not considered potentially hazardous foods. However, the number of cases of foodborne illnesses linked to these kinds of products have increased in recent years. This is largely due to increased consumption of fresh fruits and vegetables and the emergence of microbes that can cause disease with a low number of organisms. Shiga toxin-producing *Escherichia coli*, *Shigella spp.*, Hepatitis A virus, and *Cyclospora spp.* can be infective with only a few cells. Therefore, they do not require a potentially hazardous food to multiply. **Purchase raw fruits and vegetables from approved sources and wash them thoroughly to remove soil and other contaminants before they are cut, combined with other ingredients, cooked, served, or offered for human consumption in a ready-to-eat form.** Though not required, whole raw fruits and vegetables may be washed using cleaners and antimicrobial agents. When these types of chemicals are used, they must meet the requirements in the Code of Federal Regulations (21CFR 173.315). The fruits and vegetables should also be rinsed to remove as much of the residues of these chemicals as possible.

Whole raw fruits and vegetables that will be washed by the consumer before consumption do not need to be washed before they are sold.

Juice and Cider Products

In the past few years, there have been several outbreaks related to juice and cider products containing pathogens like *Salmonella* and *E. coli* O157:H7. Most juice products have a pH less than 4.6; however, some pathogens can survive over the shelf life of the product and lead to illness. Heat pasteurization is the most effective way to ensure juice products are safe. There are other types of pasteurization processes for juice that are being studied such as the use of ultraviolet light.

For juice products that have not been pasteurized, FDA now requires they be labeled to inform consumers of the potential risk with the following label information: "WARNING: This product has not been pasteurized and, therefore, may contain harmful bacteria that can cause serious illness in children, the elderly, and PERSONS with weakened immune systems." More recent regulations require all processors of nonpasteurized juice to have a HACCP program in place to minimize risks. Processors are also required to have a process in place to reduce microbial levels in juice.

Frozen Foods

Frozen products must be solidly frozen when delivered. The temperature of frozen foods can be checked by inserting the sensing portion of a thermometer between 2 packages. Receiving personnel should also look for signs that the product has been thawed and refrozen. Common signs of thawing and refreezing are large ice crystals on the surface of a frozen food and frozen liquids or juices inside the package. Reject frozen foods that are not solidly frozen or show signs of temperature abuse.

Proper Storage of Food

Merely assigning someone to check incoming shipments is not enough. Besides knowing what to look for upon delivery, employees must also know how and why to safely handle the food products that are left at the establishment. They must move the materials to the desired storage areas quickly, using clean carts and dollies to transport the food.

Stock rotation is a very important part of effective food storage. A **First In, First Out (FIFO) method** of stock rotation helps ensure that older foods are used first (Figure 4.11). Product containers should be marked with a date or other readily identifiable code to help food workers know which product has been in storage longest. When expecting food

shipments, always make certain the older stock is moved to the front of the storage area to make room for the newly arriving product in the rear.

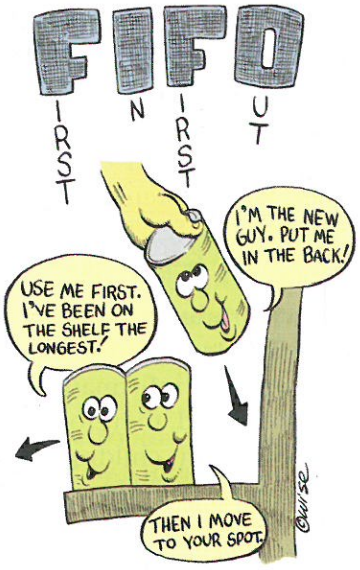


Figure 4.11 Proper Stock Rotation

Types of Storage

The three most common types of food storage areas are the:

- Refrigerator
- Freezer
- Dry storage.

Refrigerated storage is used to hold potentially hazardous and perishable foods for relatively short periods of time, usually a few days. Freezer storage is used to hold foods for longer periods of time, usually a few weeks to several months. Dry storage is typically used to store less perishable items and foods that are not potentially hazardous foods.

Refrigerated storage slows down microbial growth and preserves the quality of foods. Some common types of refrigerated storage equipment are walk-in, reach-in, and pass-through refrigerators. This equipment usually maintains the air temperature in the storage compartment at about 38°F (3° C). Potentially hazardous foods must be stored at 41°F (5°C) or below. Fish and shellfish that are especially vulnerable to spoilage should be stored at colder temperatures ranging from 30°F (-1°C) to 34°F (1°C). Some fruits and vegetables, such as bananas and potatoes, undergo undesirable chemical changes when they are refrigerated.

Therefore, although fruits and vegetables are perishable products, not all types of them should be refrigerated. Fresh fruits and vegetables requiring refrigeration should be stored at temperatures between 41°F (5°C) and 45°F (7°C). Refrigerators must be equipped with a temperature-measuring device located to measure the air temperature or a simulated product temperature in the warmest part of the refrigerated unit.

Freezers are designed to keep foods solidly frozen. Freezer equipment must also be equipped with indicating or recording thermometers to monitor the temperature of the ambient air inside the unit. If your freezer is not frost free, defrost it regularly to ensure proper operation. Wrap frozen foods and transfer them to the refrigerated storage area until the defrosting process is complete.

Some important procedures for cold storage are listed below:

- Rotate refrigerated and frozen foods on a *First In, First Out* (FIFO) basis. Store foods in covered containers that are properly labeled and dated.
- Store foods in refrigerated and freezer storage areas at least 6 inches off the floor. Space products to allow the cold air to circulate around them.
- Store raw products under cooked or ready-to-eat foods to prevent cross contamination.
- When storing raw animal foods, always store poultry on the bottom shelf, ground beef and pork on the middle shelf, and fish, eggs, and other red meat products on the top shelf.

Use a *dry storage area* to store foods that are usually packaged in cans, bottles, jars, and bags (see Figure 4.12). These products must be labeled according to federal regulation and come packaged from approved commercial facilities.

Figure 4.12 Dry Storage Area

The dry storage area should have a moderate room temperature of 50°F (10°C) to 70°F (21°C) and a relative humidity of 50% to 60% to maximize the shelf life of the foods stored there. The quality of some foods is reduced by sunlight. Therefore, windows are not recommended in dry storage areas. If windows are present, they should be blocked out or shaded.

Stored foods in the dry storage area should be on slatted shelves, at least 6-inches off the floor and away from the wall (Figure 4.13). The 6-inch clearance permits thorough cleaning under and behind the shelving. It also discourages insects and rodents from harboring there. Products should be spaced on the shelves so that air can circulate around them.

If it is necessary to transfer bulk items, such as flour, sugar, and grain foods, into other containers, these containers must be constructed of food-grade materials and equipped with tight-fitting lids. Scoops and other utensils that are used to remove food from bulk food containers must be constructed of nontoxic, nonabsorbent, and easily cleanable

material. These utensils must be equipped with handles and stored in a manner that will allow food workers to grip the handle of the utensil without touching the food with their hands.

Figure 4.13 Store Dry Foods on Slatted Shelving

Make certain the containers are properly coded, or dated, and labeled with the common name of the food. Containers holding food that can be easily and accurately recognized, such as dry pasta, do not need to be labeled.

Do not use toilet rooms, locker areas, mechanical rooms, and similar spaces for storage of food, single-service items, paper goods, or equipment and utensils. Do not expose products to overhead water and sewer lines unless the lines are shielded to interfere with potential drips (Figure 4.14).

Figure 4.14 Contamination of Ready-to-Eat Food

There are several types of chemicals that may be used in a retail food establishment. Many of these chemicals may be poisonous if consumed. Others may cause irritation to skin or can cause damage to your respiratory system. Regardless of the type of chemical, it must be properly labeled. A good label identifies the chemical and provides directions on how chemicals should be used. A person also needs to know when to use chemicals. This is often indicated on the label. However, it is always a good practice to have a "list of instructions" or standard operating procedure so employees clearly understand how and when chemicals should be used. It is very important to avoid contamination of foods by chemicals. Chemical contamination commonly occurs during improper storage and during cleaning and sanitizing operations. Chemicals need to be segregated from food items and ingredients at all times (Figure 4.15). If space permits, store chemicals in a completely separate area away from the dry food storage

area. If a separate storage space is not available, store these chemicals in a locked and labeled cabinet.

Figure 4.15 Do Not Store Chemicals Near Food

Storage Conditions for Foods

Meat and meat products come in a variety of forms including fresh, frozen, cured and smoked, dried, and canned. Fresh meat can be stored for up to 3 weeks at temperatures between 32°F (0°C) and 41°F (5°C) and with a relative humidity between 85% and 90%. Cold temperatures extend the shelf life of red meats by slowing down the growth of bacteria that cause spoilage. The high relative humidity prevents excessive drying and shrinkage.

Frozen meats can be stored for several months when held at 0°F (-18°C) or below. Frozen meats must be wrapped in moisture-proof paper to prevent them from drying out. Packaging for frozen foods should also be strong, flexible, and protect against light.

Poultry can be safely stored at temperatures between 30°F (-1°C) and 36°F (2°C) for short periods of time. A relative humidity of 75% to 85% is recommended, as excessive humidity causes sliminess due to excessive bacterial growth. Poultry should be wrapped carefully to prevent dehydration, contamination, and loss of quality. Frozen poultry and

poultry products can be stored for 4 to 6 months when held at 0°F (-18°C) or below.

Whole shell eggs will keep fresh for up to 2 weeks when stored at 41°F (5°C) or below. Egg quality deteriorates rapidly at room temperature. Egg shells are porous and odors can be absorbed very easily. Keep eggs covered and store them away from onions and other foods that have a strong odor. Discard eggs that are dirty or cracked. Always make sure to wash your hands after handling whole shell eggs.

Egg products such as whole eggs, egg whites, and yolks are pasteurized to destroy *Salmonella* bacteria. Fresh egg products should be stored at 41°F (5°C) or below. Store frozen eggs at 0°F (-18°C) or below and keep them frozen until time for defrosting. Refrigerate dried egg products or keep them in a cool, dry place. Once dried eggs have been reconstituted, they are considered potentially hazardous and must be stored out of the temperature danger zone.

Milk is one of the most perishable foods handled in a food establishment. However, properly pasteurized milk that has not been recontaminated and is held at 41°F (5°C) will keep for up to 10 days or longer. The optimal storage temperature for fluid milk is 33°F (1°C) to 41°F (5°C), and the shelf life of milk is shortened significantly at higher storage temperatures. For example, milk held at 60°F (16°C) will stay fresh less than 1 day. Milk also picks up odors from other foods. Therefore, store milk in an area away from onions and other foods that give off odors.

Fish and shellfish are more perishable than red meats, even when refrigerated or frozen. There are many bacteria in the surface slime and digestive tracts of living fish. When a fish is killed, bacteria attack the tissue of the fish. This bacteria lives on cold-blooded fish at low-water temperatures. Therefore, they adapt well to the cold and continue to grow even under refrigerated conditions. The shelf life of fresh fish depends on many factors, including species, season of the year, physical condition (whether filleted or dressed), and manner of handling.

Most shellfish are even more perishable than finfish. The shells of live clams and oysters should be closed or close when tapped. Lobsters and crabs should be kept alive until they are cooked or frozen. Otherwise, they lose quality in a day or less.

Fish and shellfish should be used within 24 hours unless they are stored in crushed ice that will drain away from the product as it melts. Products that are stored in ice should be placed *under* cooked or ready-to-eat foods to prevent cross contamination.

Maximum period

Food	Freezer	Refrigerator
Meat and Fish		
Bacon (opened)	1-2 months	5-7 days
(unopened)	1-2 months	2 weeks
Deli meat salads	N/A	3-5 days
Fish (fresh)	3-6 months	1-2 days
(cooked)	1 month	3-4 days
(smoked)	4-5 weeks	10 days
Ground beef	3-4 months	1-2 days
Ham (sealed in can)	N/A	6-9 months
Hot dogs (unopened)	1-2 months	2 weeks
(opened)	N/A	5 days
Luncheon meats (unopened)	1-2 months	2 weeks
(opened)	N/A	1 week
Meat pie or casserole	3 months	2-3 days
Meats (fresh)	3-6 months	3-7 days
Meats (ground)	3-4 months	1-2 days
Pork chops	3-4 months	2-3 days
Sausage (fresh)	3-4 months	1-2 days
Poultry and Eggs		
Poultry (cooked)	2 months	1-2 days
Poultry (fresh)	6 months	2 days
Eggs (in shell)	N/A	2 weeks
(hard-cooked)	N/A	1 week
Egg substitutes (unopened)	1-2 months	10 days
(opened)	N/A	3 days
Dairy		
Butter	10 months	2 weeks
Cheese, hard (unopened)	1-2 months	3-6 months
(opened)	N/A	3-4 weeks
(sliced)	N/A	2 weeks
Cottage cheese	N/A	10-30 days
Cream cheese	1-2 months	2 weeks
Margarine (stick form)	12 months	"use by" date
Milk	1 month	"use by" date
Sour cream	N/A	2-4 weeks
Yogurt	N/A	1-2 weeks
Fruit and Vegetables		
Asparagus (fresh)	N/A	2-3 days
(frozen)	1-2 months	1 day
Broccoli (fresh)	N/A	3-5 days
(frozen)	1-2 months	1 day
Cabbage (fresh)	N/A	1 week
Carrots (fresh)	N/A	2 weeks
Cauliflower (fresh)	N/A	1 week
Celery	N/A	7-10 days
Corn (fresh)	N/A	1 day
Fruit (fresh	9-12 months	3-5 days
(dried)	1 year	4 days (cooked)
Lettuce	N/A	1 week
Vegetables (canned, opened)	N/A	1-4 days

Figure 4.16 Recommended Cold Storage Guidelines
(Source: Washington State University Cooperative Extension Service)

The ideal storage conditions for fresh fruits are temperatures between 41°F (5°C) and 45°F (7°C), a relative humidity of about 80%, and shaded from light. During respiration and ripening, fresh fruits give off carbon dioxide and water. Because of this, they may become wilted and lose flavor. Proper air circulation in the refrigerated storage area is necessary to maintain freshness and firmness. Inadequate ventilation leads to spoilage and deterioration. Regularly inspect stored fruits. Discard any that begin to spoil.

Vegetable storage requires low temperatures and high humidity to preserve texture, tenderness, flavor, color, and nutritive content. To retain top quality, vegetables should be stored between 41°F (5°C) and 45°F (7°C) with a relative humidity of 85% to 95%. If fresh fruits and vegetables come packed with an airtight film, poke holes in it to allow the contents to breathe. Otherwise, "off" flavors and odors may develop.

Preparation and Service

The preparation and service of foods can involve one or more steps. In small food establishments, such as convenience stores, food products are commonly purchased in ready-to-eat form and are stored until sold to the consumer. Large operations, such as restaurants, supermarkets, and institutional feeding facilities, prepare and serve food in vast quantities. Food production in these larger establishments may span several hours or days. These operations are more complex and may involve many steps.

Regardless of how many steps may be involved in food production and service, foodborne illness prevention requires effective food safety measures that ensure good personal hygiene and avoid cross contamination and temperature abuse. Food safety strategies aimed at addressing these practices will be discussed in the remainder of this chapter.

During preparation, an important technique that can be used to promote food safety is "small batch" preparation. Food preparation is usually done at room temperature. This is several degrees into the temperature danger zone. Therefore, you must limit the amount of time the food is in the danger zone by working with small and manageable amounts of potentially hazardous ingredients.

Ingredient Substitution

There is normally a recipe for all products that are prepared in retail food establishments. The recipe usually includes a list of ingredients

and instructions for how to prepare, store, and label the food item. When there is a lack of ingredients available for a recipe, other ingredients may be substituted so that the food item can still be prepared and sold. However, all ingredients substitutions should be identified in the recipe beforehand. Ingredient substitutions may also be appropriate for "rework" products. For example, if there is an excess of rotisserie chickens that are unlikely to be sold, the chicken may be cooled and then used in another recipe for cold chicken salad. Ingredient substitutions may never compromise the safety of the food and should not be allowed unless they are identified and allowed in the recipe.

Handwashing

Hands, especially the tips of the fingers, are known to be significant sources of contamination and cross contamination of foods. This is especially true during the steps of preparation and service. Prevention of foodborne illnesses begins with good personal hygiene and includes proper handwashing (Figure 4.17). The importance of scrubbing forearms, hands, and nails using soap, running water, and friction cannot be overstated. With the vigorous removal of visible soil, harmful microbes can be washed down the drain.

Figure 4.17 Which Hand Do You Want to Handle Your Food?

Avoiding Temperature Abuse

In Chapter 5, the Hazard Analysis Critical Control Point System (HACCP) is presented, and you will identify areas of risk. If you work in

a food establishment, you must *know how and when to use a thermometer.* **Temperature and time are the most common critical control points as identified in the HACCP flow charts in preparation and service.** *Monitoring and controlling food temperatures* are extremely effective ways to *minimize the risks of foodborne illnesses.* Thermometers are used for stored, cooked, hot-held, cold-held, and reheated foods. Various types of thermometers are used throughout the food establishment. Some of these instruments were described and shown in Figure 3.3. Before using a thermometer, make sure that it is clean, sanitary, and properly calibrated. The "sensor" portion or probe stem of the thermometer must be inserted into the thickest part of the food.

Freezing

Most harmful bacteria and other microorganisms do not grow at temperatures below 41°F (5°C). However, many spoilage microorganisms grow at much colder temperatures. Therefore, frozen foods must be kept *solidly* frozen.

Sometimes freezing foods can make them safer. Although bacteria are generally not destroyed by freezing, parasites can be killed if frozen at the proper temperature for the proper length of time. Figure 4.18 presents the parasitic destruction guidelines that have been established for raw-marinated and marinated, partially cooked fish. Yellowfin, bigeye, bluefin-southern, bluefin-northern and certain other species of tuna may be served or sold in a raw, raw-marinated, or partially cooked ready-to-eat form without freezing.

Food should be frozen throughout to -4°F (-20°C) and held for 7 days in a freezer,

or

Food should be frozen throughout to -31°F (-35°C) using a blast chiller, and held at that temperature for 15 hours.

Figure 4.18 Guidelines for Parasitic Destruction

(Source: *FDA Food Code*)

It is difficult to measure the *internal* temperature of packaged frozen foods. However, it is acceptable to place a thermometer between 2 fully-frozen packaged foods to gain a reading. Be sure to monitor the temperature of your freezer unit regularly to make sure it is working

properly. However, you must understand that measuring the temperature of the freezer is never the same as measuring the actual food temperature.

Thawing

Freezing prevents microbial growth in foods, but does not destroy all microbes. Improper thawing provides an opportunity for surviving bacteria to grow to harmful numbers and/or produce toxins.

Thawing frozen foods is a common activity in food establishments. The most common and acceptable methods for thawing foods include: in a refrigerator, in a microwave oven followed by immediate cooking, under cool running water, and as part of the cooking process (Figure 4.19).

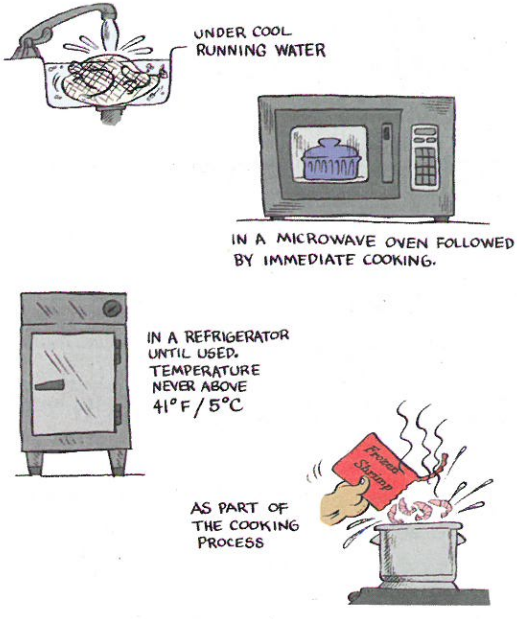


Figure 4.19 Safe Ways to Thaw Food

The preferred method of thawing is in the refrigerator, since foods thawed in this manner would not have the opportunity to be in the temperature danger zone. This method requires good planning and adequate refrigeration space. It can take 2 or 3 days and sometimes longer to thaw large food masses such as turkeys, roasts, and hams. When using this method to thaw foods, you must plan ahead.

Foods thawed in the microwave must be cooked immediately after thawing. Cooking can be done in the microwave oven or with conventional cooking equipment. Do not thaw foods in a microwave oven and *then* store them in a refrigerator before they are cooked. The thawing process may initiate microbial activity that could reach dangerous levels during refrigerated storage.

Potentially hazardous foods, like turkey and roasts, can be thawed under cool [less than 70°F (21°C)] running water. Thaw raw animal food less than 4 hours including the time it takes for preparation for cooking.

Do not allow thawed portions of potentially hazardous foods to rise above 41°F (5°C). The *FDA Food Code* permits this temperature to increase to 45°F (7°C) if refrigeration equipment currently in use is **not** capable of maintaining food at 41°F (5°C). The *FDA Food Code* also recommends that equipment that is in use and is not capable of maintaining the food at 41°F (5°C) be upgraded or replaced within 5 years of the regulatory authority's adoption of the *FDA Food Code*. Refer to the guidelines in Figure 4.20 for more information about proper thawing methods.

- ▲ Under refrigeration that maintains the food temperature at 41°F (5°C) or below
- ▲ Completely submerged under running water
  - ▼ At a water temperature of 70°F (21°C) or below
  - ▼ With enough water velocity to remove contaminants from the surface of the food
  - ▼ For a period of time that does not allow thawed portions of ready-to-eat foods to rise above 41°F (5°C)
  - ▼ For a period of time that does not allow thawed portions of a raw animal food requiring cooking to be in the temperature danger zone for more than a total time of 4 hours
- ▲ As a part of the cooking process
- ▲ Use any procedure (i.e., microwave oven) that thaws a portion of frozen ready-to-eat food that is prepared for immediate service in response to an individual consumer's order.

Figure 4.20 Guidelines for Thawing Food
(Source: *FDA Food Code*)

Food establishments will sometimes use a slacking (defrosting) process to moderate the temperature of foods prior to cooking or reheating. During the slacking process the temperature of a food is allowed to increase gradually from -10°F (-23°C) to 25°F (-4°C) in preparation for deep-fat frying or to facilitate even heat penetration during cooking or reheating. The slacking process is typically used with previously block-frozen food such as spinach.

Under no circumstances should foods be thawed or slacked at room temperature. Room temperature thawing puts foods in the temperature danger zone—the very thing you don't want to have happen. When foods are thawed at room temperature, the outer surface of the food thaws first and will soon reach room temperature. Microbial growth occurs very quickly at room temperature.

Cold Storage

Most harmful microorganisms start to grow at temperatures above 41°F (5°C). Therefore, it only makes sense to store potentially hazardous and perishable foods in cold storage at 41°F (5°C) or below.

Some cold-loving bacteria such *Listeria monocytogenes* can grow at temperatures below 41°F (5°C). You should monitor the temperature of cold-held foods routinely throughout the day to ensure that safe temperature requirements are being met.

Refrigerators and cold service bars differ in their capacity to keep foods cool. In all instances, the air inside the refrigerated compartment will need to be a few degrees colder than 41°F (5°C) to ensure that cold foods are held at 41°F (5°C) or below.

Refrigerated potentially hazardous foods must be stored at 41°F (5°C) or less whenever possible. The *FDA Food Code* permits potentially hazardous foods to be stored at 45°F (7°C) or between 45°F (7°C) and 41°F (5°C) if the existing refrigeration equipment in use is **not** capable of maintaining the food at 41°F (5°C). The existing refrigeration equipment that is not capable of maintaining the food at 41°F (5°C) must be upgraded or replaced to maintain food at 41°F (5°C) or less within 5 years of the regulatory authority adoption of the *FDA Food Code.*

Cold, ready-to-eat, potentially hazardous foods include deli meats, potato and macaroni salads, chicken and seafood salads, cooked shrimp, and similar items. The *FDA Food Code* recommends that when these products are prepared and held refrigerated for more than 24 hours they be clearly marked at the time of preparation to indicate the date by which the food must be consumed. The acceptable storage time

for these types of products is 7 calendar days when held at 41°F (5°C) or below and 4 calendar days when the food is held at 45°F (7°C) or below. The storage time begins with the day the food is prepared.

Ready-to-eat salads (i.e., chicken, seafood, potato, or pasta) must be prepared in a way that will protect them from temperature abuse. This begins with pre-chilling all ingredients in a refrigerator before mixing and storing. By pre-chilling the ingredients you are able to keep the temperature of the finished product as cold as possible. For example, when making potato salad you should make sure the cooked potatoes are properly cooked and cold before prepping the salad. Other ingredients such as celery, mayonnaise, and mustard should also be stored overnight in the refrigerator to make sure they are cold prior to mixing. It is also a good idea to prepare foods in small batches in order to ensure that the food is not in the temperature danger zone too long. Large tubs of potato salad may take 1 to 2 days to cool in the refrigerator.

Frozen, ready-to-eat, potentially hazardous foods should be consumed within 24 hours after thawing whenever possible. When large amounts of food are removed from the freezer, they should be marked to indicate the date by which the food must be consumed. Food must be consumed:

- Seven calendar days or less after the food is removed from the freezer, minus the time before freezing that food is held refrigerated, if the food is maintained at 41°F (5°C) or less before freezing
- Four calendar days or less after the food is removed from the freezer, minus the time before freezing that the food is held refrigerated, if the food is maintained at 45°F (7°C) or below.

When storing raw potentially hazardous foods like meats [Figure 4.21(a)], be sure that they are maintained at less than 41°F (5°C). Usually the temperature of the refrigerator should be at least 3°F (1.5°C) to 5°F (3°C) below the desired cold-holding temperature.

Fish and seafood products should be maintained on ice [Figure 4.21(b)] to prevent the growth of disease-causing bacteria and spoilage bacteria. Ice used for this purpose is considered to be food and must be handled safely. The ice must be produced by an ice machine that is maintained in a clean and sanitary condition. The ice must be transported to display cases in containers that are made of materials approved for food-contact surfaces. (See Chapter 6 for details). When

the ice melts, the liquid must be drained away from the food to prevent contamination.

a. Fresh Meat

b. Fresh Fish

Figure 4.21 Cold Storage of Raw, Potentially Hazardous Foods

When storing ready-to-eat potentially hazardous foods like prepared salads and luncheon meats [Figure 4.22(a)], be sure that the refrigerator unit can maintain a safe cold-holding temperature. This may be more difficult in open top and open front refrigerated display cases that do not have doors. Many open refrigerator units have a "safe load line" [Figure 4.22(b)]. This line indicates the level at which foods should be stored below to ensure that the food is at the proper temperature.

a. Prepared Salads b. The Safe Load Line

Figure 4.22 Cold Storage of Ready-to-Eat Foods

A refrigerated, ready-to-eat, potentially hazardous food must be discarded if it:

- Exceeds the prescribed time and temperature requirements;
- Is in a container or package that does not bear a date or day; or
- Is marked with a date or day that exceeds the time and temperature combinations described on page 142.

Cooking

You must expect raw foods, especially those of animal origin, to contain harmful microorganisms. Foods such as meat, poultry, fish, seafood, eggs, and unpasteurized milk should not be prepared and served raw or rare. Establishments that choose to serve raw foods increase their risk of having a foodborne illness. Practices such as using raw eggs to make a Caesar salad or serving raw oysters on the half shell increase the risk of a foodborne illness. Raw animal foods need to be cooked to the proper temperatures to be safe.

The purpose of **cooking** is to make food more palatable by changing its appearance, texture, and aroma. Cooking also heats the food and destroys harmful microorganisms that may be found in and on the product. The destruction of disease-causing microorganisms is a phenomenon involving a direct relationship between time and temperature. Requirements for cooking a particular food item should include a final internal temperature as well as a prescribed length of time at that temperature. For example, a rare roast beef could be safely cooked to 130°F (54°C) for 112 minutes or 140°F (60°C) for 12 minutes.

Most foods are cooked using stoves, conventional ovens, and microwave ovens. Because heat transfer can be different depending on the heating source, final temperature requirements have been set for conventional oven cooking and microwave cooking. Cooking guidelines for various kinds of potentially hazardous foods are presented in Figure 4.23.

Rare beef roasts require the least internal temperature. This is because the contamination is on the surface of the large roast. When an internal temperature of 130°F (54°C) for 112 minutes or 140°F (60°C) for 12 minutes is reached, the surface temperature of the food is much higher. This heat will destroy any pathogens that may have been on the surface of the roast. Animal foods such as eggs, fish, and beef (other than roasts) should be cooked to an internal temperature of at least 145°F (63°C) and held at that temperature for at least 15 seconds before serving.

Cook ground beef, ground pork, and ground game animal products to 155°F (68°C) and hold for at least 15 seconds before serving. Pork and game animals need a higher cooking temperature due to the possible presence of the trichinosis worm and other parasites.

Food Type	Minimum Internal Temperature	Minimum Time Held at Internal Temperature Before Serving
Beef Roast (rare)	130°F (54°C) 140°F (60°C)	112 min. 12 min.
Eggs, Beef and Pork (other than roasts), Fish	145°F (63°C)	15 sec.
Ground Beef, Ground Pork, and Ground Game Animals	155°F (68°C)	15 sec.
Beef Roast (medium), Pork Roast, and Ham	145°F (63°C)	4 min.
Poultry, Stuffed Meats	165°F (74°C)	15 sec.

Note: When microwave cooking, heat raw animal foods to a temperature of 165°F (74°C) in all parts of the food.

Figure 4.23 Cooking Guidelines for Potentially Hazardous Foods
(Source: *FDA Food Code*)

Poultry and stuffed meats should be cooked to an internal temperature of 165°F (74°C) and held for at least 15 seconds before serving.

Casseroles and other foods that contain a combination of raw ingredients such as meat and poultry must be cooked to a final temperature that coincides with the highest risk food. In this case, 165°F (74°C) is required to destroy pathogens that may be found in the poultry. Food mixtures, such as chili and beef stew, must be cooked to 165°F (74°C) to ensure proper destruction of disease-causing agents.

While not usually potentially hazardous foods, fruits and vegetables that are cooked should reach an internal temperature of 135°F (57°C) or above.

When cooking foods in the microwave oven, the distribution of heat is often uneven. To distribute the heat more evenly you must stir

frequently and rotate the food. The current *FDA Food Code* requires raw animal foods cooked in a microwave oven to be heated to 165°F (74°C) in all parts of the food. Allow microwaved foods to stand covered for 2 minutes before serving to allow heat to disperse more evenly.

Measure the *internal temperature* of foods while they are *being cooked.* Ideally, the internal temperature should be measured in the geometric center of the food. A commonly used practice in the food industry is inserting the appropriate thermometer or thermocouple probe into the thickest part of the food mass. This will give you an accurate reading of the internal temperature of the product.

Proper cooking is extremely important for the preparation of safe food. If a potentially hazardous food is cooked to a safe temperature, bacteria and other harmful organisms will be destroyed. Bacterial spores and some toxins may not be destroyed by normal cooking temperatures. Therefore, proper handling of these foods is required at every stage of the food flow.

Cooling

Improper cooling is one of the leading contributors to foodborne illness in food establishments. Foods are in the temperature danger zone during cooling and there is no way to avoid it. After proper cooking, potentially hazardous foods need to be cooled from 135°F (57°C) to 41°F (5°C) as rapidly as possible. The *FDA Food Code* recommends that hot foods, not used for immediate service or hot display, be cooled from 135°F (57°C) to 70°F (21°C) within 2 hours, and from 135°F (57°C) to 41°F (5°C) within 6 hours.

Large quantities of food and foods that have a thick consistency take a long time to cool. For instance, it can take 72 hours or more for the center of a 5-gallon stockpot of steamed rice to cool down to 41°F (5°C) when taken hot from the stove and placed in a refrigerator.

Foods must pass through the temperature danger zone as quickly as possible. Figure 4.24 lists some of the more commonly used methods for reducing cooling time.

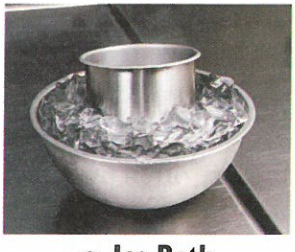
- Use containers that facilitate heat transfer (stainless steel)
- Transfer food into shallow pans that will allow for a product depth of 3 inches or less
- Transfer food into smaller containers
- Stir food while cooling
- Place containerized food in an ice water bath
- Stir food in a container placed in an ice water bath
- Use cooling paddles to stir the food
- Add ice directly to a condensed food.

Figure 4.24 Methods to Reduce Cooling Time for Food

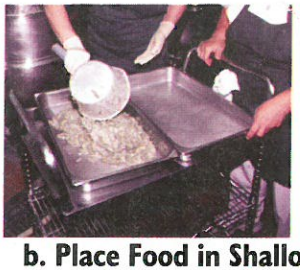
Photographs of the two most commonly used methods of cooling are presented in Figure 4.25. As it was with cooking, you must monitor times and temperatures for foods that are cooling. When large masses of food are broken down into smaller portions, cooling is more rapid.

For example, a large turkey can be sliced into smaller pieces, or creamed corn can be transferred into shallow pans to facilitate cooling. Foods cool faster in food-grade metal containers than in food-grade plastic containers.

When using shallow pans to cool liquid food, the pan should be only 4 inches high. The depth of foods cooled in a shallow pan should be less than 3 inches for liquids (soup) and less than 2 inches for viscous products (chili or beef stew) [Figure 4.25(b)].



a. Ice Bath



b. Place Food in Shallow Pans 2 to 3 Inches Deep

Figure 4.25 Approved Cooling Methods

Always use a thermometer to verify that foods are cooling properly. Never assume that any 1 method is working without checking the temperature and time that foods take to cool. Always depend on the thermometer reading with any of the methods you use to cool food.

Cooling time is greatly reduced when foods are stirred. Foods stirred every 10 to 15 minutes cool far more rapidly than unstirred foods. An ice water bath also helps to remove heat from foods [Figure 4.25(a)].

An ice water bath involves putting the container of hot food inside a larger container and surrounding it with ice to promote cooling. It is sometimes desirable to combine cooling methods, such as stirring a food after putting the container into an ice water bath.

You may also fill a large pot with ice and water. Then, insert the container of hot food into the ice water and stir the product. Keep the water level below the rim of the food container. In some instances, ice from a potable water supply can be added as a "final ingredient" in preparing hot items from condensed foods. Large quantities of soup or broth can be prepared in this way.

Hot-Holding, Cold-Holding, Reheating

All potentially hazardous foods that have been cooked, cooled, and then reheated must be held hot at 135°F (57°C) or above. **Cold-holding** is holding potentially hazardous foods which are to be consumed cold at 41°F (5°C) or below. **Hot-holding** is holding potentially hazardous foods above 135°F (57°C) during transportation and delivery to any site away from the primary preparation and service areas.

Proper holding temperatures slow down or prevent the growth of harmful microorganisms. The key is to keep foods out of the temperature danger zone [135°F (57°C) to 41°F(5°C)]. All potentially hazardous foods meant to be held hot, which have been cooked and then cooled, must be **reheated** to at least 165°F (74°C) within 2 hours. Foods can be heated more quickly when heated in smaller quantities or by using pre-heated ingredients. Stir food frequently during reheating to reduce the time needed to reheat.

Temperature and time are often used together to eliminate microbes or to prevent them from growing in foods. While temperature is usually the most important factor in controlling microbes, there are some situations where controlling time can also be used. That is why there is an allowance of 4 hours in the temperature danger zone. The use of time as a control factor is most applicable for prepared ready-to-eat foods that are being stored or displayed just prior to service. Sliced

pizza, hamburgers, and fried chicken pieces would all be good examples. If these potentially hazardous foods were hot-held at 135°F (57°C) or above, the food may dry out and the quality may deteriorate very quickly.

Figure 4.26 Hot-Holding—Store Hot-Held Foods with the Utensils in the Food

To maintain quality and safety, foods can be stored at temperatures *within* the temperature danger zone for a short period of time. Many retail food establishments limit this time to 20 to 30 minutes. Most important, the time period that foods are held in the temperature danger zone must be carefully monitored and recorded. Procedures and monitoring for using time as a method of control varies. Consult with your local regulatory authority for requirements in your jurisdiction.

Reduced Oxygen Packaging (ROP)

Reduced oxygen packaging (ROP) can lengthen the shelf life of foods. The term ROP is defined as any packaging method that reduces the amount of oxygen in a sealed package. Oxygen may be removed or it may be replaced with another gas. ROP is an inclusive term and can include other processing and packaging options such as:

- Cook-chill—a process that uses a plastic bag filled with hot cooked food from which air has been forced out and which is closed with a plastic or metal crimp.

- Controlled Atmosphere Packaging (CAP)—a system which maintains the desired atmosphere within a package throughout the shelf life of a product by the use of agents to bind or scavenge oxygen or a small packet containing compounds to emit a gas.
- **Modified Atmosphere Packaging (MAP)**—a process that employs a gas flushing and sealing process or reduction of oxygen through respiration of vegetables or microbial action.
- Sous Vide—a process where fresh raw foods are sealed in a plastic pouch and the air is removed by vacuum. The pouch is cooked at a low temperature and rapidly cooled to 38°F (3°C) or below or frozen.
- Vacuum Packaging—reduces the amount of air from a package and hermetically seals the package so that a near-perfect vacuum remains inside.

Some of the most widely recognized benefits of Reduced Oxygen Packaging are:

- It creates an environment with low oxygen that prevents the growth of aerobic (see Chapter 2) bacteria, yeast, and molds that are largely responsible for the "off" odors, slime, texture changes, and other forms of spoilage
- It prevents chemical reactions that can produce "off" odors and color changes in foods
- It reduces product shrinkage by preventing water loss.

In spite of its benefits, the use of ROP with some foods can increase safety concerns. Unless potentially hazardous foods are protected inherently, simply placing them in ROP without regard to microbial growth will increase the risk of foodborne illnesses. Some products in ROP contain no preservatives and frequently do not possess any intrinsic inhibitory barriers (such as, pH, A_w, or salt concentrations) that either alone or in combination will inhibit microbial growth. Thus, product safety is not provided by natural or formulated characteristics.

The anaerobic environment created by some ROP foods provide the potential for growth of *Clostridium botulium* and other important pathogens. Some of these organisms, including *Listeria monocytogenes*, can grow slowly at temperatures below 41°F (5°C). Another safety concern of ROP foods is that because spoilage bacteria are destroyed there may no longer be telltale signs signaling that the product is no longer fit to eat.

The *FDA Food Code* provides very specific requirements for supermarkets that desire to use ROP technology. A summary of the requirements are presented below:

- The supermarket must have a HACCP plan in place for the ROP operation that details how the 7 principles (see Chapter 5) are incorporated into the operation's food safety management system.
- Because *Clostridium botulinum* is a significant health hazard, the establishment is required to have 2 microbial growth barriers. Time/temperature are commonly used as 1 barrier, but they need to be coupled with the use of pH, A_w, or product formulation (i.e., use of preservatives such as sodium nitrite) to ensure *Clostridium botulinum* bacteria will not grow inside the package.
- All potentially hazardous foods in ROP which rely on refrigeration as a barrier to microbial growth must bear the statement "Important - Must be kept refrigerated at 41°F (5°C)" or "Important - Must be kept frozen" in the case of foods which rely on freezing as a primary safety barrier.
- Each container must bear a "use-by" date. This date cannot exceed 14 days from packaging or repackaging to consumption except the time the product is maintained frozen or the original manufacturer sell-by or use-by date, whichever occurs first.
- Associates responsible for the ROP process must receive training that will enable them to understand the key components of the process, the equipment that is used, and the specific procedures that must be followed to ensure that critical limits identified in the HACCP plan have been met. The training program must also outline the employee's responsibilities for monitoring and documenting the process and describe what corrective actions they must take when critical limits are not met.

Some products cannot be packed by ROP unless the supermarket is approved for the activity and inspected by the appropriate regulatory authority. These products include raw and smoked fish, soft cheeses (ricotta, cottage cheese, and cheese spreads), and combinations of cheese and other ingredients such as vegetables, meat, or fish. Contact your local regulatory authority to obtain a complete set of guidelines and to seek a variance for all food manufacturing/processing operations based on the prior approval of a HACCP plan.

Serving Safe Food

When you serve food, always practice good personal hygiene. Start by wearing a clean uniform and hair restraint. Food, or surfaces that may

come in contact with food, should not be touched with hands. Hold utensils only by the handles and do not touch beverage glasses by the outside or inside rim. Handle plates and bowls by the bottom or outer rim (Figure 4.27). Finally, wash your hands after handling dirty tableware and utensils. Never dry your hands on your apron. Always use a single-service towel.

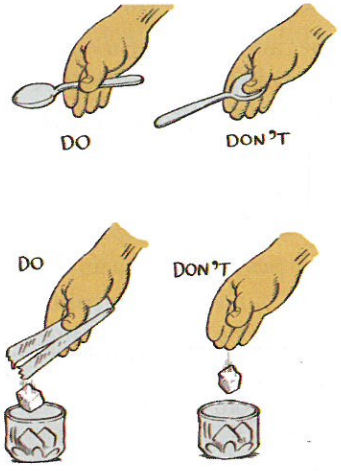


Figure 4.27 Handle Eating Utensils and Ice Properly

Food that has been served or sold to and is in the possession of a customer may not be returned and offered for service or sale to another customer. Two acceptable exceptions to this rule are:

- A container of a nonpotentially hazardous food (i.e., a narrow-neck bottle of catsup or steak sauce) that is dispensed in a way that protects the food from contamination and the container is closed between uses; or
- Nonpotentially hazardous foods such as crackers, salt, or pepper in an unopened, original package and that is maintained in a sound condition.

Employees must remember to wash their hands after touching soiled equipment, utensils and cloths. If disposable gloves are used, a fresh pair of gloves should be put on immediately prior to handling any food products.

Discarding or Reconditioning Food

A food that is unsafe, adulterated, or not honestly presented should be reworked or reconditioned using a procedure that has been approved by the regulatory authority in the jurisdiction, or it must be discarded.

Food must be discarded if it is not from an approved source or has been contaminated by food employees, consumers, or other persons via soiled hands, bodily discharges (i.e., coughs and sneezes), or other means.

Ready-to-eat foods must be discarded if they have been contaminated by an employee who has been restricted or excluded as described in Appendix C of this book.

Refilling Returnable Containers

A take-home food container returned to a retail food establishment may not be refilled with a potentially hazardous food at the establishment. Take-home food containers may be refilled with a food that is not potentially hazardous if the container is properly cleaned before being refilled. Except for food-specific beverage containers, returned empty containers intended for cleaning and refilling with food must be cleaned and refilled in a regulated food processing plant.

A food-specific container for beverages may be refilled at a food establishment if:

- Only a beverage that is not a potentially hazardous food is dispensed into the container,
- The design of the container and of the rinsing equipment and the nature of the beverage, when considered together, allow effective cleaning of the container at home or in the food establishment,
- Facilities for rinsing before refilling returned containers with fresh, hot water that is under pressure and not recirculated are provided as part of the dispensing system,
- The consumer-owned container returned to the food establishment for refilling is refilled for sale or service only to the same consumer; and
- The container is refilled by an employee of the food establishment or the owner of the container if the beverage system includes a contamination-free transfer process that cannot be bypassed by the container owner.

Personal take-out beverage containers, such as thermally insulated bottles, nonspill coffee cups, and promotional beverage glasses, may be refilled by employees or the consumer if the refilling process will protect the food and food-contact surface of the container from contamination.

Self-Service Bar

Self-service bars are very popular. They offer convenience and a wide range of selections for consumers (Figure 4.28). A properly installed sneeze guard protects the food from contamination by your customers and is required in most jurisdictions (Figure 4.29).

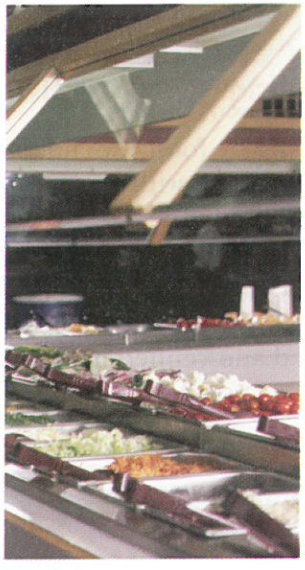


Figure 4.28 Self-Service Bar

Keep potentially hazardous foods on self-service bars hot at 135°F (57°C) or above and cold at 41°F (5°C) or below. Monitor food-holding temperatures frequently in these operations. Never serve raw animal products at a self-service bar except for ready-to-eat foods like sushi and shellfish or meats that will be cooked on the premises.

Always use clean sanitized utensils in a self-service bar. Monitor the bar and replace any utensils that become contaminated. Hold utensils by the handle. Do not allow hand contact with foods in containers.

Keep utensils in the food between use. Resting utensils on saucers beside containers is not an acceptable practice. Only 1 utensil should be used for each food item.

Self-service bars tend to get messy because of spills. *Clean the station* frequently throughout the day to reduce the potential for cross contamination. Assign a properly trained food worker to monitor and maintain a self-service bar or buffet bar.

Self-service plates and bowls should only be used once to avoid contaminating food on the buffet or salad bar. Give your customers a clean plate or bowl each time they return to the salad bar. Beverage cups and glasses may be reused to get refills.

Figure 4.29 Don't Forget the Sneeze Guard

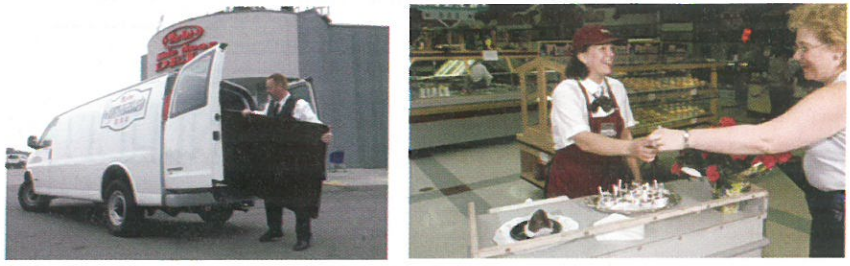
Temporary and Mobile Food Facilities

The popularity of temporary and mobile food facilities such as street fairs, festivals, catering, food sampling, and mobile carts increased rapidly during the past decade (Figure 4.30). The public patronizes these events in increasing numbers. In addition to the opportunity for community involvement, commercial and noncommercial organizations are finding it profitable to sell food at temporary food facilities.

In the beginning, temporary facilities served food items such as hamburgers and hot dogs. These foods required minimal preparation. They were taken from a cooler, placed on a grill, and cooked to order.

Depending on where you are, the food served by today's temporary facilities might consist of anything from BBQ ribs, calamari, gyros, and pizza to sushi and shish kebabs. Today's sophisticated appetites demand

foods which frequently involve risky preparation methods, such as heating, cooling, and reheating.



a. Mobile b. Temporary

Figure 4.30 Examples of Temporary and Mobile Food Facilities

Consumers also insist on freshly prepared food, prompting vendors to transport raw ingredients to their makeshift booths to chop, shred, and assemble without access to the sanitary facilities that would be standard in a permanent food establishment.

The more extensive the menu or more complex the preparation, the higher the risk, and the more demanding public health requirements become to reduce these dangers. Vendors should contact the local regulatory agency in their area to obtain a copy of the rules that govern temporary and mobile operations.

Protecting the food and food preparation equipment from contamination is the function of the structure. A temporary food stand should have:

- An overhead covering
- An enclosed area except for the serving windows and an entry door
- A source of hot and cold potable running water for handwashing, cleaning, and sanitizing.

Your menu and method of food preparation will determine your selection of equipment and utensils. Food-contact surfaces must be designed for effective cleaning and sanitizing. They must also be constructed of materials that are nontoxic. Cooking equipment must be capable of heating potentially hazardous foods to the required internal temperature. For example, hamburgers and other ground beef should be cooked to an internal temperature of 155°F (68°C); poultry to 165°F (74°C); and fish and other meats to 145°F (63°C). Foods to be reheated must reach an internal temperature of 165°F (74°C) within 2 hours. **Do not use slow cooking devices such as crockpots, steam tables,**

and sterno to heat foods. These devices may never reach temperatures high enough to kill harmful bacteria.

Foods that require refrigeration must be cooled to 41°F (5°C) as quickly as possible and held at that temperature until served. Cold foods should be at 41°F (5°C) or below when delivered to the temporary facility. If for some reason it is necessary to cool foods down, use an ice water bath or place the food in shallow pans and refrigerate. Do not forget that proper food temperatures are your most important control measure against foodborne illnesses. Minimizing the time between preparation and service is another good practice to use in order to keep food safe.

An adequate handwashing facility must be provided, and strict handwashing procedures must be observed to prevent contamination of food. Disposable gloves can provide an additional barrier to contamination. However, gloves are no substitute for handwashing.

Good food-handling practices are an important line of defense in temporary food facilities. Raw foods must be kept and handled separate from ready-to-eat foods. It is best to use tongs, napkins, disposable gloves, or other tools to handle food.

Temporary food facilities should use disposable utensils for food service. If it is necessary to use multi-use utensils, they must be washed and sanitized using a 4-step process:

1. Washing in hot, soapy water.
2. Rinsing in clean water.
3. Chemical sanitizing.
4. Air-drying.

A detailed explanation of this process is presented in Chapter 7, Cleaning and Sanitizing Operations. It is a good idea to have additional cleaned and sanitized utensils on hand to accommodate peak periods when there is not adequate time to perform the dishwashing process. Rinse and store the wiping cloths used in the operation in a pail of sanitizer solution. The concentration of the sanitizer must be checked regularly to make certain it remains at the required strength. The strength of the sanitizer can be measured using either a chemical test kit or test strips. Always replace the solution whenever it falls below the required minimum concentration.

Garbage and paper wastes should be placed in containers that are lined with plastic liners and equipped with tight-fitting lids. Keep foods and wastes covered to avoid attracting insects, rodents, and other pests.

Always store pesticides away from food, and be sure to follow the manufacturer's instructions if you apply them. Clean and sanitize all food-contact surfaces that may have been contaminated when the pesticides were applied.

Along with the fun and potential profit, food vendors should be aware of the potential public health problems with food served by temporary or mobile food service operations. Improvised facilities, large volumes of food, severe weather conditions, and untrained food workers can make keeping foods safe and sanitary a real challenge. Temporary events frequently serve large numbers of people which makes it necessary to prepare large quantities of food in advance. This increases the risk of contamination and makes proper cooking, cooling, and holding even more critical. Always consult your local food protection program on the specifics of your operation.

Vending Machines

Vending machines are self-service devices which dispense individual-sized servings of food and beverages after a customer inserts a coin, paper currency, or makes a payment by another means. Vending machines are capable of dispensing food and beverages in bulk or individually wrapped packages.

Vending machines that dispense potentially hazardous foods must have adequate refrigeration and/or heating units, insulation, and controls to keep cold foods cold and hot foods hot. These machines must also be equipped with an automatic control that prevents the machine from vending food if there is a power failure, mechanical failure or other condition that prevents cold food from being maintained at 41°F (5°C) or below and hot food maintained at 135°F (57°C) or above.

The temperature cutoff requirement does not apply:

- In a cold food machine during a period not to exceed 30 minutes immediately after the machine is filled, serviced or restocked; or
- In a hot food machine during a period not to exceed 120 minutes immediately after the machine is filled, serviced or restocked.

Refrigerated, ready-to-eat, potentially hazardous foods prepared in a food establishment and dispensed through a vending machine (with an automatic shutoff control) shall be discarded if it:

- Exceeds the time and temperature combinations prescribed by the *FDA Food Code*, or
- Is not correctly date labeled.

Home Meal Replacement

Home meal replacement has become a multi-billion dollar business for retail food establishments. A loosely defined term, home meal replacement is most often used to refer to high-quality meals prepared away from home and eaten at home.

The move toward prepared food has supermarkets selling meal solutions instead of just ingredients. Supermarkets and restaurants are competing head-to-head for the "heat and eat" business that has become very popular with today's consumer.

Home replacement meals come in the "ready-to-cook," "ready-to-heat," and "ready-to-eat" varieties. All three varieties are designed to save time and effort for families that are too frazzled to cook at the end of the day.

The "ready-to-cook" line, including foods such as beef and chicken kebabs with the peppers and onions already cut up, has found its way into most grocery stores' meat or frozen food departments.

"Ready-to-heat" is a much broader segment of the market. It includes the fully cooked hams, turkey roast, or breaded chicken cutlets found in supermarket meat sections. Many supermarkets have expanded their deli sections to include items that can be conveniently reheated, such as pizzas, rotisserie chickens; and hot-tray choices such as macaroni and cheese, meat loaf, and mashed potatoes. Several stores also stock packaged pre-cooked eggs rolls, burritos, chicken dinners, and other foods in the cold food case.

"Ready-to-eat" foods come from fast-food takeout counters and pizza shops; many of which offer family meals deals that serve 4 to 6 people. Consumers stop by on the way home from the office and buy complete meals ready to eat right out of the box.

With home replacement meals, retailers must deliver quality, consistency and safe food—and have it ready when it is picked up by or delivered to their customers. By following prescribed food safety guidelines for time and temperature, retailers can ensure that meals provided to customers for consumption away from the retail food establishment are safe and wholesome. Hot foods must be cooked to the required product temperature for the required amount of time. These foods must then be held out of the temperature danger zone while on display or during delivery. Cold foods must be chilled quickly and held at 41°F (5°C) or below during display and delivery.

The safety of home meal replacements can also be improved by controlling the amount of time that elapses between production and

consumption of the meal. For maximum safety the amount of time that passes between the production and consumption of ready-to-eat foods should be 4 hours or less.

Home replacement meals should be labeled so customers understand how to keep the product safe when they take it home. Warn them against keeping the food in the car while they do more shopping or keeping it at room temperature when they get home. Pamphlets and brochures stuffed into bags or stapled to the front of bags can help educate consumers about safe handling of home replacement meals. In addition, it is a good idea to establish "best-before" dates and codes for these foods. Retailers must be able to show they've done everything in their power, including written documentation and following industry standards, to make the food safe.

Summary

The investigation of the Shiga toxin-producing *Escherichia coli* outbreak presented in the case study at the beginning of this chapter concluded that the Shiga toxin-producing *Escherichia coli* bacteria were most likely introduced into the coleslaw by contaminated cabbage. This provides an example of how food can be contaminated when it arrives at a food establishment. Cabbage is grown on the ground where it can be contaminated by animal feces that contain Shiga toxin-producing *Escherichia coli* bacteria. In this particular case, the cabbage was shipped in net bags. This could have allowed the cabbage to become contaminated during transport. Food workers did not wash the cabbage prior to shredding even though it was quite soiled. This likely allowed the Shiga toxin-producing *Escherichia coli* to be introduced into the coleslaw. At least 1 other food establishment in the area purchased cabbage from the same supplier. However, workers at that establishment did wash the cabbage after removing the leaves. No problems were reported at that establishment.

Prevention measures that would help prevent similar types of foodborne outbreaks are washing vegetables and fruits that are to be served raw, proper personal hygiene, and proper cleaning and sanitizing of equipment and utensils to prevent cross contamination.

Not all food managers or supervisors actually will select or purchase products. However, knowledge of the rules, regulations, and procedures of receiving and storage is expected of all who are responsible for food safety.

To ensure that all foods are safe for human consumption, purchase your food supplies from approved sources and suppliers who comply with all laws concerning food processing and labeling. Schedule deliveries for the off-peak times when someone is available to inspect incoming food supplies. Make sure that food is free from filth or spoilage, in sound condition, and is at the proper temperature. If the product has been damaged or does not meet the standards, reject the delivery. The supplier should be responsible for replacing or giving credit for rejected material.

Move delivered materials into designated storage areas quickly. Storage serves as a temporary link between receiving and preparation. Storage facilities must be capable of preserving the sanitary quality of the food stored there.

Store foods in their original containers or packages whenever possible. When food is removed from the package or container in which it was delivered, it must then be stored in a clean, covered container that is properly labeled and dated. Proper stock rotation using the FIFO system is necessary to ensure that stocked items will be used within a reasonable period of time.

Provide adequate "dry storage" for dry items such as canned goods. For highly perishable items, refrigerator or freezer storage is necessary. Chilled storage is required for perishable and potentially hazardous foods such as dairy products, meat, poultry, eggs, fish, seafood, fruits, and vegetables. Store these products out of the temperature danger zone. Freezer storage, capable of holding products in a frozen condition, must be provided for all frozen foods.

To ensure the maintenance of all potentially hazardous food at the required cold temperatures during storage, refrigerators and freezers must be equipped with a numerically scaled thermometer. The thermometer should measure temperature in increments no greater than 2°F (1°C). The sensor of the temperature-measuring device must be located to measure the air temperature in the warmest part of a mechanically refrigerated unit. The temperature-sensing device should also be located to allow easy viewing of the device's temperature display. The temperature of food should be measured to verify that holding temperatures are correct.

To prevent the possibility of cross contamination, always store raw or unwashed foods below ready-to-eat foods and foods that will not receive any additional cooking. Do not store food containers on the floor or under any exposed or unprotected sewer or water lines.

Keep the storage areas, including the floors, walls, and ceilings, clean. Make sure that the shelving units in these areas are clean and in good repair. Spilled foods should be cleaned up immediately and removed from the area.

Errors that occur during the preparation and service of food are the leading causes of foodborne illness in food establishments. To ensure safe food, proper food handling is essential.

Safe food preparation and service include good personnel hygiene and taking measures to avoid cross contamination. It is critical to know when and how frequently hands and other food-contact surfaces should be cleaned and sanitized. Monitoring and controlling food temperatures during preparation are important for destroying microorganisms and preventing them from growing in the food. Keeping foods out of the temperature danger zone as much as possible and cooking them properly are both very important considerations. Foods should only be allowed in the temperature danger zone for a short time during thawing, heating, and cooling activities. The 3 main problems in foodservice, time and temperature abuse, cross contamination, and poor personal health and hygiene practices of food workers, must be prevented during the flow of food. Preparation and service are critical processes in your food establishment because they are the last steps you take before the consumer eats your food.

Case Study 4.1

David Jones is manager of the Great American Cafe. As part of a newly implemented self-inspection program, David performs an inspection of the walk-in refrigerator. During the inspection, David notices that turkeys for tomorrow's dinner are not covered during thawing, and they are stored directly above several washed heads of lettuce. Other food items are stored on shelves lined with aluminum foil in covered containers that are not labeled or dated. David also notices that boxes of produce have been stacked closely together on the floor of the walk-in cooler, and the thermometer is hanging from the condensing unit.

1. What food safety hazards exist in the walk-in refrigeration unit at the Great American Cafe? the turkeys not covered during thawing and stored under washed lettuce - other items are not labeled or dated - boxes in the floor and close together
2. Which of these hazards might result in food contamination and spoilage? the uncovered thawed turkeys and washed lettuce - and allow that the thermometer is hanging from the condensing unit so no good reading of temp
3. What should be done to correct the problems that Mr. Jones observed during his inspection? know how to organize the fridge by putting ready to eat food up then the turkeys and it must be covered and the boxes must be stored upon the floor by 6 inches and space between the boxes.

Case Study 4.2

Metro Market is a combination convenience store and delicatessen. Deliveries are received between 9:00 a.m. and 3:00 p.m., Monday through Friday. Store employees are frequently too busy to check the deliveries in and transfer products to approved storage facilities during the noon rush. Therefore, food and non-food items are held in a secured area off the receiving dock until someone is available to process them.

1. What food safety hazards exist at Metro Market? no good storage when items are received
2. If you were manager of Metro Market, what would you do to improve receiving and storage activities? Art employees that are educated and know how to deal with items and storage for this task.

Case Study 4.3

In the mid-1990s, health departments in Washington, California, Idaho, and Nevada identified nearly 600 people with culture-confirmed Shiga toxin-producing *Escherichia coli* infections. Many of the victims reported eating at Chain A restaurants during the days preceding onset of symptoms. Of the patients who recalled what they ate in a Chain A restaurant, a large percentage reported eating regular-sized hamburger patties. Chain A issued a multi-state recall of unused hamburger patties.

The Shiga toxin-producing *Escherichia coli* bacteria were isolated from 11 batches of patties from Chain A. These patties had been distributed to restaurants in all states where the illness occurred. Approximately 20% of the patties connected with the outbreak were recovered during a recall.

A team of investigators from the Centers for Disease Control and Prevention identified 5 slaughter plants in the United States and 1 in Canada as the likely sources of carcasses used in the contaminated meat. The animals slaughtered in domestic slaughter plants were traced to farms and auctions in 6 western states. No 1 slaughter plant or farm was identified as the source of contamination.

Shiga toxin-producing *Escherichia coli* can be found in the intestines of healthy cattle and can contaminate meat during slaughter. Slaughtering practices can result in contamination of raw meat with these bacteria. In addition, the process of grinding beef can transfer the disease-causing agents from the surface of the meat to the interior. Therefore ground beef can be internally contaminated.

1. What would be the likely impact of this outbreak on consumer confidence?

2. What was the impact of this outbreak on food safety?

Discussion Questions (Short Answer)

1. Purchase specifications are important to a food establishment's operation. Why?
2. Why should buyers purchase foods only from approved sources that comply with all applicable food laws?
3. Discuss the differences between grading and inspection services.
4. What range of temperatures should food temperature-measuring devices be able to measure?
5. Why should cans with swollen ends be rejected and sent back to the supplier?
6. What are typical signs of spoilage for red meats, poultry, and fish?
7. What is the meaning of FIFO?
8. Why should raw products be placed below cooked or ready-to-eat foods during storage?
9. Describe safe procedures for storing cleaning and sanitizing agents and pesticides.
10. Why should products be located at least 6 inches off the floor during storage?
11. Why is it important for a food worker to wash his/her hands?
12. Why is it important to **not** serve raw animal foods?
13. Why do safe temperature requirements differ when using a conventional oven as opposed to the microwave oven?
14. Suggest some ways to decrease the cooling time for a 5-gallon container of rice.

Quiz 4.1 (Multiple Choice)

1. Which of the following is not a rule that should be closely followed when purchasing food?
   a. Foods prepared in a private home may not be used or offered for human consumption in a retail food establishment.
   b. Buyers should only purchase food that is safe, wholesome, and from an approved source.
   c. Avoid the use of commercially raised game animals as meat and poultry items.
   d. Only buy meat and poultry that has been inspected by USDA or state agency officials.

2. The best method for measuring the temperature of frozen food products is by:
   a. Inserting the sensing probe into the center of a frozen food package until the recorded temperature stabilizes.
   b. Inserting the sensing probe between two packages of frozen foods until the recorded temperature stabilizes.
   c. Measuring the ambient temperature of the frozen food compartment of the delivery vehicle.
   d. Looking for signs of freezing and thawing, such as large ice crystals and frozen juices in the bottom of the box.
3. Frozen foods should **not** be accepted at a food establishment if:
   a. They have large ice crystals on the surface.
   b. There are frozen juices on the bottom of the package.
   c. If the temperature is above 32°F (0°C).
   d. All of the above.
4. Which of the following foods should not be rejected upon delivery?
   a. Fresh fish that has dull, sunken eyes, and soft flesh.
   b. Poultry with darkened wing tips and soft flesh.
   c. Canned fruit with small amounts of surface rust on the lid of the can.
   d. Fresh beef products that are delivered at 45°F (7°C).
5. Which of the following statements about fish and seafood is **false**?
   a. Fish and shellfish are less likely to spoil than red meat and poultry.
   b. Quality in fish and shellfish is measured by smell and appearance.
   c. Fish that may be eaten raw must be commercially frozen prior to consumption.
   d. Molluscan shellfish tags must be kept for 90 days from the date the container is emptied.

6. Which of the following storage practices should prompt a manager to take corrective action?

   a. Products in the dry storage area are being rotated on a First-In, First-Out stock basis.

   b. Foods stored in the walk-in freezer are stored on slatted shelves that are 6 inches above the floor.

   c. Raw poultry is stored above potato salad in the walk-in refrigerator.

   d. Cleaning and sanitizing agents and pesticides are stored in a locked and labeled cabinet in the dry food storage area.

7. Pork roasts should be cooked to an internal temperature of at least _____ for 3 minutes to be considered safe.

   a. 140°F (60°C).

   b. 145°F (63°C).

   c. 155°F (68°C).

   d. 165°F (74°C).

8. Which of the following is the preferred method for thawing potentially hazardous foods?

   a. In the microwave oven.

   b. At room temperature.

   c. In the refrigerator.

   d. Under 70°F (21°C) running water.

9. Hot foods should be held at _____ or above and cold foods should be held at _____ or below.

   a. 165°F (74°C); 41°F (5°C).

   b. 165°F (74°C); 32°F (0°C).

   c. 135°F (57°C); 41°F (5°C).

   d. 135°F (57°C); 32°F (0°C).

10. Poultry and stuffed meats should be cooked to an internal temperature of _____ for 15 seconds to be considered safe.

    a. 140°F (60°C).

    b. 145°F (63°C).

    c. 155°F (68°C).

    d. 165°F (74°C).

11. Ground beef meats should be cooked to an internal temperature of _____ for 15 seconds to be considered safe.
    a. 140°F (60°C).
    b. 145°F (63°C).
    c. 155°F (68°C).
    d. 165°F (74°C).
12. Regardless of the type of food, all potentially hazardous foods that have been cooked and cooled need to be reheated to an internal temperature of _____ within 2 hours to be considered safe.
    a. 140°F (5°C).
    b. 145°F (63°C).
    c. 155°F (68°C).
    d. 165°F (74°C).
13. According to the *FDA Food Code*, foods that are cooked and then cooled must be cooled in which of the following ways:
    a. From 135°F (57°C) to 41°F (5°C) in 12 hours.
    b. From 135°F (57°C) to 41°F (5°C) in 8 hours.
    c. From 135°F (57°C) to 70°F (21°C) in 2 hours, and from 135°F (57°C) to 41°F (5°C) within 6 hours.
    d. From 135°F (57°C) to 70°F (21°C) in 4 hours, and from 70°F (21°C) to 41°F (5°C) in an additional 2 hours.
14. All foods that are to be held cold must be held at _____ or below.
    a. 41°F (5°C).
    b. 50°F (10°C).
    c. 70°F (21°C).
    d. 0°F (-18°C).
15. All foods that are to be held hot must be held at _____ or above.
    a. 70°F (10°C).
    b. 98°F (37°C).
    c. 120°F (49°C).
    d. 135°F (57°C).

Answers to the multiple choice questions are provided in Appendix A.

References/Suggested Readings

Educational Foundation of the National Restaurant Association (1998). *Servsafe*, National Restaurant Association. Chicago, IL.

Food and Drug Administration (2001). *2001 Food Code.* U.S. Public Health Service. Washington, DC.

Longrèe, Karla, and G. Armbruster (1996). *Quantity Food Sanitation.* John Wiley and Sons, Inc. New York, NY.

Thayer, David W., et al. (1996). *Radiation Pasteurization of Food.* Council for Agricultural Science and Technology Issue Paper, No. 7. April, 1996.

Suggested Web Sites

Gateway to Government Food Safety Information
www.foodsafety.gov

United States Department of Agriculture (USDA)
www.usda.gov

Centers for Disease Control and Prevention (CDC)
www.cdc.gov

United States Food and Drug Administration (FDA)
www.fda.gov

The American Egg Board
www.aeb.org

America Meat Institute
www.meatami.org

The National Chicken Council
www.eatchicken.com

U.S. Poultry and Egg Association
www.poultryegg.org

USDA Foods Safety and Inspection Service (FSIS)
www.fsis.usda.gov

USDA/FDA Food and Nutrition Information Center
www.nal.usda.gov/fnic/

United States Environmental Protection Agency (EPA)
www.epa.gov

Partnerships for Food Safety Education
www.fightbac.org

The Food Marketing Institute
www.fmi.org

National Restaurant Association
www.restaurant.org