

Lesson 1: Factors That Affect Food Safety and Quality

Food safety is closely related to food spoilage, but they are not always the same thing. Food becomes unsafe when pathogens, pesticides, toxins or other potentially harmful chemicals are present. Foods that appear safe may contain toxins (poisonous plants), while other foods may look and smell very bad - yet still be quite edible (Limburger cheese). Food quality is a combination of safety and aesthetic factors.

Food Spoilage

Feeding a growing population is a large task. The effort is compounded due to food spoilage. Even if an adequate food supply is produced, it must be stored and prevented from deteriorating. Several factors cause deterioration: microorganisms in the form of bacteria, yeasts, and molds; activities of natural food enzymes; insects, parasites, and rodents; temperature (both cold and hot); moisture or dryness; air; light; and time. In essence, food undergoes progressive deterioration beginning at harvest. It is critical to know how much time the deterioration process takes.

Contaminants Influence Food Safety and Quality

When microorganisms attack food, they cause many deteriorative effects. They can ferment sugars; hydrolyze starches and fats; digest proteins; and form acids, pigments and discoloration. These can lead to rancid flavors, putrid odors, gas and foam production, and poisonous toxin production.

Enzyme activity is necessary in living plants and animals; however, it continues after harvest or slaughter. Unless these enzymes are inactivated by heat, chemicals, or radiation, they continue to catalyze reactions. Some of these reactions are desirable, like continued ripening of a tomato. Unfortunately, ripening or tenderizing beyond a critical point becomes food deterioration. The weakened tissue is subject to microbial invasion and rotting, development of rancid flavors, or browning and other discoloration.

In addition, insects cause damage, which permits microbial invasion. Parasites, like worms in raw fish and the *Trichina* worm in uncooked pork, can infect the person who consumes them and cause nerve and muscle damage. (The *Trichina* worm is no longer a problem in the U.S. pork industry.) Parasites can also cause dysentery. Rodents not only consume large quantities of food, but their excrement and urine can harbor several diseases such as typhus fever, the plague, salmonellosis, and leptospirosis.

Natural dehydrating may cause skin breakage which allows bacterial invasion. Freezing causes cell swelling which causes the cell membrane to rupture.

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The remaining factors, temperature, moisture, air, light, and time, can contribute to physical and chemical deterioration. These can also lead to microbial invasion.

Production Practices

If a food product is to be consumed safely, it must be safe when it arrives at the processing plant, at the grocery store, and at the place and time of consumption. Food producers are responsible for growing safe products. Many producers are following Quality Assurance programs to document their practices.

Producers of animals must follow withdrawal guidelines for antibiotics and vaccines, follow recommended injection site procedures so as not to damage muscle tissue; and must sort, load, and transport animals as gently as possible to avoid bruising (bruised tissue deteriorates more quickly). Plant food producers document proper use and timing of pesticides.

Grain grade standards regulate grain quality. Producers use honesty as their policy in grain sales. To place rodent damaged grain on the bottom or treated wheat on the sides of the truck to avoid the grain sampler is dishonest and may be unsafe.

Food Additives

Food additives are one very useful tool to maintain the safety and quality of food during processing, storage, and distribution. A food additive is any substance added intentionally or incidentally to food to improve its appearance, flavor, texture, nutritional value, or storage properties. The Food and Drug Administration (FDA) tests all potential additives over a two-year period on at least two different species of animals. The FDA has compiled a Generally Recognized As Safe (GRAS) list which can be added to or subtracted from as needed. Additives may not be used to deceive the customer or lower the nutritional quality of the food. They cannot be used to conceal spoilage, damage, or low quality. There are over 2,000 additives which perform a variety of functions. The Food Additives Amendment of 1958 provides legal standards for both intentional and incidental additives.

Antioxidants prevent the breakdown of vitamins and lipids in foods exposed to oxygen. Common antioxidants are butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), Vitamin E, ascorbic acid (Vitamin C), and lecithin.

Bleaching and maturing agents change the yellowish color of freshly milled flour to white. Hydrogen peroxide whitens milk for certain cheese manufacturing processes.

Buffers, acids, and alkalies modify the pH.

Flavoring agents include spices, herbs, plant extracts, and artificial flavors.

Food colors are used extensively. Extract of annatto, caramel, carotene, and saffron are used in carbonated beverages, candies, and gelatin. In 1976, FD & C Red No.2 and FD & C Red No.4 were banned. Reliance on natural reds from grapes, beets, and cranberries has subsequently increased.

Nitrates and nitrites contribute to the flavor and pink color in cured pork. They also are antimicrobial agents.

Non-nutritive and special dietary sweeteners are used in low-calorie soft drinks, in dietetic foods, and by diabetics.

Nutrient supplements such as Vitamin D in milk, iodine in salt, and iron in cereal products are useful supplements to diets that may otherwise be deficient in those nutrients.

Preservatives extend shelf life and prevent deterioration. Common preservatives include sodium nitrite in processed meats, sodium benzoate in soft drinks, sodium and calcium propionates in breads and cakes, sorbic acid in cheese, and chlorine as a germicidal wash on fruits and vegetables. Sulfur dioxide is used to control browning of fruits and ethylene oxide is used to fumigate spices.

Sequestrants chelate or sequester trace metals and prevent them from causing oxidation or off-coloring. Citric acid and ethylenediamine tetra acetic acid (EDTA) are examples.

Stabilizers prevent food products from changing chemically. They are also called thickeners. Pectin, casein, gelatin, carrageenan, and gum arabic are common stabilizers use to thicken gravies, pie fillings, chocolate milk drinks, jellies, puddings, and salad dressings.

Surface active ingredients include emulsifiers to stabilize oil-in-water, water-in-oil, gas-in-liquid and gas-in-solid mixtures. Lecithin, monoglycerides and diglycerides are commonly used.

Miscellaneous additives include yeast in breads, calcium chloride used to firm fruits and vegetables, anticaking agents in salt, and gibberellic acid to stimulate growth in barley for malting.

Monitoring Food Safety

The USDA's Food Safety and Inspection Service is responsible for inspecting and checking the quality of food products as they enter and leave processing plants. The FDA must approve processing plants and processing procedures. These include the use

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of additives. Food products must be correctly labelled to show their ingredients and nutritional information.

The state, county, or local health departments have jurisdiction over food establishments and regularly inspect them for cleanliness and approved practices.

All meat must pass state or federal inspection for wholesomeness to guarantee the consumer that meat being purchased is from healthy animals, which were slaughtered and processed under sanitary conditions.

Federal inspection of meats and poultry is supervised by the USDA. Meat that passes federal inspection is stamped with a round, purple mark. State-inspected meat will have a different shaped inspection mark depending on the state. The inspection mark is placed only once on the wholesale cut, so it will not appear on every cut that is purchased.

Risk Assessment

Life is a risk. Eating is a risk. There is some level of risk associated with everything we do. You personally must assess the risk of whatever activity you wish to do, and then make a decision on whether to do the activity. Food safety is very important and is also a very popular topic. If you want to survive, you must eat. You must be rational in assessing the risk versus the cost.

Undesirable residues in the food supply is an area of popular concern. Residues may be heavy metals, pesticides, aflatoxins, hormones, etc. The food supply is randomly sampled and tested to meet safety standards. Today's testing equipment can measure in parts per trillion and beyond. In 1958, when the Delaney Clause was adopted, measurement was done in parts per million. What was once considered safe, may very well be removed from the market today. The Delaney Clause prohibited known carcinogens from being added to the food supply.

Consumers assess risk in a variety of ways. First, they use rational thinking and common sense. They consume food that has not expired; looks, smells, and tastes wholesome; is produced, processed, and retailed by reputable businesses; and meets U.S. safety standards. However, consumers are not always rational when assessing risk. Sometimes fear of a product may be more important than any assurances of safety the processor can provide. On the other hand, some people choose to ignore the risk because of the pleasure associated with the product (Consider cigarettes and raw oysters). Consumers are the final 'line of defense' in keeping foods safe for consumption. Some consumers have allowed the media to be very influential in their decision making.

Summary

Food spoilage may be caused by a wide variety of factors including microorganisms, natural enzymes, insects, parasites, rodents, temperature, air, moisture, light and time. In reality, progressive deterioration in food occurs. The critical question is how slow or fast is the process. Microbial contamination causes sugar fermentation, hydrolyzation of fats and starches, and many other negative effects. Enzymatic activity is a natural metabolic process and can be a positive or negative agent in food preservation. Insects cause spoilage which permits microbial invasion. Several other factors can influence food spoilage. One of them includes production practices used.

Our food safety is monitored by the USDA, the FDA, and health departments. Food additives are substances added intentionally or incidentally to foods to improve appearance, flavor, texture, nutritional value, or storage properties. All consumers must assess the risk associated with eating food and rely on common sense to determine their decisions.

Credits

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