Food Packaging and Storage

NOTHING is worse that expecting your favorite snack when going to the kitchen, only to find that it has spoiled and become ruined. For food producers and packagers, being able to provide and preserve a fresh food supply is a top priority. Food packaging is the key to keeping our food fresh and able to be enjoyed weeks, months, or even years after it was produced!

Objective:

Explain why food packaging and storage are critical components of the food industry.

Key Terms:

antioxidant
glycerol
hydrolytic rancidity
oxidative rancidity
rancidity

Types of Packaging

Almost every kind of food we eat, except fresh fruit and vegetables, is probably packaged in some form. Some foods, such as potato chips, are packaged in special materials that do not allow light to penetrate. Other foods are packaged in hard containers, while some are packaged in flexible bags. Packaging helps prevent bacteria from entering and spoiling a product and keeps the product safe and in the form the producer wanted.

Packages for food products are made from a wide variety of materials that serve different functions in keeping the products fresh. Metal is a very common packaging material. It is strong, yet flexible, and able to be molded into nearly any shape. From the aluminum can holding your soft drink to the tin can containing a vegetable, metal is used when a product

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must be protected from shipping damage or shielded from light. Thin metals, such as aluminum foil, are commonly used in our own kitchens to preserve food items, but they are not as common in commercial packaging. The benefit of using metal as packaging is the relative ease of recycling the material to create another product or even more packaging!

FIGURE 1. Metal is commonly used in the food packaging industry.

We don't often think of trees as making good packages for our food items, but cardboard and paper made from trees are some of the oldest food packaging materials. Cardboard and paper are among the most widely used packaging materials on many items—a trip down any grocery store isle will display many items using cardboard and paper. Cardboard boxes and paper bags are two examples of wood products being used in food packaging. Unfortunately, cardboard and paper are not waterproof. Moisture can enter the packages, leading to microbial growth on the foods. For this reason, it is more likely that we will see paper products coupled with other food packaging materials, such as plastic, to make moisture-resistant packages. Dry breakfast cereal sealed in a plastic bag inside a cardboard box is an example of a combination of packaging techniques.

Over the years, plastics have become the standard of the food packaging industry. Plastics can be molded into a variety of strong containers to protect food products. They can also be formed into thin, flexible sheets to form bags or wrappers that can seal the food products off from exposure to oxygen and moisture. In our homes, rolls of plastic wrap are commonly used to cover food in our refrigerators so that items stay fresh. The disadvantage of plastics is their inability to break down naturally in landfills and garbage heaps. Although plastics are as easy to recycle as other packaging materials, they are much more harmful to our environment if simply thrown away. Food scientists are working with packaging specialists to design plastic packaging that is biodegradable and safer for the

FIGURE 2. Plastics are among the most commonly used food packaging materials. (Courtesy, USDA)

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environment. A new plastic made from corn is being developed that will offer all the same qualities as traditional plastics but will break down in landfills over time.

Some food packages must be able to do more than just protect products from light, moisture, and microbes. They must serve as cooking vessels and even as the serving platters! Convenience foods, such as instant soups and noodles, can be cooked in their original packaging. This means the packages must be able to withstand microwave use and extremely high temperatures without melting or cracking. Some packages must endure long-term freezing, only to be thrown directly into microwave ovens for the foods to be prepared.

FIGURE 3. Some food packages must be able to withstand the heat of cooking.

Because of the need for packaging that can provide the services that consumers demand, the government has developed guidelines and regulations that food producers and packagers must follow. Food packages must meet regulations for strength and flexibility to ensure that packages will not break or split with normal pressure found in stacking and shipping. Packaging machines must also be precise and gentle enough to package the food products without damaging them, important if you are purchasing easily broken foods, such as snack chips or crackers.

The government has set several guidelines to ensure that packaging materials are not only strong but also safe and convenient for the consumer. Packages must always be nontoxic and odorless so that the food items do not become contaminated by the packages themselves. Another quality of good packaging is the ability to be identified and opened easily by the consumer. We have all experienced difficulty in trying to open the wrapper of a food product. Though this is frustrating, we can be assured that the sealed product inside will be fresh and great tasting!

Rancidity

When we hear the term *rancidity,* most of us probably think of rancid milk. Although milk can become rancid, this condition is not limited to dairy products. **Rancidity** is a condition in food in which oxidation is taking place within the lipid (fat) material. There are two types of rancidity common in food products. **Hydrolytic rancidity** is the breakdown of fat into glycerol and fatty acids. **Glycerol** is the storage form of fat in animal tissue. **Oxidative rancidity**

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is the oxidation of saturated and unsaturated fatty acids that results in spoilage of food products.

Oxidation is the addition of oxygen to an unsaturated fatty acid in a lipid. Unsaturated fatty acids are commonly found in oils and are liquids at room temperature. Food products that contain high amounts of unsaturated fatty acids, such as potato chips, peanut butter, and crackers, have the potential for oxidative rancidity. As oxygen is added to a fatty acid, it produces aldehydes, hydroxyl acids, keta acids, and other compounds that produce off-flavors and odors that are not appealing to consumers.

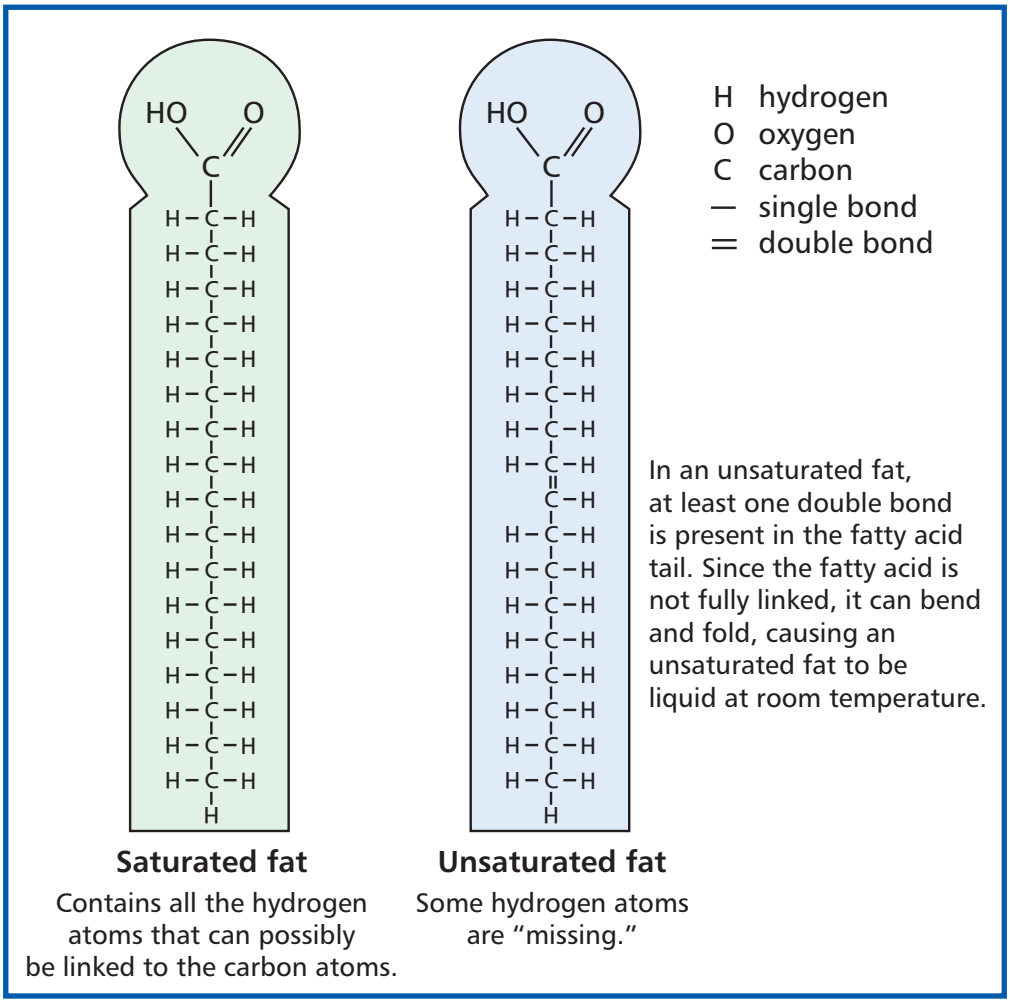

FIGURE 4. Unsaturated fatty acids have binding sites for oxygen, resulting in rancidity.

As oxygen binds to a fatty acid in a lipid, it breaks apart the bonds of the acid, releasing more molecules that will accept the binding of oxygen. If more oxygen is present, it continues to bind and break apart more molecules, causing more binding sites to be present. In this way, oxidative rancidity can continue until the oxygen supply is used up. Light, oxygen, trace elements, water, bacteria, and molds are all factors that will speed up the oxidation process. It is no wonder then that these are the very same factors that food packaging is meant to control!

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Fortunately for consumers, oxidative rancidity can be controlled, if not halted completely, in most food products. Several methods are used by food packagers and manufacturers to prevent oxidative rancidity from occurring in the time between packaging and consumption.

Probably the most successful and most widely used method of control is the removal of oxygen from the food

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UNDER INVESTIGATION...

LAB CONNECTION: Oxidative Rancidity

As long as there have been humans on the earth, there has been a demand for quality food products. With a population of more than 6 billion people now, the demand for food is even greater. But along with this demand comes another problem—how to ship and store food to avoid spoilage before the products can be consumed.

Food scientists are always working with food manufacturers to develop new ways to package and store food products so that the freshness of the products is extended. Products with long shelf lives and strong packaging can survive a trip across the globe—or to the local grocery store—without spoilage or damage.

Some of the most challenging food products to keep fresh during shipping and display are those with high lipid (fat) content. As oxidation occurs within these products, the lipids begin to produce off-flavors and odors called rancidity. Food packagers and producers are using various techniques and additives to try to control the oxidation process. In the laboratory, scientists are experimenting with the effects of light and oxygen on the oxidation of various foods, like fresh potato chips.

Oxidative rancidity is likely to occur in foods with high lipid content, such as potato chips.

Conduct your own experiment to try to solve the same problems that food scientists must face to produce a fresh and great-tasting food product. In a controlled setting, some potato chips are exposed to light, while others are kept in the dark. After a time, the flavor of the chips is tested.

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package. Oxidative rancidity cannot occur without the presence of oxygen molecules. By vacuum sealing the food product in a metal can or plastic container where oxygen is not able to reach the fatty acids, the food product can remain fresh for a long period. Unfortunately, vacuum sealing food products can be a costly method of prevention, causing some packagers to seek less expensive means of reducing oxidation. Most potato chip manufacturers do not vacuum seal their chip bags because of the costs involved. Instead, they may use machines to replace the oxygen in the bags with a nonreactive gas, such as nitrogen. Nitrogen will not begin the process of oxidative rancidity and will provide a cushion inside each bag to keep the chips from being broken during shipping and display at the grocery store.

FIGURE 5. Potato chip bags are commonly gas filled to prevent damage to the chips.

Another common method used to control oxidation is the addition of an antioxidant. An **antioxidant** is a substance added to a food product that interferes with and stops the chain reaction that occurs with oxidation. Unfortunately, the antioxidant can be consumed within the food product as it stops the oxidation reaction. When all the antioxidant is consumed, the food product will continue the oxidation process and become rancid.

Protecting the food product from light is also another method of reducing oxidation. Light will accelerate the oxidation reaction taking place within the food, speeding up the spoiling process. By using light-proof packaging material, such as foil, cardboard, or metal cans, light is not allowed to reach the food product.

Vitamins E and C have also been shown to reduce the effects of oxidative rancidity. However, they are expensive to add to the food source and are not commonly found in many of the less expensive food products. One step that any food packager and provider can take to reduce the amount of food spoilage is to distribute the product quickly to the

FIGURE 6. Speedy distribution is an economical way to reduce the amount of food spoilage. (Courtesy, USDA)

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store and the consumer. The sooner the consumer can purchase and enjoy the food product, the less time is available for the food to spoil. Speeding distribution may require changes in shipping means, delivery routes, or even packaging. These changes may be expensive to implement. Fortunately, the expenses incurred in upgrading distribution will not be as damaging to the manufacturer as the production of a food product that has spoiled by the time it reaches the store shelves.

Summary:

Proper food packaging and storage are critical for a food supply that must be produced in one location and shipped to various places around the world. Food packaging can vary from metal cans to plastic wrap, but the role is still to protect the food from invasion by microorganisms or from oxidation. Oxidation is the spoiling of the lipid content in food as the food ages. Efforts to reduce oxidative rancidity have led to more efficient food containers and to food additives that interfere with the oxidation process.

Checking Your Knowledge:

1. What are four different types of food storage containers?
2. How does the process of oxidative rancidity begin and continue within a food product?
3. What vitamins have been shown to reduce the effects of oxidative rancidity?

Expanding Your Knowledge:

Visit a local supermarket. Itemize all the different food storage containers you find. For each type of container, list the reasons a manufacturer would choose such a container for its food product.

Web Links:

Hormel—Food Packaging

http://www.hormel.com/templates/knowledge/knowledge.asp?catitemid=4&id=270

European Food Information Council

http://www.eufic.org/gb/food/pag/food33/food333.htm

Agricultural Career Profiles

http://www.mycaert.com/career-profiles

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