SERVICE IN ACTION

COLORADO STATE UNIVERSITY EXTENSION SERVICE

Meat preservation and storage

J. R. Greathouse and J. D. Tatum[1]

no. 1.812

Quick Facts

- Meat undergoes constant chemical and physical changes in all types of storage conditions; these changes are a combined effect of deterioration, which occurs naturally in meat, and degradation, caused by the storage environment.
- Oxidative rancidity is the result of a series of natural chemical reactions occurring in meat fat after exposure to air.
- Microbial deterioration results from growth of microorganisms introduced through the meat handling chain.
- Packaging meat to allow air exposure or wrapping with oxygen permeable materials increases the potential for, and rate of, deterioration.
- Refrigerator and freezer storage of meat limits the rate of deterioration, but products should be wrapped properly and stored only for recommended times.

Meat is a highly perishable product. It can deteriorate very rapidly if handled improperly, resulting in spoilage and consumer dissatisfaction. Therefore, precautions must be taken to maintain and conserve its quality prior to consumption.

For centuries humans have used available resources to preserve meat for future consumption. Salting, smoking and drying have been used as preservation methods to inhibit spoilage. Home refrigeration and freezer storage generally have replaced these earlier methods as more efficient and more convenient means of meat preservation. They also have helped to extend the storage life of fresh and processed meat products.

However, consumers often take for granted the ease of using these storage techniques and through poor packaging and excessively long storage, abuse the product they are trying to preserve. Therefore, it is essential that consumers be informed of the principles and limitations of low temperature storage of meat.

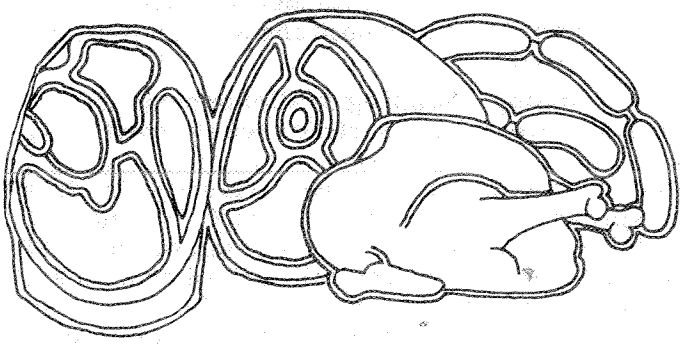
Meat Degradation

Meat undergoes constant chemical and/or physical changes in all types of storage conditions. These changes are a combined effect of deterioration, which occurs naturally in meat, and degradation caused by the storage environment. Both factors can lead to the development of oxidative rancidity and microbial deterioration, which are detrimental to the storage life of any meat product.

Oxidative rancidity is the result of a series of natural chemical reactions occuring in meat fat after exposure to air. The process of fat deterioration in the presence of oxygen eventually results in the formation of objectionable odors and flavors, which constitute spoilage of the product.

Fat from certain animal species is more susceptible to oxidative rancidity. This is due primarily to differences in the physical composition and types of fats present in these species. For example, pork fat contains a higher proportion of unsaturated fatty acids that are more susceptible to oxidation as compared to beef or lamb fat. Consequently, pork has a shorter storage life.

Cured meats have a greater potential for developing oxidative rancidity than fresh meats because of the presence of such pro-oxidants as nitrite, sodium chloride, and copper, iron, manganese and cobalt impurities often found in the curing ingredients. The addition of antioxidants (such as BHA, BHT, propyl gallate or citric acid) during the curing process, however, tends to prolong the storage life of these products.



[1]*J.R. Greathouse, CSU graduate research assistant; J.D. Tatum, CSU assistant professor, animal sciences (1/1/84)*

Microbial deterioration results from growth of microorganisms introduced through the meat handling chain. If not controlled, microbial growth can severely deteriorate the nutritional quality, appearance, odor and flavor of meat. The development of a sticky meat surface, slime formation, discoloration and sour odors and flavors often are indications of microbial spoilage. Microbial growth also can lead to rancidity.

Several environmental factors have been attributed to the development of oxidative rancidity and microbial deterioration in meat.

- **Packaging** meat to allow air exposure or wrapping with oxygen permeable materials increases the potential for, and rate of deterioration. Hence, meat should be wrapped tightly (excluding as much air as possible) using various types of oxygen impermeable packaging material (i.e.—laminated freezer papers, high density polyethylene films, saran, aluminum foil). These materials also provide moisture impermeability that prevents dehydration of the product.

A majority of fresh meats found in retail stores are packaged in highly plasticized polyvinyl chloride films or low density polyethylene films. These materials have a very low moisture transmission rate, but allow for the entrance of oxygen. The packaging materials are very desirable from a marketing standpoint because the entry of oxygen initially produces a bright red color in meat, indicating freshness for merchandising. Continued exposure to oxygen, however, can increase the rate of deterioration. Once purchased, this meat should be re-packaged or overwrapped with an oxygen impermeable material if it is to be stored for an extended period of time.

Vacuum packages often are used to maintain the quality of processed meats. Because oxygen catalyzes deterioration of these products, they should be kept in their original wrapping until use.

- **Initial product deterioration** prior to storage is a very important aspect of meat preservation. If meat already is in a deteriorated state when placed in storage, further degradation can be expected. Storage conditions will not improve product quality.

- **Grinding, chopping** or **slicing** meat prior to storage increases the surface area exposed to air and leads to incorporation of oxygen within the product. In addition, microbes on the meat surface are spread throughout the product. Consequently, such products as ground beef, hamburger and sausages are very susceptible to the development of oxidative rancidity and microbial deterioration. For this reason, comminuted meat products have a shorter storage life compared with their intact counterparts.

- **Exposure to light and heat** enhance meat deterioration in an indirect manner. Both factors interact as catalysts in chemical reactions leading to the development of rancidity. Therefore, meat should be stored at cool temperatures and kept in the dark (or packaged in an opaque type of material) to retard rancidity.

Refrigerator and Freezer Storage

Refrigerator and freezer storage of meat limits the rate of deterioration.

Refrigeration is a short-term storage method that preserves meat most effectively at temperatures slightly above 32°F (0°C). These temperatures retard enzyme activity and oxidation, as well as inhibit the growth of certain types of microbes. However, deterioration will continue to occur, limiting effective storage time.

Freezer storage works under the same principles as refrigerator storage except it usually is a longer-term storage method operating at temperatures near 0°F (-18°C). These lower temperatures result in greater retardation of enzyme and chemical changes as well as inhibiting all types of microbial growth. Therefore, frozen meat can be stored for a longer period of time with less deterioration.

Recommended refrigerator and freezer storage times for certain meat products are listed in Table 1. As mentioned previously, several factors influence the rate at which meat spoilage develops. Consequently, recommended storage times should be considered as "maximums" for products in wholesome condition that are handled properly throughout the preservation process.

Table 1: Maximum refrigerator and freezer storage recommendations for meat.

Product	Refrigerator (32-40°F)	Freezer (less than 0°F)
Beef (fresh)	2 to 4 days	6 to 12 months
Pork (fresh)	2 to 4 days	3 to 6 months
Lamb (fresh)	2 to 4 days	6 to 9 months
Ground beef	1 to 2 days	3 to 4 months
Luncheon meats	1 week	not recommended
Bacon	5 to 7 days	3 to 6 months
Frankfurters	4 to 5 days	1 month
Fresh pork sausage	1 week	2 months
Smoked sausage	3 to 7 days	——
Leftover cooked meat	4 to 5 days	2 to 3 months

Freezer Burn

Improperly stored frozen meat often will exhibit dry localized areas of discoloration. This phenomenon, known as "freezer burn," is the result of surface dehydration. Factors leading to this dehydration are a) holes in the packaging material, b) the use of moisture permeable packaging, c) the presence of air pockets between the meat surface and packaging material, or d) severe temperature fluxuations in the freezing compartment that allow for a partial defrosting and refreezing of the product during storage. Freezer burn is harmless but can decrease the attractiveness of a product and make it somewhat dry and tasteless.

Meat that is frozen for long periods of time should be wrapped in an air-tight, moisture impermeable material (i.e., freezer paper, freezer bags, vacuum bags, aluminum foil). Retail display packaging materials are often unsuitable for long periods of freezer storage because they permit the entry of oxygen.