



## Shelf-life of Meat

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The shelf-life of meat can be defined as the amount of time required before meat or meat products become visibly unacceptable, unpalatable or unfit for consumption because of the development of spoilage organisms, and/or lipid oxidation. As the industry responds to a greater demand for extended aging, increased distribution, and longer retail case display periods, there is an emphasis on shelf-life improvement of fresh and frozen meat and meat products.

Shelf-life can be extended by creating an unfavorable environment for the growth of spoilage organisms such as bacteria, yeasts, and molds. The growth of these spoilage organisms can be delayed by affecting oxygen availability, temperature, relative humidity, and time of storage. Environments that allow oxygen in for aerobic respiration typically favor growth of pseudomonas spoilage bacteria. Environments that exclude oxygen creating an anaerobic environment typically favor growth of lactic acid bacteria.

Shelf-life extension is also possible by preventing the chemical oxidation of lipids, which leads to rancidity. In the process of lipid oxidation, fats (specifically unsaturated fats) are broken down in the presence of oxygen through a free radical reaction. This breakdown of fats causes flavor deterioration, and results in the development of off-flavors that are undesirable to consumers. Lipid oxidation also can cause deterioration of color, texture, and nutritional value. The level of oxidation that occurs can be affected by oxygen concentration, temperature, moisture, surface area, UV-light, and the presence of non-heme iron ( $Fe^{3+}$ ) and metal ions.

Mechanical refrigeration (below 40°F) is the most common means of extending the shelf-life of fresh meat. Another method of controlling shelf-life is through packaging. The purpose of packaging is to protect meat against harsh environmental factors that can speed up deterioration. There are multiple packaging options available today that provide for extended shelf-life by altering the environment surrounding the meat. A common option is vacuum packaging. Vacuum packaging retards lipid oxidation by excluding oxygen and creating an anaerobic environment not suitable for the growth of aerobic spoilage organisms. This packaging option provides for the longest shelf-life of fresh meat, but also results in a darkening of the lean while under vacuum conditions. Also available is modified atmosphere packaging that involves introducing a combination of gasses into a fresh meat package to affect product shelf-life and color. Still another option for shelf-life extension is through the addition of antioxidants that help retard lipid oxidation. For example, vitamin E (alpha-tocopherol) can be added to the diets of fed cattle before harvest to increase the level of alpha-tocopherol acetate present in the resulting beef. Alpha-tocopherol serves as an antioxidant to delay product discoloration and retard lipid oxidation, and therefore, extend product shelf-life.