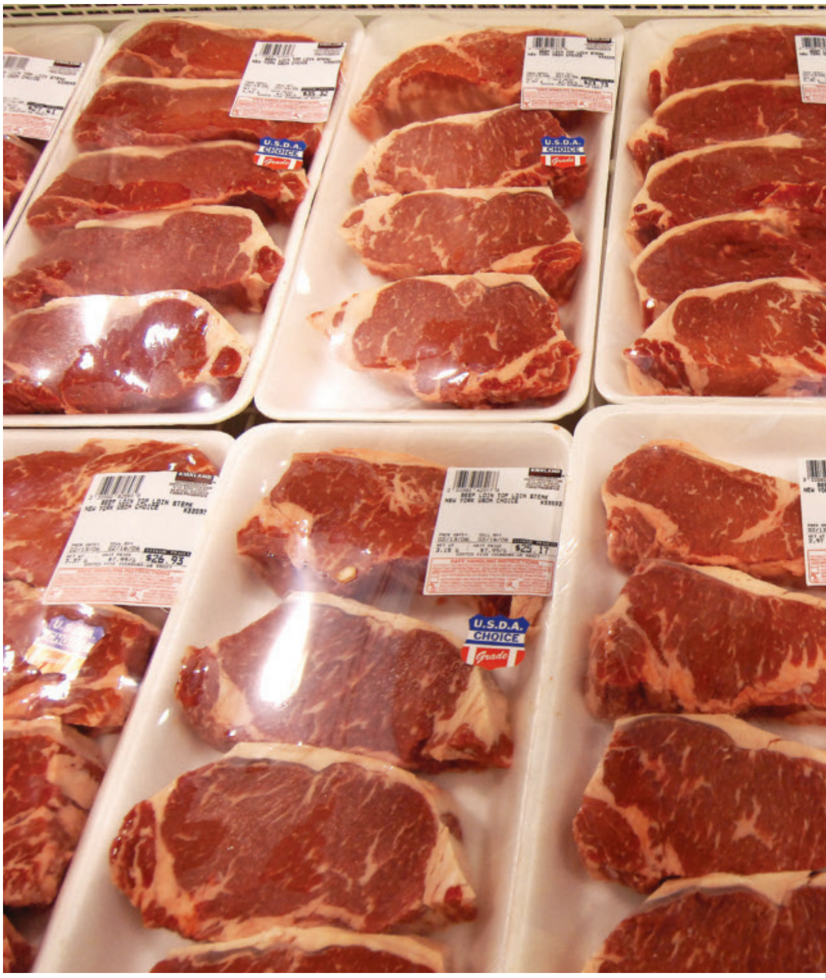
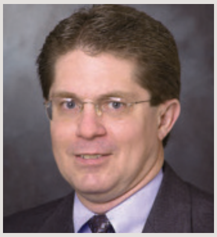
Proper chilling pays dividends



Much attention is given to the heat processing of meat products for food safety and quality. Proper chilling of the proteins after cooking, however, also is important.

From a food safety perspective, rapid chilling reduces the time that *C. perfringens* can grow in products after cooking and before reaching an internal temperature of about 80 degrees Fahrenheit.



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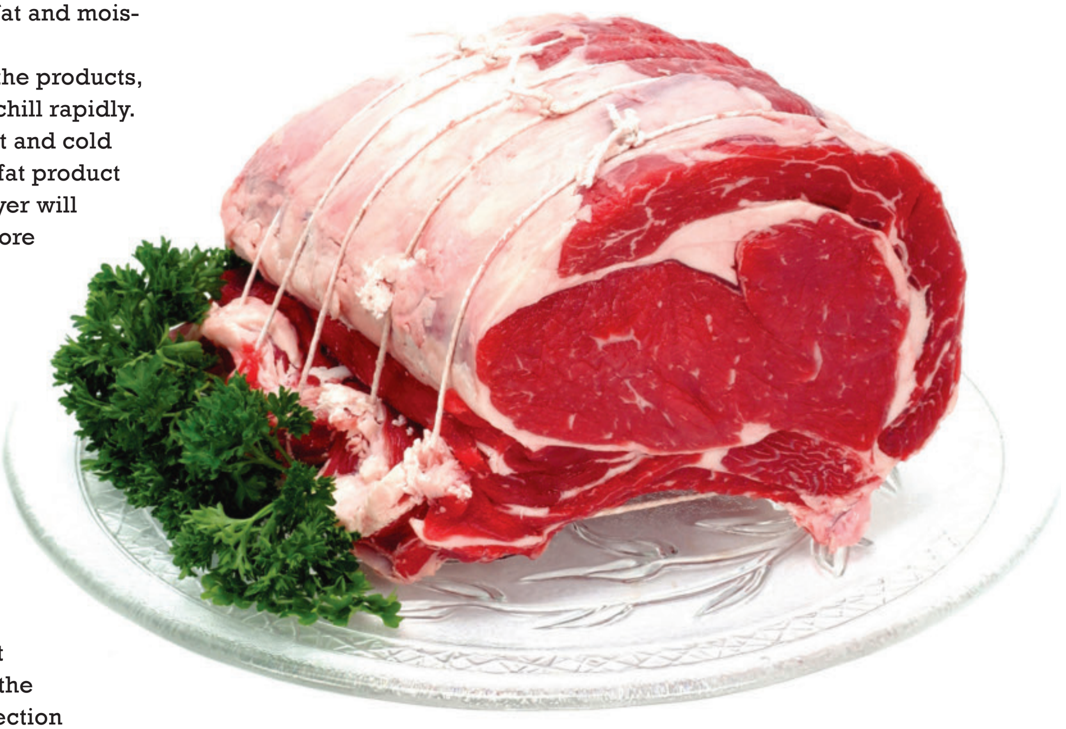
Rapid chilling also reduces exposed product shrink before packaging by reducing the time the product is exposed to the dehydrating effects, particularly when chilling with air.

In addition, proper chilling reduces the opportunity for spoilage organisms to grow, which will protect product quality and extend its shelf life. Slicing yields for many cooked products are affected by the product temperature and the method of chilling.

The heat transfer principles for heating meat products, such as conduction and convection, also apply to chilling of products, but in reverse. Convection is the transfer of heat from the product surface to the medium (air, fluid, etc.) used to chill the product. The driving force for convection is the temperature difference between the product being chilled and the cooling medium.

Conduction of cold temperatures through the product is basic to the chilling process, just like conduction is important to heating meat. Transfer of heat and/or cold through meat depends on product characteristics, such as the dimensions, fat and moisture content.

Obviously, the larger the products, the more difficult it is to chill rapidly. Also, water conducts heat and cold faster than fat, so a high-fat product or a product with a fat layer will characteristically chill more slowly by conduction.



In addition to reducing the temperature of the medium used to chill meat, chilling rate can be enhanced by increasing the speed of the cooling medium around the product.

The chilling rate for products that are difficult to chill in a cooler using the USDA's Food Safety Inspection Service's Appendix B guidelines can be dramatically increased by amplifying the air speed of the cooler around the product.

Use of cold liquids on hot products is the most efficient means of chilling items because the heat transfer coefficient of liquids is much higher than that of air.

Water, salt solutions and propylene glycol are the main options for more rapid cooling of meat. The product, however, would need to be packaged to prevent it from making contact with propylene glycol.

Misting or intermittent showering of products during air chilling also will increase the chilling rate—compared to dry air cooling—by evaporating moisture from the surface of hot items. This is referred to as evaporative cooling, and it is very effective in transferring heat across the surface of meat.

To maximize the impact of the temperature difference between the water and hot product, salt is added to water so it can be chilled to temperatures below the freezing point of pure water.

Salt solutions, or brines, can be chilled to 10 to 15 degrees Fahrenheit. Brines can cause crust freezing at such low temperatures.

Crust freezing can shorten the brine chilling time, as the frozen crust will continue the chilling process after the product leaves the brine chill as ice transfers heat more slowly than water.

Therefore, brine temperatures of 20 to 25 degrees Fahrenheit may work better for rapid chilling of meat. However, crust freezing also can cause quality problems for some poultry items.

Brine chilling also has the advantage of reducing evaporative moisture losses from the product compared to air chilling as total chilling time is reduced.

Because of its speed, brine chilling also works better in combination with continuous cooking operations.

Proper chilling not only helps produce safe meat, but is also important for maintaining product quality. The optimal chilling method for products will depend upon the composition and size of the items being chilled.

Ohio State University offers an annual Thermal Processing Short Course. Contact Lynn Knipe at knipe.1@osu.edu for more information.

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