COOLING OF LARGE MEAT PRODUCTS

Cooked meat that is cooled over a long period of time can be hazardous. Bacteria may be present in meat due to undercooking or as spores which survive the cooking process, germinate and become active again when the temperature is favourable. It is therefore essential to carefully control the cooling process.

Australian Standard for cooling meat

The Australian Standard AS4696-2007 *Hygienic production and transportation of meat and meat products for human consumption* has the following requirements for cooling meat products at the stie of microbiological concern:

Cured cooked meats (e.g., hams) are cooled so that the temperature of the meat products:

- is reduced from 52°C to 12°C within 7.5 hours, and then
- to 5°C within 24 hours of the completion of cooking

Note: product is considered to be cured if curing salts have been added at a level which preserves the product, being a minimum 2.5% salt on water phase and 100 ppm nitrite ingoing.

Uncured cooked meats (e.g., roast pork) are cooled so that the temperature of the meat products:

- is reduced from 52°C to 12°C within 6 hours and then
- to 5°C within 24 hours of the completion of cooking

For both cured and uncured meat products there are provisions for alternative cooling regimes to be used, provided the business can demonstrate that the finished product is safe.

The cooling process must be continuous

While most common food poisoning bacteria can grow between 5°C and 60°C – known as the temperature

danger zone – the most rapid growth occurs in the range of 20°C to 52°C. Therefore, it is very important to cool meat products quickly through this temperature range, especially to prevent the outgrowth of heat shocked spores of *Clostridium perfringens* and *Clostridium botulinum.*

Any cooling process should ensure there is a continuous drop in temperature and the time between 52°C to 20°C is minimised. While growth of bacteria can still occur below 20°C, it will happen at a slower rate.

Cooling should ideally begin immediately after cooking and no longer than 90 minutes after the cooking cycle is completed.

Characterising the cooling process

For large cuts of meat, it can be difficult to cool them down quickly. Conditions affecting the cooling rate include size, shape, weight of the product and how it is stacked or stored in the chiller. An over filled, crowded coolroom might not cool products at the same rate as a relatively empty one.

To best understand the capability of the equipment you use to cool meat products in your business, it is a good idea to measure the time and temperature of various meat products during the cooling cycle. This can be achieved by using a commercially available temperature data logger or manually recording the temperature periodically throughout the cooling cycle (e.g., every 1-2 hours). The aim is to limit the potential growth of *C. perfringens* in the meat product to less than a 1 log (ten-fold) increase during the cooling cycle. Good quality meat with a low post-mortem pH and finished products with low pH values, adequate levels of salt-in-moisture, nitrite and ascorbate/erythorbate all limit the growth of *C. perfringens*.

Once you have measured the temperature of the meat during cooling several times, you will have a better understanding whether you can achieve a consistent cooling outcome. The shape of the meat or product's time/temperature cooling profile could have a significant impact on the amount of growth of *C. perfringens*, even though the initial and final temperatures and the length of chilling is the same.

Approving alternative cooling process

If a business cannot rapidly cool meat product in accordance with the Australian Standard, the business must apply for an approved alternative process from the NSW Food Authority using the appropriate form (www.foodauthority.nsw.gov.au).

Any submission must be supported by information on the meat product being assessed such as the product's ingredients (e.g., salt, nitrite, ascorbate level), temperature cooling data, and final product's characteristics (e.g., pH, water activity, salt, and moisture content). The worst-case scenario cooling curve for the largest product is the best place to start. Microbial testing alone is not sufficient for this purpose.

The time required to review and accept an alternate cooling process will depend on the quality and completeness of the submission.

An alternative cooling process for large ham can be achieved by demonstrating compliance with the US Food Safety and Inspection Service (FSIS) '*Compliance guidelines for stabilization (cooling and hot-holding) of fully and partially heat-treated RTE and NRTE meat and poultry products produced by small and very small establishments and revised Appendix B' (2017)* **or** having a suitably qualified food scientist to prepare a report that demonstrates compliance with the MLA '*Guidelines for the safe manufacture of smallgoods – 2nd edition*' (2015).

FSIS specifies four options for cooling meat and poultry products that limit growth of *C. perfringens* to less than 1 log and allow no multiplication of *C. botulinum* as follows:

Option No.	Applies to	Cooling parameter
1	• fully cooked products (intact or non-intact meat or poultry), and • cured or uncured products	The product's maximum internal temperature should not remain: (a) between 54.4°C and 26.7°C for more than 1.5 hours, and (b) between 26.7°C and 4.44°C for more than 5 hours (6.5 hours total cooling time)
2		Chilling should begin within 90 minutes after the cooking cycle is completed. All product should be (a) chilled from 48.9°C to 26.7°C in 1 hour, and (b) from 26.7°C to 12.8°C in 5 hours (6 hours total cooling time), and (c) followed by continuous chilling until the product reaches 4.44°C
3	• fully cooked products (intact or non-intact meat or poultry), and • cured with at least 100 ppm ingoing sodium nitrite (either from a purified or natural source) **and** 250 ppm sodium erythorbate or ascorbate	The product's maximum internal temperature should not remain (a) between 54.4°C and 26.7°C for more than 5 hours, and (b) between 26.7°C and 7.22°C for more than 10 hours (15 hours total cooling time)
4	• fully cooked products (intact or non-intact meat or poultry), and • formulated with ≥40 ppm of sodium nitrite or its equivalent **and** a brine concentration of 6% or more, **or** • formulated with or without nitrite (such as salt cured product) but with a maximum water activity of 0.92.	The maximum internal temperature should not remain (a) between 48.9°C and 4.44°C for more than 20 hours, and (b) the cooling process causes a continuous drop in product temperature **or** controls the product's temperature so that it does not stay between 48.9°C and 26.7°C for more than 2 hours.

If the time/temperature profile of your process does not comply with the Australian Standard or the FSIS guide, predictive modelling is required to determine the growth of *C. perfringens* during the extended cooling period. Appendix 5 of the MLA's guideline provides guidance on alternative arrangements for cooling of large cured cooked meats. In essence, the characteristics of the meat product must limit growth of *C. perfringens* to no more than 1 log increase during the cooling cycle.

There are also other published studies on cooling rates which appear to show that slower cooling rates may still be safe. However, before applying such process you must consider whether your product formulations (in terms of salt, nitrite, and other preservatives) are similar to those of the products studied.

If meat products potentially contain high levels of bacterial spores (for instance containing significant levels of untreated herbs and spices distributed throughout the product) the safe cooling time from cooking to 5°C may be much shorter.

Deviation from the approved cooling process

Once an alternative cooling process is approved by the Food Authority, the business must follow the approved process. If there is any deviation from the approved process, the safety of the products must be validated by the business and an application lodged with the Food Authority for assessment before they are sold.

If a cooling deviation occurs, the business should assume that their process has exceeded the performance standard for controlling the growth of *C. perfringens* and take corrective action. The presence of the nitrite in cured meats should ensure compliance with the performance standard for *C. botulinum.*

End product sampling for viable cells of *C. perfringens* can be done as an additional safety measure but it is not sufficient on its own. If the product is considered acceptable for sale, there must be evidence to support this decision.

About the NSW Food Authority

The NSW Food Authority is the government organisation that helps ensure NSW food is safe and correctly labelled.

It works with consumers, industry and other government organisations to minimise food poisoning by providing information about and regulating the safe production, storage, transport, promotion and preparation of food.

More information

- **visit** www.foodauthority.nsw.gov.au
- **phone:** 1300 552 406