Heat Treatment

One of the most common CCP's is the use of a heat treatment for products in the heat-treated, shelf-stable; heat-treated, not shelf-stable; and not fully cooked, not shelf-stable categories. The method of cooking and the temperature to which products are cooked significantly affect the lethality of the cooking process, and the overall safety of the product. Additional information on drying processes in combination with heating may be found in Drying & Fermentation.

Cooking of Meat & Poultry

Summary:

The most common reference for time/temperature cooking is FSIS Appendix A. This guidance is intended for beef and poultry products, and is often also used in referenced in cooking pork. Alternative time/temperature guidance ("Appendix A for Poultry Products") is also available below. Note that the Appendix A guidance requires high-humidity conditions that are sometimes undesirable in making dry products such as jerky. The 2005 "Guidance on Relative Humidity..." explains which products have associated oven-humidity requirements, and which do not.

Paper Reference:

FSIS Appendix A - Click HERE for copy of the paper
Appendix A for Poultry Products - Click HERE for a copy of the paper

Critical Limit Summary:

Appendix A Critical Limit Table - Click HERE for a copy

Appendix A Guidance on Relative Humidity and Time/Temperature for Cooling/Heating and Applicability to Production of Other Ready-to-Eat Meat and Poultry Products. 2005. Iowa State. - Click HERE for a copy of the paper

Low-Temperature Cooking of Summer Sausage and Pepperoni

Summary:

The increased acid in fermented products increases the effective kill of heating processing beyond what is found in non-fermented products such as wieners and bologna. Along with the increased acidity, a low-temperature / longer-time heating process may produce a desired level of kill avoiding the need to apply higher temperatures.

Therefore these studies found that the following processes that would provide lethality and still maintain acceptable product quality.

pH 5.0 Pepperoni

1. Heat to an internal product temperature of 145°F with no holding time required.
2. Heat to an internal product temperature of 128°F and hold for at least 60 minutes at that temperature or hotter.

pH 5.0 Summer Sausage

1. Heat to an internal product temperature of 130°F and hold for at least 30 minutes at that temperature or hotter.

pH 4.6 Summer Sausage

1. Heat to an internal product temperature of 130°F with no holding time required.

Paper Reference:

Calicioglu, M., N.G. Faith, D.R. Buege, and J.B. Luchansky. 1997. Viability of *Escherichia coli* O157:H7 in fermented semidry low-temperature-cooked beef summer sausage. *Journal of Food Protection* 60(10): 1158-1162. Click HERE for a copy of this paper.

Hinkens, J.C., N.G. Faith, T. D. Lorang, P.Bailey, D. Buege, C.W. Kaspar, and J.B. Luchansky. 1996. Validation of pepperoni processes for control of *Escherichia coli* O157:H7. *Journal of Food Protection* 59(12): 1260-1266. Click HERE for a copy of this paper.

Beef Jerky Thermal Processing

Summary:

Whole muscle jerky is intended to be a dry product with desirable texture and shelf-stability. Yet, the drying of the product may reduce the lethality of the process and not adequately kill pathogens on the surface. This reduction is likely due to 2 reasons:

1. evaporative cooling on the surface of the beef strip keeps it from getting hot enough
2. early stages in heating may make the pathogens more heat-resistant so that they survive the later stages of the process

Therefore these studies investigated processes that would provide lethality and still maintain acceptable product quality.

Paper References:

Buege, D.R., G. Searls, and S.C. Ingham. 2006. Lethality of commercial whole-muscle beef jerky manufacturing processes against *Salmonella* serovars and *Escherichia coli* O157:H7. *Journal of Food Protection*. 69: 2091-2099. Click HERE for a copy of the paper.

Porto-Fett, A.C.S., J.E. Call, and J. B. Luchansky. 2008. Validation of a commercial process for inactivation of Escherichia coli O157:H7, Salmonella Typhimurium, and Listeria monocytogenes on the surface of whole muscle beef jerky. *Journal of Food Protection*. 71:918-926. Click HERE for a copy of the paper.

A. G. Borowski, S. C. Ingham, and B. H. Ingham. 2009. Lethality of Home-Style Dehydrator Processes against Escherichia coli O157:H7 and Salmonella Serovars in the Manufacture of Ground-and-Formed Beef Jerky and the Potential for Using a Pathogen Surrogate in Process Validation. *Journal of Food Protection*. 72: 2056-2064. Click HERE for a copy of the paper.

A. C. S. Porto-Fett , J. E. Call , C.-A. Hwang , V. Juneja , S. Ingham , B. Ingham , and J. B. Luchansky. 2009. Validation of commercial processes for inactivation of Escherichia coli O157:H7, Salmonella Typhimurium, and Listeria monocytogenes on the surface of whole-muscle turkey jerky. *Poultry Science.* 88 :1275–1281. Click HERE for a copy of the paper.

Borowski, A.G., S.C. Ingham, and B.H. Ingham. 2009. Validation of ground-and formed beef jerky processes using commercial lactic acid bacteria starter cultures as pathogen surrogates. *Journal of Food Protection* 72: 1234-1247. Click HERE for a copy of this paper.

Dierschke, S., S. C. Ingham and B.H. Ingham. 2010. Destruction of *Escherichia coli* O157:H7, *Salmonella*, *Listeria monocytogene*s and *Staphylococcus aureus* achieved during manufacture of whole-muscle beef jerky in home-style dehydrators. *Journal of Food Protection* 73:2034-2042. Click HERE for a copy of the paper.

Critical Limit Summary for Validated Whole-Muscle Beef Jerky Processes

Critical Limit Summary for Validated Ground-and-Formed Beef Jerky Processes

Critical Limit Summary for Validated Turkey Jerky Processes

Hams - Slow Cooking

Summary:

The USDA has cautioned against slow-cooking of meat because these conditions may allow the production of heat stable enterotoxin by Staphylococcus aureus . This paper gives critical limits for the brine injection and the thermal process that control this hazard.

Paper Reference:

Ingham, S.C., J.A. Losinski, B.K. Dropp, L.L. Vivio, and D.R. Buege. 2004. Evaluation of *Staphylococcus aureus* growth potential in ham during a slow-cooking process: use of predictions derived from the U.S. Department of Agriculture Pathogen Modeling Program 6.1 predictive model and an inoculation study. *Journal of Food Protection* 67: 1512-1516. Click HERE for a copy of the paper

Critical Limit Summary:

Hams Slow Cooking Critical Limit Summary