Appendix 3: Limits for food processes

The following table is intended as a quick guide to limits to be achieved for some food processes based on the control of commonly associated foodborne pathogens[1]. The nature of the food and the full process used to produce it, as well as how it is packaged and stored should be taken into consideration.

Process	Critical limit	Comment
Acidification	pH < 4.6	Prevents the growth of pathogenic microorganisms such as *Clostridium botulinum* and *Bacillus cereus*. Standard 2.3.1 — Fruit and Vegetables specifies that fruit and vegetables in brine, oil, vinegar or water (other than commercially canned) must not have a pH greater than 4.6. NSW Food Authority's Food Safety Guidelines for the Preparation and Display of Sushi provides guidance on the acidification of sushi rice.
	pH ≤4.2	Prevents the growth of *Salmonella*. NSW Food Authority's Food Safety Guidelines for the Preparation of Raw Egg Products provides guidance on the acidification of raw egg products such as mayonnaise and aioli.
Canning low-acid food (pH >4.6)	121°C for 3 mins (or equivalent)	Required for the elimination of *C. botulinum* spores (12 D process for proteolytic strains).
Confit	See sous vide.	
Cooking	Core temperature of at least 75°C for poultry	Recommended to eliminate *Salmonella* and *Campylobacter*.
	Core temperature of at least 75°C for stuffed, rolled, reformed or minced meat products	6D heat process for *Listeria monocytogenes.* See Meat and Livestock Australia's Guidelines for the Safe Manufacture of Smallgoods.

Process	Critical limit	Comment
Cook/Chill[2]		The combination of heat treatment, rapid chilling (to ≤ 5°C) and packaging should ensure the product is safe for the given shelf life. See Cox and Bauler's Cook Chill For Foodservice and Manufacturing: Guidelines for Safe Production, Storage and Distribution (Cox & Bauler, 2008) or PrimeSafe's Shelf Life and Labelling Requirements for Meat Products.
	Heat process of 70°C for 2 minutes or heating to 75°C (for refrigerated food with a short shelf life < 10 days)	6D heat process for *Listeria monocytogenes.*
	Heat process of 90°C for 10 minutes (or equivalent) — for refrigerated foods with an extended shelf life >10 days	6D heat process for non-proteolytic *C. botulinum.*
	Chilling to ≤ 3°C	The growth of non-proteolytic *C. botulinum* is prevented at 3°C and below. This temperature may be required for storage of extended shelf life cook chill foods where processing and package conditions can support *C. botulinum* growth.
Cooling[2]	60°C to 21°C within 2 hrs, then 21°C to 5°C within the next 4 hrs	As per Standard 3.2.2 subclause 7(3). Alternative cooling limits for cooked bulk processed meat products are provided in Appendix 5.
Drying	a_w < 0.85	Growth of pathogenic bacteria controlled (a_w 0.85 limit of growth of *Staphylococcus aureus* in salt conditions). Standard 2.2.1 — Meat and Meat Products requires food that is sold as dried meat to have a water activity of no more than 0.85. Spoilage by most xerophilic fungi prevented at a_w 0.70–0.75.

Process	Critical limit	Comment
Fermenting	pH limits will depend on the particular food and starter culture used. May need to be combined with other hurdles, such as a_w or refrigeration to achieve required preservation.	Fermentation process may use bacteria, yeasts or moulds. Starter culture used should result in adequate production of acid to prevent growth of other organisms present. Standard 2.5.3 — Fermented Milk Products requires the pH of fermented milk or yoghurt to be ≤4.5. Requirements for uncooked comminuted fermented meat are specified in Standard 4.2.3 – Primary Production and Processing Standard for Meat.
Pasteurising (thermal)	Temperature/time limits depend on the food and target microorganism.	Pasteurisation temperature and time equivalents for a 6D reduction of non-proteolytic *C. botulinum* and for *L. monocytogene*s are provided in Cox and Bauler (2008).
	72°C for 15 sec (or equivalent) for milk	See Standard 4.2.4 — Primary Production and Processing Standard for Dairy Products.
	64°C for 2.5 minutes for whole egg pulp 60°C for 3.5 minutes for liquid egg yolks 55°C for 9.5 minutes for liquid egg white	See Standard 4.2.5 — Primary Production and Processing Standard for Eggs and Egg Products.
Refrigeration	≤ 5°C	
Sous vide	55°C minimum water temperature	Effective pasteurisation or cooking is achieved by holding food at relatively low temperatures for an optimum time. A minimum temperature of 55°C is recommended to prevent growth of *Clostridium perfringens*. See NSW Food Authority's Sous Vide — Food Safety Precautions for Restaurants.

Process	Critical limit	Comment
Sugar concentration	a_w < 0.85	Concentrated sugar foods include jams, confectionery and fruit concentrates. Final a_w of ≤ 0.75 inhibits mould growth.
Vacuum and MAP packing	As per validated process — details will depend on the application. See above for cook chill foods.	Packaging materials should have good gas barrier properties.

a_w = water activity

1. Factors affecting pathogen growth, survival and toxin production are described in the International Commission on Microbiological Specifications for Foods (ICMSF 1996).
2. Useful practical guidance for controlling foodborne pathogens, particularly in cook-chill foods, is provided in Cox and Bauler 2008.

See Resources and References section for full reference information.