

Appendix 4: Foods requiring special care

Some foods can pose a higher risk of causing foodborne illness and need to be handled with special care to manage food safety risks. Some general information and best practice tips for food safety are provided below for the following foods:

- aged meat
- doner kebabs
- eggs
- fish
- kombucha
- poultry
- raw and rare meat dishes (including uncooked fermented meats)
- rockmelons
- sous vide foods
- sprouting seeds
- sushi
- vacuum-packed and modified atmosphere-packed chilled food
- vegetables and fruits in brine, oil or vinegar.

Aged meat

Aging (dry or wet) meat is a process that uses certain microorganisms and enzymes to tenderise and flavour the meat over time. Dry aging generally involves encouraging the growth of certain moulds in a temperature- and humidity-controlled environment. Wet aging is generally done by vacuum sealing the meat in plastic and leaving it to mature in its own juices.

Food safety risks must be carefully managed, since the aging process can take a number of weeks, and if the conditions allow for pathogenic microorganisms to grow or produce toxins they will reach dangerous levels in this time.

Steps that can be taken to reduce risks include:

- using high-quality fresh meat from reputable sources
- not using thawed or frozen meat (as this will not have the required enzymes to break down the tissue)
- exercising strict hygiene at all handling stages
- ensuring the meat is kept under correct temperature and humidity conditions
- for dry aging meat specifically:
 - » separating the aging meat from other foods to prevent cross contamination
 - » confirming that any mould growing on the meat is the correct mould (*Thamnidium*)
 - » aging at -0.5°C to 1°C , relative humidity 75-85% (or other validated process)
- for wet aging specifically:
 - » ensuring meat is vacuum packed in food-grade plastic under hygienic conditions
 - » aging at $<5^{\circ}\text{C}$

- monitoring the meat over the period to ensure it remains wholesome, indicated by the absence of dryness, discoloring, sliminess, odour
- conducting shelf-life and microbiological testing at the end of the maturation process to ensure microbiological specifications are met.

See also *PrimeSafe Aging of Beef* in Resources and References.

Doner kebabs

Doner kebabs are a potentially hazardous food that under certain conditions can permit rapid growth of disease-causing bacteria. Food safety issues can result from the meat being handled with poor hygiene practices, or being held at temperatures that are favourable for microorganism growth. Repeatedly cooking and chilling a large kebab block over multiple days also poses a high food safety risk.

To minimise the risks:

- Assemble the kebab block using high-quality meat and under strict hygienic conditions to minimise the chance of meat being contaminated from dirty hands or surfaces.
- Kebab meat should be thawed before cooking, as otherwise the cooking process can result in sections of meat being warmed and held at temperatures that allow pathogenic microorganisms to grow. Frozen kebab meat should be covered and thawed in the refrigerator or coolroom.
- When cooking kebab meat, it is recommended that the meat reaches a temperature of 75°C to kill pathogens that may be present.
- After cooking, the kebab meat should be kept at 60°C or above until it is served, to prevent growth of any surviving microorganisms.
- To further reduce risk, a second cook step of placing the sliced kebab meat on a grill immediately before serving is recommended.
- To prevent cross contamination, avoid touching raw and cooked meat with the same utensils or hands. Routinely disassemble shaving blades to clean and sanitise.
- Potentially hazardous foods served with kebab meat, such as dairy-based sauces and salads, should be held at or below 5°C until serving.
- Cooked kebab meat that is to be chilled and used later must be cooled rapidly to ensure the meat is safe: cool within two hours from 60°C to 21°C and then from 21°C to 5°C within a further four hours. Then refrigerate the meat at 5°C or less until ready to use.
- Kebab meat, cooked or raw, that has been held between 5°C and 60°C (the temperature danger zone) for four hours or more should be thrown out as it may be unsafe.
- It is not recommended to place uncooked kebab meat remaining on the spit/roaster at the end of the day back in the cooler for cooking the next day. This is because the meat has likely been between 5°C and 60°C for too long. Rather, it is good practice to make smaller batches of kebab meat to minimise the amount of left overs.

See also regulatory agency websites in Resources and References:

- NSW Food Authority - Doner Kebabs
- Queensland Health - Spit Roasts.

Eggs

Raw and low-cooked eggs have been linked to a significant number of foodborne illness outbreaks in Australia and are considered high risk for *Salmonella* (Astridge et al 2011, OzFoodNet 2012b, Moffat et al 2016). Egg products most commonly implicated in food poisoning include sauces and spreads (e.g. mayonnaise, aioli and hollandaise), desserts (e.g. tiramisu, mousse and deep-fried ice cream) and drinks (e.g. untreated eggnog and high-protein smoothies).

To avoid these issues, the use of safer alternatives such as commercially made products (e.g. commercial mayonnaise or aioli) or pasteurised egg pulp (readily available in 10L) is highly recommended. If foods can only be made with raw or low-cooked eggs, the following steps could be taken to minimise risks:

- Ensure eggs are sourced from a reputable supplier, are clean and uncracked.
- Use a clean and sanitised egg separator to separate eggs (not the broken shell).
- Acidify the yolk to pH 4.2 or below before blending with other ingredients (e.g. during preparation of aioli and mayonnaise), to prevent growth of pathogenic microorganisms that may have transferred from the egg shell.
- For foods that cannot be acidified to pH 4.2 or below (e.g. desserts such as mousse and tiramisu), a sous vide or in-house pasteurisation process should be used, such as the combination of time and temperature outlined below (see clause 21 of Standard 4.2.5 – Primary Production and Processing Standard for Eggs and Egg Products).

Time and temperature combinations to pasteurise egg product:

Egg product	Retention temperature to be no less than (°C)	Retention time to be no less than (minutes)	Maximum temperature to be immediately rapidly cooled to (°C)
Egg pulp (without any sugar or salt)	64	2.5	≤ 7
Liquid egg yolk	60	3.5	≤ 7
Liquid egg white	55	9.5	≤ 7

Minimise the time the product is held at ambient temperatures: refrigerate the egg product immediately after preparation, and keep it refrigerated until it is consumed.

- For egg products that are to be held warm (e.g. foods with a hollandaise or béarnaise sauce, or one of their derivatives) it is recommended that the product is prepared just before service and held only for that service period (generally up to 2 hours) (Australian Egg Corporation Ltd, AECL 2015).
- The AECL generally recommends to only prepare enough product to be used on the same food service day, keeping the product under strict temperature or time control and discarding it within 24 hours of manufacture (AECL 2015).

See also in Resources and References:

- Australian Egg Corporation Ltd The Culinary Uses of Eggs. Identification of Raw/Low-Cooked Egg Dishes that May be of Food Safety Concern
- NSW Food Authority Food Safety Guidelines for the Preparation of Raw Egg Products.

Fish

Fish is susceptible to rapid growth of pathogenic and spoilage bacteria if not handled correctly. Certain fish may also contain toxins that can cause foodborne illness (see 'Histamine poisoning' below). Exercising hygienic handling and temperature control will generally minimise food safety issues. Steps that can be taken include:

- Keep fresh fish chilled to restrict bacterial growth: refrigerated or on ice between 0°C and 4°C, or hard frozen.
- Avoid fluctuations in temperature once the fish is chilled or frozen.
- Thaw fish in a refrigerator in a container and/ or on the bottom shelf to avoid contaminating other food with raw fish juices. Fish can be thawed submerged in water-tight packaging in cold water, changing the water every 30 minutes so that it stays cool.
- Fish should not be held at ambient temperatures — if this is unavoidable during processing, the time should be kept to an absolute minimum.
- Fresh or thawed fish are best used within two days.

Histamine poisoning

- Certain fish contain bacteria that convert the amino acid histidine in fish flesh to histamine. If these fish are kept unrefrigerated for too long and start to decompose, the levels of histamine produced can be toxic and cause foodborne illness (known as histamine or Scombrotoxic poisoning).
- Fish of the *Scombridae* and *Scorpaenidae* family (e.g. tuna, mackerel, bonito, butterfly kingfish, sardines, marlin and saury) are commonly associated with histamine poisoning.
- Cooking or freezing does not destroy the histamine and fish containing unsafe levels of histamine will not necessarily appear spoiled.
- It is important that freshly caught fish capable of producing histamine are placed on ice immediately, and kept under strict temperature control until eaten.

Kombucha

Kombucha is a fermented beverage made from brewed tea and sugar and a symbiotic culture of bacteria and yeast (SCOBY). This beverage can present food safety issues if not produced with proper care, including excessive acid or alcohol levels from incorrect fermentation, and contamination from the SCOBY or dirty equipment. Steps that can be taken to avoid these issues include:

- Use proven (e.g. commercial) SCOBY starter cultures that are known to be uncontaminated and able to safely ferment.
- Use clean and sanitised equipment and strict hygiene throughout the process.
- The initial tea infusion is around pH 5 and suitable for potential contaminants to grow, so should be cooled quickly (from 60°C to 20°C within 2 hours). The SCOBY should then be added as soon as possible to begin the fermentation and subsequent acid production.
- Food-grade non-metallic containers should be used to avoid chemicals leaching from the container into the beverage.

- Since fermentation is at room temperature it is important to ferment in the presence of air for rapid acetic acid production, and to monitor the pH level during fermentation and in the final product. The production of acetic acid during fermentation needs to:
 - » be quick enough to transform the initial tea from a potentially hazardous food to a more acidic (pH 4.2 or less) non-potentially hazardous food that does not support pathogen growth or toxin production
 - » cease at the end-product stage so the final kombucha does not become too acidic to consume safely (final pH of ≥ 2.5 is typical).
 - Check that the alcohol levels in the final product are within safe limits (typically less than 1% alcohol). Standard 2.6.2 – Non-alcoholic Beverages and Brewed Soft Drinks specifies alcohol contents for non-alcoholic and brewed soft drinks.
 - The final product can be pasteurised by hot filling to avoid spoilage with moulds or yeasts.
 - Kombucha is not recommended for consumption by the immunocompromised.
- See also Nummer (2013) in Resources and References.

Poultry

Raw poultry has a high likelihood of being naturally contaminated with the pathogenic bacteria *Salmonella* and *Campylobacter*. Care should be taken when handling raw poultry to avoid cross-contaminating other foods and food contact surfaces. The following steps are recommended to reduce food safety risks:

- Utensils, chopping boards and other equipment used for handling raw chicken should not subsequently be used with any ready-to-eat foods (e.g. salads) and should be cleaned and sanitised after use to prevent cross contamination issues. Hands should be washed thoroughly with soap and warm water before and after handling poultry.
- Raw poultry should not be washed before cooking as this will not eliminate the microorganisms and may result in contamination of the sink and other food.
- Poultry should always be cooked thoroughly. An internal temperature of 75°C in the thickest part of the meat is recommended (it can be checked with a probe thermometer).
- If cooked poultry is to be held hot for serving it should be kept at a minimum of 60°C to prevent microorganism growth.
- If the cooked poultry is to be chilled for later use, it should be cooled from 60°C to 21°C within two hours and then from 21°C to 5°C within a further four hours to ensure it is safe.
- Poultry should be stored at or below 5°C to prevent growth of pathogenic microorganisms.

Pâté

- Poultry livers should be cooked at 70°C for at least two minutes (or equivalent) to ensure the target pathogenic microorganisms (*Campylobacter*) are destroyed (Merritt et al 2011). The livers may still appear slightly pink but should never be raw or bloody.
- If cooked pâté is cooled for subsequent use, it should be cooled rapidly (as above) to prevent growth of spore-forming bacteria such as *Clostridium perfringens*.

Raw and rare meat dishes

Raw meat can be contaminated with pathogenic bacteria including *Salmonella*, *Campylobacter* and pathogenic *E. coli*. Cooking meat will generally destroy these microorganisms; however, raw/ rare meat dishes such as ceviche, kibbe, steak tartare and some burgers may not undergo a pathogen control step. The onus is on the food business to ensure the microbiological safety of the meat.

Precautions to be taken when preparing raw and rare meat dishes include:

- Only select raw meat that it is high quality (e.g. whole muscle primal cuts) and very fresh from a reputable supplier.
- Refrigerate raw meat at or below 5°C before it is prepared and served. It should be stored on the bottom shelf of the refrigerator or in sealed containers to avoid juices dripping onto other foods.
- To prevent contamination of the meat during handling, wash hands thoroughly with warm water and soap both before and after touching raw meat. Ensure clothing and work spaces are kept clean.
- To avoid raw meat juices cross-contaminating other food and food contact surfaces:
 - » Prepare raw meat dishes away from other foods, especially ready to-eat foods.
 - » Trim the exterior of the meat, then use another knife and board for further chopping (or clean and sanitise the trimming knife and board before further use).
 - » Use a separate chopping board and utensils for other foods, or thoroughly clean and sanitise all equipment used with raw meat before using it for other foods.
- Raw meat dishes should not be served to vulnerable people, such as children, the elderly or ill.
- Minced meat, such as in hamburger patties and sausages, should generally not be served rare or raw. It should be cooked right through, as the mincing process distributes surface pathogens throughout the meat. High-quality mince made on-site from whole muscle and used immediately may, however, pose a lower risk.

Uncooked fermented sausages

Uncooked fermented sausages such as salami, pepperoni and mettwurst require special care to ensure they do not contain or support the growth of pathogenic microorganisms to dangerous levels. These products typically rely on processing that results in low water activity and/or pH to make them safe. Standard 4.2.3 — Primary Production and Processing Standard for Meat sets out requirements for producers of ready-to-eat meat to manage food safety risks. Standard 1.6.1 — Microbiological Limits for Foods sets microbiological specifications for these types of products.

See also in Resources and References:

- Australian Standard AS 4696-2007 *Hygienic Production and Transportation of Meat and Meat Products for Human Consumption*
- Meat and Livestock Australia's Guidelines for the Safe Manufacture of Smallgoods.

Rockmelons

Rockmelons contaminated with *Salmonella* and *Listeria monocytogenes* have been implicated in food poisoning cases in Australia (e.g. see Munnoch et al 2009). Evidence from overseas suggests that contaminated water, fertiliser, contact with pests or animals and insufficient cleaning of the fruit before sale could be sources of contamination. *Salmonella* or other pathogenic microorganisms (e.g. *E. coli*) that may be present in rockmelon skin can transfer to the flesh when the fruit is cut. The rockmelon's flesh can then support the growth of the pathogen.

To minimise food safety risks:

- Thoroughly wash and dry hands before and after handling fresh rockmelons.
- Select high-quality melons that are not bruised or damaged.
- Use clean cutting boards and utensils when handling fresh produce.
- Thoroughly clean and sanitise cutting boards, utensils and counter tops that have been in contact with rockmelons after use.
- Refrigerate fresh produce within 2 hours of peeling or cutting. Leftover cut produce should be discarded if left at room temperature for more than 2 hours.
- Display the cut fruit chilled (surrounded by ice or refrigerated at or below 5°C), or use time as a control (see Appendix 2).

Sous vide foods

Sous vide (French for 'under vacuum') is a cooking method where food is sealed in vacuum packaging and heated in a water bath, often at low temperatures for long periods. The reduced-oxygen environment created by the vacuum packaging can allow the growth of pathogens such as *Clostridium botulinum* and *Clostridium perfringens* and pose a risk to food safety.

Steps that can be taken to minimise food safety risks include the following:

- Ensure equipment is adequate for the cooking process; that is:
 - » it is capable of reaching and maintaining the required water temperature for the whole cooking time
 - » it circulates water properly to ensure even heat distribution
 - » the temperature gauge correctly measures and displays the water temperature.
- Avoid cross contamination when handling raw food to be cooked, by exercising correct hand hygiene, etc.
- Do not use mechanically minced, tenderised, rolled or reformed meats.
- Preparing thinner slices will allow portions to heat and cool more rapidly than thick cuts, reducing risks of pathogens growth and toxin formation.
- Ensure vacuum sealing does not cross contaminate food e.g. use separate equipment for raw and ready-to-eat foods.
- Cook using water bath temperatures of at least 55°C, so that the meat surface reaches at least 54.5°C.
- Limit the time that the food temperature is below 54.5°C during cooking to 6 hours.
- Check the food and water temperature with an accurate probe thermometer.

- Eat the cooked product immediately or rapidly chill it, for example in an ice slurry. For further information, including times and temperatures for cooking different thicknesses of meat, see regulatory agency websites (e.g. NSW Food Authority's *Sous Vide* — Food Safety Precautions for Restaurants) in Resources and References.

Seed sprouts

Seed sprouts such as alfalfa, mung bean and clover sprouts can become contaminated with pathogens such as *Salmonella* and pathogenic *E. coli* resulting from contamination of seeds, contamination during sprouting or subsequent processing. The warm, humid and nutritious environment provided for seeds to sprout can create an ideal environment for food poisoning bacteria to grow. Sources of contamination include fecal matter from animals in the field, fertilisers, soil and contaminated water used during growth and processing. As with any fresh ready-to-eat produce, contamination can also occur from poor handler hygiene and use of unsanitary equipment.

To reduce the risks of foodborne illness from sprouting seeds, it is important to:

- Source good quality seed from a reputable supplier.
- Decontaminate seeds (for example with a bleach solution) before sprouting.
- Use good hygienic practices throughout production.
- Store and transport sprouted seeds at $\leq 5^{\circ}\text{C}$.

Standard 4.2.6 — Production and Processing Standard for Seed Sprouts contains requirements for sprout processors.

Sushi

Sushi as a whole is considered a potentially hazardous food, regardless of whether or not it contains rice acidified with vinegar. This is because:

- Even if rice is acidified enough to inhibit the growth of pathogenic bacteria (i.e. to a pH of 4.6 or lower), added fillings are not generally acidified and so could support bacterial growth.
- If vinegar has not been thoroughly mixed through the rice or has been used only as a flavouring, the rice may not be acidic enough to prevent growth of pathogens to dangerous levels.

To minimise food safety risks with sushi, particularly sushi displayed at ambient temperatures, the following steps are recommended:

- Select high-quality ingredients, especially if using raw meat, raw fish or raw or lightly-cooked egg fillings or sauces. (See also Eggs, Fish and Raw meat sections above.)
- Protect all ingredients from contamination during receipt, preparation and storage.
- Keep ingredients under temperature control, ideally refrigerated at 5°C or below.
- Acidify the sushi rice to a pH of 4.6 or less. Rice that is not acidified to this pH or lower may still be able to support the growth of pathogenic bacteria.
- Avoid cross-contamination during sushi preparation, by washing vegetables before use, thoroughly cooking fillings, employing good hand hygiene and cleaning and sanitising utensils and equipment. As above, extra care is required with ingredients such as raw fish and raw meat.

- Once made, sushi should be kept under temperature control, preferably refrigerated at 5°C or below. If the sushi is displayed for sale at temperatures above 5°C, the **total** time the sushi is above 5°C should not exceed 4 hours.
- Exposed sushi on display should be protected from the likelihood of contamination, for example in display cabinets or on covered plates on a conveyor belt.

See also regulatory agency websites (e.g. NSW Food Authority's Food Safety Guidelines for the Preparation and Display of Sushi) in Resources and References.

Vacuum-packed and modified-atmosphere-packed chilled food

Packaging food under vacuum or in a modified atmosphere can extend its shelf life by limiting growth of food spoilage microorganisms. However, it can also create a favourable environment for certain pathogens that can grow in low-oxygen conditions.

In refrigerated vacuum-packed ready-to-eat products (e.g. sandwich meats and cheeses) *Listeria monocytogenes* is of particular concern, because it can readily grow at low temperatures and in the presence of salt. In vacuum-packed cook-chilled foods (e.g. some meat products), *Clostridium botulinum* is the main concern, as *Clostridium* spores that may have been activated by the cooking process can then multiply in the packaged food. Food poisoning caused by *Listeria* or *Clostridium* can be fatal. Technical expertise is needed to ensure the risks are strictly managed.

Some general steps that may be taken to prevent food safety issues include:

- using high-quality ingredients
- using strict hygiene practices to minimise the chance of any cross-contamination from handling
- ensuring food contact surfaces of packaging and packaging machines are clean and sanitary
- ensuring strict temperature control to minimise the opportunity for bacteria to grow: (e.g. *C. botulinum* does not grow or produce toxins below 3°C)
- correctly using processes or additives to reduce the water activity and/or pH of packaged foods to create unfavourable conditions for bacterial growth and toxin production (e.g. pH <4.6 throughout the food)
- heat treatment after packaging to kill remaining bacteria
- ensuring nominated shelf life is validated.

See also the following in Resources and References:

- Cox and Bauler — Cook Chill for Food Service and Manufacturing
- NSW Food Authority — Sous Vide - Food Safety Precautions for Restaurants
- SA Health — Vacuum Packing Ready-To-Eat Meat Food Safety Requirements
- UK Food Standards Agency and Food Standards Scotland — Vacuum packed chilled food guidance

Vegetables and fruits in brine, oil or vinegar

Vegetables and fruits packed in oil, vinegar or brine, other than commercially canned products, can provide a favourable environment for anaerobic pathogens such as *Clostridium botulinum* to grow and produce dangerous toxins if they are not correctly processed to reduce pH.

To minimise food safety risks:

- fruit and vegetables should be acidified to a pH of 4.6 or below before covering with oil, vinegar, brine or water
- jars, bottles, plastic pouches, etc. must be suitable for use with the food, and should be sterile or cleaned and sanitised before use
- unless processed to be shelf stable (e.g. hot packed into hermetically sealed containers) products should be considered to be perishable and stored and distributed under refrigeration
- shelf life should be validated.

Standard 2.3.2 — Fruit and Vegetables requires fruit and vegetables in brine, oil, vinegar or water (other than commercially canned products) to have a pH of 4.6 or below.