

## Imported food risk statement

### Fresh raw beef and beef products and *Salmonella* spp.

**Scope:** Fresh raw (chilled and/or frozen) beef and beef products, including carcasses, whole muscle meat, bone-in and non-intact cuts (e.g. mince and trim) and offal from BSE and biosecurity approved countries. Excludes all products not permitted under BSE and biosecurity restrictions such as brain and spinal tissue, blood and blood products, reproductive organs and natural casings.

#### Recommendation and rationale

Does *Salmonella* spp. in imported fresh raw beef and beef products present a potential medium or high risk to public health that may require additional management measures:

Yes

No

#### Rationale:

- *Salmonella* spp. can be highly infectious and cause incapacitating but not usually life threatening illness. Sequelae can occur but are rare.
- There is strong evidence that *Salmonella* spp. has caused foodborne illness associated with beef and beef products.
- The method of producing fresh raw (chilled and/or frozen) beef introduces contamination into the food and does not contain a pathogen elimination step. Some beef products (i.e. trim and offal) may contain higher levels of contamination as further processing steps (i.e. mincing) can introduce contamination into the product.
- HACCP based quality assurance systems are required throughout the entire supply chain to minimise the potential for contamination and subsequent growth of any contaminating pathogens.

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##### Nature of the microorganism:

*Salmonella* spp. are facultative anaerobic Gram-negative, non-spore forming rod-shaped bacteria belonging to the *Enterobacteriaceae* family. The genus *Salmonella* is divided into two species: *S. enterica* (comprising six subspecies) and *S. bongori*, with over 99% of infections in humans caused by *S. enterica* subsp. *enterica* (Bell and Kyriakides 2002; Crum-Cianflone 2008). Over 2500 serotypes of *Salmonella* spp. have been identified, which differ in their reservoir, host, growth characteristics and the severity of disease they cause. Some serotypes are host-specific, some are host-adapted, while others, such as *S. Typhimurium*, have a broad host range (Jay et al. 2003; Wallis 2006). A number of antibiotic resistant strains have also emerged such as *S. Typhimurium* definitive phage type 104 (DT104). *Salmonella* spp. colonise the intestinal tract of warm and cold-blooded vertebrates including livestock, wildlife and humans and also live in the surrounding environment (FSANZ 2013). *Salmonella* spp. are transmitted by the faecal-oral route, through consumption of contaminated food and water or from direct contact with infected people and animals (Jay et al. 2003).

Growth of *Salmonella* spp. can occur at temperatures ranging between 5.2 – 46.2°C, pH of 3.8 – 9.5 and a minimum water activity of 0.93 when other conditions are near optimum. The minimum pH for growth is dependent on temperature, presence of salt and nitrite and the type of acid present. *Salmonella* spp. can survive for months or even years in foods with a low water activity (ICMSF 1996; Podolak et al. 2010). Experimental studies have shown that *Salmonella* spp. can grow in minced beef at ambient temperatures (Dickson et al. 1992; Juneja et al. 2009). *Salmonella* spp. have the ability to survive long term frozen storage (i.e. -20°C) such as in frozen beef trim (Bosilevac et al. 2007). *Salmonella* spp. are sensitive to normal cooking conditions, however, foods that are high in fat and low in moisture may have a protective effect against heat inactivation or the

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effects of acid (FSANZ 2013; Li et al. 2013). Like all microorganisms, *Salmonella* spp. can develop resistance traits in response to various stresses including heat, acid and the use of antimicrobial substances.

### Adverse health effects:

*Salmonella* spp. cause incapacitating but not usually life threatening illness of moderate duration. Sequelae can occur but are rare (ICMSF 2002). People of all ages are susceptible to salmonellosis, however, the elderly, infants and immunocompromised individuals are at a greater risk of infection and generally have more severe symptoms (FSANZ 2013). Infection with antimicrobial resistant *Salmonella* spp. strains may also result in more severe illness which may be more difficult to treat.

Salmonellosis symptoms include abdominal cramps, nausea, diarrhea, mild fever, vomiting, dehydration, headache and/or prostration. Onset of illness is typically 24 – 48 hours after exposure to an infectious dose (range of 8 – 72 hours) and usually lasts for 2 – 7 days. Severe disease such as septicaemia sometimes develops, predominantly in immunocompromised individuals. A small number of individuals develop sequelae such as reactive arthritis, appendicitis, meningitis or pneumonia as a consequence of infection. The fatality rate for salmonellosis is generally less than 1% (FDA; FSANZ 2013).

The particular food matrix and strain of *Salmonella* spp. influence the level of *Salmonella* spp. required for illness. As few as one to 100 cells has been reported to cause illness, however, in most cases, significantly more cells are required for illness to occur (FDA; ICMSF 1996).

### Consumption patterns:

The 2011 – 2012 Nutrition and Physical Activity Survey (part of the 2011 – 2013 Australian Health Survey) provides detailed, national data on consumption of foods in Australia.

#### *Consumption of beef (excluding mixed foods that contain beef and beef products)*

In the survey, 15% of children (aged 2 – 16 years), 18% of adults (aged 17 – 69 years) and 21% of people aged 70 and above reported consumption of beef on the day of the survey. Beef consumption can be divided into minced meat, whole muscle cuts and offal. Nine percent of children (aged 2 – 16 years), 7% of adults (aged 17 – 69 years) and 9% of people aged 70 and above reported consumption of minced meat. Seven percent of children (aged 2 – 16 years), 12% of adults (aged 17 – 69 years) and 11% of people aged 70 and above reported consumption of whole muscle cuts. Less than one percent of adults (aged 17 – 69 years) and <1% of people aged 70 and above reported consumption of offal. No children (aged 2 – 16 years) reported consuming offal (Australian Bureau of Statistics 2011). No data was available for consumption of raw or minimally cooked beef and beef products.

#### *Consumption of mixed foods containing beef*

In the survey, 51% of children (aged 2 – 16 years), 48% of adults (aged 17 – 69 years) and 43% of people aged 70 and above reported consumption of mixed dishes containing beef on the day of the survey. These beef dishes can be divided into dishes containing whole muscle meat, minced meat or offal. Forty percent of children (aged 2 – 16 years), 32% of adults (aged 17 – 69 years) and 26% of people aged 70 and above reported consumption of minced meat dishes. Fifteen percent of children (aged 2 – 16 years), 22% of adults (aged 17 – 69 years) and 20% of people aged 70 and above reported consumption of whole muscle meat dishes. Less than one percent of children (aged 2 – 16 years), <1% of adults (aged 17 – 69 years) and <1% of people aged 70 and above reported consumption of mixed dishes containing offal (Australian Bureau of Statistics 2011).

### Risk factors and risk mitigation

Production of fresh raw beef and beef products does not include a pathogen elimination step. Controls are needed throughout the entire supply chain to minimise the potential for contamination and subsequent growth of any contaminating pathogens. Quality assurance (QA) programs and/or application of a Hazard Analysis and Critical Control Point (HACCP) system should be applied in the design and implementation of hygiene measures throughout the entire food chain including animal production, transport, lairage and slaughter and dressing operations (Codex 2013). Microbiological testing, for example validated process hygiene criteria or appropriate environmental testing, may be helpful in verifying the effectiveness of HACCP-based QA programs.

Ruminants are a main reservoir of *Salmonella* spp. which most often resides in the animal without causing any visible adverse effects. The presence in a herd or animal is confirmed by microbiological testing. During animal production, the key inputs and activities contributing to the presence and level of *Salmonella* spp. include the health of the animal, stress, inputs such as feed, water and veterinary medicines, and management of environmental and biosecurity factors, including transport, saleyards and lairage. During processing, contamination may occur from external sources (i.e. the animal or the environment), or internal sources during slaughter and dressing operations (FSANZ 2009a). Good agricultural practices, good hygienic practices and good

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manufacturing practices should be employed throughout the production chain.

Pathogen load in the animal can increase due to illness or stress. Stress occurs when animals are deprived of feed and water and during transport, holding and handling procedures. These stressors can lead to increased pathogen shedding, contamination of the transport vehicle and the lairage, and subsequent transfer of the contamination to other animals (FSANZ 2009a; Adam and Brulisauer 2010; ICMSF 2005). Conditions for transport and holding animals prior to slaughter should minimise the potential for cross-contamination with foodborne pathogens. QA programs should be implemented to achieve the appropriate conditions for transport and lairage (Codex 2013).

The competent authority determines the procedures used during anti-mortem and post-mortem inspections to ensure only healthy, sufficiently clean and appropriately identified animals are slaughtered and meat produced for human consumption is wholesome and safe (Codex 2013).

During slaughter or fabrication (e.g. quartering, boning and packing) contamination of the external surface of the carcass can occur (Adam and Brulisauer 2010; FSANZ 2009a). Stunning and bleeding can lead to contamination of the slaughtering and processing environment and should be performed in such a manner as to minimise contamination. During slaughter and dressing, hocks, head, hide and viscera are removed and bunging is performed to minimise faecal leakage onto the carcass and processing environment. The objective is to undertake these processes with as little contamination as possible of the exposed carcass tissue and of edible offal. Decontamination processes, such as trimming and washing (i.e. steam, hot water or organic acid sprays) are also used to reduce contamination on carcasses. Further processing of whole muscle meat or trimmings into ground or minced product will transfer any contaminating pathogens from the surface of the meat onto other surfaces or internally into the meat product. Good hygienic practices and good manufacturing practices should be employed.

Beef processing equipment, including saws and knives, used throughout the slaughtering and processing environment can also play a role in the contamination of edible meat products (Duffy et al. 2014). Effective and frequent cleaning and decontamination of equipment is essential.

Rapid chilling of adequately spaced carcasses will minimise growth of any contaminating pathogen on the surface of carcasses. Surface dehydration during chilling is an additional control measure (FSANZ 2009b). Maintenance of appropriate temperature control throughout the subsequent post-slaughter supply chain minimises further growth of any contaminating pathogens.

The competent authority should have the legal power to set and enforce regulatory meat hygiene requirements, and have final responsibility for verifying that regulatory meat hygiene requirements are met. The role and the level of training, knowledge and skills of the veterinary inspector and other personnel involved in meat hygiene activities should be defined by the competent authority. The competent authority should also verify that the establishment operator has adequate systems in place to trace and withdraw meat from the food chain (Codex 2013).

### Surveillance information:

Infection with *Salmonella* is a notifiable disease in all Australian states and territories with a reported incidence rate in 2016 of 76.1 cases per 100,000 population (18,089 cases) which includes both foodborne and non-foodborne cases. This is an increase from the previous five year mean of 59.9 cases per 100,000 population per year (ranging from 49.2 – 71.5 cases per 100,000 population per year) (FSANZ 2013; NNDSS 2017). The most common *Salmonella* serovar identified in Australia in 2011 was *S. Typhimurium* (48% of cases) with a large range of other serovars accounting for the remaining cases (OzFoodNet 2015).

### Illness associated with consumption of beef and beef products contaminated with *Salmonella* spp.

A search of the scientific literature via US CDC Foodborne Outbreak Online Database, EBSCO and other publications from 2000 – June 2017 identified >100 international salmonellosis outbreaks associated with the consumption of beef and beef products. Greig and Ravel (2009) analysed international foodborne outbreaks between 1988 and 2007 for food vehicle attribution and the type of pathogen and identified 119 salmonellosis outbreaks associated with beef and beef products. Examples are listed below:

- Denmark (2005) – 31 *Salmonella* Typhimurium DT104 cases linked to the consumption of carpaccio from a single restaurant. Eleven cases required hospitalisation. Carpaccio is made using thinly sliced raw beef or veal (Ethelberg et al. 2007).
- USA (2007) – 42 *Salmonella* Newport cases linked to consumption of ground beef from a single supermarket chain. At least 17 cases required hospitalisation. The traceback investigation highlighted the complexity of the beef supply chain for the supermarket chain across multiple states (Schneider et al. 2011).
- France (2010) – 554 clinical monophasic *Salmonella* Typhimurium 4,5,12:i:- cases linked to consumption of beef burgers in four schools. At least 31 cases required hospitalisation (Raguenaud et al. 2012).
- USA (between 2000 – 2015) –24 salmonellosis outbreaks (in addition to the 2007 *S. Newport* outbreak) where beef

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was identified as a contaminated ingredient, resulting in 918 cases and 82 hospitalisations (CDC 2016).

### Data on the prevalence of *Salmonella* spp. in beef and beef products

A search of the scientific literature via EBSCO and other publications from 2000 – June 2017 identified that surveys of beef and beef products have isolated *Salmonella* spp. in 0 to 18.3% of samples. Results from prevalence surveys are reported by the sample type (carcass, whole muscle meat, minced meat and trim, and offal) collected from abattoirs or meat processors. Retail surveys were excluded.

*Carcass – prevalence of Salmonella spp. ranged from 0% to 18.3% of carcass samples, with an overall prevalence of 2.6% (95% CI 1.3% – 5.0%) determined using a random effects meta-analysis of 12 surveys (surveys included product from Australia, Belgium, Germany, Honduras, Mexico, Northern Ireland, Poland, Republic of Ireland, UK and/or USA). Examples are listed below:*

- Australia (2004) – *Salmonella* spp. were not detected from beef carcasses (n=1155) for samples collected from abattoirs and boning (fabricating) establishments (Phillips et al. 2006).
- Republic of Ireland (2007-2009) – *Salmonella* spp. were detected on 0.2% of carcass samples (n=400) collected from abattoirs (Khen et al. 2014)
- USA (2003-2004) – *Salmonella* spp. were detected in 2.9% of chilled bison carcass samples (n=239) collected from abattoirs (Li et al. 2004).
- Mexico (pre-2014) – *Salmonella* spp. were detected in 18.3% of beef carcass samples (n=142) collected from abattoirs (Martínez-Chávez et al. 2015).

*Whole muscle meat – prevalence of Salmonella spp. ranged from 0% to 2.2% of samples, with an overall prevalence of 0.3% (95% CI 0.1% – 1.2%) determined using a random effects meta-analysis of five surveys (surveys included product from Australia, Belgium, Germany and/or USA). Examples are listed below:*

- Australia (2011) – *Salmonella* spp. were not detected from primal cut samples (n=1165) collected in boning establishments (Phillips et al. 2012).
- Belgium (2000-2003) – *Salmonella* spp. were detected in 1.2% of meat samples (n=323) collected in production plants (Ghafir et al. 2005).
- USA (2003) – *Salmonella* spp. were detected in 2.2% of meat samples (n=1022) in processing plants (Stopforth et al. 2006).

*Minced meat and trim – prevalence of Salmonella spp. ranged from 0 to 7.1% of samples, with an overall prevalence of 1.3% (95% CI 1.0% – 1.6%) determined using a random effects meta-analysis of five surveys (surveys included product from Australia, Belgium, Canada, New Zealand, Uruguay and/or USA). Examples are listed below:*

- USA (2005 – 2008) – *Salmonella* spp. were detected on 1.3% of ground beef samples (n=16160) and 1.6% of beef trim samples (n=892029) collected at meat processing facilities (Hill et al. 2011).
- USA (2005) – *Salmonella* spp. were not detected (n=220), detected on 0.4% (n=223) and 0.4% (n=256) of boneless beef trim imported from Australia, New Zealand and Uruguay, respectively, and sampled at the US border. *Salmonella* spp. were detected on 0.8% of domestic boneless beef trim (n=487) sampled at production facilities (Bosilevac et al. 2007).
- Canada (one year study) – *Salmonella* spp. were detected on 0.7% of ground beef samples (n=1370) collected at slaughter establishments (Gleeson et al. 2005).

*Offal – prevalence of Salmonella spp. ranged from 0% (n=66) for liver and 11% (n=46) for kidney samples in a single German survey of offal (Meyer et al. 2010).*

## Standards or guidelines

- Division 2 of [Standard 4.2.3 in the Australia New Zealand Food Standards Code](#) requires primary producers of meat to control inputs, waste disposal and traceability.
- Australian Standard for the hygienic production and transportation of meat and meat products for human consumption *AS 4696-2002* sets out the outcomes required for the receipt and slaughter of animals, the dressing of carcasses, the processing, packaging, handling and storage of meat or meat products; with process controls requiring a HACCP based system. The Standard also contains rules for the construction of premises and transportation of meat and meat products (Standards Australia 2002).
- Codex Code of Hygienic Practice for Meat *CAC/RCP 58-2005* covers hygiene provisions for raw meat, meat preparations and manufactured meat from the time of live animal production up to the point of retail sale (Codex 2013).

### Standards or guidelines

- End product testing for indicator organisms (e.g. generic *E. coli*) can be used to verify process control for fresh chilled and frozen meat. However, these are poor indicators of the prevalence or concentration of enteric pathogens in fresh meat (Codex 2013; ICMSF 2011).

### Management approaches used by overseas countries

- Under the European Commission (EC) regulation 178/2002 food imported into the EU must comply with the relevant EU food law or where specific agreement exists between EU and the exporting country. Regulation 852/2004 covers hygiene of food at all stages of the production process from primary production to the final consumer, with Annex I covering activities connected with primary production. Regulation 853/2004 lays down specific hygiene rules for food of animal origin for food business operators, with Section I of Annex III covering primary processing of domestic ungulates (including bovine species).
- EC regulation 1441/2007 (European Commission 2007) specifies a *Salmonella* limit for:
  - minced meat and meat preparations intended to be eaten raw (n=5, c=0, m=absence in 25g)
  - minced meat and meat preparations made from other species than poultry intended to be eaten cooked (n=5, c=0, m=absence in 10g)
  - mechanically separated meat (n=5, c=0, m=absence in 10g)
  - meat products intended to be eaten raw, excluding products where the manufacturing process or the composition of the product will eliminate the salmonella risk (n=5, c=0, m=absence in 25g)
  - carcasses of cattle after dressing but before chilling (n=50, c=2, m=absence in the area tested per carcass).
- Under the Canadian *Meat Inspection Regulations 1990* (Canadian Ministry of Justice 2014) a meat product can only be imported if the meat product was manufactured in an establishment that was operating under a HACCP principles based system determined to be equivalent to the Canadian Food Safety Enhancement Program.
- In the US, imported meat is subject to the requirements of the Federal Meat Inspection Act (USDA 2016) which sets out that carcasses and meat can only be imported if they are subject to the inspection, sanitary, quality, species verification, residue standards, and humane methods of slaughter applied to products produced in the United States. The US Department of Agriculture Food Safety and Inspection Service (FSIS) are responsible for imported food and carry out audits of foreign inspection systems and re-inspect meat at the port-of-entry to ensure that foreign countries have maintained equivalent inspection systems (FSIS 2014).
- In New Zealand imported bovine meat is not a food of high (or increased) regulatory interest for the hazard *Salmonella* spp. (NZ MPI 2016).

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