

Imported food risk statement
Ready-to-eat cooked crustaceans and *Salmonella* spp.

Commodity: Ready-to-eat (RTE) cooked crustaceans. This includes crustaceans, such as prawns and seafood mixes containing crustacea (e.g. marinara mix), which is cooked. RTE cooked crustaceans that are dried or in ambient stable sealed packages are not covered by this risk statement.

Microorganism: *Salmonella* spp.

Recommendation and rationale
<p>Is <i>Salmonella</i> spp. in RTE cooked crustaceans a medium or high risk to public health:</p> <p><input type="checkbox"/> Yes</p> <p><input checked="" type="checkbox"/> No</p> <p><input type="checkbox"/> Uncertain, further scientific assessment required</p> <p>Rationale:</p> <ul style="list-style-type: none"> • <i>Salmonella</i> spp. are a serious hazard as they cause incapacitating, though not usually life threatening, illness of moderate duration and sequelae are rare. • There is limited evidence of salmonellosis attributed to consumption of RTE cooked crustaceans. • <i>Salmonella</i> spp. are inactivated by adequate cooking during the production of RTE cooked crustaceans. • Post-cooking contamination can occur, however the potential for this is low if good hygienic handling practices are followed. • <i>Salmonella</i> spp. can grow in the product if it is present and temperature abuse occurs. • International and Australian compliance, recall and surveillance data has shown limited evidence of <i>Salmonella</i> spp. associated with RTE cooked crustaceans.

General description
<p>Nature of the microorganism:</p> <p><i>Salmonella</i> spp. are facultative anaerobic Gram-negative, non-spore forming rod-shaped bacteria. They are found in the intestinal tract of warm and cold-blooded vertebrates and in the surrounding environment (FSANZ 2013).</p> <p>Growth of <i>Salmonella</i> 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. <i>Salmonella</i> spp. can survive for months or even years in low moisture foods (and other low moisture environments) and are able to survive frozen storage at -20°C. <i>Salmonella</i> 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 (FSANZ 2013; Li et al. 2013).</p>
<p>Adverse health effects:</p> <p><i>Salmonella</i> spp. are a serious hazard as they 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</p>

salmonellosis. However, the elderly, infants and immunocompromised individuals are at a greater risk of infection and generally have more severe symptoms (FSANZ 2013).

Salmonellosis symptoms include abdominal cramps, nausea, diarrhoea, mild fever, vomiting, dehydration, headache and/or prostration. The onset of illness of salmonellosis is typically 24 – 48 hours after exposure to an infectious dose (range of 8 – 72 hours) and symptoms usually last for 2 – 7 days. Severe disease such as septicaemia sometimes develops, predominantly in immunocompromised individuals. A small number of individuals develop sequelae such as arthritis, appendicitis, meningitis or pneumonia as a consequence of infection. The fatality rate for salmonellosis is generally less than 1% (FDA 2012; FSANZ 2013).

The particular food matrix and strain of *Salmonella* spp. influence the level of *Salmonella* spp. required for illness to occur. It has been reported that as few as one to 100 cells have caused illness, however, in other cases significantly more cells were required for illness to occur (ICMSF 1996; FDA 2012).

Consumption patterns:

In the 2011 – 2012 Nutrition and Physical Activity Survey (part of the 2011 – 2013 Australian Health Survey) <1% children (aged 2 – 16 years), 1% of adults (aged 17 – 69 years) and 1% of people aged 70 and above reported consumption of RTE cooked crustaceans (Australian Bureau of Statistics 2011). Mixed foods that contained RTE cooked crustaceans were excluded from the analysis. Survey data was derived from one day of dietary recall data.

Key risk factors:

The incidence of *Salmonella* spp. in raw crustaceans is typically low but is often higher in aquaculture-reared shrimps (ICMSF 2005). Incidence of *Salmonella* spp. varies depending on location. For example, crustaceans trapped in estuarine or inshore marine waters may be contaminated with potentially pathogenic bacteria from sewage, such as *Salmonella* spp. (FSANZ 2005; FDA 2011).

Post-harvest handling and processing, such as hand-peeling of shrimp under insanitary conditions or cross-contamination of raw and cooked product, has the potential to introduce pathogens, such as *Salmonella* spp. Temperature abuse during handling, transport and/or storage may then enable the growth of *Salmonella* spp. (ICMSF 2005; FSANZ 2005).

Risk mitigation:

Sourcing crustaceans from uncontaminated waters will reduce the risk of *Salmonella* spp. being present, and subsequently introduced into the processing facility where cross-contamination of cooked product may occur (ICMSF 2005).

Adequate cooking will inactivate *Salmonella* spp. For example, cooking food to an internal temperature of 70°C for at least 2 minutes will inactivate *Salmonella* spp. (Bell and Kyriakides 2009). However, undercooking or post-cooking cross-contamination can occur. Good hygienic practices in food manufacturing and food handling minimise *Salmonella* contamination of cooked product. Contamination may be mitigated through proper facility design to control product movement and by minimising personnel and equipment contamination of cooked product (ICMSF 2005; FSANZ 2005). Rapid chilling post-cooking and adherence to low temperatures (<5°C) during processing, transport and storage will reduce the rate of growth for most microbial pathogens (FSANZ 2005; Codex 2013).

In Australia Division 2 of [Standard 4.2.1 in the Australia New Zealand Food Standards Code](#) (the Code) states that a seafood business must systematically examine all of its primary production and processing operations to identify potential seafood safety hazards and implement controls that are commensurate with the food safety risk, and must take all necessary steps to prevent the likelihood of seafood being or becoming contaminated.

[Schedule 27 of the Code](#) has a microbiological limit for cooked crustacea for *Salmonella* of n=5, c=0, m=not detected in 25g.

Compliance history:

The imported food compliance data sourced from the Imported Food Inspection Scheme of the Australian Department of Agriculture and Water Resources for January 2007 – May 2016 showed that of the 3670 *Salmonella* spp. tests applied to cooked crustaceans there were 8 fails, a 0.2% failure rate. The failed samples were from Indonesia, Taiwan and Vietnam and included cooked crab, lobster and prawns.

There have been eight notifications on the European Commission's Rapid Alert System for Food and Feed (RASFF) for *Salmonella* spp. in cooked crustaceans from January 2007 – May 2016. The products included cooked prawns and shrimp from multiple countries. There were an additional 18 notifications for crustaceans from multiple countries, however it was not stated if any of these products were cooked.

There have been no food recalls in Australia due to the presence of *Salmonella* spp. in imported or domestic cooked crustaceans from January 2007 – May 2016.

Surveillance information:

Salmonellosis is one of the most commonly reported enteric illnesses worldwide, and the second most frequently reported cause of enteric illness in Australia. It is a notifiable disease in all Australian states and territories with a notification rate in 2015 of 72.8 cases per 100,000 population (17,089 cases). This is an increase from the previous five year mean of 56.4 cases per 100,000 population per year (ranging from 49.2 – 69.4 cases per 100,000 population per year) (FSANZ 2013; NNDSS 2016).

Illness associated with consumption of RTE cooked crustaceans contaminated with *Salmonella* spp.

A search of the scientific literature via Web of Science, PubMed, Scopus, the US CDC Foodborne Outbreak Online Database and other publications during the period 1990 – April 2016 identified there are limited reports of salmonellosis outbreaks associated with consumption of RTE cooked crustaceans:

- There were two confirmed and one suspected salmonellosis outbreaks linked to consumption of RTE cooked crustaceans and six outbreaks associated with crustaceans (not stated whether cooked) on the US CDC Foodborne Outbreak Online Database from 1998 – 2014 (CDC 2015).
- There were four salmonellosis outbreaks linked to consumption of crustaceans (not stated whether cooked) reported to the national surveillance scheme for general outbreaks of infectious intestinal disease in England and Wales between 1992-1999 (Gillespie et al. 2001).
- Outbreak in South Australia in 1998 – 38 cases of *Salmonella* Typhimurium RDNC A045 infection epidemiologically linked to consumption of spatchcock (risk ratio = 2.5) and scampi (risk ratio = 2.0). Temperature abuse and cross- contamination during food preparation and cooking appeared to have contributed to the outbreak (Brennan et al. 1999).

Prevalence of *Salmonella* spp. in RTE cooked crustaceans

A search of the scientific literature via Web of Science, PubMed, Scopus and other publications during the period 1990 – April 2016 identified data on the prevalence of *Salmonella* spp. in RTE cooked crustaceans is limited:

- Survey in the United Kingdom in 2003 – *Salmonella* spp. were not detected in cooked crustacean batches collected from production premises (n=35) or in cooked crustacean batches collected from retail premises (n=372) (Sagoo et al. 2007).
- Survey in India in 1998 – 1999 – *Salmonella* spp. were not detected in quick frozen cooked, peeled and deveined tail-on tiger shrimp (n=928) collected at the processing plant (Hatha et al. 2003).
- Survey in India in 1994 – 1995 – *Salmonella* spp. were not detected in quick frozen cooked ready-to-eat shrimp (n=914) collected at the processing plant (Hatha et al. 1998).

Other relevant standards or guidelines

- Codex general principles of food hygiene *CAC/RCP 1 – 1969* follows the food chain from primary production through to final consumption, highlighting the key hygiene controls at each stage (Codex 2003).

- Codex code of practice for fish and fishery products *CAC/RCP 52-2003* applies to the growing, harvesting, handling, production, processing, storage, transportation and retail of fish, shellfish and aquatic invertebrates and products thereof from marine and freshwater sources that are intended for human consumption. Section 13A, 13B and 14 of *CAC/RCP 52-2003* is specific to the processing of lobsters, crabs, and shrimps and prawns, respectively, and describes controls at individual processing steps (Codex 2013).
- Codex standard for quick frozen lobsters *CODEX STAN 95-1981* covers the production and processing of quick frozen lobsters, including cooked squat lobsters (red and yellow) (Codex 2014a).
- Codex standard for quick frozen shrimps or prawns *CODEX STAN 92-1981* covers the production and processing of quick frozen shrimps or prawns, including fully cooked shrimps or prawns (Codex 2014b).

Approach by overseas countries

Many countries and regions, such as the United States, Canada and the European Union, have HACCP-based regulatory measures in place for production of this commodity.

In Europe, cooked crustaceans and molluscan shellfish have a *Salmonella* limit of n=5, c=0, m=absence in 25g for products placed on the market during their shelf-life (European Commission 2007).

Other considerations

Biosecurity restrictions apply to products under this commodity classification. Refer to the [BICON database](#).

This risk statement was compiled by FSANZ in: November 2016

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