

Imported food risk statement
RTE cooked prawns and shrimp and *Vibrio cholerae*

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

Microorganism: *Vibrio cholerae*

Recommendation and rationale
<p>Is <i>Vibrio cholerae</i> in RTE cooked prawns and shrimp a medium or high risk to public health:</p> <p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Uncertain, further scientific assessment required</p> <p>Rationale:</p> <ul style="list-style-type: none"> • <i>V. cholerae</i> is a severe hazard as it can cause life threatening illness. • Human illness has been associated with RTE cooked prawns and shrimp contaminated with <i>V. cholerae</i>. • The infective dose of <i>V. cholerae</i> is lower when the vehicle is food rather than water. • <i>V. cholerae</i> is inactivated by adequate cooking during the production of RTE cooked prawns and shrimp. • Post-cooking contamination can occur, for example if the product is put into contaminated water used for cooling. • <i>V. cholerae</i> can grow in the product if it is present and temperature abuse occurs. • International and Australian compliance and recall data have shown detections of <i>V. cholerae</i> in RTE cooked prawns and shrimp.

General description
<p>Nature of the microorganism:</p> <p><i>V. cholerae</i> are facultative anaerobic, Gram-negative, curved rod-shaped bacteria. <i>V. cholerae</i> are found in coastal waters and estuaries and are more common in warmer waters (Wright and Schneider 2010; Harris et al. 2012; Oliver et al. 2013).</p> <p>Growth of <i>V. cholerae</i> can occur at temperatures ranging between 10 – 43°C, pH of 5.0 – 9.6 and a water activity of 0.970 – 0.998 when other conditions are near optimum. <i>V. cholerae</i> can grow in the salt range of 0.1 – 4.0% NaCl, showing optimum growth at 0.5% NaCl (ICMSF 1996; FAO/WHO 2005). Temperatures above 55°C are lethal to <i>V. cholerae</i> (Wright and Schneider 2010). In general <i>Vibrio</i> spp. are sensitive to cold temperatures, however, studies have shown that <i>V. cholerae</i> can survive refrigeration and frozen storage (Corrales et al. 1994; ICMSF 1996; Oliver et al. 2013). Also, some <i>Vibrio</i> spp. are able to enter the viable but non-culturable state when stored under refrigeration, impacting on the ability to detect the organism (Baffone et al. 2003).</p>

Adverse health effects:

V. cholerae is a severe hazard as it can cause life threatening illness (ICMSF 2002). There are more than 200 *V. cholerae* serogroups, but only O1 and O139 produce the cholera toxin and have other virulence factors necessary to cause cholera (Seas and Gotuzzo 2010; Harris et al. 2012; Oliver et al. 2013). Other serogroups cause gastroenteritis, but not cholera (FDA 2012). People of all ages are susceptible to infection with *V. cholerae*. However, the young, previously unexposed individuals, pregnant and elderly generally have more severe symptoms and/or develop more complications. In children, clinical disease manifests similar to that in adults but hypoglycaemia, seizures, fever and mental alteration are more common. In pregnant women, infection can lead to fetal loss (Seas and Gotuzzo 2010; Harris et al. 2012).

Symptoms range from mild to severe watery diarrhoea, with vomiting and associated dehydration. Cholera gravis, the most severe form of cholera, is characterized by severe fluid and electrolyte loss from profuse, watery diarrhoea (characteristic rice-water stools) and vomiting. However, the majority of infections result in mild or even asymptomatic disease (Seas and Gotuzzo 2010; FDA 2012; Oliver et al. 2013). The onset of illness ranges from several hours to 5 days after exposure to an infective dose. In otherwise healthy and well-nourished individuals receiving fluid and electrolyte replacement therapy, recovery times range from 1 to 6 days. In malnourished individuals disease may be more severe and recovery times longer. If fluid and electrolyte replacement therapy is not administered, severe dehydration can lead to death, with a fatality rate of 30 – 50%. However, with timely treatment the fatality rate is less than 1% (ICMSF 1996; FDA 2012; Oliver et al. 2013).

Limited data are available on the dose response for naturally occurring infections. When water is the vehicle, it is estimated that more vibrio cells are needed to cause disease (10^3 – 10^6 organisms), whereas when food is the vehicle, fewer cells are required to cause disease (10^2 – 10^4 organisms) due to the acid neutralising effect of food (Seas and Gotuzzo 2010).

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 prawns and shrimp (Australian Bureau of Statistics 2011). Mixed foods that contained RTE cooked prawns and shrimp were excluded from the analysis. Survey data was derived from one day of dietary recall data.

Key risk factors:

V. cholerae is an indigenous marine species and is routinely part of the microflora of raw crustaceans harvested from estuarine waters (ICMSF 2005). *Vibrio* spp. are found in warmer waters and can show seasonal variation, with numbers peaking in warmer months (Forsythe et al. 2009; Wright and Schneider 2010).

A key risk factor for RTE cooked prawns and shrimp is microbiological contamination following the cooking process. Poor post-cooking handling processes, such as the use of contaminated sea or drinking water to cool cooked prawns and shrimp, can lead to contamination with pathogenic bacteria. Cross contamination with uncooked products can re-introduce pathogens such as *V. cholerae*. Temperature abuse post-harvest during handling, transport and/or storage may then allow the growth of *V. cholerae* (ICMSF 2005; FSANZ 2005).

Risk mitigation:

Adequate cooking will inactivate *V. cholerae*. For example, cooking to an internal temperature of 70°C for at least two minutes, will inactivate *V. cholerae* (Wright and Schneider 2010). To control for undercooking, prawns and shrimp should be graded by size to ensure adequate cooking times within like-sized batches.

Following cooking, key risk mitigation steps are minimising contamination of cooked product, rapid post-cooking chilling and adherence to low temperatures (<5°C) during storage and transport. Contamination may be mitigated by the use of clean water to cool cooked prawns and shrimp, using separate equipment for raw and cooked product and food handlers not handling raw and cooked product (FSANZ 2005; Codex 2013).

In Australia Division 2 of [Standard 4.2.1 in the Australia New Zealand Food Standards 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.

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 2594 *V. cholerae* tests applied to cooked prawns and shrimp there were 35 fails, a 1.3% failure rate. The failed samples were from multiple countries.

There were three notifications on the European Commission's Rapid Alert System for Food and Feed (RASFF) for *V. cholerae* in cooked prawns and shrimp from Malaysia, India and Bangladesh during the period January 2007 – May 2016. There were an additional 13 notifications for shrimp from Vietnam and India, however it was not stated if any of these products were cooked.

There has been one food recall in Australia for cooked prawns due to the presence of *V. cholerae* from 2007 – May 2016. This was an imported product from Thailand; there have been no recalls for domestic product.

Surveillance information:

Infection with toxigenic *V. cholerae* O1 or O139 is notifiable as a disease in all Australian states and territories, with a reported incidence rate in 2015 of <0.1 cases per 100,000 population (2 cases). This is the same as the previous five year mean of <0.1 cases per 100,000 population per year. During the time period between 2010 – 2014 the number of cases ranged from 2 – 6 cases per year (NNDSS 2016a; NNDSS 2016b).

Illness associated with consumption of RTE cooked prawns and shrimp contaminated with *V. cholerae*

A search of the scientific literature via Web of Science, PubMed, Scopus, and other publications during the period 1990 – August 2016 identified limited cholera outbreaks associated with consumption of RTE cooked prawns and shrimp:

- Outbreak in the Dominican Republic in 2011 – at least 42 cases of cholera epidemiologically linked to consumption of cooked shrimp served on ice (odds ratio of 8.5). Environmental inspection of the caterer revealed poor food-handling practices including improper refrigeration, poor hand hygiene and non-chlorinated water supply (Jimenez et al. 2011).
- Outbreak in America (airline flight from South America to the United States) in 1992 – 75 cases of cholera including one fatality epidemiologically linked to consumption of cold seafood salad (odds ratio of 11.6). The seafood salad was prepared in Peru and included shrimp, fish, pineapple, eggs and apples. The route of contamination is not known, the seafood may have been caught in cholera-contaminated waters and was then inadequately cooked, or other ingredients may have been unwashed, or washed with contaminated water, or food handling errors may have contributed (Eberhart-Phillips et al. 1996).

Data on the prevalence of *V. cholerae* in RTE cooked prawns and shrimp

A search of the scientific literature via Web of Science, PubMed, Scopus, and other publications during the period 1990 – August 2016 identified data on the prevalence of *V. cholerae* in RTE cooked prawns and shrimp is limited:

- Survey with limited sample size in Germany in 2008/2009 – *V. cholerae* was not detected in cooked prawns (n=17) (Messelhauser et al. 2010).
- Survey in Denmark in 1994/1995 – *V. cholerae* non-O1 was detected in a single cooked frozen shrimp sample and *V. cholerae* O1 was not detected in warm water shrimp samples imported into Denmark (n=748 including both raw cooked shrimp)(Dalsgaard et al. 1996).

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 14 of *CAC/RCP 52-2003* is specific to processing of shrimps and prawns and describes controls at individual processing steps (Codex 2013).
- 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 2014).
- Codex guidelines on the application of general principles of food hygiene to the control of pathogenic *Vibrio* species in seafood *CAC/GL 73-2010* highlights the key control measures that can be used to minimise the likelihood of illness arising from the presence of pathogenic *Vibrio* spp. in seafood (Codex 2010).

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.

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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