Imported food risk statement
Uncooked slow dry cured ready-to-eat ham and staphylococcal enterotoxin

Commodity: Uncooked slow dry cured ready-to-eat (RTE) ham. Examples of this type of product include Iberian ham, Parma ham, Serrano ham and prosciutto.

Microbial enterotoxin: Staphylococcal enterotoxin (SE)

Recommendation and rationale
Is SE in uncooked slow dry cured RTE ham a medium or high risk to public health: ☐ *Yes* ☑ *No* ☐ *Uncertain, further scientific assessment required* **Rationale:** • SE is a moderate hazard as it generally causes illness of short duration and usually no sequelae • Growth of *Staphylococcus aureus* is limited in uncooked slow dry cured RTE ham due to the low water activity (high salt, fat and reduced moisture content) of the product • Limited evidence of staphylococcal food poisoning attributed to uncooked slow dry cured RTE ham • Limited evidence for uncooked slow dry cured RTE ham being contaminated with high levels of *S. aureus* or the presence of SE

General description
Nature of the microbial enterotoxin: *Staphylococcus* spp. are facultative anaerobic Gram-positive, non-spore forming spherical-shaped bacteria. They are commonly found in the environment, humans (nose and skin) and animals. Although several *Staphylococcus* species can produce SEs, including both coagulase-negative and coagulase-positive isolates, the majority of staphylococcal food poisoning (SFP) is attributed to SE produced by coagulase-positive *S. aureus* (FDA 2012; FSANZ 2013). Growth of *S. aureus* can occur at temperatures between 7 – 48°C, pH of 4.0 – 10.0 and a minimum water activity of 0.83 when other conditions are near optimum. SEs are resistant to heat inactivation and cannot be destroyed by cooking. SEs remain stable under frozen storage (FSANZ 2013).
Adverse health effects: SE is a moderate hazard as it generally causes illness of short duration and usually no sequelae (ICMSF 2002). People of all ages are susceptible to SFP. However, the severity of symptoms may vary depending on the amount of SE consumed and the general health status of individuals. The young and elderly are more likely to develop more serious symptoms (FSANZ 2013). SFP is characterized by rapid onset gastroenteritis that appears around three hours after ingestion (normal range of 1 – 6 hours). Common symptoms of SFP include nausea, vomiting, abdominal cramps and diarrhea. Recovery is usually between 1 – 3 days (FSANZ 2013).

People become ill after exposure to very small quantities of SE (less than 1 µg). These levels of toxin are generally observed when *S. aureus* populations exceed 10^5 CFU/g of food (FDA 2012).

Consumption pattern:

In the 2007 Australian National Children's Nutrition and Physical Activity Survey, <1% of children aged 2 – 16 years reported consumption of uncooked slow dry cured ham (DOHA 2008). In the 2011 – 2012 Nutrition and Physical Activity Survey (part of the 2011 – 2013 Australian Health Survey) <1% of children (aged 2 – 16 years), <1% of adults (aged 17 – 69 years) and <1% of people aged 70 and above reported consumption of uncooked slow dry cured ham (Australian Bureau of Statistics 2011-12).

For both the 2007 and the 2011 – 2012 surveys, mixed foods that contained uncooked slow dry cured ham were excluded from the analysis. The 2007 survey derived data from two days of dietary recall data for each respondent (a respondent is counted as a consumer if the food was consumed on either day one or day two, or both days), compared with only one day of dietary recall data for the 2011 – 2012 survey. Using two days of data will result in a higher proportion of consumers compared to a single day only, meaning the results are not directly comparable.

Key risk factors:

Incorrect levels of added curing substances (salt and nitrite), and inappropriate combination of temperature, time and humidity applied to the curing process are key risk factors (Rentfrow et al. 2012; MLA 2015).

S. aureus growth is limited in dry cured RTE ham. Reynolds et al. (2001) showed that on artificially inoculated hams *S. aureus* growth was limited such that no SE was detected at the end of the aging process. However, other studies have shown when uncooked slow dry cured hams were artificially inoculated with high concentrations of *S. aureus* (≥10^7 CFU/ml) SE was able to be detected. These studies were performed by Portocarrero et al. (2002) on non-commercial hams that were inoculated before curing, and by Wallin-Carlquist et al. (2010) and Marta et al. (2011) on sliced serrano ham.

Temperature abuse may allow growth of *S. aureus* and potential SE production. Levels of SE likely to cause illness are generally observed when *S. aureus* populations exceed 10^5 CFU/g of food (FDA 2012).

Risk mitigation:

Time and temperature abuse of food products should be avoided by applying good practices of temperature control in food manufacturing and handling. Good manufacturing practice and good hygienic practices in food manufacturing and handling also play a role in preventing SFP.

Due to the low water activity (high salt, fat and reduced moisture content) and presence of competing microorganisms, *S. aureus* does not grow well in uncooked slow dry cured RTE ham (Wallin-Carlquist et al. 2010; Marta et al. 2011).

In Australia Division 3 of Standard 4.2.3 of the Australia New Zealand Food Standards Code states that RTE meat must be produced in Australia under a food safety management system which identifies, evaluates and controls food safety hazards.

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 – June 2013 showed that of the 1,011 coagulase positive staphylococci tests applied to uncooked slow dry cured RTE ham there were 3 fails, representing a 0.3% failure rate (test limit of n=5, c=1, m=10^3, M=10^4 applied). The failed samples had maximum counts of staphylococci of 1.7 x 10^4 – 2.2 x 10^4 CFU/g, and were prosciutto and Serrano hams imported from Italy and Spain.

There has been one notification on the European Commission's Rapid Alert System for Food and Feed (RASFF) for high levels of *Staphylococcus* in raw ham from Spain (levels of 4 x 10^5 CFU/g) during the period of January 2007 – December 2015. There was another notification for various meat products from the Netherlands. However, it was not stated if any of these products were uncooked slow dry cured RTE ham. There were no

notifications for SE.

There have been no food recalls in Australia due to the presence of SE or *S. aureus* in imported or domestically produced uncooked slow dry cured RTE ham from January 2007 – December 2015.

Surveillance information:

SFP is not a notifiable disease in Australia. While it is generally recognised that there may be significant under reporting of SFP due to the short duration of illness and self-limiting symptoms, there was one reported outbreak in Australia in 2012 and two outbreaks reported in 2011. Mixed foods including fried rice and chicken were associated with these outbreaks. Factors that may have contributed to the outbreaks include the role of infected food handlers and temperature abuse of food. In Australia it is estimated that *S. aureus* accounts for 1% of foodborne illness caused by known pathogens (OzFoodNet 2012; FSANZ 2013; Pillsbury et al. 2013).

Illness associated with consumption of uncooked slow dry cured RTE ham contaminated with SE

A search of the scientific literature via the EBSCO Discovery Service and the US CDC Foodborne Outbreak Online Database during the period 1990 – July 2015 identified there are limited reports of SFP outbreaks associated with consumption of uncooked slow dry cured RTE ham.

- Outbreak in Germany in 1988, two incidents of SFP due to consumption of dry-cured smoked ham (Untermann and Muller 1992)
- There have been 17 confirmed SFP outbreaks attributed solely to ham on the US CDC outbreak register (CDC 2015), however, it is not known if the products implicated in these outbreaks were uncooked slow dry cured RTE ham

Prevalence of *S. aureus* in uncooked slow dry cured RTE ham

A literature search with the EBSCO Discovery Service during the period 1990 – July 2015 identified data on the prevalence of SE in uncooked slow dry cured RTE ham is limited.

- Survey in Italy, *S. aureus* was isolated from 1.5% of Parma ham samples taken from factories after the dry curing process (n=204), the level of contamination was <60 CFU/g (Lori et al. 2005)
- Survey in the United Kingdom in 1996, *S. aureus* at concentrations of >100 CFU/g was isolated from 1.3% of raw/country style ham (dry cured ham) samples at retail (n=553) (Little 1998)

Relevant standard or guideline

- FSANZ guidelines for the microbiological examination of ready-to-eat food have a satisfactory level for coagulase positive staphylococci of $<10^2$ CFU/g. Food is deemed potentially hazardous if levels of coagulase positive staphylococci are $\geq 10^4$ CFU/g or SE is detected (FSANZ 2001).
- 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 hygienic practice for meat *CAC/RCP 58-2005* covers additional hygienic provisions for raw meat, meat preparations and manufactured meat from the time of live animal production up to the point of retail sale (Codex 2005)

Approach by overseas countries

Many countries, such as the European Union, the United States and Canada, have HACCP-based regulatory measures in place for meat products.

In the United States it is recommended that in order for salt cured processes to achieve sufficient reduction of bacterial pathogens of public health concern drying times should take place over an extended period of time at room temperature or higher, or a low temperature heat step must be applied after the curing step (FSIS 2012).

Other considerations
Testing for high levels of coagulase-positive staphylococci is an indicator test for the presence of SE. Biosecurity requirements apply to certain products under this commodity. Refer to the BICON database.

This risk statement was compiled by FSANZ in: March 2016

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