Imported food risk statement
Uncooked slow dry cured ready-to-eat ham and Shiga toxin-producing *Escherichia coli*

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.

Microorganism: Shiga toxin-producing *Escherichia coli* (STEC)

Recommendation and rationale
Is STEC in uncooked slow dry cured RTE ham a medium or high risk to public health: ☐ *Yes* ☑ *No* ☐ *Uncertain, further scientific assessment required* **Rationale:** • Growth of STEC is inhibited in uncooked slow dry cured RTE ham due to the low water activity (high salt, fat and reduced moisture content) of the product • The slow dry curing process achieves a greater than 5 $\log_{10}$ reduction in STEC • There is a lack of literature on STEC caused outbreaks attributed to the consumption of uncooked slow dry cured RTE ham and limited microbiological survey data for STEC contamination in uncooked slow dry cured RTE ham, although the survey data that is available suggests a low prevalence

General description
Nature of the microorganism: *E. coli* are facultative anaerobic, Gram-negative, rod-shaped bacteria. They are found in warm-blooded animals and humans as part of the normal intestinal flora (FSANZ 2013). The majority of *E. coli* are harmless, however some have acquired specific virulence attributes, such as Shiga toxin-producing *E. coli* (STEC), which can cause severe diarrheal disease in humans (FDA 2012). Major foodborne pathogenic STEC strains include O26, O45, O103, O111, O121, O145, O157 (FDA 2012) and O104 (ECDC/EFSA 2011). The major animal reservoir of STEC is ruminants. STEC can also colonise other animals and birds, although the incidence of STEC is lower than in ruminants (FSANZ 2013; Meng et al. 2013). Growth of *E. coli* can occur at temperatures between 7 – 46°C, pH of 4.4 – 10.0 and a minimum water activity of 0.95 when other conditions are near optimum. Some STEC strains are able to survive at pH 2.5 – 3.0 for over 4 hours. STEC is able to survive frozen storage at -20°C, however, it is readily inactivated by cooking (FSANZ 2013; Meng et al. 2013).
Adverse health effects: STEC is a severe hazard as it can cause life threatening illness or substantial chronic sequelae (ICMSF 2002). People of all ages are susceptible to infection with STEC. However, the young and the elderly are more susceptible and are more likely to develop serious symptoms (FSANZ 2013). Symptoms include diarrhoea, abdominal pain, vomiting and fever. The onset of illness is typically 3 – 8 days after infection and most patients recover within 10 days of the initial onset of symptoms. Acute STEC

infections (haemorrhagic colitis) are characterised by severe abdominal cramps and bloody diarrhoea. In some cases, patients develop haemolytic uraemic syndrome (HUS) which can lead to kidney failure. HUS can also have neurological effects and cause seizures, stroke and coma. Approximately 3 – 7% of haemorrhagic colitis cases develop HUS. The fatality rate of HUS is 3 – 5% (FDA 2012; FSANZ 2013).

It is generally accepted that very low levels (10 – 100 cells) of STEC can cause illness. However, depending on the food matrix and strain of STEC, illness may occur at exposure to even lower levels of STEC (FSANZ 2003; 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).

STEC can be found in pigs, although they are not considered a major reservoir. Certain raw pork products have been recalled in Canada due to possible *E. coli* O157:H7 contamination (uncooked slow dry cured ham was not one of the recalled products) (CFIA 2014).

Risk mitigation:

Using raw ingredients free of STEC provides the first level of protection in the production of safe uncooked slow dry cured RTE ham. Good manufacturing practice, good hygienic practices to prevent cross contamination and good temperature control in food manufacturing and handling play an important role in minimising STEC contamination and proliferation in uncooked slow dry cured RTE ham.

Curing agents like salt and nitrite, and correct application of curing temperature, time and humidity contribute to inhibition and inactivation of STEC present in the raw ingredients.

The low water activity of dry cured RTE ham has been found to inhibit *E. coli* O157:H7 growth. Greater than 5 $\log_{10}$ reductions in *E. coli* O157:H7 have been reported on surface artificially inoculated dry cured hams at the end of the aging process (Reynolds et al. 2001; Portocarrero et al. 2002; Graumann and Holley 2007). However, the dry curing process of Westphalian ham (up to four months) was not sufficient to eliminate STEC internalized by needle tenderization (<2 $\log_{10}$ reduction) (Graumann and Holley 2007).

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 1,027 generic *E. coli* tests applied to uncooked slow dry cured RTE ham there were seven fails, representing a 0.68% failure rate (test limit of n=5, c=1, m=3.6, M=9.2 applied). The failed samples included Serrano ham, Parma ham and Iberian ham imported from Spain and Italy. The highest generic *E. coli* level in any of the

failed samples was 130 CFU/g.

There were no notifications on the European Commission's Rapid Alert System for Food and Feed (RASFF) for STEC or excessive levels of generic *E. coli* in pork products, including uncooked slow dry cured RTE ham from January 2007 – December 2015.

There have been no food recalls in Australia due to the presence of STEC or excessive levels of *E. coli* in imported or domestically produced uncooked slow dry cured RTE ham from January 2007 – December 2015.

Surveillance information:

Infection with STEC is a notifiable disease in all Australian states and territories, with a reported incidence rate in 2014 of 0.5 cases per 100,000 population (115 cases), which includes both foodborne and non-foodborne cases. This is the same as the previous five year mean of 0.5 cases per 100,000 population per year (ranging from 0.4 – 0.8 cases per 100,000 population per year). The most common STEC serotype identified in Australia in 2011 was O157 (38% of cases), O111 was the next most common serotype. There were 7 case of STEC-associated HUS reported in Australia in 2011 (NNDSS 2015; OzFoodNet 2015).

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

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 did not identify any STEC caused outbreaks associated with consumption of uncooked slow dry cured RTE hams.

Prevalence of STEC in uncooked slow dry cured RTE ham

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

- Survey in the United Kingdom in 1996, STEC was not detected in raw/country style ham (dry cured ham) samples at retail (n=554) (Little 1998)

Relevant standard or guideline

- FSANZ guidelines for the microbiological examination of ready-to-eat food has a satisfactory level for generic *E. coli* of <3 CFU/g. Food is deemed potentially hazardous if any pathogenic strains of *E. coli* are detected (including STEC) (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 (≥ 5 $\log_{10}$ of *E. coli* O157:H7) 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
Generic *E. coli* is commonly used as an indicator of process hygiene (ICMSF 2011). Biosecurity requirements apply to certain products under this commodity. Refer to the BICON database.

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