Imported food risk statement
Uncooked ready-to-eat dried meat and staphylococcal enterotoxin

Commodity: Uncooked ready-to-eat (RTE) dried meat. Examples of this type of product include jerky and biltong.

Microbial enterotoxin: Staphylococcal enterotoxin (SE)

Recommendation and rationale
Is SE in RTE dried meat a medium or high risk to public health: ☐ *Yes* ☑ *No* ☐ *Uncertain, further scientific assessment required* **Rationale:** • Limited evidence for RTE dried meat being contaminated with high levels of *Staphylococcus aureus* or the presence of SE. • Staphylococcal food poisoning attributed to the consumption of RTE dried meat is rare • Due to its low moisture and high salt content, RTE dried meat like jerky does not support the growth of *S. aureus*

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:

RTE dried meat was not identified as being consumed by any of the respondents (2 years and over) in the 1995 National Nutrition Survey (McLennan and Podger 1999) or the respondents (2-16 years) in the 2007 Australian National Children's Nutrition and Physical Activity Survey (DOHA 2008).

Key risk factors:

Inadequate level of added curing substances (salt and nitrite) and inappropriate combinations of time, temperature and humidity applied to the drying process can contribute to production of unsafe dried meat products (FSIS 2001; MLA 2003).

Temperature abuse may allow growth of *S. aureus* and potential SE production.

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.

Salting and drying (temperatures of 55 - 65^{o}C) are critical steps in the manufacture of RTE dried meat. The combination of these two enables the product to reach a low moisture level at around 30% (MLA 2003). The temperature and time combination applied to the drying step tends to vary from one manufacturer to another. Due to its low moisture content, RTE dried meat does not usually support the growth of *S. aureus* (Ingham et al. 2006). However, neither traditional or modern biltong manufacturing processes lead to complete eradication of *S. aureus* (Naidoo and Lindsay 2010).

For dried meat products that are cooked, *S. aureus* would be inactivated. For example, 65^{o}C for 10min or equivalent (MLA 2003).

In Australia Division 3 of Standard 4.2.3 of the Australia New Zealand Food Standards Code (the Code) requires producers of RTE meat to implement a food safety management system which identifies, evaluates and controls food safety hazards. Paragraph 2.2.1–5(1) of the Code states that a food that is sold as a dried meat must be dried to a water activity of no more than 0.85.

Compliance history:

The imported food compliance data sourced from the Imported Food Inspection Scheme of the Australian Department of Agriculture for January 2007 – June 2013 showed that of the 31 coagulase positive staphylococci tests applied to RTE dried meat there were no fails.

There has been one notification on the European Commission's Rapid Alert System for Food and Feed (RASFF) for a high level of *S. aureus* in several undisclosed meat products from the Netherlands during the period of January 2007 – June 2013. It was not stated if any of these products were RTE dried meat. 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 RTE dried meat from January 2007 – June 2013.

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 were two reported outbreaks in Australia in 2011 and two outbreaks reported in 2010. The foods associated with these outbreaks were thick shakes, rice noodles and mixed foods. Factors that contributed to the outbreaks included inadequate cleaning of equipment and temperature abuse of food. In Australia it is estimated that *S. aureus* accounts for 1% of foodborne illness caused by known pathogens (OzFoodNet 2011; OzFoodNet

2012; FSANZ 2013).

Illness associated with consumption of RTE dried meat contaminated with SE

There are limited reports of SFP outbreaks associated with consumption of RTE dried meats.

- Outbreak in the United States in 2001, 6 cases of illness associated with the consumption of jerky made with rabbit meat (CDC 2013)

Prevalence of *S. aureus* in RTE dried meat

Data on the prevalence of *S. aureus* in RTE dried meat is limited.

- Small survey in South Africa isolated *S. aureus* from biltong samples collected at retail. Contamination was probably associated with food handler contamination occurring during slicing of biltong before merchandising (Shale and Malebo 2011)

Other 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 staphylococcal enterotoxin 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 the production of poultry jerky must achieve at least a 7.0 $\log_{10}$ reduction of *Salmonella* spp. as required by the Code of Federal Regulation 9 CFR 381.150. Beef jerky should achieve at least a 5.0 $\log_{10}$ reduction of *Salmonella* spp. Here *Salmonella* is treated as a reference organism, if the process achieves sufficient reductions in *Salmonella* spp. then other bacterial pathogens of public health concern should also be reduced to a safe level (FSIS 2012).

Other considerations

Testing for high levels of coagulase-positive staphylococci is an indicator test for the presence of SE.

Biosecurity restrictions apply to certain products under this commodity classification. Refer to the BICON database.

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References

CDC (2013) Foodborne outbreak online database (FOOD). http://wwwn.cdc.gov/foodborneoutbreaks/Default.aspx. Accessed 21 August 2013

Codex (2003) General principles of food hygiene (CAC/RCP 1 - 1969). Codex Alimentarius Commission, Geneva

Codex (2005) Code of hygienic practice for meat (CAC/RCP 58 - 2005). Codex Alimentarius Commission, Geneva

DOHA (2008) 2007 Australian national children's nutrition and physical activity survey - Main findings. Department of Health and Ageing, Canberra. http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-food-monitoring.htm. Accessed 27 March 2015

FDA (2012) Bad bug book: Foodborne pathogenic microorganisms and natural toxins handbook, 2nd ed. US Food and Drug Administration, Silver Spring. http://www.fda.gov/food/foodborneillnesscontaminants/causesofillnessbadbugbook/default.htm. Accessed 23 July 2015

FSANZ (2001) Guidelines for the microbiological examination of ready-to-eat foods. Food Standards Australia New Zealand, Canberra. http://www.foodstandards.gov.au/publications/documents/Guidelines%20for%20Micro%20exam.pdf. Accessed 24 March 2016

FSANZ (2013) Agents of foodborne illness. 2nd ed, Food Standards Australia New Zealand, Canberra. http://www.foodstandards.gov.au/publications/Documents/FSANZ_FoodborneIllness_2013_WEB.pdf. Accessed 4 September 2013

FSIS (2001) Performance standards for the production of processed meat and poultry meat and poultry products. Federal Register/Proposed Rules 66(39):12590–12636

FSIS (2012) FSIS compliance guideline for meat and poultry jerky produced by small and very small establishments - 2012 updated compliance guideline. US Department of Agriculture, Washington DC. http://www.fsis.usda.gov/wps/wcm/connect/5fd4a01d-a381-4134-8b91-99617e56a90a/Compliance_Guideline_Jerky_2012.pdf?MOD=AJPERES. Accessed 14 March 2014

ICMSF (2002) Microorganisms in Food 7: Microbiological testing in food safety management. Kluwer Academic/Plenum Publishers, New York

Ingham SC, Searls G, mohanan S, Buege DR (2006) Survival of *Staphylococcus aureus* and *Listeria monocytogenes* on vacuum-packaged beef jerky and related products stored at 21°C. Journal of Food Protection 69(9):2263–2267

McLennan W, Podger A (1999) National nutrition survey. Foods eaten. Australia. 1995. ABS Catalogue number 4804.0. Australian Bureau of Statistics and Commonwealth Department of Health and Family Services, Canberra. http://www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/4804.0?OpenDocument. Accessed 6 August 2014

MLA (2003) Guidelines for the safe manufacture of smallgoods. Meat & Livestock Australia, Sydney

Naidoo K, Lindsay D (2010) Pathogens associated with biltong product and their *in vitro* survival of hurdles used during production. Food Protection Trends 30(9):532–538

OzFoodNet (2011) OzFoodNet Quarterly report, 1 October to 31 December 2010. Communicable Diseases Intelligence 35(1):29–37

OzFoodNet (2012) OzFoodNet Quarterly report, 1 July to 30 September 2011. Communicable Diseases Intelligence 36(2):E188–E195

Shale K, Malebo NJ (2011) Quantification and antibiotic susceptibility profiles of *Staphylococcus aureus* and *Bacillus cereus* strains isolated from biltong. Journal of Food Safety 31:559–569