Imported food risk statement
Dried paprika and pepper and *Salmonella* spp.

Commodity: Dried paprika and pepper that is ready-to-eat. This includes spices and spice mixes derived from *Piper* spp., *Schinus terebinthifolius, Zanthoxylum bungeanum* and *Zanthoxylum piperitum* (pepper); *Pimenta* spp. (allspice); and *Capsicum* spp. (e.g. chilli and paprika). Product that will undergo further processing involving heat treatment is not covered by this risk statement.

Microorganism: *Salmonella* spp.

Recommendation and rationale
Is *Salmonella* spp. in dried paprika and pepper a medium or high risk to public health: ☑ *Yes* ☐ *No* ☐ *Uncertain, further scientific assessment required* **Rationale:** • *Salmonella* spp. are a serious hazard as they cause incapacitating, though not usually life threatening, illness of moderate duration and sequelae are rare. • Human illness has been associated with dried paprika and pepper contaminated with *Salmonella* spp. • The production of dried paprika and pepper does not include a heat treatment kill step. • Post-processing treatments such as steam sterilisation may be used, however there is inconsistency around the application of this treatment and the temperature and time combination used during the process can vary. • *Salmonella* spp. are able to survive in this commodity. • International and Australian compliance and recall data have shown detections of *Salmonella* spp. in dried paprika and pepper.

General description
Nature of the microorganism: *Salmonella* 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). Growth of *Salmonella* spp. can occur at temperatures 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. *Salmonella* 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. *Salmonella* 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).
Adverse health effects: *Salmonella* 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

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 infective 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 low as one or 100 cells 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) 63.0% of children (aged 2 – 16 years), 66.9% of adults (aged 17 – 69 years) and 60.4% of people aged 70 and above reported consumption of dried paprika and pepper (Australian Bureau of Statistics 2011). Mixed foods that contained dried paprika and pepper as an ingredient were included in the analysis. The survey derived data from one day of dietary recall data.

Key risk factors:

Key risk factors during farm production of spices include the quality of the irrigation water, use of untreated manure as fertilizer and animal access to the crop. Crops are often harvested by hand and may also be cleaned manually to remove extraneous material. The drying process often occurs in the open air and in some cases the product is left to dry directly on the ground. Risk factors associated with this include the cleanliness of the drying area and the presence of animals and birds that can shed and transmit *Salmonella* spp. (ICMSF 2000; FDA 2013).

The production of dried paprika and pepper does not include a heat treatment kill step. *Salmonella* spp. are able to survive in dried paprika and pepper for long periods as *Salmonella* spp. are able to survive dry conditions.

Risk mitigation:

Good agricultural practices on the farm and protecting the product from animals and birds during the drying process will help mitigate the risk of *Salmonella* contamination. Treatments such as steam sterilisation may be used; however there is inconsistency around the application of this treatment and the temperature and time combination used during the process can vary.

In Australia, Schedule 27 of the Australia New Zealand Food Standards Code has a microbiological limit for *Salmonella* in pepper, paprika and cinnamon 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 10079 *Salmonella* spp. tests applied to dried paprika and pepper there were 126 fails, a 1.3% failure rate. The failed samples were from multiple countries and included chilli powder, paprika and pepper.

There have been 54 notifications on the European Commission's Rapid Alert System for Food and Feed (RASFF) for *Salmonella* spp. in black and white pepper, sweet paprika, chilli powder and allspice from January 2007 – May 2016. The products were from multiple countries. There were an additional nine notifications for spice mixtures from multiple countries, however, it was not stated which spices were included in these spice mixtures.

There was one food recall in Australia due to the presence of *Salmonella* spp. in the peppercorn component of a spice rack from January 2007 – May 2016. The product was imported from China; there have been no

recalls for domestic product.

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 dried paprika and pepper contaminated with *Salmonella* spp.

A search of the scientific literature via Web of Science, PubMed, Scopus, CAB abstracts and other publications during the period 1990 – April 2016 identified a number of salmonellosis outbreaks associated with consumption of dried paprika and pepper:

- Outbreak in the United States in 2009/2010 – 272 cases of *Salmonella* Montevideo infections linked to consumption of salami containing imported red or black pepper. The pepper was added to the salami after the kill step. The outbreak strain was isolated from salami products, an environmental sample from a manufacturing plant and sealed containers of the black and red pepper at the facility (CDC 2010; Gieraltowski et al. 2013).
- Outbreak in Germany in 1993 – approximately 1000 cases of salmonellosis linked to consumption of paprika powder and paprika-flavoured products. Paprika-powdered potato chips were the main vehicle of transmission, the paprika spice mix was added to the roasted chips at the end of the production line after the cooking step. The outbreak was characterized by rare *Salmonella* serovars, altogether 94 different serovars or strains were isolated from patients and paprika-containing food items. The contaminated paprika appeared to be part of a lot of paprika powder imported from South America and released onto the market in February and March 1993 (Lehmacher et al. 1995).
- Outbreak in the United States in 2008/2009 – 87 cases of *Salmonella* Rissen infections linked to consumption of ground white pepper. The outbreak strain was isolated from pepper samples used in restaurants which had served affected individuals, and from environmental and pepper samples from the manufacturer. The manufacturer had inadequate sanitation and operation procedures for the sanitary production of food (CDPH 2010).

Prevalence of *Salmonella* spp. in dried paprika and pepper

A search of the scientific literature via Web of Science, PubMed, Scopus, CAB abstracts and other publications during the period 1990 – April 2016 identified that surveys of dried paprika and pepper have isolated *Salmonella* spp. in 0 – 20.3% of samples (Moreira et al. 2009; Hampikyan et al. 2009):

- Survey in the United States in 2010 – *Salmonella* spp. were isolated from 3.3% of shipments of dried capsicum (n=299) imported into the United States (Van Doren et al. 2013).
- Survey in Turkey – *Salmonella* spp. were isolated from 3.3% of black pepper samples (n=60) and 1.7% of red pepper samples (n=60). No *Salmonella* spp. were detected in white pepper samples (n=60). All samples were collected at retail (Hampikyan et al. 2009).
- Survey in Brazil in 2004/2006 – *Salmonella* spp. were isolated from 18.2% (n=66) black pepper samples (Moreira et al. 2009).
- Survey in Ireland in 2004 – *Salmonella* spp. were isolated from 20.3% of capsicum samples (n=88) and was not detected in *Piper* spp. samples (n=77) collected at retail, wholesale or from the manufacturer (FSAI 2005).

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 hygienic practice for low-moisture foods *CAC/RCP 75-2015* covers good manufacturing practices and good hygienic practices for the manufacturing of low-moisture foods for human

consumption. Annex III applies specifically to spices and dried aromatic herbs and covers the minimum requirements of hygiene for growing, harvesting and post-harvest practices, processing establishment, processing technology and practices, packaging and storage of processed products (Codex 2016).

Approach by overseas countries
Many countries and regions, such as Canada and the European Union, have HACCP-based measures in place for the production of dried paprika and pepper. The Canadian microbiological guidelines recommend that *Salmonella* spp. in ready-to-eat spices not be detected by a two-part sampling plan of n=5, c=0, m=0 (Health Canada 2008).

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

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