NSW GOVERNMENT Food Authority

Survey of *Listeria monocytogenes* in sliced pre-packaged RTE meats

NSW/FA/FI177/1305

The NSW Food Authority conducts food surveys throughout the year. Surveys provide a snapshot of practices at the participating businesses and may not be representative of industry-wide practices. Survey results serve to highlight potential areas requiring further attention by businesses. Where necessary, follow up enforcement action is taken by the NSW Food Authority or Council officers.

More information about our survey program is available at
http://www.foodauthority.nsw.gov.au/_Documents/science/survey_program_overview.pdf

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Executive summary

Several studies have categorised ready-to-eat (RTE) deli meats as high risk foods due to the potential for contamination with *Listeria monocytogenes* (Food Science Australia & Minter Ellison Consulting, 2002; FDA/USDA; 2003; MLA, 2003). This is due to either the absence of a listericidal step such as cooking, extended shelf life or contamination during handling subsequent to a listericidal step (ie during slicing) and the ability of many of these products to support the growth of *L. monocytogenes* during storage, even under refrigeration.

A number of outbreaks have been reported in Australia and overseas attributed to these products (Appendix 1). The contributing factors in the majority of the outbreaks were contaminated processing equipment, which in turn cross contaminated the products. In respect to meat and poultry products, the most recent outbreak in Australia occurred from January to August 2009, resulted in 36 cases of listeriosis and 3 foetal deaths and was associated with the consumption of RTE cooked diced chicken.

Numerous studies have been conducted worldwide to determine the prevalence and concentration of *L. monocytogenes* in RTE meat and poultry products. In most of these studies, enumeration was only carried out on positive samples. Seven of sixteen surveys found *L. monocytogenes* at very low levels.

Due to the limited information on the Australian situation with regard to numbers of *L. monocytogenes* in meat products, a survey was conducted to gather information on the concentration of *L. monocytogenes* in sliced, pre-packaged RTE meats sold in NSW.

From March 2011 to December 2012, a total of 303 sliced/diced, pre-packaged RTE meats were purchased from supermarkets, green grocers and delicatessens across Sydney. Samples included a range of products that may support the growth of *L. monocytogenes,* such as processed chicken and turkey, and those that are unlikely to support the growth of *L. monocytogenes,* such as salami. Samples were analysed for the levels of *L. monocytogenes*, as well as pH and water activity to determine the intrinsic properties of the products.

The survey detected *L. monocytogenes* in two samples (0.7%) at a level of 10 CFU/g (the limit of detection). Based solely on the pH and water activity of those products, it could be concluded that those products could support the growth of *L. monocytogenes* during the shelf life of the product. However, a count of 10 CFU/g suggests that minimal growth occurred. Although not compliant with the microbiological limit in the Food Standards Code, these products were not recalled because by the time the result was received, both products were at the end of their shelf life. The results from this survey contribute towards verifying the implementation of the *Listeria* management program (NSW Food Authority, 2009b) in controlling the risk of *L. monocytogenes* contamination in packaged RTE meats

Introduction

The Food Standards Code (FSANZ, 2011) defines ready-to-eat (RTE) meat as meat products (including poultry) intended to be consumed without further heating or cooking, and includes:

- cooked or uncooked fermented meat
- pâté
- dried meat
- slow cured meat
- luncheon meat
- cooked cured or uncured muscle meat
- other ready-to-eat meat that is susceptible to the growth of pathogens or the production of toxins

In addition, Standard 1.6.1 of the Food Standards Code specifies nil *Listeria monocytogenes* in five samples of 25g for packaged cooked cured/salted meat, packaged heat treated meat paste and packaged heat treated pâté. Its presence in other RTE foods with a long shelf life stored under refrigeration is also considered potentially hazardous according to the FSANZ document *Guidelines for the microbiological examination of ready-to-eat foods* (FSANZ, 2001).

Several studies have categorised RTE deli meats as high risk foods due to the potential for contamination with *L. monocytogenes* (Food Science Australia & Minter Ellison Consulting, 2002; FDA/USDA; 2003; MLA, 2003). Indeed, in the USA, the FDA/USDA risk assessment for *L. monocytogenes* identified deli meats as the highest risk food from the 23 RTE foods examined (FDA/USDA, 2003). This high risk rating was due to either the absence of a listericidal step such as cooking, extended shelf life or the potential for contamination during handling subsequent to a listericidal step (ie during slicing) and the ability of many of these products to support the growth of *L. monocytogenes* during storage, even under refrigeration.

In Australia, the *National Risk Validation Project* report (Food Science Australia & Minter Ellison Consulting, 2002) identified producers of fermented and manufactured meat products to be high risk businesses, requiring the implementation of food safety programs. The project estimated that foodborne illness (from all pathogens, not just *Listeria*) attributable to fermented and manufactured meats in Australia to be in the order of $77 million per year. This was based on the way the products were manufactured and the frequency of illness in relation to product consumption rates and the severity of illness.

A number of outbreaks have been reported in Australia and overseas attributable to these products (Appendix 1). The contributing factors in the majority of these outbreaks were contaminated processing equipment, which in turn led to the cross contamination of finished product. The most recent listeriosis outbreak associated with meat products in Australia occurred from January to August 2009, resulting in 36 cases of listeriosis and 3 foetal deaths, and was attributed to the consumption of RTE cooked diced chicken. The key contributing factors for this outbreak were: lack of skills and knowledge in process technology and food safety; inadequate heat treatment; lack of product, process and environmental monitoring and response; and no verification of shelf life.

Imported RTE uncooked and processed meats or manufactured meats are tested at the 100% level by the Department of Agriculture Fisheries and Forestry (DAFF) Biosecurity at the border. They are analysed for Coagulase positive staphylococci (CPS), *E. coli, L. monocytogenes* and *Salmonella*. From January 2010 to November 2012, thirteen products were rejected due to a failed test and 62% of those were due to the detection of *L. monocytogenes* (detail in Appendix 2). No enumeration was done on any of those products.

Due to the RTE nature of these products, the detection of pathogens will often result in a product recall. Of the 49 recalls of RTE meat in Australia between 2004 and 2012, 39 (80%) were due to the presence of *L. monocytogenes* (see Appendix 3).

Numerous studies have been conducted to determine the prevalence and concentration of *L. monocytogenes* in RTE meat and poultry products (Appendix 4). In most of these studies, enumeration was only carried out on samples where *L. monocytogenes* was detected. Seven of sixteen surveys found *L. monocytogenes* at very low levels.

Since RTE meats are categorised as high risk, samples are regularly collected and tested for the presence of *Listeria* spp. as part of the NSW Food Authority's microbiological verification program[1]. A total of 858 samples were collected from July 2003 to 5 December 2012. *Listeria* spp were found in 73 samples (8.5%); 23 samples (2.6%) contained *L. monocytogenes* (present either singly or in combination with other species). Quantification is not routinely done in this program because it is not the requirement outlined in the *NSW Food Safety Scheme Manual*.

In addition, due to a lack of current information on the microbiological quality of packaged sliced RTE meats sold in NSW, in 2008, 154 sliced packaged RTE meat products were purchased and tested for a range of microorganisms, including *L. monocytogenes* (for presence/absence and enumeration). This survey found that six samples (3.9%) were positive for *L. monocytogenes,* but at a level of less than 10 CFU/g[2] (NSW Food Authority, 2009a).

Because enumeration of *L. monocytogenes* is not routinely conducted, there is limited information on the Australian situation with regard to numbers of *L. monocytogenes* in RTE products. As such, this survey was conducted to gather information on the concentration of *L. monocytogenes* in sliced, pre-packaged RTE meats sold in NSW.

In this survey, samples included those that can support the growth of *L. monocytogenes* and those that do not support the growth. This approach was taken as in the Codex document *Microbiological criteria for Listeria monocytogenes in ready-to-eat foods* that specifies that *L. monocytogenes* may be present at levels up to 100 CFU/g in RTE products in which growth of *L. monocytogenes* will not occur during the shelf life of the product (Anonymous, 2009a).

The Codex document defines foods that **do not** support the growth of *L. monocytogenes* (growth is defined as an increase of 0.5 log CFU/g or more during the shelf life of the food).

These include:

- food with a pH value less than 4.4 (regardless of water activity)
- food with a water activity value less than 0.92 (regardless of pH)
- food with a combination of factors (eg pH < 5.0 and water activity < 0.94)
- Frozen foods
- Foods with a shelf life of less than 5 days

[1] The purpose of the NSW Food Authority's verification program is to provide a snapshot of the overall compliance of license holders with regard to microbiological and chemical testing requirements. Samples are collected from licensee and tested for a range of tests according to the *NSW Food Safety Schemes Manual* that specify requirements for businesses under Food Safety Schemes under Food regulation 2010 (http://www.foodauthority.nsw.gov.au/_Documents/industry_pdf/NSW_Food_Safety_Schemes_Manual.pdf).

[2] The presence/absence test can detect *L. monocytogenes* at lower level than the enumeration test due to the resuscitation step. The presence/absence test also uses 25g of sample. Thus, it is not unusual to get a positive on this test, but at the level of less than 10cfu/g (Limit of detection for the enumeration test).

In comparison, the European Union microbiological criteria for foodstuffs (EC No 1441/2007) has very similar, but slightly different, criteria for establishing whether a food can support the growth of *L. monocytogenes* (The Commission of the European Communities, 2007). Products with pH ≤4.4 or water activity ≤0.92, products with a combination of pH ≤5.0 and water activity ≤0.94 and products with a shelf-life of less than five days are automatically considered as do not support the growth of *L. monocytogenes*. Other categories of products can also belong to this category, subject to scientific justification.

Materials and methods

Sampling

From March 2011 to December 2012, a total of 303 sliced/diced, pre-packaged RTE meats were purchased from supermarkets, green grocers and delicatessens across Sydney. Samples included processed chicken and turkey, slow cured meat, cooked cured meat and cooked/uncooked fermented meats.

Analysis

All samples were analysed within 24 hours of receipt at the laboratory using the appropriate Australian Standard method for enumeration of *L. monocytogenes* (AS 5013.24.2). The pH and water activity for each sample was also tested to determine the intrinsic properties of the products.

Assessing microbiological quality of RTE meat products

While the Food Standards Code prescribes a 'not detected in 25g' limit for *L. monocytogenes* in specific products, the NSW Food Authority's '*Microbiological quality guide for ready-to-eat foods'* (NSW Food Authority, 2009c) states that *L. monocytogenes* should be absent in products that can support the growth of the organism and is not intended for consumption on the same day, but may have an allowable level of up to 100 CFU/g in products that do not support the growth of the organism. This aligns with the FSANZ *Recall guidelines for packaged ready-to-eat foods found to contain Listeria monocytogenes at point of sale* which allows a level of 100 CFU/g if the product does not support the growth of *L. monocytogenes* (FSANZ, 2001), such as salami. It is considered that this level is unlikely to cause illness in most consumers.

Determining if products permit the growth of *L. monocytogenes*

Products were categorised as being able to permit the growth of *L. monocytogenes* if they met the pH and/or water activity criteria specified by either Codex or the European Union. Both criteria were included for comparison because, as noted in the introduction, they are very similar but slightly different. In EC No 1441/2007 it specifies an 'equal to or less than' for the lower limit of pH and water activity, rather than just 'less than' specified by Codex. In effect, this means that the Codex criteria are more stringent.

It is acknowledged that assessing a product as supporting the growth of *L. monocytogenes* based purely on pH and/or water activity is a simplified approach in that products may include other factors such as preservatives or antimicrobials that may also result in inhibiting the growth of *L. monocytogenes*.

Results and conclusion

Of the 303 samples tested, *L. monocytogenes* was detected in two samples (0.7%), at the level of 10 CFU/g (limit of detection).

The positive samples were ham (pH = 6.2 and a_w = 0.97) and silverside (pH = 6.1 and a_w = 0.98) from two different manufacturers. Based solely on the pH and water activity of those products, it could be concluded that those products could support the growth of *L. monocytogenes* during the shelf life of the product. However, a count of 10 CFU/g suggests that minimal growth occurred. Although not compliant with the microbiological limit in the Food Standards Code, these products were not recalled because by the time the result was received, both products were at the end of their shelf life. According to the risk assessment conducted by the WHO, a level of 10 CFU/g is unlikely to cause illness, even in susceptible consumers (FAO/WHO, 2004).

Table 1 shows the predicted growth of *L. monocytogenes* across the various RTE product categories, based solely on pH and water activity measurements. Despite the very small difference between the EU and Codex criteria, the more stringent criteria applied by Codex had the effect of predicting 24 more products would support the growth of *L. monocytogenes* than the criteria cited in EC No 1441/2007. The main differences were in the slow cured and uncooked fermented comminuted meat (UCFM) categories. This illustrates the potential difficulties associated with implementing an allowable level for *L. monocytogenes* in products that do not support the growth of the organism.

Table 1. Predicted growth of *L. monocytogenes* in RTE products based on pH and water activity

RTE meat product category	Number of samples	Based on Codex criteria		Based on EC criteria	
		Growth	No growth	Growth	No growth
Slow cured	72	27	45	19	53
Deli meat, ham	61	59	2	57	4
UCFM	56	19	37	8	48
RTE poultry	52	52		51	1
Deli meat, other	25	24	1	24	1
Cooked cured	14	14		14	
Dried cured	13	13		13	
Other	9	8	1	6	3
Bacon	1		1		1
Grand Total	**303**	**216**	**87**	**192**	**111**

Note: Products may include other factors such as preservatives, antimicrobials that may result in the product not supporting the growth of *L. monocytogenes*. This would be up to each business to validate.

In this survey, 72% (218/303) of samples tested were manufactured in NSW[3]. The results from this survey coupled with the results from the NSW Food Authority's microbiological verification program (that uses a more sensitive detection methodology) indicate a considerable effort on the part of manufacturers in controlling the level of *L. monocytogenes* in packaged RTE meats.

[3] A further 22% (68/303) of samples were manufactured in other states and 6% (17/303) samples were imported.

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Appendix 1. Reported foodborne illness outbreaks attributed to RTE meat caused by *L. monocytogenes* (1992–2012)

Year	Country	Food implicated	Cases (deaths)	Reference
2012	New Zealand	Salami, pepperoni rolls, hams	6 (3)	Anonymous, 2012
2010	USA	Hog head cheese (a meat jelly made from swine heads and feet)	14	Delaune et al., 2011
2009	Australia	Cooked, diced chicken	36 (3 foetal)	Stafford, 2010
2009	Australia	Salted chicken	7	Anonymous, 2009b
2008	Canada	Deli meats	80 (23)	Birk-Urovitz, 2011
2006–2008	Germany	Ready-to-eat scalded sausages	16 (5)	Winter et al., 2009
2005	Australia (SA)	Cold meats	(3)	OzFoodNet Working Group, 2005
2002	USA	Sliced turkey deli meat	54 (8)	Anonymous, 2002; Gottlieb et al., 2006
2000	USA	Deli meat	30 (4)	Olsen et al., 2005
2000	New Zealand	Corned silverside & ham	31	Sim et al., 2002
1992	France	Deli meat	279 (63)	Salvat et al., 1995

Appendix 2. RTE meat products that failed at the border due to *L. monocytogenes* detection (January 2010 to November 2012)[4]

Date	Product description	Country of origin
4/4/2012	Serrano ham	Spain
7/2/2012	Dry cured boneless Iberico ham	Spain
2/2/2012	Serrano ham	Spain
20/1/2012	Cured ham	Spain
18/3/2011	Parma ham	Italy
18/2/2011	Parma ham – sliced	Italy
29/9/2010	Boneless Parma ham	Italy
8/6/2010	Boneless Parma ham	Italy

[4] Obtained from AQIS failing food report (23 January 2013)

Appendix 3. Food recalls in Australia for RTE meat due to *L. monocytogenes* contamination (2004–2012)[5]

Year	Month	Products	Additional information
2012	October	Smoked wagyu beef	-
2012	October	Prager ham	-
2012	June	Sliced ham	-
2012	May	Chorizo	-
2011	June	Chorizo	-
2010	January	Danish salami	Plastic wrapped
2009	December	Kabana	vacuum sealed pack
2009	November	Leg ham portion	-
2009	September	BBQ seasoned chicken	Sliced
2009	September	A range of smallgoods	-
2009	August	Ham	Sliced
2009	June	Roast beef	Cryovac packets
2009	May	Silverside & boneless ham	-
2009	May	Pastrami	Sliced, cryovac packets
2009	May	Deli roast beef	Plastic packets
2009	March	Mortadella, pancetta, salami	Sliced
2008	September	Chicken breast	Sliced
2008	August	Roast beef, pastrami	Sliced
2008	July	Ham	-
2008	March	Smoked chicken	-
2008	March	Smoked ham	Sliced
2008	February	Cabanossi	-
2007	November	Pastrami	Plastic wrapped
2007	October	Ham & silverside	Sliced
2007	September	Corned silverside	
2007	September	Cooked beef	Sliced
2007	April	Chicken breast	Shaved
2007	April	Prosciutto & ham	Sliced
2007	March	Cacciatori	-
2006	September	Moroccan lamb	Sliced
2006	May	Smoked chicken	-
2006	January	Silverside	-
2005	September	A range of packaged meats	Sliced
2004	December	Cooked roast meat	-
2004	February	Brawn	Cryovac pack
2004	February	Ham	Sliced
2004	January	BBQ chicken	Shaved
2004	January	Leg ham	Sliced
2004	January	Roast beef	Sliced, plastic wrapped

[5] Data obtained on 22 January 2013

Appendix 4. Selected surveys on the level of *L. monocytogenes* in RTE meat

Year	Country	Sample	No of samples	Key findings	Reference
2009–2010	Australia (SA)	RTE meat (sliced, packaged)	13	- 1 (7.7%) sample was positive for *L. monocytogenes* at the level of less than 100 CFU/g.	Barber, 2010
2008	Australia (NSW)	RTE meat (sliced, packaged)	154	- 6 (3.9%) samples were positive for *L. monocytogenes.* - Enumeration was done on all samples and they were all less than 10 CFU/g.	NSW Food Authority, 2009a
2008–2009	UK	Cooked meat	1,321	- 29 (2.2%) samples were positive for *L. monocytogenes.* - Enumeration was done on all samples using direct plating method: 3 samples contained *L. monocytogenes* at the level between 20 to 60 CFU/g.	Meldrum et al., 2010
2007–2009	Italy	Salami (sliced, vacuum-packaged)	112	- 23 (20.5%) samples were positive for *L. monocytogenes* at the level of less than 100 CFU/g.	Di Pinto et al., 2010
2004	Ireland	Fermented meat	762	- All samples were less than 20 CFU/g.	FSAI, 2004
2004	Greece	RTE meat products (VP/MAP, sliced/cubed)	159	- 4 (2.5%) samples were positive for *L. monocytogenes* at the level of less than 10 CFU/g.	Angelidis & Koutsoumanis, 2006
2003–2005	Spain	Deli meat products (vacuum packed)	220	- 6 (2.7%) samples were positive for *L. monocytogenes.* - The positive samples were then enumerated: 4 samples were at the level of less than 10 CFU/g and 2 samples were at the level between 100 – 1000 CFU/g.	Garrido, Vitasa & Garcia-Jalóna, 2009

Year	Country	Sample	No of samples	Key findings	Reference
2003–2004	New Zealand	Ham (pre-packed)	104	- 1 (0.96%) sample was positive for *L. monocytogenes* at the level of 50 CFU/g.	Wong et al., 2005
2003	Ireland	Cooked ham (pre-packed)	615	- All samples were less than 20 CFU/g.	FSAI, 2003
2002–2003	Italy	Salami	1,020	- 232 (22.7) samples were positive for *L. monocytogenes.* - All samples were enumerated and they were all less than 10 CFU/g.	Gianfranceschi et al., 2006
2002	UK	RTE cold sliced meat	2,874	- 61 (2.1%) samples were positive for *L. monocytogenes.* 60 of them were at the level of less than 20 CFU/g and one sample was at the level of 3.4×10^4 CFU/g.	Elson et al., 2004
2000–2001	USA	Luncheon meats	9,199	- 82 (0.89%) samples were positive for *L. monocytogenes.* - All samples were enumerated and 8 samples were found to contain *L. monocytogenes* at the level of greater than 100 CFU/g.	Gombas et al., 2003
1998–2004	Spain	Pork luncheon meat, cooked ham, cooked turkey breast	48	- 7 (14.6%) samples were positive for *L. monocytogenes,* and all of them were at the level of between 10 and 100 CFU/g.	Cabedo, Picart-Barrot, & Teixido-Canelles, 2008
Unknown	Italy	Semidry fermented sausages (loose) & deli meats (vacuum packed)	50	- Ten (20%) samples were positive for *L. monocytogenes* at the level of less than 10 CFU/g.	Meloni et al., 2009

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