

RISK ANALYSIS

Rapid Risk Assessment of the Detection of *Listeria Monocytogenes* in Enoki Mushrooms

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FSA Research and Evidence

This rapid assessment has been requested to inform a decision by FSA Policy whether a temporary overarching risk management response to the commodity (enoki mushrooms) is necessary.

Cultivated enoki mushrooms are deprived of light and grown in a CO₂-rich environment. Commercially grown enoki mushrooms are grown in hard wood sawdust that is impregnated with the spores. The sawdust is usually good for four or five crops of mushrooms. The mushrooms are encouraged to grow long and thin by placing glass tubes over them. This produces a pale white mushroom with long, slender stems, up to five inches in length, and small caps. Whilst specific practices may vary, generally the initial growing environment is humid with a temperature between 22°C – 25°C, followed by lowering the temperature to 7°C – 12°C whilst maintaining humidity. It is this change in temperature that causes the mycelium to form fruiting bodies that grow into mature mushrooms which are harvested after about 90 days (Pereira et al., 2023).

The species *Flammulina filiformis*, known and sold in different regions as “enoki”/“enokitake” Japan, “jingu” (China), “futu” (India), “paengi beoseot” (Korea), “nám kim cham” (Vietnam) also grows wild throughout a broad natural range on the rotting wood of a range of common trees, although wild-growing mushrooms appear quite different. The majority of enoki mushrooms on sale appear to be commercially cultivated and fresh rather than wild mushrooms. It is unknown if wild enoki mushrooms present a similar *L. monocytogenes* risk to cultivated mushrooms.

Listeria spp., including *L. monocytogenes*, can be present in the soil (Linke et al., 2014), and are common in natural and urban environments (Orsi and Wiedmann, 2016). Contamination and proliferation is possible during cultivation but also during harvesting and packing (uncertainty).

1. Background

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2. Risk Question

What is the risk of listeriosis for all UK consumers from enoki mushrooms contaminated with *Listeria monocytogenes*, taking into consideration cross-contamination and the contamination levels indicated during recent surveys?

Risk assessment update includes:

- Sampling, NDNS and HMRC import data
- Available literature
- Cross contamination to other RTE products
- Risk associated with transport and storage
- Source of contamination
- Out-competition of *L. monocytogenes* by other *Listeria* species

Table 1. *L. monocytogenes* levels from border and retail samples of enoki mushrooms. Only samples that had enumeration levels are included in this table, and in Annex 2.

Enumeration of <i>L. monocytogenes</i>	Number of samples	Percentage (%)
Negative	72	55%
below 100 cfu/g	22	17%
100 – 1,000 cfu/g	17	13%
1,000 + cfu/g	19	15%

The data and literature included in this risk assessment are the most recent available as of December 2023. Please note, some information has not changed from version 1 of the risk assessment as no additional data were available.

3. Hazard identification

The hazard to be assessed is *Listeria monocytogenes*. *Listeria* detection and enumeration were performed on 130 samples of cultivated enoki mushrooms (*Flammulina filiformis*) at point of entry to the UK or on sale at retail, between 2021 and 2023. Fifty-eight of the 130 samples (45%) were positive for *L. monocytogenes*, and thirty-six samples (28% of the total) had levels above 100 cfu/g. Enumeration data are given in [Table 1](#) below and also in Annex 2. There are slight differences in the data sets used to inform version 1 and version 2 of the risk assessment. Data for version 1 reported that out of 50 samples, 50% were negative, 10% had below 100 cfu/g, 14% had 10 – 1,000 cfu/g and 26% had 1,000 + cfu/g levels of contamination.

The FSA has been made aware of a number of specific incidents concerning enoki mushrooms as a result of these sampling activities, including I-001-692; I-002-925; I-002-933; I-005-534; I-005-626; I-005-654; I-005-762; I-005-737; I-005-749; I-005-981; I-006-034; I-006-226; I-006-601; I-006-603; I-006-604; I-006-693; I-006-730 resulting in interim risk management advice to protect consumers. The interim advice was generic and proportionate and took into account the uncertainty of labelling instructions, handling and preparation by consumers and the heightened risk to vulnerable consumers.

Invasive listeriosis is a rare but serious foodborne disease. It is most likely in vulnerable groups including those who are immunocompromised, the elderly, pregnant women and unborn and newly delivered infants (FSA, 2016). Listeriosis in newborns is thought to be acquired from the mother or during delivery. Non-invasive listeriosis is usually self-limiting involving milder symptoms of gastroenteritis such as diarrhoea, fever, headache and myalgia, after a short period of incubation of a few days (WHO, 2018).

The majority of cases of human listeriosis appear to be sporadic, and foods associated with transmission are predominantly ready to eat (RTE), with extended (usually refrigerated) shelf-life that are capable of supporting growth of *L. monocytogenes* (ACMSF, 2009).

Species other than *L. monocytogenes* are not pathogenic to humans, with very rare exceptions; however, the detection of other *Listeria* species at high levels in a product shows that the conditions under which it has been produced, transported or stored are potentially sufficient for the growth of *L. monocytogenes* in the food if introduced, and should therefore be viewed with concern.

4. Exposure assessment

4.1. Serving size and yearly portions consumed

Enoki mushrooms are generally imported from China, South Korea, Thailand or Taiwan, based on sampling at borders.

Based on available HMRC data from November 2022 to October 2023, 107 consignments declared as 'enoki mushrooms' (5,803 kg) were imported from South Korea and 56 consignments declared as 'mushrooms' (7,509 kg) were imported from China. It is likely the true weights imported may differ as names included on customs entry paperwork may not state enoki mushrooms, as enoki mushrooms are used in different national cuisines under different names (**uncertainty**). Import data from other countries is not available (**uncertainty**).

Based on an estimated serving size of 50 g, and assuming shrinkage during cooking of 20%, that would be approximately 3 million UK (adult) servings a year. The serving size of 50 g is based on NDNS data¹ for cooked (generic)

¹ Bates, B.; Lennox, A.; Prentice, A.; Bates, C.; Page, P.; Nicholson, S.; Swan, G. (2014) National Diet and Nutrition Survey Results from Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/2012) Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310995/NDNS_Y1_to_4_UK_report.pdf

Bates, B.; Cox, L.; Nicholson, S.; Page, P.; Prentice, A.; Steer, T.; Swan, G. (2016) National Diet and Nutrition Survey Results from Years 5 and 6 (combined) of the Rolling Programme (2012/2013 – 2013/2014) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/551352/NDNS_Y5_6_UK_Main_Text.pdf

DH (2013). Diet and Nutrition Survey of Infants and Young Children (DNSIYC), 2011. Available at: <https://www.gov.uk/government/publications/diet-and-nutrition-survey-of-infants-and-young-children-2011>

Roberts, C.; Steer, T.; Maplethorpe, N.; Cox, L.; Meadows, S.; Page, P.; Nicholson, S.; Swan, G. (2018) National Diet and Nutrition Survey Results from Years 7 and 8 (combined) of the Rolling Programme (2014/2015 – 2015/2016) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/699241/NDNS_results_years_7_and_8.pdf

Table 2. Serving size of all dishes that were made 100% of mushrooms. Data for UK population taken from the NDNS and rounded to 2 significant figures. It includes meals at restaurants/takeaways. Vulnerable groups are highlighted in yellow.

Age group	Mean consumption per consumer (g/person)	97.5th Percentile (g/person)	Maximum consumption (g)	% consumers eating mushrooms
4-18 months	12	50	73	16%
Toddlers (1.5-3yrs)	14	45	80	17%
4 - 10 yrs	21	66	130	13%
11 - 18 yrs	36	100	180	16%
19 - 64 yrs	49	140	300	27%
16-49 (Women)	45	140	300	26%
65 + yrs	45	120	200	26%

Table 3. Population levels based on [ONS data for mid-2021 estimates](#), and corresponding calculations for estimated enoki servings. Women aged 16-49 are used as a proxy for childbearing women. Vulnerable groups are highlighted in yellow.

Age group	Population	Percentage population	Estimated servings
<1 yr	675,477	1%	-
1-3 yrs	2,153,586	3%	-
4-10 yrs	5,507,632	8%	-
11-18 yrs	6,250,753	9%	-
19-64 yrs	39,901,813	60%	1,797,911
65+	12,537,031	19%	564,898
16-49 women	14,699,711	22%	662,345
Total	67,026,292		

mushrooms for the majority of the population (see [Table 2](#)) and is comparable to the serving size observed in online recipes for enoki mushrooms. Consumption levels in the general population (19-64) are comparable to consumption levels in women of child-bearing age (used as proxy for pregnant women) and those over 65.

UK population estimates are given in [Table 3](#).

The portion size is likely to be smaller if the enoki mushrooms are used as a component in a dish, such as a stir fry, or as raw garnish in a salad.

Bates, B.; Collins, D.; Jones, K.; Page, P.; Roberts, C.; Steer, T.; Swan, G. (2020) National Diet and Nutrition Survey Results from years 9, 10 and 11 (combined) of the Rolling Programme (2016/2017 to 2018/2019) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943114/NDNS_UK_Y9-11_report.pdf

We therefore assume that a typical consumer will eat 50 g and a vulnerable consumer will eat 50 g of enoki per serving. There is relatively low variability in portion sizes, and this is therefore unlikely to be the most significant source of variability in exposure.

4.2. *L. monocytogenes* growth and survival in enoki

L. monocytogenes can grow under both aerobic and anaerobic conditions. There are three main controlling conditions under which RTE foods do not support the growth of *L. monocytogenes*:

1. $\text{pH} \leq 4.2$;
2. $a_w \leq 0.92$; and
3. $\text{pH} \leq 5.0$ and $a_w \leq 0.94$.

There are other factors such as the inclusion of preservatives that are also capable of controlling the growth of *Listeria*, however it is unclear, but appears unlikely that factors such as this are used in the production of enoki mushrooms.

It is not clear whether high levels of *L. monocytogenes* develop during cultivation of enoki mushrooms or after harvesting and packing (**uncertainty**). However, mushrooms (including enoki mushrooms) have been shown to allow survival and growth of certain strains of *L. monocytogenes*, including in modified atmosphere packaging (Fay, Salazar, George, et al., 2023; González-Fandos et al., 2001; Salazar et al., 2017). It is difficult to predict the growth of the pathogen in specific batches of enoki mushrooms, as variable intrinsic and extrinsic factors are likely to contribute to growth, such as temperature, a_w value, storage material, and influence of other microorganisms (**uncertainty**). It has also been shown that there is no significant difference ($P > 0.05$) in levels of *L. monocytogenes* if affected enoki mushrooms are either dipped or rinsed under running water (Chung et al., 2023).

Of 71 samples taken at the border where storage information was recorded, 10 (14%) were stored at ambient temperature and 61 (86%) were stored chilled. *Listeria* spp. are able to grow at temperatures ranging from 0- 45 °C (Walker et al., 1990). In general, the higher the temperature, the faster the growth. No/limited growth of *L. monocytogenes* was observed in enoki mushrooms at refrigeration temperatures (≤ 5 °C), moderate growth was observed at 10°C (increasing by 1 log in 3.5 days) and a higher growth rate was observed when stored at 25°C (increasing by 1 log in just 0.76 days

(18.2 hours)) (Fay, Salazar, George, et al., 2023). These observations raise a concern for enoki mushrooms transported and/or stored at ambient temperatures.

Two studies were found assessing the effects of dehydration on *L. monocytogenes* populations on enoki mushrooms. Although not directly comparable as protocols varied, one study by Salazar et al., 2023 achieved pathogen reduction of >4 log CFU/g using 90°C for dehydration where *L. monocytogenes* was inoculated prior to dehydration, whereas no decrease was observed in enoki mushrooms by Fay, Salazar, Chavda, et al., 2023 when inoculating the mushrooms followed dehydration at 60°C. The study by Fay, Salazar, Chavda, et al., 2023 showed that *L. monocytogenes* can survive but not grow on dehydrated mushrooms (using 60°C heating) when inoculating dehydrated mushrooms with a very low a_w of 0.238. If drying conditions used in commercial practice also reduce the a_w to similar levels (uncertainty) then no growth may be expected in dehydrated enoki mushrooms. The same study also shows the extended periods over which *L. monocytogenes* can survive if growth occurs prior to dehydration. It does, however, suggest that the dehydration strategy (time and temperature combination) could be an intervention step but would need to be validated and verified as a critical control point (CCP).

It is well documented that *L. monocytogenes* is a concern in RTE foods due largely to its ability to survive and grow at low temperatures, low pH and high salinity, allowing it to out-compete other organisms in these less favourable conditions (Townsend et al., 2021). A study by Heir et al., 2018 investigated the interactions and competition between *L. monocytogenes* and other bacteria found in food processing environments, including *L. innocua* in biofilms on stainless steel. Overall, the study showed that different strains of *L. monocytogenes* have differing abilities to grow and compete in mixed cultures (strong and weak competitors). The study also identified the inhibition of certain *L. monocytogenes* strains by *L. innocua*. These findings were also demonstrated by Gnanou Besse et al., 2005 and Cornu et al., 2002 when analysing the interactions between *Listeria* spp. and *L. monocytogenes* in enrichment broth. In conclusion, the results indicate the inhibition of *L. monocytogenes* is a complex pattern of bacterial interactions with large variation in the competitiveness among *L. monocytogenes* strains. It must be noted that competition within a food matrix likely varies between matrices as well as differences in growth rates between strains and the production of inhibitors. Therefore, it is difficult to determine whether out-competition of *L. monocytogenes* could be considered a possibility (uncertainty).

Depending on the conditions of transportation and storage and specific properties of the product, from the point of sampling to the point of consumption, there may be no growth or a significant amount of growth ($>3 \log_{10}$ CFU/g).

4.3. Enoki mushroom recipes

If enoki are cooked prior to consumption, previously published studies in homogenates of meat and vegetables have shown that [70°C for 2 minutes](#) or equivalent is sufficient to deliver in excess of a 6 log reduction in *Listeria monocytogenes* (Gaze et al., 1989). Thermal processing using hot water or steam blanching, as often mentioned in online recipes (for e.g. [Enoki Mushrooms with Garlic & Scallion Sauce – The Woks of Life](#)) has been shown to deliver in excess of a 5-log reduction in levels of *Listeria monocytogenes* on a variety of vegetables although this varies according to heating method and time (Ceylan et al., 2017). Cooking or blanching enoki mushrooms is likely to significantly reduce and, in most cases, eliminate *L. monocytogenes*.

The most significant unknown in this risk assessment is the percentage of meals containing raw or partially cooked enoki mushrooms that are consumed (**uncertainty**). This could include meals where raw enoki mushrooms are used as an ingredient or as a garnish.

Based on the NDNS data for recipes containing 100% mushrooms, all consumers reported eating mushrooms that were canned, stewed or grilled – one reported eating raw mushrooms. It is **unknown** if this is correct, or a typo from the consumer). This is less than 0.01% of consumers.

Based on the hits on the first 2 pages of a Google search for “enoki mushroom salad recipe”, 3 out of 17 recipes used raw enoki mushrooms.

An FDA publication reporting the details of a listeriosis outbreak linked to enoki mushrooms stated that while enoki are typically consumed cooked in Korean cuisine, in the U.S. and Canada, enoki mushrooms may be consumed uncooked in salads, sandwiches, and as a garnish on a variety of dishes (Pereira et al., 2023 and personal communication from FDA, 2023).

It is difficult to conclude what percentage of enoki mushrooms are eaten without cooking in the UK.

4.4. Cross contamination

The risk associated with cross contamination from contaminated enoki mushrooms to other RTE foods in the home or restaurant settings remains a challenge and no data specifically referring to enoki mushrooms was found regarding this pathway. One study by Zhang et al., 2022 undertook

a quantitative exposure assessment of *L. monocytogenes* cross contamination from raw to RTE meat (ham) under different food handling scenarios, including different bacterial concentrations, chopping board materials and chopping board cleaning methods. The results indicated that the transfer rate from raw pork to chopping board, and from chopping board to ham declined gradually as the water temperature used to clean the boards increased. It also showed that cross contamination was avoided when chopping boards contaminated with high levels (6 log CFU/g) of *L. monocytogenes* were cleaned with water at 70°C and 50°C when contaminated with low levels of *L. monocytogenes* (3 log CFU/g). When chopping boards were not cleaned, contamination levels of *L. monocytogenes* that were transferred to ham were 1.84 log CFU/g from wood, 1.76 log CFU/g from plastic and 1.74 log CFU/g from stainless steel.

Pereira et al., 2023 noted that even though some people who became ill in the 2016-2020 US and Canada outbreak may not have accurately recalled eating enoki mushrooms if they were served as a garnish, they could not rule out the possibility of people not eating enoki mushrooms but being exposed to *L. monocytogenes* via cross contamination.

In conclusion, it is difficult to determine the risk via cross contamination of affected enoki mushrooms to other RTE foods, however it is a possibility.

5. Hazard characterisation

5.1. Symptoms

Invasive listeriosis is relatively rare in comparison to foodborne illnesses caused by other pathogens but is a serious disease with high fatality rates (20-30%) compared with other foodborne pathogens. This illness mainly affects vulnerable groups such as those over 65, those with underlying medical conditions (e.g. immunosuppression, HIV/AIDS and chronic conditions such as cirrhosis and diabetes that impair the immune system), infants and pregnant women (and their unborn child). Levels of miscarriage and stillbirth are around 30% and an *L. monocytogenes* infection can be asymptomatic in the mother.

L. monocytogenes infection has a long incubation time, and it can take up to 90 days for the onset of listeriosis or development of symptoms, but in some cases, symptoms can appear after only a few days (Goulet et al., 2013). Following hospitalisation from invasive listeriosis, significant risk factors for mortality include solid-organ malignancy, cardiovascular disease, liver disease, and immunosuppression, and the risk also increases significantly with age (Scobie et al., 2019).

Non-invasive listeriosis has milder symptoms of gastroenteritis such as diarrhoea, fever, headache and myalgia, after a short period of incubation of a few days (WHO, 2018). These outbreaks generally involve the ingestion of high doses of *L. monocytogenes* by otherwise healthy individuals.

5.2. Infectious dose

The infectious dose is reported to vary hugely for the vulnerable and non-vulnerable populations (EFSA, 2018). Levels under 100 CFU/g in food at point of consumption (i.e. the legal limit at the end of shelf life) are regarded as safe for the general population, meaning that people consuming foods with low levels of *L. monocytogenes* have an extremely low risk of contracting listeriosis (approximately 55 million servings of RTE meat and meat products contaminated with more than 100 CFU/g may be consumed by the ≥ 75 age group per year in the EU/EEA, as modelled by EFSA, 2018). Nevertheless, as with all disease-causing microorganisms, there is no threshold below which there is a true “zero” risk for human illness.

An observation from an outbreak connected to contaminated ice cream estimated that hospital patients had 10,000 CFU per serving (Buchanan et al., 2017). Quantitative modelling by EFSA, 2018 suggests that more than 90% of invasive listeriosis is caused by ingestion of RTE food containing more than 2,000 CFU/g, using an average serving size of 50 g, and that one-third of cases are due to growth in the consumer-owned phase.

Non-invasive listeriosis is associated with an intake of high levels of *L. monocytogenes* ($>1,000,000$ CFU/g) (Drevets & Bronze, 2008).

5.3. Outbreaks

Previous outbreaks of *L. monocytogenes* have directly implicated enoki mushrooms. The first known listeriosis outbreak linked to enoki in the USA and Canada occurred between 2016 and 2020 and had 48 confirmed cases, 37 hospitalisations and 4 deaths (Pereira et al., 2023). 7 of the cases (25%) were pregnancy-associated. The level of contamination for the enoki mushrooms ranged from <10 to 8.0×10^5 CFU/g.

There are other reported outbreaks linked to listeriosis:

- 6 cases in Australia linked to the US/Canada outbreak strain - [L. monocytogenes and imported fresh enoki mushrooms. Cases were notified between October 2017 and March 2020](#) (FSA, 2023)
- 5 cases of illness in the US between October 2022 to February 2023 - [Listeria Outbreak Linked to Enoki Mushrooms](#) (CDC, 2023)

Table 4. Risk levels according to different sub populations when consuming enoki mushrooms raw.

	Probability of illness	Severity	Uncertainty
Non-vulnerable groups	Low	Low	Medium
65+	Medium	High	Medium
Immunocompromised groups	Medium	High	Medium
Pregnant women	Medium	High	Medium

There are no documented outbreaks of listeriosis related to mushroom in the UK.

6. Risk characterisation

The risk of listeriosis associated with the consumption of enoki mushrooms by both vulnerable and non-vulnerable groups is **negligible** if they are sufficiently cooked (**low uncertainty**). At temperatures significantly higher than 70°C, such as those likely to occur during stir-frying or use in stews and soups, elimination will occur after a relatively short cooking time.

Although there is small variation in the dataset between version 1 (August 2023) and version 2 (Dec 2023) of this risk assessment, based on sampling at borders/retail, a large percentage of fresh enoki, imported from various countries, are highly contaminated (1,000 cfu/g +) with *L. monocytogenes*. It is likely that the way these products are grown, the environmental conditions etc., are very conducive for *Listeria* spp. contamination growth and survival. Although it is not completely clear whether all enoki products sampled in the UK were fresh or dried (**uncertainty**), based on photographs, the majority of enoki mushrooms appear to be sold as fresh, however *Listeria* presence is also possible on dried enoki mushrooms as supported by investigations by the FDA.

A small **unknown** percentage of consumers may eat enoki mushrooms raw, for example in salads or as a garnish. In these instances, the risks are set out in [Table 4](#). Definitions of risk level can be found in Annex 1.

The risk associated with each consumer group from the cross-contamination of contaminated enoki mushrooms to other RTE foods remains a challenge as there is a lack of data for this pathway, however it is considered a possibility.

7. Uncertainties

- The percentage of vulnerable consumers eating enoki mushrooms raw
- Cases of listeriosis as a result of cross contamination to other RTE foods.

- Source of contamination and proliferation of *L. monocytogenes* in enoki mushrooms.
- Drying protocols for dehydrated enoki mushrooms
- Out-competition of *L. monocytogenes* by other *Listeria* spp. in enoki mushrooms



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Annexes

Annex 1

Interpretation of probability categories used in this risk assessment

Probability category	Interpretation
Negligible	So rare that it does not merit to be considered
Very low	Very rare but cannot be excluded
Low	Rare, but does occur
Medium	Occurs regularly
High	Occurs very often
Very high	Events occur almost certainly

Table from [ACMSF \(ACM/1065\)](#) adapted from EFSA 2006 modified from OIE 2004.

Qualitative categories for expressing uncertainty in relation to qualitative risk estimates

Uncertainty category	Interpretation
Low	There are solid and complete data available; strong evidence is provided in multiple references; authors report similar conclusions
Medium	There are some but no complete data available; evidence is provided in a small number of references; authors report conclusions that vary from one another
High	There are scarce or no data available; evidence is not provided in references but rather in unpublished reports or based on observations, or personal communication; authors report conclusions that vary considerably between them

Table from [ACMSF \(ACM/1065\)](#) adapted from EFSA 2006.

Annex 2

Listeria spp. enumeration data

Table 5. Enumeration data for enoki samples contaminated with *Listeria* spp. in 2021-2023.

Incident reference number	Sampling at	<i>L. monocytogenes</i> detected?	<i>L. monocytogenes</i> levels (cfu/g)	<i>Listeria</i> spp. detected?	Total <i>Listeria</i> levels (cfu/g)
I-001-692	Border	Y	4,000,000	Y	4,300,000
		Y	1,000,000	Y	1,000,000
		Y	8,000	Y	11,000
		Y	3,000	Y	7,900,000
		Y	720,000	Y	720,000
I-002-925	Border	Y	1,100	Y	1,100
		N	<20	Y	2,000
		N	<20	Y	<20
		N	<20	Y	>3000
		N	<20	Y	>3000
		Y	>3000	Y	>3000

Incident reference number	Sampling at	<i>L. monocytogenes</i> detected?	<i>L. monocytogenes</i> levels (cfu/g)	<i>Listeria</i> spp. detected?	Total <i>Listeria</i> levels (cfu/g)
		Y	<20	Y	1,300
		Y	100	Y	320
		N	<20	Y	>3000
		Y	320	Y	>3000
		Y	500	Y	500
		Y	20	Y	>1500
		Y	4,000	N	200,000
		Y	140	Y	7,600
		Y	200	Y	28,000
		Y	36,000	N	>300000
		Y	50,000	N	52,000
		Y	2,900	Y	80
	Retail	Y	16,000	Y	19,000
		Y	120	Y	120
		N	<20	N	<20
		N	<20	N	<20
		N	<20	N	<20
		Y	500,000	Y	1,000,000
		Y	1,100	Y	1,100
		N	<20	Y	200,000
		N	<20	Y	<20
		N	<20	Y	3,000
		N	<20	Y	3,000
		Y	3,000	Y	3,000
		Y	<20	Y	1,300
		Y	100	Y	320
		N	<20	Y	3,000
		Y	320	Y	3,000
		N	<20	Y	24,000
		N	<20	Y	60
		Y	500	N	500
		N	<20	Y	1,400
		Y	20	Y	>150
		Y	4,000	N	4,000
		Y	140	Y	7,600
		Y	200	Y	28,000
		N	<20	Y	58,000
		N	<20	Y	300,000
		Y	36,000	Not stated	>3000000
		Y	50,000	Not stated	52,000
		N	<20	Y	4,600

Incident reference number	Sampling at	<i>L. monocytogenes</i> detected?	<i>L. monocytogenes</i> levels (cfu/g)	<i>Listeria</i> spp. detected?	Total <i>Listeria</i> levels (cfu/g)
		Y	80	Y	2,900
		N	<20	Y	58,000
I-002-933	Retail	N	<10	Y	>3000
		N	<10	Y	<10
		N	<10	Y	210
		N	<10	Y	>3000
		N	<10	Y	30
		N	<10	Y	1340
		N	<10	Y	>3000
		N	<10	Y	>3000
		N	<10	Y	200
		N	<10	Y	>3000
		N	<10	Y	<10
I-005-534	Border	Y	600	N	600
		Y	<20	Y	600
I-005-626	Border	Y	<20	N	<20
		Y	<20	N	<20
		Y	240	N	240
		N	<20	Y	3000
		N	<20	Y	<20
		Y	3000	N	3000
		Y	40	N	40
		N	<20	Y	<20
I-005-654	Border	Y	600	Y	1000
		N	<20	Y	<20
		N	<20	Y	<20
		Y	<20	Y	<20
		Y	<20	Y	600
		N	<20	N	<20
		N	<20	N	<20
		N	<20	Y	240
		Y	<20	Y	<20
		N	<20	Y	>3000
I-005-737	Border	Y	<20	N	
		Y	<20	N	
		Y	900	Y	1900
I-005-749	Border	Y	20	Y	20
		N	<20	Y	<20
		N	<20	Y	<20
		Y	<20	Y	<20
		Y	<20	N	<20
I-005-762	Border	N	<20	Y	220

Incident reference number	Sampling at	<i>L. monocytogenes</i> detected?	<i>L. monocytogenes</i> levels (cfu/g)	<i>Listeria</i> spp. detected?	Total <i>Listeria</i> levels (cfu/g)
I-005-981	Border	Y	<20	Y	20
		Y	140	Y	840
		Y	<20	Y	<20
		N	<20	Y	<20
		N	<20	Y	<20
I-006-034	Border	N	<20	Y	<20
		Y	<20	Y	<20
		N	<20	Y	<20
		N	<20	Y	<20
I-006-226	Retail	N	<20	Y	44,000
		N	<20	Y	1,500
I-006-601	Border	N	<20	Y	<20
		N	<20	Y	<20
		N	<20	Y	2100
		N	<20	Y	<20
		N	<20	N	<20
I-006-603	Border	Y	<20	Y	<20
		N	<20	Y	960
		N	<20	Y	140000
		N	<20	Y	<20
		N	<20	Y	>3000
		N	<20	Y	2200
I-006-604	Border	N	<20	N	<20
		N	<20	N	<20
		N	<20	N	<20
		Y	<20	N	<20
		N	<20	N	<20
I-006-693	Border	N	<20	Y	<20
		N	<20	Y	<20
		N	<20	Y	<20
		Y	480	N	480
		N	<20	N	<20
I-006-730	Border	N	<20	Y	120
		N	<20	Y	<20
		N	<20	Y	<20
		N	<20	Y	<20

Because this assessment was completed at pace it was not possible to cross-reference all available data on incidents and outbreaks reported to the FSA. This is necessarily therefore an incomplete list and may contain mistakes or double entries. A complete review of available data will be performed as part of the full RA when commissioned