

ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD**Relative risk ranking of ready-to-eat foods for vulnerable groups****Introduction**

1. The FSA has a strategic plan priority to reduce foodborne disease using a targeted approach, tackling the pathogens that cause the largest number of cases and severest illness such as *Campylobacter* in chicken, and *L.monocytogenes* in Ready-To-Eat (RTE) chilled foods (e.g. soft mould-ripened cheeses, pâtés, smoked fish, cooked sliced meat, sandwiches etc.). Although listeriosis is relatively rare, it is the most common cause of death from foodborne illness in the UK (CSAR 2012).
2. Although the decline in the number of UK laboratory-confirmed cases of *L.monocytogenes* infection has continued in recent years (from 254 in 2007 to 183 in 2012), the numbers remain elevated (around 38%) above those observed in 2000 (114 cases)¹. Public Health England (PHE) reported a rise in cases in England and Wales in 2012 (from 148 in 2011 to 165 in 2012²). Paper ACM/1135 provides more information on trends including 2013 data to week 50.
3. An FSA internal analysis of data from the PHE, the Advisory Committee on the Microbiological Safety of Food (ACMSF) and the Office of National Statistics (ONS) concluded in 2010 that although pregnant women remain the most vulnerable group, due to the risk to their unborn child/ren, their listeriosis case rate remains stable and the greatest increase in cases has been largely in the older population (>60 years) particularly those in this age group who have underlying conditions and/or are taking particular medication(s) (ACMSF 2007). More recently, Mook et al. (2010) have reported the emergence of pregnancy-related listeriosis amongst ethnic minorities in England and Wales.
4. The FSA's *Listeria* Risk Management Programme aims to reduce the risk of vulnerable consumers contracting listeriosis by raising awareness of the basic hygiene steps to control their exposure to *L.monocytogenes* via RTE foods and to inform them and their carers of alternative lower risk food choices or preparation methods.
5. The *Listeria* Risk Management Programme comprises three primary work streams (see diagram in Annex 1)
 - **Consumer** focused activities targeting key vulnerable groups of the UK population, promoting awareness of the risk of listeriosis and behaviours and actions that can help prevent the disease;
 - **Procurement/provision of food** focused activities to ensure that the risk of listeriosis is taken into consideration as part of public food procurement and

¹ This increase is only partly explained by the increase in the overall UK population as the number of cases per million of population rose by 32% over the same period

² <http://www.hpa.org.uk/hpr/news/default.htm#str12>

food safety management processes in settings in which vulnerable people are cared for in the UK;

- **Industry compliance/enforcement** focused activities to improve compliance of high-risk food industry sectors with existing legal requirements for *L. monocytogenes* in foods and ensure robust and consistent enforcement in this area.

Consumer advice

6. As part of the *Listeria* consumer work stream the FSA is in the process of revising the current advice for vulnerable consumers. There are plans to publish on the NHS Choices website a revised list of foods to avoid, and recommend alternative lower risk food choices or serving methods (e.g. heated). *Listeria monocytogenes* has been isolated from a wide range of RTE foods and some of these food types have been linked to outbreaks of listeriosis in the UK and elsewhere. Before a revised list of foods is published it is important that there is a clear justification for their inclusion on the list. This needs to be based on robust evidence concerning the risk posed by such foods for vulnerable groups such as pregnant women and the elderly (over 60 years of age). The purpose of the revised list is to reduce the exposure of vulnerable groups to *Listeria monocytogenes* at the point of consumption. This together with the work being taken forward in other works streams should contribute towards reducing the number of cases of listeriosis in the UK.

Approach

7. Because *Listeria monocytogenes* occurs in a wide range of RTE foods, an approach was needed which would enable the risks posed by these foods to be prioritised. In the USA a comprehensive risk assessment for *L.monocytogenes* in RTE foods has been undertaken (FDA 2003) and enables different categories of RTE foods to be ranked in terms of their relative risk rankings, along with the corresponding risk estimates in terms of the predicted number of listeriosis cases per serving and per annum in the USA. We do not have a comprehensive quantitative risk assessment for listeriosis and all RTE foods in the UK although some work has been done looking at the risk associated with specific RTE food groups; cooked meats and poultry and cheeses (Banks 2005; Jewell and Voysey 2005). Other approaches have or can be used to rank hazards and risks such as FDA-iRISK (Chen *et al.* 2013) disease attribution (Batz *et al.* 2012) and a multifactorial risk prioritisation framework (Ruzante *et al.* 2010). EFSA (2012) recently published a scientific opinion on the development of a risk ranking framework on biological hazards using 14 examples based on opinions developed by the EFSA Biohaz panel. The aim was to identify which risk ranking tools should be used in future risk assessments and to analyse the strengths and weaknesses of different approaches. Further work is currently being undertaken to develop a risk ranking toolbox for future risk assessment work.
8. The approach taken in this paper was to compare the findings from a listeriosis food attribution study in the UK (Little *et al.* 2010) with data on *Listeria monocytogenes* contamination of foodstuffs from surveys, *Listeria* incidents reported to the FSA and general outbreaks of listeriosis reported in the UK. There are numerous caveats associated with this approach including the different purposes and timeframes over

which the data was collected and the use of a wide range of different food descriptors which vary between studies.

Application of a source attribution model for listeriosis

9. Source attribution is a technique used to apportion foodborne disease into the most important sources and can be a useful approach in support of risk management activities. The Hald Bayesian source attribution model (Hald *et al* 2004) has been used to attribute human salmonellosis cases in Denmark and other countries (Mullner *et al.* 2009; Guo *et al.* 2011) and the approach was adapted by Little *et al* (2010) to examine sources of human listeriosis in England and Wales between 2004 and 2007. The study compared the number of human sporadic cases of listeriosis caused by different *L.monocytogenes* subtypes (serological and AFLP) with the prevalence of the subtypes in isolates from 13 different food groups. The food groups were specific (e.g. beef) or complex. Multicomponent foods for example included pre-packed sandwiches and pre-packed vegetable salads; the category “other foods” were for example desserts and cooked rice. Other meat products were pates, chopped livers and fermented meats.

Food surveillance data, incidents reported to the FSA and general outbreaks of listeriosis

10. The second approach involved collating data on surveys of foodstuffs for *Listeria monocytogenes* (2004-2011), incidents involving *L.monocytogenes* reported to the FSA (2005-2012) and general outbreaks of listeriosis in the UK (2002-2013). The different food categories were then ranked according to prevalence of contamination, number of incidents and number of outbreaks to provide an indication of the relative importance of different food sources in each of these data sets. The food categories used were initially based on the categorisation system used by the FSA to analyse information from incidents. They have been captured using relatively broad headings due to the variety of foods involved and differences in the categorisation systems used in the various information sources. The cheese categories were determined by the categorisation system used by FSA to analyse information from incidents. It was difficult to categorise data on cheeses from surveys and from the UK Food Surveillance System (UKFSS*) as details were often lacking on the type of cheese sampled other than pasteurised or unpasteurised or species type (cow, goat etc). The category of ‘pre-prepared sandwiches’ refers to products consisting of a variety of fillings encased in bread. Such composite or multicomponent foods could include ready-to eat meats and poultry, salad, cheese, fish jam etc., unsliced and sliced bread, butter or margarine and it was difficult to drill further into this information.
11. For the various food types some data may be represented more than once across the columns in Table 1 due to potential associations between the different information sources. For example, a survey sample in which *L. monocytogenes* was detected at a level greater than the legal limit may have also been logged as an incident. Prepared foods are RTE but may also include sandwiches.

*<http://www.food.gov.uk/enforcement/monitoring/fss/>

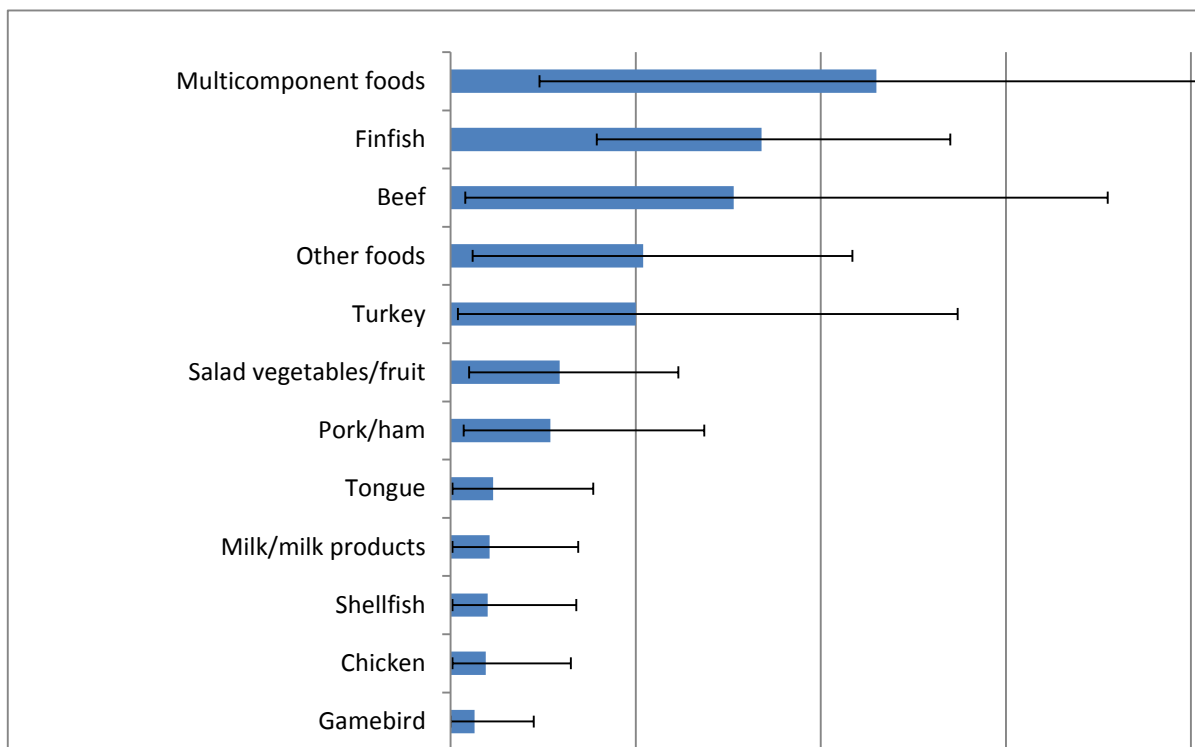
12. Multi-component foods such as sandwiches and mixed salads are foods with generally a short shelf life but can contain foods with a longer shelf life, such as deli meats.

Findings

Ranking of foods based on source attribution

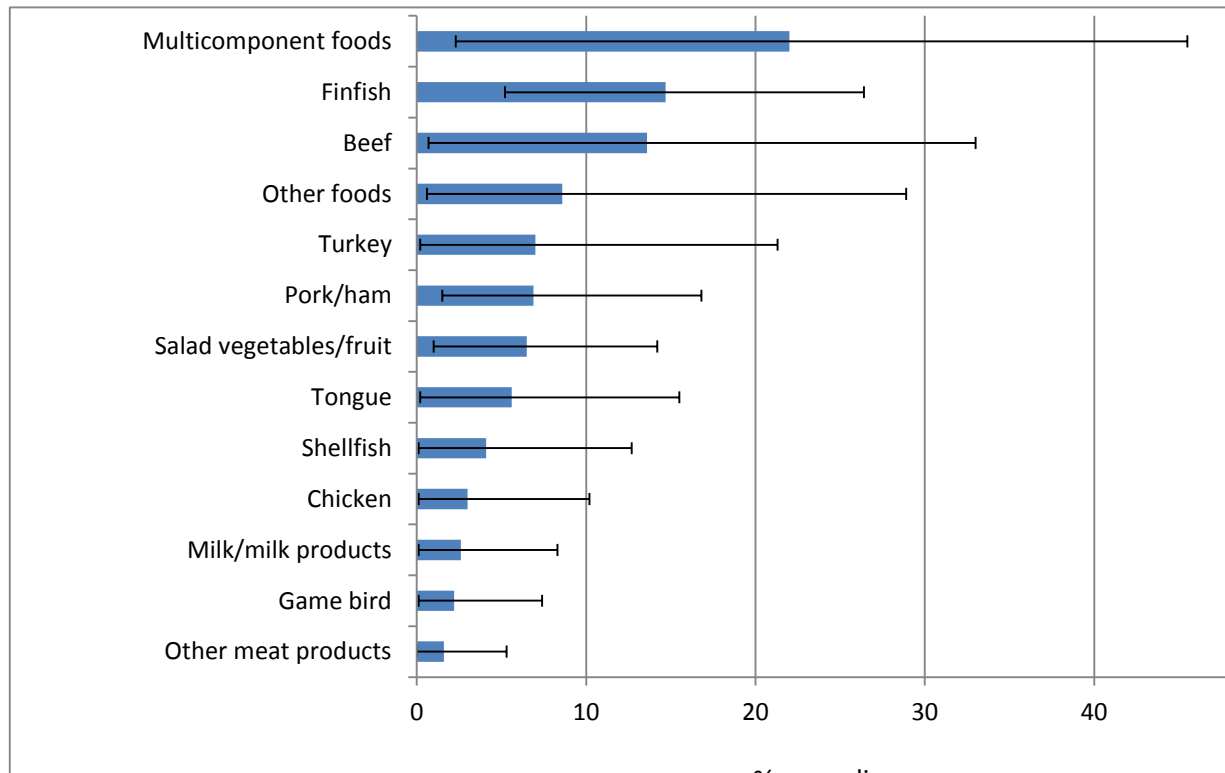
13. Figures 1-3 show the results of applying the modified Hald model to estimate the major ready-to-eat food sources for the overall population, elderly (>60 years of age) and pregnancy-associated cases of human listeriosis in England and Wales 2004-2007 respectively. For the overall population multicomponent foods, finfish, beef and other foods each accounted for more than 10% of sporadic cases. For the elderly multicomponent foods, finfish and beef were each estimated to account for more than 10% of cases. For pregnancy associated cases the foods contributing to more than 10% of cases were other foods (desserts and cooked rice), beef, finfish and milk and milk products. In most cases the 95% Bayesian credibility intervals were wide, reflecting in part the small number of cases included in the analysis particularly for pregnancy associated cases (Figure 3).

Figure 1. Estimated major ready-to-eat food sources* for overall population cases of human listeriosis in England and Wales 2004-2007 (n=564). Estimated rank order based on the percentage of sporadic cases. Error bars are the 95% Bayesian Credibility Intervals. Adapted from Little *et al.* (2010).



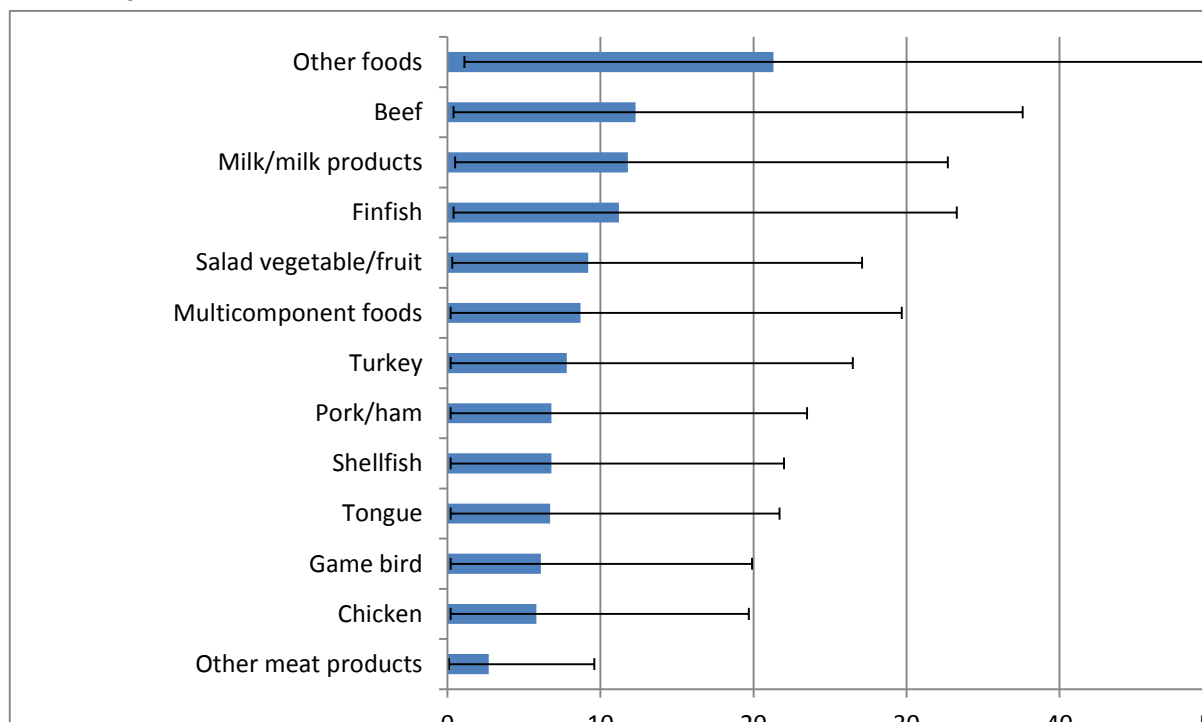
* cases attributed to unknown sources are not show

Figure 2. Estimated major ready-to-eat food sources* for elderly (>60 years old) associated cases of human listeriosis in England and Wales 2004-2007 (n=381). Estimated rank order based on the percentage of sporadic cases. Error bars are the 95% Bayesian Credibility Intervals. Adapted from Little *et al.* (2010).



* cases attributed to unknown sources are not show

Figure 3. Estimated major ready-to-eat food sources* for pregnancy-associated cases of human listeriosis in England and Wales 2004-2007 (n=70). Estimated rank order based on the percentage of sporadic cases. Error bars are the 95% Bayesian Credibility Intervals. Adapted from Little *et al.* (2010).



* cases attributed to unknown sources are not show

14. Table 1 shows the estimated % of sporadic cases of listeriosis in England and Wales 2004-2007 by the major food categories. Aggregating the data in this way highlights the important contribution of RTE meats for sporadic listeriosis in all population groups. The distribution of pregnancy and elderly associated food sources for sporadic listeriosis are different with a higher proportion of multicomponent foods and fish and shellfish as sources in the elderly whereas with pregnancy associated cases, milk and milk products and salad vegetables/fruits appear to be more important. In rank order RTE meats, multicomponent foods and fish and shellfish account for 79.1% of sporadic cases in the elderly and RTE meats, other foods and dairy products account for 78.6 % of sporadic pregnancy-associated cases. It would be interesting to extend the attribution study to subsequent years as this would increase the number of cases in the analysis and may indicate whether the food sources of listeriosis and/or their rank order have remained the same in more recent years.

Table 1. Estimated % of sporadic cases of listeriosis in England and Wales 2004-2007 grouped according to major RTE food categories. (Data derived from Little *et al.* 2010).

Population Group	Meats*	Multicomponent+	Other foods#	Fish and Shellfish	Milk and milk products	Salad vegetables/fruits
Overall	36.2	23	10.4	18.8	2.1	5.9
Pregnancy	45.5	8.7	21.3	8.0	11.8	9.2
Elderly	38.3	22	8.6	18.8	2.6	6.5

* Beef, pork/ham, tongue, chicken, turkey, game bird

Desserts and cooked rice

+ Pre-packed sandwiches and pre-packed vegetable salads

Ranking based on food surveillance data, incidents reported to the FSA and general outbreaks of listeriosis

15. Table 2 is based on food surveillance data (2004 to 2011), data on incidents reported to the FSA (2005 to 2012) and number of general outbreaks (2002-2013). Food categories were separately ranked based on food surveillance, reported incidents and number of outbreaks and given a rank score with 1 indicating the highest prevalence, number of incidents or number of outbreaks. The prevalence rank, incidents rank and outbreaks rank were then compared. For each food category, an overall (dominant) rank was assigned based on the highest rank achieved across these three sources of data.

16. For example, smoked fish was the food category with the highest prevalence of *Listeria monocytogenes* in surveillance studies and was ranked 1 in this category. For incidents reported to the FSA, smoked fish was given an incident ranking of 5. As there were no reported outbreaks and the surveillance rank was highest, smoked fish has been given a rank of 1. Pre-packed cold RTE meats and poultry was the food category with the highest number of incidents reported to the FSA (ranked 1), a

prevalence rank of 12 and an outbreak rank of 2. This food category was therefore also assigned an overall (dominant) rank of 1.

Table 2 – Ranking of food categories* based on food contamination, incidents reported to the FSA and general outbreaks involving *Listeria monocytogenes* in the UK.

Food Type	Food Prevalence+	No of Incidents	No. general Outbreaks	Food Prevalence Rank	No. of Incidents Rank	No. general Outbreaks Rank	Dominant Rank
Pre-packed cold RTE meats and poultry	2.2%	46	3	12	1	2	1
Pre-prepared sandwiches	3.8%	30	8	7	2.5	1	1
Smoked fish	8.7%	21		1	5		1
RTE deli-meats sliced at point of sale	7.8%	30		2	2.5		2
RTE chilled seafood	4.1%	10	2	4	9	3	3
Prepared salads	4.8%	1		3	17.5		3
Soft mould ripened and soft blue cheeses	0.4%	24		18	4		4
Butter	0.4%	2	1	17	14.5	4.5	4.5
RTE prepared food	3.0%	18	1	11	6	4.5	4.5
Egg and egg products (i.e. mayonnaise) (UKFSS)	4.1%	0		5	21.5		5
Pate - seafood	3.8%	3		6	12.5		6
Semi hard/hard cheese	0.4%	14		16	7		7
Unpasteurised soft cheese (not mould ripened)	1.6%	11		13	8		8
Raw fish/ shellfish (UKFSS)	3.6%	0		8	21.5		8
Cured/ dried/ fermented meats	3.3%	6		9	10.5		9
Raw meat/ poultry	3.1%	0		10	21.5		10
Pate - meat	0.1%	6		19	10.5		10.5
Pasteurised milk	ND	3		20	12.5		12.5
Raw fruit/ vegetables (UKFSS)	1.2%	0		14	21.5		14
Unpasteurised milk/ dairy products	ND	2		20	14.5		14.5
Cream pasteurised	1.0%	1		15	17.5		15
Pate - vegetable	0.0%	1		20	17.5		17.5
Ice cream pasteurised	ND	1		20	17.5		17.5

ND – no data; + number of samples not shown, most data sets comprised in excess of 100 samples

17. The surveillance data includes published information from FSA-funded surveys, some information from EU trends and sources reports, and data from HPA and Public Health Wales. Where survey data was not available, data from the UK Food Surveillance system (UKFSS) was used. UKFSS is a national database for central storage of analytical results from feed and food samples taken by enforcement authorities (local authorities and port health authorities) as part of their official controls. Surveys and UKFSS may have been targeted towards particular foods to further investigate potential issues previously identified by other sources such as incidents, outbreaks or the scientific literature.
18. The surveillance data underpinning this ranking is not exhaustive and some studies have been omitted. For example, the number of different ways in which foods have been categorised (e.g. surveillance data on cheeses) or in the case of UK surveys also reported to EU trends and sources. The information summarised in Table 2 indicates that *L. monocytogenes* has been found in a wide range of food categories during surveys and incidents, and a small subset of these categories have been linked to listeriosis outbreaks. Although there are many caveats associated with the data and care needs to be taken in its interpretation, the information highlights foods for which vulnerable groups could make informed choices to minimise the risk of listeriosis.

Comparing the two approaches

19. Although the classification of specific foods differs between the studies, when these are aggregated into broader categories there is a reasonably good alignment for the important foods contributing to sporadic listeriosis in the attribution study (Table 1) and the highest ranking food groups in the collation of food contamination, incidents and outbreaks data (Table 2). Ready-to-eat meats, pre-packed sandwiches and prepared salads (composite foods) and fish and shellfish are the main categories. Dairy products had a slightly lower ranking. They only exceeded 10% of sporadic cases in the pregnancy-associated cases being much lower (2.6%) in elderly associated cases (Table 1). Other foods (desserts and rice) were a significant source for pregnancy associated cases although there is little if any evidence of these products being represented in the data in Table 2. Of note in relation to RTE meats is that in the US risk assessment of *Listeria monocytogenes* in RTE foods the highest risk category was deli meats and Frankfurters (not reheated). Some dairy products ranked higher than in the UK (FDA 2003).
20. Although there is reasonable agreement between the findings from the two approaches it is important to emphasise that the attribution study only considered data for England and Wales between 2004 and 2007. The food surveillance data (2004 to 2011), incidents data (2005 to 2012) and number of general outbreaks (2002-2013) spans a longer timescale and there are differences in the way that food categories are described.

Questions for the committee

The committee is invited to:

- a) Comment on the relative importance of different food sources with respect to the risk of listeriosis in vulnerable groups.
- b) Whether the information provides sufficient evidence to identify the highest risk food categories to inform the FSA *Listeria* risk management programme.

Secretariat
January 2014

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LISTERIA RISK MANAGEMENT PROGRAMME (LRMP)

