LACORS/HPA Co-ordinated Food Liaison Group Studies:

Assessment of the Microbiological Safety of Speciality Meats from Markets and Small Specialist Retailers, with a focus on *Salmonella* spp. and *Listeria monocytogenes*

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On behalf of the Local Authorities Co-ordinators of Regulatory Services (LACORS) and the Health Protection Agency (HPA)

Abstract

The microbiological safety of 2,359 ready-to-eat speciality meats collected from markets and specialist food shops was assessed in a year long UK study that commenced on April 1st 2008. For the purposes of this study, speciality meats were defined as those which were fermented, dried and/or cured and required no further cooking or preparation by the consumer.

Most samples (98.9%) were of satisfactory or acceptable microbiological quality, indicating good control in the manufacture and retail of speciality meats in the UK. However, 16 (0.7%) samples were unsatisfactory as a result of *Escherichia coli* or *Listeria* spp. at $\geq 10^2$ cfu/g and/or *Staphylococcus aureus* between 10^2-$<10^4$ cfu/g. A further nine (0.4%) samples were unacceptable due to contamination by *Salmonella* spp. or *Listeria monocytogenes* at $>10^2$ cfu/g. Dried meats had the lowest bacterial contamination where all samples were found to be of satisfactory or acceptable quality.

The six meat samples with unacceptable levels of *L. monocytogenes* were within shelf life (range: 8-143 days remaining). *L. monocytogenes* isolate characterisation revealed nine different subtypes with the most common serovar AFLP type 1/2c VII accounting for 39%. *Salmonella* spp. detected in the three samples of speciality meats were identified as *S*. Derby, *S.* Typhimurium DT 193a, and *S.* Unnamed (I 1,4,12: i: -).

Continental sausage and cured/fermented products were primarily stored at <8°C (96%) at premises and 89% of the unacceptable samples were also stored at <8°C. Hand-washing facilities were not available and accessible for use in 9.0% of premises, and this was more evident for market premises (21.1%) than for specialist food shops (7.4%). Samples of unacceptable quality were all pre-packed prior to supply to the retail premises (OR=0.1 p=0.003) suggesting contamination occurred earlier in the production chain.

This study highlights that the majority of ready-to-eat speciality meats sold in the UK are of satisfactory/acceptable microbiological quality, suggesting that there is good control in the manufacture and retail of speciality meats. The presence of pathogens in pre-packed ready-to-eat meats suggests that contamination occurred before the point of sale, either with incomplete elimination during processing or as a result of cross-contamination. The study demonstrates the importance of ensuring products do not become contaminated before final packaging, that storage conditions are controlled, and that durability dates are an accurate indication of the shelf life of the product so as to minimise the potential for *L. monocytogenes* to be present at levels hazardous to health at the point of sale.

Introduction

Markets, delicatessens and other specialist food shops may offer a wide variety of speciality foods such as RTE speciality meats for sale direct to the consumer. These meats on retail sale in the UK are sourced worldwide and include dried, cured or fermented meats such as chorizo, salami, biltong and prosciutto. The microbiological safety of ready-to-eat (RTE) speciality meats is of major importance to both consumers and the food industry. Since these meat products do not require further treatment (such as cooking) before consumption, the absence of potentially pathogenic microorganisms in these products is paramount.

The production of speciality meats generally involves traditional techniques, however, both the quality and in particular the safety of such products intrinsically rests with the microbiology of these processes. This is generally ensured by the microenvironments the meats provide as a result of their intrinsic preservation. Fermented meats, for example, have a typical pH of 4.6-5.3, which will inhibit growth of many microorganisms (Greig *et al.* 2005). The low maximum water activity (a_W) (as low as 0.85) of dried meats also restricts microbial growth. The resulting characteristics of these RTE meats allow for a long shelf-life, for example, dried meats have a typical shelf life of 12 months.

Shelf life is linked to the temperature at which products are stored and it is known that psychrotrophic pathogens such as *Listeria monocytogenes* can grow in chilled meats. Sliced RTE meats are a potential source of *L. monocytogenes* and cross contamination during handling or slicing on the premises can occur if proper controls are not in place (Swaminathan and Gerner-Smidt 2007). Utensils such as meat slicing machines and knives have been shown to facilitate the spread of the organism (Vorst *et al.* 2006). Slicing machines may act as harbourage sites for *L. monocytogenes* (Humphrey 1990) and this organism can rapidly adhere to other food preparation surfaces, e.g. stainless steel surfaces, which will also act as a reservoir for contamination (Beresford *et al.* 2001;Frye *et al.* 2002;Gombas *et al.* 2003). Published studies have reported a *L. monocytogenes* prevalence of 13.3% in Italian style salamis collected in Brazilian markets (De Fatima Borges *et al.* 1999), 19.0% in unpacked raw dry sausages from markets in Yugoslavia (Buncic 1991), and 2.6% in whole or sliced (loose sold) fermented meats on retail sale in Ireland (Food Safety Authority of Ireland 2004). Furthermore, investigations of dried sausage processing plants in France showed that *L. monocytogenes* could be isolated at all stages of the processing (Thevenot *et al.* 2005).

Salmonella, *L. monocytogenes* and verocytotoxin-producing *Escherichia coli* O157 (*E. coli* O157) have been shown to survive some fermentation, maturation and drying processes of dried and fermented meats (Lucke 2009). Previous studies in the UK in the mid 1990s reported the presence of *Salmonella* (0.1-0.2%) and *L. monocytogenes* at 10-100 cfu/g (3.3%) in retail fermented and dried meats (Little *et al.* 1998;Ministry of Agriculture 1997). More recently, *Salmonella* incidents reported to the Health Protection Agency (HPA) have been linked to speciality meats sampled from travelling markets and specialist shops (e.g. *S.* London from cured, smoked ham, *S.* Typhimurium PT 18 isolated from chorizo, and *S*. Typhimurium PT U320 also isolated from chorizo) and as a result were withdrawn from sale (Food Standards Agency (FSA) 2004a;Food Standards Agency (FSA) 2004b). Additionally, recent European outbreak investigations have identified meats such as salami to be important vehicles for infection of salmonellosis, listeriosis and *E. coli* O157 (Emberland *et al.* 2006;Luzzi *et al.* 2007;Swaminathan and Gerner-Smidt 2007). *E. coli* O157 has also been implicated in outbreaks involving Genoa salami in Canada (Williams *et al.* 2000), commercially distributed dry cured salami in the United States (Alexander *et al.* 1995) and homemade jerky in the United States (Keene *et al.* 1997). *S. aureus* can also be a

cause of concern in relation to foodborne illness owing to its enterotoxin production potential and ability to grow in environments of high salt concentration (Gillespie 2007). In cured meats, such as cured hams, which have a high pH, the a_w should be below 0.90 to prevent the production of staphylococcal enterotoxin (Christian 2000). Good manufacturing practice, good hygiene practice, and Hazard Analysis Critical Control Point (HACCP) systems are important to prevent the occurrence of pathogens in RTE speciality meats.

Prior to this study, there was no published microbiological information on these meats from UK markets and specialist food shops. The Local Authorities Co-ordinators of Regulatory Services (LACORS) and HPA Co-ordinated Food Liaison Group programme therefore undertook a microbiological study of speciality meats to assess their microbiological safety primarily in relation to prevalence of *Salmonella* and frequency and levels of *L. monocytogenes.* The study also was designed to evaluate the effect of risk factors (e.g. packed on or off the premises, display and storage temperatures, hygiene conditions) on the microbiological safety of these meats at market and specialist food shops.

Materials and Methods

Sample collection

A total of 2,359 ready-to-eat (RTE) speciality meat samples were collected from 968 markets and specialist food shops between 1st April 2008 and 31st March 2009. Samples were collected and transported in accordance with the Food Standards Agency (FSA) Food Law Code of Practice (Food Standards Agency (2008a) and LACORS guidance on microbiological food sampling (LACORS 2006). Samples (≥100g) were collected by sampling officers from 257 Environmental Health Departments, involving 50 Local Authority food liaison groups (Annex 1). These samples were examined by 28 Official Control Laboratories throughout England, Wales, Scotland and Northern Ireland (Annex 1).

Speciality meats were defined as those which were fermented, dried and/or cured and required no further cooking or preparation by the consumer, and included:

- Strip-dried meats, such as biltong and jerky;
- Continental sausages, including salami, chorizo, bologna, pepperoni and mettwurst;
- Cured or fermented meats, including 'raw' hams (e.g. proscuitto, Serrano, York, Ardennes, Westphalian) and beef (e.g. pastrami and bresaola).

Information on samples and premises was obtained by observation and enquiry, and recorded on a standard questionnaire (Annex 3). Information on meats sampled in Scotland was collected using the UK Food Surveillance System (FSS UK) (Cree and Reid 2009). Here sampling officers input a minimum dataset pertaining to the food sample being taken for examination. It should be noted that whilst FSS UK is able to record information on food categories and broad premises categories, information on food handling and hygiene risk factors at the premises visited in relation to the foods sampled are currently unable to be recorded on this system. In this study, the contribution of samples from Scotland comprised 1.8% (44 samples) (Annex 1). Information missing from such a small sample size on handling and hygiene factors collected in this study (e.g. place meat sliced, equipment used to slice meats, etc.) had no significant effect on the findings reported ($p>0.05$).

Sample examination

The microbiology of the sampled meats was assessed with respect to contamination by *Salmonella* spp., *L. monocytogenes*, other *Listeria* spp. *S. aureus* and *E. coli*. The presence of *Salmonella* and the concentration of the other organisms were determined in accordance with Health Protection Agency Standard Microbiological Methods, as detailed in Figure 1.

All isolates of *Salmonella* were sent to the Laboratory of Gastrointestinal Pathogens (LGP), HPA Centre for Infections, for sero-typing and phage typing (Bale *et al.* 2007;Popoff and Le Minor 2001). Isolates of *L. monocytogenes* were sent to the LGP for further characterisation. This included sero-typing and amplified fragment length polymorphism (AFLP) as described previously by Doumith *et al*. (Doumith *et al.* 2004) and Guerra *et al*. (Guerra *et al.* 2002).

Microbiological results were interpreted in accordance with the microbiological criteria detailed in Table 1. These criteria use the presence or level of bacterial contamination as an indicator of food safety, and classify RTE foods as being satisfactory, acceptable, unsatisfactory or of unacceptable (potentially hazardous) microbiological quality.

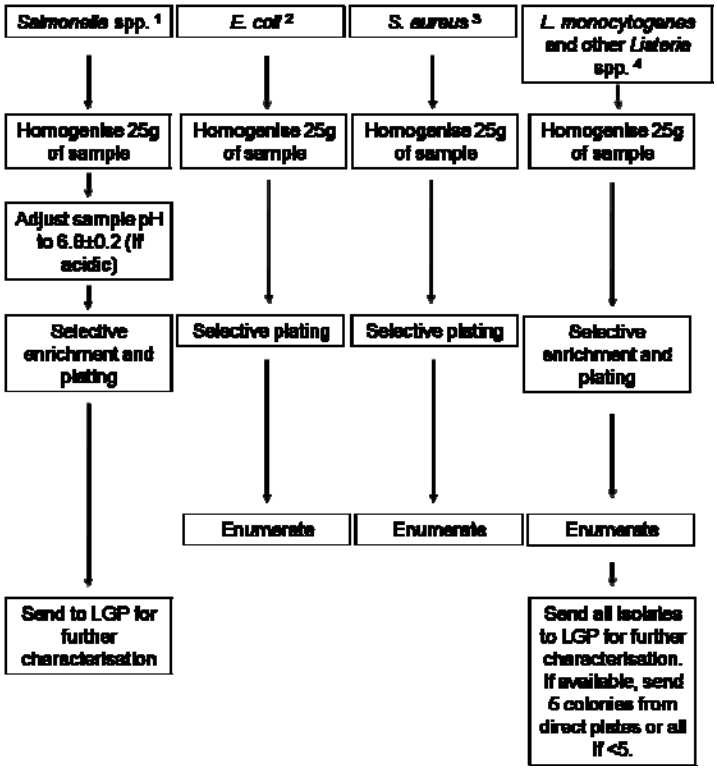

Figure 1. Flow diagram of process of pathogen detection from speciality meat samples (25g representative sub-samples). [1] Health Protection Agency. Detection of *Salmonella* species. National Standard Method F 13 (Health Protection Agency 2008); [2] Health Protection Agency. Standard Methods for Food Products. Enumeration of *Escherichia coli*. Standard Method: F20 (Health Protection Agency 2005b); [3] Health Protection Agency. Methods for Food Products. Enumeration of *Staphylococcus aureus*. Standard Method: F12 (Health Protection Agency 2005a); [4] Health Protection Agency. Detection and enumeration of, *Listeria monocytogenes* and other Listeria species. Standard method F19 (Health Protection Agency 2009).

Table 1. Microbiological Criteria / Guidelines for Ready-to-eat Speciality Meats placed on the market.

Criterion	**Guidelines: Microbiological Quality (cfu/g unless stated)†**				**Regulation (EC) No. 2073/2005:**
	Satisfactory	**Acceptable**	**Unsatisfactory**	**Unacceptable/ potentially hazardous**	**Food safety criteria (cfu/g)**
L. monocytogenes	<20§	20 - ≤10^2		>10^{2}‡	>10^{2} *‡
E. coli	<20	20 - <10^2	≥10^2		
Listeria spp.	<20	20 - <10^2	≥10^2		
S. aureus	<20	20 - <10^2	10^2 - <10^4	≥10^4‡	
Salmonella spp.	Not detected in 25g			Detected in 25g‡	

*, a *L. monocytogenes* count of >10^2 cfu/g exceeds food safety criteria for ready-to-eat foods placed on the market during their shelf-life and is thus deemed to be legally unsatisfactory (Regulation (EC) No. 2073/2005, as amended).

§, Not detected in 25g for certain long shelf-life products under refrigeration.

†, Guidelines for the Microbiological Quality of Some Ready-To-Eat foods sampled at the Point of Sale. Communicable Disease Public Health 2000; 3:163-167.

‡, Potentially injurious to health and/or unfit for human consumption (contravenes Article 14 Food Safety Requirements of Regulation (EC) No.178/2002 (the General Food Law Regulation)

Data Analysis

Data analysis was performed using Microsoft Excel. Relative proportions were compared using the chi-squared test and Fisher's exact test (http://home.clara.net/sisa/twoby2.htm) and a probability value of less than 0.05 was defined statistically significant. Comparisons of means were achieved using 2 tailed student's t tests using Microsoft Excel.

Results

Microbiological quality of speciality meats

The microbiological quality within each of the different meat categories is presented in Table 2 and Figure 2. The majority of meat samples were of satisfactory quality, ranging from 95.7% - 97.2%. Samples of unsatisfactory or unacceptable quality were observed in continental sausages (0.9%) and cured/fermented meats (1.7%). None of the 141 samples of dried meats were found to be of unsatisfactory or unacceptable quality.

Of the 2,359 speciality meat samples examined, 0.8% (18) were of unsatisfactory microbiological quality due to *E. coli* (≥10^2 cfu/g, 0.5%), *Listeria* spp. (≥10^2 cfu/g, 0.04%), or *S. aureus* (≥10^2 - <10^4 cfu/g, 0.2%) (Table 2). A further nine samples were found to be of unacceptable microbiological quality due to high levels of *L. monocytogenes* (≥10^2 cfu/g, 6 samples, 0.3%) or presence of *Salmonella* (3 samples, 0.1%). These meats were therefore not compliant with the food safety requirements of Regulation (EC) No. 178/2002 (General Food Law Regulation). The six samples of speciality meats with *L. monocytogenes* levels at >10^2 cfu/g also exceed the food safety criteria in Regulation (EC) No. 2073/2005 (as amended) for ready-to-eat foods placed on the market during their shelf-life and these samples are thus also judged to be legally unsatisfactory.

Table 2. Microbiological quality of speciality meats.

		Microbiological quality			
	Total	**Satisfactory (% of samples)**	**Acceptable (% of samples)**	**Unsatisfactory (% of samples)**	**Unacceptable/potentially hazardous (% of samples)**
All samples	2,359	2,272 (96.3)	62 (2.6)	16 (0.7)	9 (0.4)
Continental sausage	1,642	1,584 (96.5)	43 (2.6)	10 (0.6)	5 (0.3)
Cured or fermented meat	575	550 (95.7)	15 (2.6)	6 (1.0)	4 (0.7)
Dried meat	141	137 (97.2)	4 (2.8)	0 (0.0)	0 (0.0)
Not recorded	1	1 (100.0)	-	-	-
L. monocytogenes	2,359	2,352 (99.7)	1 (0.04)	-	6 (0.3)
Listeria spp.	2,359	2,357 (99.9)	1 (0.04)	1 (0.04)	-
S. aureus	2,359	2,318 (98.3)	37 (1.6)	4 (0.2)	-
Salmonella	2,359	2,356 (99.9)	-	-	3 (0.1)
E. coli	2,359	2,338 (99.1)	8 (0.3)	13 (0.5)	-

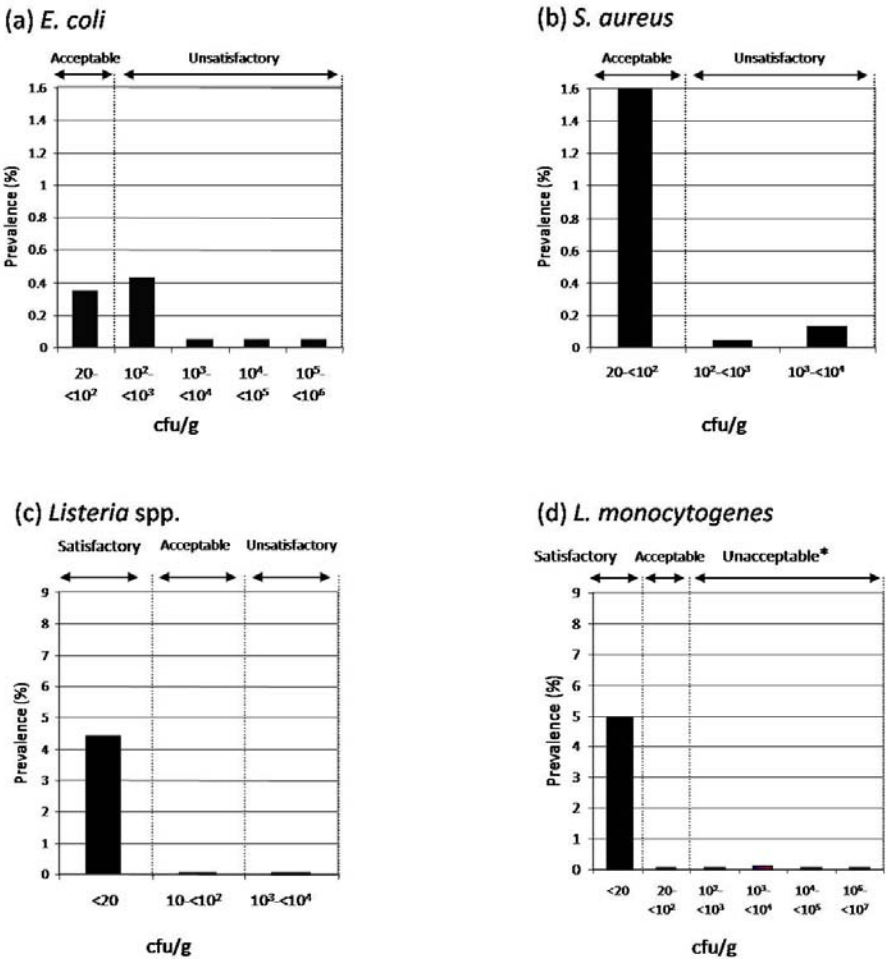

Figure 2. Prevalence of (a) *E. coli*, (b) *S. aureus*, (c) *Listeria* spp. and (d) *L. monocytogenes* in all RTE speciality meat samples. Samples where no organisms were detected are not included. * a *L. monocytogenes* count of ≥10^2 cfu/g exceeds food safety criteria for ready-to-eat foods placed on the market during their shelf-life and is thus deemed to be legally unsatisfactory (Regulation (EC) No. 2073/2005, as amended).

Salmonella spp. and *L. monocytogenes* (>10^2 cfu/g) isolated from ready-to-eat speciality meats

The three samples contaminated with *Salmonella* (S. Unnamed (I 1,4,12: i: -), *S*. Typhimurium DT 193a and *S*. Derby) comprised of two chorizo products and one turkey salami product. The six samples contaminated with *L. monocytogenes* at unacceptable levels (2.2 x 10^2 - 1.5 x 10^6 cfu/g) were a cured bacon extra product, a Napoli salami, three Lithuanian ear and tongue rolls and a Hungarian sausage (Table 3).

Of these nine meat samples, eight were stored below 8°C, while the chorizo sample contaminated with *S*. Derby was stored at 10.1°C at the premises. Eight of the meats were pre-packed while the Napoli salami sample was open and sliced on requirement using a meat slicing machine at the premises. This slicing machine was recorded to be cleaned only

at the end of trading and this salami sample was also contaminated with *L. monocytogenes* at 1.1 x 10^3 cfu/g.

Best before dates or use-by dates indicate the remaining shelf-life of the meat samples (Table 3). All nine products were within their shelf life at the time of sampling and their remaining shelf-lives ranged from 8 days (ears and tongue roll) to 203 days (chorizo extra).

Subsequent investigations found that two of the unacceptable meat samples were not in-fact ready to eat. One of the chorizo products contaminated with *S.* Derby was found to have cooking instructions but in a very small font size on the bottom of the packaging. The Bacon Extra product was also found to require cooking but had no cooking instructions on the packaging. However, as the instructions or indications that these speciality meats required cooking were inadequate, their risks to public health remained high and were therefore not removed from analysis.

Table 3. *Salmonella* spp. and *L. monocytogenes* (>10^2 cfu/g) isolated from ready-to-eat speciality meats

Speciality meat	Country of origin	Salmonella sero- and phage types	L. monocytogenes (cfu/g)	Storage temperature (°C)	Date sampled	Best before date	Use by date	Remaining shelf life (days)
Chorizo Extra	Spain	S. Unnamed (I 1,4,12:i :-)*	ND†	5.0	14/05/2008	3/12/2008		203
Chorizo	Spain	S. Derby	ND	10.1	03/06/2008	-	4/08/2008	62
Turkey meat		S. Typhimuruim						
Salami	Germany	DT193a	ND	3.0	03/12/2008	12/01/2009		40
Bacon Extra	Portugal	ND	3.5 x 10^4	5.0	03/07/2008	23/11/2008		143
Napoli Salami	Italy	ND	1.1 x 10^3	5.0	08/07/2008	10/08/2008		33
Ears & tongue roll	Lithuania	ND	3.6 x 10^3	3.5	08/10/2008	16/10/2008		8
Ears & tongue roll	Lithuania	ND	1.5 x 10^6	3.5	08/10/2008	16/10/2008		8
Ears & tongue roll	Lithuania	ND	4.4 x 10^2	3.5	02/10/2008	16/10/2008		14
Hungarian sausage	Hungary	ND	2.2 x 10^2	5.7	06/11/2008		19/12/2008	43

* *Salmonella* Unnamed (I 1,4,12: i: -); although the isolate was monophasic, it showed a reaction with the *S*. Typhimurium phages and had the pattern for definitive type (DT) 195.
†Not detected

Diversity of *L. monocytogenes* isolates

Fifty four of the 126 *L. monocytogenes* isolates were referred for serotyping and AFLP typing (Table 4 and Annex 2). Amongst the 54 isolates, 40 (74.1%) of the isolates were from continental sausage and the remaining 14 (25.9%) were from cured/fermented meats. Overall, nine different *L. monocytogenes* subtypes were obtained with 1/2c VII recovered from most (37.0%, 20/54) of these, followed by 1/2a IX (20.3%, 11/54) (Table 4).

L. monocytogenes isolates originated from meats from 13 different countries. However, the majority of *L. monocytogenes* strains were characterised from meat samples which originated in Italy (25.9%, 14) (Annex 2).

Table 4. Subtypes of *L. monocytogenes* isolated from RTE speciality meats.

Serotype/AFLP* type	No. samples	RTE speciality meat type
1/2a III	7	Chorizo (3), cured pork (1), lietuviska (1), Polish sausage (1), salami (1)
1/2a IX	11	Bacon extra (1), chorizo (2), metka cebulowa (1), pastrami (3), pepperoni (1), salami (3)
1/2a VIII	2	Ears and tongue roll (2)
1/2a XII	2	Chorizo (1), Salami (1)
1/2b II	8	Chorizo (2), ear and tongue roll (1), salami (3), snack sausage (1), zemaitiska (1)
1/2b IV	1	Prosciutto/parma (1)
1/2c IV	1	Mettwurst (1)
1/2c IX	2	French driyel (1), pancetta (1)
1/2c VII	20	Black forest ham (1), chorizo (3), cured snack sausage (1), Hungarian sausage (1), kielbasa domowa (1), prosciutto/parma (1), salami (9), speck (1), Schiacciata Piccante (1), Saucisson Porc(1)

*Amplified fragment length polymorphism.

Shelf life of speciality meats

From 2,359 RTE speciality meats sampled, 1,455 (61.7%) displayed a durability date (best before date or use by date). The samples had between 0 to 389 days remaining until they reached this durability date (Table 5). Dried meats had a significantly longer remaining shelf until they reached the durability date displayed on their packaging (94 days, range: 9-335 days) compared to continental sausage (68 days, range: 0-389 days) (p=0.0004, 2 tailed t-test) and cured/fermented meats (65 days, range: 0-380 days) (p=0.0006, 2 tailed t-test). Three samples of continental sausage (0.2%, 1062) and two samples of cured/fermented meats (0.6%, 305) were sampled on the day of expiry but were all found to be of satisfactory quality.

Table 5. Remaining time until durability date reached for RTE speciality meats.

Speciality meat categories	Total*	Remaining time until durability date reached (days)			
		Mean	Median	Mode	Range
All samples	1455	69	47	22	0-389
Continental sausage	1062	68	47	22	0-389
Cured or fermented meat	305	65	33	7	0-380
Dried meat	88	94	81	87	9-335

* Data included is for samples where a durability date was specified.

The relationship between the time remaining until the durability date is reached and bacterial contamination was investigated (Table 6). For samples where *E. coli*, *S. aureus* and *Listeria* spp. was present at acceptable levels, the mean time remaining was not significantly longer for samples of unsatisfactory microbiological quality (p>0.05).

The six samples with *L. monocytogenes* exceeding the food safety criteria limit (>100 cfu/g) were within their durability date: two samples with levels of >10^2-10^3 cfu/g had 14 and 43 remaining until their durability date was reached; three samples with levels of 10^3-10^4 cfu/g and 10^6-10^7 cfu/g had 8 and 33 remaining days until reaching the durability date, respectively (Figure 3, Table 4); and one sample with a concentration of 10^4-10^5 (3.5 x 10^4 cfu/g) had 143 days until reaching the durability date .

Table 6. Remaining time until durability date reached for meat samples contaminated with specified bacteria.

			Remaining time until durability date reached (days)	
Organism (cfu/g)	**Microbiological quality**	**No. of samples***	**Mean**	**Maximum**
L. monocytogenes				
ND	Satisfactory	1,372	69	389
<20	Satisfactory	77	65	268
10-<10^2	Acceptable	0	0	0
10^2-<10^3	Unacceptable	2	29	43
10^3-<10^4	Unacceptable	2	21	33
10^4-<10^5	Unacceptable	1	143	143
10^6-<10^7	Unacceptable	1	8	8
***Listeria* spp.**				
ND	Satisfactory	1,333	68	389
<20	Satisfactory	121	73	364
10^3-<10^4	Unsatisfactory	1	33	33
S. aureus				
<20	Satisfactory	1,437	69	389
20-<10^2	Acceptable	16	61	222
10^2-<10^3	Unsatisfactory	1	26	26
10^3-<10^4	Unsatisfactory	1	5	5
Salmonella				
Detected	Unacceptable	3	102	203
Not detected	Satisfactory	1,452	69	389
E. coli				
<20	Satisfactory	1,444	69	389
20-<10^2	Acceptable	3	69	139
10^2-<10^3	Unsatisfactory	6	67	170
10^3-<10^4	Unsatisfactory	1	3	3
10^4-<10^5	Unsatisfactory	1	43	43

* Data included is for samples where a durability date was specified.

Speciality meat sample details and origin

Of the 2,359 RTE speciality meats sampled, 11.3% (266) were from markets/market stalls and 88.7% (2,093) from specialist food shops (Table 7). The continental markets (5.6% of the total, 132) were the most common in the former group, and delicatessens (including continental grocery stores) predominated (63.3 %, 1,493) amongst the specialist food shops.

Table 7. Premises types from which RTE speciality meats were sampled.

Premises type	Specific premises	No. of meat samples (% of total)	No. of unsatisfactory or unacceptable samples (% of total)
Market/market stall	Continental	132 (5.6)	-
(samples =266)	Other	27 (1.1)	-
	Local	80 (3.4)	1 (0.04)
	Farmers	27 (1.1)	-
Specialist food shop (samples=2,093)	Delicatessen (inc continental grocery stores)	1493 (63.3)	18 (0.76)
	Butcher's shop	213 (9.0)	2 (0.93)
	Farm shop	124 (5.3)	-
	Other	222 (9.4)	4 (1.80)
	Not recorded	41 (1.7)	-
Total samples		**2,359**	**25 (1.1)**

The RTE speciality meats sampled were extremely diverse. These were categorised into three main categories: continental sausage (69.6%, 1642/2359), cured/fermented meats (24.4%, 575) and dried meats (6.0%, 141) (Table 8). The most commonly sampled variety of continental sausages was chorizo (22.8%, 375), prosciutto/parma were the most common type sampled of cured and fermented meats (32.0%, 184), and biltong (66.0%, 93) in the dried meat category.

Table 8. Summary of the RTE speciality meat categories and the most common varieties within each.

Meat type	Specific type	No. of samples (% of meat type)	No. of unsatisfactory or unacceptable samples (% of total)
Continental sausage (n=1642)	Other*	839 (51.1)	7 (0.3)
	Chorizo	375 (22.8)	5 (0.2)
	Milano salami	258 (15.7)	3 (0.1)
	Danish Salami	93 (15.7)	-
	Pepperoni	38 (2.3)	1 (0.04)
	Hungarian salami	31 (1.9)	-
	Bologna	8 (0.5)	-
Cured or fermented meat (n=575)	Other**	224 (39.0)	5 (0.2)
	Prosciutto/Parma	184 (32.0)	3 (0.1)
	Pastrami	78 (13.6)	1 (0.04)
	Serrano	60 (10.4)	-
	Bresaola	29 (5.0)	-
Dried Meat (n=141)	Biltong	93 (66.0)	-
	Other***	37 (26.2)	-
	Jerky	11 (7.8)	-
Not recorded (n=1)		1 (100)	-
Total		**2,359**	**(1.1)**

* Other continental sausages primarily included salami varieties such as Napoli, German, Italian and garlic. **Other cured or fermented meat included pancetta, sopocka and other cured ham varieties. *** Other dried meats included droewars. In each of the three main categories, the diversity of other types was so high that the majority of samples were single types.

The 2,359 meat samples originated in 24 different countries, with the majority of meats sampled produced in Italy (24.0%, 566), Poland (15.6%, 368), Spain (14.0%, 330) and the UK (11.6%, 273) (Table 9).

Table 9. Country of origin of RTE speciality meat samples.

Country of Origin	Total	No. of unsatisfactory or unacceptable samples (%)
Italy	566 (24.0)	9 (0.4)
Poland	368 (15.6)	-
Spain	330 (14.0)	6 (0.3)
UK	273 (11.6)	1 (0.04)
Germany	111 (4.7)	2 (0.08)
Denmark	91 (3.9)	-
France	66 (2.8)	-
Lithuania	37 (1.6)	3 (0.13)
Portugal	35 (1.5)	1 (0.04)
Hungary	26 (1.1)	1 (0.04)
Belgium	20 (0.8)	-
Netherlands	13 (0.3)	-
Austria	8 (0.3)	-
South Africa	7 (0.3)	-
Republic of Ireland	6 (0.3)	-
Israel	3 (0.1)	-
New Zealand	3 (0.1)	-
Turkey	3 (0.1)	-
Slovakia	2 (0.1)	-
USA	2 (0.1)	-
Brazil	1 (0.04)	1 (0.04)
Madagascar	1 (0.04)	-
Old Yugoslavia Border	1 (0.04)	-
Romania	1 (0.04)	-
Not Recorded	385 (16.3)	1 (0.04)
Total	**2,359**	**25 (1.1)**

Speciality meat storage and hygiene at retail premises

Thirty seven percent (867) of the 2,359 speciality meats sampled were pre-packed, 714 (30.3%) were covered, 700 (29.7%) were open and for the remaining 78 (3.3%), the display and storage details were not recorded. There was no significant association between packaging and the microbiological quality of the samples, even when comparing those which were covered or open with those pre-packaged (p>0.05).

The mean remaining days until durability date was reached was significantly higher in meats stored >8°C (88 days) compared to that of samples stored ≤8°C (64 days) (p=0.001, 2 tailed t-test). Some RTE meat products are shelf stable, for example dried meats, which have a sufficiently low water activity (a_w), and are therefore exempt from chill holding requirements. Because of this, the 141 dried meat samples were omitted from the following analysis as a result of their relative temperature independent shelf life.

From the remaining 2,218 continental sausage and cured or fermented meats, storage temperature data was available for 2,109 (95%) of the samples: 1,791 (84.9%) were stored ≤8°C (mean: 4.5°C, range: 0-8°C) and 318 (15.1%) were stored >8°C (mean: 11.8°C,

range: 8.1-25°C). Comparisons were made between the proportions of meat samples stored at each temperature grouping (i.e. ≤8°C and >8°C) and their microbiological status (Table 10). The microbiological quality was shown not to be significantly affected by storage temperature for each categories (p>0.05).

Hand washing facilities were available and accessible for use in 736 (76.0%) of the 968 retail premises, absent in 87 (9.0%), and for the remaining 145 (15.0%) this information was not recorded. A greater proportion of market premises did not have these facilities (21.1%, 22/104) compared to specialist food shops (7.4%, 63/856) (p<0.0001). Meat samples from market premises with no hand washing facilities available were more likely to contain unsatisfactory levels of *E. coli* (0.4%, 1/266) than those that had these facilities (0%, 0/266). In contrast, meat samples collected from specialist food shops that had available hand washing facilities were more likely to contain unsatisfactory levels of *E. coli* (0.9%, 20/2052) than those without these facilities (0.1%, 2/2052).

Table 10. Relationship between the microbiological quality of speciality meats and premises storage temperature*.

Microbiological quality	**≤8°C** n=1,766 (74.9%)	**>8°C** n=318 (13.5%)	**Odds Ratio[a]**	**95% CI[b]**	**Significance[c]**
Satisfactory	1,696 (96.0)	306 (96.2)	0.7	0.3,1.3	0.16
Acceptable	48 (2.7)	9 (2.8)	0.9	0.5,1.9	0.65
Unsatisfactory	14 (0.8)	2 (0.6)	1.2	0.3,5.5	0.56
Unacceptable/Potentially hazardous	8 (0.5)	1 (0.3)	1.4	0.2,11.4	0.60

*Dried meat samples were excluded from calculations.
[a] Odds ratio (OR) defined as the ratio of the odds of a sample being of a particular microbiological quality at above or below a storage temperature of 8°C.
[b] Confidence interval defined as the estimated range of values which is likely to include an unknown population parameter, the estimated range being calculated from a given set of sample data.
[c] Statistical significance at p<0.05.

Of the 2,359 samples, 1332 (56.5%) were sliced on request, 306 (13.0%) were sliced off the premises and 531 (22.5%) were un-sliced (e.g. strips). This information was not available for 190 samples (8.0%). Of the 1332 samples sliced on request, 83.2% (1109) were sliced using a slicing machine, 13.4% (179) with a knife and for 3.3% (44) this information was not recorded (Table 11).

Microbiological quality was not significantly different in meats sliced on the premises compared to those sliced off the premises for all quality categories (p>0.05) with the exception of meats of unacceptable quality which were more likely to be sliced off the premises (OR 0.1, p=0.003).

Table 11. Relationship between the microbiological quality of speciality meats slicing and storage at the premises.

Microbiological quality	Sliced on premises	Sliced off premises	Odds Ratio[a]	95% CI[b]	Significance[c]
	n=1,332 (56.5%)	n=306 (13.0%)			
Satisfactory	1,278 (96.0)	297 (97.1)	0.7	0.4, 1.5	0.23
Acceptable	42 (3.2)	4 (1.3)	2.5	0.9, 6.9	0.05
Unsatisfactory	11 (0.8)	1 (0.3)	2.5	0.3, 19.7	0.31
Unacceptable/Potentially hazardous	1 (0.08)	4 (1.3)	0.1	0.0, 0.5	0.005

[a] Odds ratio (OR) defined as the ratio of the odds of a sample being of a particular microbiological quality at above or below a storage temperature of 8°C.
[b] Confidence interval defined as the estimated range of values which is likely to include an unknown population parameter, the estimated range being calculated from a given set of sample data.
[c] Statistical significance at $p<0.05$.

Discussion

Salmonella and *Listeria monocytogenes*

This study highlighted that 99% of the 2,359 ready to eat (RTE) speciality meats sampled from specialist retailers in the UK were of satisfactory or acceptable microbiological quality. While this is an important finding, the study also showed that 1% of samples were either of unsatisfactory or unacceptable quality. The findings here are comparable to that found in retail fermented meats sampled in the Republic of Ireland in 2004 (Food Safety Authority of Ireland 2004), where 98% of meats were shown to be of satisfactory or acceptable microbiological quality, and 2% found to be of unsatisfactory quality. There was no significant difference between the findings of the Republic of Ireland study and the findings of the current HPA/LACORS study ($p>0.05$).

Ready-to-eat foods contaminated with *Salmonella* spp. are unsafe. They are considered to be injurious to health and/or unfit for human consumption and therefore contravene the food safety requirements (Article 14) of Regulation (EC) No.178/2002 (European Commission, 2002). The *Salmonella* detected in 0.1% of speciality meats included *S*. Derby, *S*. Typhimuruim DT 193a and *S*. Unnamed (I 1, 4, 12:i:-). The latter showed similarities with *S*. Typhimurium through phage typing.

S. Derby (isolated from chorizo) has long been associated with pork and is one of the most common serotypes in swine (Valdezate *et al.* 2005). Further, the serotype represents a high proportion of the *Salmonella* subtypes observed in Spanish pig farms (14% from 100 positive herds) (Garcia-Feliz *et al.* 2007). The European Food Safety Authority (EFSA) baseline survey of *Salmonella* in slaughter pigs showed that *S*. Derby and *S.* Typhimurium were isolated from carcasses in 20/25 and 24/25 Member States, respectively (European Food Safety Authority 2008). This *Salmonella* contamination of pre-packed chorizo suggests that the contamination may have occurred either on the pig farms, at slaughter or possibly meat processing, prior to packaging the product. Contamination with *S*. Typhimuruim DT 193a was detected in one pre-packed sliced turkey salami sample, suggesting contamination occurred at some earlier stage in production or indeed at the previous premises where it was sliced. These findings indicate that improved food safety and reduction of *Salmonella* at the farm, slaughterhouse or food processing plant is required, through Good Agricultural Practice (GAP), Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP) and overall coherence with all stages of HACCP.

Only one of the six meats contaminated with unsafe levels of *L. monocytogenes* (>100 cfu/g) that exceeded food safety criteria was sliced on the premises it was sampled from. Interestingly, the slicing machine (used for slicing this product) was cleaned *only* at the end of trading as opposed to after each use. This suggests that the organism may have been acquired from another source through cross-contamination. Although the meat was sampled early in the trading day at 10.15am (suggesting that the machine may have not been used much that day) it is known that *L. monocytogenes* cells may adhere to stainless steel therefore cross-contamination cannot be ruled out. The speciality meat samples of unacceptable quality were significantly associated with being sliced off the premises, impling that the source of contamination was indeed elsewhere. Research has suggested that the increased handling and/or cutting of RTE meats prior to packaging may increase the risk of *L. monocytogenes* contamination (Angelidis and Koutsoumanis 2006). In another study, microbiological investigation of a RTE meat processing plant as a result of *L. monocytogenes* detection in a range of RTE meats found that the risk of *L. monocytogenes* contamination was reduced with improved sanitary practice within the plant (Gibbons *et al.*

2006). Since 2006 in the EU, processing areas and equipment used in the manufacture of ready-to-eat foods must be monitored for *L. monocytogenes* (Regulation (EC) No 2073/2005) (EC 2005).

The UK Food Standards Agency was informed of the unacceptable samples during the current study and the affected batches were recalled (Food Standards Agency (FSA) 2008b;Food Standards Agency (FSA) 2008c;Food Standards Agency (FSA) 2008d;Food Standards Agency (FSA) 2008f). Follow up investigations by local authorities of the chorizo sample contaminated with *Salmonella* Unnamed (I 1,4,12:i:-) revealed a further batch to be contaminated (Food Standards Agency (FSA) 2008e). The chorizo contaminated with *Salmonella* Derby was also further investigated to reveal the presence of *Salmonella* Unnamed (I 1,4,5,12:i:-). Similarly, further investigation and product sampling by local authorities at the UK importer level was carried out for the ears and tongue roll contaminated with high levels of *L. monocytogenes* (Food Standards Agency (FSA) 2008d). In total unacceptable levels of this pathogen (>10^2 cfu/g, ranging up to 2.8 x 10^6 cfu/g) were observed in nearly all investigative samples (94.4 %, 17/18). Such findings highlight the value of the current study in identifying products which are potentially hazardous to public health and ensure that such contaminated products will be removed from the market.

Shelf life

The remaining time left before durability date (e.g. use by date) was reached was on average significantly higher for dried meat products than continental sausage (p=0.0004) or cured/fermented meat products (p=0.0006). This was not surprising, considering the microbiological stability of these types of meat. Dried meats are typically low in water content (a_W approximately ≤0.87) and, when prepared, are subjected to thermal lethality followed by prolonged drying. Previous work has shown that experimental inoculation of *L. monocytogenes* and *S. aureus* on to jerky and related products did not allow growth of the organisms, even at 21°C (Ingham *et al.* 2006). Similarly in the current study, *L. monocytogenes* was not detected in any dried meat and *S. aureus* was not detected at levels greater than 20 cfu/g (maximum resolution of the enumeration method).

The mean remaining time left before durability date was reached was significantly higher for meats stored >8°C (88 days) compared to that of samples stored ≤8°C (64 days), despite excluding dried meats owing to their temperature independent stability. The storing of some RTE speciality meats, such as continental sausages and cured or fermented meats, should be below 8°C (food hygiene regulations) as the chilled temperature requirements help minimise the risk of bacterial growth as certain bacteria are either unable to grow below this temperature or grow at such a slow rate that they may not pose a risk.

The time remaining until the durability date was reached for meats contaminated with unacceptable levels of *L. monocytogenes* ranged from eight to 143 days. While these speciality meats were all stored below 8°C, *L. monocytogenes* levels were already at concentrations that pose a serious threat to the consumer. *L. monocytogenes* levels below 10^2 cfu/g may be equally detrimental if there is a long enough remaining shelf life and the food is able to sustain the growth of the pathogen. This problem could be exacerbated by the inconsistency in which consumers may refrigerate meat products, with storage temperatures often being too high to prevent *L. monocytogenes* growth (Kennedy *et al.* 2005).

The *L. monocytogenes* serogroups most often causing human infection in the UK are 4b and 1/2a, with the subtype 4b AFLP I being most common in England and Wales (Gillespie and McLauchlin 2007;McLauchlin J 1997). The predominant serogroup of *L. monocytogenes* recovered in this study from speciality meats was serotype 1/2c, with AFLP

subtype VII most common. The subtype 1/2c VII was not overrepresented in any particular speciality meat. This is the fourth most common type observed in food isolates in the UK (behind types 1/2a IX, 4b I and 1/2a VII, accounting for 10% of isolates from 2004-March 2009, and is primarily associated with meats including ham, pork and beef (HPA, unpublished data).

Hygiene

The presence of *E. coli* generally indicates faecal contamination and may be used as general hygiene indicators; therefore their presence in heat treated foods, including some speciality meats, suggests post-processing contamination. The presence of *E. coli* generally indicates faecal contamination or poor cleaning practice. Unsatisfactory quality was identified in 1.0% of speciality meat samples as a result of this organism present at levels over 100 cfu/g. Hand washing facilities were not accessible or used in 21.1% of market premises compared to 7.4% for specialist food shops visited to sample speciality meats. However, meat samples collected from specialist food shops that had available hand washing facilities were more likely to contain unsatisfactory levels of *E. coli* suggesting that either personal hygiene is not being maintained, or there is potentially a breakdown in the food safety management system.

The maintenance of a food safety management system based on HACCP principles (as required by Regulation (EC) No 852/2004) in food retail is essential, particularly when, as in this study, 57% of meats were sliced upon request. The increased potential for transfer of faecal bacteria and cross-contamination to meats is multiplied through handling, thus such good hygiene practice must be ensured.

Conclusions

Overall, there is good control in the manufacture and retail of speciality meats in the UK as the vast majority (99%) of samples examined were of satisfactory/acceptable microbiological quality. The presence of pathogens in pre-packed RTE meats suggested that for some meats, contamination occurred either during processing or as a result of post processing cross-contamination. Efforts must be made to ensure that speciality meats do not become contaminated before final packaging. Durability dates must accurately reflect the shelf life of the product so that contamination with *L. monocytogenes* does not result in the growth of this pathogen to unsafe levels, more than 100 cfu/g. Where the product is sold through other retail premises, the performance of the proposed distribution chain, including refrigeration storage temperatures, should be taken into account when calculating the shelf life of the product.

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Annex 1: Participating food liaison groups and laboratories.

Table 1. Participating food liaison groups and number of samples.

Food Liaison Group	Number of samples
Berkshire	48
Buckinghamshire	28
Cambridgeshire	40
Cheshire	75
Cornwall	62
Cumbria	36
Derbyshire	5
Devon	51
Dorset	29
Durham	1
East Sussex	99
Essex	98
Gloucestershire	51
Greater Manchester	140
Hampshire & Isle of Wight	105
Hereford & Worcester	35
Hertfordshire & Bedfordshire	17
Humberside/North Lincoln	17
Kent	51
Lancashire	118
Leicestershire	45
LFCG[1] NE Sector	12
LFCG NW Sector	57
LFCG SE Sector	2
LFCG SW Sector	33
Lincolnshire	54
Merseyside	21
Norfolk	41
North Wales	10
North Yorkshire	26
Northamptonshire	67
Northern Ireland Food Group[2]	41
Northumberland	24
Nottinghamshire	51
Oxfordshire	97
SFELG[3]	44
Somerset	39
South East Wales	39
South West Wales	1
South/West Yorkshire	56
Staffordshire	22
Suffolk	58
Surrey	149
Tees Valley	42
Tyne & Wear	30
Warwickshire	29
West Midlands	50
West of England	53
West Sussex	45
Wiltshire	15
Total	2,359

[1] LFCG, London food coordinating group.
[2] Northern Ireland Food Group consists of Northern Ireland and Northern Ireland Southern.

[3] SFELG, Scottish Food Enforcement Liaison Group consisting of North Scotland, West of Scotland and Lothian and Scottish Borders

Table 2a. Participating HPA and HPA Collaborating Laboratories and number of samples.

HPA Region	HPA/HPA collaborating laboratory	Number of samples
East	Chelmsford	157
	Norwich	80
East Midlands	Leicester	45
	Lincoln	106
London	London[1]	149
North East and Yorkshire and Humberside	Newcastle	103
	Leeds	74
	Sheffield	23
North West	Carlisle	36
	Chester	92
	Preston	272
South East	Ashford	73
	Haywards Heath	267
	WEMS[2]	283
South West	Bristol	126
	Exeter	56
	Plymouth	18
	Truro	72
West Midlands	Birmingham	120
	Coventry	42
	Hereford	23
	Stoke	18
Total		**2,235**

[1] London Food, Water and Environmental Microbiology Services Laboratory
[2] Wessex Environmental Microbiology Services

Table 2b. Other participating Official Food Control Laboratories in Wales, Scotland, Northern Ireland & England and number of samples examined.

Country	Laboratory	Number of samples
Northern Ireland	Belfast City Hospital	41
Scotland	Aberdeen City Council Public Analysts	10
	Aberdeen Royal Infirmary (PHL)	1
	Edinburgh Analytical and Scientific Services	11
	Glasgow Scientific Services	22
Wales	NPHS Wales-Cardiff	39
Total		**124**

Annex 2. Detailed list of subtypes of *L. monocytogenes* isolated from RTE speciality meats.

Sero/AFLP	cfu/g	Microbiological quality*	Meat type	Specific type	Origin
1/2a IX	<10	Acceptable	Continental sausage	Chorizo	Spain
1/2a III	<10	Satisfactory	Continental sausage	Chorizo	Spain
1/2a IX	<10	Acceptable	Continental sausage	Chorizo	Denmark
1/2a III	<10	Satisfactory	Continental sausage	Lietuviska	Lithuania
1/2a III	<10	Satisfactory	Cured or fermented meat	Cured Pork	France
1/2a III	<10	Acceptable	Continental sausage	Homemade Salami	UK
1/2a III	<10	Acceptable	Continental sausage	Chorizo	Not Known
1/2a III	<10	Satisfactory	Continental sausage	Polish Sausage	Not Known
1/2a III	<10	Satisfactory	Continental sausage	Chorizo	South Africa
1/2a VIII	440	Unacceptable/Potentially hazardous	Cured or fermented meat	Ears & Tongue Roll	Lithuania
1/2a VIII	$1.5x10^6$	Unacceptable/Potentially hazardous	Cured or fermented meat	Ears & Tongue Roll	Lithuania
1/2a IX	<10	Satisfactory	Continental sausage	Pepperoni	Italy
1/2a IX	<10	Satisfactory	Continental sausage	German salami	Germany
1/2a IX	$3.5x10^4$	Unacceptable/Potentially hazardous	Cured or fermented meat	Bacon Extra	Portugal
1/2a IX	<10	Satisfactory	Continental sausage	Danish salami	Not Known
1/2a IX	<10	Acceptable	Continental sausage	Milano salami	Italy
1/2a IX	<10	Satisfactory	Cured or fermented meat	Pastrami	Not Known
1/2a IX	<10	Satisfactory	Cured or fermented meat	Pastrami	Netherlands
1/2a IX	<10	Satisfactory	Continental sausage	Metka Cebulowa	Poland
1/2a IX	<10	Satisfactory	Cured or fermented meat	Pastrami	Netherlands
1/2a XII	<10	Satisfactory	Continental sausage	French Salami	France
1/2a XII	<10	Satisfactory	Continental sausage	Chorizo	Not Known
1/2b IV	<10	Satisfactory	Cured or fermented meat	Prosciutto/Parma	Italy
1/2b II	$3.6x10^3$	Unacceptable/Potentially hazardous	Cured or fermented meat	Ears & Tongue Roll	Lithuania
1/2b II	<10	Satisfactory	Continental sausage	Milano salami	Italy
1/2b II	<10	Satisfactory	Continental sausage	Zemaitiska	Lithuania
1/2b II	$1.1x10^3$	Unacceptable/Potentially hazardous	Continental sausage	Napoli Salami	Italy
1/2b II	60	Acceptable	Continental sausage	Milano salami	Italy
1/2b II	<10	Satisfactory	Continental sausage	Chorizo	Not Known
1/2b II	<10	Satisfactory	Continental sausage	Chorizo	Spain
1/2b II	<10	Satisfactory	Continental sausage	Snack Sausage	UK
1/2c VII	<10	Satisfactory	Continental sausage	Mettwurst	Italy
1/2c VII	<10	Satisfactory	Continental sausage	German Salami	Germany
1/2c VII	<10	Satisfactory	Continental sausage	Napoli Salami	UK
1/2c VII	<10	Acceptable	Continental sausage	Schiacciata Piccante	Italy
1/2c VII	<10	Satisfactory	Continental sausage	Salami Toscano	Italy
1/2c VII	<10	Satisfactory	Continental sausage	Chorizo	Spain
1/2c IX	<10	Satisfactory	Continental sausage	French Driyel	France
1/2c IX	<10	Satisfactory	Cured or fermented meat	Pancetta	UK
1/2c VII	<10	Satisfactory	Cured or fermented meat	Black Forest Ham	Germany
1/2c VII	<10	Satisfactory	Cured or fermented meat	Spek	Italy
1/2c VII	<10	Satisfactory	Continental sausage	Saucisson Porc	France
1/2c VII	<10	Satisfactory	Continental sausage	Hungarian salami	Hungary
1/2c VII	<10	Satisfactory	Continental sausage	Italian Salami	Italy
1/2c VII	<10	Satisfactory	Continental sausage	Comte French salami	France
1/2c VII	<10	Satisfactory	Continental sausage	French Salami	France
1/2c VII	<10	Satisfactory	Cured or fermented meat	Prosciutto/Parma	Italy
1/2c VII	$2.2x10^2$	Unacceptable/Potentially hazardous	Continental sausage	Hungarian Sausage	Hungary
1/2c VII	<10	Satisfactory	Continental sausage	Chorizo	Spain
1/2c VII	<10	Satisfactory	Continental sausage	Chorizo	UK
1/2c VII	<10	Satisfactory	Continental sausage	Milano salami	Italy
1/2c VII	<10	Satisfactory	Continental sausage	Napoli Salami	Italy
1/2c VII	<10	Satisfactory	Cured or fermented meat	Kielbasa Domowa	Poland
1/2c VII	<10	Satisfactory	Continental sausage	Cured Snack Sausage	UK

* Microbiological quality of RTE speciality meats may be satisfactory or acceptable depending on other bacterial contamination in addition to *L. monocytogenes*.

Annex 3. LACORS/HPA co-ordinated food liaison group study questionnaire.

LABORATORY NAME..... Laboratory Sample Number.....

Annex 3 for Study 33 LACORS/HPA CO-ORDINATED FOOD LIASION GROUP STUDY: QUESTIONNAIRE

Microbiological Study on Speciality Meats from Markets & Specialist Food Shops with a focus on *Salmonella* spp. and *Listeria monocytogenes*: 1 Apr 08 – 31 Mar 09

All information must be correctly and clearly entered on the form using black ink to facilitate clear photocopying

1. Local Authority..... 2. Food Liaison group .....

3. Samplers Name..... & contact number: ..... 4. Sample collected at..... (time) on (date) ...../...../.....

5. LA Premises Ref. No. (where available)..... 6. LA Sample Ref. No.....

Premises details:

7. Name of premises.....

8. Trading address of premises ..... Postcode.....
Registered address (if different from above)..... Postcode.....

9. Type of Premises **[NOTE *Supermarket/Multiple Retailer delicatessen/meat counters should not be included*]:**

Market / Market Stall	☐ & Specify:	Continental	☐	Farmers	☐	Local	☐	Other	☐(Specify).....
Specialist Food Shop	☐ & Specify:	Delicatessen (inc. continental grocery stores)	☐			Butcher's shop	☐		
				Farm shop	☐			Other	☐(Specify).....

10. On the day of sampling were hand washing facilities available & accessible for use? YES ☐ NO ☐

Speciality Meat Sample Details:

11. Type collected: [*Where 'Other' specify below*]

Dried meat	☐ & Specify:	Jerky	☐	Biltong	☐	Other	☐				
Continental sausage	☐ & Specify:	Pepperoni	☐	Chorizo	☐	Mettwurst	☐	Bologna	☐		
		Hungarian salami	☐	Danish salami	☐	Milano salami	☐	Other	☐		
Cured or fermented meat	☐ & Specify:	Ardennes	☐	Serrano	☐	Green york ham	☐	Westphalian	☐		
		Prosciutto/Parma	☐	Pastrami	☐	Bresaola	☐	Other	☐		

12. At the time of sampling was the product displayed / stored: Open ☐ Covered ☐ Packed ☐

13. If the sample is stored/displayed refrigerated, what was the temperature (**Note** *some products are 'shelf-stable'*): Equal/below 8°C ☐ & Specify temperature.....°C
or above 8°C ☐ & Specify temperature.....°C

14. Is the sample: Un-sliced (e.g strips) ☐ Sliced ON the premises ☐ Pre-sliced OFF the premises ☐

If sliced on the premises go to Q 15 & 16, If not go to Q17

15. If sliced on the premises, was the meat sliced using a: Knife ☐ Meat slicing machine ☐

16. How often is the slicer/knife cleaned? As required during the day ☐ At the end of trading ONLY ☐

Product Details:

17. Specify (where available) Product Name **exactly** as it appears on the label/display card:.....

18. Brand/ Producer (specify):..... Not known ☐

19. Product Date (specify): Use by date ...../...../..... Best before date ...../...../..... Not Known ☐

20. Weight (specify): ..... ***Sample must be a minimum of 100 grams***

21. What is the country of origin? ..... Not known ☐

22. Is there an EC approval number? YES ☐ NO ☐; If YES please specify code.....

23. Is there a batch code? YES ☐ NO ☐; If YES please specify code.....

COPY TO: Laboratories to retain a copy of the questionnaire for the purposes of validating data within the Excel Workbook

Page 1 of 2

Laboratory details:

Sample(s) received in laboratory..... (time) on (date) ...../. ..../.....
Sample(s) received by.....
Sample(s) received from.....
Temperature on receipt.....°C
Within the cool box is a temperature monitoring device used e.g. data logger : YES ☐ NO ☐
Sample(s) examined. ..... (time) on (date) ..../...../ .....

RESULTS

Recording results

Please record the results of count/g tests as **ACTUAL NUMBERS** in the appropriate box within the table. Only place ticks in the column headed (<20), i.e. the limit of detection for that test, and columns headed ND (Not Detected) and Detected.

***L. monocytogenes* at ≥10^2 cfu/g exceeds food safety criteria for ready-to-eat foods placed on the market during their shelf-life and is thus deemed to be legally unsatisfactory (Regulation (EC) No. 2073/2005, as amended).**
***Salmonella* spp. or *S. aureus* should not be present at unacceptable/potentially hazardous levels in ready-to-eat food and thereby are covered by Regulation (EC) No. 178/2002.**

Laboratory Sample No.....

	ND	Detected	<10/20	10/20-<10^2	10^2-<10^3	10^3-<10^4	10^4-<10^5	10^5-<10^6	10^6-<10^7	≥10^7
Escherichia coli /g										
Staphylococcus aureus / g										
Listeria spp. / 25g or g										
Listeria monocytogenes / 25g or g										
Salmonella spp. 25/g										

Microbiological Quality: Satisfactory ☐ Acceptable ☐ Unsatisfactory ☐ Unacceptable/Potentially hazardous ☐

Date *Salmonella* isolates sent to the Laboratory of Enteric Pathogens, HPA Centre for Infections or in Scotland to the Scottish Reference Laboratory (Stobhill Hospital Glasgow) .....

Date *L. monocytogenes* (All) and *S. aureus* isolates (≥10^4 cfu/g) sent to the Food Safety Microbiology Laboratory (FSML), HPA Centre for Infections.....

MICROBIOLOGISTS COMMENTS.....
.....

Signature ..... Date reported .....

WHERE POSSIBLE THE LABORATORY SHOULD TAKE A DIGITAL PHOTO OR MAKE AND RETAIN A PHOTOCOPY OF THE PRODUCT LABEL FOR FUTURE REFERENCE OR RETAIN THE REMAINING PRODUCT UNTIL THE END OF THE STUDY

Methods as defined in LACORS/HPA Speciality Meats (Study 33); Annex 4

COPY TO: Laboratories to retain a copy of the questionnaire for the purposes of validating data within the Excel Workbook