



**1<sup>st</sup> National Microbiological Survey 2008 (08NS1)**

**Prevalence of *Salmonella* spp. in raw pork sausages**

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## Executive Summary

Raw pork sausages were sampled by Environmental Health Officers (EHOs) from retail establishments in Ireland between January and April 2008. Samples were analysed for salmonellae in the Official Food Microbiology Laboratories of the Health Service Executive (HSE). The results of 1098 samples were considered for this report. The following were the main findings:

1. Salmonellae were detected in 1.7% (n=19/1098) of samples. Three salmonellae serovars were identified: *S. Typhimurium* (n=17), *S. Brandenburg* (n=1) and *S. Bredeney* (n=1). These serovars are commonly isolated from pig carcasses and pig meat. Furthermore, in Ireland *S. Typhimurium* was the leading cause of human salmonellosis in 2008 accounting for 31% (139/447) of human isolates referred to the National Salmonella Reference Laboratory (NSRL, 2008).
2. Phage typing was performed on the 17 isolates of *S. Typhimurium*. Seven different phage types were identified: DT193 (n=6), DT104 (n=3), DT104b (n=3), DT12 (n=1), DT208 (n=1), DT27 (n=1), U302 (n=1), untypeable (n=1). Four of the phage types identified in this study (DT193, DT104, DT104b and U302) were among the most common reported phage types associated with human salmonellosis in the EU for the period 2006-2007.
3. The survey included a questionnaire through which information was collated on the sample source, the location of manufacture, the nature of the sausages (fresh or frozen), the type of packaging, labelling information etc. There was a 76.8% (844/1098) response rate to the questionnaire. The detailed data collated for this subset of survey samples revealed that 56.4% of sausages were sampled from supermarkets, 87.6% of sausages were manufactured by another food business establishment (i.e. in an establishment other than where the sausages were sampled), 90.8% of sausages were fresh (i.e. chilled as opposed to frozen) and 56.5% of sausages were pre-packaged.
4. 57.7% of samples were not appropriately labelled to inform the consumer of the need for thorough cooking prior to consumption. A breakdown by packaging type revealed that 38.2% (182/447) of pre-packaged samples and 87.7% (272/310) of loose samples did not carry this information on or near the sausages. Although it is normal practice in Ireland to thoroughly cook sausages prior to consumption, the provision of cooking instructions by manufacturers on raw sausages would be a useful reminder to consumers and would support the messages of national food safety campaigns. Furthermore, in some situations this labelling is a legal requirement (i.e. Article 6 of Commission Regulation (EC) No 2073/2005 on Microbiological Criteria for Foodstuffs and Article 11 of Directive 2000/13/EC). Considering that 73.5% (228/310) of loose sausages and 97.3% (464/477) of pre-packaged sausages were manufactured off-site (i.e. in an establishment other than where the sausages were sampled), the FSAI has requested official agencies to follow-up at manufacturing

level. This will also be undertaken at retail establishments manufacturing raw sausages.

The key to consumer health protection lies in the control of salmonellae in the national pig herd and the implementation of hygienic slaughter practices. Furthermore, as the presence of pathogenic bacteria in raw meat is not uncommon, the continuing education of consumers on good practices during handling, cooking and cooling of meat is essential. Some of these control strategies are discussed in this report.

## **Acknowledgements**

The Food Safety Authority of Ireland wishes to thank the Environmental Health Officers, the laboratory staff in the Official Food Microbiological Laboratories of the Health Service Executive and the laboratory staff in National Salmonella Reference Laboratory (Galway University Hospitals & School of Medicine at NUI Galway) who participated in this survey.

## Abbreviations

<b>DAFF</b>	Department of Agriculture, Fisheries & Food
<b>EHO</b>	Environmental Health Officer(s)
<b>ELISA</b>	Enzyme-Linked ImmunoSorbent Assay
<b>EU</b>	European Union
<b>FSAI</b>	Food Safety Authority of Ireland
<b>HACCP</b>	Hazard Analysis and Critical Control Point
<b>HSE</b>	Health Service Executive
<b>LA</b>	Local Authority
<b>MS</b>	Member State
<b>NSRL</b>	National Salmonella Reference Laboratory
<b>OFMLs</b>	Official Food Microbiology Laboratories of the Health Service Executive
<b>RTE</b>	Ready-to-Eat
<b>S.I.</b>	Statutory Instrument

## 1. Introduction

### ***Salmonella spp. in pigs and evidence for its spread through the food chain:***

In pigs, salmonellae infections are generally seen in 1<sup>st</sup> and 2<sup>nd</sup> stage weaners. Infection is often sub-clinical, although some animals may show clinical signs varying from mild diarrhoea to acute septicaemia and death. The greatest significance of salmonellae infection in pigs is the potential for its transmission through the food chain resulting in human infection and disease (EFSA, 2008a).

Infected pigs can remain carriers of salmonellae for up to 36 weeks (Wood and Rose, 1992) and can shed the bacterium in their faeces, especially when stressed (Nørrung and Buncic, 2008). A recent Irish study has shown that increased shedding occurs during transport and that there is a high risk of cross contamination from salmonellae positive to salmonellae negative animals during transport and lairage (Mannion *et al.*, 2008). It has been shown that pigs can acquire infection from the floors of contaminated pens in as little as 2 hours (Hurd *et al.*, 2001). Furthermore, contamination increases with time spent in the lairage. Carcase contamination increased from 9.3% to 27.3% when the time spent in lairage increased from < 24 hours to 66 hours respectively; while, caecal contamination increased from 18.5% to 47.7% for the same time periods (Morgan *et al.*, 1987).

Once carcasses are contaminated, salmonellae cannot be removed (carcass decontamination treatments other than washing in potable water are currently not authorised in the EU<sup>♦</sup>). During further processing such as cutting and mincing, salmonellae may spread from the carcass surface into the meat (e.g. fresh meat cuts, meat preparations) and into the manufacturing environment. At retail and consumer level, cross-contamination, improper storage and improper cooking temperatures can increase the risk of salmonellosis for consumers.

EU data for 2007 shows that salmonellosis is the second most commonly reported human zoonoses after campylobacteriosis (EFSA, 2009). Furthermore, it is the organism most commonly implicated in foodborne outbreaks (EFSA, 2009a). Pig meat and associated products accounted for 4.7% of all verified outbreaks caused by salmonellae in 2007 (EFSA, 2009a). Further information on salmonellosis and foodborne outbreaks attributed to salmonellae is provided in Appendix 1.

### ***Legal provisions for the control of salmonellae in the food chain:***

The European Commission have adopted a number of legal provisions which aim to reduce the risk of foodborne salmonellosis.

Regulation (EC) 2160/2003 sets out EU measures to control salmonellae and other specified food-borne zoonotic agents. It requires the establishment of European Community targets for the reduction of the prevalence of certain zoonoses and zoonotic

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<sup>♦</sup> EC Regulation No 853/2004 allows carcass decontamination treatments to be considered as a supplement to good hygiene practices. No decontamination treatments are currently authorised in the EU but the practice is authorised in a number of other countries worldwide.

agents in different animal populations at farm level. The purpose of setting these targets at farm level is to reduce the spread of salmonellae to the next stage of the food chain and finally to the consumer. Regarding pig populations, the European Commission is in the process of establishing targets for salmonellae reduction in slaughter pigs and foresees the establishment of targets for breeding pigs (further details are provided in Appendix 1). Once these targets are established, Member States (MS) must implement salmonellae control programmes to achieve them.

Commission Regulation (EC) No 2073/2005 lays down a process hygiene criterion<sup>⊗</sup> for salmonellae in pig carcasses and food safety criteria<sup>•</sup> for salmonellae in minced meat, meat preparations and meat products. The process hygiene criterion currently permits a prevalence of 10% salmonellae in pig carcasses; however, this is subject to review as progress is made in reducing the salmonellae prevalence in the pig population. Failure to comply with this criterion requires corrective actions including hygiene improvements. Despite the permitted prevalence of salmonellae on carcasses; minced meat, meat preparations and meat products should comply with the food safety criterion of no detectable salmonellae in 10g or 25g depending on the intended use of the product (see Appendix 2 for further details). Failure to comply requires the withdrawal or recall<sup>∞</sup> of the product in accordance with Article 19 of Regulation (EC) No 178/2002.

Testing against these criteria should be undertaken by FBOs as appropriate when validating and verifying the correct functioning of HACCP based procedures and other GHP. Regulation (EC) No 852/2004 requires food business operators carrying out any stage of production, processing and distribution of food after primary production to put in place, implement and maintain a permanent procedure or procedures based on the HACCP principles and GHP. All food business operators are required to comply with the general hygiene requirements laid down in Regulation (EC) No 852/2004 and the specific hygiene rules for foods of animal origin laid down in Regulation (EC) No 853/2004.

### ***Initiatives on-going in Ireland:***

A number of initiatives are on-going in Ireland. An all island study<sup>⊘</sup> has been undertaken to assess the risk factors contributing to the transmission of *Salmonella* spp. in pork in Ireland ([SafeFood / FIRM Funded Project, 2004 to 2009](#)<sup>⊘</sup>). Furthermore, DAFF are:

- 1) implementing a more detailed study of salmonellae prevalence in carcasses during slaughter with a view to enforcing better hygiene standards in slaughter plants and
- 2) revising the national salmonellae control programme (further details provided in Appendix 1) in consultation with the FSAI and other stakeholders. The risk factors

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<sup>⊗</sup> A process hygiene criterion indicates the acceptable functioning of the production process.

<sup>•</sup> A food safety criterion defines the acceptability of a product or a batch of foodstuffs and is applicable to products placed on the market.

<sup>∞</sup> A product recall is the removal of unsafe food from the consumer; whereas, a product withdrawal is the removal of an unsafe foodstuff from the market up to and including the point of retail sale.

<sup>⊘</sup> Project partners: Ashtown Food Research Centre, University College Dublin, Queens University, and University of Ulster.



identified by EFSA (EFSA, 2006; EFSA, 2008b) and the establishment of Community targets will inform future decisions regarding revisions to the national salmonella control programme.

***This study:***

To implement an effective control programme it is important to have knowledge of contamination levels at different stages in the production chain, i.e. from farm to fork (Boughton *et al.*, 2004). As very few studies have examined the prevalence of salmonellae in pork at retail level; this study was undertaken to collate baseline data on salmonellae serovars in pork sausages on retail sale in Ireland. Pork sausages were chosen as a representative retail pork meat preparation.

## **2. Specific Objectives**

The specific objective of this survey was to collate baseline data on salmonellae serovars in pork sausages on retail sale in Ireland with a view to determine prevalence, numbers and nature of salmonellae for future risk assessment purposes.

## **3. Method**

### **3.1 Sample Source**

Samples were obtained from retail establishments including butcher shops and supermarkets.

### **3.2 Sample Period**

Sampling took place between January and April 2008 inclusive.

### **3.3 Sample Description**

Raw pork sausages were sampled.

These samples included:

- Fresh and frozen sausages
- Loose and pre-packed sausages.

The following were excluded from this survey:

- Sausages containing a mixture of pork and meat from other species
- Pork sausages which were cooked or partly cooked
- Fermented ready-to-eat sausages, e.g. chorizo, salamis etc
- Other meat preparations and any meat products from pigs or any other species (e.g. rashers, cooked hams etc).

### **3.4 Sample Collection**

Sampling was undertaken by Environmental Health Officers (EHOs) from the Health Service Executive (HSE). The samples, which were taken at random across the country, covered a wide range of sausages. However, considering the large number of sausages available from both domestic and imported producers, all sausages on the market may not have been sampled. Multiple sampling of major brands was unavoidable, however, to minimise this problem, EHOs were requested where possible to:

- Sample local brands of sausages.
- Submit only one sample of each brand from each premise (If it was necessary to submit more than one sample per brand, EHOs were requested to ensure these were from different production batches).

The minimum sample size was 50g. EHOs were requested to complete sections 1, 2, 3 & 4 of the questionnaire provided (Appendix 3) at the time of sampling and transport samples to the OFML under appropriate conditions (i.e. in a cool box).

### 3.5 Sample Analysis

Samples were analysed for *Salmonella* spp. in the Official Food Microbiology Laboratories (OFMLs) of the Health Service Executive (HSE). These laboratories were requested to use the analytical reference method specified in Commission Regulation (EC) No. 2073/2005 when testing sausages for *Salmonella* spp., i.e. ISO 6579. This method requires definitive confirmation of isolates which are considered to be *Salmonella* spp or isolates which may be *Salmonella* spp. by a recognised salmonella reference centre. Therefore, OFMLs were requested to submit these isolates to the National Salmonella Reference Laboratory (NSRL) (Galway University Hospitals & School of Medicine at NUI Galway) for confirmation.

### 3.6 Reporting of Results

Results were reported as presence or absence of *Salmonella* spp. in 10g.

Laboratory reports from the OFMLs were forwarded to EHOs and the FSAI using the normal reporting channels. OFMLs were requested to forward reports to the FSAI within 1 month of the survey completion date.

Laboratory reports of follow-up samples were not included in this report as this type of sampling is not random and hence would bias the original data set.

### 3.7 Follow-up Action

Following a positive result from the Food Microbiology Laboratories of the HSE, EHOs were advised to notify the food business where the sausages were sampled. Furthermore,

- **If the sausages were manufactured in an establishment under the control of the HSE (e.g. butcher shop):**

EHOs were requested to identify the source of the raw meat and notify the relevant agency (e.g. Department of Agriculture, Fisheries and Food (DAFF) or the Local Authority Veterinary Service (LA)) of the result and review on-site hygiene practices with the food business operator (FBO).

- **If the sausages were manufactured in an establishment not under the control of the HSE:**

EHOs were requested to notify the agency (e.g. DAFF or LA) responsible for official control of the establishment where the sausages were manufactured.

- **If the sausages were imported:**

EHOs were requested to complete an incident report form and submit it to the rapid alert section of the FSAI.

In all cases where a positive result was confirmed by the NSRL, EHOs were advised to request the withdrawal of the contaminated batch from the market where such product was still on the market. Other appropriate follow-up action was determined by the EHO on a case by case basis.

### 3.8 Questionnaire Data

Upon receipt of the laboratory results, EHOs were requested to complete the questionnaire (Appendix 2) and return it to the FSAI within 6 weeks of the survey

completion date. Questionnaires received after this date were excluded from the analysis in this report.

### **3.9 Statistical Analysis**

Chi square ( $\chi^2$ ) and Fisher's Exact Test analysis was performed using SPSS version 14.0 (alpha = 0.05 significance level).

## 4. Results & Discussion

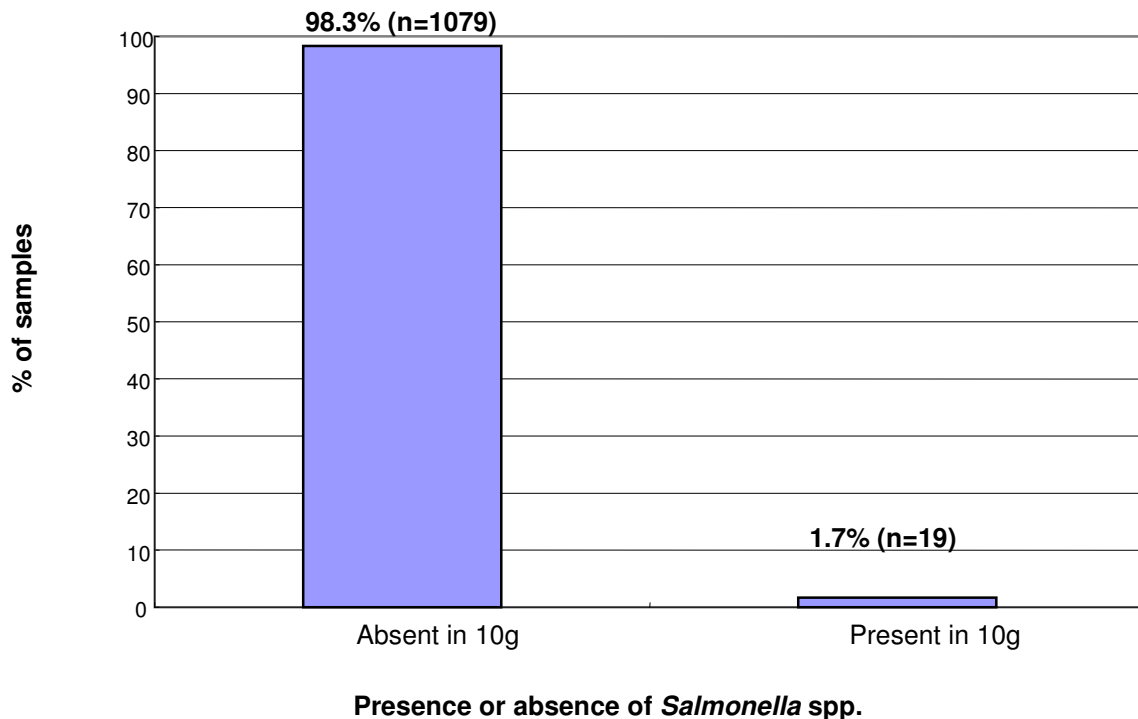
### 4.1 General Microbiological Results

1,101 samples were collected between January and April 2008 and were analysed by the seven Official Food Microbiology Laboratories of the HSE. Three of these samples did not meet the survey criteria; therefore, 1098 samples were considered for this report (Appendices 4 and 5).

Salmonellae were detected in 1.7% (19/1098) of samples (Figure 1). A higher prevalence was reported in an earlier Irish study (Boughton *et al.*, 2004) when sausages were sampled over two 8-week periods; i.e. from October to December 2001 and June to August 2002. In that study, the overall prevalence was 2.9% (27/921) with a higher prevalence occurring during the winter months (4.4%, 20/455). However, it should be noted that the sample size tested was 25g (compared to 10g in this current survey – Commission Regulation 2073/2005 requires testing of 10g samples) and thus the likelihood of detecting salmonellae (if present) was greater in the earlier study.

A more recent Irish study, reported the prevalence of salmonellae in 25g samples of raw pork (i.e. pork pieces, pork chops and minced pork which were sampled between January and November 2007) on retail sale as 2.6% (Prendergast *et al.*, 2009).

**Figure 1:** Presence or absence of *Salmonella* spp. in raw sausage samples (n=1098)



The sampling plan specified in Regulation 2073/2005 for salmonellae in meat preparations (e.g. sausages) requires 5 samples from the same production batch to be tested and salmonellae must not be present in any sample (Sampling plan: n=5, c=0; Microbiological limit: absence in 10g). Failure to comply with this criterion requires recall/withdrawal<sup>∞</sup> of the foodstuff in accordance with article 19 of Regulation (EC) No 178/2002. This survey examined single\* rather than batch samples (n=5). In relation to the 19 samples in which salmonellae were detected, EHOs investigated and took the necessary follow-up action with retailers and manufacturers to protect consumer health (see section 3.7). Product recalls were not considered proportional to the risk posed by contaminated raw sausages as it is common practice in Ireland to thoroughly cook sausages prior to consumption and consumers are regularly reminded of this fact by national food safety campaigns carried out by the State. The presence of pathogenic bacteria in raw meat and meat products is not uncommon, hence the need for good hygienic practices during handling, cooking and cooling.

#### 4.1.1 Serotyping and phage typing

Serotyping was performed on the 19 isolates and the findings are presented in Table 1. The majority of isolates (89.5%, n=17) were *Salmonella enterica* serovar Typhimurium. *Salmonella enterica* serovar Brandenburg and *Salmonella enterica* serovar Bredeney were also identified.

**Table 1: Serotyping of salmonellae isolates (n=19)**

Serovar	No. (%) of isolates
Typhimurium	17 (89.5)
Brandenburg	1 (5.3)
Bredeney	1 (5.3)

<sup>∞</sup> A product recall is the removal of unsafe food from the consumer; whereas, a product withdrawal is the removal of an unsafe foodstuff from the market up to and including the point of retail sale.

\* The EC in their *Guidance Document on official controls, under Regulation (EC) No 882/2004*, concerning microbiological sampling and testing of foodstuffs have stated that in the context of monitoring and surveillance programmes single samples may be used.

Phage typing was performed on the 17 isolates of *S. Typhimurium*. Seven different phage types were identified. *S. Typhimurium* DT193 accounting for over a third (35.3%, n=6) of all phage types (Table 2):

**Table 2: Phage Typing of *S. Typhimurium* (n=17):**

Phage Type	No. (%) of isolates
DT193	6 (35.3%)
DT104	3 (17.6%)
DT104b	3 (17.6%)
DT12	1 (5.9%)
DT208	1 (5.9%)
DT27	1 (5.9%)
U302	1 (5.9%)
Untypable	1 (5.9%)
Total	17 (100%)

The serovars identified in this study have previously been isolated from pigs at slaughter. The EU slaughter pigs baseline survey 2006-2007 (EFSA, 2008a) has shown that *S. Typhimurium*, *S. Bredeney* and *S. Brandenburg* were among the top ten serovars isolated from lymph nodes and the top five serovars isolated from carcass swabs.

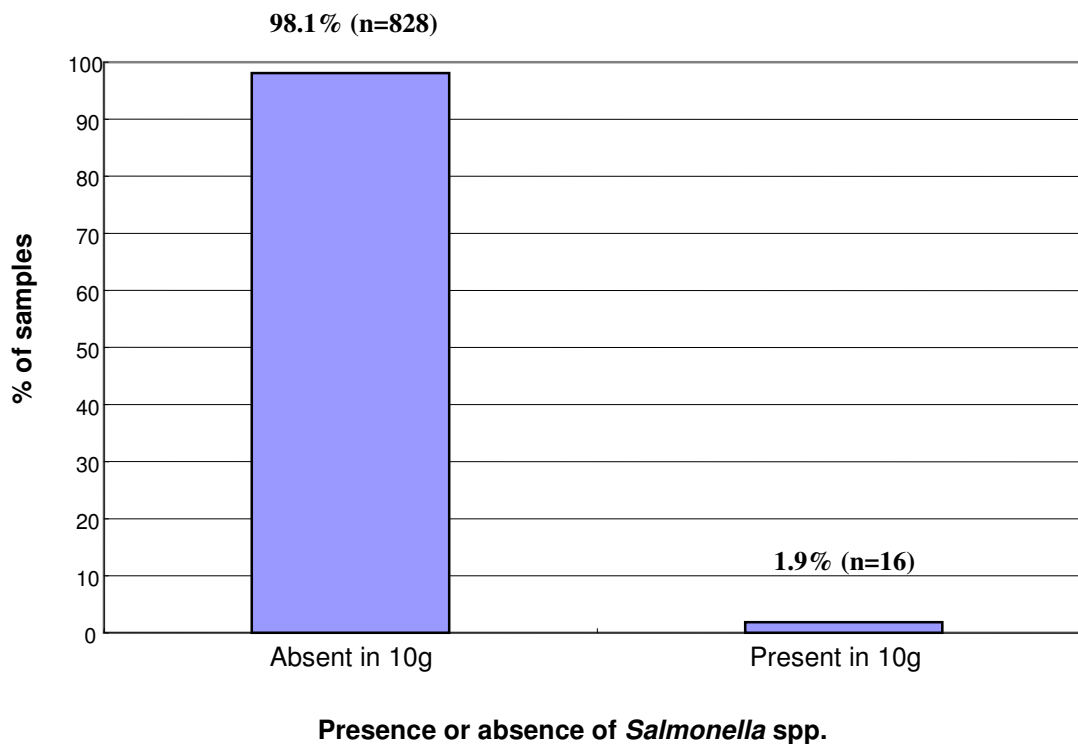
In relation to pig meat, these three serovars were amongst the top ten reported by the EFSA *Community Summary Report on Trends and Sources of Zoonoses and Zoonotic Agents in the EU in 2007* (EFSA, 2009). The overall data presented in that report from eight MS (including Ireland) showed that *S. Typhimurium* was the serovar most frequently isolated from pig meat (accounting for 37.6% of all isolates serotyped), while *S. Bredeney* and *S. Brandenburg* ranked 6<sup>th</sup> and 9<sup>th</sup> respectively (accounting for 2.8% and 1.6% of all isolates serotyped respectively). Similarly data presented in that report from Ireland, showed that *S. Typhimurium* was also the most frequently isolated serovar (accounting for 45.3% of all isolates serotyped), while *S. Bredeney* and *S. Brandenburg* ranked 3<sup>rd</sup> and 5<sup>th</sup> respectively (accounting for 10.3% and 3.4% of all isolates serotyped respectively) (EFSA, 2009).

The presence of *S. Typhimurium* in pig meat is significant as this serovar (after *S. Enteritidis*) is one of the main causes of confirmed salmonellosis cases in humans in the EU. Furthermore, four of the *S. Typhimurium* phage types identified in this study (DT193, DT104, DT104b and U302) were among the top six reported phage types attributed in the EU to confirmed salmonellosis cases in humans (EFSA, 2009). In Ireland, *S. Typhimurium* was the leading cause of human salmonellosis in 2008 accounting for 31% (139/447) of human isolates referred to the National Salmonella Reference Laboratory (NSRL); while, *S. Bredeney* accounted for 1.3% (6/447) (NSRL, 2008).

## 4.2 Survey Questionnaire

This survey included a questionnaire through which information was provided by the EHO on the: sample source, nature of the pork sausage (i.e. fresh or frozen), type of packaging (loose or pre-packed), location of manufacture (i.e. on the establishment where the product was sampled or elsewhere) and provision of information for the customer regarding the need for thorough cooking prior to consumption. A total of 844 questionnaires were returned within the specified time period (i.e. there was a 76.8% (844/1098) response rate) and these questionnaires were matched with the corresponding laboratory reports. The microbiological results of this subset of 844 samples are presented in Figure 2.

**Figure 2:** Microbiological Quality of raw sausages samples with accompanying questionnaire (n=844)



The microbiological results of these 844 samples are similar<sup>⊕</sup> to the microbiological results of the 1098 samples presented in Figure 1; therefore, in terms of microbiology these 844 samples are representative of the total sample population.

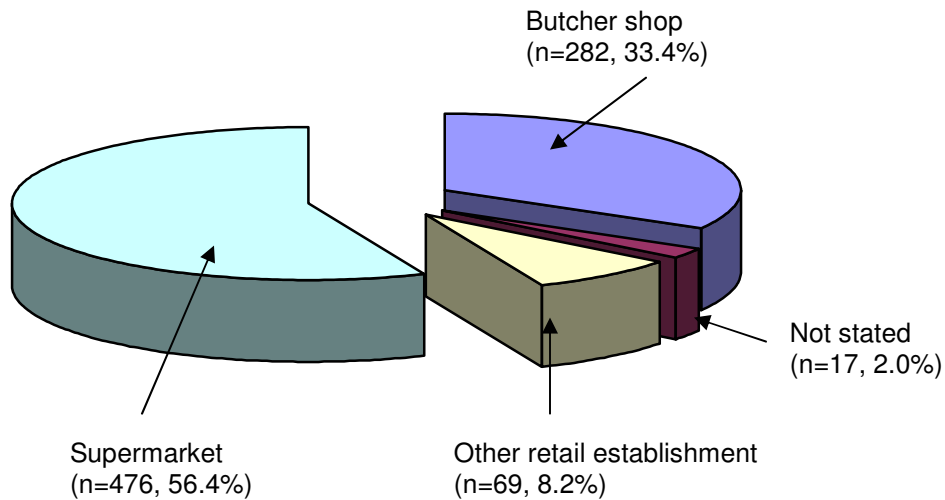
<sup>⊕</sup> No statistical difference (alpha = 0.05 significance level)



### 4.2.1 Sample source

The majority of samples (56.4%, 476/844) were reported to have been obtained from supermarkets. Other sample sources reported included butcher shops (33.4%, 282/844) and other retail establishments (8.2%, 69/844) (Figure 3).

**Figure 3:** Type of retail establishments where raw sausage samples were obtained (n=844)



**Other retail establishments (n=69):** canteen (n=1), corner shop (n=4), Deli (n=6), farm shop (n=2), forecourt (n=5), small grocery shop (n=29), fish shop (n=1), hospital (n=1), off licence (n=2), organic market stall (n=1), restaurant (n=2), mixed retail (n=1), type of other retail establishment not specified (n=14)

It was reported that only 10.1% (85/844) of sausages were manufactured on-site (i.e. on the retail establishment where they were sampled) (Table 3).

**Table 3:** Location of manufacture of sausages (n=844)

Location of manufacture of sausages	No. (%) of samples
On-site (i.e. On the retail establishment where the sausages were sampled)	85 (10.1%) <sup>⊕</sup>
Off-site (i.e. Establishments other than where the sausages were sampled)	739 (87.6%)
Not stated	20 (2.4%)
<b>Grand Total</b>	<b>844 (100%)</b>

<sup>⊕</sup> The majority of these samples were from butcher shops (n=73). Supermarkets (n=7) and other retail establishments (n=3) accounted for the remainder of the samples. Information regarding sample source was not provided for two samples.

A statistical analysis was undertaken to investigate if any relationship existed between the location of manufacture and the presence/absence of salmonellae (data presented in Table 4). This analysis revealed that the salmonellae findings were similar<sup>⊕</sup> irrespective of manufacturing location.

**Table 4:** Effect of location of manufacture on the presence/absence of *Salmonella* spp. (n=844)

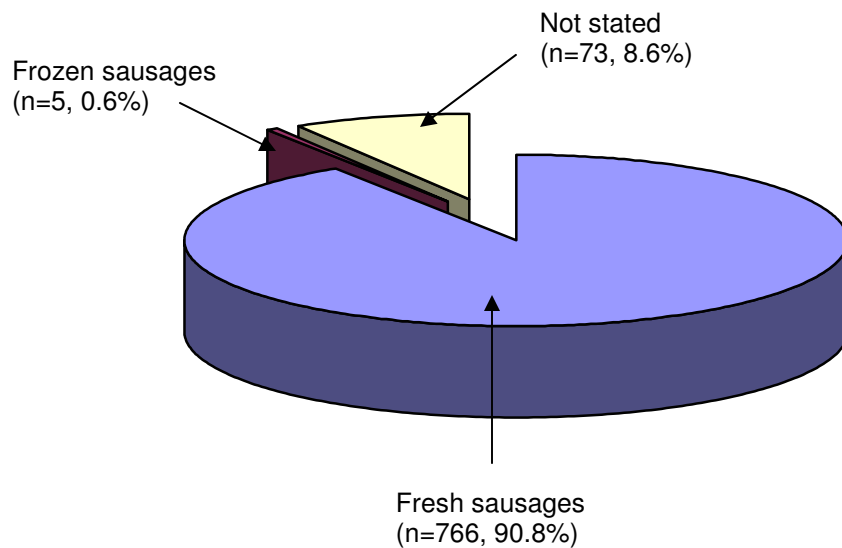
Location of manufacture of sausages	No. (%) of samples		
	Absence of <i>Salmonella</i> spp. in 10g	Presence of <i>Salmonella</i> spp. in 10g	Total
On-site (i.e. On the retail establishment where the sausages were sampled)	82 (96.5%)	3 (3.5%)	85
Off-site (i.e. Establishments other than where the sausages were sampled)	726 (98.2%)	13 (1.8%)	739
Not stated	19 (100%)	0 (0%)	20
<b>Grand Total</b>	<b>828 (98.1%)</b>	<b>16 (1.9%)</b>	<b>844</b>

<sup>⊕</sup> No statistical difference (alpha = 0.05 significance level)

#### 4.2.2 Fresh Vs. Frozen sausages

The majority of samples (90.8%, 766/844) were reported as fresh (Figure 4). Only 0.6% (5/844) samples were reported as frozen. Salmonellae were not present in any of the frozen samples (n=5); however, they were present in 1.8% (14/766) of fresh samples (Table 5).

**Figure 4:** Physical status of raw sausage samples, i.e. Fresh Vs. Frozen (n=844)



**Table 5:** Presence/absence of *Salmonella* spp. in fresh and frozen sausages (n=844)

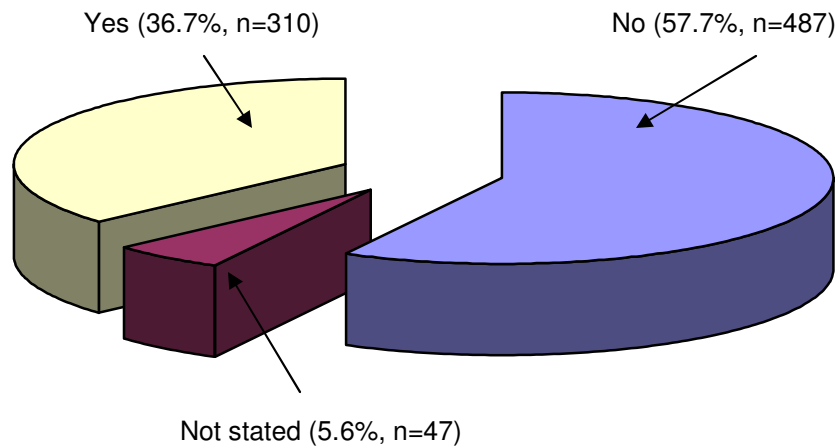
Fresh or Frozen sausages	No. (%) of samples		
	Absence of <i>Salmonella</i> spp. in 10g	Presence of <i>Salmonella</i> spp. in 10g	Total
Fresh	752 (98.2%)	14 (1.8%)	766
Frozen	5 (100%)	0 (0%)	5
Not stated	71 (97.3%)	2 (2.7%)	73
<b>Grand Total</b>	<b>828 (98.1%)</b>	<b>16 (1.9%)</b>	<b>844</b>

The sample size was too small to determine if freezing had a statistical effect on salmonellae prevalence in this study; however, it is well documented that during freezing, cells undergo physiological stress leading to sublethal injury. In relation to salmonellae, death is greater during the freezing process than during subsequent frozen storage (ICMSF, 1996). Serovars of salmonellae common in foods and environmental sources differ in their sensitivities to freezing and some foods provide substantial protection to the cells during freezing and frozen storage. Thus, although freezing can be detrimental to salmonellae in food it does not guarantee its complete destruction. Regarding salmonellae in sausages, a study by Boughton *et al.* (2004) found that salmonellae levels were reduced to undetectable levels in 50% (6/12) of sausage samples after freezing at -20°C. A study by Escartin *et al.* (2000) on salmonellae in raw pork also showed a clear trend towards a decrease in counts during frozen storage.

### 4.2.3 Labelling information

In response to the question ‘Did the labelling on or near the sausages: inform the consumer of the need for thorough cooking prior to consumption?’ it was reported that 57.7% of samples did not carry this information on the label (Figure 6).

**Figure 6:** Responses to question ‘Did the labelling on or near the sausages inform the consumer of the need for thorough cooking prior to consumption?’ (n=844 responses)



A breakdown of response by packaging type shows that this information was not provided for 38.2% of pre-packaged sausages compared to 87.7% of loose sausages (Table 7).

**Table 7:** Relationship between type of packaging and response to question ‘Did the labelling on or near the sausages inform the consumer of the need for thorough cooking prior to consumption?’

Type of packaging	No. of samples (% of samples)			Grand Total
	Response to question: ‘Did the labelling on or near the sausages inform the consumer of the need for thorough cooking prior to consumption?’			
	Yes	No	Not stated	
<b>Pre-packaged</b>	272 (57.0%)	182 (38.2%)	23 (4.8%)	477 (100%)
<b>Loose</b>	17 (5.5%)	272 (87.7%)	21 (6.8%)	310 (100%)
<b>Not stated</b>	21 (36.8%)	33 (57.9%)	3 (5.3%)	57 (100%)

Although it is normal practice in Ireland to thoroughly cook sausages prior to consumption, the provision of cooking instructions on raw sausages by manufacturers would be a useful reminder to consumers and would support the messages of national food safety campaigns. Furthermore, two pieces of EU legislation lay down labelling requirements:

- Article 6 of Regulation 2073/2005 on Microbiological Criteria for Foodstuffs applies to certain foodstuffs including meat preparations (all species) intended to be eaten cooked. When meat preparations complying with the food safety criterion for salmonellae (Sampling plan: n=5 & c=0; Microbiological limit: Absence in 10g) are placed on the market, they must be clearly labelled by the manufacturer to inform the consumer of the need for thorough cooking prior to consumption. This applies whether the food is placed on the market pre-packaged or loose<sup>⊗</sup>.
- Notwithstanding the above, pre-packaged food must comply with Directive 2000/13/EC (relating to the labelling, presentation and advertising of foodstuffs). Article 11 requires that instructions for use of a foodstuff shall be indicated in such a way as to enable appropriate use to be made thereof, e.g. where cooking is required then cooking instructions must be provided.

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<sup>⊗</sup> It should be noted however, that a manufacturer may contend that they are not required to comply with Article 6 where the microbiological criterion for meat preparations intended to be eaten raw are met (Sampling plan: n=5 c=0; Microbiological limit: absence in 25g). In this instance it would be up to the food business operator to demonstrate that all tested batches comply with this microbiological criterion and that the product is handled and distributed as a ready-to-eat foodstuff.

Considering that 73.5% (228/310) of loose sausages and 97.3% (464/477) of pre-packaged sausages were manufactured off-site (i.e. on establishments other than where the sausages were sampled), the FSAI has requested official agencies to follow-up at manufacturing level to ensure manufacturers are aware of their legal obligations regarding labelling. This will also be undertaken at retail establishments manufacturing sausages.

## 5. Main Findings and Conclusions

Salmonellae were detected in 1.7% (19/1098) of raw pork sausages. The isolation from raw sausages of salmonella serovars and phage types typically associated with human salmonellosis suggests that salmonellae may be transmitted via sausages to consumers. Further evidence of this comes from additional work undertaken by the NSRL on the *S. Typhimurium* isolated during this survey (Appendix 7).

There is no step in the manufacture of raw pork sausages that can eliminate salmonellae and since EU legislation permits a low percentage of salmonellae contaminated pig carcasses it is expected that salmonellae will be found in pork preparations such as sausages. The key to consumer health protection lies in the control of salmonellae in the national pig herd and hygienic slaughter practices. This coupled with continuing education of consumers on hygienic handling and cooking of raw meat is essential. Some of these control strategies are discussed below:

### **1) More stringent controls from farm to abattoir:**

In Ireland, progress is being made in this regard. An all-island study has been undertaken to assess the risk factors contributing to the transmission of salmonellae in pork. Furthermore, DAFF are: 1) implementing a more detailed study of salmonellae prevalence in carcasses during slaughter with a view to enforcing better hygiene standards in slaughter plants and 2) revising the national salmonellae control programme in consultation with the FSAI and other stakeholders.

At European level, the Commission is in the process of established targets for salmonellae reduction in slaughter pigs and is expected to set targets in breeding pigs.

### **2) Maintenance of the cold chain:**

Under Article 4 of Regulation (EC) No 852/2004, all food business operators have a legal obligation to maintain the cold chain. Consumers should also be aware of the importance of temperature control to prevent the proliferation of microorganisms such as salmonellae in raw pork sausages.

### **3) Implementation of good hygiene practices throughout the food chain:**

All food business operators are required to comply with the general hygiene requirements laid down in Regulation (EC) No 852/2004; while, specific hygiene rules for foods of animal origin are laid down in Regulation (EC) No 853/2004. Furthermore, food business operators carrying out any stage of production, processing and distribution of food after primary production are required to put in place, implement and maintain a permanent procedure or procedures based on the HACCP principles (Regulation (EC) No 852/2004).

Good hygienic practices will minimise the proportion of sausages that contain salmonellae; however, it will not eliminate this pathogen. Therefore, consumers should be aware of the risk associated with handling raw pork sausages and should adopt good hygiene practices to avoid cross contamination in the kitchen.



#### **4) Adequate cooking:**

Finally the importance of adequate cooking cannot be over emphasised. To inactivate bacterial pathogens including salmonellae, food should be cooked to a core temperature of 75°C or an equivalent time temperature combination (e.g. 70°C for 2 minutes) (NSAI, 2007). Although it is normal practice in Ireland to thoroughly cook sausages prior to consumption, the provision of cooking instructions by manufacturers on raw sausages would be a useful reminder to consumers and would support the messages of national food safety campaigns. Furthermore, two pieces of EU legislation lay down labelling requirements. This survey revealed that cooking instructions were not carried on 38.2% of pre-packaged sausages and 87.7% of loose sausages. Considering that 73.5% (228/310) of loose sausages and 97.3% (464/477) of pre-packaged sausages were manufactured off-site (i.e. on establishments than where the sausages were sampled), the FSAI has requested official agencies to follow-up at manufacturing level to ensure manufacturers are aware of their legal obligations regarding labelling. This will also be undertaken at retail establishments manufacturing raw sausages.

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## **APPENDIX 1**

### **Salmonellosis and foodborne outbreaks**

*Salmonella* spp. are zoonotic bacteria which can potentially be transmitted to humans through direct contact with infected animals or through ingestion of contaminated foodstuffs (the latter may arise as a result of improper cooking or poor hygienic and handling practices resulting in cross-contamination of ready-to-eat foods from bacteria on raw foods). Human salmonellosis is usually characterised by acute onset of fever, abdominal pain, nausea and vomiting. The symptoms are often mild and most infections are self limiting, lasting a few days. However, a small proportion of affected people exhibit more severe complications and long term sequelae such as reactive arthritis (EFSA, 2009).

The incidence of salmonellosis continues to decrease in the EU with a statistically significant downward trend over the past four years; however, it is still the second most commonly reported human zoonoses after campylobacteriosis (EFSA, 2009). In 2007, a total of 151,995 confirmed cases of human salmonellosis were reported in the EU (i.e. 31.1 cases per 100,000). In Ireland, the incidence of confirmed salmonellosis (10.2 cases per 100,000) is much lower than the EU average although it generally accepted that laboratory confirmed cases of salmonellosis represent and a significant underestimate of the actual incidence of infection.

Regarding foodborne outbreaks, EU data from 2007 show that salmonellae were the most commonly reported cause. Twenty-two MS reported 2,201 outbreaks and 26.8% (n=590) of these were verified. The verified outbreaks affected 8,922 people, resulted in 1,773 hospitalisations and caused 10 deaths. *S. Enteritidis* followed by *S. Typhimurium* were the predominant serovars (very few outbreaks provided precise information of the isolated phage type). Information on the food vehicle was provided in 87.6% of verified outbreaks. Eggs and egg products were the most frequently implicated sources accounting for 42% of all verified outbreaks. Pig meat and products thereof accounted for 4.7% of all verified outbreaks (EFSA, 2009a). In relation to the latter, pork meats have been identified as a significant source of salmonellae. More specific conclusions about the relative importance of specific meat categories, (e.g. fresh meat, minced meat, meat products, meat preparations) cannot be made (EFSA, 2008c).

#### **Legal provisions for the control of salmonellae in the food chain**

##### **Regulation (EC)2160/2003:**

Regulation (EC) 2160/2003 sets out EU measures to control salmonellae and other specified food-borne zoonotic agents. It forsee the establishment of Community targets for the reduction of the prevalence of certain zoonoses and zoonotic agents in the animal population. The Commission is in the process of establishing targets for salmonella reduction in slaughter pigs and forsee the establishment of targets for breeding pigs. In order to set this target, a 12 month EU-wide baseline survey, from 1<sup>st</sup> October 2006, was undertaken to collate comparable data on the prevalence of salmonellae in populations of

slaughter pigs (Commission Decision 2006/668/EC). Pigs were randomly selected from slaughterhouses that accounted for 80% of pigs slaughtered within each MS. All of the participating MS sampled ileo-caecal lymph nodes; while, 13 MS also collected carcass swabs from the same pigs to determine the rate of carriage of salmonellae from animals to carcasses post slaughter and dressing. This survey found a Community prevalence of salmonellae in 10.3% of ileo-caecal lymph nodes (prevalence in Ireland was 15.4%) and an overall prevalence of 8.3% on carcasses (prevalence in Ireland was 16.8%) (EFSA, 2008a). In the risk factor analysis, an association was observed between the prevalence of slaughter pigs infected with salmonellae in their lymph nodes and the frequency of surface contamination on the carcass. However, contaminated carcasses could also occur from uninfected pigs, suggesting potential for cross-contamination in the slaughterhouse environment (EFSA, 2008b). This potential for cross contamination has also been demonstrated in a recent Irish study (Prendergast *et al.*, 2008). Once the Community targets for salmonellae reduction in slaughter pigs are established, MS will be required to implement control programmes to achieve them. It should be noted that many MS (including Ireland) already have salmonellae control programmes in place for pigs although these may need to be reviewed and possibly revised to achieve Community targets.

### **The National Salmonellae Control Programme**

In Ireland, the national salmonellae control programme which is run by the Department of Agriculture, Fisheries and Food (DAFF) aims to reduce the incidence of salmonellae in carrier pigs at slaughter (Teagasc, 2008; Kelliher, 2002). Under this programme every herd must be tested (ELISA method) on an on-going basis to establish its salmonellae status. Based on these results herds are categorised into low, medium and high incidence (category 1, 2 and 3 respectively) (S.I. No. 111 of 2007). Responsibility for testing rests with the herd owner and if a valid categorisation certificate is not available at the time of slaughter then the herd must be treated as category 3. Pigs from category 3 must be slaughtered on separate days or times and selected offal and head meat from these herds are considered unfit for human consumption unless they are heat treated. Unfit meat must be isolated, marked, stained, stored and disposed of in accordance with legislative requirements (S.I. No. 114 of 2007).

## APPENDIX 2

**Food safety criteria** for *Salmonella* spp. in minced meat, meat preparations and meat products as specified in Commission Regulation (EC) No 2073/2005 on Microbiological Criteria for Foodstuffs

Food category	Sampling plan <sup>⊗</sup>		Limit		Analytical reference method	Stage where the criterion applies
	n	c	m	M		
Minced meat and meat preparations intended to be eaten raw	5	0	Absence in 25g		EN/ISO 6579	Products placed on the market and during their shelf life
Minced meat and meat preparations made from other species than poultry intended to be eaten cooked	5	0	Absence in 10g		EN/ISO 6579	Products placed on the market and during their shelf life
Meat products intended to be eaten raw, excluding products where the manufacturing process or the composition of the product will eliminate the salmonella risk	5	0	Absence in 25g		EN/ISO 6579	Products placed on the market and during their shelf life

<sup>⊗</sup> For official sampling, single samples are permitted at retail level (single sampling should be done in the context of a monitoring and surveillance programme).

**NOTE:**

For a full interpretation of these criteria please consult Commission Regulation (EC) No 2073/2005 <sup>1</sup> and the EU Guidance document on official controls <sup>2</sup>:

1. [http://www.fsai.ie/legislation/food/eu\\_docs/Food\\_hygiene/Consol\\_Reg2073\\_2005\\_01Jan06.pdf](http://www.fsai.ie/legislation/food/eu_docs/Food_hygiene/Consol_Reg2073_2005_01Jan06.pdf)

2. [http://www.fsai.ie/legislation/food/eu\\_docs/Food\\_hygiene/EU\\_Guidance\\_882.pdf](http://www.fsai.ie/legislation/food/eu_docs/Food_hygiene/EU_Guidance_882.pdf)

## APPENDIX 3

### FINAL Questionnaire 08NS1: Prevalence of *Salmonella* spp. in pork sausages

#### 1. General Information:

- \* EHO Name: \_\_\_\_\_
- \* EHO Sample Reference Number (i.e. EHO's own personal reference number for the sample) \_\_\_\_\_
- \* Laboratory Reference Number (upon receipt of lab report) \_\_\_\_\_

#### 2. Premises Information (see Section 3 of protocol):

- \* Supermarket ; Butcher Shop ; Other retail establishment  Please specify: \_\_\_\_\_

#### 3. Sample information:

Product name/description: \_\_\_\_\_

Batch code: \_\_\_\_\_

Nature of pork sausage: Fresh  or Frozen   
Type of packaging: Loose  or Pre-packed

#### Did the labelling on or near the sausages:

- i) inform the consumer of the need for thorough cooking prior to consumption?  
Yes  or No
- ii) provide a Use-by  or a Best-before date   
Please record the date provided: \_\_\_\_\_

#### 4. Location of manufacture:

Were the sausages prepared on the premises where the product was sampled? Yes  or No

#### If yes, please state:

i) Approval number of the plant which supplied the meat: \_\_\_\_\_

#### If no, please state:

i) The name & address of manufacturer: \_\_\_\_\_

ii) Approval number of the manufacturing premises: \_\_\_\_\_

#### 5. Microbiological results

Satisfactory  Or Unsatisfactory\*

\* A sample should only be classified as unsatisfactory following definitive typing at the National Salmonella Reference Laboratory (see section 8 of the protocol)

#### 6. Follow-up action (see section 10 of protocol):

(Follow-up action is only required for unsatisfactory results. Please tick as many boxes as necessary)

- Notify FBO:
- Notification of result to other agency: DAFF  or Local Authority  or FSAI
- Review of hygiene practices:
- Product withdrawal:
- Other action (please provide details): \_\_\_\_\_



## APPENDIX 4

### Number of Samples Submitted from each Health Service Executive (HSE) Region and Area:

HSE Region	HSE Area	Number of Samples Submitted
HSEDMLR	East Coast Area	65
	Midlands Area	96
	South Western Area	109
HSEWR	Mid-Western Area	97
	North Western Area	86
	Western Area	93
HSEDNER	North Eastern Area	92
	Northern Area	56
HSESR <sup>♦</sup>	South Eastern Area	288
	Southern Area	116
<b>Total</b>		<b>1098</b>

♦ 3 samples submitted from the HSESR were not included in the final data set as they did not meet the survey protocol regarding sample source.

## APPENDIX 5

### Number of samples analysed in each Food Microbiology Laboratory:

Official Food Microbiology Laboratory	Number of Samples Analysed
Cherry Orchard	187
Cork	116
Galway	93
Limerick	97
Sligo <sup>⊕</sup>	86
SPD	231
Waterford <sup>⊕</sup>	288
<b>Grand Total</b>	<b>1098</b>

⊕ 2 samples analysed in Cork Food Microbiology Laboratory & 1 sample analysed in Waterford Food Microbiology Laboratory were not included in the final data set as they did not meet the survey protocol regarding sample source.

## APPENDIX 6

### Salmonella results by Health Service Executive (HSE) Region and Area:

HSE Region	HSE Area	Number of Samples		
		<i>Salmonella</i> spp. absent in 10g	<i>Salmonella</i> spp. present in 10g	Total no.
<b>HSEDMLR</b>	East Coast Area	64	1	65
	Midlands Area	92	4	96
	South Western Area	108	1	109
<b>HSEWR</b>	Mid-Western Area	97	0	97
	North Western Area	83	3	86
	Western Area	90	3	93
<b>HSEDNER</b>	North Eastern Area	90	2	92
	Northern Area	54	2	56
<b>HSESR♦</b>	South Eastern Area	285	3	288
	Southern Area	116	0	116
<b>Total</b>		<b>1079</b>	<b>19</b>	<b>1098</b>

## APPENDIX 7

### Evidence of Links between *S. Typhimurium* in Humans, Food and Food Animals.

All salmonellae isolated from raw sausages were sent by the OFMLs to the National Salmonella Reference Laboratory (NSRL) for confirmation of speciation (this is a requirement of the salmonella testing method ISO 6579).

Additional analysis was undertaken by the NSRL on the *S. Typhimurium* isolates after the completion of this survey. This additional work (although not a requirement of the survey) is reported in this appendix as it shows five distinct clusters (similarities) between *S. Typhimurium* isolated from raw sausages and humans. In two of these clusters (cluster no. 1 and 2) the link is complete between animal, food and humans. It is important to note that the isolates from sausages and human illness that were identified in these five clusters were not linked by an epidemiological study.

Cluster No.	Isolate No.	Source	Phage type	Antibiotic resistance <sup>♦</sup>	MLVA profile <sup>♦</sup>
1	S08-0188	Pork sausages	DT104	ACSSuT	02-07-11-04-03
	S08-0189	Pork sausages	DT104	ACSSuT	02-07-11-04-03
	S08-0359	Swine faeces	DT104	ACSSuT	02-07-11-04-03
	S08-0603	Human	DT104	ACSSuT	02-07-11-04-03
	S08-0821	Human	DT104	ACSSuT	02-07-11-04-03
	S08-0943	Human	DT12	ACSSuT	02-07-11-04-03
2	S08-0310	Raw sausage	DT104b	ACSSuT	02-07-19-05-03
	S08-1308	Swine carcass	DT104b	ACSSuTTm	02-07-19-05-03
	S08-0269	Human	DT104b	ACSSuT	02-07-19-05-03
3	S08-0448	Raw sausage	DT104b	ACSSuT	02-08-03-04-03
	S08-0823	Human	DT104b	ACSSuTTm	02-08-03-04-03
4	S08-0416	Raw sausage	DT193	ACSSuTTm	04-11-06-00-02
	S08-0417	Raw sausage	DT193	ACSSuTTm	04-11-06-00-02
	S08-0414	Human	DT193	ACSSuTTm	04-11-06-00-02
	S08-0438	Human	DT193	ACSSuTTm	04-11-06-00-02
5	S08-0062	Pork sausage	DT193	ACSSuTTm	04-15-05-13-02
	S08-0379	Human	DT193	ACSSuTTm	04-15-05-13-02

- ♦ Resistance to: A=Ampicillin, C=Chloramphenicol, S=Streptomycin, Su=Sulphonamide, T=Tetracycline and Tm= Trimethoprim
- Multi locus variable number tandem repeat analysis (MLVA) is a new technology that allows for very fine discrimination between isolates that appear very closely related by other methods including PFGE.

This information was published in the NSRL annual report for 2008 (NSRL, 2008).