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FoodMicro Database Report

A Harmonised System for Approval and Monitoring of Private Laboratories Testing for Foodborne Pathogens

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A Harmonised System for Approval and Monitoring of Private Laboratories Testing for Foodborne Pathogens

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This research project was made possible through the co-operation of Department of Agriculture and Food (DAF) and Department of Agriculture and Rural Development for Northern Ireland (DARD) approved private laboratories on the island of Ireland. A list of the laboratories that participated in 2002 and 2003 is contained in Annex 1.

Collation of the data in the FoodMicro Database was made possible through the financial support of ***safe*food**, the Food Safety Promotion Board.

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THE DEPARTMENT OF AGRICULTURE & FOOD
AN ROINN TALMHAÍOCHTA AGUS BIA

Foreword

Food safety is the primary responsibility of food producers and the vast majority of food surveillance on the island of Ireland is undertaken by the food industry to monitor their products and processing establishments. Food surveillance enables the identification of the main vehicles of the foodborne pathogens and the tracking of trends in the incidence of specific pathogens in particular foods over time. Despite huge amounts of potentially useful data being generated annually via food industry testing, these data have not until now been collated and made more widely available.

A recent ***safe*food** consultation paper, 'Towards the Enhancement of Foodborne Disease Surveillance', indicated that the guiding principles for the development of surveillance on the island of Ireland should be the integration of the currently disparate systems of human illness, zoonoses and food surveillance. Integration of these systems and publication of combined integrated data would achieve the objectives of foodborne disease surveillance more completely and efficiently through timely sharing of food safety epidemiological information. Such information would greatly assist in the prevention of foodborne disease and help identify critical points along the food chain.

The FoodMicro Database is a major step towards such integration of surveillance information. The Database is a harmonised system for collating data arising from food and environmental testing for foodborne pathogens performed by the food industry and analysed by independent laboratories approved by the Department of Agriculture and Rural Development (DARD) and/or the Department of Agriculture and Food (DAF) on the island of Ireland.

This is the first report from the FoodMicro Database and its completion highlights the high level of co-operation between food producers and the regulatory agencies in ensuring the highest standards of safety and quality of food in the Republic of Ireland (ROI). The FoodMicro Database contains information on over 300,000 microbiological tests undertaken by the ROI food industry during 2002 and 2003. The next phases in the development of the FoodMicro Database will be the incorporation of similar data for food produced in Northern Ireland and an updating of the data on a regular basis.

***safe*food** wishes to extend its appreciation and gratitude to the project coordinators, DAF and DARD, as well as the approved laboratories for their generous collaboration and support of the project.

Dr. Thomas Quigley
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Contents

List of Figures

List of Tables

1. Introduction

Food safety is the cornerstone of the food industry nationally and internationally. In 2002 the agri-food industry in the Republic of Ireland (ROI) accounted for 8.4 % of Gross Domestic Product (GDP), and represented almost 10% of the ROI workforce (Annual Review and Outlook for Agriculture and Food 2002/2003). Primary agriculture remains more important to the economy of ROI than in most other European states. During the last decade, food safety has attracted significant public interest worldwide due to growing concerns about food safety, production methods, animal welfare and environmental issues. Each Member State of the European Union (EU) is responsible for control and enforcement of EU Directives regarding food safety at the primary production stage up to the processing stages and beyond. Although the primary responsibility for ensuring the safety of food rests with the food producers themselves, it is through the respective roles of industry and government that effective food safety systems are developed and maintained. The primary function of national authorities is to ensure that such systems are well established and controlled.

In ROI the Department of Agriculture and Food (DAF) and other agencies monitor the effectiveness of these systems throughout the food chain from "farm to fork". The more reliable the epidemiological information available to the stakeholders, the more effective the analysis of risks from various foods and any corrective or preventive actions put in place.

Data on the potential risks posed to the consumer from different foods are available from two main sources. Firstly, there are data from testing undertaken by the food industry to monitor their products and processing establishments and, secondly, there are data from testing generated by the regulatory agencies validating, monitoring and verifying process control measures applied by industry. The vast bulk of data on food safety is generated by the producer testing in their own or private laboratories and in most European countries these data are not generally released for public evaluation. Food safety data available to the regulatory agencies in the ROI is primarily (but not exclusively) generated by official testing undertaken in laboratories of DAF or Department of Health and Children, or their agencies.

The bacteriological testing of food producing animals, and food at various stages during its passage from farm to table, is an essential component of protection of the consumer from foodborne pathogens. The earlier in the food chain that pathogens are controlled, the less risk there is that consumers will be exposed to potential illness and death. In a recent all-island study, coordinated by the National Disease Surveillance Centre (NDSC), it was found that 23% of those who had suffered gastroenteritis reported that it was likely to

have been caused by consuming contaminated food or water. It was also estimated that 17.4% of those with acute gastroenteritis, or a member of their family, had to take time off work due to their illness. This results in approximately 1.5 million working days lost each year on the island of Ireland due to acute gastroenteritis or an estimated €173.5 million in lost earnings.

In the ROI, the sectors of the food industry regulated by DAF must analyse all samples collected in laboratories approved by DAF. These laboratories are required to comply with certain conditions to maintain their approval status. These include using test methods approved by the Central Veterinary Research Laboratory (CVRL), or the Central Meat Control Laboratory (CMCL), Abbotstown. They must also participate in a national proficiency ring trial organised annually by the CVRL and submit all isolates of *Salmonella* for confirmatory testing. In addition, each month all approved private laboratories submit a summary of tests undertaken on food and related samples during the month to the CVRL.

To standardise reporting of the test results, a monthly reporting template was designed for the laboratories to complete. This was designed after a series of discussions were undertaken with all the private laboratories, firstly in the ROI and subsequently in Northern Ireland (NI). Overall, 25 private laboratories (23 in ROI and 2 in NI) testing food or other samples from food processing plants regulated by DAF, were visited and agreed to contribute fully to this food safety initiative (Annex 1). A database (the FoodMicro Database) was created to collate and analyse all of the data supplied. This agreed template was based on the annual EU Zoonoses report categories, which are:

1) Raw Meat;
2) Raw Meat Products;
3) Cooked Meat and Cooked Meat Products - further divided into bovine (beef and veal), porcine (pork, ham, bacon etc), chicken, turkey, ovine (lamb, mutton etc), and not specified;
4) Fish and Fish Products - broken down into shellfish and molluscs, other fish raw, fish products raw, and cooked fish and fish products;
5) Eggs and Egg Products - divided into table eggs (raw), egg products (raw) and egg products (ready to eat);
6) Dairy Products - subdivided into raw milk, pasteurised milk, milk powder and dairy products not specified;
7) Other Food Products - which includes ready-to-eat foods, prepared foods (to be cooked), food grade water, vegetables and fruit (including salads), mushrooms and foods not specified;
8) Samples from Food Premises - categorised as environmental dust, environmental swabs, and environmental not specified;

9) Food Related Samples – Raw Materials for Mushroom Production, are further broken down as mushroom casings, sugar beet lime processed, sugar beet lime raw, mushroom compost, peat and shavings.For all of the above categories data are maintained on testing for *Salmonella*, *Listeria*, *Campylobacter* and verocytotoxigenic *Escherichia coli* (VTEC) O157. All suspect *Salmonella* isolates are sent from the private laboratories to CVRL for confirmatory testing and typing;
10) *Salmonella* Monitoring Programme for the Poultry Sector - this category records the *Salmonella* testing on dust (breeders, broilers and layers), fluff (hatchery fluff), cloacal swabs, drag/sponge swabs, chick box liners, meconium, litter (bedding or faecal droppings), dead in shells, water, and post mortem samples.

Animal Feed Samples are also recorded; these are broken into three final groupings.

11) Feed Ingredients - including ingredients of animal origin and ingredients not specified.
12) Finished Feed - including feed for poultry, feed for animals (excluding poultry) and feed not specified.
13) Feed Mills - environmental dust including feed for poultry, feed for animals (excluding poultry) and feed not specified.

As most laboratories submitted the information electronically, it allowed the data to be processed quickly. All sample details remained confidential to the private laboratories and their customers, except in cases where a food safety issue was suspected. Generally, only summary data are used by the regulatory agencies for trend analysis and food safety monitoring purposes. The FoodMicro Database was established to gather all of the information on samples originating in the ROI that are tested by private laboratories in both ROI and NI and collate that information into one central database. It therefore represents a laboratory-based monitoring system for the food production sector regulated by DAF. The FoodMicro Database was launched by Mr. Noel Treacy, the then Minister of State at DAF, in June 2002.

This is the first report from the FoodMicro Database and its completion highlights the high level of co-operation between food producers and the regulatory agencies in ensuring the highest standards of safety and quality of food in the ROI. The FoodMicro Database contains information on over 300,000 microbiological tests undertaken by the ROI food industry during the years 2002 and 2003.

2. Salmonellosis

Salmonellosis is a major cause of bacterial enteric illness in both humans and animals. *Salmonella* spp. and *Campylobacter* spp. are the leading causes of zoonotic infections in the European Union. Although *Salmonella* spp. can infect a wide range of host species including mammals, birds, reptiles and fish, they infrequently cause clinical disease in these animals. Of the 2,541 *Salmonella* serovars described in the Kauffmann–White scheme (Popoff et al, 2004), *Salmonella* Enteritidis and *Salmonella* Typhimurium account for the majority of human infections. The NDSC Annual Report in 2003 listed *S.* Enteriditis as accounting for 40% and 42% and *S.* Typhimurium as accounting for 34% and 28% of human infections with *Salmonella* serotypes in the Republic of Ireland in the years 2002 and 2003, respectively.

Human infection can be acquired through direct contact with carrier domestic or wild animals or through the consumption of contaminated foods or water. *Salmonella* Enteritidis infection is most commonly associated with the consumption of chicken and lightly cooked egg dishes. *Salmonella* Typhimurium is associated with the consumption of a variety of foods including beef, dairy produce, pork, lamb, chicken and turkey. In addition, outbreaks of infection with *Salmonella* serotypes have been associated with poor cooking, reheating and poor food handling. Salmonellosis presents as an acute enterocolitis, with sudden onset of headache, abdominal pain, diarrhoea, nausea and occasionally vomiting. Fever is almost always present.

A total of 87,464 and 96,768 tests for *Salmonella* serotypes were recorded on the FoodMicro Database during 2002 and 2003, respectively. The samples tested included various foods, animal feed, samples from the *Salmonella* Monitoring Programme (SMP) for Poultry, and environmental samples from food premises. Samples tested as part of the SMP for poultry accounted for only 10.2% of all *Salmonella* tests entered in the FoodMicro Database in 2002 and 9.3% in 2003.

2.1 Salmonella Monitoring Programme for Poultry

A control programme for *Salmonella* infection in poultry has been in operation in the ROI since the late 1980s. The programme was primarily directed towards the elimination of both *S.* Enteritidis and *S.* Typhimurium from all poultry stock. The programme began with a code of practice, which was agreed between DAF, the poultry industry and the poultry veterinary consultants. The main provisions of this code included compulsory slaughter, without compensation, of infected breeding and layer flocks, heat treatment of feed, dedicated conveyors and transport, proper cleansing of poultry houses, control of vermin and other measures. The use of vaccination, competitive exclusion or antibiotics for control of infection with *Salmonella* serotypes was not allowed. All registered breeding flocks of domestic fowl are required to have specific samples taken and

submitted to an approved laboratory for examination for the presence of *Salmonella* serotypes. Samples collected by industry are generally tested in one of the DAF or DARD approved private laboratories. Official samples are tested at the CVRL. The samples of choice for monitoring poultry breeding and table egg producing flocks are environmental dust samples. Environmental samples are also collected from hatcheries to monitor breeding flocks during the laying period. Cloacal swabs, faeces, 'dead-in-shell' birds and meconium samples may also be tested. If *S.* Enteritidis or *S.* Typhimurium is confirmed in a breeding flock, no further eggs may be sent for hatching and the flock is slaughtered.

Table 1 shows the results of the poultry industry tests recorded on the FoodMicro Database. The *Salmonella* serotypes isolated from poultry dust samples in 2002 and 2003 are shown in Figures 1 and 2. *Salmonella* serotypes isolated from drag/sponge swabs in 2002 and 2003 are shown in Figures 3 and 4. *Salmonella* serotypes isolated from poultry caecum samples 2002 and 2003 are shown in Figures 5 and 6.

Table 1: Results of tests for *Salmonella* serotypes carried out under the *Salmonella* Monitoring Programme for the Poultry Sector in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Dust	5744	357 (6.2)	Figure 1	6044	630 (10.4)	Figure 2
Fluff	322	6 (1.9)	S. Kentucky (4) S. Mbandaka (1) S. Livingstone (1)	335	1 (0.3)	S. Kentucky (1)
Cloacal Swab	92	3 (3.3)	S. Kentucky (3)	2	0	
Drag/sponge swab	1470	63 (4.3)	Figure 3	1376	90 (6.5)	Figure 4
Chick box Liners	56	1 (1.8)	S. Kentucky (1)	72	1 (1.4)	S. Unnamed (1)
Meconium	386	3 (0.8)	S. Kentucky (3)	415	1 (0.24)	Not Typed (1)
Litter	51	0		24	0	
Other	3	2 (66.7)	S. Livingstone (2)	9	0	
Caecal	760	30 (3.9)	Figure 5	676	55 (8.1)	Figure 6
Total	**8884**	**465 (5.2)**		**8953**	**778 (8.6)**	

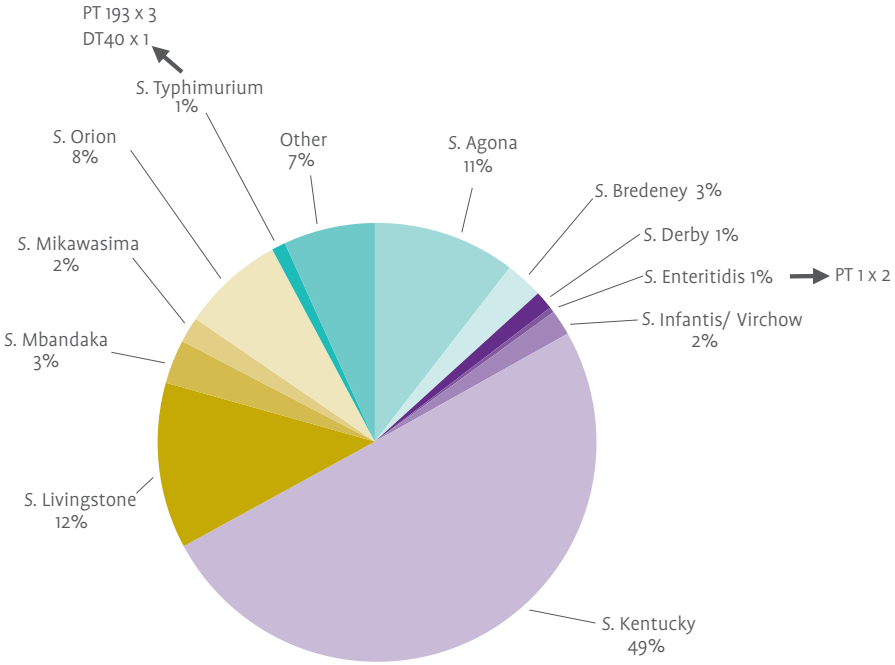

Figure 1: *Salmonella* serotypes isolated from poultry dust samples 2002 (n=357).

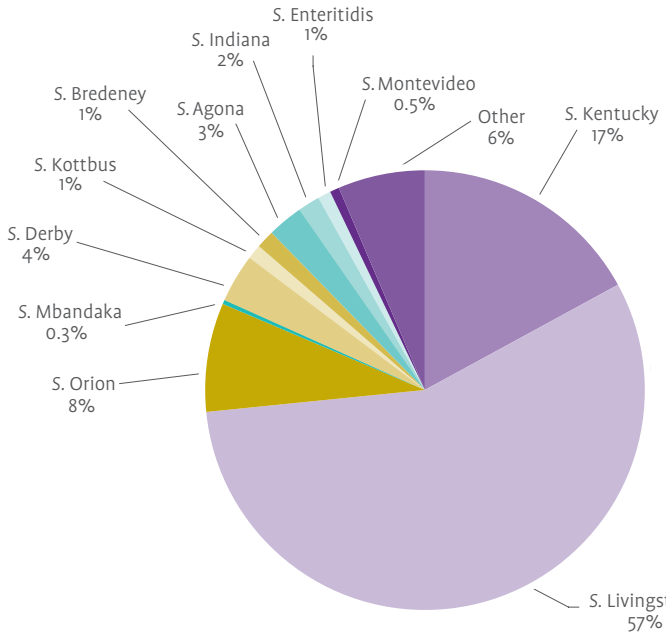

Figure 2: *Salmonella* serotypes isolated from poultry dust samples 2003 (n=630).

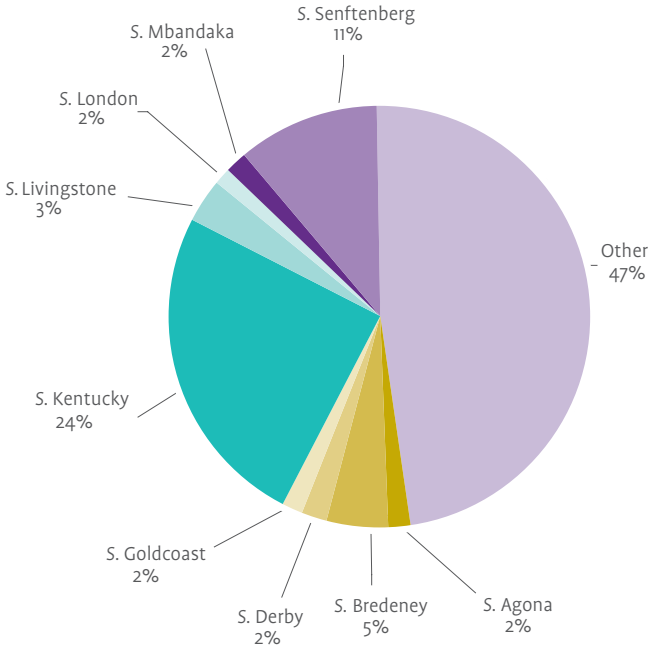

Figure 3: *Salmonella* serotypes isolated from drag/sponge swabs 2002 (n=63).

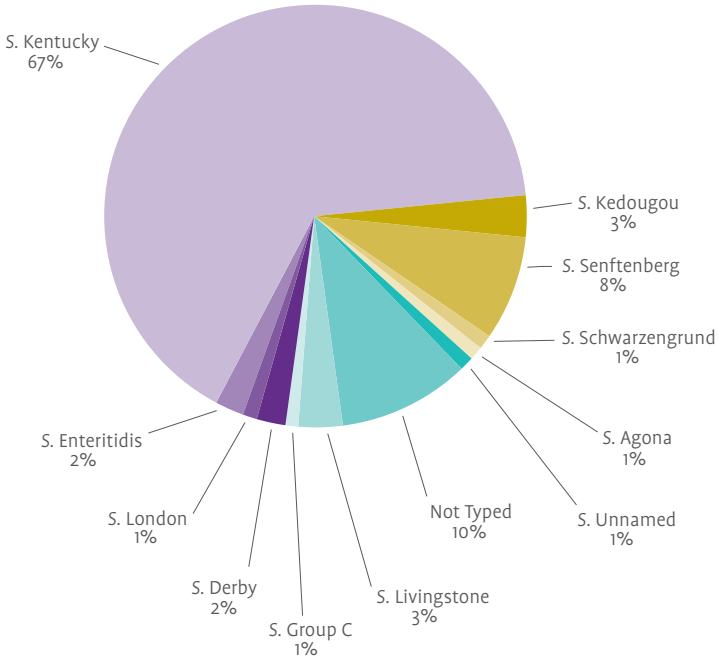

Figure 4: *Salmonella* serotypes isolated from drag/sponge swabs 2003 (n=90).

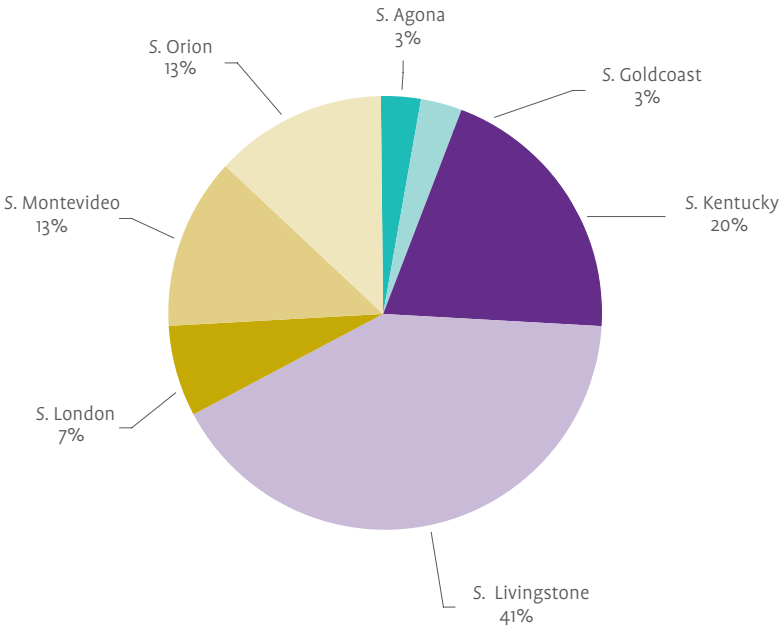

Figure 5: *Salmonella* serotypes isolated from poultry caeca 2002 (n=30).

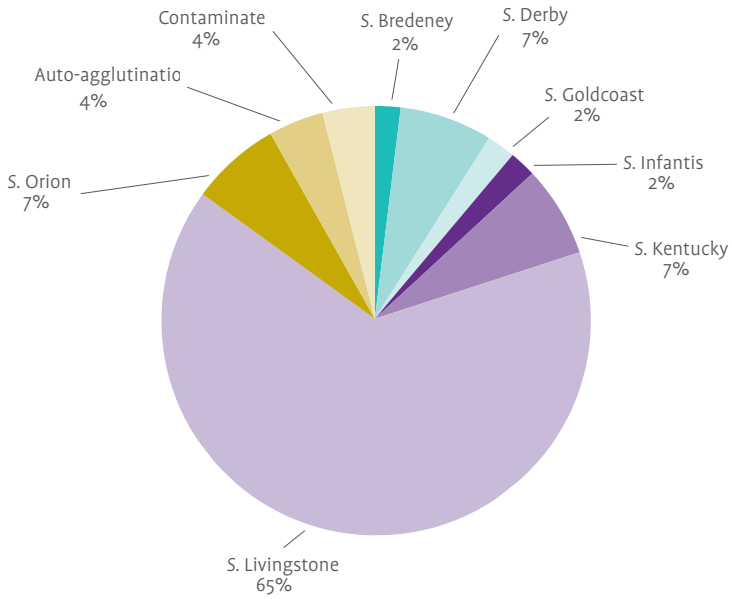

Figure 6: *Salmonella* serotypes isolated from poultry caeca 2003 (n=55).

2.2 *Salmonella* in Meat and Meat Products

Bacteriological monitoring of all aspects of the meat production chain is undertaken by both the meat industry and officially by DAF. Samples collected by industry are generally tested in one of the DAF approved private laboratories while all the officially collected samples are tested at the CMCL at Abbotstown.

2.2.1 *Salmonella* in Raw Meat and Meat Products

Results of tests for *Salmonella* serotypes in raw meat and raw meat products are shown in Tables 2 and 3. The raw meat and raw meat products are broken down into the following categories: bovine (beef, veal, etc), porcine (pork, ham, bacon, etc), chicken, turkey, duck, ovine (lamb, mutton, etc) and raw meat not specified. *Salmonella* serotypes and phage types isolated from raw bovine meat are shown in Figures 7, 8 and 9. *Salmonella* serotypes and phage types isolated from raw porcine meat are shown in Figures 10, 11, 12 and 13. *Salmonella* serotypes and phage types isolated from raw chicken meat are shown in Figures 14 and 15. *Salmonella* serotypes and phage types isolated from raw meat not specified are shown in Figures 16 and 17.

Table 2: Results of tests for *Salmonella* serotypes in raw meat carried out in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Bovine	15129	16 (0.1)	Figure 7	18463	38 (0.2)	Figure 8 & 9
Ovine	2165	0		1346	12 (0.89)	S. Dublin (8) S. Derby (3) S. Typhimurium DT 104b (1)
Porcine	5616	147 (2.6)	Figure 10 & 11	4629	96 (2.0)	Figure 12 & 13
Chicken	4204	166 (3.9)	Figure 14	3745	122 (3.2)	Figure 15
Turkey	268	3 (1.1)	S. Typhimurium	178 DT104 (1) S. Bredeney (1) S. Kottbus (1)	7 (3.9)	S. Infantis (2) S. Heidelberg (1) S. Blockley (1) S. Hadar (1) S. Enteritidis (2) PT 4 &
Duck	19	0		143	4 (2.8)	S. Derby (1) S. Indiana (1) S. Goldcoast (1) S. Hadar(1)
Edible Fat/ Dripping	711	0		923	2 (0.2)	Not Typed (2)
Raw Meat – Not Specified	2018	25 (1.2)	Figure 16	1028	14 (1.3)	Figure 17
Miscellaneous				59	0	
Total	**30130**	**357 (1.2)**		**30514**	**295 (1.0)**	

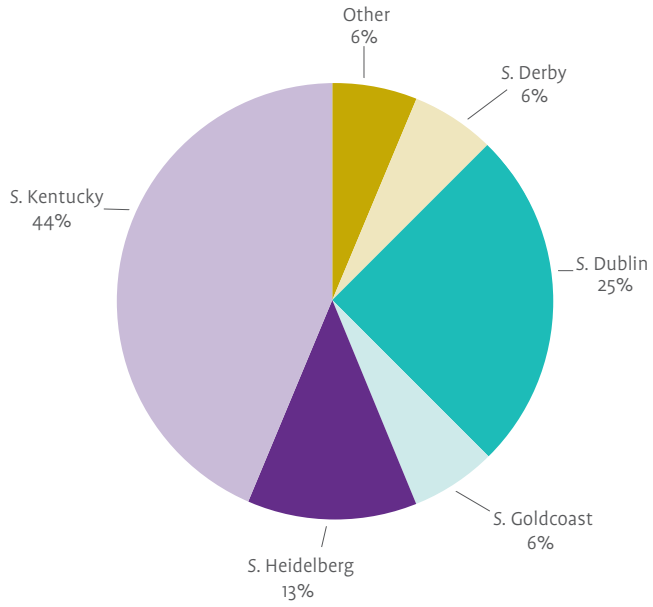

Figure 7: *Salmonella* serotypes isolated from raw bovine meat 2002 (n=16).

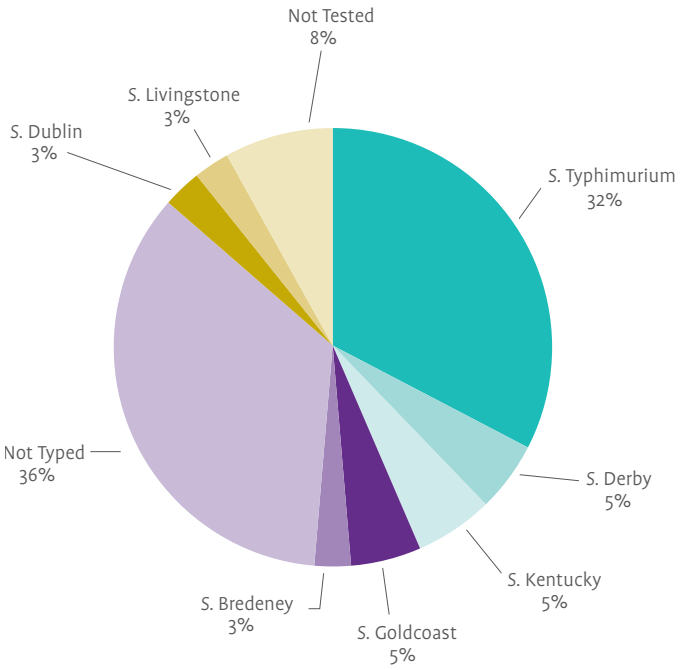

Figure 8: *Salmonella* serotypes isolated from raw bovine meat 2003 (n=38).

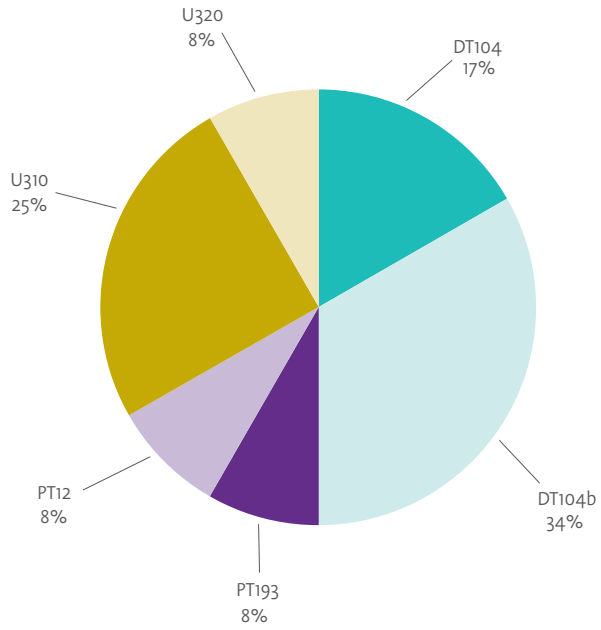

Figure 9: S. Typhimurium phage types from raw bovine meat 2003 (n=12).

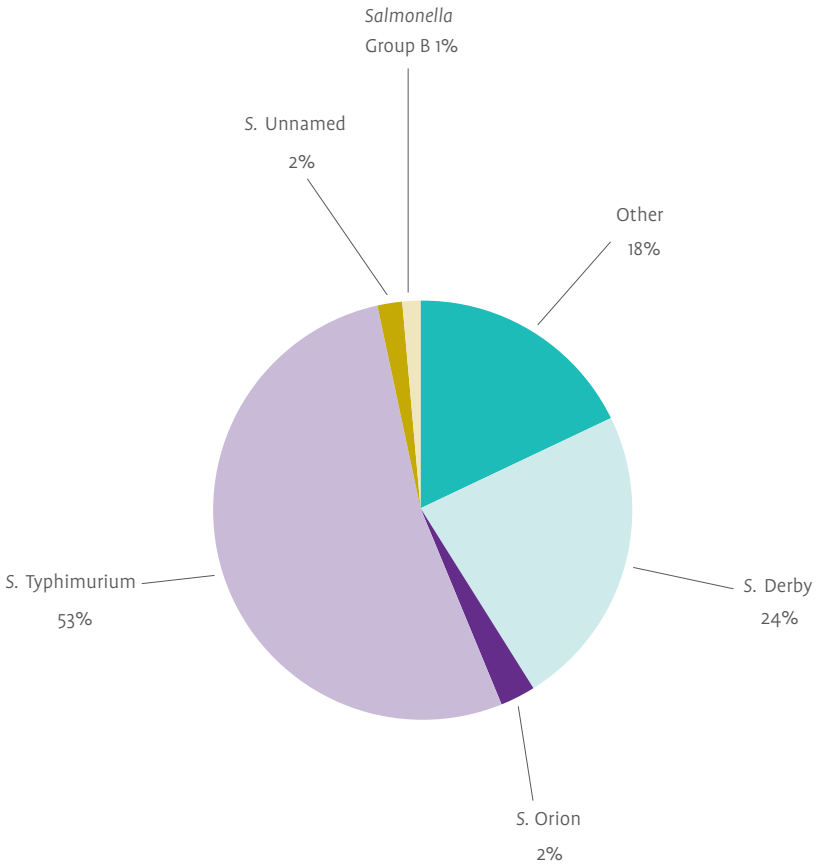

Figure 10: *Salmonella* serotypes isolated from raw porcine meat 2002 (n=147).

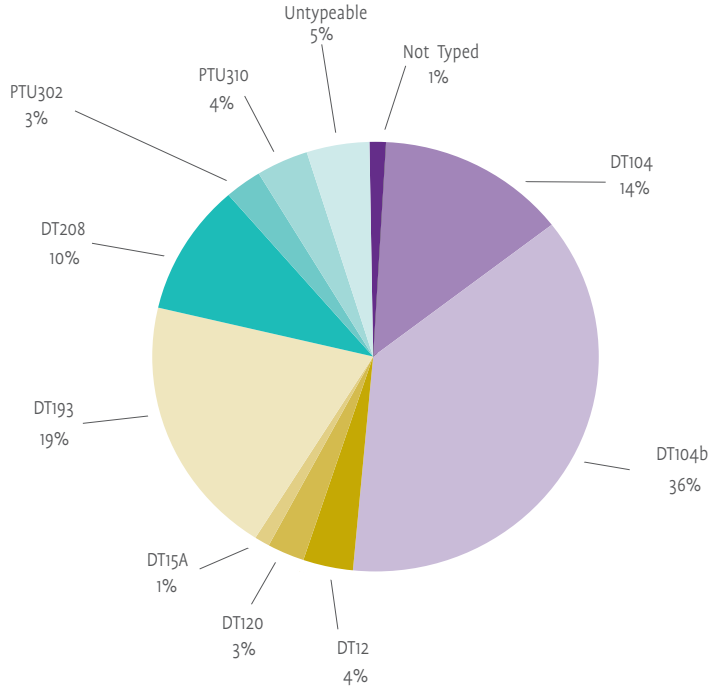

Figure 11: *S.* Typhimurium phage types from raw porcine meat 2002 (n=78).

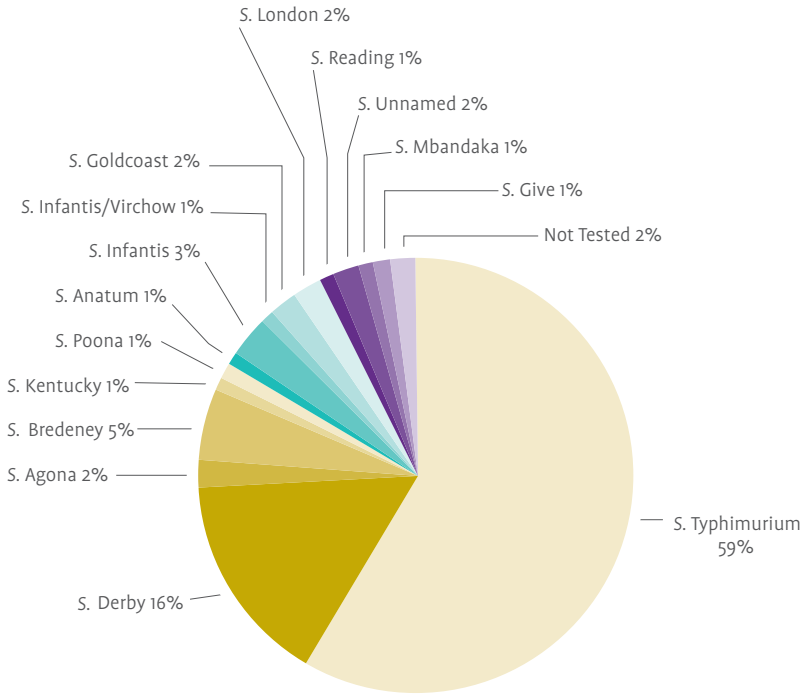

Figure 12: *Salmonella* serotypes isolated from raw porcine meat 2003 (n=96).

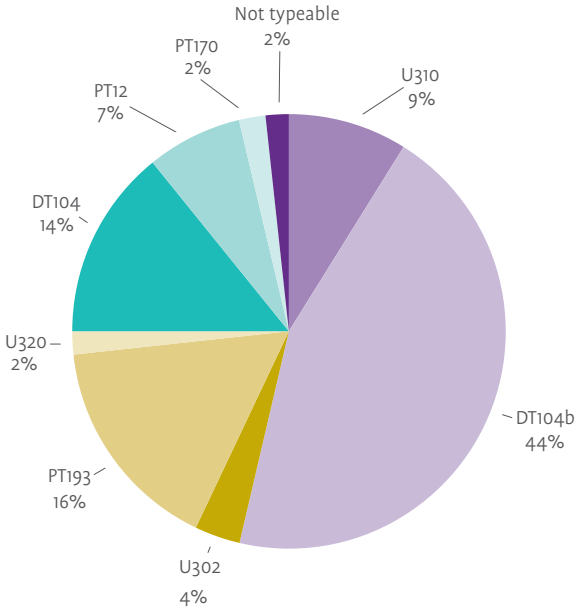

Figure 13: S. Typhimurium phage types from raw porcine meat 2003 (n=56).

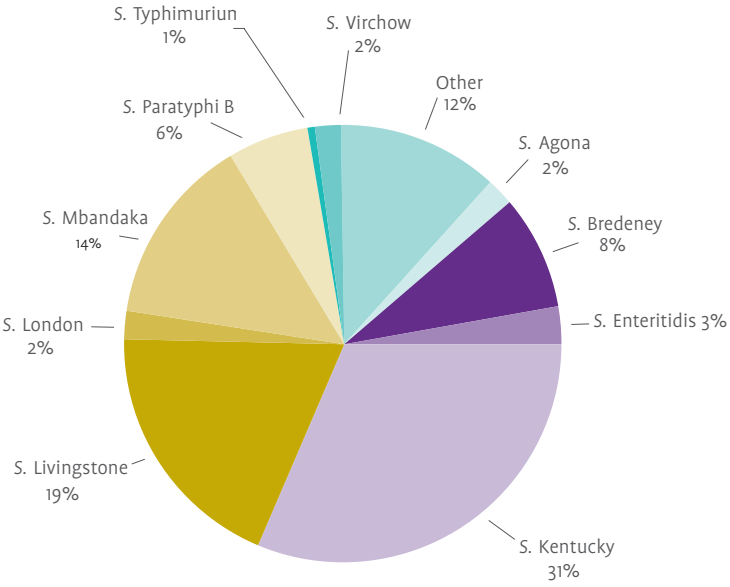

Figure 14: *Salmonella* serotypes isolated from raw chicken meat 2002 (n=166).

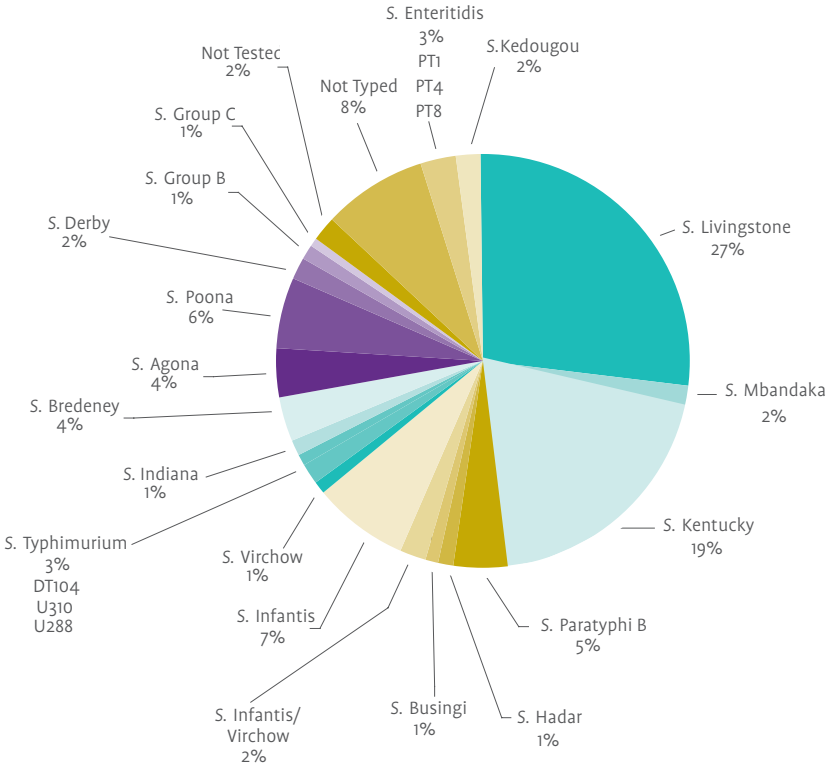

Figure 15: *Salmonella* serotypes isolated from raw chicken meat 2003 (n=122).

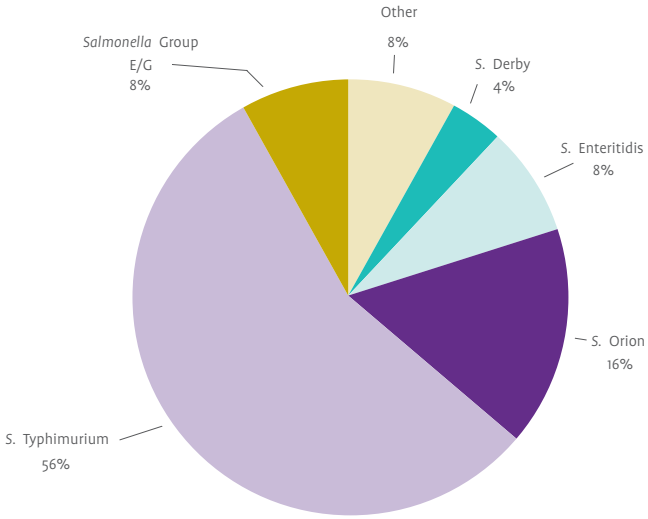

Figure 16: *Salmonella* serotypes isolated from raw meat not specified 2002 (n=25).

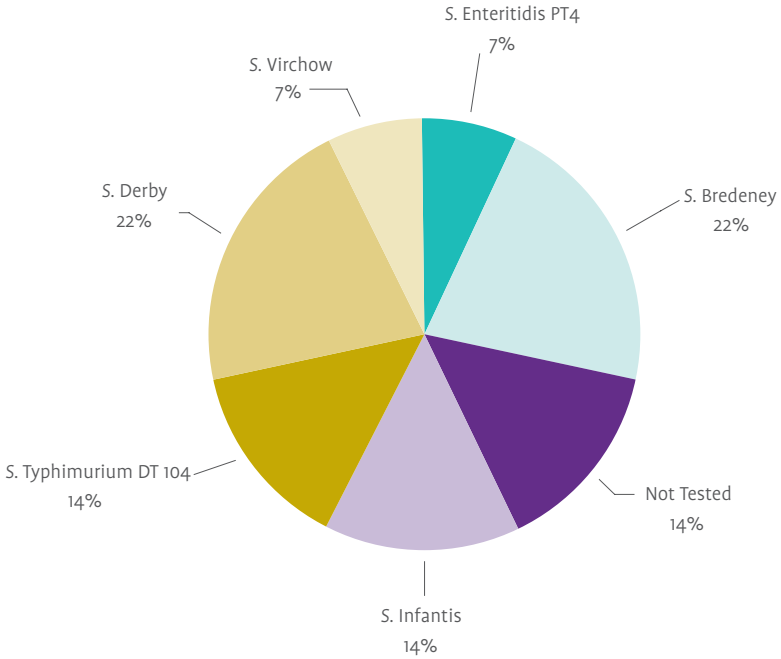

Figure 17: *Salmonella* serotypes isolated from raw meat not specified 2003 (n= 14).

Table 3: Results of tests for *Salmonella* serotypes in raw meat products carried* out in 2002 and 2003.

Sample Type*	No. Samples Tested 2002	No. Positives 2002(%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Bovine	1660	3 (0.2)	S. Heidelberg (2) S. London (1)	1003	2 (0.2)	S. Typhimurium (2) DT 104 b & DT 104
Ovine	91	0		38	0	
Porcine	1207	13 (1.1)	Figure 18 & 19	2009	40 (1.9)	Figure 20 & 21
Chicken	1534	52 (3.4)	Figure 22	2562	66 (2.6)	Figure 23
Turkey	93	3 (3.2)	S. Livingstone (2) S. Kottbus (1)	38	2 (2.6)	S. Infantis(1) S. Typhimurium (1) U302
Duck				2	0	
Raw Meat Not Specified	52	0		327	2 (0.6)	S. Typhimurium (1) DT 104 b S. Unnamed (1)
Total	**4637**	**71 (1.5)**		**5979**	**112(1.8)**	

*Raw meat products have undergone processing other than cooking, e.g. mincing, bread-crumbing etc.

2.2.2 *Salmonella* in Cooked Meat and Cooked Meat Products

Results of *Salmonella* tests on cooked meat and cooked meat products are shown in Table 4. Only one isolate, *S.* London was found in the 6942 products tested in 2002. Thirteen of 8249 samples tested in 2003 were *Salmonella* positive.

Table 4: Results of tests for *Salmonella* serotypes in cooked meat and cooked meat products carried out in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Bovine	587	0		913	0	
Ovine	8	0		28	0	
Porcine	2335	0		2529	0	
Poultry	2569	1 (0.04)	S. London (1)	2322	1 (0.04)	Not tested (1)
Not Specified	1443	0		2457	12 (0.48)	Not Typed (12)
Total	**6942**	**1 (0.01)**		**8249**	**13 (0.15)**	

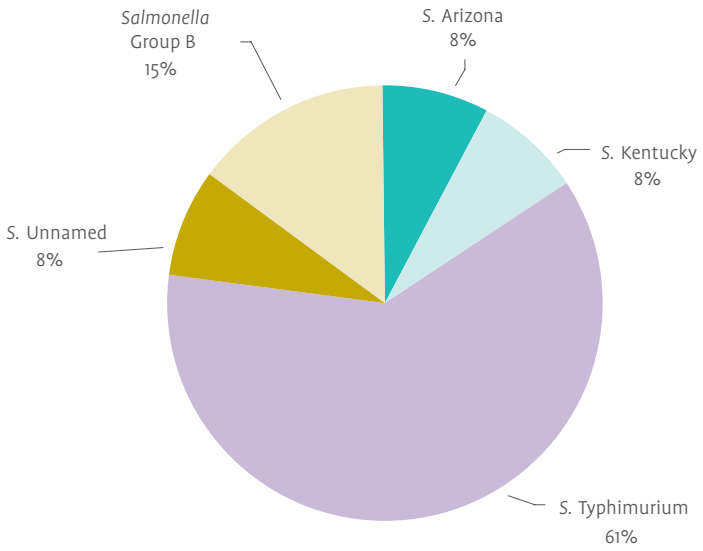

Figure 18: *Salmonella* serotypes isolated from raw porcine meat products 2002 (n=13).

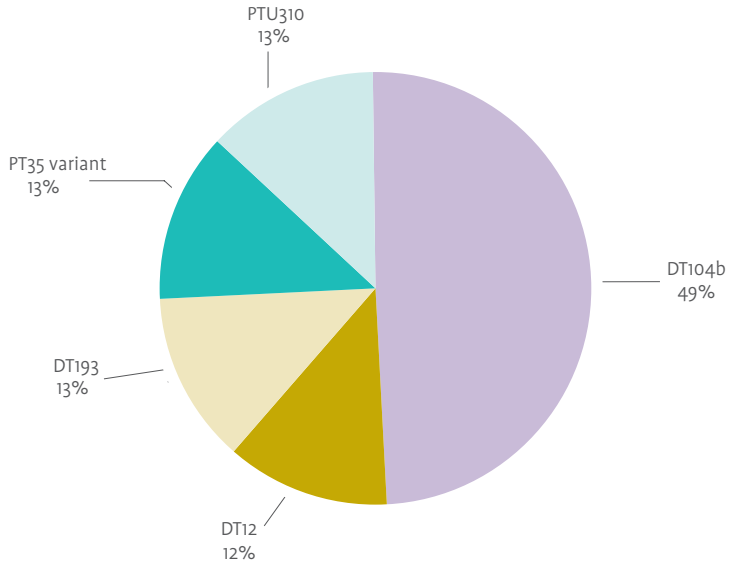

Figure 19: S. Typhimurium phage types isolated from raw porcine meat products 2002 (n=8).

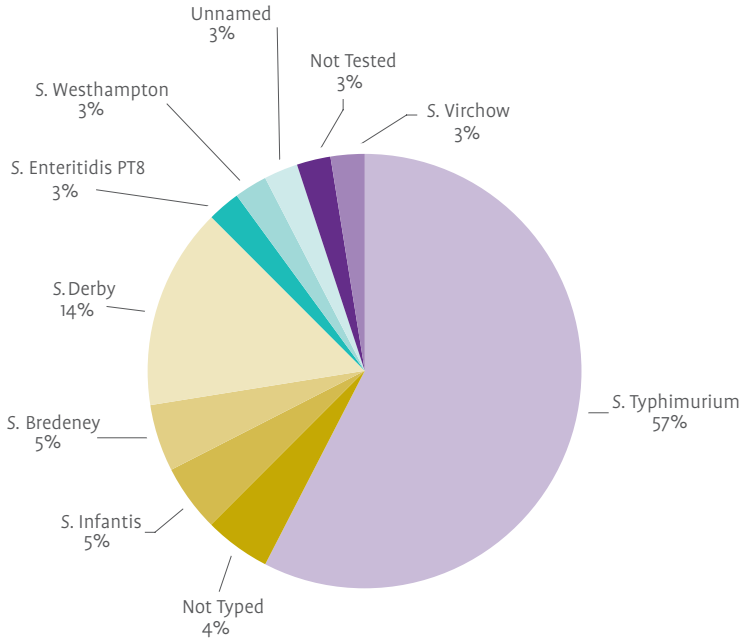

Figure 20: *Salmonella* serotypes isolated from raw porcine meat products in 2003 (n=40).

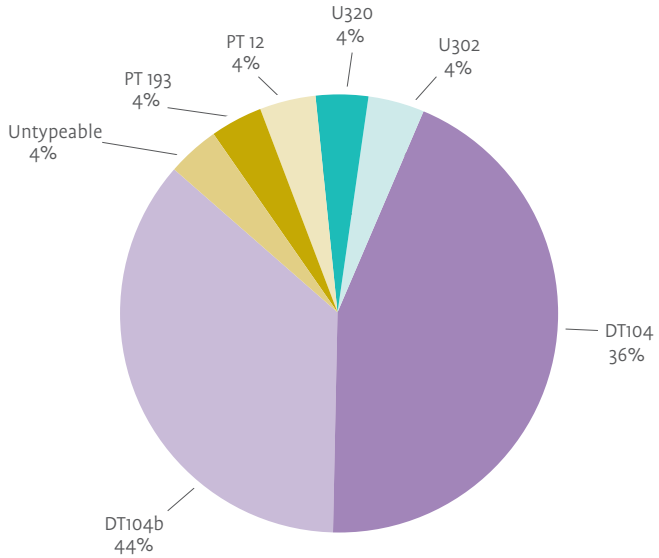

Figure 21: *S.* Typhimurium phage types isolated from raw porcine meat products in 2003 (n=25).

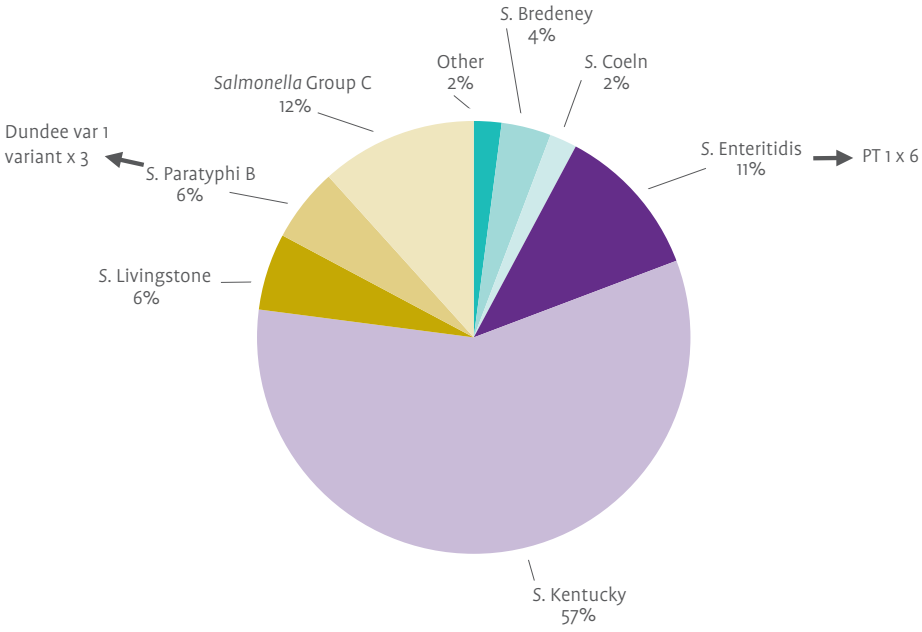

Figure 22: *Salmonella* serotypes isolated from raw chicken meat products 2002 (n=52).

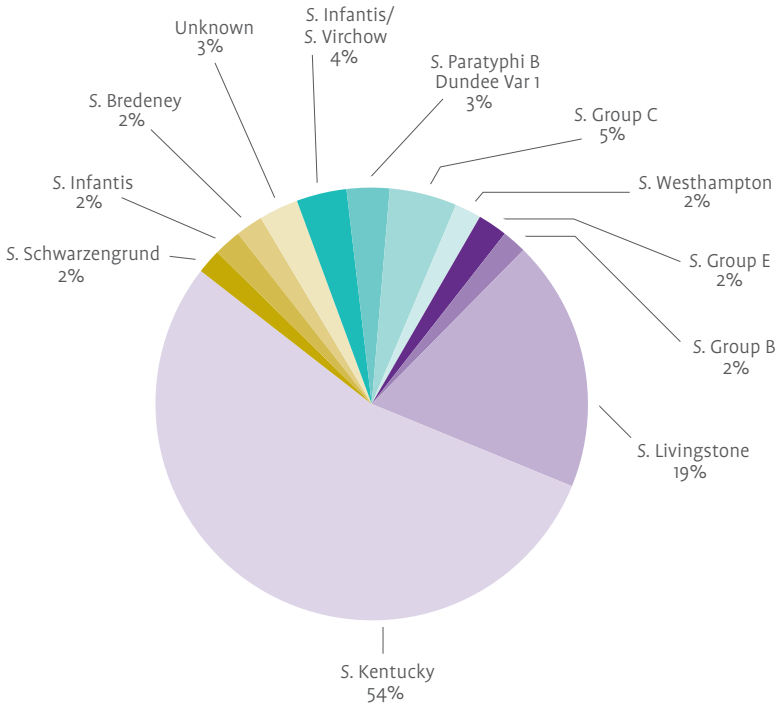

Figure 23: *Salmonella* serotypes isolated from raw chicken meat products 2003 (n = 66).

2.3 Dairy Products

The sale of raw cows' milk for direct human consumption has been prohibited in ROI since 1997. EU Directive 92/46 specifies the minimum microbiological standards with which milk and dairy products must comply in order to trade within the EU.

The results of tests on milk and dairy products from private laboratories in 2002 and 2003 were grouped into the following categories: Raw Milk, Pasteurised Milk, Milk Powder, and Milk Products not specified. A total of 6553 samples of milk or dairy products were tested for *Salmonella* serotypes in 2002 compared with 10,165 in 2003. No positive results were reported in 2002. In 2003, one milk sample was reported as positive for S. Poona. After consulting with the laboratory this was thought most likely to be as a result of cross-contamination in the laboratory with their QC *Salmonella* strain. A breakdown of the tests undertaken is shown in Table 5.

Table 5: Results of tests for *Salmonella* serotypes undertaken on milk and dairy products in 2002 and 2003.

Sample No. Type	Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Raw milk	9	0		13	0	
Pasteurised milk	62	0		531	1 (0.2)	S. Poona (1)
Milk powder	4620	0		3533	0	
Type not specified	1862	0		6088	0	
Total	**6553**	**0**		**10165**	**1 (0.009)**	

2.4 *Salmonella* in ready-to-eat foods, vegetables, fruit and other samples

Ready-to-eat foods, vegetables, fruit and other samples were categorised as follows: ready-to-eat food, prepared foods to be cooked, foods not-specified, food grade water, vegetables and fruit, including salads. Results of tests for *Salmonella* serotypes on these samples for 2002 and 2003 are shown in Table 6.

Table 6: Results of tests for *Salmonella* serotypes undertaken on ready-to-eat foods, vegetables, fruit and other samples in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positive 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positive 2003 (%)	Breakdown of Serotypes Isolated 2003
Ready-to-eat food	5323	0		4523	0	
Prepared foods to be cooked	1041	1 (0.1)	S. Livingstone (1)	1483	0	
Foods, type not specified	7146	3 (0.04)	S. Mbandaka (1) S. Typhimurium (1) DT104b Not Typed (1)	6652	10(0.15)	S. Enteritidis (3) PT4 & 2 X PT21 S. Goldcoast (1) S. Havana (1) S. Infantis (1) S. Schwarengrund (1) S. Typhimurium (1) PT193 Not Tested (2)
Food grade water	146	1 (0.68)	S. Goldcoast (1)	325	0	
Veg and fruit	325	0		272	0	
Total	**13981**	**5 (0.04)**		**13255**	**10(0.07)**	

2.5 Animal Feed

Grasslands provide about 80% of the diet of cattle and sheep in ROI, with the balance being supplied mainly by compound feeding stuffs. In the case of poultry and pigs, compound feed represents the main diet. These compound feeding stuffs are manufactured from plant materials; mainly cereals and plant proteins, with minerals and vitamins added to provide a balanced diet. Meat and bone meal has been banned since 1 January 2001 from inclusion in the diets of all food-producing animals in accordance with Council Decision 200/766/EC (S.I. No. 551 of 2002). All compound feed produced in the ROI is fully traceable, with records maintained by the manufacturer and retailers of the ingredients, the source of the ingredients, the date of manufacture and the purchaser of the feeding stuff. Ensuring that feedstuffs remain free of contamination with *Salmonella* serotypes is a critical part of preventing animal exposure to the organism. Monitoring of feeding stuffs includes sampling of both compound feed and raw materials. Environmental samples are also examined from various sites in the feed mill to ensure effective control of processing. Results of tests for 2002 and 2003 are shown in Table 7.

Table 7: Results of tests for *Salmonella* serotypes carried out on compound feeds, raw materials and environmental samples in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Ingredients (vegetable origin)	216	3(1.4)	S. Kentucky (1) S. Group C (1) S. Unknown(1)	266	2 (0.8)	S. Group E (2)
Ingredients (not specified)	460	2(0.4)	S. Senftenberg (1) S. Unknown (1)	383	2 (0.7)	Not Typed (2)
Finished feed – poultry	325	0		394	0	
Finished feed – non poultry	673	0		490	0	
Finished feed – (not specified)	1933	1 (0.05)	S. Mbandaka (1)	1899	7 (0.4)	S. Agona (2) Not Typed (2) S. London (1) S. Dublin (1) S. Livingstone (1)
Environmental samples (dust)	1170	64 (5.5)	S. Kentucky (62)) S. Infantis/Virchow (1) S. Unknown (1)	1237	88 (7.1)	S. Kentucky (78) Not Typed (8) S. Livingstone (1) S. Group C (1)
Total	**4777**	**70 (1.5)**		**4669**	**99 (2.1)**	

2.6 Rendered Product

A total of 1098 samples of meat and bone meal samples were tested for *Salmonella* serotypes in 2002 compared with 778 in 2003. None of the samples was positive for *Salmonella* spp.

2.7 Mushroom Production

Testing within the mushroom industry focuses on testing mushrooms, mushroom casings, raw and processed sugar beet lime, mushroom compost and peat. Table 8 shows the results of tests for *Salmonella* serotypes undertaken in 2002 and 2003. None was positive. Nineteen (2.3%) of the samples collected from ingredients used in the production of mushrooms were positive in 2001 and 3 were positive in 2002. *Salmonella* Kedougou was identified in 16 of the 19 positive samples in 2002 and in two of the three positive samples in 2003.

Table 8: Results of tests for *Salmonella* serotypes undertaken on samples from the mushroom industry in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Mushrooms	292	0		168	0	
Mushroom casings	448	17 (3.8)	S. Kedougou (15) S. Agona (2)	428	2 (0.5)	S. Kedougou (2)
Sugar beet lime (processed)	212	2 (0.9)	S. Kedougou (1) S. Agona (1)	138	0	
Sugar beet lime (raw)	13	0		5	0	
Mushroom compost	101	0		16	0	
Peat	45	0		32	1 (3.2)	S. Group C (1)
Miscellaneous				23	0	
Total	**1111**	**19 (1.7)**		**810**	**3(0.37)**	

2.8 Eggs and Egg Products

Approximately 582 million eggs were produced in ROI in 2002 (Annual Review and Outlook for Agriculture and Food 2002/2003). DAF is responsible for the enforcement of EU regulations governing the production and marketing of eggs from the farm to the retailer. This is achieved by inspecting and sampling at farms, packaging centres, storage depots, wholesalers and retail outlets. Results of a total of 339 tests undertaken in 2002 and 496 tests in 2003 were recorded in the FoodMicro Database. *Salmonella* Livingstone and S. Poona were isolated from two samples in 2003. After consulting the laboratory concerned, it was found that the *S.* Poona isolate most likely resulted from cross-contamination in the laboratory with the *Salmonella* strain used for QC. The *S.* Livingstone culture was from a single whole egg (shell and contents), however, it is not known if the shell contamination was measured.

Table 9: Results of tests for *Salmonella* serotypes undertaken on Eggs and Egg Products in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Table Eggs	89	0		53	2 (3.8)	S. Poona (1) S. Livingstone(1)
Egg Products (raw, to be cooked)	82	0		175	0	
Egg Products (ready-to-eat)	166	0		268	0	
Not Specified	2	0				
Total	**339**	**0**		**496**	**2 (0.4)**	

2.9 Fish and Fish Products

Results of 2563 tests for *Salmonella* in fish and fish products were recorded in the FoodMicro Database in 2002 and 2003. In 2002 *S.* Typhimurium DT170 was isolated from one shellfish sample and *S.* Kentucky from a cooked fish/fish product. One raw fish product was positive in 2003. The serotype is unknown.

Table 10: Results of tests for *Salmonella* serotypes undertaken on Fish and Fish Products in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Shellfish/ molluscs	374	1 (0.3)	*S.* Typhimurium DT 170 (1)	313	0	
Other Fish Raw	460	0		437	1 (0.2)	Not tested
Fish Products Raw	61	0		168	0	
Cooked fish/ fish products	287	1 (0.3)	*S.* Kentucky (1)	463	0	
Total	**1182**	**2 (0.16)**		**1381**	**1(0.07)**	

2.10 Environmental samples from food premises

Table 11 shows the results of tests for *Salmonella* serotypes undertaken on samples from Food Premises. A total of 7830 environmental samples, primarily swabs and some dust samples, were tested from food premises in 2002. *Salmonella* serotypes were isolated from a total of 174 (2.2%) samples. The principal serotypes isolated in 2002 was S. Kentucky (79 samples), S. Typhimurium (26 samples) and S. Mbandaka (6 samples), (Figure 24). Phage types of S. Typhimurium included DT104 or DT104b (18 samples), PT193 (7 samples), DT120 (2 samples) and DT107, DT208 and DTU 310 (1 sample each), (Figure 25). In 2003, 11519 tests of samples from food premises were recorded and a wider range of serotypes were isolated from the environmental swabs, as can be seen in Figures 26 and 27.

Table 11: Results of tests for *Salmonella* serotypes undertaken on environmental sampling from ROI Food Premises in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Positives 2002 (%)	Breakdown of Serotypes Isolated 2002	No. Samples Tested 2003	No. Positives 2003 (%)	Breakdown of Serotypes Isolated 2003
Environmental Dust	333	0		788	8 (1.0)	S. Mbandaka (1) S. Infantis (2) S. Kentucky (2) S. Livingstone (1) S. Unnamed (1) Not Typed (1)
Environmental Swabs	6555	161 (2.5)	Figure 24 & 25	9143	97 (1.0)	Figure 26 & 27
Not Specified	942	13 (1.3)	S. Typhimurium (5) (DT208, PTU310 2 X DT120, DT 104 b) S. Derby (2) S. Senftenberg (1) S. London (2) S. Orion (1) Not Typed(1) S. Unnamed (1)	1588	5 (0.3)	S. Rissen (1) S. Typhimurium (1) DT 104b S. Group E/G (1) S. Livingstone (1) S. Orion (1)
Total	**7830**	**174(2.2)**		**11519**	**110(0.95)**	

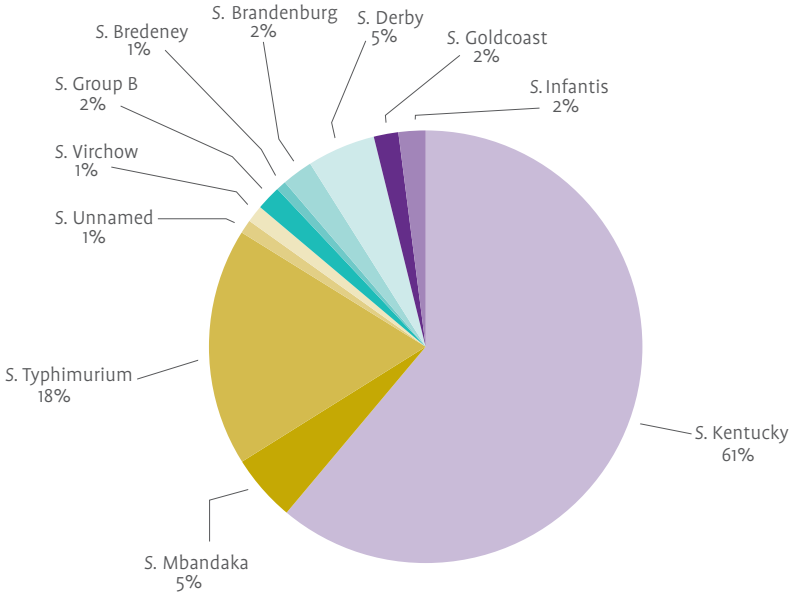

Figure 24: *Salmonella* serotypes isolated from environmental swabs collected from food premises in 2002 (n=161).

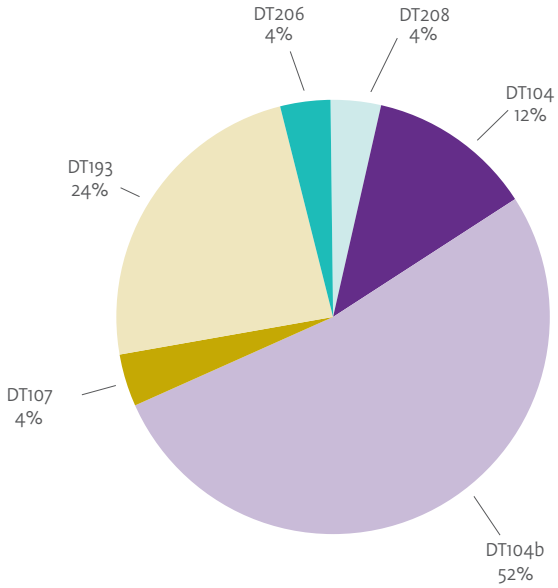

Figure 25: S. Typhimurium phage types isolated from environmental swabs collected from food premises in 2002 (n=25).

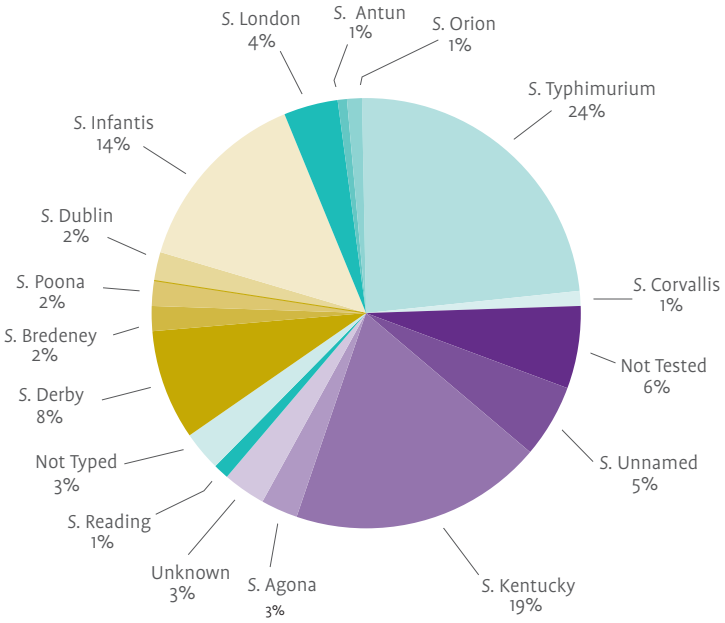

Figure 26: *Salmonella* serotypes isolated from environmental swabs collected from food premises in 2003 (n=97).

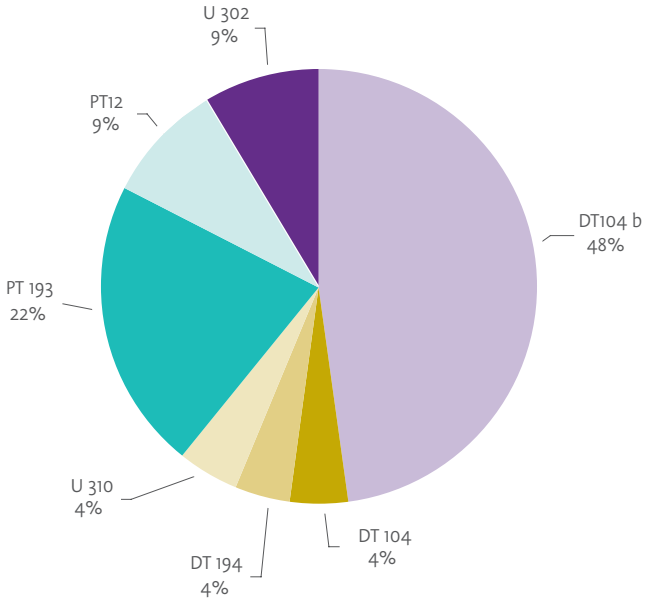

Figure 27: S. Typhimurium phage types isolated from environmental swabs collected from food premises in 2003 (n =23).

2.11 Discussion

Data on testing for *Salmonella* serotypes comprise the largest and most significant group of results reported to the FoodMicro Database. The data obtained from the poultry industry's monitoring of *Salmonella* control in poultry flocks are most comprehensive, but it has not been feasible to analyse all of the information, particularly relating to flock types, for this report.

Results of tests undertaken under the *Salmonella* Monitoring Programme for poultry showed an increase in isolations of *Salmonella* serotypes, from 5.2 % in 2002 to 8.6 % in 2003. The increase was mainly in poultry dusts, drag/sponge swabs and caecal samples. In 2002 the predominant serotype from poultry dust was *S.* Kentucky (49%), whereas in 2003 the predominant serotype in the dust samples was *S.* Livingstone (57%). *S.* Kentucky accounted for 24 % of isolates from drag sponge swabs in 2002 compared with 67% of isolates in 2003. *Salmonella* Livingstone accounted for 41% and 65% of the serotypes found in caecum samples in 2002 and 2003 respectively. Although the increase in isolation rates on farm was not reflected in a corresponding increase in isolates from raw chicken meat in 2003 (Table 2), both *S.* Livingstone and *S.* Kentucky comprised a sizeable proportion of isolates from chicken meat in 2002 and 2003 (Figures 14 and 15). In 2002, the most frequently isolated serotype from raw chicken meat was *S.* Kentucky (31%) followed by *S.* Livingstone (19%). In 2003 this situation was reversed with *S.* Livingstone being the most common at 27% followed by *S.* Kentucky at 19%. The predominance of the two serotypes in on-farm samples and in raw chicken meat suggests that improvements on farm could result in worthwhile reductions in carcass contamination at the abattoir. *Salmonella* Enteritidis was present at 3% levels in both years.

Isolation rates of *Salmonella* serotypes from raw meat and raw meat products showed little overall change over the two-year period analysed. Significant changes were seen, however, in the serotypes isolated. In 2002 the serotype most frequently isolated from raw bovine meat was *S.* Kentucky (44%), followed by *S.* Dublin (25%). In 2003, *S.* Typhimurium (32%) was the most common serotype with *S.* Kentucky only accounting for 5% and *S.* Dublin for 3%. The most common *Salmonella* serotype isolated from raw porcine meat for both years was *S.* Typhimurium, 53% in 2002 and 59% in 2003, with DT104b being the most common phage type isolated. This trend was mirrored in the raw porcine meat products with 61% of isolates in 2002 and 57% of isolates in 2003 being *S.* Typhimurium. The most common phage type was again DT104b. These results broadly correlate with the serotypes and phage types recorded in on-farm and porcine carcass swab samples analysed under Food Institutional Research Measure (FIRM) project 00/R&D/D/32. *S.* Kentucky

was most frequently isolated from raw chicken meat products in both years, 57% and 54% respectively. Although there was an increase in the isolation of *Salmonella* serotypes from cooked meat products over the two years, from 0.01% in 2002 to 0.15% in 2003, the number of isolates, 1 and 13 respectively in 2002 and 2003, were extremely small. Isolates were not available for serotyping.

Following the contamination of some sectors of the mushroom production industry with *S.* Kedougou in 2001 testing was continued in 2002 and 2003. In 2001, sugar beet lime was suspected as one of the potential sources of the contamination. *Salmonella* Kedougou was isolated from one sample of lime in 2002 but no isolates were reported in 2003. Only two casing samples were positive in 2003 compared with 17 in 2002. This suggests that the problem is now under control.

Two isolates of *Salmonella* were cultured from table eggs in 2003. These were *S.* Poona and *S.* Livingstone. The *S.* Poona was thought to result from cross-contamination in the laboratory. With regard to the *S.* Livingstone, it is unusual to isolate salmonellae from eggs as most producers in the Republic of Ireland adhere to the Bord Bia Egg Quality Assurance scheme (EQAS). The *S.* Livingstone culture was from a single whole egg (shell and contents), however, it is not known if the shell contamination was measured. The key components of egg production covered by the EQAS scheme include flock sourcing, hygiene, disease control, flock welfare and environmental protection. There is particular emphasis on hygiene and disease control, especially on the control of contamination with *Salmonella* serotypes. Controls are built around the sourcing of pre-lay birds from approved sources, the heat treatment of feed and routine *Salmonella* testing on the farm.

An improvement was seen in the overall *Salmonella* isolation rate for environmental samples taken from food premises between 2002 and 2003, with a reduction from 2.2% to 0.95% positives. The majority of the positive isolations came from environmental swab samples. Even though the level of testing of such samples increased from 6555 in 2002 to 9143 in 2003, the percentage of isolations dropped from 2.5% to 1.0%. In 2002, *S.* Kentucky accounted for 61% of the environmental swabs compared to 19% in 2003. However, there was an increase in the isolation of *S.* Typhimurium from these samples, 18% in 2002 compared to 24% in 2003, with DT 104b being the main phage type present. This change in serotypes could indicate a possible change in source of contamination from a high proportion associated with poultry products to contamination from other sources, such as pork.

Salmonella serotypes recorded in the FoodMicro Database were compared with those found in the human population for 2002 and 2003 (NDSC Annual Reports 2002 and 2003). The crude incidence rate per 100,000 population of salmonellosis in ROI was 10.2 in 2002 and 11.5 in 2003 (NDSC Annual Reports 2002, 2003). In 2002 there were 416 human clinical isolates of *Salmonella* enterica referred to the Human *Salmonella* Reference Laboratory (HSRL) at University College Hospital Galway for typing, 82 (19.7%) of which were associated with travel outside ROI, the majority being associated with travel to Spain. In 2003 there were 486 human clinical isolates typed by HSRL, 72 (14.8%) of which were associated with travel abroad, also to Spain. Table 12 lists the *Salmonella* serotypes isolated from food and humans in ROI during 2002 and 2003. In 2002, 28 (62%) of the 45 *Salmonella* serotypes isolated from humans were not seen in the FoodMicro Database entries for the same year. In 2003, 22 (47%) of the 47 *Salmonella* serotypes isolated from humans were not seen in the FoodMicro Database entries for 2003. If the data on travel-related infection with *Salmonella* serotypes are combined with those found in the current surveillance of foods, then there are approximately 15-20% of human cases where the potential source of the isolate is not known. Equivalent concurrence investigations such as those carried out in USA and Australia by Sumner et al. (2004) and Schlosser et al. (2000), which try to match data on serotypes isolated from meat and poultry products with those isolated from patients, showed that data from food and patients do not match perfectly. A plausible explanation offered for disagreement in the two sets of data may be that some serotypes that occur less often in animals could be more pathogenic in humans than serotypes that occur more often in livestock and poultry. Sumner et al. (2004) also points out that handling of foods in the home is a risk factor in the acquisition of infection with *Salmonella* serotypes, which cannot be quantified. In addition, non-food sources such as contaminated water and contact with pets and farm animals have an unknown impact on all of these data.

Table 12: Comparison of the numbers of isolations of *Salmonella* serotypes from human cases (NDSC Annual Reports 2002 and 2003) with those obtained from food (FoodMicro Database 2002 & 2003) in the Republic of Ireland. The serotypes highlighted in bold were isolated from both food and humans in one or both years.

	2002		2003	
Serotype	**FoodMicro**	**NDSC**	**FoodMicro**	**NDSC**
S. Abaetutba	1	0	0	0
S. Adelaide	0	1	0	0
S. Agama	0	1	0	0
S. Agbeni	0	0	0	1
S. Agona	**46**	**5**	**31**	**5**
S. Alachua	0	1	0	0
S. Anatum	**2**	**0**	**3**	**5**
S. Apapa	0	1	0	0
S. Arizona	1	0	0	0
S. Bareilly	0	1	1	0
S. Blockley	1	0	1	2
S. Bovismorbificans	0	0	0	1
S. Braenderup	**3**	**2**	**0**	**3**
S. Brandenburg	**1**	**3**	**0**	**2**
S. Bredeney	33	2	22	3
S. Businga	0	0	1	0
S. Cerro	**0**	**0**	**6**	**1**
S. Colindale	0	1	0	0
S. Coeln	2	0	0	0
S. Corvalis	0	1	1	3
S. Cotham	0	0	0	1
S. Derby	**54**	**0**	**71**	**1**
S. Dublin	**4**	**9**	**12**	**5**
S. Durban	0	2	0	0
S. Enteriditis	**15**	**165**	**16**	**205**
S. Give	0	2	1	0
S. Goldcoast	9	0	8	0
S. Hadar	**0**	**6**	**3**	**21**
S. Havana	0	0	1	1
S. Heidelberg	4	2	1	1
S. Indiana	4	0	13	1
S. Infantis	**9**	**3**	**39**	**4**

	2002		2003	
Serotype	**FoodMicro**	**NDSC**	**FoodMicro**	**NDSC**
S. Infantis/Virchow	9	0	7	0
S. Java	0	0	0	1
S. Javiana	0	0	0	1
S. Johannesburg	0	1	0	0
S. Kedougou	18	0	8	0
S. Kentucky	**450**	**1**	**332**	**10**
S. Kissi	3	0	0	0
S. Kottbus	**3**	**6**	**4**	**5**
S. Lexington	**2**	**1**	**2**	**0**
S. Lindenburg	1	0	0	0
S. Litchfield	0	0	0	1
S. Livingstone	100	0	444	0
S. London	15	0	8	0
S. Manhattan	0	0	0	1
S. Mbandaka	**46**	**3**	**6**	**3**
S. Menston	0	1	0	0
S. Mikawasin	6	0	0	0
S. Montevideo	5	0	6	0
S. Muenchen	1	0	0	2
S. Muenster	0	1	0	0
S. Newport	0	5	0	5
S. Ohio	0	3	0	1
S. Ohlstedt	0	0	0	1
S. Oranienburg	**2**	**1**	**0**	**0**
S. Orion	40	0	56	0
S. Panama	0	2	0	1
S. Paratyphi A	0	0	0	6
S. Paratyphi B	**14**	**3**	**7**	**1**
S. Poona	**0**	**2**	**11**	**1**
S. Putten	0	3	0	0
S. Reading	**0**	**0**	**2**	**2**
S. Redhill	0	1	0	0
S. Rissen	**1**	**1**	**1**	**1**
S. Rough	0	1	0	0
S. Saintpaul	0	0	0	4
S. Sandiego	0	0	0	2

	2002		2003	
Serotype	**FoodMicro**	**NDSC**	**FoodMicro**	**NDSC**
S. Senftenberg	**10**	**2**	**10**	**1**
S. Schwarzengrund	0	1	2	0
S. Singapore	0	1	0	0
S. Stanley	0	7	0	4
S. Tennessee	**0**	**0**	**2**	**1**
S. Thompson	0	1	0	0
S. Tshiongwe	0	0	1	0
S. Typhi	0	5	0	9
S. Typhimurium	**140**	**140**	**125**	**135**
S. Unnamed	10	0	14	0
S. Urbana	0	1	0	0
S. Virchow	**4**	**10**	**4**	**10**
S. Wangata	0	0	0	1
S. Welikade	0	0	0	1
S. Welteverden	0	0	0	1
S. Westhampton	0	0	7	0
S. Worthington	0	1	0	0
S. Group B	8	0	2	0
S. Group C	8	0	7	0
S. Group E	0	0	3	0
S. Group E/G	4	0	4	0
S. Unknown	**0**	**3**	**4**	**8**
S. Not Typed	100		73	
S. Not Tested	0	0	22	0

3. Campylobacteriosis

Campylobacteriosis is an infectious disease caused by bacteria of the genus *Campylobacter*. *Campylobacter* species are the most commonly isolated bacterial gastrointestinal pathogens in the EU and have significant social and economic consequences worldwide. Symptoms include diarrhoea, cramping, abdominal pain, and fever within 2 to 5 days after exposure to the organism. Typically people are ill for a week to ten days. In rare cases of disease caused by *Campylobacter* species, patients may develop reactive arthritis or Guillain-Barré syndrome (GBS), a severe neurological disorder. Most cases of infection with *Campylobacter* species are sporadic, and occur more frequently in the summer months than in the winter, and appear to affect more men that women. There are fifteen members of the *Campylobacter* genus, however, most human illness (95%) is caused by either *C. jejuni* or *C. coli* (Park, 2000). The route of transmission remains unclear although handling raw meat and poultry, drinking unpasteurised milk and contaminated water, and eating under-cooked meat and poultry are frequently implicated, as the source of infections. Domestic and farm animals have also been implicated although *Campylobacter* species rarely cause disease in farm animals. The organism can be isolated from the intestines of healthy farm animals, poultry, pets and wild birds, and is generally considered as a commensal in these hosts. Birds, in particular, may become heavily colonised. Surveys have shown that poultry meat is frequently contaminated with *Campylobacter* species. Cross-contamination of ready-to-eat foods by raw meat may be an important source of infection.

There was a dramatic increase in the number of cases of campylobacterosis in humans reported in Ireland in the latter half of the 1990's. However, some of this increase was likely to have been due to increased reporting, although the majority of infections still go unreported. In 2001 a total of 1286 cases of laboratory confirmed campylobacteriosis were reported according to the NDSC (Campylobacteriosis Report 2001). This gave a crude incidence rate (CIR) of 35.5 per 100,000 population. This was down from 44.5 in 2000, and 57.5 in 1999. Campylobacteriosis remains one of the biggest causes of gastroenteric infection in ROI. Control measures, including improved bio-security, proven to be effective in controlling *Salmonella* serotypes, have not been as effective or consistent for control of *Campylobacter* species on farms. Good practice in meat handling, hygiene and cooking are crucial.

3.1 Campylobacter species in food

A total of 3380 tests for *Campylobacter* species were recorded in 2002 and a further 2153 tests in 2003. The organism was isolated from 518 (15.3%) samples in 2002 and from 747 (34.7%) samples in 2003. Results of tests for *Campylobacter* species in raw meat and raw meat products are shown in Table 13.

Table 13: Results of tests for *Campylobacter* species in raw meat and raw meat products, carried out in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Bovine	13	1 (7.7)	8	0
Ovine	2	0	2	0
Porcine	13	0	9	0
Poultry	1605	516 (32.1)	2122	746 (35.1)
Not specified	30	0	12	1 (8.3)
Total	**1663**	**517 (31)**	**2153**	**747(34.7)**

The results of tests for *Campylobacter* species in cooked meat and cooked meat products are shown in Table 14. In 2002 one porcine product tested positive for *Campylobacter* species. No positive results were recorded from the 1053 tests undertaken on cooked meat and cooked meat products in 2003.

Table 14: Results of tests for *Campylobacter* species in cooked meat and cooked meat products in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Bovine	11	0	111	0
Ovine	0	0	0	0
Porcine	747	1 (0.1)	200	0
Poultry	552	0	441	0
Not specified	223	0	301	0
Total	**1533**	**1(0.06)**	**1053**	**0**

None of the 184 food samples including ready-to-eat foods and vegetables tested in 2002 or the 325 samples tested in 2003 was positive for *Campylobacter* species. Few tests were carried out on dairy products.

3.2 Discussion

Several studies have been carried out focusing on the distribution of *Campylobacter* species in different food sources. Kramer et al. (2000), looked at the contamination of raw meat and poultry at the retail level in the United Kingdom (UK) and found that chicken exhibited the highest contamination rate, 83.3% of samples tested, followed by lamb (72.9%), pork (71.7%) and beef (54.2%). *Campylobacter Jejuni* was the most common species in chicken, lamb and beef in his study, with *C. coli* being the most prevalent in pigs. Data supplied to the FoodMicro Database from most laboratories did not identify the species found in samples.

4. Listeriosis

The genus *Listeria* includes six species. *Listeria monocytogenes* is the major pathogenic species in both animals and man. Listeriosis principally causes intra-uterine infection, flu-like symptoms, fever, muscle aches, and sometimes gastroenteric symptoms such as nausea and diarrhoea. If the infection spreads to the central nervous system it can result in meningitis and septicaemia. Pregnant women, unborn children *in utero*, newborns and immuno-compromised adults are most at risk from listeriosis. Infection of pregnant women can result in abortion of the foetus or stillbirth. McLauchlin *et al*, (2004) demonstrated that listeriosis affects women under forty more than men, probably because this age group includes the childbearing years. However, men over 55 are more at risk than women of the same age. Listeriosis can have incubation periods between one day and up to three months. This can make it impossible to identify outbreaks, as links between cases are difficult to establish.

Listeria monocytogenes is a ubiquitous organism and is widely distributed in the environment. Previous surveys have shown that a wide range of foods may be contaminated with the organism although the number of organisms is usually low. Possible mechanisms whereby food can become contaminated with *Listeria* species are listed on the NDSC website. Vegetables can become contaminated from the soil or from manure used as fertiliser. Animals can carry the bacterium without appearing ill; meat and dairy products from these animals can then be contaminated. The bacterium has also been found in a variety of raw foods, such as uncooked meats and vegetables, as well as in processed food, that becomes contaminated after processing, such as cheese. Unpasteurised (raw) milk or foods made from raw milk may contain the organism. Ingestion of heavily contaminated foods is the principal route of infection for both animals and humans. Human infection can also follow contact with an infected animal. *Listeria monocytogenes* can survive and even grow at refrigeration temperatures. Cooking effectively kills *Listeria monocytogenes* in raw products, however, refrigerated ready-to-eat foods may potentially be contaminated.

4.1 Listeria in food

The DAF approved private laboratories reported 30,151 tests for *Listeria* species in 2002, 1827 (6%) of which were positive. A substantial increase in testing was seen in 2003 with 55,648 tests being recorded on the FoodMicro Database. *Listeria* species were isolated in 3206 (5.7%) of samples. Results of tests for *Listeria* species in raw meat and raw meat products, cooked meats and cooked meat products, other foods and vegetables, and in dairy products recorded on the FoodMicro Database are shown in Tables 15-18, respectively.

Table 15: Results of tests for *Listeria* species in raw meat and raw meat products in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Bovine	511	77 (15.1)	1003	133 (13.2)
Ovine	178	1 (0.6)	11	0
Porcine	793	115 (14.5)	1094	136 (12.4)
Poultry	195	18 (9.2)	246	48 (19.5)
Not specified	226	9 (4.0)	509	133 (22.2)
Total	**1903**	**220 (11.5)**	**2863**	**430 (15)**

Table 16: Results of tests for *Listeria* species in cooked meat and cooked meat products in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Bovine	438	12 (2.7)	479	14 (2.9)
Ovine	3	0	21	2 (9.5)
Porcine	4778	311 (6.5)	5380	203 (3.7)
Poultry	2509	78 (3.1)	2803	93 (3.3)
Not specified	1269	27 (2.1)	3179	159 (5.0)
Total	**8997**	**428(4.7)**	**11862**	**471(3.9)**

Table 17: Results of tests for *Listeria* species in ready-to-eat foods, vegetables and other samples in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Ready-to-eat foods	7068	122 (1.7)	5163	169 (3.2)
Prepared foods to be cooked	1372	166 (12.1)	1577	298 (18.8)
Foods not specified	5255	516 (9.8)	4940	330 (6.6)
Food grade water	26	0	124	0
Vegetables/fruit	937	51 (5.4)	455	15 (13.2)
Mushrooms	127	10 (7.9)	7	0
Total	**14785**	**865 (5.8)**	**12266**	**812(6.6)**

A total of 27 egg or egg products were tested for *Listeria* species in 2002. One sample of a ready-to-eat product was positive. A total of 87 egg products were tested in 2003; one ready-to-eat egg product was positive.

A total of 10,104 environmental swabs or other samples from food premises was tested for *Listeria* species in 2002. Of these, 672 (6.7%) were positive. A total of 1189 (5.8%) of 20,478 samples tested in 2003 were positive.

Table 18: Results of tests for *Listeria* species in dairy samples in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Raw milk	9	0	12	0
Pasteurised milk	62	0	291	8 (2.7)
Milk powder	4620	6 (0.5)	1234	2 (0.16)
Sample not specified	1862	63 (3.0)	4457	177 (3.9)
Total	**6553**	**69 (1.0)**	**5994**	**187 (3.1)**

4.2 Discussion

Because of the ubiquitous nature of *Listeria* species and the ability of these organisms to grow at low temperatures, *L. monocytogenes* is regarded as a potentially serious public health threat. However, while the organism is frequently isolated from a variety of foods, including ready-to-eat products, it is not considered a serious hazard if less than 100 organisms per gram are present (Food Safety Authority of Ireland, 2001).

The percentage of samples of raw meat that tested positive for *Listeria* species increased from 11.5% in 2002 to 15 % in 2003. A similar increase was seen in the samples of prepared foods requiring pre-cooking, the percentage of positive samples rising from 12.1% in 2002 to 18.8% in 2003. Even though these samples have to be cooked prior to consumption they have the potential to cross-contaminate other food types that may be ready to eat or pre-prepared meals. There was a decrease in the isolation of *Listeria* species from fruit and vegetables between 2002 and 2003. No *Listeria* species were isolated from mushrooms in 2003, although a total of only seven samples were tested.

While a decrease in the prevalence of *Listeria* species in cooked meats and cooked meat products was reported over the two years (4.7% in 2002 compared with 3.9% in 2003) there was an increase in isolations in ready-to-eat foods, vegetables and other samples (5.8% in 2002 compared with 6.6% in 2003).

The increase in the ready-to-eat foods gives greatest cause for concern. Similarly there is a concern with the isolation of *Listeria* species from pasteurised milk and milk powder. Organisms of the genus *Listeria* are temperature sensitive and should be destroyed by pasteurisation. Their isolation from pasteurised products may be the result of contamination after the pasteurisation process.

The data on isolation of *Listeria* species provided in this report are incomplete as full information on the species isolated was not available. There are also no details available on the number of organisms present in the samples tested.

5. *Verocytotoxigenic Escherichia coli (VTEC)*

Verocytotoxin (VT) producing *E. coli* (VTEC) is a well-recognised cause of severe illness in humans. Infection with VTEC can result in a wide spectrum of clinical manifestations. Many strains of *E. coli* can produce verotoxins but strains of serotype O157:H7 are among those most frequently reported as associated with haemorrhagic colitis, haemolytic uraemic syndrome (HUS) and thrombotic thrombocytopenic purpura (TTP) in humans. *Escherichia coli* O157 infections can also be asymptomatic, or cause non-bloody diarrhoea (NDSC reports on VTEC O157 in Ireland 2001). Up to 30% of people infected with *E. coli* O157 can develop kidney failure and 3–5% of these people die. Disease is most severe in infants and the elderly. Since the early 1980's VTEC has emerged as a group of pathogens of worldwide significance. In 2000, 41 cases of VTEC O157 were reported to the NDSC.

The main reservoir of *E. coli* O157 is the gastrointestinal tract of ruminants, particularly cattle, sheep and goats. The organism can be transmitted via consumption of contaminated food or water, person to person spread, contact with livestock, and environmental exposure to animal manure. The high levels of contamination on beef and other animal products were attributed largely to the slaughter process, during which carcases were contaminated from punctures in the gastrointestinal tract. This led to the implementation in 1998 of a number of measures in abattoirs to minimise the faecal contamination of carcases, 'the clean cattle policy'. These measures include prohibiting the slaughter of animals showing significant faecal contamination of the fleece or hide and implementing enhanced hygiene practices to prevent contamination of the carcase during evisceration.

Water and a variety of foods including cold cooked meats; raw dairy products; minced beef products and salad vegetables have been implicated in outbreaks of infection. As the infective dose is low (between 10 and 100 organisms), cross-contamination of ready to eat foods from raw meats is a serious threat in retail outlets, and in both domestic and commercial kitchens.

5.1 VTEC in food

Results of 8046 tests for VTEC O157 tests on various foods and vegetables were recorded on the FoodMicro Database in 2002, and 9281 tests were recorded for 2003. A total of 24 (0.3%) were positive in 2002 and 7 (0.07%) in 2003. Results of tests undertaken on raw meat and raw meat products are shown in Table 19. In addition, 284 samples of cooked meat or meat products were tested for VTEC O157 in 2002. None was positive. In 2003, 272 cooked meat products were tested for VTEC O157 and one 'not specified' sample was confirmed as positive.

Table 19: Results of tests for verocytotoxigenic *E. coli* O157 in raw meat and raw meat products in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Bovine	3763	2 (0.1)	5050	2 (0.1)
Ovine	313	0	313	0
Porcine	525	0	136	0
Poultry	36	0	15	0
Not specified	364	0	182	0
Total	**5001**	**2 (0.04)**	**5701**	**2 (0.04)**

Results of tests undertaken on other foods and vegetables are shown in Table 20. In 2002, 2298 tests were carried out with no positive samples; in 2003, 2799 tests were carried out and two samples were positive, a vegetable sample and a mushroom sample.

Table 20: Results of tests for verocytotoxigenic *E. coli* O157 in ready-to-eat foods, vegetables, fruit and other samples in 2002 and 2003.

Sample Type	No. Samples Tested 2002	No. Samples Positive (%) 2002	No. Samples Tested 2003	No. Samples Positive (%) 2003
Ready-to-eat foods	3	0	8	0
Prepared foods to be cooked	110	0	12	0
Foods, type not specified	2088	0	2708	0
Food grade water	7	0	7	0
Vegetables/fruit	6	0	7	1 (14.3)
Mushrooms	84	0	57	1 (1.8)
Total	**2298**	**0**	**2799**	**2 (0.07)**

A total of 385 and 308 environmental swabs or other samples were tested for VTEC O157 in 2002 and 2003, respectively. A total of 9 (2.3%) were found positive in 2002 and there were no positives in 2003.

In 2002 and 2003 respectively, 53 and 68 samples of dairy origin were tested for VTEC O157. Eight of 31 raw milk samples tested in 2002 were positive. A further 3 of 21 samples tested in 2002, for which the origin was not specified, were also positive. There were no positive dairy samples in 2003.

In 2003, two VTEC O157 were isolated from mushroom casings. This contamination may have been from the mushroom compost, which can be derived from composting wheat straw and various animal manures.

5.2 Discussion

Testing for verocytotoxigenic *E. coli* in foods primarily focused on meat of bovine origin and on VTEC of serotype O157. A clean cattle policy was introduced in meat processing plants in 1998 to reduce the risk of cross-contamination of carcases by dirty hides. The results on over 5000 tests on meat products for both years show only two raw bovine meat samples were positive in 2002 and in 2003 for VTEC O157. This indicates that reducing faecal contamination of carcases during slaughter and dressing is an important step in reducing contamination on meat, which in turn should result in reduced incidence of illness associated with beef, ground beef and other raw meats.

6. Conclusions

The basis for regulation of the food production and processing sector by DAF and other regulatory agencies is to maintain public health standards and reduce the incidence of food-borne illness. By regulating for effective food safety measures, the official agencies place significant costs on the food industry to comply with best practices in food production from farm to fork. The effectiveness of food safety controls applied by the food industry is monitored by the DAF inspectorate in processing plants . This includes the regular collection and analysis of official samples. An additional safeguard is applied through the requirement for industry to undertake their testing in approved laboratories. This has allowed the development of a laboratory-based food monitoring system, which has added a further safeguard to consumer safety.

This report, the first on the FoodMicro Database, highlights the level of microbiological testing being carried out by food producers and processors in DAF approved private laboratories on the island of Ireland. The FoodMicro Database contains information on over 300,000 microbiological tests undertaken by the food industry in 2002 and 2003. The data presented here are the most comprehensive available on the island of Ireland. These data will help the industry and regulatory agencies demonstrate the extent of monitoring of the food sector and will also facilitate more effective targeting of sectors that need additional monitoring or more effective controls. This FoodMicro Database will, in time, allow detailed trend analyses to be carried out on food safety risks in the sector of the food industry regulated by DAF. In addition, the FoodMicro Database will be of assistance in allowing the regulatory agencies to assess the impact of any future regulatory changes on consumer exposure to food-borne pathogens.

Although there are some gaps in information supplied by the laboratories, the data are relatively comprehensive. The extent of data recorded by laboratories on individual samples varies, making it difficult to precisely define all sample types. In addition, some laboratories process products originating outside the ROI and in some cases this information is not readily available. However, attempts are being made to improve the detail and flow of information into the FoodMicro Database. Overall, the quality of the data supplied was generally of a high standard. Originally the laboratories submitted summary data on *Salmonella* testing, however, these reports varied in the type of information they provided. Now the laboratories all complete a DAF report template that complements the FoodMicro Database, enhancing the collection of data.

An important consideration for DAF in requiring industry to use DAF approved laboratories for sample analysis is to further ensure the quality of the testing undertaken. Although tests in many of the

laboratories are accredited by the relevant national authorities, the laboratories are required to demonstrate satisfactory proficiency in the isolation of *Salmonella* prior to approval. Some issues of quality control on testing by the laboratories were apparent during collection of data on microbiological testing. Two laboratories, for instance, isolated *S.* Poona from samples, one from table eggs and the other from milk powder. As both of these isolations were unexpected, it gave rise to concerns that the result may be due to cross-contamination of samples in the laboratories. Both laboratories were using *S.* Poona as an in-house QC strain. Cross-contamination of samples is an issue of concern for all laboratories and will be discussed in a future report of the Annual National *Salmonella* Ring Trial organised by the CVRL.

Overall, the results from testing by the food industry indicate that controls on zoonotic pathogens in the food chain are operating effectively in the ROI. Most notable is the effective control of *S.* Typhimurium and *S.* Enteritidis in the poultry sector. These results concur with the results of official DAF testing. All isolations of these serotypes are officially investigated and any flocks found positive are removed from production. Vaccination, competitive exclusion and antibiotic prophylaxis are not permitted. Other *Salmonella* serotypes, particularly *S.* Kentucky and *S.* Livingstone are, however, more widely distributed in flocks. Both serotypes are also among the most frequent serotypes isolated from poultry meat. While there is no evidence of any *Salmonella* being present in poultry feed, both serotypes have been isolated from the feed mill environment suggesting contaminated feed as the potential source. More effective controls may be required by the feed industry to prevent spread of these and related serotypes.

Control of *S.* Typhimurium in other sectors of the meat industry is also apparent. The organism is most frequently isolated from pig meat. The introduction of a compulsory *Salmonella* control programme for the pig sector in 2002, requiring additional precautions to be applied when slaughtering pigs from *Salmonella* infected herds, should in time result in a reduction in *Salmonella* prevalence throughout this sector.

The data presented in this report will assist in further assessing the sources of *Salmonella* in the human population. The current results indicate that 26 of the 46 (56%) *Salmonella* serotypes found in humans were not seen in the FoodMicro Database entries for 2002. Combining the travel-related *Salmonella* serotypes with those found in the current surveillance of foods shows there are approximately 20% of human cases where the potential source of the isolate is not known. Currently work is underway to combine these data with results of official testing to further quantify sources of human *Salmonella* serotypes.

The clean cattle policy also appears to be effective with little evidence of VTEC *E. coli* O157 contamination in the beef sector. However, it is worth remembering that *E. coli* O157 is not the only significant VTEC. *Escherichia coli* O111, O26 and O113 also cause human illness and display symptoms similar to those caused by *E. coli* O157:H7. Because the majority of outbreaks of human illness have been attributed to O157:H7, selective media and rapid detection kits have been developed specifically for O157. This has resulted in many laboratories limiting their screening to just O157 and not the other members of the VTEC family.

Results of *Listeria* testing in the food sector highlight the need for further investigation. The reports show some increase in isolations from the ready-to-eat foods between 2002 and 2003. As the data on individual sample tests are available to the official inspectorate supervising individual processing facilities, it was beyond the scope of this project to undertake any follow-up analysis.

7. References

Annual Review and Outlook for Agriculture and Food 2002/2003. [Online] http://www.agriculture.gov.ie

Brenner, F.W., Villar, R.G., Angulo, F.J., Tauxe, R. and Swaminathan, B. (2000) *Salmonella* nomenclature. Journal of Clinical Microbiology 38(7), 2465–2467.

Food Safety Authority of Ireland (2001) Guidance Note No. 3: Guidelines for the Interpretation of Results of Microbiological Analysis of Some Ready to Eat Food Samples at Point of Sale.

Kramer, J.M., Frost, J.A, Bolton, F.J. and Wareing, D.R.A. (2000) *Campylobacter* contamination of raw meat and poultry at retail sale: identification of multiple types and comparison with isolates from human infection. Journal of Food Protection 63(12), 1654–1659.

McLauchlin, J., Mitchell, R.T., Smerdon, W.J. and Jewell, K. (2004) *Listeria monocytogenes* and listeriosis: a review of hazard characterisation for use in microbiological risk assessment of foods. International Journal of Food Microbiology 92,15-33.

National Disease Surveillance Centre (2001) Report on Campylobacteriosis in Ireland 2001.
[Online] http://www.ndsc.ie/Publications/CampylobacterAnnualReports/d927.PDF

National Disease Surveillance Centre (2001) VTEC 0157 in Ireland. Epi-Insight 2,7.
[Online] http://www.ndsc.ie/Publications/EPI-Insight/2001Issues/d152.PDF

National Disease Surveillance Centre, Annual Report 2001.
[Online] http://www.ndsc.ie/Publications/AnnualReports/d584.PDF

National Disease Surveillance Centre, Annual Report 2002.
[Online] http://www.ndsc.ie/Publications/AnnualReports/d818.PDF

National Disease Surveillance Centre, Annual Report 2003.
[Online] http://www.ndsc.ie/Publications/AnnualReports/d1202.PDF

Park, S.F. (2000) The physiology of *Campylobacter* species and its relevance to their role as foodborne pathogens. International Journal of Food Microbiology 74, 177-188.

Popoff, M.Y., Bockemuhl, J. and Gheesling, L.L. (2004) Supplement 2002 (no. 46) to the Kauffmann–White scheme. Research in Microbiology 155(7), 568-570.

Sumner, J., Raven, G. and Givney, R. (2004) Have changes to meat and poultry food safety regulation in Australia affected the prevalence of *Salmonella* or of salmonellosis. International Journal of Food Microbiology 92(2), 199-205.

Schlosser, W., Hogue, A., Ebel, E., Rose, B., Umholtz, R., Feris, K. and James, W. (2000) Analysis of *Salmonella* serovars from selected carcasses and raw ground product samples prior to implementation of the pathogen reduction: hazard analysis and critical control point final rule in the US. International Journal of Food Microbiology 58, 107-111.

Department of Agriculture, Food and Rural Development (2001) The Safe Food Chain... Every Link is Vital.

Watabe, M., Rao, J.R., Xu, J., Millar, B.C., Ward, R.F. and Moore, J.E. (2004) Identification of novel eubacteria from spent mushroom compost (SMC) waste by DNA sequence typing: ecological considerations of disposal on agricultural land. Waste Management 24, 81-86.

Annex 1

List of DAF laboratories approved for microbiological testing 2003 under Directives 92/117/EEC, 91/497/EEC, 90/667/EEC, 92/5/EEC 94/65/EEC 92/116/EEC, 89/437/EEC.

Advanced Micro Services, South Ring Business Park, Tramore Rd, Cork.

Aire Laboratories, Cappagh Cross, Fermoy, Co. Cork.

Anser Laboratories, 69A Killyman Street, Moy, Co. Tyrone.

Aqua Lab, Donegal Rd, Killybegs, Co. Donegal.

Biosearch, Dufferin Rd, Belfast.

Complete Laboratory Solution, Ros Muc, Connemara, Co. Galway.

City Biologic, School of Biotechnology, DCU, Glasnevin, Dublin 9.

Consult-Us, Glanmire Industrial Estate, Glanmire, Co. Cork.

Dairygold Pathogen Lab, West End, Mallow, Co. Cork.

Eurofins Ryland Research, Finnabair Industrial Estate, Dundalk, Co. Louth.

Envirolab, Christendom, Ferrybank, Waterford.

Foodtech Consultants, Rocklawn, West Village, Ballincollig, Co. Cork.

Food Safety Lab, Veterinary Department, County Hall, Cork.

Foodtech Laboratories, Unit 4E, NorthWest Business Park, Blanchardstown, Dublin 15.

Independent Micro Lab, Lismard Industrial Estate, Timahoe Road, Portlaoise.

Irish Equine Centre, Johnstown, Naas, Co. Kildare.

Microlab, Drumillard Little, Monaghan Road, Castleblaney, Co. Monaghan.

Microchem, Clogherane, Dungarvan, Co.Waterford.

Mid-Antrim Laboratory Service, 42A Broughshane Road, Ballymena, Co. Antrim.

Monaghan Veterinary Laboratory, Clones Road, Monaghan.

National Food Centre, The Limerick Food Centre, Raheen Business Park, Limerick.

National Food Centre, Teagasc, Dunsinea, Dublin 15.

Oldcastle Laboratories, Cogan Street, Oldcastle, Co. Meath.

Q-Lab, Kerlogue Industrial Estate, Drinagh, Wexford.

Slaney Foods, Ryland, Bunclody, Co. Wexford.

Southern Scientific, Dunrine, Killarney, Co. Kerry.

Abbreviations

CIR	Crude incidence rate
CMCL	Central Meat Control Laboratory, Abbotstown, Dublin
CVRL	Central Veterinary Research Laboratory, Abbotstown, Dublin
DAF	Department of Agriculture and Food
DARDNI	Department of Agriculture and Rural Development for Northern Ireland
EQAS	Bord Bia Egg Quality Assurance Scheme
EU	European Union
FIRM	Food Institutional Research Measure
GBS	Guillain-Barré Syndrome
HUS	Haemolytic Uraemic Syndrome
NDSC	National Disease Surveillance Centre (now Health Protection Surveillance Centre)
NI	Northern Ireland
NSRL	National *Salmonella* Reference Laboratory, Galway
QC	Quality control
ROI	Republic of Ireland
SMP	*Salmonella* Monitoring Programme
TTP	Thrombotic thrombocytopenic purpura
UCD	University College Dublin
UK	United Kingdom
VT	Verocytotoxin
VTEC	Verocytotoxigenic *Escherichia coli*

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