Results of 3rd Quarter National Survey 2003 (03NS3)

Bacteriological Safety of Eggs produced under the Bord Bia Egg Quality Assurance Scheme (EQAS)

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Summary

Eggs produced under the Bord Bia Egg Quality Assurance Scheme (EQAS) were tested for the presence of *Samonella* spp. A total of 1169 samples were tested (each sample comprised of 6 eggs). Samples were obtained from EQAS approved farms; EQAS approved egg packing centres and retail premises. Sampling was carried out over a 3 month period (July to September 2003).

Salmonella spp. was not detected in any sample. Given the number of samples taken and assuming that a negative sample equals the absence of salmonella in 6 eggs, the findings of this study show that there is a 95% certainty that the true infection rate lies below 1 in 2657 eggs.

1. Introduction

Salmonellosis (the disease caused by *Salmonella enterica*) is one of the leading causes of foodborne illness worldwide. Symptoms range from mild gastroenteritis to enteric fever and bacteraemia.

There are over 2500 serotypes of *S. enterica* and all serotypes are capable of causing illness in humans [(1)]. In Ireland, the *S. enterica* serotypes most commonly associated with human illness are *Salmonella* ser. Enteriditis and *Salmonella* ser. Typhimurium. Of the reported food borne outbreaks in Europe caused by an identified agent, more than one third were confirmed to be caused by *S*. Enteritidis [(1)].

A wide range of foods (including those of animal origin and those subject to faecal contamination) have been implicated as vehicles in the transmission of foodborne salmonellosis. However, the emergence of *S*. Enteritidis as the leading cause of human salmonellosis in many countries has been attributed to this serovars ability to colonise the ovarian tissue of hens and thus contaminate the contents of intact shell eggs [(2)]. The Scientific Committee for Veterinary Measures relating to Public Health in its 'Opinion on Salmonellae in Foodstuffs' have identified eggs and products containing raw eggs as a food group which pose a hazard to public health [(3)]. Outbreaks of salmonellosis associated with eggs are widely reported in the literature [(4,5)].

The initial site of salmonellae contamination in eggs is the albumen [(6, 7)], however, contamination can spread to the iron rich yolk contents as the porosity of the vitelline membrance increases (see Appendix 1 for a diagrammatic representation of the compositional structure of an egg). The change in porosity is related to the storage temperature., e.g. at 20^{o}C the change becomes significant in 3-4 weeks, while at 30^{o}C the change is significant in 7 days [(8)]. Growth of salmonellae is rapid in the iron rich yolk.

Infection of the reproductive tissue of the hen is considered to be the major route by which the egg contents become contaminated [9], however, migration of the pathogen through the shell and membrane has also been recognised as a transmission route. Contamination of the shell may result from infection of the lower reproductive tract and/or from faecal contamination [8]. This contamination route is facilitated by moist shell eggs, storage at ambient temperatures [10], shell damage [11]. Contaminated shells not only increase the risk of egg content contamination but also increase the risk of cross contamination to other products/produce.

In the Republic of Ireland, *Salmonella* spp. is controlled in the egg production chain under the Zoonoses Directive (Council Directive 92/117/EEC which is transposed into Irish law as S.I. No. 2 of 1996 [12]). Under this Directive all hatcheries, poultry breeder farms (grandparent and parent farms) and laying flocks are monitored for *Salmonella* spp. and any flocks confirmed with *S*. Enteritidis or *S*. Typhimurium are slaughtered. In addition, both feed materials and compound feedingstuffs for poultry are tested for *Salmonella* spp. This directive also provides for the implementation of salmonella control programmes by member states. In Ireland, the Department of Agriculture and Food (DAF) operate comprehensive independent salmonella monitoring and control programme within the poultry industry. This programme has been in place since 1988 and includes strict monitoring of hatcheries, table egg producing farms, growing and rearing farms and poultry feedmills.

The Bord Bia Egg Quality Assurance Scheme (EQAS) [13] is an additional salmonella control programme in the Republic of Ireland. EQAS is a voluntary integrated management scheme which incorporates recognised International Quality Management Systems, HACCP and EU legislation. This scheme incorporates additional *Salmonella* spp. controls to those specified in legislation. It covers all aspects of egg production (hygiene, disease control and flock welfare) and packaging. During the production stage the salmonella controls are built around the sourcing of pre-lay birds from approved sources with the relevant documentary evidence. Product identification and traceability are the key requirements at the packaging stage.

Despite these control steps, there are no published data on eggs tested in the Republic of Ireland for *Salmonella* spp. This survey was proposed to address this issue. This survey focused on eggs produced under the Bord Bia EQAS. Another survey may be undertaken at a later stage to study non quality assured eggs.

2. Specific Objectives

To investigate the incidence of *Salmonella* spp. in eggs on retail sale in Ireland which have been produced under the Bord Bia Egg Quality Assurance Scheme (EQAS).

3. Method

3.1 Sample Source

Samples were obtained from:

1) EQAS approved farms and egg packing centres
2) Retail premises

3.2 Sample Description

Raw shell eggs (hen eggs) which were produced under the Bord Bia EQAS were sampled. These eggs were readily identifiable because of their quality logo (Appendix 2). These eggs may have been battery cage (e.g. 'farm fresh'), organic, free range or barn eggs.

Eggs closest to their best before date were sampled. Both pre-packed and loose eggs were suitable for analysis. In addition, eggs were checked for intactness and any cracked eggs were not submitted for analysis.

The following were specifically excluded from this survey

- Eggs produced under any other quality assurance schemes, e.g. Lion quality eggs.
- Boiled, pasteurised, preserved and liquid eggs.
- All egg products e.g. prepared dishes, mayonnaise etc.
- Eggs with the Q mark (unless they are also EQAS). The Q mark alone does not indicate that eggs are produced under the Bord Bia EQAS.

3.3 Sample Collection and Analysis

Sampling from EQAS approved farms and EQAS approved packing centres was undertaken by the egg inspectorate of the Department of Agriculture and Food. Sampling from retail premises was undertaken by the Environmental Health Officers (EHOs) from the 10 health boards (Appendix 3). Sampling predominantly took place between July and September 2003 inclusive (Note: some samples from the NWHB were obtained in October).

Batch samples (6 eggs per batch) were obtained from all premises. If the eggs were pre-packed the batch for analysis was comprised of 6 eggs from the same carton. If the eggs were loose the batch for analysis was comprised of 6 eggs from the same production batch. If this was not known 6 eggs (stored in the premises under the same conditions) from the same producer/manufacturer were used. For transport to the laboratory, the loose eggs were packaged in a carton as the customer would receive them.

The batch samples were analysed in one of the 7 Official Food Microbiology Laboratories (OFMLs) (Appendix 4). On receipt in the laboratory the eggs were checked for intactness. If the intactness of any of the 6 eggs in the batch was in doubt, the batch was not subjected to microbiological analysis. To prevent cross contamination between the shell and the egg, the shell of each egg was sanitised using an alcohol wipe before cracking open. The 6 eggs in each batch were pooled,

homogenised and either the pooled sample or 25g of the pooled sample was tested for the presence/absence of *Salmonella* spp. using a standard/accredited method.

3.4 Reporting of results

The OFMLs reported the microbiological results (presence/absence of salmonella) to the FSAI and the EHOs via the normal reporting channels.

If *Salmonella* spp. was present, the OFMLs were requested to: i) identify the species and send the isolate to The Interim National Salmonella Reference Laboratory in University College Galway for further analysis and ii) inform the egg inspectorate of DAF.

4. Results and Discussion

4.1 Sample Details

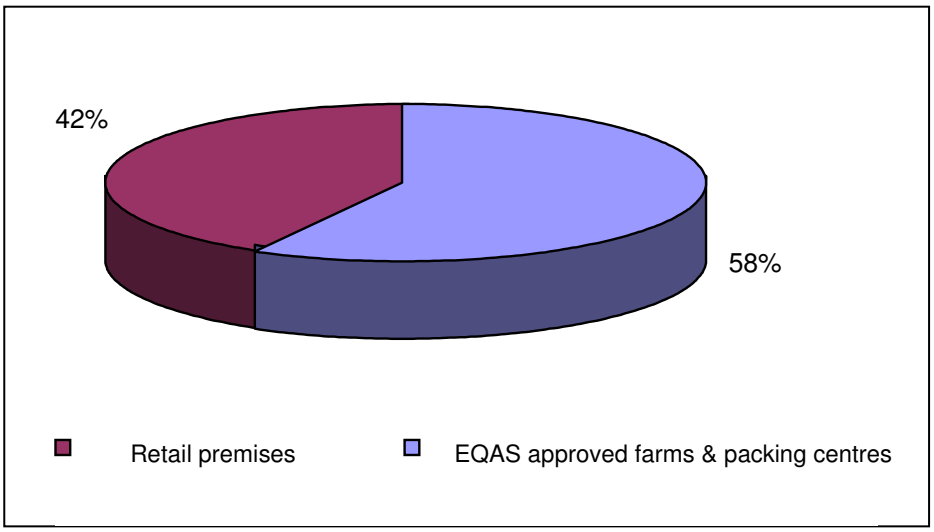
4.1.1 Sample Numbers and Source

A total of 1181 samples were submitted for microbiological analysis. 12 samples were not suitable for analysis because of broken or cracked shells, therefore microbiological analysis was carried out on 1169 samples (Appendix 5 & 6).

Of the 1169 samples analysed:

- 58% (n=679) were sampled from either EQAS approved farms or egg packing centres (i.e. samples submitted by the egg inspectorate of DAF) and
- 42% (n=490) were sampled from retail premises (i.e. samples submitted by EHOs) (Figure 1).

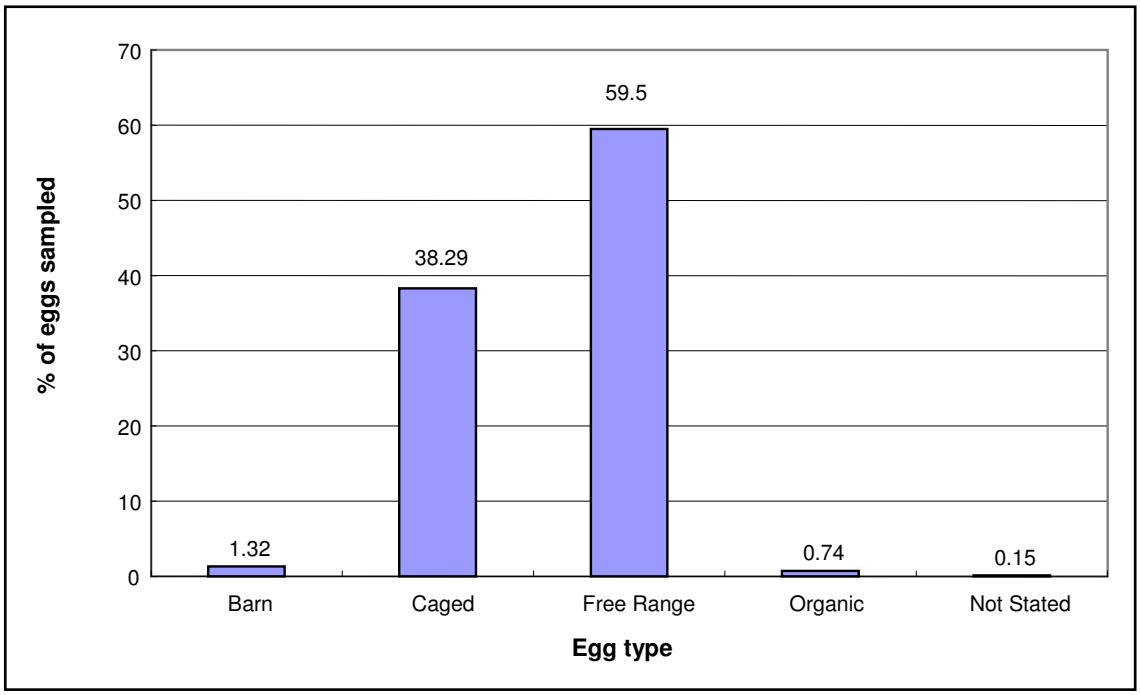
Figure 1: Source of samples analysed



4.1.2 Type of Egg Production (i.e. barn, caged, free-range,organic)

i) Samples from EQAS approved farms and packing centres:
Information on the type of egg production was recorded for eggs which were sampled from both EQAS approved farms and packing centres (i.e. samples taken by the egg inspectorate of DAF). Over half (59.5%, 404/679) of the eggs sampled were free range (Figure 2).

Figure 2: Type of egg submitted from EQAS approved farms and packing centres (n=679)



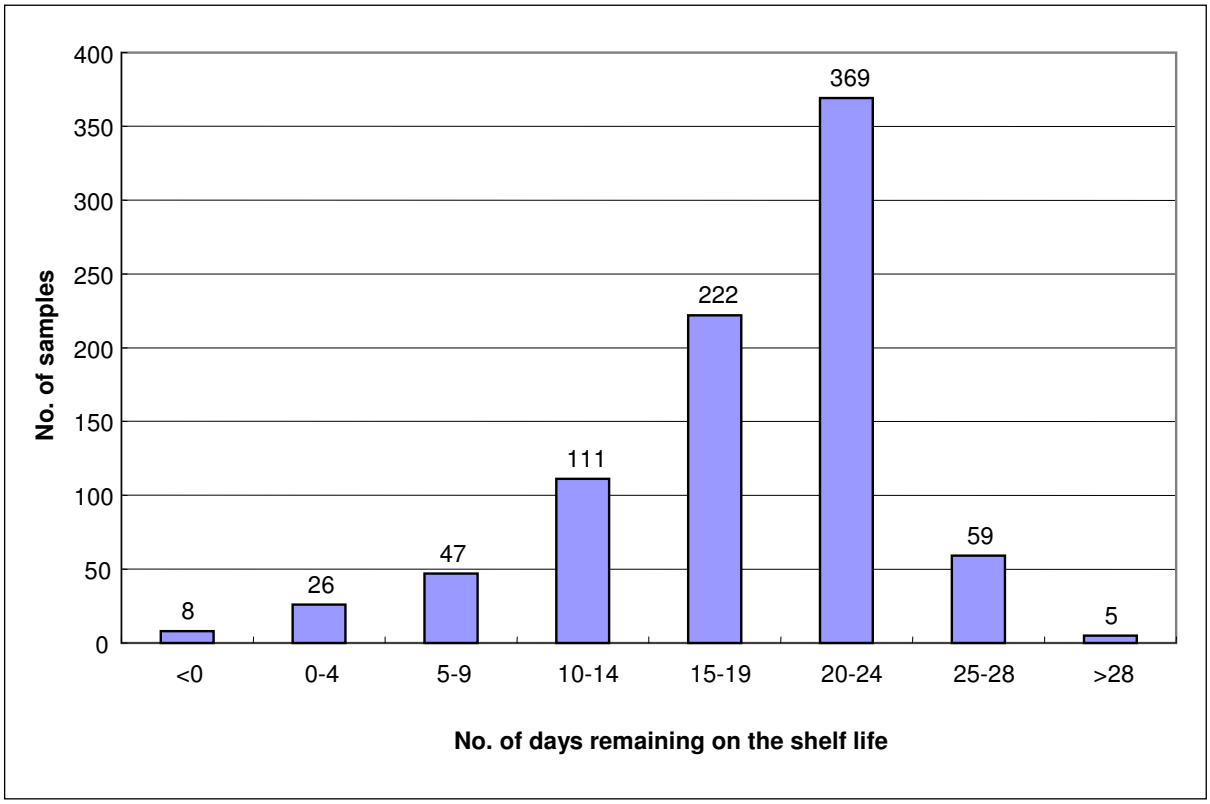
ii) Samples from retail premises:
Although it was not a requirement of this survey, information on the type of egg production was recorded for 22.8% (112/490) of eggs sampled from retail premises. Of the 112 egg samples for which information was available, 94.6% (106/112) were free range.

4.1.3 Best Before Date

The best before date of eggs must not exceed 28 days from the day of lay.

The best before date was recorded for 72.5% (847/1169) of samples submitted. For each of these samples, the number of days remaining on the shelf life (i.e. the number of days between the date of sampling and the best before date) was determined and the results are illustrated in Figure 3.

Figure 3: Number of days remaining on the shelf life (n=847)



A total of 8 samples were sampled after their best before date, 834 samples had between 0 and 28 days remained on their shelf life and 5 samples had in excess of 28 days remaining on their shelf life. These 5 samples are not in compliance with the shelf life requirements (i.e. it must not exceed 28 days). However, it is possible that misinterpretation and/or misprinting of the best before date on the report form may be responsible for this finding. It is reasonable to assume that the remaining 842 samples complied with the shelf life requirements.

4.2 Microbiological Results

Salmonella spp. was not detected in any sample tested irrespective of sample source.

The prevalence of *Salmonella* spp. in eggs as reported in other studies is presented in Table 1. The results of surveillance studies are reported from the UK [14, 15], Northern Ireland [16] and Denmark [17], while the findings of routine analysis are reported from Austria [17], Germany [17], Italy [17] and Spain [17]. From the data presented the prevalence of *Salmonella* spp. ranged from 0 to 4.9% and the prevalence of *S.* Enteritidis ranged from 0 to 1.6%. The highest prevalence for both *Salmonella* spp. and *S.* Enteritidis was recorded in Spain.

The findings of this Irish study are comparable ($p<0.05$) to the findings of the UK, Northern Ireland and Danish surveillance studies.

Table 1: Prevalence of *Salmonella* spp. in eggs as reported in other studies

Year	Country	No. of samples	Sample source	Area sampled (shell/ contents)	No. + for *Salmonella* spp. (%)	No. + for *S.* Enteritidis
August '92 – April '93[¥]	UK [14]	7730[ϒ]	Retail premises	Shell & Contents	17 (0.2)	16[∞] (0.2)
March-July '03	UK [15]	4753[ϒ]	Retail premises	Shell & Contents	9 (0.34)[■]	7
April '96 – Oct '97[§]	NI [16]	2090[ϒ]	Retail premises	Shell & Contents	9 (0.43)	3[♣] (0.14)
2001	Austria [17]	223[♦]	N/S	N/S	3 (1.4)	1 (0.5)
2001	Germany [17]	11435[♦]	N/S	N/S	69 (0.6)	50 (0.44)
2001	Italy[17]	590[♦]	N/S	N/S	4 (0.7)	3 (0.5)
2001	Spain[17]	305[♦]	N/S	N/S	15 (4.9)	5 (1.6)
2001/2002	Denmark [17]	9820[∝] 1480[1⊗]	N/S	Shell & Contents	6 (0.06) 10 (0.7)	6 (0.06) 10 (0.7)
2003	Ireland (this study)	1169[ϒ]	Farm, packing centres & retail premises	Contents	0 (0)	0 (0)

[¥] Samples stored at 21°C for 5 weeks before examination

[ϒ] Results of surveillance studies presented. Each sample comprised of 6 eggs.

[∞] 13 of the 16 isolates were *S.* Enteritidis phage type 4 (6 of these were isolated from the shell and 7 were isolated from the egg contents).

[■] Prevalence at 95% confidence interval

[§] Samples stored at room temperature for <1week before examination

[♣] Other serotypes isolated included *S.* Mbandaka (n=1); *S.* Montevideo (n=1); *S.* Typhimurium (n=1); *S.* Infantis (n=2); *S.* Kentucky (n=1). The 9 isolates were detected on the shell (n=8) and in the egg contents (n=1).

[♦] It was assumed that this data was from routine surveillance

[∝] Danish eggs tested in this surveillance study. The 6 isolates were detected on the shell (n=4) and in the egg contents (n=2)

[⊗] Imported eggs tested in this surveillance study. The 10 isolates were detected on the shell (n=7), in the contents (n=2) and both (n=1)

5. Conclusions

The finding that *Salmonella* spp. was not detected in any egg sample tested (n=1169); suggests that the salmonella control steps of the Bord Bia EQAS and the Zoonoses Directive (S.I. No. 2 of 1996) are effective in controlling this pathogen. Given the number of samples taken and assuming that a negative sample equals the absence of salmonella in 6 eggs, the findings of this study show that there is a 95% certainty that the true infection rate lies below 1 in 2657 eggs. To confirm a lower infection rate many more samples would need to be taken (e.g. 30,000 to confirm an infection rate of <1 in 10,000).

The FAO/WHO in their *risk assessments of salmonella in eggs and broiler chickens* have shown that control measures which reduce both the flock prevalence and the prevalence of salmonella within the flock results in a directly proportional reduction in human health risks. In Ireland the number of reported cases of salmonellosis has decreased from a peak of 1261 in 1998 to 428 in 2001 (NDSC) [18]. This decrease may be partly attributed to a number of factors including the Bord Bia EQAS, the Department of Agriculture and Food Salmonella control programme etc.

The current advice given by the FSAI to caterers is that the safest eggs available should be used in the preparation of dishes which are not thoroughly cooked e.g. mousse, quiche and omelette[¥]. Dishes of this nature pose a high risk of salmonella as the do not undergo a cooking process sufficient to kill any salmonella which may be present (the required temperature is 70^{o}C for 2 minutes). In addition, further risks are associated with large-scale food production in the catering industry due to the large volumes of eggs that are used. One egg infected with salmonella could contaminate a whole batch. Thus in the interest of consumer protection it is imperative that caterers use the safest eggs available.

[¥] In a survey carried out by the FSAI in May 1999 on egg usage in the Irish catering sector, approximately a quarter of all establishments surveyed used fresh shell eggs (no differentiation was made between quality assured and non-quality assured eggs) in uncooked dishes.

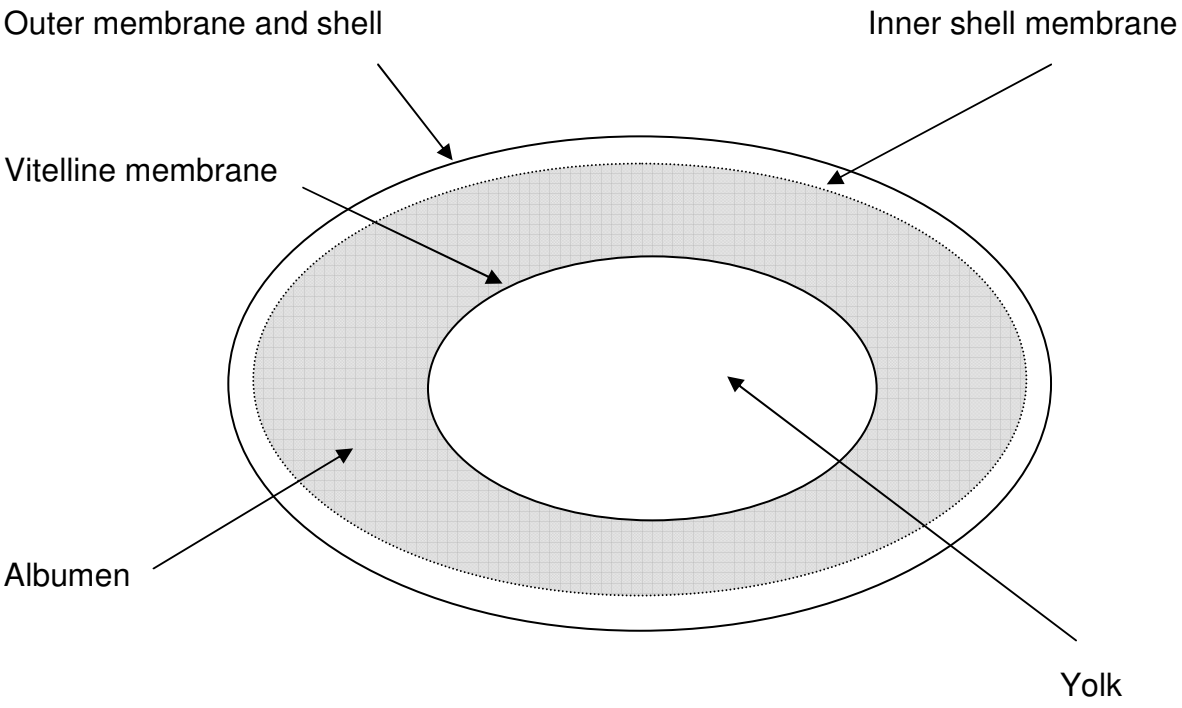
6. Bibliography

1. Food and Agriculture Organisation of the United Nations/ World Health Organisation. 2002. Risk assessments of Salmonella in eggs and broiler chickens. http://www.fao.org/DOCREP/005/Y4392E/Y4392E00.HTM#Contents
2. Food and Agriculture Organisation of the United Nations/ World Health Organisation. 2002. Risk assessments of Salmonella in eggs and broiler chickens. Interpretative Summary. http://www.fao.org/DOCREP/005/Y4393E/Y4393E00.HTM
3. European Commission. Opinion of the Scientific Committee for Veterinary Measures Relating to Public Health on salmonellae in Foodstuffs. http://europa.eu.int/comm/food/fs/sc/scv/out66_en.pdf
4. Perales, I. and Audicana, A. 1989. The role of hens eggs in outbreaks of salmonellosis in North Spain. Int J Food Microbiol., **8**, 175-180.
5. Stevens, A., Joseph, C., Bruce, J., Fenton, D., O'Mahony, M., Cunningham, D., O'Connor, B. and Rowe, B. 1989. A large outbreak of *Salmonella enteritidis* phage type 4 associated with eggs from overseas. Epidem. Inf., **103**, 425-433.
6. Gast, R.K., Beard, C. W., 1990. Production of *Salmonella enteritidis*-contaminated eggs by experimentally infected hens. Avian Dis., **34**, 438-446
7. Humphrey, T.J., Whitehead, A., Gawler, A.H.L., Henley, A., and Rowe, B. 1991. Numbers of *Salmonella enteritidis* in the contents of naturally contaminated hens eggs. Epidemiol. Infect., **106**, 489-496.
8. Advisory Committee on the Microbiological Safety of Food. 2001. Second report on *Salmonella* in eggs.
9. Advisory Committee on the Microbiological Safety of Food. 1993. Report on salmonella in eggs.
10. Rizk, S.S., Ayres, J.C. and Kraft, A.A. 1996. Effect of holding condition on the development of salmonellae in artificially inoculated hens eggs. Polt. Sci., **45**, 823-829.
11. Vadehra, D.V., Baker, R.C. and Naylor, H.B. 1969. *Salmonella* infection of cracked eggs. Poult. Sci., **48**, 954-957
12. S.I. No. 2 of 1996. European Communities (Zoonoses) Regulations, 1996.
13. Bord Bia. Egg Quality Assurance Scheme Technical Manual.
14. de Louvois, J. 1994. *Salmonella* contamination of stored hens' eggs. PHLS Microbiology Digest, **11**, (4), 203-205.
15. Food Standards Agency. Report of the survey of *Salmonella* contamination of UK produced shell eggs on retail sale. http://www.food.gov.uk/science/surveillance/fsis2004branch/fsis5004eggs
16. Wilson, I.G., Heaney, J.C.N., Powell, G.G. 1998. *Salmonella* in raw shell eggs in Northern Ireland: 1996-7. Communicable Disease and Public Health, **1**, (3), 156-160.
17. European Commission. Trends and sources of zoonotic agents in animals, feedingstuffs, food and man in the European Union and Norway in 2001. http://europa.eu.int/comm/food/fs/sfp/mr/mr_zoo_rep2001_en.html
18. National Disease Surveillance Centre. Notifiable Infectious Diseases in Ireland 2001. http://www.ndsc.ie/IDStatistics/AnnualIDStatistics/d592.PDF

7. Appendices

APPENDIX 1

Basic diagrammatic representation of the compositional structure of an egg



APPENDIX 2

Quality Mark: Bord Bia Egg Quality Assurance Scheme (EQAS)

The following quality mark identifies shell eggs produced under the Bord Bia EQAS.

QUALITY
ASSURED
BORD BIA – IRISH FOOD BOARD

Green Pantone 3425

Appendix 3

Health Boards

Health board	Abbreviation
East-Coast Area Health Board	ECAHB
Midland Health Board	MHB
Mid-Western Health Board	MWHB
Northern Area Health Board	NAHB
North-Eastern Health Board	NEHB
North-Western Health Board	NWHB
South-Eastern Health Board	SEHB
Southern Health Board	SHB
South-Western Area Health Board	SWAHB
Western Health Board	WHB

Appendix 4
List of the Official Food Microbiology Laboratories (OFMLs)

Laboratory
Public Health Laboratory SWAHB at Cherry Orchard Hospital
Mid-Western Regional Hospital
Public Analysts Laboratory, Dublin
Sligo General Hospital
St Finbarr's Hospital, Cork
University College Hospital, Galway
Waterford Regional Hospital

Appendix 5

Retail samples
(i.e. samples submitted by EHOs)

Health board	Abbreviation	No. of samples submitted	No. of samples analysed
East-Coast Area Health Board	ECAHB	42	42
Midland Health Board	MHB	23	23
Mid-Western Health Board	MWHB	113	108
Northern Area Health Board	NAHB	3	3
North-Eastern Health Board	NEHB	10	10
North-Western Health Board	NWHB	98	97
South-Eastern Health Board	SEHB	79	79
Southern Health Board	SHB	82	82
South-Western Area Health Board	SWAHB	15	15
Western Health Board	WHB	31	31
		496[♣]	**490**

[♣] 6 samples were unsuitable for analysis due to broken or cracked eggs [MWHB (n=5) and NWHB (n=1)]

Appendix 6

Samples from EQAS approved farms and packing centres (i.e. samples submitted by egg inspectorate of DAF)

Laboratory to which samples were submitted	No. of samples submitted	No. of samples analysed
Cherry Orchard	184	184
Sir Patrick Dun's	61	61
Cork	128	127
Galway	88	88
Limerick	40	35
Sligo	32	32
Waterford	152	152
	685[♣]	**679**

[♣] 6 samples were unsuitable for analysis due to broken or cracked eggs [Cork (n=1) and Limerick (n=5)]