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Third National Microbiological Survey 2008 (08NS3): Prevalence of *Campylobacter* spp. on (a) surface of chicken packaging and (b) surface of display cabinets

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Executive Summary

The purpose of this survey was to determine (1) the prevalence of *Campylobacter* spp. on (a) the external surface of chicken packaging and on the (b) surface of display cabinet shelves; and (2) to establish whether handling and cooking instructions deviate from accepted best practice.

Seven hundred and eighty five samples were taken by Environmental Health Officers (EHOs) from retail establishments in Ireland between September and December 2008. Each sample consisted of two swabs: one swab from the exterior of the chicken packaging and one swab from the cabinet displaying that package (i.e. 1570 swabs). Samples were analysed for the presence of *Campylobacter* species (spp.) in the Food Microbiology Laboratories of the Health Service Executive (HSE).

Campylobacter spp. were detected on 13.2% (104/785) of the external surface of packaging and 10.9% (86/785) of the surface of display cabinets.

This survey included a questionnaire which captured information on the sample source, the packaging and the sample and had a response rate of 75% (590/785). Based on statistical analysis the microbiological results of this subset of 590 samples were considered representative of the total sample population.

Almost two-thirds of the packaging sampled (61.2%, 361/590) was conventional packaging (i.e. the plastic covering wrapped around the tray and sealed underneath); while, one-third (32%, 189/590) was leak-proof packaging (i.e. the plastic wrapping sealed onto the tray).

The following are key findings relating to packaging which were statistically significant ($p \leq 0.05$):

- *Campylobacter* spp. were detected on the exterior of 18.9% (68/361) of the conventional packaging and 2.1% (4/189) of the leak-proof packaging. The contamination detected on the display cabinet which was in contact with the sampled packaging and the evidence of leakage reported to be visible on that display cabinet further supported this finding (see below).
- *Campylobacter* spp. were detected on 13.9% (50/361) of display cabinets in contact with conventional packaging; while *Campylobacter* spp. were detected on only 2.6% (5/189) of display cabinet surfaces in contact with leak-proof packaging.
- When chicken was packaged in the conventional manner, leakage was evident on 17.2% (62/361) of display cabinets. With leak-proof packaging, leakage was evident on only 6.3% (12/189) of display cabinets.
- *Campylobacter* spp. were detected on 19.5% (71/365) of packages containing whole birds compared to 3.2% (7/221) of packages containing chicken portions. Some studies in Ireland and other countries have shown that whole birds are more contaminated than chicken portions.

The following are key findings relating to labelling:

- Approximately one-third of chicken packages provided handling, preparation and/or cooking instructions on the front of the label. Of the 381 samples which did not provide such instructions on the front of the label, 63% (240/381) carried these instructions on the reverse of the label To view this information the consumer must either peel off the label (which can be difficult to do), or look at the label through the plastic film. This latter practice could encourage consumers to touch the internal surface of the packaging which would be expected to be more contaminated than the external surface.
- Of the 365 samples which were identified as whole birds on the questionnaire, 6.8% (25/365) carried instructions advising customers to wash the whole bird or the cavity of the bird prior to cooking. This instruction is contrary to current best practice advice and can lead to the spread of campylobacter around the kitchen in water droplets.

Based on the findings of this report, recommendations are made for retailers to control the risk of cross contamination from conventional packaging, to change to sourcing chicken in leak-proof packaging and to change labels which carry cooking and handling instructions that are contrary to accepted best practice.

The message to consumers is to continue to keep raw meat separate from ready-to-eat foods while shopping, storing and preparing food. Where consumers use reusable bags they should consider designating one bag for use with raw meats only and consistently use that bag for the purpose of transporting raw meat to their home.

Acknowledgements

The Food Safety Authority of Ireland wishes to thank the Environmental Health Officers, the laboratory staff in the Food Microbiology Laboratories of the Health Service Executive who participated in this survey.

Abbreviations

EFSA	European Food Safety Authority
EHO	Environmental Health Officer(s)
EU	European Union
FSAI	Food Safety Authority of Ireland
HPSC	Health Protection Surveillance Centre
HSE	Health Service Executive
ISO	International Standards Organisation
MPN	most probable number
spp.	species
UK	United Kingdom
USA	United States of America

1. Introduction

Campylobacteriosis is the most common bacterial cause of gastroenteritis in Ireland and Europe (HPSC, 2009 and EFSA, 2010a). The Irish Health Protection Surveillance Centre (HPSC) was notified of 1758 cases in 2008, approximately four times the number of salmonellosis cases (449) reported for that year. Despite a decrease from 45.2 cases of campylobacteriosis per 100,000 of the population reported in 2007 to 41.4 cases per 100,000 in 2008 (HPSC, 2009), provisional data for 2009 suggests an increase on the 2008 incidence rate. The European average incident rate for 2008 was 40.7 cases per 100,000 (EFSA 2010a)

A recent all-Ireland case control study identified eating chicken (in particular undercooked chicken), consuming lettuce and eating from a takeaway restaurant (other than Chinese or Indian) as the most important risk factors for sporadic cases of *Campylobacter* infection in Ireland (Danis *et al*. 2009). An opinion by the European Food Safety Authority's (EFSA) scientific panel on biological hazards identified poultry meat as a major source of campylobacteriosis (EFSA, 2005). The opinion identified cross-contamination of ready-to-eat foods and direct hand-to-mouth transfer during food preparation as important modes of transmission, and to a lesser extent the consumption of undercooked poultry meat (EFSA, 2005). In 2010, a second EFSA Opinion estimated that handling, preparation and consumption of broiler[1] meat may account for 20% to 30% of human cases of campylobacteriosis in European member states (EFSA, 2010b). This opinion was followed by an EFSA report on an EU-wide baseline study of campylobacter in chicken at slaughterhouses (EFSA 2010c). This study found that 83% of Irish chickens were infected on arrival at the slaughterhouse and 98% of Irish carcasses were found to be contaminated at the end of the slaughter process.

Studies in the United Kingdom (UK) have shown that between 3% and 6% of the external surface of raw chicken packaging can be contaminated with *Campylobacter* species (Harrison *et al*. 2001; Jorgensen *et al.* 2002 and Burgess *et al.* 2005) and a study in New Zealand found 24% of packaging was contaminated (Wong *et al.* 2004). This may be due to contamination of the surface in the processing plant or leakage due to damage of the packaging during handling, transport and storage etc. Contamination of the external surface may lead to a risk of cross-contamination between the packaging and ready-to-eat foods in the shopping basket/trolley, the shopping bag and in the home. *Campylobacter spp.* have been found to be common contaminants of poultry in Ireland. In one all-Ireland retail study, contamination was found in 50% of chicken, 46% of duck and 38% of turkey samples at retail sale (Whyte *et al*. 2006). With this level of contamination on the raw meat, it is possible that contamination of packaging also occurs in Irish retail outlets and that the risk of cross-contamination with ready-to-eat foods has potentially increased since the introduction of the tax on plastic bags in March 2002. In Ireland, conventionally packed chicken is typically sold in plastic trays covered with plastic which wraps around the meat and under the tray. When condensation builds up during chilled storage the liquid can leak out through the bottom of the packaging. Other factors which may lead to leakage include, the permeability of the plastic used, packs being stored tilted for display and physical damage to the plastic through mishandling. In recent years leak-proof packaging has been introduced by some producers and retailers. This packaging is designed such that the plastic cover is sealed on top of the tray, trapping potentially contaminated liquid within the tray.

In one of the UK studies, over half (i.e. 56%) of the internal surface of the packaging was found to be contaminated (Jorgensen *et al.* 2002). This is significant in view of the practice by some producers of including handling and cooking instructions on the reverse of the label. To view the information on the back of a label, the consumer must either peel off the label (which can be difficult to do), or look at the label through the plastic film. This latter practice could encourage the consumer to touch the internal surface of the packaging which is expected to be more contaminated than the external surface.

The practice of washing oven-ready birds has been identified as a means of spreading *Campylobacter* spp. onto kitchen surfaces such as taps and counter tops (Cogan *et al.* 1999; Gorman *et al.* 2002). In December 2005, *safe*food, the Food Safety Promotion Board ran a radio campaign advising consumers not to wash

[1] Broilers are young chickens which are reared for their meat.

oven-ready birds. However, some birds are still labelled with instructions to wash inside the cavity before cooking.

2. Specific Objectives

The specific objectives of this survey were to determine:

1. the prevalence of *Campylobacter* spp. on (a) the external surface of chicken packaging and on the (b) surface of display cabinet shelves.
2. whether preparation instruction labels and their location could lead to handling and cooking of chicken that is contrary to accepted best practice.

3. Methodology

3.1 Sample Source

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

3.2 Sample Period

Sampling took place between September and December 2008 inclusive.

3.3 Sample Description

Each sample consisted of two swabs:

a) A swab of the **external surface of chicken packaging**
Including swabs of:

- pre-packaged raw whole chicken
- pre-packaged raw chicken portions

Excluding swabs of:

- pre-packaged raw chicken with any seasonings, stuffing or sauces (e.g. marinades)
- loose raw whole chicken or chicken portions
- all frozen chicken

b) A swab of the **surface of the display cabinet** for each chicken packaging sample taken. The direct area covered by the package was swabbed.

3.4 Sample Collection

Sampling was undertaken by Environmental Health Officers (EHOs) from the Health Service Executive (HSE).

In the case of the packaging swab, only one sample of each brand was obtained per premises sampled. However, it was permitted to sample from the same brand if the product type was different (i.e. a whole chicken sample versus chicken portions samples).

A chicken sample which was in contact with the display cabinet surface was randomly selected. The entire external surface of the packaging (i.e. top and bottom) was swabbed using a TSC™ (Technical Service Consultants Ltd.) 50 cm^2 Blue Sponge dosed with Neutralizing Buffer (or other similar sponge surface sampling product). The surface of the display cabinet covered by the chicken sample was then swabbed using a separate TSC™ Blue Sponge. For both the packaging and cabinet surfaces, swabbing was done in both directions (i.e. horizontally and vertically) and involved changing the face of the swab. The swab was returned to the sterile container and transported to the laboratory as soon as possible in a cool box.

As *Campylobacter* spp. are considered fragile microorganisms, a long delay in delivery of swab samples to the laboratory may reduce the likelihood of detection. To enable assessment of this possible impact on results, the length of time between sampling and analysis was recorded on the questionnaire (Appendix 1)

EHOs were requested to complete sections 1, 3 4, 5 and 6 of the questionnaire provided (Appendix 1) at the time of sampling and section 2 upon delivery to the laboratory.

3.5 Sample Analysis

Samples were analysed for *Campylobacter* spp. in the Food Microbiology Laboratories of the Health Service Executive (HSE).

The method for processing swabs was based on ISO 18593. Swabs were processed as soon as possible on receipt at the laboratory. Where samples were not processed on the day of receipt, the laboratory was asked to indicate this on the laboratory report form to enable assessment of a possible impact of the delay in analysis on detection of *Campylobacter* spp. Swabs were aseptically removed from the transport container and placed in a food jar of suitable size. Approximately 225mls (or the dilution that the laboratory routinely use in accordance with its accredited procedure) of the appropriate camplyobacter enrichment broth was added to the receptacle containing the sponge and mixed thoroughly by shaking for 30 seconds. The receptacle was topped up with additional campylobacter enrichment broth to reduce the headspace and ensure microaerophilic conditions were produced.

ISO method 10272-1 was used to detect *Campylobacter* spp.

3.6 Reporting of Results

Results were reported as *Campylobacter* spp. 'present' or 'not detected' per swab.

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

3.7 Follow-up Action

As criteria are not specified in legislation for the samples in this survey, it was not envisaged that legal enforcement action would be taken. Where positive results were reported EHOs were advised to reinforce the need with the retailer for best hygiene practice regarding prevention of cross-contamination during handling and storage of raw chicken and during cleaning of the display cabinets.

3.8 Questionnaire Data

A questionnaire (Appendix 1) was completed for every sample set (i.e. each packaging and related cabinet swab sample) to obtain information on details such as the premises sampled, the sample type, the location and content of the labelling on the packaging.

Upon receipt of the laboratory results, EHOs were requested to complete the questionnaire and return it to the FSAI within six weeks of the survey completion date. Questionnaires received after this date were excluded from the analysis in this report.

3.9 Statistical Analysis

Chi square (X^2) and Fisher's Exact Test analysis was preformed using SPSS version 14.0, with significance defined at the $p \leq 0.05$ level.

4. Results & Discussion

4.1 Overall Microbiological Results

The results of 785 samples were considered for this report. Each sample consisted of two swabs: one swab from the external surface of the packaging and one swab from the surface of the cabinet displaying that package (i.e. 1570 swabs were considered for this report)[2].

Results are presented in Table 1. *Campylobacter* spp. were detected on 17.2% (135/785) of samples (i.e. they were detected on the exterior of the packaging and/or the display cabinet). Considering each surface type individually, *Campylobacter* spp. were detected on 13.2% (104/785) of packaging and 10.9% (86/785) of display cabinets.

Studies in the United Kingdom (UK) have shown that between 3% and 6% of the external surface of raw chicken packaging can be contaminated with *Campylobacter* species (Harrison *et al*. 2001; Jorgensen *et al.* 2002 and Burgess *et al.* 2005) and a study in New Zealand found 24% of packaging was contaminated (Wong *et al.* 2004).

Table 1: Overall microbiological results (n=785)

Campylobacter spp. detected/not detected		Number of samples	% of samples
Exterior of package	Display cabinet		
Not detected	Not detected	650	82.8
Detected	**Detected**	55	7.0
Detected	Not detected	49	6.2
Not detected	**Detected**	31	3.9
Total		**785**	**100.0**

[2] Three swabs from packaging were not considered for this report because corresponding swabs from the display cabinets were not submitted.

Where *Campylobacter* spp. were detected on both the packaging and the display cabinet (n=55), the species/sub-species identified on both surfaces were compared (Table 2). For 87% (48/55) of samples, the species/sub-species identified on the packaging matched the species/sub-species identified on the display cabinet. For 13% (7/55) of samples, the species/sub-species identified on both surfaces differed. This suggests that i) cross- contamination may have occurred between surfaces and/or ii) the chicken may have been contaminated with more than one species of campylobacter.

Table 2: Species/sub-species identified on the packaging and display cabinet (n=55)

Species identified on chicken packaging	Species identified on the display cabinet	No. of samples
C. coli	*C. coli*	1
	C. jejuni subsp 2	1
C. jejuni	*C. jejuni*	21
C. jejuni subsp 1	*C. coli*	1
	C. jejuni subsp *doylei*	2
C. jejuni subsp 2	*C. jejuni* subsp 2	1
	C. jejuni subsp *doylei*	1
C. jejuni subsp *doylei*	*C. jejuni* subsp *doylei*	1
	C. jejuni subsp 1	2
Campylobacter spp.	*Campylobacter* spp.	24
Total		**55**

4.2 Questionnaire Data

This survey included a questionnaire which captured information on the sample source, the packaging and the sample. Questionnaires were returned for 590 samples, i.e. there was a 75% (590/785) response rate. The microbiological results of this subset of 590 samples are presented in Table 3.

There was no statistical difference ($p>0.05$) between these results and the results of the 785 samples presented in Table 1; therefore, in terms of microbiology these 590 samples were considered representative of the total sample population.

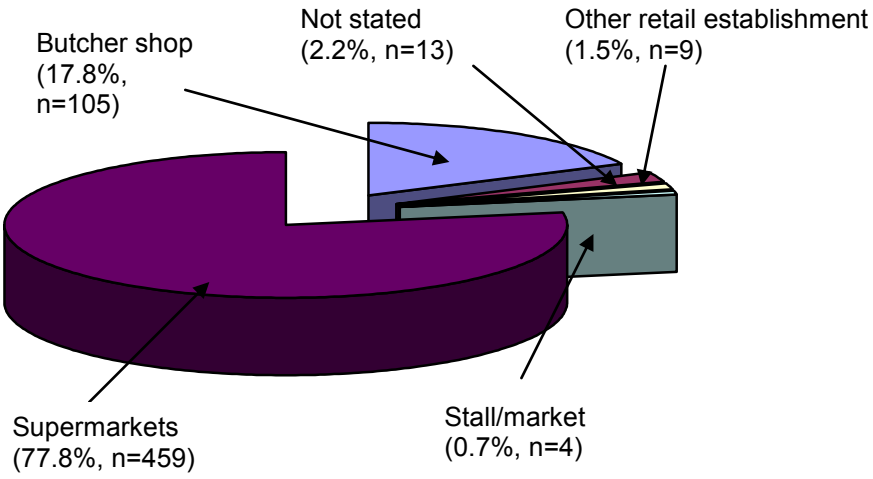
Table 3: Overall microbiological results of samples returned with a questionnaire (n=590)

Campylobacter spp. detected/not detected		Number of samples	% of samples
Swab from exterior of package	**Swab from display cabinet**		
Not detected	Not detected	489	82.9%
Detected	**Detected**	40	6.8%
Detected	Not detected	38	6.4%
Not detected	**Detected**	23	3.9%
Total		**590**	**100%**

4.2.1 Sample source

The vast majority of samples were obtained from supermarkets (77.8%, 459/590). Other sample sources included butcher shops and stalls/markets (Figure 1).

Figure 1: Sample source (n=590)

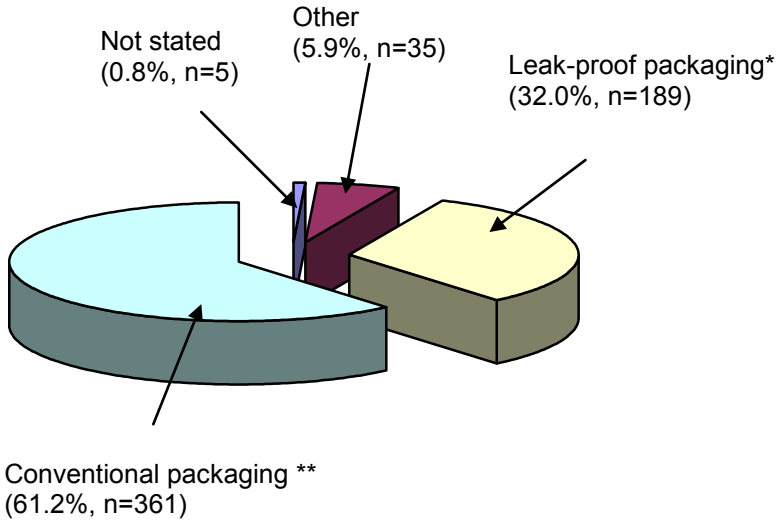


4.2.2 Information Relating to Packaging

4.2.2.1 Types of packaging

Figure 2 provides information on the type of packaging. Almost two-thirds of the packaging sampled (61.2%, 361/590) was conventional packaging (i.e. the plastic covering wrapped around the tray and sealed underneath); while, one-third (32%, 189/590) was leak-proof packaging (i.e. the plastic wrapping sealed onto the tray).

Figure 2: Type of packaging (n=590)



* **Leak-proof packaging**: The plastic is sealed onto the tray.
** **Conventional packaging**: The plastic is wrapped around the tray and sealed underneath.

Table 4 presents the relationship between the type of packaging and the prevalence of *Campylobacter* spp. on 1) the exterior of the packaging and 2) the display cabinet.

When chicken was packaged in the conventional manner *Campylobacter* spp. were detected on 18.9% (68/361) of packages; however, with leak-proof packaging *Campylobacter* spp. were detected on only 2.1% (4/189) of packages. This difference was statistically significant ($p<0.05$).

Campylobacter spp. were detected on 13.9% (50/361) of display cabinets in contact with conventional packaging; while *Campylobacter* spp. were detected on only 2.6% (5/189) of display cabinet surfaces in contact with leak-proof packaging. This difference was also statistically significant ($p<0.05$).

Table 4: Relationship between the type of packaging and the prevalence of *Campylobacter* spp. on the exterior of the packaging and the display cabinet (n=590)

Type of packaging	Number of samples (% of samples)				
	Campylobacter spp. not detected	*Campylobacter* spp. detected			Grand total
		On packaging and display cabinet	On packaging only	On display cabinet only	
Conventional packaging*	279 (77.3%)	36 (10.0%)	32 (8.9%)	14 (3.9%)	361 (100%)
Leak-proof packaging**	181 (95.8%)	1 (0.5%)	3 (1.6%)	4 (2.1%)	189 (100%)
Not stated	4 (80%)	1 (20%)	0 (0%)	0 (0%)	5 (100%)
Other	25 (71.4%)	2 (5.7%)	3 (8.6%)	5 (14.3%)	35 (100%)
Grand total	**489 (82.9%)**	**40 (6.8%)**	**38 (6.4%)**	**23 (3.9%)**	**590** (100%)

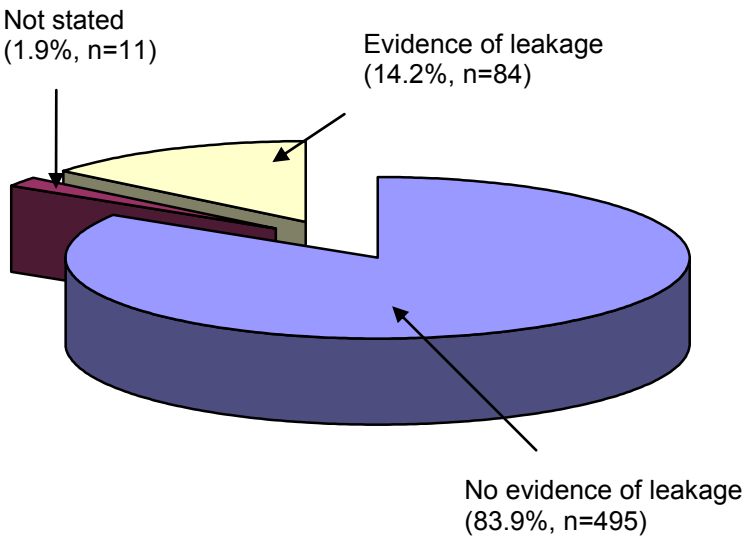
*** Conventional packaging:** The plastic is wrapped around the tray and sealed underneath
**** Leak-proof packaging:** The plastic is sealed onto the tray.

These findings clearly show that contamination is more prevalent on i) the exterior of the packaging and ii) the display cabinet, when conventional rather than the leak-proof packaging is used.

4.2.2.2 Evidence of leakage on the display cabinet

At the time of sampling, EHOs checked the display cabinet for evidence of leakage from the chicken packs. Evidence of leakage was reported in 14.2% (84/590) of display cabinets (Figure 2).

Figure 2: Evidence of leakage in the display cabinet (n=590)



Evidence of leakage was influenced by the type of packaging (Table 5). When chicken was packaged in the conventional manner, leakage was evident on 17.2% (62/361) of display cabinets. With leak-proof packaging, leakage was evident on only 6.3% (12/189) of display cabinets. This difference is statistically significant ($p<0.05$).

Table 5: Relationship between type of packaging and evidence of leakage (n=590)

Type of packaging	Evidence of leakage on the display cabinet Number of samples (% of samples)			Grand total
	Yes	No	Not stated	
Conventional packaging *	62 (17.2%)	292 (80.9%)	7 (1.9%)	361
Leak–proof packaging **	12 (6.3%)	175 (92.6%)	2 (1.1%)	189
Other	9 (25.7%)	24 (68.6%)	2 (5.7%)	35
Not stated	1 (20.0%)	4 (80.0%)	0 (0%)	5
Grand total	**84 (14.2%)**	**495 (83.9%)**	**11 (1.9%)**	**590**

*** Conventional packaging:** The plastic is wrapped around the tray and sealed underneath
**** 'Leak-proof packaging':** The plastic is sealed onto the tray.

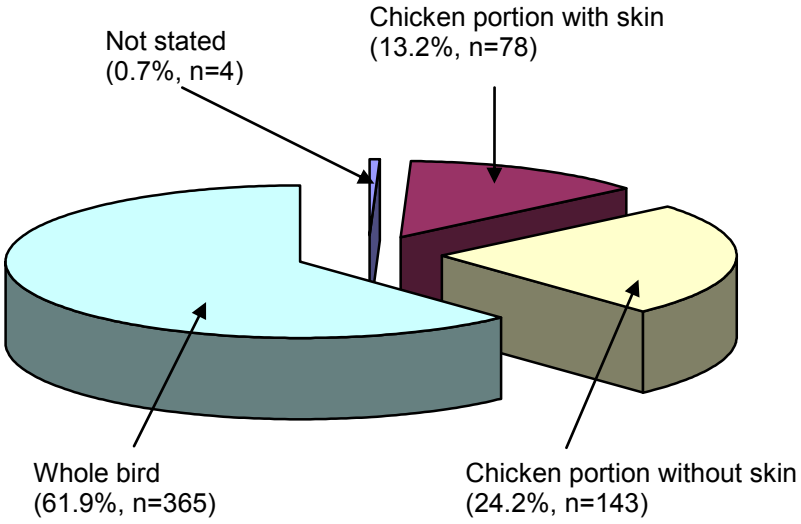
These findings clearly show that chicken juices are more likely to leak onto the display cabinet when chicken is packaged in the conventional manner. If these juices are contaminated with *Campylobacter* spp., spread of contamination onto the packaging surface and the display cabinet can occur. This may explain the findings of section 4.2.2.1.

4.2.3 Information relating to the sample

4.2.3.1 Type of chicken, i.e. whole chicken vs. chicken portions

Whole birds represented 61.9% (365/590) of all samples; while, chicken portions with skin and chicken portions without skin represented 13.2% (78/590) and 24.2% (143/590) of all samples respectively (Figure 3).

Figure 3: Type of chicken (n=590)



The relationship between the type of the chicken (i.e. whole bird, chicken portion with skin or chicken portion without skin) and the presence of *Campylobacter* spp. on the exterior of the packaging is presented in Table 6.

Table 6: Relationship between the type of the chicken and the presence of *Campylobacter* spp. on the exterior of the packaging (n=590)

Type of chicken		Total no. of samples	*Campylobacter* spp. detected	
			No. of samples	% of samples
Whole bird		**365**	**71**	**19.5%**
Chicken portion	With skin	78	4	5.1%
	Without skin	143	3	2.1%
	Total	**221**	**7**	**3.2%**
Not stated		**4**	**0**	**0%**
Grand total		**590**	**78**	**13.2%**

Whole birds vs. chicken portions:
Campylobacter spp. were detected on 19.5% (71/365) of packages containing whole birds compared to 3.2% (7/221) of packages containing chicken portions (Table 6). This difference is statistically significant ($p<0.05$).

Two factors may explain this finding:
1) In this study, 84.1% (307/365) of whole birds were packaged in the conventional manner compared to 23.1% (51/221) of chicken portions (Table 7). Contamination (if present on the raw chicken) is more likely to spread via conventional packaging (see section 4.2.2.2) and
2) Some studies (conducted in the USA and Belgium) have shown that *Campylobacter* spp are more prevalent on whole birds than chicken portions (Davis and Conner, 2000 and Ghafir *et al.* 2007). An Australian study found a similarly high prevalence on whole birds and portions (Pointon *et al*. 2008). It would appear from the results of a five-year monitoring programme of Irish poultry, conducted between 2000 and 2004 (FSAI, 2009), that the former was likely to be the situation in Ireland during this present study (i.e. higher prevalence on whole birds) and therefore a higher prevalence might be expected to be found on the exterior of the packaging of whole birds.

Table 7: Relationship between type of chicken and type of packaging (n=590)

Type of chicken		Conventional packaging	Leak-proof packaging	Other	Not stated	Grand total
Whole bird		**307 (84.1%)**	**31 (8.5%)**	**23 (6.3%)**	**4 (1.1%)**	**365**
Chicken portion	**With skin**	**20 (25.6%)**	**52 (66.7%)**	**6 (7.7%)**	**0**	**78**
	Without skin	31 (21.7%)	105 (73.4%)	6 (4.2%)	1 (0.7%)	143
	Total	**51 (23.1%)**	**157 (71%)**	**12 (5.5%)**	**1 (0.5%)**	**221**
Not stated		3 (75.0%)	1 (25%)	0	0	4
Grand total		**361 (61.2%)**	**189 (32.0%)**	**35 (5.9%)**	**5 (0.8%)**	**590**

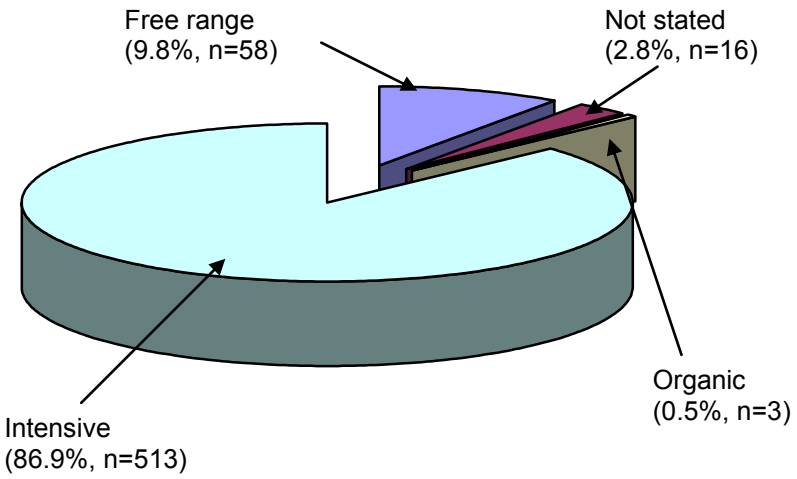
*** Conventional packaging:** The plastic is wrapped around the tray and sealed underneath
**** Leak-proof packaging:** The plastic is sealed onto the tray.

Chicken portions with skin vs. chicken portions without skin:
Campylobacter spp. were detected on 5.1% (4/78) of packages containing chicken portions with skin compared to 2.1% (3/143) of packages containing chicken portions without skin (Table 6). This difference was not statistically significant (p>0.05).

Although some researchers have found that *Campylobacter* spp. are better able to survive on poultry skin by comparison to poultry meat (Davis and Conner, 2007), this study has shown no difference in the prevalence of *Campylobacter* spp. on the exterior of packaging containing chicken portions with or without skin. This may be explained by the finding that most chicken portions are packaged in leak-proof packaging (contamination, if present on the raw chicken, is less likely to spread with this type of packaging) (Table 7).

4.2.3.2 Type of primary production (i.e. conventional, free range, organic)
The vast majority of samples were intensively reared chicken (86.9%, 513/590); while, 9.8% (58/590) of samples were free range chicken. Only three samples (0.5%, 3/590) were organic chicken (Figure 4).

Figure 4: Type of primary production (n=590)



An EFSA Opinion on campylobacter in 2005 concluded that free range and organic flocks appeared to have a higher prevalence than conventional flocks due to greater exposure to *Campylobacter* spp. in the outdoor environment (EFSA, 2005). Statistical analysis of the conventional and free range results (the number of organic samples were too small to include) did not detect any relationship (p>0.05) between the production

method and the prevalence of *Campylobacter* spp. on the exterior of the packaging (Table 8). For conventional chicken, *Campylobacter* spp. were detected on 13.6% (70/513) of packages. Where chickens were reared using free range methods, *Campylobacter* spp. were detected on 10.3% (6/58) of packages. Similarly, no relationship was observed ($p>0.05$) between production method (i.e. conventional and free range) and type of packaging (Table 9).

Table 8: Relationship between the production method and the presence of *Campylobacter* spp. on the exterior of the packaging (n=590)

Production method	Total no. of samples	*Campylobacter* spp. detected	
		No. of samples	% of samples
Intensive	513	70	13.6%
Free range	58	6	10.3%
Organic	3	0	0
Not stated	16	2	12.5%
Grand total	**590**	**78**	**13.2%**

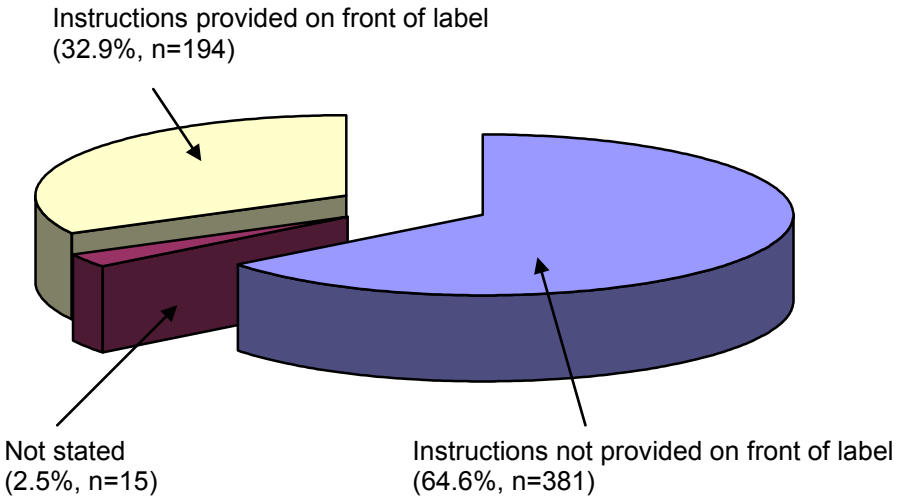
Table 9: Relationship between production method and type of packaging (n=590)

Production method	Type of packaging No. of samples (% of samples)				Grand Total
	Conventional packaging	Leak-proof packaging	Other	Not stated	
Intensive	311 (60.6%)	169 (32.9%)	29 (5.7%)	4 (0.8%)	513
Free range	38 (65.5%)	15 (25.9%)	4 (6.9%)	1 (1.7%)	58
Organic	2 (66.7%)	1 (33.3%)	0	0	3
Not stated	10 (62.5%)	4 (25.0%)	2 (12.5%)	0	16
Grand total	**361 (61.2%)**	**189 (32.0%)**	**35 (5.9%)**	**5 (0.8%)**	**590**

4.2.4 Labelling Details

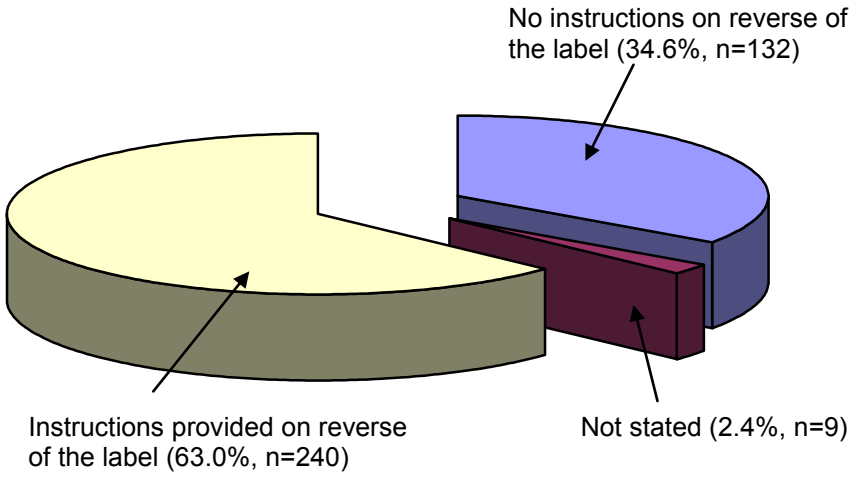
Just under one-third of chicken packages provided handling, preparation and/or cooking instructions on the front of the label (Figure 5).

Figure 5: Provision of handling, preparation and/or cooking instructions on the front of the label (n=590)



Where these instructions were not provided on the front of the label (n=381), EHOs were requested to check the reverse of the label. In 63% (240/381) of cases this information was provided there (Figure 6).

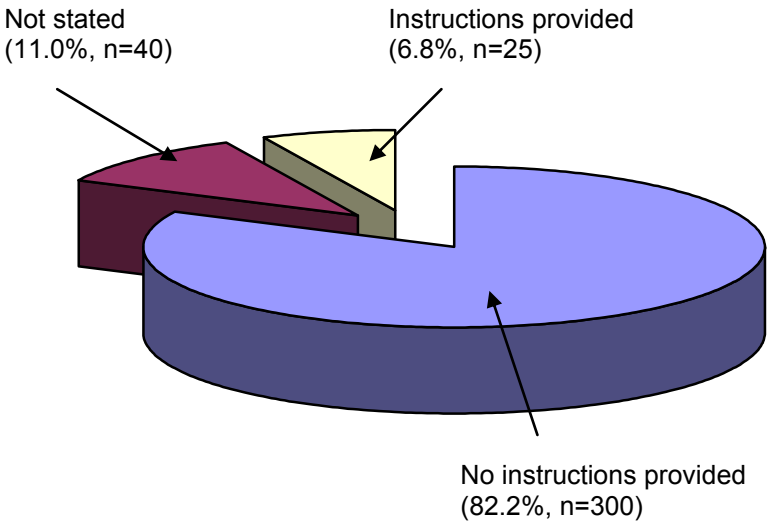
Figure 6: Provision of instructions on the reverse of the label (n=381)



Of the 365 samples which were identified as whole birds on the questionnaire, 6.8% (25/365) carried instructions advising customers to wash the whole bird or the cavity of the bird prior to cooking (Figure 7). This is contrary to current best practice advice.

Studies have identified the practice of washing oven ready birds as a means of spreading *Campylobacter* spp. onto kitchen surfaces such as taps and counter tops (Cogan *et al.* 1999; Gorman *et al.* 2002). In December 2005, *safe*food, the Food Safety Promotion Board ran a radio campaign advising consumers that it was not necessary to wash oven ready birds.

Figure 7: Provision of instructions to wash the whole bird and/or cavity (n=365)



4.2.5 Time between sampling and delivery to the laboratory

As *Campylobacter* spp. are considered fragile microorganisms, which do not survive well outside their natural environment (i.e. the intestines tract of warm-blooded animals) a long delay in delivery of swab samples to the laboratory may have reduced the likelihood of detection. To enable assessment of this possible impact on results, the length of time between sampling and analysis was recorded (Table 10). Most samples were delivered to the laboratory within four hours.

Table 10: Time period between sampling and delivery to the laboratory

Time period between sampling and delivery to the laboratory	Number of samples	% of samples
Within 4 hours	344	58.3
Within 8 hours	87	14.7
Within 20 hours	24	4.1
Greater than 20 hours	23	3.9
Don't know	71	12.0
Not stated	41	6.9
Grand total	**590**	**100.0**

The relationship between time period for delivery to the laboratory and the microbiological results are presented in Table 11. There was no statistical significant difference in the microbiological results ($p>0.05$) and it was concluded that the time period between sampling and delivery to the laboratory did not influence the detection of *Campylobacter* spp.

Table 11: Relationship between time period for delivery to the laboratory and microbiological results

Time period between sampling and delivery to the laboratory	*Campylobacter* spp. not detected on either packaging or shelving		*Campylobacter* spp. detected on packaging and/or shelving		Total
	No. of samples	% of samples	No. of samples	% of samples	
Within 4 hours	281	81.7	63	18.3	**344 (100%)**
Within 8 hours	69	79.3	18	20.7	**87 (100%)**
Within 20 hours	23	95.8	1	4.2	**24 (100%)**
Greater than 20 hours	17	73.9	6	26.1	**23 (100%)**
Don't know	63	88.7	8	11.3	**71 (100%)**
Not stated	36	87.8	5	12.2	**41 (100%)**
Grand total	489	82.9	101	17.1	**590 (100%)**

5. Main Findings and Conclusion

5.1 Packaging

Campylobacter spp. were detected on 13.2% (104/785) of the external surface of packaging and 10.9% (86/785) of the surface of display cabinets. These findings suggest that the exterior of raw chicken packaging could serve as a source of contamination for ready-to-eat foods in the shopping basket/trolley, checkout conveyor belt, the shopping bag and in the home. Contaminated packaging could also potentially serve as a direct source of infection for consumers and retail staff handling the packaging. However, this study did not determine the actual numbers of campylobacter present and therefore the precise risk to consumers and retail staff is difficult to determine. A study in New Zealand, which found contamination on the surface of 24% of chicken packs (Wong *et al.* 2004), reported that 32 samples had counts of <6 MPN(most probable number)/pack and the remaining 40 samples had counts ranging from 6 to >2,200 MPN/pack. The authors concluded that the contribution of this surface contamination to foodborne illness could only be determined by development of a validated risk assessment model.

In this study the type of packaging was shown to be important whereby:

- contamination was more prevalent on the exterior of conventional packaging (18.9%; 68/361) than on leak-proof packaging (2.1% 4/189);
- contamination on the display cabinet was more prevalent on surfaces in contact with the former (13.9%; 50/361) rather than the latter (2.6%; 5/189) type of packaging; and
- evidence of leakage was more common on the display cabinets in contact with the former (17.2%; 62/361) rather than the latter (6.3%; 12/189) type of packaging.

The survey was not designed to investigate the source of contamination on leak-proof packaging but one could speculate that it may be the result of (i) failure of the pack to prevent leakage; (ii) storage beside chicken sold in the conventional packaging; (iii) storage on shelves previously used to store chicken sold in the conventional packaging which had not been properly cleaned before restocking; or (iv) poor hygiene in the original processing plant or contamination during transport.

The fact that packaging of whole birds was more contaminated (19.5%; 71/365) than that of chicken portions (3.2%; 7/221) appears to be linked to the fact that more whole birds are packaged in the conventional packaging and that studies in Ireland and elsewhere have shown whole birds to be more contaminated than portions (Davis and Conner, 2000 Ghafir *et al.,* 2007; and FSAI, 2009).

In conclusion and notwithstanding the unquantified risk of the surface contamination, the findings of this study suggest that there is a risk which could be better managed by changing to leak-proof packaging.

5.2 Labelling

Approximately one-third of chicken packages provided handling, preparation and/or cooking instructions on the front of the label. Of the 381 samples which did not provide such instructions on the front of the label, 63% (240/381) carried these instructions on the reverse of the label. To view the information on the back of a label, the consumer must either peel-off the label (which can be difficult to do), or look at the label through the plastic film. This latter practice could encourage consumers to touch the internal surface of the packaging which would be expected to be more contaminated than the external surface (Jorgensen *et al.* 2002).

Since 2005, the advice in Ireland has been that consumers should not wash whole birds and their cavities. Of the 365 samples which were identified as whole birds on the questionnaire, 6.8% (25/365) carried instructions advising customers to wash the whole bird or the cavity of the bird prior to cooking. This instruction is contrary to current best practice advice.

In conclusion, this study found that handling and cooking instructions (through location and content) on some of the samples analysed encourage risky food handling practices among consumers.

5.3 Recommendations

The following recommendations arise from this report:

- Retailers should change to sourcing chicken in leak- proof packaging.
- Where chicken is sold in the conventional packaging, retailers need to control the risk of cross-contamination to ready-to-eat foods through minimising leakage (e.g. displaying products on the flat and not in an upright position, removing product with damaged packaging from display etc.) and regular cleaning and disinfection of display cabinets, and other areas in the shop which might become contaminated (e.g. trolleys/baskets, checkout conveyor belts etc.). Retailers should also consider the provision of plastic bags at poultry display cabinets to enable consumers to protect their hands and ready-to-eat foods from contamination.
- The practice of having handling and cooking instructions on the reverse of a label should be discontinued. All instructions should be clearly visible on the outside of the packaging.
- Labels on whole birds should not advise consumers to wash the bird. If a bird needs to be cleaned then it should be done by wiping the cavity with damp kitchen paper which should be carefully discarded immediately and hands thoroughly washed.

The message to consumers is to continue to keep raw meat separate from ready-to-eat foods while shopping, storing and preparing food. Where consumers use reusable bags they should consider designating one bag for use with raw meats only.

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APPENDIX 1: Questionnaire

Please note: 1) EHOs must complete this questionnaire for all samples, 2) all questions are mandatory& 3) all questionnaires must be returned to the FSAI by 13/02/09

1. General Information:

EHO Name: _____

Packaging -EHO Sample Reference Number *(i.e. EHO's own personal ref. no. for the sample)* **A**_____

-Laboratory Reference Number *(upon receipt of lab report)* _____

Cabinet -EHO Sample Reference Number = same number as for packaging swab sample but prefixed with **'B'**)

-Laboratory Reference Number *(upon receipt of lab report)* _____

2. Sample delivery info:

Sample delivered to lab:

☐ Within 4 hours or
☐ Within 8 hours or
☐ Within 20 hours or
☐ Greater than 20 hours or
☐ Don't know (e.g. as courier used)

Note: Samples should be delivered as soon as possible.

3. Premises Information:

☐ Supermarket or ☐ Butcher Shop or ☐ Stall/Market or ☐ Other retail establishment (*Please specify:* _____

4. Sample information:

Product name/Brand: _____

Batch code: _____ **Plant approval no:** _____

Imported: Yes ☐ or No ☐

Type of chicken: Whole bird ☐ or Portion with skin on ☐ or Portion without skin ☐

Nature of chicken: Organic ☐ or Free range ☐ or Standard ☐

Evidence of leakage in the Display Cabinet : Yes ☐ or No ☐

5. Packaging details:

Type of packaging:

☐ Plastic cover wrapped over and around the tray or
☐ Plastic cover sealed onto the tray or
☐ Other, please describe: _____

_____

6. Labelling details:

Instructions (handling, preparation and/or cooking) **visible on front of label:** Yes ☐ or No ☐

***If 'No'* are there instructions on the reverse of label** (i.e. in contact with the meat)**:** Yes ☐ or No ☐

For whole birds are there instructions to wash bird and/or cavity: Yes ☐ or No ☐

7. Microbiological Results:

Packaging sample *Campylobacter* spp.
Not detected ☐ or Present ☐
Cabinet sample *Campylobacter* spp.
Not detected ☐ or Present ☐

APPENDIX 2

Sample* numbers by Health Service Executive (HSE) Region & Area

HSE Region	HSE Area	No. of samples considered for this report
HSEDMLR	East Coast Area	43
	Midlands Area	68
	South Western Area	88
HSEDNER	North Eastern Area	58
	Northern Area	69
HSESR	South Eastern Area	113
	Southern Area	123
HSEWR	Mid-Western Area	89
	North Western Area	53
	Western Area	81
Total		**785**

*Note: Each sample consisted of two swabs: one swab from the exterior of the packaging and one swab from the cabinet displaying that package (i.e. 1570 swabs were considered for this report). Three swabs from packaging were not considered for this report because corresponding swabs from the display cabinets were not submitted.

APPENDIX 3

Sample* numbers per Food Microbiology Laboratory of the HSE

Laboratories	No. of samples considered for this report
Cherry Orchard	144
Cork	123
Galway	81
Limerick	89
Sligo	53
Sir Patrick Duns	182
Waterford	113
Total	**785**

*Note: Each sample consisted of two swabs: one swab from the exterior of the packaging and one swab from the cabinet displaying that package (i.e. 1570 swabs were considered for this report). Three swabs from packaging were not considered for this report because corresponding swabs from the display cabinets were not submitted.

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