

A microbiological survey of *Campylobacter* contamination in fresh whole UK-produced chilled chickens at retail sale – February 2014 to February 2015

Background to the survey

Foodborne *Campylobacter* is estimated to make more than 280,000 people ill each year in the UK and is the biggest cause of food poisoning. An EFSA Opinion¹ stated that up to 80% of cases can be attributed to raw poultry meat and a tenfold decrease in the exposure levels from this source is likely to reduce the number of human *Campylobacter* cases by 50 to 90% across all Member States.

The Food Standards Agency (FSA) has set up a joint target with industry to reduce *Campylobacter* in chicken. The target is focussed on levels greater than 1000 colony forming units per gram (cfu/g). It is thought that chickens with this level of *Campylobacter* contamination are the most likely to infect consumers. The joint FSA-industry target is to reduce the prevalence of these most contaminated chickens (greater than 1000 cfu/g) to below 10% at the end of the slaughter process, by the end of 2015.

This UK-wide survey was established to review the levels of *Campylobacter* on fresh whole retail chickens and their packaging. The intention of the survey was to represent a full 12 month period (mid-February 2014 – mid February 2015). However, owing to the practicalities of collecting the samples required, the survey had to be extended slightly into the first week of March 2015.

The survey tested a total of 4,011 samples of whole, UK-produced, fresh chicken. The samples are distributed evenly throughout the year and throughout the UK (in proportion to the population size of each country). Retailers were sampled in proportion to their market share, according to available data, with the share of free-range and organic chickens taken into account.

More detail on methodological issues, including key features of laboratory and statistical sampling, design and analysis, are contained in an annex.

¹ Scientific Opinion on *Campylobacter* in broiler meat production: control options and performance objectives and/or targets at different stages of the food chain: <http://www.efsa.europa.eu/en/efsajournal/doc/2105.pdf>

Results

Overall results

Table 1 shows the cumulative results over the whole survey of the levels of Campylobacter found on chicken skin, by separate bands. The lowest band (<10 cfu/g) means that the level of Campylobacter is too low for tests to detect it. Where Campylobacter has been detected, the results have been grouped into the following categories based on the number of colony forming units per gram: 10-99 cfu/g; 100-1000 cfu/g and >1000 cfu/g. The highest band (>1000 cfu/g) is the primary focus of attention. The table also shows the upper and lower bounds of the 95% confidence intervals around each prevalence estimate. These provide bounds between which there is a 95% probability that the true prevalence lies.

Just over 19% of the chickens tested were found to contain Campylobacter at a level above 1000 cfu/g. Just under 73% were positive for Campylobacter at any level (i.e. were found to contain Campylobacter at a level above the detectable limit of 10 cfu/g).

Table 1: Prevalence of Campylobacter (cfu/g), for different contamination bands, in chicken skin samples (with 95% confidence intervals in brackets).

Chicken Skin	cfu/g			
	<10	10-99	100-1000	>1000
Weighted² % (95% confidence interval)	27.2 (25.8 - 28.6)	22.3 (21.0 - 23.6)	31.1 (29.7 - 32.6)	19.4 (18.2 - 20.6)
No. samples	1,069	902	1,260	780

The presence of Campylobacter on the outer packaging of chicken packs may also pose a risk. Table 2 shows the results over the whole survey period of the levels of Campylobacter found on the packaging of the chickens, by separate bands. The 95% confidence intervals are also provided for these results (shown in brackets in the table).

Just under 7% of the samples were positive for Campylobacter on the outer packaging (i.e. contained Campylobacter at a level above the detectable limit of 10 cfu/g). For 5 out of the 4,005 samples (for which valid results were available for the outer packing), the level on the outer packaging was found to be above 1000 cfu/g.

² Results are weighted to correct for differences in the number of samples taken per quarter.

Table 2: Prevalence of Campylobacter (cfu/swab) for different contamination bands, in samples of chicken packaging (with 95% confidence intervals in brackets).

Chicken Packaging	cfu/swab			
	<10	10-99	100-1000	>1000
Weighted ² % (95% confidence interval)	93.3 (92.5 - 94.1)	5.1 (4.5 - 5.8)	1.4 (1.1 - 1.8)	0.1 (0.0 - 0.3)
No. samples	3,733	209	58	5

Results by retailer

Table 3 presents a summary of key results over the whole survey, broken down by retailer. The results of the skin samples are presented in two ways: (a) the proportion of chickens with any level of Campylobacter (including >1000 cfu/g); (b) the proportion >1000 cfu/g. The results for the packaging samples are given as one result; any level of Campylobacter.

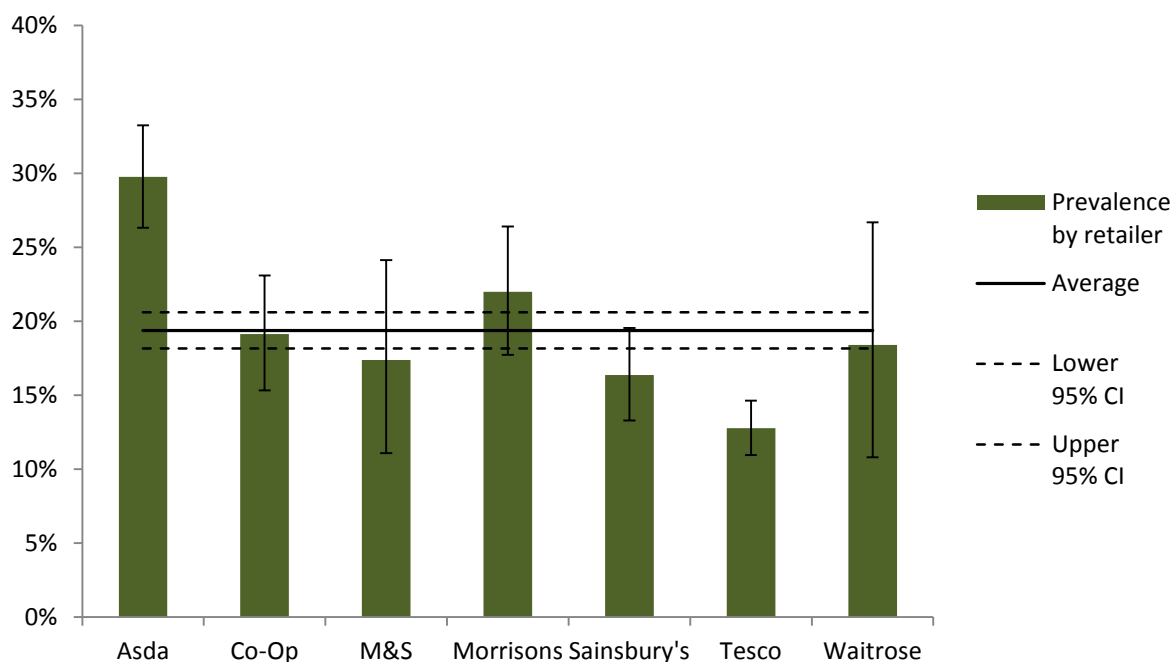
The numbers of samples taken for each retailer is proportional to their market share. Retailers whose market share was below a certain cut-off have been grouped within the “other” category. No conclusions can be drawn about the individual retailers within this category. The market share data, on which these judgements were made, are described in the methodological annex.

The 95% confidence intervals reflect the uncertainty in the results: they provide lower and upper bounds that have a 95% probability of containing the true prevalence. A key factor determining the width of this interval is the sample size. Those retailers with a relatively low market share have a low sample size and correspondingly wide confidence intervals. It is particularly important to take note of the confidence intervals when comparing results across retailers, due to the differences in sample sizes. Where the upper and lower bounds overlap between retailers it suggests caution should be used in drawing conclusions about which may have a lower or higher proportion of chickens with the given level of Campylobacter.

Table 3: Results for Q1-Q4 broken down by retailer for: the overall prevalence of Campylobacter on chickens sampled; the prevalence of chickens with levels of over 1000 cfu/g of Campylobacter; and the prevalence of Campylobacter on the outside of the chicken packaging. All results are weighted for any uneven sampling across quarters

Retailer	No. of samples	% skin samples positive for Campylobacter (95% confidence interval)	% skin samples >1000 cfu/g Campylobacter (95% confidence interval)	% pack samples positive for Campylobacter (95% confidence interval)
Asda	662	80.4 (77.3 - 83.4)	29.7 (26.3 - 33.2)	12.4 (10 - 15.0)
Co-op	378	78.1 (73.8 - 82.2)	19.1 (15.3 - 23.1)	4.9 (2.9 - 7.2)
M&S	130	67.1 (58.9 - 75.1)	17.4 (11.1 - 24.1)	2.9 (0.6 - 6.0)
Morrisons	349	75.8 (71.4 - 80.0)	22.0 (17.7 - 26.4)	11.2 (8.1 - 14.6)
Sainsbury's	557	69.7 (65.8 - 73.5)	16.4 (13.3 - 19.6)	4.9 (3.1 - 6.8)
Tesco	1,235	66.5 (63.9 - 69.0)	12.8 (10.9 - 14.6)	4.0 (3.0 - 5.2)
Waitrose	111	73.8 (65.0 - 82.1)	18.4 (10.8 - 26.7)	9.7 (3.8 - 16.3)
Others ³	589	76.8 (73.3 - 80.1)	23.9 (20.5 - 27.4)	6.7 (4.8 - 8.8)
Total	4,011	72.8 (71.4 - 74.2)	19.4 (18.2 - 20.6)	6.7 (5.9 - 7.5)

Figure 1: The percentage of chickens with levels over 1000 cfu/g of Campylobacter (dark green bars), for each of the main retailers (with 95% confidence intervals). The graph also shows the mean proportion of results greater than 1000 cfu/g (solid lines), with 95% confidence intervals (dashed lines).



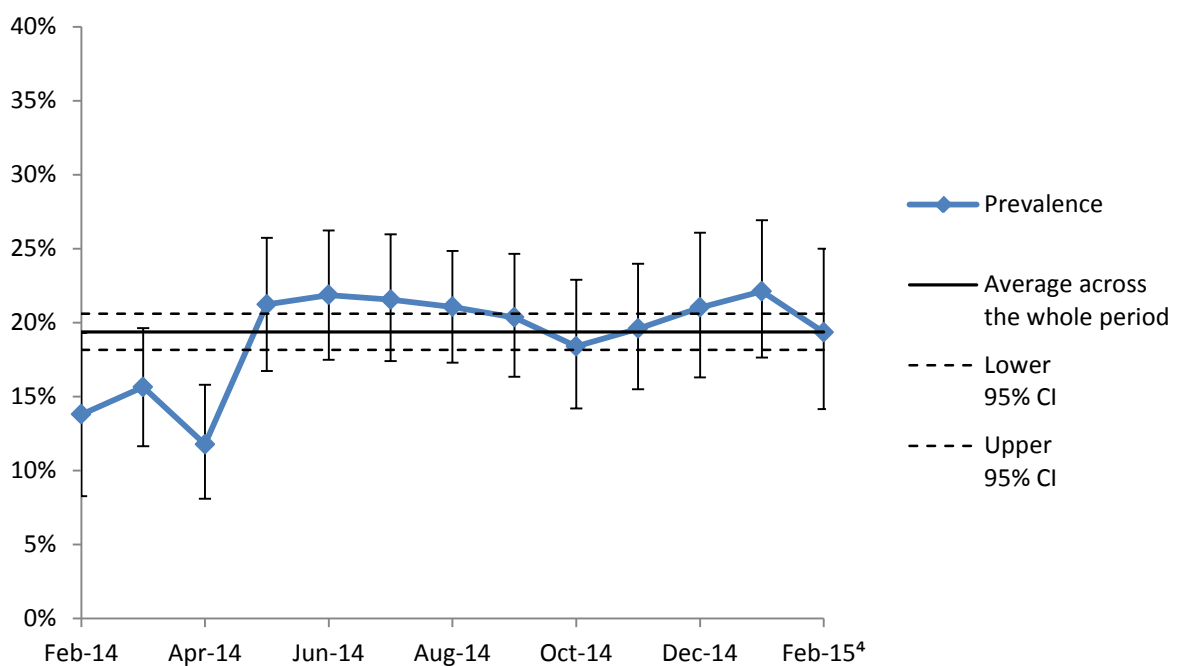
³ The 'Others' category includes supermarkets where the market share was deemed small using the 2010 Kantar data: e.g. Lidl, Aldi, Iceland, plus convenience stores, independents, butchers etc.

Figure 1 presents the retailers' proportion of Campylobacter results greater than 1000 cfu/g. The vertical error bars show the 95% confidence intervals for each retailer. The Industry average for levels >1000 cfu/g are shown by the horizontal lines. The 95% confidence intervals of these prevalence estimates are given by the additional horizontal lines. Where the error bars for the retailers overlap there is insufficient data from which to draw firm conclusions about differences between retailers.

Each retailer's result has been compared to the average of all other retailers. Asda was the only named retailer to have a statistically significantly higher proportion of chickens with Campylobacter levels at >1000 cfu/g compared to the average of all other retailers ($p < 0.001$). Tesco was the only named retailer to have a statistically significantly lower proportion than the average of the others ($p < 0.001$).

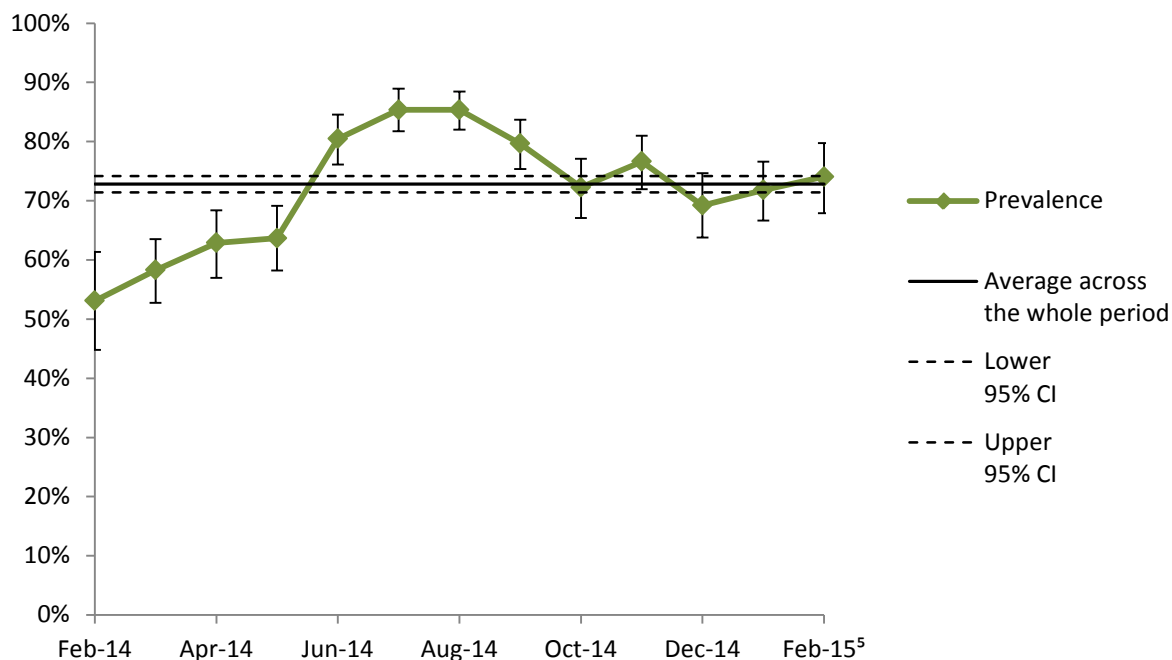
Figure 2 and 3 present the month by month variation in the proportion of campylobacter results greater than 1000 cfu/g and the proportion of results showing the presence of campylobacter, respectively. These charts should be treated with caution owing to the low number of results available for individual months. In addition to this, with data only available over a single 12 month period, it is not possible to assess how much of this variation is attributable to usual seasonal variation; interventions by chicken suppliers; random fluctuations in the weather; or a range of other potential factors.

Figure 2: The percentage of chickens with levels over 1000 cfu/g of Campylobacter (blue line) by month⁴ (with 95% confidence intervals). The graph also shows the mean proportion of results greater than 1000 cfu/g (solid black line), with 95% confidence intervals (dashed lines).



⁴ Feb-15 includes some samples taken during the 1st week of March 2015

Figure 3: The percentage of chickens positive for *Campylobacter* (green line) by month⁵ (with 95% confidence intervals). The graph also shows the mean proportion of results greater than 1000 cfu/g (solid black line), with 95% confidence intervals (dashed lines).



Additional notes

All chickens, regardless of which retail outlet they are bought from, are at risk of being contaminated with *Campylobacter*, which is why it is important for consumers to handle and cook their chicken safely. Effective cooking will kill any *Campylobacter* on the chicken.

There are other survey variables by which results could be disaggregated, e.g. to explore possible differences associated with the nature of production (free-range, housed, etc), or pack weight, among others. These associations are best studied as part of a considered analysis that takes account of the correlations between all the variables involved. Such an analysis will be included as part of a more in-depth report, to be published later in the year and the raw data from the survey will also be put into the public domain.

The design of the current survey is geared primarily to estimating the mean prevalence of *Campylobacter* in fresh retail chicken in the UK, averaged across all retail outlets (in proportion to market share) and over a full 12-month period. As the survey has progressed it has become clear that there is a high level of interest in the degree of similarity, or difference, in prevalence across major retailers.

⁵ Feb-15 includes some samples taken during the 1st week of March 2015

The FSA is planning to conduct a follow-up survey, beginning later in 2015. The follow-up survey will be substantially similar to the current survey, but, in order to facilitate better comparison of retailers, a sample size boost will be applied where appropriate. The boost will ensure that the sample size for all retailers, whose market share exceeds a certain cut-off, is no lower than a fixed minimum level. Updated market share data will be procured to inform this. It is possible that there will be a slightly increased number of retailers for whom itemised results will be provided, once this follow-up survey is under way.

Methodological Annex

Eligibility criteria

Chickens eligible for inclusion in the survey were:

- Whole, chilled, raw, UK-produced standard, free range or organic chickens;
- Where contained in a package, it was unopened and undamaged;
- NOT frozen;
- NOT basted, herbed, stuffed, marinated or otherwise modified.

Samples were collected from retail premises in the UK and information gathered included temperature on receipt, the approved premises code of the poultry plant and use-by dates.

Statistical features

The survey was designed to get a robust estimate of the typical UK prevalence of *Campylobacter* in whole fresh chicken, averaged across a full 12-month period. The survey is to be used as a baseline against which to assess future *Campylobacter* prevalence. To achieve this, chickens were tested according to a sampling plan aimed at reflecting market share.

Market share data were supplied by Kantar in June 2010 and fulfilled several criteria which made them an ideal fit: the data derived from a large consumer panel; they were UK-wide; they specifically identified UK-produced chicken. Unfortunately, the complexity of the survey, including the crucial importance of rigorously validating the laboratory methods, meant that the survey took longer than expected to get off the ground. In 2012 the FSA approached the original supplier for updated market share data. However, two important features of the data could no longer be replicated: non-UK chicken could not be differentiated from UK-produced; Northern Ireland sales were no longer included. The FSA decided to try a different approach and asked British Retail Consortium (BRC) to grant access to industry sales data. This was partially successful. However, the data were supplied piecemeal by individual retailers. There was no independent normalisation or validation of data and it was incomplete. Where the BRC data could be compared with the pre-existing 2010 market share data, the two sources were found to be broadly consistent. Since the latter source was more complete, it was decided to use this for final planning of the survey in 2013.

Given the history associated with the market share data, there will be a degree of under-representation of any retailer whose market share has risen sharply since June 2010. If better market share data were to become available, it would be possible, in principle, to re-weight the survey data to correct for this.

Seven main retailers were identified. The survey was designed to return individual sample sizes that reflected their respective market shares. All "other" retailers were pooled into a single group, with sampling of independent butchers approximately reflecting their market share.

The aim was to sample evenly across the year. This has been more-or-less achieved, but is not perfect: e.g. the 1st quarter ended up with slightly fewer than the 1000 samples planned. Because of the possibility of changes due to seasonal variation, a correction was applied so that each quarter has exactly equal weighting in the cumulative results, at each stage of reporting. This is designed to remove any possible bias due to seasonal imbalance in the sampling.

Confidence intervals, for estimates of prevalence, have been calculated using bootstrap sampling.

Laboratory testing

The testing laboratories were the five Public Health England (PHE) Food, Water and Environmental Microbiology Laboratories, as well as the Agri-Food Biosciences Institute (AFBI) Laboratory in Northern Ireland. Once samples reached the laboratory, testing was usually initiated within 24 hours, and certainly before 48 hours after sampling. Chickens were tested before or on their use-by dates. Handlers prevented cross contamination between samples and from the surrounding environment at all stages, e.g. by wearing gloves and changing them between handling each chicken, and the cleaning of equipment and work surfaces regularly.

Two samples for each chicken were analysed; one sample consisting of 25g skin (mainly neck-skin), and one sample representing the outer packaging (prepared by examining a sponge swab rubbed over the entire outer packaging of the chicken).

The chicken samples tested were examined using an enumeration method based on ISO/TS 10272-2:2006 Microbiology of food and animal feeding stuffs -- Horizontal method for detection and enumeration of *Campylobacter* spp. -- Part 2: Colony-count technique. Enumeration using direct plating with a detection limit of ten colony forming units (cfu) per gram (g) of neck-skin, or per swab sample, was used.

Any isolates of *Campylobacter* species were sent to the PHE laboratory in Colindale for further speciation.

Further information

Additional information on the survey design can be found in the original survey protocol at:

<http://www.food.gov.uk/sites/default/files/Campylobacter%20in%20Chicken%20PROTOCOL%20FINAL%20with%20amends%20Mar14.pdf>

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