

Food Survey Information sheet 04/09

A UK survey of *Campylobacter* and *Salmonella* contamination of fresh chicken at retail sale.

A UK-wide survey was undertaken by the Agency between May 2007 and September 2008 to determine *Campylobacter* and *Salmonella* prevalence on fresh chicken at retail. During the course of the survey 3363 samples were collected, with 3274 being acceptable for testing and microbiological examination using a presence/absence method for the detection of *Campylobacter* and *Salmonella*. *Campylobacter* enumeration tests were conducted on 927 samples, collected between April 2008 and August 2008.

Campylobacter

It is well recognised that *Campylobacter* can be a difficult organism to isolate in the laboratory and that the presence/absence method has limitations. This may, in turn, lead to underestimates of prevalence.

In this survey the *Campylobacter* prevalence detected using the enumeration method was higher (50.5%) than that by the presence/absence method (33.9%) for the 927 samples tested. The overall prevalence and prevalence for UK-origin chicken is reported based on the combined data for those samples tested using both presence/absence and enumeration methods (n=927). This approach has been taken in some recent studies to provide a more accurate measure of *Campylobacter* prevalence in food samples.

The prevalence of *Campylobacter* in chicken at retail in the UK was 65.2%, based on the results from both methods combined, for the 927 samples tested.

The prevalence of *Campylobacter* in whole chicken of UK-origin was 76.1%, based on the results from both methods combined, for the 416 whole UK-origin chicken samples tested.

The change in approach taken to determine prevalence in this survey means that it is no longer valid to make direct comparisons to the 2005 baseline of 70%. However, this data provides the Agency with a more robust evidence base for setting targets.

Underlying trends for *Campylobacter* are reported for the 3274 samples tested using the presence/absence method only.

Overall, the species *Campylobacter jejuni* accounted for 52.9% of the *Campylobacter* isolates found in the survey, whereas *Campylobacter coli* made up 47.1%. Although *C. jejuni* continues to be seen more frequently on chicken at retail this finding indicates an increase in the proportion of isolates identified as *C. coli* since the 2001 survey was conducted. The public health significance of this finding is unclear.

A total of 1519 *Campylobacter* isolates were tested for their sensitivity to a series of antimicrobial drugs. Of these isolates, 197 (13.0%) were sensitive to all the drugs tested. This figure represents an increase in the frequency of antimicrobial resistance among *Campylobacter* isolated from retail chicken compared to that seen in the 2001 survey. There has also been an increase in resistance to the quinolones ciprofloxacin and nalidixic acid. The increase in resistance may, in part, be due to a decrease in the concentration of ampicillin used (from 32mg/l to 8mg/l) to test resistance.

The prevalence of *Campylobacter* was higher for chilled chicken (47.6%) than for frozen (13.6%). The enumeration results, from the 927 samples tested also show that, when detected, levels of *Campylobacter* (cfu/sample) were significantly lower ($p=0.006$) on frozen samples.

The prevalence of *Campylobacter* was similar for both whole and portioned samples and skin-on and skin-off portions. However, median levels of *Campylobacter* detected on samples was higher on whole carcasses (160 cfu/sample) and skin-on portions (60 cfu/sample) when compared to portions (26 cfu/sample) and skin-off (18 cfu/sample) respectively.

Campylobacter prevalence was higher in samples from chicken reared using free-range (51.3%) or organic (60.4%) production systems than that recorded for housed birds (42.6%). The median levels of *Campylobacter* enumerated on housed samples (91 cfu/sample) exceeded that for free-range (80 cfu/sample) or organic (66 cfu/sample). However the sample size for chicken reared using free-range or organic systems was too small to make statistical comparisons between prevalence.

The data indicates some variation in the prevalence of *Campylobacter* according to the retailer type – major supermarkets (44.4%), other supermarkets (41.9%), butchers (32.3%), farm shop (33.0%), and market stall (0.0%). However, when tested statistically this variation was not found to be significant.

Campylobacter prevalence in poultry flocks is known to vary with season, showing a pronounced summer peak. This survey was not designed to investigate seasonality, but *Campylobacter* prevalence did vary over the course of this survey according to the month of purchase. The highest prevalence was detected in August 2007 (68.1%) and the lowest in May 2008 (28.8%). However the results do not show a similar trend to that normally observed in poultry flocks.

Salmonella

Salmonella was found in 207 samples giving a weighted prevalence of 6.6%. This indicates that *Salmonella* prevalence has remained low since the 2001 survey which reported a prevalence of 5.7%.

Thirty different *Salmonella* serotypes were isolated during the survey. *Salmonella* Kentucky and *Salmonella* Bredeney were found most frequently, accounting for 11.5% and 9.7% of the isolates respectively. *Salmonella* Enteritidis (7.0%) was the seventh most common serotype and *Salmonella* Typhimurium (1.8%) the fourteenth. Of the 16 *S. Enteritidis* isolates, 7 (43.8%) were phage typed as PT4 and 6 (37.5%) as PT5c. Three (75%) of the *S. Typhimurium* isolated were typed as DT120, with 1 (25%) found to be DT104. All salmonellas are potentially pathogenic therefore the change in the pattern of serotypes observed is of limited public health significance.

Of the 227 *Salmonella* isolates tested for their sensitivity to a number of antimicrobial drugs, 134 (59.0%) were sensitive to all of the drugs tested. This indicates a decrease in antimicrobial resistance from the 2001 survey (46% isolates fully sensitive); this may reflect differences in the serotypes isolated.

All 14 isolates of *Salmonella* Java PT Colindale were found to be multi-drug resistant. Three of these were resistant to one or more cephalosporins and 7 were resistant to both cephalosporins and the fluoroquinolone ciprofloxacin. This is the first report of *S. Java* with this resistance pattern isolated from food in the UK. These isolates will be fully characterised as part of another project to determine the mechanism of resistance.

Salmonella prevalence was significantly higher ($p < 0.001$) in chicken of non-UK origin (11.3%) compared to that of UK-origin (5.7%). The frequency of contamination was higher for frozen chicken (11.7%) than for chilled chicken (5.9%).

The overall *Salmonella* contamination rate was higher in whole chicken compared to chicken portions at retail (6.9% vs 6.3%). The frequency of *Salmonella* contamination present on chicken portions with skin-on was 6.6%, while those without skin had a prevalence of 6.1%.

Conclusions

A significant proportion of fresh chicken on sale in the UK remains contaminated with *Campylobacter*. As such, *Campylobacter* in poultry continues to be a priority for the Agency in terms of foodborne disease risk, highlighting a continuing need to work with industry to address this.

There have been shifts in the *Campylobacter* spp. and *Salmonella* serotypes isolated since the 2001 survey. Antimicrobial resistance levels have also changed. Human *Salmonella* and *Campylobacter* infections however are

rarely treated with antibiotics and the primary concern is the presence of these organisms on food.

Key facts

- A UK-wide survey of fresh chicken at retail was carried out between May 2007 and September 2008.
- 3274 samples were tested for the presence of *Campylobacter* and *Salmonella* using the presence/absence method.
- *Campylobacter* enumeration was conducted on 927 of the samples, collected between April and August 2008.
- The overall prevalence is reported based on the combined data for those samples tested using both presence/absence and enumeration methods (n=927). This approach has been shown provide a more accurate measure of prevalence.
- The prevalence of *Campylobacter* in chicken at retail in the UK was 65.2%, based on the results from both methods combined, for the 927 samples tested.
- The prevalence of *Campylobacter* in whole chicken of UK-origin was 76.1%, based on the results from both methods combined, for the 416 whole chicken samples tested.
- The change in approach taken to determine prevalence in this survey means it is no longer valid to make direct comparisons to the 2005 baseline of 70%.
- *C. jejuni* was isolated more frequently than *C. coli*, although the proportion of *C. coli* isolated has increased since the 2001 survey.
- There was an increase in the frequency of antimicrobial drug resistance, including quinolone resistance, in *Campylobacter* isolates compared to that observed in the 2001 survey.
- *Salmonella* was found in 207 samples, giving a weighted prevalence of 6.6%.
- Of the 30 serotypes isolated during the survey *S. Kentucky* and *S. Bredeney* were found most frequently.
- There was an overall decrease in antimicrobial drug resistance among *Salmonella* isolates compared to the 2001 survey.
- Ten *S. Java* isolates had a resistance pattern not previously found in food in the UK and will be further characterised to determine the mechanism of resistance.
- A significant proportion of fresh chicken on sale in the UK remains contaminated with *Campylobacter*.

Aims of survey

The aims of the survey were to:

- Establish the prevalence of *Campylobacter* on UK produced and non-UK produced chilled and frozen, whole and portioned chicken at retail in the UK;
- Quantify any reduction in *Campylobacter* prevalence since the baseline was established in 2005;
- Identify the *Campylobacter* species present and determine the susceptibility of these isolates to antimicrobial agents;
- Establish the prevalence of *Salmonella* on UK produced and non-UK produced chilled and frozen, whole and portioned chicken at retail in the UK;
- Identify the *Salmonella* serotypes and phage types present and determine the susceptibility of these isolates to antimicrobial agents.

Background and approach

Campylobacter is the most common bacterial cause of foodborne illness in the UK and is therefore one of the key organisms the Agency is tackling in order to reduce levels of foodborne disease. It is accepted that there are a number of routes by which humans are exposed to *Campylobacter*; however there is strong evidence that the most significant is the presence of this organism on chicken.

As part of the Agency's strategic plan a specific target was set in 2005 to deliver a 50% reduction in the prevalence of *Campylobacter* in UK produced chicken at retail by 2010. No single data set could provide an absolute measure of the baseline for *Campylobacter* stakeholders were consulted to help set an appropriate level against which to measure progress towards the target. The Agency's 2001 survey indicated that the baseline fell within the range 42-76%; however there was a degree of uncertainty with these results. The 2001 survey was considered alongside other evidence to indicate that the prevalence was at least 70%. Therefore, following a public consultation in 2005 a baseline of 70% was proposed as a starting point.

This UK-wide survey of fresh chicken at retail was carried out between May 2007 and September 2008. The survey methods used were based on those provided in the FSA protocol 'UK-wide survey of *Campylobacter* and *Salmonella* contamination in fresh chicken at retail sale'.

Retail outlets were randomly selected from each Member of the European Parliament (MEP) region in the UK to meet the requirements of the sampling plan. The sampling plan was amended during the course of the survey to ensure all regions were represented and to reflect the difficulties in obtaining particular types of samples from certain retailers. As the original sampling framework provided relatively few samples from Scotland, Wales and Northern Ireland, sample sizes in these regions were increased to 500 each to enable comparison between the different parts of the UK.

Samples were collected between May 2007 and August 2008 by trained individuals, who purchased a maximum of 4 samples at each retailer from a list provided. The type(s) of product to be purchased was also specified. Product details were recorded and care taken to avoid cross-contamination. Samples were transported at $\leq 5^{\circ}\text{C}$ (chilled samples) or $\leq 0^{\circ}\text{C}$ (frozen samples).

Campylobacter spp. and *Salmonella* spp. were recovered from samples using ISO methods; EN/ISO 10272-1 for *Campylobacter* spp. detection (presence/absence), ISO/TS 10272-2 for *Campylobacter* spp. enumeration and EN ISO 6579:2002 for *Salmonella* spp. Following the initial identification of *Campylobacter* spp. or *Salmonella* spp. isolates were sent to the Health Protection Agency (HPA) Centre for Infections (CfI) for confirmation, serotyping (*Salmonella*), phage typing (*Salmonella*), antibiotic susceptibility testing and archiving.

All analyses were performed by trained staff in a UKAS accredited laboratory operating an internal audit and review process. The contractor participated in the HPA Standard Proficiency Scheme and Internal Quality Control (IQC) samples were prepared and analysed on a weekly basis for the duration of the survey.

During the course of the survey 3363 samples were collected, with 3274 deemed acceptable for testing and microbiological examination for the presence of *Campylobacter* and *Salmonella*. In addition, *Campylobacter* was also enumerated with 927 samples, collected between April and August 2008.

The prevalence of *Salmonella* and *Campylobacter* was determined by the presence of the organism on the sample. The Agency's statisticians conducted a comprehensive analysis of the data using Microsoft Excel and SPSS. Weighted prevalence was determined for major variables. Weighting was necessary to ensure that the data was representative of the UK retail chicken market, as sample numbers were boosted in certain sub-sections to enable statistical analysis. Weighting was conducted according to market share information.

The levels of *Campylobacter* on the 927 samples enumerated was recorded in colony forming units (cfu) per sample. Median levels of *Campylobacter* on different categories of product i.e. chilled/frozen, whole/portions, were determined for statistical analysis. These samples were also tested for the presence of *Campylobacter* using the presence/absence method.

The data for the 927 samples tested using both methods (presence/absence and enumeration) revealed that there were some samples where *Campylobacter* could not be detected using one method but was found using the other method. Therefore these results were combined to give a *Campylobacter* prevalence for these samples. Samples were considered positive if the organism was found using either method i.e. a sample can be regarded as positive when either the presence/absence or enumeration test

(or both) is positive. This approach was taken as recent research suggests that both methods used in parallel can complement each other to provide a more accurate measure of *Campylobacter* prevalence on food samples.