

**LACORS/HPA Co-ordinated Food Liaison Group Studies:  
Microbiological Quality of Salad Vegetables and Sauces from Kebab Take-  
away Restaurants**

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**On behalf of the Local Authorities Co-ordinators of Regulatory Services  
(LACORS) and the Health Protection Agency**

## Summary

Previous studies in the UK have shown cooked kebab meat to be of good microbiological quality. However, evidence from foodborne outbreaks suggests that contamination of other foods available from kebab takeaway restaurants may also be an important factor. The purpose of this study was to establish the microbiological quality of the salad vegetables and sauces served in kebab take-away restaurants, with the aim of identifying the risk to the consumer and controls that improve food safety.

The study was carried out between June and July 2007. A total of 1213 salad vegetable and 1208 sauce samples were collected from 1277 premises across England, Wales and Northern Ireland. Salad vegetable and sauce samples were examined for *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* spp. Sauces were additionally examined for *Bacillus* spp.

Using HPA (PHLS) guidelines for the microbiological quality of some ready-to-eat foods, 94.9% of samples were of satisfactory or acceptable microbiological quality. However, 57 (4.7%) of salad vegetable samples were found to be of unsatisfactory microbiological quality due to *E. coli* and/or *S. aureus* levels at  $\geq 10^2$  cfu/g. A further 0.3% of the salad vegetable samples were of unacceptable quality due to *S. aureus* at  $\geq 10^4$  cfu/g (2 samples) and the presence of *Salmonella* Kentucky (1 sample). Cucumber was the most contaminated salad vegetable with regards to unsatisfactory levels of *E. coli* (6.0%) and *S. aureus* (4.5%).

Fifty five (4.7%) sauce samples were of unsatisfactory microbiological quality due to *E. coli*, *S. aureus* at  $\geq 10^2$  cfu/g and/or *B. cereus* and other pathogenic *Bacillus* spp. at  $\geq 10^4$  cfu/g. A further seven (0.6%) of the sauce samples were of unacceptable quality due to pathogenic *Bacillus* spp. (*B. subtilis*, *B. pumilis*, *B. licheniformis*) at  $\geq 10^5$  cfu/g or the presence of *Salmonella* Agbeni (1 sample). More samples of chilli sauce (8.7%) were of unsatisfactory or unacceptable microbiological quality than any other sauce types.

Ready-to-eat salad vegetables and sauces contaminated with pathogens such as *Salmonella* spp. or with unacceptable levels of *S. aureus* or *B. cereus* are unsafe. They are considered to be injurious to health and/or unfit for human consumption. The results emphasize the need for good hygiene practices in kebab take-away restaurants handling these types of ready-to-eat products.

## Introduction

The 'kebab' is one of the fastest growing sectors in the fast food market in some parts of Europe, including in the UK. The purchase of take-away food from kebab and middle eastern outlets in the UK has risen significantly<sup>1</sup>. Kebab meat varieties include doner, shwherma, kofte, shish and varieties containing a mixture of meats, such as mixed doners. Kebabs are generally served with a salad made from lettuce, tomatoes, onions, cabbage and cucumber. There is usually a choice between yoghurt, chilli, or garlic sauces.

Although cooked kebab meat has been shown to be of good microbiological quality in previous UK studies<sup>2-5</sup>, there have been a number of outbreaks of foodborne disease in recent years associated with kebabs and products served from take-away restaurants. Between 1992 and 2006, 13 such outbreaks were reported in England and Wales<sup>2,6,7</sup>. Eleven of these were caused by *Salmonella*, one by vero-cytotoxigenic *E. coli* (VTEC) O157 and the other by *Campylobacter*. There were 739 cases linked to these outbreaks, with 12.7% (94) hospitalised. The potential for large outbreaks to occur is illustrated by the two most recent outbreaks of infection associated with various foods from two take-away kebab shops (*S. Enteritidis* PT 56 in 2003, *S. Enteritidis* PT 1 in 2005)<sup>2,6</sup>. At least 340 people were affected in the outbreak of *S. Enteritidis* PT 56 in 2003, with 19% of individuals hospitalised. The outbreak of *S. Enteritidis* PT 1 in 2005 affected 195 people, 4% of whom were hospitalised. Evidence from these outbreaks indicates that cross-contamination risks due to poor hygiene during food handling and preparation within these premises is of importance<sup>2,7,8</sup>.

The European Commission Regulation on the hygiene of foodstuffs (Regulation (EC) No. 852/2004)<sup>9</sup> provides a risk-based approach to controlling food hygiene. The Regulation requires businesses to implement a written food safety management system based on hazard analysis and critical control point (HACCP) principles, to keep clean and maintain premises in good repair and condition, and to ensure food handlers are trained or instructed in good hygiene practices. Despite the legal requirements, cross-contamination remains an important contributory factor in outbreaks associated with kebab take-away restaurants in England and Wales<sup>2,7,8</sup>. This highlights the continuing importance of good hygiene practices and adequate training for food handlers.

The purpose of this study was to establish the microbiological quality of salad vegetables and sauces served in kebab take-away restaurants in order to estimate the risk these particular ready-to-eat food products presented to the consumer. The study

was also designed to evaluate the effect of risk factors (e.g. the supply, storage and service of salad vegetables and sauces) on the microbiological quality of these ready-to-eat food types and to examine the extent to which kebab take-away restaurants complied with the legal requirements.

## **Materials and Methods**

### **Sample collection**

A total of 1213 salad vegetable and 1208 sauce samples were collected from 1277 take-away kebab restaurant that served these foods as an accompaniment to kebab meat. Samples were collected by sampling officers from 238 Environmental Health Departments in 46 Local Authority Food Liaison Groups across England, Wales and Northern Ireland (as shown in Annex 1) between 1 June and 31 July 2007. All sample details were recorded on a standard questionnaire (Annex 2). Premises were randomly selected by either taking every fifth suitable kebab take-away premises on the Local Authority food business database or by using a random number generator.

All samples collected weighed at least 100g and were “in use” at the time of sampling. Aseptic technique was used to transfer the sample into a sterile plastic bag or container, using single use sterile utensils. If sauces were pre-dispensed then sufficient pots were taken to give a cumulative total of 100g. Samples were collected and transported to the laboratory (or laboratory collection point) in accordance with the Food Law Code of Practice and Guidance issued by the Food Standards Agency<sup>10</sup> and the Local Authorities Co-ordinators of Regulatory Services (LACORS) guidance on microbiological food sampling<sup>11</sup>.

### **Sample preparation and examination**

Salad and sauce samples were examined by 25 Official Control Laboratories using HPA Standard Microbiological Methods<sup>12-15</sup>. The presence of *Salmonella* spp., *E. coli* and *S. aureus* were enumerated for salad and sauce samples. Sauce samples were also examined for *Bacillus cereus* and other *Bacillus* spp.

All *B. cereus* and other *Bacillus* spp. isolates from counts of  $\geq 10^4$  cfu/g were sent to the Food Safety Microbiology Laboratory, HPA Centre for Infections for further confirmation<sup>16,17</sup>. All isolates confirmed as *Salmonella* were sent to the Laboratory of Enteric Pathogens, HPA Centre for Infections, for further characterization<sup>18,19</sup>.

Microbiological results were interpreted in relation to microbiological criteria in the HPA (PHLS) guidelines for the microbiological quality of some ready-to-eat foods sampled at the point of sale (Table 1)<sup>20</sup>.

**Table 1 Microbiological criteria for ready-to-eat salad vegetables and sauces<sup>20</sup>**

| Micro-organism  | Results (cfu/g unless otherwise specified) | Interpretation of microbiological quality |
|---|--|---|
| <i>Escherichia coli</i>   | $\geq 10^2$                                | Unsatisfactory                            |
| <i>Staphylococcus aureus</i>  | $10^2$ - $<10^4$                           | Unsatisfactory                            |
|   | $\geq 10^4$                                | Unacceptable <sup>a</sup>                 |
| <i>Salmonella</i> spp.  | Detected in 25g                            | Unacceptable <sup>a</sup>                 |
| <i>Bacillus cereus</i> and other pathogenic <i>Bacillus</i> spp. <sup>b</sup> | $10^4$ - $<10^5$                           | Unsatisfactory                            |
|   | $\geq 10^5$                                | Unacceptable <sup>a</sup>                 |

a, Potentially injurious to health and/or unfit for human consumption (contravenes Article 14 Food Safety Requirements of Regulation (EC) No.178/2002 (the General Food Law Regulation)

b, Sauce samples only

### Statistical Analysis

Descriptive and statistical analysis of the data, including the evaluation of risk factors, was undertaken using Microsoft Excel and the GraphPad statistical calculator. Relative proportions were compared using the chi-squared ( $\chi^2$ ) and Fisher's exact tests. A probability value of less than 5% was deemed to be significant.

### Results

Amongst the 2421 salad vegetable and sauce samples tested, 2299 (94.9%) were of satisfactory or acceptable microbiological quality, 112 (4.7%) were unsatisfactory, and 10 (0.4%) were of unacceptable quality.

### Microbiological quality of salad vegetables

Of the 1213 salad vegetables sampled during this survey, 4.7% (57) were of unsatisfactory microbiological quality due to *E. coli* ( $\geq 10^2$  cfu/g, 3.7%), *S. aureus* ( $\geq 10^2$  -  $<10^4$  cfu/g, 0.8%) or both organisms (0.2%) (Table 2). Cucumber samples had the highest proportion of unsatisfactory results for both *E. coli* (6.0%) and *S. aureus* (4.5%).

Tomato samples had the lowest unsatisfactory rates for these organisms (*E. coli*, 1.0%, *S. aureus*, 0%).

Three samples were found to be of unacceptable microbiological quality due to high levels of *S. aureus* at  $\geq 10^4$  cfu/g (2 samples, 0.4%) or presence of *Salmonella* Kentucky (1 sample, 0.2%). The sample contaminated with *S. Kentucky* was shredded lettuce. Follow-up investigations by the local authority at the premises from which the sample was taken revealed the presence of *S. Kentucky* in further prepared salad vegetable items, food preparation surfaces, cleaning materials (including cloths) and mouse droppings. A number of corrective measures were taken to address hygiene within the premises, including closure for professional cleaning and refurbishment<sup>21</sup>. No cases of human infection of *S. Kentucky* were reported in the area at the time of the study.

**Table 2 Microbiological quality of ready-to-eat salad vegetables**

| Micro-organism         | Salad type         | No. samples<br>n= 1213 (%) | No. samples of unsatisfactory or unacceptable quality (%) |                  |
|------------------------|--------------------|----------------------------|---|------------------|
|                        |                    |                            | Unsatisfactory  | Unacceptable     |
| <i>E. coli</i>         | Cabbage            | 123 (10.1)                 | 4 (3.2)   | n/a <sup>b</sup> |
|                        | Cucumber           | 67 (5.5)                   | 4 (6.0)   | n/a              |
|                        | Lettuce            | 454 (37.5)                 | 21 (4.6)  | n/a              |
|                        | Onion              | 111 (9.2)                  | 3 (2.7)   | n/a              |
|                        | Tomato             | 102 (8.4)                  | 1 (1.0)   | n/a              |
|                        | Mixed <sup>a</sup> | 356 (29.3)                 | 14 (3.9)  | n/a              |
| <i>S. aureus</i>       | Cabbage            | 123 (10.1)                 | 2 (1.6)   | 0 (0.0)          |
|                        | Cucumber           | 67 (5.5)                   | 3 (4.5)   | 0 (0.0)          |
|                        | Lettuce            | 454 (37.5)                 | 3 (0.7)   | 2 (0.4)          |
|                        | Onion              | 111 (9.2)                  | 0 (0.0)   | 0 (0.0)          |
|                        | Tomato             | 102 (8.4)                  | 0 (0.0)   | 0 (0.0)          |
|                        | Mixed <sup>a</sup> | 356 (29.3)                 | 4 (1.1)   | 0 (0.0)          |
| <i>Salmonella</i> spp. | Cabbage            | 123 (10.1)                 | n/a   | 0 (0.0)          |
|                        | Cucumber           | 67 (5.5)                   | n/a   | 0 (0.0)          |
|                        | Lettuce            | 454 (37.5)                 | n/a   | 1 (0.2)          |
|                        | Onion              | 111 (9.2)                  | n/a   | 0 (0.0)          |
|                        | Tomato             | 102 (8.4)                  | n/a   | 0 (0.0)          |
|                        | Mixed <sup>a</sup> | 356 (29.3)                 | n/a   | 0 (0.0)          |

a, Mixed: cabbage, lettuce, tomato,

b, Not applicable

### Microbiological quality of sauces

Of the 1208 sauce samples examined, 4.7% (57) were of unsatisfactory microbiological quality due to *E. coli* ( $\geq 10^2$  cfu/g, 0.7%), *S. aureus* ( $\geq 10^2$  -  $< 10^4$  cfu/g, 0.2%) or *B. cereus*

and/or other pathogenic *Bacillus* species ( $\geq 10^4$  -  $< 10^5$  cfu/g 3.8%) (Table 3). A further seven samples (all chilli sauce) were found to be of unacceptable microbiological quality due to high levels of *B. cereus* and/or other pathogenic *Bacillus* species ( $\geq 10^5$  cfu/g, 6 samples, 0.4%) or presence of *Salmonella* Agbeni (1 sample, 0.1%).

The proportion of chilli sauce samples of unsatisfactory or unacceptable microbiological quality (8.7%) was significantly higher than all other sauce types (yoghurt; 4.8%, garlic; 2.2%, other types; 1.1%) ( $p < 0.0001$ ). The chilli sauce sample contaminated with *S. Agbeni* was made at the take-away premises and stored uncovered at a temperature of 11.8°C. The premises would not usually have discarded at the end of the trading day.

*Salmonella* Agbeni infection is very rare in England and Wales, with only 26 cases having been identified between 2004 and 2006. There were no cases of *S. Agbeni* reported during 2007, the year that this study took place.

**Table 3 Microbiological quality of ready-to-eat sauces**

| Micro-organism   | Sauce type         | No. samples<br>n= 1208 (%) | No. samples of unsatisfactory or unacceptable quality (%) |                  |
|--|--------------------|----------------------------|---|------------------|
|  |                    |                            | Unsatisfactory  | Unacceptable     |
| <i>E. coli</i>   | Chili              | 548 (45.4)                 | 5 (0.9)   | n/a <sup>b</sup> |
|  | Garlic             | 493 (40.8)                 | 1 (0.2)   | n/a              |
|  | Yoghurt based      | 82 (6.8)                   | 1 (1.2)   | n/a              |
|  | Other <sup>a</sup> | 85 (7.0)                   | 1 (1.2)   | n/a              |
| <i>S. aureus</i>   | Chili              | 548 (45.4)                 | 2 (0.4)   | 0 (0.0)          |
|  | Garlic             | 493 (40.8)                 | 1 (0.2)   | 0 (0.0)          |
|  | Yoghurt based      | 82 (6.8)                   | 0 (0.0)   | 0 (0.0)          |
|  | Other <sup>a</sup> | 85 (7.0)                   | 0 (0.0)   | 0 (0.0)          |
| <i>B. cereus</i> and other pathogenic <i>Bacillus</i> spp. | Chili              | 548 (45.4)                 | 34 (6.2)  | 6 (1.1)          |
|  | Garlic             | 493 (40.8)                 | 9 (1.8)   | 0 (0.0)          |
|  | Yoghurt based      | 82 (6.8)                   | 3 (3.7)   | 0 (0.0)          |
|  | Other <sup>a</sup> | 85 (7.0)                   | 0 (0.0)   | 0 (0.0)          |
| <i>Salmonella</i> spp.                                     | Chili              | 548 (45.4)                 | n/a   | 1 (0.2)          |
|  | Garlic             | 493 (40.8)                 | n/a   | 0 (0.0)          |
|  | Yoghurt based      | 82 (6.8)                   | n/a   | 0 (0.0)          |
|  | Other <sup>a</sup> | 85 (7.0)                   | n/a   | 0 (0.0)          |

a, Curry, sweet and sour, mango and tomato sauces

b, Not applicable

#### **Pathogenic *Bacillus* spp. and *B. cereus* isolated at $\geq 10^4$ cfu/g from sauces**

Of the 59 *Bacillus* spp. and *B. cereus* isolates at  $\geq 10^4$  cfu/g (obtained from 52 samples; levels ranged from  $1.0 \times 10^4$  –  $8.6 \times 10^5$  cfu/g) referred for characterisation, 40 (67.8%)

were *B. subtilis*, and the remaining 19 were *B. pumilus*, *B. cereus* and *B. licheniformis*. (Table 4).

**Table 4** *B. cereus* and other pathogenic *Bacillus* spp. isolated at  $\geq 10^4$  cfu/g from sauces

| <b><i>Bacillus</i> species</b> | <b>Number of isolates*</b> |
|--------------------------------|----------------------------|
| <i>B. cereus</i>               | 4                          |
| <i>B. licheniformis</i>        | 4                          |
| <i>B. pumilus</i>              | 11                         |
| <i>B. subtilis</i>             | 40                         |

\* 7 samples had more than one type of *Bacillus* spp. present

### **Microbiological quality of salad vegetables and sauces in relation to premises and product details**

The supply, storage, and service details and hygiene factors at the kebab take-away premises (presented below) had no significant statistical effect on the microbiological quality of the vegetables and sauces with regard to samples of unsatisfactory or unacceptable quality (Tables 5-6).

Forty eight percent of samples were collected from premises serving a Turkish cuisine (Table 5) and 85.9% of samples were from premises that had staff who had received some form of food hygiene training. Of the remainder, 10.0% of samples were from premises where staff had received no training in food hygiene and in 4.1% of premises, this information was not recorded (Table 5). Only half (50.9%) of the samples collected were from premises that complied with HACCP requirements as provided in Article 5 of Regulation (EC) No. 852/2004<sup>9</sup> (Table 5).

Most salad vegetables were supplied to the kebab take-away premises in a loose and unprepared format (i.e. open, unwashed) (88.3%). Sauces sampled were in the main made at the takeaway premises (47.9%) or otherwise commercially manufactured (32.3%) (Table 5).

**Table 5 Microbiological quality of salads and sauces in relation to premises details**

| Premises Factor                          | No. samples         |                     | No. samples of unsatisfactory / unacceptable quality (%) |       |
|--|---------------------|---------------------|--|-------|
|  | Salad<br>n=1213 (%) | Sauce<br>n=1208 (%) | Salad  | Sauce |
| <b>Type of cuisine:</b>                  |                     |                     |  |       |
| Greek                                    | 66 (5.4)            | 68 (5.6)            | 7.6  | 1.5   |
| Indian                                   | 151 (12.5)          | 153 (12.7)          | 5.3  | 7.2   |
| Middle Eastern                           | 85 (7.0)            | 84 (6.9)            | 3.5  | 2.4   |
| Turkish                                  | 590 (48.6)          | 582 (48.2)          | 4.1  | 5.8   |
| Other <sup>a</sup>                       | 292 (24.1)          | 290 (24.0)          | 5.4  | 4.8   |
| Not recorded                             | 29 (2.4)            | 31 (2.6)            | 13.7   | 3.2   |
| <b>Food Hygiene Training:</b>            |                     |                     |  |       |
| <b>Total Yes</b>                         | 1043 (86.0)         | 1037 (85.9)         | 4.9  | 5.5   |
| Foundation                               | 929 (89.1)          | 920 (88.7)          | 5.0  | 4.8   |
| Intermediate                             | 37 (3.5)            | 38 (3.7)            | 2.7  | 15.8  |
| Advanced                                 | 7 (0.7)             | 7 (0.7)             | 0.0  | 0.0   |
| Other <sup>b</sup>                       | 19 (1.8)            | 19 (1.8)            | 5.3  | 0.0   |
| Yes, but not recorded                    | 51 (4.9)            | 53 (5.1)            | 3.9  | 11.3  |
| No                                       | 121 (10.0)          | 121 (10.0)          | 3.3  | 3.3   |
| Not recorded                             | 49 (4.0)            | 50 (4.1)            | 10.2   | 4.0   |
| <b>Compliance with HACCP:</b>            |                     |                     |  |       |
| Yes                                      | 617 (50.8)          | 616 (51.0)          | 5.9  | 5.9   |
| No                                       | 479 (39.5)          | 475 (39.3)          | 3.3  | 4.6   |
| Not recorded                             | 117 (9.7)           | 117 (9.7)           | 6.8  | 4.3   |
| <b>Salad-format supplied to premises</b> |                     |                     |  |       |
| Loose & unprepared                       | 1071 (88.3)         | n/a <sup>c</sup>    | 5.0  | n/a   |
| Pre-packed pre-cut (unwashed)            | 41 (3.4)            | n/a                 | 2.4  | n/a   |
| Pre-packed pre-cut (washed)              | 58 (4.8)            | n/a                 | 6.9  | n/a   |
| Not recorded                             | 43 (3.5)            | n/a                 | 4.6  | n/a   |
| <b>Sauce-place of manufacture</b>        |                     |                     |  |       |
| Commercial                               | n/a                 | 390 (32.3)          | n/a  | 5.2   |
| On premises                              | n/a                 | 579 (47.9)          | n/a  | 6.7   |
| Not recorded                             | n/a                 | 239 (19.8)          | n/a  | 1.6   |

a, Cypriot, Pakistani, Portuguese

b, In house training, RIPH qualification

c, Not applicable

In 60.4% of kebab take-away premises salad vegetables and sauces were displayed or stored at above 8°C. The majority (67.8%) had been in the service area for four or less hours (Table 6). Salad vegetables were mainly served/handled using a designated (61.5%) or shared (31.4%) serving utensil (Table 6). Ninety four percent of sauces were served by the food handler rather than self-service (3.2%) (Table 6). In

72.7% of food service/preparation areas visited to collect samples, salad vegetables were not covered. By contrast, 78.1% of sauces were covered (Table 6). In 75.3% of kebab take-away premises the salad vegetables were discarded at the end of the serving period, but most sauces were not (70.6%) (Table 6).

**Table 6 Microbiological quality of salads and sauces in relation to storage and service details**

| Storage and service details      | No. samples         |                 | No. samples of unsatisfactory /unacceptable quality (%) |       |
|----------------------------------|---------------------|-----------------|---|-------|
|                                  | Salad<br>n=1213 (%) | Sauce<br>n=1208 | Salad   | Sauce |
| <b>Storage temperature:</b>      |                     |                 |   |       |
| ≤8°C                             | 462 (38.1)          | 417 (34.5)      | 6.2   | 5.8   |
| >8°C                             | 709 (58.5)          | 753 (62.3)      | 4.2   | 5.1   |
| Not recorded                     | 42 (3.4)            | 38 (3.2)        | 2.4   | 2.6   |
| <b>How long in service area:</b> |                     |                 |   |       |
| ≤4hrs                            | 936 (77.2)          | 706 (58.4)      | 4.6   | 4.8   |
| >4hrs                            | 159 (13.1)          | 313 (25.9)      | 6.3   | 5.8   |
| Not known                        | 118 (9.7)           | 189 (15.7)      | 5.9   | 10.1  |
| <b>Service of sauces</b>         |                     |                 |   |       |
| Self service                     | n/a                 | 39 (3.2)        | n/a   | 7.7   |
| Served                           | n/a                 | 1139 (94.3)     | n/a   | 5.2   |
| Not recorded                     | n/a                 | 30 (2.5)        | n/a   | 0.0   |
| <b>Service of salads</b>         |                     |                 |   |       |
| Bare hands                       | 36 (3.0)            | n/a             | 2.8   | n/a   |
| Gloved/protected hand            | 24 (2.0)            | n/a             | 4.2   | n/a   |
| Designated serving utensils      | 746 (61.5)          | n/a             | 5.5   | n/a   |
| Shared utensils                  | 381 (31.4)          | n/a             | 4.2   | n/a   |
| Other                            | 4 (0.3)             | n/a             | 0.0   | n/a   |
| Not recorded                     | 22 (1.8)            | n/a             | 4.5   | n/a   |
| <b>Food covered</b>              |                     |                 |   |       |
| Yes                              | 310 (25.6)          | 944 (78.1)      | 5.4   | 4.9   |
| No                               | 882 (72.7)          | 240 (19.9)      | 4.7   | 5.8   |
| Not recorded                     | 21 (1.7)            | 24 (2.0)        | 4.8   | 8.3   |
| <b>Discarded at end of day</b>   |                     |                 |   |       |
| Yes                              | 913 (75.3)          | 327 (27.1)      | 5.4   | 7.0   |
| No                               | 257 (21.1)          | 853 (70.6)      | 3.1   | 4.6   |
| Not recorded                     | 43 (3.6)            | 28 (2.3)        | 4.6   | 3.6   |

The food preparation area in most premises (91.5%) was judged to be visibly clean by the sampling officer, in 6.3% it was unclean and for 2.2% of premises, this information was not recorded. A sanitiser or disinfectant was used for cleaning in the majority of premises (81.2%), in 16.6% these cleaning materials were not used and for 2.2% of premises, this information was not recorded. The majority of premises (63.2%) used only re-useable cleaning cloths, 30.2% used disposable cloths and a further 2.8% used both re-useable and disposable cloths. For 3.8% of premises, this information was

not recorded. Most premises did not use a dishwasher (84.8%), although 12.3% did, and for 2.8%, this information was not recorded. Adequate sanitary provision in food premises, with hand washing facilities for staff, is a legal requirement (Regulation (EC) No. 852/2004<sup>9</sup>). Although most premises (73.3%) had hand wash basins with hot water and soap available for their staff to use, 12.4% did not and for 14.3% of premises, this information was not recorded.

### **Kebab meat served at kebab take-aways**

Of the kebab take-away premises visited, 82.1% served kebabs made from lamb and chicken (46.9%) or lamb alone (35.2%) (Table 7). Most of the take-aways did not prepare the kebab meat on the premises (70.1%) but bought and stored meat frozen (68.8% supplied frozen, 81.0% stored frozen). At the end of the day, 47.1% of premises discarded left over kebabs, refrigerated them at  $\leq 8^{\circ}\text{C}$  (24.8%) or stored them in a freezer (21.2%) (Table 7).

**Table 7 Overview of kebab meat type, supply and storage**

| <b>Kebab meat details</b>                  | <b>No. premises<br/>n=1277 (%)</b> |        |
|--|------------------------------------|--------|
| <b>Type of kebab meat:</b>                 |                                    |        |
| Chicken                                    | 30                                 | (2.3)  |
| Lamb                                       | 449                                | (35.2) |
| Lamb and beef                              | 111                                | (8.7)  |
| Lamb and chicken                           | 599                                | (46.9) |
| Lamb, beef and chicken                     | 88                                 | (6.9)  |
| <b>Prepared on premises:</b>               |                                    |        |
| Yes  | 330                                | (25.8) |
| No   | 895                                | (70.1) |
| Not recorded                               | 52                                 | (4.1)  |
| <b>Meat supplied to premises:</b>          |                                    |        |
| $\leq 8^{\circ}\text{C}$                   | 60                                 | (4.7)  |
| $> 8^{\circ}\text{C}$                      | 19                                 | (1.5)  |
| Frozen                                     | 879                                | (68.8) |
| Mixture of fresh and frozen                | 135                                | (10.6) |
| Not recorded                               | 184                                | (14.4) |
| <b>Meat stored at premises:</b>            |                                    |        |
| $\leq 8^{\circ}\text{C}$                   | 138                                | (10.8) |
| $> 8^{\circ}\text{C}$                      | 24                                 | (1.9)  |
| Frozen                                     | 1034                               | (81.0) |
| Other                                      | 14                                 | (1.1)  |
| Not recorded                               | 67                                 | (5.2)  |
| <b>At the end of day left over kebabs:</b> |                                    |        |
| Discarded                                  | 602                                | (47.1) |
| Stored $\leq 8^{\circ}\text{C}$            | 317                                | (24.8) |
| Stored $> 8^{\circ}\text{C}$               | 35                                 | (2.7)  |
| Stored in freezer                          | 271                                | (21.2) |

|              |    |       |
|--------------|----|-------|
| Not recorded | 52 | (4.1) |
|--------------|----|-------|

## Discussion

This study has shown that the vast majority (95%) of prepared ready-to-eat raw salad vegetables and sauces sampled from kebab take-aways in England, Wales and Northern Ireland were of satisfactory/acceptable microbiological quality according to published microbiological guidelines<sup>20</sup>. However, 5% of salad vegetable and sauces sampled were shown to be of unsatisfactory or unacceptable microbiological quality due to high levels of *E. coli*, *S. aureus* and *Salmonella* spp. and additionally for chilli sauces high levels of *B. cereus* and other pathogenic *Bacillus* spp. Ready-to-eat foods contaminated with pathogens such as *Salmonella* spp. or with unacceptable levels of *S. aureus* or *B. cereus* are unsafe. They are considered to be injurious to health and/or unfit for human consumption as they contravene the food safety requirements (Article 14) of Regulation (EC) No.178/2002<sup>23</sup>. The presence of *Salmonella* in salad vegetables and spices, which can be used to make sauces, has been linked to a number of recent outbreaks in the UK and elsewhere<sup>24,25</sup>. *Bacillus cereus* may also be present in spices, usually at counts below 10<sup>3</sup> cfu/g but can multiply to high levels (10<sup>5</sup> – 10<sup>6</sup> cfu/g) in food to which it is added, such as sauces. This may be sufficient to cause food poisoning if the food is inappropriately handled or stored<sup>25</sup>.

Microbial contamination of open food, including salad vegetables and sauces served with kebabs, can occur from the environment, from contact with contaminated containers, equipment and utensils, hands, aerosols, cleaning cloths or pests<sup>26,27</sup>. Food handlers are usually the main source of food contamination in *Staphylococcus aureus* food poisoning, but equipment and environmental surfaces can also be sources of contamination with *S. aureus*<sup>27</sup>. The presence of *S. aureus* in ready-to-eat salad vegetables (2.7%) and sauces (1.0%) found in this study is an indication of poor hygiene practices. Levels of faecal indicator organisms such as *E. coli* are also an indication of contamination and hygienic quality. The incidence of *E. coli* at  $\geq 10^2$  cfu/g in salad vegetables found in this study (3.7%) is slightly higher than that found in an earlier UK study of open prepared ready-to-eat salad vegetables from a range of different food service premises in 2001 (3.0%)<sup>28</sup>. A small proportion of sauces also contained *E. coli* at  $\geq 10^2$  cfu/g (0.7%), and these levels in raw ready-to-eat vegetables and sauces should be avoided<sup>20</sup>.

Smaller premises (such as take-away catering premises) have been highlighted as an area for concern with regard to microbiological quality of ready-to-eat food and

food safety risks<sup>29</sup>. A Food Standards Agency survey on consumer attitudes indicated that hygiene standards in takeaway and fast food premises are also a key area of concern for consumers, with these premises emphasised more than any other outlet in relation to food hygiene concerns (27% of the UK sample)<sup>22</sup>. Good hygiene practices and high standards of cleanliness must be maintained at all times to avoid microbiological contamination occurring. Application of good food hygiene has been identified as greatly reducing the risk of transmission of foodborne disease from ready-to-eat foods via infected food handlers or cross-contamination<sup>24</sup>. The Food Standards Agency's 'Safer Food Better Business for Caterers' pack is a guide to implementing a food safety management system in smaller catering premises. The pack has been developed to help small catering businesses, such as takeaways, to comply with food hygiene regulations introduced in January 2006 and to minimise microbial food safety hazards in their food business operations<sup>30</sup>.

Although the results from this study indicate that overall ready-to-eat salad vegetables and sauces from kebab take-aways were of satisfactory/acceptable quality, two recent large outbreaks of salmonellosis in the UK<sup>2,6</sup> demonstrate that significant health problems can arise from consumption of contaminated salad and sauce products in addition to kebab meat. It follows that sound approaches to food safety management in kebab take-aways must be implemented. It is also recommended that enforcement officers pay attention to such food products when both visiting and sampling from these types of premises.

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**Annex 1 Participating laboratories and Local Authority Food Liaison Groups**

**Table I Participating food liaison groups and sample numbers**

| <b>Local Authority Food Liaison Group</b> | <b>Number of Food Samples</b> | <b>Local Authority Food Liaison Group</b> | <b>Number of Samples</b> |
|---|-------------------------------|---|--------------------------|
| Berkshire                                 | 12                            | LFCG SW Sector                            | 33                       |
| Buckinghamshire                           | 14                            | Lincolnshire                              | 70                       |
| Cambridgeshire                            | 31                            | Merseyside                                | 53                       |
| Cheshire                                  | 66                            | Norfolk                                   | 47                       |
| Cornwall                                  | 28                            | North Wales                               | 14                       |
| Cumbria                                   | 28                            | North Yorkshire                           | 39                       |
| Derbyshire                                | 30                            | Northamptonshire                          | 16                       |
| Devon                                     | 46                            | Northern Ireland                          | 100                      |
| Dorset                                    | 47                            | Nottinghamshire                           | 103                      |
| Durham                                    | 4                             | Oxfordshire                               | 24                       |
| East Sussex                               | 28                            | Shropshire                                | 36                       |
| Essex                                     | 114                           | Somerset                                  | 12                       |
| Gloucestershire                           | 25                            | South East Wales                          | 12                       |
| Greater Manchester                        | 71                            | South/West Yorkshire                      | 80                       |
| Hampshire & Isle of Wight                 | 66                            | Staffordshire                             | 58                       |
| Hereford & Worcester                      | 46                            | Suffolk                                   | 34                       |
| Hertfordshire & Bedfordshire              | 99                            | Surrey                                    | 79                       |
| Humberside/North Lincoln                  | 82                            | Tees Valley                               | 59                       |
| Kent                                      | 106                           | Tyne & Wear                               | 44                       |
| Lancashire                                | 87                            | Warwickshire                              | 58                       |
| Leicestershire                            | 74                            | West Midlands                             | 138                      |
| LFCG <sup>a</sup> NE Sector               | 62                            | West Sussex                               | 55                       |
| LFCG NW Sector                            | 49                            |   |                          |
| LFCG SE Sector                            | 42                            | <b>Total</b>                              | <b>2421</b>              |

a, London Food Co-ordinating Group

**Table II Participating laboratories and sample numbers**

| <b>Region</b>                        | <b>Laboratory Name</b> | <b>Number of Samples</b> |
|--------------------------------------|------------------------|--------------------------|
| East                                 | Chelmsford             | 146                      |
|                                      | Norwich                | 90                       |
| East Midlands                        | Leicester              | 74                       |
|                                      | Lincoln                | 181                      |
| London                               | London                 | 299                      |
| North West                           | Carlisle               | 28                       |
|                                      | Chester                | 131                      |
|                                      | Preston                | 158                      |
| South East                           | Ashford                | 106                      |
|                                      | Hayward's Heath        | 156                      |
|                                      | WEMS <sup>a</sup>      | 155                      |
| South West                           | Exeter                 | 54                       |
|                                      | Gloucester             | 25                       |
|                                      | Plymouth               | 4                        |
|                                      | Truro                  | 28                       |
| West Midlands                        | Birmingham             | 78                       |
|                                      | Coventry               | 74                       |
|                                      | Hereford               | 28                       |
|                                      | Shrewsbury & Telford   | 94                       |
|                                      | Stoke                  | 80                       |
| North East, Yorkshire and the Humber | Leeds                  | 165                      |
|                                      | Sheffield              | 47                       |
|                                      | Newcastle              | 118                      |
| Northern Ireland                     | Belfast                | 100                      |
| Wales                                | Rhyl                   | 2                        |
| <b>Total</b>                         |                        | <b>2421</b>              |

a, Wessex Environmental Microbiology Services, Southampton Laboratory

LACORS/HPA Salads and Sauces from Kebab take- aways: June- July 2007

LABORATORY NAME.....

Laboratory Sample Number.....

Annex 2



**Study 31: LACORS/HPA CO-ORDINATED FOOD LIAISON GROUP STUDY: QUESTIONNAIRE**



**LACORS/HPA Microbiological Examination of Salads and Sauces from Kebab Take-aways**

All information must be correctly and clearly entered on the form using black ink to facilitate clear photocopying

1. Local Authority..... 2. Food Liaison group.....  
 3. Samplers Name..... & contact number:..... 4. Sample collected at..... (time) on (date) ..../../..  
 5. LA Premises Reference Number..... 6. LA Sample Reference Number(s).....

**Premises details:**

7. Name of premises.....  
 8. Address..... Postcode.....  
 9 a. Does the premises comply with the principles of HACCP (Article 5 of EC 852/2004)? YES  NO   
 b. Has the manager undertaken food hygiene training? YES  NO  If YES, what level? Foundation  Intermediate   
 Advanced  Other  Specify.....  
 c. Was hot water & soap/detergent readily available at wash hand basins in food preparation areas at the time of the visit? YES  NO   
 10. Type of cuisine : Greek  Turkish  Middle Eastern  Indian  Other  Specify.....  
 11. Type of kebab meat served at the premises: Lamb  Lamb & beef  Chicken  Other  Specify.....  
 12. Is the kebab meat prepared on the premises: YES  Go to Q 14 NO  Go to Q13  
 13. Is kebab meat supplied to the premises: Frozen  ≤ 8° C  > 8° C  Some frozen & some fresh   
 14. Is the kebab meat stored: Frozen  ≤ 8° C  Specify..... > 8° C  Specify.....  
 15. At the end of the day is any kebab left over: Discarded  Stored in a freezer  Stored ≤ 8°C  Stored > 8°C

**Food Service/ Preparation Area Details**

16. Was the preparation/storage area visually clean: YES  NO   
 17. Is a sanitizer / disinfectant used to clean surfaces at the premises? YES  NO   
 18. Is a commercial dish washer used to clean food utensils, equipment etc. ? YES  NO   
 19. Are cleaning cloths used: Disposable  or Re-useable  If re-usable, do staff appear to be aware of cross-contamination risks: YES   
 NO

**Note: For each premises only take one sample of a salad and one sample of a sauce**

**Salads Details**

20. Please indicate type of salad sampled: Lettuce  Cucumber  Tomato  Onion  Other  Specify.....  
 21. Was the salad stored/ kept for service at: Equal/below 8° C  Specify..... Or Above 8°C  Specify.....  
 22. How long has the salad been in the food service area: ≤4hrs  > 4hrs  Not known   
 23. Was the salad covered: YES  NO   
 24. Was the salad handled/served using: Designated serving utensils  Shared utensils  Gloved/protected hand   
 Bare hand (in direct contact with salad)  Other  Specify.....  
 25. At the end of the day is the salad: Discarded  Or Stored   
 26. Was the salad supplied as: Pre-packed pre-cut (washed)  Pre-packed pre-cut (unwashed)  Loose & unprepared

**Sauces Details**

27. Please indicate type of sauce sampled: Chilli  Garlic  Other  Specify.....  
 28. Was the sauce(s) stored/ kept for service at: Equal/below 8° C  Specify..... Or Above 8°C  Specify.....  
 29. How long have the sauces been in the food service area: ≤4hrs  > 4hrs  Not known   
 30. Was the sauce(s) covered: YES  NO   
 31. Was the sauce(s): Served  Or Self-service   
 32. At the end of the day is the sauce: Discarded  Or Stored   
 33. Was the sauce Made on the premises  Commercially manufactured  Other  Specify.....

LACORS/HPA Salads and Sauces from Kebab take- aways: June- July 2007

LABORATORY NAME.....

Laboratory Sample Number.....

Annex 2

**RESULTS**

**Recording results**

Please record the results of count/g tests as **ACTUAL NUMBERS** in the appropriate box within the table. Only place ticks in the column headed (<20), i.e. the limit of detection for that test, and columns headed ND (Not Detected) and Detected.

Regarding detection of *Salmonella* spp. and microbiological quality please check the Unacceptable category above but NOTE that:

- *Salmonella* spp. detected in unprepared and pre-cut salad vegetables exceeds food safety requirements (Regulation (EC) No. 178/2002) and food safety criteria (Regulation (EC) No. 2073/2005), respectively and are thus deemed to be legally unsatisfactory
- S. aureus* and *B. cereus* should not be present at unacceptable/potentially hazardous levels in ready-to-eat food and thereby are also covered by Regulation (EC) No. 178/2002.

Salad Sample ..... Laboratory Sample No.....

|                                  | ND | Detected | <20 | 20-<10 <sup>2</sup> | 10 <sup>2</sup> -<10 <sup>3</sup> | 10 <sup>3</sup> -<10 <sup>4</sup> | 10 <sup>4</sup> -<10 <sup>5</sup> | 10 <sup>5</sup> -<10 <sup>6</sup> | 10 <sup>6</sup> -<10 <sup>7</sup> | ≥10 <sup>7</sup> |
|----------------------------------|----|----------|-----|---------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------|
| <i>Escherichia coli</i> / g      |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |
| <i>Staphylococcus aureus</i> / g |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |
| <i>Salmonella</i> spp. 25/g      |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |

Microbiological Quality: Satisfactory  Acceptable  Unsatisfactory  Unacceptable/Potentially hazardous

MICROBIOLOGISTS COMMENTS.....  
.....

Sauce type..... Laboratory Sample No.....

|                                  | ND | Detected | <20 | 20-<10 <sup>2</sup> | 10 <sup>2</sup> -<10 <sup>3</sup> | 10 <sup>3</sup> -<10 <sup>4</sup> | 10 <sup>4</sup> -<10 <sup>5</sup> | 10 <sup>5</sup> -<10 <sup>6</sup> | 10 <sup>6</sup> -<10 <sup>7</sup> | ≥10 <sup>7</sup> |
|----------------------------------|----|----------|-----|---------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------|
| <i>Escherichia coli</i> / g      |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |
| <i>Staphylococcus aureus</i> / g |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |
| <i>Bacillus</i> spp. / g         |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |
| <i>Bacillus cereus</i> / g       |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |
| <i>Salmonella</i> spp. 25/g      |    |          |     |                     |                                   |                                   |                                   |                                   |                                   |                  |

Microbiological Quality: Satisfactory  Acceptable  Unsatisfactory  Unacceptable/Potentially hazardous

MICROBIOLOGISTS COMMENTS.....  
.....

Date *Salmonella* isolates sent to the Laboratory of Enteric Pathogens, HPA Centre for Infections or in Scotland to the Scottish Reference Laboratory (Stobhill Hospital Glasgow) .....

Date *Bacillus* spp and *S. aureus* isolates giving counts ≥10<sup>4</sup> cfu/g sent to the Food Safety Microbiology Laboratory (FSML), HPA Centre for Infections.....

Signature ..... Date reported .....

Methods as defined in LACORS/HPA take- away Kebabs (Study 31); Annex 3