3rd Trimester National Microbiological Survey 2006 (06NS3):

Examination of the Microbiological Status of Food Preparation Surfaces

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Executive Summary

This 6 month survey (July to December 2006 inclusive) examined the hygiene of food preparation surfaces (worktops and chopping boards) in premises preparing sandwiches at the point of sale.

A total of 2,320 environmental swabs obtained by Environmental Health Officers and analysed in the 7 Official Food Microbiology Laboratories were considered for this report. The swabs were obtained from worktop surfaces (54.2%, n=1258) and chopping boards (44.5%, n=1032). The surface type was not specified for a small number of swabs (1.3%, n=30). Swabs were analysed for Aerobic colony count (ACC) and *Escherichia coli* (hygiene indicators). Data specific to i) the food preparation surfaces and ii) cleaning practices in the premises were captured via a questionnaire. The response rate to the questionnaire was 83.9%.

The following were the main findings:

- *E. coli* counts ≥1 cfu/cm^2 were detected on 1.2% (27/2320) of food preparation surfaces.
- ACC counts ≥ 10^3 cfu/cm^2 were detected on 15.6% (364/2320) of food preparation surfaces (other studies have associated ACC levels > 10^3 cfu/cm^2 with poor hygiene practices).
- The type of food preparation surface (i.e. chopping board or worktop) had a significant effect ($p<0.0001$) on the ACC results. Counts ≥ 10^3 cfu/cm^2 were recorded for 20.7% (n=259/1032) of swabs from chopping boards compared with 9.6% (n=98/1258) of swabs from worktops.
- The material (e.g. stainless steel, plastic, glass etc) of the food preparation surfaces (i.e. chopping board or worktop) did not have a significant effect on the ACC results.
- The i) specific use *(i.e. RTE food only/RTE and raw food*), ii) surface condition *(smooth/rough)*, iii) surface appearance *(clean/dirty)* and iv) presence of moisture *(wet/dry)* had a significant effect on the ACC count of chopping boards. These parameters did not have a significant effect on the ACC counts of worktops.
- The period of time since the last cleaning had a significant effect on the ACC count of worktops but not of chopping boards.

Cleaning schedules were in place in 88% (843/958) of premises and were documented in 86.7% (731/843) of these premises. In two thirds (66.1%, 483/731) of these premises documentation included details of the cleaning procedure. In over three quarters (78.2%, 572/731) of these premises documentation included the cleaning frequency. The

- presence/absence of a cleaning schedule
- documentation of the cleaning procedure
- documentation of the cleaning frequency

had no significant effect on the ACC results.

1. Introduction

All food businesses have a legal obligation to produce safe food [(1)]. Food safety is primarily achieved through a preventative approach such as the implementation of a food safety management system based on the principles of Hazard Analysis and Critical Control Point (HACCP) and good hygiene practice (GHP). Both of these are legal requirements. Article 5 of Regulation 852/2004 on Hygiene of Foodstuffs [(2)] requires food business operators (FBOs) to put in place, implement and maintain a permanent procedure or procedures based on the principles of HACCP; while, Article 4 requires FBOs comply with general and specific hygiene requirements (i.e. GHP). The National Standards Authority of Ireland (NSAI) has produced standards for food businesses to assist them comply with the requirements of Regulation 852/2004. Irish Standard 340:2007 applies to the catering sector [(3)] and Irish Standard 341:2007 applies to the food retailing and wholesale sectors [(4)].

Good cleaning practices are prerequisites to the implementation of a HACCP system and are essential for the production of safe food. Good cleaning practices are important for both food contact surfaces (e.g. equipment, worktops, chopping boards, utensils, containers etc) and non food contact surfaces (e.g. floors, ceiling, drains etc) to prevent the build up of food debris and microorganisms which could directly or indirectly contaminate food [(5)]. Good cleaning practices are particularly important in premises handling ready-to-eat (RTE) foods, as these foods are consumed without further cooking or processing to eliminate or reduce the level of microorganisms to a safe level. In all food businesses, cleaning practices should be outlined in a cleaning schedule and cleaning records should be maintained.

The effectiveness of cleaning practices can be monitored and/or verified by environmental sampling. Under Commission Regulation (EC) No 2073/2005 on Microbiological Criteria for Foodstuffs [(6)] environmental sampling must be undertaken in:

i) premises producing RTE foods which may pose a risk of *L. monocytogenes* and
ii) premises producing dried infant formula or dried foods for special medical purposes intended for infants below 6 months which pose a risk of *Enterobacter saklazakii* (in these premises the processing environment and equipment should be sampled for *Enterobacteriaceae*).

In other premises, environmental sampling should be carried out as necessary. The Regulation does not specify criteria for the acceptable level of microorganisms on surfaces. Rather, environmental sampling should be used as a tool by FBOs to ensure the foodstuffs under their control meet the relevant process hygiene[∞] and food safety[⊗] criteria.

[∞] A process hygiene criterion indicates the acceptable functioning of the production process.

[⊗] A food safety criterion defines the acceptability of a product or a batch of foodstuffs. It is applicable to products placed on the market and throughout their shelf life.

Very few guidelines [∂] have been published on the acceptable level of microorganisms on surfaces. The US Public Health Service recommends that cleaned and disinfected food service equipment should not exceed 10 viable microorganisms per cm^2 [(7)]. The Public Health Laboratory Service (PHLS) in the UK [⊗] recommended guidelines for cleaned surfaces ready for use: less than 80cfu/cm^2 is satisfactory, 80-10^3cfu/cm^2 is borderline and over 10^3cfu/cm^2 is unsatisfactory [(8)]. In addition, a Local Authorities Co-ordinating Body on Food and Trading Standards (LACOTS)/PHLS study of cleaning standards and practices in food premises correlated samples (surface samples and cleaning cloths) having aerobic colony counts > 10^3cfu/cm^2 with premises that did not have adequate food hygiene training, hazard analysis, cleaning schedules or cleaning records in place [(9)].

[∂] Guidelines are not legally enforceable. They can complement legally enforceable standards or provide a benchmark in situations where standards are not considered necessary.

[⊗] The PHLS ceased to exist on 01 April 2003 and has been replaced by the Health Protection Agency.

2. Specific Objectives

This study examined the hygiene of food preparation surfaces in premises preparing sandwiches at the point of sale using aerobic colony count (ACC) and *E. coli* as hygiene indicators.

3. Method

3.1 Sample source

Environmental Health Officers (EHOs) obtained environmental swabs from premises preparing sandwiches at the point of sale, e.g. delicatessens, bagel bars, restaurants, hotels, supermarkets, etc. All other food businesses including sandwich manufacturing premises were excluded.

3.2 Type of surface

In each premises the following food preparation surfaces were swabbed:

- chopping board
- worktop

The following surfaces were specifically excluded:

- Chopping boards or worktops which had just been disinfected/sanitised
- Any surface other than a chopping board or a worktop (e.g. slicers etc)

Food preparation surfaces were in operational use at the time of swabbing.

3.3 Sample period

Sampling was undertaken by EHOs from the Health Service Executive (HSE) over a 6 month period, i.e. July-December 2006 inclusive.

3.4 Sample numbers

Two swabs were submitted from each premises, i.e. one swab from the chopping board and one swab from the worktop. In premises where only one food preparation surface was available (i.e. either a chopping board or a worktop), the two swabs were obtained from different areas of that surface.

3.5 Technique for swabbing

Swabs were obtained over a measured surface area using a sterile template and a viscose tip swab using a technique based on ISO 18593 [(10)].

Sampling Equipment

- Viscose Tip Swab in Peel Pouch with 10ml (or 5ml) of neutralising buffer
- 10 cm x 10 cm (i.e. 100cm^2) Sterile Plastic Template in Ziploc bag

- Plastic universal container with 10ml of recovery diluent (this was only necessary if the swab had been provided with 5ml of neutralising buffer, it was not necessary if the swab had been provided with 10ml of neutralising buffer).

Swab Preparation

- The plastic template was removed from the package using only the handle.
- The template was placed on the food preparation surface to be swabbed.
- The swab was removed from the peel pouch and inserted into the tube containing the neutralising buffer.
- The tip of the swab was pressed against the wall of the tube to remove any excess liquid.

Swabbing the food preparation surface

- The area within the template was swabbed by rubbing the swab over the surface. The surface was swabbed (whilst rotating the swab between the thumb and forefinger) in two directions at right angles to each other, e.g. horizontally and vertically. The area was swabbed for approximately 20 seconds.
- The swab was inserted more than half way into the neutralising buffer (10ml) or the recovery diluent (10ml). It was broken or cut aseptically so that the swab remained in the fluid.
- The swab container /universal was labelled clearly with sample reference number, site, date and time.
- The following sample details were filled out on the sample submission form

  - The survey code: 06NS3
  - The EU food category code: 21 (Others)
  - If a repeat sample was taken, 'Repeat Sample 06NS3' was recorded on the sample submission form. A questionnaire was **not** completed for a repeat sample.

- The samples were placed into a cool box maintained between 1 °C and 4 °C and transported to the laboratory within 4 hours where possible.

3.6 Sample analysis

Samples were submitted to the HSE Official Food Microbiology Laboratories (OFMLs) for analysis. Analysis was carried out as soon as possible and not later than 24 hours after receipt of the sample in the laboratory.
Enumeration tests were carried out for:

- Aerobic Colony Count (ACC)
- *Escherichia coli*

3.7 Reporting of Microbiological Results

Results were reported to the FSAI and the relevant EHO as the number of microorganisms per cm^2 of the area swabbed.

3.8 Questionnaire data

EHOs completed a questionnaire (Appendix 1) and returned it to the FSAI within 2 months of the survey completion date. Questionnaires received after this period were excluded from the survey report.

3.9 Statistical analysis

Chi squared analysis was preformed using SPSS version 14.0.

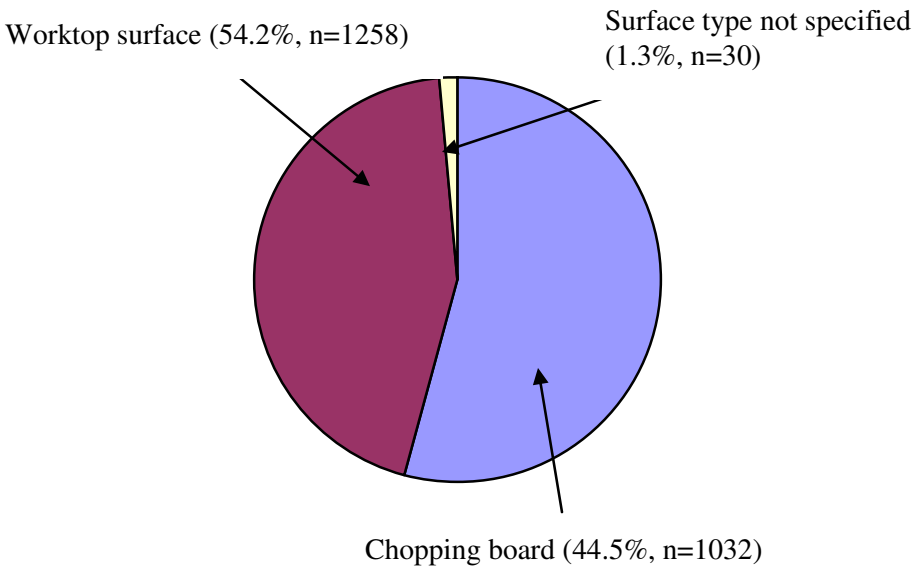
4. Results and Discussion

4.1 Overall Microbiological Results

A total of 2,320 swabs (i.e. 1,160 pairs of swab samples) were submitted from the 10 HSE areas and were analysed in the 7 OFMLs. Further details are provided in Appendices 2 & 3.

The swabs were obtained from worktop surfaces (54.2%, n=1258) and chopping boards (44.5%, n=1032) in premises preparing sandwiches at the point of sale. The surface type was not specified for a small number of swabs (Figure 1).

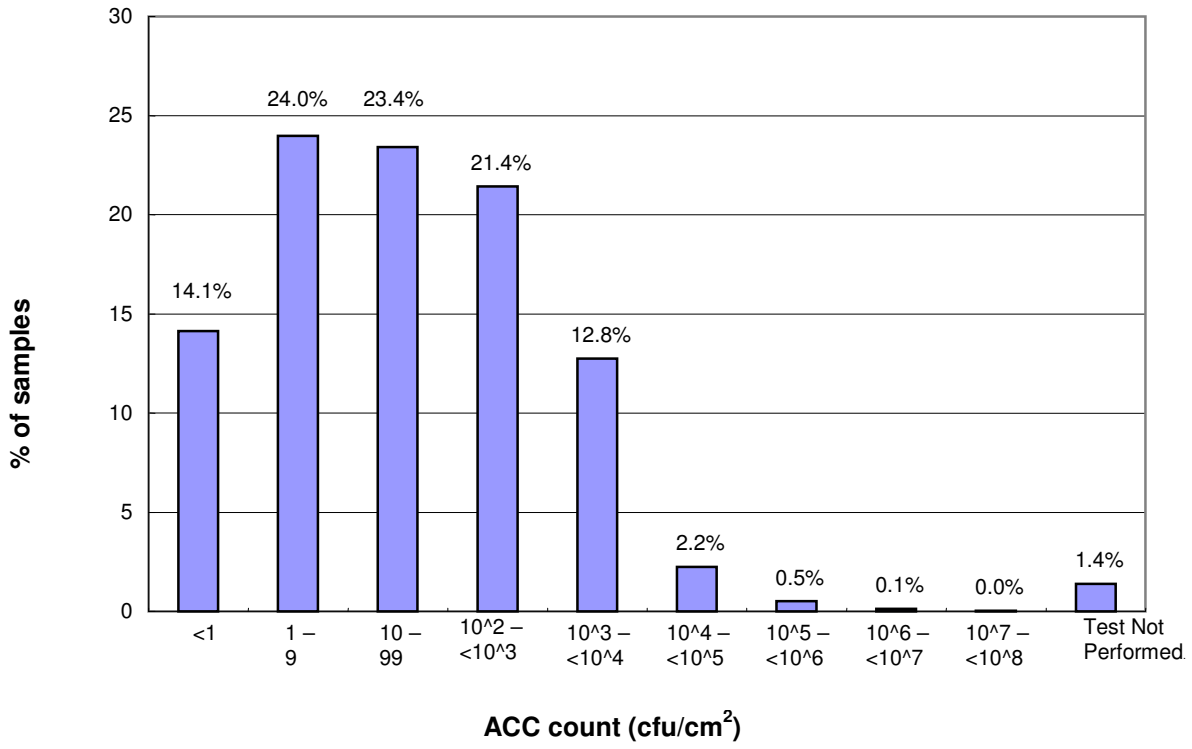
Figure 1: Food preparation surface type (n=2320 swabs)



4.1.1 ACC results

The overall ACC results are presented in Figure 2 (results by HSE are presented in Appendix 4). In this study, ACC counts $\geq 10^3$ cfu/cm^2 were recorded for 15.6% (n=364) of swabs (Other studies [8, 9] have associated ACC levels >10^3cfu/cm^2 with poor hygiene. This level is used as a benchmark throughout this report).

Figure 2: Overall ACC results (n=2320)



A breakdown of these results by surface type is provided in Table 1. The surface type had a significant effect ($p < 0.0001$) on ACC results. ACC counts $\geq 10^3$ cfu/cm^2 were recorded for 20.7% (n=259) of swabs from chopping boards compared with 9.6% (n=98) of swabs from worktop surfaces.

Table 1: Relationship between food preparation surface and ACC count

ACC count (cfu/cm^2)	Surface type			Total (% Total)
	Chopping board (% of chopping boards)	Worktop surfaces (% of worktop surfaces)	Not Specified (% not specified)	
<1	125 (9.9%)	200 (19.4%)	3 (10.0%)	328 (14.1%)
1 to 9	248 (19.7%)	299 (29.0%)	9 (30.0%)	556 (24.0%)
10 to 99	284 (22.6%)	254 (24.6%)	5 (16.7%)	543 (23.4%)
10^2 - <10^3	324 (25.8%)	167 (16.2%)	6 (20.0%)	497 (21.4%)
10^3 - <10^4	207 (16.5%)	84 (8.1%)	5 (16.7%)	296 (12.8%)
10^4 - <10^5	39 (3.1%)	11 (1.2%)	2 (6. 7%)	52 (2.2%)
10^5 - <10^6	10 (0.8%)	2 (0.2%)	0 (0.0%)	12 (0.5%)
10^6 - <10^7	2 (0.2%)	1 (0.1%)	0 (0.0%)	3 (0.1%)
10^7 - <10^8	1 (0.1%)	0 (0.0%)	0 (0.0%)	1 (0.0%)
Test not performed	18 (1.4%)	14 (1.4%)	0 (0.0%)	32 (1.4%)
Grand Total	**1258 (100%)**	**1032 (100%)**	**30 (100%)**	**2320 (100%)**

Table 2 compares the results of this study with the results of a UK study [9] which investigated cleaning standards and practices in food premises.

Table 2: Comparison with UK study [9]

Surface type	Study	Total no. of swabs	No. (%) of swabs with ACC count $\geq 10^3$ cfu/cm^2
Chopping board	**UK study [9]**	2033	498 (24.5%)
	This study	1258	259 (20.7%)
Worktop	**UK study [9]**	2009	150 (7.5%)
	This study	1032	98 (9.6%)

In relation to chopping boards, there was a significant difference ($p = 0.01$) between the ACC results of the UK study [9] and this study (ACC counts $\geq 10^3$ cfu/cm^2 were detected on 24.5% of swabs in the UK study compared with 20.7% of swabs in this study). In relation to worktops, there was no significant difference ($p = 0.053$) in the ACC results between the two studies.

The findings of this study were also compared with the findings of an Irish study commissioned by *safe*food (2001/2002) [11]. That study investigated among other things the total viable count of swabs from cutting boards and worktops in 200 restaurant kitchens throughout the island of Ireland. The average count on both chopping board and worktops was approximately 10-fold lower in this study (Table 3).

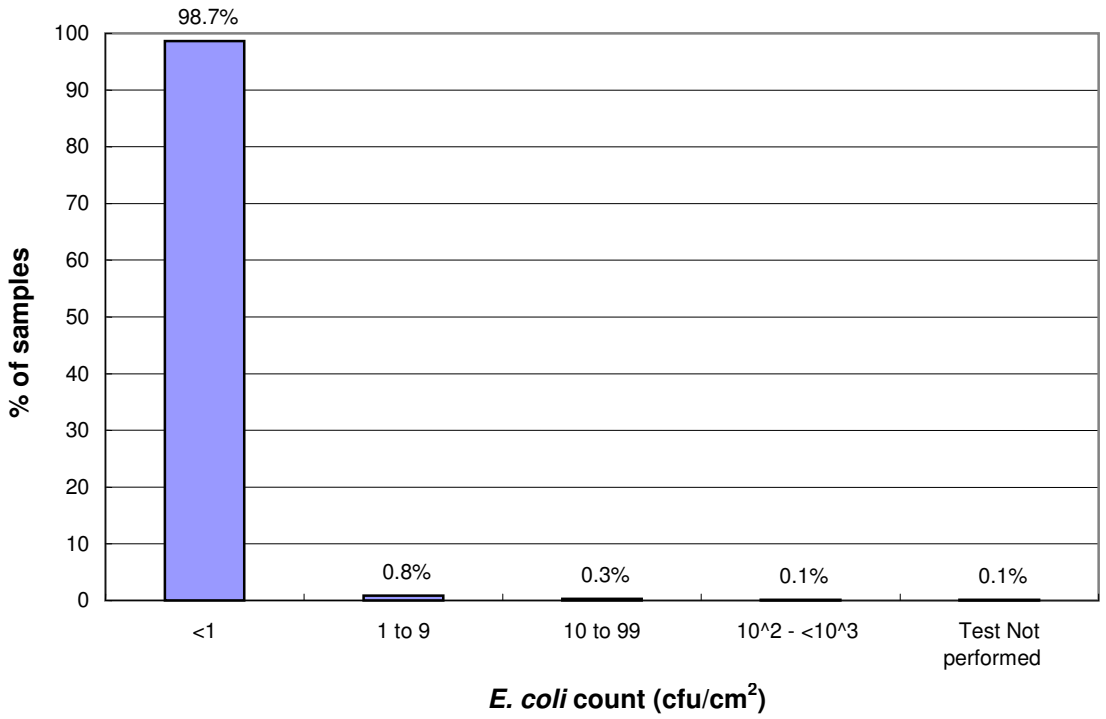
Table 3: Comparison with *safe*food study

Surface type	Average no. of bacteria (ACC) present/cm^2	
	***safe*food study (2001/2002) [11]**	**This study**
Chopping board	6.02×10^5	2.1×10^4
Worktop	9.4×10^4	3.3×10^3

4.1.2 *E. coli* results

The overall *E. coli* results are presented in Figure 3 (results by HSE are presented in Appendix 5). *E. coli* counts ≥ 1 cfu/cm^2 were recorded for 1.2% (n=28) of swabs.

Figure 3: Overall *E. coli* results



A breakdown of results by surface type is given in Table 4. The surface type had no significant effect (p = 0.998) on *E. coli* results. *E. coli* counts ≥ 1 cfu/cm^2 were recorded for 1.2% (n=15) of swabs from chopping boards and 1.2% (n=12) of swabs from worktops.

Table 4: Relationship between surface type and *E.coli* count

E. coli count (cfu/cm^2)	Surface type			Total (% of total)
	Chopping board (% of chopping boards)	Worktop (% of worktops)	Not Specified (% not specified)	
<1	1243 (98.8%)	1017 (98.5%)	29 (96.7%)	2289 (98.7%)
1 to 9	10 (0.8%)	8 (0.8%)	1 (3.3%)	19 (0.8%)
10 to 99	4 (0.3%)	3 (0.3%)	0 (0.0%)	7 (0.3%)
10^2 - <10^3	1 (0.1%)	1 (0.1%)	0 (0.0%)	2 (0.1%)
Test not performed	0 (0.0%)	3 (0.3%)	0 (0.0%)	3 (0.1%)
Grand Total	**1258 (100%)**	**1032 (100%)**	**30 (100%)**	**2320 (100%)**

Table 5 compares these results with the results of a UK study which investigated cleaning standards and practices in food premises [9].

Table 5: Comparison with UK study [9]

Surface type	Study	Total no. of swabs	No. (%) of swabs with *E. coli* count ≥ 20 cfu/cm^2
Chopping board	**UK study [9]**	2033	19 (0.9%)
	This study	1258	4 (0.3%)
Worktop	**UK study [9]**	2009	13 (0.6%)
	This study	1032	3 (0.3%)

In relation to chopping boards, there was a significant difference ($p = 0.039$) between the *E. coli* results of the UK study [9] and this study (*E. coli* counts ≥ 20 cfu/cm^2 were recorded for 0.9% of swabs in the UK study compared with 0.3% of swabs in this study). In relation to worktop surfaces, there was no significant difference ($p = 0.198$) in the *E. coli* results between studies.

4.2 Questionnaire data

4.2.1 Data on food preparation surfaces

Questionnaires were returned for 1946 swabs (response rate of 83.9%, 1946/2320), i.e. 1085 swabs from chopping boards and 848 swabs from worktops (Table 6).

Table 6: Number of questionnaires returned

Food preparation surface	Number of swabs	%
Chopping board	1085	55.8
Worktop	848	43.6
Not Stated	13	0.7
Total	**1946**	**100.00**

Data extracted from the questionnaires were correlated with ACC counts (data were not correlated with *E. coli* counts as counts < 1cfu/cm^2 were recorded for most swabs). Data relevant to chopping boards (n=1085) are presented in Table 7 and are summarised below:

A) Chopping Boards

- Most chopping boards were made of plastic (93.9%). The material of the chopping board had no significant effect (p=0.153) on the ACC count. This finding is similar to the UK study [9].
- Most chopping boards were used for ready-to-eat (RTE) foods only (87.3%). ACC counts $\geq 10^3$ cfu/cm^2 were detected on 20.5% of boards used for RTE foods only compared with 6.1% of boards used for both RTE and raw foods. This difference is significant (p = 0.04). This finding differs to the UK study [9] where significantly (p<0.00001) more boards used for both raw and RTE foods had ACC counts $\geq 10^3$ cfu/cm^2.
- The surface condition of the chopping board was assessed by the EHO on a scale of 1 (smooth) to 5 (rough). There was a significant difference (p=0.032) between the ACC counts of smooth boards and the ACC counts of all other boards. ACC counts $\geq 10^3$ cfu/cm^2 were detected on 14.2% of smooth boards compared with 21.5% of all other boards. This correlation is similar to the UK study [9].
- The surface appearance of the chopping board was assessed by the EHO on a scale of 1 (clean) to 5 (dirty). There was a significant difference (p=0.01) between the ACC counts of clean boards and the ACC counts of all other boards. ACC counts $\geq 10^3$ cfu/cm^2 were detected on 15.1% of clean boards compared with 22.2% on all other boards. This correlation is similar to the UK study [9].
- The presence of moisture on the chopping board was assessed by the EHO on a scale of 1 (dry) to 5 (wet). There was a significant difference (p=0.035) between the ACC counts of dry boards and the ACC counts of all other boards. ACC counts $\geq 10^3$ cfu/cm^2 were detected on 18.5% of dry boards compared with 23.9% of all other boards. This correlation is similar to the UK study [9].

- Over a half (56.1%) of all boards were reported to have been last cleaned in the 3 hour period before swabbing. The period since cleaning had no significant effect (p=0.15) on the ACC counts. ACC counts $\geq 10^3$ cfu/cm^2 were detected on 19% of boards cleaned in the 3 hour period before swabbing compared with 22.5% of all other boards. The UK study [9] found that boards cleaned over 24 hours before swabbing had a significantly higher (p<0.00001) ACC count than those cleaned within 24 hours.

Table 7: Details of Chopping Boards (n=1085)

Chopping Board	Number of samples (%)			
	Total number	ACC count cfu/cm^2		Test not performed
		<10^3	≥10^3	
Material of Surface:				
Plastic	**1019 (93.9%)**	795 (78.0%)	211 (20.7%)	13 (1.3%)
Glass	**28 (2.6%)**	24 (85.7%)	4 (14.3%)	0 (0.0%)
Stainless steel	**7 (0.6%)**	5 (71.4%)	2 (28.6%)	0 (0.0%)
Other	**25 (2.3%)**	24 (96.0%)	1 (4.0%)	0 (0.0%)
Not Stated	**6 (0.6%)**	4 (66.7%)	2 (33.3%)	0 (0.0%)
Used For:				
RTE food only	**947 (87.3%)**	744 (78.6%)	194 (20.5%)	9 (1.0%)
All food	**33 (3.0%)**	31 (93.9%)	2 (6.1%)	0 (0.0%)
Not Stated	**105 (9.7%)**	77 (73.3%)	24 (22.9%)	4 (3.8%)
Surface Condition:				
1 (Smooth)	**155 (14.3%)**	133 (85.8%)	22 (14.2%)	0 (0.0%)
2	**370 (34.1%)**	274 (74.1%)	93 (25.1%)	3 (0.8%)
3	**378 (34.8%)**	299 (79.1%)	71 (18.8%)	8 (2.1%)
4	**140 (12.9%)**	108 (77.1%)	31 (22.1%)	1 (0.7%)
5 (Rough)	**34 (3.1%)**	31 (91.2%)	3 (8.8%)	0 (0.0%)
Not Stated	**8 (0.7%)**	7 (87.5%)	0 (0.0%)	1 (12.5%)
Surface Appearance:				
1 (Clean)	**272 (25.1%)**	229 (84.2%)	41 (15.1%)	2 (0.7%)
2	**403 (37.1%)**	317 (78.7%)	80 (19.9%)	6 (1.5%)
3	**280 (25.8%)**	208 (74.3%)	69 (24.6%)	3 (1.1%)
4	**99 (9.1%)**	72 (72.7%)	27 (27.3%)	0 (0.0%)
5 (Dirty)	**18 (1.7%)**	15 (83.3%)	2 (11.1%)	1 (5.6%)
Not Stated	**13 (1.2%)**	11 (84.6%)	1 (7.7%)	1 (7.7%)
Presence of moisture:				
1 (Dry)	**675 (62.2%)**	542 (80.3%)	125 (18.5%)	8 (1.2%)
2	**272 (25.1%)**	206 (75.7%)	62 (22.8%)	4 (1.5%)
3	**93 (8.6%)**	66 (71.0%)	27 (29.0%)	0 (0.0%)
4	**26 (2.4%)**	21 (80.8%)	5 (19.2%)	0 (0.0%)
5 (Wet)	**6 (0.6%)**	5 (83.3%)	1 (16.7%)	0 (0.0%)
Not Stated	**13 (1.2%)**	12 (92.3%)	0 (0.0%)	1 (7.7%)

Table 7 continued overleaf……..

Table 7 continued ……..

Chopping board	Number of samples (%)			
	Total number	ACC count cfu/cm^2		Test not performed
		<10^3	≥10^3	
Period of time since last cleaning:				
<1h	**339 (31.2%)**	266 (78.5%)	69 (20.4%)	4 (1.2%)
1 - <3h	**270 (24.9%)**	223 (82.6%)	47 (17.4%)	0 (0.0%)
3 - <6h	**79 (7.2%)**	59 (74.7%)	16 (20.3%)	4 (5.1%)
6 - <9h	**29 (2.7%)**	24 (82.8%)	4 (13.8%)	1 (3.4%)
9 - <12h	**60 (5.5%)**	50 (83.3%)	9 (15.0%)	1 (1.7%)
12 - <24h	**211 (19.4%)**	151 (71.6%)	58 (27.5%)	2 (0.9%)
>24h	**44 (4.1%)**	36 (81.8%)	8 (18.2%)	0 (0.0%)
Not Stated	**53 (4.9%)**	43 (81.1%)	9 (17.0%)	1 (1.9%)
Period of time to next cleaning:				
<1h	**434 (40.0%)**	341 (78.6%)	90 (20.7%)	3 (0.7%)
1 - <3h	**307 (28.3%)**	245 (79.8%)	58 (18.9%)	4 (1.3%)
3 - <6h	**148 (13.6%)**	115 (77.7%)	31 (20.9%)	2 (1.4%)
6 - <9h	**66 (6.1%)**	44 (66.7%)	21 (31.8%)	1 (1.5%)
9 - <12h	**38 (3.5%)**	27 (71.1%)	9 (23.7%)	2 (5.3%)
12 - <24h	**30 (2.8%)**	29 (96.7%)	1 (3.3%)	0 (0.0%)
>24h	**16 (1.5%)**	15 (93.8%)	1 (6.3%)	0 (0.0%)
Not Stated	**45 (4.1%)**	36 (80.0%)	8 (17.8%)	1 (2.2%)
Other	**1 (0.1%)**	0 (0.0%)	1 (100.0%)	0 (0.0%)

B) Worktop surfaces

Data relevant to worktop surfaces (n=848) is presented in Table 8 and are summarised below.

Most worktops were made of stainless steel (71.3%) and were used for RTE foods only (83.7%). Most worktops were smooth (64.4%), clean (47.2%) and dry (74.3%). Most worktops (60.5%) had been cleaned within three hours prior to swabbing and most (67.7%) were due to be cleaned again within the next three hours. Of these, the time since cleaning was the only parameter which had a significant effect (p=0.032) on the ACC counts. ACC counts $\geq 10^3$ cfu/cm^2 were detected on 7% of boards cleaned in the 3 hour period before swabbing compared with 11.5% of all other boards. The findings of the UK study [9] that differed to this study are listed below. In the UK study:

- Significantly more worktops used for RTE foods only had an ACC count of $\geq 10^3$ cfu/cm^2 compared to worktops used for both RTE and raw foods (p<0.0001).
- Significantly more worktops that were wet had an ACC count of $\geq 10^3$ cfu/cm^2 compared with worktops that were dry (p<0.01).
- There was no significant difference between the time the surface was last cleaned and the ACC counts.

Table 8: Details of worktop surfaces (n=848)

Worktop surfaces	Number of samples (%)			
	Total number	ACC count cfu/cm^2		Test not performed
		<10^3	≥10^3	
Material of Surface:				
Plastic	**146 (17.2%)**	123 (84.2%)	20 (13.7%)	3 (2.1)
Glass	**2 (0.2%)**	2 (100%)	0 (0.0%)	0 (0.0%)
Stainless steel	**605 (71.3%)**	558 (92.2%)	42 (6.9%)	5 (0.8%)
Other	**87 (10.3)**	79 (90.8%)	7 (8.0%)	1 (1.1%)
Not Stated	**8 (0.9%)**	4 (50.0%)	3 (37.5%)	1 (12.5%)
Used For:				
RTE food only	**710 (83.7%)**	645 (90.8%)	56 (7.9%)	9 (1.3)
All food	**83 (9.8)**	76 (91.6)	7 (8.4%)	0 (0.0%)
Not Stated	**55 (6.5)**	45 (81.8%)	9 (16.4)	1 (1.8%)
Surface Condition:				
1 (Smooth)	**546 (64.4%)**	501 (91.8%)	40 (7.3%)	5 (0.9%)
2	**159 (18.8%)**	141 (88.7%)	14 (8.8%)	4 (2.5%)
3	**88 (10.4%)**	76 (86.4%)	11 (12.5%)	1 (1.1%)
4	**34 (4.0%)**	29 (85.3%)	5 (14.7%)	0 (0.0%)
5 (Rough)	**17 (2.0%)**	15 (88.2%)	2 (11.8%)	0 (0.0%)
Not Stated	**4 (0.5%)**	4 (100.0%)	0 (0.0%)	0 (0.0%)
Surface Appearance:				
1 (Clean)	**400 (47.2%)**	369 (92.3%)	27 (6.8%)	4 (1.0%)
2	**292 (34.4%)**	255 (87.3%)	31 (10.6%)	6 (2.1%)
3	**112 (13.2%)**	101 (90.2%)	11 (9.8%)	0 (0.0%)
4	**33 (3.9%)**	31 (93.9%)	2 (6.1%)	0 (0.0%)
5 (Dirty)	**6 (0.7%)**	5 (83.3%)	1 (16.7%)	0 (0.0%)
Not Stated	**5 (0.6%)**	5 (100.0%)	0 (0.0%)	0 (0.0%)
Presence of moisture:				
1 (Dry)	**630 (74.3%)**	572 (90.8%)	51 (8.1%)	7 (1.1%)
2	**165 (19.5%)**	146 (88.5%)	16 (9.7%)	3 (1.8%)
3	**32 (3.8%)**	28 (87.5%)	4 (12.5%)	0 (0.0%)
4	**13 (1.5%)**	13 (100.0%)	0 (0.00)	0 (0.0%)
5 (Wet)	**2 (0.2%)**	1 (50.0%)	1 (50.0%)	0 (0.0%)
Not Stated	**6 (0.7%)**	6 (100.0%)	0 (0.0%)	0 (0.0%)

Table 8 continued overleaf……..

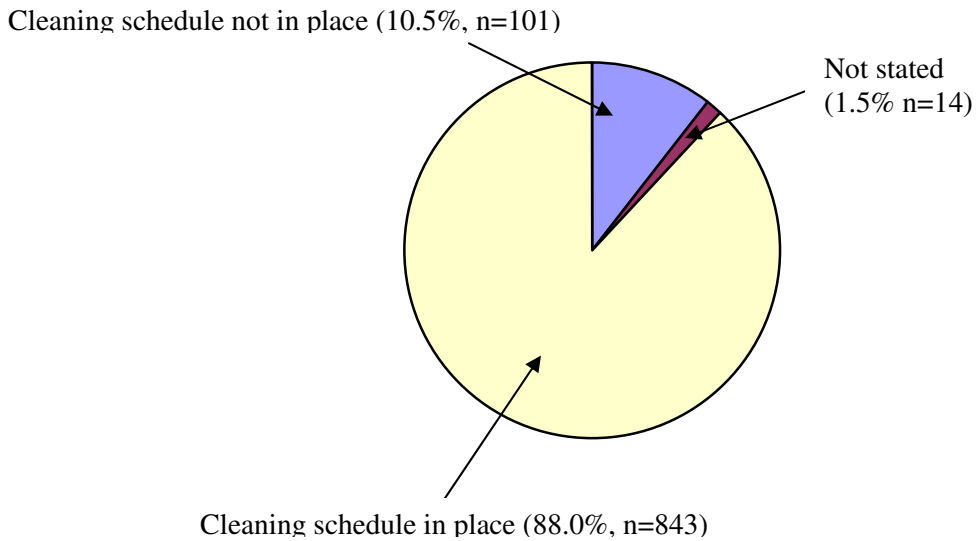
Table 8 continued ……..

Worktop surfaces	Number of samples (%)			
	Total number	ACC count cfu/cm^2		Test not performed
		<10^3	≥10^3	
Period of time since last cleaning:				
<1h	**275 (32.4%)**	251 (91.3%)	21 (7.6%)	3 (1.1%)
1 - <3h	**238 (28.1%)**	220 (92.4%)	15 (6.3%)	3 (1.3%)
3 - <6h	**66 (7.8%)**	53 (80.3%)	12 (18.2%)	1 (1.5%)
6 - <9h	**19 (2.2%)**	18 (94.7%)	1 (5.3%)	0 (0.0%)
9 - <12h	**38 (4.5%)**	35 (92.1%)	3 (7.9%)	0 (0.0%)
12 - <24h	**151 (17.8%)**	133 (88.1%)	16 (10.6%)	2 (1.3%)
>24h	**14 (1.7%)**	13 (92.9%)	1 (7.1%)	0 (0.0%)
Not Applicable	**2 (0.2%)**	2 (100.0%)	0 (0.0%)	0 (0.0%)
Not Stated	**45 (5.3%)**	41 (91.1%)	3 (6.7%)	1 (2.2%)
Period of time to next cleaning:				
<1h	**314 (37.0%)**	287 (91.4%)	24 (7.6%)	3 (1.0%)
1 - <3h	**260 (30.7%)**	238 (91.5%)	19 (7.3%)	3 (1.2)
3 - <6h	**112 (13.2%)**	97 (86.6%)	15 (13.4%)	0 (0.0%)
6 - <9h	**61 (7.2%)**	53 (86.9%)	7 (11.5%)	1 (1.6)
9 - <12h	**25 (2.9%)**	24 (96.0%)	1 (4.0%)	0 (0.0%)
12 - <24h	**25 (2.9%)**	21 (84.0%)	3 (12.0%)	1 (4.0%)
>24h	**6 (0.7%)**	6 (100.0%)	0 (0.0%)	0 (0.0%)
Not Applicable	**2 (0.2%)**	2 (100.0%)	0 (0.0%)	0 (0.0%)
Not Stated	**42 (5.0%)**	37 (88.1%)	3 (7.1%)	2 (4.8)
Other	**1 (0.1%)**	1 (100.0%)	0 (0.0%)	0 (0.0%)

4.2.2 Information on cleaning schedules and cleaning records

Information extracted from the questionnaires showed that 1946 swabs were obtained from 958 different premises. Cleaning schedules were in place in 88% (843/958) of these premises (Figure 4).

Figure 4: Information regarding cleaning schedule (n=958 premises)



The relationship between cleaning schedule and ACC results of the swabs (chopping boards and worktop surfaces) is outlined in Table 9. The presence or absence of a cleaning schedule had no significant effect (p=0.885) on the ACC results. This contrasts with the findings of the UK study [9] where significantly (p<0.00001) more swabs with ACC counts ≥ 10^3 cfu/cm^2 were obtained from premises where cleaning schedules were not in place.

Table 9: Relationship between cleaning schedule and ACC results of swabs

Cleaning schedule	Number of premises (% of premises)	Number of swabs from chopping boards and worktops (% of swabs)			
		Total number	ACC count cfu/cm^2		Test not performed
			<10^3	≥10^3	
In place	**843 (88.0%)**	**1716**	1435 (83.6%)	258 (15.0%)	23 (1.3%)
Not in place	**101 (10.5%)**	**202**	172 (85.1%)	30 (14.9%)	0 (0.0%)
Not Stated	**14 (1.5%)**	**28**	24 (85.7%)	4 (14.3%)	0 (0.0%)
TOTAL	**958 (100%)**	**1946**	**1631 (83.8%)**	**292 (15.0%)**	**23 (1.2%)**

Documentation of cleaning schedules:
Cleaning schedules were documented in 86.7% (731/843) of the premises where cleaning schedules were in place (Table 10).

Table 10: Documentation of cleaning schedules (n=843 premises)

Documentation of cleaning schedule	Total number of premises	% of premises
Documented	731	86.7
Not documented	111	13.2
Not stated	1	0.1
Total	**843**	**100.0**

The cleaning procedure was documented in two thirds (66.1%, 483/731) and the cleaning frequency was documented in over three quarters (78.2%, 572/731) of premises (Table 11). Documentation of the cleaning procedure and documentation of the cleaning frequency had no significant effect (p=0.931 and p=0.717 respectively) on the ACC results.

Table 11: Relationship between documented information and ACC results (n=731 premises)

Type of Information		Number of premises (% of premises)	Number of swabs (% of swabs)			
			Total	ACC count cfu/cm^2		Test not performed
				$<10^3$	$\geq 10^3$	
Cleaning procedure	**Documented**	483 (66.1%)	994	830 (83.5%)	151 (15.2%)	13 (1.3%)
	Not documented	233 (31.9%)	466	390 (83.7%)	70 (15.0%)	6 (1.3%)
	Not stated	15 (2.1%)	30	28 (93.3%)	2 (6.7%)	0 (0.0%)
	Total	**731 (100%)**	**1490**	**1248 (83.8%)**	**223 (15.0%)**	**19 (1.3%)**
Cleaning frequency	**Documented**	572 (78.2%)	1170	979 (83.7%)	179 (15.3%)	12 (1.0%)
	Not documented	143 (19.6%)	288	240 (83.3%)	41 (14.2%)	7 (2.4%)
	Not stated	16 (2.2%)	32	29 (90.6%)	3 (9.4%)	0 (0.0%)
	Total	**731 (100%)**	**1490**	**1248 (83.8%)**	223 (15.0%)	**19 (1.3%)**

Cleaning records were maintained in 74.4% (713/958) premises (Figure 5) and in 77.98% (556/713) of premises these records were verified by a supervisor/manager (Figure 6).

Figure 5: Maintenance of cleaning records (n=958 premises)

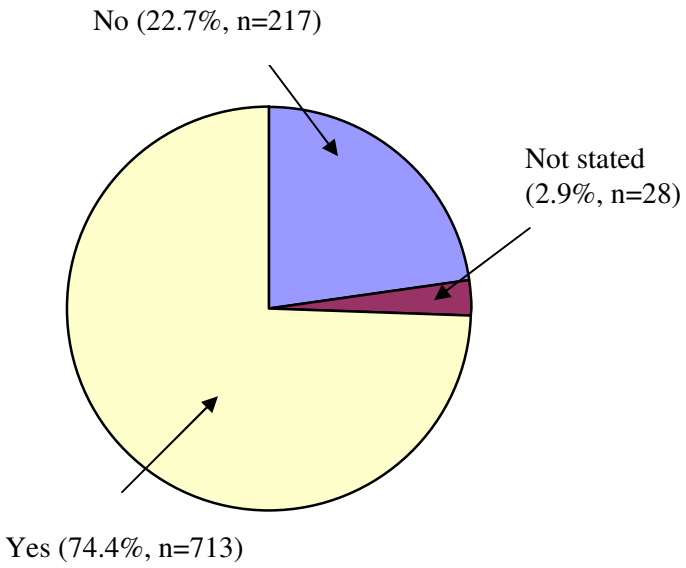
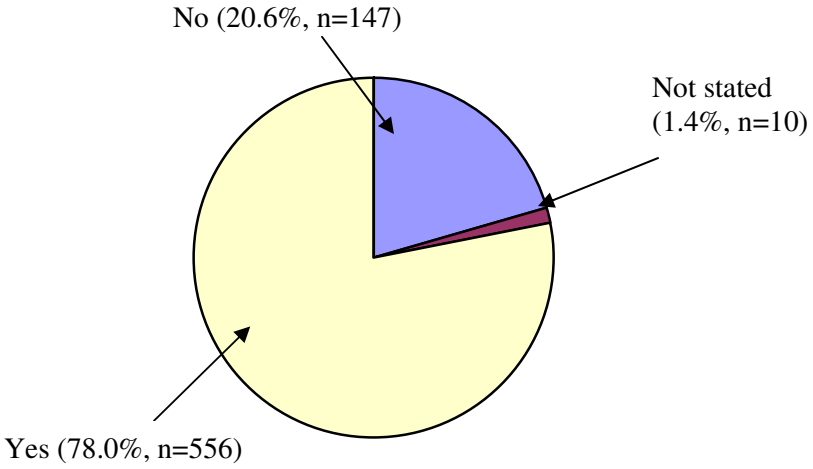


Figure 6: Verification of cleaning records by supervisor/manager (n=713)



5. Conclusions

In this study, *E.coli* counts ≥ 1 cfu/cm^2 were detected on only 1.2% (27/2320) of food preparation surfaces. ACC counts ≥ 10^3 cfu/cm^2 were detected on 15.6% (n=364/2320) of food preparation surfaces. ACC counts in excess of 10^3cfu/cm^2 on food preparation surfaces have been associated with poor hygiene practices [8, 9]. Despite this, the microbiological results of this study are comparable and in some cases better than the microbiological results of a similar UK study [9] on cleaning standards and practices in food premises undertaken in 2000.

The type of food preparation surface had a significant effect on the ACC count. ACC counts ≥ 10^3 cfu/cm^2 were detected on 20.7% (n=259) of swabs from chopping boards compared with 9.6% (n=98) of swabs from worktop surfaces. Other parameters affecting the ACC counts of chopping boards were i) specific use *(i.e. RTE food only/RTE and raw food*), ii) surface condition *(smooth/rough)*, iii) surface appearance *(clean/dirty)* and iv) presence of moisture *(wet/dry)*.

In this study, cleaning schedules were in place in 88% (843/958) of premises and were documented in 86.7% (731/843) of these premises. No correlation was found between the presence/absence of cleaning schedules and the hygiene of the food preparation surfaces; however, it should be noted that the absence of a cleaning schedule does not necessarily imply poor cleaning and hygiene practices. Despite this, the importance of cleaning schedules should not be under estimated (particularly in businesses with a high turnover of staff) and although a cleaning schedule is not an explicit legal requirement it is considered best practice [3, 4]. Irish Standard 340:2007 (Hygiene in the catering sector) [3] recommends that a detailed cleaning schedule defining the following should be in place:

- Item/are to be cleaned
- Equipment to be used and its method of operation
- Cleaning agent to be used and its concentration and contact time
- Frequency of cleaning
- Person responsible for cleaning.

The standard recommends that a suitably trained and/or qualified person should be responsible for checking that cleaning has been carried out to the required standard. Annex 1 of the standard provides sample cleaning schedules and cleaning records. Similar recommendations are made in Irish Standard 341:2007 (Hygiene in Food Retailing and Wholesaling) [4].

Few standards have been published on the acceptable level of microorganisms on food preparation surfaces. This is because many factors (including the level of microorganisms on food, the availability of nutrients, the presence of preservatives and the environmental temperature) influence the microbial surface population prior to cleaning and the design and performance of the sanitation programme will determine the levels after cleaning. As these factors differ for every establishment, a common standard is hard to set [5]. However, as a guideline ACC counts ≥ 10^3 cfu/cm^2 appear to be a suitable cut-off point between acceptable and unacceptable surface hygiene for the food preparation surfaces

examined in this survey (the applicability of this guideline to other types of food preparation surfaces cannot be assumed). Where appropriate, swabbing can be used in conjunction with other inspection activities to draw a complete picture of the hygiene of a food premises.

6. Bibliography

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Food Safety AUTHORITY OF IRELAND

7. APPENDICES
APPENDIX 1

FINAL Questionnaire 06NS3
Microbiological Status of Food Preparation Surfaces

Please note: 1) EHOs must complete this questionnaire for the 2 samples obtained from each premises, 2) all questions are mandatory & 3) all questionnaires must be returned to the FSAI by 9th February '07

1. General Information:

* **EHO Name:** _____
* **Premises Reference Name (or Number):** _____ _____
* **Type of premises:** Delicatessen □, Bagel bar □, Restaurant □, Hotel □, Supermarket □, Other (please specify) _____

2. Information Relating to Food Preparation Surface Number 1:

2.1 EHO sample reference number: _____
(i.e. EHO's own personal reference number for the sample):

2.2 Laboratory reference number: _____

2.3 Type of surface:
Worktop □ or Chopping board □

2.4 Material of surface:
Stainless steel □ , Plastic □ , Glass □ , Other (please specify): _____

2.5 Used for:
RTE food only □ or All food □

Please answer the following 3 questions by circling the appropriate number on the scale:

2.6 Surface condition: 1----2----3----4----5 (1=Smooth, 5=Rough)

2.7 Surface appearance: 1----2----3----4----5 (1=Clean, 5=Dirty)

2.8 Presence of moisture: 1----2----3----4----5 (1=Dry, 5=Wet)

2.9 Microbiological Results:
ACC count: _____
E. coli count: _____

3. Information Relating to Food Preparation Surface Number 2:

3.1 EHO sample reference number: _____
(i.e. EHO's own personal reference number for the sample):

3.2 Laboratory reference number: _____

3.3 Type of surface:
Worktop □ or Chopping board □

3.4 Material of surface:
Stainless steel □ , Plastic □ , Glass □ , Other (please specify): _____

3.5 Use:
RTE food only □ or All food □

Please answer the following 3 questions by circling the appropriate number on the scale:

3.6 Surface condition: 1----2----3----4----5 (1=Smooth, 5=Rough)

3.7 Surface appearance: 1----2----3----4----5 (1=Clean, 5=Dirty)

3.8 Presence of moisture: 1----2----3----4----5 (1=Dry, 5=Wet)

3.9 Microbiological Results:
ACC count: _____
E. coli count: _____

4. Cleaning Practices and Cleaning Schedules for the Food Preparation Area

Cleaning schedule:

1) **Is there a cleaning schedule in place?** Yes □ or No □
2) **If a cleaning schedule is in place, is it documented?** Yes □ or No □
3) **If the cleaning schedule is documented does it contain the following information?**
   How the food preparation areas should be cleaned? Yes □, No □, N/A □
   How often the food preparation areas should be cleaned? Yes □, No □, N/A □

Cleaning Records:

4) **Are cleaning records maintained by the food business?** Yes □ or No □
5) **Are cleaning records verified by the manager/supervisor?** Yes □ or No □

Information specific to food preparation surface number 1 & 2:

6) **Period of time since last cleaning***
   Surface no. 1: <1h □, 1-<3h □, 3-<6h □, 6-<9h □, 9-<12h □, 12-<24h □, >24h □
   Surface no. 2: <1h □, 1-<3h □, 3-<6h □, 6-<9h □, 9-<12h □, 12-<24h □, >24h □

7) **Period of time to next cleaning***
   Surface no. 1: <1h □, 1-<3h □, 3-<6h □, 6-<9h □, 9-<12h □, 12-<24h □, >24h □
   Surface no. 2: <1h □, 1-<3h □, 3-<6h □, 6-<9h □, 9-<12h □, 12-<24h □, >24h □

* *This refers to a thorough cleaning rather than a wipe-down of the surface*
N/A: Not Applicable

APPENDIX 2

Sample numbers per Health Service Executive (HSE) Region & Area

HSE Region	HSE Area	Number of samples analysed	No. of samples considered for this report
HSEDMLR	East Coast Area	218	218
	Midlands Area	220	220
	South Western Area	268	266
HSEDNER	North Eastern Area	170	170
	Northern Area	142	134
HSESR	South Eastern Area	727	686
	Southern Area	213	192
HSEWR	Mid-Western Area	194	186
	North Western Area	130	126
	Western Area	127	122
Total		**2409 ***	**2320**

***** 89 samples were not considered for this report because they were not taken according to the survey protocol (i.e. they were taken as a single rather than a paired swab in the sampling premises).

APPENDIX 3

Sample numbers per Official Food Microbiology Laboratory (OFML)

OFML	No. of samples analysed	No. of samples considered for this report
Cherry Orchard	440	432
Cork	213	192
Galway	127	122
Limerick	194	186
Sligo	130	126
SPD	578	576
Waterford	727	686
Total	**2409**	**2320**

***** 89 samples were not considered for this report because they were not taken according to the survey protocol (i.e. they were taken as a single rather than a paired swab in the sampling premises).

APPENDIX 4
Aerobic Colony Count (ACC) results by HSE Area

Health Board Area	Number of samples										
	ACC Count cfu/cm^2									Test Not Performed	Total number of samples
	<1	1-9	10 - <10^2	10^2 – <10^3	10^3 - <10^4	10^4 - <10^5	10^5 - <10^6	10^6 - <10^7	10^7 - <10^8		
East Coast Area	34	40	51	49	27	5	1	0	0	11	**218**
Midlands Area	22	35	52	66	27	5	2	0	0	11	**220**
Mid-Western Area	35	37	61	33	16	0	0	2	1	1	**186**
North Eastern Area	15	30	26	46	51	2	0	0	0	0	**170**
North Western Area	12	39	42	20	8	5	0	0	0	0	**126**
Northern Area	14	22	28	43	17	8	1	0	0	1	**134**
South Eastern Area	166	216	133	91	60	17	3	0	0	0	**686**
South Western Area	16	60	51	75	52	4	0	0	0	8	**266**
Southern Area	10	60	61	37	22	1	1	0	0	0	**192**
Western Area	4	17	38	37	16	5	4	1	0	0	**122**
Total number of samples	**328**	**556**	**543**	**497**	**296**	**52**	**12**	**3**	**1**	**32**	**2320**
%	**14.14**	**23.97**	**23.41**	**21.42**	**12.76**	**2.24**	**0.52**	**0.13**	**0.04**	**1.38**	**100.00**

APPENDIX 5
E. coli results by HSE Area

Health Board Area	Number of samples					
	E. coli count cfu/cm^2				Test Not Performed	Total number of samples
	< 1	1-<10	10-<10^2	10^2 - <10^3		
East Coast Area	213	1	2	0	2	**218**
Midlands Area	217	2	1	0	0	**220**
Mid-Western Area	180	3	1	1	1	**186**
North Eastern Area	168	2	0	0	0	**170**
North Western Area	121	4	0	1	0	**126**
Northern Area	134	0	0	0	0	**134**
South Eastern Area	682	1	3	0	0	**686**
South Western Area	262	4	0	0	0	**266**
Southern Area	190	2*	0	0	0	**192**
Western Area	122	0	0	0	0	**122**
Total number of samples	**2289**	**19**	**7**	**2**	**3**	**2320**
%	**98.66**	**0.82**	**0.30**	**0.09**	**0.13**	**100.00**

* These 2 samples were recorded as <10 cfu/cm^2