



**2<sup>nd</sup> National Microbiological Survey 2008 (08NS2):**

**Microbiological quality of whipped and scoop ice-cream**

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## Executive Summary

Soft ice-cream (whipped and scoop ice-cream) was sampled by Environmental Health Officers (EHOs) from establishments in the retail and service sectors between May and August 2008. Samples were analysed for the hygiene indicators Aerobic Colony Count (ACC) and Enterobacteriaceae in the Official Food Microbiology Laboratories (OFMLs) of the Health Service Executive (HSE). The results of 859 samples were considered for this report. The following were the main findings:

- The type of ice-cream had a weak statistically significant effect on the microbiological results. Over one third (36%, 228/643) of whipped ice-cream was unsatisfactory for one or more microbiological parameter compared to one fifth (22%, 19/86) of scoop ice-cream samples.
- There was a strong statistically significant improvement in the ACC results of whipped ice-cream sampled in this survey compared with the ACC results of whipped ice-cream sampled in a national survey conducted in 2001. However, there was no significant difference in the Enterobacteriaceae results. The improvement in ACC may be influenced by the fact that more food businesses used self-pasteurising machines in 2008 (84%) than in 2001 (73%).

This survey included a questionnaire which was completed by the EHO. A total of 582 questionnaires were returned within the specified time period, i.e. there was a 68% (582/859) response rate.

For scoop ice-cream, 85% of samples were maintained at the recommended temperature of  $\leq -12^{\circ}\text{C}$  during service. Regarding the serving utensils, scoop ice cream samples were of a better microbiological quality (ACC and Enterobacteriaceae) when the serving utensils were cleaned both before and during serving. The technique used to store the serving utensils also influenced the microbiological results but definitive conclusions on best

practice could not be drawn due to the small number of samples taken where there was a practice other than storage of utensils in water.

For whipped ice cream, the type of machine had a strong statistically significant effect on both the ACC and the Enterobacteriaceae results. Better results were obtained for whipped ice-cream obtained from self pasteurising machines than from non-pasteurising machines. Furthermore, the temperature display on the machine had a statistically significant effect on both the ACC and the Enterobacteriaceae results. Better results were obtained when the temperature display was  $\leq 5^{\circ}\text{C}$  compared to  $>5^{\circ}\text{C}$ . The majority of samples (63%) were obtained from machines with a documented cleaning schedule. The cleaning procedure and the cleaning frequency were stated in 78% and 86% of the documented cleaning schedules respectively. The survey revealed good compliance with the recommendations regarding cleaning frequency of ice-cream machines (96% of samples were obtained from machines which were cleaned within the recommended timeframe).

## **Acknowledgements**

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

## 1.0 Introduction

Whipped and scoop ice-cream are collectively termed 'soft ice cream'<sup>1</sup>. Soft ice-cream is a dairy product produced by freezing a heat treated mixture of milk, cream, milk solids, sugars, stabilisers, emulsifiers and flavourings.

Previous studies have indicated that the microbiological quality of soft ice-cream has been unsatisfactory (FSAI 2001; Little and De Louvois 1998 and 1999). A survey on the microbiological quality of whipped ice-cream, carried out by the Food Safety Authority of Ireland (FSAI) in 2001 (FSAI 2001), revealed a poor overall level of hygiene, highlighting the need for improvement. In that survey's report, the FSAI made a number of recommendations to retailers in order to improve hygiene standards (Appendix 1). The FSAI also published an information leaflet to help retailers involved in the service and sale of soft ice-cream comply with their legal obligation to provide safe food (FSAI 2008).

This survey is a follow-up on the 2001 survey.

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<sup>1</sup> The survey does not cover pre-packed hard ice-cream (i.e. ice-cream sold in cartons, tubs or on a stick)

## **2.0 Specific Objectives**

1. Assess the microbiological quality of whipped and scoop ice-cream on retail sale in Ireland
2. Determine whether the microbiological quality of whipped ice-cream has improved since the 2001 National Microbiological Survey.

## **3.0 Method**

### **3.1 Sample description**

Whipped ice-cream from ice-cream machines and scoop ice-cream were included in this survey. Excluded from the survey were all pre-packed ice-cream, dry ingredients (such as wafers and toppings), ice-cream cones from self-dispensing machines (e.g. Cornetto soft serve ice-cream) and any ice-cream manufactured on the sample premises.

### **3.2 Sample collection**

Environmental Health Officers (EHOs) of the Health Service Executive (HSE) were requested to collect ice-cream samples ( $\geq 100$  g) from retail establishments. It was requested that only one sample of whipped and/or scoop ice-cream was collected from each outlet, that scoop ice-cream samples were collected using the utensils used in that establishment for serving the customer, and that samples were transported to the laboratory under cool conditions (for example, in a cool box).

### **3.3 Sample period**

EHOs were requested to collect samples during the months of May, June, July and August 2008.

### **3.4 Sample analysis**

Analysis was undertaken by the seven Official Food Microbiology Laboratories (OFMLs) of the HSE. Two microbiological tests were used to determine the hygienic quality of the ice-cream sampled: aerobic colony count (ACC) at 30°C for 48 hours, and Enterobacteriaceae.

The ACC (also known as the aerobic plate count, standard plate count, mesophilic count or total plate count) quantifies the total number of aerobic bacteria present in a food. Enterobacteriaceae numbers are a good estimate of the effectiveness of cleaning and pasteurisation processes as they are readily inactivated by sanitisers and are heat sensitive, so will not survive



pasteurisation<sup>2</sup>. Neither count can directly indicate the safety of a food (because they are not designed to differentiate bacterial species within the general group and hence detect the presence of pathogens) but their numbers do act as indicators of hygiene and the microbiological quality of the food.

### 3.5 Classification of results

Results were classified using the guidelines specified in the FSAI's Interim Guidance Note (FSAI 2007) (Table 1).

**Table 1:** Classification of soft serve ice-cream (FSAI 2007)

Organism	Microbiological quality (cfu/g)		
	Satisfactory	Acceptable	Unsatisfactory
<b>Aerobic colony count (ACC)</b>	<10 <sup>4</sup>	10 <sup>4</sup> - <10 <sup>5</sup>	≥ 10 <sup>5</sup>
<b>Enterobacteriaceae*</b>	<100	100 - <10 <sup>4</sup>	≥ 10 <sup>4</sup>

Commission Regulation (EC) No 2073/2005 on Microbiological Criteria for Foodstuffs (as amended by Commission Regulation (EC) No 1441/2007) specifies a process hygiene criterion for Enterobacteriaceae in ice-cream and frozen dairy desserts; but as the criterion applies at the end of the manufacturing process, it is not applicable to this survey.

### 3.6 Reporting of results

The OFMLs forwarded the laboratory results to the FSAI and to EHOs using the normal reporting channels. OFMLs were requested to submit results to the FSAI by 26<sup>th</sup> September 2008. Results received after this date were not included in this report. Furthermore, laboratory results of follow-up samples were not included because this type of sampling is not random and would bias the original data set.

### 3.7 Survey questionnaire

For each sample, EHOs were requested, at the time of sampling, to complete Sections 1-5 of the questionnaire (Appendix 2). Upon receipt of the laboratory reports, EHOs were requested to complete Sections 6 and 7 of the questionnaire, and to return the questionnaire to the FSAI by 10<sup>th</sup> October

<sup>2</sup> Traditionally the coliform group has been used for this purpose. The Enterobacteriaceae and the coliform group overlap substantially; however, the Enterobacteriaceae family include a broader range of microorganisms and their numbers therefore provide more detailed information

2008. Questionnaires received later than this date were not included in this report.

### **3.8 Follow-up action**

As ACC and Enterobacteriaceae are indicators of hygiene, EHOs were requested to undertake an inspection of the premises when unsatisfactory results were identified.

### **3.9 Statistical analysis**

Chi-square ( $\chi^2$ ) and Fisher's Exact Test analysis was performed using SPSS version 14.0 (alpha = 0.05 significance level).

## 4.0 Results

### 4.1 Sample collection

EHOs collected 866 samples for this survey; however, seven samples were excluded because they were collected outside the specified time-frame (n=6), or because the sample type was outside the scope of the survey (n=1). Therefore, 859 samples were considered for this report. The number of samples submitted per HSE region and the number of samples analysed in each OFML of the HSE are presented in Appendices 3 and 4 respectively.

Information regarding the type of ice-cream was provided (either on the laboratory report form or on the questionnaire) for 733 samples: 88% (n=647) whipped ice-cream and 12% (n=86) scoop ice-cream. This information was not provided to FSAI for 126 samples.

### 4.2 Microbiology results

#### 4.2.1 ACC and Enterobacteriaceae results

Ice-cream samples were categorised as unsatisfactory when the ACC count was  $\geq 10^5$  cfu/g or the Enterobacteriaceae count was  $\geq 10^4$  cfu/g (Table 1).

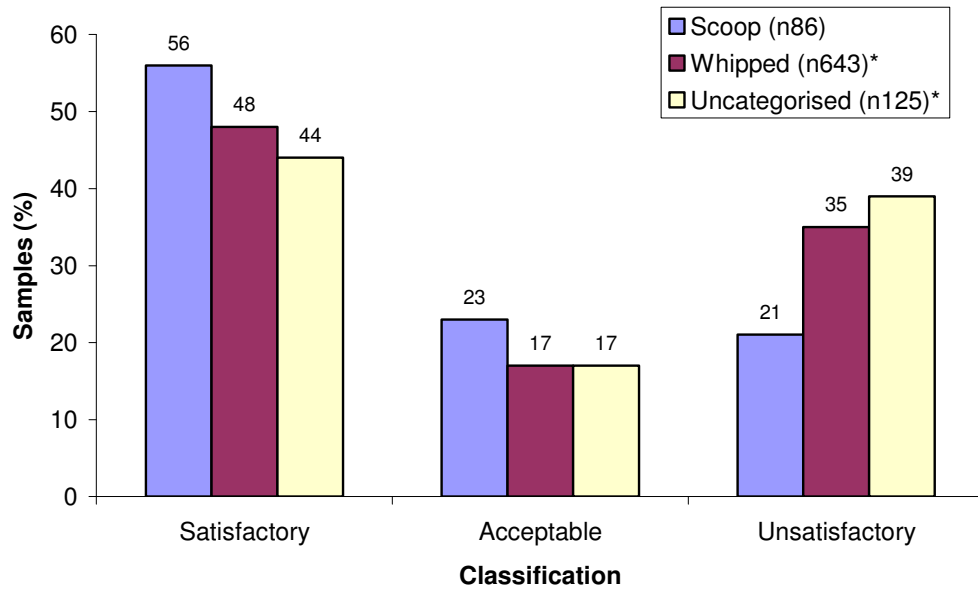
In relation to ACC, 21% (18/86) of scoop ice-cream, 35% (223/643<sup>3</sup>) of whipped ice-cream and 39% (49/125<sup>4</sup>) of uncategorised samples were classified as unsatisfactory (Figure 1). In relation to Enterobacteriaceae, 5% (4/86) of scoop ice-cream, 8% (53/647) of whipped ice-cream and 8% (10/126) of uncategorised ice-cream samples were classified as unsatisfactory (Figure 2). The range of ACC and Enterobacteriaceae counts for unsatisfactory samples are provided in Table 2. The results are presented by sampling region (HSE region) in Appendix 5.

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<sup>3</sup> ACC test result is not available for four whipped ice-cream samples due to an instrument fault at the laboratory

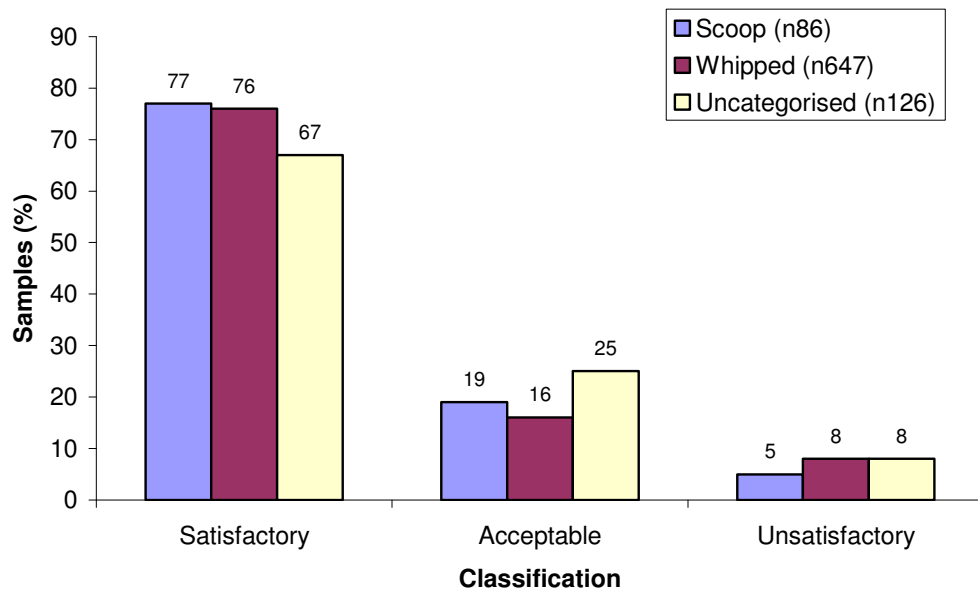
<sup>4</sup> ACC test result is not available for one uncategorized sample due to an instrument fault at the laboratory

**Figure 1: ACC results for ice-cream samples**



\* ACC test result is not available for four whipped ice-cream samples and one uncategorised ice-cream sample due to an instrument fault at the laboratory

**Figure 2: Enterobacteriaceae results for ice-cream samples**



**Table 2:** Range of counts for unsatisfactory ice-cream samples

Test	Type of ice-cream	Number of unsatisfactory samples (total no. of samples)	Range of counts (cfu/g)
ACC	Scoop	18 (86)	$1.3 \times 10^5$ to $3.5 \times 10^7$
	Whipped	223 (643)	$1 \times 10^5$ to $>1 \times 10^8$
	Uncategorised	49 (125)	$1.18 \times 10^5$ to $5.6 \times 10^8$
Enterobacteriaceae	Scoop	4 (86)	$1 \times 10^4$ to $5.8 \times 10^4$
	Whipped	53 (647)	$1 \times 10^4$ to $1.5 \times 10^7$
	Uncategorised	10 (126)	$1 \times 10^4$ to $3.8 \times 10^5$

#### 4.2.2 Overall microbiological classifications

In total, 854 samples were analysed for both ACC and Enterobacteriaceae (whipped ice-cream n=643, scoop ice-cream n=86 and uncategorised ice-cream samples n=125). The overall microbiological classifications of these 854 samples are presented in Table 3.

**Table 3:** Overall microbiological classification

Type of ice-cream	Overall microbiological classification		
	% of samples (number of samples)		
	Satisfactory*	Acceptable <sup>⊗</sup>	Unsatisfactory <sup>⊘</sup>
Scoop	51% (44/86)	27% (23/86)	22% (19/86)
Whipped	47% (300/643)	18% (115/643)	36% (228/643)
Uncategorised	42% (53/125)	18% (22/125)	40% (50/125)
Total	46% (397/854)	19% (160/854)	35% (297/854)

\* The overall classification was deemed to be satisfactory if the sample was satisfactory for both parameters (ACC and Enterobacteriaceae)

⊗ The overall classification was deemed to be acceptable if the sample was i) acceptable for both parameters or ii) acceptable for either ACC or Enterobacteriaceae and satisfactory for the other parameter

⊘ The overall classification was deemed to be unsatisfactory if the sample was unsatisfactory for ACC and/or Enterobacteriaceae

Although most samples were categorised as satisfactory or acceptable, 35% (297/854) were unsatisfactory for ACC and/or Enterobacteriaceae. The type of ice-cream had a weak statistically significant effect ( $\chi^2$  test,  $p=0.024$ ) on the overall microbiological classification: 22% (19/86) of scoop ice cream samples

were unsatisfactory for one or both parameters compared to 36% (228/643) of whipped ice-cream samples.

#### 4.2.3 Effect of sampling month on overall microbiological classification

Of the 854 samples analysed for both ACC and Enterobacteriaceae, 20% (n=174) were obtained in May, 26% (n=221) in June, 34% (n=293) in July and 19% (n=166) in August. For both whipped and scoop ice-cream, the overall microbiological quality decreased as the months progressed. This difference in microbiological results between sampling month was weakly statistically significant for whipped ice-cream ( $\chi^2$  test, p=0.032) but not scoop ice-cream<sup>⊗</sup>

**Table 4:** Unsatisfactory ice-cream samples, by month collected

Month	% Unsatisfactory samples*			
	(number of unsatisfactory samples/total number of samples)			
	Scoop ice-cream	Whipped ice-cream	Uncategorised Ice-cream	Total
May	7% (1/14)	26% (38/144)	31% (5/16)	25% (44/174)
June	26% (5/19)	35% (63/181)	33% (7/21)	34% (75/221)
July	23% (7/31)	38% (79/207)	42% (23/55)	37% (109/293)
August	27% (6/22)	43% (48/111)	45% (15/33)	42% (69/166)
<b>Total</b>	22% (19/86)	35% (228/643)	40% (50/125)	35% (297/854)

\*The overall classification was deemed to be unsatisfactory if the sample was unsatisfactory for ACC and/or Enterobacteriaceae

#### 4.2.4 Effect of establishment type on overall microbiological classification

Of the 854 samples analysed for both ACC and Enterobacteriaceae, the majority (80%; 681/854) were collected from retail establishments. A further 19% (165/854) were collected from the food service sector. The type of establishment had a statistically significant effect (Fishers Exact Test, p=0.003) on the microbiological results of whipped ice-cream but not scoop ice-cream<sup>♦</sup>. For whipped ice-cream, 38% (206/548) of samples from retail

<sup>⊗</sup> Applying the Fishers Exact Test, there was no significant difference (at alpha=0.05) between the microbiological results obtained in May and August

<sup>♦</sup> Applying the Fishers Exact Test, there was no significant difference at alpha=0.05

establishments were unsatisfactory for ACC and/or Enterobacteriaceae compared to 21% (19/89) of samples from the service sector.

**Table 5:** Effect of premises type on overall microbiological classification

Ice-cream type	% Unsatisfactory samples* (number of unsatisfactory samples/total number of samples)			
	Retail sector	Service sector	Uncategorised food business	Total
Scoop	26% (11/43)	20% (8/41)	0% (0/2)	22% (19/86)
Whipped	38% (206/548)	21% (19/89)	50% (3/6)	35% (228/643)
Uncategorised	48% (43/90)	20% (7/35)	0% (0/0)	40% (50/125)
<b>Total</b>	38% (260/681)	21% (34/165)	38% (3/8)	35% (297/854)

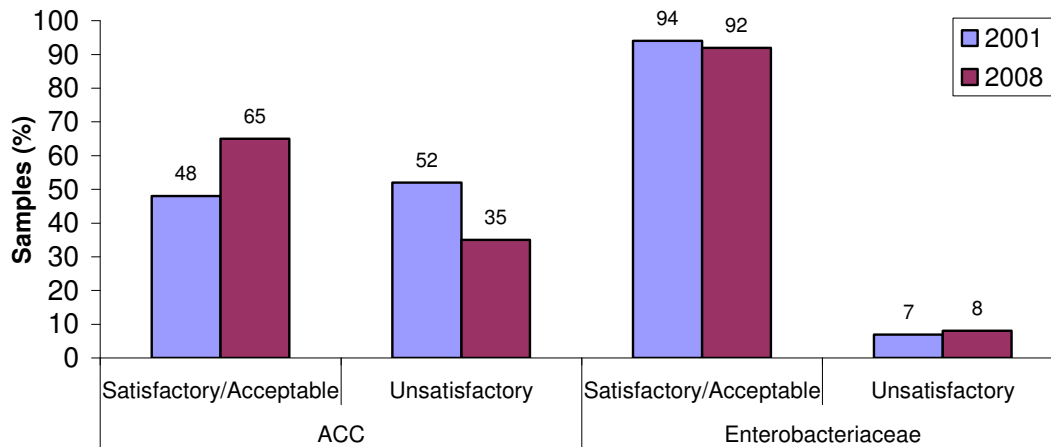
\*The overall classification was deemed to be unsatisfactory if the sample was unsatisfactory for ACC and/or Enterobacteriaceae

### 4.3 Whipped ice-cream: 2001 and 2008

There was a strong statistically significant improvement in the ACC results of whipped ice cream sampled in 2008 compared to samples taken in 2001 (Fishers exact test,  $p=2.4 \times 10^{-9}$ ). In 2001, only 48% (261/543) of samples were satisfactory or acceptable for ACC compared to 65% (420/643) in 2008. However, there was no significant difference<sup>♦</sup> in the Enterobacteriaceae results. In 2001, 94% (509/545), of samples were satisfactory or acceptable for Enterobacteriaceae compared to 92% (594/647) in 2008 (Figure 3). Scoop ice-cream was not sampled in 2001 so a comparison between years can not be made.

<sup>♦</sup> Applying the Fishers Exact Test, there was no significant difference at  $\alpha=0.05$

**Figure 3:** Comparison of the microbiological quality of whipped ice-cream samples in 2001 and 2008



#### 4.4 Questionnaire returns

This survey included a questionnaire (Appendix 2) which was completed by the EHO. A total of 582 questionnaires were returned within the specified time period, i.e. there was a 68% (582/859) response rate. These questionnaires were matched with the corresponding laboratory reports.

Information regarding the type of ice-cream was provided on 567 of the 582 questionnaires. The microbiological results of these scoop (n=62) and whipped ice cream (n=505) samples are similar<sup>♦</sup> to the overall microbiological results from all the scoop and whipped ice cream samples presented in Figures 1 and 2. Therefore in terms of microbiology, the subset of samples for which questionnaires were returned is representative of the total sample population.

The remainder of this report discusses the microbiological quality of these 567 samples (scoop ice-cream n=62 and whipped ice-cream n=505).

<sup>♦</sup> Applying the  $\chi^2$  test, there was no significant difference at  $\alpha=0.05$



#### 4.5 Unsatisfactory scoop ice-cream samples with questionnaire returned (n=62)

Of the 62 scoop ice-cream samples, for which a questionnaire was returned, 21% (n=13) were unsatisfactory for ACC, with counts ranging from  $1.3 \times 10^5$  to  $3.2 \times 10^7$  cfu/g. The unsatisfactory samples were obtained in June (n=5), July (n=3) and August (n=5). Only 3.2% (n=2) of scoop ice-cream samples were unsatisfactory for Enterobacteriaceae (counts of  $1.0 \times 10^4$  and  $1.5 \times 10^4$  cfu/g), these samples were also unsatisfactory for ACC. Both samples were obtained in August.

Information was collated on the questionnaire about the practices used to clean and store the serving utensils, and on the temperature reading of the ice-cream display unit. This information is discussed in Sections 4.5.1 - 4.5.3, and the practices for the unsatisfactory samples are summarised in Table 6.

**Table 6:** Summary of unsatisfactory scoop ice-cream samples, returned with questionnaire (n=62)

Parameter		n	Samples unsatisfactory for:	
			ACC (n=13)	Enterobacteriaceae (n=2)
			% (number)	% (number)
Utensil cleaning*	Before serving	28	29% (8)	4% (1)
	Throughout serving	23	17% (4)	4% (1)
	Before and throughout serving	9	11% (1)	0% (0)
Utensil storage <sup>⊗</sup>	In water	39	26% (10)	3% (1)
	In container	8	13% (1)	13% (1)
	In sanitiser	4	25% (1)	0% (0)
	Other	10	10% (1)	0% (0)

\* Response not provided for two samples

⊗ Response not provided for one sample

#### 4.5.1 *When are the utensils cleaned?\**

Responses: before serving (28), throughout serving (23), both (9), not stated (2); total (62).

A response was recorded for 60 samples. Of these samples, 47% were served with utensils cleaned before serving; while, 38% were served with utensils cleaned throughout serving and 15% were served with utensils cleaned both before and throughout serving. The best microbiological results were obtained for the latter (11% of samples were unsatisfactory for ACC and no sample was unsatisfactory for Enterobacteriaceae).

#### 4.5.2 *Where are utensils stored between servings?\**

Responses: in water (39), in container (8), in sanitiser (4), other (10), not stated (1); total (62).

A response was recorded for 61 samples. The majority of samples (64%) were served with utensils which were stored 'in water' between servings. Other responses included storage 'in containers' (13%), 'in sanitiser' (7%) or 'elsewhere' (16%). Regarding ACC, 26% of samples were unsatisfactory when the serving utensil was stored 'in water' compared to 25% and 13% of samples when the utensil was stored 'in sanitiser' or 'in container', respectively. The results differed for Enterobacteriaceae where 13% of samples were unsatisfactory when the serving utensil was stored 'in container', compared to 3% when the utensil was stored 'in water'. No sample was unsatisfactory for Enterobacteriaceae when the utensils were stored 'in sanitiser'. However, it is difficult to statistically validate conclusions on best practice from this result due to the small number of instances where utensils were stored in sanitizer or in dry containers.

#### 4.5.3 *Temperature display reading \**

Responses: temperature display  $\leq -12^{\circ}\text{C}$  (35),  $> -12^{\circ}\text{C}$  (6), not stated (21); total (62).

Guidelines indicate that deep freezers used to serve ice-cream should maintain the ice-cream at  $-12^{\circ}\text{C}$ , subject to the ice-cream being stored for not more than one week (FSAI 2008).

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\* Due to the small sample numbers in some categories, it was not possible to statistically compare results.

Temperature display readings were reported for 41 samples. Of these, 85% (n=35) were reported as  $\leq -12^{\circ}\text{C}$ . The remaining 15% (n=6) were reported as  $-11^{\circ}\text{C}$  (n=2),  $-10^{\circ}\text{C}$  (n=1),  $-8^{\circ}\text{C}$  (n=1),  $-4^{\circ}\text{C}$  (n=1) and  $2^{\circ}\text{C}$  (n=1).

#### **4.6 Unsatisfactory whipped ice-cream samples with questionnaire returned (n=505)**

Of the 505 whipped ice-cream samples for which a questionnaire was returned, 34% (172/503<sup>5</sup>) were unsatisfactory for ACC. ACC counts  $>10^8$  cfu/g were recorded for two of these samples. The ACC count of the remaining unsatisfactory samples, ranged from  $1 \times 10^5$  to  $8.3 \times 10^7$  cfu/g. Regarding Enterobacteriaceae, 10% (49/505) of whipped ice-cream samples were unsatisfactory with counts ranging from  $1.1 \times 10^4$  to  $1.5 \times 10^7$  cfu/g.

During sample collection, further information on the whipped ice-cream samples was collated via the survey questionnaire (Appendix 2). This included information on the type of dispensing machine and the cleaning practices for the machine. This information is discussed in Sections 4.6.1 - 4.6.5, and the results are summarised in Table 7.

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<sup>5</sup> ACC result is not available for two whipped ice-cream samples because of an instrument fault at the laboratory

1 **Table 7: Summary of unsatisfactory whipped ice-cream samples**

Parameter		Samples unsatisfactory for:			
		ACC		Enterobacteriaceae	
		%	Number unsatisfactory/ total number of samples	%	Number unsatisfactory/ total number of samples
Type of machine	Self-pasteurising	26	91/349*	7	24/351
	Non-pasteurising	60	41/68	24	16/68
Temperature display reading on machine	≤ 5°C	30	87/295	7	21/295
	>5°C	55	17/31	23	7/31
Does the food business have a cleaning schedule?	Yes	31	111/362*	10	36/364
	No	44	56/128	9	12/128
Is the cleaning schedule documented?	Yes	27	61/226*	9	21/228
	No	37	49/131	11	15/131
Does the cleaning schedule describe how to clean the machine?	Yes	27	46/172*	8	14/174
	No	27	13/48	10	5/48
Does the cleaning schedule describe how often the machine should be cleaned?	Yes	27	52/190*	10	19/192
	No	26	8/31	3	1/31
Are cleaning records maintained by the food business?	Yes	30	64/214**	11	24/215
	No	43	91/210**	11	23/211
Are cleaning records verified by a manager/supervisor?	Yes	28	46/163**	10	17/164
	No	35	12/34	15	5/34
When was the self-pasteurising machine last cleaned?	≤ 21 days ago	26	75/293*	6	19/295
	>21 days ago	20	2/10	10	1/10
When was the non-pasteurising machine last cleaned?	≤ 6 days ago	60	37/62	24	15/62
	>6 days ago	67	4/6	17	1/6

2

3 \* ACC results for two samples are unavailable because of an instrument fault at the laboratory

4 \*\*ACC results for one sample is unavailable due to an instrument fault at the laboratory

#### **4.6.1 Type of machine**

Responses: self-pasteurising (351), non-pasteurising (68), not stated (86); total (505).

Information on the type of machine was provided for 419 samples. The majority of these samples (84%, 351/419) were obtained from a self-pasteurising machine. This is an increase on the 2001 study, where 73% of samples (for which machine type was recorded) were collected from a self-pasteurising machine. In this current study the type of machine had a strong statistically significant effect on both the ACC (Fishers exact test,  $p=1.2 \times 10^{-7}$ ) and the Enterobacteriaceae results (Fishers exact test,  $p=8.8 \times 10^{-5}$ ). Regarding ACC, 26% of samples from self-pasteurising machines were unsatisfactory for ACC, compared to 60% of samples from non-pasteurising machines. Regarding Enterobacteriaceae, 7% of samples from self-pasteurising machines were unsatisfactory for Enterobacteriaceae, compared to 24% of samples from non-pasteurising machines.

#### **4.6.2 Temperature display reading on machine**

Responses:  $\leq 5^{\circ}\text{C}$  (295),  $>5^{\circ}\text{C}$  (31), not stated/available (179); total (505).

The temperature display on the ice-cream machine was recorded for 326 samples. Of these, 90% (295/326) were recorded as  $\leq 5^{\circ}\text{C}$  and 10% (31/326) as  $>5^{\circ}\text{C}$  (temperature range 5.1-15 $^{\circ}\text{C}$ ). The temperature display had a statistically significant effect on both the ACC (Fishers exact test,  $p=0.007$ ) and the Enterobacteriaceae (Fishers exact test,  $p=0.01$ ) results. For ACC, 30% of samples were unsatisfactory when the temperature display of machines was  $\leq 5^{\circ}\text{C}$  compared to 55% of samples when the temperature display was  $>5^{\circ}\text{C}$ . For Enterobacteriaceae, 7% of samples were unsatisfactory when the temperature display of machines was  $\leq 5^{\circ}\text{C}$ , compared to 23% of samples when the temperature display was  $>5^{\circ}\text{C}$ .

#### **4.6.3 Cleaning schedule**

*Is there a cleaning schedule for the ice cream machine?*

Responses: yes (364), no (128), not stated (13); total (505).

A response was recorded for 492 samples. The majority of samples (74%, 364/492) were obtained from machines with a cleaning schedule. The

presence/absence of a cleaning schedule had a statistically significant effect on the ACC results (Fishers exact test,  $p=0.009$ ) but not on the Enterobacteriaceae results<sup>♦</sup>. For ACC, 31% of samples were unsatisfactory when a cleaning schedule was in place compared to 44% when no schedule was in place. For Enterobacteriaceae, 10% of samples were unsatisfactory when a cleaning schedule was in place compared to 9% when no schedule was in place.

*Is the cleaning schedule documented?*

Responses: yes (228), no (131), not stated (5); total (364).

A response was recorded for 359 samples. The majority of samples (64%, 228/359) were obtained from machines with a documented cleaning schedule. A 'documented'/'undocumented' cleaning schedule had a weak statistically significant effect on the ACC (Fishers exact test,  $p=0.044$ ) but not the Enterobacteriaceae results<sup>♦</sup>. For ACC, 27% of samples were unsatisfactory when the cleaning schedule was documented compared to 37% when it was not documented. For Enterobacteriaceae, 9% of samples were unsatisfactory when the cleaning schedule was documented compared to 11% when it was not documented.

*Does the documented cleaning schedule describe how to clean the machine?*

Responses: yes (174), no (48), not stated (6); total (228).

A response was recorded for 222 samples. The majority of samples (78%, 174/222) were obtained from machines where the cleaning procedure was described. The presence or absence of this information had no significant effect<sup>♦</sup> on the ACC or the Enterobacteriaceae results. For ACC, the same percentage of samples (27%) was unsatisfactory irrespective of whether the information was provided or not. For Enterobacteriaceae, 8% of samples were unsatisfactory when the information was provided compared to 10% when it was not provided.

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<sup>♦</sup> Applying the Fishers Exact Test, there was no significant difference at  $\alpha = 0.05$  significance level

*Does the documented cleaning schedule state how often the machine should be cleaned?*

Responses: yes (192), no (31), not stated (5); total (228).

A response was recorded for 223 samples. The majority of samples (86%, 192/223) were obtained from machines where the frequency of cleaning was documented in the cleaning schedule. The presence or absence of this information had no significant effect<sup>♦</sup> on the ACC or the Enterobacteriaceae results. For ACC, 27% of samples were unsatisfactory when the information was provided compared to 26% when it was not provided. For Enterobacteriaceae, 10% of samples were unsatisfactory when the information was provided compared to 3% when it was not provided.

#### **4.6.4 Cleaning of the machines**

Guidelines recommend that non-pasteurising ice-cream machines should be cleaned every six days, while self-pasteurising machines should be cleaned every 21 days, as long as the machine enters its pasteurising cycle every three days (FSAI 2008).

*When was the interior of the ice-cream machine last cleaned?*

##### *i) Non-pasteurising machines\**

Responses: interior last cleaned  $\leq$  6 days ago (62),  $>$ 6 days ago (6); total (68).

A total of 68 samples were obtained from non-pasteurising machines. Ninety one percent (n=62) of these samples were obtained from machines where the interior was last cleaned in the six day period prior to sampling; 60% were unsatisfactory for ACC and 24% were unsatisfactory for Enterobacteriaceae. Nine percent of samples (n=6) were obtained from machines where the interior was last cleaned more than 6 days prior to sampling; 67% were unsatisfactory for ACC and 17% were unsatisfactory for Enterobacteriaceae.

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<sup>♦</sup> Applying the Fishers Exact Test, there was no significant difference at alpha = 0.05 significance level

<sup>\*</sup> Due to the small sample numbers in some categories, it was not possible to statistically compare results.

#### *ii) Self-pasteurising machines\**

Responses: self-pasteurising machine last cleaned  $\leq$  21 days ago (295),  $>$ 21 days ago (10), not stated (46); total (351).

A total of 351 samples were obtained from self-pasteurising machines and information regarding the time of last cleaning was available for 305 of these samples. Ninety seven percent (n=295) were obtained from machines where the interior was last cleaned in the 21 day period prior to sampling; 26% were unsatisfactory for ACC and 6% were unsatisfactory for Enterobacteriaceae. Only 3% of samples were obtained from machines where the interior was last cleaned more than 21 days before sampling. Information on whether the self-pasteurising machine entered the pasteurising cycle every three days (as recommended) or not was not collected on the questionnaire.

#### **4.6.5 Cleaning records**

*Are cleaning records relating to the machine maintained by the food business?*

Responses: yes (215), no (211), not stated (79); total (505).

A response was recorded for 426 samples. Half of these samples (50%, 215/426) were obtained from machines where cleaning records were maintained. Maintenance of cleaning records had a statistically significant effect on the ACC (Fishers exact test,  $p=0.005$ ) but not the Enterobacteriaceae results\*. For ACC, 30% of samples were unsatisfactory when cleaning records were maintained compared to 43% of samples when records were not maintained. For Enterobacteriaceae, the same percentage of samples (11%) was unsatisfactory irrespective of whether cleaning records were maintained or not.

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\* Applying the Fishers Exact Test, there was no significant difference at  $\alpha = 0.05$  significance level

\* Due to the small sample numbers in some categories, it was not possible to statistically compare results.



*Are cleaning records verified by the manager/supervisor?*

Responses: yes (164), no (34), not stated (17); total (215).

A response was recorded for 198 samples. The majority of samples (n=164) were obtained from machines where the cleaning records were verified by the manager/supervisor. Verification of cleaning records had no significant effect<sup>♦</sup> on the ACC or the Enterobacteriaceae results. For ACC, 28% of samples were unsatisfactory when cleaning records were verified compared to 35% when records were not verified. For Enterobacteriaceae, 10% of samples were unsatisfactory when cleaning records were verified compared to 15% when records were not verified.

#### **4.7 Follow-up Action**

Information on follow-up action was provided in the questionnaire for samples that were unsatisfactory for ACC and/or Enterobacteriaceae. Follow-up action included inspecting establishments, reviewing hygiene practices in the establishment, taking repeat samples and/or providing the business with further information, such as the FSAI guidelines on the safe handling and serving of soft ice-cream.

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<sup>♦</sup> Applying the Fishers Exact Test, there was no significant difference at alpha = 0.05 significance level

## 5.0 Discussion

Overall, whipped ice-cream was of a lower microbiological quality than scoop ice-cream, with 36% of whipped ice-cream unsatisfactory for one or both parameters compared to 22% of scoop ice-cream.

In general, a higher proportion of samples of both whipped and scoop ice-cream samples were unsatisfactory for ACC than for Enterobacteriaceae. The ACC quantifies the total number of mesophilic aerobic bacteria present in the ice-cream sample, so unsatisfactory results can indicate poor hygiene practices in the establishment surveyed. Unsatisfactory Enterobacteriaceae results may indicate that cleaning and/or pasteurisation methods are ineffective as Enterobacteriaceae are readily inactivated by sanitisers and heat.

Ice-cream samples were collected over the summer months: May, June, July and August. For both whipped and scoop ice-cream, the overall microbiological quality decreased as the months progressed. This decrease was weakly statistically significant for whipped ice-cream but it was not significant for scoop ice-cream.

For scoop ice-cream, it was encouraging to find that 85% of samples were maintained at the recommended temperature of  $\leq -12^{\circ}\text{C}$  during service. Guidelines also recommend that clean utensils are used at all times (FSAI, 2008). This survey found that scoop ice cream samples were of a better microbiological quality (ACC and Enterobacteriaceae) when the serving utensils were cleaned both before and during serving. The technique used to store the serving utensils also influenced the microbiological results; although, small sample numbers prevent definitive conclusions on the most appropriate practice to maintain microbiological quality of the product. However, an earlier study in Northern Ireland revealed a statistically significant association between aerobic plate count, coliforms and *E. coli* in scoop water and ice-cream (Wilson, Heaney and Weatherup 1997). Opened tubs of ice-creams

which were in use had higher aerobic plate counts than unopened ice-cream, and around half of the ice-cream scoop waters contained high coliform counts ( $>100$  coliforms  $\text{ml}^{-1}$ ). The storage solution used for utensils between servings can easily become contaminated by the food handler or from the serving environment and, in turn, contaminate the ice-cream via the scoop. In turn, the numbers of bacteria in the scoop water will depend on the ambient temperature and how often the water is changed. Even when a sanitiser is used in the scoop water, it will be ineffective if it is not changed frequently enough. The Milk Marketing Board in the UK recommends that scoop water and disinfectant solution are changed at least once every hour (Wilson, Heaney and Weatherup 1997).

For whipped ice cream, the type of machine had a strong statistically significant effect on both the ACC and the Enterobacteriaceae results. Better results were obtained for whipped ice-cream obtained from self pasteurising machines rather than non-pasteurising machines. Furthermore, the temperature display on the machine had a statistically significant effect on both the ACC and the Enterobacteriaceae results. Better results were obtained when the temperature display was  $\leq 5^{\circ}\text{C}$  compared to  $>5^{\circ}\text{C}$ . The higher the temperature above  $5^{\circ}\text{C}$  the faster bacteria can grow if present in the ice-cream mix.

Regarding cleaning of the machine, information was collated on the cleaning schedule, the frequency of cleaning and the maintenance of cleaning records. This information has shown that presence of a documented cleaning schedule had a weak statistically significant effect on the ACC results but not the Enterobacteriaceae results (better ACC results were obtained when the cleaning schedule was documented). The cleaning procedure and the cleaning frequency were stated in 78% and 86% of the documented cleaning schedules respectively. Although not a legal requirement, documentation of cleaning schedules is best practice (particularly in premises with a high turn over of staff). This survey did not verify if staff adhered to the cleaning procedure and frequency specified in the cleaning schedule.

It is recommended that the interior of self-pasteurising machines are cleaned at least every 21 days and the interior of non-pasteurising machines are cleaned at least every six days (FSAI, 2008). The survey revealed good compliance with these recommendations as 96% of samples were obtained from machines which were cleaned within the recommended timeframe. Cleaning records were maintained in approximately 50% of cases and 83% of cleaning records were verified by a manager/supervisor. Although not a legal requirement, maintenance of cleaning records is best practice.

The results of whipped ice cream in this study were compared to a similar study conducted on whipped ice-cream in 2001 (FSAI, 2001). There was a strong statistically significant improvement in the ACC results of whipped ice cream sampled in 2008 compared to samples taken in 2001 (there was a 14% decrease in the number of unsatisfactory samples in 2008 compared to 2001). The improvement in ACC may be influenced by the fact that more food businesses used self-pasteurising machines in 2008 (84%) than in 2001 (73%). However, there was no significant difference in the Enterobacteriaceae results between samples obtained in 2008 and 2001. In both surveys, the proportion of unsatisfactory results for both ACC and Enterobacteriaceae was lower in samples obtained from self-pasteurising machines rather than non-pasteurising machines.

## 6.0 Recommendations

1. Where soft ice-cream is being sold, food businesses operators should follow the recommendations laid down in the FSAI guidelines (FSAI, 2008). Furthermore, food business operators should follow the NSAI standards I.S. 340:2007 (Hygiene in the catering Sector) and I.S. 341 (Hygiene in food retailing and wholesaling) as appropriate (NSAI 2007 a, b).

2. Where scoop ice-cream is served, particular attention should be paid to

- The cleanliness of the serving utensils: These utensils should be cleaned both before and during service. Between services, they should be stored in conditions which do not lead to an increase in microbiological contamination.
- The temperature of the ice-cream display/serving unit: Deep freezers used to serve ice-cream should be maintained at or below  $-12^{\circ}\text{C}$  subject to the ice-cream being stored for not more than one week (FSAI, 2008; NSAI 2007a).

3. Regarding whipped ice-cream, food business operators should use self-pasteurising machines where possible and the machine temperature should be maintained at  $\leq 5^{\circ}\text{C}$ . All information regarding cleaning of the machine (e.g. cleaning procedure, cleaning frequency etc) should be captured in a documented cleaning schedule which should be adhered to at all times by appropriately trained and supervised staff.

## References

**FSAI 2001.** 3rd Quarter National Survey 2001 (NS3): soft ice cream. [www.fsai.ie/surveillance/food\\_safety/microbiological/3rdQuarter.pdf](http://www.fsai.ie/surveillance/food_safety/microbiological/3rdQuarter.pdf)

**FSAI 2007.** Interim guidance document on the use of: (i) Food safety criteria specified in Commission Regulation EC (No.) 2073/2005 on Microbiological Criteria for Foodstuffs and (ii) Guidelines for the Interpretation of Results of Microbiological Analysis of Some Ready-To-Eat Foods Sampled at Point of Sale (FSAI GN No. 3).

**FSAI 2008.** Safe handling and serving of soft ice-cream. Available online at: [www.fsai.ie/publications/leaflets/ice\\_cream.pdf](http://www.fsai.ie/publications/leaflets/ice_cream.pdf) . 2008.

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**National Standards Authority of Ireland. 2007a.** I.S. 340:2007. Hygiene in the catering sector.

**National Standards Authority of Ireland. 2007b.** I.S. 340:2007. Hygiene in food retailing and wholesaling.

**Wilson, I., Heaney, J., & Weatherup, S. 1997.** The effect of ice-cream-scoop water on the hygiene of ice cream. Epidemiology and Infection 119, 35-40.

## **Appendix 1: Recommendations to retailers (FSAI 2001)**

Recommendations made to retailers in the 2001 national Microbiological Surveillance Report on the microbiological quality of soft ice-cream (FSAI 2001):

1. A food safety management system based on the principles of HACCP should be developed
2. All staff should have basic training in food hygiene and safety
3. Retailers should consult manufacturers about the ease and efficacy of machine cleaning
4. Manufacturer's instructions regarding cleaning and sanitation of ice cream machines should be understood and adhered to by all responsible staff
5. Manufacturer's instructions regarding preparation, use and storage of ice cream mix should be understood and adhered to by all responsible staff.

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## Appendix 2: Questionnaire

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### FINAL Questionnaire 08NS2

Microbiological Quality of Whipped & Scoop Ice-Cream

*NOTE: This questionnaire MUST be completed for every sample EXCEPT repeat samples. Questionnaires must be returned to the FSAI by 10/10/2008*

### 1. General Information:

- \* EHO Name: \_\_\_\_\_
- \* EHO Sample Reference Number (i.e. EHO's own personal reference number for the sample) \_\_\_\_\_

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### 2. Premises information (section 3 of protocol):

Supermarket , Corner Shop , Van , Food stall , Other retail establishment  Please specify: \_\_\_\_\_

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### 3. Sample information (section 4 of protocol):

Whipped ice-cream  or Scoop ice-cream

If the sample is:

- whipped ice-cream do NOT complete section 4
- scoop ice-cream do NOT complete section 5

### 4. Information relating to scoop ice-cream :

- When are the utensils cleaned?** Before serving , Throughout serving  or Both
- Where are the utensils stored between servings?** \_\_\_\_\_
- Is there a temperature display on the serving unit:** Yes  (If yes, record the temp \_\_\_\_°C) **or** No

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### 5. Information relating to whipped ice-cream machine:

**Type of ice-cream machine:** Non-pasteurising , Self pasteurising  or Don't know

**Brand / Make of machine:** \_\_\_\_\_

**Is there a temperature display on the machine:** Yes  (If yes, record the temp \_\_\_\_°C) or No

**Is there a cleaning schedule for the machine?** Yes  or No

**If there is a cleaning schedule, is it documented?** Yes , No  or N/A

**If the cleaning schedule is documented does it contain the following information?**

**How** the machine should be cleaned? Yes , No  or N/A

**How often** the machine should be cleaned? Yes , No  or N/A

**Are cleaning records relating to the machine maintained by the food business?** Yes  or No

**If yes, are they verified by the manager/supervisor?** Yes , No  or N/A

**When was interior of the ice-cream machine last cleaned?** \_\_\_\_ days ago or Don't know

### 6. Microbiological results (section 8 of protocol):

**Lab. Ref. No.** (this info is essential): \_\_\_\_\_

	Satisfactory	Acceptable	Unsatisfactory
ACC (at 30°C for 48hours)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enterobacteriaceae	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 7. Follow-up action in the event of unsatisfactory results:

(section 10 of protocol, Please tick as many boxes as necessary)

- Inspection of the premises:
- Review of hygiene practices:
- Repeat sample:  Lab. ref. no. of repeat sample: \_\_\_\_\_
- Other action:  Details: \_\_\_\_\_



### Appendix 3

**Number of Samples Submitted from each Health Service Executive (HSE) Region:**

HSE Region	Number of Samples Submitted
HSEDMLR	193
HSEDNER	130
HSESR	286*
HSEWR	250
<b>Grand Total</b>	<b>859</b>

\* 293 samples submitted from HSESR; however, seven samples were excluded because they were collected outside the specified time-frame (n=6), or because the sample type was outside the scope of the survey (n=1).

### Appendix 4

**Number of samples analysed in each Official Food Microbiology Laboratory of the HSE:**

Official Food Microbiology Laboratory of the HSE	Number of Samples Analysed
Cherry Orchard	138
Cork	115**
Galway	79
Limerick	66
Sligo	105
SPD	185
Waterford	171***
<b>Grand Total</b>	<b>859</b>

\*\* 117 samples were analysed in Cork OFML; however, two samples were excluded because they were collected outside the specified time-frame.

\*\*\* 176 samples were analysed in Waterford OFML; however, five samples were excluded because they were collected outside the specified time-frame (n=4), or because the sample type was outside the scope of the survey (n=1).

## Appendix 5

### ACC results by Health Service Executive (HSE) Region:

HSE Region	Satisfactory	Acceptable	Unsatisfactory	Grand Total
HSEDMLR*	94	27	70	191*
HSEDNER**	49	25	53	127**
HSESR	127	57	102	286
HSEWR	144	41	65	250
<b>Grand Total</b>	<b>414</b>	<b>150</b>	<b>290</b>	<b>854</b>

\* 193 samples submitted but ACC test was not carried out on 2 samples due to an instrument fault at the laboratory

\*\* 130 samples submitted but ACC test not carried out on 3 samples due to an instrument fault at the laboratory

### Enterobacteriaceae results by Health Service Executive (HSE) Region:

HSE Region	Satisfactory	Acceptable	Unsatisfactory	Grand Total
HSEDMLR	160	26	7	193
HSEDNER	97	21	12	130
HSESR	180	78	28	286
HSEWR	203	27	20	250
<b>Grand Total</b>	<b>640</b>	<b>152</b>	<b>67</b>	<b>859</b>