4th Quarter National Microbiological Survey 2003 (NS4):

Microbiological quality/safety of pre-prepared rice

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Executive Summary

The microbiological status (*Bacillus cereus*, ACC and *Enterobacteriaceae*) of 507 samples of pre-prepared rice was determined using the national microbiological guidelines for ready-to-eat foods (FSAI Guidance Note No. 3). Overall 55% (n=279) of samples were classified as satisfactory, 19.5% (n=99) as acceptable, 24.3% (n=123) as unsatisfactory and 1.2% (n=6) as unacceptable/potentially hazardous.

Additional information regarding the samples was obtained by means of a questionnaire. Questionnaires were returned with 300 samples, i.e. 59% response rate. The following were the main findings:
1) The time between cooking and sampling had a significant effect on microbiological status. 11.1% (10/90) of rice which was sampled within 4 hours of cooking was unsatisfactory compared with 32.7% (57/173) of rice which was sampled more than 4 hours after cooking.
2) The storage conditions at the time of sampling (i.e ambient or refrigerated) had no significant effect on the microbiological status of samples obtained within 4 hours of cooking. However, the storage conditions had a significant effect on samples obtained more than 4 hours after cooking. The samples with the poorest microbiological status were those sampled more than 4 hours after cooking and stored at ambient temperature.
3) The quantity of rice cooked had no significant effect on microbiological status.
4) Reheating had no significant effect on microbiological status.

This study highlights the necessity for improvements in process control during the preparation and subsequent handling of cooked rice.

1. Introduction

B. cereus is a spore forming, toxin producing bacterium. It is ubiquitous in nature and occurs widely in soil, cereals, spices, vegetables, dairy products, foods and the environment [(1)]. Foods such as rice are considered to be a chief source of *B. cereus* [(2)].

The presence of *B. cereus* in foods which undergo a cook-chill process (e.g. rice) is of concern. This is because the heat generated during the cooking process will not kill the heat resistant spores but may provide the energy required to initiate spore germination. Subsequent temperature abuse during cooling/storage will result in germination, cell proliferation and possibly toxin production (the levels of *B. cereus* reported to cause illness are $>10^5$ cfu/g [(1)]). *B. cereus* is known to produce two types of toxin – the emetic and the diarrhoeal toxin. The emetic toxin is extremely stable and highly resistant to proteolytic degradation (e.g pH extremes and high temperatures [(3)]). (The toxin has been reported to be stable at 126^{o}C for 90 minutes [(4)]). Reheating will not inactivate the toxin and render the food safe.

B. cereus poisoning associated with the consumption of rice and other starchy products is widely reported [5, 6]. *B. cereus* food poisoning occurs after ingestion of food in which the organism has grown and formed its toxin(s). Two types of food poisoning referred to as the emetic and diarrhoeal syndromes are known. The first is characterised by emesis occurring within a short period of time (1-6 hours) after ingestion of the toxin. The diarrhoeal syndrome is characterised by the occurrence of diarrhoea 8-24 hours after the ingestion of large numbers of cells or toxin. Recovery from both types of illness is rapid and neither form of illness is life threatening to a healthy individual [1].

Poor process control during the cook chill process and poor handling/hygiene techniques will also influence the Aerobic Colony Counts (ACC) and *Enterobacteriaceae* levels of pre-prepared rice. The ACC gives an overall indication of the microbiological quality, while *Enterobacteriaceae* are indicators of hygiene and post process contamination of heat processed foods. *Enterobacteriaceae* give an indication of the likelihood of the presence of pathogens as well as providing accurate information on the handling and storage of the foodstuff.

2. Specific Objective

The aim of this study was to investigate the microbiological safety/quality (*B. cereus*, ACC and *Enterobacteriaceae*) of pre-prepared rice.

3. Method

3.1 Sample source:

Pre-prepared rice was sampled from any premises serving rice. Typical premises included large catering premises (hotels, restaurants, ethnic restaurants, take-aways), food stalls and public institutions (hospitals, nursing homes).

3.2 Sample description:

Pre-prepared rice refers to rice which was cooked (boiled) and subsequently cooled, i.e. rice which was cooled to either refrigeration or room temperature.

The following were specifically excluded from the sample description:

- Freshly cooked rice, i.e rice for immediate serving or rice which has not cooled to at least room temperature.
- Rice dishes, e.g. fried rice, risotto, rice salads
- Rice puddings typically used for desserts

3.3 Sample collection and analysis:

Environmental Health Officers from the 10 health boards (Appendix 1) collected samples (75 g or more) during October, November and December 2003. Only one sample was submitted from each batch of pre-prepared rice per premises. If a repeat sample was deemed necessary, it was not included in the survey.

The samples were analysed in one of the 7 Official Food Microbiology Laboratories (OFML's – Appendix 2) using approved/standard methods (methods accredited by the National Accreditation Board). The samples were analysed for the following parameters:

1. *Bacillus cereus*
2. Aerobic Colony Count (ACC)
3. *Enterobacteriaceae*

The results were classified according to the 2001 Irish '*Guidelines for the Interpretation of Results of Microbiological Analysis of Some Ready-To-Eat Foods Sampled at the Point of Sale'* (FSAI Guidance Note No.3 [(7)]). These guidelines are outlined in Table 1.

Table 1: Guidelines [7] for the assessment of the microbiological quality/safety of pre-prepared cooked rice.

	Microbiological quality			
Parameter	Satisfactory	Acceptable	Unsatisfactory	Unacceptable/potentially hazardous
B. cereus	$<10^3$	10^3-$<10^4$	10^4-$<10^5$	$\geq 10^5$
ACC	$<10^5$	10^5-$<10^6$	$\geq 10^6$	N/A
Enterobacteriaceae	<100	100-$<10^4$	$\geq 10^4$	N/A

N/A: Not Applicable

3.4 Questionnaire:

Information on premises type, quantity of rice cooked, time since cooking, storage conditions, reheating and sample temperature was obtained by EHOs at the time of sampling and the findings were recorded on the questionnaire provided (Appendix 3).

4. Results and Discussion

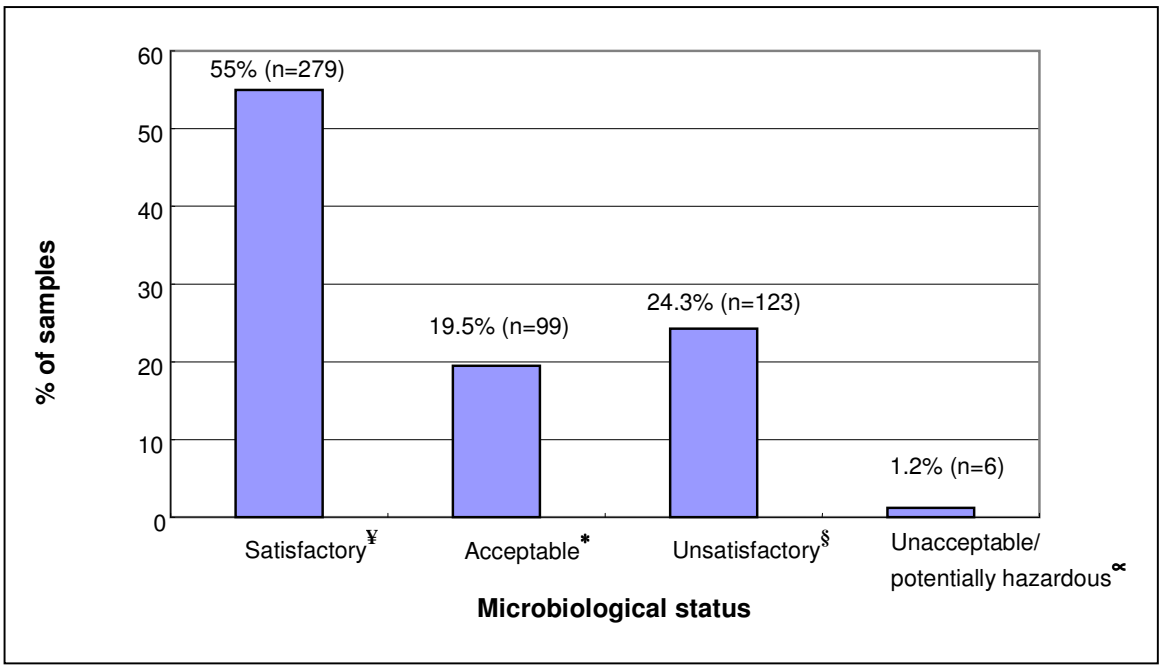
4.1 Microbiological Results

A total of 508 samples were submitted for analysis. The number of samples submitted from each health board and analysed in each OFML are presented in Appendix 4.

4.1.1 Overall microbiological status

A total of 507 samples were analysed for all 3 microbiological parameters (one sample was analysed for only 2 parameters) and the overall microbiological status of these samples are represented in Figure 1.

Figure 1: Overall microbiological status♣ of pre-prepared rice samples (n=507)



♣ Overall status was determined based on the results for the 3 microbiological parameters: *B. cereus,* ACC and *Enterobacteriaceae.*

¥ **Satisfactory:** Sample satisfactory for all 3 microbiological parameters

* **Acceptable:** Sample acceptable for one or more microbiological parameter and satisfactory for the remaining parameter(s).

§ **Unsatisfactory:** Sample unsatisfactory for one or more microbiological parameter and satisfactory and/or acceptable for the remaining parameter(s).

∝ **Unacceptable/potentially hazardous:** Sample unacceptable/potentially hazardous for *B. cereus* and either unsatisfactory, acceptable or satisfactory for ACC or *Enterobacteriaceae*.

Of the 123 samples which were classified as unsatisfactory, 88.6% (109/123), were unsatisfactory for ACC alone, 56.1% (69/123) were unsatisfactory for *Enterobacteriaceae* alone and 2.4% (3/123) were unsatisfactory for *B. cereus* alone (Table 2).

Table 2: Samples with an overall classification of unsatisfactory (n=123)

Total no. unsatisfactory	Unsatisfactory (%) for ACC only	Unsatisfactory(%) for *Enterobacteriaceae* only	Unsatisfactory (%) for *B. cereus* only
123[¥]	109 (88.6)	69 (56.1)	3 (2.4)

[¥] 1 sample was unsatisfactory for *B. cereus,* ACC and *Enterobacteriaceae*
57 samples were unsatisfactory for both ACC and *Enterobacteriaceae*

Of the 6 samples which were classified as unacceptable/potentially hazardous (i.e unacceptable/potentially hazardous for *B. cereus*), 5 (83%) of these were unsatisfactory for both *Enterobacteriaceae* and ACC (Table 3).

Table 3: Samples with an overall classification of unacceptable/potentially hazardous (n=6)

	Microbiological status		
Number of samples (%)	***B. cereus***	***Enterobacteriaceae***	**ACC**
5 (83.3)	Unacceptable/potentially hazardous	Unsatisfactory	Unsatisfactory
1 (16.7)	Unacceptable/potentially hazardous	Acceptable	Unsatisfactory

4.1.2 *Bacillus cereus* results

A total of 507 samples were analysed for *B. cereus*. Overall, 97.4% (494/507) of samples were categorised as satisfactory for *B. cereus*, the remaining 2.6% (13/507) were categorised as acceptable, unsatisfactory and unacceptable/potentially hazardous (Table 4). The results of the samples submitted from each health board are presented in Appendix 5.

Table 4: Microbiological safety of samples based on *B. cereus* results

No. of samples	Satisfactory $<10^3$ cfu/g (%)	Acceptable 10^3 - $<10^4$ cfu/g (%)	Unsatisfactory 10^4 - $<10^5$ cfu/g (%)	Unacceptable/potentially hazardous $\geq 10^5$ cfu/g (%)
507	494 (97.4)	4 (0.80)	3 (0.60)	6[¥] (1.2)

[¥] *B. cereus* results of $1x10^5$, $3.1x10^6$, $1.6x10^5$ (n=2), $2.8x10^5$ and $2.5x10^7$ were recorded for these 6 samples.

The number of samples containing *B. cereus* at unsatisfactory and unacceptable/potentially hazardous levels is comparable with the findings of a UK study [9] (Table 5).

Table 5: A comparison with other studies – *B. cereus* results

Location of study	Year of study	Total no. of samples	Unsatisfactory 10^4 - $<10^5$ cfu/g	Unacceptable/potentially hazardous $\geq 10^5$ cfu/g (%)
UK [8]	Aug. 2001	508	-	16[ɾ] (3.1)
UK [9]	April & May 1995	1972	5 (0.25)	4 (0.2)
This study	Oct. – Dec. 2003	507	3 (0.60)	6 (1.2)

[ɾ] Unacceptable results were due to high levels of *Bacillus* spp. and/or *B. cereus*.

The presence of *B. cereus* at unsatisfactory and unacceptable/potentially hazardous levels suggests poor process control in the cook/chill process. Particular concern is raised when *B. cereus* levels exceeds 10^5 cfu/g (i.e. samples classified as unacceptable/potentially hazardous) because of the potential for toxin production.

In this study, questionnaires were returned with 3 of the 6 samples which were classified as unacceptable/potentially hazardous for *B. cereus* (Table 6). This information shows that 2 samples were stored at ambient temperature despite being cooked 12-24 hours previously. These conditions may have enhanced the proliferation of *B. cereus* cells.

Table 6: Details of 3 samples unacceptable/potentially hazardous for *B. cereus*[¥]

Sample	Sample Sample Source	Time since sample was cooked	Quantity of rice cooked	No. of times sample was reheated	Storage conditions at time of sampling	Temperature of rice at time of sampling (^{o}C)
1	Chinese restaurant	12-<24h	<5kg	0	Ambient	16.2
2	Restaurant	12-<24h	<5kg	0	Refrigerated	5
3	Indian restaurant	12-<24h	<5kg	0	Ambient	15.7

[¥] A total of 6 samples were unacceptable/potentially hazardous for *B. cereus*, however questionnaires were only returned with 3 of these samples

4.1.3 Aerobic Colony Count (ACC) results

All 508 samples were analysed for ACC. Overall, 62.4% (317/508) of samples were categorised as satisfactory for ACC, the remaining 37.6% (191/508) were classified as acceptable or unsatisfactory (Table 7). The results of the samples submitted from each health board are presented in Appendix 6.

Table 7: Microbiological quality of samples based on ACC results

No. of samples	Satisfactory $<10^5$ cfu/g (%)	Acceptable 10^5 - $<10^6$ cfu/g (%)	Unsatisfactory $\geq 10^6$ cfu/g (%)
508	**317 (62.4)**	**76 (15.0)**	**115 (22.6)**

ACC levels provide information on the overall microbiological quality of the samples. In a RTE food such as pre-prepared rice, high ACC levels are indicative of poor process control (including poor temperature control in the cook chill process) and/or post process contamination. The finding that 22.6% of samples were unsatisfactory for ACC suggests that more emphasis must be placed on control measures.

In this study, the percentage of unsatisfactory samples is higher than that of two UK studies (Table 8). In this study 22.6% (115/317) of samples were unsatisfactory compared with 4.3% (85/1972) and 7.6% (39/508) in the UK studies.

Table 8: A comparison with other studies – ACC results

Location of study	Year of study	Total no. of samples	No. of unsatisfactory samples ($\geq 10^6$ cfu/g)	% unsatisfactory
UK [8]	Aug. 2001	508	39	7.6
UK [9]	April & May 1995	1972	85	4.3
This study	Oct. – Dec. 2003	507	115	22.6

4.1.4 *Enterobacteriaceae* results

All 508 samples were analysed for *Enterobacteriaceae*. Overall, 14.6% (74/508) of samples were categorised as unsatisfactory for *Enteroabcateriaceae*. The remainder were classified as satisfactory or acceptable (Table 9). The results of the samples submitted from each health board are presented in Appendix 7.

Table 9: Microbiological quality of samples based on *Enterobacteriaceae* results

No. of samples	Satisfactory <100 cfu/g (%)	Acceptable 100- $<10^4$ cfu/g (%)	Unsatisfactory $\geq 10^4$ cfu/g (%)
508	324 (63.8)	110 (21.6)	74 (14.6)

Enterobacteriaceae are indicators of hygiene and post process contamination of heat processed foods and give an indication of the likelihood of the presence of pathogens. In this study the finding that 14.6% (74/508) samples were unsatisfactory for *Enterobacteriaceae* is of concern.

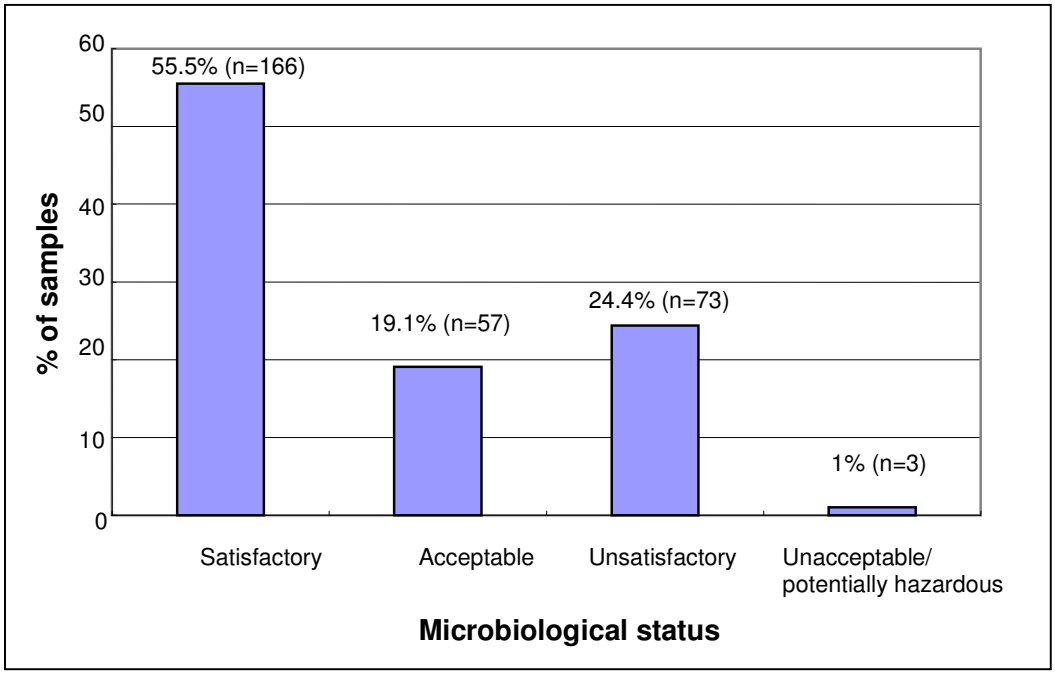
4.2 Questionnaire data

A total of 300 questionnaires were returned, this represented a response rate of 59% (300/508). The numbers of questionnaires returned from each health board are presented in Appendix 8.

4.2.2 Overall microbiological status of samples returned with a questionnaire

Of the 300 questionnaires returned, 299 were returned with samples which were analysed for all 3 microbiological parameters. The overall microbiological status of these samples (n=299) are represented in Figure 2.

Figure 2: Overall microbiological status of samples returned with a questionnaire (n=299)

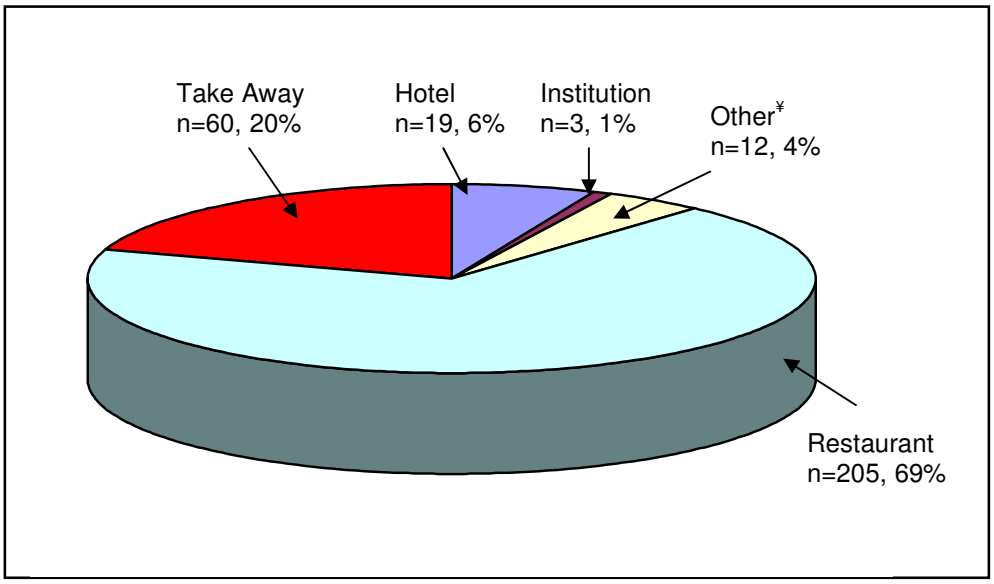


The overall status of these 299 samples is similar to the status of the total number of samples analysed (figure 1).

4.2.2 Sample source

The majority (69%, 205/299) of samples were obtained from restaurants. The remainder were obtained from premises such as take aways, hotels and institutions (Figure 3).

Figure 3: Sample Source (n=299)



¥ **Other (n=12):** canteen=n (n=1), catering supplier (n=1), Delicatessen (n=2), hospital (n=1), public house (n=1), supermarket (n=2), not stated (n=4)

The microbiological status of samples from each premises type is outlined in Table 10.

Table 10: Effect of premises type on microbiological status

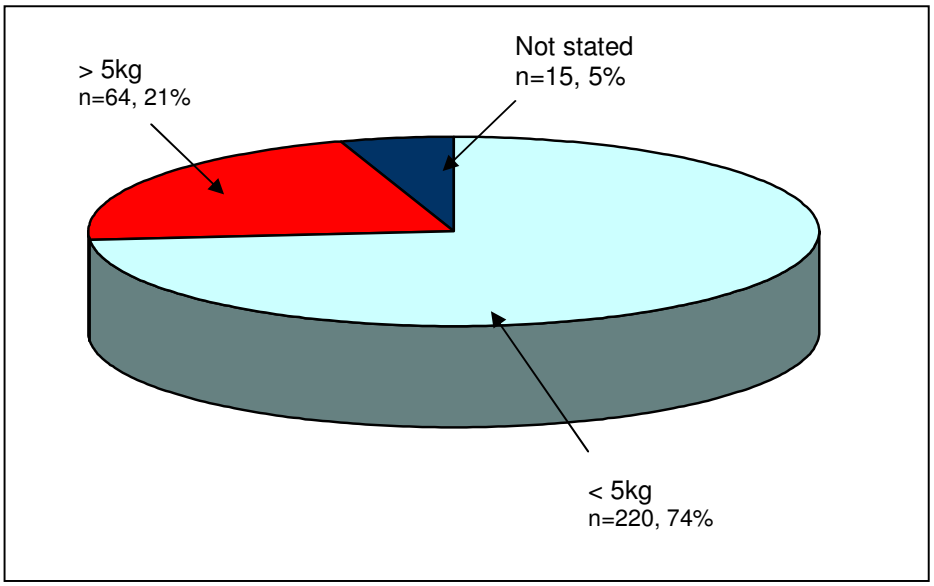
Premises type	Overall Microbiological Status				Total
	Satisfactory (%)	Acceptable (%)	Unsatisfactory (%)	Unacceptable/ potentially hazardous (%)	
Restaurant	107 (52.2)	40 (19.5)	55 (26.8)	3 (1.5)	**205 (100)**
Take-away	41 (68.3)	12 (20)	7 (11.7)	0 (0)	**60 (100)**
Hotel	9 (47.4)	3 (15.8)	7 (36.8)	0 (0)	**19 (100)**
Institution	2 (66.7)	1 (33.3)	0 (0)	0 (0)	**3 (100)**
Other	7 (58.3)	1 (8.3)	4 (33.3)	0 (0)	**12 (100)**
Total	**166 (55.5)**	**57 (19.1)**	**73 (24.4)**	**3 (1.0)**	**299 (100)**

In this study, premises type had no significant effect on microbiological status (95% confidence limit). It is worth noting that a UK study [8] found significantly more rice samples from Indian premises were of unsatisfactory or unacceptable microbiological quality compared to samples from Chinese premises. The authors attributed this finding to differences in practices (storage and reheating) between premises and the addition of spices to Indian rice (spices are often contaminated with spores of *Bacillus* spp.).

4.2.3 Quantity of rice cooked

The majority of samples (74%, 220/299) were cooked in batches which were < 5kg in size. Information on batch size was not provided for 5% (15/299) of samples (Figure 4).

Figure 4: Quantity of rice cooked (n=299)



The overall microbiological status of samples based on the quantity of rice cooked is outlined in Table 11.

Table 11: The effect of quantity of rice cooked on microbiological status

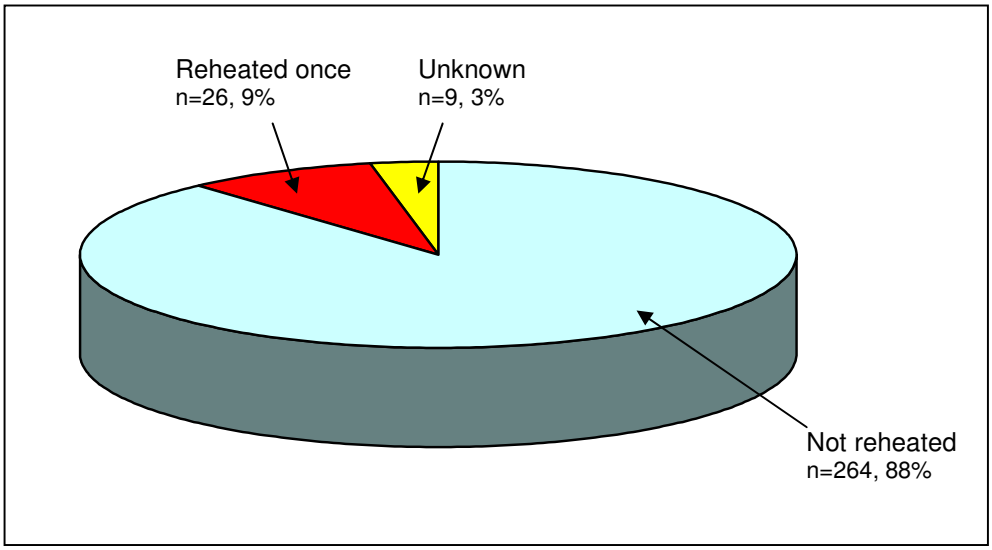
Quantity of rice cooked	Overall microbiological result				Total
	Satisfactory (%)	Acceptable (%)	Unsatisfactory (%)	Unacceptable/ potentially hazardous (%)	
<5kg	123 (55.9)	42 (19.1)	52 (23.6)	3 (1.4)	**220 (100)**
>5kg	32 (50)	13 (20.3)	19 (29.7)	0 (0)	**64 (100)**
Not stated	11 (73.3)	2 (13.3)	2 (13.3)	0 (0)	**15 (100)**
Total	**166 (55.5)**	**57 (19.1)**	**73 (24.4)**	**3 (1.0)**	**299 (100)**

In this study, the quantity of rice cooked had no significant effect on microbiological status (95% confidence limit). The authors of a US study recommended that rice should be cooked in small batches [(2)].

4.2.4 Reheating of samples

The majority of samples (88%, 264/299) were not reheated. Information regarding reheating was not available for 3% (9/299) of samples (Figure 5):

Figure 5: Reheating of samples (n=299)



The overall microbiological status of samples based on reheating is outlined in Table 12.

Table 12: Effect of reheating on overall microbiological status

No. of times sample was reheated	Overall microbiological result				Grand Total
	Satisfactory	Acceptable	Unsatisfactory	Unacceptable/ Potentially hazardous	
0	140 (53)	54 (20.5)	67 (25.4)	3 (1.1)	**264 (100)**
1	18 (69.2)	2 (7.7)	6 (23.1)	0 (0)	**26 (100)**
unknown	8 (88.9)	1 (11.1)	0 (0)	0 (0)	**9 (100)**
Grand Total	**166 (55.5)**	**57 (19.1)**	**73 (24.4)**	**3 (1.0)**	**299 (100)**

In this study, reheating had no significant effect on microbiological status (95% confidence limit). This finding differs to that of a UK study [8] where significantly more ($p<0.00001$) samples served reheated were of unsatisfactory/unacceptable microbiological quality compared to those freshly cooked.

Further information on the:

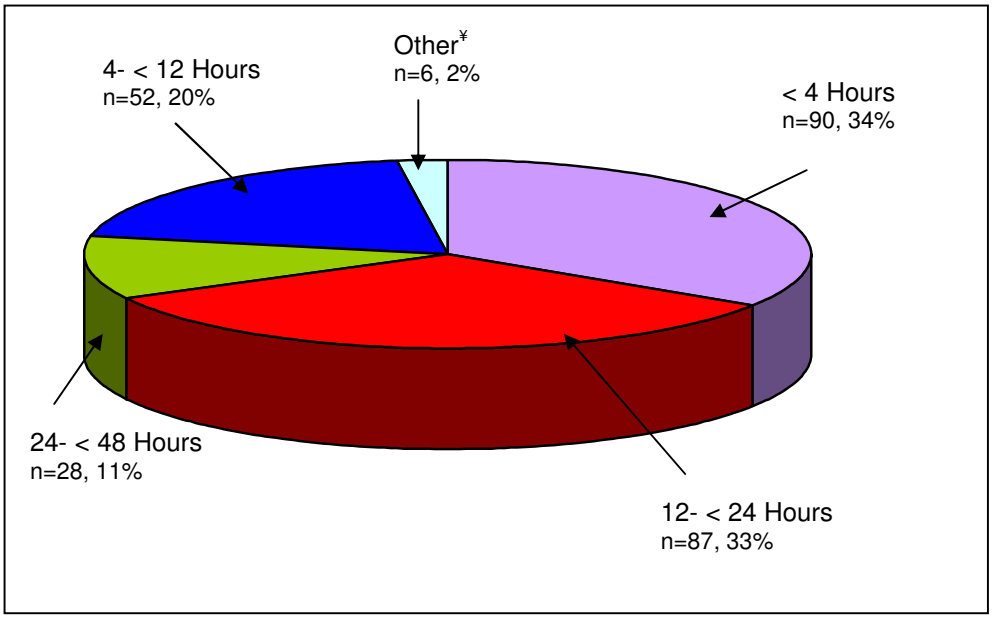
- time period between cooking and sampling,
- storage condition at the time of sampling and
- sample temperature,

were captured on the questionnaire and for the purpose of this report this information was analysed for the 264 samples which did not undergo a reheating step.

4.2.5 Time period between cooking and sampling

The time period between cooking and sampling was captured for 263 of the 264 samples which did not undergo a reheating step. 34% (90/263) of samples were obtained within 4 hours of cooking; the remaining 66% (173/263) were obtained more than 4 hours after cooking (Figure 6).

Figure 6: Time between cooking and sampling (n=263[ϒ])



ϒ These samples were not reheated

¥**Other (n=6):** > 45h, 52h, 96h, 2-3 days, 3 - 4 days, 5 days

Table 13 outlines the relationship between i) the time between cooking and sampling and ii) microbiological status of the samples.

Table 13: Effect of time between cooking and sampling on the overall microbiological status (n=263[ϒ])

Time between cooking and sampling (hours)	Overall microbiological status				Total no. of samples
	Satisfactory	Acceptable	Unsatisfactory	Unacceptable	
< 4	67 (74.4)	13 (14.4)	10 (11.1)	0 (0)	**90 (100)**
>4	73 (42)	40 (23.6)	57 (32.7)	3 (1.7)	**173 [ᵅ] (100)**
Total	**140 (53.0)**	**53 (20.5)**	**67 (25.4)**	**3 (1.1)**	**263 [¥] (100)**

[ϒ] These samples were not reheated
[ᵅ] **>4h (n=173):** 4-<12h (n=52); 12-<24h (n=87), 24-<48h (n=29); >48h (n=5)
[¥] A total of 264 samples were not reheated, however details regarding the time since cooking was not recorded for 1 sample

In this study, the time between cooking and sampling had a significant effect (95% confidence limit) on the microbiological status of the samples (Table 13). Only 11.1% (10/90) of rice which was sampled within 4 hours of cooking was unsatisfactory compared with 32.7% (57/173) of rice which was sampled more than 4 hours after cooking (Table 13).

4.2.6 Storage conditions at the time of sampling

Of the 90 samples which were obtained within 4 hours of cooking, 52.2% (47/90) were stored at ambient conditions and 33.3% (30/90) were stored at refrigeration conditions at the time of sampling (Table 14).

Of the 173 samples which were obtained more than 4 hours after cooking, 74% (128/173) were stored at refrigeration conditions and 23.1% (40/173) were stored at ambient temperature at the time of sampling (Table 14).

Table 14: Storage conditions of samples at the time of sampling (n=263)

Time between cooking and sampling	No. of samples			Total no. of samples
	Refrigerated	Ambient	Other	
< 4 Hrs	30 (33.3)	47 (52.2)	13 [¥](14.4)	**90 (100)**
> 4 hours	128 (74.0)	40 (23.1)	5 [§] (2.9)	**173 (100)**
Grand Total	**158 (60.1)**	**87 (33.1)**	**18 (6.8)**	**263 (100)**

[¥] hot hold (n=10); steamer (n=2); not stated (n=1)
[§] stored in cool unit/box (n=5)

Table 15 outlines the relationship between i) storage conditions at the time of sampling, ii) time between cooking and sampling and iii) overall microbiological status.

Table 15: Effect of storage conditions on microbiological status (n=173)[¥]

Time between cooking and sampling (hours)	Storage conditions	Average sample temp. (°C)	Overall Microbiological Status				Total no. of samples
			S	A	U	U/PH	
<4	**Refrigerated**	8.52	19 (63.3)	6 (20)	5 (16.7)	0 (0)	**30 (100)**
	Ambient	27.4	36 (76.6)	7 (14.9)	4 (8.5)	0 (0)	**47 (100)**
>4	**Refrigerated**	6.99	61 (47.6)	24 (18.8)	42 (32.8)	1 (0.8)	**128 (100)**
	Ambient	18.35	10 (25)	14 (35)	14 (35)	2 (5)	**40 (100)**

¥ S = satisfactory, A = acceptable, U = unsatisfactory, U/PH = unacceptable/potentially hazardous

The storage conditions (at the time of sampling) had no significant effect on the microbiological status of samples obtained within 4 hours of cooking. However, the storage conditions (at the time of sampling) had a significant effect on samples obtained more than 4 hours after cooking (95% confidence limit). The samples with the poorest microbiological status were those sampled more than 4 hours after cooking and stored at ambient temperature.

5. Conclusions

The finding of this study that 24.3% (123/507) of pre-prepared rice samples were classified as unsatisfactory and that 1.2% (6/307) of samples were classified as unacceptable/potentially hazardous is of concern. These results highlight the necessity for improvements in process control and in food handling practices.

Particular attention should be paid to the following:
1. Quantity of rice cooked: Although the findings of this study suggest that the quantity of rice cooked has no significant effect on microbiological status; previous studies have shown that rice should be cooked in small batches to ensure microbiological safety/quality.

2. Cooking process: Irrespective of batch size, it is imperative that the core temperature of the rice should reach 70^{o}C for 2 minutes (or equivalent) [(10)]. Food business operators should be aware that although cooking will kill vegetative cells it will not kill the heat resistant *B. cereus* spores. In addition, it may provide the heat necessary to initiate spore germination.

3. Chilling: Chilling should begin within 30 minutes (maximum) following the completion of cooking and/or portioning. Following this the food must be chilled to $\leq$ 3^{o}C within a further time of 150 minutes (maximum).

4. Storage: Control (time and temperature) is required during storage to prevent the proliferation of bacterial cells. This is particularly important for *B. cereus* as toxin production is associated with a high cell count. To prevent proliferation of bacterial cells, cooked rice should be stored either hot (>63^{o}C) or cold ($\leq$3^{o}C). (It is worth noting that although some strains of *B. cereus* are psychrotrophic, there is no evidence to date to suggest that toxin producing strains grow under such conditions [(11)]).

5. Hygiene practices: Good hygiene and food handling practices are essential to prevent post process contamination.

Finally, control measures for *B. cereus* and other pathogenic microorganisms should be incorporated into a food safety management system based on the principles of HACCP (implementation of HACCP has been a legal requirement in Ireland since 1998 [(12)]).

Recommended reading:

• National Standards Authority of Ireland. 1994. I.S. 340. Hygiene in the catering sector [13].

• National Standards Authority of Ireland. 2000. I.S. 343. Food safety management incorporating hazard analysis and critical control point (HACCP) [14].

- Food Safety Authority of Ireland. HACCP Leaflets [15]

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7. Appendices

Appendix 1

List of health boards

Health board	***Abbreviation***
East-Coast Area Health Board	ECAHB
Midland Health Board	MHB
Mid-Western Health Board	MWHB
Northern Area Health Board	NAHB
North-Eastern Health Board	NEHB
North-Western Health Board	NWHB
South-Eastern Health Board	SEHB
Southern Health Board	SHB
South-Western Area Health Board	SWAHB
Western Health Board	WHB

Appendix 2

List of the Official Food Microbiology Laboratories (OFMLs)

Laboratory
Public Health Laboratory SWAHB at Cherry Orchard Hospital
Mid-Western Regional Hospital
Public Analysts Laboratory, Dublin
Sligo General Hospital
St Finbarr's Hospital, Cork
University College Hospital, Galway
Waterford Regional Hospital

Appendix 3: Questionnaire

Questionnaire 03NS4
Microbiological quality and safety of pre-prepared rice

This questionnaire should be completed for <u>all</u> samples and returned to the FSAI by 31st January 2004 (at the latest).

1. EHO Name: _____

2. EHO Reference Number: _____
(i.e. EHO's own personal reference number for the premises)

3. Laboratory Reference Number (upon receipt of lab report): _____
(i.e. unique laboratory reference number)

4. Type of Premises

Hotel [□ hotel restaurant, □ hotel function]
Restaurant [□ European, □ Chinese, □ Indian, □ Other (please specify)_____]
Take away [□ European, □ Chinese, □ Indian, □ Other (please specify)_____]
□ Institution (e.g. hospital, nursing home)
□ Other (please specify): _____

5. Quantity of rice cooked (i.e. quantity of dry rice grains prior to cooking)

□ <5kg /batch (approximately)
□ ≥ 5kg /batch (approximately)

6. Approximate time since cooking

□ < 4 hours
□ 4-<12 hours
□ 12-<24 hours
□ 24-<48 hours
□ Other (please specify the number of hours): ☐

7. Storage conditions of rice in the premises since cooking

□ Refrigerated
□ Ambient
□ Other, e.g. cool box (please specify): _____

8. Number of times the sample was reheated (excludes initial cooking):
Please insert number: ☐

9. Temperature of rice at time of sampling:
Please insert temperature recorded using the insertion probe: ☐

Appendix 4

Details of sample numbers submitted from each health board and analysed in each OFML

	Official Food Microbiology Laboratory (OFML)							
Health Board	Cherry Orchard Hospital	St Finbarr's Hospital, Cork	University College Hospital, Galway	Mid-Western Regional Hospital	Sligo General Hospital	Public Analysts Laboratory, Dublin	Waterford Regional Hospital	**Total**
ECAHB	13	-	-	-	-	22	-	35
MHB	-	-	-	-	-	23	-	23
MWHB	-	-	-	38	-	-	-	38
NAHB	32	-	-	-	-	17	-	49
NEHB	38	-	-	-	-	-	-	38
NWHB	-	-	-	-	65	-	-	65
SEHB	-	-	-	-	-	-	60	60
SHB	-	74	-	-	-	-	-	74
SWAHB	54	-	-	-	-	18	-	72
WHB	-	-	54	-	-	-	-	54
Total	**137**	**74**	**54**	**38**	**65**	**80**	**60**	**508**

Appendix 5

Bacillus cereus results by health board

	Microbiological Safety				
Health Board	**Satisfactory $<10^3$ cfu/g**	**Acceptable 10^3 - $<10^4$ cfu/g**	**Unsatisfactory 10^4 - $<10^5$ cfu/g**	**Unacceptable/ potentially hazardous $\geq 10^5$ cfu/g**	**Grand Total**
ECAHB	32	1	1		34[§]
MHB	23				23
MWHB	33	2		3	38
NAHB	49				49
NEHB	38				38
NWHB	64		1		65
SEHB	60				60
SHB	74				74
SWAHB	71	1			72
WHB	50		1	3	54
Grand Total	**494**	**4**	**3**	**6[¥]**	**507**

[§] A total of 35 samples were submitted from the ECAHB, however the *B. cereus* results are not available for 1 sample due to a laboratory accident.

[¥] *B. cereus* results of $1x10^5$, $31x10^5$, $1.6x10^5$ (n=2), $2.8x10^5$ and $2.5x10^7$ were recorded for these 6 samples.

Appendix 6

ACC results by health board

	Microbiological quality			
Health Board	**Satisfactory $<10^5$ cfu/g**	**Acceptable 10^5 - $<10^6$ cfu/g**	**Unsatisfactory $\geq 10^6$ cfu/g**	**Grand Total**
ECAHB	21	4	10	35
MHB	14	5	4	23
MWHB	19	9	10	38
NAHB	37	5	7	49
NEHB	18	5	15	38
NWHB	50	5	10	65
SEHB	41	6	13	60
SHB	40	21	13	74
SWAHB	52	10	10	72
WHB	25	6	23	54
Grand Total	**317**	**76**	**115**[¥]	**508**

[¥] 10^6-$<10^7$ (n=48); 10^7-$<10^8$ (n=43); $>10^8$ (n=15); $>1.4x10^8$ (n=8); $>4x10^8$ (n=1)

Appendix 7

Enterobacteriaceae results by health board

	Microbiological Quality			
Health Board	**Satisfactory <100 cfu/g**	**Acceptable 100- <10^4 cfu/g**	**Unsatisfactory ≥ 10^4 cfu/g**	**Grand Total**
ECAHB	25	5	5	35
MHB	18	3	2	23
MWHB	21	9	8	38
NAHB	34	13	2	49
NEHB	23	7	8	38
NWHB	45	16	4	65
SEHB	38	17	5	60
SHB	39	17	18	74
SWAHB	52	15	5	72
WHB	29	8	17	54
Grand Total	**324**	**110**	**74**[§]	**508**

[§] >10^4 (n=40); >3x10^5 (n=3); >1.5x10^7 (n=2); 10^4-10^5 (n=11); 10^5-<10^6 (n=14); 10^6-<10^7(n=3); 1.3x10^7 (n=1)

Appendix 8

Number of questionnaires returned from each health board

Health Board	No. of questionnaires	No. of samples submitted	% Questionnaire response rate
ECAHB	31	35	88.6
MHB	22	23	95.6
MWHB	31	38	81.6
NAHB	32	49	65.3
NEHB	26	38	68.4
NWHB	15	65	23.1
SEHB	47	60	78.3
SHB	44	74	59.5
SWAHB	32	72	44.4
WHB	20	54	37.0
Grand Total	**300**	**508**	**59.0**