ACT HEALTH PROTECTION SERVICE

MICROBIOLOGICAL QUALITY OF READY-TO-EAT FOODS

JULY 2004– JUNE 2005

Report prepared by
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OBJECTIVE

- Determine the bacteriological status of ready-to-eat food products available on the ACT market.
- Determine the compliance of these products to Food Standards Australia New Zealand (FSANZ) Draft Guidelines for the Microbiological Examination of Ready-to-Eat Foods.

BACKGROUND

"Ready-to-Eat" (RTE) food is food that is ordinarily consumed in the same state as that in which it is sold or distributed and does not include nuts in the shell and whole, raw fruits and vegetables that are intended for hulling, peeling or washing by the consumers." [1]

Sandwiches, rolls, stir-fries, baked goods as well as various other RTE foods are widely available in approximately 450 ACT establishments of which approximately 250 are considered high risk. Due to the diverse nature and popularity of these foods it was considered prudent to perform ongoing surveys on these products in conjunction with the Environmental Health Section Premises Auditing Program of high-risk food producing establishments.

STANDARDS

Samples collected for surveillance and monitoring purposes are often multi-component products for which there are no microbiological standards or guidelines. Interpreting the significance of the types and levels of reported microorganisms for these foods may therefore be difficult. The FSANZ Guidelines for the Microbiological Examination of Ready-to-Eat Foods (the Guidelines) identify four categories of microbiological quality ranging from satisfactory to potentially hazardous. Table 1 below details the recommended guidelines. This Table reflects both the high level of microbiological quality that is achievable for RTE foods in Australia and New Zealand and also indicates the level of contamination that is considered to be a significant risk to public health.

Table 1[1]

Test	Microbiological Quality (CFU per gram)			
	Satisfactory	**Marginal**	**Unsatisfactory**	**Potentially Hazardous**
Standard Plate Count (SPC)				
Level 1*	$<10^4$	$<10^5$	$\geq 10^5$	
Level 2*	$<10^6$	$<10^7$	$\geq 10^7$	
Level 3*	N/A	N/A	N/A	
Indicators				
Escherichia coli	<3	3-100	>100	**
Pathogens				
Coagulase positive staphylococci	$<10^2$	10^2-10^3	10^3-10^4	$\geq 10^4$ SET +ve
Bacillus cereus	$<10^2$	10^2-10^3	10^3-10^4	$\geq 10^4$
Salmonella spp.	not detected in 25g			detected
Listeria monocytogenes	not detected in 25g	detected but $<10^{2\,\#}$		$\geq 10^{2\,\#\#}$

NOTE:
*see below "Standard Plate Counts" for definition of level.
** Pathogenic strains of *E. coli* should be absent.
# Foods with a long shelf life stored under refrigeration should have no *L. monocytogenes* detected in 25g.
The detection of *L. monocytogenes* in ready-to-eat-foods prepared specifically for "at risk" population groups (the elderly, immuno-compromised and infants) should also be considered as potentially hazardous.
SET +ve: Staphylococcus enterotoxin positive.
N/A – SPC testing not applicable. This applies to foods such as fresh fruits and vegetables (including salad vegetables), fermented foods and foods incorporating these (such as sandwiches and filled rolls).

Standard Plate Count (SPC)
The Standard Plate Count (SPC), also referred to as the Aerobic Plate Count or the Total Viable Count, is one of the most common tests applied to indicate the microbiological quality of food. The total count of viable microbes reflects the handling/ storage history of the food. Total counts may be taken to indicate the type of sanitary control exercised in the production, transport, and storage of the food. The significance of SPC, however, varies markedly according to the type of food product and the processing it has received. When the SPC testing is applied on a regular basis it can be a useful means of observing trends by comparing SPC results over time. Three levels of SPC are listed in Table 1 based on food type and the processing/ handling the food has undergone.

Level 1 – applies to ready-to-eat foods in which all components of the food have been cooked in the manufacturing process/preparation of the final food product and, as such, microbial counts should be low.

Level 2 – applies to ready-to-eat foods which contain some components which have been cooked and then further handled (stored, sliced or mixed) prior to preparation of the final food or where no cooking process has been used.

Level 3 – SPCs not applicable. This applies to foods such as fresh fruits and vegetables (including salad vegetables), fermented foods and foods incorporating these (such as sandwiches and filled rolls). It would be expected that these foods would have an inherent high SPC because of the normal microbial flora present.

Note: An examination of the microbiological quality of a food should not be based on SPC alone. The significance of high (unsatisfactory) SPC cannot truly be made without identifying the microorganisms that predominate or without other microbiological testing.

SURVEY
This survey was conducted between the 01 July 2004 and 30 June 2005. During this period 195 samples from 42 ACT retail outlets were collected randomly by Health protection service officers (EHO) and processed by the Australian Capital Territory Government Analytical Laboratory (ACTGAL). The samples were collected in such a manner as to cover a wide range of the available RTE food types including salads, sushi, pies, quiches, sandwiches, noodles, pasta, meats and desserts. All of the samples were tested for the hygiene indicators SPC, *E.coli*, coagulase positive *Staphylococci,* and the food pathogens *Salmonella* spp. and *Listeria monocytogenes.* Foods containing pasta or rice were also tested for *Bacillus cereus*. The survey collected multiple samples from single outlets and in general outlets were only tested once.

RESULTS / DISCUSSION

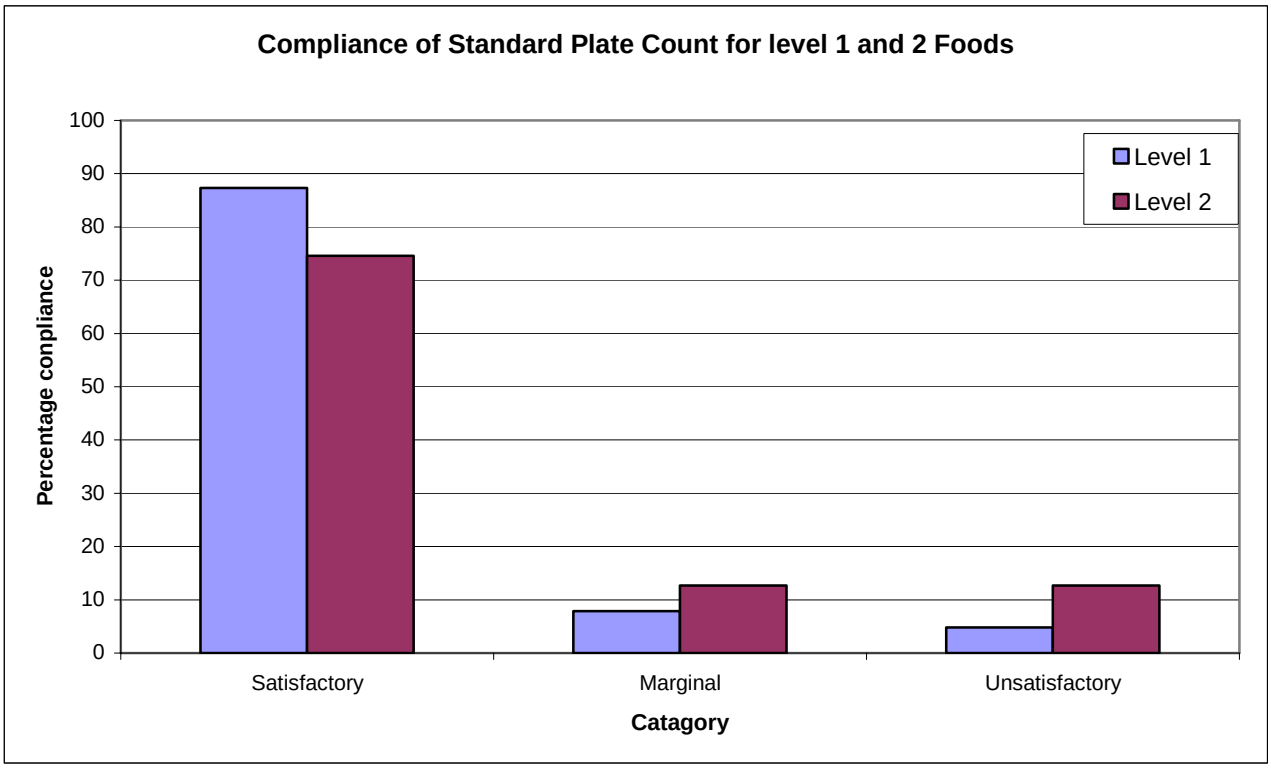
Standard Plate Counts (SPC)

All samples (195) were tested for SPC. The results for the samples ranged between <50 and 360,000,000 colony forming units per gram (cfu)/g. A total of 63 of the RTE food samples were assessed as having to comply with the Level 1 SPC criterion with counts ranging between <50 and 37,000,000 cfu/g. Of the 63 samples, 55(87.3%) were in the satisfactory category while 5 samples (7.9%) were in the marginal category. There were 3 samples (4.8%) in the unsatisfactory category.

A total of 63 samples were assessed as having to comply with the Level 2 SPC criterion. The results ranged between <50 and 46,000,000 cfu/g. 47 of these samples (74.6%) were in the satisfactory category. 8 samples (12.7%) were in the marginal category and 8 samples (12.7%) were in the unsatisfactory category.

A total 69 samples were assessed as having to comply with the Level 3 SPC criterion. As such there are no SPC limits applicable to these products. The results for these products ranged from as low as <50 to as high as 360,000,000 cfu/g. This is to be expected as these foods, (mostly raw fruits and vegetables or fermented foods) would have an inherently high SPC because of their normal microbial flora.

Figure 1.

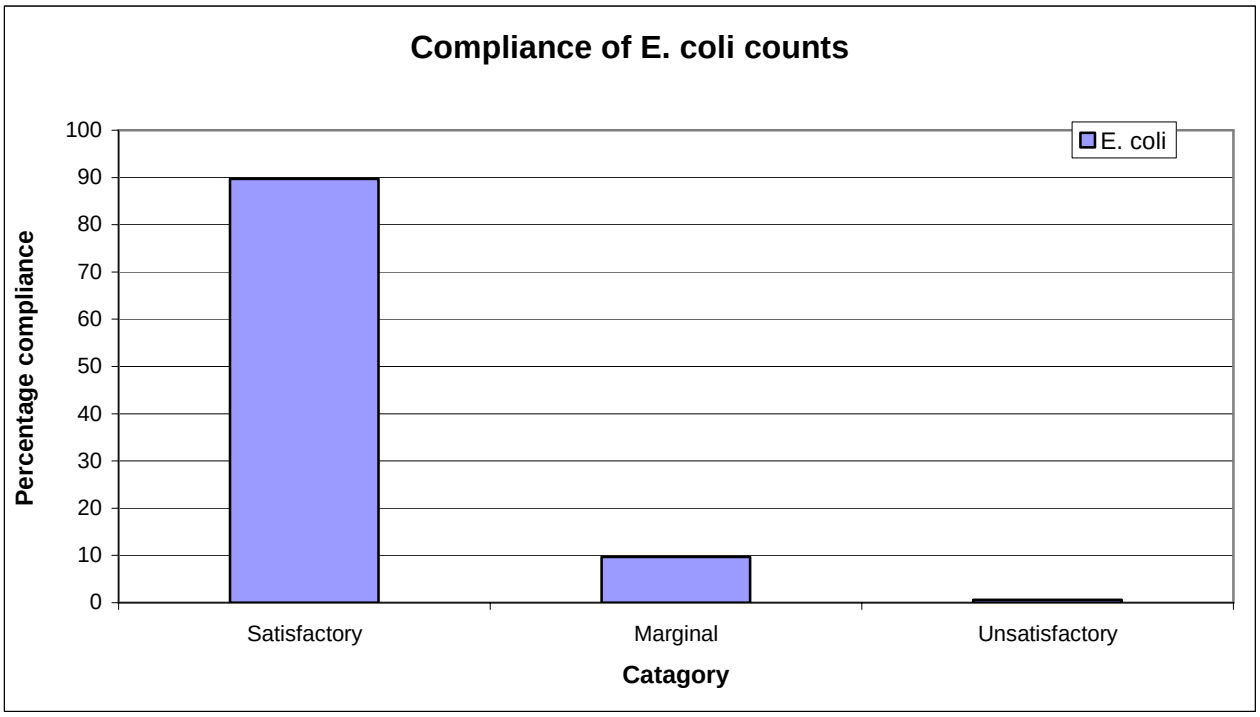


Escherichia coli

195 samples were tested for *E. coli*. Figure 2 represents the results for the three microbiological categories included in the Guidelines. The presence of *E. coli* in RTE foods is undesirable because it indicates that the food has possibly been prepared under poor hygienic conditions. Ideally *E. coli* should not be detected and as such a level of <3 cfu/g (the limit of the Most Probable Number test) has been set for satisfactory samples. 175 (89.4%) of the samples had <3 cfu/g *E.coli* and met the satisfactory criterion. There were 19 (9.7%) samples with *E. coli* in the marginal category i.e. from 3 to 100cfu/g. Levels exceeding 100 per gram are unacceptable and indicate a level of contamination which may have introduced pathogens or that pathogens, if present in the food prior

to processing, may have survived processing.[1] A total of 2 (1.1%) sample had levels >100 cfu/g of *E. coli* and were considered unsatisfactory. Resamples were requested for both items.

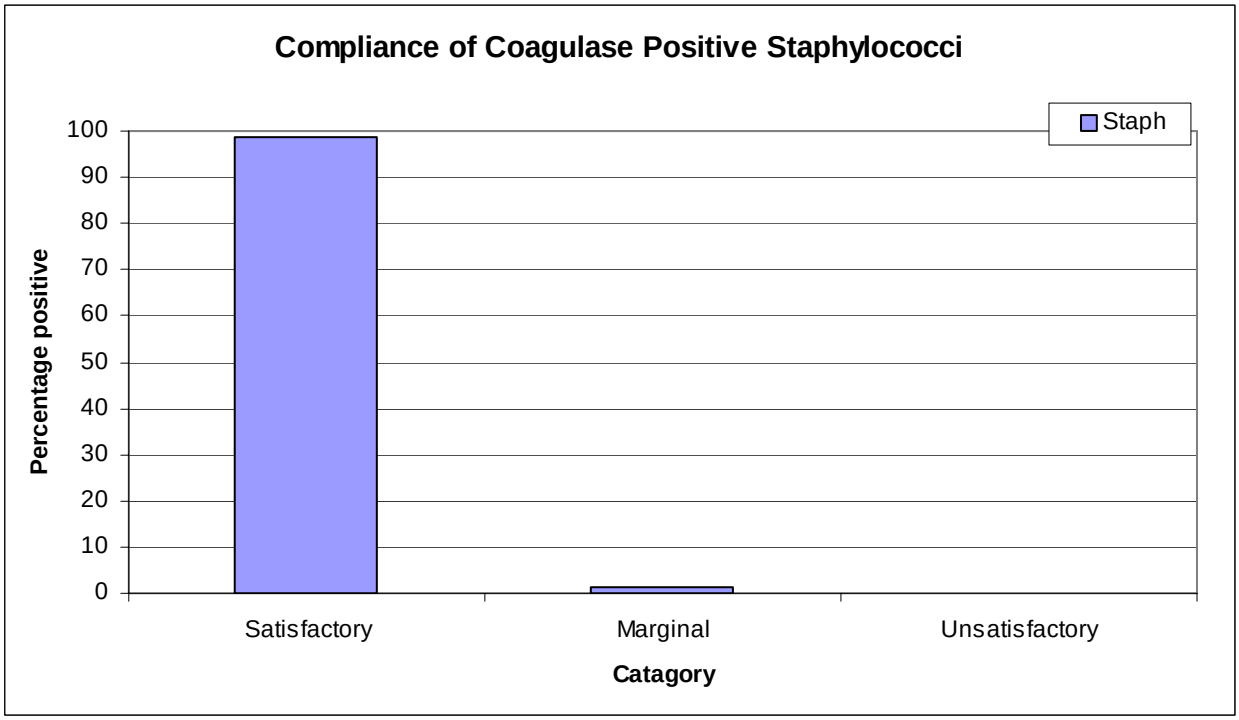
Figure 2.



Coagulase positive *Staphylococci*

195 RTE samples were tested for coagulase positive *Staphylococci.* 192 (98.9%) of the samples were in the satisfactory category, i.e. <100 cfu/g, while 2 samples (1.1%) were in the marginal category i.e. 100-1000cfu/g. There were no samples in the Unsatisfactory or Potentially Hazardous categories. See Figure 3. The positive results for coagulase positive *Staphylococci* ranged from 50-200cfu/g. The presence of coagulase positive *Staphylococci* indicate that handling and/or time/temperature abuse of a food is likely to have occurred due to improper procedures during food preparation.

Figure 3



***Salmonella* spp.**
Salmonella spp. was not detected in any of the 195 samples tested. RTE foods should be free of *Salmonella* as consumption of food containing this pathogen may result in food borne illness.

Listeria monocytogenes
195 samples were analysed for *Listeria monocytogenes*. 183 (93.8%) of the samples were satisfactory i.e. *Listeria monocytogenes* was not detected, whereas 12 (6.2%) samples from 8 establishments were positive for *Listeria monocytogenes.* Resamples of the positive samples were requested, all resampled items, tested negative. Foods in which all components have been cooked in the final food preparation, or have received some other listericidal treatment, should be free of *Listeria monocytogenes*. The detection of *L. monocytogenes* in such foods indicates the food was inadequately cooked or the food was contaminated post preparation. The detection of high levels ($>10^2$ cfu/g) of *Listeria monocytogenes* in RTE foods that have not undergone a listericidal treatment indicates a failure of food handling controls and is also considered a public health risk. Ready to Eat foods prepared specifically for "at risk" populations should be free of *L. monocytogenes.* None of the RTE foods in this survey were prepared specifically for "at risk" populations.

Bacillus cereus (Tested for in RTE foods containing rice only)
25 samples contained rice or pasta and were tested for *B. cereus.* 24 (96.0%) of samples tested were satisfactory with i.e. <100 cfu/g and 1 sample (4.0%) in the marginal category i.e. 100 - 1,000cfu/g. There were no samples in the unsatisfactory or potentially hazardous categories.

CONCLUSION

Overall the results of the 2004-5 Ready–To-Eat survey were similar to previous years with the Staphylococci results being the best to date. There was an increase in the number of *Listeria monocytogenes* isolated compared to the previous year. eg 12 to 10. It should be noted that this is second year in a row that no *Salmonella sp.* has been isolated.

BIBLIOGRAPHY

1. Guidelines for the microbiological examination of ready-to-eat foods FSANZ Dec 2001

ACT HEALTH PROTECTION SERVICE

COMPARISON of AUDIT SCORE to MICROBIOLOGICAL QUALITY OF READY-TO-EAT FOODS

JULY 2004– JUNE 2005

Report prepared by
Geoff Millard

OBJECTIVE

- Determine if there is a correlation between the audit score of a food premise and the microbiological quality of Ready to Eat food sampled at the same time from that premise.

BACKGROUND

As part of the commitment to Health Protection in the ACT, Food premises in the ACT are audited on a regular basis by Environmental Health Officers. These officers will inspect the premises and on the basis of that inspection assign an audit score to the premises. A number of papers in the international literature have suggested that the audit scores for restaurants that have experienced outbreaks do not necessarily differ from those that have not experienced outbreaks [1-3.] This audit score is determined on the basis of three separate criteria each carrying different weighting see appendix 1. An audit score of between 14 and 28 is considered 'Satisfactory', between 29 and 42 'Unsatisfactory' and over 42 'Critical'.

A microbiological score was assigned to each premise on the basis of the microbiological quality of the foods collected at that audit. The microbiological results of the collected foods were compared to those in the "Guidelines for the microbiological examination of ready-to-eat foods" FSANZ Dec 2001 If the individual microbiological food results fell into the satisfactory range it scored 0, marginal range 1, Unsatisfactory range 3 and potentially hazardous 5, see Appendix 2.

SURVEY

This audit survey was conducted between the 1 July 2004 and 30 June 2005. During this period 195 samples were collected from 42 ACT retail outlets. The outlets were selected randomly by Environmental Health Officers (EHO) and processed by the Microbiology Unit of Australian Capital Territory Government Analytical Laboratory (ACTGAL). The samples were collected in such a manner as to cover a wide range of the available RTE food types including salads, sushi, pies, quiches, sandwiches, noodles, pasta, meats and desserts. All of the samples were tested for the hygiene indicators SPC, *E. coli*, coagulase positive *Staphylococci* and also food pathogens *Salmonella* spp and *Listeria monocytogenes.* Foods containing pasta or rice were additionally tested for *Bacillus cereus*. Normally five samples collected at each audit and in general premises were only tested once.

Where fewer than five samples were collected the microbiological score was adjusted to represent five samples. One set of results were excluded from analyses due to the premises acting only as a sales outlet, the sandwiches were received in a sealed container and the attendant sold them sealed.

RATIONAL

The premise behind the analysis of the results is that the poorer an establishment scores on the audit scale i.e. higher score, the poorer will be the quality of the food prepared and served by that establishment. This correlation should be linear e.g. the higher the audit score for the premise the higher the microbiological score of the food produced at the premise

M ETHOD

If the results for each premise are plotted on X-Y graph, with the audit score along the X-axis and microbiological score along the Y-axis, if there is a strong correlation between the scores you should see a string of points rising from left to right. The most commonly used measure of linear correlation between two variables is the *Sample Correlation Coefficient* (Pearson correlation). Using Microsoft Excel it to possible to calculate the *Sample Correlation Coefficient (r),* once you have r it is possible to determine the percentage of the variation in values of the variable Y that may

be accounted for by the linear relationship with the variable X.

% Variation in Y = r^2 x100.

For example if the *Correlation Coefficient* was 0.947 (a very good relationship) then
$r^2 = 0.947^2 = 0.896$
0.896 x 100 = 89.6
We can say that 89.6% of the variation in the values of Y, can be accounted for by the linear relationship with the variable X.

RESULTS
The results were broken down into Full microbiology score per premise, full premise score minus Listeria scores, Full audit score and audit score weighted components.

MICRO		AUDIT	Weighted audit scores		
Full	minus List	Full	Food safety	Sanitation	Construction
0	0	21	7	8	6
0	0	17	7	4	6
0	0	35	14	12	9
0	0	18	7	8	3
0	0	14	7	4	3
0	0	14	7	4	3
0	0	14	7	4	3
0	0	17	7	4	6
0	0	14	7	4	3
0	0	17	7	4	6
0	0	21	7	8	6
0	0	14	7	4	3
0	0	17	7	4	6
0	0	24	14	4	6
0	0	25	14	8	3
0	0	17	7	4	6
0	0	14	7	4	3
0	0	17	7	4	6
0	0	21	14	4	3
0	0	21	7	8	6
1	1	17	7	4	6
1	1	14	7	4	3
1	1	14	7	4	3
1	1	18	7	8	3
1	1	21	7	8	6
3	3	14	7	4	3
3	3	14	7	4	3
4	4	17	7	4	6
4	4	29	14	12	3
4	4	14	7	4	3
4	4	22	7	12	3
5	0	17	7	4	6
7.5	7.5	14	7	4	3
7.5	7.5	21	7	8	6
9	4	18	7	8	3
9	4	14	7	4	3
10	10	18	7	8	3
10	0	24	7	8	9
10	0	21	7	8	6
11	11	14	7	4	3
40	15	14	7	4	3

As can be seen from the table above the variables collected were

- Full microbiology score for premise
- Full microbiology score minus Listeria Scores

- Full audit score
- Individual Audit components
    - Food safety
    - Sanitation
    - Construction

The initial r and % variation of Micro score due to Audit score were calculated as

Variables	Pearson Correlation	% Variation
Full Microbiology Score v Full Audit Score	-0.114	1.604
Full Microbiology Score - Listeria v Audit Score	0.0785	0.6116
Full Microbiology Score v Food Safety Score	-0.1516	2.2996
Full Microbiology Score v Sanitation Score	.0023	0.00053
Full Microbiology Score v Construction Score	-0.138	1.9198

Discussion

This survey demonstrated that there is no significant relationship between the results of the audits performed on the premises and the microbiological quality of the food produced by that premise.

The results of this survey indicate that the elements audited within the premise are not strongly correlated with the microbiological results achieved.

Recommendation

That thought is given, to revising the audit elements to make them more relevant to microbiological quality.

Bibliography

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2. Jones T. F et al. Restaurant Inspection Scores and Foodborne Disease. Emerging Infectious Diseases, Vol.10, No 4, April 2004 pp 688-692

3. Penman A.D et al. Failure of routine restaurant inspections: Restaurant-related foodborne outbreaks in Alabama, 1992, and Mississippi, 1993. Journal of Environmental Health, April 1996. Vol. 58. Issue 8 pp 23-7

4. Introduction to Statistics 2nd Ed.1974, Ronald e. Walpole. Collier Macmillan.

Appendix

Table 1

Test	Microbiological Quality (CFU per gram)			
	Satisfactory	**Marginal**	**Unsatisfactory**	**Potentially Hazardous**
Standard Plate Count (SPC)				
Level 1*	$<10^4$	$<10^5$	$\geq 10^5$	
Level 2*	$<10^6$	$<10^7$	$\geq 10^7$	
Level 3*	N/A	N/A	N/A	
Indicators				
Escherichia coli	<3	3-100	>100	**
Pathogens				
Coagulase positive staphylococci	$<10^2$	10^2-10^3	10^3-10^4	$\geq 10^4$ SET +ve
Bacillus cereus	$<10^2$	10^2-10^3	10^3-10^4	$\geq 10^4$
Salmonella spp.	not detected in 25g			detected
Listeria monocytogenes	not detected in 25g	detected but $<10^{2\ \#}$		$\geq 10^{2\ \#\#}$

NOTE:

*see below "Standard Plate Counts" for definition of level.

** Pathogenic strains of *E. coli* should be absent.

Foods with a long shelf life stored under refrigeration should have no *L. monocytogenes* detected in 25g.

The detection of *L. monocytogenes* in ready-to-eat-foods prepared specifically for "at risk" population groups (the elderly, immuno-compromised and infants) should also be considered as potentially hazardous.

SET +ve: Staphylococcus enterotoxin positive.

N/A – SPC testing not applicable. This applies to foods such as fresh fruits and vegetables (including salad vegetables), fermented foods and foods incorporating these (such as sandwiches and filled rolls).

RISK RATING CRITERIA

FOOD SAFETY

. TEMPERATURE CONTROL: - Refrigeration units
- Bain-marie

. FOOD STORAGE: - Food protected
- Appropriate containers
- Stored off the floor
- Adequate capacity
- Thawing correctly
- Air circulation
- Cooling correctly
- Stock rotated
- Raw food separated
- Refrigerated storage
- Compliance (ie. labelling)

. STANDARDS COMPLIANCE CHECKS EG.FERMENTED MEAT

. FOOD SPOILAGE

. FOOD NOT RE-SERVED

. FOOD COOKED TO ADEQUATE TEMPERATURES

. CHEMICALS STORED AWAY FROM FOOD

- CROSS CONTAMINATION PREVENTED DURING PREPARATION:

Working surfaces separated/ sanitised

. FOOD HANDLING:
- Food handling barriers
- Personal cleanliness
- Disease free and cuts are protected

. BULK STORAGE OF PREPARED FOODS

SANITATION

- CLEANING UTENSILS/CLOTHS: - Adequately st<;>red
- Soiled linen properly stored

,. CLEANLINESS: - Food contact surfaces
- Non-food contact surfaces - Utensils

. REFUSE CONTROL:
- Adequate number of bins
- Outside free of spillage and odour

. VERMIN EVIDENT

. CLEANING REGIMES: . - Cleaning compounds are available - Wash water changed

- Utensils rinsed and air dried
- Dish washer is not over loaded

. FREE OF UNNECESSARY APPLIANCES

. SOAP AND HAND TOWELS AVAILABLE

- GREASE TRAPS

- FREE OF SMOKE, STEAM, CONDENSATION

. UTENSILS FREE OF CRACKS AND CORROSION

CONSTRUCTION

Construction is generally related to the "fixed immovable components of the food premises". It also includes:

. ALL THOSE COMPONENTS OF THE BUILT ENVIRONMENT USED TO HANDLE OR PROTECT FOOD FROM CONTAMINATION

. THE MECHANISMS SUCH AS STANDS WHICH ARE USED TO ALLOW FOR ACCESSIBLE CLEANING

- THE TEMPERATURE AND SIZING COMPONENTS OF HOT WATER SYSTEMS

- THE OVERALL SIZE OF FOOD PREMISES

- SELF SERVE SALAD BARS - SNEEZE GUARDS

. THE PROVISION OF VERMIN CONTROL BARRIERS

. FLOORS, WALLS, CEILINGS . VENTILATION

. PLUMBING:

- Utensil cleaning facilities hot water requirements
- Hand Washing Facilities

- TOILETS:

- Access requirements/air locks

- LIGHTING

. EQUIPMENT LOCATION AND i CLEARANCES!

- GARBAGE ROOMS