Risk Assessment Studies
Report No. 46

Microbiological Hazard Evaluation

MICROBIOLOGICAL QUALITY OF NON-PREPACKAGED BEVERAGES MIXED OR TOPPED WITH SOLID INGREDIENTS IN HONG KONG

September 2011
Centre for Food Safety
Food and Environmental Hygiene Department
The Government of the Hong Kong Special Administrative Region

Correspondence:
Risk Assessment Section
Centre for Food Safety
Food and Environmental Hygiene Department
43/F, Queensway Government Offices,
66 Queensway, Hong Kong
Email: enquiries@fehd.gov.hk

Table of Contents

	Page
Executive Summary	2
Objectives	5
Introduction	5
Scope of Study	7
Methodology	8
Results	11
Discussion	16
Conclusion and Recommendations	21
References	25

Risk Assessment Studies
Report No. 46

MICROBIOLOGICAL QUALITY OF NON-PREPACKAGED BEVERAGES MIXED OR TOPPED WITH SOLID INGREDIENTS IN HONG KONG

EXECUTIVE SUMMARY

This study aims to provide an overview of the microbiological quality of some cold-served non-prepackaged beverages (NPB) mixed or topped with solid ingredients available in retail outlets. Results of this study also highlighted potential microbiological risks associated with NPB locally.

During July and mid-October 2010, the Centre for Food Safety (CFS) obtained a total of 198 NPB samples from different retail outlets. Laboratory analysis for five microbiological parameters, namely aerobic colony count (ACC), *Escherichia coli*, *Salmonella* spp., *Staphylococcus aureus* count and *Clostridium perfringens*, were conducted by the Public Health Laboratory Services Branch of the Centre for Health Protection (CHP), Department of Health.

Results showed that out of the 198 NPB sampled, the microbiological quality of 148 (74.7%) were Class A, 35 (17.7%) were Class B, 15 (7.6%) were Class C, and none were Class D (Unacceptable). All the Class C samples were due to excessive ACC. The ACC assessment was only applicable to 145 NPB samples; 15 of them were found to have excessive ACC ($\geq 10^5$ cfu/g). Further analysis showed that samples containing dairy ingredients or red/green beans were more likely to have excessive ACC. It is believed that prolonged storage of the prepared ingredients at ambient temperature may result in unsatisfactory microbiological quality of the samples.

Conclusion

Majority (92.4%) of the NPB purchased in local retail outlets were of Class A or Class B microbiological quality, while no samples were of Class D microbiological quality. The Class C samples, which hygienic quality needs improvement, in the study were all due to excessive levels of ACC. Prolonged storage of the prepared or ready-to-eat ingredients within the temperature danger zone (4 to 60 ^{o}C) may be the cause for Class C results. Members of the trade should take note of the results of this study and avoid prolonged storage of prepared or ready-to-eat ingredients at ambient temperature.

Advice to public

- Patronise reliable and licensed food premises.
- Consume NPB as soon as possible.
- If NPB are not consumed immediately, keep them at or below 4°C.

Advice to trade

- Store drink mixes and beverage ingredients preferably in containers with lids at safe temperatures e.g. perishable items including fresh ingredients at 4^{o}C or below, frozen items at -18°C or below.
- Estimate the demand of the food ingredients for preparing beverages carefully to avoid over-production.
- Keep prepared or ready-to-eat ingredients for beverage in covered containers and away from non ready-to-eat food, in the upper compartment if stored in the same refrigerator, at temperature at 4^{o}C or below.
- Adopt appropriate measures to ensure first-in-first-serve of ingredients which are cooked or prepared in advance e.g. use date and time coding to show the storage time.
- Wear disposable gloves when handling ready-to-eat food including

ingredients for NPB.

- Clean and sanitise all utensils and equipment regularly including tongs and packaging machines with suitable facilities and procedures.

Microbiological Quality of Non-prepackaged Beverages Mixed or Topped with Solid Ingredients in Hong Kong

OBJECTIVES

The objective of this study is to provide an overview of the microbiological quality of some cold-served non-prepackaged beverages (NPB) mixed or topped with solid ingredients available in retail outlets in the territory. Results of this study also highlighted the potential microbiological risks associated with NPB locally.

INTRODUCTION

2. A wide variety of beverages are available in Hong Kong. In recent years, more and more takeaway beverage shops selling NPB are available. Some of these NPB are mixed or topped with different solid ingredients such as pearl tapioca, jelly, aloe vera, fruit, and red beans. They are generally prepared for immediate consumption and not stored in sealed bottles or cans. Although they are termed as NPB, some of these products may have plastic cup lid or heat seal plastic film provided by vendors. In addition, many of these drinks are served cold and hence are preferred by consumers especially during summer.

3. However, these drinks may have variable microbiological quality. Ingredients added to NPB may be prepared in advance and processed

manually e.g. mixing different ingredients together before serving. Unhygienic handling of these ingredients may result in contamination and improper storage may allow microorganisms to multiply to a high level. In addition, some NPB may be added with raw ingredients like fresh fruit or its juice, which are prone to contamination from the environment and during handling like cutting and peeling.[1]

4. On the other hand, cold-served drinks may have higher microbiological risk in comparison with the hot-served drinks. Hot-served drinks are generally prepared with boiling hot water where microbiological hazards could be reduced by the high temperature, whilst there may not be such step when preparing iced or cold beverages. Hot-served drinks are also more likely to be prepared upon ordering, while some cold-served drinks, e.g. milk tea, may be prepared and cooled in advance.

5. A microbiological test on some Taiwanese style iced beverages available in the local market conducted by the media in 2009 suggested that some of these beverages were of unsatisfactory microbiological quality due to excessive levels of total bacterial count or *Escherichia coli*. However, the Microbiological Guidelines for Ready-to-eat Food issued by the Centre for Food Safety (CFS) were not taken as reference for result interpretation. The result was compared against the criteria in Taiwan for packed beverage products.[2]

6. On the other hand, there are licensing conditions for the control and monitoring of the microbiological quality of non-bottled drinks such as soft drinks from vending machines and fresh fruit juices in Hong Kong. Due to various nature of the products, other iced or cold beverages, such

as red bean icy drink and iced milk tea with pearl tapioca, are not governed under the foresaid licensing conditions. Although NPB are also collected during routine surveillance, the number of samples examined may not be as many as that for non-bottled drinks.

7. In order to give an overview of the microbiological quality of locally available cold-served NPB especially those mixed or topped with solid ingredients, a risk assessment study was conducted by the CFS.

SCOPE OF STUDY

8. Due to the diversity of cold-served NPB available in the market, this study focused on NPB that contain solid ingredients or toppings. The drinks containing these ingredients may be of higher microbiological risk as the ingredients may be prepared in advance and have variable microbiological quality. Many of these beverages are prepared with milk tea or fruit juice/fruit flavours as the liquid component. The solid ingredients or toppings may be added upon consumers' request. Collected samples were divided into three types:-

(a) Dairy: NPB containing dairy ingredients such as milk and cream

(b) Fruit/fruit-flavoured: NPB containing fruit / fruit-flavoured ingredients

(i) NPB containing fresh fruit or vegetables components (Cat. 5, where aerobic colony count (ACC) assessment is not applicable)

(ii) NPB containing fruit-flavoured or processed fruit

(c) Others: NPB containing ingredients other than fruit/fruit-flavoured or dairy products, also included NPB

containing non-dairy creamer

9. On the other hand, the following beverages were excluded in this study: (1) Beverages that are permitted to be sold with a non-bottled drinks permit issued by Food and Environmental Hygiene Department (FEHD), e.g. drinks served with dispensing machines; (2) Beverages that may belong to frozen confection, e.g. sorbet and flavoured ice beverages; and (3) Beverages that may be of lower microbiological risk, e.g. hot-served beverages, yoghurt containing beverages. The first two were not included because they are covered by routine food surveillance and tested in accordance with specific microbiological criteria in licensing conditions or regulations.

METHODOLOGY

Sampling

10. The sampling was conducted from July to mid-October 2010.

11. A total of 198 NPB samples were collected from different types of premises:

- Fast food shops;
- Light refreshment restaurants, e.g. café, coffee shop, dessert shop;
- Tea restaurants / General restaurants; and
- Takeaway beverage outlets, e.g. Taiwanese style beverages shop.

12. The samples were mainly taken from tea restaurants/general restaurants and takeaway beverage outlets, which generally provide beverages mixed with various kinds of ingredients or toppings. As some

target samples are also available in other shops such as fast food shops and light refreshment restaurants, these shops were also included. The distribution of collected samples among these categories is outlined in Table 1.

Table 1: Sampling distribution of different regions

Regions	No. of Samples taken				
	FFS	**LRR**	**TR/GR**	**TBO**	**Region Total**
Hong Kong	5	6	34	21	**66**
Kowloon	3	11	25	27	**66**
New Territories	1	5	34	26	**66**
Total	**9**	**22**	**93**	**74**	**198**

FFS = Fast food shops; LRR = light refreshment restaurants; TR/GR =Tea restaurants /General restaurants; TBO = Takeaway beverages outlets

13. Health inspectors were required to note down the main ingredients of the drinks and the temperature of the samples during sampling. Food premises were selected by the responsible health inspectors by applying the following criteria as far as possible:

(i) take samples from different districts within the region;

(ii) avoid sampling at different outlets belonging to the same retail chain; and

(iii) avoid taking more than one sample from any outlet.

Laboratory analysis

14. All samples were stored at 4°C or below during transport and they were delivered to the Public Health Laboratory Services Branch of the Centre for Health Protection, Department of Health, within four hours of sampling. ACC, *E. coli* count, presence or absence of *Salmonella* spp. in 25 g (ml) sample, *Staphylococcus aureus* count and *Clostridium*

perfringens count were used to reflect the microbiological quality of NPB.

15. ACC is a count of bacteria which includes those naturally occurs in most foods and those as a result of contamination. The number of bacteria increases significantly over time in response to poor temperature control of the product. It was used as a quality indicator for NPB in this study. For fresh fruit or vegetables, ACC is likely to be high and hence this criterion is not applied to NPB containing fresh fruit or vegetable ingredients, such as sliced mango. However, the criterion applied to NPB samples containing canned fruit and processed fruit which are processed and have reduced bacterial count as compared to fresh fruit.

16. *E. coli* is commonly used as an indicator organism to reflect the hygienic quality of food. Its presence in food generally indicates direct or indirect faecal contamination. Substantial number of the bacterium in food suggests a general lack of cleanliness in handling and improper storage.

17. *Salmonella* spp., *C. perfringens* and *S. aureus* are pathogenic bacteria that may cause food poisoning. They are the pathogenic bacteria included in licensing conditions for non-bottled drinks and were used to evaluate the safety of NPB in this study.

18. The enumeration of ACC (Spiral Plate Method at 30°C), enumeration of *C. perfringens*, and detection of *Salmonella* spp. were performed respectively according to National Standard Method F11 Issue 1, F14 issue 2 and F13 issue 1 published by Health Protection Agency in the U.K. *S. aureus* counts were enumerated by AOAC Official Method

2003.11 and samples with unsatisfactory counts were double-confirmed by ISO 6888-2:1999.[3]

Result analysis

19. The microbiological results of the NPB samples were analysed by the Risk Assessment Section of the CFS. The microbiological quality of samples was assessed against the criteria listed in Table 2. This part of the criteria was extracted from the Microbiological Guidelines for Ready-to-eat Food issued by the CFS.[4]

Table 2. Microbiological criteria used in this study

Microbiological parameter	**Microbiological quality** Colony-forming unit (cfu) per gram unless specified			
	Satisfactory (Class A)	Acceptable (Class B)	Unsatisfactory (Class C)	Unacceptable (Class D)
Aerobic colony count†	$<10^4$	10^4 - $<10^5$	$\geq 10^5$	N/A
Escherichia coli (total)	<20	20 - <100	≥100	N/A
Salmonella spp.	Not detected in 25 g	N/A	N/A	Present in 25 g
Staphylococcus aureus	<20	20 - <100	100 - $<10^4$	$\geq 10^4$
Clostridium perfringens	<20	20 - <100	100 - $<10^4$	$\geq 10^4$

† NPB belongs to Category 2 when assessing the ACC, except for those containing "fruit and vegetables (fresh)", which belong to Category 5 (i.e. ACC not applicable).
N/A denotes "Not applicable"

RESULTS

Overall microbiological results

20. The overall microbiological results of the NPB tested are presented in Table 3. Out of the 145 NPB samples where ACC

assessment applies, the count in 130 (89.7%) samples was less than 10^5 cfu/g. *Salmonella* spp. were not detected in all samples. All NPB samples, including the 53 samples containing fresh fruit ingredients, had *E. coli* and *C. perfringens* counts less than 20 cfu/g. All, except one pineapple punch sample, contained less than 20 cfu/g *S. aureus*. That pineapple punch sample contained 30 cfu/g *S. aureus*, in which the microbiological quality still laid within the acceptable range.

Table 3. Microbiological results of NPB (Number of samples=198)

Criteria	Microbiological results								
	in 25g		cfu per g						
	Detected	Not detected	<20	20-<10^2	10^2-<10^3	10^3-<10^4	10^4-<10^5	10^5-<10^6	≥10^6
Aerobic colony count (applicable to 145 samples)			65			30	35	11	4
Escherichia coli (total)			198	0	0	0	0	0	0
Clostridium perfringens			198	0	0	0	0	0	0
Staphylococcus aureus			197	1	0	0	0	0	0
Salmonella spp.	0	198							

21. When compared with the microbiological limits set out in the Microbiological Guidelines for Ready-to-eat Food (Table 2), the microbiological quality of 74.7% NPB were Class A, 17.7% were Class B, 7.6% were Class C and none were Class D (Table 4). All of the Class C samples, which hygienic quality need improvement, were due to excessive ACC.

Table 4. Number of NPB samples in each of the microbiological quality class, classified in accordance with the Microbiological Guidelines for Ready-to-eat Food issued by the CFS

	Satisfactory (Class A)	Acceptable (Class B)	Unsatisfactory (Class C)	Unacceptable (Class D)
Aerobic colony count (applicable to 145 samples)	95	35	15	N/A
Escherichia coli	198	0	0	N/A
Clostridium perfringens	198	0	0	0
Staphylococcus aureus	197	1	0	0
Salmonella spp.	198	0	0	0
Overall	148 (74.7%)	35 (17.7%)	15† (7.6%)	0 (0%)

N/A denotes "Not applicable"

†Samples were taken from Light refreshment restaurants (1); Tea restaurants /General Restaurant (8); and Takeaway beverages outlets (6)

Analytical results of Aerobic Colony Count

22. Around 10% of the NPB samples where ACC assessment applies were found to contain excessive ACC. The ACC of the samples were further compared in terms of different types of shops or ingredients which were believed to be the factors affecting the hygienic quality.

Different types of premises and NPB in this study

23. Comparison of ACC of NPB obtained from different types of premises and NPB with different ingredients are shown in Table 5 and Table 6 respectively. There is not much difference in number of samples with excessive levels of ACC between tea restaurants /general restaurant and takeaway beverages outlets. For fast food shop and light refreshment restaurants which have fewer samples collected, only one sample was found with excessive level of ACC. For NPB with different types of ingredients, more NPB samples in "Type (a) Dairy" were found

to have excessive levels of ACC in comparison with other types of NPB.

Table 5. ACC of NPB obtained from different types of premises (Number of samples=145)

Types of food premises	Aerobic colony count (cfu per g)					Samples with Class C results [ACC $\geq 10^5$] (%)
	$<10^3$	10^3-$<10^4$	10^4-$<10^5$	10^5-$<10^6$	$\geq 10^6$	
Fast food shops	4	1	3	0	0	0/8 (0)
Light refreshment restaurants	4	5	5	1	0	1/15 (6.7)
Tea restaurants /General restaurants	35	10	9	5	3	8/62 (12.9)
Takeaway beverages outlets	22	14	18	5	1	6/60 (10)

Table 6. ACC of different types of NPB (Number of samples=145)

Types of samples	Aerobic colony count (cfu per g)					Samples with Class C results [ACC $\geq 10^5$] (%)
	$<10^3$	10^3-$<10^4$	10^4-$<10^5$	10^5-$<10^6$	$\geq 10^6$	
Type (a) Dairy	28	10	20	9	2	11/69 (15.2)
Type (b) Fruit or fruit-flavoured†	27	14	12	1	1	2/55 (3.6)
Type (c) Others	10	6	3	1	1	2/21 (4.8)

†without fresh fruit or vegetables components

Different solid ingredients

24. As shown in Table 7, NPB samples with Class C microbiological quality included those prepared from hot or cold water, but many of them were found to contain pearl tapioca and/or red/green beans as solid ingredients. The distributions of ACC in NPB samples containing these two components are shown in Table 8. Comparison in Table 8 revealed that NPB samples containing red/green beans had a higher unsatisfactory rate for ACC assessment, in which around one third of them were found to be of Class C microbiological quality.

Table 7. Summary on ACC of NPB samples with Class C microbiological results

	Premises*	**Food Item purchased**	**Prepared with hot or cold water**	**Solid Ingredients**	**ACC (cfu/g)**
1	TR/GR	Iced milk tea with red bean	Hot	Red bean	$>10^6$
2	TR/GR	Iced milk tea with pearl tapioca	Hot	Pearl tapioca	110,000
3	TR/GR	Iced green milk tea with pearl tapioca	Hot	Pearl tapioca	290,000
4	TR/GR	Iced green tea with red bean	Hot	Red bean	460,000
5	TBO	Iced brown sugar milk tea with pearl tapioca	Hot	Pearl tapioca	110,000
6	TBO	Iced green milk tea with pearl tapioca	Hot	Pearl tapioca	200,000
7	LRR	Iced mixed tea-coffee with pearl tapioca	Hot	Pearl tapioca	250,000
8	TBO	Iced milk tea with red bean	Cold	Red bean	470,000
9	TR/GR	Tri-colour icy drink	Cold	Mung bean, red bean and jelly	110,000
10	TBO	Iced brown sugar milk tea with pearl tapioca	Cold	Pearl tapioca	110,000
11	TR/GR	Iced milk tea with green bean	Hot	Green bean	$>10^6$
12	TBO	Iced milk tea with pearl tapioca	Cold	Pearl tapioca	180,000
13	TR/GR	Red bean icy drink	Cold	Red bean	$>10^6$
14	TR/GR	Iced milk tea with red bean	Hot	Red bean	150,000
15	TBO	Iced mango green tea with jelly	Cold	Jelly	$>10^6$

* Refer to Table 1 for abbreviation

Table 8. ACC of NPB containing pearl tapioca and red/green bean (Number of samples=145)

Solid ingredients	Aerobic colony count (cfu per g)					Samples with Class C results [ACC $\geq 10^5$] (%)
	$<10^3$	10^3-$<10^4$	10^4-$<10^5$	10^5-$<10^6$	$\geq 10^6$	
Pearl Tapioca	28	11	17	7	0	7/63 (11.1)
Red/Green beans	9	4	3	4	3	7/23 (30.4)

25. By comparing the unsatisfactory rates (Class C) of NPB with or without pearl tapioca or red/green beans, it is noted that more NPB samples with red/green beans were of Class C quality than those without

red/green beans, while similar unsatisfactory rates are observed for NPB samples with or without pearl tapioca as a solid ingredient. (Table 9)

Table 9. Comparison of the unsatisfactory rates (Class C) under ACC assessment of NPB containing or not containing pearl tapioca and red/green bean (Number of samples=145)

Solid ingredients	Samples with Class C results [ACC $\geq 10^5$] (%)	
	Contain the ingredient	Do not contain the ingredient
Pearl Tapioca	7/63 (11.1)	8/82 (9.8)
Red/Green beans	7/23 (30.4)	8/122 (6.6)

Temperature

26. The temperatures of all NPB samples were found to be lower than 7°C during sampling.

DISCUSSION

27. This study showed that majority (92.4%) of the NPB purchased in retail outlets were of Class A or Class B microbiological quality, while no samples were of Class D. None of the samples were found to be potentially hazardous to human health. However, 7.6% of samples were found to have Class C results and all are due to excessive ACC. High level of ACC does not indicate an immediate risk to public health; however, it may indicate a sub-optimal hygienic conditions and further improvement on the hygienic conditions is required.

28. There is an increasing number of takeaway beverage shops selling these NPB, known as “Taiwanese style beverages”, in recent years.

Many of these shops have a confined area for preparation of NPB, including snacks in some shops, for customers to takeaway. The limited space may result in raw and cooked ingredients/snacks being prepared in the same area, thus allowing cross-contamination of microorganisms. On the other hand, NPB can be mixed with different solid ingredients or toppings. These ingredients can be prepared in different ways, e.g. some may involve cooking, some are just prepared from raw ingredients, and some are mixed with both cooked and raw ingredients. These may contribute to variable microbiological quality of the NPB. Some NPB samples were found to have hygienic problems in this study, ACC were further compared to identify the potential risk factors that food handlers may need to observe.

29. Hygienic conditions of the ingredients used may be a contributing factor to the microbiological quality of the NPB samples. Majority of the NPB were found to be of Class A or Class B microbiological quality, while more NPB samples containing dairy ingredients or red/green beans were found to have less than satisfactory microbiological quality due to excessive levels of ACC. It is believed that prolonged storage of these ingredients under temperature danger zone (4 to 60°C) may result in an increase in bacterial number and hence higher level of ACC.

30. Different types of processed milk, such as milk powder, sterilised milk may be used for preparation of milk tea. Dried milk powder is generally not favourable for microbial growth. For liquid milk, subject to different heat treatment methods employed, there are different microbiological standards under the Milk Regulation (Cap. 132AQ) for the milk and milk beverages. Pasteurised milk should have a total

bacterial count of no more than 30 000 per ml and coliform organisms should be absent in 0.1 ml, and sterilised milk should have a colony count of less than ten. The CFS takes different kinds of milk samples for examination and failed samples are very uncommon. Hence, the presence of excessive levels of ACC in NPB samples prepared from processed milk is likely to be due to prolonged storage of the heat treated milk after opening or the prepared milk tea, at abused temperature.

31. Among different types of solid ingredients in samples collected, many of those containing red/green beans were of less than satisfactory hygienic quality. Red/green beans are required to be cooked in advance and they are also available in a canned form. The microbial load should be low. However, if red/green beans are cooled for a prolonged period of time after cooking, or the prepared red/green beans are used for several days during which the ingredients may be exposed to abused temperature, this would allow the microorganisms to grow to a large number and affect the microbiological quality of the food products. On the other hand, this phenomenon was not noted for pearl tapioca, which was also prepared in advance. It may be due to the fact that pearl tapioca is usually freshly prepared everyday.

32. Most pathogenic bacteria can grow well at the temperature range between 4°C to 60°C and refrigeration can slow bacterial growth. However, spoilage bacteria can grow at low temperature where they may grow to large number on food that has been stored too long in the refrigerator.[5] The bacteria are able to decompose food and cause taste/smell changes, which affect the quality of food. Spoilage bacteria do not normally cause illness, however, when consumed in very large numbers, they can cause gastrointestinal disturbance. Hence, although

ingredients for NPB prepared in advance can be stored in refrigerator, they should not be stored for too long. This also applies to prepackaged or canned ingredients stored under refrigeration after opening.

33. A number of NPB samples collected contained fruit ingredients. Canned or preserved fruit are generally processed and the microbiological risk should be low, except when there is improper handling or storage after taking out from the package. On the other hand, a number of NPB samples were prepared with raw fruits. Although they may be contaminated at any point during their growth, harvesting, processing, distribution, retail sale and final preparation and they may be considered to be of higher risk, none of the NPB samples containing raw fruit was unsatisfactory. This is also in line with our previous study that pre-cut fruits taken from the retail outlets were all satisfactory.[6]

34. All the NPB samples taken were cold drinks and below 7°C, ice cube is commonly added to maintain the low temperature of drinks for consumers. Although the ice cube from the NPB were not sampled in this study, the CFS has previously collected edible ice from ice manufacturing plants and retail businesses in Hong Kong.[7] Comparing with packaged ice sampled from manufacturing plants, higher percentages of packaged ice sourced from manufacturing plants but sampled from retail outlets was found to have higher coliform counts and ACC. The reason might be that the surface of ice bags had been contaminated during transportation and storage. The contaminated surface might subsequently contaminate the ice during opening and emptying of the ice bags. Food premises producing NPB should note this potential source of contamination. Edible ice is one of the items under CFS' food surveillance and collected samples would be assessed in

accordance with the microbiological criteria for edible ice established by the CFS in 2009:-

	Ice from ice manufacturing plants and retail outlets (packaged ice)	*Ice from retail business (loose ice)*
Coliforms	0 cfu /100ml	<100 cfu /100 ml
E. coli	0 cfu /100ml	0 cfu /100 ml
ACC	<500 cfu /ml	<1,000 cfu /ml

Follow-up on the unsatisfactory samples

35. In this study, 15 NPB samples were of Class C that need improvement in microbiological quality. For these samples with Class C results, the CFS gave health advice to relevant parties and took follow-up samples, where available. Some products were stopped for sale afterwards. For available follow-up samples, no Class C results were found.

Limitations

36. In this study, only around 200 NPB samples were taken and because of wide variety of NPB available on the market, only selected types of NPB were covered due to limited sample size. Several types of NPB were assigned to each targeted premise for health inspectors to collect, but the selected NPB may not be available in some of the targeted premises. Hence, the number of samples in each type of NPB was unevenly distributed.

37. Collected samples were categorised based on ingredients and information given to the health inspectors. It should be noted that the food production process and the ingredients may vary among food

producers.

CONCLUSION AND RECOMMENDATIONS

38. This study showed that the microbiological quality of more than 90% of the NPB samples taken from retail outlets was Class A or Class B. None of the samples were found to have food safety problem. ACC was the only microbiological parameter associated with the unsatisfactory quality, where 15 samples were of unsatisfactory quality among 145 samples which ACC assessment applied. This may indicate a sub-optimal hygienic conditions and further improvement on the hygienic conditions is required. Around half of the unsatisfactory samples were found to contain dairy or red/green beans. Food handler may need to observe good personal and hygiene practices on handling and storage of ingredients for preparation of NPB; prevent post-cooking contamination and avoid prolonged storage under temperature danger zone (4 to 60°C).

39. The CFS recommends practising the Five Keys to Food Safety in the daily operation for preparation and handling of NPB.

1. Choose (Choose safe raw materials)
2. Clean (Keep hands and utensils clean)
3. Separate (Separate raw and cooked food)
4. Cook (Cook thoroughly)
5. Safe Temperature (Keep food at safe temperature)

Below are some advices for trade and public in relation to NPB.

<u>Advice to Public</u>

- Patronise reliable and licensed food premises.
- Consume non-prepackaged beverages as soon as possible.
- If non-prepackaged beverages are not consumed immediately, keep them at or below 4°C

Advice to Trade

Purchase and Receiving

- Obtain drink mixes and other ingredients from approved and reliable sources.
- Use fresh and wholesome food ingredients and check the quality of the ingredients upon receipt, e.g. ensure there are no signs of contamination or damage to the raw ingredients, avoid mouldy food.

Storage

- Store drink mixes and beverage ingredients preferably in containers with lids at safe temperatures e.g. perishable items including fresh ingredients at 4^{o}C or below, frozen items at -18°C or below.
- Ideally, use two separate refrigerators for storing non ready-to-eat food or ready-to-eat food.
- If non ready-to-eat food and ready-to-eat food have to be stored in the same refrigerator, store food in containers with lids to avoid contact between non ready-to-eat food and ready-to-eat food.
- Apply the first-in-first-out principle to store food. Do not use food beyond its expiry date or expected shelf life.

Preparation

- Food contact surfaces of equipment and utensils should be maintained in a clean and sanitary condition.
- Use safe and clean water for making ice.
- Use only boiled water and/or distilled water for diluting drink mixes/fruit juices in the preparation of the beverages.
- Estimate the demand of the food ingredients for preparing beverages carefully to avoid over-production.
- Plan the production schedule ahead to avoid preparing food ingredients for beverages too far in advance.
- Use separate utensils to handle non ready-to-eat or ready-to-eat food.
- Use utensils, such as, tongs, scoops, spoons, small cup, tissue paper or clean gloves when handling ready-to-eat food or ice used in drinks.
- Wash fruits and vegetables thoroughly under running water, especially if they are to be eaten raw or with little cooking.

Cooking (If applicable)

- Cook thoroughly, with core temperature at 75^{o}C or above for at least 30 seconds.

Cooling

- Cool food and drinks from 60°C to 20°C as quickly as possible (within 2 hours); and from 20°C to 4°C, within 4 hours or less.
- Speed up the cooling process by using wide, shallow containers or reducing the size of the portions.
- Use potable water/ ice wherever necessary to cool ingredients for drinks.

Cold Holding

- Keep prepared ingredients for beverages in covered containers and away from non ready-to-eat food, in the upper compartment if stored in the same refrigerator, at temperature at 4°C or below. Check the temperature regularly to ensure that the food is kept at designated temperature.
- As a general rule, after proper cooling, if prepared ingredients have been kept under room temperature:
  - for less than 2 hours, they can be refrigerated for final use later or used before the 4 hours limit is up.
  - for more than 2 hours but less than 4 hours, they should be used within the 4 hours limit is up but should not be returned to the refrigerator.
  - for more than 4 hours, they should be discarded.
- Adopt appropriate measures to ensure first-in-first-serve of beverage ingredients which are cooked or prepared in advance e.g. use date and time coding to show the storage time.

Personal and Environmental Hygiene

- Always follow good personal hygiene practices, including:
  - Wash hands thoroughly with running water and soap for 20 seconds before handling foods, often during food preparation and after going to the toilet;
  - Wear clean and light-coloured outer clothing or protective overalls;
  - Wear disposable gloves when handling ready-to-eat food;
  - Open wound should be covered by gloves or bright-coloured waterproof bandages;
  - Suspend from engaging in any food handling work when suffering or suspected to be suffering from an infectious disease or symptoms of illness such as flu, diarrhoea, vomiting, fever, sore throat and abdominal pain.
- Ensure hygiene of equipment/utensil by:
  - Clean and sanitise all utensils and equipment regularly including tongs and packaging machines with suitable facilities and

procedures;

- Check, clean and change water filter regularly if used;
- Keep all drinking straws (or tubes) in dust-proof containers.

REFERENCES

1. Harris, L. J., J. N. Farber, L. R. Beuchat, M. E. Parish, T. V. Suslow, E. H. Garrett, and F. F. Busta. 2003. Outbreaks Associated with Fresh Produce: Incidence, Growth, and Survival of Pathogens in Fresh and Fresh-Cut Produce. Comprehensive Reviews in Food Science and Food Safety 2**:**79-141.
2. Food and Drug Administration, Department of Health, Executive Yuan, 2010. 飲料類衛生標準. Available from: URL: http://www.fda.gov.tw/people_laws.aspx?peoplelawssn=1150&keyword=&classifysn=62 [Accessed 16 May 2011]
3. CHP, 2010. Guide to Requests for Laboratory Testing : 4. Public Health. Available from: URL: http://www.chp.gov.hk/files/pdf/grp-specimenhandbook-en-2004122804.pdf [Accessed 16 May 2011].
4. CFS, 2007. Microbiological Guidelines for Ready-to-eat Food. Hong Kong: CFS; May 2007. Available from: URL: http://www.cfs.gov.hk/english/whatsnew/whatsnew_act/files/MBGL_RTE%20food_e.pdf [Accessed 16 May 2011]
5. U.S. Department of Agriculture, 2010. Safe Food Handling: Refrigeration and Food Safety. Available from: URL: http://www.fsis.usda.gov/factsheets/refrigeration_&_food_safety/index.asp [Accessed 16 May 2011]
6. CFS, 2006. Risk Assessment Studies Report No. 25 Microbiological Quality of Pre-Cut Fruits for Sale or Serving in Retail Outlets. Available from: URL: http://www.cfs.gov.hk/english/programme/programme_rafs/files/RAS25Pre-cut-fruits.pdf [Accessed 16 May 2011]
7. CFS, 2005. Risk Assessment Studies Report No. 21 The Microbiological Quality of Edible Ice from Ice Manufacturing Plants and Retail Businesses in Hong Kong Available from: URL: http://www.cfs.gov.hk/english/programme/programme_rafs/files/edible_ice_ra.pdf [Accessed 16 May 2011]