

Risk Assessment Studies
Report No. 4

Microbiological Hazards Evaluation

SANDWICHES IN HONG KONG

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SANDWICHES IN HONG KONG

An Evaluation of Sandwiches
Microbiological Surveillance
1997 – 1999

Abstract

Sandwich is one of the most popular fast food in Hong Kong. There are many styles of sandwiches available in local market, such as large sandwich chain stores, restaurants and supermarkets. In reviewing the microbiological surveillance findings on 1,023 sandwich samples collected from 1997 through 1999, 88 samples (8.6%) were found unsatisfactory in one or more microbiological tests. Trend analysis showed that the percentage of unsatisfactory samples decreased from 11.5% in 1997 to 9.9% in 1998 and then, to 3.8% in 1999. 82 out of 88 unsatisfactory samples (93.2%) failed in total bacterial count which reflects the hygienic quality of foods. The remaining 6 unsatisfactory samples were found unsatisfactory in the examination of pathogens. *Salmonella* species was detected in 3 samples in 1997 and in 1998. *Listeria monocytogenes* and *Staphylococcus aureus* were detected in 2 samples and 1 sample in 1998 respectively. Not all the ingredients for sandwiches are cooked and many preparation steps are done by bare hands. Therefore, ingredients and post cross-contamination are the two main pathways to contaminate the final products. Both the trade and consumers are advised to take necessary precautions to enhance food safety in preparation and consumption of sandwiches.

Sandwiches in Hong Kong

- An Evaluation of Sandwiches Microbiological Surveillance 1997 – 1999

OBJECTIVE

The aim of this paper is to evaluate the microbiological hazards of sandwiches. The food surveillance findings from 1997 through 1999 were reviewed and analyzed to determine the microbiological status of sandwiches available in the local market.

INTRODUCTION

2. Sandwich is one of the most popular fast food in Hong Kong. They are also considered as light meals for lunch. As more people are eating-out, the commercially available sandwiches may be their choice. Many different styles of sandwiches could be found in the menu in most restaurants. Large sandwiches chain stores may supply other kinds of light refreshments such as bagel, roll, salad and fruits to customers. Sandwiches can also be found in supermarkets.

3. The classic sandwich consists of one to two pieces of bread with filling in the middle. Different fillings, such as meat, fish, egg, cheese, vegetables with or without sauces, may be used to prepare sandwiches according to customers' orders. Sandwiches may be served cold or hot.

Production of sandwiches

4. Most sandwiches available in local market are commonly fresh-made in sandwich chain stores and restaurants. Pre-packaged sandwiches are also supplied from some food factories to retail outlets and/or supermarkets thus involving delivery step in production.

5. The production of sandwich includes purchasing raw materials, filling preparation, assembly of bread and fillings, packaging, delivery and serving. The general production of sandwiches is illustrated in the flowchart at figure 1.

6. Raw materials include eggs, meat and poultry products, vegetables, bread and sauce. Some of these raw materials, like eggs, meat, poultry products and vegetables must be processed first. Others such as breads and sauces, are usually readily available for immediate use. In order to control the quality of food products, large sandwich chain stores purchase some ready-to-use fillings from the suppliers. These fillings normally packed and delivered in packages below 3kg per bag.

7. The processing of raw ingredients for fillings will undergo steps such as washing, cutting, marinating, cooking and mixing with salad dressings, depending on the styles of the fillings. Salad dressing may be added to bind ingredients in the fillings and improve taste and texture of the products. In some instances, it may contribute preservative effect to food to a certain extent.

8. When all ingredients are ready to be used, “sandwiching” will follow. This refers to the assembly of breads with fillings. Butter may be spread on bread and different style of fillings may be put in between pieces of bread depending on consumer’s choice. Afterwards, sandwiches may be cut into triangular shape.

9. The finished product may be served immediately in shops or restaurants. Otherwise, the fresh-made sandwiches may be packed in factory and delivered to retail outlets or supermarkets for sale.

Potential microbiological hazards

10. Some high-risk ingredients, such as vegetables and eggs, are commonly used in sandwiches. Raw vegetables are well known to be used in sandwich together with salad dressing commonly. Vegetables if not properly cleansed would be contaminated with *Listeria monocytogenes* and *Clostridium perfringens* commonly found in soil (1).

11. For *Salmonella* species, raw egg is one of the commonest food vehicles (2). The pathogen may be introduced from raw materials to final products if the eggs used for the sandwiches are not cooked thoroughly.

12. As sandwich preparation often involves handling of pre-cooked or ready-to-eat ingredients, good personal and environmental hygienic practices should be observed to minimize the chance of cross contaminations of microbiological hazards. Common pathogens transmitted through bare-hand handling are *Salmonella* spp. and *S. aureus* (1, 3).

MICROBIOLOGICAL SURVEILLANCE ON SANDWICHES

13. The microbiological examination results of sandwiches from 1997 through 1999 are reviewed and analyzed. The samples were taken by public health inspectors from retail outlets and examined by the Institute of Pathology, Department of Health. The microbiological tests for sandwiches included that of hygienic quality and specific pathogens.

14. The food surveillance results were evaluated based on the departmental microbiological guidelines for ready-to-eat food. According to the guidelines, sandwiches are classified under (i) sandwich without salad, and (ii) sandwiches with salad (Appendix 1).

15. The operational definition for sandwiches with salad refers to those with salad dressing as filling. For these sandwiches, a higher total bacterial count in the final product is allowed. However, the expected *E. coli* count which is an indicator for faecal contamination remained the same for both categories of sandwiches. They should also comply with the same requirement in terms of the specific pathogens.

RESULTS

16. From 1997 to 1999, a total of 1,023 sandwich samples were taken for microbiological examinations (Table 1). Of these, 930 and 93 samples were sandwiches without salad and with salad respectively.

17. Of the period under study, 88 out of 1,023 sandwich samples (8.6%) were found unsatisfactory in one or more microbiological tests. Trend analysis showed that the percentage of unsatisfactory samples decreased from 11.5% in 1997 to 9.9% in 1998, and then to 3.8% in 1999 (table 1).

Hygienic quality

18. The hygienic quality of food is reflected in the total bacterial count (TBC) and total *E. coli* (total) count. From 1997 through 1999, 82 samples of sandwiches had unsatisfactory level of TBC and no sample was found unsatisfactory in *E. coli* (total) count.

19. The distribution of TBC in sandwiches was studied and presented in log-scale (figure 2). It is shown that this is a clear demarcation at \log_{10} counts of 6.00 – 6.99 in which more than 90% of all samples fall under this category.

20. When the results are stratified into sandwich without and with salad, it is shown that more than 90% of sandwiches without salad are with the \log_{10} count of 6.00 or less (figure 3). The distribution pattern is same as the overall distribution of all sandwiches. The distribution pattern of sandwiches with salad, however, is extremely different (figure 4). Of the 93 samples being analysed, 18 samples (19.4%) gave \log_{10} counts of more than 7.00.

21. Although 8.6% of sandwich samples with unsatisfactory results were found from 1997 to 1999, a decreasing trend was observed (Year 1997 – 11.5%; Year 1998 – 9.9%; Year 1999 – 3.8%). The results reflected that the microbiological quality of sandwiches sold in local market has been improved in the past three years.

Specific pathogens

22. From 1997 through 1999, only 0.6% (6 out of 1,407 samples) of the

test samples failed in specific pathogen detection. 2 out of 6 unacceptable samples were contaminated with *Listeria monocytogenes*. *Salmonella* species was detected in 3 samples and one was found to contain *Staphylococcus aureus* (table 2).

DISCUSSION

23. The fact that bare hands are involved in many of the production steps in sandwiches are provided an explanation why more than 90% of all unsatisfactory samples failed in TBC. However, most of the samples with low TBC in the past three years are evidence to show that the food handlers involved in sandwich business have taken precaution to maintain good quality of sandwiches.

24. *Salmonella* species, *Staphylococcus aureus* and *Listeria monocytogenes* could be introduced by food handlers and cross-contamination between ready-to-eat foods and raw items.

25. *L. monocytogenes* were found in 2 out of the 6 unacceptable samples. Both these two samples were with cheese ingredient. Dairy products are good media to support the growth of *L. monocytogenes* at low temperature. However, all cheese products must be pasteurized before they are sold in market. Pasteurization could effectively eliminate *Listeria monocytogenes*. Therefore, precautionary measures must be taken in subsequent production steps to prevent the risk of potential microbiological hazards.

26. As for salmonella contamination, the pathogen may be present in raw egg or introduced by cross-contamination during processing, such as preparation of vegetable salads. For eggs that are not cooked thoroughly, *Salmonella* species may be found or even multiplied in the finished products if the storage conditions such as nutrient contents, pH value, water activity and time favour for their growth.

27. Vegetables in sandwiches are frequently eaten raw. Lettuce, cucumber and tomato are the most common ingredients. It is therefore of paramount importance that these vegetables should be washed thoroughly to minimize the microbiological hazards. Disinfectant may be applied to decrease the bacterial log. However, when such chemical is used, the handlers must follow the instructions from the suppliers of the disinfectants to

prevent any chemical hazard being introduced into the final products.

28. *Staphylococcus aureus* is naturally present in human nasopharynx. Its presence obviously reflects poor personal and food handling hygiene. Health education and good personal hygiene are important to prevent contamination of food by such bacterial agent.

CONCLUSIONS & RECOMMENDATIONS

29. The food surveillance findings reflected that food handlers involved in sandwich business have practiced the principle of Good Manufacturing Practices (GMP) to maintain the quality of their food products. However, sandwich is a perishable food item with short shelf life (1 – 2 days). Therefore, the trade should take further precautionary steps especially in the preparation of filling, in order to improve good hygienic quality of sandwich products. For the consumers, they should also observe some key points to eliminate microbiological hazards. The following are some recommendations.

Advice to trade

(A) Handling of raw materials –

1. Choose fresh food ingredients.
2. Obtain the raw materials from reputable and reliable suppliers.
3. Refrigerate the opened salad dressing.
4. Wash all vegetables thoroughly.
5. Cook egg and meat thoroughly.

(B) Hygienic principles –

1. Observe good personal hygiene and food hygiene.
2. Prevent cross-contamination.
3. Ensure optimal storage temperature and duration.

Advice to consumer

The following are some clues for the consumers to understand how they can choose sandwiches with good quality –

1. Buy sandwiches from reputable and reliable suppliers.
2. Check the “expiry date” and pay attention to the storage temperature of pre-packed sandwiches.
3. Consume the sandwiches as soon as possible.
4. If not consumed immediately, the sandwiches (including home-made ones) should be
 - Packed and stored at 0 - 4°C;
 - Separated from raw food;
 - Consumed within 1 – 2 days.

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Figure 1: Flow chart of sandwiches production

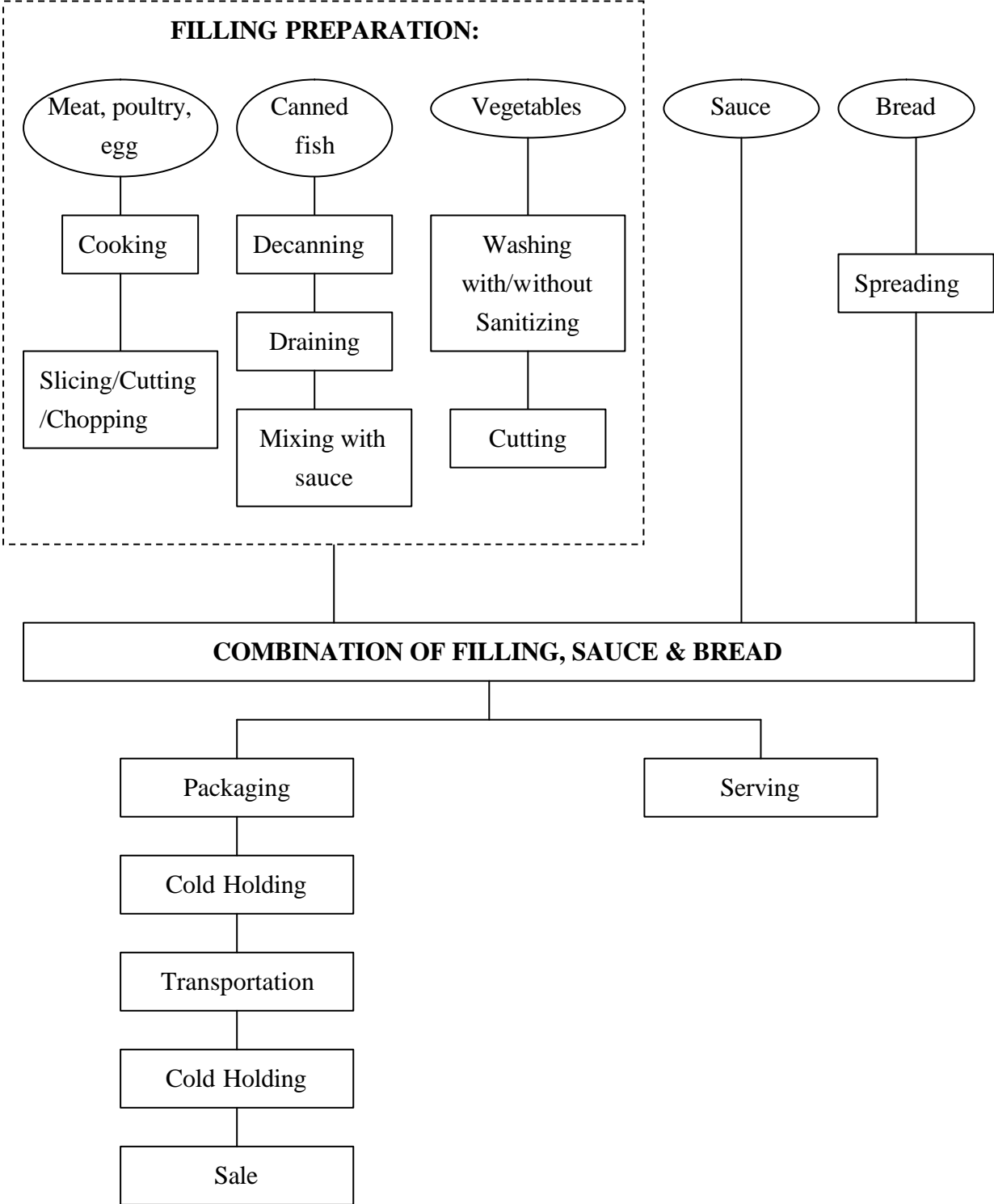


Figure 2: Total bacterial count of sandwiches (1997 – 1999)

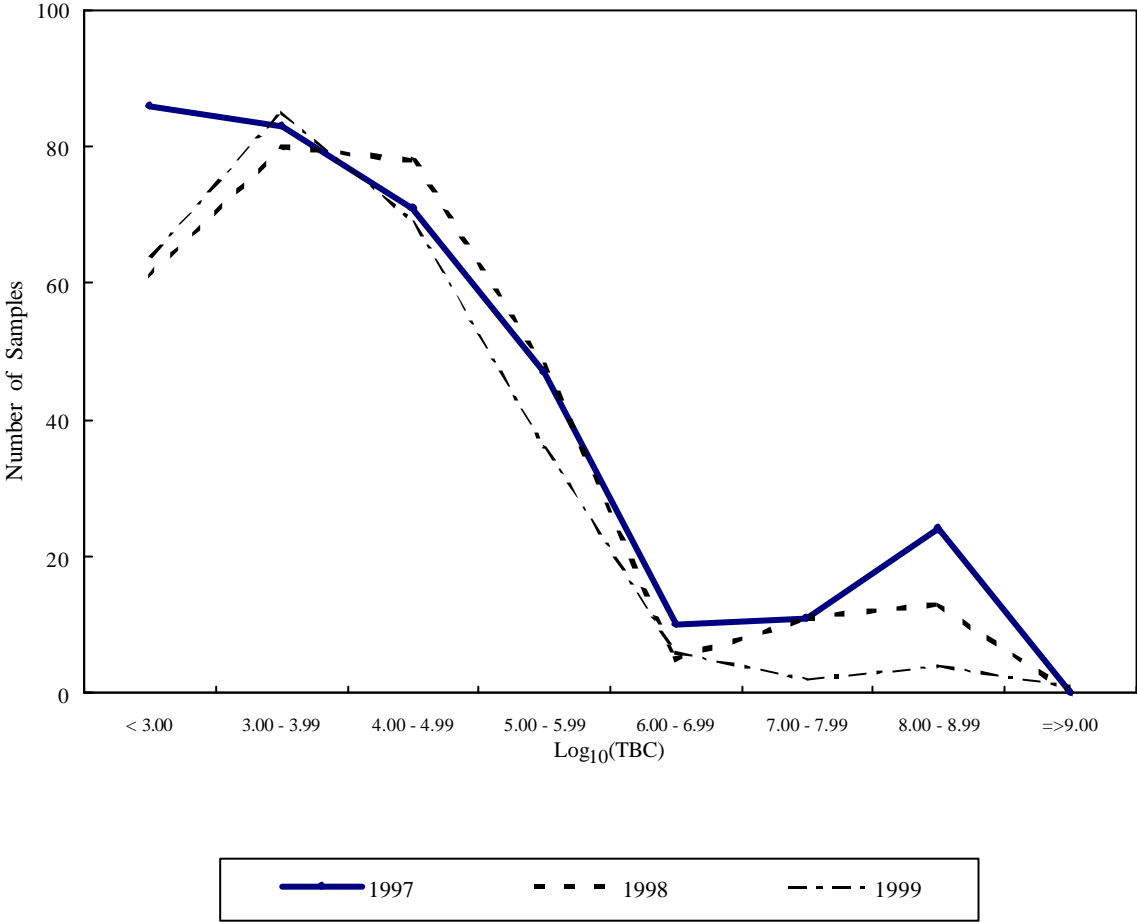


Figure 3: Total bacterial count of sandwich without salad (1997 – 1999)

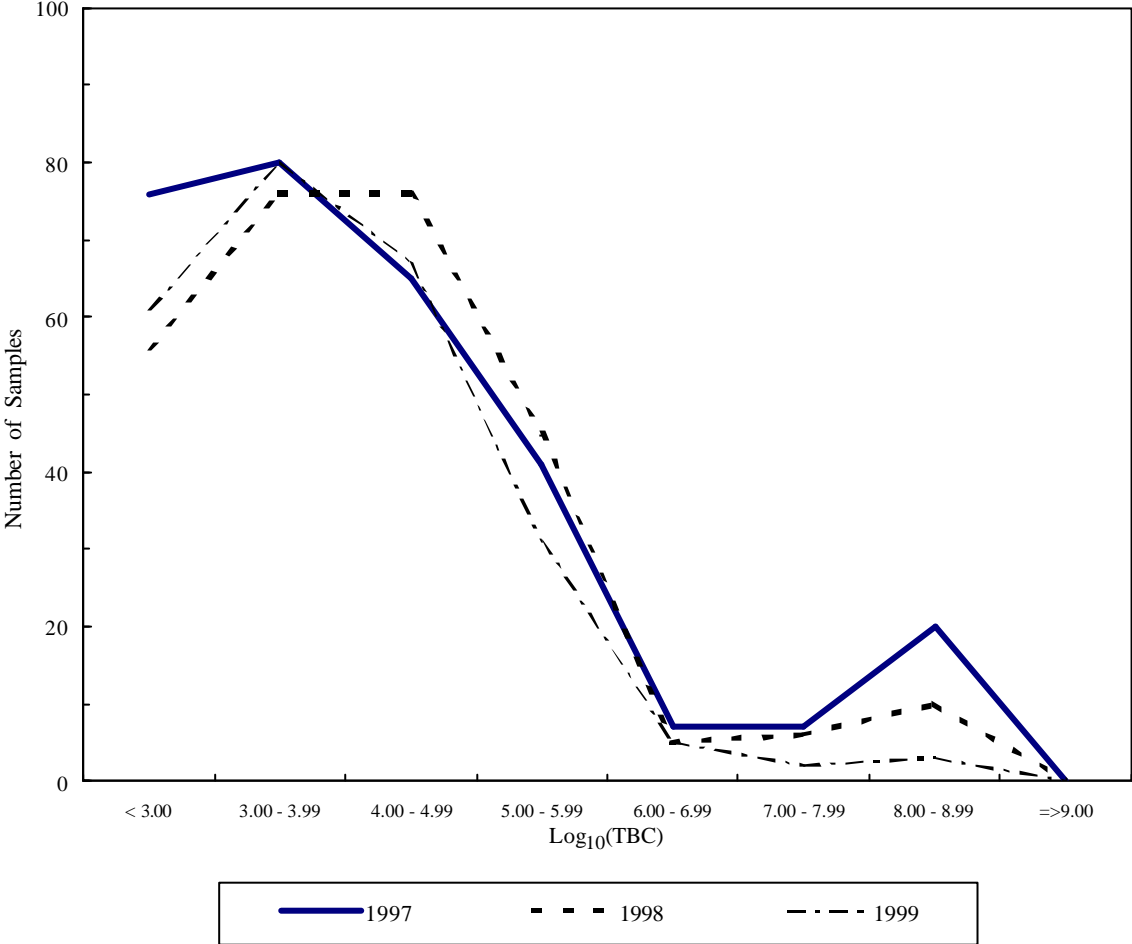


Figure 4: Total bacterial count of sandwich with salad (1997 – 1999)

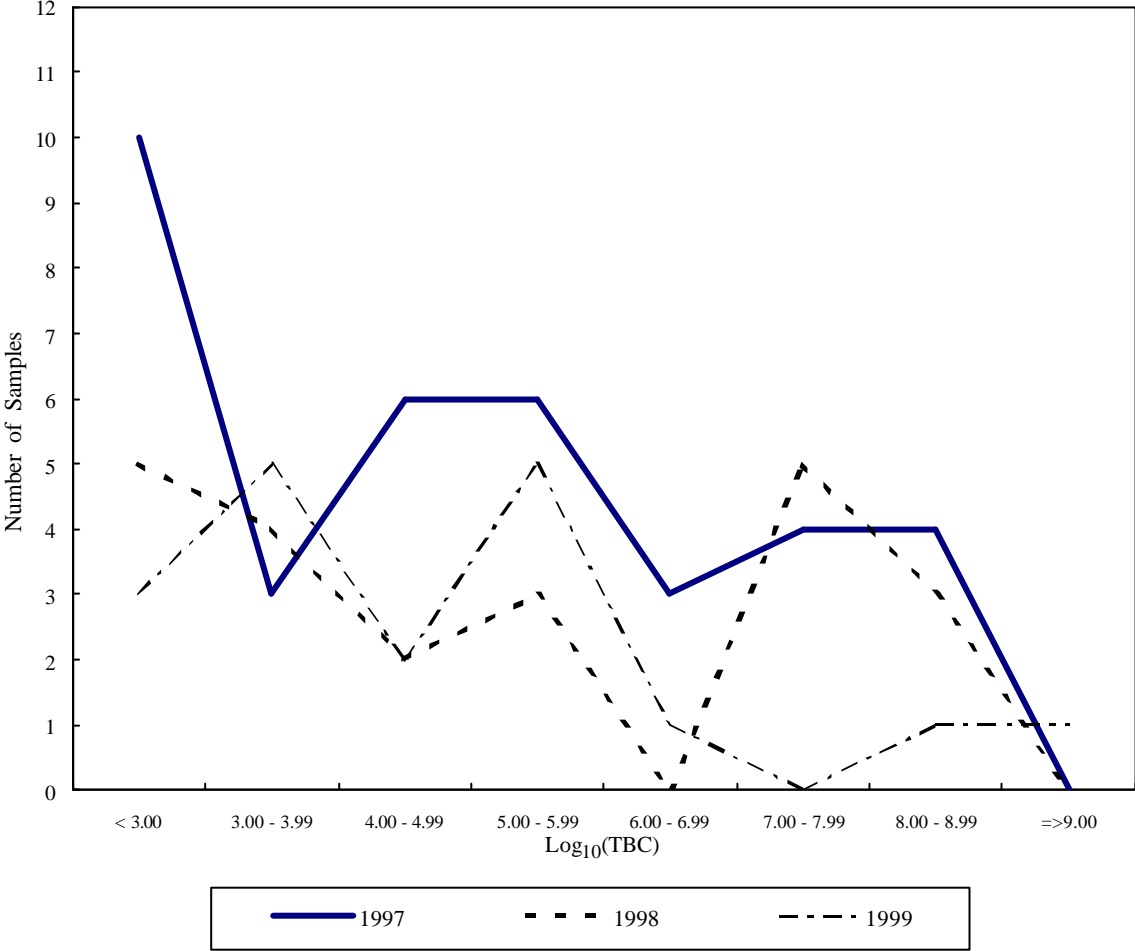


Table 1: Food surveillance findings from 1997 to 1999

Sample Year	Sandwiches without salad		Sandwiches with salad		All sandwiches	
	Total no. of sample	No. of unsat. sample (%)	Total no. of sample	No. of unsat. sample (%)	Total no. of sample	No. of unsat. sample (%)
1997	328	34 (10.4%)	36	8 (22.2%)	364	42 (11.5%)
1998	319	26 (8.2%)	24	8 (33.3%)	343	34 (9.9%)
1999	283	10 (3.5%)	33	2 (6.1%)	316	12 (3.8%)
1997 - 1999	930	70 (7.5%)	93	18 (19.4%)	1,023	88 (8.6%)

Table 2: Description of unsatisfactory results (1997 – 1999)

Year	No. of samples	Pathogens	Type of sandwich
1997	1	<i>Salmonella</i> species: present (Gp D)	Mixed vegetable sandwich with salad
1998	1	<i>Staphylococcus aureus</i> : 14,000	Ham & egg sandwich without salad
	2	<i>Salmonella</i> species: present (Gp C)	Egg sandwich without salad
	2	<i>Listeria monocytogenes</i> : present	Cheese sandwich without salad; cheese & ham sandwich without salad
1999	0	---	---
Total	6	---	---

Appendix 1

Microbiological guidelines for sandwiches*

Hygienic quality

Aerobic Plate Count (APC)	
With salad	$\leq 10^7$ /g
Without salad	$\leq 10^6$ /g
<i>E. coli</i> (total)	$\leq 10^4$ /g

Food safety

<i>Campylobacter</i> spp.	absent in 25g
<i>E. coli</i> O157	absent in 25g
<i>L. monocytogenes</i>	absent in 25g
<i>Salmonella</i> spp.	absent in 25g
<i>V. parahaemolyticus</i>	$\leq 10^3$ /g
<i>S. aureus</i>	$\leq 10^4$ /g
<i>C. perfringens</i>	$\leq 10^4$ /g
<i>B. cereus</i>	$\leq 10^5$ /g

*The “Microbiological Guidelines for Ready -To-Eat Food” has been updated and the above guidelines may no longer be applicable. Please refer to the latest version at <http://www.fehd.gov.hk/english/safefood/control-ready-to-eat-food.html>