# Microbiological quality of selected foods from selected premises in Kota Bharu, Kelantan

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## ABSTRACT

A cross sectional study was carried out to determine the total plate count, coliform and *E. coli* counts in 712 selected foods sample taken from 362 food premises in the area under the Municipal Jurisdiction of Kota Bharu. The foods were classified according to the groups. Standard method were used to determine the total plate count (TPC in CFU/gm), coliform count (CC in MPN/ml) and *E. coli* count in ( MPN/ml). Microbiological analysis of food samples showed that 34.08% of sample had unsatisfactory in total plate count, 47.8% in coliform count and 24.7% in *E. coli* count. *E. coli* count was detected more in staple foods as compared to snacks/ kuih. There was a significant difference of the satisfactory levels of microbiological analysis amongst different groups of food ($P<0.001$). This study was found to have overall relationship between microbiological findings of selected food examination and the hygiene score of food premises. Appropriate measures, such as education of food handlers in improving the hygienic practice, particularly by environmental health officers, public health inspectors and local authorities are needed in order to reduce the prevalence of foodborne diseases.

*Keywords:*, Microbiological quality; Food; Food premises; Kota Bharu

## Introduction

Bacteria contaminate food in many ways, and it is not always possible to recognize the spoilage by sight, smell or taste. Some of the bacteria that are important from public health point of view can multiply to dangerously high numbers in food without changing the appearance, odour or taste of the food (Longree, 1980).

The safety of foods is affected by several factors, from the quality of raw materials, to food handling and storage practices. In most cases, improper water supplied for food vendors, leading the vendors to store water under vulnerable conditions subject to contamination.

A variety of intrinsic and extrinsic factors determine whether microbial growth will preserve or spoil the food. According to Prescott *et. al* (1999) the intrinsic or related factors include pH, moisture content, water activity or availability, oxidation-reduction potential, physical structure of the food, available nutrients, and

the possible presence of natural antimicrobial agents. Extrinsic or environmental factors include temperature, relative humidity, gases ($CO_2$, $O_2$) present, types and numbers of microorganism present in food.

The total plate count analysis is a useful tool in monitoring food process and the results may reflect the hygienic level of food handling and retail storage (Collins *et al,* 1989). Improper handling and storage may increase the number of coliforms in food or water. Coliforms are also found on many types of plant material since the organisms are usually found at high levels in soil.

*E coli* is commonly used as surrogate indicator in which its presence in food generally indicates direct or indirect faecal contamination. According to Eley (1992a), presents of *E. Coli* in food may indicate poor hygienic practice in of food handlers. However, the regular presence of *E. coli* in the human intestine and faeces has led to tracking the bacteria in nature may reflect water contamination by intestinal parasites of humans. A significant number of *E coli* in food may also suggest a general lack of cleanliness in food handling and improper storage of food (Food and Environmental Hygiene Department of Hong Kong, 2001).

A study done in Jakarta by Kampen (1998) compared the quality of streets food with similar home-prepared food, and food from tourist hotels. They found that even food from five star hotels were not always safe. A study done in United Kingdom by Powell and Attwell (1995) showed that there was no correlation between inspections rating and bacteriological counts of foods. However, there were no such data for Malaysia. In Bangkok, Thailand, coliform bacteria were found in more than 50 percent of the food samples (Dawson, 1996)

## Material and Methods

In this study, on-site evaluation of the selected premises were done based on the evaluation list used District Health Office. The premises were assessed in 6 main areas; food hygiene and food protection (4 variables), food handlers (4 variables), cleanliness of equipment and utensils (2 variables), garbage, and refuse disposal (2 variables), structure and design of premises (1 variables), maintenance of the premise (1 variables). Each section of the hygiene list was scored separately, and added together to give a total score. The scoring system was a demerit method of scoring. The total scoring up to 100 were given to all selected premises.

A total of 712 food samples were purchased from September 2001 to Mac 2002. About 150-200 g of each sample were collected. Among the food samples, 362 (88%) belong to staple group (rice, mee, vermicelli etc.) whereas 350 were snacks (kuih, desert etc). All of the foods were taken between 8.00 am to 10.00 am. Most of foods were ready to eat food, which are locally popular for morning breakfast. The food were sampled from each selected premises at the same time of hygienic evaluation

The samples were collected in the morning, using the vendors' own utensils, and arranged into sterile plastics bags for transportation in icebox container. The analysis began within 2 hours after the sample arrival at laboratory. Each food sample was mixed and had a 25g portion homogenized in 225ml of 0.1% sterile peptone

water. Serial tenfold dilutions of the suspension were performed for further microbiological analysis.

Determination of the total plate count, coliform count and *Escherichia coli* count was carried out according to the method as in Manual for Microbiological Examination of Food Quality Control Division, Ministry of Health Malaysia. The TPC in CFU/gm was counted by the presence of colonies on plate after 48 hours incubation at 37 o C. The MPN of coliform was calculated considering gassing BGLB tubes. For *Escherichia coli* identification, a loopful of suspension from gassing BGLB broth tubes was streak onto EMB agar and incubated at 37o C for 18-24 hours for confirmative identification. A total plate count of greater than $1x10^5$ CFU/gm or coliform counts of greater than 50 MPN per ml and *E. coli* of 3 MPN per ml and above are regarded as unacceptable. These are the cut off point used by the Food Quality Control Division, Malaysian Ministry of Health based on the Microbiological Standard 15th schedule Malaysian Food Regulation 1985.

Statistical analysis was performed using a Statistical Program for Social Sciences (SPSS) for Windows, version 10.0 (SPSS Inc., 1998) for one-way Anova, Chi Square, independent t and simple logistic regression. Significance was determined at the $P \leq 0.05$ level. For simple logistic regression crude and adjusted odds ratio was noted with 95% CI.

## Results

A total of 362 premises were involved in the study. They were equal number of static vendors, canteens / food stalls and restaurants (Table 1). Out of the 362 premises, 78.2 % had satisfactory score with a mean ± SD of 62.43 ± 9.0 and 21.8 % had unsatisfactory score with a mean ± SD of 44.40 ± 4.0. The score range from 36 to 87 (Table 2).

There were a total of 713 (362 staples and 351 snacks) food sampled. The majority of foods selected were ready to eat foods. Almost one third (34.08%) of the food sampled had unsatisfactory total plate count (Table 3). *E.coli* count was detected in about a quarter of food sampled which more in staple food. There was a significant association ($P<0.001$) between the satisfactory levels of microbiological analysis among different groups of food.

There was a significant association between the premise hygiene score in all three variables of microbiological analysis ($P <0.001$), whereby premises with the score less than 50 had more unsatisfactory results.

In multiple logistic regression analysis (Table 4), it was found that the premises with improper use of food container, unclean area of food preparation, improper use of shoes and inadequacy and improper garbage bin were more likely to have unsatisfactory total plate count.

The evaluation parameters of improper use of food container, unclean area of food preparation, improper uses of shoes and inadequacy or improper garbage bin were significantly associated with unsatisfactory coliform count. For unsatisfactory *E.coli* count the only significant association was found in the parameters of improper use of food container and unclean area of food preparation.

## Discussion

To prevent the occurrence of foodborne illnesses, it is important to ensure that foods sold are safe and hygienic. Total plate count was used to measure the general bacteria load of the food sampled and is useful tool in monitoring food process and the results may reflect the hygienic level of food handling and retail storage (Collins *et al,* 1989). Thirty four percent of total foods sampled, and almost half (40.3%) of the staple food had unsatisfactory total plate count. This result was almost equal to the Kelantan State Health Office(2000) study whereby it was found that 41.7% of staple foods sampled were unsatisfactory. The total food sampled by the Kelantan Health Office during their study, only 15% out of 386 samples had unsatisfactory total plate count. This lower percentage could be because of a lower proportion of staple foods in their study compared to the current study (50.7%). Almost one third of their food samples were "raw water" (29.7%). Unsatisfactory coliform count was found in 47.8% of total food sampled, affecting almost 50% of both staple and snack food. The presence coliforms in the samples indicate a high risk that other pathogenic organisms have also contaminated the food. The report by Kelantan Health Office (2000) showed that, the percentage of food with unsatisfactory coliform count was almost equal to this study for the total food sampled, but lower in staple food (26%). Instead, the majority of unsatisfactory coliform count in their study was found in raw water (38.2%). According to Eley (1992b), the presence of total coliforms and *E. coli* in foods may indicate faecal contamination which could be due to insufficient cooking, use of raw vegetables, cross contaminations because of not separating raw and cooked food, and contaminated ingredients. The frequency of faecal contamination of street foods in Latin American cities ranged from 9.4% to 56.7% above the standard considered (Ameida et al., 1996).

E.coli was present in 33.2% of samples, probably from raw vegetables and due to the lack of good hygienic practices. The presence of *E.coli* was found to be higher than reported by the Kelantan State Health Office for the total food sampled (7.7%). However, they found 50% of their raw water had significant *E.coli* count. This indicates high proportions of water used by the premises were contaminated but comparison could not be done because the current study did not collect water sample. Since water is used in all stages of food preparation including serving and washing utensils, and if the results produced by Kelantan Health Office was true, it could explained that the high incidence rate of food and waterborne diseases that frequently occur in Kelantan (Ministry of Health Malaysia, 1999b).

A study conducted in one no industrialized country by Monge and Chinchilia (1996) also demonstrated a significantly high prevalence of *E.coli* in raw vegetables sampled from open markets. The result of their study showed a serious contamination of vegetables with faeces. Some of the staple food sampled in the current study used raw vegetables as part of the food served. The result of the study mentioned above could be significant as contamination could come from either water or vegetables or materials used. However our scope is grossly limited; as we did not study specify raw water or vegetables, specifically. The lack of public sanitary facilities can be another hurdle to keep the desirable hands' hygiene of the vendors.

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**Table 1: Types of premises selected in the study**

| Types | No | % |
|---|---|---|
| Restaurants | 118 | 33 |
| Static vendors | 124 | 34 |
| Food stalls | 120 | 33 |

**Table 2: Distribution of 362 selected premises according to satisfactory level of premises' score**

| Score group of premises | n(%) | Mean ± SD | (95 % CI) |
|---|---|---|---|
| Satisfactory (≥ 50) | 283 (78.2) | 62.43 ± 9.0 | 61.38 – 63.48 |
| Unsatisfactory (< 50) | 79 (21.8) | 44.40 ± 4.0 | 43.45 – 45.31 |
| Total | 362 | 58.50 ± 11.0 | 57.35 – 59.63 |

**Table 3: Microbiological results of food according to parameter of analysis**

| Parameter of analysis | Staple foods | | Snacks / kuih | | Total | p value * |
|---|---|---|---|---|---|---|
| | No | (%) | No | (%) | No (%) | |
| 1. Total Plate count | | | | | | |
| Satisfactory | 216 | (59.7) | 254 | (72.4) | 470 (66.0) | <0.001 |
| Unsatisfactory | 146 | (40.3) | 97 | (27.6) | 243 (34.0) | |
| 2. Coliform count | | | | | | |
| Satisfactory | 164 | (45.3) | 208 | (59.3) | 372 (52.2) | <0.001 |
| Unsatisfactory | 198 | (54.7) | 143 | (40.7) | 341 (47.8) | |
| 3. *Escherichia coli* count | | | | | | |
| Satisfactory | 242 | (66.8) | 295 | (84.0) | 537 (75.3) | |
| Unsatisfactory | 120 | (33.2) | 56 | (16.0) | 176 (24.7) | <0.001 |

* *Chi Square test*

**Table 4 : Total plate, Coliform and *E. Coli* counts of foods and score of food premises**

| | Premises | | | | $\chi^2$ (df) | p value* |
|---|---|---|---|---|---|---|
| | Score ≥ 50 | | Score <50 | | | |
| | No | % | No | % | | |
| TPC | | | | | | |
| Pass | 387 | (69.8) | 83 | (52.5) | | |
| Fail | 168 | (30.2) | 75 | (47.5) | 16.2 (1) | <0.001 |
| Coliform | | | | | | |
| Pass | 312 | (56.2) | 60 | (38.0) | | |
| Fail | 243 | (43.8) | 98 | (62.0) | 16.4 (1) | <0.001 |
| *E. coli* | | | | | | |
| Pass | 437 | (78.8) | 100 | (63.3) | | |
| Fail | 118 | (21.2) | 58 | (36.7) | 15.8 (1) | <0.001 |

**Chi Square* Pass = satisfactory, Fail = unsatisfactory

**Table 5: Food microbiology and parameters of premise hygiene evaluation**

| Factors | Crude Odds ratio * | Adjusted Odds ratio | 95% CI Of Adjusted Odds ratio | *P #* |
|---|---|---|---|---|
| Total plate count | | | | |
| Improper use of food container | 1.90 | 1.81 | 1.30 , 2.50 | <0.001 |
| Unclean area of food preparation | 2.03 | 1.95 | 1.41 , 2.70 | <0.001 |
| Improper use of shoes | 1.50 | 1.40 | 1.01 ,1.95 | 0.038 |
| Inadequacy and improper garbage bin | 1.46 | 1.43 | 1.03 , 1.99 | 0.032 |
| Coliform count | | | | |
| Improper use of food container | 1.87 | 1.80 | 1.31, 2.49 | <0.001 |
| Unclean area of food preparation | 1.51 | 1.43 | 1.06, 1.94 | 0.021 |
| Improper use of shoes | 1.61 | 1.53 | 1.12, 2.08 | 0.007 |
| Inadequacy and improper garbage bin | 1.79 | 1.78 | 1.31, 2.45 | <0.001 |