



UNIVERSITI SAINS MALAYSIA

**Laporan Akhir**  
**Projek Penyelidikan USM Jangka Pendek**

**(No akaun: 304/PPSP/6131206 )**

A Study on Hygienic Standard of Food Premises  
and  
Microbiological Quality of Food in Kota Bharu



**BAHAGIAN PENYELIDIKAN & PEMBANGUNAN  
CANSELORI  
UNIVERSITI SAINS MALAYSIA**

Laporan Akhir Projek Penyelidikan Jangka Pendek

1) Nama Penyelidik: Dr. Mohamed Rusli bin Abdullah

Nama Penyelidik-Penyelidik  
Lain (Jika berkaitan) : Dr Zaliha bt Ismail

2) Pusat Pengajian/Pusat/Unit : Pusat Pengajian Sains Perubatan

3) Tajuk Projek: A Study on Hygienic Standard of Food Premises and  
Microbiological Quality of Food in Kota Bharu

4) (a)

**Penemuan Projek/Abstrak**

(Perlu disediakan maklumat di antara 100 – 200 perkataan di dalam Bahasa Malaysia dan Bahasa Inggeris. Ini kemudiannya akan dimuatkan ke dalam Laporan Tahunan Bahagian Penyelidikan & Pembangunan sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti).

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(b) Senaraikan Kata Kunci yang digunakan di dalam abstrak:

<u>Bahasa Malaysia</u>	<u>Bahasa Inggeris</u>
makanan	Food
premis yang menjual makanan	Food premises .....
kualiti mikrobiologi	Microbiological quality
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5) Output Dan Faedah Projek

(a) Penerbitan (termasuk laporan/kertas seminar)  
(Sila nyatakan jenis, tajuk, pengarang, tahun terbitan dan di mana telah diterbitkan/dibentangkan).

Poster presentation – A study on hygienic Standard of food premises and microbiological quality of food in Kota Bharu di Persidangan Kesihatan Awam Kebangsaan Ketiga pada 28-30 April 2003 di Hotel Hilton di Seremban

A study on microbiological quality of ready to eat food in Kota Bharu Sent to Malaysian Journal of Public Health Medicine . Status: Awaiting reply

Hygiene Standard of Food Premises in Kota Bharu – in reviewing process

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- (b) Faedah-Faedah Lain Seperti Perkembangan Produk, Prospek Komersialisasi Dan Pendaftaran Paten.  
(Jika ada dan jika perlu, sila guna kertas berasingan)

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- (c) Latihan Gunatenaga Manusia

i) Pelajar Siswazah: .....DR ZALIHA BT ISMAIL.....

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ii) Pelajar Prasiswazah: .....

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iii) Lain-Lain : .....

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6. Peralatan Yang Telah Dibeli:

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**UNTUK KEGUNAAN JAWATANKUASA PENYELIDIKAN UNIVERSITI**

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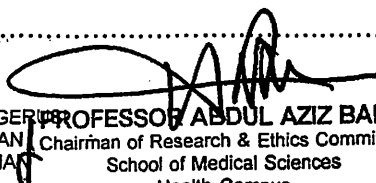
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**T/TANGAN PENERANG** **PROFESSOR ABDUL AZIZ BABA**  
**J/K PENYELIDIKAN** Chairman of Research & Ethics Committee  
**PUSAT PENGAJIAN** School of Medical Sciences  
Health Campus  
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# Microbiological 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<sub>2</sub>, O<sub>2</sub>) 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 °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 37 °C for 18-24 hours for confirmative identification. A total plate count of greater than  $1 \times 10^5$  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  $\pm$  SD of  $62.43 \pm 9.0$  and 21.8 % had unsatisfactory score with a mean  $\pm$  SD of  $44.40 \pm 4.0$ . 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 Chinchilla (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.

## Acknowledgements

We wish to acknowledge Universiti Sains Malaysia for funding this study under the Short Term Grant (304/PPSP/6131206) and the assistance of Kelantan State Health Department. We would also like to thank Dr Hamzah Awang Mat, Medical Officer of Health Kota Bharu and all the Assistant Environmental Health Officers and Puan Natrah Ariffin, Food Technologist at Kelantan Food Quality Control Laboratory and staff who made this study possible.

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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 $\pm$ SD	(95 % CI)
Satisfactory ( $\geq 50$ )	283 (78.2)	62.43 $\pm$ 9.0	61.38 – 63.48
Unsatisfactory ( $< 50$ )	79 (21.8)	44.40 $\pm$ 4.0	43.45 – 45.31
Total	362	58.50 $\pm$ 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. <i>Escherichia coli</i> count						
Satisfactory	242	(66.8)	295	(84.0)	537 (75.3)	<0.001
Unsatisfactory	120	(33.2)	56	(16.0)	176 (24.7)	

\* 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 $\geq$ 50		Score <50			
	No	%	No	%		
<b>TPC</b>						
Pass	387	(69.8)	83	(52.5)		
Fail	168	(30.2)	75	(47.5)	16.2 (1)	<0.001
<b>Coliform</b>						
Pass	312	(56.2)	60	(38.0)		
Fail	243	(43.8)	98	(62.0)	16.4 (1)	<0.001
<b><i>E. coli</i></b>						
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 #
<b>Total plate count</b>				
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
<b>Coliform count</b>				
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

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*E.coli* count

Improper use of food container	2.08	2.03	1.43, 2.88	<0.001
Unclean area of food preparation	1.69	1.63	1.14, 2.31	0.007

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\* Simple logistic regression #Multiple logistic regression

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 JABATAN BENDAHARI  
 KUMPULAN PENYELIDIKAN GERAN JANGKA PENDEK  
 PENYATA PERBELANJAAN SEHINGGA 31 DISEMBER 2004

Jumlah Geran		16,541.00	Ketua Projek	DR MOHAMED RUSLI BIN ABDULLAH
Peruntukan 2002 (Tahun 1)	RM	16,541.00	Tajuk Projek	A STUDY ON STATUS OF HYGIENE STANDARDS OF FOOD PREMISES AND MICROBIO- LOGICAL QUALITY OF FOOD IN KOTA BHARU
Peruntukan 2003 (Tahun 2)	RM	0.00		
Peruntukan 2004 (Tahun 3)	RM	0.00	Tempoh	MAC 2002-
			No.Akaun:	304/PPSP/6131206

Kwgan	Akaun	PTJ	Projek	Donor	Peruntukan Projek	Perbelanjaan Terkumpul sehingga Tahun lalu	Peruntukan Semasa	Tanggung Semasa	Bayaran Tahun Semasa	Belanja Tahun Semasa	Baki Projek
304	11000	PPSP	6131206		3,072.00	-	3,072.00	-	3,047.22	3,047.22	24.78
304	14000	PPSP	6131206		-	-	-	-	-	-	-
304	15000	PPSP	6131206		-	-	-	-	-	-	-
304	21000	PPSP	6131206		912.00	1,632.33	(720.33)	-	808.00	808.00	(1,528.33)
304	22000	PPSP	6131206		-	-	-	-	-	-	-
304	23000	PPSP	6131206		300.00	-	300.00	-	-	-	300.00
304	24000	PPSP	6131206		-	-	-	-	-	-	-
304	25000	PPSP	6131206		-	-	-	-	24.00	24.00	(24.00)
304	26000	PPSP	6131206		-	-	-	-	-	-	-
304	27000	PPSP	6131206		10,747.00	155.00	10,592.00	-	3,500.00	3,500.00	7,092.00
304	28000	PPSP	6131206		-	-	-	-	-	-	-
304	29000	PPSP	6131206		1,510.00	200.00	1,310.00	-	252.00	252.00	1,058.00
304	35000	PPSP	6131206		-	3,400.00	(3,400.00)	-	-	-	(3,400.00)
					16,541.00	5,387.33	11,153.67	-	7,631.22	7,631.22	3,522.45

A STUDY ON HYGIENIC STANDARD OF FOOD PREMISES AND  
MICROBIOLOGICAL QUALITY OF FOOD  
IN KOTA BHARU

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**ABSTRACT**

**Introduction** - The hygienic aspects of food premises are a major concern for public health officers and inspectors in preventing foodborne illness. A study of the status of hygiene standard of food premises and microbiological quality of food provided findings on hygienic standard of food premises in relation to microbiological quality of food for further analysis of sources of food contamination.

**Methods** - A cross sectional study of 362 food premises in the area under the Municipal Jurisdiction of Kota Bharu were randomised and evaluated for hygienic aspects based on standardized form used by the District Health Office. Staple and snack / kuih groups of food were selected at the time of premises evaluation which then analysed for total plate count (CFU/gm), coliform count (MPN/ml) and *E. coli* (MPN/ml).

**Results** - Out of the 362 premises, 78.2 % had satisfactory score with a mean  $\pm$  SD of  $62.43 \pm 9.0$  and 21.8 % had unsatisfactory score with a mean  $\pm$  SD of  $44.40 \pm 4.0$ . 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 association between the premise hygiene score in all three variables of microbiological analysis ( $P < 0.001$ ).

**Conclusion**-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. Training in food handling and practices on the parameters identified should be focused more on the premises with low hygiene score.

*Keywords: Food , Food premises, microbiological quality*



## INTRODUCTION

In Malaysia from 1990 to 1997, a total of 24,056 persons were reported to suffer from food poisoning (Ministry of Health Malaysia, 1999). Food poisoning cases increased from 3,078 in 1995 to 8000 in 1998 while, inspection failure increased from 3607 in 1995 to 7,000 in 1998. Available information based on activities of Food quality Control Division does not allow correlation analysis between premises rating score and status of food microbiology because the score and food samplings were done at different time. This is because inspection and food sampling may have been carried out independently of each other. Although a premise with low score would often have food samples collected, they were not normally done at the same time of premise rating. This study was intended to look at the actual association between the hygiene of premises and microbiological quality of food. The basis is that, the hygiene score would affect microbiological quality of food.

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)

## METHODOLOGY

The food premises selling meals and snacks in main area under the Municipal Council jurisdiction of Kota Bharu were selected by randomization of the mapping numbers according to the proportion of total premises in eight divided zones (Appendix 1). Selected premises were scored using standard evaluation checklists. A score of 50% or more were categorized as acceptable. Food were collected at the time of premises evaluation and analyzed for total plate, coliform and *Escherichia coli* count in the Food Quality Control Laboratory, Kota Bharu.

## RESULTS

Out of the 362 premises, 78.2 % had satisfactory score with a mean  $\pm$  SD of  $62.43 \pm 9.0$  and 21.8 % had unsatisfactory score with a mean  $\pm$  SD of  $44.40 \pm 4.0$  (Table 1). Almost half (47.2%) of the food premises sampled had unsatisfactory cleanliness in the area of food preparation. About one third of food handlers were not wearing a proper shoes or used sandals, improper used of kitchen waste bag, inadequate and improper used of garbage bin and did not labelled the source and food ingredients properly (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 also 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 (Table 3). 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

In this study, the unsatisfactory hygiene score (21.8%) of premises was lower as compared to the data reported by the Kelantan State Health Office (2000) whereby, out of 113 premises that were studied from January to June 1998 and 1999, 34% were found to have hygiene score of less than 50. The study was conducted in districts of Kota Bharu (57 premises), Pasir Mas (21 premises) and Tanah Merah (35 premises) among the street food premises (road side stall or canteen and static hawker). The percentage of unsatisfactory of hygiene score in Kota Bharu was not specifically mentioned. The difference could be because of the type of the premises studied. The Health Department's data only included "stalls / hawkers " type of premises which were sold different types of foods, whereas our study included all types of premises which sold staple and snack food.

In Bangkok, Thailand, it was also found that, contamination of food handlers' hands and utensils ranged from 18 to 69 percent depending on the availability of adequate and safe water supply (Dawson, 1999) In our study most of the food stalls / canteens had water supplied by the state water agency. However, the quality of water supplied could not be ascertained, as it was not tested. The evaluation of the premises in this study using the evaluation form was quite comprehensive. Among the parameters assessed, more than 30% of the premises had unsatisfactory score in labelling and quality aspects of ingredients, area of food preparations, used of proper food container, immunization of Thyphoid vaccine (TY2) among food handlers, wearing a proper shoes, overcrowding of kitchen environment and usage of proper kitchen waste bag and garbage bin. Improper handling of garbage bin will provide the attraction and food for insects and rodents. Such conditions and practices are likely lead to cross contamination of cooked foods. The high percentage of unsatisfactory evaluation parameters and the premises with low hygiene score needed further attention.

Foodborne illnesses can be prevented by good hygiene practices during the preparation of food (Scott, 2000). To prevent the occurrence of foodborne illnesses, it is therefore 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 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 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 (1992), 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.

In this study, *E. coli* count was found in a quarter of the total food sampled, which was noted to be more in the staple foods (33.2%). 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 proportion 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 nonindustrialized 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.

Analysis of the data showed that there was a significant association between the hygiene scores and microbiological results. Even though there was a significant association, the poor microbiological quality of food could not be directly due to

condition of the premises. In this study only the end-stage handling could be observed, which may be irrelevant to the actual initial handling and subsequent storage of the cooked food. Some of the food was prepared elsewhere and the inability to fully assess all the activities in the kitchen, assessment of the kitchen's environment and other facilities prevented a possibility of direct association to be made.

The total plate count, coliform count and *E.coli* count results were found significantly associated with some parameters of premises evaluation. However, poor hygiene practices of food handlers during food preparation might not have resulted in food contamination if the food is adequately cooked (Longree, 1980). This occurs provided that the contamination does not occur during serving. The organisms that may have been transmitted by dirty hands or dirty work surfaces were killed during cooking. There could only two possible sources of infection that could be think of. It could be contaminated water or raw materials used in the preparations. Mosupye (1999) suggested that the presence of contamination of indicator organisms in food may be attributed to poor personal hygiene, poor practices among food handlers and cross contamination from the environment.

## CONCLUSION

Overall, the relationship between microbiological quality of food and the hygiene evaluation score of food premises were significant. Even though it is not possible to assume direct relationship between the hygiene condition of the premises and the quality of foods, effort should be made to achieve 100 percents satisfaction of hygiene status of premises. The relationship could be studied again once this has been achieved to look again at the association between hygiene score of premises and quality of food.

The presence of indicator organism in foods beyond acceptable limit, especially *E.coli* contamination that showed significant association between hygienic status of premises, therefore the sources need to be verified.

The complexity of determining the status of hygiene of food lies not in the testing or analysis of food, but rather in determining the source of contamination. A detailed assessment is definitely going to be expensive, time consuming and labour intensive, not to mention the expertise needed. However, if the issue of food safety is going to be addressed comprehensively, this issue must be tackled.

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**Table 1: Score of the 362 premises according to the types**

Types of premise	Score >50 No (%)	Score <50 No (%)	Mean + SD
Static vendor	112 (90.3)	12 (9.7)	60.8 ± 9.4
Canteen / food stall	68 (56.7)	52 (43.3)	50.2 ± 6.0
Restaurant	103 (87.3)	15 (12.7)	64.5 ± 11.6

\* One Way ANOVA F statistic =74.36 p value <0.001

Table 2: Frequency distribution of parameters used in evaluation of hygiene score group of 362 selected premises in Kota Bharu

Parameters of evaluation	Satisfactory No (%)	Unsatisfactory No (%)
Area of food preparation	191 (52.8)	171 (47.2)
Wearing proper shoes / no sandals	222 (61.3)	140 (38.7)
Proper used of kitchen waste bag	232 (64.1)	130 (35.9)
Adequacy/use of garbage bin	233 (64.4)	129 (35.6)
Labelling / source of ingredients	236 (65.2)	126 (34.8)
Overcrowding of kitchen environment	239 (66.0)	123 (34.0)
Used of proper food container	246 (68.0)	116 (32.0)
Immunization of TY2	249 (68.8)	113 (31.2)
Wearing proper costume / apron	257 (71.0)	105 (29.0)
Cleanliness of the premise & environment	293 (80.9)	69 (19.1)
Separation of raw and cooked food	306 (84.5)	56 (15.5)
Cleanliness food utensils	310 (85.6)	52 (14.4)
Personal hygiene	328 (96.6)	34 (9.4)
Dish washing places	356 (98.3)	6 (1.7)



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

Parameter of analysis	Staple foods		Snacks / kuih		Total	p value *
	No	(%)	No	(%)	No (%)	
<b>1. Total Plate count</b>						
Satisfactory	216	(59.7)	254	(72.4)	470 (66.0)	
Unsatisfactory	146	(40.3)	97	(27.6)	243 (34.0)	<0.001
<b>2. Coliform count</b>						
Satisfactory	164	(45.3)	208	(59.3)	372 (52.2)	
Unsatisfactory	198	(54.7)	143	(40.7)	341 (47.8)	<0.001
<b>3. <i>Escherichia coli</i> count</b>						
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 $\geq$ 50		Score <50			
	No	%	No	%		
<b>TPC</b>						
Pass	387	(69.8)	83	(52.5)		
Fail	168	(30.2)	75	(47.5)	16.2 (1)	<0.001
<b>Coliform</b>						
Pass	312	(56.2)	60	(38.0)		
Fail	243	(43.8)	98	(62.0)	16.4 (1)	<0.001
<b><i>E. coli</i></b>						
Pass	437	(78.8)	100	(63.3)		
Fail	118	(21.2)	58	(36.7)	15.8 (1)	<0.001

\**Chi Square*

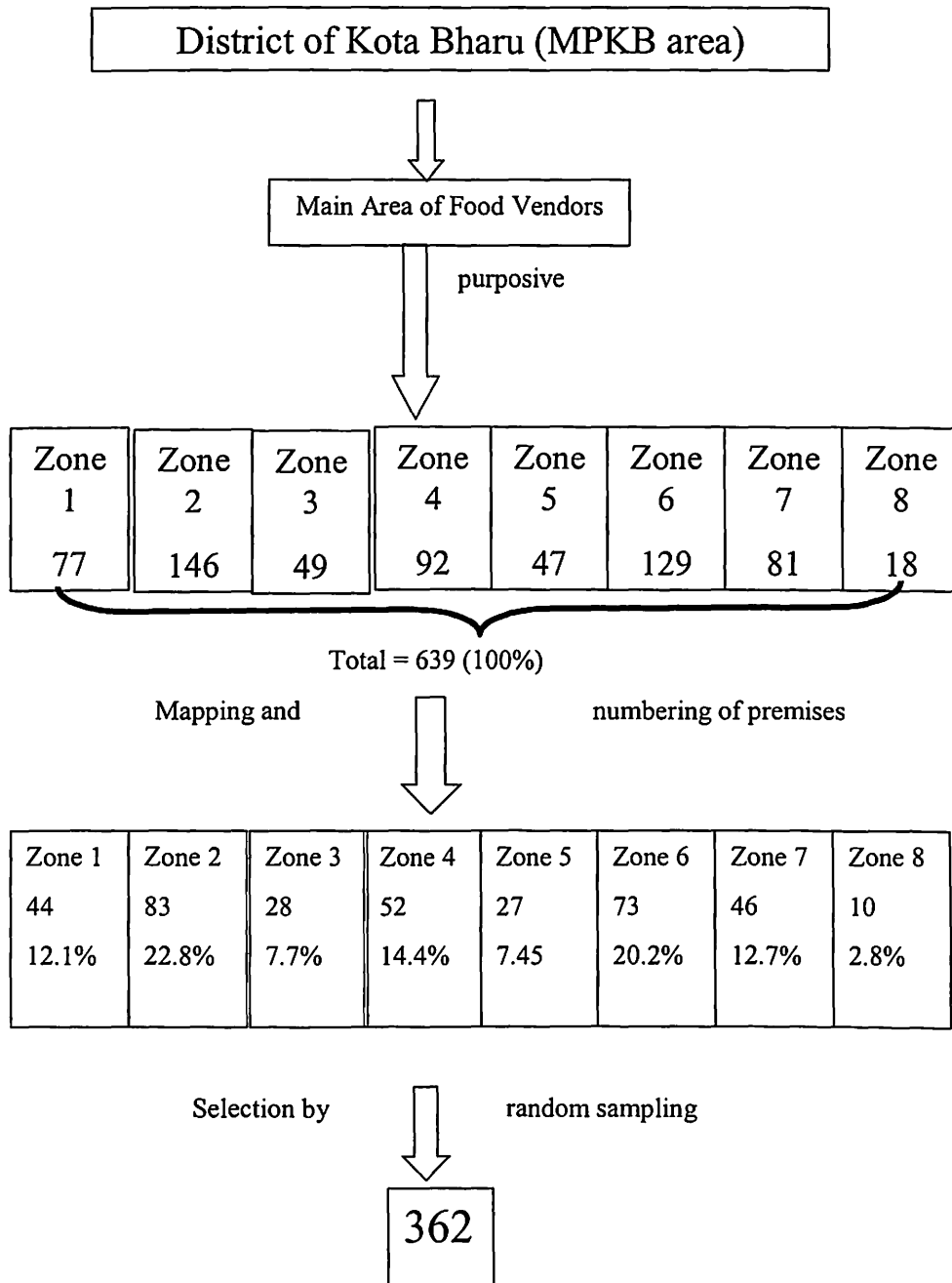
Pass = satisfactory, Fail = unsatisfactory

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

Factors	Crude Odds ratio *	Adjusted Odds ratio	95% CI Of Adjusted Odds ratio	P #
<b>Total plate count</b>				
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
<b>Coliform count</b>				
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
<b><i>E.coli</i> count</b>				
Improper use of food container	2.08	2.03	1.43, 2.88	<0.001
Unclean area of food preparation	1.69	1.63	1.14, 2.31	0.007

\* Simple logistic regression #Multiple logistic regression

Appendix 1





# Universiti Sains Malaysia

## Pusat Pengajian Sains Perubatan School of Medical Sciences

**Our Ref.:** USM/PPSP®/Ethics Com./2001[60.3(4)]

**Date :** 9 September 2001

Dr. Mohd. Rusli Abdullah  
Department of Community Medicine.  
School of Medical Sciences  
Universiti Sains Malaysia  
Health Campus  
16150 Kubang Kerian  
Kelantan.

Dear Dr.,

### APPLICATION FOR ETHICAL APPROVAL

**Protocol Title :** A Study on Status of Hygiene Standard of Food Premises and Microbiological Quality of Food in Kota Bharu.

I Refer to your Application of **19 June 2001**.

I am pleased to inform you that Research & Ethics Committee, School of Medical Sciences, Universiti Sains Malaysia has met on **26 June 2001** and has approved in principle the application of the above title.

**Title:** A Study on Status of Hygiene Standard of Food Premises and Microbiological Quality of Food in Kota Bharu.

**Research Centre:** Kota Bharu, Kelantan

**Date Start:** 1 September 2001

**Duration:** 1 years

**Number of Samples:** 350 food premises

**Name of Research Principle:** Dr. Mohd. Rusli Abdullah

**Name of M. Med/Masters Student:** Zaliha Ismail

Members of the Research & Ethics Committee who reviewed the study protocol are as follows:

#### Chairman :

Assoc. Prof. Zabidi Azhar Mohd. Hussin - Dean, School of Medical Sciences

**Members :**

- i. Y. Bhg. Dato' Hj. Wan Mohamed Yusof- Ex- State Secretary of Kelantan
- ii. Assoc. Prof. Abd. Rashid Abd. Rahman- Deputy Dean (Research)
- iii. Assoc. Prof. Kamaruddin Jaalam - Lecturer, Anaesthesiology Department
- iv. Assoc. Prof. Jafri Malin Abdullah - Coordinator, Neuroscience Unit
- v. Dr. Ramli Saad - Director, HUSM
- vi. Dr. Syed Hatim Noor - Coordinator, Bio statistic & Research Methodology Unit
- vii. Dr. Ab. Hamid Mat Sain - Head, Department of Surgery
- viii. Hj. Ismail Hassan - Ex-USM Linguistic Teacher

Thank you.

***"GLOBAL COMPETITIVENESS: OUR COMMITMENT"***

Yours sincerely



**(ASSOC. PROF. ZABIDI AZHAR MOHD. HUSSIN)**  
*Chairman of Research & Ethics Committee*

- c.c.  *Deputy Dean (Research)*  
 *Secretary of Research & Ethics Committee*



# MAJLIS PERBANDARAN KOTA BHARU

Jalan Hospital, 15000 Kota Bharu Kelantan.

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NO. FAX

MPKB (KL) 2 / 2001 / (7)

Bertarikh : 24 Rabiul Akhir 1422H  
16 Julai 2001.

Sila nyatakan bilangan kertas ini  
manakala menjawab.

@@ ASSALAMUALAIKUM @@

Ke Majlis

YBrs. Dr. Zaleha bt Ismail  
Sarjana Perubatan Masyarakat (Environmental Health)  
Pusat Pengajian Sains Perubatan  
Universiti Sains Malaysia

Tuan

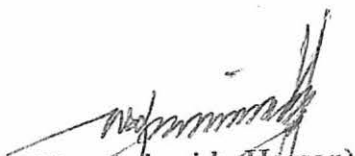
## KEIZINAN MENJALANKAN KAJIAN DISERTASI SARJANA PERUBATAN MASYARAKAT

Dengan sukacitanya dimaklumkan bahawa pihak saya tiada apa-apa halangan dan boleh memberi kerjasama sepenuhnya kepada puan dalam menjalankan kajian di kawasan Majlis Perbandaran Kota Bharu.

Sekian dimaklumkan, terima kasih.

@@ MEMBANGUN BERSAMA ISLAM @@

Yang menurut perintah,

  
(Wan Azhari b. Hassan)  
KETUA JABATAN KESIHATAN AWAN & LOGISTIK  
MAJLIS PERBANDARAN KOTA BHARU



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*Sila rujukkan bilangan surat ini  
apabila menjawab.*

*Ruj Kami: Bil( ) dlm. PKKB(*

*Tarikh: 30 September 2001*

Dr Zaliha bt Ismail  
Sarjana Perubatan Masyarakat  
(Environmental Health) Tahun III  
Jabatan Perubatan Masyarakat  
Pusat Pengajian Sains Perubatan  
Universiti Sains Malaysia  
16150 Kubang Kerian

Puan,

**Keizinan Menjalankan Pemeriksaan Kantin Serta Pengambilan Sampel Makanan bagi  
Kajian Sarjana Perubatan Masyarakat.**

Dengan sukacitanya perkara diatas adalah dirujuk.

Unit Kawalan Mutu Makanan Pejabat Kesihatan Kota Bharu tiada halangan serta membenarkan puan untuk menjalankan pemeriksaan tahap kebersihan kantin sekolah dan pengambilan sampel makanan di semua sekolah di bawah Pejabat Kesihatan Kota Bharu, seperti yang dilakukan oleh Inspektor Kesihatan Unit Kawalan Mutu Makanan yang mana ianya hanya bertujuan untuk menjalankan kajian bagi menyiapkan disertasi program Sarjana Perubatan Masyarakat dan tiada kena mengena dengan penguatkuasaan mana-mana undang-undang.

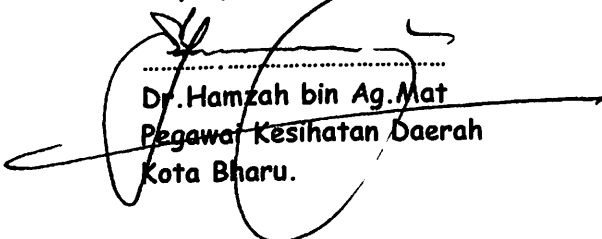
Sekian, terima kasih.

“BERKHIDMAT UNTUK NEGARA”

Sekian, terima kasih.

**BERKHIDMAT UNTUK NEGARA.**

Saya yang menurut perintah,

  
.....  
Dr. Hamzah bin Ag. Mat  
Pegawai Kesihatan Daerah  
Kota Bharu.





PKA 2003

**Persatuan Doktor Pakar Kesihatan Awam Malaysia**

d/a Jabatan Kesihatan Masyarakat  
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Ruj. (34) dlm PDPKAM/PKA 2003/SU/01  
Tarikh: 8 April 2003

DR ZALIHA ISMAIL  
JABATAN PERUBATAN MASYARAKAT  
PUSAT PENGAJIAN PERUBATAN MASYARAKAT  
UNIVERSITI SAINS MALAYSIA  
16151 KUBANG KERIAN

Y. Bhg Prof/Tan Sri/Dato'/Datin/Tuan/Puan,

**PENGESAHAN PENDAFTARAN MENGHADIRI  
PERSIDANGAN KESIHATAN AWAM KETIGA (PKA 2003)  
28 – 30 APRIL 2003; HOTEL HILTON SEREMBAN.**

Dengan hormatnya dan sukacitanya saya merujuk perkara diatas,

2. Sukacita dimaklumkan bahawa :

2.1 [ ] Urusetia telah menerima borang pendaftaran Y. Bhg Prof/Tan Sri/ Dato'/ Datin/Tuan/Puan dan bayaran sebanyak RM300.00 / RM350.00 / RM400.00 / RM250.00 / RM200.00 melalui pesanan kerajaan no. \_\_\_\_\_ / cek / wang pos. Y. Bhg Prof/Tan Sri/Dato'/Datin/Tuan/Puan telah diterima menjadi peserta dalam persidangan tersebut.

2.2 [ ✓ ] Urusetia telah menerima borang pendaftaran Y. Bhg Prof/Tan Sri/ Dato'/ Datin/Tuan/Puan dan Y. Bhg Prof/Tan Sri/Dato'/Datin/Tuan/Puan telah diterima menjadi peserta dalam persidangan tersebut. Sehubungan dengan itu Y. Bhg Prof/Tan Sri/ Dato'/ Datin/Tuan/Puan dan bayaran sebanyak RM300.00 / RM350.00 / RM400.00 / RM250.00 / RM200.00 melalui pesanan kerajaan / cek / wang pos/tunai diatas nama PERSIDANGAN KESIHATAN AWAM 2003 sebelum atau pada hari pendaftaran persidangan.

3. Kami juga mat berbesar hati sekiranya Y. Bhg Prof/Tan Sri/Dato'/Datin/Tuan/Puan dapat mengesahkan kehadiran dan perkara yang berkaitan dengannya seperti, bengkel yang akan dihadiri dan kehadiran kemajlis makan malam melalui tel 03-91702541, fax 03-91737825 atau email [noraziah@mail.hukm.ukm.my](mailto:noraziah@mail.hukm.ukm.my) sebelum 24 April 2003.

4. Untuk makluman Y. Bhg Prof/Tan Sri/Dato'/Datin/Tuan/Puan pendaftaran untuk bengkel adalah dari pukul 8.00 pagi 27 April 2003 dan pendaftaran peserta untuk mengadiri persidangan sahaja adalah 2.00 petang 27 April 2003 dan persidangan akan bermula pada pukul 8.30 pagi 28 April 2003.

Sekian, terima kasih

**BERBAKTI KEARAH KESEJAHTERAAN MASYARAKAT**

Yang benar

  
**Pn Noraziah Daud**  
Sekretariat PKA 2003

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Knowledge and perception of the staff of Pandan Hospital regarding Total Hospital Information System (THIS).

T. Ramelah T. Senik

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Myopia Survey among chinese primary School children : genetic factor or environmental factor

Teoh SC, Chen AH

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A Study Of Microalbuminuria And Associated Factors In Patients With Type 2 Diabetes Mellitus In Hospital Universiti Sains Malaysia, Kelantan

TH Tengku Norbanee\*, I Abdul Aziz Al-Safi\*, MD Kamaliah\*\*

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A cost-effective analysis of intrapartum care for low risk mothers at two levels of care in Jeli, Kelantan.

Hashim, MH., Mazlan, A. and Wnorlida, WI.

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The Seasonal Abundance of Aedes Mosquitoes (Dengue Vectors) In The Serdang Main Campus of Universiti Putra Malaysia

Wan Omar, A.<sup>1</sup>, Mohd. Yunus, A.<sup>2</sup>, Malina, O.<sup>1</sup>, Ngah, Z.<sup>1</sup>, Roslaini, A.M.<sup>1</sup> & Nawawi, D.<sup>1</sup>

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Seroepidemiologi Studies of Lymphatic Filariasis Among Immigrants, Local Endemic Population, Orang Asli Population and Animal Reservoirs At Perak Tengah District, West Malaysia

Wan Omar, A.<sup>1</sup>, Roslaini, A.M. and Ngah, Z.<sup>1</sup> and Yusof, S.<sup>2</sup>, Low, C.K.<sup>2</sup>

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PP2001

Yusof Ahmad

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Particulate Matter (Pm10) On Lung Function Of Children In Sungsi Siput Utara, Perak Darul Ridzuan.

Abdul Mujid Abdullah, Zailina Hashim and Juliana Jalaludin

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Setting Infectious Disease Priority In Malays

Dr. Zainudin Abdul Wahab

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A Study On Hygienic Standard Of Food Premises And Microbiological Quality Of Food In Kota Bharu.

Zaliha Ismail and Mohamed Rusli bin Abdullah