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Microbial quality of selected sandwiches sold at retail outlets of fast food shops in Dhaka city and Mymensingh town of Bangladesh

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ABSTRACT

The experiment was designed to undertake a study on the sanitary quality of commercial fast foods sold at retail outlets of fast food shops in Dhaka city and Mymensingh town of Bangladesh. One hundred sandwiches were subjected to bacteriological examinations. The mean values of total viable count (TVC), total coliform count (TCC) and total staphylococcal count (TSC) in wrapped and unwrapped samples of pre-microwave oven and post-microwave oven fast foods were determined. In pre-microwave oven the TVC, TCC and TSC were log 6.36, log 3.42 and log 4.21 respectively. Similarly in post-microwave oven the TVC, TCC and TSC were log 4.89, log 2.60 and log 3.03 respectively. The role of packaging and heat treatment prior to sale on the bacterial changes of the fast foods were demonstrated. It was observed that the values of TVC of all fast food samples except post-microwave oven treated McDonald's; Pizza and Ruma were higher than the maximum microbial limit. In TCC and TSC all values were higher than the maximum limit. The degree of initial contamination in fast food samples which may pose health hazard to public health has been discussed. It was concluded that the hygienically packaged fast foods and microoven treatment prior to sale would retain the best quality attributes required for consumer's acceptability and safety.

1. Introduction

The uses of fast foods have currently become an integral part of convenient food preparation patterns all over the world including Bangladesh. The most popular fast foods in Bangladesh are burger, pizza, french fries and so on. The consumption of these ready-to-eat foods has been reported to be associated with serious health problems (Adams and Moss, 2000; FDA, 2000). Changes in life-style and food habits have been bringing about this evolving shift from traditional foods. People consciously or subconsciously make the decision to invest their time more in actions other than food preparation. The other choices of investment include professional employment volunteer work, social activity and family requirements. Besides, consumers prefer to have certain readily available foods for which they do not possess the skill and or equipment to prepare. Fast foods may satisfy these desires.

The disease causing agents spread by food not only incapacitate large groups of people, but also sometimes result in serious disability and even death. The transmission of human diseases through food is a global problem, particularly in developing countries where gastrointestinal diseases are one of the most important causes of mobility and mortality. However, food habits adopted by populations may mitigate or increase the hazards (WHO, 1968; WHO, 1976). The above mentioned hazards can be minimized to a great extent simply by monitoring the microbiological quality of food and creating awareness among the people about the fundamental principles of sanitation and hygienic quality of foods.

Food-borne diseases and problems relating to the sanitary and microbiological quality of foods continue to be of major interest and concern in Bangladesh and other countries of the world. New problems have been created due to recent development the processing and handling of foods change of food habits and availability of convenience foods. Current consumer’s oriented publicity on freshness of fast foods available for sale in stores has created general impression that age per se of a food is closely related to acceptability. The question of dating and labeling or retail packages has been considered essential features of acceptable quality assurance and quality control programs. However, in Bangladesh such programs are still rudimentary, as little information is available on the microbiological aspects and keeping quality of commercially processed fast foods produced under the prevailing conditions. Therefore, the present study was designed to determine the sanitary quality of commercial fast foods sold at retail outlets of fast food shops in Dhaka city and Mymensingh town of Bangladesh.

2. Materials and methods

2.1. Sources, collection and transportation of samples

This experiment was carried out in the Bacteriology Laboratory of Bangladesh Agricultural University, Mymensingh from July to October, 2006. Five different brands of sandwiches available at retail stores were selected for this study. These brands belonged to (i) McDonald’s (ii) Pizza hut (iii) Ruma (iv) Best bite and (v) Shoukhin. Each brand samples for this study was either wrapped or unwrapped. All of these types are of two categories, pre-microwave oven (fresh sample from retail outlets) and post-microwave oven treated prior to sale or offered to customers. These sandwiches were prepared almost entirely using open hand and the ingredients used for their preparation did not receive any heat treatment or otherwise processed. The ingredients were meat, egg, vegetables, fish and mayonnaise. The food items collected for this study were carefully handled and transported to the laboratory in ice-packed condition. Due aseptic care was taken during transportation and the samples were kept cool until they were subjected bacteriological analysis.

2.2. Preparation of samples

Portions of all food samples were uniformly homogenized in Colworth Stomacher blender using a sterile diluent as per recommendation of ISO (1995). A quantity of 20 gm homogenate sample of each sandwich was taken aseptically with a sterile forceps and transferred carefully into a sterile container containing 180 ml 0.1% peptone water. A homogenized suspension was made in the Colworth Stomacher blender. Thus 1:10 dilution of the samples was obtained. Later on using whirly mixture machine different serial dilutions ranging from 10^{-2} to 10^{-6} were prepared according to the standard method (ISO, 1995).

2.3. Enumeration of total viable count

0.1 ml of each ten fold dilution was transferred and spread on duplicate plate count agar using a fresh pipette for each dilution for the determination of total bacterial count. The diluted samples were spread as quickly as possible on the surface of the plate with sterile glass spreader. One sterile spreader was used for each plate. The plates were kept in an incubator at 35^0C to for 24-48 hrs. After incubation, plates exhibiting 30-300 colonies were counted. The average number of colonies in particular dilution was multiplied by the dilution to obtain the total viable count. The total viable count was calculated according to ISO (1995). The results of the total bacterial count were expressed as the number of colony forming units CFU per gram of food samples.

2.4. Enumeration of total coliform count

For the determination of total coliform count 1ml of each tenfold dilution was transferred to MacConkey agar. For each dilution five test plates containing MacConkey agar were used. All the agar plates were incubated at 30^oC temperature for 48 hours. The total coliform count was calculated according to ISO (1995). The results of the total coliform count were expressed as the number of organism or colony forming units per gram (CFU/gm) of food sample.

2.5. Enumeration of total staphylococcal count

For the determination of total staphylococcal count 1ml of each tenfold dilution was transferred to Staphylococcal 110 medium (SM-110). For each dilution three test plates containing Staphylococcal 110 medium were used. All the agar plates were incubated at 37^oC temperature for 48 hours. The total staphylococcal count was calculated according to ISO (1995). The results of the total staphylococcal count were expressed as the number of organism or colony forming units per gram (CFU/gm) of food sample.

Cultural and Biochemical Examination of Bacterial Isolates Obtained from Food Samples

The cultural examination of food samples for bacteriological analysis was done according to the standard method (ICMSF, 1985). The examination followed detail study of colony characteristics including the morphological and biochemical properties. In order to find out different types of microorganisms in food samples, different kinds of bacterial colonies were isolated in pure culture.

2.6. Statistical analysis

The data on TVC, TCC and TSC obtained from the bacteriological examination of food samples of five different sandwiches sold at retail stores were analyzed, by employing factorial experiment in Completely Randomized Design (CRD) and using computer package MASTAT-C (Freed, 1992). Using of t-test for each attribute, where applicable Duncan's Multiple Range Test was also employed to find out treated product difference.

3. Results

The chief purpose of microbiological examination of foods are to give assurance that the foods will be acceptable from the public health standpoint and that the foods will be of satisfactory quality, i.e., will consist of good original materials that have not deteriorated or become unduly contaminated during processing, packaging, storage, handling or marketing. The practice that has been in effect for many years and continues to be followed is to determine the sanitary quality of foods by their content of certain indicator organisms and pathogens. The present study is therefore undertaken to determine the total viable bacterial load, the presence of coliforms and detection of staphylococci in fast foods. The result of pre-microwave oven samples presented in Table 1 showed the total viable bacterial load of 100 different fast food samples of two different categories (i. e., wrapped and unwrapped) of five different sources as received from local retail stores of Dhaka city and Mymensingh town of Bangladesh. The bacterial load was not uniform and varied quite consistently by at least 2 to 3 log cycles. The mean counts per gram of wrapped and unwrapped samples belonging to McDonald's, Pizza hut, Ruma, Best bite and Shoukhin were found log 5.08±0.47 and log 4.86±0.48; log 6.42±1.06 and log 5.82±0.96; log 6.58±0.50 and log 6.20±1.06: log 7.08±1.05 and log 6.81±0.96; log 7.44±0.26 and log 7.31±0.50 respectively (Table 1). In case of wrapped samples the minimum and maximum counts of different manufacturers ranged in McDonald's from log

4.62 to log 5.48, in Pizza hut log 5.61 to log 6.90, in Ruma log 5.74 to log 6.91, in Best bite log 6.85 to log 7.34 and in Shoukhin log 7.11 to log 7.74 (Table 1). On the other hand, in case of unwrapped samples the minimum and maximum ranges recorded were for McDonald's log 4.57 to log 5.18, Pizza hut log 5.30 to log 6.54, Ruma log 5.04 to log 6.78, Best bite log 5.99 to log 7.18 and Shoukhin log 7.08 to log 7.65 (Table 1). In case of post-microwave oven treated samples, the results were represented in Table 2. The mean values of TVC of different sandwich samples belonging to McDonald's were log 3.80±018 and log 3.74±0.22, Pizza hut log 4.91±0.50 and log 4.88±0.20, Ruma log 4.90±0.26 and log 4.88±0.19, Best bite log 5.63±0.18 and log 5.56±0.14 and in Shoukhin log 5.68±0.26 and log 5.55±0.18 in case of wrapped and unwrapped samples respectively (Table 2). The range of minimum and maximum counts of wrapped samples were in McDonald's log 3.74 to log 3.83, in Pizza hut log 4.88 to log 4.94, in Ruma log 4.85 to log 4.95, in Best bite log 5.51 to log 5.72 and in Shoukhin log 5.59 to log 5.76 respectively (Table 2). On the other hand, the minimum and maximum ranges of unwrapped samples were in McDonald's log 3.68 to log 3.85, in Pizza hut log 4.84 to log 4.92, in Ruma log 4.81 to log 4.91 in Best bite log 5.48 to log 5.65 and in Shoukhin log 5.48 to log 5.56 (Table 2). It is evident from the above data that microwave oven treatment has resulted in some affect in destroying the microbes and thereby reducing the occurrence of microbial load at least by one log cycle.

The values of the total coliform count of the pre-microwave oven treated samples are recorded in Table 3. The mean counts/gm of McDonald's, Pizza hut, Ruma, Best bite and Shoukhin were log 2.59±0.11 and log 3.45±0.18; log 2.78±0.21 and log 3.69±0.26; log 2.89±0.20 and log 3.95±0.10; log 2.95±0.47 and log 4.17±0.78; log 3.25±0.47 and log 4.46±0.11 in case of wrapped and unwrapped sandwiches respectively (Table 3). The minimum and maximum ranges coliform count as revealed in wrapped samples of different brands were in McDonald's log 2.48 to log 2.68 to Pizza hut log 2.72 to log 2.84, Ruma log 2.85 to log 2.94, Best bite log 2.62 to log 3.11 and Shoukhin log 3.04 to log 3.43 (Table 3). In respect of unwrapped samples the minimum and maximum coliform counts evidenced respectively in McDonald's log 3.15 to log 3.76, Pizza hut 2.90 to log 3.90, Ruma log 3.91 to log 3.99, Best bite log 3.54 to log 4.41 and Shoukhin log 4.36 to log 4.57 (Table 3). The coliform counts of post-microwave oven treated samples are shown in Table 4. The mean values as obtained in wrapped unwrapped samples McDonald's log 2.50±0.26 and log 2.31±0.14, Pizza hut log 2.60±0.35 and log 2.33±0.18, Ruma log 2.68±0.18 and log 2.55±0.11, Best bite log 2.88±0.20 and log 2.71±0.18 and Shoukhin log 2.81±0.11 and log 2.66±0.19 respectively (Table 4). The values of the minimum and maximum samples of wrapped samples of different brands were McDonald's log 2.30 to log 2.61, Pizza hut 2.49 to log 2.70, Ruma log 2.59 to log 2.77, Best bite log 2.83 to log 2.92 and Shoukhin log 2.69 to log 2.91 (Table 4). Similarly the minimum and maximum ranges of unwrapped samples of different brands were in McDonald's log 2.15 to log 2.43, Pizza hut log 2.18 to log 2.49, Ruma log 2.46 to log 2.65, Best bite log 2.60 to log 2.79 and Shoukhin log 2.58 to log 2.76 (Table 4).

The staphylococcal count of the pre-microwave oven samples as obtained are presented in Table 5. The mean values of different brand samples were in McDonald's log 3.71±0.26 and log 3.63±0.47, Pizza hut 3.78±0.18 and log 3.67±0.18, Ruma log 3.85±0.11 and log 3.80±0.30, Best bite log 4.53±0.11 log 4.47±0.11 and Shoukhin 5.28±0.11 log and 5.37±0.34 in case of wrapped and unwrapped sandwiches respectively (Table 5). The wrapped samples minimum and maximum ranges were in McDonald's log 3.52 to log 3.91, in Pizza hut log 3.57 to log 3.93, in Ruma log 3.60 to log 3.96, in Best bite log 4.30 to log 4.68 and in Shoukhin log 5.04 to log 5.59 (Table 5). The minimum and maximum ranges of unwrapped samples were McDonald's log 3.30 to log 3.86, Pizza hut 3.48 to log 3.83, Ruma log 3.51 to log 3.93, Best bite log 4.28 to log 4.65 and Shoukhin log 4.95 to log 5.99 (Table 5). In case of post-microwave oven samples the results are recorded in Table 6. The average values of different brand samples were McDonald's log 2.84±0.11 and log 2.51±0.12, Pizza hut 2.84±0.10 and log 2.53±0.47, Ruma 2.79±0.12 log and log 2.85±0.10, Best bite log 3.29±0.36 and log 2.95±0.47 and Shoukhin log 4.42±0.11 and log 3.25±0.11 (Table 6). In different brand wrapped samples the minimum and maximum bacterial count ranged respectively McDonald's log 2.74 and log 2.90, Pizza hut log 2.79 and log 2.90, Ruma log 2.00 and log 2.99, Best bite log 3.11 and log 3.52 and Shoukhin log 4.30 to log 4.54 (Table 6). Anlogously in unwrapped samples the minimum and maximum bacterial counts ranged respective McDonald's log 2.43 and log 2.61, Pizza hut log 2.38 and log 2.69, Ruma log 2.74 and log 2.85, Best bite log 2.90 and log 3.00 and Shoukhin log 3.11 and log 3.40 (Table 6).

The mean values of wrapped and unwrapped samples of both in pre-microwave oven and post-microwave oven cases are summarized in Table 7. In all the samples of pre-microwave oven and post-microwave oven both in wrapped and unwrapped ones staphylococci and *Escherichia coli* ranked predominantly and staphylococci were more abundantly spread over the plates and percentage of colony counts were higher. Bacilli were found to occupy the third position. Other organisms isolated from the fast food samples were streptococci *Micrococci spp.*, *Enterobacter spp.*, *Salmonella spp. Proteus spp, Pseudomonas spp.* and (Table 8).

In the all brands of fast food samples of pre-microwave oven a significant correlation ($p<0.01$) was found between TVC and TSC, but no significant was recorded between TVC and TCC (Table 9). A significant correlation ($p<0.01$) between TVC and TCC and vice versa and in TCC and TSC and vice versa. No significant correlation ($p<0.01$) between TVC and TSC (Table 10).

Table 1
Range of total viable count (TVC) per gram of fast food samples (pre-microwave oven) obtained from retail stores.

Brand specification	Type of sample	No of sample	Range of TVC/gm		Mean±SD
			Minimum	Maximum	
McDonald's	wrapped	10	4.62	5.48	5.08±0.47
	unwrapped	10	4.57	5.18	4.86±0.48
Pizza hut	wrapped	10	5.61	6.90	6.42±1.06
	unwrapped	10	5.30	6.54	5.82±0.96
Ruma	wrapped	10	5.74	6.91	6.58±0.50
	unwrapped	10	5.04	6.78	6.20±1.06
Best bite	wrapped	10	6.85	7.34	7.08±1.05
	unwrapped	10	5.99	7.18	6.81±0.96
Shoukhin	wrapped	10	7.11	7.74	7.44±0.26
	unwrapped	10	7.08	7.65	7.31±0.50

* All counts are expressed in logarithm

Table 2
Range of total viable count (TVC) per gram of fast food samples (post-microwave oven) obtained from retail stores.

Brand specification	Type of sample	No of sample	Range of TVC/gm		Mean±SD
			Minimum	Maximum	
McDonald's	wrapped	10	3.74	3.83	3.80±0.18
	unwrapped	10	3.68	3.85	3.74±0.22
Pizza hut	wrapped	10	4.88	4.94	4.91±0.50
	unwrapped	10	4.84	4.92	4.88±0.20
Ruma	wrapped	10	4.85	4.95	4.90±0.26
	unwrapped	10	4.81	4.91	4.88±0.19
Best bite	wrapped	10	5.51	5.72	5.63±0.18
	unwrapped	10	5.48	5.65	5.56±0.14
Shoukhin	wrapped	10	5.59	5.76	5.68±0.26
	unwrapped	10	5.48	5.56	5.55±0.18

* All counts are expressed in logarithm

Table 3
Range of total coliform count (TCC) per gram of fast food samples (pre-microwave oven) obtained from retail stores.

Brand specification	Type of sample	No of sample	Range of TVC/gm		Mean±SD
			Minimum	Maximum	
McDonald's	Wrapped	10	2.48	2.68	2.59±0.11
	Unwrapped	10	3.15	3.76	3.45±0.18
Pizza hut	Wrapped	10	2.72	2.84	2.78±0.21
	Unwrapped	10	2.90	3.90	3.69±0.26
Ruma	Wrapped	10	2.85	2.94	2.89±0.20
	Unwrapped	10	3.91	3.99	3.95±0.10
Best bite	Wrapped	10	2.62	3.11	2.95±0.47
	Unwrapped	10	3.54	4.41	4.17±0.78
Shoukhin	Wrapped	10	3.04	3.43	3.25±0.47
	Unwrapped	10	4.36	4.57	4.46±0.11

* All counts are expressed in logarithm

Table 4
Range of total coliform count (TCC) per gram of fast food samples (post-microwave oven) obtained from retail stores.

Brand specification	Type of sample	No of sample	Range of TVC/gm		Mean±SD
			Minimum	Maximum	
McDonald's	wrapped	10	2.30	2.61	2.50±0.26
	unwrapped	10	2.15	2.43	2.31±0.14
Pizza hut	wrapped	10	2.49	2.70	2.60±0.35
	unwrapped	10	2.18	2.49	2. 33±0.18
Ruma	wrapped	10	2.59	2.77	2.68±0.18
	unwrapped	10	2.46	2.65	2.55±0.11
Best bite	wrapped	10	2.83	2.92	2.88±0.20
	unwrapped	10	2.60	2.79	2.71±0.18
Shoukhin	wrapped	10	2.69	2.91	2.81±0.11
	unwrapped	10	2.58	2.76	2.66±0.19

* All counts are expressed in logarithm

Table 5
Range of total staphylococcal count (TSC) per gram of fast food samples (pre-microwave oven) obtained from retail stores.

Brand specification	Type of sample	No of sample	Range of TVC/gm		Mean±SD
			Minimum	Maximum	
McDonald's	wrapped	10	3.52	3.91	3.71±0.26
	unwrapped	10	3.30	3.86	3.63±0.47
Pizza hut	wrapped	10	3.57	3.93	3.78±0.18
	unwrapped	10	3.48	3.83	3.67±0.18
Ruma	wrapped	10	3.60	3.96	3.85±0.11
	unwrapped	10	3.51	3.93	3.80±0.30
Best bite	wrapped	10	4.30	4.68	4.53±0.11
	unwrapped	10	4.28	4.65	4.47±0.11
Shoukhin	wrapped	10	4.95	5.99	5.28±0.11
	unwrapped	10	5.04	5.59	5.37±0.34

* All counts are expressed in logarithm

Table 6
Range of total staphylococcal count (TSC) per gram of fast food samples (post-microwave oven) obtained from retail stores.

Brand specification	Type of sample	No of sample	Range of TVC/gm		Mean±SD
			Minimum	Maximum	
McDonald's	wrapped	10	2.74	2.90	2.84±0.11
	unwrapped	10	2.43	2.61	2.51±0.12
Pizza hut	wrapped	10	2.79	2.90	2.84±0.10
	unwrapped	10	2.38	2.69	2.53±0.47
Ruma	wrapped	10	2.74	2.85	2.79±0.12
	unwrapped	10	2.00	2.99	2.85±0.10
Best bite	wrapped	10	3.11	3.52	3.29±0.36
	unwrapped	10	2.90	3.00	2.95±0.47
Shoukhin	wrapped	10	4.30	4.54	4.42±0.11
	unwrapped	10	3.11	3.40	3.25±0.11

* All counts are expressed in logarithm

Table 7
Mean viable count of selected microbial groups of fast foods obtained from retail stores.

Brand specification	Total viable bacteria count				Total coliform count				Total staphylococcal count			
	Pre		Post		Pre		Post		Pre		Post	
	W	U	W	U	W	U	W	U	W	U	W	U
McDonald's	5.08±0.47	4.86±0.48	3.80±0.18	3.74±0.22	2.59±0.11	3.45±0.18	2.50±0.26	2.31±0.14	3.71±0.26	3.63±0.47	2.84±0.11	2.51±0.12
Pizza hut	6.42±1.06	5.82±0.96	4.31±0.50	4.88±0.20	2.78±0.21	3.69±0.26	2.60±0.35	2.33±0.18	3.78±0.18	3.67±0.18	2.84±0.10	2.53±0.47
Ruma	6.58±0.05	6.20±1.06	4.90±0.26	4.88±0.19	2.89±0.20	3.95±0.10	2.68±0.18	2.55±0.11	3.85±0.11	3.80±0.30	2.79±0.12	2.85±0.10
Best bite	7.08±1.05	6.81±0.96	5.63±0.18	5.56±0.14	2.95±0.47	4.17±0.78	2.88±0.20	2.71±0.18	4.53±0.11	4.47±0.11	3.29±0.36	2.95±0.47
Shoukhin	7.44±0.26	7.31±0.50	5.68±0.26	5.55±0.18	3.25±0.47	4.46±0.11	2.81±0.11	2.66±0.19	5.28±0.11	5.37±0.34	4.42±0.11	3.25±0.11

* All counts are expressed in logarithms
W: Wrapped; U: Unwrapped; Pre: Pre-microwave oven treated; Post: Post-microwave oven treated

4. Discussion

Since the numbers of bacteria in foods are considered indicative of index of hygienic production, therefore the bacterial content of fast food could be taken as a measure to determine the sanitary quality. In view of this perspective, the present study reflects an approach to the recognition of potential public health hazard in fast food samples obtained from different retail stores. The study undertaken revealed that the ingredients present in sandwiches did not cause inhibition of the propagation of microbes; rather they multiply at the storage temperature. Hall et al. (1967) found that the mean total count of sandwiches increased from an initial level of 4.2×10^6/gm to 2×10^8/gm. after 48 hr storage at room temperatures. In this investigation generally the bacterial content of the "pre-microwave oven" and "post-microwave oven" treated sandwiches differed consistently. The former was always found higher than the later. This may be ascribed to be due to heat treatment which caused death of organisms, as a result there was a fall of microbial growth rate by 2 to 3 log cycle.

Table 8
Frequency distribution of microorganisms isolated from different fast food samples.

Genus	Percentage of flora found in fast food samples			
	Pre-microwave oven samples		Post-microwave oven samples	
	Wrapped	Unwrapped	Wrapped	Unwrapped
Staphylococci	100	100	100	100
Coliforms	100	100	94	100
Bacilli	48	50	70	54
Streptococci	19	21	30	12
Micrococci	14	19	12	15
Enterobacter	18	15	10	8
Salmonella	4	4	3	3
Proteus	2	3	2	2
Pseudomonas	1	1	0	0
Others unidentified bacteria	5	4	4	2

Table 9
Correlation between TVC, TCC and TSC (pre-microwave oven treated sample).

		Total viable counts from all brands	Total coliform counts from all brands	Total staphylococcal counts from all brands
Total viable counts from all brands	pearson correlation	1	0.284 NS	0.823**
	sig (2 tailed)	0.00	0.427	0.003
	n	10	10	10
Total coliform counts from all brands	pearson correlation	0.284 NS	1	0.382 NS
	sig (2 tailed)	0.427	0.00	0.275
	n	10	10	10
Total staphylococcal counts from all brands	pearson correlation	0.823**	0.382 NS	1
	sig (2 tailed)	0.003	0.275	0.00
	n	10	10	10

**Correlation is significant at the P<0.01.

Table 10
Correlation between TVC, TCC and TSC (post-microwave oven treated sample).

		Total viable counts from all brands	Total coliform counts from all brands	Total staphylococcal counts from all brands
Total viable counts from all brands	pearson correlation	1	0.781**	0.622 ^{ns}
	sig (2 tailed)	0.00	0.008	0.055
	n	10	10	10
Total coliform counts from all brands	pearson correlation	0.781**	1	0.724**
	sig (2 tailed)	0.008	.	0.018
	n	10	10	10
Total staphylococcal counts from all brands	pearson correlation	0.622^{ns}	0.724**	1
	sig (2 tailed)	0.055	0.018	0.00
	n	10	10	10

**Correlation is significant at the P<0.01.

It is evidenced from the analyses of the above data that the samples of five brands differed among themselves with regard to their microbiological quality. When total counts were taken as an index of quality then samples belonging to McDonald have revealed the lowest counts. On the other hand the samples belonging to best bite and shoukhin demonstrated to have the highest microbial load. Samples of Pizza hut and Ruma exhibited intermediate level of contamination. It is interesting to note that highest bacterial count was observed in premicrowave oven treated wrapped samples of shoukhin brand and the value was log 7.74 where as the lowest count was found in post-microwave oven treated unwrapped samples of McDonald's and the value was log 3.68. It is indicated from the study that the total viable bacteria in the wrapped fast foods were found always higher than the unwrapped ones. Since all of these sandwiches were fabricated by hand and held at ambient air temperature (23-30^{0}C) prior to sale, it may be assumed that the "wrapped" and "unwrapped" types although received a similar initial contamination but the final numbers were found to have increased in wrapped samples. This may be due either to favorable oxygen-reduction potential or may be the wrappers do not meet the sanitary specification.

Adame et al. (1960) led to similar opinion. They opined that the wrapped sandwiches showed high total numbers during preparation and the intrinsic environment for the growth of bacteria per gram. Since the post-microwave oven treated food is a heat treated food, it is obvious that a considerable number of bacteria would be killed. In the present study the post-microwave oven treated samples of McDonald's, Pizza hut and Ruma showed lower count than the recommended level, however in Best bite and Shoukhin the counts obtained were higher. The reason for higher count can be attributed to high initial microbial load, heat resistance growth of initial contamination or post harvest contamination which resulted in microbial growth and propagation when fast foods were held at ambient temperature. Many investigators (Christiansen and King, 1970, Khan and McCaskey, 1972) similarly concluded that the fast foods were contaminated during fabrication by hand and growth of the initial contamination taken place as a result of being held at ambient temperature. The heat treatment is not adequate enough to reduce the microbial load, as a result the potential danger of health hazard is retained.

Many public health officials and food safety inspection service while examining foods of various types believe that a minimum level of coliform contamination should always be present (Lewis and Angelotti, 1964). The exact significance of the association of these organisms although is clearly understood, but the sanitarians consider coliform counts as an indicator of faecal pollution and this has been cautiously applied and evaluated with heat treated foods (Hall et al. 1967). In the present study the mean values of TCC of Pre-microwave oven treated is higher than the post microwave oven treated food samples. All fast food samples of different brands exceeded the coliform limit of the recommended standard. The highest count was found in pre-microwave oven unwrapped samples of Shoukhin brand and the value was log 4.57 where as the lowest count was found in post-microwave oven treated unwrapped samples of McDonald's and the value was log 2.15. It was therefore a matter of concern that to what extent the products were initially contaminated and later declined after microwave oven treatment. The source of contamination could be the different ingredients added to fast foods or the food handlers. The latter may be an important source of food borne pathogens gaining access into sandwiches. The coliform counts in the "wrapped" sandwich probably obtained less favorable growth conditions compared to the "unwrapped" types and, in the case of the post-microwave oven fast foods the coliform organisms might have declined. This observation was in close agreement with Adame et al. (1960) and Hall et al. (1967). The presence of coliforms in commercially prepared wrapped or unwrapped fast foods advocated that a great deal of hygienic application is needed to improve the sanitary quality and the consumes should be made aware about the "hot" fast foods. That is fast foods should be served hot so that coliform organisms are killed by the heat processing. Many researchers led to opinions that the increase of coliforms is associated with the sanitary and technological procedures employed. The food industry finds it a useful tool in maintaining good sanitary condition. Evidence as obtained from this study clearly supported that heat treatment for short period does not always destroy potential food borne coliforms. Exposure of food at room temperature may allow coliforms to multiply. While the presence of large numbers of coliforms is highly undesirable, it would be virtually impossible to eliminate all of these organisms from fresh and processed food. It can be seen that low numbers of coliform are permitted ranging from 1 to not over 100/g or ml. (Slanetz et al. 1962). The present investigation showed that in pre-microwave oven samples the presence of coliform was too high and did not meet the microbial standards and limit. Although in post-microwave oven samples there was reduction in number of coliform, but the counts found were always more than microbial specification, emphasizing for improved technological and sanitary measures in the preparation of fast foods. The hygienic handling of raw foods prior to preparation and after distribution to retail stores must be given due attention so that the post-harvest food safety is maintained.

Presence of staphylococci of the food poisoning type has been demonstrated in long ago commercially prepared fast foods by Gunderson et al. (1954). These organisms are capable of growing in fast foods at room temperature has been reported by Hall et al. (1967), but probably would be unable to grow in properly refrigerated sandwiches. Also, as suggested by preliminary trials, growth is unlikely even in sandwiches held at 37^0C. Thus, the levels of staphylococci found in the sandwiches appear to originate in raw materials and/or from contamination during production, giving cause to question the quality of the raw materials and the sanitation practices. In addition, given that the sandwiches may be held at room temperature for several hours there is the potential danger of growth and enterotoxin production in these products as demonstrated by Christiansen and King (1970).

The highest count was found in pre-microwave oven treated wrapped samples of Shoukhin and the value was log 5.99 where as the lowest count was found in post-microwave oven treated unwrapped samples of Ruma and the value was log 2.00. In such a case should the sandwiches be held at room temperature and due to mishandling, the staphylococci would require only a short time to multiply to a level at which they could produce a significant amount of enterotoxin. The occurrence of staphylococci in nearly all the samples evaluated, emphasized the fact that constant vigilance must be maintained over the technological and sanitary procedures used in the manufacture of fast foods of this type. Although it may be difficult to produce sandwiches which are constantly free of these organisms; certainly the operation should be such that their number will be low in the final product.

The data obtained cautiously dictated that the fast foods which contain staphylococci may have a probable food poisoning potential. These organisms are capable of growing in fast foods at room temperature. It can be taken into consideration that gross mishandling of the food ingredients and unsanitary practices have resulted in growth of the staphylococci. This could bring about possible health hazard, as the staphylococci would require only a short time to multiply to a level at which they could produce a significant amount of enterotoxin. The staphylococci count in some fast foods was found more than total viable bacterial load. It is however fortunate that no coagulase positive strains were recovered. However it is reason to believe that food poisoning types might be able to multiply under the same condition that is at ambient air temperature for 17-20 hours prior to sale (Miller, 1961).

staphylococci occupied the highest percentage of occurrence. presence of high number of pathogenic Staphylococci in fast food is alarming. next to Staphylococci, coliform ranks the second position. the high *E. coli* percentage indicates poor practice sanitary conditions during handling, and transportation of fast foods. the organisms gaining access to fast foods were not only the cause of deterioration and spoilage but also responsible for giving warning signal of indication of the presence of many food borne disease outbreaks. presence of strepotococci and *Salmonella* spp. in fast foods must receive particular attention, as these organisms are responsible for causing hazard to public health.

In the all brands of fast food samples of pre-microwave oven a significant correlation ($p<0.01$) was found between TVC and TSC, i.e., if TVC is increased than TSC is increased. No significant correlation was recorded between TVC and TCC. A significant correlation was found between TVC and TCC in case of post-microwave oven treated sample. The results contradict with the report of Sankaran et al. (1975), where they found no significant correlation between viable count and coliform count of fast foods. The present study however agrees with one point of Sankaran et al. (1975). It appears from the study that where staphylococci were detected in large numbers, the total plate count was proportionally evidenced high in density. The present study also revealed that there was significant correlation between TSC and TCC. Correlation between TVC and TCC signified that coliform count cold be taken as an index of bacteriological quality of fast foods, but as there were no significant correlation between TVC and TSC, so counts of staphylococci cold not be taken as a good index of bacteriological quality of fast foods although high staphylococci count present may cause alarm or potential hazards.

5. Conclusion

It is unfortunate that there has been not yet any application of legal standard relating to the hygienic production, processing and distribution of fast foods in Bangladesh. The present study has focused on the pre-harvest and post-harvest safety of fast food and their impact on potential health hazard arising from consumption. The result contributes in making suggestions to ensure delivering safe food product to meet the demands of consumers now and in future. The following suggestions to be ensured hygienic food safety and obtaining hygienic quality fast foods may be credible -

- ✓ Procurement of raw materials of the best possible microbiological quality.
- ✓ Prevention of undue contamination of fast foods prior to processing.
- ✓ Appropriate processing of fast foods.
- ✓ Proper measures to avoid contamination during and particularly after processing of fast foods.
- ✓ Quality packaging to keep foods fresh and get rid of health risk factors
- ✓ Adequate storage, ideal transportation, and hygienic handling of the finished product and if needed cold-chain application
- ✓ Microwave oven treatment prior to serving to consumption.

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References

Adame, J.L., Post, F.J., Bliss, A.H., 1960. Preliminary report on a bacteriological study of selected commercially prepared wrapped sandwiches. J. Milk Food Tech. 23, 363-366.

Adams, M.R., Moss, M.O., 2000.Food Microbiology.2nd Edn., Royal Society of Chemistry, Cambridge, UK., ISBN-13: 9780854046119, pp, 479.

Christiansen, L.N., King, N.S., 1970. The microbial content of some salads and sandwiches at retail outlets.Department of Food Science North Carolina State University. Raleigh, 27607.

FDA, 2000. Food Code Recommendation of the United States Public Health Service. Food and Drug Administration, Washington, DC., USA.

Freed, R.D., 1992. MSTAT Director.Crop and Soil Sciences Department, Michigan State University, USA.

Gunderson, M.F., McFadden, H.W., Kyle, T.S., 1954.The Bacteriology of commercial Poultry Processing. Burgess Publ.Co.Minneapolis, Minn.

Hall, H.E., Brown, D.F., Lewis, K.H., 1967.Examination of market foods for coliform organisms. Appl. Micro. 15, 1062-1069.

ICMSF, 1985. Microorganism in foods; samples for Microbiological Analysis: Principles and specific applications.Recommendation of the International Commission on Microbiological Specification for Foods.Association of Microbiological Societies, Toronto, University of Toronto Press, pp. 4-38.

ISO, 1995.Recommendation of the meeting of the subcommittee, International Organization for Standardization, on meat and meat products.ISO/TC-36/Sc-6.The Netherlands. 10-18.

Khan, N.A., McCaskey, T.A., 1972. Incidence of salmonellae in commercially prepared sandwiches for the vending trade. Department of Animal and dairy Sciences, Auburn University Agricultural Experiment Station, Auburn, Alabama 36830.

Lewis, K.H., Angelotti, R., 1964. Examination of foods for enteropathogenic and indicator bacteria. U.S. Public Health Serv.Publ.1142.

Miller, W.A., 1961. The microbiology of some self-service, packaged, luncheon meats. J. Milk Food Tech. 23, 374-377.

Sankaran, R., Thangamani, R.K., Parihar, B.D., Nath, H., 1975. Microbial profiles of dehydrated cured mutton mince from raw material to the finished product. J. Food Prot. 43, 135-140.

Slanetz, L.W., Chichester, C.O., Gaufin, A.R., Ordal, Z.J., 1962. Microbiological Quality of foods.Academic Press. New York.

WHO, 1968. Microbiology aspects of food hygiene. Technical Report, Series No.399.World Health Organization (WHO), Geneva.

WHO, 1976. Microbiological aspects of food hygiene. Technical Report, Series No.598.World Health Organization (WHO), Geneva.