Full Length Research Paper

Source(s) of contamination of 'raw' and 'ready-to-eat' foods and their public health risks in Mekelle City, Ethiopia

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The study was carried out from December 2010 to June 2011 to determine the hygienic and sanitary conditions on the available cafeterias, restaurants, juice houses, supermarkets, and food handlers of Mekelle city. Using the standardized pre-tested questionnaire and observational check list, data was collected from a total of 510 catering establishments. Microbiological examination of 260 food samples indicated that food provided to the consumers in the city was less hygienic and had prepared under poor sanitation conditions. General hygiene of food handlers, sanitary facilities of food establishments, physical conditions of food catering establishments, disposal services, legal licensing and environmental hygiene were identified as major sanitary deficiencies. Less understanding in food hygiene among food handlers were also commonly observed. High mean values of bacterial load were found in mayonnaise (2.64×10^6) among the food samples taken from the supermarkets and 2.89×10^6 bacterial load was found in samples from restaurants. The bacteriological swab tests of food utensils confirmed the gross unhygienic condition of food offered to the consumers. Pathogens such as *Salmonella* spp., *Shigella* spp. and *Escherichia coli* were the main identified organisms in the catering establishments. It is concluded that the sanitary conditions of studied subjects required strict follow up for the provisions of sanitary codes. Periodic sanitary-hygienic evaluation and inspection of catering establishments should be strengthened to reduce public health hazards.

Key words: Food safety, hygiene, catering establishments, bacterial load, bacterial isolation, Mekelle, Ethiopia.

INTRODUCTION

Food borne diseases are common in developing countries including Ethiopia because of the prevailing poor food handling and sanitation practices, inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in safer equipments, and lack of education for food-handlers (WHO, 2004). National Hygiene and Sanitation Strategy program (MoH, 2005) reported that about 60% of the disease burden was related to poor hygiene and sanitation in Ethiopia. Unsafe sources, contaminated raw food items, improper food storage, poor personal hygiene during food preparation, inadequate cooling and reheating of food items and a prolonged time lapse between preparing and consuming food items were mentioned as contributing factors for outbreak of food borne diseases (Linda du and Irma, 2005). Studies conducted in different parts of the country showed the poor sanitary conditions of catering establishments and presence of pathogenic organisms like campylobacter, *Salmonella, Staphylococcus aureus, Bacillus cereus and Escherichia coli,* (Kinfe and Abera, 2007; Abera et al., 2006; Bayleyegn et al., 2003; Tefera et al., 2009; Mekonnen et al., 2011).

World Health Organization of the United Nations (2005) highlighted in its report that food prepared in large quantities are liable to contamination. Food business establishments in Mekelle are booming forcing service providers to prepare food in large quantities. Though the establishments offer good economic opportunities, prepared foods should also get proper handling and

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Table 1. Distribution of type and number of samples collected.

Type of sample	Source of sample		
	Cafeterias	Juice houses	Restaurants
Food/juices	40	40	40
Table scraping*	40	40	30
Supermarkets		30	
Total		260	

*Sample types collected during sampling of the respective food items.

preservation in order to safeguard public health. Regional bureau of health has put different program initiatives in place to decrease possible food borne disease (threats) in the city. Regulatory enforcement and promotional activities are among the initiatives; however, lack of proper information flow on possible food contaminant sources critically hinders the ability of the bureau to effectively regulate. Assessment of food safety knowledge and practices of abattoir and butchery shops in the city (Mekonnen et al., 2011) showed that meat samples collected from butchery shops had viable bacterial load in the range of 1.1×10^5 to 4.3×10^6 cfu/g.

The study results and lack of regulatory enforcements indicated that there is critical need for thorough investigation of food contaminant sources in the city. Therefore, the present study was designed to determine the bacteriological load of raw and ready-to-eat foods, identify the major food contaminating bacteria, and to investigate the knowledge, attitudes and perceptions of members of the public about the health risks associated with the consumption of these food items.

MATERIALS AND METHODS

Study area

The study was carried out in Mekelle city, the capital of Tigray Regional State, situated about 783 km North of Addis Ababa at 38.5° East longitude and 13.5° North latitude, and at an altitude of 2300 m a.s.l. The city has six sub-cities and a total population of 215,546 (CSA, 2007) which is home to over 800 grain mills, 500 food shops, an extensive public transport network and an active urban-rural exchange of goods which has 30,000 micro and small enterprises (Bryant, 2009).

Study design

A descriptive survey design was undertaken from December 2010 to June 2011 to determine the hygienic and sanitary conditions on the available cafeterias, restaurants, juice houses, supermarkets, and food handlers at Mekelle city. Within the available resources, half of (535) the food catering establishments were selected from a total of approximately 1070 food catering centers in the city for interview purpose. The representative samples were selected by a combination of simple random sampling and stratifying the city into sub-cities. The variable of interest considered as an output variable at the food center was food hygienic and/or contaminant status.

The explanatory variables considered were food contaminant organisms, hygienic conditions of kitchen and dining, cooking materials, hands and cloths of food handlers, disposal system of rubbishes, and the water used to wash the materials, availability of latrine etc.

Questionnaire survey

Well structured questionnaire was used to collect relevant information from health professionals, catering places, food handlers and distributers, and consumers to assess the food safety knowledge and food-borne diseases in Mekelle town. Interviewers were selected on the basis of their experience in administering questionnaire surveys and one day training was given to them. Role-playing was used as the main training technique. Other relevant data records were collected from regional, zonal and sub-city heath offices, hospitals and clinics to determine the most revealed food-borne diseases and their different risk factors for the occurrence in the city.

Sample size

The sample size for the bacterial load count and identification of harmful microorganisms in the present study was determined according to the formula given by Thrusfield (2005) for random sampling method. A 5% absolute precision and 95% confidence interval was used for determining sample size. An expected prevalence of 20% was used to determine the maximum sample size. Accordingly, about 260 catering places were included in the study from the interviewed catering establishments as summarized in Table 1.

Sample collection

Food samples of different ready-to-eat food items and table scratches were randomly collected from restaurants, cafeterias and juice houses of the seven sub-cities in Mekelle town. Ten samples each of packed food items such as Margarine, Mayonnaise and sardine were procured from supermarkets, some of which were already expired. The food samples were also grouped on the basis of their major components. Some samples were composed mainly of tomato sauce, other samples were mainly ready foods (macaroni, "fata", yoghurt cheese), and some other samples were juices of different kind (Mango, avocado, fruit mix). Samples were also collected from table scratches where the respective food items prepared. All the samples were collected aseptically in sterile universal bottles and transported to the laboratory under low temperature and stored at 4°C, until testing. All the samples were analysed within 24 h of sampling and bacteriological analysis was conducted as described by the method of Fawole and Oso (2001).

Enumeration of total viable count, isolation and identification of bacteria

The isolation and identification of bacteria was performed following the standard microbiological technique recommended by Quinn et al. (2002). Identification of colonies and appropriate biochemical tests were done according to Oyeleke and Manga (2008) and colony was counted using pour plate method. The isolates were identified by comparing their morphological and biochemical characteristics (catalase, oxidase, coagulase, indole, urease, sugar tests) with standard reference organisms of known taxa, as described by Bergey's Manual for Determinative Bacteriology (Buchanan and Gribbons, 1974).

Data were analyzed through Statistical Package for Social Sciences version 11.5 statistical package (SPSS, 2002). Descriptive statistics such as means and frequencies were used to present the findings. To answer the question of whether or not there is a significant correlation between the selected parameters and inspection of catering establishments by sanitarian, we conducted two-sided Fisher's exact test using the cross tabulation feature of the software. Univariable logistic regression was applied to measure the strength of that association or to calculate OR. P<0.05 was taken as significant.

RESULTS AND DISCUSSION

Characteristics of study subjects

A total of 510 food catering establishments were investigated during the study, consisting of 222 (43.5%) restaurants, 171 (33.5%) cafeterias, 72 (14.2%) juice houses and 45 (8.8%) supermarkets. The non response rate was 25(4.9%). There were a total of 2476 food handlers' 784 males and 1692 females serve in all of the establishments, this is 4 to 5 food handlers per establishment. This indicates that food establishments play an important socio-economic role in the region's economies in terms of employment potential. Among these establishments 438 (85.9%) were licensed.

However, some of the establishments give the services for which they got permit from licensing organizations while others give other services in addition of their permit. This type of system is also common in a study carried out in Ambo town (Dugassa, 2007). Nel et al. (2004) highlight the education of food handlers as a crucial line of defense in the preventions of most types of food-borne illnesses. In the current study only 6.9% of the vendors interviewed illiterate and others are achieved a variety of educational levels. More than half of the owners/managers 279 (54.7%) of the establishments was females.

Acquisition of knowledge and personal hygiene during food preparation

It was important to know how the food cookers acquired their cooking skills to establish their knowledge in handling food safely. Most (83.9%) of the cookers acquired their cooking skills from observation, 7.8% were taught by their parents while 8.3% gained the skills from formal training. Training about hygiene during handling and cooking of food items is very important. According to FAO (1990), food handlers should have the necessary knowledge and skills to enable them to handle food hygienically. As indicated in Table 2, the majority of the respondents reported that they usually washed their hands before food preparation and after handling raw food items. A smaller number reported that they sometimes washed their hands after handling raw food items. Moreover, it was found that some cookers did not wash fresh foods properly and the same water was used without replacement for washing utensils , this is because they did not have enough water hence hygiene was compromised.

Although more than 99% of the respondents indicated that municipal pipe water is the only source of water supply for their activities, around 74.1% of them revealed that water problem is main trouble in the city (Table 2). This study is in agreement with a study done in Accra and Kenya on the safety of street food, which found that running water was not available (Mensah et al., 2002; Muinde and Kuria, 2005).

However; without enough water, hygiene and sanitary practices cannot be met. Although a large percentage of respondents reported that they usually washed their hands before the commencement of food preparation, the number that indicated following the correct procedure of using detergents and water for lathering and rinsing was low. 64.1% of the respondents who reported washing their hands use only water with no detergents prior to food preparation and after handling raw food items. The current study in agreement with Linda du and Irma (2005) who were carried out a study on food practices associated with increased risk of bacterial food-borne diseases of female students in self-catering residences at the Cape Peninsula University of Technology.

Few of the food handlers observed minimal personal hygiene during food preparation. It was found that 41.6% of the food handlers did not use protective clothes, 11.4% had short/long nails, which were not polished and used false fingernails, and 43.9% had their hair not covered. 43.9% of the food handlers handled money while serving food and 26.7% of them had worn jewelry materials (Table 2).

However, money is dirty and can contaminate safe food thus the food handlers should not handle money while they are preparing food. Moreover hands come in contact with many surfaces and can be exposed to a lot of germs. To get rid of germs and dirt, it is important to wash hands properly and frequently with detergents and warm water. Hands that have long nails or jewelry, such as rings and bracelets, are more difficult to clean thoroughly and can collect small pieces of debris and bacteria that does not wash off easily. False fingernails and nail polish are not allowed. Skin infections on open surfaces, respiratory infections, eye and nose discharges were observed among food handlers working in 38 (7.5%) establishments, the most common being skin lesions.

General hygiene during preparation

During food preparation pathogenic organisms may be transferred to food items by the handler both directly or

Table 2. Acquisition of knowledge and personal hygiene during food preparation.

Parameter	Frequency	Percent
Acquisition of food preparation skills		
Observation	428	83.9
Parents	40	7.8
Formal training	42	8.3
Washing hands before starting food preparation and handling raw food		
Usually	441	94.8
Sometimes	24	5.2
Manner of washing hands		
Using detergents and water	167	35.9
Rinsing with water only	298	64.1
Source and availability of water		
Municipal pipe	503	99.6
Wall	12	2.4
Water problem	378	74.1
Protective clothes		
Used	298	58.4
Not used	212	41.6
Hair		
Covered	286	56.1
Not covered	224	43.9
Jewelry materials		
Worn	136	26.7
Not worn	374	73.3
Handling money		
Food handler with bare hands	224	43.9
Cashers	286	56.1
Finger nails		
Short and polished	452	88.6
Short/long not polished	58	11.4

by cross contamination through hands, surfaces, utensils and equipment that have been inadequately clean and disinfected between the preparation of different types of food (Linda du and Irma, 2005).

Therefore fresh food products should be washed under cold running tape water before preparation or consumption to reduce or remove microorganisms.

As Table 3 indicated the majority of the respondents reported that they usually washed the raw food items before preparation.

However, 7.1% of them may wash it sometimes and they thought as the fresh food is hygienic and some of

them faced water shortage.

Cooking and serving utensils

Cross-contamination can be avoided if utensils or equipment is washed with detergents and water in between using it for raw and ready-to-eat food items. As seen in Table 3, 34.4% of the respondents reported usually using the same knife for slicing raw and ready-to-eat food items. 62.1% of the respondents revealed that washing the knife with water; 6% of them wiping with

Table 3. General hygiene practices of respondents.

Parameter	Respondents	
	N	%
Washing fresh produce (n=465)		
Usually	432	92.9
Sometimes	33	7.1
Not washing	-	-
Using the same plate/chopping board for raw and ready-to-eat food items (n=393)		
Usually	92	23.4
Sometimes	234	59.5
Not using	67	17.1
Treatment of plate/chopping board in between use of raw and ready-to-eat food items (n=326)		
Washing with soap and water	72	22.1
Rinsing with water	223	68.4
wiping	31	9.5
Cooking/preparing food in advance of consumption (n=465)		
Usually	173	37.2
Sometimes	206	44.3
Not cooking in advance	86	18.5
Storing food cooked/prepared in advance (n=379)		
In refrigerator	123	32.5
In cupboard or on kitchen or stove	256	67.5
Reheating of food cooked in advance (n=307)		
Usually	165	53.7
Sometimes	121	39.5
No	21	6.8
Properly covered in advance prepared food (n=465)		
Yes	372	80
No	93	20
Perishable food storage (n=510)		
In refrigerator	329	64.5
Plastic container	53	10.4
Cupboards	128	25.1
If refrigerator (n=329)		
One food item in one refrigerator	92	28
Different food items in one refrigerator	163	49.5
Sometimes	74	22.5
Presence of sanitary regulation system (n=510)		
Yes	337	66.1
No	173	33.9

clothes and 31.9% of them reported washing it with water and soap in between use. While 23.4% of the respondents reported usually using the same plate/chopping board for raw and ready-to-eat food items, 22.1% of them reported washing it with soap and water in between use. 38.9% of the respondents also reported using usually the same cloth for wiping raw food items and/or surfaces and to clean or dry dishes.

The results indicate a great degree of cross-contamination as only a small percentage of the respondents reported that they would clean with soap and water for both the knife and the plate in between using it for raw and ready-to-eat food items.

Food items like minced beef should be cooked to specified temperatures to kill microorganisms associated with bacterial food-borne disease (Bennion and Scheule, 2004). In the current study, 37.2% of the respondents reported that foods were usually cooking in advance of consumption for 3 to 4 hours and 67.5% of them storing the food cooked in advance in cupboard or on kitchen counter or stove.

Observations showed that some cooked food and utensils were not covered properly, which could result in food contamination due to dust and microbes. The utensils in which the food is displayed for sale must be kept clean, covered and protected as they easily become contaminated if left dirty or unprotected (FAO, 1995, 2001). Kinton and Ceserani (1992) recommend that foodstuffs of all kinds should be kept covered as much as possible to prevent contamination from dust and flies.

Storage of food

On reaching the kitchen, food items should be stored and handled correctly to decrease the growth of the microorganisms already present and to minimize the risk of contamination (Gorman et al., 2002).

However results from the present study revealed that 35.5% of the respondents did not have chilling facilities for perishable food.

Also 49.5% of the respondents reported that they did not have a separate area for storage of raw materials and ready-to-eat food items also perishable and non perishable foods or cooked and raw food stored in a single refrigerator (Table 3).

Regulatory condition

Consumers have the right to a good quality and safe food supply, and government and food industry actions are constantly needed to ensure this.

For this aim, effective food safety and quality control programs are essential.

In the current study, 33.9% of the respondents were revealed that no sanitary regulation system in the mass caterings establishments of the city (Table 3).

Place of preparation and sanitary facilities of food establishments

Kitchen conditions

Observations revealed that most of the establishments of the kitchen had adequate ventilation and good lighting. Some of the kitchens were found to be congested with kitchen goods and also used as storage and as the result, space of the kitchen was compromised, and cockroaches were also prevalent in some of the inspected kitchens. Most of the establishments had two compartments of glass and dish washing devices, which used "bowl and/or bucket" system as a surrogate to sink or vat washing devices. Three compartments for both soiled dish washing and glass washing were also used by some of the food establishments (Table 4).

Latrine facilities

Regarding latrine facility 41.5% of the establishments had private or used communal latrine together with neighbors and which were properly placed with good management and 19% of the establishments had not enough water as the result flies infested it while 19.5% of the establishments had no latrine facility. In 14% of the establishments the available latrine was not functional at time of visit which was locked.

Hand washing facilities

Hand washing is an essential component of infection control (Larson, 2003). During the study, observations were revealed that 5.6% of the food establishments had not any means of hand washing services like water and soap (Table 4).

Practices regarding the hygienic status of the food establishment's environment

From food hygiene point of view, the quality of the working environment depends on the facilities or equipment provided like disposal of waste products. Based on observation, about 6.5% of the vendors interviewed prepared their foods in unhygienic conditions given that the liquid waste was disposed close to the stalls. This concurs with another study done in Nairobi, (Muinde and Kuria, 2005) who found that, proper garbage collection and disposal were lacking and venders had to put garbage in their own space. Of the catering establishments interviewed in the current study, 10.3% of them stored solid waste improperly, and 2.6% of the respondents reported that the solid wastes collected were dumped into municipal water drainage (Table 5).

Table 4. Physical conditions of food catering establishments.

Parameter	Frequency	Percent
Type of dish and glass washing facility (n=465)		
One compartment	23	4.9
Two compartments	241	51.8
Three and above compartments	201	43.3
Not available	-	-
Latrine availability (n=465)		
Properly placed with good management	193	41.5
Less managed with less/no water	116	25
Not available	91	19.5
locked	65	14
Hand washing facilities for consumers (n=393)		
Enough water and detergents	220	56
Water only	151	38.4
Not available	22	5.6

Table 5. The hygienic status of the food establishment's environment.

Parameter	Frequency	Percent
Liquid waste disposal (n=465)		
Open area dumping	30	6.5
Septic tank/latrine	373	80.2
Municipal water drainage	62	13.3
Solid waste storage holders (n=465)		
Proper container available	402	86.5
Improperly stored	48	10.3
Not available	15	3.2
Solid waste collection and disposal (n=465)		
Municipal container	419	90.1
On site disposal	34	7.3
Municipal water drainage	12	2.6

Food handler's practice in relation to sanitary inspection activity

Some of the questionnaire data that included parameters associated with sanitary conditions like dining room, covering of food handlers hair, solid waste storage and disposal system, latrine conditions, washing facilities, presence of protective clothes were administered and association of these parameters with the presence or absence of sanitary inspection was assessed using competing P-value and OR. Statistically significant association was observed in parameters such as solid waste storage (P-value < 0.001, OR = 4.208), solid waste disposal (P-value = 0.001, OR = 2.735), latrine conditions (P-value < 0.001, OR = 3977), presence of license (P-value < 0.001, OR = 3.281) and hand washing facilities (P-value < 0.001, OR = 2.165). However, the parameters such as covering of hair and presence of protective cloth did not show statistically significant association (Table 6). Therefore, inspection of food establishments by the city sanitarians seemed to have a positive influence on the hygienic conditions of the aforementioned parameters.

Bacterial count

In developing countries there is significant under-reporting of food-borne illness. In these countries street

Table 6. Food handler's practice in relation to sanitary inspection activity.

Parameter	Sanitary regulation		P-value	OR	95% CI of OR	
	Yes	No			Lower	Upper
Hair						
Covered	189	97	0.998	1.001	0.692	1.448
Not covered	148	76				
Solid waste storage						
Proper	266	136	0.000	4.208	2.420	7.317
Improper	32	31				
Solid waste disposal						
Proper	276	142	0.001	2.735	1.474	5.073
Improper	20	26				
Latrine condition						
Properly placed with good management	128	65	0.000	3.977	2.560	6.177
Improper managed or not available	127	145				
License						
Licensed	307	131	0.000	3.281	1.968	5.470
Not licensed	30	42				
Protective clothes						
Used	197	101	0.987	1.003	0.692	1.455
Not used	140	72				
Hand washing facilities for consumers						
Water and soap	146	74	0.000	2.165	1.416	3.310
Water only	72	79				

foods are widely distributed and unhygienic food handling practices are common. In developed countries food-borne illnesses have been reported from foods such as ham in USA (CDC, 1983), cooked chicken in UK (Hepner, 1980), smoked fish in Finland (Him and Aho, 1986) and mayonnaise or mayonnaise containing foods in Spain (Perez et al., 1986). The present study also indicated for the presence of bacterial contaminants from foods such as Margarine, Mayonnaise and Sardine collected from supermarkets and foods that originated from restaurants, cafeterias, and juice houses. The bacterial load of packed food samples namely Margarine, Mayonnaise and Sardine from supermarkets summarized in Table 7. The result indicated that the highest mean of total viable count of microbial load was observed in Mayonnaise.

World Health Organization has set minimum standards for the recovery of micro-organisms from foods of various origins. When compared with that standard the recovery rate in our study was higher and this could be due to absence of hygienic practices and strict follow up of this sector by the concerned authorities. According to the Public Health Laboratory Services (UK) guidelines, $<10^4$ CFU/g is satisfactory, $10^4<10^5$ acceptable and $> 10^5$ unsatisfactory. None of the samples screened in the present study were in satisfactory grade; however, the average samples of sardine were within acceptable range where as margarine and mayonnaise samples were unsatisfactory as the total viable count was above 10^5 CFU/g. Samples collected from catering establishments of cafeteria, juice houses, restaurants and table scrapings were also in the unsatisfactory grade (Table 8).

Relative frequency of bacteria in different food samples

The most predominant bacterial pathogens isolated in the present study include *S. aureus, E. coli, Salmonella* spp. and *Shigella* spp. (Table 9). The isolation of these pathogens have also been reported by previous workers from various foods (raw and ready to eat foods)

Table 7. Bacterial count of food samples collected from supermarket.

Food type	Average bacterial count	Minimum bacterial count	Maximum bacterial count
Margarine	9.43×10^5	2.74×10^3	6.70×10^7
Mayonnaise	2.64×10^6	2.22×10^4	9.42×10^7
Sardine	1.32×10^4	2.68×10^3	2.36×10^5

Table 8. Bacterial count from food samples collected from cafeteria, juice houses and restaurants.

Food type	Average bacterial count	Minimum bacterial count	Maximum bacterial count
Cafeterias	2.21×10^5	5.70×10^4	3.40×10^6
Juice houses	1.20×10^6	1.98×10^5	2.42×10^7
Restaurants	2.89×10^6	9.30×10^5	8.70×10^8
Table scrapings	1.83×10^5	2.68×10^4	2.37×10^5

Table 9. Relative frequency and incidence of Gram positive and negative bacterial pathogens in the food samples in different sub-cities of Mekelle, Ethiopia.

Food item	No. of samples processed	Positive samples (%)	Percentage of positive samples (%)			
			S. aureus	*E. coli*	*Salmonella* spp.	*Shigella* spp.
Margarine	10	4 (40.0)	50.0	100.0	0.0	0.0
Mayonnaise	10	4 (40.0)	0.0	50.0	50.0	50.0
Sardine	10	2 (20.0)	0.0	0.0	100.0	0.0
"Wot"	30	17 (56.7)	5.9	23.5	76.5	64.7
Macaroni	10	6 (60)	16.7	0.0	33.3	66.7
"Fata"	30	15 (50.0)	33.3	66.6	0.0	33.3
"Zahla"	10	6 (60)	33.3	33.3	66.7	33.3
Mango juice	15	12 (80)	42.9	28.6	57.1	85.7
Avocado juice	17	11 (64.7)	20.0	60.0	40.0	20.0
Fruit mix	8	3 (37.5)	0.0	33.3	66.7	66.7
Table scraping	110	88 (80.0)	62.5	37.5	12.5	0.0
Total	260	168 (64.6)	23.7	32.2	47.4	45.8

(Arumugaswamy et al., 1995; Duffy et al., 1999; Fang et al., 1999; Mukhopadhyay et al., 2002). The magnitude of food-borne contamination in various foods tested indicated for the wide prevalence of food-borne diseases in the area. According to the report of Tigray bureau of health Shigella dysentery is the most commonly reported case of food-borne contaminants. Our study also signifies that *Shigella* spp. are the most commonly isolated food-borne pathogens and this may be associated with the report of the region where shigella dysentery is the most common disease in the area. Therefore, the detection of these food-borne pathogens in high numbers from foods of various origins is an indication of poor hygienic practices in the study area.

In general the results of the present study revealed that food provided to the consumers in the city was found less hygienic and had found poor sanitation conditions. General hygiene of food handlers, personal hygiene, sanitary facilities of food establishments, physical conditions of food catering establishments, disposal services, legal licensing and environmental hygiene was identified as the major sanitary deficiencies. Therefore, the probability of food contamination in these establishments was high due to poor sanitary conditions of the establishments and improper handling practice of food. The bacteriological swab tests of food utensils confirmed the gross unhygienic condition of food offered to the consumers. Pathogens such as *Salmonella* spp., *Shigella* spp. and *E. coli* were the main identified organisms in the establishments which are the most common diseases reported from the health bureau of the region. Thus, health hazards from catering establishments may be minimized by avoiding poor handling and awareness of personal hygiene and care in preparation, storage and dispensing of foods in all procedures necessary to maintain the safety and suitability of food

from the establishments, appropriate solid and liquid waste collection and disposal should be planned and implemented and periodic sanitary-hygienic evaluation and inspection of catering establishments should be strengthened to reduce public health hazards associated with food-borne pathogens using systems such as HACCP.

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