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# Microbiological Quality and Safety of Sambusa and Fried Fish in Bahir Dar, Ethiopia

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**Abstract**
The street food industry has an important role in the cities and towns of many developing countries in meeting the food demands of the urban dwellers. It feeds millions of people daily with a wide variety of foods that are relatively cheap and easily accessible. However, concerns have been raised about the safety and quality of street vended foods. This study was carried out to determine the microbial quality and the hygienic and sanitary practices of street vendors of Sambusa and fried fish from November 2010 to March 2011 in Bahir Dar. A total of 120 food samples were collected from roadside and retailing houses or containers in two sampling batch. A semi-structured questionnaire and checklist were used in interviews to determine the status of the vending sites and associated food handling practices. Aerobic mesophilic bacteria, total coliform and *S. aureus* were determined using standard methods. On comparing the microbial qualities from the two sectors, there was no significance difference in their mean count ($P > 0.05$). However, a significance difference ($P < 0.05$) was observed between the two sampling baths in both foods for all microbial parameter. The overall hygienic status of the vending environment and the sanitary condition and handling practices of the vendors were not to the standard. The food is sold to unsuspecting clients who are likely to get food-borne diseases. This study recommends training of street food vendors on hygiene, sanitation and the establishment of code of practice for the street food industry.
**Keywords**: Microbial quality, street food, Sambusa and Fried fish

## Introduction

Street foods are foods and beverages prepared and/or sold by venders in streets and other public places for immediate consumption or consumption at later time without further processing or preparation (WHO, 1996). Street food may be consumed where it was purchased or can be taken away and eaten elsewhere. Street-vended foods include foods as diverse as meat, fish, fruits, vegetables, grains, cereals based ready to eat foods, frozen produce and beverages (WHO, 1996). Types of vending site encompass a variety of push-cart, roadside stands, hawkers with head-loads and other arrangements depending on the ingenuity of the individuals, resources available, types of food sold and availability of other facilities (FAO, 1990). Street food vendors are common in both developing and industrialized countries with a considerable expansion in developing countries. Extensive Street vending of foods in the world arises from multiple causes: migration of people to cities and accelerated urbanization leading to enormous urban congestion, long commuting distances between the workplace and home, and a shortage or absence of establishments that serve reasonably priced food close to the work place (FAO, 2000). Moreover, migration to the cities has given most cities an overpopulation of rural dwellers who, while striving for better opportunities, have contributed to the existence of marginal urban areas and unemployment. This has generated one of the present characteristics of the countries of the world: a large informal economy, of which street food vending is a part. Evidently in large cities of developing countries, various food items of animal and plant origin are commonly vended at areas with busy economic activities and heavy movements of people (Bryan *et al.,* 1992; FAO, 1996; FAO, 1997; Van Kamp, 1998) include transportation centers, large constructions sites, schools, factories, hospitals and other similar business centers. The Street vended foods contribute a significant role to both vendors and consumers. They are readily available, inexpensive, and nutritionally-balanced and also provide a source of income, chance of self-employment and opportunity to develop business skill with low capital investments to the vendors (WHO, 1996). Despite these benefits, concerns have been raised about the safety and quality of street vended foods. Studies on street foods have highlighted a number of food safety problems and issues. Most of people involved in the preparation and vending of street foods have low levels of education and little or no knowledge of good hygienic practice and preparation of food and delivery to the consumers (WHO, 1996; Moy *et al*., 1997; FAO, 2000). Furthermore vendors work under crude and often unsanitary conditions. Street food vendors also prepare foods from raw materials of doubtful quality, use waters of questionable hygienic quality, unaware of the basic importance of personal hygiene (Ashenafi, 1995; FAO, 2000). Furthermore vending site lacks basic infrastructure and services such as potable running water and waste disposal facilities, hand and dish washing water is usually insufficient and often reused, waste water and garbage often disposed off around vending site providing nutrients for rodents

 

and flies (Abdussalam and Kaferstein, 1993; FAO, 2000). Other common real risk factors include time-temperature abuse involving preparation of food long before consumption and holding prepared foods under unsafe storage temperature and serving such foods cold or without sufficient reheating (Ashenafi, 1995; Ekanem, 1998; Muleta and Ashenafi, 2001). Consequently street foods are perceived to be the major public health risk. Microbiological contamination is a major problem associated with street foods due to cross contaminations. According to the nature of the food and the conditions under which it is held and the manner in which it is served the associated risks may vary considerably. Several studies have demonstrated high count of coliforms and aerobic mesophilic bacteria in foods collected from street vendors (Wei *et al*., 2006; Abdalla and Mustafa, 2010; Chung *et al*., 2010). Similarly, a large number of pathogenic microorganisms such as *Staphylococcus aureus Bacillus cereus* and *Salmonella* spp have been detected in various types of street foods (Lues *et al*., 2006; Tambekar *et al*., 2008; Mhango *et al*., 2009). In Ethiopia, various street foods have been reported to carry aerobic mesophilic bacteria, *Staphylococcus aureus*, *Salmonella* and *Shigella* (Mogessie, 1995). However there is limited information on the microbial load and safety of street foods in Bahir Dar. A FAO/WHO joint Expert Committee on Food Safety concluded as early as 1983 that ―illness due to contaminated food is perhaps the most widespread health problem in the contemporary world‖ (WHO, 1984). Data published since then by various countries confirm this statement and indicate that the problem has been on increase since then (WHO, 1997). More aggravated situations and challenges prevail in Ethiopia where food safety issues are not well understood and have received little attention. Though reliable statistics on food borne diseases are not available due to poor or nonexistent reporting systems in most developing countries (Kinfe, 2005), such diseases take a heavy toll in human life and suffering, particularly among children. Foodborne bacterial infections are particularly prevalent. The transmission of enteric pathogenic bacteria occurs directly or indirectly by food, water, nails, and fingers contaminated with feces indicating the importance of fecal-oral person-to-person transmission. Consequently, food handlers with poor personal hygiene working in food serving establishments are potential sources of infection with enteric pathogens (Abel, 2009). Studying the microbial safety of ready-to-eat foods and hygienic practice of the street food vendors have paramount importance to understand the public health risks posed by street vended foods. Food safety is more importantly a public health issue as it plays a noteworthy role in health development and consequently national economic development. Thus great endeavors should be made to improve it at all levels of the food chain.

## Materials and methods

### Study design and location:

A cross sectional prospective study was conducted in Bahir Dar City from November 2010 to March 2011 to examine the microbiological quality and handling practices of street vended Sambusa and fried fish foods. Bahar Dar city which is the capital of the Amhara National Regional State in Ethiopia, is located at $11^{0}38‘N$, $37^{0}$ 10‘E on the southern side of Lake Tana (where Blue Nile River starts). The altitude of the city is about 1800 m above sea level and average annual rainfall and temperature of 1455.5mm and $18.8^{o}$ C respectively. The city has a total population of 180,094(CSC, 2007). Street food vendors in the city around main road groceries, taxi ranks and bus station areas are common practice.

### Sample description and sampling technique

The food items considered in this study were fried fish and sambusa from street food vendors. ‘Sambusa‘is a triangle-shaped pastry filled with Lentils and green peppers spiced with garlic and onion. It is popular favorite among Ethiopian appetizers. This meatless dish is lightly deep fried in vegetable oil to a golden perfection. The hawkers either prepare it around the road or get it from other distributors. The second food was fried fish. It is prepared through frying using its oil without any additives except salt. The sellers obtain the raw fish from informal fishermen who move around the city hugging the fishes using wood and covered by leaves. Both food items were prepared at morning or night before the selling day and displayed the whole day for sale. A total of 120 ready to eat foods representing the two types of street vended foods (60 each of fried fish and Sambussa) were collected from the vendors in two sampling batches at morning (9:00 AM) and afternoon (4:00 PM). Fifteen sample of each food item was collected from each of two vendors namely retailing houses and roadside vendor found around main road of the city. All samples were collected using sterile glass containers and immediately transported in an icebox to the post graduate microbiology laboratory in Bahir Dar University. Samples were stored in refrigerator until microbiological analysis.

### Sample preparation

Fried fish were aseptically deboned using sterilized scalpel and forceps. In case of sambussa, the bread part was removed and only internal part was taken. Both food types were crushed using pistil and mortal.

 

**Microbiological analysis**

**Aerobic mesophilic bacteria**

Total aerobic mesophilic bacterial count was determined according to Maturin and Peele (2001). 25 gm of each food type was added in to 225 ml of two separate flasks containing each sterile 0.1%(w/v) peptone water (OXOID CM0009) and shaked for 2-3 minute using shaker(STUART, UK) to prepare initial ( $10^{-1}$ ) homogenate dilution. Further dilution was made through transfer of 1 ml of the $10^{-1}$ food homogenate in to test tube containing 9 ml of sterilized 0.1%(w/v) peptone water to prepare $10^{-2}$ dilution. The process was proceeded to prepare $10^{-3}$ and $10^{-4}$ serial dilution in similar manner. One ml of the last three dilutions ($10^{-2}$, $10^{-3}$ and $10^{-4}$) was dispensed to sterilized Petri plate in triplicate. Then sterile molten plate count agar (GREEN STAR) was added to each Petri plate. The plates were then incubated at 37$^{o}$C for 48 h. Then colonies were counted using colony counter (STUART SCIENTIFIC, UK) device that allows viewing of individual colonies. All plates were counted but those showing colony counts between 30 and 300 were selected and their colony forming unit per gram of food item (cfug$^{-1}$) were calculated by multiplying by the dilution factor.

**Total coliform bacteria**

25 g of both food items were added to two separate flasks containing each 225 ml of sterile 0.1% peptone water (OXOID, CM0009). The mixture was shaked mechanically using shaker (STUART UK) to prepare $10^{-1}$ food homogenate. Further serial dilution ($10^{-2}$, $10^{-3}$ and $10^{-4}$) was prepared as above. Presumptive test for total coliforms was carried out using a 3-tube multiple fermentation most probable number (MPN) technique according to Hitchins *et al*. (2001). Aliquots for three consecutive dilutions (1ml of each of $10^{-1}$, $10^{-2}$ and $10^{-3}$) were added to triple test tubes containing lauryl tryptose broth (BLULUX) having inverted Durham tubes. The test tubes were incubated at 37$^{o}$C for 24- 48 hours and examined for gas production. The numbers of tubes which show gas formation from each dilution were recorded. Finally the corresponding MPN value for total coliform was taken from the MPN tables and the number of total coliforms per gram of both foods was calculated and recorded (Garthright, 2001).

***Staphylococcus aureus***

*S. aureus* were isolated from both samples (25g) homogenized in 225ml of 0.1% sterile peptone water (OXOID, CM0009). Further dilutions of 10-2, 10-3 and 10-4 were made as mentioned above from the food homogenate. One ml of each $10^{-2}$, $10^{-3}$ and $10^{-4}$ serial dilution were dispensed on to sterilized Petri plate in triplicate. Sterile molten Manitol salt agar (BLULUX) was poured to each Petri plate. The plates were then incubated at 37$^{o}$c for 48 h. Yellow to orange colonies surrounded by yellow zone due to Manitol fermentation were counted using colony counter (STUART SCIENTIFIC, UK) and recorded as colony forming unit per gram (cfu/g) of both food items. Five of these yellow colour colonies were purified and transferred to nutrient agar (MERCK) slant for further biochemical tests. All biochemical tests were performed after gram staining according to Cheesbrough (2006). Those include catalase test, sugar fermentation and coagulase test.

**Survey of the handling practices of the food handlers**

Census was performed to identify the existing number of catering street vendors of sambussa and fried fishes, 40 vendors were identified, and all of the available vendors were included in this study. This sample size is assumed adequate to describe the conditions in the city for the selected food items. A semi-structured questionnaire and a checklist covering topics on various aspects relating to food safety and food handling practices among the street food vendors were prepared. These consisted of four categories, i.e., (i) general characteristics of vendors, (ii) food handling, preparation and storage practices, (iii) personal hygiene (iv) care of cooking utensils, and (v) hygienic status of vending environments and waste disposal practices. The questionnaires were completed by means of face-to-face interviews. The checklist was used to assess the physical layout of the stall, the hygiene of the cooking area and the personal hygiene of the food handlers.

**Data analysis**

The statistical analysis of all data was conducted using SPSS software (version 16.0). T-test was used to compare mean count variation between the two sampling time. Chi-square was also used to test the relationship between education and some aspects of hygiene. Significance was determined at $P < 0.05$ level.

**Results and discussion**

The street food industry plays an important role in developing countries in meeting the food demands of the urban dwellers. Street foods feed millions of people daily with a wide variety of foods that are relatively cheap and easily accessible (Latham, 1997). However there are significant reports of health problems that have been associated with these street foods (Abdussalam and Kaferstein, 1993; Ashenafi, 1995; Muleta and Ashenafi, 2001; Mensah *et al*., 2002; Omemu and Aderoju, 2008). Street foods are sources of nutrition for many low-

 

income groups at affordable prices in large urban areas. Nevertheless, there is also several health hazards associated with them. These foods could be main vehicle for transmission of severe and fatal diseases that could be life threatening. Contamination of these foods could result from pre or post cooking contamination from the food handlers. Street food vendors are untrained in food safety, food hygiene and sanitation, and work under crude unsanitary conditions (FAO, 1990).

**Microbiological Quality of street vended fried fish and 'Sambusa' in Bahir Dar**

Food type, number of samples, number/percentage and count in log cfu/g of total colony count, total coliforms, and *S. aureus* detected from fried fish and sambusa samples are provided in Fig. 1 – 3 and and Table 1 and 2. Microbial safety standards for ready to eat foods have been taken from international regulations, like the public health laboratory service guidelines for the microbiological quality of ready to eat foods (PHLS, 2000) and NSW Food Authority microbiological quality guide for ready-to-eat foods (NSW, 2009) .

**Aerobic mesophilic bacteria**

The total colony counts on the food samples obtained in this study are illustrated in Fig 1. The mean microbial count (log cfu/g) for aerobic mesophilic bacteria of Sambusa was 5.07 and 4.97 from roadside and retailing houses respectively while 5.25 from roadside and 3.99 from retailers were recorded in fried fish samples at morning. These were almost similar with previously reported studies, for example mean counts of aerobic mesophilic bacteria not exceeding 1.6 x 105 cfu/ g in Sambusa was reported in a study done by Muleta and Ashenafi (2001) in Addis Ababa. In addition to this, results of aerobic mesophilic count >106 was also reported from ready to eat Spaghetti and macaroni, while roasted offals, fish soup, and shiro sauce had aerobic mesophilic counts relatively lower (< 105 cfu/g) in a study done in Awassa by Ashenafi (1995).

Based on the average AMB count, fried fish from Retailing house rendered the lowest count at the beginning of the selling day (3.99 log cfu/g), followed by _sambusa' from the same site (4.97 log CFU/g). On comparing the mean count of the AMB, it was found that there was no significance difference between the qualities of Sambusa sold from the two sectors (P > 0.05), but significance difference was observed in fried fish between the two vendors (P < 0.05). Changes of AMB count in the samples after seven hours following the beginning of the selling day are shown in Fig. 1A and B. From this figure, it was observed that AMB growth was significantly increased in both food samples from the two vendors (P< 0.05).

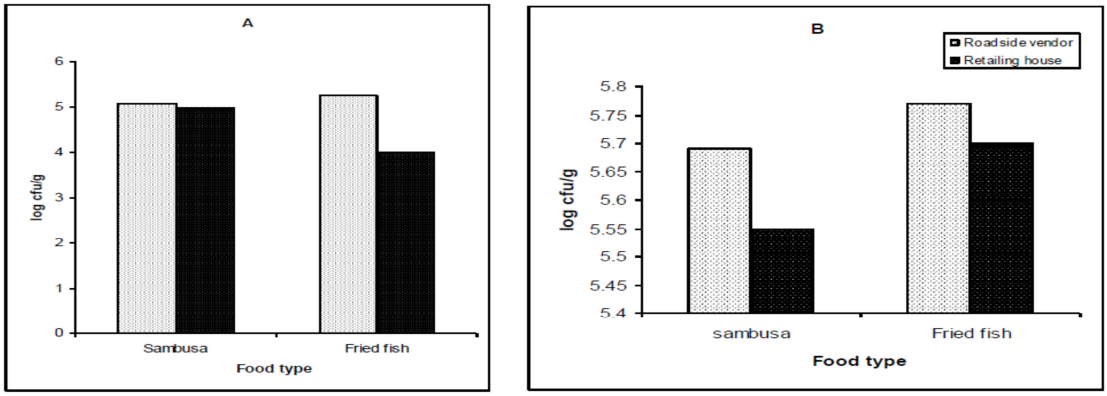


**Figure 1**. Average total plate count of RTE fried fish and 'Sambusa'samples at the morning (A) and afternoon (B) of the vending day from the two street food vendors.

It is not unexpected that such high counts were obtained because several unsatisfactory sanitary operations were practiced mainly by the food handlers. Moreover, all samples were hold in an ambient temperature the whole day while displayed for sale. Thus, the holding temperature, poor handling and keeping method by the vendors could promote rapid growth of common microorganisms with prolonged holding periods as exercised by street vendors.

**Total Coliforms**

A total of 30% of the Sambusa and 40% of fried fish samples were contaminated with coliforms at the beginning of the sale. Ekanem (1998) reported similar coliform counts (between 102 and 103 cfu/g) in ready to eat food products sold on the streets of Nigeria. Results of Sambusa sold in the retailing house had the lowest number of coliforms (3.59 MPN/g) at the beginning of the vending day, whereas fried fish from the same site had the largest mean count of coliforms (49.87MNP/g) (Figure 2A).

 

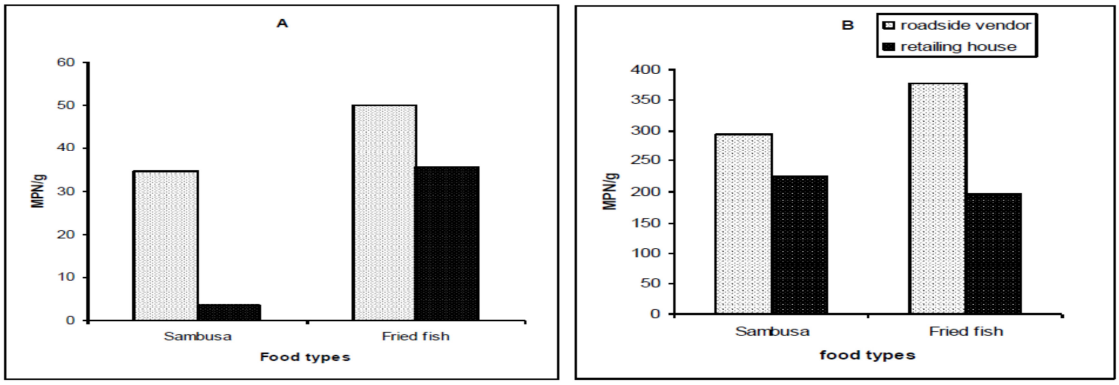


**Figure 2**. Average total coliform counts of street vended RTE fried fish and sambusa at the morning (A) and afternoon (B) of the vending day from the two vendors.

At the end of marketing day, a total of 76.67% of sambusa and 73.33% of fried fish were contaminated with coliform bacteria. It was observed that coliform growth had significantly ($P<0.05$) increased in both fried fish and sambusa samples at the afternoon sampling batch. Fried fish from retailing vendor had the maximum coliform growth (376 MPN/g) at the end of the marketing day while it had the least coliforms from roadside vendors, (196 MPN/g), compared to RTE sambusa samples from both sampling sites (Figure 2B). A similarly significance coliform growth was observed in a study done at Hulu Langat, in Malaysia by Alyaaqoubi *et al*. (2009) in ready to eat meals collected in two sampling batch. Since the samples were collected during the holding period after the food had already been exposed to high temperature processing but displayed for sale for prolonged (six to seven hours) after preparation, any presence of coliform could only be attributed to fecal contamination from the hands of food handlers and/or from contaminated working surfaces and utensils. Results confirm that specific attention to proper personal hygiene, particularly with regard to hand-washing after visiting the toilet, is of utmost importance. This is probably one of the biggest problems facing the street vending industry: the majority of its workers are not adequately informed about the importance hygiene.

***Staphylococcu aureus***

*S. aureus* ranged between undetectable and 4.75 log cfu/g in Sambusa and between undetectable and 3.81 log cfu/g in fried fish in the first sampling batch. Based on the average count of *S. aureus*, sambusa from retailing house have the lowest colony count at the beginning of the selling day (2.8 log cfu/g), while it was the largest from roadside vendor Fig. 3A). Although mean count variation were observed, there was no significance difference between the two vendors ($P>0.05$). At the end of the selling day a significance difference ($P<0.05$) were observed in both food types sampled from the two vending sites frm samples collected at morning. Sambusa showed the highest growth sampled from retailing houses (Fig. 3B). This may be due to the poor handling and storage practices of the vendors.

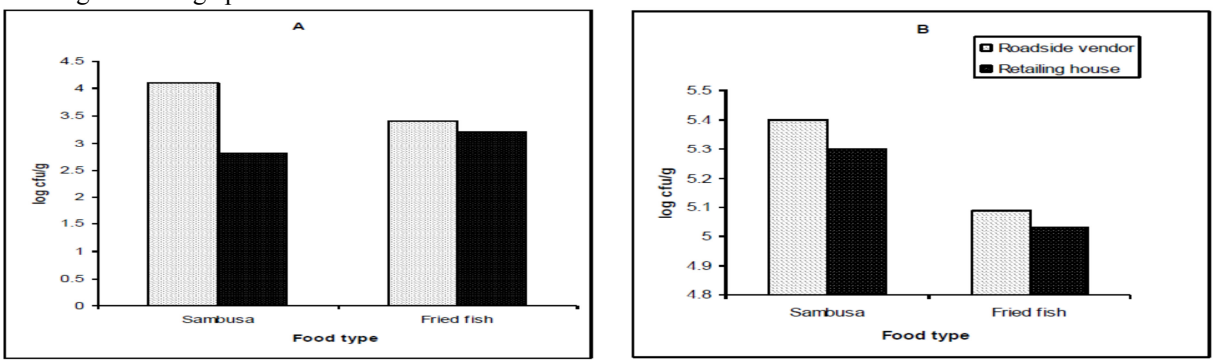


**Figure 3.** Average *S. aureus* counts of street vended RTE fried fish and Sambusa at the morning (A) and afternoon (B) of the vending day.

*S. aureus* is common inhabitants of the skin and mucous membranes and 20% to 50% of normal healthy adults may be carriers of *S. aureus* **(**Talaro & Talaro 1999). Its presence in a foodstuff may be attributed to it being introduced into the food from the handlers or from utensils used by vendors to serve food. Observation of preparation practices indicated the use of knives that had not been properly sanitized for cutting and chopping of raw vegetables. In a study done in the Johannesburg, South Africa, Mosupye and Von Holy (1999) reported similar observations.

 

Two critical practices are typically involved in disease-causing due to time–temperature abuse: (a) preparation of food several hours before consumption and its holding at temperatures that favour the growth of pathogenic bacteria and/or the formation of toxins, and (b) inadequate cooking or re-heating of food to minimize or eliminate pathogens. Longer storage at ambient temperatures was commonplace practice of the street vendors. Evidently, holding foods for more than 4–6 h is one of the main contributing factors of high possible counts (El-Sherbeeny *et al.* 1985, Bryan *et al.* 1992). In this study, time–temperature abuse was deemed particularly potentially hazardous, as observed by other investigators (Van Kampen *et al.* 1998, Joseph and Doser 1999). At a temperature range of 15–47°C and a pH above 4.4 and 5.0, growth of pathogens can be promoted (Freese *et al.* 1998). Unfortunately, both of the street foods considered in the present study were stored at ambient temperature without cooling facilities. As the street-vended foods in this study were cooked or fried, initial microbial load should be low. The fact that the counts were high in the ready-to eat food items was indicative of post-cooking contamination and proliferation thereafter due to long holding at ambient temperatures. It is, thus, important to avoid time– temperature abuse through either immediate consumption or holding at much lower temperatures.

**Compliance of Samples with Microbiological Criterion**

**Sambusa**

The non-compliance percentages of street vended RTE ‗sambusa' foods in Bahir Dar sampled at morning (3:00AM) and afternoon (9:00PM) of the marketing day from two defined sampling sites to acceptable microbiological standards are shown in Table 1. Very few of the food samples at the morning of the marketing day exceeded the microbiological guideline/standards for all microbial count. In terms of TPC and *S. aureus*, the samples of sambusa gave only 23.33% and 35% noncompliance with microbiological criteria at morning respectively. On other hand, none of the samples failed to meet the standards set for total coliforms at the two sampling batch. That means 100% of the samples were within good and acceptable limits for coliforms. However, in terms of AMB and *S. aureus* moajority of the Sambusa sample were within unsatisfactory limit ranges (70% and 75% respectively) at the afternoon of vending day according to the public health laboratory service guidelines for the microbiological quality of ready to eat foods (PHLS, 2000) and NSW Food Authority microbiological quality guide for ready-to-eat foods (NSW, 2009).

**Table1**. Number and percentage of good, acceptable and unsatisfactory fried fish samples at the morning and the afternoon of vending day.

| Microbial parameter | Sampling time | | | | | |
|---|---|---|---|---|---|---|
| | Morning (n=30) | | | Afternoon (n=30) | | |
| | No (%) of good Samples | No (%) of acceptable samples | No (%) of unacceptable samples | No (%) of good Samples | No (%) of acceptable samples | No (%) of unacceptable samples |
| AMB | 8(26.67) | 15(50) | 7(23.33) | 2(6.67) | 7(23.33%) | 21(70%) |
| TC | 27(90) | 3(10) | - | 15(50) | 15(50%) | - |
| *S. aureus** | 9(45) | 4(20) | 7(35) | 5(25%) | - | 15(75%) |

* =*S. aureus* were detected from 20 samples

Ranges according to the public health laboratory service guidelines for the microbiological quality of ready to eat foods (PHLS, 2000) and NSW Food Authority microbiological quality guide for ready-to-eat foods (NSW, 2009):

AMB: Good <104; Acceptable <105; Unsatisfactory ≥105

Total coliform: Good <102; Acceptable <104; Unsatisfactory ≥104

*S. aureus*: Good <102; Acceptable <103; Unsatisfactory<104

The percentages of non-compliant samples in this study suggest that the two foods sampled in Bahir Dar city were of poor microbiological quality, consequently due to improper preparation, storage and handling practices.

**Fried fish**

The compliance and non-compliance number/percentage of fried fish in Bahir Dar sampled at morning and afternoon of marketing day in two sampling site to acceptable microbiological standard are shown in Table 2. The study has shown that the majority of samples of fried fish had shown an increase in unacceptability limit between the two sapling batch for AMB and *S. aureus* (36.67% to76.67% and 35% to65% respectively) to ranges according to the public health laboratory service guidelines for the microbiological quality of ready to eat foods (PHLS, 2000) and NSW Food Authority microbiological quality guide for ready-to-eat foods (NSW, 2009) for TPC at the end of vending day. However, none of the food samples were failed to meet those guidelines for

 

total coliforms at morning and afternoon.

**Table2.** Number and percentage of good, acceptable and unsatisfactory fried fish samples at the morning and afternoon of vending day

| Microbial parameter | Sampling time | | | | | |
|---|---|---|---|---|---|---|
| | Morning (n=30) | | | Afternoon (n=30) | | |
| | Number(%) of good samples | No(%)of acceptable samples | No(%) of unacceptable samples | No(%) of good samples | No(%)of acceptabe samples | No(%) of unacceptable samples |
| AMB | 12(40) | 7(23.33) | 11(36.67) | 3(10) | 4(13.33) | 23(76.67) |
| TC | 25(83.33) | 5(16.67) | - | 10(33.33) | 20(66.67) | - |
| *S. aureus** | 10(50) | 3(15) | 7(35) | 6(30) | 1(5) | 13(65) |

*= *S. aureus* was detected from20 samples

**Survey of handling practices and personal hygiene of the street food vendors**

Most of the street food vendors neither underwent any form of formal training in food preparation nor did they attempt to seek it. According to FAO (1997), food handlers should have the necessary knowledge and skills to enable them to handle food hygienically. Systems should be put in place to ensure that food handlers remain aware of all procedures necessary to maintain the safety and suitability of food. FAO (1999) recommends that every vendor/helper of food should undergo a basic training in food hygiene before licensing.

**General characteristics of street food vendors in Bahir Dar**

Table-1 shows the characteristics of fried fish and 'sambusa' food vendors in Bahir Dar. Peak prevalence in education is primary school level with 50% of all those surveyed. 95% of the vendors operated from stalls and retailing containers while only 5% of those surveyed were mobile. The vending sites were spread between wooden stalls (22.5%), canopies (37.5%) and metal containers (40%). It was also important to know how the vendors acquired their vending skills to establish their knowledge in handling street foods. Knowledge for food vending was acquired by observation of others or taught by their parents in (62.5%) of the street vendors. The remaining (37.5%) of the vendors surveyed acquired their knowledge through trial and errors. Muinde and Kuria (2005) reported that most (61%) of the vendors in Nairobi acquired cooking skills from observation, 33.3% were taught by their parents while 6.3% gained the skills by trial and error (self-taught). Omemu *et al* (2008) noted in their study at Abeokuta, Nigeria that few vendors (12%) acquired the knowledge of food preparation by formal training.

**Table 3:** Characteristics of 'sambusa' and fried fish vendors in Bahir Dar November 2010 and March 2011 (n=40)

| Parameter | Frequency (%) |
|---|---|
| **Educational attainment** | |
| Did not attend formal school | 14(35%) |
| Primary school completed | 20(50%) |
| Secondary school completed | 6(15%) |
| College completed | 0 (%) |
| **Types of vendor** | |
| Stationary | 38(95%) |
| Mobile | 2(5%) |
| **Types of vending unit** | |
| Wooden with cover | 9(22.5%) |
| Without cover | 15(37.5%) |
| Metal container with cover | 16(40%) |
| **Food vending knowledge acquisition** | |
| Observation of others/Taught by parents | 25(62.5%) |
| Through trial and error | 15(37.5%) |
| Formal training | - |

**Food handling, preparation and storage practices of the vendors**

Hygiene during handling and cooking of street foods was observed. It was observed that the preparation surfaces used by the vendors had remains of foods prepared earlier. Observation revealed that the oil used for deep frying fish was re-used more than once. The colour of the oil was dark and the vendors did not replace it with fresh oil.

 

The use of the recycled oil made the fish to have an unusual dark colour and unpleasant odour.

The food handling practices of the vendors are shown in Table 2. 90% of the vendor warmed the food before serving it to the customers. It was noted that foods were prepared on same surface more than twice by 72.5% of them. 75% handled food with bare hands. It was also observed that 92.5% were handling money while serving food. Food was mainly served in paper (47.5%).while most of them stored their food in openly in the stall (42.5%) and in cupboard (40%). Cooked street food should not be handled with bare hands. According to revised guidelines for the design of control measures for street-vended foods in Africa (FAO, 1999), clean tongs, forks, spoons or disposable gloves should be used when handling, serving or selling food. Handling with bare hands may result in cross contamination, hence introduction of microbes on safe food. The person handling money should not handle food. This is because money is dirty and can contaminate safe food (FAO, 1997). Training should, therefore, be conducted for the street food vendors on various aspects of personal hygiene.

The peak vending time were morning (47.5%) and evening (42.5%), however most of them prepared the food at night before selling. Proper methods of storing left-over food were not used; Leftovers were consumed or stored for use next day. Hence this could promote the sale of stale food. At an international conference on nutrition (FAO, 1992) it was resolved that if food cannot be served immediately, it should be kept hot or cooled down rapidly and reheated completely to a temperature of at least $70^0$ C before eating. This is to make sure that microbes will not thrive on the food because there they flourish well between $10^0$C and $60^0$C. It is recommended that the street food vendors prepare enough food for the day, so that they can sell all the food since most of them do not have good storage facilities.

**Table 4:** Food handling, preparation and storage practices of the vendors of fried fish and sambbsa in Bahir Dar November 2010 to March 2011 (n=40)

| Parameter | Frequency (%) |
|---|---|
| **Reheating of food before serving** | 36(90%) |
| **Preparation on same surface more than twice** | 29(72.5%) |
| **Preparation time** | |
| Night before selling | 23(57.5% |
| Morning of selling | 7(17.5%) |
| During day | 7(17.5%) |
| On demand | 3(7.5%) |
| **Place of preparation** | |
| At home | 14(35%) |
| At the site of sell | 18(45%) |
| Other places | 8(20%) |
| **Peak vending time** | |
| Morning | 19(47.5%) |
| Evening | 17(42.5%) |
| Any time | 4(10%) |
| **Serving food** | |
| Plastic bag | 11(27.5%) |
| Paper | 19(47.5%) |
| Fork/tong | 10(25%) |
| **Handling money while serving food** | 37(92.5%) |
| **Handles food with bar hand** | 30(75%) |
| **Food storage** | |
| Openly in the stalls/uncovered | 17(42.5%) |
| Plastic bag | 7(17.5%) |
| Cupboards | 16(40%) |
| **Leftovers** | |
| Consumed | 19(47.5%) |
| Stored for use next day | 21(52.5%) |
| Throw away | - |

**Personal hygiene of the vendors**

The vendors observed minimal personal hygiene. Personal hygiene is important because according to Marriot [39], human beings are the largest contamination sources of food. Personal hygiene of the vendors was observed. It was found that 70% of the vendors did not use aprons, 60%. 42.5% had long nails, which were not polished and 77.5% had not covered their hair. Because hair is known to harbor *S. aureus*, it is essential to prevent loose hair and dandruff from falling onto the food or food preparation areas (Education Foundation of the National

 

Restaurant Association, 1992). Only 7.5% of them had worn jewellery. Most of the vendors wash their hand (77.5%) using clean water and soap but only 2% and 12% wash their hand after blowing nose and scratching and after touching money respectively although they wash after using toilet. Table 3 shows how vendors observed various aspects of hygiene.

**Table-5** Personal hygiene of food vendors

| Parameter | Frequency n=40 (%) |
|---|---|
| **Use of apron** | |
| Full apron used | - |
| Half apron used | 12(30%) |
| Not used | 28(70%) |
| **Has long finger nails** | 17(42.5%) |
| **Wears jewelers** | 3(7.5%) |
| **Hair** | |
| Covered | 9(22.5%) |
| Uncovered | 31(77.5%) |
| **Definition of hygiene situation** | |
| Satisfactory | 4(10%) |
| Unsatisfactory | 26(65%) |
| **Hand washing method** | |
| Using Clean water | 6(15%) |
| Using Clean water and soap | 31(77.5%) |
| Any water | 3(7.5%) |
| **Hand washing** | |
| After blowing of nose and scratching | 12(30%) |
| After using toilet | 40(100%) |
| After touching money | 2(5%) |

**Care of Cooking and serving utensils**

Table -6 shows the care of utensils by the vendors. It is significant to note that 75% cleaned their utensils with water put on plate while 42.5% washed their utensils severally with water before replacement. Most of the vendors washed their utensils in cold water with detergent (72.5%) and mostly at the end of the day (70%).

**Table 6:** Care of utensils by the vendors

| Parameter | Frequency n=40(%) |
|---|---|
| **What do you use for cleaning utensil?** | |
| Bucket | 7(17.5%) |
| Basin | 3(7.5%) |
| Water put on plate and wash | 30(75%) |
| **Method of washing utensils** | |
| Hot water and detergent | 11(27.5%) |
| Cold water and detergent | 29(72.5%) |
| Any water without detergent | - |
| **Frequency of washing of utensils** | |
| Only at the end of the day | 28(70%) |
| With preparation of each next batch | 12(30%) |
| Only when I have time | 0 |
| **How many times water is used before replacement** | |
| Once | 9(22.5%) |
| Twice | 14(35%) |
| Several | 17(42.5%) |

**Hygienic status and waste disposal practice of food vendors**

Based on observation, about 75% of the vendors interviewed prepared their foods in unhygienic conditions given that garbage and dirty waste were conspicuously close to the stalls. Of the vendors interviewed, 22.5% did not have garbage receptacles; hence they disposed their garbage just near the stalls. Sixty-five percent of the vendors threw waste water just beside the stalls making the environment surrounding the eateries quite filthy. Water for street food preparation was not enough. This resulted in vendors using little water for washing utensils hence hygiene was compromised. This study is in agreement with a study done in Accra on the safety of street food,

 

which found that running water was not available (Mensah *et al*., 2002). Without enough water, hygiene and sanitary practices cannot be met. World Bank (1995) asserts that safe water is an essential pillar for health. Latham (1997) emphasizes that personal hygiene can only be achieved if adequate water is available. Therefore, vendors should have sufficient potable water for drinking, preparation of all kinds of foods and sufficient running water for all washing operations. A chi square test was done to test the relationship between education and the state of the environment where the street foods were prepared. The results revealed significant P value > 0.05 indicating that there was no significant relationship between education and state of environment. This shows that despite some of the vendors having secondary education, they had unclean environments just like their counterparts who had primary education. This calls for training in food hygiene for all vendors. It was observed that, houseflies were present in most of the stalls (86.5%). Flies were present in all stalls selling fried fish.

**Table 7:** hygienic status of vending Environment and Waste disposal practice of vendors

| Parameter | Frequency n=40(%) |
|---|---|
| **Rating of the vending environment** | |
| Very clean | 0 |
| Fairly clean | 10(25%) |
| Poorly clean | 30(75%) |
| **Where do you throw waste water?** | |
| Throw on the surface | 25(62.5%) |
| Throw into storm water drainage | 15(37.5%) |
| Other | 0 |
| **Presence of houseflies in the stall** | |
| Yes | 35(87.5%) |
| No | 5(12.5%) |
| **Frequency of waste disposal** | |
| Daily | 13(2.5%) |
| Twice weekly | 21(52.5%) |
| Weekly | 6(15%) |
| **Were bins available for garbage disposal?** | |
| Yes | 31(77.5%) |
| No | 9(22.5%) |

**Conclusion**

The change of bacterial growth from morning where street vended RTE foods started to be sold and at the afternoon of all the sites has been studied. The growth of all microbiological parameters considered in the study for the sites were significantly different ($P<0.05$) within the two sampling batch. Possibly, cross-contamination may occur to the foods between these intervals at some of the sites. On the other hand based on the acceptable level of the microbiological guideline/standards, only the total plate count and *S. aureus* was exceeded in both samples collected at intervals of marketing times. In addition, street food vendors practiced minimal hygienic and sanitary practices. The hygienic practices in question included food preparation, handling of utensils; place for food preparation and waste disposal, personal hygiene and methods of storing cooked food. Due to lack of proper knowledge and guidance on food safety and handling practices, vendors prepared their foods in explicitly unhygienic and unsanitary conditions. As the street-vended foods in this study were cooked or fried, initial microbial load should be low. The fact that the counts were high in the ready-to eat food items was indicative of post-cooking contamination and proliferation thereafter due to long holding at ambient temperatures. It is, thus, important to avoid time– temperature abuse through either immediate consumption or holding at much lower temperatures.

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