ORIGINAL ARTICLE

Microbiological Safety of Street Vended Foods in Jigjiga City, Eastern Ethiopia

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ABSTRACT

BACKGROUND: Food safety problems are particularly becoming an increasingly serious threat to public health in developing countries. This study was conducted to assess microbiological safety of street vended foods from May to November, 2014 in Jigjiga City.
METHODS: A cross-sectional design was used to answer questions concerning the current status of food hygiene and sanitation practire of street food vending sites. Interview and observational assessments were used to collect socio-demographic data about street food venders. One hundred thirty-two samples of street foods were aseptically collected from four 'kebeles' of Jigjiga City. Both descriptive and analytical statistical methods were applied.
RESULTS: The majority of the street food vendors were women, 120(90.9%), with the average age group of 23-49 years, (42.85%), and 99(66.7%) them were illiterate. The study revealed that 95(72%) of the food samples had pathogenic bacterial contaminations. Three different bacterial species were isolated: E. coli 68(51.5%), S. aureus 85(64.4%) and 26(19.7%) Salmonella species. The highest incidence of S. aureus 23/33(69%) was seen in 'Sambusa'; the highest incidence of E. coli 24/33(73.5%) was observed in 'Pasta', while the highest Salmonella incidence was observed in 'Ades'.
CONCLUSION: This study revealed that there is a reasonable gap on food safety knowledge among street food venders. The microbial profile was also higher compared to standards set by the World Health Organization. Due attention should be given by the government to improve knowledge about food safety and the quality standard of street foods sold in the City.
KEY WORDS: Microbiological safety, Street vended foods, Isolation, Jigjiga

INTRODUCTION

'Street food' refers to a wide variety of foods and beverages prepared and/or sold by vendors and hawkers especially in streets around trading centers and other public places for immediate consumption or consumption at a later time without further processing or preparation (1). Street-vended foods are predisposed to contaminations because they are sold in the open and are often not covered. Additionally, since street vendors prefer to take their products to their customers, they often operate from places such as bus terminals, industrial areas, schools, market places and streets. Such locations usually do not meet food and safety requirements. Sale of food in the streets is very controversial from a health Point of view. The main health hazard associated with street foods is microbial contamination.

A number of studies have shown that street foods are sometimes held at improper temperatures, excessively handled by food vendors and sold at very dirty surroundings (2) that make them prone to contamination. In addion, most of the vendors have no formal

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education or few years of schooling. Therefore, they are uninformed of proper food handling and their role in transmission of pathogens (3). Knowing the microbiological safety ofstreet vended foods is an important factor to appreciate the safety problems related to street foods so that concerned organizations should take proper steps to improve safety and sanitation with respect to this sector (4).

The results of different surveys revealed that street food and fast foods are commonly consumed in all town centers of Ethiopia. The increasing use of fast foods, and more recently street foods, pose many questions for public health advocates. Should nutritionists condemn the use of street foods in a country which is undergoing a rapid transition from consumption of traditional foods to more commercially available, ready-to-eat foods? How do these foods "fit" into the food-based dietary guidelines (5) which health professionals promote? Apart from fruit, which was found to be a popular street food choice, the remaining items would not be nutritionally recommended by nutritionists and would not feature on the list of food-based dietary guidelines. However, the reality lies in the fact that street foods are generally affordable (6). As such, they are very appealing to poor people who need to relieve their hunger as cheaply as possible.

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 (7). However, there are several ports of health problems that have been associated with street foods (8-12). Street foods are sources of nutrition for many low-income groups at affordable prices in large urban areas. These foods could be main vehicles for the transmission of severe and fatal diseases that could be life-threatening.

In the past few years, street foods are flourishing in major towns of Ethiopia. There are many people who get involved in the preparation and sale of street foods. In Ethiopia, almost all categories of people are consuming street foods especially individuals who earn low income per day, while some are protected from using these foods for fear of contamination. Different studies in Ethiopia showed different level of contamination of street foods (4, 8). However, information on the microbial load and safety of street foods and associated risk factors in Jigjiga City is limited. Therefore, the aim of this study was to assess the bacteriological safety of street vended foods in the City.

MATERIAL AND METHODS

Study Design and Study Area: A cross-sectional study was conducted from May to November 2014 in Jigjiga City. The study included four 'kebeles' in Jigjiga City where the numbers of street food vendors and their customers are high.

Data Collection: The sample size was calculated to be 132 at 80% power, 95% CI, and alpha error of 5%. Therefore, 132 street food vendors were included in this study from the four study sites in Jigjiga City. Hygiene and sanitation status of vending sites were determined by through pre-tested structured questionnaire, interview and observations. The native language of the district is Somali; hence, the questionnaire was translated into this language. Then, it was back-translated blindly into English to check its validity. Validity was checked by two experts who were fluent in both Somali and English.

Sample Collection and Processing: Thirty-three (33) vendors were selected for sampling from each study sites because there is a similar distribution of street food venders, and the food items among the four study site. A total of 132 samples of street foods consisting of *33 'Fuol', 33 'Ades', 33 'Pasta' and 33 'Sambusa'* were taken for microbiological analysis. The 132 study subjects are calculated from the 201 estimated street food venders by Jigjiga City Trade and Small Scale Enterprise.The constituents and description of the four street foods are presented in (Table 1). All samples were aseptically collected in sterile aluminum foil and analyzed within 3hrs after collection. Ten gram of each sample was mixed with 90 ml of 0.1% sterile peptone water and homogenized well and appropriate serial dilution was done (13). All the samples were processed in Somali Regional State Public Health Laboratory, based on Laboratory Manual of Food Microbiology for Ethiopian Health and Nutrition Research Institute (EHNRI).

Table 1: The ingredients and description of local street foods analyzed from Jigjiga City

Food items	Ingredients	Description
'Fuol'	Bean, Onion, tomatoes, cooking oil	The boiled bean and then mixed with onion, tomato and other Ethiopian spices
'Sambusa'	Wheat dough lentils, chopped onions, cooking oil	'Sambusa' is a deep fried triangle of wheat dough stuffed with lentils, chopped onions.
'Pasta'	'Cylindrical tube shaped Macaroni (wheat), Tomatoes, Onion	Boiled 'Macaroni' and then mixed with already prepared tomato stew
'Ades'	Camel Milk, tea, spice	It is tea made of normal tea plus camel milk and boiled with spice.

Bacterial Colony Count: For bacterial enumeration 0.1ml of the appropriate dilution from each tube was seeded on appropriate media using spread plate method, and then incubated at proper temperature and time under aerobic atmosphere (Table 2).

Table 2: Bacterial colony count

Microbial group	Culture media	Time (h)	Temperature	Characteristics of the colony
Aerobic mesophilic	Plate Count Agar (Oxoid)	48-72	30^0C	All colonies
Staphylococci	Mannitol Salt Agar (Oxoid)	24- 48	37^0C	All colonies
Enterobacteriaceae	Violet Red Bile Glucose Agar(Oxoid)	20-24	$30\text{-}32^0$C	Pink to red purple with/without haloes of bile precipitate
Coliform	Violet Red Bile Agar(Oxoid)	48	30^0C	Purplish red colonies bounded by reddish zone of precipitated bile

Floral Analysis: From aerobic mesophilic bacteria, 10-15 colonies were picked randomly from countable plates. Each colonies were purified by repeated plating to appropriate culture media. The isolated individual bacteria and groups of bacteria were characterized to the genus level and various bacterial groups (14) using Cell morphology, KOH test, Oxidation-fermentation (O/F) test, Catalase test and Cytochrome oxidase test.

Isolation and Identification of *Staphylococcu:* Yellow Colonies from Mannitol Salt Agar (MSA) were picked and inoculated into Nutrient Broth containing 7.5% sodium chloride and MSA (15).

The characteristic colonies (yellow Mannitol fermenting colonies on MSA plates) were aseptically picked, further purified by repeated streaking and characterized using established microbiological methods that include colonial morphology, cell shape, gram reaction, catalase and coagulase tests.

Statistical Analysis: Both descriptive and analytical statistical methods were applied. Data were entered and analyzed using Microsoft Excel version 2007.

Ethical Considerations: Ethical clearance was obtained from the Ethical Clearance Committee of Jigjiga University and Ethiopian Somali Regional Health Bureau. Informed written consent was also obtained from each study participant after explaining the objective of the study. Health education was given to the study participants by trained a health professional at the end of the study. All the information about the study participants was kept confidential.

RESULTS

Socio-Demographic Profile of Respondents: The majority of the street food vendors were women, 120(90.9%), with the average age group of 23-49 years, (42.85%), and with mean age of 35 years. The majority (66.7%) of the respondents were found to be illiterate, while the rest (33.3%) received some form of formal education and are able to read and write. About 124 (94%) of the vendors operated from stalls along the streets, while only 8(6%) of those surveyed were mobile (Table 3).

The vending sites were spread in wooden stalls 63(47.7%), canopies 31(23.5%) and polythene containers 38(28.8%). About two-third of the street food vendors surveyed said that they prepared the food and sold at the stalls (Table 3). Knowledge about food vending was acquired by self-teaching, trial and error in 79(59.8%) of the street vendors. Only 1(0.8%) of the vendors surveyed participated formal training in food handling and vending, while 52(39.4%) of them acquired their knowledge via observation or were taught by their parents.

Table 3: Characteristics of street food vendors in Jigjiga City

Attributes		Frequency (n=132)
Age (years)	21 – 30	25(18.9%)
	31 – 40	60(45.5%)
	41 – 50	47(35.6%)
Sex	Male	12(9.1%)
	Female	120(90.9%)
Educational attainment	None	88(66.7%)
	Primary	38(28.8%)
	Secondary	6 (4.5%)
Type of vendor	Stationary	124(94%)
	Mobile	8(6%)
Type of vending site	Wooden	63(47.7%)
	Canopy	31(23.5%)
	Polythene	38(28.8%)
Place of preparation of food	At home	43(33)
	At the stall	89(66.67)
Food vending knowledge acquisition	Self-Taught	79(59.8%)
	Taught by parents	52(39.4%)
	Formal Training	1(0.8%)

Knowledge and Practice of Street Food Venders about Food Handling: Seventy-eight (59.1%) of the vendors admitted that they washed food before cooking, while 19(14.4%) warmed the food before serving it to the customers. It was noted that some of the foods were prepared on same surface more than twice by 73% of them. The preparation surfaces were dirty in 83.3% of those surveyed. Thirty nine point four(39.4)% claimed that they washed the preparation surface before reuse, while 25% of them reused oil for frying. It had been observed that 86% of the vendors prepared food in unhygienic conditions. Only 12.9% used apron while cooking or serving food, while 75% handled food with bare hands. About 69.7%

wore hair covering, and 41.3% wore jewelry while handling foods. It was observed that all the respondents handle money while serving foods. Food was mainly served in metal plates (61.9%). While most of them (69.43%) stored their food in covered warmers or utensils, none of them could afford storage in refrigerators when electric is available.

Prevalence of Food Contamination: A total of 132 street vended food samples were analyzed for the presence of bacterial pathogens. The study revealed that 95(72%) of the foods had pathogenic bacterial contamination. Three different bacterial species were isolated from the foods sampled: *E. coli* 68(51.5%), *S. aureus* 85(64.4%) and 26 (19.7%) *Salmonella spp.* The

highest incidence of *S. aureus* 23/33(69%) was seen in '*Sambusa'*, while *E. coli* 24/33(73.5%) was observed in '*Pasta'* and the highest *Salmonella* incidence was observed in 'Ades'.

Samples from Kebele 06 were more contaminated with *S. aureus,* while samples from kebele 04 were more contaminated with *E. coli* than from the other vending sites (Table 4).

Table 4: Incidence of isolates from street foods in Jigjiga City.

Food items by area		Total examined	Bacteriological result		
			E. coli	*Salmonella*	*S. aureus*
"Fuol"	Kebele 3	9	3	2	6
	Kebele 4	8	1	1	5
	Kebele 6	8	1	1	6
	Kebele 10	8	1	0	4
	Total	**33**	**6(18.2%)**	**4(12.1%)**	**21(63.6%)**
Sambusa	Kebele 3	9	5	2	6
	Kebele 4	8	4	2	6
	Kebele 6	8	6	0	4
	Kebele 10	8	5	3	7
	Total	**33**	**20(60.6%)**	**7(21.2)**	**23(69.7)**
Pasta	Kebele 3	9	7	1	6
	Kebele 4	8	5	3	5
	Kebele 6	8	6	1	4
	Kebele 10	8	6	2	6
	Total	**33**	**24(72.7%)**	**7(21.2%)**	**21(63.6%)**
Ades	Kebele 3	9	6	3	6
	Kebele 4	8	3	2	4
	Kebele 6	8	5	1	6
	Kebele 10	8	4	2	4
	Total	**33**	**18(54.5%)**	**8(24.2%)**	**20(60.6%)**
	Overall	**132**	**68(51.5%)**	**26(19.7%)**	**85(64.4%)**

The Mean Bacteriological Count of Street Foods: All the samples showed high aerobic mesophilic count ranging from $1.9\text{-}4.6*10^6$ CFU/g to $0.9\text{-}8.3\times10^4$CFU/g coliform. The *S. aureus* count also ranged from $1.3\text{-}4.1\times10^4$CFU/g. the bacteriological count of organisms was more in 'Pasta' and 'Sambusa' compared with the other food sample items (Table 5). The food samples taken from Kebele 03 were more contaminated with total coliform than other street food vending sites (Table 5). Generally, 61.6% of the samples were dominated by gram positive organisms (Table 6). The aerobic mesophilic bacterial flora of street vended foods were dominated by *Enterobacteriaceae* (22.1%) followed by *Staphylococcus* (18.4%), *Pseudomonas spp* (11.4%), and *Bacillus* (11.2%). *Micrococcus* (10.6%), gram negative coccus (8.9%) and *Streptococcus* (7.2%) and other gram negative rods (4.95%) were also encountered in street vended foods. *Lactobacillus* (6%) and *Enterococcus* (4.2%) were also among the dominant aerobic mesophilic bacteria in the four different food types. Out of the 989 aerobic mesophilic bacteria which were characterized, 578(38.4%) were gram negative (Table 6). Among the total 132 streets vended foods which were enrolled 98.7% of them had aerobic mesophilic count greater than 8 log CFU/g.

Table 5:   Mean level of bacterial count in different street food items and kebeles in Jigjiga City

Food items	Mean bacterial count (CFU/g)			Kebeles	Mean bacterial count(CFU/g)		
	AMC	Total coliform	*S. aureus*		*AMC	Total coliform	*S. aureus*
'Foul'	2.7×10^6	3.6×10^4	1.5×10^4	**Kebele 03**	3.5×10^6	6.9×10^4	1.9×10^4
'Sambusa'	3.1×10^6	1.7×10^4	2.9×10^4	**Kebele 04**	3.2×10^6	5.3×10^4	1.6×10^4
'Pasta'	3.92×10^6	7.3×10^4	2.3×10^4	**Kebele 06**	3.0×10^6	6.4×10^4	1.7×10^4
'Ades'	2.6×10^6	4.3×10^4	1.4×10^4	**Kebele 10**	2.9×10^6	5.1×10^4	1.35×10^4

*AMC=Aerobic Mesophilic Count

Table 6: Frequency distribution (%) of dominant bacteria in street vended foods collected from Jigjiga City

Food type	Total isolate	Dominant aerobic mesophilic bacteria									
		Enterobacteriaceae	Staphylococcus	Pseudomonas	Bacillus	*Micrococcus*	Gram nega-tive coccus	Streptococcus	Lactobacillus	Other gram positive rods	Enterococcus
'Ades'	235	48	32	23	34	24	20	19	16	10	9
'Foul'	244	54	48	26	25	21	19	12	15	13	11
'Pasta'	251	56	47	30	19	19	23	17	16	15	9
'Sambusa'	259	61	55	24	23	31	16	13	12	11	13
Total	**989**	219	182	103	101	95	78	61	59	49	42

Prevalence of *Staphylococcus aureus*

Of the total of 132 samples examined, 51(38.6%) were found positive for *S. aureus*. Moreover, *S. aureus* were isolated from 13(39.4%) 'Foul', 17 (51.5%) 'Sambusa', 15(45.5%) 'Pasta' and 6 (18.2%) 'Ades'. The frequencies of isolation of *S. aureus* differed among the food types and ranged from 18.2% ('Ades') to 51.5% ('Sambusa').

DISCUSSION

The results of this survey showed that street food and fast food consumption are commonly consumed in Jigjiga City of Ethiopia, and consequently contribute to dietary intake.   A recent pilot survey (16) in deep rural villages in Mpumalanga, South Africa, showed similar trends, with the sale of street foods being a very common occurrence even in these very rural and remote areas. This pilot study, undertaken in

Jigjiga, showed that the food items most commonly available for sale were 'foul' (cooked beans), 'sambusa' (fried dough in oil), 'pasta' (cooked spaghetti), and 'Ades' (boiled camel milk along with tea).

Contamination of these foods could result from pre- or post-cooking contamination from the food handlers. Street food vendors are often unlicensed, untrained in food safety, food hygiene and sanitation, and they work under crude unclean conditions (17). Muinde and Kuria (18) in their study in Nairobi, Kenya, found that over 35% of the vendors belonged to the age category of 20-25 years. Sixty percent of the vendors were males while 40% were females. Sixty-two percent of the vendors had primary education and below, 36.3% had secondary education, while only 1.3% had college education.

This study found that women made up 91% of the vendors, while males made up 9% who fell into

the average age group of 21-50 years with mean age of 34 years. This is in contrast with the report by Muinde and Kuria (18). In Accra, the street food trade was conducted by children aged >10years and by women aged <52 years. The Study in Accra on street vendors were found to be mainly women (11) which is in agreement with the findings in this study.

In this study, 67% the vendors had no educational background, 28.8% of them had primary education, while 4.5% had secondary education. Knowledge for food vending was acquired by self-teaching, through trial and error, in 59.8% of the street vendors. Only 0.8% of the vendors attended formal training in food handling and vending, while 39.4% acquired their knowledge through observation or were taught by their parents. Muinde and Kuria (18) 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 through trial and error (self-taught). Omemu *et al* (12) noted, in their study at Abeokuta, Nigeria, that few vendors (12%) acquired the knowledge of food preparation from formal training.

Hygiene in handling and cooking of street foods is very important. According to FAO (19), food handlers should have the necessary knowledge and skills to handle food hygienically. From this study, it has been observed that 23.81% of the vendors prepared food in unhygienic conditions. The study in Nairobi reported that about 85% of the vendors prepared their foods in unhygienic conditions (18). Many studies have reported that due to lack of proper knowledge and guidance on street food vending, vendors prepared their foods in explicitly unhygienic and unsanitary conditions. However, Martins (20) observed otherwise in his study showed a high hygiene standard maintained by most vendors during preparation and serving of the foods. This study indicated that the health risks of consuming street foods are high, that street food vendors depend on vending for their livelihood and that their customers depreciate their trade. On a contrary note, Von and Makhoane (1) found that street food vendors were capable of producing relatively safe food with low bacterial counts, although there was still a need for proper hygienic conditions and access to basic sanitary facilities. Von and

Makhoane (1) observations are in agreement with Azanza *et al* (21) in which they found in their study that among 54 street food vendors surveyed in the Philippines, knowledge on food safety concepts was established particularly on topics that dealt with health, personal hygiene and food contamination.

In this study, majority of the vending sites were 47.7% wooden , 28.8% polythene and 23.5% canopy which were poorly constructed. Meuide *and* Kuria (18) confirmed in their study that these sites do not give proper protection of street foods from dust and smoke from vehicles. Food safety also largely depends on personal hygiene. Personal hygiene is important because according to Marriot 1985, human beings are the largest sources of food contamination. Handling with bare hands may result in cross-contamination, hence introduction of microbes on safe food. From the present study , it has been found that 52.14% of food venders did not use aprons, while 47.62% handled food with bare hands. About 30.3% food venders wore no hair covering, while 100% handled money while serving food. Forty one point four(41.4%) food venders wore jewelry while serving foods. This is in line with the findings by Muinde and Kuria (18) in Niarobi where they found that 81.3% of the vendors did not use aprons, 60% handled food with their bare hands and 65% had no hair cover. All their vendors handled money while serving food and only 10% of them wore jewelry. About 21.2% of the street food vendors stored food for serving openly in stalls, while 9% stored them in wheelbarrows. About 82% had leftover for next-day serving and none of the vendors had refrigerators for storage. In this study, it has been observed that 39.4% washed their utensils with dirty water which is reuesed several times. The fact that 72.7% of the food venders complained of water shortages. Some of them threw waste water carelessly around the stalls. In 23.8%, the environment was dirty even when about three forth (74.2%) of the vendors had garbage receptacles. The problem was mainly on how they disposed of the garbage which is poorly done and litter the environment most of the time.

In this study, 64.3% of the food samples confirmed the presence of bacterial pathogens. The presence of aerobic mesophilic count in all the samples varied between 1.9-4.6 x 10^6CFU/g,

which is higher than those of a study (12.16 - 25.81x10^5 CFU/ g) conducted in Tirumala(22).

The high total aerobic plate counts indicated poor general quality of the street vended foods. Both total coliform and the total faecal coliform counts were notably high indicating faecal contamination of the samples. The high total *Staphylococcus* counts and the presence of *S. aureus* may be attributed to totally unhygienic handling by the vendors. Qualitative analysis showed the presence of *Salmonella spp* in three samples, which further confirms the poor microbiological quality of these products. Hazard analysis and Critical Control Points-Total Quality Management lay down the microbial quality of the foods that containing <4 log cfu/ml of organisms is rated "good" and those containing approximately >8 log cfu/ml as spoiled food. The present study indicated a prevalence of *S. aureus*, which is able to grow at wide range of pH (4.8-9.3), and temperatures (7-43^{0}C). A high number of *S. aureus* may result in the production of enterotoxins causing food-borne diseases. Furthermore, growth of these pathogens, especially in the street vended foods (pH of foods surfaces range from 6.5-7.5) during the long display periods (6-8hrs) at ambient temperature is quite possible.

In this study, the level of coliforms varied between 0.9- 8.3 x 10^{4}CFU/g, which were higher than the work conducted in Tirumala (22) with the reported finding of 0.28-3.99x10^{3}CFU/g. The presence of total coliform in street vended foods can be linked to contamination resulting from inappropriate processing, incomplete heating, use of contaminated water during preparation and washing or secondary contamination via contact with contaminated materials such as chopping boards, knives and serving wares (23). *Enterobacericeae* were detected in all of the food samples. This detection rate was consistent with a previous study carried out in Amravati City, which reported finding of 92% of all food samples (24). The presence of *Enterobactericeae* in this study might be attributed to the heat processing failure or post-processing contamination, faecal contamination and poor hygienic practice of food handlers (25). One major source of contamination of foods sold by street vendors is the water used for washing and processing (26). In Onitsha-Owerri, South-east Nigeria, a study on microbial

safety of the ready-to-eat food of wallnut showed high coliform counts. Poor handling of wallnut and the natural microflora could thus have contributed to the high level of contamination (27). The presence of *Salmonella, Shigella* and *E. coli* O157:H7 in 25grams of examined sample is regarded as potentially hazardous to consumers, and is unacceptable for consumption(28). The vendors can be carriers of pathogens like *E. coli, Salmonella, Shigella, Campylobacter* and *S. aureus,* and can eventually transfer these food-borne hazards to consumers. From a study done in Onitsha-Owerri, *Salmonella, Shigella* and *E. coli,* were isolated from ready-to-eat foods, indicating poor sanitary control and practice (27).

The presence of *S. aureus* in the whole food samples was 34.3% with a range of 1.3-4.1*10^4 CFU/g. These results were less than a study conducted by Suneetha et al (22). The highest detection of *S. aureus* was found in 'Bonbolino' (56.2%). The presence of *S. aureus* was an indication of contamination from the skin, mouth or nose of food handlers through coughing and sneezing. This contamination can be introduced into the street foods during handling, processing or vending (29).

In this study, *Salmonella spp* detection rate was 12.9%. This is different from previous works done on 'Sambusa' and 'Macaroni' in Ethiopia (4). Usually, it is difficult to predict the association of *Salmonella spp* with specific food products. However, in some situations, the *S. enteritidis*, can be associated with beef, meat, milk poultry and eggs or egg products (30). The presence of *Salmonella spp.* might be due to the difference in the ingredients in that the foods in this study included animal products. The presence of *SalmonellaSpp in* these foods is attributed to inadequate sanitation and poor personal hygiene. Although raw eggs and egg products have been implicated in contamination with *Salmonella enteritidis,* the ability of this pathogen to survive for up to 7-14 days on the surface of many fresh fruits as in melons has been reported.

'Sambusa' and 'Pasta' were highly contaminated with bacteria. This could be due to the method of poor handling and improper preparation(cooking). These street food items are cooked for short periods. 'Sambusa' is handled excessively during transport, storage and sale. 'Pasta' is cooked in boiling water for a few

minutes and added to cold water after the hot water is drained. This could be the means of contamination. Among vending sites, food samples from Kebele 03 were more contaminated with *S. aureus* than food items from the other locations. Observational studies have shown that Kebele 03 is overcrowded and the mobility of people is high because it is the area where market place is found. The street foods are displayed and sold openly at very dirty surroundings on the road side. The foods can easily be contaminated by dust, insects, and hands of intending consumers. The contamination levels of coliform and *S. aureus* were higher in food samples from Kebele 06. This could be the result of use of unhygienic water for cleaning utensils and cooking of foods.

The results of this study clearly demonstrated that the street-vended foods in Jigjiga were contaminated with different pathogenic bacteria. The existence of these bacteria in foods could induce potential health problems for consumers. Poor personal hygiene, improper handling and storage practice of foods and poor knowledge of food vendors about food borne disease were the associated risk factors to contamination of street vended foods in Jigjiga. The consumption of street food provides employment for a large proportion of the population (31), and there may be ways and means by which this practice can be encouraged if vendors sell healthier food items such as fresh fruit, dry fruit, nuts , vegetables and roasted maize cobs. Since the sale of street food is likely to increase, consideration should be given to ways and means that the practice can be done in a healthy and safe manner. This is particularly relevant in schools in poorer areas where, at times, numerous vendors sell their products to children at break periods (6).

In conclusion, this study revealed that almost all the samples are unacceptable microbiologically and safety levels.The situation calls for formulation of strict public-health regulations regarding the sale of street foods in these particular city. Therefore, consumption of such contaminated street vended foods poses a serious problem to community health. These provide information for responsible organizations to take actions to provide regular training and to create awareness on food handling and personal hygiene among street food venders as well as consumers. Governments should invest more in basic social services such as water supply, electricity and education for food venders particularly women who dominate the street food sector.

ACKNOWLEDGMENT

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