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Bacterial Load Assessment of some Food Items Sold in Street in Woldia Town, North-East Ethiopia

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Abstract

Infectious diseases due to contaminated street vended food items has happened to an essential concern and public health issue in low socio-economic status individuals. The goal of this study was to evaluate bacterial quality and safety of some food items sold in street based on aerobic mesophilic bacteria, *Salmonella, Staphylococcus aureus* and *Escherichia coli* in Woldia town. Cross-sectional study was performed on some selected street vended foods from March 2019 to May 2019 in Woldia town. A total of 36 ready-to-eat food samples such as 'Sambussa', 'Bonbolino' and 'Ambasha' were collected for microbial analysis. Finding of the study indicates that 32(88.9 %) of the vendors were females, 28(77.7%) handled food with bare hands, 28(77.7%) vendors were washing their hands after toilet. The mean total count of aerobic mesophilic bacteria, *Salmonella, Staphylococcus aureus* and *Escherichia coli* was $4.5 \times 10^2 \pm 5.2 \times 10^1$ CFUg^{-1}, $1.5 \times 10^2 \pm 4.5 \times 10^1$ CFUg^{-1}, $1.1 \times 10^2 \pm 1.4 \times 10^1$ CFUg^{-1} and $2 \times 10^2 \pm 3.4 \times 10^1$ CFUg^{-1}, respectively. The dominant bacterial isolate from the street vended foods was *Escherichia coli* (53.5%), followed by *Salmonella* (24.1%) and *Staphylococcus aureus* (22.4%). The result of this study demonstrates the non hygienic practices of the vendors in street vended foods showed high bacterial load. Therefore, the street vended foods were contaminated with food borne pathogenic bacteria that can create a potential risk to public health in the study area. In general, the bacterial quality of the food quality sold in street in Woldia town was very poor and needs especial attention to avoid bacterial contamination.

Keywords: Street-vended food, *Staphylococcus aureus, Salmonella*, *Escherichia coli*

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INTRODUCTION

In low income countries foods sold in the street by food vendors prepared at home and consumed on the street without further preparation[1]. In developing countries where there is high unemployment, low salary incomes, little work chance and where urbanization is taking place, consumption of street vended food items is common[2]. Both food venders and consumers are beneficiary from the street vended foods. Street food items are accessible, cheap, and nutritionally-balance and also supply a base of income, opportunity of self-employment and chance to develop business skill with low capital investments to the vendors[3]. Foods vended in the street are predisposed to contaminations since they are exposed to dust and are often not covered. Consuming unsafe food poses an important community health risk in both developed and developing countries[4]. Diseases due to contaminated food are still a common problem and causes mortality and morbidity in the community. Transmission of food related diseases due to lack of hygiene of food handlers is a common worldwide problem and a wide range of enteric pathogenic microorganisms might be carried by food handlers and implicate infections in the public[5]. A number of scholars reported that food borne infections have been alarmingly increasing throughout the world. These reports have shown that inadequate food hygiene and safety practices during food handling, preparation and serving are the major causes[6]. Even if there is a well awareness about diseases transmitted because of consumption of contaminated street vended food items, most of the consumers do not give attention these health hazards[7]. Several studies have showed that different types of disease causing microorganisms such as *Bacillus cereus, Staphylococcus aureus*, *Salmonella* spp and *E. coli* have been obtained in various types foods sold in the street[8]. Every year, food borne infections cause the suffering of millions of people throughout the world[9]. A report done in 2005 only showed that diarrheal diseases cause for the death of 1.8 million[10]. The National Hygiene and Sanitation Strategy program in Ethiopia reported that about 60% of the infection load is related to poor hygiene and sanitation practice of the consumers[11]. *Salmonella*, *Shigella* and related food borne infectious causing microorganisms were identified in the foods sold in the street and become serious health problem in Ethiopia. Diarrheal disease represents the second leading cause of death in Ethiopia[12,13]. Uses of street foods are nowadays common in different towns of Ethiopia and it is observed in areas of many people found such as bus stations, schools and other places. The low income category of the people commonly consumes foods sold in the street in Woldia town. However, the awareness of the consumers on the safety and microbial load of the food items sold in the street and related factors in this study area are limited.

The main purpose of the present study was to investigate the microbial safety of street vended foods and food handling practice of the venders in Woldia town, North East Ethiopia.

MATERIALS AND METHODS

The study area

This study was done in Woldia, the main town of North Wollo, located 530km North East of Addis Ababa, the capital city of Ethiopia (Fig. 1). The town's geographical coordination is 11°50'N latitude and 39°36'E longitude. The town has an elevation of 2112 m above sea level.

Study design

A cross sectional study design was conducted in Woldia town from February to June 2019 to examine the bacteriological quality and handling practices of food sold in the street such as 'Sambussa', 'Bonbolino' and 'Ambasha' vended at Gonderber, Mugad, Menehariya and Piazza. In the present study the study population was randomly selected street food venders in Woldia town.

Sampling technique

Random and nonrandom sampling techniques were used to select representative street food sellers in the study area. Four common street food vending sites such as Gonderber, Mugad, Menehariya and Piazza were selected purposefully. A Total of 36 samples of food items sold in the street which consist of 12'Sambussa', 12 'Bonbolino' and 12'Ambasha' were selected by random sampling technique and taken into microbiology laboratory of Woldia University for bacteriological load analysis.

Socio-demographic data collection

Socio-demographic data and personal

hygiene practices of the street food vendors from 36 venders were selected by using random sampling technique. The data were collected by face to face interview method using semi-structured questionnaire and an observation checklist.

Sample collection

Three most street vended food stuffs, namely 'Sambussa' 'Bonbolino' and 'Ambasha' were selected for bacteriological analysis and randomly bought from street food vendors. The food items for laboratory analysis were aseptically collected from street food sellers by using sterile glass material and immediately stored in icebox. All the collected food items were taken to microbiology laboratory of Woldia University for bacteriological analysis. The collected food samples were placed in the refrigerator at 4°C till bacteriological analysis was carried out. Bacterial analysis was conducted within one to three hours after sample collection.

Bacteriological methods
Food sample preparation

For microbiological analysis 10g of each food samples namely 'Sambussa', 'Bonbolino' and 'Ambasha' were homogenized in 90 ml buffered peptone water. Then after, the food sample homogenates were processed to serial dilutions of 10^{-2}, 10^{-3}, 10^{-4}, and 10^{-5} of all food items, the suspected bacterial load of 0.1ml dilutions were transferred to plates and spread by L-shaped glass tube to plates and incubated at 37°C for 48 hours, finally the load of bacteria counted by colony counter. The counted colonies were expressed in colony forming units per gram ($CFUg^{-1}$).

Microbial enumeration
Aerobic mesophilic bacteria

The pour plate technique on plate count agar (PCA) (Oxoid Ltd, United Kingdom) was used to count aerobic mesophilic bacteria. A homogenized food sample of 0.1ml was inoculated onto plate count agar in triplicate and the plates
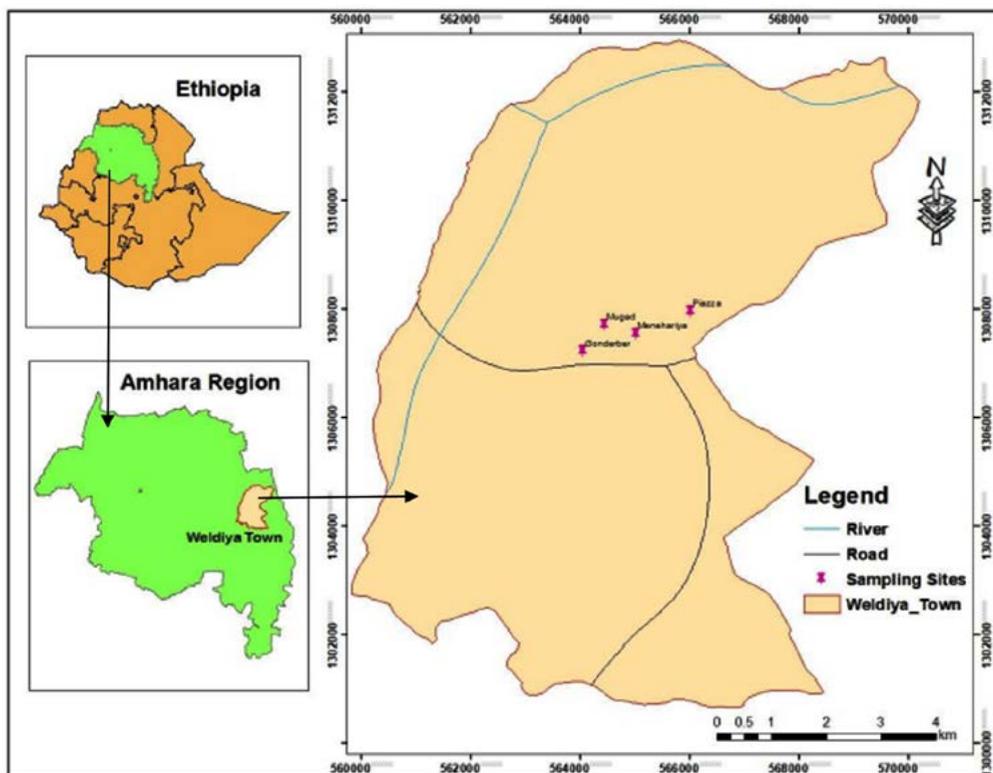

Fig. 1. Street food sampling sites in Woldia town

were incubated aerobically at 37°C for 48 hrs. All plates 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.

Isolation of *Salmonella*

To detect *Salmonella,* 10g of food sample was homogenized in 90 ml buffered peptone water and shook for 2-3 minutes using shaker (STUART, UK) to prepare homogenate dilution. A serial dilutions of 10^{-2}, 10^{-3}, 10$^{-4,}$ and10^{-5} were underwent from homogenate food sample and 0.1ml dilutions were transferred to xylose-lysine-deoxycholate (XLD) agar and spread by L-shaped glass tube to plates and incubated at 37°C for 48 hours. Then black centered pink colonies were enumerated using colony counter (STUART SCIENTIFIC, UK). Colony forming unit per gram of food item (CFUg^{-1}) was determined by multiplying with the dilution factor.

Isolation of *Staphylococcus aureus*

For *Staphylococcus aureus*, 10g of food sample was homogenized in 90 ml buffered peptone water and shook for 2-3 minutes using shaker (STUART, UK) to prepare homogenate dilution. A serial dilutions of 10^{-2}, 10^{-3}, 10$^{-4,}$ and10^{-5} were underwent from homogenate food sample and 0.1ml dilutions were transferred to sterile molten Mannitol salt agar (BLULUX) petri plate and then incubated at 37°C for 48 hours. Finally, due to Mannitol fermentation yellow to orange colonies surrounded by yellow zone was enumerated using colony counter (STUART SCIENTIFIC, UK) and the obtained data was recorded as colony forming unit per gram (CFUg^{-1}) of all food items.

Isolation of *E. coli*

Ten gram of food sample was homogenized in 90ml buffered peptone water and shook for 2-3 minutes using shaker (STUART, UK) to prepare homogenate dilution. A serial dilutions of 10^{-2}, 10^{-3}, 10$^{-4,}$ and10^{-5} were underwent from homogenate food sample and 0.1ml dilutions were transferred to Eosin Methylene Blue (EMB, Himedia, India) agar for isolation of *E. coli* and spread by L-shaped glass tube to plates and incubated at 37°C for 48 hours then green metallic sheen colonies showing a dark nucleated centre were recorded using colony counter (STUART SCIENTIFIC, UK).

Data analysis

Data obtained from different food samples were analyzed by using SPSS software version 20.0 and mean bacterial loads of food samples from different sites were compared using one way ANOVA. A p value of ≤ 0.05 at 95% confidence interval was considered as statistically significant.

RESULTS

### Socio-demographic data of the street food sellers

In this study, 32(88.9%) of the vendors were females while 4(11.1%) were males. Majority vendors 20(55.6%) were between the age of 18 to 29, while 12(33.3%) of them were between 30 and 40 years old and 4(11.1%) were above 40 years. From the vendors 4(11.1%), 8(22.2%), 8(22.2%), 12(33.3%) and 4(11.1%) were illiterate, had basic education, elementary school, secondary school and had college diploma, respectively (Table 1).

Knowledge about food safety and personal hygiene of the food sellers

As indicated in table 2, 28(77.8%) of the street food sellers had a good awareness of food safety, while 8(22.2%) of the street food sellers had no awareness of food safety. This implies that the vendors contaminate the food items during preparation, handling, transportation, and while they sold. All vendors, 36(100%), knew hand washing before work reduces the risk of food contamination as well as proper utilization of utensils, proper handling ,well cooking of food,

Table 1. Socio-demographic profile of food sellers in the study area

Variable		Vendors (N=36)	Percent (%)
Sex	Male	4	11.1
	Female	32	89.9
Age	18-29	20	55.6
	30-40	12	33.3
	>40	4	11.1
Marital status	Single	4	11.1
	Married	32	88.9
Educational status	Illiterate	4	11.1
	Basic education	8	22.2
	Elementary school	8	22.2
	Secondary school	12	33.3
	Diploma	4	11.1
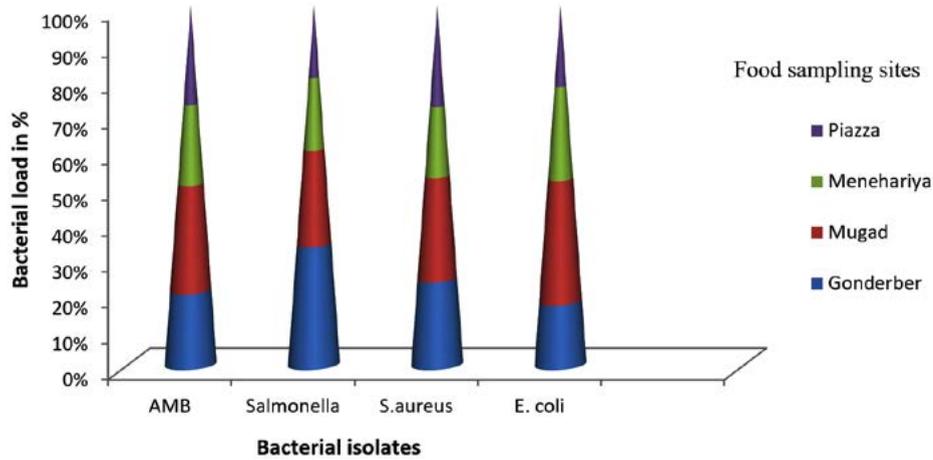
AMB; Aerobic mesophilic bacteria

Fig. 2. Aerobic mesophilic bacteria and isolated species in street vended food items

Table 2. Food safety awareness and handling practices of respondents

Parameter	Vendors (n=36)	Frequency	Percentage (%)
Knowledge of food safety	Yes	28	77.8
	No	8	22.2
Hand washing before work	Yes	36	100
	No	-	-
Handling foods by using gloves	Yes	24	66.4
	No	12	33.6
Covering of hair when handling and serving of food	Yes	24	66.7
	No	12	33.3
Washing utensils with detergent	Yes	36	100
	No	-	-
Knowledge about hand hygiene and food-borne diseases	Yes	36	100
	No	-	-
Hand Washing after visiting the toilet	Yes	28	77.8
	No	8	22.2
Food selling sites protected from sun, dust and wind	Yes	-	-
	No	36	100
Presence of animals or pests (flies etc) around the food selling sites	Yes	36	100
	No	-	-
Presence of clear water at the site or close to the food selling sites	Yes	-	-
	No	36	100
Sufficient hands washing facilities accessible	Yes	-	-
	No	36	100
vendors handle money while serving food	Yes	36	100
	No	-	-
vendors wash hands after handling money before handling food for a second time	Yes	-	-
	No	36	100
The food sellers handle food with uncovered hands	Yes	30	83
	No	6	17

Table 3. Aerobic mesophilic bacteria and identified bacterial species in some selected food items in CFUg⁻¹.

	Food items	No of sample	AMB (CFU/g⁻)	*Salmonella* (CFU/g)	*S.aureus* (CFU/g⁻)	E.coli (CFU/g⁻)	Average
Gonderber	'Sambussa'	S1	755	301	220	234	252
		S2	334	126	96	112	111
		S3	272	47	102	123	91
	'Bonbolino'	S4	434	122	109	203	145
		S5	453	97	89	267	151
		S6	350	85	76	189	117
	'Ambasha'	S7	659	101	123	435	220
		S8	422	74	115	233	141
		S9	394	64	96	234	131
		Total	4073	1017	1026	2030	1358
Mugad	'Sambussa'	S10	563	107	111	345	188
		S11.	515	119	74	322	172
		S12	499	66	86	347	166
	'Bonbolino'	S13	1484	218	473	793	495
		S14	699	122	121	456	233
		S15	585	151	90	344	195
	'Ambasha'	S16	596	99	108	389	337
		S17.	476	105	93	278	159
		S18	473	96	79	298	158
		Total	5890	1083	1235	3572	1963
Menehariya	'Sambussa'	S19	522	60	97	365	174
		S20.	463	94	79	290	154
		S21	493	103	88	302	164
	'Bonbolino'	S22	504	107	100	297	173
		S23	461	119	85	257	148
		S24	530	66	95	369	186
	'Ambasha'	S25	587	106	94	387	196
		S26.	392	99	99	194	131
		S27	402	58	105	239	134
		Total	4354	812	842	2700	1460
Piazza	'Sambussa'	S28	435	105	97	233	145
		S29	310	120	80	110	103
		S30	276	65	89	122	92
	'Bonbolino'	S31	806	108	400	298	270
		S32	490	118	120	252	163
		S33	525	63	92	370	175
	'Ambasha'	S34	611	100	121	390	204
		S35	464	75	112	277	155
		S36	460	64	97	299	153
		Total	4377	818	1208	2351	1460
Over all total		36	18694	3730	4311	10653	6240

washing hand after toilet ,washing of utensils with detergent and hygiene practices, cleaning and sanitation procedures. From 36 vendors, 24(66.7%) covered their hair when handling and serving of food, 24(66.7%) knew the risk of food contamination could be reduced using gloves while handling food, while 12(33.4%) didn't know using gloves reduce contamination.

From observation of vendors, all vending stall is not protected from dust, wind, sun, as well as animals are available in the vending site, flies can subsequently contaminate other surfaces with

Table 4. Mean and standard error of bacteriological counts of AMB, *Salmonella, S.aureus* and *E.coli* CFUg^{-1} in Woldia town

Food sampling sites	Mean and S.E of AMB	Mean and S.E of *Salmonella*	Mean and S.E of *S.aureus*	Mean and S.E of *E.coli*
Gonderber	$4.5 \times 10^2 \pm 5.2 \times 10^{1a}$	$1.5 \times 10^2 \pm 4.5 \times 10^{1b}$	$1.1 \times 10^2 \pm 1.4 \times 10^{1b}$	$2.1 \times 10^2 \pm 3.4 \times 10^{1a}$ *
Mugad	$6.5 \times 10^2 \pm 1.1 \times 10^{2a}$	$1.2 \times 10^2 \pm 1.4 \times 10^{1b}$	$1.4 \times 10^2 \pm 4.2 \times 10^{1b}$	$4.0 \times 10^2 \pm 5.2 \times 10^{1b}$
Menehariya	$4.8 \times 10^2 \pm 2.1 \times 10^{1a}$	$9.0 \times 10^1 \pm 7.60^b$	$9.4 \times 10^1 \pm 2.72^b$	$3.0 \times 10^2 \pm 2.2 \times 10^{1a}$
Piazza	$4.9 \times 10^2 \pm 5.2 \times 10^{1a}$	$9.1 \times 10^1 \pm 7.97^b$	$1.3 \times 10^2 \pm 3.4 \times 10^{1b}$	$2.6 \times 10^2 \pm 3.2 \times 10^{1a}$
Total	$5.2 \times 10^2 \pm 3.4 \times 10^1$	$3.1 \times 10^2 \pm 12.40$	$1.2 \times 10^2 \pm 13.66^b$	$3.0 \times 10^2 \pm 21.18$
LSD	34	0.67	3.00	38

Mean values indicated with the same letters are not significant at P≤0.05; * significant at P≤0.01; LSD, List Significant Difference; S.E, Standard Error of the mean

Table 5. Incidence of dominant bacteria species in some street-vended foods in Woldia town

Food type	Number of isolates Number	*Salmonella* Frequency (%)	*Staphylococcus aureus* Frequency (%)	*E.coli* Frequency (%)
'Sambussa'	5437	1313(24.1%)	1219(22.4%)	2905(53.5%)
'Bonbolino'	7321	1376(18.8%)	1850(25.2%)	4095(56%)
'Ambasha'	5936	1041(17.5%)	1242(21%)	3653(61.5%)
Total	18694	3730(20%)	4311(23%)	10653(57%)

pathogens from livestock manure by regurgitation, fecal deposition, or mechanical transfer[14]. In all vending site no clean water at the site or close to the site, no washing facilities for hands, vendors didn't wash down their hands in clean water each time before the handling and serving of food and all (100%) of the street food vendors didn't wash hands after handling money before handling food again and 30(83%) of the vendors handle food or money with uncovered hands.

Bacteriological analysis of street-vended foods

From four street food vending sites 36 food samples were analyzed from the food items to assess the level of contamination based on aerobic mesophilc bacteria, *Salmonella, Staphylococcus aureus* and *E.coli* is indicated in table 3. The study showed that the food samples were contaminated by pathogenic bacteria. Three types of bacterial species were identified from the three kinds of food items. The maximum numbers of *Salmonella* was seen in 'Sambusa' (S1) from Gonderber and the maximum numbers of *S.aureus* was observed in 'Bonbolino' (S31) from Piazza. In the case of *E. coli* the highest load was observed in 'Bonbolino' (S13) from Mugad. A total of 18694 bacterial

isolates were analyzed from 36 food samples, 5437 bacterial strains were isolated from 'Sambussa', 7321 from 'Bonbolino' and 5936 from 'Ambasha' by using selective media. Among the total bacterial isolates, the dominant bacterial group was *E.coli* (57%) followed by *Staphylococcus aureus* (23%) and *Salmonella* (20%).

From table 4 and Fig. 2, the maximum mean load of aerobic mesophilic bacteria $6.5 \times 10^2 \pm 1.1 \times 10^2$ CFUg^{-1} (29.74%) and *Salmonella* $1.5 \times 10^2 \pm 4.5 \times 10^1$ CFUg^{-1}(33.6%) were observed from Mugad and Gonderber, respectively. Whereas, the maximum mean load of *Staphylococcus aureus* $1.4 \times 10^2 \pm 4.2 \times 10^1$ CFUg^{-1}(28.59%) and *E.coli* $3.9 \times 10^2 \pm 5.2 \times 10^1$ CFUg^{-1}(34.1%) were observed from Mugad. The minimum observed mean load of aerobic mesophilic bacteria from Gonderber, *Salmonella* from Menehariya, *Staphylococcus aureus* from Menehariya *and E.coli* from Gonderber were $4.5 \times 10^2 \pm 5.2 \times 10^1$ CFUg^{-1}(20.66%), $9.0 \times 10^1 \pm 7.60$ CFUg^{-1}(19.87%), $9.4 \times 10^1 \pm 2.72$ CFUg^{-1}(19.49%) and $2.1 \times 10^2 \pm 3.4 \times 10^1$ CFUg^{-1} (17.68%), respectively. Regarding the dominant bacterial species, 10653(57%) *E.coli* was observed (Table 5). Statistical significant difference was

observed in mean value of *E. coli* between 'Sambussa' and 'Bonbolino' at p≤ 0.05. However, there was no statistical considerable difference among the mean load of aerobic mesophilic bacteria, Salmonella and Staphylococcus aureus among the four food sampling sites (p≤ 0.05).

DISCUSSION

Food items vended in the street plays significant role in low-income countries in order to address the need of food demands of the urban peoples. It is widely utilized by the world's community of millions of people daily due to its accessibility and cheap in price[15]. The present study was conducted to examine the microbial quality of some selected street vended foods sold in four locations in Woldia town.

In this study the socio-demographic characteristics indicated that the majority (89.9%) of street food sellers were females. A study done in Gondar, Ethiopia reported that 95% of the vendors were females[16]. Similarly a study done in Jima[17] also reported the majority (85.5%) of street food vendors were females. Among 36 venders participated in the current study, 28(77.8%) of the vendors were washing their hands after toilet which was high compared to findings in Hawassa, Ethiopia (68.6%)[5] and Gondar (63.3%)[18] but it is in line with Addis Ababa, Ethiopia (80.8%)[19] and Jimma, Ethiopia (77%)[20]. In this study 66.7% of the vendors cover their hair while serving and handling foods which was higher than a study reported in Ihiagwa (12.7%)[21].

In the present study, the greater part (83%) of the vendors served their customers by handling food with bare hands. A similar study done in Jigjiga City, Ethiopia[4] indicated 47.62% of the street food sellers handled food with uncovered hands. The street food sellers can be contaminated by pathogens like *Salmonella*, *S. aureus* and *E.coli* and in due course can transmit these food borne disease causing microorganisms to the consumers. This is the fact that those street vended food items are frequently contacted with unhygienic hands of vendors at some point in preparation, handling and serving[22]. World Health Organization[23] reported those unhygienic food handlers' hands are the main significant vehicle for the transfer of microorganisms from skin, feces and nose to the food.

Overall study indicated that all the food items sold on the street were contaminated with variety of pathogenic microorganisms. As indicated in table 5, in this study, the mean total count of AMB was $5.2 \times 10^2 \pm 3.4 \times 10^1$ CFUg^{-1}. The load of aerobic mesophilic bacteria is significantly high in 'Bonbolino' mainly due to unhygienic condition of the venders. A similar study in Yaounde-Cameroon[24], reported there was high count of AMB in the street vended food items. Similarly, a study done in Ambo, Ethiopia[25] reported that the highest AMB count (2.6×10^3 CFUg^{-1}) was observed in street vended foods. Another study done in Jima, Ethiopia[17] reported a mean aerobic mesophilic bacterial count of $10^5 \pm 3.16$ CFUg^{-1} which was higher than the present study. The mean total count of *Salmonella* in the study area was $3.1 \times 10^2 \pm 1.2 \times 10^1$ CFUg^{-1} which was in agreement with a study done in Hawasa, Ethiopia[22]. In Ago-Iwoye, Nigeria[26], reported only 0.7% of the food samples were contaminated with *Salmonella* which was very low compared with the present study.

In the case of *Staphylococcus aureus*, the mean count in the study area was $1.2 \times 10^2 \pm 1.4 \times 10^1$ CFUg^{-1}. High mean count of *Staphylococcus aureus* ($1.4 \times 10^2 \pm 4.2 \times 10^1$ CFUg^{-1}) was observed in Mugad. A study done in Bahir Dar, Ethiopia[3] observed high load of *Staphylococcus aureus* in 'Sambussa' which was in agreement with the findings of the present study. Similarly, a study done in Gonder[27] 35.54% of the food samples were contaminated with *Staphylococcus aureus*. Another study done in Jima, Ethiopia[28] 28.2% of the food samples were contaminated by *Staphylococcus aureus* which was higher than the frequency of the present study (23%).

The mean count of *E.coli* observed in the study area was $2.9 \times 10^2 \pm 2.1 \times 10^1$ CFUg^{-1} which was higher than the mean count of AMB, *Salmonella* and *S. aureus*. High mean load of *E.coli* count was observed in Mugad ($3.9 \times 10^2 \pm 5.2 \times 10^1$ CFUg^{-1}). The load of *E. coli* observed in the present study was not in line with a previous result reported in Gondar[29]. A study done in Bangladesh[30] a maximum of 4.0×10^3 CFUg^{-1} *E.coli* was reported that was not in agreement with the present findings. A similar investigation done in Zimbabwe[31] reported that 53% of the food samples were contaminated with

E. coli which was lower than the present study. The occurrence of high mean count of *E.coli* in this study area demonstrates a potential high health risk and their occurrence is a suggestion of likely fecal contamination of food or water, water or food handlers and inferior hygienic processing practices[8].

A high mean count of AMB, *Salmonella, S. aureus* and *E.coli* suggests contamination of foods due to inappropriate processing, contamination through contact with contaminated utensils and poor personal hygiene of the vendors.

CONCLUSION

This study revealed the street vended food items were potentially contaminated by the *Salmonella, S.aueres* and *E. coli*. Therefore, the occurrence of these microorganisms might be predicted for the presence of potential disease causing microorganisms. Very high bacterial loads from 'Sambussa', 'Bonbolino' and 'Ambasha' food samples suggests a potential health risk to the consumers from the utilization of foods sold in the street in the study area. This indicates poor food handling practice and personal hygiene of the vendors in the street and high risk of food borne infections. To enhance bacterial quality of foods sold in the street by venders providing regular training and creating awareness on food handling and personal hygiene among street food venders as well as consumers is recommended.

ETHICS STATEMENT

Ethical clearance was obtained from the Ethical Committee of Woldia University. .

DATA AVAILABILITY

All the necessary data are available in the submitted manuscript.

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