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Bacteriological quality of food in Arba Minch University, Abaya campus student's cafeteria

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Abstract

A food which is made in university can be vehicle for food -borne diseases and food poisoning if it is not handled properly. In this study the microbiological quality of foods (rice, shuro, miser, cabbage and meat) was assessed, in Arba Minch University Abaya campus. A total of thirty food samples were collected from the campus student's cafeteria. The result obtained revealed that the mean bacterial count from the total sample was 30056 cfu/ml on Cabbage, 24278 cfu/ml on suro, 22945 cfu/ml on miser, 31833 cfu/ml on meat and 2778 cfu/ml on rice. There was a significant difference of microbial load between the food samples. The food samples which are found in the student's cafeteria have both gram negative and positive bacteria. This study recommended that food handlers should ensure strict personal hygiene and that of environment, and general sanitary condition of the cafeteria should be improved and maintained.

Keywords: Bacterial count, food, microbiological quality, microbial load.

Introduction

Microbiological quality of food indicates the amount of microbial contaminants it has, a high level of contamination indicates low quality of food storage and its handling more likely to transmit diseases[1].

Today, disease result from contaminated food are considered as one of the major health problems in different countries and are occurring repeatedly in advanced and industrial countries so that in the U.S., food borne diseases are of secondary importance after respiratory and lung diseases[2]. Among different bacteria agents *staphylococcus aurous, Salmonella, Escherichia coli* and *Campylobacter jejuni* are the most common bacterial causing infections and food poising[3].

Consumption of the dairy products contaminated with salmonella leads to two epidemics in the United States during which 170 and 224 individuals were poisoned respectively and *Salmonella enteritidis* and *Salmonella typhimurium* were introduced as their agent[4].

Universities food programs are popular government assistance programs that have an impact on education and children's (students) health. In several countries, school and universities food programs are becoming useful strategies to protect socially vulnerable individuals in light of the recent economic crisis[5].

School (universities) food service facilities have become relevant in the issue of food safety because of food borne illnesses. Approximately 45% of the outbreaks in Brazilian schools and universities are attributable to food borne transmission[6]. Food borne illnesses have been reported in various parts of the world[7]. Several risk factors related to the food service environment contribute to occurrences of food borne illness: poor personal hygiene, inadequate sanitization of surfaces or equipment, contamination of prepared food with contaminated ingredients and inadequate temperature control[8].

Statement of the problem: Many people are affected by contaminated food (presence of pathogenic bacteria in food). A food which is made in university can be vehicle for food -borne diseases and food poisoning if it is not handled properly. In recent times, there have been reported cases of food borne diseases such as typhoid fever, diarrhea, dehydration and other intestinal disease which can be attributed to consumption of contaminated food.

Objectives: General objective: i. To assess bacteriological quality of food in Arba Minch university Abaya campus student cafeteria.

Specific objective: i. To determine bacteriological load of food from student's cafeteria. ii. To compare bacteriological load among food verities in students cafeteria. iii. To assess the associated risk factors for the contamination of foods.

Significance of study: There is no project before, which focus on the bacteriological quality of food, in Arba Minch University Abaya campus student's cafeteria.

So, this study will help to identify the hazards associated with disease in universities which is caused by the presence of pathogenic bacteria in the food. This study also helps to

determine factors which are important for contamination of food and also to determine efficient control methods. All the university community is beneficial from this study, either directly or indirectly.

Scope of study: This study deals about the bacteriological quality of food, including the contamination and number/amount of bacteria present in the given sample. This study focus on only Arba Minch University Abaya campus student Cafeteria.

Materials and methods

Description of the study area: This study was conducted in Abaya Campus student's cafteria, Arba Minch Universiy, Arbaminch town. Arba Minch University is nestled at the foot of GamoGofa mountain ranges facing huge abaya lake. Arbaminch is found in the south nation nationalities and people's regional state (SNNPRS). It is located at 30^0 56'North of equator and 37^0 44' East. The area is about 2184 hectares at an elevation of 1,285m (4,216 ft). It is 505 km south of Addis Ababa in greater east African Rift valley. It is the largest town in GamoGofa zone and the second largest town in (SNNPRS) next to Hawassa. It is surrounded by Arba Minch zuria werda[9].

Study design: Cross-sectional study was used to assess bacteriological quality of food in Arba Minch University Abaya Campus students Cafeteria.

Source of sample: Selected food items served in the cafeteria has been used for this study. The selected food items for this study were "meat", "cabbage", "rice", "shuro" and "miser". Observational check list was administered to collect primary data from food processor of the cafeteria regarding the associated risk factors.

Sample technique and sample size: Five food items were purposely selected and six samples for each (total 30) were randomly collected and processed.

Sample collection and transportation: Aseptic procedures were followed to collect the selected food samples and transported to microbiology laboratory and reserved in refrigerator until processed. The food samples were processed immediately within 2 hours.

Laboratory procedure: For solid food samples ("Rice", "Cabbage" and "Meat") 1g have been measured and dissolved in distilled water. Then 1ml of the aliquot part was taken and added to 9 ml of sterilized distilled water and up to 10^{-3} fold serial dilution was performed. For liquid food sample such as "Suro" and "Miser") 1 ml of the dissolved solution was taken and added to 9 ml of sterilized distilled water and serially diluted up to 10^{-3} fold. Then, from dilution food samples, 0.1ml was transferred to Nutrient Agar, Mannitol salt agar and MacConkey simultaneously using micropipette and spreaded on the surface of medium by using spreader. Finally all plates were incubated at 37^oC for 24 hours[10].

Description of bacteriological loads of the sample: Colonies on each plate was counted by using colony counter after 24 hr and described as colony forming unity per milliliters (cfu/ml) by using the following formula[10].

Number of colonies in original sample = number of colony counted $x\frac{1}{df}$ x V

Where: *df*, dilution factors and V, volume of the sample.

Data analysis: Data from the check list and from experiment was analyzed by using tables, percentages and graph.

Results and discussion

Bacterial colonies grown on different medium: All the records of colonies on different media and the bacterial colonies on the original sample for the selected food samples are described by the Table-1.

Table-1: Bacterial colonies on different media.

Food items	Time	Type of media	Dilution factor	No of Colony	No colonies in original sample (cfu/ml)
Cabbage	C1	Nutrient agar	10^{-3}	85	$85x\ 10^3$
		MacConkey	10^{-3}	06	$6x\ 10^3$
		Manitol salt agar	10^{-3}	04	$4x\ 10^3$
	C2	Nutrient agar	10^{-3}	79	$79x\ 10^3$
		MacConkey	10^{-3}	11	$11x\ 10^3$
		Manitol salt agar	10^{-3}	07	$7x\ 10^3$

Food items	Time	Type of media	Dilution factor	No of Colony	No colonies in original sample (cfu/ml)
	C3	Nutrient agar	10^{-3}	45	$45x\ 10^3$
		MacConkey	10^{-3}	04	$4x\ 10^3$
		Manitol salt agar	10^{-3}	01	$1x\ 10^3$
	C4	Nutrient agar	10^{-3}	89	$89x\ 10^3$
		MacConkey	10^{-3}	10	$10x\ 10^3$
		Manitol salt agar	10^{-3}	03	$3x\ 10^3$
	C5	Nutrient agar	10^{-3}	64	$64x\ 10^3$
		MacConkey	10^{-3}	12	$12x\ 10^3$
		Manitol salt agar	10^{-3}	05	$5x\ 10^3$
	C6	Nutrient agar	10^{-3}	91	$91x\ 10^3$
		MacConkey	10^{-3}	17	$17x\ 10^3$
		Manitol salt agar	10^{-3}	08	$8x\ 10^3$
Shuro	S1	Nutrient agar	10^{-3}	74	$74x\ 10^3$
		MacConkey	10^{-3}	3	$3x\ 10^3$
		Manitol salt agar	10^{-3}	0	0
	S2	Nutrient agar	10^{-3}	84	$84x\ 10^3$
		MacConkey	10^{-3}	0	0
		Manitol salt agar	10^{-3}	0	0
	S3	Nutrient agar	10^{-3}	31	$31x\ 10^3$
		MacConkey	10^{-3}	05	$5x\ 10^3$
		Manitol salt agar	10^{-3}	01	$1x\ 10^3$
	S4	Nutrient agar	10^{-3}	47	$47x\ 10^3$
		MacConkey	10^{-3}	12	$12x\ 10^3$
		Manitol salt agar	10^{-3}	06	$6x\ 10^3$
	S5	Nutrient agar	10^{-3}	59	$59x\ 10^3$
		MacConkey	10^{-3}	21	$21x\ 10^3$
	S6	Manitol	10^{-3}	0	0
		Nutrient agar	10^{-3}	79	$79\ x\ 10^3$
		MacConkey	10^{-3}	10	$10\ x\ 10^3$
		Manitol	10^{-3}	03	$3\ x\ 10^3$

Food items	Time	Type of media	Dilution factor	No of Colony	No colonies in original sample (cfu/ml)
Miser	Mi1	Nutrient agar	10^{-3}	94	94×10^3
		MacConkey	10^{-3}	29	$29x\ 10^3$
		Manitol salt agar	10^{-3}	11	$11x\ 10^3$
	Mi2	Nutrient agar	10^{-3}	41	$41x\ 10^3$
		MacConkey	10^{-3}	09	$9x\ 10^3$
		Manitol salt agar	10^{-3}	0	0
	Mi3	Nutrient agar	10^{-3}	43	$43x\ 10^3$
		MacConkey	10^{-3}	0	0
		Manitol salt agar	10^{-3}	01	$1x\ 10^3$
	Mi4	Nutrient agar	10^{-3}	28	$28x\ 10^3$
		MacConkey	10^{-3}	04	$4x\ 10^3$
		Manitol salt agar	10^{-3}	05	$5x\ 10^3$
	Mi5	Nutrient agar	10^{-3}	55	$55x\ 10^3$
		MacConkey	10^{-3}	12	$12x\ 10^3$
		Manitol salt agar	10^{-3}	05	$5x\ 10^3$
	Mi6	Nutrient agar	10^{-3}	64	$64x\ 10^3$
		MacConkey	10^{-3}	09	$9x\ 10^3$
		Manitol salt agar	10^{-3}	03	$3x\ 10^3$
Cabbage	C1	Nutrient agar	10^{-3}	38	$38x\ 10^3$
		MacConkey	10^{-3}	0	0
		Manitol salt agar	10^{-3}	04	$4x\ 10^3$
	C2	Nutrient agar	10^{-3}	71	$71x\ 10^3$
		MacConkey	10^{-3}	19	$19x\ 10^3$
		Manitol salt agar	10^{-3}	08	$8x\ 10^3$
	C3	Nutrient agar	10^{-3}	85	$85x\ 10^3$
		MacConkey	10^{-3}	16	$16x\ 10^3$
		Manitol salt agar	10^{-3}	01	$1x\ 10^3$

Food items	Time	Type of media	Dilution factor	No of Colony	No colonies in original sample (cfu/ml)
	C4	Nutrient agar	10^{-3}	86	$86x\ 10^3$
		MacConkey	10^{-3}	23	$23x\ 10^3$
		Manitol salt agar	10^{-3}	0	0
	C5	Nutrient agar	10^{-3}	74	$74x\ 10^3$
		MacConkey	10^{-3}	09	$9x\ 10^3$
		Manitol salt agar	10^{-3}	16	$16x\ 10^3$
	C6	Nutrient agar	10^{-3}	78	$78x\ 10^3$
		MacConkey	10^{-3}	31	$31x\ 10^3$
		Manitol salt agar	10^{-3}	14	$14x\ 10^3$
Meat	Me1	Nutrient agar	10^{-3}	42	$42x\ 10^3$
		MacConkey	10^{-3}	25	$25x\ 10^3$
		Manitol salt agar	10^{-3}	12	$12x\ 10^3$
	Me2	Nutrient agar	10^{-3}	76	$76x\ 10^3$
		MacConkey	10^{-3}	24	$24x\ 10^3$
		Manitol salt agar	10^{-3}	06	$06x\ 10^3$
	Me3	Nutrient agar	10^{-3}	79	$79x\ 10^3$
		MacConkey	10^{-3}	23	$23x\ 10^3$
		Manitol salt agar	10^{-3}	01	$1x\ 10^3$
	Me4	Nutrient agar	10^{-3}	56	$56x\ 10^3$
		MacConkey	10^{-3}	0	0
		Manitol salt agar	10^{-3}	11	$11x\ 10^3$
	Me5	Nutrient agar	10^{-3}	60	$60x\ 10^3$
		MacConkey	10^{-3}	21	$21x\ 10^3$
		Manitol salt agar	10^{-3}	0	0
	Me6	Nutrient agar	10^{-3}	43	$43x\ 10^3$
		MacConkey	10^{-3}	16	$16x\ 10^3$
		Manitol salt agar	10^{-3}	05	$5x\ 10^3$

*N.B: S = Suro, R = Rice, Mi = Miser, C =Cabbage and Me = Meat.

The Table-1 show that the bacterial colony range from 28x 10^3cfu/ml to 94x 10^3cfu/ml on nutrient agar, 0 to 31 x 10^3cfu/ml on Manitol salt agar and 0 to 31 x 10^3cfu/ml on MacConkey.

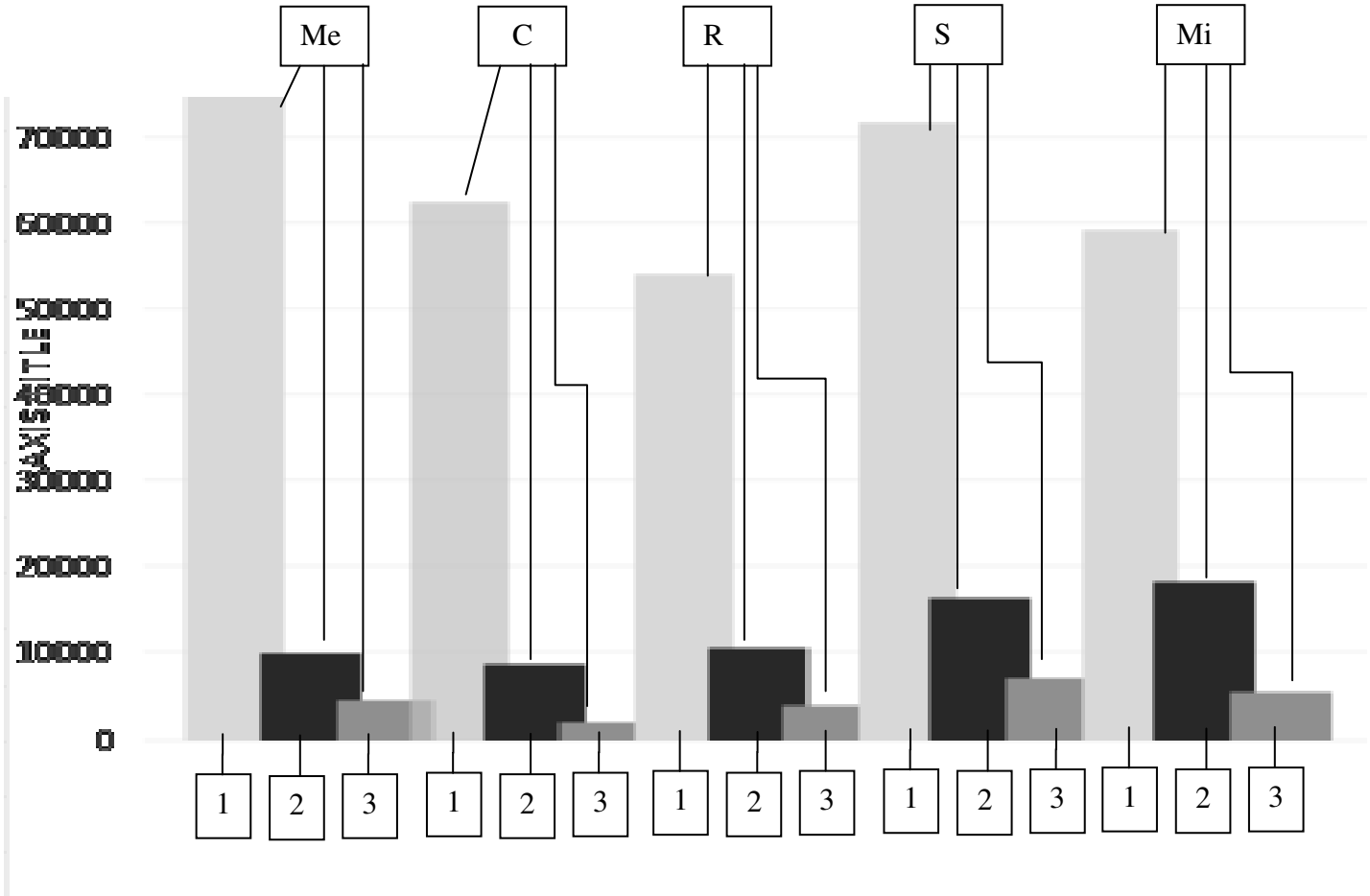
Mean of bacterial colony counted from each sample on 3 medium: The mean of bacterial colony from each sample on different media is described in Table-2.

Table-2, show that mean of total colony count on Nutrient agar; there were high number of bacteria in all of the five sample, which were 75500cfu/ml, 62333cfu/ml, 54167cfu/ml, 72000cfu/ml and 59333cfu/ml from cabbage, shuro, miser, meat and rice respectively. On MacConkey agar; 22333cfu/ml, 8500cfu/ml, 10500cfu/ml, 16333cfu/ml and18167cfu/ml bacterial colony was observed from cabbage, shuro, miser, meat and rice respectively and On Manitol salt agar 4667cu/ml from cabbage, 2000cfu/ml from shuro, 4167cfu/ml from miser, 7167cfu/ml for and 5933cfu/ml from meat was observed.

There was a variation of bacterial colony number between each sample on different media. This variation is shown in Figure-1.

Table-2: Mean of bacterial colony counted from each sample on 3 medium.

Food items	Type of media	Mean of bacterial count (cfu/ml)
Cabbage	Nutrient agar	75500
	MacConkey	10000
	Manitol salt agar	4667
Suro	Nutrient agar	62333
	MacConkey	8500
	Manitol salt agar	2000
Miser	Nutrient agar	54167
	MacConkey	10500
	Manitol salt agar	4167
Meat	Nutrient agar	72000
	MacConkey	16333
	Manitol salt agar	7167
Rice	Nutrient agar	59333
	MacConkey	18167
	Manitol salt agar	5833



*N.B: Me=Meat, C= Cabbage, R=Rice, S=Shuro and Mi=Miser and 1, 2 and 3 indicates Nutrient agar, MacConKey and Manitol Salt agar respectively.

Figure-1: Mean of bacterial colony counted from each sample on 3 medium.

Over all Mean of bacterial colony counted on all Medias: The mean of Bacterial colony on Nutrient Agar, MacConKey Agar and Manitol Salt Agar for each sample described as below.

Table-3: Mean bacterial colony counted from each sample.

Food item	Over all Mean (cfu/ml)
Cabbage	30056
Suro	24278
Miser	22945
Meat	31833
Rice	27778

Table-3, above show that, the mean of bacterial colony was 30056cfu/ml from Cabbage, 24278cfu/ml from suro, 22945cfu/ml from miser, 31833cfu/ml from meat and 2778cfu/ml from rice. This indicates, there was greater amount of contamination on meat than the rest food samples. The second contaminated food was cabbage and the third contaminated food was rice. The rest food called shuro and miser take the fourth and fifth place of contamination respectively.

Associated risk factors: The contamination of foods by bacteria in the cafeteria is associated with several risk factors like improper hygienic conditions of food handlers, equipment, kitchen and exposure of food to flies/dust.

Table-4: Associated risk factors for the contaminations of food.

	Observational check lists	Yes	No
Hygiene related with food handlers (10)	Cover hair in net/cap during cooking	3	7
	Clean/or short nails	6	4
	Wear apron during cooking	4	6
	Wash hands before handling food	5	5
	Wash hands in between food handling operations	4	6
	Wash hands with water only	8	2
	Wash hands with water and soup	2	8
Hygiene related with food and equipment for 6 days	Does all equipment which is used for food processing is washed?	4	2
	Does the food Exposure to flies/dust?	5	1
	Does the kitchen is cleaned?	3	3
	Does the food tasted with fingers by the food processer?	4	2
	Does the food Served by food handlers with ladle/spatula/tongs?	6	0

Table-4, show that total hygiene related with food handlers of 10 individuals who handle and process the food and hygiene related with food and equipment for 6 days. By average, three of the handlers cover their hair with a net cap, 6 of them has clean/short nails, 4 of them wear apron during cooking, 5 of them wash hands before handling food, 4 of them wash their hands in between food handling operation, 8 of them wash their hands with water only and 2 of them wash their hands with water and soap. This indicates that the contamination of food is associated with the food handlers' poor personal hygiene.

In addition with the food handlers, some equipment which are used for food handling process were not washed; the foods were also exposed to flies/dust for five days from our six day observation.

The kitchen is clean for three days, but on the rest three days, the kitchen area is not clean. From the observation, food handlers were tasted the foods with their fingers for four days. Almost on all observation, the food handlers served the food with ladle/spatula/tongs. This result indicates that there is contamination of food due to less protection for the food hygiene.

Discussion: The mean bacterial count result which is obtained from the three agars for each food samples shows that meat (31833cfu/ml) contains the highest amount of bacteria followed by cabbage (30056cfu/ml), rice (27778cfu/ml), suro (24278cfu/ml) and miser (22945cfu/ml). This difference on number of bacterial colony (bacterial load) among food samples was due to the difference content of nutrient and moisture. Meat is good medium for microbial growth than the rest of food samples due to its high content of nutrient and moisture.

The international standards for microorganisms in foods recommended a limit of bacterial count of less than 10^5cfu/ml[11,12]. On this study, from all samples the bacterial colony range from 0 to 94×10^3cfu/ml, which is less than the standard. But the colony count on this study is near to the standard, which means the food item is contaminated by bacteria and it is risk for health.

According to the research conducted at Akoka area of Yaba-Lagos, Nigeria; the mean colony count on meat and rice is 49000cfu/ml and 35000cfu/ml respectively[13]. But on this study, the mean colony count of meat and rice is 31833cfu/ml and 27778 cu/ml respectively. This indicates that the two food items are comparatively more contaminated at Akoka area of Yaba-Logos, Nigeria than the present study.

On Manitol salt agar and MacConkey agar, there were 0 bacterial colonies on some samples except cabbage.

According to the result of the conducted on restaurants of military centers at Ankara; Turkey, the salt selective bacteria like *Staphylococcus aureus* found in high amount on the given food samples due to the food handlers mostly use their hands

with poor hygiene[14]. Similarly, the amount of selective bacteria like *Staphylococcus aureus* which grown on manitol salt agar ranges from 2000-7167cfu/ml; which indicates *Staphylococcus aureus* is found in high amount.

Counts of *s.aureus* above 10^3 cfu/ml increases the probability of production of staphylococcal toxins that are resistant to boiling/cooking[15]. This study revealed that, the average bacterial colony which grown on manitol salt agar is greater than 10^3. Considering this, most of the samples had numbers of *S. aureus* above 10^3 CFU/mL, thus such foods consumed in students cafeteria has a serious risk to the health of the students.

Contamination of food items by specific species of microorganisms is largely due to the presence of pathogenic organisms and their entrance into food or beverage as a result of poor hygiene and sanitation[16]. Considering this, in the result of this study there were too many bacteria present on the given food samples near to the standard which reveals there is poor hygiene during the food processing.

The present result is in line with the study conducted, about the contamination of foods which is associated with several risk factors related to the food service environment that contribute to occurrences of food borne illness: poor personal hygiene, inadequate sanitization of surfaces or equipment, contamination of prepared food with contaminated ingredients and inadequate temperature control[8].

Conclusion

The bacterial colonies counted on this study from the food items demonstrated that the foods are highly contaminated by bacteria and it is risk for health of students. From the result of the study, the food which is served in the cafeteria has been contaminated by both Gram negative and positive bacteria.

The contamination of foods with bacteria was associated with several risk factors. In general, the results of the present study revealed that foods provided to the students in the cafeteria were found less hygienic. Lack of general hygiene of food handlers, personal hygiene, and environmental hygiene were identified as the major sanitary deficiencies. Therefore, the probability of food contamination in this cafeteria was high.

Recommendation: Based on the results of present study the following recommendations are forwarded: i. Information on health hazards associated with contaminated food should be extended to the university community. ii. Food handlers should ensure strict personal hygiene and that of environment, and general sanitary condition of the cafeteria should be improved and maintained. iii. The present result should help the cafeteria managers to adopt better control strategies to prevent food borne disease in the university environment and ensure food safety. iv. Health officials who are found in the university must give knowledge on the food safety and food born disease.

References

1. Oranusi S.U., Oguoma O.I. and Agusi E. (2013). Microbiological quality assessment of foods sold in students cafeterias. *Glo.Res. J of Microbial*, 3(1), 1-7.

2. Razavilar V. (2010). Pathogenic bacteria in food. Tehran university publication, 3rd Ed.

3. Nkere C.K., Ibe N.I. and Iroegbu C.U. (2011). Bacteriological quality of foods and water sold by vendors and in restaurants in Nsukka, Enugu State, Nigeria: A comparative study of three microbiological methods. *Journal of health, population, and nutrition*, 29(6), 560.

4. Ryan C.A. (2002). Massive outbreak of antimicrobial resistant salimonelisis traced to pasturiesed milk. *J medassos*, 278, 389-395.

5. Alderman H. and Bundy D. (2011). School feeding programs and development: are we framing the question correctly?. *The World Bank Research Observer*, 27(2), 204-221.

6. Lee M.B. and Greig J.D. (2010). Effective Infection Control Interventions.A Review of Gastrointestinal Outbreaks in Schools. *J. Sch. Health*, 80(12), 588-598.

7. Daniels N.A., Mackinnon L., Rowe S.M., Bean N.H., Griffin P.M. and Mead P.S. (2002). Foodborne disease outbreaks in United States schools. *The Pediatric infectious disease journal*, 21(7), 623-628.

8. Todd E.C., Greig J.D., Bartleson C.A. and Michaels B.S. (2007). Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 3. Factors contributing to outbreaks and description of outbreak categories. *Journal of food protection*, 70(9), 2199-2217.

9. Briggs P. and Blatt B. (2009). Ethiopia.-: Bradt Travel Guides. ISBN 9781841622842.

10. Sharma I. and Mazumdar J.A. (2014). Assessment of bacteriological quality of ready to eat food vended in streets of Silchar city, Assam, India. *Indian journal of medical microbiology*, 32(2), 169-171.

11. Owhe U., Ekundayo A.O. and Ohue P. (1993). Bacteriological examination of some ready to eat foods in Ekpoma. *Edo State*.

12. Rose E.O. and Osunnaiye E. (2003). Evaluation of microbial quality of foods in Bauchi. *27th Annual NIFST conference, Kano, Nigeria*.

13. Badru O. (2012). Isolation of pathogenic bacteria from some foods sold at selected private schools in Akoka area of Yaba Lagos, Nigeria. *African Journal of Food Science*, 6(3), 65-69.

14. Aycicek H., Cakiroglu S. and Stevenson T.H. (2005). Incidence of *S. aureus* in ready-to-eat meals from military

cafeterias in Ankara, Turkey. *Food Control*, 16(6), 531-534.

15. Reis Tebaldi V.M., Coutinho de Oliveira T.L., Andrade Boari C. and Hilsdorf Piccoli R. (2008). Isolamento de coliformes, estafilococos e enterococos de leite cru provenientes de tanques de refrigeração por expansão comunitários: identificação, ação lipolítica e proteolítica. *Ciência e Tecnologia de Alimentos*, 28(3), 753-760.

16. Bibek R. (2001). Fundamental Food Microbiology. 2nd Ed., The CRC Press Ltd Washington, DC, 56-90.