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Review Article

A Review on Food Hygiene Knowledge, Practice and Food Safety in Ethiopia

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ABSTRACT

Food safety is the assurance that food would not cause any harm to the consumers when it is prepared and/or consumed according to its intended use. Ensuring food safety to protect public health remains a significant challenge in both developing and developed countries. In the last decade, large efforts have been made on the global level towards development and implementation of food safety management systems to assure food safety in the agri food chain. This is demonstrated by multiple Codex Alimentarius guidelines and for example in European Union, illustrated by the introduction of the General Food Law. In Ethiopia, data on sanitation conditions and ensuing effects on health are very limited. Food safety system in Ethiopia is not as organized and developed as in other developed countries. Moreover, problems of growing population, urbanization, environment and food hygiene issues mean that food systems in the country continue to be stressed, adversely affecting the quality and safety of food supplies. The objective of this review is to provide a brief overview of hygiene and food safety system in Ethiopia and forward suggestions to bridge gaps.

Keywords: Ethiopia, Food safety, Food Law, Hygiene

INTRODUCTION

Ethiopia is a fast growing economy facing rural-urban migration problem. Due to this transition, food habits of people is changing with more people in urban areas eating outside the home and giving preference to ready-to-eat foods sold in the open market and small restaurants at a low price [1]. In developing countries, up to 70% of cases of diarrheal disease are associated with the consumption of contaminated foods [2]. This does not mean that the risk for foodborne diseases would be eliminated but there is room for improvement to reduce the risks if basic hygiene and sanitary practices are implemented in all places where food is produced, processed, prepared and consumed. Foodborne diseases surveillance system is non-existence in Ethiopia due to lack of efficient food analysis capabilities at national and regional level [1]. The only referral public health laboratory in the country is The Ethiopian Health and Nutrition Research Institute under the Federal Ministry of Health that has the competence to test for microbiological and chemical contaminants of foods. Due to the limitation of the surveillance infrastructure there is no reliable data on the burden of foodborne diseases to convince policy makers about the public health importance of allocating funds to prevent foodborne diseases [1]. However health statistics show that in Ethiopia on average a child experiences five to twelve diarrhea episodes a year and more than 250,000 children under the age of five years of age die annually as a result of diseases related to poor environmental sanitation and hygiene [3]. So, the objective of this review is to provide a brief overview of food handler's hygiene knowledge, practice, assess the catering establishment of food and drinking establishment and food safety system in Ethiopia and forward suggestions to bridge gaps.

FOOD SAFETY

Food safety implies absence or acceptable and safe level of contaminants, adulterants, or any other substances that may make food injurious to persons [4]. At a national level, however, both food shortage and lack of appropriate food safety assurance systems are problems that have become obstacles to the Ethiopian economic development and public health safety [5]. Though the country is endowed with enormous potential for the production of agricultural and industrial food products, its competitiveness in the world market has been so far very low [6].

Ensuring food safety to protect public health remains a significant challenge in both developing and developed countries. Even though considerable progress to strengthen food safety systems, up to one third of the population of developed countries is affected by foodborne diseases each year, and the problem is likely to be even more widespread in developing countries [7]. Ensuring food safety in today's complex world is a daunting task and is possible only with a concerted effort of all sectors including government, consumer organizations and industry [8].

Effective food safety systems are vital to maintain consumer confidence in the food system and to provide a sound regulatory foundation for domestic and international trade in foods, which supports economic development. The Sanitary and Phytosanitary Agreement (SPS) permits countries to take legitimate measures to protect the life and health of consumers, animals and plants provided such measures can be justified scientifically and do not unnecessarily impede trade [9].

Food safety system is broadly classified in to two namely, traditional and science-based food safety systems [10]. Traditionally food safety system had defined unsafe food and has prescribed the enforcement tools for removing unsafe food from commerce and punishing responsible parties after the fact. Traditional food safety system incorporate food laws and regulations, food control management, inspection and laboratory services, and sometimes mechanisms for information, education and communication and monitoring of the food supply [11]. Because it is relied on Government stakeholders it shouldn't solve the current problems. Accordingly, the Science (risk)-based food safety system is related to processes such as good agricultural practices, good hygienic practices, good manufacturing practices and Hazard Analysis and Critical Control Point system (HACCP), which are already used in many countries. What is new is the use of risk analysis as a framework to view and respond to food safety problems in a systematic, structured and scientific way in order to enhance the quality of decision-making throughout the food chain [10].

A modern science-based food safety system approach is as follows:

A. Preventive approach

B. Addresses the farm-to-table continuum

C. Use structured risk analysis and establishes priorities

D. Relies on integrated process control and shared responsibility; and

E. Enables attainment of enhanced level of risk reduction [9].

CHALLENGES TO FOOD SAFETY

Food safety challenges differ by region, due to differences in income level, diets, local conditions, and government infrastructures

[4]. Here are some trends prevalent in both developed and developing countries that can increase food safety [12].

Changes in animal husbandry: This has resulted in the emergence and increased prevalence *Salmonella* and *Campylobacter* in flocks or herds of all the most important production animals [13]. Crowding of animals has led to the increased use of antibiotics on so-called "factory farms" which in turn has been linked to the emergence of new strains of antibiotic-resistant bacteria [13].

Increases in international trade and travel: The increased time between processing and consumption of food due to long distance international travels leads to additional opportunities for contamination, time/temperature abuse, and increasing the risk of food borne illness [4].

Changes in food or agricultural technology: Advances in processing, preservation, packaging, shipping, and storage technologies bring new forms of foods to the market, and sometimes new hazards. For example, the increased use of refrigeration to prolong shelf-life of ready-to-eat foods has contributed to the emergence of Listeria monocytogenes [12].

Changes in lifestyle and consumer demands: In developing countries, there is a general rise in urban living and street food is an important component of the daily diet. As a result, outbreaks associated with food prepared outside the home are increasing in many regions [4,13].

BIOTERRORISM

Food terrorism is defined as an act or threat of deliberate contamination of food for human consumption with biological (viruses, bacteria and Parasites), chemical and physical agents or radionuclear materials for the purpose of causing injury or death. Following rising incidents of terrorist attacks in many countries in recent years, concerns about intentional adulteration of food by terrorists, criminals, or other antisocial groups have risen and led to the need for new preparedness efforts [14].

Food hygiene status and practice in food and drinking establishment in Ethiopia

Food is an important vehicle for spread infectious agents causing disease resulting appreciable morbidity and mortality. Food handlers play an important role in ensuring food safety. However, in developing countries like Ethiopia the proportion of certified food handlers and their carrier status is not well studied [15]. The hands of food service employees can be vectors in the spread of food borne diseases because of poor personal hygiene or cross contamination. Lack of basic infrastructure, lack of knowledge of hygiene, absence of potable water, lack of proper storage facility and unsuitable environments for food operations (such as proximity to sewers and garbage dumps) can contribute to poor microbial quality of foods [16].

Various studies carried out in different parts of Ethiopia also indicate that the environmental conditions, under which food is produced, stored, prepared and consumed at home and in catering establishments pose a significant public health risk. *Staphylococcus aureus, Klebisella, E.coli, Seratia* and *Citrobacter* were isolated from 16.5%, 5.6%, 3.1%, 1.58%, and 0.8% of the finger nails content of food handlers working in the University of Gondar Northwest Ethiopia students' cafeteria [17]. Swab samples taken from the eating plates and drinking bowls showed the presence of *E.coli and S.aureus* as well as a total faecal coliforms, Aerobic mesophilic bacteria (>100 colonies/utensil). *S.aureus* was isolated from 2.8% of swabbed utensils. Acid and gas formation was seen in 19.4% of the examined utensils confirming the presence of total and faecal coliform in Addis Ababa student's cafeteria [18]. *E.coli* and *S.aureus* were isolated from 18.2% and 27.3% of the swabbed utensils, respectively in Mekelle town and south Ethiopia [19,20]. These results indicate the sanitary deficiency of the utensils; equipment and food contact surfaces and the isolation of S.aures show the existence of poor hygiene of the food handlers due to contamination through air particles while coughing or sneezing.

Studies on the conditions of food and drink establishments have been scanty in Ethiopia [2,21]. A study conducted among food handlers in Bahir Dar town indicated that most of them were infected with enteric bacteria and parasites [22]. Good personal hygiene and food handling practices are the basis for preventing the transmission of pathogens from food handlers to the consumers [23]. A USA based study suggested that improper food handling practices contribute to about 97% of food borne illnesses in food services establishments and homes [24]. Therefore, to reduce foodborne illnesses, it is crucial to gain an understanding of the knowledge and practices of food handlers [25]. According [21] and [20] food and drinking establishments did not have adequate facilities for washing utensils nor for clients to wash their hands. Poor personal hygiene frequently contributes to foodborne illness which indicates that food handlers' knowledge and handling practices needs to be improved.

During food preparation pathogenic organisms may be transferred to food items by the handler both directly or by cross contamination through hands, surfaces, utensils and equipment that have been inadequately clean and disinfected between the preparations of different types of food [26]. According to [27] observations in Mekelle city most of the establishments of the kitchen were found to be congested, dirty and also used as storage. As the result, space of the kitchen was compromised and cockroaches were also prevalent in some of the inspected kitchens. Most of the establishments had two compartments of glass and dish washing devices, which used "bowl and/or bucket" system as a surrogate to sink or vat washing devices which predispose food to be contaminated. Regarding latrine facility most of the establishments had private or used communal latrine together with neighbors and had not enough water, as the result flies infested it. In a study by [28], majority of butcher shops floor was not constructed of materials that help cleaning and more than half of the butcher shops floor had cracks, nearly half of the walls of the shops were not painted with white color and one-third of the shops did not have a ceiling which further hinder cleaning. Moreover, most of the walls and ceilings were dusty. Additionally, this study showed that a good number of the butcher shops did not have shelf to display meat. Off those who had shelves, one-third of them were not insect proof. About 70 % of the shops were with no refrigerator for meat preservation [28]. In this regard, WHO and FAO recommend the following specific conditions to be satisfied where necessary to protect the safety and suitability of food: the surfaces of floors and walls should be made of impervious materials with no toxic effect in intended use; floors should be constructed to allow adequate drainage and cleaning; walls should have a smooth surface up to a height appropriate to the operation; ceilings and overhead fixtures should be constructed and finished to minimize the buildup of dirt and condensation, and the shedding of particles [29].

In Woldia town 63.5% and 84.6% of the establishments engage in the undesirable practices of disposing of liquid waste and solid waste in

open fields, respectively [30]. These proportions are higher than those in a similar study conducted in Awassa, in which 27.9% of the study establishments dispose of liquid waste, and 57.3% dispose of solid waste, in open fields [20]. Moreover, inadequate sanitary facilities, and an improper liquid and solid waste storage and disposal in Addis Ababa [31]. Two different studies undertaken in Ethiopia reveal that common features of catering establishments are inadequate sanitary facilities and improper waste management [15,21].

Food handlers who had good knowledge were 1.69 times more likely to have good food handling practices compared to those who had poor knowledge [32,33]. Food handlers who were working in an establishment which had shower facility were 1.89 times more likely to have good food handling practices compared to those who were working in an establishment which had no shower facility and Food handlers who were working in an establishment which had separate dressing room were 1.97 times more likely to have good food handling practices compared to those who were working in an establishment which had no separate dressing room [33]. Most handlers had good knowledge of food hygiene. Most handlers appear to have good knowledge of food hygiene. However, it has been observed that they had poor knowledge in practice [2,15]. Establishments whose kitchens had been inspected had better storage conditions for prepared foods and food utensils, cleaner kitchen walls and ceilings, and a higher proportion of food handlers with trimmed fingernails and outer working garments when compared to establishments that had not been inspected [2,21,31]. Food preparation areas and kitchens were unclean and not well repaired as reported by [20,21,31] (Figure 1).

Food borne bacterial diseases in Ethiopia

Food-borne bacterial illnesses primarily caused by *Salmonella spp., Shigella spp., staphylococcus aureus and Bacillus cereus* (Table 1 & 2). The annual incidence of food-borne illnesses in Ethiopia ranged from 3.4 to 9.3%, the median being 5.8% for the years 1985/86 to 1989/90 [35]. The Primary Health Care Review for Ethiopia (1985) indicated that the proportion of deaths associated with diarrhea alone in different regions ranged from 22.6 to 62% with a median of 45%. Ministry of Health indicates 280,458 cases of food borne diseases, which is approximately shown to be 9.39% [35].

According the survey conducted in 2003/4, show that in 1995, there were 12,568 ascariases, 3,167 typhoid, 3,106 tapeworm, 16,424 tuberculoses, 457 infectious hepatitis cases in Addis Ababa Administrative Region, and in 1990 in Oromia region, there were 31,867 ascariases, 12,823 typhoid, 16,119 tapeworm, 56,740 tuberculoses, and 1,479 infectious hepatitis cases reported [36].

In 1991 in Amhara region there were 1,493 ascariases, 260 typhoid, 8,565 tuberculoses, 51 infectious hepatitis cases, and in 1995 in SNNP region there were 321 ascariases, 1,451 typhoid, 2,061 tuberculoses, 232 infectious hepatitis cases were reported. In 1995 in Gambela region there were 260 ascariases, 131 dysentery, 191 typhoid, 834 tuberculoses, and in 1991 in Afar region there were 75 ascariases, 270 typhoid, 65 tapeworm, 1,630 tuberculoses, and 29 infectious hepatitis cases reported [9]. In 2007 in Oromia Region alone 1913 cases of acute watery diarrhea) and 41 deaths were reported from June 25 to July 27. In the first week of September, 2009, 13, 652 cases were reported from 77 woreda (districts) in 7 regions with case fatality rate of 2.2%. The population at risk was estimated at 8.63 million [35].

Outbreaks of typhoid fever, acute watery diarrhea and dysentery have been also reported from different Regions of Ethiopia in recent years [3]. In April 2017 Ethiopia declared acute watery diarrhea in the Southern border with Somalia resulting in 19 deaths mostly children and more than 700 illnesses that required treatment [37]. Earlier in 2007 a suspected outbreak of cholera epidemic which was reported as acute watery diarrhea by the government resulted in 60,000 cases and 684 deaths in less than a year [38]. Annual Report of Epidemic Diseases from a national outpatient health facilities showed

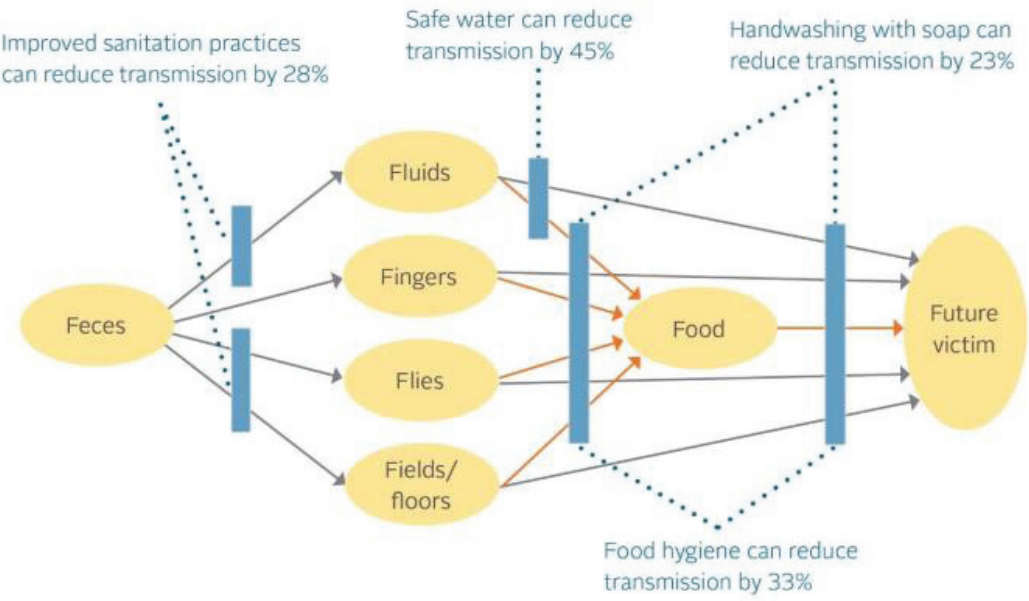

Figure 1: Pathways of transmission of pathogens through the fecal-oral route and percentage reductions in risk of diarrheal disease from improved water, sanitation, and hygiene practices [34].

that dysentery and typhoid fever cases were 140,867 and 323,008, respectively. Whereas the number of annual national inpatient dysentery and typhoid fever cases/deaths were 1,264 (16 deaths) and 3,545 (12 deaths), respectively [39].

CONCLUSION AND RECOMMENDATION

Food safety system in Ethiopia is not as organized and developed as in other developed countries. Besides, problems of growing population, urbanization, and environment and food hygiene issues mean that food systems in the country continue to be stressed, adversely affecting the quality and safety of food supplies. As such, the following points are suggested to overcome these problems:

- Introduction of standards, development of food safety management systems.
- Small and Medium Size enterprises require government's special intervention in form of sponsored training, publicity and other means of awareness creation.
- Increases public awareness on good hygiene and food safety practices.
- Upgrade the capacity of existing public health laboratory, personnel, food-borne diseases surveillance system and legal and policy frame work

Implement strict hygienic measures in the manufacturing, handling, storage and selling of food in order to guarantee the quality of these foods.

Table 1: Food borne diseases in different regions of Ethiopia

Region	Type of FBD	No.	%
Tigray		44281	10.9
Afar	Amoeba	2634	1.2
	Gastro enteritis	4167	2
Amhara	Intestinal parasites	94991	10.5
	diarrhea	48880	5.4
Oromia	Gastro enteritis/ duodenitis	88442	8
Somali	Gastro-enteritis	39468	11.8
	dysentery	23568	7
Beneschangul-Gumuz	Gastro-enteritis/ duodenitis	11543	8.5
	Internal parasites	5806	4.3
SNNP	Gastro-enteritis-duodenitis	1 30570	5
	Typhoid	77001	2.9
Gambella	Intestinal parasites	2765	14.6
	diarrhea	360	1.9
Harari	Gastro -enteritis	3211	9.1
	Helminthes	1738	4.9
	Dysentery	1458	4.1
Addis Ababa	Gastro-enteritis	36667	7.9
Dire Dawa	Gastro -enteritis	4 662	6.2

Source, CSA [39].

Table 2: Food-borne bacterial pathogens in Ethiopia.

FBD	Region	Sample	Author	Prevalence (%)
L. monocytogenes	Addis Ababa	Retail meat and milk	[40]	5.1
	Gondar	cake, raw meat, ice cream, minced beef, fish, unpasteurized milk and pizza	[41]	6.25
	Addis Ababa	retail meat and dairy products	[42]	5.4
	Addis Ababa	chicken, cottage cheese, fish, ice cream, minced beef and pork	[43]	5.1
	Addis Ababa	pasteurized milk, cheese, ice cream and cakes, minced beef, pork and chicken carcasses	[44]	4.8
Tuberculosis	Nazareth	Abattoir	[45]	5.2
	Hossana	Abattoir	[46]	4.5
	Addis Ababa	Abattoir	[47]	3.5
	Gondar	Abattoir	[48]	0.02
	Mekelle	Abattoir	[48]	1.83
	Wolaita-Sodo	Abattoir	[49]	7.96
Escherichia coli	Modjo	skin swabs	[50]	8.7
	Debre Zeit and Modjo	Beef	[51]	8
	Jimma	raw beef	[52]	26.6
Campylobacter	Debre-Zeit	sheep and goat carcasses	[53]	10.1
	Addis Ababa and Debre Zeit	Meat	[54]	9.3
	Bahir Dar	Chicken	[55]	8
Salmonella	Addis Ababa	milk and faecal samples from lactating cow	[56]	10.7
	Kombolcha	Egg	[57]	11.5
	Eastern Ethiopia	Camel	[40]	16.2
	Bahir Dar	Cattle	[58]	7

REFERENCES

1. Birke W, Zawide F. Transforming research results in food safety to community actions: A call for action to advance food safety in Ethiopia. Environment and Ecology Research. 2019; 7: 153-170. DOI: 10.13189/eer.2019.070305
2. Zeru K, Kumie A. Sanitary conditions of food establishments in Mekelle town, Tigray, North Ethiopia. Ethiop J Health Dev. 2007; 21: 3-11. DOI: 10.4314/ejhd.v21i1.10025
3. Ethiopian Weekly Epidemiological Bulletin. 2018; 4: 39.
4. WHO Regional Office for Africa. Developing and maintaining food safety control systems for Africa. Current Status and Prospects for Change, Second FAO/WHO Global Forum of Food Safety Regulators, Bangkok, Thailand. 2004.
5. FAO/WHO. Joint FAO/WHO food standards programme FAO/WHO coordinating committee for Africa, seventeenth session, Rabat, morocco. 2007; 23-26.

6. NCC. National conference on food safety and CODEX activities in Ethiopia. (NCC). 2010.

7. The Royal Society of Chemistry. Food Safety and Food Quality. Issues in Environment. 2001.

8. Motarjemi Y, Mortimore S. Industry's need and expectations to meet food safety, 5th International meeting: Noordwijk food safety and HACCP forum 9-10 December 2002. Food Control. 2005; 16: 523-529. DOI: 10.1016/j.foodcont.2004.10.014

9. FAO/WHO. Practical actions to promote food safety. Regional conference on food safety for Africa. Harare, Zimbabwe. 2005.

10. FAO/WHO. Assuring food safety and quality. Guidelines for strengthening national food control systems. Food and Nutrition. 2003; 76. https://bit.ly/31qpIDv

11. FAO. The importance of food quality and safety for developing countries. 2009; 1. https://bit.ly/2PvQWTL

12. Rocourt J, Moy G, Vierk K, Schlundt J. The present state of food borne disease in OECD countries. World Health Organization, Food Safety Department. (ISBN 92 4 1591099). 2003. p. 8-9. https://bit.ly/3gGkqdy

13. Global and Local. Food Safety around the World Center for Science in the Public Interest. June 2005. Washington, D.C; 20009- 5728. 2005. p. 5. https://bit.ly/2PtPjWN

14. WHO. Global strategy for food safety, safer food for better health, Food Safety Programme. World Health Organization. Geneva, Switzerland, 2002. https://bit.ly/3fxWmZ7

15. Kibret M, Abera B. The sanitary conditions of food service establishments and food safety knowledge and practices of food handlers in Bahir Dar town. Ethiop J Health Sci. 2012; 22: 27-35. **PubMed:** https://pubmed.ncbi.nlm.nih.gov/22984329/

16. FAO. Food and nutrition paper M 80: Street foods. Report of an FAO Technical Meeting on Street Foods Expert Consultation, Calcutta, India, 6-9 November 1995 Food and Agriculture Organization of the United Nations. Rome. 1997.

17. Andargie G, Kassu A, MogesF, Tiruneh M, Huruy K. Prevalence of bacteria and intestinal parasites among food-handlers in Gondar town, northwest Ethiopia. J Health Popul Nutr. 2008; 26: 451-455. DOI: 10.3329/jhpn.v26i4.1887

18. Meleke A, Henok A, Tefera W, Lamaro T. Asessment of the sanitary conditions of catering establishments and food safety knowledge and practices of food handlers in Addis Ababa University Students, Cafeteria. Science Journal of Public Health. 2015; 3: 733-743. https://bit.ly/31yVI8O

19. Zeru K, Kumie A. Sanitary conditions of food establishments in Tigray, North Ethiopia. J Health Dev. 2008; 21: 3-11. DOI: 10.4314/ejhd.v21i1.10025

20. Mariam ST, Roma B, Sorsa S, Worku S, Erosie L. Assessment of sanitary and hygiene status of catering establishments of Awassa town. Ethiop J Health Dev. 2000; 14: 91-98. DOI: 10.4314/ejhd.v14i1.9934

21. Kumie A, Genete K, Worku H, Kebede E, Ayele F, Mulugeta H. The sanitary conditions of public food and drink establishments in the district town of Zeway, Southern Ethiopia. Ethiop J Health Dev. 2002; 16: 95-104. DOI: 10.4314/ejhd.v16i1.9831

22. Abera B, Biadegelgen F, Bezabih B. Prevalence of *Salmonella typhi* and intestinal parasites among food handlers in Bahir Dar Town, Northwest Ethiopia. Ethiop J Health Dev. 2010; 24: 46-50. DOI: 10.4314/ejhd.v24i1.62944

23. Evans HS, Madden P, Doudlas C, Adak GK, O'Brien SJ, Djuretic T, et al. General outbreaks of infectious intestinal diseases in England and Wales: 1995 and 1996. Commun Dis Public Health. 1998; 1: 165-171. **PubMed:** https://pubmed.ncbi.nlm.nih.gov/9782630/

24. Howes M, McEwen S, Griffiths M, Harris L. Food handler cortication by home study: Measuring changes in knowledge and behavior. Dairy, Food Environ Sanitation. 1996; 16: 737-744. https://bit.ly/33C8wxE

25. WHO. Foodborne disease: Focus on Health Education. Geneva, Switzerland, 2000.

26. Linda Du, Irma V. Food practices associated with increased risk of bacterial food-borne disease of female students in self-catering residences at the Cape Peninsula University of Technology. J Fam Ecol Consum Sci. 2005; 33. https://bit.ly/3gEKYMq

27. Haileselassie T, Taddele H, Adhana K. Source(s) of contamination of 'raw' and 'ready-to-eat' foods and their public health risks in Mekelle City, Tigray Regional National State, Science and Technology Agency, Tigray, Ethiopia. ISABB Journal of Food and Agriculture Science. 2012; 2: 20-29. DOI: 10.5897/ISABB-JFAS.9000012

28. Garedew L, Hagos Z, Addis Z, Tesfaye R, Zegeye B. Prevalence and antimicrobial susceptibility patterns of *Salmonella* isolates in association with hygienic status from butcher shops in Gondar town, Ethiopia. Antimicrobial Resistance and Infection Control. 2015; 4: 21. DOI: 10.1186/s13756-015-0062-7

29. WHO and FAO. Food Hygiene Basic Texts. 4th ed. Rome, Italy; 2009. p. 8-22.

30. Abate M, Tessfa M, Adere A. The sanitary conditions of food and drink establishments in Woldia town, Northeastern Ethiopia. Ethiop J Health Dev. 2018; 32: 189-196.

31. Fisseha G, Berhane Y, Teka GE. Public catering establishments in Addis Ababa: Physical and sanitary facilities. Ethiop J Health Dev. 1999; 13: 127-134.

32. Nigusse D, Kumie A, Food hygiene practices and prevalence of intestinal parasites among food handlers working in Mekelle university student's cafeteria, Mekelle. Global Adv Res J Soc Sci (GARJSS). 2012; 1: 065-071. https://bit.ly/3gzQrE0

33. Tessema AG, Gelaye KA, Chercos DH. Factors affecting food handling Practices among Food handlers of Dangila town food and drink establishments, North West Ethiopia. BMC Public Health. 2014; 14: 571. DOI: 10.1186/1471-2458-14-571

34. Wagner EG, Lanoix LN. Excreta disposal for rural areas and small communities. Geneva, Switzerland: WHO. 1958.

35. Wendafrash A. Food safety and codex activities In Ethiopia. Food□borne diseases. Addis Ababa. 2010; 21□26.

36. Environmental Health Department/MOH. Study survey on the burden of food-borne diseases in the country. Unpublished document. 2003/4.

37. Fente H, Solomon S, Frew E. Ethiopia declares another Diarrhea outbreak. VOA, 2017.

38. Rice X. Fatal outbreak not a cholera epidemic insists Ethiopia. The Guardian, 2007.

39. Central Statistical agency. Food borne illness in Ethiopia. 2008.

40. Molla B, Mohammed A, Salah W. *Salmonella* prevalence and distribution of serotypes in apparently healthy slaughtered camels (Camelus dromedarius) in Eastern. Ethiopia. Tropical Animal Health and Production. 2004; 36: 451-458. DOI: 10.1023/b:trop.0000035013.01459.c9

41. Garedew L, Taddese A, Biru T, Nigatu S, Kebede E, Ejo M, et al. Prevalence and antimicrobial susceptibility profile of listeria species from ready-to-eat foods of animal origin in Gondar Town, Ethiopia. BMC Microbiology. 2015; 15: 100. DOI: 10.1186/s12866-015-0434-4

42. Firehiwot A. Prevalence and antimicrobial profile of listeria monocytogenes in retail meat and dairy products in Addis Ababa and its surrounding towns, Ethiopia, 2012.

43. Yilma R. Occurrence of listeria species in retailed meat and milk products in Addis Ababa. (DVM Thesis]) Addis Ababa University, Ethiopia, 2004.

44. Mengesha D, Zewde BM, Toquin MT, Kleer J, Hildebrandt G, Gebreyes WA. Occurrence and distribution of Listeria monocytogenes and other Listeria species in ready-to-eat and raw meat products. Berl Munch Tierarztl

Wochenschr. 2009; 122: 20-24. **PubMed:** https://pubmed.ncbi.nlm.nih.gov/19226932/

45. Ameni G, Wudie A. Preliminary study on bovine tuberculosis in Nazareth municipality abattoir of central Ethiopia. Bulletin of Animal Health and Production in Africa. 2003; 51: 125-132.

46. Teklu A, Aseeged B, Yimer E, Gebeyehu M, Woldesenbet Z. Tuberculous lesions not detected by routine abattoir inspection: the experience of the Hossana municipal abattoir, Southern Ethiopia. Rev Sci Tech. 2004; 23: 957-964. DOI: 10.20506/rst.23.3.1534

47. Shitaye JE, Getahun B, Alemayehu T, Skoric M, Treml F, Fictum P, et al. A prevalence study of bovine tuberculosis by using abattoir meat inspection and tuberculin skin testing data, histopathological and IS6110 PCR examination of tissues with tuberculosis lesions in cattle in Ethiopia. Veterinarni Medicina. 2006; 51: 512-522.

48. Hailemariam S. A brief analysis of activities of meat inspection and quarantine division. Department of Veterinary Service, MOA, Addis Ababa, Ethiopia. 1975.

49. Regassa A. Preliminary study on bovine tuberculosis in Wolaita-Sodo, South Ethiopia. (DVM Thesis) Faculty of Veterinary Medicine, Addis Ababa University, Debre-Zeit, Ethiopia, 1991.

50. Gezahegne L. Economical aspect of condemned organs and parts due to cystycercosis, hydatidosis, fasciolosis and tuberculosis. Analysis report MOA, Addis Ababa, Ethiopia. 1991.

51. Hiko A, Asrat D, Zewde G. Occurrence of *Escherichia coli* O157:H7 in retail raw meat products in Ethiopia. J Infect Dev Ctries. 2008; 2: 389-393. DOI: 10.3855/jidc.203

52. Tassew H, Abdissa A, Beyene G, Gebre-Selassie S. Microbial flora and food borne pathogens on minced meat and their susceptibility to anti-microbial agents. Ethiop J Health Sci. 2010; 20: 137-143. DOI: 10.4314/ejhs.v20i3.69442

53. W. Tefera, A. Daniel and Z. Girma. Prevalence of Thermophilic Campylobacter species in carcasses from sheep and goats in an abattoir in Debre Zeit area, Ethiopia. Ethiopian J Health Dev. 2009; 23: 230.

54. Dadi L, Asrat D. Prevalence and antimicrobial susceptibility profiles of thermotolerant *Campylobacter* strains in retail raw meat products in Ethiopia. Ethiop J Health Dev. 2008; 22: 31-37. DOI: 10.4314/ejhd.v22i2.10072

55. Ewnetu D, Mihret A. Prevalence and antimicrobial resistance of *Campylobacter* isolates from humans and chickens in Bahir Dar, Ethiopia. Food-borne Pathogens and Disease. 2010; 7: 667-670. DOI: 10.1089/fpd.2009.0433

56. Addis Z, Kebede N, Worku Z, Gezahegn H, Yirsaw A, Kassa T. Prevalence and antimicrobial resistance of *Salmonella* isolated from lactating cows and in contact humans in dairy farms of Addis Ababa: A cross sectional study. BMC Infectious Disease. 2011; 11: 222-228. DOI: 10.1186/1471-2334-11-222

57. Assefa M, Akafete T, Haileleul N. The prevalence and public health importance of *salmonella* from chicken table eggs, Ministry of Agriculture, Kombolcha Agricultural Bureau, Kombolcha, Ethiopia. American-Eurasian J Agric and Environ. Sci. 2011; 11: 512-518.

58. Alemu S, Zewde BM. Prevalence and antimicrobial resistance profiles of *Salmonella enterica* serovars isolated from slaughtered cattle in Bahir Dar, Ethiopia. Trop Anim Health Prod. 2012; 44: 595-600. DOI: 10.1007/s11250-011-9941-y