



**ASSESSMENT OF MICROBIAL AND FOOD SAFETY KNOWLEDGE,
ATTITUDE AND PRACTICE AMONG FOOD HANDLERS IN HOTELS /
RESTAURANTS IN WOLDIA TOWN, NORTH WOLLO, ETHIOPIA**

BY: MEKURIAW MELESSE (BSc.)

ADVISOR:

Dr. ASHAGRIE ZEWUDU (PhD.)

February, 2025
ADDIS ABABA, ETHIOPIA



COLLEGE OF HEALTH SCIENCES, SCHOOL OF PHARMACY,
DEPARTMENT OF PHARMACEUTICS AND SOCIAL PHARMACY

ASSESSMENT OF MICROBIAL AND FOOD SAFETY KNOWLEDGE,
ATTITUDE AND PRACTICE AMONG FOOD HANDLERS IN HOTELS /
RESTAURANTS IN WOLDIA TOWN, NORTH WOLLO, ETHIOPIA

BY:

MEKURIAW MELESSE (BSc.)

A Thesis Submitted to Addis Ababa University College of Health Sciences, School of Pharmacy in Partial Fulfillment of the Requirements For MSc in regulatory affairs (food regulation).

February, 2025

ADDIS ABABA, ETHIOPIA

Addis Ababa University

College of Health Sciences

School of Pharmacy

This is to certify that the thesis prepared by Mekuriaw Melesse, entitled “Food Safety Knowledge, Attitude and Handling Practices among Food Handlers of Hotels /Restaurants in Woldia Town, North Wollo, Ethiopia” and submitted in partial fulfillment of the requirements for the degree of master in food regulatory affairs complies with the regulation of the university and meets the accepted standard for originality and quality.

Signed by the Examining Committee

Dr. Ashagrie Zewudu (PhD)
Advisor

Signature

Date

Internal Examiner

Signature

Date

External Examiner

Signature

Date

Graduate Program Coordinator

Signature

Date

Acknowledgments

I would like to send my heartfelt appreciation to Addis Ababa University Department of Pharmaceutics and Social Pharmacy, School of Pharmacy, College of Health Sciences for providing the MSc Program with such a wonderful opportunity. First and foremost, I sincerely thank my advisors, Dr. Ashagrie Zewdu for his immeasurable support, guidance, counseling, and encouragement during every single step of this work. I would also like to acknowledge Addis Ababa Food Medicine, HealthCare Administration and Control Authority for allowing me to join Addis Ababa University, College of Health Sciences, and School of Pharmacy. For their contribution to this work, I am deeply appreciative to all of the instructors and coordinators of the MSc program at Addis Ababa University. I would also like to thank Mr. Tesfa Marew from the Department of Pharmaceutics and Social Pharmacy staff for being very cooperative and helping me a lot with his advice. I also want to thank data collectors and supervisors for their great contribution for the completion of this work, especially being able to tolerate the hardship situation. Also, study participants and their managers, food handlers in Hotels and Restaurants, were key to the study.

Acronyms and abbreviation

KAP	Knowledge, Attitude and Practice
MSc	Master of Science
WHO	World Health Organization
SPSS	Statistical Product and Service Solution
EC	Ethiopian Calendar
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization
MBC	Mesophilic Bacterial Count
CFU	Colony Forming Units
PCA	Plate Count Agar
PHLS	Public Health Laboratory Service
CC	Coliform Count
USA	United States of America

Abstract

Background: Insufficient knowledge, attitude and practices with respect to food safety can contribute to the outbreaks of food borne illness. Most foods, to include meat, legume and vegetable based sauces, could be vulnerable to food borne pathogens. More specifically, there is an association of inadequate Knowledge, negative attitudes and poor practices on food hygiene, with hygienically unsuitable condition, and unfit food handling practices.

Objective: purpose of this study was to assess food safety knowledge attitude practice (KAP) among food handlers and to perform microbiological analysis of food samples in Restaurants/Hotels in Woldia Town, Northern Ethiopia.

Methods: A cross-sectional study was conducted to assess the KAP of food handlers towards food safety. Furthermore microbiological analysis of food samples obtained from restaurants/hotels was carried. All food handlers in restaurants/Hotel were recorded and ID number had been assigned for each based on the sampling frame prepared. Two cooks and two waiters were selected by lottery method from each Restaurants/Hotels. Well-structured and pretested questionnaire were used for data collection after reviewing relevant literature and incorporating views of Professionals in the area. In addition linear regression test was used to compare the KAP among the food handlers between Hotels and Restaurants. Value of $p < 0.05$ were taken as statistically significant.

Results: The food handlers had good knowledge at 51.8% and good attitude at 95.8%. Their overall good food safety practices were at 78.2%. The respondents who correctly said they wash their hands after touching their body parts had an average 0.928 increase compared to those who answered incorrectly. The attitude level of food handlers towards food safety was significantly impacted by factors such as gender, religion, and the specific questions used to assess their knowledge. The microbial tested samples for most of sauce types were satisfactory as most results were within good and acceptable range

Conclusion: overall level of food safety knowledge was poor. Food safety practices and attitude in this group of population was relatively high, but still needs further intervention like implement regular training, comprehensive education programs to address knowledge gaps, ensuring safer food handling practices. But the presence of total coliform and total plate count positive bacteria indicate possible post-cooking contamination.

Table of Contents

Acknowledgments.....	i
Acronyms and abbreviation	ii
Abstract.....	iii
List of Tables.....	vii
List of Figures	viii
1. Chapter One: Introduction.....	1
1.1 .Background	1
1.2 . Statement of the Problem	2
1.3 . Conceptual framework of the study	3
1.4 Significant of the study.....	4
2. Chapter Two: Literature Review.....	5
2.1 . Knowledge, Attitude and practice of food handlers on food safety	5
3. Chapter Three: Methods and Materials	9
3.1 . Study design	9
3.2 . Study Area and Period.....	9
3.3 .Source of population.....	9
3.4 .Study population.....	9
3.5 .Inclusion and Exclusion Criteria's.....	9
3.5.1 Inclusion Criteria	9
3.5.2 Exclusion Criteria	9
3.6 .Sample size determination	10
3.6.1 KAP of food handlers.....	10

3.6.2 Sampling of Method	10
3.7 .Sampling Procedure	11
3.8 .Procedures for bacteriological analysis	11
3.8.1 Aerobic Mesophilic bacterial count (Total plate count).....	11
3.8.2 Coli form Bacteria Count	12
3.8.3 E. coli bacteria count	12
3.9 .Study variables.....	12
3.9.1 Dependent variable	12
3.9.2 Independent variables.....	13
3.10 Operational definitions	13
3.11 Data collection procedures	15
3.12 Data Quality Assurance.....	15
3.13 Data processing and analysis	16
3.14 Ethical considerations.....	16
4. Chapter Four: Results and discussion.....	17
4.1 .Descriptive Statistics	17
4.1.1 Socio-demographic characteristics	17
4.1.2 Food Safety Knowledge of Food Handlers	19
4.1.3 Food Safety Attitude of Food Handlers.....	20
4.1.4 Status of Food Safety Practice of Food Handlers.....	23
4.2 . Microbiological analysis of food.....	30
4.2.1 Aerobic mesophilic bacteria count.	30
4.2.2 Coliform count (CC).....	31
4.2.3 E. coli count.....	31
4.2.4 Mean comparison of microbiological test between food type.....	32
5. Chapter five: Limitations and Strength of the study	33

5.1	Strength of the study	33
5.2	Limitations of the study	33
6.	Chapter six: Conclusion and recommendation	34
6.1	. Conclusion	34
6.2	. Recommendations.....	35
	References	36
I.	Annex.....	41
II.	ANNEX.....	46
III.	ANNEX.....	51

List of Tables

Table 1: Socio demographic Characteristics.....	17
Table 2: Cross tabulation between Training and Certificate	18
Table 3: Food Safety Knowledge of food handlers	20
Table 4: Attitude about food safety of food Handlers	22
Table 5: Food safety practice of food handlers.....	24
Table 6: Descriptive Statistics of mesophilic bacteria counts	30
Table 7: Number and percentage of good, acceptable and unsatisfactory samples in ten hotels/ restaurants	31
Table 8: Independent sample t-test	46
Table 9: Descriptive Statistics of the dependent variables	46
Table 10: Correlation analysis	46
Table 11: Parameter estimates for knowledge	47
Table 12: Linear regression Parameter estimates for Attitude.....	48
Table 13: Parameter estimates for Status of Food Safety Practice of Food Handlers	49
Table 14: Shapiro-Wilk W test for normal data.....	49
Table 15: Constant variance assumption test.....	49
Table 16: Autocorrelation Test	50
Table 17: ANOVA table for microbiological test.....	50

List of Figures

Figure 1: Mean Aerobic Mesophilic bacteria count	30
--	----

1. Chapter One: Introduction

1.1. Background

The World Health Organization (WHO) defines food safety as the conditions and measures necessary to ensure food is safe, sound, wholesome and fit for human consumption, through production, processing, storage, distribution and preparation (WHO, 1984). Food safety remains a critical issue nowadays among professionals in the food service sector as well as for consumers (Badrie et al., 2006; Scheule & Sneed, 2001). This is mainly due to outbreaks of food-borne diseases resulting in substantial costs to individuals and the economy (Egan et al., 2007; Reilly & Käferstein, 1997) and the widespread and increasing incidence of food-borne diseases have severe social and economic impacts on the human population (Molins et al., 2001).

A food handler is a person who works in a food business and who either handles food or surfaces that are likely to be in contact with food such as cutlery, plates and bowls. Food handlers are those who work in food and drink manufactories and who handles food or contact with any equipment or utensils that are likely to be in contact with food, such as cutlery, plates, bowls, or chopping boards (Elaine S., et al, 2011).

Food-borne diseases are common in developing countries including Ethiopia because of the prevailing poor food handling and sanitation practices, inadequate food safety laws and lack of education for food handlers. A study conducted in Northern parts of Ethiopia showed 30.3% and 52.5% of food handlers had good food handling practices in Gondar and Dangila town respectively (Gizaw, Z., et al., 2014).

Due to eating unsafe food, millions of people became sick and many died. This is caused due to less knowledge and practice on the part of food handlers. Food contamination in developing and under developing countries is caused by many factors which includes traditional food processing methods, inappropriate handling of food, holding temperatures, and poor personal hygiene of food handlers, the safety of food handlers is therefore one of the most important health and safety issues facing most developing countries since it leads to both public health and social problems (Medeiros et al., 2004).

Food safety involves several principles utilized to keep food safe from any chemical, microbiological or other contamination that could make it unfit for human consumption, prevent the transmission of communicable disease related to food and food processing, and ensure that consumers of food do not suffer fraud (Temeche ME et al, 2016).

Research indicates that most outbreaks occur from improper food handling practices. Therefore, to minimize food-borne illnesses, it is important to get an understanding of knowledge and practices of food handlers. Further food-borne outbreaks by food service workers can result from many factors. However, improper practices and a low level of knowledge are the most important factors (Temeche ME et al, 2016).

1.2. Statement of the Problem

A joint FAO/WHO Expert Committee on Food Safety concluded as long ago as 1983 that "illness from contaminated food is perhaps the most widespread health problem in the modern world" (WHO,1984; Molins et al., 2001). Subsequent data published by various countries have confirmed this statement and that the problem has been increasing ever since (Feben, 2010; Molins et al., 2001).

Foodborne and waterborne diarrheal diseases combined, kill about 2.2 million people internationally every year. Approximately 5000 outbreaks from foodborne illness has been attributed to foodborne illnesses in the USA, England and Wales, collectively were 500 deaths, annually, associated with the same illnesses. Reports from other areas of Europe in addition to North America similarly revealed this same trend. (Food et al., 2015)

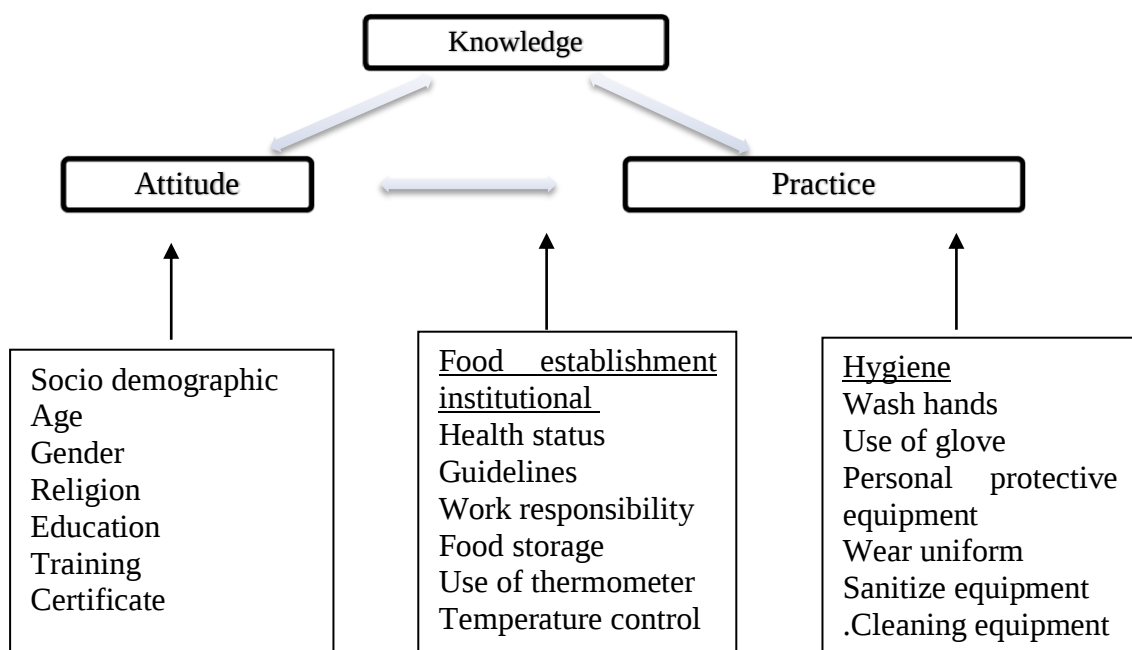
From eating unsafe food, hundreds of millions of people fell ill and many die due to the poor knowledge and practices of food handlers. There are a number of way in which food is contaminated in developing countries many of these are due to traditional food processing methods and due to poor handling (four hours and dangerous holding temperatures, poor general and personal hygiene of food handlers, high-risk use of farm, factory and work waste as food, etc.), the safety of the food handlers is typically one of the more significant health and safety issues facing most developing countries predominantly because they can lead to either public health or social Problems (Medeiros et al., 2004).

Many foodborne illnesses stem from food handlers not knowing proper safety practices or failing to follow them carefully. In developing countries, contaminated food may be responsible for nearly 70% of diarrhea cases. When food is prepared in bulk, the risk of contamination increases unless strict hygiene measures are consistently enforced. (Medeiros et al., 2004).

Most studies assessing the knowledge, attitudes, and practices (KAP) of food handlers rely solely on questionnaires, without including microbiological tests on food samples. Additionally, many of these studies focus only on specific types of food establishments or limit their scope to handlers dealing with packaged/unpackaged food, utensils, or food contact surfaces. Another issue is that some studies use non-random sampling methods, such as purposive sampling, which can introduce bias and make findings less representative of the broader population. Therefore, based on the above limitation of previous literature and high prevalence of food borne and water borne illness due to eating unsafe foods, it is necessary to assess the current Knowledge, Attitude and Practice of restaurant food handlers.

1.3. Conceptual framework of the study

After various literature was reviewed a conceptual framework was developed. The literature review was deals determined that sex, educational status, religion, training and license. Factors which affect KAP are health status, guidelines, work responsibility, food storage, use of thermometer, food born disease, wash hands, use glove, personal protective equipment, wear uniform, sanitize equipment and field of specialism e.g. food related and others (Admasu & Kelbessa, 2018).



1.4 Significant of the study

This study aims to establish the determinant of microbiological tests of food and KAP for food handlers and food workers. The study will also assist the local health office, health institution, administrators and other non-governmental organizations that are engaged in Hotels/Restaurants services, to consider and take action to deal with the problem. Furthermore, the district/Woreda will utilize the findings to improve the regulatory activities to food handlers and food institution, and it will also be a reference for future study.

1.5. Objectives

1.5.1 General objective

The main objective of this study was to assess the status of KAP among food handlers and the safety of food prepared in Hotels/Restaurants in relation to microbiological safety in Woldia Town, North Eastern Ethiopia.

1.5.2 Specific objectives

- ✓ To assesses the level of food handlers' knowledge towards food safety.
- ✓ To assess the Attitudes of Food handlers towards safe food handling.
- ✓ To assesses the level of safe food handling practices among food handlers
- ✓ To review the status of microbiological safety of (total plate count, E.coli, and CC) food prepared in the hotels and restaurants.

2. Chapter Two: Literature Review

Various Scholars indicate that foodborne diseases had significant public health risks especially to the younger generation, the elderly and pregnant women in both developed and developing countries. Hence, foodborne diseases may affect users differently by causing health problems, potential loss of life and then economic drains due to expenses Related to treating the medical problems. Food poisoning outbreaks have been extensively traced in various food service sectors, especially in restaurants and hotels (Admasu & Kelbessa, 2018).

Research showed that most outbreaks are attributed to improper food handling practices. To decrease food-borne illnesses, it is unique to understand the knowledge, attitude and practices of food handlers; there are many variables that may be contributed to the extent of food borne outbreaks by food handlers. Among these factors, unsuitable practices and an overall low level of knowledge are viewed as the most important factors (Admasu & Kelbessa, 2018).

So, food handlers have a crucial role to play in food safety, and those that do not observe good personal hygiene, specifically hand washing at times and with the best techniques, can contaminate food. In addition to being an important part of providing your customers with safe food, good personal hygiene practices also help protect your business reputation. (Admasu & Kelbessa, 2018).

2.1. Knowledge, Attitude and practice of food handlers on food safety

Food safety remains a critical issue nowadays among professionals in the food service sector as well as consumers (Badrie et al., 2006; Scheule & Sneed, 2001). This is basically due to outbreaks of food-borne diseases resulting in substantial costs to individuals and the economy (Egan et al., 2007; Reilly & Käferstein, 1997).

A study conducted in Sokoto, Nigeria, showed that most respondents (75.3%) had good knowledge of food hygiene, with 24.7% of respondents having poor knowledge of food hygiene. Almost all the respondents knew how to wash their hands before cooking (99.6%) and after using the toilet (98.9%) (Ezenwoko et al., 2017). The study conducted in Africa showed that Poor personal hygiene frequently contributes to food-borne illness which indicates that food workers' knowledge and handling practices needs to be improved

(Mohamed et al 2020). Another study also showed that 21.1% of food handlers say that washing removes contamination (Mjoka & Selepe, 2018).

A study performed in Ghana showed that 96% of participants felt raw and cooked foods should be stored separately in order to reduce the risk of food contamination, yet the study also suggested that only 33.6% of participants felt it was necessary to check the temperature of the refrigerators/ freezers periodically to minimize the risk of food contamination (Akabanda et al., 2017). In Ghana stated that 56.9% of respondents agreed that not monitoring refrigerator and freezer temperatures might be harmful to health (Akabanda et al., 2017) but 69.5% of food handlers worn gown during inspection among those who had gown 136(45%) of them kept their gown clean. Half, 160(53%), of them covered hair with restraints and 179 (59.5%) of them did not worn any finger ornaments during inspection time.

Food safety issues and foodborne problems in Ethiopia are extremely high due to the poor knowledge, attitude, and practices of food handlers or workers on food hygiene and safety requirements. The study was carried out in Addis Ababa. On field observation, it was found that around 52.3% of food handlers had poor food handling practices and 47.7% had good food handling practices. Approximately 69.5% of food handlers had uniforms during the inspection- among those who had uniforms, 45% of them kept their uniforms clean. Half, 53% of them covered hair with restraint and 59.5% of them did not cover. About 97.7% of food handlers wash their hands always before engaging in any activity. About 50.3% of food handlers check ingredients' expiry date before using them. The percentage of food handlers who had finger ornaments was 41.5%. About 65.2% of food handlers had training about safe food handling and preparation practice (Meleko, A., et al.,2015).

Additionally, a study conducted in Addis Ababa found that most food workers (86.8%) were not aware of the appropriate temperature for a refrigerator, and (78.9%) believed that chilling and freezing eliminate harmful microorganisms in food. Further, (71.1%) of them were not aware of the most effective method to wash fresh fruits and vegetables to remove food poisoning microorganisms and only (5.3%) knew the correct answer to the question "If I have a sore on the back of my hand, is it OK if I prepare food for other people?", (94.7%) knew the times hands should be washed when preparing foods. The food workers had adequate knowledge about some hygienic practices, such as correctly implementing cleaning procedures without equipment and food, the steps taken will reduce the risk of infectious agents transmitting to patients(97.4%); washing hands before touching food reduces the risk

of contamination (100%) on the other hand 100% of food service employees wore caps while distributing/preparing food or any contact with food, (65.8%) of food workers made positive comments about washing hands prior to touching raw uncovered food, (68.4%) washed hands after touching raw, uncovered food, while (100%) washed hands prior to touching exposed cooked foods and only 47.4% of them wash their hands after touching unwrapped cooked food. About 219 (72.5%) of food handlers' fingernail trimmed properly and almost all, 295 (97.7%), of them wash hands always before starting any activity. About 152 (50.3%) of food handlers check ingredients expiry date before they use them (Mohamed, M., et al., 2020).

The importance of the use of caps, masks, protective gloves and adequate closing reduce the risk of food contamination 92.1% and the importance of knowing the temperature of the refrigerator to reduce the risk of food contamination 97.4%. 100% of them were aware that raw foods have to be kept separate from cooked foods and that food service staff with cuts and abrasions on hands should not touch unwrapped foods (Feben, G. 2010).

The study carried out in Ethiopian, Asosa town found that the knowledge level of food handlers was 75.8%, the overall practices of food handlers were 67.8% and of the respondents 75.8% had positive/favorable attitude while 24.2% had unfavorable attitude. Temperature Control is an effective method of reducing the cases of food poisoning, disagree with 2.3% and agree 38.6%. In temperature control of food, 73.4% of food handlers in this study reported that they never use a thermometer which is different from the practice. Lack of food safety training affects safe food handling agree 61.7% lack of supervisor commitment effects safe food handling agree 56.3%. In this study 40.6 % of food handlers did report as they always or sometimes wear jewelry while serving food. Food safety attitude of food handlers also was among the statistically significant factors. Food handlers with a neutral and negative attitude toward food safety were 63% and 51% less likely to have satisfactory food safety practice respectively (Admasu & Kelbessa, 2018).

A Study which was done in Gondar town reported that about 49.0% of food handlers had good food safety practice (Azanaw et al., 2019). In another study done in the same place showed 65% of the food handlers had neutral attitudes towards food safety. The rest 31.80% and 3.20% had positive and negative attitude respectively (Gizaw, Z., et al., 2014). Another study in Gondar 49.0% food handlers had good food safety practice. About 28.4% of the food handlers were certified in food safety training (Azanaw et al, 2019).

The study conducted in Arbaminch shows that 32.6% of respondents had good practice and 67.40% have poor practice towards food hygiene (Legesse et al., 2017). The study conducted in Dire Dawa also showed that 52.4% of food handlers have satisfactory practice (Getachew et al., 2007).

A study done in Dangila showed the majority of food handlers (71.2%) of the respondents had poor knowledge scores on food handling Practices. Most of the food handlers 88.9% had heard about food borne diseases of which 32.4% had a good knowledge. Among food handlers who believed that personal hygiene prevents food-borne disease of which 28.6% had a good knowledge (Tessema et al., 2014).

3. Chapter Three: Methods and Materials

3.1. Study design

An institutional-based cross-sectional study incorporating microbiological food testing was conducted among food handlers working in private food establishments in Woldia Town.

3.2. Study Area and Period

This study was conducted in North Eastern Ethiopia Woldia Woreda, North Wollo Zone from September 2021 to August 2022 G.C. The Woreda was located in Amhara Regional State, North wollo zone, in Woldia town and found at about 520 km from Addis Ababa, the capital city of Ethiopia, and 360 km from Bahir Dar, Regional capital city of the Amhara region. The woreda was one of 14 woredas in North Wollo Zone with catchment populations are 176942. Agro-ecological situation of the woreda is 23.3% high lands (called “Dega” in Amharic), 42.2% is middle land (called “woynadega” in Amharic) and 29.5% is low land (called “Kola” in Amharic).

3.3.Source of population

All food handlers and workers in restaurants and hotels in Woldia town

3.4.Study population

All food handlers currently working in preparation and service areas from all restaurants and hotels in Woldia town

3.5.Inclusion and Exclusion Criteria's

3.5.1 Inclusion Criteria

The inclusion criteria were any Food handlers working in food preparation and service areas of restaurants/ hotels.

3.5.2 Exclusion Criteria

Food handlers those unable to hear, mental illness or generally those who could not communicate due to serious illness were excluded from the study.

3.6. Sample size determination

3.6.1 KAP of food handlers

Sample size was determined using the formula for single population proportion and assuming that the proportion of practicing safe food handling among food handlers were ($p = 74.6\%$), 95% level of confidence and 5% margin of error (Admasu & Kelbessa, 2018). Therefore, the sample size was determined as follows:

$$n = \frac{\left(\frac{Z\alpha}{2}\right)^2 * p(1 - p)}{d^2}$$
$$n = \frac{(1.96)^2 * 0.746(1 - 0.746)}{(0.05)^2} = 291$$

The sample took a 9.9 % non-response rate. The final sample size was 320.

The second sample size was calculated for factors affecting food handling Practices By using the Epi info version by taking Power 80%, confidence level 95% and AOR 3.4. Factors that have significant associations with food handling Practices in different literatures (Admasu & Kelbessa, 2018) by using double population proportion formula for educational status of the sample size is 300.

The sample size for factors by adding a 9.9% non-response rate becomes 330. The final sample size will be determined by comparing all possible results from the two options for data collection taken from second objectives to get a maximum sample size of 330.

3.6.2 Sampling of Method

Regarding the bacteriological analysis of food, a total of 30 samples by simple random sampling from 10 hotels and 50 restaurants (total numbers of 60 institutes) were sampled between 11:30 a.m and 1:50 p.m. Each food sample was collected using the vendors' serving utensils and placed aseptically in sterile bags. The samples were appropriately labeled according to their sampling site, date, and code number. They were immediately stored in ice box with lower temperatures and transported to the EFDA laboratory. The samples were analyzed according to the procedure outlined in the Ethiopian standard, specifically ES ISO 4833-1:2015, ES ISO 4831:2015, ES ISO 7251: 2012 and ES ISO [6579]:2012. For each

sample, 25ml was mixed with 225 mL of Buffer peptone water and homogenized for 2 minutes using a Stomacher (Model 400, Circular, England). Then, 1 mL of the resultant homogenate was added to 9 mL of sterile peptone water in a test tube and diluted serially to obtain dilutions up to 10^{-5} (ES ISO 6887-1:[2001]). All the samples were processed in the Microbiology laboratory of the Ethiopian Food and Drug Authority.

3.7.Sampling Procedure

Eight urban kebeles were consisting of 20 Hotels and 63 Restaurants. The KAP of food handlers were implemented in all Hotels and Restaurants and microbiological tests of food were implemented in selected by simple random sampling from 10 Hotels and 50 Restaurants in the Woreda. All food handlers in restaurants/hotels had been recorded and ID number had been assigned for each and a sampling frame had been prepared. Then the sample was selected by lottery method from the sample frame.

3.8.Procedures for bacteriological analysis

3.8.1 Aerobic Mesophilic bacterial count (Total plate count)

10^{-1} , 10^{-2} serial dilutions to 10^{-5} were prepared. One mL of each food sample was added to 9 mL of sterile peptone water to make the initial dilution (10^{-1}). This was continued through further dilutions (adding 1 mL of the initial dilution to 9 mL of peptone water to obtain the second dilution). The Aerobic Mesophilic bacterial count was made by the pour plate method using plate count agar (PCA) in duplicate plates (2 plates for every dilution) according to ES ISO 4833-1:2015. One mL of each diluted food sample and 15-20 mL of plate count agar were mixed with sterile pipettes using sterilized Petri dishes. Each temporal set of serial dilution (10^{-1} , 10^{-2} , and 10^{-3}) was done in duplicates and used to determine the Aerobic Mesophilic bacterial counts (AMBC) in food samples from hotels and restaurants. The inoculums from the molten agar culture medium were mixed, by rotating and exchanging the Petri dishes until, and allowed to set on a cool horizontal surface. This process re-occurs under the same conditions for each decimal dilution. After inoculation, the plates were incubated aerobically at 30°C for 72 hours, in an inverted position. After incubation, colonies were counted using a colony counter. The number of CFU per mL of each sample was determined using the number of colonies obtained from each plate.

Results were then presented as the number of Aerobic Mesophilic bacterial count per mL, and reported as log CFU/gm. (ES ISO 7218; 2015)

3.8.2 Coli form Bacteria Count

Serial dilution is conducted to give different dilutions of the sample, then 1 mL of each dilution is added to 9 mL of peptone water to give the next dilution. For incubating, three tubes of double-strength Lauryl Sulfate Tryptose (LST) broth and three tubes of single-strength LST medium broth were inoculated from the appropriate dilution of the sample. The tubes are incubated at 37°C for 24 hours. If a tube shows no gas, it is further incubated for an additional 24 hours to determine if gas formation happened in the Durham tube. If gas forms in the Durham tube, this means positive in coli form. From the tube that shows positive, cultures were taken, and a number were introduced to the Brilliant Green Lactose Broth (BGLBB) and incubated for 48 hours at 37°C. If gas was formed, this proved that coli forms were positive to use against the MPN table. The number of tubes that formed gas was used against the MPN table to produce the most probable number (MPN) of coli forms per mL (ES ISO 4831:2015, ES ISO 7218:2015).

3.8.3 E. coli bacteria count

Dilutions of the food sample were pre-enriched in buffered peptone water and enriched in LSB broth, incubated at 37 °C for 24 and 48 hours. The positive tubes (those that produced gas) were sub-cultured into 3 tubes (MPN) containing a liquid selective medium (EC broth) and gas formation was observed after 24 hours. Positive tubes (those that produced gas in EC broth) were inoculated into tryptone water and then incubated at 44 °C for 48 hours. *Escherichia coli* was confirmed with use of an indole reagent; a red ring formed in the alcoholic phase was considered a positive test. Results were reported as "detected" or "not detected" based on the MPN table index (ES ISO 7251: 2012, ES ISO 7218:2015).

3.9.Study variables

3.9.1 Dependent variable

The dependent variables were Knowledge, Attitude and Practice of food handlers and microbiological analyses of food in hotels and restaurants.

3.9.2 Independent variables

Socio-demographic variables: - sex, educational status, religion, training, license. Health status, guidelines, work responsibility, food storage, use of a thermometer, wash hands, use of glove, personal protective equipment, wear uniform, sanitize equipment and temperature control .

3.10 Operational definitions

Food safety: Food should be safe to eat when it's made and used the way it's supposed to be.

Food safety Knowledge: The respondents who know the four critical food safety factors (food borne diseases, cross-contamination, personal health and hygiene and temperature control).

Microbiological quality of food: a load of microbes existing in a certain food item.

Practice status: The food handling practice reported among food handlers in terms of food safety (satisfactory and unsatisfactory).

Food handlers: are the persons who work in food establishments and who handles packaged/unpackaged food, food equipment and utensils or food contact surfaces.

Good knowledge: If the respondent's knowledge score/cut point/ will be 70% and above for critical food safety factor-related questions.

Poor knowledge: If the respondent's knowledge score is below the cut point (70%) for critical food safety factor related questions.

Good attitude: If respondents score for attitude related questions will be 70% and above.

Poor attitude: If respondents score is below the cut point (70%) of attitude-related questions.

Good practice: If respondents score/cut point/ for food safety/hygiene practice-related questions will be greater than or equal / $\geq$ /to 70%.

Poor practice: If respondents score for food safety/hygiene practice-related questions will be

less than $< / 70 \%$.

3.11 Data collection procedures

Structured and pretested standard questionnaires were developed based on associated published studies with modification and microbiological analysis of food samples to collect data. The questionnaire was prepared in English version, and it was translated to Amharic and translated back to English to confirm the accuracy of the translation. The questionnaire contains three parts the basic socio-demographic characteristics and questions related to knowledge, attitude and practice of the population of study toward safe food handling. The data collectors conducted data collection. Interview was used by data collectors to all Restaurants and Hotels of food handlers.

3.12 Data Quality Assurance

To find problem areas, unintended interpretations, cultural sensitivity issues for any of the questions for food handlers in Mersa town, a pre-test of the questionnaire was undertaken by taking 10% of the sample size. Based upon the results of the pre-test, the questionnaire was contextually and terminologically altered again and administered on the questionnaires for the whole sample size. Daily filled questionnaires were double checked and, as well, supervisors and investigators undertook routine supervision.

Following a review of the relevant literature and the opinions of professionals in the field, a structured questionnaire was developed for data collection. The structured questionnaire was developed to allow for the responses of respondents, as well as physical observations by data collectors..

Total plate count, detection of coliform, and detection of *E. coli* from all samples are analyzed, and food samples have been analyzed based on the methodology described in the Manual of Food Quality Control, FAO (Reilly & Käferstein, 1997). Microbial safety standards for specific types of foods have been taken from international regulations, like the public health laboratory service guidelines for the microbiological quality of ready to-eat foods (Eric, B.2009).

3.13 Data processing and analysis

Data were entered into Epi-info version 7.2, prepared through cleaning, editing, coding, and checking for missing values and analysis was performed using SPSS version 25. One-sample t-test will assess whether total bacterial count, coliforms and E. coli presence and microbiological results from the samples were within acceptable ranges. In addition, a linear regression test was used to compare the KAP among the food handlers between Hotels and Restaurants. Descriptive analysis was used to investigate the socio-demographic characteristics and the KAP of the respondent (Office et al., 2013). Finally, variables with a p-value of <0.05 were considered statistically significant. Based on the results, a conclusion and recommendations were made.

3.14 Ethical considerations

Ethical clearance was obtained from the ethics review committee of the School of Pharmacy, College of Health Sciences, Addis Ababa University with ethical clearance letter reference number of ERB/SOP/300/13/2021. Moreover, official letters of support were written from the Department of Pharmaceutics and Social Pharmacy to the respective Zonal health department, Woreda health office and Kebele. Before data collection, permission was granted from all participating Hotels and restaurants based on the letter of support and ethical clearance. Informed consent was obtained from all study institutes and individual participants before data collection.

4. Chapter Four: Results and discussion

4.1.Descriptive Statistics

The study involved 330 participants who were waiters and cooks from 83 different food establishments. The study achieved a 100% response rate from the participants. The results of the study primarily focused on the topics of food safety and microbiological analyses of food.

4.1.1 Socio-demographic characteristics

From table 1 given below; Out of the total 330 respondents, 252 (76.4%) were female. In terms of religion, 267 (80.9%) of the respondents were Orthodox, 67 (18.5%) were Muslim, and the remaining respondents were Protestant. According to education level, 317 (96.1%) of the respondents were literate. According to the data, 178 (53.9%) of the 330 total respondents did not receive any training in the field. Additionally, 185 (56.1%) of the respondents did not have any certificates.

Table 1: Socio demographic Characteristics

		Count	Percentage
Sex of participant	Female	252	76.4%
	Male	78	23.6%
Religion	Orthodox	267	80.9%
	Muslim	61	18.5%
	Protestant	2	0.6%
Educational level	Illiterate	13	3.9%
	Literate	317	96.1%
Have you ever trained?	No	178	53.9%
	Yes	152	46.1%
Do you have certificate?	No	185	56.1%
	Yes	145	43.9%

According to the information provided in Annex table 8, there is no statistically significant difference in the mean values of knowledge, attitude, and practice between males and females. This is because the p-values for knowledge (0.388), attitude (0.443), and practice (0.059) are all greater than significance level of 0.05. Therefore, we cannot conclude that there is a difference in the mean knowledge, attitude, and practice between male and female participants.

According to the information provided in the Annex table 8, there is no statistically significant difference in the mean values of knowledge, attitude, and practice between

illiterate and literate. This is because the p-values for knowledge (0.198), attitude (0.467), and practice (0.653) are all greater than significance level of 0.05. Therefore, we cannot conclude that there is a difference in the mean knowledge, attitude, and practice between male and female participants.

From table 8 in the annex, there is statistically significant difference in the mean values of knowledge and attitude between having and not having training. This is because the p-values for knowledge (0.033) and attitude (0.007) are all less than significance level of 0.05. Therefore, we can conclude that there is a difference in the mean knowledge and attitude. But mean practice between having and not having training was not significant.

From table 2 below; of the 330 total respondents, 178 (53.9%) were untrained and all of these untrained respondents had no certificates. The remaining 152 (46.1%) respondents were trained, and 145 (43.9%) of these trained respondents had certificates.

Table 2: Cross tabulation between Training and Certificate

		Do you have certificate			
		No		Yes	
		Frequency	percentage	Frequency	Percentage
have you ever trained	No	178	53.9%	0	0.0%
	Yes	7	2.1%	145	43.9%

4.1.2 Food Safety Knowledge of Food Handlers

To evaluate the knowledge status of food handlers, 330 participants were asked a total of 11 close-ended questions regarding food hygiene and food handler safety. Each correct response was awarded 1 mark, giving a total possible score of 11. Incorrect responses received 0 marks. The study determined that respondents who answered 8 or more of the 11 questions correctly had good knowledge about food safety. According to the result displayed below in table 3, 51.8 percent of food handlers who participated in this study had adequate levels of knowledge about food safety because they answered correctly for greater than or equal to 7.7 questions and 48.2 percent of food handlers who participated in this study had inadequate levels of knowledge about food safety because they answered incorrectly for less than 7.7 questions..

When comparing the results of the study to prior studies, the findings suggest that food handlers generally show a less good level of knowledge concerning food safety. In Dangila, for example, a study found that 71.2% of food handlers were at an adequate level, which is above the level expected (Tamiru et al., 2022; Tessema et al., 2014).

Similarly, a study in Sekoto found that 75.3% of food handlers had a good knowledge level, exceeding the expected standard (Ezenwoko et al., 2017).

Additionally, a study in Asosa reported that an even higher proportion, 81.1%, of food handlers had a good knowledge level (Admasu & Kelbessa, 2018).

Respondents in the area have less knowledge about food safety comparing with other research finding therefor the findings suggest that continuous food hygiene and safety educations, as well as motivation for food handlers, are crucial to maintain and improve their knowledge levels.

In terms of food safety almost all food handlers 322(97.6%), 313(94.8%), 304(92.1%), 298(90.3%), 282(85.5%) and 264(80.0%) totally realized the following information about food safety; wash hands with soap and water after visiting the toilet, wash hands properly after sneezing or blowing you nose, wear a clean uniform and cap when cooking or serving, raw vegetables may contain harmful microbes, wash hands if touching body parts, canned foods potentially contain harmful microbes, canned foods may contain harmful microbes, respectively. But in most of food handlers had a low understanding; less than half of the

participants 105(31.8 %) do have knowledge about fresh meat always has microbes on the surface, a relatively higher number of participants 228(69.1 %)were aware of the fact that healthy people can cause-illness by carrying germs to food, 99(30.0%) knew wearing gloves, you can handle cooked foods after handling raw meat and 59(17.9%) cooked of the participants had knowledge about foods do not have microbes and you can prepare food with a wound on the hand if the wound is covered with a bandage (Table 3). Other related studies also showed that only 21.1% of the food handlers say that washing removes contamination (Mjoka &Selepe, 2018).

Table 3: Food Safety Knowledge of food handlers

	Incorrect	Correct
	Frequency (%)	Frequency (%)
Fresh meat always has microbes on the surface	225 (68.2)	105 (31.8%)
Preserved foods may have harmful microbes	66 (20)	264 (80)
Healthy people can cause illness by carrying germs to food	102(30.9)	228 (69.1)
lettuce and other raw vegetables might have harmful microbes	32 (9.7)	298 (90.3)
Cooked foods do not have microbes	123(37.3)	207(62.7)
Prepare food with a wound on hand if the wound covered by a bandage	271 (82.1)	59 (17.9)
After using toilet we should always wash hands with soap and water	8 (2.4)	322 (97.6)
Hands should washed if fondling body parts happen	48 (14.5)	282 (85.5)
Wearing gloves can handle cooked foods after handling raw meat	231 (70)	99 (30)
Wear clean uniform and cap while cook or serve is necessary	26 (7.9)	304 (92.1)
Hands should properly washed after sneezing or blowing your nose	17 (5.2)	313 (94.8)
Over all Knowledge	Inadequate Knowledge	Adequate knowledge
	159 (48.2)	(51.8)

4.1.3 Food Safety Attitude of Food Handlers

The survey examined the food handlers' attitudes towards food safety using a Likert scale with 9 statements and response options of strongly disagree (1) to strongly agree (5). The total score ranges from 9 to 45. The scores were classified into two levels, Good attitude level (≥ 31.5) or Poor attitude level (< 31.5). The study found that 14 (4.2%) of participants had a poor attitude towards food safety using a score of < 31.5 and 316 (95.8%) respondents had a good attitude about food safety with a score of > 31.5 .

Table 4 shows that the attitude level is unsatisfactory to work in the food preparation area < 70% (Akabanda et al., 2017). Food handlers' attitudes towards food safety have a significant impact on food-borne illnesses incidence. This implies there is a strong connection between positive attitudes and food handlers' knowledge regarding safe food handling techniques (Lestantyo et al., 2017). However, in other studies, the attitudes of the food handlers towards food safety was positive, except on issues relating to job responsibilities such as handling food safely (Akabanda et al., 2017). The discrepancy between these studies' results may be due to exposure and culture of the community.

The vast majority 289 (87.6%) of food handlers agreed that temperature control is an effective method for reducing the number of foodborne illness cases. 248 (75.2%) of the respondents agreed on that food handlers have food safety training qualifications. Furthermore, a large majority 248 (75.5%) of food handlers agreed that a lack of food safety training negatively impacts their safe food handling practices. The majority of respondents 206 (62.4%) agreed that a lack of commitment by a supervisor impairs safe food handling. On the other hand, the attitude of participants towards certain food handlers was relatively low; 18(2.5%) agreed on the issue that Temperature Control is an effective means of reducing cases of food poisoning, 219 (61.7%) agreed on the issue that lack of food safety training affects confident safe food handling, 200 (56.3%) on the issue that lack of supervisor commitment affect safe food handling, (Admasu & Kelbessa, 2018). A related study also mentioned that only 33.6% of participants agreed that it is necessary to check the temperature of refrigerators/ freezers periodically to reduce the risk of food contamination (Akabanda et al., 2017).

However, the study conducted in Ghana stated that 56.9% of respondents agreed that not monitoring refrigerator and freezer temperatures might be harmful to health (Teferi SC, 2020). 135(40.9%) participants agreed that raw and cooked food should be stored separately (Table.4). On the other hand, the attitude of participants towards certain food handlers was relatively high; 38(95%) agreed on the issue that raw and cooked food should be stored separately (Auad et al., 2019). Additionally, nearly all respondents, 317 (96%), strongly agreed and agreed that they had a responsibility to handle food safely. Almost all 96.9% of the respondents do believe that their knowledge about food safety is important for handling food safety.

Table 4: Attitude about food safety of food Handlers

Question		Frequency	Percent
Temperature Control effective method of reduce number of cases of food poisoning	strongly disagree	4	1.2%
	Disagree	12	3.6%
	Neutral	5	1.5%
	Agree	289	87.6%
	strongly agree	20	6.1%
All food handlers should have food safety training qualification	strongly disagree	3	0.9%
	Disagree	6	1.8%
	Neutral	2	0.6%
	Agree	248	75.2%
	strongly agree	71	21.5%
Lack of food safety training affects safe food handling	strongly disagree	5	1.5%
	Disagree	15	4.5%
	Neutral	2	0.6%
	Agree	249	75.5%
	strongly agree	59	17.9%
Unavailability food handle guideline can affect food safety	strongly disagree	6	1.8%
	Disagree	40	12.1%
	Neutral	0	0.0%
	Agree	228	69.1%
	strongly agree	56	17.0%
Lack of supervisor commitment affect safe food handling	strongly disagree	6	1.8%
	Disagree	53	16.1%
	Neutral	7	2.1%
	Agree	206	62.4%
	strongly agree	58	17.6%
One of my job responsibilities is handling the food safely	strongly disagree	3	0.9%
	Disagree	7	2.1%
	Neutral	3	0.9%
	Agree	145	43.9%
	strongly agree	172	52.1%
I believe food safety knowledge is important to me	strongly disagree	6	1.8%
	Disagree	3	0.9%
	Neutral	1	0.3%
	Agree	176	53.3%
	strongly agree	144	43.6%
Personal protective equipment reduce risk food contamination	strongly disagree	6	1.8%
	Disagree	17	5.2%
	Neutral	7	2.1%
	Agree	221	67.0%
	strongly agree	79	23.9%
Raw and cooked food should be stored separately	strongly disagree	1	0.3%
	Disagree	8	2.4%
	Neutral	3	0.9%

Overall attitude	Agree	135	40.9%
	strongly agree	183	55.5%
	Favorable attitude	Unfavorable attitude	
	316 (95.8%)	14 (4.2%)	

4.1.4 Status of Food Safety Practice of Food Handlers

From Table 5 below, the study found that 78.2 % of participants (out of the 258 participants) scored above 29.5 and therefore had satisfactory practice while 21.8 % of participants (out of the 72 participants) scored below 29.5 and thus had unsatisfactory practice towards food safety. The finding is relatively higher than the study completed in Asosa (74.6 %), Addis Ababa (47.7%), Dangilla (52.5%); and in the study conducted on Gamo Gofa Zone, Southern Ethiopia (32.6%). The difference in the prevalence of food handler practice can be attributed to differences in the geographical setting and study population. There are possible differences for increased satisfactory food safety practice in this study could be the hot weather understanding of foods in due to heat may have made food handlers more aware in the study area. Nonetheless, good food safety knowledge can lead to satisfactory practices by food-handlers (Admasu & Kelbessa, 2018). However, 63% of food handlers demonstrating knowledge of food safety did demonstrate a corresponding positive behavior towards food safety practices (Auad et al., 2019). This shows that food-handlers might be good practicing food safety procedures during food handling.

In evaluating food handlers' food safety practices, 99.4% of workers reported they always sanitize their utensils once they were washed. No other of the eleven variables had a higher response rate of positive agreement than 73%. In terms of washing hands after touching unwrapped raw foods, most food handlers (51.2% or 169) indicated that they sometimes wash their hands after touching unwrapped raw foods. Furthermore, 47% of respondents (155) indicated that they always wash their hands after touching unwrapped raw foods. In terms of washing hands before touching cooked foods, the majority (77.3% or 255) of food handlers indicated that they always wash their hands before touching cooked food, 21.5% of respondents (71) reported they sometimes wash their hands before touching cooked foods, and the rest (4 respondents or 1.2%) never wash their hands before touching cooked foods.

The vast majority of food handlers, 242 (73.3%), reported always they use separate utensils when preparing raw and cooked foods, while a sizable minority, 84 (25.5%), sometimes did so, and a very small percentage 4 (1.2%) never use separate utensils when preparing raw and cooked foods.

Only 43.6% of participants used gloves while serving unwrapped foods, 27.9 % of participants wore a hat or head covering when serving food, 9.4% of participants have come to work when ill a fever, upset stomach, 37.8 % of participants use a thermometer to check temperature, 37.6% of participants check the expiry dates of all products, 27.9 % wash your hands after using gloves, 29.7% of participants wash your hands before using gloves , 24.8% wear uniform when serving food, 67.9% disinfect cutting boards after each use and 8.2% wear jewelry when serving food (Table.5). Some previous studies presented that 84.8% of food handlers check the expiry dates of all products, 80.6% of the food handlers wear uniforms when serving food and 69.0% of the food handlers wash their hands after touching unwrapped raw foods (Admasu & Kelbessa, 2018). Generally, our study indicated that most workers didn't have good knowledge and practice towards food safety.

Table 5: Food safety practice of food handlers

Questions	Never Freq (%)	Sometimes Freq (%)	Always Freq (%)
Do you wash your hands after touching unwrapped raw foods	6 (1.8)	169 (51.2)	155 (47)
Do you wash your hands before touching cooked foods	4(1.2)	71 (21.5)	255 (77.3)
Do you use separate utensils when preparing raw and cooked foods	4 (1.2)	84 (25.5)	242 (73.3)
Do you check the expiry dates of all products	19 (5.8)	187 (56.7)	124 (37.6)
Do you use a thermometer to check temperature	33 (10)	182 (55.2)	115 (34.8)
Do you use gloves while serving unwrapped foods	26 (7.9)	160 (48.5)	144 (43.6)
Do you wash your hands after using gloves	145 (43.9)	93 (28.2)	92 (27.9)
Do you wash your hands before using gloves	145 (43.9)	87 (26.4)	98 (29.7)
Do you wear uniform when serving food	56 (17)	192 (58.2)	82 (24.8)
Do you come to work when ill a fever upset stomach	190 (57.6)	109 (33)	31 (9.4)
Do you wear a hat or head covering when serving food	69 (20.9)	169 (51.2)	92 (27.9)
Do you wear jewelry when serving food	172 (52.1)	131 (39.7)	27 (8.2)

Do you disinfect cutting boards after each use	1 (0.3)	105 (31.8)	224 (67.9)
Do you sanitize utensils after washing them	1 (0.3)	1 (0.3)	328 (99.4)
Overall practice	Satisfactory Practice	Unsatisfactory Practice	
	258(78.2)	72 (21.8)	

From table 9 in the annex, the average score for knowledge about food safety is 68.34%, which is less than the desired 70% threshold. This indicates that more focus is needed on improving knowledge in this area. However, the attitudes and practices related to food safety are somewhat good, but could still benefit from additional attention and improvement. The lowest correct answer provided by respondents was 4, while the highest correct answer was 11, for the knowledge portion of the assessment. For the attitude portion, the lowest correct answer was 26 and the highest was 44. Finally, for the practice portion, the lowest correct answer was 25 and the highest was 39.

As one can see from table 10 in the annex, the relationship between knowledge and practice is statistically significant, but the strength of the correlation is small. At 0.05 level of significance, both knowledge and practice show no statistically significant correlation with attitude.

Regression Parameter estimates for Knowledge

From table 11 in the annex given below, the variable "washing hand after fondling body parts" is statistically significant at the 95% confidence level, with a p-value of 0.001.

Respondents who answered the question about washing hands after touching body parts correctly, compared to those who answered incorrectly, had an expected average increase of 0.928 in their knowledge about food safety. In other words, correctly answering that question was associated with a 0.928 unit increase in the respondent's overall food safety knowledge, holding all other factors constant.

The other variables included in the model have no statistically significant impact on the average change in knowledge about food safety. This is because the p-values associated with these other variables are greater than the 0.05 significance level.

Regression Parameter estimates for attitude

From table 12 in the annex, variable like gender, religion, Temperature Control effective method of reduce number of cases of food poisoning, The unavailability of food handling guidelines can affect food safety, One of my job responsibilities is handling the food safely, I believe personal protective equipment and clothes reduces the risk of food contamination, and Raw and cooked food should be stored separately have statistically significance effect on attitude of respondents on food safety.

After controlling for the effects of the other variables in the model, being female compared to being male is associated with a 0.395 increase in the average attitude about food safety.

The model estimates that Orthodox respondents have an average attitude about food safety that is 0.784 units higher compared to Muslim respondents, holding all other variables constant.

For respondents who disagree, neutral, and strongly disagree that temperature control is an effective method for reducing the number of food poisoning cases, their average attitude about food safety decreases by 1.117, 2.847, and 5.402 units compared to respondents who agree that temperature control is an effective method respectively, but those who strongly agree average attitude increases by 1.459 comparing to those who agree, keeping the effect of other variables constant.

For respondents who disagree that the unavailability of food handling guidelines can affect food safety, their average attitude about food safety decreases by 3.674 units compared to respondents who agree that the unavailability of food handling guidelines can affect food safety. For respondents who strongly disagree that the unavailability of food handling guidelines can affect food safety, their average attitude about food safety decreases by 3.458 units compared to respondents who agree that the unavailability of food handling guidelines can affect food safety. For respondents who strongly agree that the unavailability of food handling guidelines can affect food safety, their average attitude about food safety increased by 1.403 units compared to respondents who agree that the unavailability of food handling guidelines can affect food safety.

For respondents who disagree that one of their job responsibilities is handling food safety, their average attitude about food safety decreases by 3.353 units compared to respondents who agree that one of their job responsibilities is handling food safety. For respondents who strongly disagree that one of my job responsibilities is handling the food safety, their average attitude about food safety decreases by 3.983 units compared to respondents who agree that one of my job responsibilities is handling the food safety. For respondents who are neutral that one of my job responsibilities is handling the food safety, their average attitude about food safety decreases by 1.408 units compared to respondents who agree that one of my job responsibilities is handling the food safety. For respondents who strongly agree that the one of my job responsibilities is handling the food safety, their average attitude about food safety increased by 0.928 units compared to respondents who agree that one of my job responsibilities is handling the food safety.

For respondents who disagree and strongly disagree that they believe personal protective equipment and clothes reduce the risk of food contamination, their average attitude about food safety decreases by 2.455 and 3.216 units compared to respondents who agree that they believe personal protective equipment and clothes reduce the risk of food contamination respectively. For respondents who strongly agree that they believe personal protective equipment and clothes reduce the risk of food contamination, their average attitude about food safety increases by 0.896 units compared to respondents who agree that they believe personal protective equipment and clothes reduce the risk of food contamination keeping the other constant.

For respondents who disagree, neutral and strongly disagree that raw and cooked food should be stored separately., their average attitude about food safety decreases by 2.19, 2.81 and 7.765 units compared to respondents who agree that raw and cooked food should be stored separately respectively. For respondents who strongly agree that raw and cooked food should be stored separately, their average attitude about food safety increases by 0.896 units compared to respondents who agree that raw and cooked food should be stored separately keeping the other constant.

Regression Parameter estimates for practice

From table 13 in the annex, the only variable that has a statistically significant effect on Status of Food Safety Practice of Food Handlers was religion.

Assumption about the model

Normality

The Shapiro-Wilk test is a statistical hypothesis test used to determine if a dataset follows a normal distribution.

From the table 14 in the annex, the normality assumption appears to be fulfilled; meaning the data likely comes from a normal distribution. This can be seen from the Shapiro-Wilk test results, where the p-value (0.956, 0.695, and 0.964) for knowledge, attitude, and practice respectively are greater than the chosen significance level ($\alpha=0.05$). Since the p-value is above the threshold, we fail to reject the null hypothesis that the data follows a normal distribution. Therefore, the evidence supports the assumption that the data is normally distributed.

Heteroscedasticity

From table 15 in the annex, the results of the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity indicate that the assumption of homoscedasticity appears to be met. The p-value from this test is 0.9143, 0.4975, and 0.6993 which are greater than the chosen significance level of 0.05. Since the p-value exceeds the threshold, we fail to reject the null hypothesis that the variance of the residuals is constant across the range of the predictor variables.

Autocorrelation

The Durbin-Watson test is a statistical test used to detect the presence of autocorrelation in the residuals of a regression model. Autocorrelation refers to the correlation between the current value of a variable and its past values. From table 16 in the annex, since the value is approximately 2 the decision is no autocorrelation. But in attitude and practice it shows a positive autocorrelation because Durbin-Watson test is less than 2 but since this is cross sectional data it doesn't change the analysis that much.

4.2. Microbiological analysis of food

4.2.1 Aerobic mesophilic bacteria count.

The mean aerobic mesophilic bacteria count (total plate count) varied significantly ($p < 0.05$) among the different food types sampled from the same location (Table 6). The highest overall aerobic mean bacterial count was found in Key Wet (3.06 log 10 cfu ml⁻¹), followed by vegetables (2.45 log 10 cfu ml⁻¹) and Legumes (1.48 log 10 cfu ml⁻¹). However, there was no significant difference ($P < 0.05$) between the bacterial counts in vegetables and the other two food types. Distinct trends in aerobic mesophilic bacteria counts were observed across different food types, with higher counts in Key Wet compared to Legumes, while the counts in vegetables were similar to those in Legumes and Key Wet (Fig 1).

Table 6: Descriptive Statistics of mesophilic bacteria counts

Food Types	Aerobic mesophilic bacteria count (Log10 cfu ml ⁻¹)		
	N	Mean	Standard error (S.E)
Legumes	10	1.48 ^a	.376
Vegetables	10	2.45 ^{ac}	.376
Key wet	10	3.06 ^c	.376

Column and row mean values with different superscript letters are significantly different ($p < 0.05$), S.E. = standard error n= number of samples

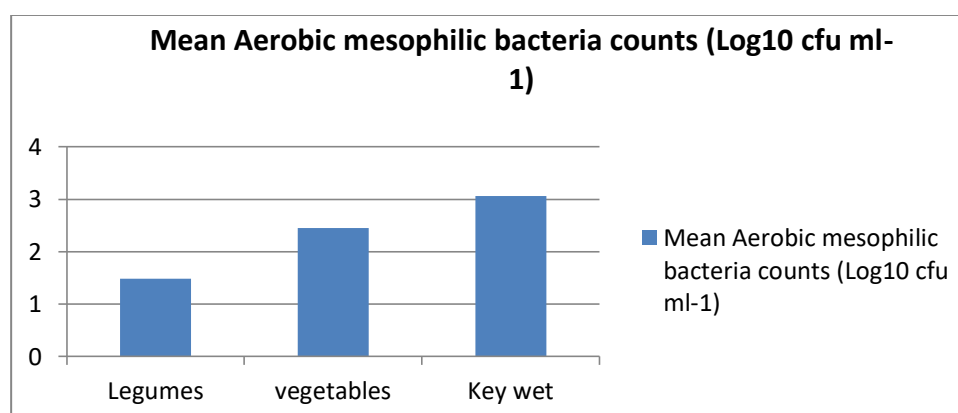


Figure 1: Mean Aerobic Mesophilic bacteria count

4.2.2 Coliform count (CC)

Coliform bacteria were detected in two samples (20%) of Key wet, with counts exceeding 110 MPN/ml. In vegetables, only one sample (10%) tested positive for coliform bacteria, with a count of 2.3 MPN/ml. However, no coliform bacteria were observed in the Legume samples. In total, coliform bacteria were found in only three out of the 30 collected samples, accounting for 10% of the samples.

4.2.3 E. coli count

No E. coli bacteria were detected in any of the 30 samples collected, including samples from Legumes, vegetables and Key Wet.

Table 7: Number and percentage of good, acceptable and unsatisfactory samples in ten hotels/ restaurants

Microbial Parameter	Sauce type	Number of samples	Number of good samples	Number of acceptable samples	Number of unsatisfactory samples
Total plate counts	Meat	10	10(100%)	-	-
	Vegetable	10	10(100%)	-	-
	Legume	10	10(100%)	-	-
Detection of coliforms	Meat	10	8(80%)	2(20%)	-
	Vegetable	10	1(10%)	9(90%)	-
	Legume	10	10(100%)	-	-
E. coli	Meat	10	10(100%)	-	-
	Vegetable	10	10(100%)	-	-
	Legume	10	10(100%)	-	-

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

Total bacterial counts: Good<10²; Acceptable < 10⁴; Unsatisfactory ≥10⁴

Total coliforms: Good<10²; Acceptable < 10⁴; unsatisfactory ≥10⁴

E. coli: Absent: Good< 3; Acceptable 3-10²; unsatisfactory ≥10²

The study has shown that the majority the meat sauces prepared in hotels and restaurants good 10 (100%) tested samples. The border line limit of total bacterial counts (10^5 cfu/g) was not exceeded in the majority of the vegetable sauces as 10(100%) of the vegetable sauces were of good total bacterial counts tested samples. Legume-based sauces showed similar results. Total coliforms showed that 8(80%) of the meat sauces were of good microbial tested samples, 2(20%) were of acceptable sample tested. For the same microbial parameter 1(10%) and 9(90%) of vegetable sauces were found to be of good and acceptable microbial tested of samples respectively. Total coliform count fore legume-based sauces showed that 10(100%) of good microbial tested samples.

Contact with surrounding environment might be major reason for microbial contamination of food. This includes contaminated food containers, unclean utensils and equipment's, hands and close of the food handlers or pastes (Alves A et al, 2021).

4.2.4 Mean comparison of microbiological test between food type

From table 17 in the annex, we can observe that the mean difference microbiological test between the three food categories is not statistically significant. Because the (p-values 0.127 and 0.055) are greater than 0.05 level of significance which indicates the mean microbiological tests (Coliform and plate count) form eat, vegetables and legumes are not statistically different. Therefor there is no need to proceed to post-hoc tests.

5. Chapter five: Limitations and Strength of the study

5.1Strength of the study

- ✓ The study to evaluate food handlers; knowledge, attitude and practice and laboratory analyses were made for microbiological tests of food that could increase the quality of data.
- ✓ The study tries to build linear regression model for all three dependent variable.
- ✓ When the study was on progress there was a lot of conflicts in the study area, but I try to finish the study through different challenges.

5.2Limitations of the study

- ✓ The limitation of this study was food handlers working only in selected types of food establishments were considered.
- ✓ Participants recall bias, and difficulty getting exact much of the study subject:
- ✓ Lack of literature due to internet has been lost for almost a year.

6. Chapter six: Conclusion and recommendation

6.1. Conclusion

Most of the workers' profession was not directly related to their working position. The study also indicated that most workers didn't have good knowledge towards food safety.

According to the research, almost half of the employees lacked adequate knowledge of food safety. Practically everyone who handled food was aware that we should always wash our hands with soap and water after using the restroom. However, most other food safety employees knew very little. Managers must encourage the provision of ongoing training to staff members on food safety procedures because, despite the fact that the majority of employees understood the significance of always washing their hands with soap and water after using the restroom, they were practically not complying.

In contrast to the knowledge level, overall, we can say almost all of the participants had a good level of attitude towards food safety. Most of them have also a good attitude toward each of the attitude-assessing parameters they were asked. Likewise, the attitude of participants towards certain food safety was very low. 318 (96.4%) agreed that raw and cooked food should be stored separately.

Concerning practice issues, the study found that their overall level of food safety practices was good. Though the total practice level was good, most of them were also good at some of the specific food handlers, mentioned, 77.3% of workers wash their hands before touching cooked foods and 99.4% of them sanitize utensils after washing them.

Based on the findings of this study, it was concluded that the microbial tested samples of most of the sauce types were satisfactory as most results fell within good and acceptable range but the presence of total coliform and total plate count positive bacteria indicate possible-post cooking contamination. Better management and control is therefore, required. Consequently, changes should also be made in the distribution conditions of meals to improve their microbial safety.

It is recommended that participants wash their hands after fondling their bodies because the regression model indicates that this has a positive and significant impact on respondents' knowledge.

6.2. Recommendations

This study has concentrated on precondition programs and microbiological analysis of foods. Further studies should be directed on chemical and physical hazards. In addition, microbial analysis of tools surfaces and selection food handlers for hand uncleanness should be approved out.

By considering food safety knowledge as below par, authorities such as the FDA deem it necessary to develop clear-cut, uniform standards applicable throughout the country to food establishments. These standards should establish a uniform basic playing field for food safety regulations and practices throughout states and localities. The enactment of these standards should involve training programs on these standards for food handlers, encompassing areas such as sanitation, hygiene, cooking temperatures, and contamination prevention.

Food establishments to be truly functional, it's crucial to go beyond the physical presence of the facility. This means ensuring that all operational areas, like food production, service, dining, receiving, and storage, are optimized with specialized equipment and efficient layouts. Service quality must be prioritized, with well-trained staff understanding their roles to deliver excellent customer experiences.

A food handler has to make an effort to self-learning and update. Hence resources could affect the food-handling knowledge of food handlers, researchers need to consider assessing such probable factors in their studies.

Besides researchers need to consider the food safety knowledge of other types of food establishments not included in this study

References

1. Admasu, M., & Kelbessa, W. (2018). Food Safety Knowledge, Handling Practice and Associated Factors among Food Handlers of Hotels/Restaurants in Asosa Town, North Western Ethiopia. *SM Journal of Public Health and Epidemiology*, 4(1), 1–9.
2. Akabanda, F., Hlortsi, E. H., & Owusu-Kwarteng, J. (2017). Food safety knowledge, attitudes and practices of institutional food-handlers in Ghana. *BMC Public Health*, 17(1), 1–9. <https://doi.org/10.1186/s12889-016-3986-9>
3. Ana Alves , Cristina Viveiros, Jéssica Lopes, António Nogueira, Bruno Pires, Andrea F. Afonso and Cristina Teixeira(2021).Microbiological Contamination in Different Food Service Units Associated with Food Handling. <https://doi.org/10.3390/app11167241>.
4. Auad, L. I., Ginani, V. C., Stedefeldt, E., Nakano, E. Y., Nunes, A. C. S., & Zandonadi, R. P. (2019). Food safety knowledge, attitudes, and practices of brazilian food truck food handlers. *Nutrients*, 11(8). <https://doi.org/10.3390/nu11081784>
5. Azanaw, J., Gebrehiwot, M., & Dagne, H. (2019). Factors associated with food safety practices among food handlers: Facility-based cross-sectional study. *BMC Research Notes*, 12(1), 10–15. <https://doi.org/10.1186/s13104-019-4702-5>
6. Badrie, N., Gobin, A., Dookeran, S., & Duncan, R. (2006). Consumer awareness and perception to food safety hazards in Trinidad, West Indies. *Food Control*, 17(5), 37 <https://doi.org/10.1016/j.foodcont.2005.01.003>
7. Egan, M. B., Raats, M. M., Grubb, S. M., Eves, A., Lumbers, M. L., Dean, M. S., & Adams, M. R. (2007). A review of food safety and food hygiene training studies in the commercial sector. *Food Control*, 18(10), 1180–1190. <https://doi.org/10.1016/j.foodcont.2006.08.001>
8. Elaine Scallan, Robert M. Hoekstra, Frederick J. Angulo, Robert V. Tauxe, Marc-Alain Widdowson, Sharon L. Roy, Jeffery L. Jones, and Patricia M. Griffin (2011).Foodborne Illness Acquired in the United States—Major Pathogens Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 17, No. 1, January 2011

9. Eric, B.(2009).Guidelines for Assessing the Microbiological Safety of Ready-to-Eat Foods. London: Health Protection Agency, November 2009.
10. ES ISO 4833-1:2015, Microbiology of the food chain – Horizontal method for the enumeration of microorganisms, Part 1: Colony count at 30 °C by the pour plate technique
11. ES ISO 4831:2015, Microbiology of food and animal feeding stuffs - Horizontal method for the detection and enumeration of coliforms – Most probable number technique
12. ES ISO 7251: 2012, Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of presumptive *Escherichia coli* — Most probable number technique
13. ES ISO 6579:2012, Microbiology of food and animal feeding stuffs - Horizontal method for the detection of *Salmonella* spp.
14. ES ISO 6887-1:2001, Microbiology of food and animal feeding stuffs - Preparation of test samples initial suspension and decimal dilutions for microbiological examination, Part 1:General rules for the preparation of the initial suspension and decimal dilutions.
15. Ezenwoko, A., Awosan, K., Oche, M., Makusidi, M., Abubakar, B., & Raji, I. (2017). Knowledge and Practices Related to Food Hygiene among Food Handlers in Sokoto, Nigeria. *International Journal of TROPICAL DISEASE & Health*, 26(1), 1–16. <https://doi.org/10.9734/ijtdh/2017/35728>
16. Feben, G. (2010). Hospital Food Safety-An Assessment of the Hygienic and Food Handling Practices in Selected Hospitals in Addis Ababa-Ethiopia. *Addis Ababa University*, 5, 41–48.
17. Food, E., Authority, S., & Centre, E. (2015). The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2014. *EFSA Journal*, 13(12). <https://doi.org/10.2903/j.efsa.2015.4329>

18. Getachew, S., Gebre-Michael, T., Erko, B., Balkew, M., & Medhin, G. (2007). Non-biting cyclorrhaphan flies (Diptera) as carriers of intestinal human parasites in slum areas of Addis Ababa, Ethiopia. *Acta Tropica*, 103(3), 186–194. <https://doi.org/10.1016/j.actatropica.2007.06.005>
19. Gizaw,Z.,Gebrehiwot,M. & Teka,Z. (2014). Food Safety Practice and Associated Factors of Food Handlers Working in Substandard Food Establishments in Gondar Town, Northwest Ethiopia, 2013/14. *International Journal of Food Science, Nutrition and Dietetics, January*, 138–146. <https://doi.org/10.19070/2326-3350-1400027>
20. Legesse, D., Tilahun, M., Agedew, E., & Haftu, D. (2017). Food Handling Practices and Associated Factors among Food Handlers in Arba Minch Town Public Food Establishments in Gamo Gofa Zone, Southern Ethiopia. *Epidemiology: Open Access*, 07(02). <https://doi.org/10.4172/2161-1165.1000302>
21. Lestantyo, D., Husodo, A. H., Irvati, S., & Shaluhayah, Z. (2017). Safe Food Handling Knowledge, Attitude and Practice of Food Handlers in Hospital Kitchen. *International Journal of Public Health Science (IJPHS)*, 6(4), 324. <https://doi.org/10.11591/ijphs.v6i4.10778>
22. Medeiros, L. C., Hillers, V. N., Chen, G., Bergmann, V., Kendall, P., & Schroeder, M. (2004). Design and development of food safety knowledge and attitude scales for consumer food safety education. *Journal of the American Dietetic Association*, 104(11), 1671–1677. <https://doi.org/10.1016/j.jada.2004.08.030>
23. Meleko,A.,Henok,A.and Lamaro,T. (2015). Assessment 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*, 3(5), 733. <https://doi.org/10.11648/j.sjph.20150305.30>
24. Mjoka, J., & Selepe, M. (2018). Assessment of food hygiene knowledge and practices among food handlers in selected hotels around uMhlathuze Area. *African Journal of Hospitality, Tourism and Leisure*, 7(4), 1–12.
25. Mohamed,M., Abdella,A., Abadir,A., Mulusew,G., Sabit,A. and Abera,K, (2020).Food Hygiene Practices and Associated Factors Among Food Handlers

Working in Food Establishments in the Bole Sub City, Addis Ababa, Ethiopia. *Risk Manag Health Policy* -2020 Oct 1;13:1861-1868.doi:10.2147.

26. Molins, R. A., Motarjemi, Y., & Käferstein, F. K. (2001). Irradiation: A critical control point in ensuring the microbiological safety of raw foods. *Food Control*, 12(6), 347–356. [https://doi.org/10.1016/S0956-7135\(01\)00035-4](https://doi.org/10.1016/S0956-7135(01)00035-4)
27. Office, C. R., Office, E. R., Office, N. R., & Office, W. R. (2013). *Food Safety Manual for the Food Service Worker*. January, 0–10.
28. Reilly, A., & Käferstein, F. (1997). Food safety hazards and the application of the principles of the hazard analysis and critical control point (HACCP) system for their control in aquaculture production. *Aquaculture Research*, 28(10), 735–752. <https://doi.org/10.1111/j.1365-2109.1997.tb00999.x>
29. Scheule, B., & Sneed, J. (2001). From farm to fork: Critical control points for food safety. *Journal of Nutrition in Recipe & Menu Development*, 3(2), 3–23. https://doi.org/10.1300/J071v03n02_02
30. Tamiru, S., Bidira, K., Moges, T., Dugasa, M., Amsalu, B., & Gezimu, W. (2022). Food safety practice and its associated factors among food handlers in food establishments of Mettu and Bedelle towns, Southwest Ethiopia, 2022. *BMC Nutrition*, 8(1). <https://doi.org/10.1186/s40795-022-00651-3>
31. Teferi SC (2020). A Review on Food Hygiene Knowledge, Practice and Food Safety in Ethiopia *Sci J Food SC Nutr* 6(1): 004-010.
32. Temeche ME, Satheesh NE, Dibaba KU (2016). Food Safety Knowledge, Practice and Attitude of Food Handlers in Traditional Hotels of Jimma Town, Southern Ethiopia.
33. Tessema, A. G., Gelaye, K. A., & Chercos, D. H. (2014). Factors affecting food handling Practices among food handlers of Dangila town food and drink establishments, North West Ethiopia. *BMC Public Health*, 14(1), 1–5. <https://doi.org/10.1186/1471-2458-14-571>.
34. WHO (1984). The Role of Food Safety in Health and Development. World Health

Organization Technical Report Series No 705.Geneva.

I. Annex

Questionnaires for KAP study part

10.1. English version Questionnaire

Checklist Format for Food handlers in Hotels/Restaurants in Woldia Town

Facility name _____

Woreda _____

Kebele _____

Data recorder name _____ signature _____

Date ____//____//____ Food handlers ID _____

Part 1: Socio-Demographic Characteristics.

101. Sex- Male..... Female

102. Religion - orthodoxMuslim Protestant

103. Educational status:-literate..... illiterate

104. Have you ever trained? YesNo

105. Do you have certificate? Yes No

Part 2: Knowledge on Food Safety Practice of food handlers.

2.1. Transmission of food borne diseases

106. Fresh meat always has microbes on the surface,

Correct.....In correct.....

107. Canned foods may have harmful microbes,

Correct.....In correct.....

108. Healthy people can cause illness by carrying germs to food,

Correct.....In correct.....

109. Lettuce and other raw vegetables might have harmful microbes,

Correct...In correct.....

110. Cooked foods do not have microbes,

Correct.....In correct.....

2.2. Personal health and hygiene

111. You can prepare food with a wound on the hand if the wound is covered with a bandage,

Correct.....In correct.....

112. After using the toilet, we should always wash hands with soap and water,

Correct.....In correct.....

113. Hands should be washed if fondling body parts happen,

Correct.....In correct.....

114. When wearing gloves, you can handle cooked foods after handling raw meat,

Correct.....In correct.....

115. Wearing clean uniform and cap while cooking or serving is necessary,

Correct.....In correct.....

116. Hands should be properly washed after sneezing or blowing your nose,

Correct.....In correct.....

Part 3. Attitude on Food Safety Practice of Food handlers

117. Temperature Control is an effective method of reducing the number of cases of food

Poisoning

Strongly disagree ... Disagree ... Neutral ... Agree ... Strongly agree

118. All food handlers should have a food safety training qualification.

Strongly disagree ... Disagree ... Neutral ... Agree ... Strongly agree

119. Lack of food safety training affects safe food handling.

Strongly disagree ... Disagree Neutral ... Agree ... Strongly agree

120. Unavailability of food handling guideline can affect food safety.

Strongly disagree ... Disagree Neutral ... Agree ... Strongly agree

121. Lack of supervisor commitment affect safe food handling.

Strongly disagree ... Disagree Neutral Agree ... Strongly agree

122. One of my job responsibilities is handling the food safely.

Strongly disagree ... Disagree ... Neutral Agree ... Strongly agree ...

123. I believe food safety knowledge is important to me.

Strongly disagree ... Disagree ... Neutral ... Agree ... Strongly agree ...

124. I believe personal protective equipment and clothes reduces the risk of food contamination.

Strongly disagree ... Disagree ... Neutral ... Agree ... Strongly agree ...

125. Raw and cooked food should be stored separately.

Strongly disagree ... Disagree ... Neutral ... Agree ... Strongly agree ...

Part. 4. Food Safety Practice of Food handlers

126. Do you wash your hands after touching unwrapped raw foods?

Always Sometimes..... Never.....

127. Do you wash your hands before touching cooked foods?

Always Sometimes..... Never.....

128. Do you use separate utensils when preparing raw and cooked foods?

Always Sometimes..... Never.....

129. Do you check the expiry dates of all products?

Always Sometimes..... Never.....

130. Do you use a thermometer to check temperature?

Always....Sometimes... Never.....

131. Do you use gloves while serving unwrapped foods?

Always Sometimes..... Never.....

132. Do you wash your hands after using gloves?

Always Sometimes..... Never.....

133. Do you wash your hands before using gloves?

Always Sometimes..... Never.....

134. Do you wear uniform when serving food?

Always Sometimes..... Never.....

135. Do come to work when ill a fever, upset stomach?

Always Sometimes..... Never.....

136. Do you wear a hat or head covering when serving food?

Always Sometimes..... Never.....

137. Do you wear jewelry when serving food?

Always Sometimes..... Never.....

138. Do you disinfect cutting boards after each use?

Always Sometimes..... Never.....

139. Do you sanitize utensils after washing them?

Always Sometimes..... Never.....

II. ANNEX

Table 8: Independent sample t-test

		knowledge	Mean-dif	Attitude	Mean-dif	Practice	Mean-dif
		Mean	(Sig)	Mean	(Sig)	Mean	(Sig)
sex of participant	Female	7.55	0.14(0.388)	37.19	0.29(0.443)	31.59	0.59(0.059)
	male	7.41		36.90		31.00	
educational level	illiterate	7.08	-0.46(0.198)	36.54	-0.61(0.467)	31.15	-0.31(0.653)
	literate	7.54		37.15		31.46	
have you ever trained	No	7.38	-0.29(0.033)	36.72	-0.87(0.007)	31.58	0.28(0.288)
	yes	7.68		37.59		31.30	
Doyouhavecertificat e	No	7.39	-0.28(0.044)	36.72	-0.92(0.005)	31.59	0.32(0.232)
	yes	7.68		37.63		31.27	

Table 9: Descriptive Statistics of the dependent variables

Average reached 70%			Minimum	Maximum	Mean $\pm$ Std.dev
Knowledge	68.3471		4.00	11.00	7.5182 $\pm$ 1.26009
Attitude	82.4916		26.00	44.00	37.1212 $\pm$ 2.94073
Practice	74.8773		25.00	39.00	31.4485 $\pm$ 2.40543

Table 10: Correlation analysis

		knowledge	Attitude	Practice
knowledge	Pearson Correlation	1	-.018	.134*
	Sig.		.747	.015
Attitude	Pearson Correlation	-.018	1	-.015
	Sig.	.747		.786
Practice	Pearson Correlation	.134*	-.015	1
	Sig.	.015	.786	

*. Correlation is significant at the 0.05 level (2-tailed).

Table 11: Parameter estimates for knowledge

Knowledge	Coef.	St. Err.	t-value	p-value	(95%) Conf	Interval	Sig
Gender							
Female	.182	.164	1.11	.268	-.141	.505	
Religion							
Orthodox	-.135	.18	-0.75	.453	-.489	.219	
Protestant	-.414	.88	-0.47	.638	-2.144	1.317	
Training							
Yes	.425	.475	0.90	.371	-.509	1.359	
Certificate							
Yes	-.13	.473	-0.27	.784	-1.061	.801	
Educational status							
Literate	.465	.353	1.32	.188	-.229	1.16	
Wear clean uniform							
Correct	.279	.25	1.12	.265	-.213	.771	
Wash hand after fondling body parts							
Correct	.928	.197	4.72	0.001	.541	1.315	***
Constant	5.85 5	.48	12.20	0.001	4.911	6.799	***
*** $p < .01$, ** $p < .05$, * $p < .1$							

Table 12: Linear regression Parameter estimates for Attitude

Attitude sum	Coef.	St. Err.	t-value	p-value	[95% Interval]	Sig
Sex						
Female	.395	.185	2.13	.034	.03 .76	**
Religion						
Orthodox	.784	.205	3.83	0.001	.381 1.188	***
protestant	1.532	.963	1.59	.113	-.364 3.428	
Training						
Yes	-.294	.523	-0.56	.574	-1.324 .736	
Certificate	0	.	.	.	.	
Yes	.568	.524	1.08	.279	-.462 1.598	
Temperature						
Disagree	-1.117	.42	-2.66	.008	-1.944 -.291	***
Neutral	-2.847	.632	-4.50	0.001	-4.091 -1.602	***
strongly agree	1.459	.316	4.62	0.001	.837 2.081	***
strongly disagree	-5.402	.702	-7.69	0.001	-6.784 -4.021	***
Guideline						
Disagree	-3.674	.249	-14.73	0.001	-4.165 -3.183	***
strongly agree	1.403	.208	6.74	0.001	.993 1.812	***
strongly disagree	-3.458	.682	-5.07	0.001	-4.8 -2.117	***
Responsibility	0	.	.	.	.	
Disagree	-3.353	.625	-5.37	0.001	-4.582 -2.124	***
Neutral	-1.408	.835	-1.69	.093	-3.051 .234	*
strongly agree	.928	.163	5.68	0.001	.606 1.249	***
strongly disagree	-3.983	.823	-4.84	0.001	-5.602 -2.364	***
Equipment	0	.	.	.	.	
Disagree	-2.455	.343	-7.16	0.001	-3.13 -1.78	***
Neutral	-.694	.549	-1.26	.207	-1.776 .387	
Strongly agree	.896	.183	4.90	0.001	.536 1.256	***
strongly disagree	-3.216	.591	-5.45	0.001	-4.379 -2.054	***
Raw and cooked	0	.	.	.	.	
Disagree	-2.19	.582	-3.77	0.001	-3.334 -1.046	***
Neutral	-2.812	.819	-3.43	.001	-4.423 -1.201	***
strongly agree	1.804	.171	10.52	0.001	1.466 2.141	***
strongly disagree	-7.765	1.499	-5.18	0.001	-10.715 -4.816	***
Constant	35.117	.294	119.3	0.001	34.538 35.696	***

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 13: Parameter estimates for Status of Food Safety Practice of Food Handlers

Practice sum	Coef.	St. Err.	t-value	p-value	[95% Interval]	Sig
Gender						
Female	.502	.321	1.56	.119	-.129 1.133	
Religion						
Orthodox	.739	.345	2.14	.033	.059 1.419	**
Protestant	.373	1.723	0.22	.829	-3.018 3.764	
Training						
Yes	.595	.932	0.64	.524	-1.238 2.428	
Certificate						
Yes	-.772	.929	-0.83	.406	-2.599 1.055	
Educational status						
Literate	.584	.691	0.84	.399	-.776 1.943	
Constant	29.97	.791	37.87	0	28.413 31.527	***

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 14: Shapiro-Wilk W test for normal data

	Prob>z
Knowledge	0.95643
Attitude	0.69471
Practice	0.96388

Table 15: Constant variance assumption test

Knowledge	Attitude	Practice
Breusch-Pagan/ Cook-Weisberg test for heteroscedasticity Ho: Constant variance Variables: fitted values of Knowledge chi2(1) = 0.01 Prob> chi2 = 0.9143	Breusch-Pagan/Cook-Weisberg test for heteroscedasticity Ho: Constant variance Variables: fitted values of attitude sum chi2(1) = 1.59 Prob> chi2 = 0.4975	Breusch-Pagan / Cook-Weisberg test for heteroscedasticity Ho: Constant variance Variables: fitted values of practice sum chi2(1) = 0.15 Prob> chi2 = 0.6992

Table 16: Autocorrelation Test

Knowledge	Attitude	Practice
Durbin-Watson d-statistic (9, 330) = 2.053	Durbin-Watson d-statistic (20, 330) = 1.526385	Durbin-Watson d-statistic (7, 330) = 1.166692

Table 17: ANOVA table for microbiological test.

		Sum of Squares	Df	Mean Square	F	Sig.
E.coli	Between Groups	.000	2	.000	.	.
	Within Groups	.000	27	.000		
	Total	.000	29			
Coliform	Between Groups	3180.104	2	1590.052	2.229	.127
	Within Groups	19258.144	27	713.265		
	Total	22438.248	29			
Plate count	Between Groups	947410734.467	2	473705367.233	3.233	.055
	Within Groups	3956516781.400	27	146537658.570		
	Total	4903927515.867	29			

III .ANNEX

በ ፋርማሲ ት/ዘ/ት
የኢትዮጵያ ሪፑብሊክ ኮምፒውተር

አዲስ አበባ ዩኒቨርሲቲ
Addis Ababa University



School of Pharmacy
Ethical Review Committee

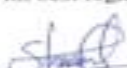
ቀን
Date July 12, 2021
ቁጥር
Ref. No. ERB/SOP/300/13/2021

To: Mekriaw Melesse
School of Pharmacy

Re: Ethical Clearance

It is to be recalled that you submitted a research proposal entitled "Food Safety Knowledge, Attitude and Handling Practice Among Food Handlers of Hotels/Restaurants in Woldia Town, North Wollo, Ethiopia". The committee thoroughly reviewed the proposal based on its operational guidelines and found that it fulfills all ethical requirements stipulated in the guidelines. This is, therefore, to inform you that the proposal is ethically approved for implementation.

With best regards,


Shemsi Uqder (PhD)
Chairperson, ERC
School of Pharmacy
College of Health Sciences
Addis Ababa University



002511556 02 12

1175

የፋክስ
Telax: 21205

ፋክስ
Fax: 0025111313558566

ኢንተርኔት
Cable: AAUNEV