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# Journal of Environmental and Occupational Science

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## Original Research

### Assessment of bacteriological quality of meat contact surfaces in selected butcher shops of Mekelle city, Ethiopia

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Received: March 17, 2013

Accepted: April 16, 2013

Published: May 1, 2013

DOI : 10.5455/jeos.20130416114711

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**Key words:** Hygiene, bacterial load, meat cutting surfaces, butcher shops

**Abstract**

**Aim:** Microbiological methods are not commonly used to inspect the hygienic status of butcher shops. Therefore, the study was intended to identify and assess the bacterial quality of meat contact surfaces in 12 randomly selected meat shops in Mekelle city, Ethiopia.

**Method:** A total of 72 swab samples were obtained from the butchers' knives, processing tables and workers' hands. The swab samples were inoculated on plate count agar for enumeration of bacterial load and on different selective media to isolate pathogenic bacteria. Out of the 72 swab samples, 24 each were collected from tables, workers' hands and knives of butcher shops. A structured questionnaire was also prepared to assess the knowledge of butchers on hygienic processing of meat.

**Results:** The swabs collected pre-processing were analyzed and the mean bacterial count ( $\log_{10}$  cfu/cm<sup>2</sup>) was found to be 6.28, 5.67 and 5.30 from tables, hands and knives, respectively. Whereas the result for post processing was 6.56, 6.15 and 6.89 from tables, hands and knives, respectively. *E. coli* was the predominant isolate (32%) followed by *Staphylococcus species* (28%). The least bacterial isolates were *Streptococcus species* and *Salmonella species* with frequency of isolation 20% each. The study revealed higher potential of contamination of meat from the working surfaces.

**Conclusion:** It could be concluded that there was poor level of personnel hygiene and poor sanitation at the butcher shops. And there was lack of knowledge on hygienic practices to be followed. Thus there is need to educate butchers for practicing good sanitation and meat handling techniques.

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## INTRODUCTION

Food borne diseases occur commonly in developing countries particularly Africa because of the prevailing poor food handling and sanitation practices, inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in safer equipment and lack of education for food-handlers[1]. Of the foods intended for humans, those of animal origin tend to be most hazardous unless the principles of food hygiene are employed. Animal products such as meats, fish and their products are generally regarded as high risk commodity in respect of pathogen contents, natural toxins and other possible contaminants and adulterants [2].

Food borne diseases have been considered as an imperative health problem in different countries [3]. In developing countries like Ethiopia, there is no precise data about the incidence of food borne out breaks and it seems to be higher compared to developed countries. World Health Organization (WHO) has reported that 50 million children under five years of age get diarrheal diseases each year, due to the contaminated water and food stuffs [4].

Meat is a good source of animal protein and the expectation of all consumers is to purchase meat that is safe and wholesome [5]. Meat produced in an unhygienic condition could pose threat to the health of the consumers as well as impair the keeping quality of such meat. Contamination of meat can result from

contaminated working surfaces, equipments and the workers' hands used in the processing [6]. The quality of water used in meat processing at the butcher shops also play a major role in reducing or increasing meat contamination, as water is used in washing the working surfaces, carcasses, blood of meat, equipment and workers' hands. Bacterial contamination of meat products is unavoidable consequence of meat processing [7].

Hygienic and quality control methods of meat and meat products, especially in food catering have been recommended in many countries [4]. Without proper hygienic control, the environment in butcher's area can act as important sources of bacterial contamination [8].

No comparable data were available regarding the assessment of food safety practice, food borne diseases and microbial load of meat cutter surfaces in butcher shops of Mekelle city. These factors could hinder government's ability to accurately apply measures on the impact of food contamination problems on public health. Therefore, the present study was designed to assess the meat cutters safety, knowledge and practices in meat cutter handling, and to determine microbial load and pathogenic organisms in meat cutter in butcher shops of Mekelle city.

## MATERIALS AND METHODS

### Study area

The assessment survey was carried out from October 2011 to May 2012 in Mekelle butcher shops in Tigray Regional State, Ethiopia.

### Study design

A descriptive survey design was used to answer questions concerning the current status of food hygiene and sanitation practiced in butcher shops. Hygiene and sanitation was determined by the use of structured interview and through direct observations of the hygienic status and practices by butcher shop workers. Bacteriological analysis of swabs taken from meat cutter with the intention of colony count and identifying pathogenic bacteria were conducted to supplement the sanitary survey.

### Sample collection

Sample swabs were randomly collected aseptically twice a week for a period of 6 weeks from butcher's knives, processing tables and workers' hands. An area of 1cm<sup>2</sup> was used for swabbing and sterile swabs soaked into 10 ml of sterile nutrient broth were used for this purpose. The swab samples were kept in this sterile broth in icebox cooler and taken to the laboratory for further study. The 10 ml of test tube containing the swab was shaken for 10 seconds for uniform

distribution.

### Enumeration of total viable count and isolation of bacteria

Serial dilutions were made from 1ml of the sample and 9ml of the normal saline solution[9]. Appropriate dilutions were surface plated on plate count agar for enumeration of total aerobic viable counts [10]. Plates were incubated at 37 °C for 24-48 hours. The number of distinct colonies on each plate was enumerated using a colony counter, colony Forming Units (CFU) per ml or cm<sup>2</sup> of sample was calculated, using the dilution factor of each and converted to log<sub>10</sub>CFU/ cm<sup>2</sup> or ml values. Mean values of total aerobic viable counts were determined and reported.

### Identification of bacteria

Bacterial isolation was performed using nutrient agar (NA) and blood agar (BA) as general and enriched media and other media with selective and differential characteristics for isolation and identification of *Streptococci species*, *Staphylococci species*, *Salmonella species* and *Escherichia coli* [11]. All media were prepared according to the manufacturer's (Himedia, India) specification and suspected samples were inoculated on MacConkey agar (MCA), Eosin Methylene Blue agar (EMB), Edward's Medium, Salmonella-Shigella agar and Mannitol Salt agar (MSA). Plates were incubated at 37°C for 24 -48 hours. Discrete colonies were sub cultured into fresh agar plates aseptically to obtain pure cultures of the isolates. Pure isolates of resulting growth were then stored at 4°C and used for further identification of bacteria. Colonies identified as discrete on nutrient agar were carefully examined macroscopically (Olympus light microscope, Germany) for cultural characteristics such as the shape, color, size and consistency. Gram staining as well as appropriate biochemical tests were carried out according to standard procedures [12]. The isolates were identified by comparing their morphological and biochemical characteristics with standard reference organisms with those of known taxa, as described by Bergey's Manual for Determinative Bacteriology [13].

### Questionnaire survey

A structured questionnaire was prepared to assess the knowledge of workers in butcher shops regarding the hygienic practices during processing of meat. The respondents were posed with the following questions to answer. Educational status, exposure and frequency of training, if they wore apron, hair cover, jewelry; if they handle money; how often they wash; and effectiveness of training.

### Data management and analysis

The data collected from the study area and the results

of the laboratory investigations were entered into MS-excel spread sheets and analyzed.

## RESULTS

### Questionnaire survey

Total of 24 butcher shop workers were interviewed. 41.7% of them were illiterate and 58.3% of the respondents did not take training regarding meat and butcher area hygiene. Those who received training were not appreciating the effectiveness of the training which is only focused on the management of their hands and equipments. The study showed that 41.7% of the butcher workers did not wear aprons and 58.3% did not cover their hair; 91.7% of the butchers handled money while serving food and 66.7% of them had worn jewelry materials. It was also showed that 58.3 % of butcher shop used only water for washing as shown in

Table -1.

### Standard plate count

The study recorded mean standard total plate count for butchers knife, tables and hands before and after processing. The figure obtained before processing was 6.28, 5.67, 5.30  $\log_{10}$  cfu/cm<sup>2</sup> for table, hand and knives, respectively. While the figure after processing was 6.56, 6.15 and 6.89  $\log_{10}$  cfu/cm<sup>2</sup> for table, hand and knives, respectively (Table 2 and 3).

### Bacterial Isolation

The bacterial contaminants of meat samples in the study were *E. coli*, *Staphylococci species*, *Streptococci species* and *Salmonella species*. *Escherichia coli* was the predominant isolate (32%) followed by *Staphylococcus species* (28%). The least bacterial isolates were *Streptococcus species* and *Salmonella species* with frequency of 20% each (Table 4).

**Table 1.** Questionnaire survey on knowledge of butchers on hygienic practices in Mekelle, Ethiopia

Questionnaire and Observation Types	Values	Frequency	Percent	Valid Percent
Educational status	Grade 1-4	4	33.3	33.3
	Grade 5-10	3	25.0	25.0
	Illiterate	5	41.7	41.7
Training	Yes	7	58.3	58.3
	No	5	41.7	41.7
Hair cover	Not covered	7	58.3	58.3
	Covered	5	41.7	41.7
Apron	Not used apron	5	41.7	41.7
	Used apron	7	58.3	58.3
Jewelry	Not worn Jewelry	4	33.3	33.3
	Worn Jewelry	8	66.7	66.7
Money	Cashier money handler	1	8.3	8.3
	Butcher money handler	11	91.7	91.7
Washing	Water only	7	58.3	58.3
	Water and soap	5	41.7	41.7
Effectiveness of training	No training taken	7	58.3	58.3
	Effective	3	25.0	25.0
	Not effective	2	16.7	16.7

**Table 2.** Standard plate count of bacterial colonies from swab samples of meat cutters before processing of the meat

Sample Type	Number of Sample	Mean count (10g <sub>10</sub> cfu/cm <sup>2</sup> )	Minimum count (10g <sub>10</sub> cfu/cm <sup>2</sup> )	Maximum count (10g <sub>10</sub> cfu/cm <sup>2</sup> )
Table	12	6.28	5.57	6.68
Hand	12	5.67	4.49	6.36
Knife	12	5.30	4.00	5.89

**Table 3.** Standard plate count from swabs of meat cutters after Processing of the meat

Sample Surface	Number of Samples	Mean count (10g <sub>10</sub> cfu/cm <sup>2</sup> )	Minimum count (10g <sub>10</sub> cfu/cm <sup>2</sup> )	Maximum count (10g <sub>10</sub> cfu/cm <sup>2</sup> )
Table	24	6.56	6.11	6.93
Hand	24	6.15	5.49	6.54
Knife	24	6.89	5.48	6.30

**Table 4.** Gram positive and negative bacterial pathogens in meat cutter from butcher hops of Mekelle city, Ethiopia

Isolated bacteria	Table	Knife	Hand	Total
<i>Escherichia coli</i>	4(50%)	2(25%)	2(25%)	8(32%)
<i>Streptococci species</i>	2(40%)	2(40%)	1(20%)	5(20%)
<i>Staphylococci Species</i>	1(20%)	2(40%)	2(40%)	7(28%)
<i>Salmonella Species</i>	3(42.86%)	1(14.29%)	3(42.86%)	5(20%)

## DISCUSSION

Total of 24 butcher shop workers were interviewed about their knowledge on meat hygiene. 41.7% of them were illiterate and 58.3% of the respondents did not take training regarding meat and butcher area hygiene. Those who received training were not appreciating the effectiveness of the training which only focused on the management of their hands and equipments. The same result was reported by [14]. The study recognized that trainings are important to encourage hygienic practice. The results indicated that there are no personal and general hygiene measures in place. Hence there is a need for more effective training in both personal and general hygiene practices. This is well supported by [15, 16] who advocated training of food handlers regarding the basic concepts and requirements of personal hygiene. The scientific community should join regulatory authorities to spread awareness about basic hygiene principles. It is especially important to provide training to meat handlers regarding food safety.

Since the purpose of wearing overalls is to protect both the food product and the meat handler from cross contamination, overalls should be suitable to wear over other clothing [17]. However, this study showed that 41.7% of the butcher workers did not wear aprons and 58.3% did not cover their hair. The findings disagree with the reports of [18] indicates difference in knowledge of meat handlers in different countries.

Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce. All this trade is in hard currency, with lower - denomination notes receiving the most handling because they are exchanged many times, this

makes it lasts less than a few years in circulation and provides a large surface area as a breeding ground for pathogens [19]. According to the present study 91.7% of the butchers handled money while serving food. This finding agrees with [17] who reported that meat handlers are probable sources of contamination and all possible measures should be taken to reduce or eliminate such contamination.

Meat is the most perishable of all important food since it contain sufficient nutrient needed to support the growth of microorganisms [20]. The results of this study showed that that mean standard total plate count obtained from the butcher's knife, before and after carcass processing was 5.30 and 6.89 log<sub>10</sub> cfu/cm<sup>2</sup> respectively. The number obtained from butcher's knives in this study is almost similar to values of obtained by [21] who reported total aerobic viable count of 6.7 ± 0.53 log cfu/cm<sup>2</sup> in Russia and 5.52 ± 0.03 logcfu/cm<sup>2</sup> in India, respectively. The high microbial load on the knife is an indication of inadequate cleaning and poor or absence of sterilization, continuous use of a single knife despite contact with dirty or contaminated surfaces and lack of separation between clean and dirty processes. The total mean bacterial load 6.45 cfu/cm<sup>2</sup> obtained from the processing table in this study was higher than the value reported by [22] which is 5.54 log cfu/cm<sup>2</sup> from meat sellers' tables from various markets in Ibadan, Nigeria. The high microbial load obtained from the butchers table is an indication of the ineffectiveness of the method used in cleaning the tables, which are usually washed with water only. The presence of bacterial pathogens in meat contact surfaces may contribute to the contamination of meat.

*Escherichia coli* was the predominant isolate (32%) followed by *Staphylococcus species* (28%). The least bacterial isolates were *Streptococcus species* and *Salmonella species* with frequency of 20% each. The bacterial contaminants of meat samples in the study were *E. coli*, *Staphylococci species*, *Streptococci species* and *Salmonella species*. Similar bacterial contaminants have been reported by other workers in foods, water and environmental samples [23-26]. *Escherichia coli* was the predominant isolate (32%) followed by *Staphylococcus species* (28%) and this is in close agreement to previous reports by [26-27] where they isolated almost similar organisms from meat, sea-foods and other ready to eat food stuffs. The higher rate of contamination of meat with these organisms is an indication of deplorable state of poor hygienic and sanitary practices employed right from the slaughtering, transportation to butcher shops and processing.

Moreover, swab from tables, knives and workers hands showed higher counts of aforementioned microorganisms. These higher counts may be attributed to unsanitary practices performed in the plant, employee's ignorance, by personal hygiene and contaminated floors which are considered to be important source of contamination since they transfer contaminations to workers' shoes [28]. The workers in turn circulate inside the establishment there by disseminating the contamination. Hygiene problems are not limited to knife and the table but are also associated with hand contamination. According to the results of this study, most of the butcher shop workers handle money while processing the meat. Since the money is being full of microbes, it can contaminate the food. Handling of foods with bare hands may also result in cross contamination, hence introduction of microbes on safe food. Because meat handlers are probable sources of contamination for microorganisms, it is important that all possible measures be taken to reduce or eliminate such contamination [17].

The high microbial load on the processing facility surfaces in this study underscores the poor level of personnel hygiene and poor sanitation at the butcher shops. The personnel working in the butcher shops did not apply hygienic practices which is mainly due to lack of knowledge. Based on the bacteria isolated and bacterial load on different surfaces in the butcher shops, meat could be contaminated by contact with contaminated surfaces and equipments in the butcher shops to pose public health hazards. Thus to safeguard the public against the risks of food borne bacterial infections, there is need to educate and advocate for practicing good sanitation and meat handling techniques in the butcher shops.

## ACKNOWLEDGMENTS

The authors would like to acknowledge Mekelle University College of Veterinary Medicine, for providing the necessary facilities for the successful completion of the research work.

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