

**ASSESSMENT OF HYGIENE PRACTICES FOLLOWED BY  
RETAILERS AND BUTCHERS OF SMALL SLAUGHTERING  
PREMISES IN JAMMU CITY**

**By**

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**Thesis submitted to Faculty of Veterinary Science  
in partial fulfilment of the requirements  
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IN  
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**Division of Veterinary Public Health and Epidemiology  
Sher-e-Kashmir University of Agricultural Sciences & Technology  
Main Campus, Chatha, Jammu-180009**

**2021**

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SMALL SLAUGHTERING PREMISES IN JAMMU CITY**

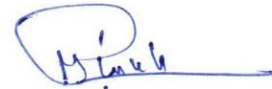
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**2021**

## CERTIFICATE-I

This is to certify that the thesis entitled “ASSESSMENT OF HYGIENE PRACTICES FOLLOWED BY RETAILERS AND BUTCHERS OF SMALL SLAUGHTERING PREMISES IN JAMMU CITY” submitted in partial fulfillment of the requirements for the degree of **Master of Veterinary Science in Veterinary Public Health and Epidemiology** to **Faculty of Veterinary Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu**, is original work and has similarities with published work not more than minor similarities as per UGC norms of 2018 adopted by the University. Further the level of minor similarities has been declared after checking the manuscript with URKUND software provided by the University.

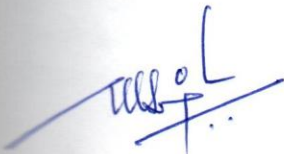
The work has been carried out by **Ms. Kavya Gupta** under my supervision and guidance. No part of the thesis has been submitted for any other degree of diploma. It is further certified that help and assistance received during the course of thesis investigation have been duly acknowledged.



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Date: 29/07/21




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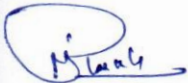
### CERTIFICATE-III

This is to certify that the thesis entitled "**Assessment of hygiene practices followed by retailers and butchers of small slaughtering premises in Jammu city**" submitted by **Ms. Kavya Gupta**, Reg. No. **J-19-MV-603**, to the Faculty of Veterinary Science, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, in partial fulfillment of the requirements for the degree of **Master of Veterinary Science in Veterinary Public Health and Epidemiology**, was examined and approved by the advisory committee and external examiner (s) on

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*Dated: 13.08.2021*

*Placed: R.S. Pura, Jammu*

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## ABSTRACT

**Title of the Thesis** : **Assessment of hygiene practices followed by retailers and butchers of small slaughtering premises in Jammu city.**

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In the present investigation, 30 butchers studied across the Jammu city. All the butchers were male, mostly in the age group of 16-45 years. Thirty seven percent of the butchers had acquired higher secondary qualification and most of the butchers are involved in the slaughtering profession for less than 5 years. Majority of the butchers were trained by relatives and friends (73%). The infrastructure of the 30 retail shops/outlets and slaughtering premises were studied. Sixty seven percent retail shops/outlets and slaughtering premises were in the market area and most of them (63%) were small structured. Majority of the shops were operational with proper licensing from the municipal corporation authorities of the Jammu city. Most of the butchers (100%) were found using soaps and detergents (10%) for hand sanitization. Generally, butchers gave importance to selection of healthy birds. None of butchers in the present study were aware of history of flock.

Thirty poultry meat samples collected from different locations of Jammu city were analysed to determine the bacteriological quality. The mean counts of SPC CC, SAC and EFC were found  $6.59 \pm 0.13$ ,  $4.87 \pm 0.19$ ,  $3.79 \pm 0.07$  and  $3.88 \pm 0.81 \log_{10} \text{cfu/gm}$ , respectively. The analysis of variance indicated that all the 10 areas of Jammu city from where the meat samples were collected differed significantly for SPC and EFC whereas other counts viz., CC and SAC were at par with each other for the locations under study. In conclusion, the microbiological quality of meat in Jammu city is not satisfactory. It is therefore, suggested that the raw meat should be handled with appropriate hygienic measures and continuous microbial monitoring to safeguard the health of consumers.

**Keywords:** Hygienic practices, Risk factors, DMRT, *E. coli*, *S. aureus*, *E faecalis*.



Signature of Major Advisor



Signature of the Student

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## ABBREVIATIONS AND SYMBOLS USED

|                 |  |
|-----------------|--|
| APHA            | American Public Health Association                           |
| BIS             | Bureau of Indian Standard                                    |
| BPA             | Baird Parker Agar  |
| CDC             | Centre of Disease Control and Prevention                     |
| Cfu/gm          | Colony forming unit per gram                                 |
| b/w             | Between  |
| C               | Degree Celsius   |
| ECC             | <i>E.coli</i> count  |
| <i>E.coli</i>   | <i>Escherichia coli</i>                                      |
| EMB             | Eosin Methylene blue   |
| FSSAI           | Food Safety and Standard Authority of India                  |
| µg              | Micro gram   |
| µl              | Micro litre  |
| Fig             | Figure   |
| gm              | Gram   |
| hrs             | Hours  |
| HACCP           | Hazard Analysis Critical Control Point                       |
| DNase           | Deoxyribonuclease  |
| ICMSF           | International Commission on Microbial Specification for food |
| Mins            | Minutes  |
| ml              | Milli-liter  |
| mM              | Mili molar   |
| ND              | Not detected   |
| NSS             | Normal saline solution                                       |
| %               | Percent  |
| ±               | Plus minus   |
| SAC             | <i>Staphylococcus aureus</i> count                           |
| <i>S.aureus</i> | <i>Staphylococcus aureus</i>                                 |
| SPC             | Standard plate count   |
| SE              | Standard Error   |
| SPSS            | Statistical Package For Social Sciences                      |
| WHO             | World health organization                                    |
| VP              | Voges- Proskauer   |

Chapter-1

*Introduction*

## CHAPTER – I

### INTRODUCTION

---

The World Health Organization (WHO) indicated that each year as many as 600 million people in the world fall ill of which 420,000 die after consuming contaminated food (WHO,2015).In the United States, food borne illness affect an estimated 48 million people every year resulting in 128,000 hospitalization and 3000 death (CDC,2011).The repeated occurrence of food borne diseases has led to an increase in global concern about food hygiene and safety among food handlers(Grace,2015).However ,epidemiological data on food borne diseases remain scare because cases often go unrecognized, unreported or uninvestigated (Havellar *et al.*, 2015).

The contamination of meat can occur in multiple steps along the food production chain including production, processing, distribution, retail marketing and handling (Zaho *et al.*, 2001). Bello and Oyedemi (2009) reported that effluent from slaughter houses contribute contamination of both surface and ground water during processing in abattoir blood, fat, manure, urine and meat tissues which further discharge to the water streams. After the animals are slaughtered and inspected in the abattoir, meat is transported by meat van to different meat retail outlets for selling to consumers. During selling in retail meat outlets, further contamination can occur through contacts with handling equipments, insects, air, personnel and even consumers. It has been demonstrated that the workers and slaughtering instruments could spread contamination into the internal organs of animals. Dickson and Anderson (1992) isolated *Salmonella* and *Escherichia coli* from the hands of worker. The presence of such bacteria of potential public health significance was explained by Dolye (2007) and Biss and Hathaway (1995) during slaughtering operations. There was significant increase in total bacterial count at skinning point than that of washing operation and also dirty worker's hands, clothes and equipments of the slaughtering house which acted as intermediate sources of the contamination of meat (Gill 1998; Gillmour *et al.*, 2004; Abdalla *et al.*, 2009a).

India is most important livestock rearing country of the world with a large population of cattle, buffaloes, sheep, goats and other livestock. The country has 1/6 of the world's cattle and ½ world's buffalo population. The share of livestock in GDP

was 610 in terms of value (FAO, 2006). The relative share of poultry in national economy has remained below 1 percent. Poultry is today the major sources of meat in India and its share in meat consumption is 28 percent. The per capita consumption in India is 1.6 kg of poultry meat which is below the levels recommended by Nutritional Advisory Committee. The demand of poultry in India has increased from 382.3(2000) to 537(2006) thousand tones represented an increase of 40.4percent ( FAO,2006). In spite of having a great livestock wealth and organized poultry industry in India, the meat and meat products are treated as by-products of animal husbandry.

Meat is a nutritious diet of animal origin and highly susceptible to microbial contamination and thereby spoilage (Bryan, 1988). The types and extent of microbial contamination depend on sanitation procedures followed during meat handling, storage, distribution and processing (Ercolini *et al.*, 2006; Adu-Gyamfi *et al.*,2012). Lacking of poor sanitation and hygienic practices can lead to microbial contamination, meat quality deterioration and post harvest meat losses (Bogere and Baluka, 2014). Others factors affecting meat quality in developing countries are prevailing poor food handling and sanitation practices, inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in safe equipments and lack of education for food handlers (Okonko *et al.*,2009).

In India, just like other developing countries with predominately agricultural-based economies, fresh meat is mainly distributed through butcherries. Lack of awareness on good hygiene practices, hygienic means of transporting meat and hygienic situation of butcherries may lead to deterioration of the meat quality.

Slaughterhouse is a premise that is used for slaughtering and dressing of meat for human consumption. At the same time, it enables proper meat inspection to be carried out and the resulting waste materials are thus suitably be handled to remove any potential danger or meat-borne infectious agents reaching the public or contaminating the environment (FAO,2012).

Most of the slaughtering premises are highly ill managed, overcrowded, unhygienic and lacking basic facilities like water, electricity, and ventilation, drainage and water disposal in Jammu city. In spite increased consumer demand on food safety standards there are still hygiene and sanitary practices along with food production chain which contribute to unacceptable level of microbial load in meat and poses a

health risk to consumers ,several studies have been conducted to assess the degree of meat losses due to contamination of carcasses and offals (Mtenga *et al.*, 2000) and detection of zoonotic condition through the post mortem inspection (Komba *et al.*,2012). Limited work has been conducted to assess the hygienic practices used by the retailers and butchers in slaughtering premises and risk factors of meat contamination along with the determination of bacteriological quality of meat produced by retailers and butchers with the help of indicator organisms, therefore the present study was undertaken with the following objectives.

#### OBJECTIVES:

1. To assess hygienic practices of retail shops and butchers of small slaughtering premises of Jammu city.
2. To assess risk factors of meat contamination of production chain.
3. To assess bacteriological quality of meat produced by retailers and butchers of small slaughter premises with the help of indicator organism.

## Chapter-2

# *Review of Literature*

The majority of food borne diseases arise from the food of animal origin (Abdullahi *et al.*,2016 and Nyamakwere *et al.*,2017). The food handlers health status and hygiene practices are the foremost determinants of food contamination (Tefera and Mebrie,2014). According to World Health Organization, almost 1 in 10 people fall ill and 420000 die every year, dinning on cuisine tainted by microorganism (WHO, 2015).

The production of hygienic meat is a great challenge and major concern for the meat industry in India. The food can be handled during preparation, processing and storage (Sani and Siow,2014). It has been shown that most outbreaks of food poisoning result from food handling practices (Ansai-Lari, *et al.*,2010). According to Codex Alimentarius Commission, improper food handling is a major cause of food borne diseases and proper hand hygiene is a significant risk factor in the occurrence of contamination (Al-Shabib *et al.*,2016).

### **Health hazards associated with meat production and consumption**

Food animals are important source of quality proteins but on the other hand they serve major sources of disease pathogens. Raw meat has been identified major sources of food borne diseases in man. Mishandling and disregard for hygiene measures by handler frequently contributes to outbreaks of food borne illness caused by *Staphylococcus aureus* and Gram-negative *Bacilli* such as *Escherichia coli* and *Salmonella* spp. (Abd-Elaleem,2014). Personal hygiene and meticulous hand washing would lead to control of faeces- to- hand to- mouth spread of potentially pathogenic transient microorganisms (Jumaa,2005). Inspection would also ensure handling poultry slaughtering and handling of meat is very important. There are numbers of reports of food poisoning occurring due to meat consumption of contaminated poultry meat. Berghold *et al.*, (2004) reported occurrence of *Salmonella enteritis* phage type 29 in Austria. Health hazards due to chicken meat production and consumption due to various bacterial, viral, protozoan and fungal diseases have also been clearly reviewed by Gracey and Collins (1992).

### **Sources of microbial contaminants in meat**

The presence of microorganisms on post slaughter carcasses is due to the contamination occurring immediately before, during and after slaughter. Microbial status of fresh raw meat depends on animal rearing, transportation, slaughtering, cutting and packaging, besides hygiene and processing condition of the slaughter plant (Biswas *et al.*, 2011). The skin of many meat animals may contain *Micrococci*, *Staphylococci* and *Streptococci* (Biswas *et al.*, 2011). People working in meat processing plants can also act as a vector of many pathogenic bacteria (Frazier and Westhoff, 1999). The main sources of meat contamination include animal source (Borch and Arinder, 2002; Bell, 1997; Galland, 1997), on farm factors (Galland 1997 and Mtenga *et al.*, 2000), transport factors (Galland 1997), abattoir and butcher facilities, (Fasanmi *et al.*, 2010; Galland 1997; Adzitey *et al.*, 2011; Ali *et al.*, 2010 and Akinro *et al.*, 2009) parasites and wild animals, (Adeyemo, 2002) meat van, (Sulley, 2006) and abattoir and retail meat outlet workers (Jeffery, 2003 and Adetunde *et al.*, 2011).

### **Incidence of microbial load in meat, handling, equipments and facilities**

The microbial profile of meat products is one of the key criteria for determining quality and safety of fresh produce. Vanderlinde *et al.*, (1998) did extensive study on microbial quality of beef carcass meat from retail outlets as well as export markets.

Bhandare *et al.*, (2009) reported TVC at  $5.8 \pm 0.17 \log \text{CFU} / \text{cm}^2$  and  $6.05 \pm 0.25 \log \text{CFU} / \text{cm}^2$  in modern Indian and traditional meat shop and in abattoir respectively. Ziauddin *et al.*, (1994) reported that the differences in bacterial counts on the different regions of the carcasses as well as two slaughter units were marginal. The SPC of leg, loin, shoulder and neck cuts varied from 4.82-4.92, 4.71-5.13, 5.41-5.49 and 4.52-4.80  $\log_{10} \text{cfu cm}^2$ , respectively. In surveys of seven European abattoirs, Roberts *et al.*, (1984) reported mean aerobic plate counts for beef carcasses ranged between 2.29 and 3.85  $\log$  units  $\text{cm}^2$ . Beef carcass from Germany (Ingram and Roberts, 1976), New Zealand (Keeley, 1988) and USA (McNamara, 1995) showed an average APC of 4.51, 4.51 and 2.68  $\log \text{cfu cm}^2$ , respectively. However, trimmings had higher APC than different beef cuts (Scanga *et al.*, 2000). Gill (1998) reported that potential meat

contamination of *Streptococcus faecalis* occurred during slaughtering and butchering of food animals. They further revealed that knife trimming did not contribute to enhancing the microbiological quality of dressed carcasses, except aesthetic values.

The incidence of coagulase-positive *Staphylococcus* sp., on both domestic and export beef carcasses in Australia were 20 and 29 percent, respectively (Vanderlinde *et al.*, 1998).

Birhanu *et al* (2017) examined 159 swab (53 swab sample from tables, knives and hand of the workers each) samples for microbial load and obtained bacterial count as 6.52, 7.84 and 6.96 log<sub>10</sub>CFU/cm<sup>2</sup>, respectively. They also reported the predominant bacteria 20(37.74%) followed by *Staphylococcus* spp 13(24.53%) and *Salmonella* spp 11(20.75%). All the risk factors in their study had almost equal contribution for microbial contamination of meat.

Tuneer and Madhavi (2015) conducted their study to inspect the hygienic status of slaughter man of meat and fish markets of Jagdalpur city and reported standard plate count of bacteria during the morning for chicken, slaughter man and fisher monger was 7x10<sup>5</sup>, 10x10<sup>5</sup>, 15x10<sup>5</sup> CFU/ml, respectively in contrast to the sample taken from normal man was around 0.4x10<sup>5</sup>CFU/ml.

Ntenga (2013) assessed microbial contamination in beef production chain from abattoir to retail meat outlets in Morogoro municipality and analyzed a total of 102 water, meat and surface swab samples from evisceration tables, walls, floors, meat van floors and knives in abattoir for Total Viable Counts (TVC), Total Coliform Counts (TCC) and Total Faecal Coliform Counts (TFC). The mean values for TVC, TCC and TFC in abattoir were found highest in meat samples from neck regions with 7.72, 6.92 and 6.73 log Colony Forming Unit per gram (CFU/g) respectively. The lowest TVC was on knives being 4.13 log CFU/cm<sup>2</sup>. Their study indicated no growth for TCC and TFC in water samples

Haileselassie *et al.*, (2013) reported bacterial load of an abattoir meat, butcher's shop and street meat of 1.1x10<sup>5</sup>, 5.6x10<sup>5</sup> and 4.3x10<sup>6</sup> CFU/gm, respectively. The major pathogens isolated were *E coli*, *S.aureus* and *B.cereus*.

Mawia *et al.*, (2012) worked on bacteriological assessment of chevon and poultry meat from local markets of Jammu and reported standard plate count, coliform count, *Staphylococcus aureus* count and *Enterococcus faecalis* count  $6.37 \pm 0.06$ ,  $3.85 \pm 0.85$ ,  $3.98 \pm 0.12$  and  $4.15 \pm 0.15$  respectively for chevon sample and poultry meat samples, the counts were  $6.64 \pm 0.06$ ,  $2.81 \pm 0.11$ ,  $4.09 \pm 0.13$  and  $4.02 \pm 0.12$  respectively.

### **Knowledge of food safety, Attitudes and Practices (KAP) among food handlers**

It is important to have an understanding of the interaction on prevailing food safety belief knowledge and practices of the food handlers in order to minimize food borne outbreaks (WHO,2012)

Mortlock *et al.*, (1999) stated that there was a general agreement which revealed from the several authors as a good level of knowledge towards food safety among food handlers and effective practices of such knowledge in food handling were imperative in ensuring the safe production of food in any catering operations.

The knowledge and training of meat handler in meat industry in meat hygiene and food safety are very important in ensuring the health safety of consumer (Jianu and Golet,2014).

Akabanda *et al.*, (2017) reported that food handlers possessed knowledge about the hygienic practices, cleaning and sanitation procedure almost all the food handlers were aware of critical role of general sanitary practices in the work place ,such as hand washing (98.7%), using gloves(77.9%)proper cleaning of instruments (86.4%) and use of detergent (72.8%).On the disease transmission, their study indicated that 76.2% of the food handler did not know that salmonella is a food borne pathogen and 70.6% did not know that Hepatitis A is a food borne pathogen.

Bafanda *et al.*, (2017) reported that all the slaughtered houses in Nagrota, Rehari and Gujjar Nagar were lacking important infrastructure required for hygienic meat production. None of the slaughter houses were divided into different sections for hygienic meat production as well as no sanitary facilities was present in the slaughter houses.The study also reported that there was no system of disposal of slaughter waste in slaughter houses.

Khanal and poudel (2017) worked on factors associated with meat safety knowledge and practices among butchers of Ratnanagar Nepal and reported that none of the butcher fall into “adequate” knowledge and “good” practice category.

Cook *et al.*, (2017) reported from their study that almost all the slaughterhouses had poor infrastructure and very few slaughter houses had hand washing and toilet facilities.

Lee *et al.*, (2017) reported that the food handlers Kuala Lumpur, Malaysia had moderate levels of food safety knowledge (61.7%) with good attitude (51.9/60) and self-reported practices (53.2/60). Sixty five percent of the food handlers examined had a total aerobic count  $\geq 20$  CFU/cm<sup>2</sup> and *Salmonella* was detected on 48% of the food handlers’ hands. Their study suggested that the food handlers had adequate food safety knowledge, but perceived knowledge failed to be translated into practices at work.

### **Regulations and international agencies**

The quality control of food products is carried out by various regulatory mechanisms. Each country in the world had well enrolled monitoring setup for meat and meat products. Several developed countries in the world like USA, UK, Germany, France, Italy and the Netherlands also come under the same catalog .Several international organization such as Codex Alimentarius Commission (CAC), Food and Agricultural organization/World Health Organization (FAO/WHO)are also keeping their efforts for suitable commitments. International commission on microbial specification for foods (ICMSF), international organization for standardization (ISO),Office international des epizootics(OIE) and commission of European union are also keeping their commitment on regulatory enforcement in view of public safety and global trade.

In India, quality control for food products is carried out by such regulatory mechanisms such as Prevention Of Food Adulteration act (1954), Amendment (2004);Agricultural Grading and Marketing (AGMARK),Raw Meat (chilled and frozen)Grading and Marketing Rules 1991; Bureau of Indian Standard1995; Agricultural and Processed Food Export Development Authority (APEDA)and Meat Food Product Order(MFPO)1973 ,Amendment 1994 and Microbial Standards under PFA Rules,1954,Amentment 2004 Health Analysis Critical Control point (HACCP)

This is a system of food control to render foods safe for human consumption. In India HACCP guidelines have been developed and implemented to prevent food adulteration (PFA,1954) which serves as a watched dog for meat hygiene. It is also important to implement HACCP in unorganized sector also as the meat food is being produced and processed in unorganized sector to larger extend in India. (ICMR bulletin, 2000)

### **Importance of clean premises**

The clean premises are very important for getting the safe wholesome poultry meat. The byproducts and waste from the slaughterhouses should be properly disposed. Disposal of poultry waste and by products can contaminate the environment and may lead to the spread of infection in the community. In Punjab particularly in Nangal where the slaughter houses do exist the laid down procedure is not followed. In the recent past a lot of birds perished after consuming the 'leftover' of the slaughtered animals. At that time the entire waste of the slaughter house was also discharged into the river Sutlej thereby led to water pollution (Anonymous,2005). The disposal of the waste generated from the slaughtered animals was another problem in Nangal and in the absence of any suitable place for disposal the river Sutlej and the canal passing through Ropar were remained favourite place for dumping of the waste. (Anonymous, 2005).

## Chapter-3

# *Materials and Methods*

## CHAPTER – 3

### MATERIALS AND METHODS

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#### 3.1 Place of work

The study was conducted in the Division of Veterinary Public Health and Epidemiology, Faculty of Veterinary Sciences and Animal Husbandry, SKUAST-J, R.S Pura, Jammu and Kashmir, India during 2020-2021.

#### 3.2 Study design

The present study was conducted in the Jammu city to assess the hygienic practices used by the butchers of small slaughtering premises. A cross sectional study based on the questionnaire was administered to know the current status of food hygiene and sanitation practices of butcher shops and various other parameters mentioned in the interview schedule (Appendix-1). The risk factors of meat contamination were also determined by gathering information using a semi structured questionnaire (Appendix- 2).

#### 3.3 Study area

The present study was conducted in 10 locations of Jammu city namely Sidhra, Amphalla, Rehari, Kacchi chawni, Channi himmat, Narwal, Gandhi nagar, New plot, Bathindi and Gujjar nagar from September 2020 to December 2021.

#### 3.4 Sampling method and size

Butchers were randomly chosen and interviewed by visiting their retail shops/outlets. The respondents were not compelled to participate in the interview. A total of 30 retail shops/outlet were surveyed.

#### 3.5 Laboratory media preparations.

##### 3.5.1 Chemicals and reagents

Chemicals and reagents used in the study were procured from Hi-Media (India), and other reputed national manufacturers. Glassware and other materials of routine use were cleaned and sterilized following the standard procedure. Media and antibiotics used in the present study were procured from Hi-Media. Chemicals and reagents used were from reputed national and international firms. Details of media

/chemicals used in the present study are listed below:

**NSS (Normal Saline Solution)**

| <b>Ingredients</b> | <b>Amount (gm/ litre)</b> |
|--------------------|---------------------------|
| Sodium chloride    | 800 mg                    |
| Distilled water    | 100 ml                    |

Dissolved 800 mg of sodium chloride solution in 100 ml of distilled water and sterilized by autoclaving at 15 lbs (121<sup>0</sup>C) for 15 minutes.

**Plate Count Agar (M 091 Hi Media, Mumbai)**

| <b>Ingredient</b>         | <b>Amount (gm/ litre)</b> |
|---------------------------|---------------------------|
| Casein enzyme hydrolysate | 5.0                       |
| Yeast extract             | 2.5                       |
| Dextrose                  | 1.0                       |
| Agar                      | 15.0                      |

Suspended 23.5 grams in 1000 ml of distilled water. Boiled to dissolve the medium completely. Sterilized by autoclaving at 15 lb (121<sup>0</sup>C) for 15 minutes.

**MacConkey's Agar (M 081 Hi Media, Mumbai)**

| <b>Ingredient</b>               | <b>Amount (gm/litre)</b> |
|---------------------------------|--------------------------|
| Peptic digest of animal tissue  | 20                       |
| Bile salts                      | 10                       |
| Sodium chloride                 | 5                        |
| Neutral red                     | 0.07                     |
| Agar                            | 15                       |
| Final pH (at 25 <sup>0</sup> c) | 7.4±0.2                  |

55.07 grams were added in 1000 ml of distilled water. Heated to boiling to completely dissolve the medium. Sterilized by autoclaving at 15 lb (121<sup>0</sup>C) for 15 minutes.

**Mannitol Salt Agar (MH118-500G, Hi-Media, Mumbai):**

| <b>Ingredient</b> | <b>Amount (gm/litre)</b> |
|-------------------|--------------------------|
| Peptone           | 10                       |

|                 |           |
|-----------------|-----------|
| Meat extract    | 1         |
| D-Mannitol      | 10        |
| Sodium chloride | 75        |
| Phenol Red      | 0.025     |
| Agar            | 20        |
| Distilled water | 1000 ml   |
| Final pH        | 7.1 ± 0.2 |

111.02 gm of media was suspended in 1000 ml distilled water and heated to dissolve. It was then sterilized in an autoclave at 121° C for 15 mins

**EMB Agar (M317-500G, Hi-Media, Mumbai)**

| <b>Ingredients</b>             | <b>Amount (gm/litre)</b> |
|--------------------------------|--------------------------|
| Peptic digest of animal tissue | 10.000                   |
| Dipotassium phosphate          | 2.000                    |
| Lactose                        | 5.000                    |
| Sucrose                        | 5.000                    |
| Eosin – Y                      | 0.400                    |
| Methylene blue                 | 0.065                    |
| Agar                           | 13.500                   |
| Final pH (at 25°C)             | 7.2±0.2                  |

35.96 gm of media was suspended in 1000 ml distilled water and mixed well until suspension was uniform. The medium was heated to dissolve completely and sterilized by autoclaving at 15 lbs pressure (121°C) for 15 minutes (overheating was avoided). The medium was cooled to 45-50°C and was shaken to oxidize the methylene blue (i.e., to restore its blue colour) and to suspend the flocculent precipitate.

**Nutrient Agar (M001-500G Hi Media, Mumbai)**

| <b>Ingredients</b>             | <b>Amount (gm/litre)</b> |
|--------------------------------|--------------------------|
| Peptic digest of animal tissue | 5.0                      |
| Sodium chloride                | 5.0                      |
| Beef extract                   | 1.5                      |
| Yeast extract                  | 1.5                      |
| Agar                           | 15                       |
| Distilled water                | 1000 ml                  |
| Final pH (at 25°C)             | 7.3±1                    |

Dissolved 37.0 grams in 1000 ml in distilled water and sterilized by autoclaving at 15 lbs pressure (121<sup>0</sup>C) for 15 minutes.

**Simmon's Citrate Agar (M099 Hi-Media, Mumbai)**

| <b>Ingredients</b>            | <b>Amount (gm/litre)</b> |
|-------------------------------|--------------------------|
| Magnesium sulphate            | 0.2                      |
| Ammonium dihydrogen phosphate | 1.0                      |
| Dipotassium phosphate         | 1.0                      |
| Sodium citrate                | 2.0                      |
| Sodium chloride               | 5.0                      |
| Bromothymol blue              | 0.08                     |
| Agar                          | 15.0                     |
| Final pH (at 25°C)            | 6.8±0                    |

**Slantez and Bartley Medium (M612 Hi-Media, Mumbai)**

| <b>Ingredients</b> | <b>Amount (gm/litre)</b> |
|--------------------|--------------------------|
| Lactose            | 10.00                    |
| Sucrose            | 10.00                    |
| Dextrose           | 1.00                     |
| Sodium Chloride    | 5.00                     |
| Ferrous sulphate   | 0.20                     |

|                     |         |
|---------------------|---------|
| Sodium thiosulphate | 0.30    |
| Phenol red          | 0.024   |
| Agar                | 12.00   |
| Final pH (at 25°C)  | 6.8±0.2 |

Dissolved 65.00 grams in 1000 ml in distilled water and sterilized by autoclaving at 15 lbs pressure (121 °C) for 15 minutes.

#### **Kanamycin Esculin Azide Agar (M510 Hi-Media, Mumbai)**

| <b>Ingredients</b>      | <b>Amount (gm/litre)</b> |
|-------------------------|--------------------------|
| Tryptone                | 20.000                   |
| Yeast extract           | 5.000                    |
| Sodium chloride         | 5.000                    |
| Sodium citrate          | 1.000                    |
| Esculin                 | 1.000                    |
| Ferric ammonium citrate | 0.500                    |
| Sodium azide            | 0.150                    |
| Kanamycin sulphate      | 0.020                    |
| Agar                    | 12.000                   |
| Final pH ( at 25°C)     | 7.0±0.2                  |

Suspend 44.67 grams in 1000 ml purified / distilled water. Heated to boiling to dissolve the medium completely. Sterilized by autoclaving at 15 lbs pressure (121°C) for 15 minutes.

#### **MR-VP Medium (M070 Hi-Media, Mumbai)**

| <b>Ingredients</b>    | <b>Amount (gm/litre)</b> |
|-----------------------|--------------------------|
| Buffered peptone      | 7                        |
| Dextrose              | 5                        |
| Dipotassium phosphate | 5                        |
| Final pH (at 25°C)    | 6.9±0.2                  |

The broth is boiled to dissolved and dispensed in tubes. Autoclaved at 15 lbs pressure (121 °C) for 15 minutes. Allowed by pouring in plates.

#### **Peptone Water (RM001-500G, Hi-Media, Mumbai)**

| <b>Ingredient</b> | <b>Amount (gm/litre)</b> |
|-------------------|--------------------------|
| Peptone           | 10 g                     |
| Sodium chloride   | 5 g                      |
| Distilled water   | 1000 ml                  |
| Final pH          | 7.2± 0.2                 |

Suspended 15 grams in 1000 ml distilled water and heated to dissolve the medium completely. Dispensed in tubes and sterilized by autoclaving at 15 lbs pressure (121°C) for 15 minutes.

#### **DNase Test Agar base (M482-100G, Hi-Media, Mumbai)**

| <b>Ingredient</b>              | <b>Amount (gm/litre)</b> |
|--------------------------------|--------------------------|
| Casein enzymic hydrolysate     | 15.00                    |
| Papaic digest of soyabean meal | 5.00                     |
| Deoxyribonucleic acid (DNA)    | 22.00                    |
| Sodium chloride                | 5.00                     |
| Agar                           | 15.00                    |
| Final pH (at 25°C)             | 7.3 ± 0.2.               |

42.0 gm of agar was suspended in 1000 ml distilled water and heated with frequent stirring for proper mixing and sterilized at 121°C for 15 mins at 15 lbs psi followed by pouring in plates.

#### **3.5.2 Chemicals/Kits**

|                     |                                |
|---------------------|--------------------------------|
| Kovac's reagent     | R008-100 ml, Hi-Media, Mumbai. |
| Gram's staining kit | K001, Hi-Media, Mumbai         |
| Methyl red          | 1007, Hi-Media, Mumbai         |
| Oxidase discs       | DD018, Hi-Media, Mumbai        |
| α- naphthol         | R009-100ML, Hi-media, Mumbai   |
| Kovac's reagent     | R008-100ml, Hi-media, Mumbai   |

### 3.5.3 Collection of samples

A total number of 30 samples of chicken meat, 3 each from 10 locations of Jammu city were collected. 11gm of each sample was taken in sterilized packs and transported in ice box with all aseptic precautions. The samples were randomly collected from local markets of Jammu city. After collection, all the samples were labelled accordingly and held at 4<sup>0</sup>C until examination. To keep time factor constant between sample collection and analysis, all the samples were analysed within 2-3hrs after collection.

### 3.5.4 Evaluation of meat samples for SPC, CC, SAC and EFC

SPC, CC, SAC and EFC in the samples were enumerated following the methods of American Public Health Association (APHA, 1984) with suitable modifications whenever necessary. For serial dilution, a 11 g portion of meat sample was aseptically weighed and triturated to 99 ml of sterile normal saline solution (NSS) so as to give 10<sup>-1</sup> dilution. The sample was homogenized for uniform dispersion. This was further serially diluted 10 fold till 10<sup>-5</sup> dilution. The count of the microorganisms in meat sample was calculated by using the following formula:

$$\frac{\text{Average no of colonies}}{\text{Dilution factor X volume plated}}$$

#### 3.5.4.1 Standard plate count (SPC):

For evaluating Standard Plate Count (SPC), the standard pour plate technique was followed using 10<sup>-4</sup> and 10<sup>-5</sup> dilutions. From this dilution, 1 ml of the mixture was then transferred in a sterile petri plates in duplicate which were then added with molten agar (Plate Count Agar, Hi-Media Mumbai, India; Code No. M091) and incubated at 37<sup>0</sup>C for 24 h after solidification. Following dilution, plates showing 30-300 colonies were counted using colony counter (Plate 1). Counts were then expressed as log cfu/g .

#### 3.5.4.2 Coliform count (CC):

Coliform was isolated and enumerated using MacConkey agar (Mac Conkey agar, Hi-Media, Mumbai, India; Code No. M 081). Briefly, 0.1 ml of the 10<sup>-2</sup> and 10<sup>-3</sup> dilution were spread plated in duplicate on dried plates of Mac Conkey agar and incubated at 37±2 <sup>0</sup>C for 24h. The presumptive colonies were determined by

counting number of sharp pinkish colonies with about 0.5 mm in diameter and the average numbers of colonies were recorded as log cfu/g of sample (Plate 3). *E.coli* colonies were further confirmed by streaking 4-5 colonies on to EMB agar (Eosin-methylene-blue agar, Hi-Media, Mumbai, India; Code No. MU 022) and colonies with typical metallic sheen (Plate 4) were further confirmed by biochemical tests using HiMViC™ test kit (Hi-Media, Mumbai, India; Code No. KB 010) and other biochemical tests (Plate 11 & 12).

#### **3.5.4.3 *Staphylococcus aureus* count (SAC):**

Baird Parker agar (BPA, Hi-Media Mumbai, India; Code No. M 1140) was used for isolation and enumeration of *Staphylococcus aureus*. Briefly, 0.1 ml of the  $10^{-2}$  and  $10^{-3}$  dilution were spread plated in duplicate on dried plates of Baird Parker agar with egg yolk tellurite emulsion (Hi-Media Mumbai, India; Code No. FD 046) and incubated at 37 °C for 24h. The presumptive colonies were determined by counting number of typical morphology (grey-black, shiny convex colony with a narrow entire margin surrounded by a zone of clearing) (Plate 2). Average numbers of colonies were recorded as log cfu/g of sample. Colonies were further confirmed by DNase test (Plate 7).

#### **3.5.4.4 *Enterococcus faecalis* count (EFC):**

*Enterococcus faecalis* count were estimated by use of Slanetz and Bartley medium (Slanetz and Bartley medium, Hi-Media, Mumbai, India; Code No. 612). Briefly, 0.1 ml of the  $10^{-2}$  and  $10^{-3}$  dilution were spread plated in duplicate on dried plates on Slanetz and Bartley medium and incubated at 37 °C for 24–48 h. Typical colonies of red or maroon colour with about 0.5 mm diameter were counted and the average numbers of colonies were recorded as log cfu/g of sample (Plate 5). The presumed colonies were analyzed for Gram staining. The colonies having Gram positive cocci that occur in pairs or short chain and further subjected to subculturing on an aesculin-containing agar followed by incubation at 44°C for 18-24 hrs for confirming the identity of colonies (Plate 6).

### 3.6 Interpretation of results

Below mentioned are the guideline levels for determining the microbiological quality for raw meat (Bureau of Indian Standard, 1995; FSSAI, 2011)

|                              | Satisfactory | Marginal    | Unsatisfactory |
|------------------------------|--------------|-------------|----------------|
| Standard plate count (cfu/g) | $<10^4$      | $<10^5$     | $\geq 10^5$    |
| <i>E. coli</i> (cfu/g)       | $<3$         | 3-100       | $\geq 100$     |
| <i>S. aureus</i> (cfu/g)     | $<10^2$      | $10^2-10^3$ | $10^3-10^4$    |
| <i>E. faecalis</i> (cfu/g)   | $<10^2$      | $10^2-10^3$ | $10^3-10^4$    |

### 3.7 Identification and characterization of isolated bacterial pathogens

#### 3.7.1 Gram's staining

All the presumed cultures of *Staphylococcus* spp., *E. coli* and *Enterococcus faecalis* were subjected to Gram's staining and observed for Gram's reaction, size, shape and arrangement of cells (Plate 8-10).

**Table 3.1: Characteristics of bacterial pathogens on selective agar and Gram's staining**

| S.No. | Bacteria                     | Media used   | Colony characteristics  | Gram's Staining                           |
|-------|------------------------------|--|---|---|
| 1     | Coliform count               | i) MacConkey agar<br>ii) Eosin methylene blue agar | i) Pink to rose-red colonies. Colonies may be surrounded by a zone of precipitated bile<br>ii) Green metallic sheen on EMB  | Gram negative rod-shaped bacterium        |
| 2     | <i>S. aureus</i>             | i) Baird- Parker agar<br>ii) Mannitol salt agar    | i) Circular, smooth, convex, moist, 2-3 mm in diameter, gray to jet black colonies, frequently surrounded by a halo on BPA<br>ii) Yellow coloured colonies on MSA | Gram positive cocci (grape like clusters) |
| 3     | <i>Enterococcus faecalis</i> | Slantez and Bartley agar                           | Typical colonies of red or maroon colour with about 0.5 mm diameter.  | Gram positive cocci pairs or short chains |

### **3.7.2 Biochemical characterization**

#### **3.7.2.1 Catalase test**

A colony of bacteria was taken over a clean microscopic slide, a loopful of 3 per cent H<sub>2</sub>O<sub>2</sub> was added. Prompt effervescence indicated catalase production indicating a positive result.

#### **3.7.2.2 Indole test**

This test demonstrates the ability to decompose the amino-acid tryptophan to indole. The test culture was inoculated in 2 % tryptone water followed by incubation at 37<sup>0</sup>C for 48 to 96 hours. After incubation, 0.5 ml Kovac's reagent was added to the culture medium and shaken gently. Appearance of red colour indicated positive reaction.

#### **3.7.2.3 Methyl red test**

The test was performed by inoculating glucose phosphate peptone water (MR-VP broth) with test organism and incubated at 37<sup>0</sup>C for 24 to 48 hrs. Appearance of red colour upon addition of methyl red indicator indicated positive reaction.

#### **3.7.2.4 Voges- Proskauer test**

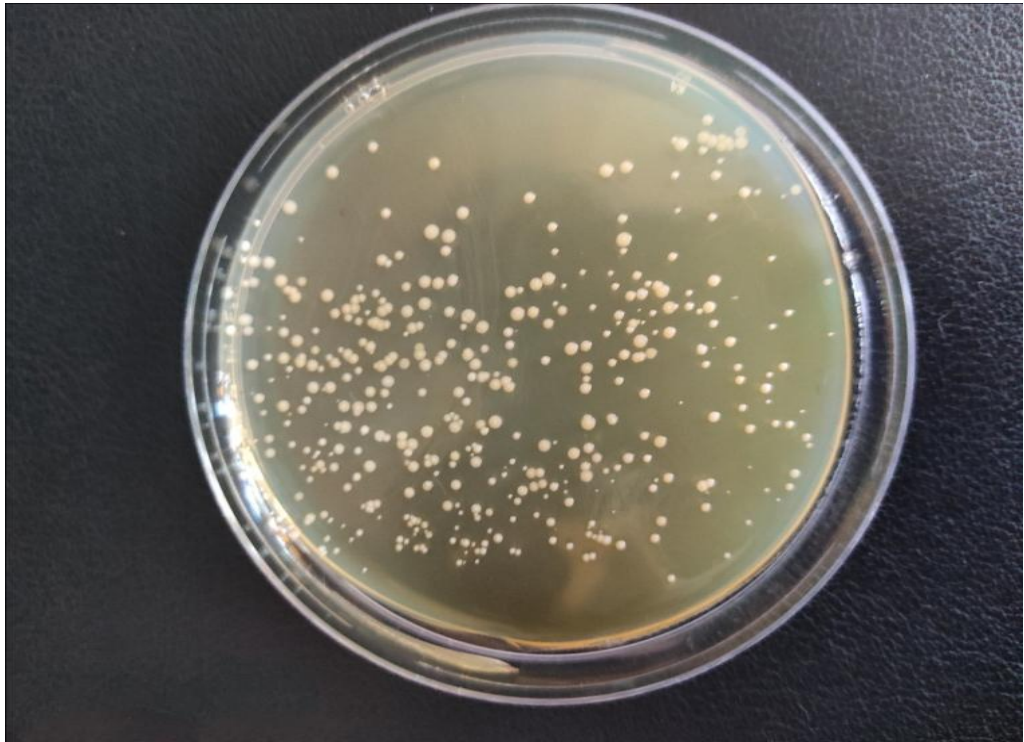
Five ml of glucose phosphate peptone water (MR-VP Broth) Hi-Media Pvt. Ltd. was inoculated with isolated organism and incubated at 37<sup>0</sup>C for 48 hours. Then 1 ml of 40 per cent potassium hydroxide and 3 ml of 5 per cent  $\alpha$ -naphthol (in absolute ethanol) were added. Appearance of red colour indicated a positive reaction.

#### **3.7.2.5 Citrate utilization test**

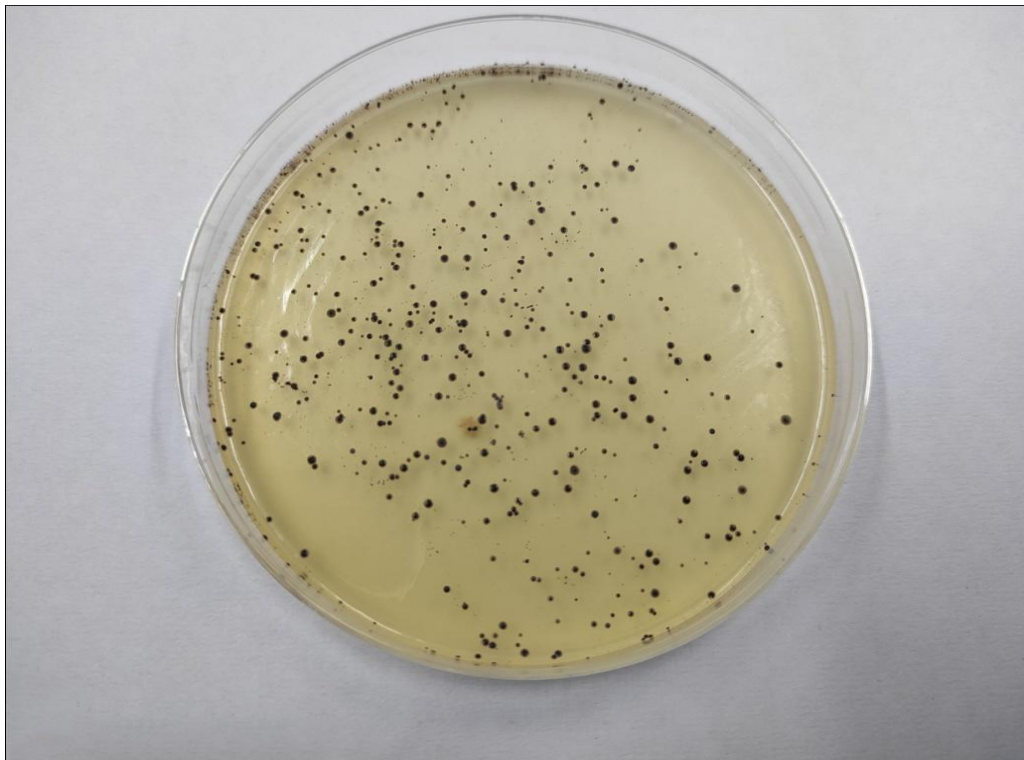
Simmons's citrate medium was used to detect ability of the organism to utilize citrate as the sole source of carbon and energy for growth and an ammonium salt as the sole source of nitrogen. The test was carried out by inoculating Simmon's citrate media with test organism and incubating at 37<sup>0</sup>C up to 48-96 hrs. Change in green solid slant to blue indicated a positive reaction. No change in colour indicated negative results.

#### **3.7.2.6 Triple sugar iron test (TSI)**

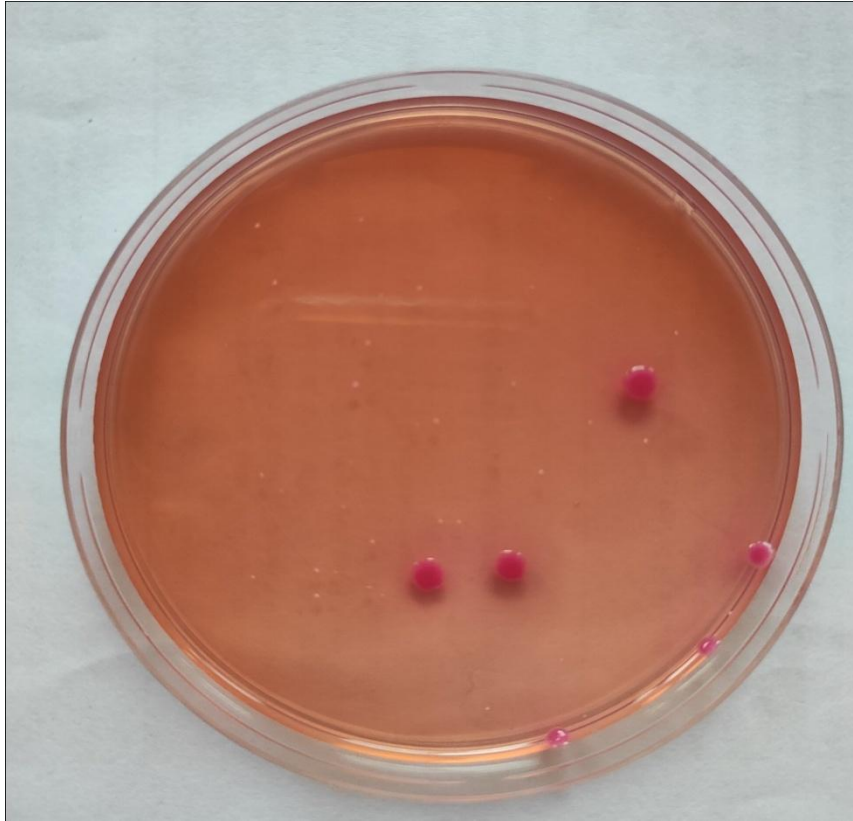
The test organism was inoculated on TSI agar (Hi-Media, Mumbai, India). The needle was stabbed to the bottom of the butt and then the needle was drawn over



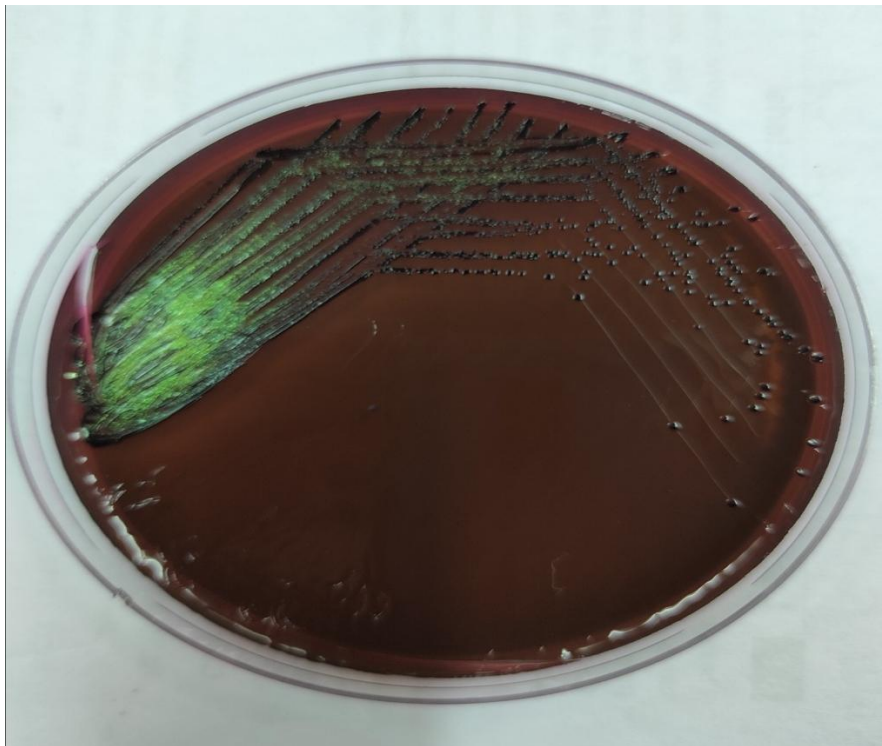
**Plate 1. Standard plate count on plate count agar medium.**



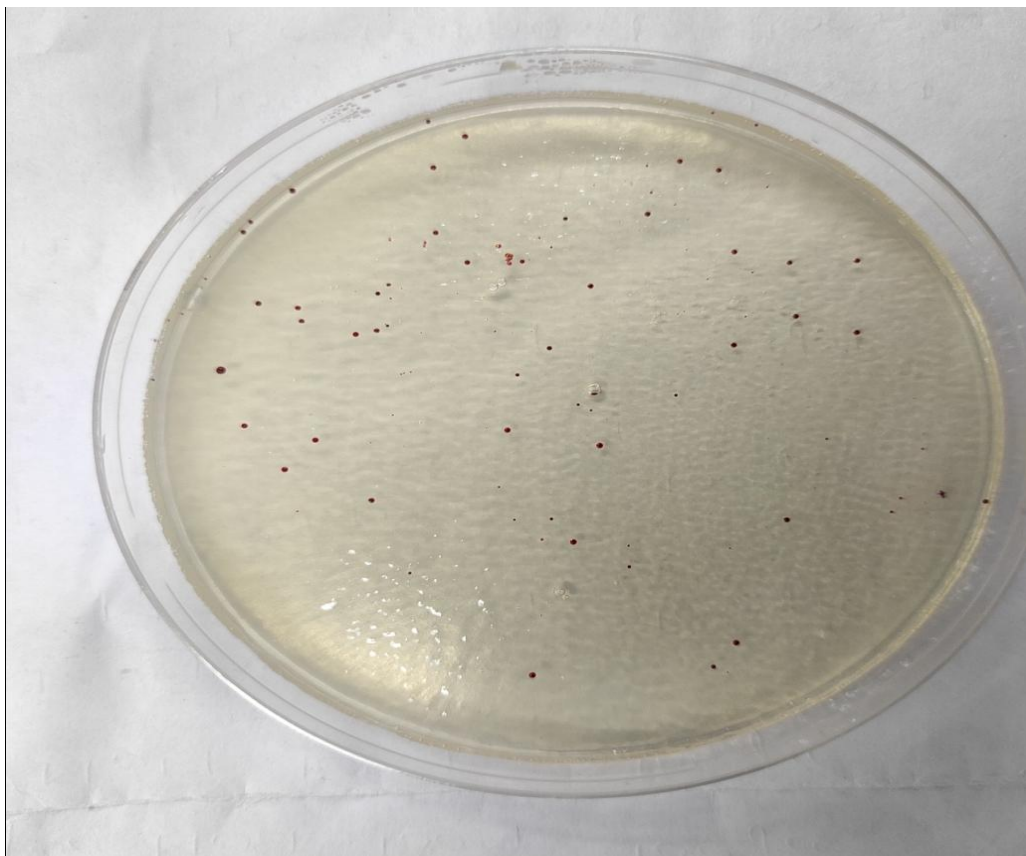
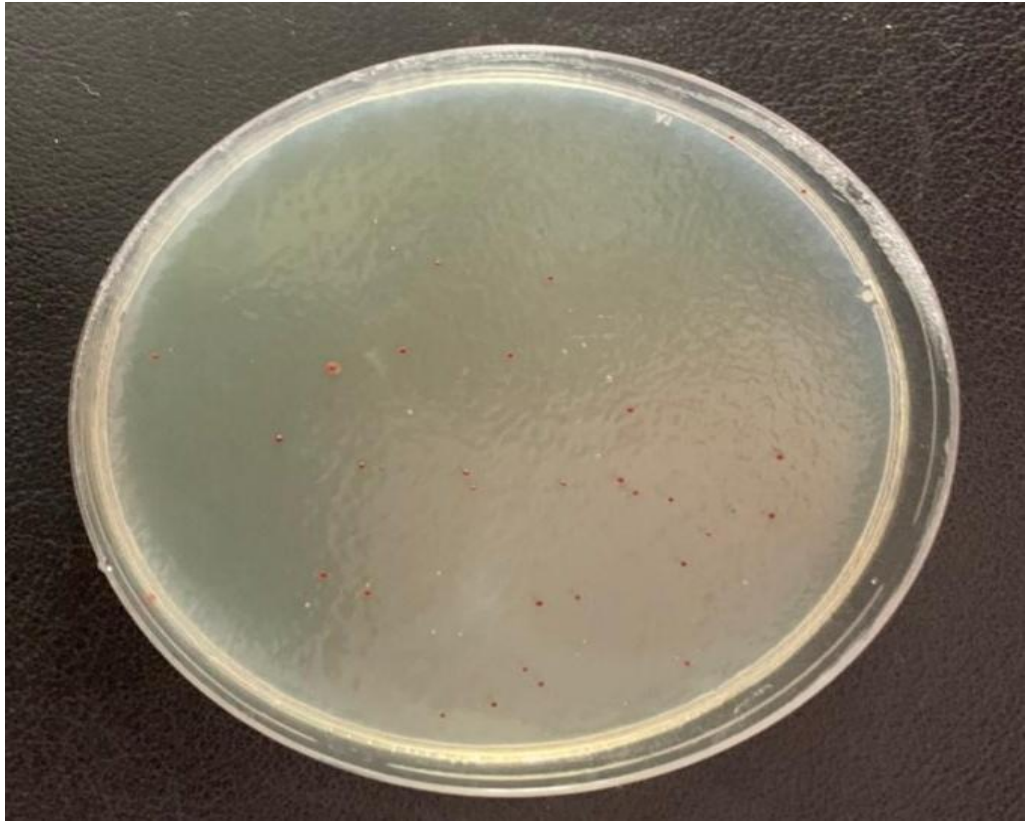
**Plate 2. *Staphylococcus aureus* count on Baird Parker agar medium.**



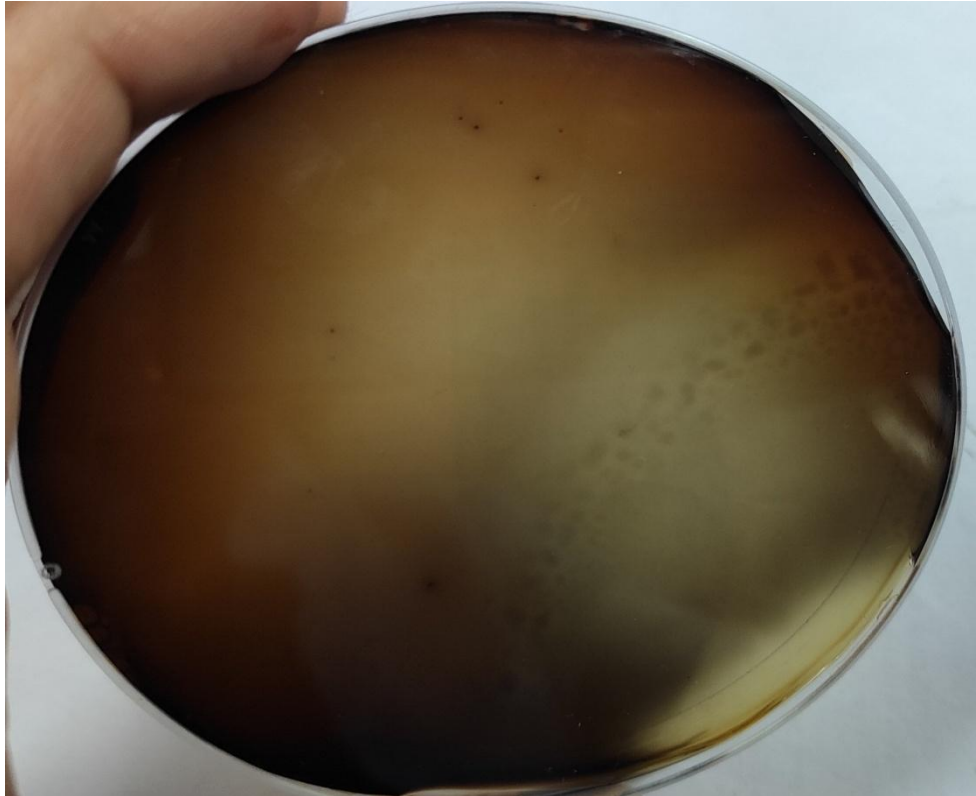
**Plate 3. Pink colonies of *E. coli* on MacConkey agar plate.**



**Plate 4. Greenish metallic sheen of *E. coli* on Eosin Methylene Blue Agar plate.**



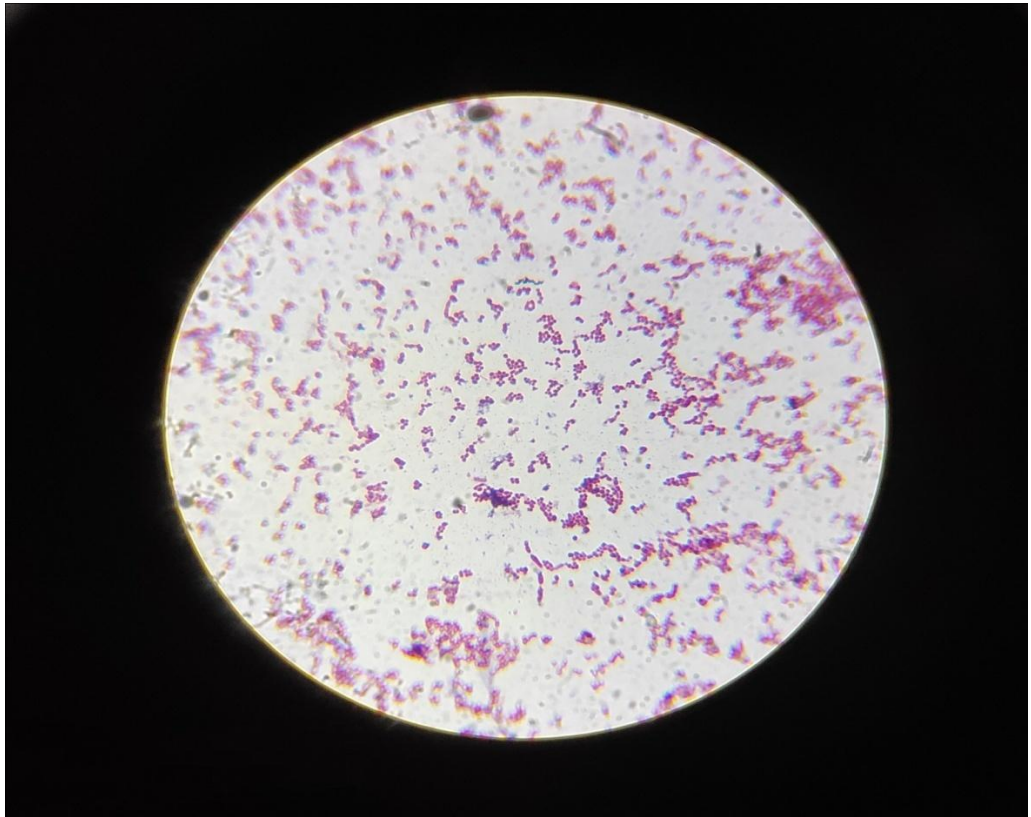
**Plate 5. Red or maroon colour colonies of *Enterococcus faecalis* on Slantez and Bartley Agar Plate.**



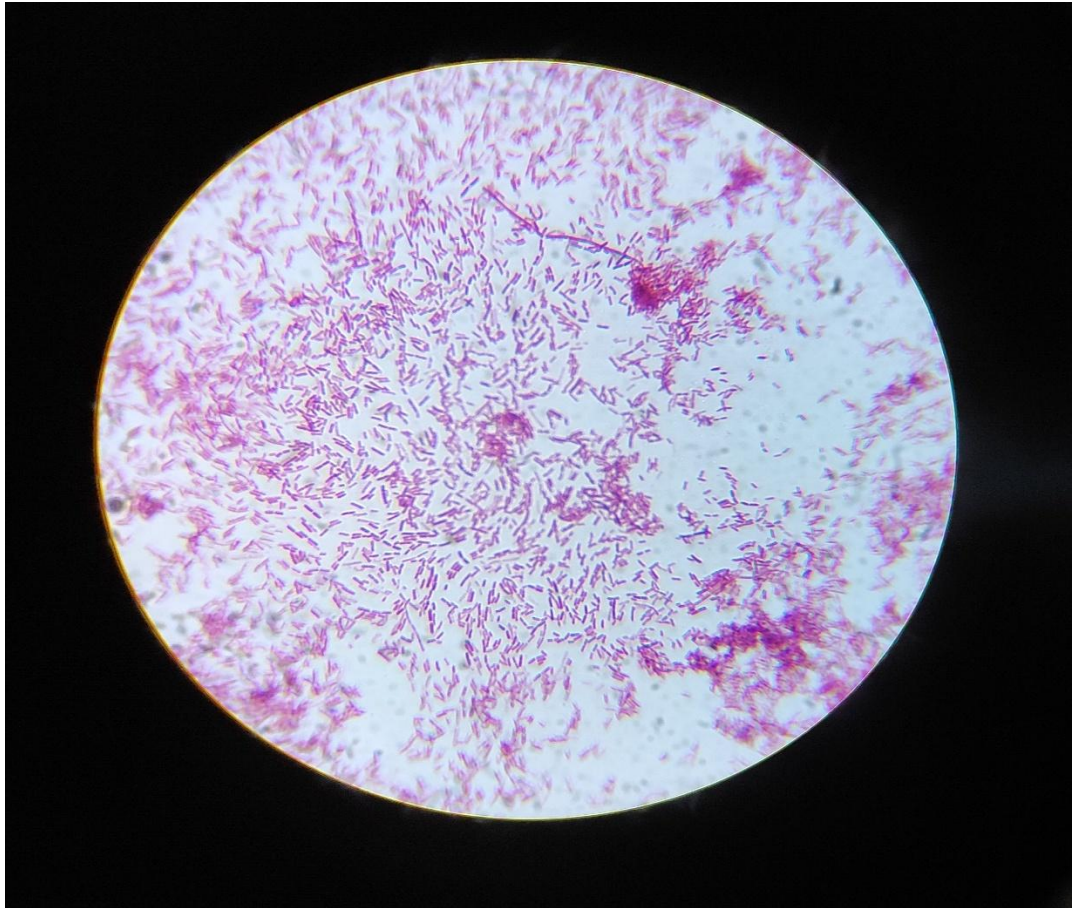
**Plate 6. Bile Esculin Azide Agar showing a zone of black precipitate around the colonies of *Enterococci faecalis*.**



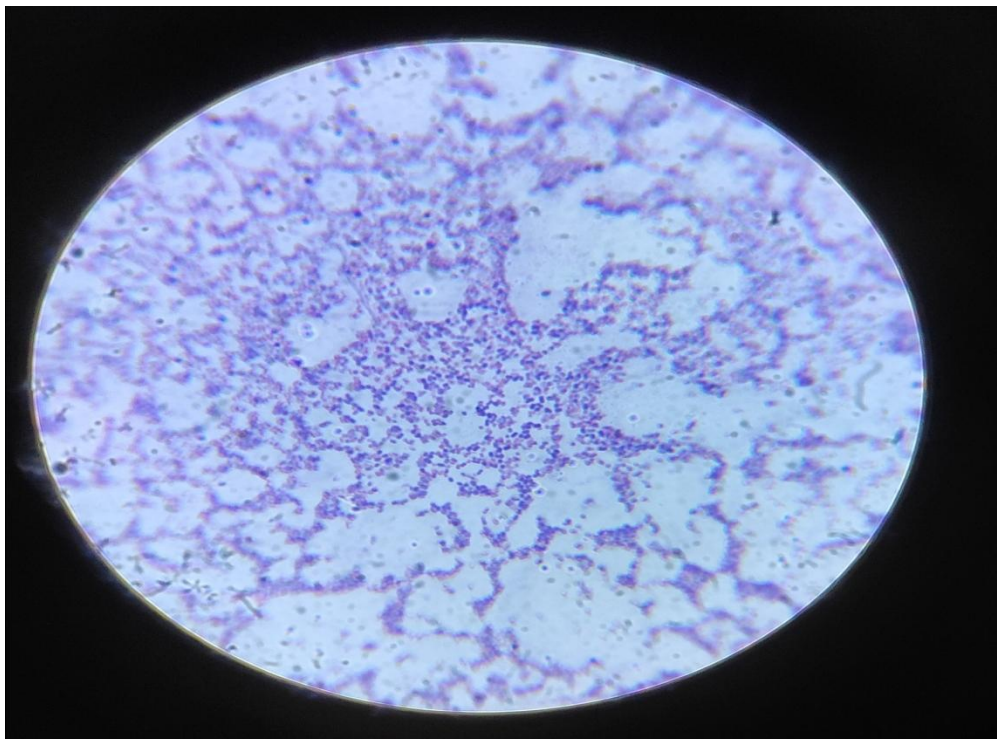
**Plate 7. DNase test for *Staphylococcus aureus*.**



**Plate 8.**Gram's staining showing cocci pairs or short chains shaped *Enterococcus faecalis*.



**Plate 9.**Gram's staining showing rod shaped *E. coli*.



**Plate 10.**Gram's staining showing grape bunch shaped *Staphylococcus aureus*.



**Plate 11. IMVIC test for *E. coli* (Indole Test showing Positive, Methyl Red test showing positive, Voges-Proskauer test showing negative and Citrate Utilisation Test showing negative results for *E. coli*).**



**Plate 12. Triple Sugar Iron Test for *E. coli*.**

the slant so as to produce sufficient surface growth and incubated at 37<sup>0</sup>C for 24hrs. After incubation, the TSI agar was examined carefully to estimate different reaction. The tubes showed acid butt (yellow), acid slant with gas production and no H<sub>2</sub>S production for *Escherichia coli*.

#### **3.7.2.7 DNase test.**

DNA hydrolysis test or Deoxyribonuclease (DNase) test is used to determine the ability of an organism to hydrolyse DNA to utilize it as a source of carbon and energy for growth. The test is used to differentiate *S. aureus* from other Staphylococci, which do not produce the enzyme responsible for hydrolysis. The DNase test is particularly useful when plasma is not available to perform the “Coagulase test” or the results of a coagulase test are difficult to interpret as there is high correlation between *S. aureus* for coagulase and DNase production. For this test, Staphylococcus isolate was streaked on DNase agar plate and incubated at 37<sup>0</sup>C for 24 hrs. After that 1percent HCl was poured over it. The plates with positive results showed a clear zone around the streaked area indicating DNA hydrolysis.

### **3.8 Statistical analysis**

Data from questionnaire were tabulated. The frequency and the percentage were determined and stored in excel sheet for the statistical analysis. The Statistical Package for the Social Science (SPSS) and Statistical Analysis System (SAS) was applied. All the bacterial counts were properly tabulated; their mean values and standard deviation were computed. The mean values of all the bacterial counts were subjected to Duncan Multiple Range Test (Duncan,1955) and Analysis of Variance to test the differences between locations/outlets and the mean values of different bacterial counts.

## Chapter-4

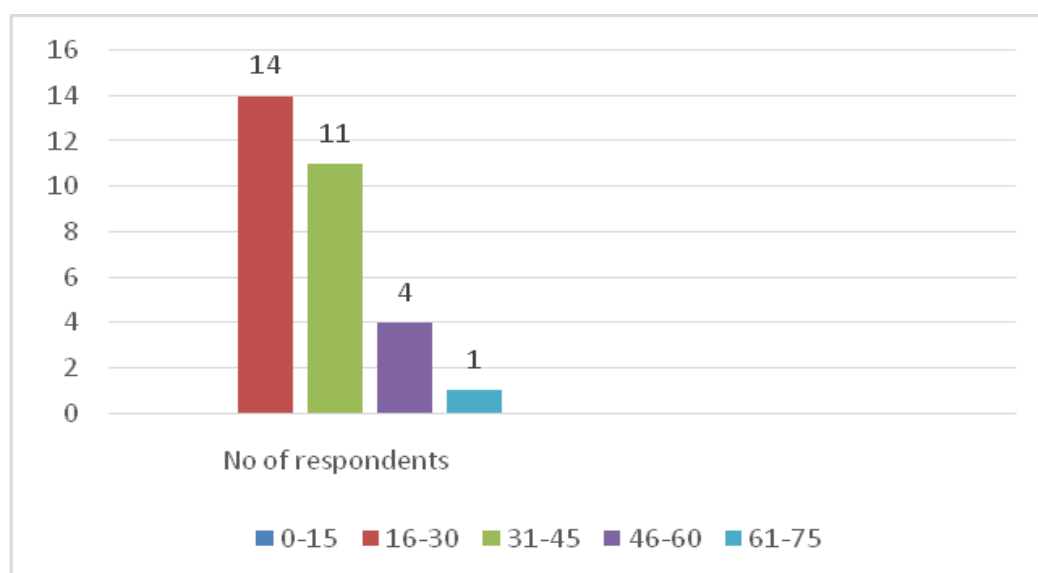
# *Results*

The present investigation entitled, “Assessment of hygiene practices followed by retailers and butchers of small slaughtering premises in Jammu city” was carried out during the two consecutive years i.e. 2020 and 2021 with an objective to assess the hygienic practices followed by retail shopkeepers and butchers, risk factors for meat contamination in the production chain and bacteriological quality of meat at both the retailers and butchers’ level with the help of indicator organisms. The results obtained are presented under the following heads:

### 4.1. Social characteristics of respondents.

#### 4.1.1. Age and Sex distribution of respondents.

A total number of 30 respondents were interviewed during study and all the respondents were observed to be males. The average age of all the respondents was 34years and maximum of the respondents (14) came under the category of 16-30 age group followed by (11) in the age group of 31-45 years. However, only one candidate was found in the category of 51-65 age group. (Table 4. 1, Fig 4.1).



**Fig.4.1. No. of respondents in different age groups**

**Table 4.1. No. of respondents in different age groups.**

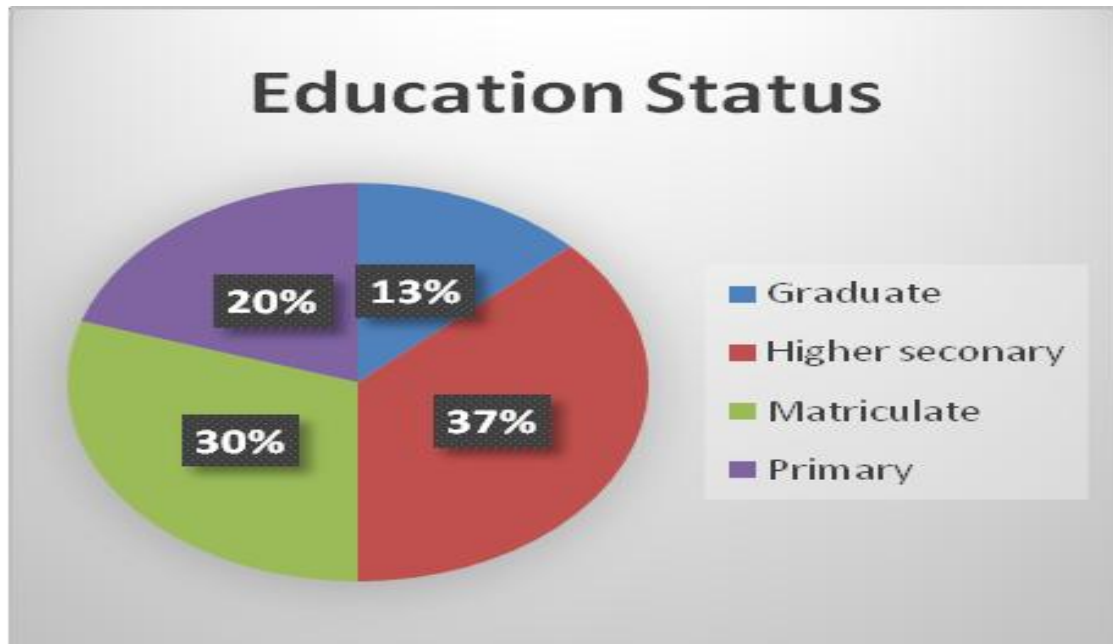
| <b>Age group<br/>(In years)</b> | <b>No of the respondents</b> |
|---------------------------------|------------------------------|
| 0-15                            | 0                            |
| 16-30                           | 14                           |
| 31-45                           | 11                           |
| 46-60                           | 4                            |
| 61-75                           | 1                            |

**4.1.2. Education status.**

The educational attainment of the respondents was evaluated in terms of different levels of school education. 37% of the respondents had acquired education up to higher secondary level. 30% of the respondents were matriculate, whereas 20% of the respondents had acquired only primary education. Out of the total respondents, only 13% were graduate. The level of schooling was found highly significant (Table 4.2, Fig.4.2).

**Table 4.2. Education status of the respondents**

| <b>Level of Schooling</b> | <b>Number (%)</b> | <b>Chi square test<br/>Likelihood ratio)</b> |
|---------------------------|-------------------|--|
| Graduate                  | 4.0 (13.0)        | 4.00 <sup>ns</sup>                           |
| High Secondary            | 11.0 (37.0)       |  |
| Matriculate               | 9.0(30.0)         |  |
| Primary                   | 6.0(20.0)         |  |



**Fig.4.2. Education status of the respondents**

#### **4.1.3. Infrastructure details.**

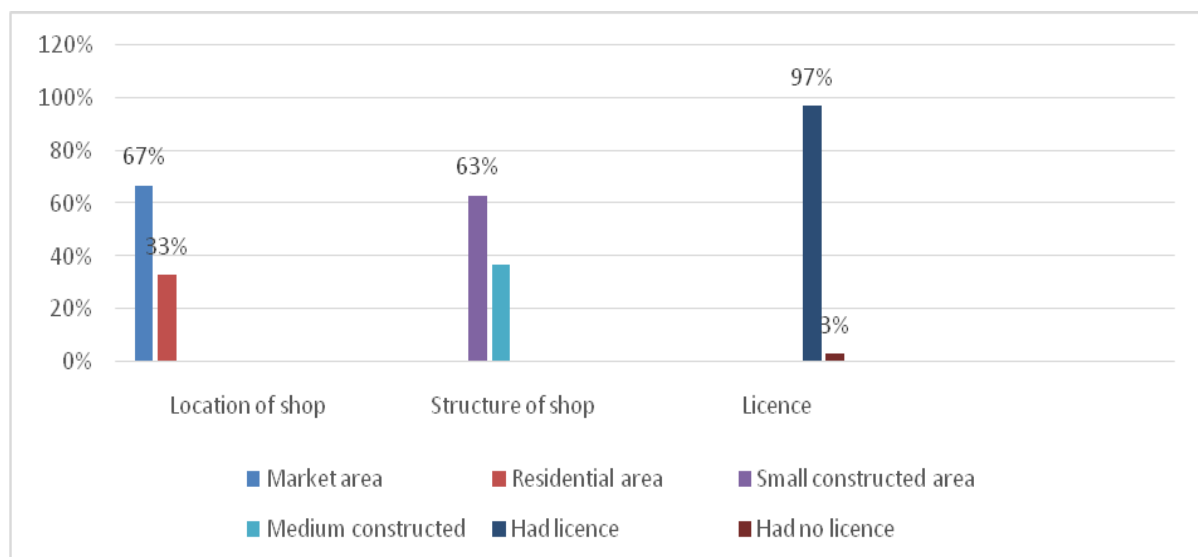
##### **4.1.3.1. Location and structure of shops.**

The location of 67 percent shops (20 shops) was in the main market area, whereas 10 shops were located in residential area (63% of the shops were small constructed shops whereas 37% were medium size.

The location of shops in market area are at par with residential area and small structures shops are also at par with medium constructed shops as indicated by chi square test (Table 4.2). The respondents under study differed significantly with respect to holding license of the shop for doing. Further, the location and structure of the shop were found non-significant whereas the frequency related to respondents with and without license were significant as indicated by chi square test (Table 4.2). Majority of the shops (97%) were operational with proper licensing from municipal authorities to do the business. (Table 4.3, Fig.4.3)

**Table 4.3. Location and Structure of Shop**

| Location and Structure of Shop(n=30) | Number (%) | Chi square test (Likelihood ratio) |
|--------------------------------------|------------|------------------------------------|
| <b>Location of shop</b>              |            |                                    |
| Market area                          | 20(67.0)   | 3.39 <sup>ns</sup>                 |
| Residential area                     | 10(33.0)   |                                    |
| <b>Structure of shop</b>             |            |                                    |
| a) Small constructed shop            | 19(63.0)   | 2.15 <sup>ns</sup>                 |
| b) Medium constructed shop           | 11(37.0)   |                                    |
| <b>Licence</b>                       |            |                                    |
| a) with licence                      | 29(97.0)   | 32.82 <sup>**</sup>                |
| b) without licence                   | 01(3.0)    |                                    |

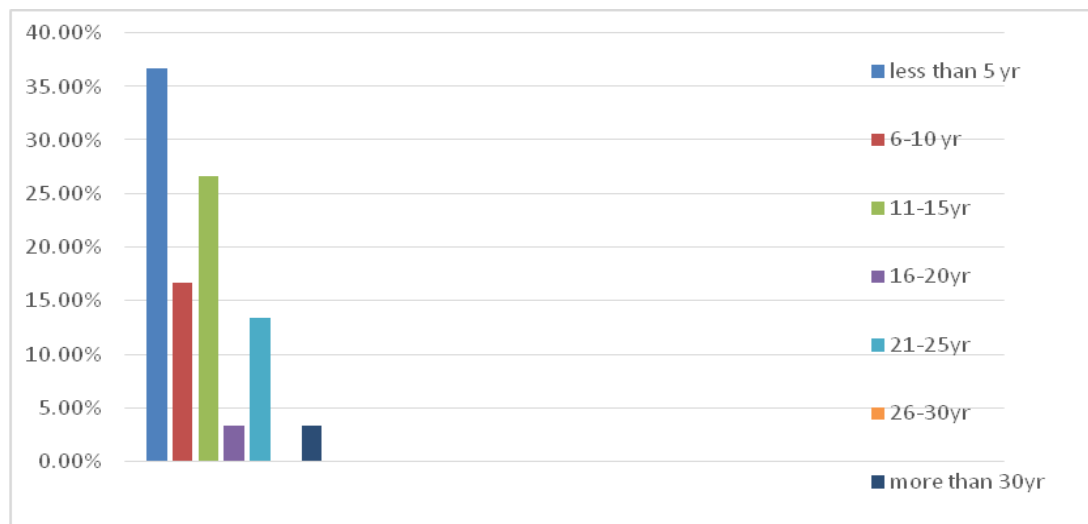
**Fig.4.3. Location and Structure of Shop**

#### 4.1.4. Distribution of respondents according to working experience in slaughtering.

The average working experience in slaughtering was 9.06 years with a minimum of 1 year and maximum of 30 years. The majority of the respondents (37%) had experience of less than 5 years of slaughtering followed by 26% of the respondents with experience of 11-15 years (Table 4.4, Fig. 4.4)

**Table 4.4: Years of involvement in slaughtering job.**

| Years | Number (%) | percentage |
|-------|------------|------------|
| ≤5    | 11(36.66)  | 36.66      |
| 6-10  | 5(16.66)   | 16.66      |
| 11-15 | 8(26.06)   | 26.06      |
| 16-20 | 1(3.33)    | 3.33       |
| 21-25 | 4(13.33)   | 13.33      |
| 26-30 | 0(0)       | 0          |
| ≥30   | 1(3.33)    | 3.33       |

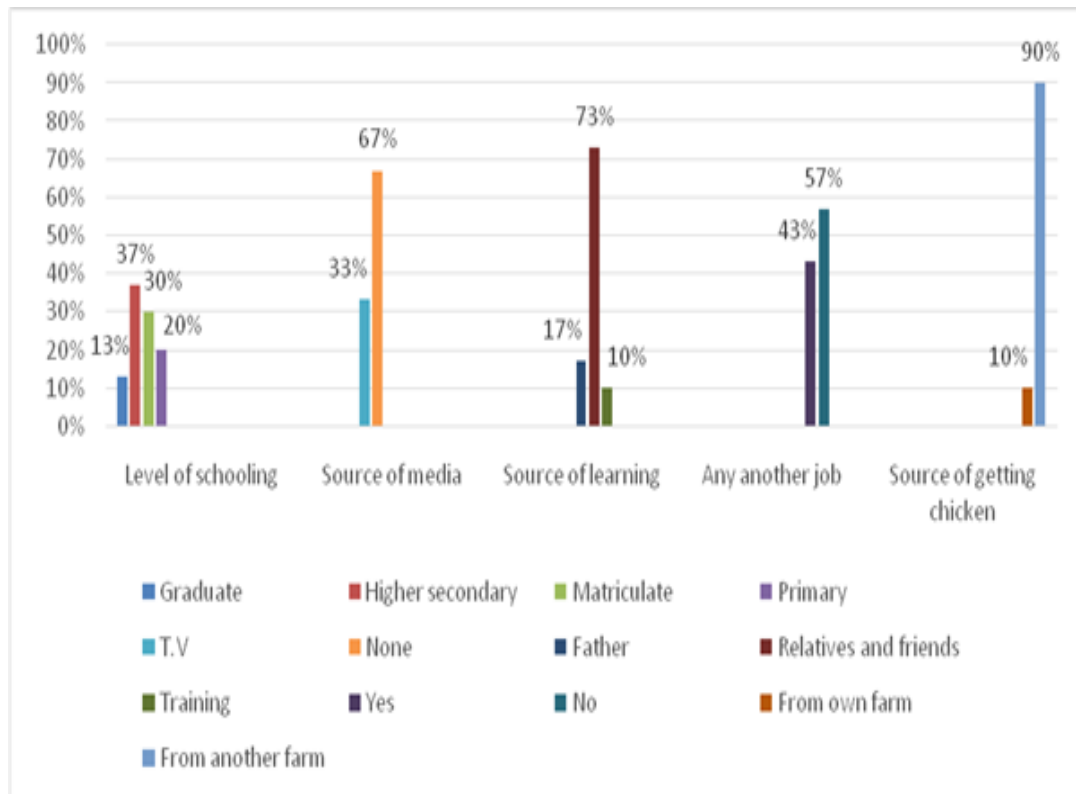
**Fig.4.4. Years of involvement in slaughtering job****4.1.5. Other details of butchers.**

All the butchers surveyed under study had own shops. The slaughtering was the sole income earning activity for 43% of the respondents. Majority of the butchers (67%) had no T.V as source of media and no significant differences were found for the sources of media among the butchers,73% butchers had got training from their friends and relative followed by their parents (17%). Only 10% of the butchers got training from specialized sources. All the butchers differed significantly for sources of learning significantly for learning the slaughtering job. Out of the 30 butchers ,17% got training from father and 73% from relatives and friends. Only 10%butchers received from specialized source. Out of the 30 butchers surveyed, only 13 butchers had additional job and rest of the butchers had no alternative job. The present study

revealed that 36.7 percent butchers on an average slaughtered chicken per day. The source of chicken slaughtered in 90 percent of the shops was from own farms and found statistically significant. (Table 4.5, Fig .4.5)

**Table 4.5. Butcher's detail**

| <b>Butchers Detail</b>      |                   |   |
|-----------------------------|-------------------|---|
| <b>Item</b>                 | <b>Number (%)</b> | <b>Chi square test (Likelihood ratio)</b> |
| 1.Source of Media           |                   |   |
| a)T.V                       | 10.0(33.0)        | 3.39 <sup>ns</sup>                        |
| b)None                      | 20(67.0)          |   |
| 2.Source of Learning        |                   |   |
| a)Father                    | 5(17.0)           | 20.53 <sup>**</sup>                       |
| b)Relative and Friends      | 22(73.0)          |   |
| c)Training                  | 3(10.0)           |   |
| 3.Any other job             |                   |   |
| a)Yes                       | 13.0(43.0)        | 0.53 <sup>ns</sup>                        |
| b)No                        | 17.0(57.0)        |   |
| 4.Source of getting chicken |                   |   |
| a) From own farm            | 3.0(10)           | 22.08 <sup>**</sup>                       |
| b) From other farm          | 27(90.0)          |   |



**Fig.4.5. Butcher's detail**

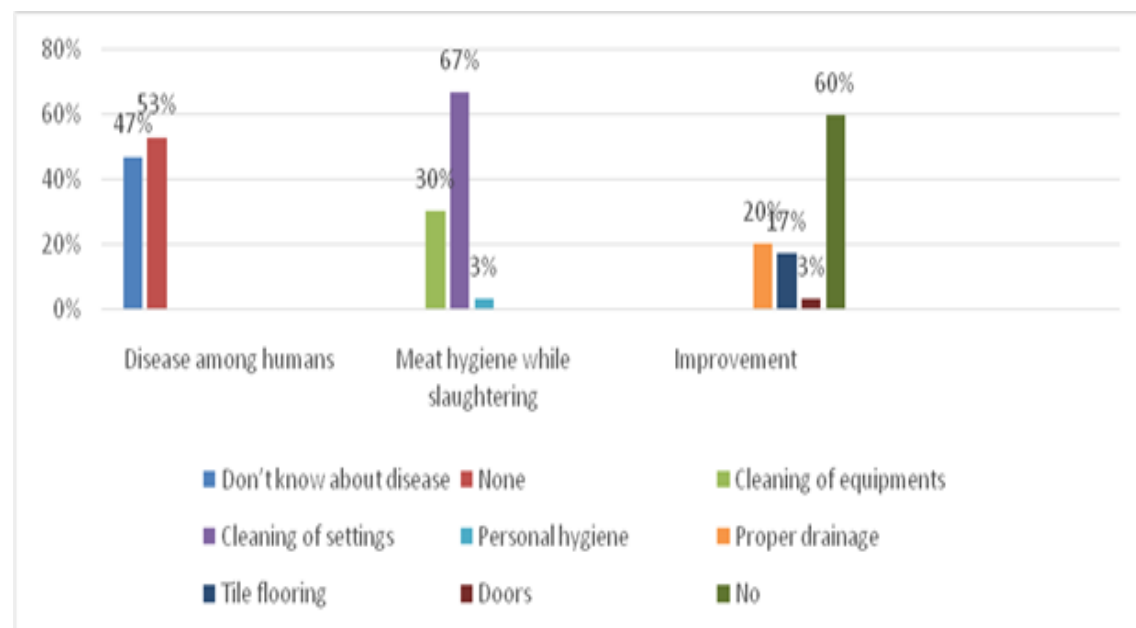
#### 4.2. Awareness level of butchers

The survey concluded in 10 locations of Jammu city revealed that 47 percent of butchers had no knowledge about any disease like diarrhoea, fever, cough, itching, warts etc after eating poultry meat. Fifty three percent believed that there was no occurrence of any disease from poultry/meat.

Regarding hygienic aspects of slaughtering, 37%, 67% and 3% were aware of cleaning of equipment, cleaning of settings and personal hygiene, respectively. All the butchers differed significantly with respect to these three hygienic aspects. However, were aware about the occurrence of diseases among humans as indicated by Chi square test (Table 6). Twenty percent of the butchers were aware regarding maintenance of proper drainage and proper tile flooring. Twelve percent and three percent wanted proper doors in their shops. Sixty percent butchers wanted no improvement in their existing infrastructure. (Table 4.6, Fig. 4.6)

**Table 4.6. No. of the respondents and the Chi square test**

| Awareness  | Number (%) | Chi square (likelihood ratio) |
|--|------------|-------------------------------|
| <b>Occurrence of disease among human because of eating meat</b>              |            |                               |
| a. Don't know about the disease  | 14 (47)    | 0.133 <sup>ns</sup>           |
| b. None.   | 16 (53)    |                               |
| <b>Hygienic aspects to maintain while slaughtering</b>                       |            |                               |
| a. Cleaning of equipments.   | 9 (30)     | 21.22 <sup>**</sup>           |
| b. Cleaning of settings  | 20 (67)    |                               |
| c. Personal hygiene  | 1 (3)      |                               |
| <b>Type of improvement for butchering job to maintain hygienic practices</b> |            |                               |
| a. Proper drainage   | 6(20)      | 20.75 <sup>**</sup>           |
| b. Tile flooring   | 5(17)      |                               |
| c. Doors   | 1(3)       |                               |
| d. No  | 18(60)     |                               |

**Fig.4.6. Awareness level of butchers.**

### 4.3 Observations on hygienic practices

#### 4.3.1. Cleanliness of equipments

The facilities of cleanliness of equipment were almost adequate except sanitization of equipment before the start of new period of work. Ninety percent of the facilities had a rust-free knife (corrosion of resistance) and 76.66% had clean cutting and rust-free slab. Ninety seven percent of the butchers had cleaned their knife before start of new work and only 20 and 33.3 percent sanitized their knives and slabs respectively before initiating new work (Table 4.7).

**Table 4.7. Cleanliness of Equipments.**

| <b>A. Cleanliness of Equipments</b>        |                 |                |
|--|-----------------|----------------|
| <b>Knife</b>                               | <b>Yes/ (%)</b> | <b>No/ (%)</b> |
| 1.Good state of repair                     | 27(90.0)        | 3(10.0)        |
| 2.Corrosion / resistance                   | 27(90.0)        | 3(10.0)        |
| 3.Clean before each new period of work     | 29(96.6)        | 1(3.33)        |
| 4.Sanitized before each new period of work | 6(20.0)         | 24(80.0)       |
| <b>Slab</b>                                |                 |                |
| 1.Good state of repair                     | 23(76.6)        | 7(23.3)        |
| 2.Corrosion/ resistance / rust free status | 23(76.6)        | 7(23.3)        |
| 3.Clean before each new period of work     | 28(93.3)        | 2(6.6)         |
| 4.Sanitized before each new period of work | 10(33.3)        | 20(66.6)       |

### 4.3.2. Cleanliness of settings

All the shops surveyed had clean floor (80%), good drainage facilities in the floor (70%) and proper sloppy floor (73.3%). Fifty six percent shops had maintained the facilities of disinfectants in their shops. None of the shop was found free from insects and stray animals. The stray animals (50%) and insects including flies (70%) were reported by the butchers. All the butchers had clean lairage (46.6%), clean feed (83.3%), clean drinking water (73.3%) and good drainage facilities (46.6%) (Table 4.8).

**Table 4.8. Cleanliness of setting**

| <b>B. Cleanliness of Setting</b> |                 |                |
|----------------------------------|-----------------|----------------|
| <b>Floor</b>                     | <b>Yes /(%)</b> | <b>No/ (%)</b> |
| 1.Clean                          | 24(80.0)        | 6(20.0)        |
| 2.Good Drainage                  | 21(70.0)        | 19(63.0)       |
| 3.Sloppy                         | 22(73.3)        | 18(60.0)       |
| 4.Disinfected                    | 17(56.6)        | 13(43.3)       |
| <b>Sewage</b>                    | 16(53.3)        | 14(46.6)       |
| <b>c)Animal and Insects</b>      |                 |                |
| 1.Insects                        | 21(70.0)        | 19(30.0)       |
| 2.Animals                        | 15(50.0)        | 15(50.0)       |
| <b>Lairage (Cage)</b>            |                 |                |
| 1.Sufficient clean               | 14(46.6)        | 16(53.3)       |
| 2.Clean feed                     | 25(83.3)        | 5(16.6)        |
| 3.Clean drinking water           | 22(73.3)        | 8(26.6)        |
| 4.Good Drainage                  | 14(46.6)        | 16(53.3)       |

### 4.3.3. Other hygienic facilities

Only 50 and 70% of the shops had availability of hot and cold water respectively. Majority of the shops (90%) had adequate lightening. Ten percent of butchers were frequently disposing the poultry by products and waste material. Only 36.6% had disposed their byproduct safely. (Table 4.9)

**Table 4.9 Other Facilities**

| C. Other Facilities(n=30)      |                 |                |
|--------------------------------|-----------------|----------------|
| <b>Water</b>                   | <b>Yes/ (%)</b> | <b>No/ (%)</b> |
| a) Availability of hot water   | 15(50.0)        | 15(50.0)       |
| b) Availability of cold water  | 21(70.0)        | 9(30.0)        |
| <b>Lightings</b>               | 27(90.0)        | 3(10.0)        |
| <b>Disposal of By Products</b> |                 |                |
| a) Frequently                  | 3(10.0)         | 27(90.0)       |
| b) Safely                      | 11(36.6)        | 19(63.3)       |

### 4.3.4. Cleaning and sanitation

In general, 100,30 and 10 percent shops used detergents, disinfectant and soap, respectively (Table 4.10)

**Table 4.10. Cleaning and sanitation.**

| <b>2. Cleaning and Sanitation</b> | <b>Yes (%)</b> | <b>No (%)</b> |
|-----------------------------------|----------------|---------------|
| 1. Use of soap                    | 30(100.0)      | 0             |
| 2. Use of disinfectant            | 9(30.0)        | 21(70.0)      |
| 3. Use of detergent               | 3(10.0)        | 27(90.0)      |

### 4.3.5. Poultry and meat health

Most of the butchers (83%) had selected healthy birds for slaughtering. Only 50% butchers had given the importance to cleanliness of birds. Ninety percent of the butchers had withheld feed 24hrs prior to culling. None of the butchers had maintained the history of flock under slaughter. Only 83.3% butchers had washed the

carcass before evisceration and after evisceration. Only 20 percent butchers had performed by product inspection of viscera .None of the retail/outlet had any system for poultry and meat certification by any competent authority. (Table 4.11).

**Table 4.11 Poultry and Meat Health.**

| Poultry and Meat Health            |                |               |
|------------------------------------|----------------|---------------|
| <b>Slaughtering Birds</b>          | <b>Yes (%)</b> | <b>No (%)</b> |
| a) Healthy                         | 25(83.3)       | 5(16.6)       |
| b) Clean                           | 15(50.0)       | 15(50.0)      |
| <b>Withheld feed before 24 hrs</b> | 27(90.0)       | 3(10.0)       |
| <b>History of Flock</b>            | 0              | 30(100)       |
| <b>By Product Inspection</b>       |                |               |
| a) Viscera                         | 6(20.0)        | 24(80.0)      |
| b) Inedible Products               | 7(23.3)        | 23(76.6)      |

#### **4.3.6. Cross Contamination.**

The chance of cross contamination of meat was present in almost all the facilities in majority of the cases (40%). The carcass was also found to come in contact with the floor due to carelessness on the part of the butchers.

#### **4.4. Practices of butchers.**

##### **4.4.1 Protective clothing.**

It was observed that 63.3, 60 and 76.6% of butchers had used light coloured, clean and easily cleanable clothes, respectively. About 80% butchers had not sanitized their clothes during sale of the meat (Table 4.12).

**Table 4.12. Protective clothing**

| <b>1.Protective clothing</b> | <b>Yes (%)</b> | <b>No (%)</b> |
|------------------------------|----------------|---------------|
| a) Light colour              | 19(63.3)       | 11(36.6)      |
| b) Clean                     | 18(60.0)       | 12(40)        |
| c)Easily cleanable           | 23(76.6)       | 7(23.3)       |
| d)Sanitized                  | 6(20.0)        | 24(80.0)      |

#### 4.4.2. Personal habits.

Few of the butchers were found consuming tobacco products (10%) before start of work or during the work. Ninety percent of the respondents did not spit while performing the slaughtering work. Most of the butchers (73.3%) had wiped their hand with clothes and counted money (73.3%) during the work or in-between the work. Only (40%) of the butchers had performed other jobs in-between or during the work (Table 4.13).

**Table 4.13. Personal habits**

| 2. Personal habits                       | Yes/ (%) | No/ (%)  |
|--|----------|----------|
| a) Spitting in between                   | 2(6.66)  | 28(93.3) |
| b) Use of tobacco products during work   | 3(10.0)  | 27(90.0) |
| c) Wiping hands with clothes during work | 22(73.3) | 8(26.6)  |
| d) Counting money in between work        | 22(73.3) | 8(26.6)  |
| e) Doing other work in between           | 12(40.0) | 18(60.0) |
| f) No speaking                           | 2(6.66)  | 28(93.3) |
| g) Others                                | 4(13.3)  | 26(86.6) |

#### 4.4.3. Protective equipments and butchers health.

No shopkeeper was found using gloves during the slaughtering. Only 70% were found wearing gumboots/sleepers.

All the butchers had a routine check-up of their health status. Only 36.6% had used wash proof covering over the cuts on their hands. All the butchers had washed their body or body parts before start of work or during the work. All butchers (100%) had cleaned their hands and sanitized (66.6%) before start of work. While performing the work 90% of the butchers had cleaned their hands before the start of work whereas 40% had sanitized their hands during work (Table 4.14).

**Table 4.14. Protective equipments and butchers' health**

| <b>3.Protective equipments and butchers health</b>       | <b>Yes/(%)</b> | <b>No/(%)</b> |
|--|----------------|---------------|
| 1.Gloves   | 0              | 30(100.0)     |
| 2.Gumboots/Shoes or at least sleepers                    | 21(70.0)       | 9(30.0)       |
| 4.Medical certificate/ Health check up                   | 30(100.0)      | 0             |
| 5.use of wash proof covering over cuts and injury if any | 11(36.6)       | 19(63.3)      |
| 6.Washing of body  |                |               |
| a) Before start of work                                  | 30(100.0)      | 0             |
| b) On every episode of work                              | 14(46.6)       | 16(53.3)      |
| 7.Clean hands  |                |               |
| a) Cleaning before start of work                         | 30(100.0)      | 0             |
| b) Sanitized before start of work                        | 20(66.6)       | 10(3.33)      |
| c)Cleaning during the work                               | 27(90.0)       | 3(10.0)       |
| d)Sanitized during the work                              | 12(40.0)       | 18(60.0)      |

**4.5. Risk factors for meat contamination.**

Very few slaughtering facilities (13%) were found with no water stagnation, floods, smoke, dust and other contaminants. Eighty seven percent butchers had hoisting facilities for carcass for skinning and evisceration, whereas 63% of the butcher's facilities had clear demarcation between dirty and clean area during slaughtering. Majority of the butchers had removed heads, hides immediately after slaughtering and only (40%) butchers had a separate room for handling offals. Most of slaughtering premises (73%) had adequate light for performing proper operation whereas (90%) did not have disposal pit. Eighty percent of the shops had floor made of hard material for easy washing and cleaning, 40% slaughtering premises had good drainage system whereas (37%) had adequate hot and cold-water facilities for washing used utensils, floor and walls after slaughtering. Seventy three percent of the slaughtering premises had a provision of washing dirty animals before slaughtering.

Seventy percent butchers had used clean equipments before the start of slaughtering operations. Seventy seven percent wash their hands with cold water and soap before start of work and (73%) butchers had undergone the regular medical checkup. Majority of the butchers washed the carcass thoroughly when it came in contact with faeces and intestinal contents. The Chi square test indicated the significant differences for all the factors except clear demarcation between dirty and clean area during slaughtering, separate room for handling offal's, good drainage system and for availability of cold and hot water for washing used utensils, floor after slaughtering (Table 4.15).

**Table 4.15. Risk factors of meat contamination.**

| Factors  | (Yes)/ (%) | (No)/ (%) | Chi square<br>(Likelihood ratio) |
|--|------------|-----------|----------------------------------|
| 1. Is the location of the slaughtering facility subject to water stagnation, floods, odour, smoke, dust or contaminants? | 22(73)     | 8(27)     | 6.79*                            |
| 2. Are there hoisting facilities before skinning and evisceration?   | 26(87)     | 4(13)     | 18.02**                          |
| 3. Is there a clear demarcation b/w dirty & clean area during slaughtering & handling?                                   | 19(63)     | 11(37)    | 2.15 <sup>ns</sup>               |
| 4. Are heads ,hides, skins and legs removed immediately after slaughtering?  | 27(90)     | 3(10)     | 22.08**                          |
| 5. Is there any separate room for handling offals?   | 12(40)     | 18(60)    | 1.208 <sup>ns</sup>              |
| 6. Is there adequate light to enable proper operation?   | 22(73)     | 8(27)     | 6.79*                            |
| 7. Do you have a disposal pit?   | 3(10)      | 27(90)    | 22.08**                          |
| 8. Are floors & walls made of hardy material for easy washing & disinfection?  | 24(80)     | 6(20)     | 11.56*                           |
| 9. Is there a good Drainage?   | 12(40)     | 18(60)    | 1.208*                           |
| 10. Are your slaughtering equipments made of easy clean  | 20(67)     | 10(33)    | 3.398*                           |

|  |        |        |                     |
|--|--------|--------|---------------------|
| material like stainless steel?   |        |        |                     |
| 11. Is there adequate cold & hot water for washing utensils floor & walls after slaughtering?            | 11(37) | 19(63) | 2.15 <sup>ns</sup>  |
| 12. Is there any provision of washing dirty animals during slaughtering operation?                       | 22(73) | 8(27)  | 6.79 <sup>ns</sup>  |
| 13. Do you ensure that all the equipments are clean before start of slaughtering operation?              | 21(70) | 9(30)  | 4.93 <sup>*</sup>   |
| 14. Do you ensure that all personnel involved in the slaughter process have protective & clean covering? | 15(50) | 15(50) | 0.00 <sup>ns</sup>  |
| 15. How do you maintain your hands clean after visiting toilet or before start of work?                  | 23(77) | 7(23)  | 8.99 <sup>*</sup>   |
| 16. Have slaughter facility personnel undergo any training on minimum meat hygiene handling practices?   | 22(73) | 8(27)  | 6.7 <sup>*</sup>    |
| 17. Have slaughter facility personnel undergo a regular medical check-up every year?                     | 6(20)  | 24(80) | 11.56 <sup>*</sup>  |
| 18. What do you do when carcass meat comes in contact with faeces or intestinal content?                 | 29(97) | 1(3)   | 32.82 <sup>**</sup> |

\*, \*\*: significant at 5 and 1 percent level of significance respectively.

#### 4.6. Bacteriological quality of meat

In the present study, a total of 30 sample (n=30) from different outlets/small slaughtering premises of Jammu city were analysed to evaluate hygienic status by quantifying bacteria. The quantification was done by standard plate count (SPC), coliform count (CC), *Staphylococcus aureus* count (SAC), *Enterococcus faecalis* count (EFC). The different bacteria were identified on the basis of cultural, morphological and biochemical characters.

#### 4.6.1. SPC, CC, SAC, EFC of raw chicken sample

The result presented in Table 4.17 revealed that the mean values ( $\log_{10}$  cfu/gm) of the SPC, CC, SAC, EFC are  $6.59 \pm 0.13$ ,  $4.87 \pm 0.19$ ,  $3.79 \pm 0.07$  and  $3.88 \pm 0.81$ , respectively.

##### 4.6.1.1. Analysis of variance for different bacterial counts.

The two-way analysis of variance techniques has been applied to study the bacterial counts of all the ten areas (locations) of Jammu city from where the meat samples were collected differed significantly for SPC and EFC count whereas CC and SAC were non-significant (Table 4.17). The retailer shops/outlets were differed significantly for EFC only, (Table 4.17). Further, to study the class comparisons among the locations in case of bacterial counts the Duncan Multiple Range Test was been applied.

**Table 4.16. Analysis of variance for different bacterial counts.**

| Source   | d.f | F-Value            |                    |                    |                     |
|----------|-----|--------------------|--------------------|--------------------|---------------------|
|          |     | SPC                | CC                 | SAC                | EFC                 |
| Location | 9   | 2.83 <sup>**</sup> | 0.87 <sup>ns</sup> | 0.48 <sup>ns</sup> | 71.66 <sup>**</sup> |
| Shop     | 2   | 1.28 <sup>ns</sup> | 0.16 <sup>ns</sup> | 0.39 <sup>ns</sup> | 3.78 <sup>*</sup>   |

\*, \*\*: significant at 5 and 1 percent level of significance respectively

##### 4.6.1.2. Mean based comparison of bacteriological count per gram of poultry meat in different area of Jammu city.

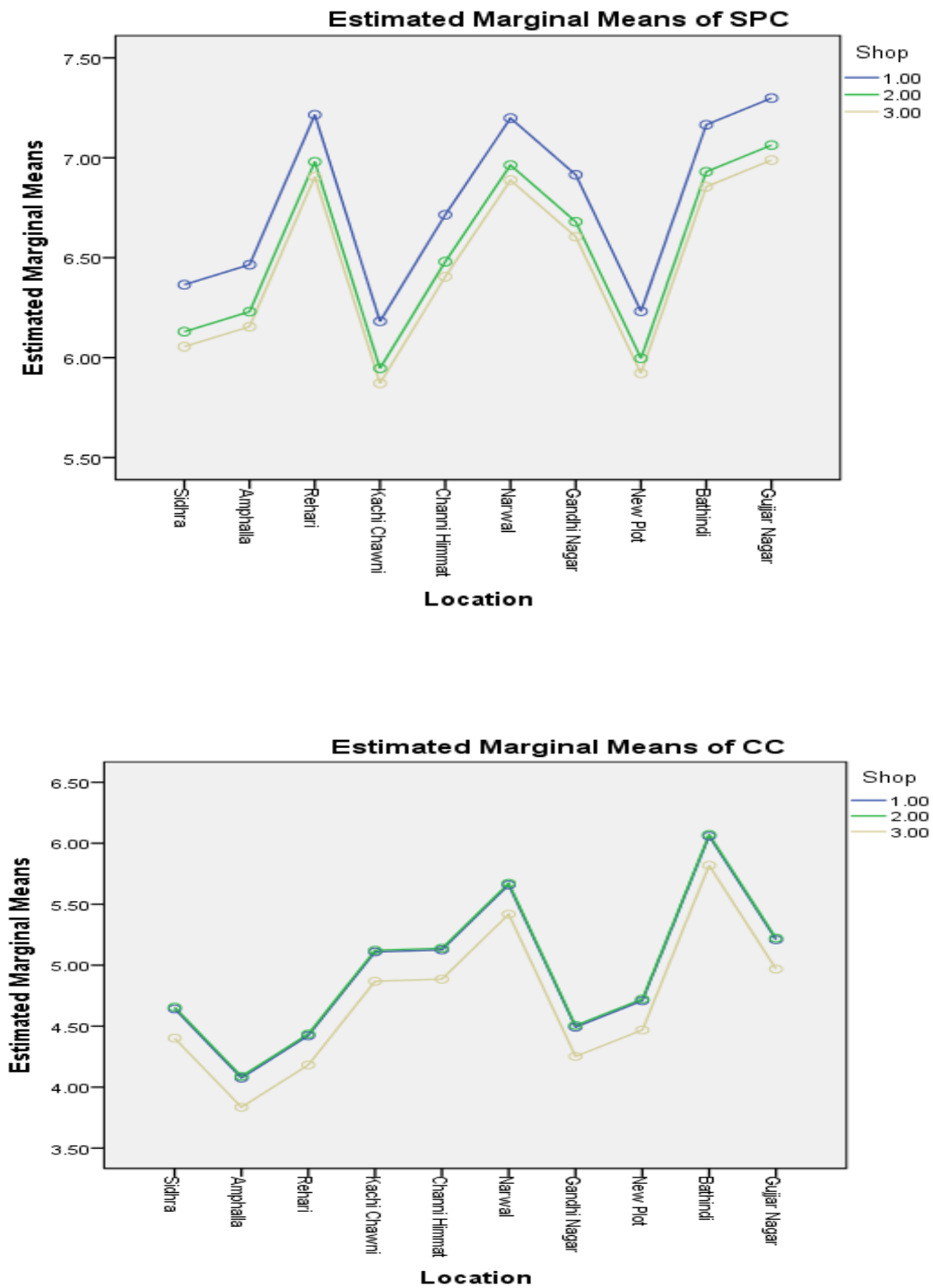
The mean count of SPC was found highest in Gujjar nagar area ( $7.11 \pm 0.08$ ) and at par with Rehari ( $7.03 \pm 0.31$ ), Narwal ( $7.01 \pm 0.44$ ), Bathindi ( $6.98 \pm 0.28$ ), Gandhi nagar ( $6.73 \pm 0.19$ ) and Channi himmat ( $6.53 \pm 0.24$ ). The lowest SPC found in Kacchi chawni ( $6.00 \pm 0.31$ ) and at par with Sidhra ( $6.18 \pm 0.28$ ), Amphalla ( $6.28 \pm 0.13$ ) and New plot ( $6.05 \pm 0.10$ ). The minimum mean count of CC was found in Ambphalla ( $4.00 \pm 0.55$ ) followed by Rehari ( $4.35 \pm 0.55$ ). The highest mean count was observed in Bathindi ( $5.98 \pm 0.33$ ) followed by Narwal ( $5.58 \pm 1.07$ ) and Gujjar nagar ( $5.13 \pm 0.59$ ). In case of SAC, the highest mean count was found in Narwal ( $4.00 \pm 0.33$ ) and Sidhra ( $4.00 \pm 0.35$ ) areas of Jammu city. The EFC count was not detected in the meat samples collected from Rehari and New plot areas of Jammu city. The highest mean value of EFC was found in sidhra ( $5.13 \pm 0.34$ ) followed by Kacchi chawni ( $4.08 \pm 0.46$ ) and Gujjar nagar ( $3.78 \pm 0.10$ ) (Table 4.17).

The occurrence of SPC in meat samples collected from Sidhra , Amphalla, Kacchi chawni, Channi himmat, Gandhi nagar, New plot was found at par with each other whereas as Rehari, Channi himmat, Narwal and Bathindi were also found at par with each other but significantly differed from New plot and Kacchi chawni (Table 4.17). Gujjar Nagar was the only location which differed significantly from Sidhra, Kacchi chawni and New plot with respect to SPC. In case of SAC and CC all the samples collected from all the areas were found at par with each other with respect to bacterial count. The EFC was not detected in meat samples collected from Rehari and New plot area of Jammu city whereas this count was found at par with each other in meat samples collected from rest of the locations of Jammu city (Table 4.17). The mean values SPC, CC, SAC and EFC of different shops at different locations of Jammu city are also presented in the figures 4.7 and 4.8.

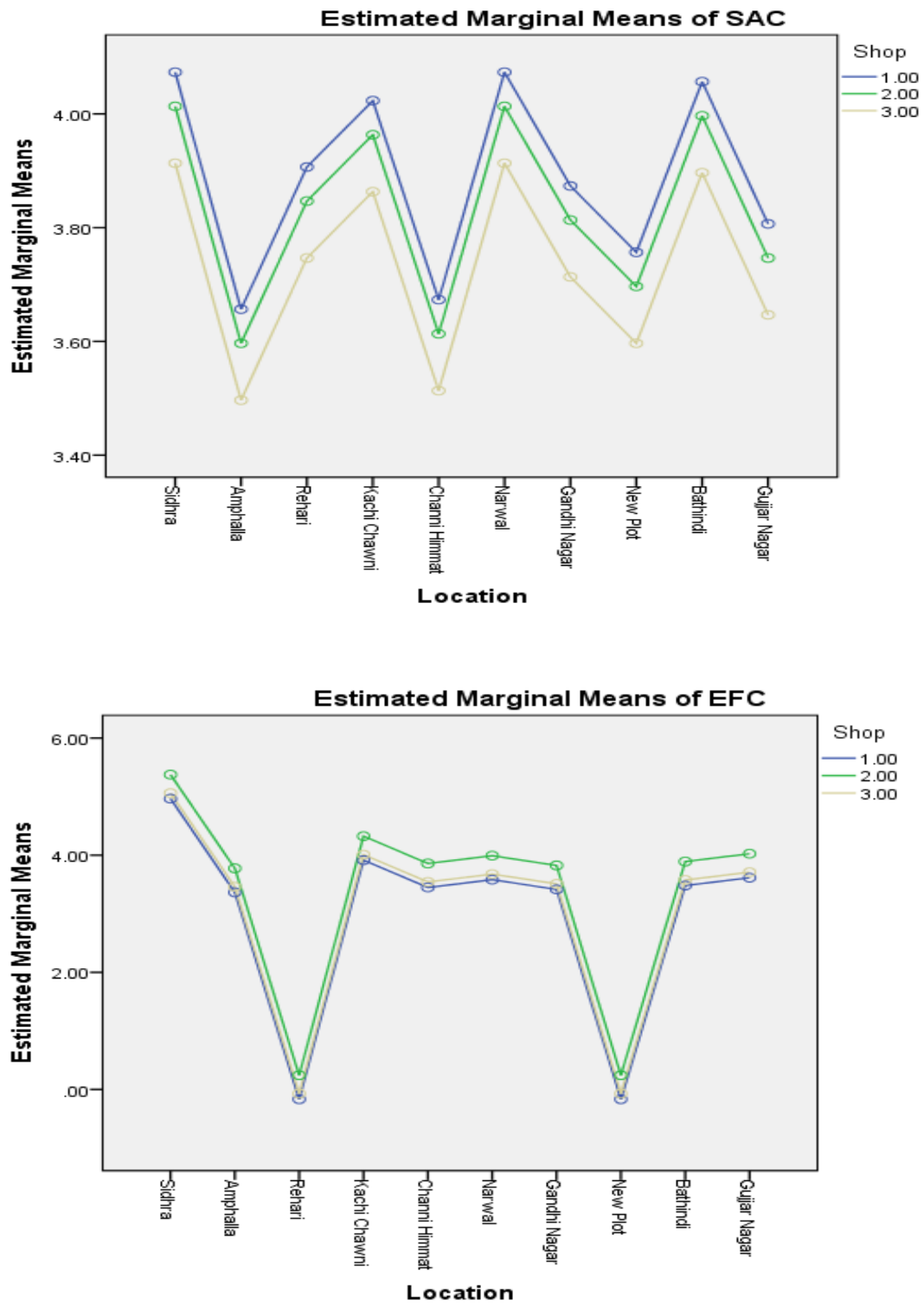
**Table 4.17. Mean bacteriological count per gram of poultry meat in different area of Jammu city.**

| Locality              | SPC                       | CC                      | SAC                     | EFC                     |
|-----------------------|---------------------------|-------------------------|-------------------------|-------------------------|
| Sidhra                | 6.18 <sup>ab</sup> ±0.28  | 4.56 <sup>a</sup> ±0.37 | 4.00 <sup>a</sup> ±0.35 | 5.13 <sup>b</sup> ±0.34 |
| Amphalla              | 6.28 <sup>abc</sup> ±0.13 | 4.00 <sup>a</sup> ±0.55 | 3.58 <sup>a</sup> ±0.20 | 3.53 <sup>a</sup> ±0.20 |
| Rehari                | 7.03 <sup>bc</sup> ±0.31  | 4.35 <sup>a</sup> ±0.26 | 3.83 <sup>a</sup> ±0.08 | ND                      |
| Kachi Chawni          | 6.00 <sup>a</sup> ±0.31   | 5.03 <sup>a</sup> ±0.64 | 3.40 <sup>a</sup> ±0.29 | 4.08 <sup>a</sup> ±0.46 |
| Channi Himmat         | 6.53 <sup>abc</sup> ±0.24 | 5.05 <sup>a</sup> ±0.84 | 3.60 <sup>a</sup> ±0.02 | 3.61 <sup>a</sup> ±0.14 |
| Narwal                | 7.01 <sup>bc</sup> ±0.44  | 5.58 <sup>a</sup> ±1.07 | 4.00 <sup>a</sup> ±0.33 | 3.75 <sup>a</sup> ±0.25 |
| Gandhi Nagar          | 6.73 <sup>abc</sup> ±0.19 | 4.42 <sup>a</sup> ±0.38 | 3.80 <sup>a</sup> ±0.18 | 3.58 <sup>a</sup> ±0.09 |
| New Plot              | 6.05 <sup>a</sup> ±0.10   | 4.63 <sup>a</sup> ±0.64 | 3.98 <sup>a</sup> ±0.19 | ND                      |
| Bathindi              | 6.98 <sup>bc</sup> ±0.28  | 5.98 <sup>a</sup> ±0.33 | 3.98 <sup>a</sup> ±0.24 | 3.65 <sup>a</sup> ±0.20 |
| Gujjar Nagar          | 7.11 <sup>c</sup> ±0.08   | 5.13 <sup>a</sup> ±0.59 | 3.73 <sup>a</sup> ±0.12 | 3.78 <sup>a</sup> ±0.10 |
| Grand mean±S.E m mean | 6.59±0.13                 | 4.87±0.19               | 3.79±0.07               | 3.88±0.18               |

- The same superscript in a column indicates the locations are at par and different statistically significant per Duncan multiple range test (DMRT).
- ND=Not detected



**Fig 4.7. Graphs depicting mean values of SPC and CC of different shops at different locations of Jammu city.**



**Fig 4.8. Graphs depicting mean values of SAC and EFC of different shops at different locations of Jammu city.**

## Chapter-5

# *Discussion*

The word hygiene usually refers to cleanliness and especially to any practice which leads to removal or reduction of harmful infectious agents (Abd-elaleem *et al.*,2014). Maintenance of hygienic practices at retailers shops is essential to provide healthy meat for public consumption. A study in the U.S.A suggested that improper food handling practices contributed to 97% of food borne disease illnesses (Jumaa, 2005).In the present study, we have explored the various factors associated with the hygiene practices, risk factors of meat contamination and bacteriological quality of meat produced by retailers and butchers with the help of indicator organisms. Out of the 30 butchers studied across the Jammu city, all the butchers were male, mostly in the age group of 16-45 years. Thirty seven percent had acquired higher secondary qualification. Most of the butchers (36.6%) in the study were involved in the slaughtering profession for less than 5 years. Majority of the butchers got their training of slaughtering from relatives and friends. Very few (3%) butchers had received specific training/formal training on butchering practices. Study conducted in Dharan, Nepal in 2012, Patna, India in 2006, Nairobi and Isiolo, Kenya in 2015 and Gondar town in Ethiopia in 2015 revealed that none of the meat handlers or butchers had got any formal training on meat handling hygiene (Adhikari *et al.* .2012; Rajesh 2017; Chepkemoi *et al.*,2015; Garedew *et al.*, 2015). Handling meat without any training could enhance risk of cross contamination. On an average butcher handled 36.7 chickens per day and which is very low number, this may be due to the fact that the butchers had other additional job. In our study 43% butchers were involved in other jobs or business. The people in Jammu city perhaps may not consume animal protein on regular basis because of the quite high price compared with vegetable protein. Secondly most of the people may be vegetarian and therefore, they prefer vegetarian diet. Hygienic practices of butchers are discussed in the following subdivision including infrastructure details, hygienic slaughtering practices and awareness level of butchers

#### **5.1. Hygienic practices and infrastructure.**

The infrastructure of the 30 retail shops/outlets and slaughtering premises were studied. Sixty seven percent retail shops/outlets and slaughtering premises were

in the market area and most of them (63%) were small constructed. Majority of the shops were operational with proper licensing from the municipal corporation authorities of the Jammu city. The same results were also reported by (Khanal and Poudel 2017).

## **5.2. Hygienic practices.**

Majority of the retail shops/outlets had a clean and rust-free knife, clean cutting slab, clean floor, good drainage, sloppy and sewage system. The adequacy of the above facilities can be prospected for bacteriological studies for evaluating the level of contamination. The above observations are also at par with the observations published by Reddy *et al.*, (2019) and Pradhan *et al.*,(2018). In the present study ,70% of the shops had insects and flies in the shop and stray animal 50% around the butcheries setting which may be the vector for many dreadful infectious diseases. Mensah *et al.*, (2002) reported 35% of the shops had problem with flies and insects among the food vendors in Accra, Ghana. Majority of the butcheries had clean cages/lairage, feed and drinking water needed for poultry and animals which indicated that butchers had appropriate knowledge through the respective authorities. Most of the shops had availability of hot and cold water and also adequate lightening system. Majority of the butchers were using detergent and soaps whereas few of them were using disinfectants, the same observations were also reported by Reddy *et al.*,(2019) which may reflect the risk of contamination due to higher microbial load due to unhygienic practices followed in most of the retailer shops/outlets. Sagoo *et al.*,(2003) reported strong association of such deficiencies at food premises with the high chances of microbial contamination. Generally, butchers were selecting healthy birds but 50% of them only gave importance to the cleanliness of birds. The importance of meat inspection was also highlighted by Bisailon *et al.*,1998. The present study also indicated the chance of cross contamination of meat in almost all the facilities and the slaughtered meat was also found in contact with the floor due to the carelessness on the part of the butchers. Washing of the carcass before and after evisceration was followed at all the shops in the present study. Geornaras *et al.*, (1995) showed that spray washing of carcass before and after carcass would reduce bacterial count in carcass and the meat contamination. In the present study most of the butchers did not spit, used no tobacco products and not spoken during the work. Majority of the butchers counted money, wiped hand with common clothes and

performed other work during or in-between the work which may be the potential sources of contamination. Burt *et al.*, (2003) carried one study on safety of vendor prepared foods and reported that no one had spitted or used smoking during twenty minutes of study/observations. Wiping hands with common clothes during the work is a dirty practice as revealed by the study carried out by Tebbut, (1986) and also reported that wiping clothes were heavily contaminated with *E coli* and *Clostridium perferingens*. None of the 30 butchers studied were found using hand gloves and only 70% were using gumboots/sleepers. The similar results were also reported by Tuneer and Madhvi (2015) in one of their study on hygienic status of butchers and identified bacteria among the slaughter meat, chicken and fish markets of Jagdalpur city, Chhattisgarh in India. In the present study, all the butchers had under gone the medical check up and few of them had used wash proof covering over the cuts on their hands. All the butchers had washed their body or body parts before the start or during the work and most of the butchers had cleaned and sanitized their hands before the start of work.

### **5.3. Awareness level of butchers.**

In the present study, the butchers were not aware of any risk of meat borne diseases such as diarrhoea, fever, cough, itching, cancer and warts etc. It is worthwhile to mention here that diarrheal outbreak occurred among the childrens in Poland in 1995 due to meat contamination (Rozynek *et al.*,2005). Majority of the butchers were aware of cleaning of settings. None of the butcher in Jammu city had maintained their personal hygiene. Very few of the butchers had awareness regarding the proper drainage, proper doors and proper tile flooring in their shops.

### **5.4. Risk factors of meat contamination.**

Very few slaughtering facilities were found with no water stagnation, floods, smoke, dust and other contaminants. Majority of the butchers had hoisting facilities before skinning and evisceration, whereas 63% of the butcher's facilities had clear demarcation between dirty and clean area during slaughtering. Most of slaughtering premises had adequate light for performing proper operation and did not have disposal pit. Majority of the shops had floors made up of hard material for easy washing and cleaning, very few slaughtering premises had good drainage system, adequate hot and cold-water facilities for washing used utensils, floor and walls after

slaughtering. Muinde and Kuria ,(2005) reported that 70% of the street food vendors in Nairobi, Kenya had cleaned their utensils with cold water. Alhaji and Baiwa (2015) reported that cleaning of utensils and surface was the most common preventive hygiene practices and that only 16.3% knew about protective capacity of frequent cleaning and sanitation of meat handling facilities. Majority of the slaughtering premises had a provision of washing dirty animals before slaughtering. Most of the butchers had used cleaned equipments before the start of slaughtering operations. Majority of the butchers washed the carcass thoroughly when it came in contact with faeces and intestinal contents. The Chi square test indicated the significant differences for all the factors except clear demarcation between dirty and clean area during slaughtering, separate room for handling offals, good drainage system and for availability of cold and hot water for washing used utensils, floor after slaughtering.

### **5.5. Bacteriological quality of meat.**

In the present study, 30 poultry meat samples collected from different locations of Jammu city were analysed to determine the bacteriological quality. The mean count of SPC was found ( $6.59 \pm 0.13 \log_{10} \text{cfu/gm}$ ). Similar results ( $6.58 \log_{10} \text{cfu/gm}$ ) were also reported by (Bersisa *et al.*, (2019), Mawia *et al.*, (2012) Chowdhary *et al.*, (2008), Shekhar *et al.*, (2008) and Santosh Kumar *et al.*, (2010) for SPC in their study. Higher count was also reported by other workers, Bhandari *et al.*, 2013 ( $11.1 \pm 0.3, 11.5 \pm 0.3$  and  $12.2 \pm 0.5 \log_{10} \text{cfu/gm}$ ) in Chitwan, Nepal and Mukhopadhyaya *et al.* ,2004 ( $7.6 \log_{10} \text{cfu/gm}$ ). However, lower counts were also reported by Lillard (1989), Willayat *et al.*, (2006) and Khalifa *et al.*, (2004) with mean SPC of (3.71, 3.74 and  $5.50 \log_{10} \text{cfu/gm}$ ) respectively.

Coliform count in the present study was found  $4.87 \pm 0.19 \log_{10} \text{cfu/gm}$  and similar results were also reported by Mawia *et al.*, 2012 ( $3.81 \pm 0.11 \log_{10} \text{cfu/gm}$ ), Alvarez-Astorga *et al.*, 2002 (2.60 to  $4.33 \log_{10} \text{cfu/gm}$ ) and Abu-Ruwaida *et al.*, 1994 ( $3.6 \log_{10} \text{cfu/gm}$ ). Higher count ( $6.5$  to  $7.7 \pm 0.14 \log_{10} \text{cfu/gm}$ ) were also reported by Bhandari *et al.* ,2013 ( $6.5$  to  $8.4 \pm 0.5 \log_{10} \text{cfu/gm}$ ) in Chitwan, Nepal and lower counts was reported by Abdel-Rahman *et al.*, 2008 ( $2.20 \pm 0.15 \log_{10} \text{cfu/gm}$ ), Al-Mohizea *et al.* ,1994 ( $2.21 \log_{10} \text{cfu/gm}$ ), Chaiba *et al.*, 2007 ( $2.32$  to  $2.34 \log_{10} \text{cfu/gm}$ ) and Santosh Kumar *et al.*, 2010 ( $2.33 \log_{10} \text{cfu/gm}$ ). The high frequency of coliform in

meat samples probably indicate cross contamination of meat with the intestinal contents during slaughtering ,processing and use of contaminated water etc.

*Staphylococcus aureus* count for poultry meat was  $(3.79\pm 0.07 \log_{10}\text{cfu/gm})$  similar to those of Mawia *et al.*,2012 with  $4.09\pm 0.13 \log_{10}\text{cfu/gm}$ . Similar results were also reported by Abu-Ruwaida *et al.*,1994 with  $4.1 \log_{10}\text{cfu/gm}$ . Higher count (6.5 to  $7.7\pm 0.4 \log_{10}\text{cfu/gm}$  was recorded by Bhandari *et al.* ,2013 in Chitwan, Nepal. Alvarez-Astorga *et al.*, 2002 recorded slightly lower count with a value ranging from (2.47 to  $3.48 \log_{10}\text{cfu/gm}$ ). The presence of *Staphylococcus aureus* in the sample indicates its possible contamination from the skin, Mouth or nose of the workers handling the food; also, the unclean equipments may be the source of contamination (Fraizer and Westhoff, 1983)

In case of enterococcus, *Enterococcus faecalis* count was found to be  $3.88\pm 0.81 \log_{10}\text{cfu/gm}$ . Similar results were also reported by Mawia *et al.*,2012( $4.02\pm 0.12 \log_{10}\text{cfu/gm}$ ) and slightly lower EFC ( $3.02 \log_{10}\text{cfu/gm}$ ) was reported by Yashoda *et al.*,2002 in Mysore. *Enterococcus faecalis* bacteria has faecal origin and are good indicator of sanitary quality of foods, higher bacterial counts might be due to poor sanitary condition and low skill level of operators creating ideal condition for faecal contamination of meat surfaces during slaughtering operations.

## Chapter-6

# *Summary and Conclusion*

## CHAPTER –6

### SUMMARY AND CONCLUSIONS

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Meat is a nutritious diet of animal origin and occupy a unique position in human diet and the extent of contamination depend on sanitation procedures followed during meat handling, storage, distribution and processing. Owing to poor sanitation and hygienic practices such as washing of hands, wearing of protective clothing, cleaning and sanitization of butchery equipments and utensils, transportation of meat in containers and storage of meat can lead to microbial contamination. Therefore, the present study was undertaken to assess various hygienic practices followed by retailers and butchers of small slaughtering premises in Jammu city.

In the present investigation, 30 butchers studied from 10 locations across the Jammu city. All the butchers were male, mostly in the age group of 16-45 years. Thirty seven percent of the butchers had acquired higher secondary qualification and most of the butchers are involved in this profession for less than 5 years. Majority of the butchers were trained by relatives and friends (73%) and few (17%) were trained by their fathers. The infrastructure of the 30 retail shops/outlets and slaughtering premises were studied. Sixty seven percent retail shops/outlets and slaughtering premises were located in the market area and most of them (63%) comprised of small structures. Majority of the shops were operational with proper licensing from the municipal corporation authorities of the Jammu city. Most of the retail shops/outlets had clean and rust-free knives, clean cutting slabs, clean floors, good drainage, proper slope and sewage system. In the present study 70 percent of the shops had insects and flies and stray animal (50%) around the butcheries setting which may be the vector for many dreadful infectious diseases. Stray animals may act as source for many zoonotic diseases which may put the health of public at risk. Majority of the butcheries had apparently clean cages/lairage, feed and drinking water needed for poultry and animals awaiting slaughter. Most of the shops had availability of hot (50%) and cold water (70%) and also adequate lighting system (90%). Majority of the butchers were using soaps (100%) and detergents (10%) whereas (30%) of them were using disinfectants. Generally, butchers were selecting healthy birds but 50 percent of them gave importance to the cleanliness of birds. None of them were aware of history

either of flock or of any diseases of the birds. No retail/outlet had any system for poultry meat certification by any competent authority. Washing of the carcass before and after evisceration was followed at all the shops. Most of the butchers did not spit (93.3%), and did not use tobacco products (90%) during the work. Majority of the butchers counted money (73.3%), wiped hands with common cloth (73.3%) and performed other work (40%) during and in-between the work. In the present study, none of the butchers were found wearing hand gloves and 70% were using gumboots/sleepers. All the butchers in the present study had undergone medical check-up. Very few slaughtering facilities were found no water stagnation, floods, smoke, dust and other contaminants. Majority of the butchers had carcass hoisting facilities for skinning and evisceration, whereas 63% of the butcher's facilities had clear demarcation between dirty and clean area during slaughtering. Majority of the slaughtering premises had a provision of washing dirty animals before slaughtering and most of the butchers were using clean equipments before slaughtering operations. The Chi square Test indicated the significant differences for all the factors except for clear demarcation between dirty and clean area during slaughtering, separate room for handling offals, good drainage system, availability of cold and hot water for washing used utensils, floor after slaughtering. The retailer shops/outlets differed significantly for EFC only. In conclusion the absence of bird inspection and meat certification by the competent authority should be taken up by the Jammu municipality. All the butchers in the present study had license which being made mandatory for butchers in the Jammu city by the municipality. However, only those workers who had undergone proper training on hygienic slaughtering should be allowed to open their retail shops/outlets

In the present study, 30 poultry meat samples collected from different locations of Jammu city were analyzed to determine the bacteriological quality. The mean count of SPC, CC, SAC and EFC was found  $6.59 \pm 0.13$ ,  $4.87 \pm 0.19$ ,  $3.79 \pm 0.07$  and  $3.88 \pm 0.81$   $\log_{10}$ cfu/gm respectively. The analysis of variance indicated that all the 10 areas of Jammu city from where the meat samples were collected differed significantly for SPC and EFC whereas for other counts (CC and SAC) were at par with each other in all the locations under study. In conclusion, the microbiological quality of meat under study was not satisfactory. It is, therefore, suggested to create awareness about the raw meat handling with appropriate hygienic measures and

importance of continuous microbial monitoring to safeguard the wholesomeness of meat and thus protecting health of consumers.



# *References*

## REFERENCES

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- Abdalla, M.A., Suliman, S.E., Ahmed, D.E. and Bakhiet, A.O.2009a. Estimation of bacterial contamination of indigenous bovine carcasses in Khartoum (Sudan). *African Journal of Microbiology Research* **3**(10) 882-886.
- Abd-Elaleem, R., Bakr, W.M.K., Hazzah, W.A and Nasreldin O. 2014. Assessment of the personal hygiene and the bacteriological quality of butchers' hands in some abattoirs in Alexandria, Egypt. *Food Control*.**41**:147-50.
- Abdel-Rahman, H. A., Yassein, M.A., Ahmed, A.M., Hayashidani, H. and Elhelaly, A. E. 2008. Bacteriological Profile of Frozen Broiler Chickens.*Suez Canal Veterinary Medical Journal*.**13** (1): 49-60.
- Abdullahi, A., Hassan, A., Kadarman, N., Saleh, A., Shuaibu, Y.B. and Lua, P.L. 2016. Foodsafetyknowledge,attitude, and practice toward compliance with abattoir laws among the abattoir workers in Malaysia. *International Journal of GeneralMedicine*,**9**:79.
- Abu-Ruwaida, A. S., Sawaya, W. N., Dashti, B. H., Murard, M., & Al-Othman, H. A. 1994. Microbiological quality of broilers during processing in a modern commercial slaughterhouse in Kuwait. *Journal of Food Protection*, **57**: 887-890.
- Adetunde, L. A., Glover, R. L. K., Oliver, A. W. O. and Samuel, T. 2011. Source and distribution of microbial contamination on Beef and Chevron in Navrongo, Kassena Nankana District of Upper East Region in Ghana. *Journal of Animal Production Advances* ,**1**(1): 21-28.
- Adeyemo, O. K. 2002. Unhygienic operation of a city abattoir in South Western Nigeria: Environmental Implication. *African Journal of Environmental and Applied Microbiology*,**4**(1):23-28.
- Adhikari, B.M, Subedi R.P and Subba D. 2012. A study on standard of buffalo meat hygiene in Dharan Nepal. *Journal of Food Science Technology* ,**7**:99-101.

- Adu-Gyamfi A., W. Torgby-Tetteh and V. Appiah. 2012. Microbiological Quality of Chicken Sold in Accra and Determination of D10-Value of *E.coli*. *Food Nutrition Science*, **3** (5): 693-698.
- Adzitey, F., Teye, G. A., Kutah, W. N. and Adday, S. 2011. Microbial quality of beef sold on selected markets in the Tamale Metropolis in the Northern Region of Ghana. *Livestock Research for Rural Development*, **23** (1): 445 – 449.
- Akabanda, F., Hlortsie E. H, and Owusu-Kwarteng, J. 2017. Food safety knowledge, attitudes and practices of institutional foodhandlers in Ghana. *BMC Public Health*, **17**(1):40.
- Akinro, A. O., Ologunagba, I. B. and Yahaya, O. 2009. Environmental Implications of unhygienic operation of a city abattoir in Akure, Western Nigeria. *Journal of Engineering and Applied Sciences*, **4**(9): 60-63.
- Al- Mohizeal, I.S., Fawaad, A.S.M.B. and Al Shahehat, A. 1994. Microbiological shelf-life assessment of chilled eviscerated chicken broiler in Saudi Arabia. *British Poultry Science*, **35**: 519-526.
- Alhaji, N.B and Baiwa, M. 2015. Factors affecting workers' delivery of good hygienic and sanitary operations in slaughterhouses in north-central Nigeria. *Sokoto Journal of Veterinary Science*, **13** (1): 29-37.
- Ali, N. H., Farooqui, A., Khan, A., Khan, A.Y. and Kazmi, S.U. 2010. Microbial contamination of raw meat and its environment in retail shops in Karachi, Pakistan. *Journal of Infection in Developing Countries*, **4**(6): 382-388.
- Al-Shabib, N. A., Mosilhey, S. H. and Husain, F. M. 2016. Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. *Food Control*, **59**: 212–217.
- Álvarez, M.A., Capita, R., Alonso-Calleja, C., Moreno, B., María del and García-Fernández C. 2002. Microbiological quality of retail chicken by-products in Spain. *Meat Science*, **62**(1): 45-50.
- Angelillo, F., Viggiani, N.M.A., Greco, R.M. and Rito, D. 2001. HACCP and food

hygiene in hospitals knowledge, attitudes, and practices of food-services staff in Calabria, Italy. *Infection Control & Hospital Epidemiology*, **22**(6):363–369.

Anonymous. 2005. BBC news Fears grow over bird flu outbreak [On line]. [cited 2006 Sept 10]; Available from [URL:http://news.bbc.co.uk/2/hi/asia-pacific / 3422035 .stm](http://news.bbc.co.uk/2/hi/asia-pacific/3422035.stm)

Ansari-Lari, M., Soodbakhsh, S. and Lakzadeh, L. 2010. Knowledge, attitudes and practices of workers on food hygienic practices. *Food Control*, **21**(3):260-263.

APHA. 1984. Compendium of methods for Microbiological Examination of foods. 2<sup>nd</sup> edn. (ed. M.L. Speck). *American Public Health Association, Washington, DC*.

Bafanda, R.A., Khandi, S.A and Sharma, R. 2017. Assessment of Existing Meat Handling and Hygienic Practices among Butchers and Meat Retailers in Jammu District of Jammu and Kashmir: A Socio-Economic Analysis. *Asian Journal of Agricultural Extension, Economics & Sociology*, **18**(3): 1-9.

Bell, R. G. 1997. Distribution and source of microbial contamination on beef carcasses. *Journal of Applied Microbiology*, **82**: 292-300.

Bello, Y.O, Oyedemi, D.T.A 2009. The Impact of Abattoir Activities and Management in Residential Neighbourhoods: A Case Study of Ogbomoso, Nigeria. *Journal*, **19**(2):121-127.

Berghold C, Kornschöber C, Lederer I, Allerberger F. 2004. Occurrence of *Salmonella* Enteritidis phage type 29 in Austria: an opportunity to assess the relevance of chicken meat as source of human salmonella infections. *European Surveillance*, **9**(10):31-4.

Bersisa, A., Tulu, D and Negera, C. 2019. Investigation of bacteriological quality of meat from abattoir and butcher shops in Bishoftu, Central Ethiopia. *International Journal of Microbiology*, <http://doi.org/10.1155/2019/6416803>.

Bhandare, S. G., Paturkar, A. M., Waskar, V. S. and Zende, R. J. 2009. Bacteriological screening of environmental sources of contamination in an

- abattoir and the meat shops in Mumbai, India. *Asian Journal Food Ag-Industry*, **2**(03):280-290.
- Bhandari, N., Nepali, D.B and Paudyal. 2013. Assesment of bacterial load in broiler chicken meat from the meat retail shops in chitwan, Nepal. *International Journal of infection Microbiology*, **2**(3):99-104.
- Birhanu, S. and Menda, S. 2017. Hygienic handling and processing of raw beef meat at slaughter houses and meat stalls in Gojjam area, Ethiopia. *International Journal of Veterinary Health Science & Research*, **5**(8): 213–218.
- BIS. 1995.Mutton and goat meat(chevon)-fresh, chilled and frozen technical requirements. In: IndianStandard: Meat and meat products. Bureau of Indian Standard, New Delhi.
- Bisaillon, J.R, Meek, A.H and Feltmate, T.E. 1988. An assessment of condemnations of broiler chicken carcasses. *Canadian Journal Veterinary Research*,**52**(2):269-76.
- Biss, ME. and Hathaway, S.C. 1995. Microbiological and visible contamination of lamb carcasses according to pres laughter presentation status: Implications for HACCP. *Journal of Food Protection*. **58**:776-783.
- Biswas, A. J., Kondaiah, N., Anjaneyulu, A. S. R. and Mandal, P. K. 2011. Cause, concern, consequences and control of microbial contaminants in meat- A Review. *International Journal of Meat Science***1**(1):27 – 35.
- Bogere, P and Baluka S A. 2014. Microbiological quality of meat at the abattoir and butchery levels in Kampala City, Uganda. *Internet Journal Food Safety*, **16**:29-35.
- Borch, E. and Arinder, P. 2002. Bacteriological safety issues in beef and ready- to – eat meat products as well as control measures. *International Journal of Meat sciences* **62**(3):381-390.ajor abattoir (Bodija) in Ibadan, Nigeria. *African Journal of Biomedical Research*,**5**: 51-55.
- Bryan, F.L. 1988. Risks of practices, procedures and processes that lead to out-breaks of food borne disease. *Journal of food protection*, **51**: 663-673.

- Burt BM, Volel C and Finkel M. 2003. Safety of vendor-prepared foods: evaluation of 10 processing mobile food vendors in Manhattan. *Public Health Reporter*, **118**(5):470-6.
- CDC. 2011. Estimates of Foodborne Illness in the United States. [https://www.cdc.gov/foodborneburden/pdfs/FACTSHEET\\_A\\_FINDINGS.pdf](https://www.cdc.gov/foodborneburden/pdfs/FACTSHEET_A_FINDINGS.pdf).
- Chaiba, A., Rhazi, F, F., Chahlaoui, A., Soulaymani, B. R. and Zerhouni, M. 2007. Microbiological Quality of Poultry Meat on the Meknès Market (Morocco). *Journal of Food Safety*, **9**: 67-71.
- Chowdhary, S.P., Tiwari, J.G. and Roychoudhury, P. 2008. Assessment of Bacteriological Quality of Beef samples collected from slaughter units. *Indian Veterinary Journal*, **85** : 1190-1192.
- Chepkemoi S, Lamuka PO, Abong GO and Matofari J. 2015. Sanitation and hygiene meat handling practices in small and medium enterprise butcheries in Kenya— case study of Nairobi and Isiolo Counties. *International Journal of Food Safety.*; **17**:64-74.
- Coleman, P. and Roberts, A. 2005. Food hygiene training in the UK: A time for change. *Journal of Food Service Technology* 5: 17-22.
- Cook, E.A.J., de Glanville, W.A., Thomas, L.F., Kariuki, S and Bronsvort, B.M. 2017. Working condition and public health risks in slaughterhouses in western Kenya *Public Health*, **17**:14.
- Dickson, J.S. and Anderson, M.E. 1992. Microbiological decontamination of food animal carcasses by washing and sanitizing systems. *Journal of Food Protection*. **55**: 133-140.
- Doyle M. E. 2007. Microbial food spoilage – Losses and control strategies, Literature), ([www.wisc.edu/fri/](http://www.wisc.edu/fri/)).
- Duncan, D.B. 1955. Multiple range and multiple F tests. *Biometrics*. 11:1-42.

- Ercolini, D., Russo, F., Torrieri, E and Masi Fand Villani, F. 2006. Changes in the spoilage-related microbiota of beef during refrigerated storage under different packaging conditions. *Applied Environmental Microbiology*, **72**:4663-4671.
- FAO, 2006. Food Outlook, [Online]; Available from [cited 2006 Sept.12]URL:<http://www.fao.org/DOCREP/004/AD452E/ad452e38.htm#TopOfPage>.
- FAO,2006. Production of meat and share in world [Online]. [cited 2006 Sept 11]; Available fromURL:[http://www.fao.org/ES/ess/yearbook/vol\\_1\\_1/site\\_en.asp?page=production](http://www.fao.org/ES/ess/yearbook/vol_1_1/site_en.asp?page=production)
- FAO,2012. Food and Agriculture Organization, Rome, STAT data.
- Fasanmi, G. O., Olukole, S. G. and Kehinde, O. O. 2010. Microbial studies of table scrapings from meat stalls in Ibadan Metropolis, Nigeria: Implications on meat hygiene. *African Journal of Biotechnology*,**9**(21): 3158-3162.
- Food Safety and Standard Authority of India. 2011. Food safety and standard regulations.<https://www.fssai.gov.in>.
- Frazier, W. C. and Westhoff, D. C. 1983: Food Microbiology. 3<sup>rd</sup> Edition Tata McGraw. Hill PUBL. Company LTD New Delhi.
- FSA (Food Standards Agency). Meat Industry Guide; 2015.
- Galland, J. C. 1997. Risk and prevention of contamination of beef carcasses during the slaughter process in United States of America. *Scientific and Technical Review of the Office International des Epizooties***16**(3):395-404.
- Garedew,L, Hagos, Z, Addis, Z, Tesfaye, R and Zegeye B. 2015. Prevalence and antimicrobial susceptibility patterns of Salmonella isolates in association with hygienic status from butcher shops in Gondar town, Ethiopia. *Antimicrobial Resistance and Infection Control*.4:21. doi:10.1186/s13756-015-0062-7.
- Geornaras, I, de Jesus A, van Zyl E and von Holy A. 1995. Microbiological survey of a South African poultry processing plant. *Journal of Basic Microbiology*,**35**(2):73-82.

- Gill, C and Baker, L., 1998. Assessment of the hygienic performance of a sheep carcass dressing process. *Journal of Food Protection*, **61**: 329– 333.
- Glimour, A., Murry, K.A. and Madden, R.N, 2004. Determination of the principal points of products contamination during beef 'carcass dressing process in Northern Ireland. *Journal of Food Protection*. **67** (7): 1494-6.
- Grace D. Food Safety in Low- and Middle-Income Countries. *Int J Environ Res Public Health*. 2015:10490–507. <https://doi.org/10.3390/ijerph120910490>  
PMID: 26343693
- Gracey, J. F and Collins, D. S. 1992. *Meat Hygiene*, 9th edition ELBS.
- Haileselassie, M., Taddele H., Adhana, K and Kalayou, S. 2013. Food safety knowledge and practices of abattoir and butchery shops and the microbial profile of meat in Mekelle City, Ethiopia. *Asian Pacific journal of tropical biomedicine* **5**:407-12.
- Havelaar, A.H., Kirk, M.D., Torgerson, P.R., Gibb, H.J., Hald, T., Lake, R.J., Praet, N., Bellinger, D.C., Silva, N.R. de, Gargouri, N., Speybroeck, N., Cawthorne, A., Mathers, C., Stein, C., Angulo, F.J. and Devleesschauwer, B. 2015. On behalf of World Health Organization Foodborne Disease Burden Epidemiology Reference Group. 2010.
- ICMR Bulletin. 2000. Application of Hazard Analysis and Critical Control Point for improvement of quality of processed foods. *30*(5):1-6.
- Ingram, M. and T.A. Roberts, 1976. The microbiology of red meat carcass and the slaughterhouse. *The Royal Society for Public Health*, **96**:270-276.
- Jeffery, B., Donald, A. B. and Gill, C. O. 2003. Implementation of validated HACCP System for the control of microbiological contamination of pig carcass at small abattoir. *Canadian Veterinary Journal*, **44**:1.
- Jianu, C and Golet, I. 2014. Knowledge of food safety and hygiene and personal hygiene practices among meat handlers operating in western Romania. *Food Control*, **42**: 214–219.

- Jumaa, P. A. 2005. Hand hygiene: simple and complex. *International Journal of Infectious Diseases*, **9**:3-14.
- Keely, G. M., 1988. The microbiological status of meat from some typical New Zealand meat slaughtering and processing lines. *International congress of meat science and technology*, part B.504-507.
- Khalifa, E. M. I. and Abd El-Shaheed, Y. T. U. 2005. Bacteriological Evaluation Of Chicken Meat And Some Chicken Meat Products Sold In Kafr El-Sheikh. *4<sup>th</sup> International Science Conference*, 135-144.
- Khanal, G and Poudel, S. 2017. Factors associated with meat safety knowledge and practices among butchers of Ratnanagar municipality, Chitwan, Nepal: a cross-sectional study. *Asia Pacific Journal of Public Health*, **29**(8): 683–691.
- Komba, E.V.G., Komba, E.V., Mkupasi, E.M., Mbyuzi, A.O., Mshamu, S. and Mzula, A and Luwumbra, D. 2012. Sanitary practices and occurrences of zoonotic conditions in cattle at slaughter in Morogoro municipality, Tanzania: Implication for public health. *Tanzania Journal Health Research*, **14**(2):1-12.
- Kumar, A., Kebede, E. and Kassaye, E. 2010. Evaluation of quality of beef produced and sold in parts of Tigray Region of Ethiopia. *Tropical Animal Health Production*, **42**: 445 – 449.
- Lee, H.K., Hishamuddin Abdul Halim, Kwai Lin Thong and Lay ChingChai. 2017. Assessment of Food Safety Knowledge, Attitude, Self-Reported Practices, and Microbiological Hand Hygiene of Food Handlers. *International Journal of Environmental Research and Public Health*, **14**(1): 55.
- Lillard, H.S. 1989. Incidence and recovery of *salmonella* and other bacteria from commercially grown poultry carcasses at selected pre and post-evisceration steps. *Journal of Food Protection*, **52**: 88-91.
- Mawia, K., Kotwal, S.K., Lone, J.A., Kumar, A., Kumar, Y., Sharma, P., Rashid, M., Najima, N.A and Singh. 2012. Bacteriological assessment of chevon and poultry meat from local markets of Jammu. *Journal of Veterinary Public Health*, **10**(1):27-30.

- McNamara, A. M., 1995. Establishment of baseline data on the microbiota of meats of meats. *Journal of Food Safety*, **15**:113-119.
- Mensah, P, Yeboah-Manu, D, Owusu-Darko, K and Ablordey, A. 2002. Street foods in Accra, Ghana: how safe are they? *Bull World Health Organ*, **80**(7):546-54.
- Mortlock, M. P., Peters, A.C. and Griffith, C. 1999. Food hygiene and HACCP in the UK food industry, practices, perceptions and attitudes. *Journal of Food Protection*, **62**: 786-792.
- Mtenga, L. A., Lemma, B. E., Muhikambele, V. R., Maeda, G. K., Nnko, S. M. and Makungu, P. J. 2000. Assessment of bacterial contamination of meat, water and meat handling equipment at some abattoirs and butcher shops in Dar es salaam 55 city and its hygienic implication. Sokoine University of Agriculture. Suanorad project tan, 28pp.
- Muinde, O.K and Kuria E. 2005. Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *African Journal of Food, Agriculture, Nutrition and Development*, **5**(1):1-14.
- Mukhopadhyay, H.K., Pillai, R.M., Pal, U.K. and Ajay Kumar, V.J. 2004. Microbial quality of fresh chicken in retail outlets of Pondicherry. *Indian Journal of Poultry Science*, **39**: 291-293.
- Ntenga, P.D. 2013. Assessment of microbial contamination in beef from abattoir to retail meat outlets in Morogoro municipality. M.Sc. thesis submitted to Sokoine University of Agriculture, Morogoro, Tanzania in Public Health and Food Safety.
- Nyamakwere, F., Muchenje, V., Mushonga, B., Kandiwa, E., Makepe, M and Mutero, G. 2017. Evaluation of Meat Safety Knowledge, Attitudes and Practices Among Slaughter House Workers of Amathole District in Eastern Cape Province, South Africa, *Journal of Food Safety and Hygiene*, **3**:1-2.
- Okonko, I., Adejoye, O., Ogun, A., Ogunjobi, A., Nkang, A and Adebayo-Tayo, B. 2009. Hazard's analysis critical control points (HACCP) and microbiology qualities of sea-foods as affected by handler's hygiene in Ibadan and Lagos,

- Nigeria. *African Journal of Food Science*, **3**(2):35-50.
- Pradhan, S. R, Patra, G, Nanda, P. K, Dandapat, P, Bandyopadhyay, S and Das A.K.2018 Comparative microbial load assessment of meat, contact surfaces and water samples in retail chevon meat shops and abattoirs of Kolkata, WB, India. *International Journal of Current Microbiology*,**7**:158-64.
- PFA. 1954. Annual report 2000-2001 of Govt. of India. Ministry of Health and Family Welfare, Nirman Bhawan, New Delhi.
- Rajesh K. Assessment of awareness and hygienic practices among poultry butcher's in Patnacity, Bihar. [http://dspace.sctimst.ac.in/jspui/bitstream/123456789/2113/1/MPH\\_5495.pdf](http://dspace.sctimst.ac.in/jspui/bitstream/123456789/2113/1/MPH_5495.pdf). Published October 2006. Accessed November 6, 2017.
- Reddy ,V.S., Sujitha, B., Reddy, M D. and Vani, S. 2019. Awareness and practices followed by the butchers in hygienic meat production chain in YSR Kadapa district of Andhra Pradesh. *The Pharma Innovation Journal*, **8**(10): 140-145.
- Roberts,T.A.,Hudson,W.R.,Whelehan,O.P.,Simonsen,B.,Olgaard,K., Labots,H., Snijders,J.M., Van Hoof, J., Debevere,J., Dempster,J.F ., Devereux J., Leistner, L., Gehra,H., Gledel,J., and Fournaud,J.1984.Number and distribution on bacteria on some beef carcasses of selected abattoirs in some member states of European communities. *Meat Science* 11:191-205.
- Rozynek E, Dzierzanowska-Fangrat K, Jozwiak P, Popowski J, Korsak D, and Dzierzanowska D, 2005. Prevalence of potential virulence markers in Polish *Campylobacter jejuni* and *Campylobacter coli* isolates obtained from hospitalized children and from chicken carcasses. *Journal of Medical Microbiology*,**54**(7):615-972.
- Sagoo, S.K, Little, C.L, Griffith, C.J, and Mitchell, R.T.2003. Study of cleaning standards and practices in food premises in the United Kingdom. *Common Disease of Public Health*,**6**(1):6-17.
- Sani, N. A. and Siow, O. N. 2014. Knowledge, attitudes and practices of food handlers on food safety in food service operations at the Universitiy Kebangsaan Malaysia. *FoodControl*, **37**:210–217.

- Santosh Kumar, H.T., Pal, U.K., Korukonda, S., Mandal, P.K., Das, C.D. and Kesava and Roa, V. 2011. Quality of chicken meat under different slaughter conditions. *Indian Veterinary Journal*, **88**: 57-59.
- Scanga, J. A., Grona, A.D., Belk, K.E., Sofos, J.N., Bellinger, G.R. and Smith, G.C. 2000. Microbiological contamination of raw beef Breast meat with skins and ground beef. *Meat Science*, **56**: 145-152.
- Shekhar, C and Bist, B. 2008. Bacteriological examinations of Buffalo meat and its public health significance. *Journal of Veterinary Public Health*, **6** (2): 67-71.
- Sofos, J. N. 1994. Microbial growth and its control in meat, poultry and fish. In A. M. Pearson, & T. R. Dutson (eds.). Quality attributes and their measurement in meat, poultry and fish products. *Blackie Academic and Professional, London*. 358.
- Soyiri, I. N., Agbogli, H. K. and Dongdem, J. T. 2008. A Pilot microbial assessment of beef in the Ashaima Market, a suburb of Accra Ghana. *African Journal of Food Agriculture Nutrition and Development* **8**(1):91-103.
- Sulley, M. S. 2006. The Hygienic Standard of meat handling in the Tamale metropolis. BSc. Dissertation, University for Development Studies, Tamale Ghana. 23-29pp.
- Tebbutt G.M .1986. An evaluation of various working practices in shops selling raw and cooked meats. *Journal of Hygiene London*, **97**(1):81-90.
- Tefera, T. and Mebrie, G. 2014. Prevalence and predictors of intestinal parasites among food handlers in Yebu town, southwest Ethiopia. *The Public Library of Science*, **9**(10): 110621.
- Tuneer K and Madhavi T.2015. A comparative study of Hygienic status of Butchers and Identify bacteria among the Slaughters of Meat, Chicken and Fish markets of Jagdalpur city. *International Research Journal of Biological Sciences*,**4**(1), 16-24

- Vanderlinde, B.P., B. Shay and J.Murray, 1998. Microbial quality of Australian beef carcass meat and frozen bulk packed beef. *Journal of food protection*, **61**: 437-443.
- WHO, 2012. Variant Creutzfeldt-Jakob Disease. <http://www.who.int/mediacentre/factsheets/fs180/en/> (accessed 12 December 2016).
- WHO, 2015. WHO's First Ever Global Estimates of Foodborne Diseases Find Children under 5 Account for Almost One third of Deaths. *Saudi Medical Journal*. **37**(1): 109–110.
- Willayat, M.M., Sheikh, G.N., Ahmed, R. and Gunjan, Das. 2006. Isolation of Salmonella Serotypes from Fresh and Frozen chicken. *Indian Veterinary Journal*, **83**: 1253-1255.
- Yashoda, K.P., Sachindra, N.M., Sakhare, P.Z., Narasimha Rao, D. 2002. Microbiological quality of chicken carcass process hygienically in a small scale processing unit. *Meat science*, **62** (3): 381-390.
- Zhao, C., Ge, B., DeVillena, J., Sudler, R., Yeh, E., White, D. G., Wagner, D. and Meng, J. 2001. Prevalence of Campylobacter spp., Escherichia coli, and Bacillus cereus serovars in retail chicken, turkey, pork, and beef from the Greater Washington, D.C., area. *Journal of Applied Environmental Microbiology* **67**(12): 5431- 6.
- Ziauddin, S.K., D.N. Rao and B.L.Amla, 1994. A study of microbial profiles of buffalo carcasses processed in local slaughter units. *Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases*, **15**: 61-62.



# *Appendix*

## Appendix 1: Interview Schedule

Name of Butcher

1. Location of shop-
  - a) Market area
  - b) Residential area
  - c) Others, specify
2. Construction of shop
  - a) Open space
  - b) Small constructed shop with single butcher doing all jobs like butchering and meat selling
  - c) Medium level constructed shop where butcher does slaughtering job only
  - d) Others, specify
3. Sex: Male / Female
4. Age in completed years:
5. What is your highest level of schooling?
6. What do you have among followings?
  - a) Newspaper
  - b) T.V.
  - c) Radio
  - d) Others, specify
  - e) None
7. Is it your own shop? Yes / No
8. How long you are involved slaughtering job (in years)?
9. From where have you learnt butchering?
  - a) Father
  - b) Relatives and friends
  - c) Formal (institutional) training
  - d) Any training
  - e) Others, specify
10. Have you owned another job? Yes / No
11. What is average work-load (per day)?
  - a) in kg
  - b) in numbers
12. From where you get the chickens? Own poultry farms / Buy from others
13. Is your shop has licence? Yes / No

### Awareness

15. Among the following diseases, which can occur among humans because of eating meat?
  - a) Diarrheab
  - b) Fever
  - c) Cough
  - d) Itching
  - e) Cancer
  - f) warts
  - g) None
  - h) Don't know
  - i) Others, specify
16. What are the reasons why the butchers get it?
17. What are the hygienic aspects, which is/are essential to maintain the meat hygiene while slaughtering (Multiple answering)
  - a) Cleanliness of equipment
  - b) Cleanliness of setting
  - c) Personal hygiene
  - d) Poultry and meat hygiene
  - e) Disposal of by-products
  - f) Others, specify
18. Are you able to maintain hygienic practice (whatever you have mentioned above)?  
Yes / No
19. If not then, what type of improvement you want to do in your shop?
20. What type of improvement do you want to do for your butchering job in order to maintain the hygienic practices?

**Hygienic practices (observation checklist)**

| <b>Main topic</b>                    | <b>Sub topic</b>                  | <b>Codex Alimentarius Commission and EICI (a),</b>   | <b>Yes/No</b> | <b>Remarks if any</b> |
|--------------------------------------|-----------------------------------|--|---------------|-----------------------|
| <b><u>Facilities and setting</u></b> |                                   |  |               |                       |
| <b>Cleanliness of equipments</b>     | Knife                             | Good state of repair (a)   |               |                       |
|                                      |                                   | Corrosion / resistance (a)   |               |                       |
|                                      |                                   | Clean before each new period of work (a)   |               |                       |
|                                      |                                   | Sanitized before each new period of work (a) or immersion in hot water during and between the work |               |                       |
|                                      | Slab/cutting board/dressing board | Good state of repair (a)   |               |                       |
|                                      |                                   | Corrosion / resistance (a)   |               |                       |
|                                      |                                   | Clean before each new period of work   |               |                       |
|                                      |                                   | Sanitized before each new period of work (a) or immersion in hot water during and between the work |               |                       |
| <b>Cleanliness of setting</b>        | Floor                             | Clean  |               |                       |
|                                      |                                   | Good drainage  |               |                       |
|                                      |                                   | Sloppy   |               |                       |
|                                      |                                   | Disinfected  |               |                       |
|                                      | Sewage                            | Good drainage (a)  |               |                       |
|                                      | Animals and insects               | No insects including flies should be there   |               |                       |
|                                      |                                   | No animals   |               |                       |
|                                      | Lairage (cage)                    | Sufficiently clean   |               |                       |
|                                      |                                   | Clean feed   |               |                       |
|                                      |                                   | Clean drinking water   |               |                       |
|                                      |                                   | Good drainage  |               |                       |
| <b>Other facilities</b>              | Water                             | Easily available hot water all the time  |               |                       |
|                                      |                                   | Easily available cold water all the time   |               |                       |
|                                      | Lightening                        | Adequate (natural or artificial)   |               |                       |
|                                      | Disposal of by-products           | Frequent   |               |                       |
|                                      |                                   | Safe   |               |                       |

| <b>Cleaning and sanitation</b> |   |                     |  |  |
|--------------------------------|---|---------------------|--|--|
|                                | Soap  |                     | For washing the body parts                     |  |
|                                | Disinfectant  |                     | Using for sanitation                           |  |
|                                | Use of detergent                                    |                     | Using for cleaning                             |  |
| <b>Poultry and meat health</b> |   |                     |  |  |
| <b>Poultry and meat health</b> | Slaughtering birds                                  |                     | Healthy  |  |
|                                |   |                     | Clean  |  |
|                                | Withheld feed before cutting                        |                     | 24 hour before                                 |  |
|                                | History of flock                                    |                     | Should be there                                |  |
|                                | Screening of birds                                  |                     | On arrival of birds and valid for 72 hours (a) |  |
|                                | Ante mortem inspection                              |                     | By competent person* within 24 hour            |  |
|                                | Killing   |                     | Rapid decapitation or stunning                 |  |
|                                | Bleeding  |                     | Complete bleeding for at least 90 sec          |  |
|                                | Washing of carcass                                  | Before evisceration | With potable water                             |  |
|                                |   | After evisceration  | With potable water                             |  |
|                                | Evisceration  |                     | Immediate after bleeding                       |  |
|                                | Post-mortem inspection                              |                     | By competent person*                           |  |
|                                | By-product inspection                               |                     | Viscera inspection (a)                         |  |
|                                |   |                     | Inedible product                               |  |
| <b>Cross contamination</b>     | Mixing of GIT content or Feathers or both with meat |                     | Should not there                               |  |
|                                | Meat touches to floor                               |                     | No   |  |
|                                | Other sources                                       |                     | Not any direct contact                         |  |

| <b>Butcher's health</b> |                            |   |           |  |
|-------------------------|----------------------------|---|-----------|--|
| <b>Butchers</b>         | Protective clothing        | Light coloured (a)  |           |  |
|                         |                            | Clean   |           |  |
|                         |                            | Easily cleanable  |           |  |
|                         |                            | Sanitized   |           |  |
|                         | Personal habits            | Spitting in-between                                       |           |  |
|                         |                            | Use of tobacco products                                   |           |  |
|                         |                            | Wiping hand with cloths                                   |           |  |
|                         |                            | Counting money in-between                                 |           |  |
|                         |                            | Doing other work in-between without sanitizing            |           |  |
|                         |                            | Nose picking  |           |  |
|                         |                            | Others  |           |  |
|                         | Protective equipments like | Gloves  | Clean     |  |
|                         |                            |   | Cleanable |  |
|                         |                            |   | Sanitized |  |
|                         |                            | Gumboot or shoe or at least slipper                       | Clean     |  |
|                         |                            |   | Cleanable |  |
|                         |                            |   | Sanitized |  |
|                         | Medical Certificate        | No communicable disease during work                       |           |  |
|                         | Cuts and injury            | Wash proof covering during slaughter                      |           |  |
|                         | Washing of body            | Before start of the work                                  |           |  |
|                         |                            | Body parts on every episode of work                       |           |  |
|                         | Clean hands                | Clean before start of the work                            |           |  |
|                         |                            | Sanitize before start of the work                         |           |  |
|                         |                            | Clean during the work                                     |           |  |
|                         |                            | Sanitize during the work or frequent clean with hot water |           |  |

@ Other meat handler, dust, cloths, table and one which will be observed in that context and it will be mentioned in column of remark. Competent person means person under the authority to respect the meat and specially trained for meat inspection that might Public Health.

## Appendix 2: To assess risk factors of meat contamination

Date: dd/month/year .....

Name of Respondent..... sex ..... age....

Name of city .....

Ownership.....

Average No. of Slaughter per Day .....

Goats .....

Sheep.....

Others

No. of Inspectors.....

Government/private .....

No. of Employees .....

Sanitation Standard Operating Procedures (SSOP)

1. Is the location of the slaughter facility subject to water stagnation, floods, objectionable odours, smoke, dust or other contaminants?

Yes/No

2. Are there hoisting facilities before skinning and evisceration?

Yes/No

3. Is there a clear demarcation between the dirty area and a clean area during slaughtering and handling?

Yes/No

4. Are heads, hides, skins and legs remove immediately after slaughter?

Yes/No

5. Is there a separate room for handling offal?

Yes/No

6. Is there adequate natural and or artificial light to enable proper operations?

Yes/No

7. Do you have a disposal pit. That is lockable?

Yes/No

8. Are floors and walls made of impervious hard material for easy washing and disinfection?

Yes/No

9. Is there a good drainage system?

Yes/No

10. Are your slaughter equipments e.g. knives, hooks, receptacles and cleaning table for offals made of easy to clean material like stainless steel?

Yes/No

11. Is there adequate cold and hot potable water (82°C) for washing used utensils, floor and walls after slaughter?

Yes/No

12. Is there a provision of washing dirty animals presented for slaughter before slaughter?

Yes/No

13. Do you ensure that all the equipments are clean before start of slaughter operations?

Yes/No

14. Do you ensure that all personnel in the slaughter process have protective and clean covering e.g. aprons, head cap, gumboots, sanitary wears?

Yes/No

15. How do you maintain your hands clean after visiting toilet or before start of work?

Wash with warm water and soap/Wash with cold water and soap

16. Have slaughter facility personnel undergone any training on minimum meat hygiene handling practices?

Yes/No

17. Do slaughter facility personnel undergo a regular medical check up every year?

Yes/No

18. What do you do when carcass meat comes in contact with faeces or intestinal contents?

Wash thoroughly/ Trim the meat or scrub off the faeces.



*Vita*

## **VITA**

|                                       |                                       |
|---------------------------------------|---------------------------------------|
| <b>Name of the Student</b>            | <b>Kavya Gupta</b>                    |
| <b>Father's name</b>                  | Dr Surinder Gupta                     |
| <b>Mother's Name</b>                  | Dr. Neena Gupta                       |
| <b>Nationality</b>                    | Indian                                |
| <b>Date of Birth</b>                  | 27-01-1997                            |
| <b>Permanent Home Address</b>         | 10/7 Tawi Vihar Sidhra, Jammu 180019. |
| <b>Telephone Nos. &amp; E-mail ID</b> | 9796815971,<br>gkavya2701@gmail.com   |

## **EDUCATIONAL QUALIFICATION**

|                                     |  |
|-------------------------------------|--|
| <b>Bachelor Degree</b>              | B.V.Sc. & A.H  |
| <b>University and Year of award</b> | SKUAST-J (2019)  |
| <b>OGPA</b>                         | 6.504/10   |
| <b>Master's Degree</b>              | M.V.Sc. (Veterinary Public Health & Epidemiology)  |
| <b>Title of Master's Thesis</b>     | <b>“ASSESSMENT OF HYGIENE PRACTICES FOLLOWED BY RETAILERS AND BUTCHERS OF SMALL SLAUGHTERING PREMISES IN JAMMU CITY”</b> |
| <b>University and Year of award</b> | SKUAST-J (2021)  |
| <b>OGPA</b>                         | 8.25/10  |

## CERTIFICATE-IV

Certified that all the necessary corrections as suggested by the external examiner/evaluator and the Advisory Committee have been duly incorporated in the thesis entitled **“ASSESSMENT OF HYGIENE PRACTICES FOLLOWED BY RETAILERS AND BUTCHERS OF SMALL SLAUGHTERING PREMISES IN JAMMU CITY ”** submitted by **Ms. Kavya Gupta**, Registration No: **J-19-MV-603**.



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