

بسم الله الرحمن الرحيم

**Sudan University of Science and Technology**

**College of Graduate Studies**

**Evaluation of Hazard Analysis and Critical Control Point System  
Application in Elkadaro and Elshaheed Slaughterhouses Located in  
Khartoum State, Sudan.**

تقويم تطبيق نظام تحليل الخطر والتحكم في النقاط الحرجة في مسلخي الكدرو والشهيد في ولاية  
الخرطوم، السودان

**A thesis submitted in partial fulfillment of requirements for the master  
degree of preventive veterinary medicine (M.P.V.M).**

**By**

**Abdou Mahmood Abdelrhman Mohamed**

**BVSC, 2016- West Kordufan University**

**Supervisor**

**Prof. Dr. Mohamed Abdelsalam Abdalla**

**October- 2019**

قال تعالى:

بسم الله الرحمن الرحيم

[سبح لله ما في السموات والارض وهو العزيز الحكيم]

{صدق الله العظيم}

{الاية ١ سورة الحديد}

## **DEDICATION**

WITH ALL MY LOVINGNESS AND APPRECIATIVE TO, My MOTHER, FATHER, MY BROTHERS AND SISTERS, MY SUPERVISOR AND MY FRIENDS.

## **ACKNOWLEDGEMENTS:**

First of all, thanks to allah for giving me the strength and patience to do this study.

### **I would like to show my deep gratitude:**

To my promoter, Prof. Mohammed Abdelsalam Abdalla, who consume his time to my study, for his guidance, encouragement and help during this work. To the Sudan University of Science and Technology College of Veterinary Medicine and Animal Production College Research Committee. To everyone who eased this study.

## LIST OF CONTENTS

LIST	page
الاية	I
DEDICATION	ii
ACKNOWLEDGEMENTS	iii
LIST OF CONTENTS	iv
LIST OF TABLES	vi
ABSTRACT	vii
المستخلص	viii
INTRODUCTION	1
CHAPTER ONE	
1.1.Slaughterhouse	3
1.1.1. Location	3
1.1.2. SLAUGHTER HOUSE LAYOUT PLAN	3
1.1.3. SECTIONS OF A SLAUGHTER HOUSE	3
1.1.3.1.Reception	3
1.1.3.2.Lairage	3
1.1.3.4.Slaughter hall	3
1.1.3.5.Stunning area	3
1.1.3.6.Bleeding area	4
1.1.3.7.Hoisting area	4
1.1.3.8.Flaying section	4
1.1.3.9.Evisceration area	5
1.1.3.10.Carcass splitting	5
1.1.3.11.Carcass washing area	5
1.1.3.12.Inspection facilities	6
1.1.3.13.Carcass chilling area	6
1.1.4.ANCILLIARY/AUXILIARY FACILITIES	6
1.1.4.1.DISTRIBUTION ROOM	6
1.1.4.2.HIDES/SKINS ROOM	6
1.1.4.3.OFFAL ROOM	6
1.1.4.4.RETENTION ROOM	6
1.1.4.5.LABORATORY	6
1.1.4.6.DISPOSAL OF CONDEMNED MEAT	6
1.1.4.7.SANITATION FACILITIES	6
1.1.4.8.SUPPLY OF WATER	6
1.1.4.9.SLAUGHTER HOUSE WASTE WATER DISPOSAL	7
1.1.4.10.GREASE TRAP	7
1.1.4.11.MANURE DISPOSAL	7
1.1.4.12.EMERGENCY SLAUGHTER HOUSE	7
1.1.4.13.POST MORTEM ROOM	7

1.1.4.14.VETERINARY OFFICES	7
1.1.4.15.SAFETY REQUIREMENT	7
1.1.5.General Provision	8
1.2.Sudanese slaughterhouse	8
1.3.Contamination in slaughterhouse	9
1.4.Slaughtering process	11
1.4.1. Receiving	11
1.4.2. Holding	12
1.4.3. Reject diseased animals	13
1.4.4. Feeding	14
1.4.5. Skinning	14
1.4.6. Washing knives and workers hands	14
1.4.7. Separate rooms	15
1.4.8. Protective clothes	16
1.4.9. Using water	17
1.4.10. Chilling rooms	18
CHAPTER TWO	
2-MATERIALS AND METHODS	20
2.1- Study Area and Slaughterhouses	20
2.2- Study Design and Sampling Strategy	20
2.3. Statistical analysis	20
CHAPTER THREE	
Results	21
CHAPTER FOUR	
Discussion	24
Conclusion	32
Recommendations	33
REFERENCES	34

## List of Tables

<b>Number</b>	<b>Title</b>	<b>Page</b>
<b>1</b>	Frequency distribution of respondents {n=35} in EL-shaheede slaughterhouse –Khartoum state	<b>22</b>
<b>2</b>	Frequency distribution of respondents {n=35} in EL-kedaro slaughterhouse, Khartoum state	<b>23</b>

## **ABSTRACT**

The present study was carried out from January/2019 to June/2019 to evaluate the appropriate of applying of hazard analysis and critical control point in two slaughterhouses Located In Khartoum State, Sudan. A total of 70 Questionnaires cotaining 10 various questions were taken from two slaughterhouses (EL-kedaro, EL-shaheede) each slaughterhouse was covered with 35 questionnaires to know is there an application of HACCP. Ten critical control points were choosen in a cattle, sheep and goat these points were receiving, holding, abattoir rejects,feeding, skinning, wash of hands and knives, separate rooms, special clothes for work, using water and chilling rooms. The result showed that the workers in EL-shaheede slaughterhouse were practiced rejection of diseased animals(62%),skinning(77%) and using of water(65%) but in EL-kedaro slaughterhouse all the workers practiced the control points except washing hands and knives(60%). The applying of HACCP can reduce contamination of meat physically, chemically and biologically.



## المستخلص

أجريت هذه الدراسة من يناير ٢٠١٩ الي يونيو ٢٠١٩ لتقييم اجراءات تطبيق نظام تحليل الخطر والتحكم في النقاط الحرجة في مسلخين يقعان في ولاية الخرطوم، السودان. تم اخذ عدد ٧٠ إستبيان تحتوي علي عشرة اسئلة مختلفة من مسلخين (الشهيد، الكدرو) من كل مسلخ تم تغطية ٣٥ استبيان لمعرفة تطبيق نظام تحليل الخطر والتحكم في النقاط الحرجة . تم اختيار عشرة نقاط التحكم الحرجة في الابقار،الماشية والماعز هذه النقاط يضم استقبال الحيوانات، فحص قبل الذبيح، استبعاد الحيوانات المريضة من قبل المسلخ، التغذية،السلم، غسل اليدين والسكاكين، الغرف المفصلة، ملابس واقية، المياه المستخدم و غرف التبريد. النتيجة أظهرت ذلك العمال في مسلخ الشهيد متبعين استبعاد الحيوانات المريضة(٦٢%)، السلم(٧٧%) واستخدام الماء(٦٥%) لكن في مسلخ الكدرو كل العمال متبعين نقاط التحكم ما عدا غسل اليدين والسكاكين(٦٠%). تطبيق نظام تحليل الخطر والتحكم في النقاط الحرجة يقلل من التلوث في اللحوم فيزيائياً، كيميائياً وبيولوجياً.

## INTRODUCTION

Hazard Analysis and Critical Control Point (HACCP) is a system which attempts to guarantee food safety and harmlessness, it ensures the protection of products and the correction of failures which decrease the costs for quality defects and practically eliminates the need for a final super control (Saleh *et al.*, 2015). HACCP plans are process and product specific, targeting specific hazards. Hazard Analysis Critical Control Point (HACCP), one of the systems that tries to identify, evaluate, and control biological, chemical, and physical hazards in food, is based on a coherent interdepartmental and multidisciplinary Application of food quality management systems aim at increasing competitiveness of firms, ensuring food safety and quality, as well as protecting public health (McElhatton, 2012) is growing in food producing and processing firms. Food safety has become an increasingly important issue globally for many reasons, including the emergence of foodborne diseases such as ‘mad cow’ disease, as well as *Vibrio vulnificus* (in shellfish) and pathogenic *Escherichia coli* (in beef and sprouts) infections; increasing scientific knowledge and the ability to detect pathogens; concerns about food-based bioterrorism; and reduced trust of consumers in the agro food industry (Geburu and Gebretinsae, 2018). Existing ones need renovation with expert advice to reduce this risk. Future ones, no matter how small must be built with public health expertise inputs and environmental risk assessment. Political authorities must also enact and enforce laws to protect public health. The Veterinary Public health authorities, as well as the consuming public, must raise a voice in this advocacy (Annan-Prah, 2012). The identification of biological, chemical, and physical hazards in all materials and process steps is Principle 1. After analysis of the potential hazards identified assessing a consistent risk, according to the preventive measures designed to control hazards. Principle 2 suggests the identification of adequate critical control points (CCPs) in materials and process

steps to control the hazards. Principle 3 is the definition of critical limits for each CCP. Principle 4 is monitoring to assure fulfillment of procedures at each stated CCP. When non-conformities from the outlined limits occur at a CCP. Principle 5 states that corrective action should be immediately applied to restore the control. Actions of verification to evaluate compliance of the HACCP plan are stated in Principle 6. All the procedures planned and implemented for monitoring, corrective actions, and verification performed should be recorded, providing an effective demonstration of the system at work in Principle 7. HACCP plan improvement is needed, and its update is based on any output of the system and when any input to the system changes such as premises, layouts, process, or if new legal or trade requirements are introduced and could have impact on safety. The HACCP plan is specific of a certain product, process, and organization. The use of a generic HACCP model to build specific HACCP plans should be taken as an assisting document that always needs creative adaptation and changing. Pre-requisites need to be fulfilled to accomplish with success the implementation of an HACCP plan. They are mandatory for food safety (Ramos and da Silva, 2017).

### **Objectives of the study:**

1. To evaluate application of Hazard Analysis and Critical Control Point System in two slaughterhouses in Khartoum state, Sudan.

**CHAPTER ONE**  
**LITERATURE REVIEW**

# **CHAPTER ONE**

## **LITERATURE REVIEW**

### **1.1. Slaughterhouse:**

Means any place kept for the purpose of the slaughter of animals for human consumption (PRD, 2018). Slaughterhouses are defined as places where animals are slaughtered for food (Stevenson, 2013).

#### **1.1.1. Location of slaughterhouse:**

A slaughterhouse shall be located in an area which is reasonably free from objectionable odors, smoke and dust. Adequate dust-proof access-ways connecting the slaughterhouse with public roads shall be available. The slaughterhouse must be completely separated from any other buildings used for industrial, commercial, agricultural, residential or other purposes other than connected building used for the processing of the meat. The plan for construction of slaughter house shall follow the relevant provisions of EMCA Act, Physical Planning Act, Meat Control Act, Food Drugs and Public Health Act, Public Health Act and County physical Development Plans. The slaughter house site shall be guided by the Part Development Plan(PDP) of the area (PRD, 2018).

#### **1.1.2. Slaughterhouse layout plan:**

The slaughter house shall have the essential facilities for the following activities:

- 1.1.2.1. Receiving the animal.
- 1.1.2.2. ante-mortem inspection.
- 1.1.2.3. isolation of sick/diseased animals.
- 1.1.2.4. Resting place for animals before slaughter.
- 1.1.2.5. Carrying out humane slaughter – stunning box.

- 1.1.2.6. Flaying, dressing and washing of the carcasses.
- 1.1.2.7. Hanging carcasses and edible offal.
- 1.1.2.8. Handling by-products.
- 1.1.2.9. Handling solid and liquid wastes.
- 1.1.2.10 Inspection of meat.
- 1.1.2.11. Chilling and Freezing facilities.
- 1.1.2.12. Emergency slaughter.
- 1.1.2.13. Staff welfare.
- 1.1.2.14. provision of hot and cold of potable water.
- 1.1.2.15. Toilets and changing rooms (PRD, 2018).

### **1.1.3. Sections of a slaughterhouse:**

#### **1.1.3.1. Reception:**

The slaughter house shall have reception area of adequate size and shall have adequate artificial lighting if animals are offloaded at night. Offloading ramps shall be movable or stationary.

#### **1.1.3.2. Lairage:**

Cattle, goats, sheep and pigs shall be penned separately. In the case of pigs, pigs from different origins should be penned separately, in accordance with their origins. Depending on the size of the animals and the duration of time that the animals will be penned.

#### **1.1.3.4. Slaughter hall:**

The slaughter halls and ancillary accommodation thus provided shall be separated, keeping in view the economic and local requirements, by solid walls depending upon the site. The slaughter hall shall have the following facilities:-

#### **1.1.3.5. Stunning area:**

There shall be a separate area designated for stunning the animals depending on the species.

#### **1.1.3.6. Bleeding area:**

A curbed-in bleeding area of adequate size shall be provided. It shall be so located that the blood shall not be splashed on other animals being slaughtered or on the carcass being skinned. A floor wash point should be provided for intermittent cleaning.

#### **1.1.3.7. Hoisting area:**

A suitable means of hoisting the slaughtered animal shall be provided. The bleeding rail shall be of sufficient height for the animal carcass to hang above the floor.

#### **1.1.3.8. Flaying section:**

Flaying of carcasses shall not be done on floor. Adequate means and tools for dehiding or belting of the animals shall be provided. Means for immediate disposal of hides or skins shall be provided. Hides or skins shall be immediately transported either in a closed and appropriate carriage or by a chute provided

with self-closing door to a room where they shall be held before moving to the preservation area. Means for immediate disposal of legs, horns, hooves, etc, should be provided.

**1.1.3.9. Evisceration area:**

For cattle either a mechanical evisceration table or individual paunch/gut holders can be used for the reception and inspection of these products. Facilities shall be provided for the eviscerator to do the job hygienically. In the case of a mechanical conveyor belt, boot washing, apron washing and other washing/sterilising facilities shall be made available. The evisceration platform used at smaller slaughter house shall be provided with a hand basin/steriliser. In all cases there shall be facilities for the sterilisation of the evisceration platform or offal containers. Racks and/or facilities for handling red and green/rough offals shall be provided.

**1.1.3.10. Carcass splitting:**

Appropriate carcass splitting equipment shall be provided in the slaughter house. Carcasses shall be split straight down the middle as appropriate so as not to damage to the meat applicable for beef and pork carcasses.

**1.1.3.11. Carcass washing area:**

Potable water at sufficient pressure shall be provided to remove all blood, slight blood marks, bone, dust and marrow.

**1.1.3.12. Inspection facilities:**

The following facilities, conditions and such others as may be essential to efficient conduct of inspection and maintenance of sanitary conditions shall be provided by each slaughterhouse:-

Adequate space, suitable and properly located facilities shall be provided for inspection of the various types of animals slaughtered. This section shall have adequate facilities for hand washing, equipment sterilization and floor washing and for immediate separation and disposal of condemned material. Sufficient natural and/or abundant artificial light at all places and such times of day when natural light may not be adequate for proper conduct of inspection. Rooms shall be kept sufficiently free from vapours and steam for inspection to be properly made. Racks, receptacles, or other suitable devices for retaining such parts as the head, tongue, tail, thymus gland and viscera, and other parts and blood to be in the preparation of meat until after the post-mortem is completed, in order that they may be accurately identified in case of condemnation of the carcass. Watertight metal carriers or receptacles for holding and handling diseased carcasses and parts, so constructed as to be easily cleaned; such trucks or receptacles shall be suitably marked in a conspicuous manner with the word— condemned in letters not less than five centimetres high, and when required by the inspecting officer, to be equipped with facilities for locking or sealing.

#### **1.1.3.13. Carcass chilling area:**

Facilities that shall ensure chilling of the meat at temperature range -2 to 4 °C shall be provided. The space required per carcass and the distance between the rails in hanging or chill room (PRD, 2018).

#### **1.1.4. Ancillary/Auxiliary Facilities:**

##### **1.1.4.1. Distribution Room:**

A separate area /room set aside for various functions i.e. sales or collection of products and or by products to avoid customers or outsiders from accessing prohibited areas in the slaughterhouse.

##### **1.1.4.2. Hides/Skins Room:**

A separate room outside the slaughter house shall be provided for temporarily storage of the hides/skins.

##### **1.1.4.3. Offal Room:**

A separate room and hanging space shall be provided for emptying and cleaning of stomachs and intestines. This room shall be provided with sufficient potable running water work tops. This room shall have a separate exit and sufficiently drained.

##### **1.1.4.4. Retention Room:**

Suitable and sufficient room shall be provided for the retention of all meat condemned as unfit for human consumption and shall be locked up separately. Suitable and sufficient facilities shall be provided for the isolation of meat requiring further examination by the veterinary inspector within the premises of the slaughter house.

##### **1.1.4.5. Laboratory:**

A laboratory within the premises of the slaughter house may be provided.

##### **1.1.4.6. Disposal of Condemned Meat:**

Suitable and sufficient facilities shall be provided for the disposal of condemned meat. This shall be through an appropriately designed condemnation pit or appropriately designed incineration facilities or other approved means of disposal.

##### **1.1.4.7. Sanitation Facilities:**

Appropriately located toilet and changing rooms should be provided in the slaughter house building sufficiently away from slaughter walls for the dirty and clean areas. A separate hall with lockers and shower facilities should be provided. Solid and liquid wastes from the sanitation facility shall be handled separately from slaughter house waste. Adequate drinking water and washing facilities shall be provided at convenient locations.

##### **1.1.4.8. Supply of water:**

Adequate supply of potable water shall be available at appropriate pressure throughout the premises. Sufficient supply of potable hot water above 82°C for sterilizing of equipment shall be available in the slaughter hall and workrooms during working hours. Suitable facilities for washing of hands (including



adequate supplies of hot and cold running water, and soap or other detergent) shall be provided for persons working in an Slaughter house. Where non-potable water is used for fire control, it shall be carried in completely separate lines preferably identified by colour and with no cross-connection or back siphonage with lines carrying potable water.

**1.1.4.9. Slaughterhouse waste water Disposal:**

An efficient method of disposing of slaughter house wastes shall be provided in accordance.

**1.1.4.10. Grease Trap:**

Catch basin for the recovery of grease shall be suitably located and not placed in or near edible products department or area where edible products are unloaded from or loaded on to vehicles, to facilitate ready cleaning, such basins shall have inclined bottoms and shall be without covers. They shall be so constructed that they may be completely emptied of their contents for cleaning. The area surrounding an outside catch basin should be paved with impervious material, such as concrete, and shall be provided with suitable drainage facilities. Suitable facilities shall be provided for the transfer of grease to the point of disposal after it is skimmed from the basins by mechanical or other means.

**1.1.4.11. Manure Disposal:**

A suitably designed facility for disposal of manure shall be provided. A separate drain line for water containing manure shall be provided. This waste water may be pumped by wet pit or dry pit non-clog pumps. And manure screened out and disposed off by mechanical or the other suitable means. Some consideration as in catch basin shall be given for location of this plant. An access path for easy and convenient removal of the manure shall be provided.

**1.1.4.12. Emergency Slaughterhouse:**

Appropriate facility shall be provided for the emergency slaughter of animals. The facility shall have all the necessary equipments for hygienic meat preparation.

**1.1.4.13. Post mortem Room:**

Appropriate facilities shall be provided for conducting post mortem of animal arriving dead at the slaughter house or dies at the lairage.

**1.1.4.14. Veterinary Offices:**

There shall be suitable and sufficient offices facilities for the veterinary/inspecting officer equipped with adequate sanitary and hygiene facilities. The offices shall be located in the slaughter house to enable the officers have effective control of all activities within the slaughter house.

**1.1.4.15. Safety Requirement:**

Adequate firefighting equipment and appliances shall be fixed in accordance with Occupation Safety and Health Act (OSHA). Adequate facilities for first-aid shall also be provided (PRD, 2018).

### **1.1.5. General Provision:**

Slaughter house shall be hygienically managed and under the supervision of a competent authority. A slaughterhouse shall have—

Properly built and drained lairage erected not less than ten meters from the slaughterhouse and equipped with adequate facilities for ante-mortem inspection and Isolation pens for suspect animals. Fenced cattle races from the lairages to the slaughterhouse, properly drained and in a suitable place equipped with facilities for washing the animals. Separate facility for handling hides and skins. Separate room for the cleaning and treatment of intestines and ovals. Separate room for the storage, disposal and treatment of inedible and condemned animals, carcass and meat. Impervious, easily cleaned and resistant to wear and corrosion materials. Floors constructed of dense, acid-resistant, waterproof concrete and have appropriate non slip finish. Walls smooth and flat and made of smooth-surfaced Portland cement plaster or other non-toxic, non-absorbent material applied to a suitable base, and walls shall be provided with sanitary bumpers to prevent damage by movable equipment. Coves with sufficient radii to promote good sanitation shall be installed at the juncture of floors and walls in all rooms. Ceilings of adequate head room be smooth and flat and be constructed of portland cement plaster or other acceptable impervious material that allow for easy cleaning. Provisions for adequate natural lighting and ventilation. Doorways at least one hundred and fifty centimeters wide and the doors must be made of rust-resistant metal having tight soldered or welded seams. Door jambs shall be covered with rust-resistant metal. Pest proofing to prevent the entry of insects and rodents. Dressed timber used for all exposed interior wood work, and it shall be painted with a good non-toxic oil or plastic base paint, treated with linseed oil or with a clean wood sealer. All parts of floors where wet operations are conducted well drained, with at least one drainage inlet provided for each thirty five square meters of floor space. The inlets shall be placed under the dressing rails if necessary together with drainage valleys, not less than seven decimal five centimeters wide, with a slope of the floor towards drainage valleys or inlets of at least two decimal five centimeters per meter (PRD, 2018).

## **1.2. Sudanese slaughterhouses:**

The processing methods adopted in Sudanese slaughterhouses are analogous and the hygienic standards too. Generally in the Sudanese slaughterhouses, there are no strict hygienic measures in place and many practices and conditions might lead to cross contamination and facilitate bacterial growth and, hence,

result in high levels of TVCs. These practices and conditions include: there are no demarcations between the clean and dirty areas in the processing halls, the working personnel do not wear the recommended protective clothes and they move freely to and from the clean and dirty areas. Knives are cleaned in same water more than once, in addition to that, this water is not heated, and no disinfectants are used for the same purpose. These knives are used for processing more than one animal before being washed and they are sharpened by the same device. As well, carcasses are cut into pieces by the same device without cleaning it and the ambient temperature in the processing halls is not adjusted at the wanted and recommended degrees. However, in the Sudan, slaughtering procedure is mainly artisanal and manual (Shuaib *et al.*, 2015). The review disclosed the strengths and weaknesses of the Sudanese Meat Safety Management System with regard to HACCP system. The current condition and level of applicability of the HACCP prerequisites programs is still below the recommended level (Elniema, 2016).

### **1.3. Contamination in slaughterhouse:**

The protein requirement of man may be obtained from either animal or plant sources. Animal protein contains the essential amino acids tryptophan and lysine, which plants lack. Fat of meat also contain the essential the fatty acid, linoleic acid that plants lack (Annan-Prah, 2012). Meat safety has remained a key issue of public health concern to both developing and developed countries particularly under the current concept of one World One Health (Ndalama, 2013). Slaughtered animals may harbour relatively few bacteria, but the meat surface is exposed to contamination during slaughter, evisceration, and other operations after slaughter, transportation conditions and exposure during vending operations can lead to contamination (Asse *et al.*, 2011). In Tanzania, poor sanitary and meat handling practices have been documented (Nonga *et al.*, 2010; Mdegela *et al.*, 2011; Komba *et al.*, 2012). Data documented in Food and

Agriculture Organisation Statistics (FAOSTAT, 2012), indicate beef as the most consumed meat in Tanzania. Further, biological, chemical, and physical hazards are encountered in beef slaughtered and processed in the slaughterhouse facilities in the country (UNIDO, 2012). It was found that contaminants in the abattoir include Gram positive bacteria. The dominant bacteria isolated *Staph. Spp.*, *E. coli* or *salmonella* were isolated which is a significant results. The sources of meat contamination were investigated and determined at several critical points where hygienic faults were marked out. Air of cattle slaughter hall (C.C.P.10), meat before wash (C.C.P.7) and beef splitting saw (C.C.P.6) were found to have the highest number of bacteria compared with the other critical control points. Pathogenic bacteria such as *Salmonellaspp.*, *Staphylococcus aureus*, *Listeria monocytogens*, *Campylobacter spp.* and *Escherichia coli* O157:H7, have been implicated in a number of food borne illnesses. The contamination causing these bacteria in the slaughterhouse occurs during processing of live animals into meat where the routine veterinary inspection procedures cannot detect these bacteria on meat (Nouichi S and Hamdi TM, 2009). Meat contamination results more often than not during meat slaughtering and processing at the slaughterhouse, causing food poisoning or food-borne diseases and thus precipitating a food safety issue (FAO, 2015; Bakhtary *et al.*, 2016). Food and meat poisoning are acute foodborne disease caused by contamination and have been common occurrences and a worldwide public health concern (Malangu, 2016). Food poisoning, meat contamination and food safety have become areas of interest and have attracted global attention due to consumers' awareness and concern for the type of meat and food which they eat (FAO, 2015). There are multiple failings in the slaughter process that result in meat contamination and allow the transmission of pathogens: inadequate infrastructure, poor hygiene, lack of ante and post mortem inspection, and inadequate training (FAO, 2010). Poor hygiene practices during carcass handling have been suggested as sources of meat contamination ( Biffa

*et al.*, 2010). All the meat contact surfaces had pathogenic and indicator bacteria. The findings have highlighted high contamination levels of abattoir and retail houses meat contact surfaces. This may contribute towards a high incidence of food associated illnesses through cross contamination of different food products. Maintenance of slaughter hygiene and regular monitoring of meat establishments is essential to minimize the risk of direct and cross-contamination of the meat thereby ensuring meat quality and public health protection (Ayalew *et al.*, 2015). The sources of meat contamination were investigated and determined at several critical points where hygienic faults were marked out. It was found that contaminants in the abattoir include Gram positive bacteria. The dominant bacteria isolated and *Staph.* spp. They were the more frequent isolate. Quality control on production is likely to operate at three levels: hygiene control of the processing (and this includes cleaning regimes for equipment, etc); detection of possible hazards from pathogenic organisms in the product, and the assessment of the potential shelf-life (or storage-life) of the product. The application of the usual system of quality control based only on the sampling of finished products and rejection of batches which fail the standard is unlikely to succeed in its aim since microbiological testing of limited use and informative, and in consequence only a relatively small sample of the entire batch can be tested (Eid, 2010). Microbiological contamination of carcasses occurs mainly during processing and manipulation, such as skinning, evisceration, storage and distribution at slaughterhouses and retail establishments (Abdalla *et al.*, 2009).

## **1.4. Slaughtering process:**

### **1.4.1. Receiving:**

Animals that are received will giving 12 hours to be ready for Slaughtering (Gebru and Gebretinsae, 2018).

### **1.4.2. Holding:**

There was no ante-mortem inspection of animals carried out and animals were often brought in tied with ropes and chased into the abattoir. All sort of diseased, cachectic and moribund animals were slaughtered in the abattoir. Sometimes, dead animals slaughtered during transport were brought to the abattoir for dressing because the animals could not make it to the abattoir alive. Generally, there was no postmortem inspection of slaughtered animals in this abattoir since there was no compensation to be paid by the government to the animal owners for any condemned organ or carcass. Hence, such diseased meat and offals were often seen sold to the unsuspecting buyers. Through our on-site observation, diseases such as bovine tuberculosis, helminthoses, and dermatophylosis were commonly Seen (Kwaghe *et al.*, 2016). Recent report however indicates that some African countries have now appeared to be using abattoir inspection services in the control of tuberculosis (African Union-Interafrican Bureau for Animal Resources [AU-IBAR],2013). Received animals are recorded and ante mortem inspection is carried out by attestation Veterinarian. The veterinarian decides whether to accept or refuse the animals received for slaughtering, based on the animals' body condition and health status (Gebru and Gebretinsae, 2018). A person who is in possession of a carcass or meat which is in a slaughterhouse shall not part with the carcass or meat, unless the carcass or meat has been inspected by an inspecting officer. A person shall not sell, display, deposit, convey or deliver or cause to be sold, displayed, deposited, conveyed or delivered for purposes of or in the process of sale of any carcass or meat, unless the carcass or meat has been inspected by an inspecting officer and found to be fit for human consumption (AR, 2010). When animals arrive at the slaughterhouse, they undergo a thorough ante-mortem examination with animals having any visually detectable health problem and disease symptoms excluded. Poor body condition, behavioural disorders,

diarrhoea, skin diseases, profuse discharges and apparent pregnancy in females usually disqualify animals from being slaughtered (Shuaib *et al.*, 2015). Ante mortem inspection is the inspection of live animals prior to being slaughtered. All livestock presented for slaughter by the establishment to which you are assigned must receive ante mortem inspection. This inspection is performed by an Food Safety and Inspection Service veterinarian (PHV) or by a Food Inspector under veterinary supervision. If it is performed by a Food Inspector, the PHV must be notified of any disease conditions that are observed ( Anonymous, 2014). The same person carried out all the antemortem inspections, in order to homogenize the classification criteria. The animals assessed were categorized broadly into three major groups namely (Shima *et al.*, 2015).

#### **1.4.3. The abattoir rejects animals that have visible signs of illness or that are emaciated:**

Animals showing symptoms of disease or originating in herds/flocks known to be contaminated with agents of public health importance may only be transported to the slaughterhouse when the competent authority so permits. Only animals that have suffered an accident that prevented transportation on animal welfare grounds and been subject to ante-mortem inspection are slaughtered for human consumption. The slaughtered and bled animal is transported hygienically and without delay. If the time between slaughter and arrival at the slaughterhouse is more than 2 hours, the animal is refrigerated unless active chilling is unnecessary due to climate. The animals must have a veterinary ante-mortem inspection and be stunned and bled in a hygienic and humane manner (Anonymous, 2017). Slaughterhouses provide an excellent opportunity for detecting diseases of both economic and public health importance (Raji *et al.*, 2010). The prevalence of zoonotic diseases such as tuberculosis,

dermatophilosis, mange, fascioliasis and hydatidosis contribute to organ condemnation associated with economic loss (Bala *et al.*, 2011).

#### **1.4.4. Feeding:**

To accommodate food safety concerns of processors and minimise the impact on eating quality, animals destined for MSA are held for a minimum of 12 hours or up to a maximum of 48 hours without access to feed before slaughter. The minimum time will depend on feed type, weather, and processor food safety requirements. They processors may require that sheep be held off feed for a minimum of 12 hours before being presented for slaughter, as animal excreta contains immense concentrations of microbes, which present contamination risks during trucking, lairage and the preliminary stages of slaughter (MLA, 2015). The long period of care and investment in producing an animal with high eating quality potential is most at risk in the two weeks prior to slaughter and the first few hours post slaughter. Optimum eating quality can be reduced to low quality, unacceptable product by inappropriate handling preslaughter. When there is insufficient glycogen in the muscle at the point of slaughter, inadequate lactic acid is produced and high pH meat can result. High pH meat is often referred to 'dark cutting' due to its unattractive dark colour and is often tough, cooks inconsistently and has a reduced shelf life (MLA, 2015).

#### **1.4.5. Skinning:**

Ensure that hide is properly removed, Ongoing, Carcass is not contaminated with hair and dirt. Employees performing the skinning must wash and sanitize after each carcass and Trim away any contaminated tissue (FP BC CDC, 2012).

#### **1.4.6. Wash the knives and hands of workers:**

It is important to clean knives after cutting through contaminated tissues such as skin. Less frequent cleaning may be acceptable when, for example, exposing



kidneys for inspection. Slaughterhouse must have facilities for disinfecting tools in hot water supplied at a temperature of not less than 82°C or by an alternative method having an equivalent effect (Anonymous, 2017). Equipment and tools as required for purpose which include bleeding chain, preaders, cradles, hooks, splitting axes, knives, stands and offals inspection racks. Hand washing basins with sterilizers next to it. The presence of various bacteria on meat is an indication of low standard levels of animals, the handling of meat from pre-slaughter to post-slaughter, abattoir facilities and sales of meat (Obeng *et al.*, 2013). The washing of knives by warm water (82 °C) decreased the level of viable bacteria result of (Magdaa *et al* , 2013). Was at the point of washing on different sites' of examination of bovine carcasses. The variability in microbial counts (especially after washing) can be attributed to the absence of prerequisite programmes. Contrary to their above mentioned findings, revealed that sterilization by hot water (82 'C) to knives in all slaughtering operations and fairly warm water to workers' hands resulted in reduction in TVCs of worker's hands and their knives with statistically significant difference ( $P < 0.05$ ). The researchers concluded that the elimination of contamination sources by practicing good sanitary measures will reduce the occurrence of microorganisms and that appropriate methods should be applied during slaughtering operations, using adequate water and disinfection. They also pointed that control measures should include an extensive education programs for proper hygiene and improvement of management (Abdalla *et al.*, 2010). Hand washing is predominantly used to protect meat from contamination, but also protects workers against directly transmitted bacterial pathogens such as *Salmonella* sp (Gomes-Neves *et al.*, 2012).

#### **1.4.7. Separate Rooms:**

Where establishments are approved for the slaughter of different animal species or for the handling of farmed ratites and small wild game, precautions

must be taken to prevent cross contamination by separation either in time or in space of the operations carried out on the different species. Separate facilities for the reception and storage of carcasses of farmed ratites slaughtered at the farm and for small wild game must be available (Anonymous, 2017). Separate room for the cleaning and treatment of intestines and stomachs. Separate room for the storage, disposal and treatment of inedible and condemned animals, carcass and meat. Separate area for bleeding and for dressing the carcasses with all appropriate equipment. Separate areas for de-hairing, singeing, de-clawing and pre-evisceration wash of pigs. Separate room to keep hides and skins, hair and inedible materials. Separate room for skin on heads and feet. Separate rooms for emptying and cleaning offals. The room shall be interconnected to the dressing room by a closable hatch or door and should have exterior doors for removal of these materials. Detention room to keep detained carcasses, portions or organs. Condemnation room to keep condemned carcasses, portions and organs before removal from the slaughterhouse but where the condemned material is removed on a continuous basis during slaughter or a storage chiller is available for these materials then; such a room is not required. Such a room shall be fitted with facilities for hand, boot and apron wash for persons handling the materials. Separate changing rooms and toilets for persons working in the slaughterhouse dirty and clean areas (AR, 2010).

#### **1.4.8. Special clothes for work:**

As soon as any person engaged in or about a slaughterhouse handling carcasses or meat becomes aware or suspects that he is suffering from a disease of intestinal disorders, sore throat, cough and open or suppurating wounds, the person shall forthwith notify the management or the inspecting officer of this fact. A person who is engaged in or about the slaughterhouse handling meat shall wear suitable protective clothing, including head covering and boots that are readily washable and keep them as clean as is reasonably, practicable. A

person engaged in the handling of meat in or about slaughterhouse shall while being engaged keep as may reasonably expected thoroughly and frequently washed all parts of his person which are likely to come into contact with meat. A person who dresses or handles diseased carcasses shall before handling and dressing other carcasses, cleanse his hands and other parts of his person which may come into contact with the diseased meat with soap and hot water and rinse in cold water. Implements used in dressing diseased carcasses shall be thoroughly cleaned in boiling water followed by rinsing in clean water. An employee of the slaughterhouse who handles any meat, after visiting the toilet rooms or urinals wash their hands before handling meat or equipment used in the preparation of meat (AR, 2010). This should include protective clothing that can be effectively cleaned and reduces accumulation of contaminants. In addition to change rooms, showers, flush toilets, hand washing and drying facilities (Samuel, 2012). The purpose of protective clothing within the slaughterhouse is primarily to protect the meat product from contamination but has also been shown to be protect meat handlers against directly transmitted zoonoses including leptospirosis and brucellosis (Brown *et al.*, 2011).

#### **1.4.9. Water using:**

Hot water may be applied for meat decontamination by spraying at higher, or low, pressures, deluging with cascading sheets of hot water, may take place at pre-evisceration and after final washing during slaughter and dressing, and after chilling during carcass deboning on meat cuts and trimmings for manufacturing ground beef (Panel, 2010). Hot water boiler connected to sterilizing equipment. The supply of clean water with adequate pressure is essential for any abattoir to have hygienic and safe slaughtering operations (Gebru and Gebretinsae, 2018). Water supply and water, ice, and solution reuse. A supply of running water that complies with the National Primary Drinking Water regulations, at a suitable temperature and under pressure as needed, must be provided in all areas where

required (for processing product, for cleaning rooms and equipment, utensils, and packaging materials, for employee sanitary facilities, etc.). If an establishment uses a municipal water supply, it must make available to Food Safety and Inspection Service, upon request, a water report, issued under the authority of the State or local health agency, certifying or attesting to the potability of the water supply. If an establishment uses a private well for its water supply, it must make available to Food Safety and Inspection Service, upon request, documentation certifying the potability of the water supply that has been renewed at least semi-annually (Anonymous, 2016).

#### **1.4.10. Chilling rooms:**

Separate chillers for carcasses and red offals and another for rough offals unless the red offals are removed from the facility continuously within four hours after evisceration. In case of washed rough offals unless they are removed continuously from the facility but within four hours after evisceration. Freezers of at least minus 10 degrees centigrade to ensure the meat remains fit and suitable for human consumption and a separated compartment of the freezer for detained measly carcasses, portions or organs (AR, 2010). The abattoir lacks chilling rooms and other facilities for storing conditionally passed meats and holding them for longer times with minimum risk of spoilage. To prevent or even reduce the deterioration of meat by the growth of microorganisms, chilling has to be carried out quickly at the end of the slaughter process, and the chilled state has to be maintained until the meat is processed for consumption (Gebru and Gebretinsae, 2018). Primary chilling: the majority of carcass meat is chilled in conventional air chill room normally operating at one or sometimes two conditions during the chilling cycle, temperature reduction at the surface and within the carcass has a substantial influence on the weight loss, storage life and eating quality of the meat produced, therefore, it is necessary to have legislation for chilling temperature of the meat, European Union regulations require that all

meat temperature within the carcass must be reduced below 7°C before the carcass is further processed. Freezing: meat for processing is usually frozen in the form of carcasses, quarters or boned in the air-blast freezers. Its aim is to reduce weight loss from unwrapped meat (Samuel, 2012).

**CHAPTER TWO**  
**MATERIALS AND METHODS**

## **CHAPTER TWO**

### **MATERIALS AND METHODS:**

#### **2.1. Study Area and Slaughterhouses**

This study was carried out at EL- shaheede and EL-Kedaro slaughterhouses, are located in Khartoum State, the Sudan. Khartoum State is located in the semi-arid savannah belt, with an average annual rainfall of 100-200 mm and a long dry season from September to June. A wide range of production systems are practiced ranging from household subsistence to large-scale commercial farming; for milk, meat, and poultry are operational in the state. The state today has an estimated population of 7 million people (Shuaib *et al.*, 2015).

#### **2.2. Study Design and Sampling Strategy:**

To assess the Hazard Analysis and Critical Control Point System in Slaughterhouses in Khartoum State qualitative data were collected using questionnaire survey and expert observation methods. Qualitative data related to the slaughterhouses Receiving, Holding, abattoir rejects, Feeding, skinning, wash of hands and knives, separate rooms, special clothes for work, using water and chilling rooms . Expert observation data were supported with discussions with staffs of the abattoir. A total of 70 Questionnaires were taken from two slaughterhouses from 10 different questions from each slaughterhouse 35 questionnaire.

#### **2.3. Statistical analysis:**

Statistical analysis using analysis of frequency distribution to know the percentages of respondents.

## **CHAPTER THREE:**

### **RESULTS:**



## **CHAPTER THREE:**

### **RESULTS:**

According to table (1) different critical points were adopted in EL-shaheed slaughterhouse with different percentages as follow: (28%) of receiving practiced, but (71%) not practice, (48%) of holding practiced, but (51%) not practice, (62%) of reject diseased animals practiced, but (37%) not practice, (17%) of feeding practiced, but (82%) not practice, (77%) of skinning practiced, but (22%) not practice, (25%) of washing hands and knives practiced, but (74%) not practice, (45%) of separate rooms practiced, but (54%) not practice, (31%) of protective clothes practiced, but (68%) not practice, (65%) of using water practiced, but (34%) not practice and (11%) of chilling rooms practiced, but (88%) not practice. Responders that practiced rejection of diseased animals (62%), skinning (77%) and using water (65%).

**Table 1: Frequency distribution of respondents {n=35} in EL-shaheede slaughterhouse –Khartoum state**

Questions	Yes	No	Total
Receiving	10(28.6%)	25(71%)	35
Holding	17(48%)	18(51%)	35
Reject diseased animals	22(62%)	13(37%)	35
Feeding	6(17%)	29(82%)	35
Skinning	27(77%)	8(22%)	35
Washing hands and knives	9(25%)	26(74%)	35
Separate rooms	16(45%)	19(54%)	35
Protective clothes	11(31%)	24(68%)	35
Using water	23(65%)	12(34%)	35
Chilling rooms	4(11%)	31(88%)	35

According to table (2) different critical points were adopted in EL-kedaro slaughterhouse with different percentage as follow (60%) of receiving practiced, but (40%) not practice,(80%) of holding practiced, but(20%) not practice,(54%) of reject diseased animals practiced, but (45%) not practice,(62%) of feeding practiced, but (37%) not practice,(94%) of skinning practiced, but (5%) not practice,(40%) of washing hands and knives practiced, but (60%) not practice,(51%) of separate rooms practiced, but (48%) not practice,(85%) of protective clothes practiced, but (14%) not practice,(97%) of using water practiced, but (2%) not practice and (82%) of chilling rooms practiced, but (17%) not practice.Responders that practiced all points exceptWashing hands and knives(40%). The result showed that the application of HACCP exist in EL-

kedaro slaughterhouse but not exist in EL-shaheede slaughterhouse it mean the meat coming from kedaro slaughterhouse will be less contamination than EL-shaheede because the Appling of HACCP reduce the contamination of meat chemically, physically and biologically.

**Table 2: Frequency distribution of respondents {n=35} in EL-kedaro slaughterhouse, Khartoum state**

Questions	Yes	No	Total
Receiving	21(60%)	14(40%)	35
Holding	28(80%)	7(20%)	35
Reject diseased animals	19(54%)	16(45%)	35
Feeding	22(62%)	13(37%)	35
Skinning	33(94%)	2(5%)	35
Washing hands and knives	14(40%)	21(60%)	35
Separate rooms	18(51%)	17(48%)	35
Protective clothes	30(85%)	5(14%)	35
Using water	34(97%)	1(2%)	35
Chilling rooms	29(82%)	6(17%)	35

**CHAPTER FOUR**  
**DISCUSSION**

## CHAPTER FOUR

### DISCUSSION

In the present result EL-kedaro slaughterhouse the application of HACCP let the meat comes from it less contaminated Gebru and Gebretinsae (2018) reported that animals that are received can giving 12 hours to be ready for Slaughtering. Ante mortem inspection is the inspection of live animals prior to being slaughtered. All livestock presented for slaughter by the establishment to which you are assigned must receive ante mortem inspection. This inspection is performed by an Food Safety and Inspection Service veterinarian (PHV) or by a Food Inspector under veterinary supervision. If it is performed by a Food Inspector, the PHV must be notified of any disease conditions that are observed ( Anonymous ,2014). The same person carried out all the antemortem inspections, in order to homogenize the classification criteria. The animals assessed were categorized broadly into three major groups namely (Shima *et al.*, 2015).When animals arrive at the slaughterhouse, they undergo a thorough ante-mortem examination with animals having any visually detectable health problem and disease symptoms excluded. Poor body condition, behavioural disorders, diarrhoea, skin diseases, profuse discharges and apparent pregnancy in females usually disqualify animals from being slaughtered (Shuaib *et al.*, 2015). Received animals are recorded and ante mortem inspection is carried out by attestation Veterinary. The vet decides whether to accept or refuse the animals received for slaughtering, based on the animals' body condition and health status (Gebru and Gebretinsae, 2018). Slaughterhouses provide an excellent opportunity for detecting diseases of both economic and public health importance (Raji *et al.*, 2010). The prevalence of zoonotic diseases such as tuberculosis, dermatophilosis, mange, fascioliasis and hydatidosis contribute to organ condemnation associated with economic loss (Bala *et al.*, 2011). To

accommodate food safety concerns of processors and minimise the impact on eating quality, animals destined for MSA are held for a minimum of 12 hours or up to a maximum of 48 hours without access to feed before slaughter. The minimum time will depend on feed type, weather, and processor food safety requirements. Processors may require that sheep be held off feed for a minimum of 12 hours before being presented for slaughter, as animal excreta contains immense concentrations of microbes, which present contamination risks during trucking, lairage and the preliminary stages of slaughter. The long period of care and investment in producing an animal with high eating quality potential is most at risk in the two weeks prior to slaughter and the first few hours post slaughter. Optimum eating quality can be reduced to low quality, unacceptable product by inappropriate handling pre-slaughter. When there is insufficient glycogen in the muscle at the point of slaughter, inadequate lactic acid is produced and high pH meat can result. High pH meat is often referred to 'dark cutting' due to its unattractive dark colour and is often tough, cooks inconsistently and has a reduced shelf life (MLA, 2015). Ensure that hide is properly removed, Ongoing, Carcass is not contaminated with hair and dirt. Employees performing the skinning must wash and sanitize after each carcass and Trim away any contaminated tissue (FP BC CDC *et al.*, 2012). It is important to clean knives after cutting through contaminated tissues such as skin. Less frequent cleaning may be acceptable when, for example, exposing kidneys for inspection. Slaughterhouse must have facilities for disinfecting tools in hot water supplied at a temperature of not less than 82°C or by an alternative method having an equivalent effect (Anonymous, 2017). Equipment and tools as required for purpose which include bleeding chain, preaders, cradles, hooks, splitting axes, knives, stands and offals inspection racks. hand washing basins with sterilizers next to it. The presence of various bacteria on meat is an indication of low standard levels of animals, the handling of meat from pre-slaughter to post-slaughter, abattoir facilities and sales of meat (Obeng *et al.*,

2013).The washing of knives by warm water (82 °C) decreased the level of viable bacteria result of (Magdaa, 2013). Separate room for the cleaning and treatment of intestines and stomachs. Separate room for the storage, disposal and treatment of inedible and condemned animals, carcass and meat. Separate area for bleeding and for dressing the carcasses with all appropriate equipment. Separate areas for de-hairing, singeing, de-clawing and pre evisceration wash of pigs. Separate room to keep hides and skins, hair and inedible materials. Separate room for skin on heads and feet. Separate rooms for emptying and cleaning of fals. The room shall be interconnected to the dressing room by a closable hatch or door and should have exterior doors for removal of these materials. Detention room to keep detained carcasses, portions or organs. Condemnation room to keep condemned carcasses, portions and organs before removal from the slaughterhouse but where the condemned material is removed on a continuous basis during slaughter or a storage chiller is available for these materials then; such a room is not required. Such a room shall be fitted with facilities for hand, boot and apron wash for persons handling the materials. Separate changing rooms and toilets for persons working in the slaughterhouse dirty and clean areas (AR, 2010). As soon as any person engaged in or about a slaughterhouse handling carcasses or meat becomes aware or suspects that he is suffering from a disease of intestinal disorders, sore throat, cough and open or suppurating wounds, the person shall forthwith notify the management or the inspecting officer of this fact. A person who is engaged in or about the slaughterhouse handling meat shall wear suitable protective clothing, including head covering and boots that are readily washable and keep them as clean as is reasonably, practicable. A person engaged in the handling of meat in or about slaughterhouse shall while being engaged keep as may be reasonably expected thoroughly and frequently washed all parts of his person which are likely to come into contact with meat. A person who dresses or handles diseased carcasses shall before handling and dressing other carcasses, cleanse his hands

and other parts of his person which may come into contact with the diseased meat with soap and hot water and rinse in cold water. Implements used in dressing diseased carcasses shall be thoroughly cleaned in boiling water followed by rinsing in clean water. An employee of the slaughterhouse who handles any meat shall in all cases, after visiting the toilet rooms or urinals wash their hands before handling meat or equipment used in the preparation of meat (AR, 2010). Hot water may be applied for meat decontamination by spraying at higher, or low, pressures, deluging with cascading sheets of hot water, may take place at pre-evisceration and after final washing during slaughter and dressing, and after chilling during carcass deboning on meat cuts and trimmings for manufacturing ground beef (Panel, 2010). Hot water boiler connected to sterilizing equipment. The supply of clean water with adequate pressure is essential for any abattoir to have hygienic and safe slaughtering operations (Gebru and Gebretinsae, 2018). Water supply and water, ice, and solution reuse. A supply of running water that complies with the National Primary Drinking Water regulations , at a suitable temperature and under pressure as needed, must be provided in all areas where required (for processing product, for cleaning rooms and equipment, utensils, and packaging materials, for employee sanitary facilities, etc.). If an establishment uses a municipal water supply, it must make available to Food Safety and Inspection Service, upon request, a water report, issued under the authority of the State or local health agency, certifying or attesting to the potability of the water supply. If an establishment uses a private well for its water supply, it must make available to Food Safety and Inspection Service, upon request, documentation certifying the potability of the water supply that has been renewed at least semi-annually (Anonymous, 2016). The abattoir lacks chilling rooms and other facilities for storing conditionally passed meats and holding them for longer times with minimum risk of spoilage. To prevent or even reduce the deterioration of meat by the growth of microorganisms, chilling has to be carried out quickly at the end of the slaughter



process, and the chilled state has to be maintained until the meat is processed for consumption (Evaluating the Implementation of Hazard Analysis Critical Control Point (HACCP) (Gebru and Gebretinsae, 2018). Primary chilling: the majority of carcass meat is chilled in conventional air chill room normally operating at one or sometimes two conditions during the chilling cycle, temperature reduction at the surface and within the carcass has a substantial influence on the weight loss, storage life and eating quality of the meat produced, therefore, it is necessary to have legislation for chilling temperature of the meat, European Union regulations require that all meat temperature within the carcass must be reduced below 7°C before the carcass is further process. Freezing: meat for processing is usually frozen in the form of carcasses, quarters or boned in the air-blast freezers. It is aim to reduce weight loss from unwrapped meat (Samuel, 2012)

In EL-shaheede slaughterhouse the HACCP not applying it can let the meat come from it contaminated because There was no ante-mortem inspection of animals carried out and animals were often brought in tied with ropes and chased into the abattoir. All sort of diseased, cachectic and moribund animals were slaughtered in the abattoir Sometimes, dead animals slaughtered during transport were brought to the abattoir for dressing because the animals could not make it to the abattoir alive. Generally, there was no postmortem inspection of slaughtered animals in this abattoir since there was no compensation to be paid by the government to the animal owners for any condemned organ or carcass. Hence, such diseased meat and offals were often seen sold to the unsuspecting buyers. Through our on-site observation, diseases such as bovine tuberculosis, helminthoses, and dermatophylosis were commonly Seen. The Debilitating State of the Maiduguri Main Abattoir, Poor Sanitary and Waste Disposal Methods (Kwaghe *et al.*, 2016).

Recent report however indicates that some African countries have now appeared to be using abattoir inspection services in the control of tuberculosis (African Union-Interafrican Bureau for Animal Resources [AU-IBAR], 2013). It was observed that 4 out of 100 meat samples collected before the application of HACCP showed abnormal color (4 %), while, there was no meat samples showed abnormal color among samples collected after the application of HACCP. This may be due to the fact that HACCP program steps decreased the contamination of the meat with deferent microorganisms, moreover good slaughtering steps (slaughtering , washing, cleaning, transportation and storage) and discarding of the abnormal meat products, storage time and temperature have a great effect on color stability. It was recorded in Table (1) that 6 out of 100 meat samples collected before the application of HACCP showed defects in meat odor (6 %), while, there was no meat samples showed abnormal odor among samples collected after the application of HACCP (Saleh *et al.*, 2015). The presence of bacteria in meat in the slaughterhouse indicated that unhygienic handling of meat. The decontamination processes are important to eliminate the sources of contamination and that by practicing an appropriate training for personnel, application of good hygienic methods (Magdaa *et al.*, 2012). The level of the TVC was set and agreed to be a criterion for assessing and evaluating the microbial contamination of carcasses and a useful mean to know the hygienic and safety states of meat. Hazard Analysis Critical Control Point (HACCP) should be applied properly during slaughtering operations by using sufficient clean heated water and safe disinfectants. To make all these, extensive education and training programs on hygiene for workers should immediately be started. The processing methods adopted in Sudanese slaughterhouses are analogous and the hygienic standards too (Shuaib *et al.*, 2015).

All the meat contact surfaces had pathogenic and indicator bacteria. The findings have highlighted high contamination levels of abattoir and retail houses meat contact surfaces. This may contribute towards a high incidence of

food associated illnesses through cross contamination of different food products. Maintenance of slaughter hygiene and regular monitoring of meat establishments is essential to minimize the risk of direct and cross-contamination of the meat thereby ensuring meat quality and public health protection (Ayalew *et al.*, 2015). The sources of meat contamination were investigated and determined at several critical points where hygienic faults were marked out. It was found that contaminants in the abattoir include Gram positive bacteria. The dominant bacteria isolated and *Staph.* spp. They were the more frequent isolate. Quality control on production is likely to operate at three levels: hygiene control of the processing (and this includes cleaning regimes for equipment, etc); detection of possible hazards from pathogenic organisms in the product, and the assessment of the potential shelf-life (or storage-life) of the product. The application of the usual system of quality control based only on the sampling of finished products and rejection of batches which fail the standard is unlikely to succeed in its aim since microbiological testing of limited use and informative, and in consequence only a relatively small sample of the entire batch can be tested (Eid, 2010). Being a key element in the production and distribution chain for meat it is essential that slaughter house or slab should be hygienic as possible in order to prevent the spread of both human and animal diseases as well as to reduce economic losses due to premature spoilage of meat caused by cross-contamination. All slabs are lacking ante-mortem inspection, water system for washing meat, light during slaughtering process, carcass carriers and very poor drainage system, hygiene condition, no appropriate structured rooms for division of different slaughtering process, no fence except for Juba slab, use of unsterilized and improperly cleaned knives and equipment. Cattle are slaughter on filthy slaughter floor. These slabs are operating without any hygiene measures which make them to contain high level of cross contamination with high risky food pathogens such as *salmonella* and *E. Coli* 0157:H7 as meat from all slabs are not been washed (Samuel, 2012).

Microbiological contamination of carcasses occurs mainly during processing and manipulation, such as skinning, evisceration, storage and distribution at slaughterhouses and retail establishments (Abdalla *et al.*, 2009). Lack of protective clothing has been identified as an occupational health risk for brucellosis in slaughterhouse workers in Uganda and Tanzania (Nabukenyam *et al.*, 2013).

# **CONCLUSIONS AND RECOMMENDATION**

## **Conclusions**

This study Showed that HACCP is exist in EL-kedaro slaughterhouse but not exist in EL-shaheede slaughterhouse it mean the meat come from EL-kedaro slaughterhouse is less contaminated than EL-shaheede because the application of HACCP reduce the contamination of meat chemically, physically and biologically. This may contribute towards a high incidence of food associated illnesses through cross contamination of meat products. The improvement of food safety in beef chain is a core responsibility of all levels of government, with support of chain actors and chain supporters. Therefore, the abattoirs are not equipped with the basic facilities and the personnel needed for designing and implementing a HACCP plan.

## **Recommendations:**

1. Slaughterhouse shall have— properly built and drained lairages erected not less than ten meters from the slaughterhouse and equipped with adequate facilities for ante-mortem inspection and special lairage for suspect animals.
2. Fenced cattle races from the lairages to the slaughterhouse, properly drained and in a suitable place equipped with facilities for washing the animals.
3. Separate room for the cleaning and treatment of intestines and stomachs.
4. Separate room for the storage, disposal and treatment of inedible and condemned animals, carcass and meat. Materials used shall be impervious, easily cleaned and resistant to wear and corrosion.
5. Floors shall be constructed of dense, acid-resistant, waterproof concrete and have a wood float finish.
6. Walls shall be smooth and flat and made of smooth-surfaced portland cement plaster or other non-toxic, non-absorbent material applied to a suitable base, and walls shall be provided with sanitary bumpers to prevent damage by movable and other equipment.
7. Window-sills shall be at least one hundred and fifty centimeters from the floor and be sloped forty five degrees.
8. Doorways must be at least one hundred and fifty centimeters wide and the doors must be made of rust-resistant metal having tight soldered or welded seams.

## REFERENCES:

**Abdalla, M.A.; Suliman, S. E; Ahmed, D.E.andBakhiet, A.O. (2010).** Methods for Reduction of Contamination of Indigenous Cattle Carcasses during Slaughtering. *AssuitVet.Med. J.*,56 (158), 86-93.

**Asse, T. A.; Kagambe, G. A.; Kaisa, Haukka.;Anja. Sittonen; Alfred, S. Traore.andNiclas,Barro. (2011).** Prevalence of Salmonella enterica and hygienic indicatorEsherichia coli in raw meat at markets in Ouagadougou, Burkina faso: *Journal ofFood Protection*, 74,pp. 1547-1551.

**Abdalla, M. A; Siham, E; Suliman; YYH, Alian, A.(2009).** Microbial contamination of sheep carcasses at El Kadero slaughterhouse – Khartoum State. *Sud. J. Vet. Sci. Anim. Husb.* 48:1-2.

**Annan-Prah A., Mensah A. A., Akorli S. Y., Asare P. T. and Kumi-Dei I. D.(2012).**Slaughterhouses, Animal slaughter and Slaughter Hygiene in Ghana,*Journal of Veterinary Advances*.pp.19

**African Union-Interafrican Bureau for Animal Resources [AU-IBAR] (2013, September).**Pan African animal resources yearbook, 2013 (60 p.). African Union Commission (AUC).ISSN: 1811-007X. Retrieved from <http://www.au-ibar.org/pan-african-animal-resources-yearbook>.

**Arrangement of Regultions (AR)( 2010).** Meat Control (Local Slaughterhouse) Regulations.*Cap. 356* ,pp.55-67.

**Ayalew, H. ;Berhanu, A. ; Sibhat, B. and Serda1, B. (2015 ).**Microbiological assessment of meat contact surfaces at abattoir and retail houses in Jigjiga town *.ISABB-Journal of Food and Agricultural Science*, Vol,5 No,3 pp.21-26.

**Anonymous. (2014).** Ante Mortem Inspection, Livestock Ante mortem Inspection, U.S. Department of Agriculture Food Safety and Inspection Service Meat and Poultry Inspection Operations, pp.2.

**Anonymous (2016):** List Hazard Analysis and Critical Control Point, Slaughter Food Safety Standard, *FSIS Directive 6420.2*, Regulations: 9 CFR 310.17(a), 310.18, and part 417; pp7-22.

## Overview

**Anonymouse. (2017).**Chapter 11 Acceptance and Slaughter of Animals,Meat Industry Guide,pp.8-45. [www.food.gov.uk/business/industry/farmingfood/cleaner-animals](http://www.food.gov.uk/business/industry/farmingfood/cleaner-animals) or the Food Standards Scotland website at:

<http://www.foodstandards.gov.scot/publications-and-research/red-meat-safety-and-clean-livestock-guidance>.

**Bakhtiary, F.; Sayevand, H. R.; Remely, M.; Hippe, B.; Hosseini, H. and Alexander, G. (2016).** Evaluation of bacterial contamination sources in meat production line. *Journal of Food Quality* 39(6):1-7.  
<http://onlinelibrary.wiley.com/doi/10.1111/jfq.12243/pdf>

**Bala, A. N.; Garba, A. E.; Adamu James Yazah, A. J.( 2011 ).**Bacterial and parasitic zoonoses encountered at slaughter in Maiduguri abattoir .*Department of Veterinary Public Health and Preventive Medicine*Vol,4,No.10,pp.441.

**Biffa, D; Bogale, A and Skjerve, E. (2010):** Diagnostic efficiency of abattoir meat inspection service in Ethiopia to detect carcasses infected with *Mycobacterium bovis*: implications for public health. *BMC Public Health*. ;10:462.

**Brown, P. D; McKenzie, M; Pinnock, M. and McGrowder, D.(2011):** Environmental risk factors associated with leptospirosis among butchers and their associates in Jamaica. *Int J Occup Environ Med* ;2(1):47–57.

**E. Ndalama, R.H. Mdegela, H.E. Nonga.(2013).**Assessment of hygienic practices and faecal contamination of beef at Vingunguti slaughterhouse in Dar



es salaam, *Department of Veterinary Services, Ministry of Agriculture and Livestock*, P.O. Box 60025, pp.17.

**Elniema, A.; Mustafa; Adil, M. A; Salman. and Iman, M. Hamad.(2016).** Review On Food Safety System With Reference To Meat Operations In Khartoum State, *RA Journal of Applied Research*, vo 21, no 7, pp.500.

**Eid, G. A. A. (2010).** Quality Management of Meat In A slaughterhouse In Khartoum state, Department of Preventive Medicine Faculty of Veterinary Medicine University of Khartoum, pp.56-63.

**Food Protection BC Centre for Disease Control In Collaboration with: BC Ministry of Health and the Five Regional Health Authorities(: Vancouver Coastal, Fraser, Interior, Northern and Vancouver Island(FP BC CDC) (2012 ).** Guidelines for the Application of a Hazard Analysis Critical Control Point (HACCP) System in a Meat Plant. *provincial Health Services Authority*, pp.1-8.

**FAOSTAT. (2012).** Country STAT United Republic of Tanzania, Food and Agriculture Organisation, Rome. [www.agriculture.go.tz].

**Food and Agriculture Organisation (FAO) (2015).** Food safety: What you should know. World Health Day, SEA-NUT-196.

[http://www.searo.who.int/entity/world\\_health\\_day/2015/whd-whatyou-should-know/en](http://www.searo.who.int/entity/world_health_day/2015/whd-whatyou-should-know/en).

**FAO. (2010):** Abattoir Development. In: Options and designs for hygienic basic and medium sized abattoirs. Rome: Food and Agriculture Organization of the United Nations;

**Gomes-Neves, E; Antunes, P; Tavares, A; Themudo, P; Cardoso, M. F; Gartner, F; Costa, J. M. and Peixe, L.(2012):** Salmonella cross-contamination in swine abattoirs in Portugal: Carcasses, meat and meat handlers. *Int J Food Microbiol*;157(1):82–7.

**Govender, R. and Genis, E.M. (2010).**Advancing the hygiene management system at red meat abattoirs in Gauteng’, *Journal of New Generation Sciences*, Vol. 8, No. 1, pp.64–79.

**Govender, R. (2013).** ‘Advancing the hygiene management system at poultry abattoirs in Gauteng’, *Journal for New Generation Sciences*, Vol. 10, No. 3, pp.67–86.

**Govender, R. (2014).** ‘A hazard analysis methodology for the South African abattoir hygiene management system’, *British Food Journal*, Vol. 116, No. 12, pp.2026–2047.

**Govender, R. (2016).**A review of HACCP and the South African abattoir hygiene management system towards integration.*Int. J. Food Safety, Nutrition and Public Health*, Vol. 6, No. 1,pp.

**Gebru, G. and Gebretinsae, T . (2018 ).**Evaluating the Implementation of Hazard Analysis Critical Control Point (HACCP) in Small Scale Abattoirs of Tigray Region . Dept. of Animal Science, College of Agriculture, Aksum University, Shire Endaselasie, Tigray, Ethiopia,Vol.38 No.4,pp.250-256.

**Komba, E. V. G; Komba, E. V; Mkupasi, E. M; Mbyuzi; AO; Mshamu, S; Luwumba; D; Busagwe, Z.andMzula, A.(2012).** Sanitary practices and occurrence of zoonotic conditions in cattle at slaughter in MorogoroMunicipality,Tanzania: Implications for public health. *Tanz J Health Res*14: 2.

**Kwaghe, A. V; Adesokan, H. K; Ameh, J. A; Ambali, A; Ndahi, M. D; SimeonIdowu Cadmus, S. I. and Kudi, A. C. (2016).**The Debilitating State of the Maiduguri Main Abattoir, Poor Sanitary and Waste Disposal Methods; the WayForward, *Nature and Science*,vol,no,pp.40-47.

**McElhatton, A. P. J. and A. Sobral (eds.). (2012).** Novel technologies in food science, integrating food science and engineering knowledge into the food chain. Springer.

**Malangu, N. (2016).** Risk Factors and Outcomes of Food Poisoning in Africa. Agricultural and Biological Sciences “Significance, Prevention and Control of Food Related Diseases. Book edited by Hussain Anthony Makun pp. 1-41. ISBN 978-953-51-2277-7.  
<https://cdn.intechopen.com/pdfs-wm/49838.pdf>.

**Meat And Lifestoke Astralia(MLA).( 2015 ).** meat standards astralia (MSA) requirements for handling sheep,pp.5.

**Mdegela, R. H; Laurence, K; Jacob, P. and Nonga, H. E.(2011).** Occurrence of thermophilic Campylobacter in pigs slaughtered at Morogoro slaughter slabs, *Tanzania. Trop Anim Health Prod*43: 83-87.

**Magdaa, A. Mohamed Ahmed; Siham E. Suliman<sup>1</sup>; Shuaib, Y. A.<sup>1</sup> and Abdalla, M.A. ( 2012 ).** Assessment of Bacterial Contamination of Sheep Carcasses at Slaughterhouse in Khartoum State. *SUST Journal of Science and Technology*,pp.7.

**Nonga, H. E; Sells, P. and Karimuribo, E. D.(2010).**Occurrence of thermophilicCampylobacter in cattle slaughtered at Morogoro Municipal abattoir, Tanzania. *Trop Anim Health Prod* 42(1): 73-8.

**Nabukenyam, I; Kaddu-Mulindwa, D and Nasinyama, G. W. (2013):** Survey of Brucella infection and malaria among Abattoir workers in Kampala and Mbarara Districts, Uganda. *BMC Public Health*;13:901.

**Nouichi, S. and Hamdi, T. M. (2009).** Superficial Bacterial Contamination of Ovine and Bovine Carcasses at El- Harrach Slaughterhouse (Algeria).*Europ. J. Scientific Res.* 38(3): 474-485.

**Obeng, A. K. S. Johnson, F. O. Appenteng S. (2013).** Microbial Quality of Fresh Meat from Retail Outlets in Tolon and Kumbungu Districts of the Northern Region of Ghana. *Int. J. of Sci. & Tech.*,2(6), 423 – 428.

**Panel, Contam. (2010).** Scientific Opinion on the safety and efficiency of using recycled hot water as a decontamination technique for meat carcasses: *Journal of European Food Safety Authority*, 8(9): p1827.

**Public Review Draft (PRD)(2018).**Basic requirements for a slaughter house – Specification.*Draft Keny Standard*. pp.6-14.

**Ramos, M. J. F. and Da Silva, L. A. C. P.(2017).**Constraints of HACCP Application on Edible Insect for Food and Feed,clarivate analytics books citation index,vol,no,pp.94-95

**Raji, M.A.; Salami, S.O. and Ameh, J.A. (2010).** Pathological conditions and lesions observed in slaughtered cattle in Zaria abattoir. *J. Clin. Pathol. Forensic Med.*, 1(2): 9 - 12.

**Samuel, P. A. A.( 2012 ).**Assessment of Hygiene practices used by Small Butchers and Slaughter Slabs in beef value chain in Juba town . University of Applied sciences.pp.3-33.

**Stevenson A. ( 2013).** Oxford English Dictionary. Oxford: Oxford University Press.

**Saleh, E. A; El-Shehemy, S; Ayoub, M. A; Ghorba, S. H and A, A. K. H.(2015).** Application of Hazard Analysis and Critical Control Point (HACCP) in Egyptian Slaughter Houses to Obtain High Quality Meat. *General Authority of Veterinary Services Ministry of Agriculture* ,pp.297-298.

**Shuaib, Y. A; Mohamed, A. K; Mohamed-Noor, S. EL; Suliman, S. E; and Abdalla, M.A. ( 2015 ).**Evaluation of the Safety Status of Beef for Domestic Consumption during Processing at Three Slaughterhouses in

Omdurman . *IOSR Journal of Agriculture and Veterinary Science* vol,8 no,4 ,pp.23-24.

**Shima, K; Mosugu, I. and Apaa, T.(2015).**Assessment of livestock slaughtered for food and meat inspection issues in selected abattoirs in Benue State, Nigeria,*Cogent Food & Agriculture*,vol,no,pp.3.

**United Nations Industrial Development Organisation(UNIDO)** (2012).Tanzania's Red Meat Value Chain: A diagnostic. Africa Agribusiness and Agroindustry Development Initiative (3ADI) Reports, Vienna, Austria.