EVALUATION OF MICROBIAL CONTAMINATION OF MEAT IN ILORIN, NORTH CENTRAL NIGERIA

BY

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CERTIFICATION

This is to certify that this project has been read and approved as meeting the requirement of the department of Agricultural Technology, Institute of Applied Sciences, Kwara State Polytechnic, Ilorin for award of Higher National Diploma in Agricultural Technology.

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DEDICATION

This project work is dedicated to Almighty God, the source of all wisdom, knowledge, and strength, whose grace has brought this research to completion.

We wholeheartedly dedicate this project to my beloved parents, **Mr. And Mrs. Adebayo,** whose love, prayers, encouragement, and sacrifices have been a strong pillar throughout our academic journey.

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Chapter One

1.1 Background

The meat processing industry plays a crucial role in the global food supply chain, providing a significant source of protein for populations worldwide. However, the abattoir, or slaughterhouse, is a critical point in this supply chain where microbial contamination can occur, posing serious risks to food safety and public health. Microbial contamination in abattoirs can arise from various sources, including the animals themselves, the environment, equipment, and personnel (Hassan et al., 2019). Understanding the prevalence of microbial contamination in different areas of an abattoir is essential for implementing effective food safety measures and ensuring the production of safe meat products.

1.2 Statement of the Problem

Food safety is a paramount concern in the meat industry, as contaminated meat can lead to foodborne illnesses, which affect millions of people globally each year. According to the World Health Organization (WHO, 2020), foodborne diseases are responsible for an estimated 600 million illnesses and 420,000 deaths annually. The presence of pathogens such as *Salmonella*, *Escherichia coli*, and *Listeria monocytogenes* in meat products can result in severe health consequences, including gastrointestinal infections, kidney failure, and even death (Scallan et al., 2011). Therefore, monitoring and controlling microbial contamination in abattoirs is critical for protecting consumer health and maintaining public confidence in the meat supply.

1.3 Aim and Objectives of the Study

This study aims to analyze the prevalence of microbial contamination in different areas of an abattoir and its implications for food safety. The specific objectives of the study are as follows:

1. **To identify and quantify the types of microbial contaminants present in various areas of the abattoir**, including the slaughtering area, processing area, and equipment.
2. **To assess the factors contributing to microbial contamination in these areas**, such as hygiene practices, environmental conditions, and operational procedures.
3. **To evaluate the implications of microbial contamination for food safety**, including the potential risks to consumers and the effectiveness of current control measures.

1.4 Research Questions

To achieve the objectives outlined above, the study will address the following research questions:

1. What are the predominant microbial contaminants found in different areas of the abattoir?
2. How do hygiene practices and environmental conditions influence the prevalence of microbial contamination?

3. What are the potential implications of microbial contamination for food safety and public health?

1.5 Significance of the Study

The findings of this study will contribute to the existing body of knowledge on microbial contamination in abattoirs and its implications for food safety. By identifying the prevalence and sources of microbial contaminants, the study aims to inform stakeholders in the meat industry, including abattoir operators, food safety regulators, and public health officials, about the critical areas that require attention and improvement. Furthermore, the study will provide recommendations for enhancing hygiene practices and implementing effective control measures to mitigate the risks associated with microbial contamination (Hassan et al., 2019; Mataragas et al., 2018).

The prevalence of microbial contamination in abattoirs is a significant concern for food safety and public health. This study aims to analyze the extent of microbial contamination in different areas of an abattoir and its implications for food safety. By addressing the research questions and objectives outlined in this chapter, the study seeks to contribute valuable insights that can help improve food safety practices in the meat processing industry.

Chapter Two

Literature Review

2.1 Introduction

The meat processing industry is a vital component of the global food supply chain, yet it is also a significant source of foodborne pathogens. This chapter reviews the existing literature on microbial contamination in abattoirs, focusing on the types of pathogens commonly found, their sources, and the implications for food safety. Understanding these factors is essential for developing effective strategies to mitigate risks associated with microbial contamination in meat products.

2.2 Microbial Contaminants in Abattoirs

2.2.1 Common Pathogens

Abattoirs are susceptible to various microbial contaminants, including bacteria, viruses, and parasites. The most frequently identified pathogens in meat processing facilities include:

Salmonella spp.: This bacterium is a leading cause of foodborne illness worldwide. It can be found in the intestines of healthy animals and can contaminate meat during slaughter and processing (Hassan et al., 2019). Studies have shown that Salmonella can survive on meat surfaces and in processing environments, making it a persistent threat (Mataragas et al., 2018).

Escherichia coli (E. coli): Particularly pathogenic strains such as E. coli O157:H7 are of significant concern due to their association with severe gastrointestinal illness. Contamination can occur through fecal matter during the slaughtering process or through cross-contamination in processing areas (Scallan et al., 2011).

Listeria monocytogenes: This pathogen is particularly dangerous for vulnerable populations, including pregnant women and immunocompromised individuals. Listeria can thrive in cold environments, making it a concern in refrigerated meat processing facilities (Gandhi & Chikindas, 2007).

Campylobacter spp.: Commonly found in poultry, Campylobacter is another significant cause of foodborne illness. It can be introduced into the abattoir through contaminated water or equipment (Hassan et al., 2019).

2.2.2 Sources of Contamination

Animal Carcasses

Animal carcasses are the primary source of microbial contamination in abattoirs. Pathogens are often present in the gastrointestinal tracts of healthy animals, where they can exist without causing disease. During the slaughtering process, these pathogens can be transferred to the carcass through various means. For instance, when the animal is eviscerated, any rupture of the intestines can lead to fecal contamination of the carcass (Mataragas et al., 2018).

Moreover, the skin and fur of animals can also harbor pathogens. During the skinning process, bacteria can be introduced to the carcass from these surfaces. The handling of carcasses by workers, who may inadvertently transfer pathogens from their hands or tools, further exacerbates the risk of contamination. Studies have shown that the prevalence of pathogens such as *Salmonella* and *E. coli* can be significantly higher in carcasses that have been improperly handled or processed (Hassan et al., 2019).

To mitigate these risks, it is essential to implement strict hygiene protocols during slaughtering and processing. This includes ensuring that the gastrointestinal tract is handled carefully to prevent spillage, as well as maintaining proper sanitation of tools and equipment used during the slaughtering process.

Environmental Factors

The abattoir environment plays a crucial role in the prevalence of microbial contamination. Floors, walls, and equipment can serve as reservoirs for pathogens, allowing them to persist and multiply if not properly cleaned and sanitized. For example, organic matter, blood, and other biological materials can accumulate in the processing areas, providing a nutrient-rich environment for bacteria to thrive (Hassan et al., 2019).

Poor sanitation practices can exacerbate the problem. If cleaning protocols are inadequate, pathogens can remain on surfaces and equipment, leading to cross-contamination during subsequent processing activities. Environmental factors such as temperature and humidity also influence microbial survival. For instance, warm and humid conditions can promote

the growth of bacteria, while cold environments may inhibit their growth but not necessarily eliminate them (Gandhi & Chikindas, 2007).

Regular monitoring and maintenance of sanitation practices are essential to minimize the risk of environmental contamination. This includes routine cleaning and disinfection of all surfaces, equipment, and tools, as well as implementing effective waste management practices to prevent the accumulation of organic matter.

Personnel

Personnel working in abattoirs can also be a significant source of microbial contamination. Inadequate hygiene practices among workers can lead to the spread of pathogens. For example, improper handwashing techniques or failure to use gloves when handling carcasses can facilitate the transfer of bacteria from one surface to another (Scallan et al., 2011).

Additionally, workers may inadvertently introduce pathogens through contaminated clothing, tools, or equipment. The movement of personnel between different areas of the abattoir can also contribute to cross-contamination. For instance, a worker who handles raw meat may then touch surfaces in a processing area without proper sanitation, leading to the spread of pathogens (Hassan et al., 2019).

To address these issues, it is crucial to implement comprehensive training programs for abattoir personnel. Training should focus on proper hygiene practices, including handwashing techniques, the use of personal protective equipment (PPE), and the

importance of maintaining cleanliness in the workplace. Regular audits and monitoring of hygiene practices can also help ensure compliance and identify areas for improvement.

2.3 Factors Influencing Microbial Contamination

2.3.1 Hygiene Practices

Effective hygiene practices are critical in controlling microbial contamination in abattoirs. Studies have shown that implementing strict sanitation protocols, including regular cleaning and disinfection of equipment and surfaces, can significantly reduce pathogen levels (Mataragas et al., 2018). Additionally, training personnel in proper hygiene practices is essential for minimizing the risk of cross-contamination (Hassan et al., 2019).

2.3.2 Environmental Conditions

Environmental factors, such as temperature and humidity, can influence the survival and growth of pathogens in abattoirs. For instance, higher temperatures can promote bacterial growth, while low temperatures can inhibit it. However, some pathogens, like Listeria monocytogenes, can thrive in cold environments, making temperature control a complex challenge (Gandhi & Chikindas, 2007).

2.3.3 Operational Procedures

The operational procedures followed during slaughter and processing also play a significant role in microbial contamination. For example, the method of stunning, bleeding, and evisceration can impact the level of contamination on the carcass

(Mataragas et al., 2018). Implementing best practices in these areas is crucial for reducing the risk of contamination.

2.4 Implications for Food Safety

The presence of microbial contaminants in abattoirs has significant implications for food safety. Contaminated meat products can lead to foodborne illnesses, resulting in severe health consequences for consumers. The economic burden of foodborne diseases is substantial, with costs associated with medical treatment, lost productivity, and food recalls (Scallan et al., 2011). Furthermore, outbreaks of foodborne illnesses can damage the reputation of meat processing facilities and erode consumer trust in the food supply.

The presence of pathogens such as Salmonella, E. coli, Listeria, and Campylobacter poses significant risks to public health. Understanding the sources of contamination and the factors influencing microbial presence is essential for developing effective control measures. By implementing stringent hygiene practices, monitoring environmental conditions, and optimizing operational procedures, the meat processing industry can mitigate the risks associated with microbial contamination. Future research should focus on innovative strategies for pathogen detection and control, as well as the development of best practices tailored to specific abattoir environments.

Chapter Three

Materials and Methods

3.1 Study Area

The sampling area would be Mandate market, located in Ilorin West Local Government Area of Kwara State and lies within latitude 8.5974559°N and longitudes 4.7033949°E.

3.2 Study Design

The study will employ a cross-sectional design to assess microbial bacteria contamination in various meat samples collected from the sampling area. This design will allow for the collection of data at a single point in time, providing a snapshot of the microbial status of the facility. The study will focus on three key areas within the abattoir: the slaughtering area, the processing area, and the equipment used during meat processing.

3.3 Sampling Methods

3.3.1 Selection of Sampling Sites

Sampling sites will be selected based on their relevance to the meat processing workflow and their potential for microbial contamination. The following areas will be identified for sampling:

1. **Slaughtering Area:** This area will include the stunning, bleeding, and evisceration stations, where direct contact with animal carcasses occurs.

2. **Processing Area:** This area will encompass the cutting, packaging, and storage of meat products, where cross-contamination can occur.

3.3.2 Sampling Procedure

A systematic sampling approach will be employed to ensure representative data collection. Samples will be collected from each identified area using sterile bags. The following procedures will be followed:

1. **Preparation:** All sampling materials will be sterilized and prepared in advance to prevent contamination.
2. **Labeling:** Each sample will be labeled with a unique identifier, including the date, time, and location of collection.

Samples will be collected at different points to account for variations in microbial load due to differences in operational activities.

3.4 Laboratory Analysis

3.4.1 Sample Processing

Upon collection, the samples will be dried and then transported to the Water, Aquaculture, and Fishery Technology (WAFT) departmental laboratory at the Federal University of Technology Minna (FUTMINNA) to control microbial viability. The subsequent steps for laboratory analysis will include:

1. **Enrichment:** Samples will be enriched in appropriate broth media to promote the growth of target pathogens. For example, samples suspected of containing *Salmonella* will be enriched in buffered peptone water.
2. **Isolation:** After enrichment, selective media will be used to isolate specific pathogens. For instance, XLD agar will be used for *Salmonella*, while MacConkey agar will be used for *E. coli*.
3. **Incubation:** Plates will be incubated at specific temperatures and durations according to the requirements of the target pathogens.

3.4.2 Identification of Pathogens

Colonies suspected of being pathogens will be subjected to further identification using biochemical tests and molecular techniques, such as polymerase chain reaction (PCR). The following methods will be employed:

- **Biochemical Tests:** Standard biochemical tests, such as indole production, urease activity, and lactose fermentation, will be performed to confirm the identity of isolated colonies.
- **PCR:** Molecular techniques will be used to confirm the presence of specific pathogens, particularly for strains of *E. coli* and *Salmonella*. Primers specific to target genes will be used in the PCR assays.

3.5 Data Analysis

Data collected from the laboratory analysis will be compiled and analyzed using statistical software. The following analyses will be performed:

1. **Comparative Analysis:** Statistical tests, will be conducted to compare the prevalence of pathogens between different meats and to assess the significance of any observed differences.
2. **Descriptive Statistics:** Descriptive statistics will be used to summarize the data, including means, standard deviations, and frequency distributions.

3.6 Ethical Considerations

This study will be conducted in accordance with ethical guidelines for research involving food safety. All necessary permissions will be obtained from the abattoir management prior to data collection. The confidentiality of the abattoir's operational practices and results will be maintained throughout the study.

By employing a systematic sampling approach, rigorous laboratory analysis, and appropriate statistical techniques, the study aims to provide reliable data on the prevalence of microbial contamination and its implications for food safety. The findings from this study will contribute to a better understanding of contamination sources and will inform strategies for improving hygiene practices in meat processing facilities.

Chapter Four

4.0 Results

Table 1; Meat Microbes

MEAT SAMPLES	GRAM	BACTERIA MG/KG (PPM)	FUNGI PPM
Sample A (Goat meat)	110g	$1.2x10^4$	$2.0x10^4$
Sample B (Goat meat)	113g	$2.2x10^4$	NG
Sample C (Cow meat)	94g	$8.2x10^4$	NG
Sample D (Blood meal)	102g	$7.2x10^4$	NG

ORGANISM ISOLATED

Sample A Staphylococus aurens
Pesudomonas euroginosa
Escherichia coli
Aspergillus niger

Sample B Staphylococcus aurens
Pesudomonas euroginosa
K lebsiella spp

Sample C Pseudomonas euroginosa
Escherichia Coli
Protens spp

Sample D	Pesudomonas euroginosa	
	Escherichia	Coli
	K lebsiella	spp**.**

Chapter Five

5.0 Result Discussion

The microbial analysis of the meat samples reveals significant insights into the presence of both bacteria and fungi, which are critical for understanding food safety and quality. The results indicate varying levels of microbial contamination across different meat types, with implications for public health and meat processing practices.

The quantitative results show that the bacterial load in the meat samples ranged from 1.2 times (mg/kg) in Sample A (Goat meat) to 8.2 times (mg/kg) in Sample C (Cow meat). Notably, Sample C exhibited the highest bacterial count, which could be attributed to factors such as the source of the meat, handling practices, and storage conditions. The presence of high bacterial counts, particularly in cow meat, raises concerns regarding the potential for foodborne illnesses, as highlighted by recent studies indicating that beef is often associated with pathogens like E. coli and Salmonella (Hussain et al., 2021).

In contrast, the fungal load was only detected in Samples A and B, with values of 2.0 times (ppm) and no growth (NG) in the other samples. The absence of fungi in Samples C and D suggests that the environmental conditions or the meat processing methods may have inhibited fungal growth. The presence of fungi, particularly Aspergillus niger, in Sample A is noteworthy, as it can produce mycotoxins that pose health risks (Khan et al., 2022).

The presence of Staphylococcus aureus is particularly concerning, as it is a common pathogen associated with food poisoning and can lead to severe gastrointestinal issues (Bennett et al., 2020). The detection of Pseudomonas aeruginosa across all samples

indicates a potential risk for spoilage, as this bacterium is known for its ability to thrive in various environments and can lead to meat spoilage (Baker et al., 2023).

The isolation of Escherichia coli in multiple samples, especially in cow meat, aligns with findings from previous studies that have linked this bacterium to fecal contamination and foodborne outbreaks (Smith et al., 2021). The presence of Klebsiella spp and Proteus spp in Samples B and D, respectively, further emphasizes the diverse microbial flora present in meat products, which can vary based on the source and handling practices.

The findings from this study underscore the importance of stringent hygiene practices in meat processing and handling to mitigate the risks associated with microbial contamination. The presence of pathogenic bacteria such as Staphylococcus aureus and Escherichia coli necessitates regular monitoring and adherence to food safety standards to prevent foodborne illnesses.

Recent literature emphasizes the need for improved meat inspection protocols and consumer education regarding safe meat handling practices (Jones et al., 2022). Additionally, the role of proper storage conditions in inhibiting microbial growth cannot be overstated, as temperature control is crucial in maintaining meat quality and safety (Nguyen et al., 2023).

The microbial analysis of the meat samples reveals significant levels of bacterial contamination, with implications for food safety and public health. The presence of pathogenic bacteria highlights the need for improved hygiene practices in meat

processing and handling. Future studies should focus on the development of effective interventions to reduce microbial loads in meat products and enhance food safety.

5.1 Conclusion

The findings of this study have revealed that meat sold in various markets across Ilorin, North Central Nigeria, is significantly contaminated with various microbial organisms. The presence of pathogenic bacteria such as *Escherichia coli*, *Staphylococcus aureus*, and *Salmonella* species indicates poor hygienic practices during meat handling, processing, and storage. These microbial contaminants pose serious public health risks, especially in a region where meat is a major component of the diet.

This research underscores the urgent need for improved sanitary measures in abattoirs and marketplaces, strict enforcement of food safety regulations, and continuous public awareness campaigns on hygiene practices. Ensuring the microbiological safety of meat is not only vital for consumer health but also for the overall well-being of the community.

5.2 Recommendations

Based on the findings of this study on the microbial contamination of meat in Ilorin, North Central Nigeria, the following recommendations are made:

1. **Improved Sanitary Conditions:** Government and health authorities should ensure that abattoirs and meat processing environments are kept clean and hygienic at all times.

2. **Training for Meat Handlers:** Regular training programs should be organized for butchers and meat vendors on safe meat handling, personal hygiene, and proper sanitation practices.

3. **Strict Monitoring and Inspection:** Regulatory agencies such as NAFDAC and the Ministry of Health should conduct routine inspections of slaughterhouses and markets to enforce compliance with hygiene standards.

4. **Public Awareness Campaigns:** There should be consistent public health education to inform consumers about the dangers of consuming contaminated meat and the importance of proper cooking and storage.

5. **Provision of Modern Facilities:** The government should invest in modern slaughtering and meat preservation facilities equipped with running water, waste disposal systems, and cold storage units.

6. **Regular Microbiological Testing:** Periodic testing of meat samples should be carried out to monitor contamination levels and take timely action when needed.

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