PREVALENCE OF *CRYPTOSPORIDIUM* INFECTION IN SLAUGHTERED CATTLE AT IKPOBA HILL ABATTOIR, EDO STATE

BY

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SCHOOL OF BASIC MEDICAL SCIENCES

COLLEGE OF MEDICAL SCIENCES

UNIVERSITY OF BENIN, NIGERIA

SEPTEMBER, 2025

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A PROJECT SUBMITTED TO THE DEPARTMENT OF MEDICAL LABORATORY SCIENCE, SCHOOL OF BASIC MEDICAL SCIENCES, COLLEGE OF MEDICAL SCIENCES, UNIVERSITY OF BENIN, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE DEGREE IN MEDICAL LABORATORY SCIENCE

SEPTEMBER, 2025

CERTIFICATION

We the undersigned certify that this research work was carried out by **NWARIBE CHIOMA BLESSING** in the Department of Medical Laboratory Science, School of Basic Medical Science, University of Benin, Benin City in partial fulfillment of the requirements for the award of Bachelor of Science in Medical Laboratory Science.

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DEDICATION

This project is dedicated to Almighty God.

ACKNOWLEDGEMENT

My heartfelt gratitude goes to the Almighty God, whose divine guidance and blessings paved the way for this project's success.

I am forever indebted Dr. Mrs Zainab Omoruyi for the commitment and precious time spent in guiding and correcting my scripts. Her expertise and feedback have been instrumental in shaping this work.

I would like to express my sincere gratitude to all my lecturers for their invaluable guidance and support throughout this project.

To my loving parents, Mr. Okechukwu Nwaribe and Mrs. Ijeoma Nwaribe, your unwavering support, love, and encouragement mean the world to me. Thank you for being my pillars of strength.

To my siblings, Chigozie, Okechukwu, and Chibuikem Nwaribe, your love and motivation inspired me to push beyond limits.

Special thanks to my godfather and Uncle, Mr. Francis Ifejianyi, whose generosity and guidance have been invaluable. Your immense support has made a significant impact on my journey.

I'm also grateful to my dear friends and course mates, Erinyanga George, Obasi Peter, and Iyoha Vera, whose shared experiences enriched my academic journey.

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ABSTRACT

Cryptosporidium is a zoonotic protozoan parasite of significant public health concern. Cattle serve as major reservoirs, and abattoir contamination represents a potential route of human infection. This study aimed to determine the prevalence of Cryptosporidium infection in cattle at Ikpoba Hill abattoir Benin city. A cross-sectional survey was conducted, and 180 fecal samples were collected post-slaughter. Samples were processed using the formol-ether concentration method and examined for Cryptosporidium oocysts with the modified Ziehl-Neelsen staining technique. The overall prevalence was 6.7% (12/180), with younger cattle showing higher infection rates than adults. The detection of Cryptosporidium in slaughtered cattle highlights a potential zoonotic risk, underscoring the need for improved sanitary practices within the abattoir and targeted health education for workers to reduce public health hazards.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

Cryptosporidium is a genus of parasitic protozoa that leads to the disease known as cryptosporidiosis, affecting a variety of hosts, including livestock, wildlife, and humans. The infectious stage of *Cryptosporidium*, known as Oocysts, is highly resistant to environmental stresses and is primarily transmitted through the fecal-oral route, either via contaminated water or food or through direct contact with infected individuals or animals (Ayele *et al*., 2018). Cryptosporidiosis is especially concerning among immunocompromised individuals, as it can lead to severe diarrhea and other gastrointestinal illnesses, significantly impacting health outcomes (Ayele *et al*., 2018; Saidu *et al*., 2023). In cattle, *Cryptosporidium* spp. can lead to significant economic losses due to reduced growth rates, milk production, and veterinary costs associated with the management of infections (Ola-Fadunsin *et al*., 2022).

In Edo State, cattle farming is a crucial aspect of the agricultural economy, providing not only a source of livelihood for many farmers but also serving as a primary source of protein for the local populace (Oyebola *et al*., 2019). The movement of cattle from various regions to slaughterhouses, including the Ikpoba Hill Abattoir, along with differing hygiene and management practices, creates fertile grounds for the transmission and spread of parasitic infections, including *Cryptosporidium* spp (Dankwa *et al*., 2021). Cattle may become infected through exposure to contaminated feed, water, or environments that have been compromised by fecal matter from infected animals, reinforcing the zoonotic potential of the parasite (Ayele *et al*., 2018).

Studies on the prevalence of *Cryptosporidium* infections in cattle throughout Nigeria have indicated notable rates of infection. For example, research conducted in the Federal Capital Territory revealed prevalence rates of approximately 10.9% (Adeiza *et al*., 2023). Furthermore, findings suggest that overall prevalence in Nigeria may range from 4.8% to as high as 52.7%, depending on various factors, such as geographical location and environmental conditions (Anejo-Okopi *et al*., 2017; Adeiza *et al*., 2023). Currently, however, there is a deficiency of data specifically addressing the prevalence of *Cryptosporidium* spp among cattle in Edo State, highlighting an urgent need for focused research in this area.

1.2 Statement of the Problem

The investigation into the prevalence of *Cryptosporidium* infections among slaughtered cattle at Ikpoba Hill abattoir is prompted by the notable absence of focused studies in Edo State, Nigeria. Cryptosporidiosis is recognized as a significant zoonotic disease with public health implications, yet there is a scarcity of epidemiological data that address its prevalence among cattle populations in this specific locale. Existing literature indicates a heightened prevalence of *Cryptosporidium* infection in cattle populations across various regions of Nigeria. For example, a study in Kaduna State reported infection rates ranging from 16% to 29% among different cattle herds, with certain locations reporting up to 52.7% prevalence (Esonu *et al*., 2025; Adeiza *et al*., 2022). However, research pertinent to Edo State specifically has not been sufficiently explored, underscoring a critical gap in our understanding of local infection dynamics.

Additionally, published studies predominantly focus on urban areas or specific cattle breeds, thereby neglecting the rich diversity of cattle management practices across rural settings in Edo State. This could result in findings that do not accurately represent the unique risk factors associated with local pastoralism and market dynamics that may contribute to increased susceptibility to *Cryptosporidium* infections (Adeiza *et al*., 2022). Previous works often utilized limited sample sizes, constraining the generalizability of findings, and leading to an incomplete representation of infection patterns (Esonu *et al*., 2025).

This study aims to address these gaps by implementing a comprehensive epidemiological framework, utilizing a sufficient sample size as well as molecular characterization techniques to accurately depict the prevalence and risk factors of *Cryptosporidium* infection in Edo State.

Realizing these research opportunities is critical, not only for assessing the economic and health impacts on agriculture but also for developing risk mitigation strategies that could reduce zoonotic transmission from cattle to humans. Such insights will be instrumental in guiding public health policy aimed at improving food safety and mitigating risks associated with livestock management practices in the area.

1.3 Significance of the Study

This study's significance lies primarily in its potential to contribute foundational knowledge regarding the prevalence and epidemiology of *Cryptosporidium* infections in cattle within Edo State. By adequately addressing the identified gaps, the study will yield valuable data to inform both farmers and public health authorities about the risks associated with *Cryptosporidium* infection, particularly concerning zoonotic transmission to humans (Abare *et al*., 2019; Gong *et al*., 2017).

Moreover, the findings from this study may highlight specific environmental and socio-economic factors contributing to infection rates, thus enabling targeted interventions tailored to the local cattle farming context. Such insights can directly inform best practices in livestock management, which could mitigate infection risks and enhance food safety standards within the local food supply chain, benefiting the entire community (Shaw *et al*., 2021).

Additionally, this study can serve as a pilot for similar future research initiatives across other states in Nigeria, contributing to a more comprehensive national understanding of *Cryptosporidium* epidemiology (Hlavsa *et al*., 2017; Fan *et al*., 2017). Establishing localized prevalence rates and risk factors will enable the development of tailored public health policies aimed at safeguarding livestock health and, by extension, human health.

Lastly, the comprehensive approach taken in this study, including the detailed exploration of potential risk factors associated with *Cryptosporidium* shedding in cattle populations, will lay the groundwork for future research into other zoonotic diseases that similarly pose risks. Furthermore, informing public health policies through empirical evidence can significantly contribute to a more aware and health-conscious community, both protecting rural livelihoods tied to cattle farming and enhancing human health outcomes across the region.

By addressing these gaps and presenting data that reflects the realities in Edo State, this research endeavors to foster a more nuanced understanding of *Cryptosporidium* infection transmission dynamics, contributing significantly both to academic discourse and to practical public health initiatives addressing zoonotic infections in Nigeria.

1.4 Justification of Study

The pressing need for this research stems from the significant public health implications associated with this zoonosis. Ikpoba Hill abattoir in Benin City serves as a significant economic and cultural center in Southern Nigeria, with the abbatoir playing a critical role in meat production and supply for the region. Given the high volume of cattle processed at this facility, understanding the prevalence of *Cryptosporidium* infections provides essential insights into public health and food safety risks associated with zoonotic infections.

Cryptosporidium infections have been documented to cause severe gastrointestinal illnesses in both cattle and humans, leading to outbreaks with serious health consequences, particularly for immunocompromised individuals, children, and the elderly (Dankwa *et al*., 2021; Fareed *et al*., 2024). Moreover, transmission pathways often involve contaminated food and water sources, emphasizing the necessity of understanding the potential risks posed by cattle infected with *Cryptosporidium* (Oduro *et al*., 2024).

Previous studies have established connections between livestock, particularly cattle, and human infections. Research conducted in Ghana indicated that certain species of *Cryptosporidium* found in cattle are also implicated in human infections, causing conditions such as diarrhea, abdominal cramps, and nausea (Dankwa *et al*., 2021). A systematic review in Sri Lanka noted that cryptosporidiosis remains a global health concern due to its zoonotic nature, reiterating the need for surveillance and control measures for *Cryptosporidium* infection in livestock (Fareed *et al*., 2024). This reinforces the urgent requirement for the current study, as the absence of data specific to Edo State leaves both consumers of cattle products and the general public vulnerable to potential outbreaks.

Additionally, the lack of localized data regarding prevalence may hinder the ability to devise effective public health interventions and best practices in livestock management (Oduro *et al*., 2024). Understanding the prevalence rates and the factors affecting *Cryptosporidium* infections in cattle at Ikpoba Hill will fill a knowledge void, offering evidence to guide public health policies and strategies to reduce human exposure to this pathogen. It is critical to characterize the environmental and management factors that influence *Cryptosporidium* infection transmission to formulate appropriate control measures in Edo State, where veterinary awareness and biosecurity measures may be lacking (Hussain *et al*., 2021; Firoozi *et al*., 2019).

Findings from this research will not only illuminate the epidemic situation but also inform product safety protocols for consumers and promote public health initiatives aimed at minimizing the transmission risk of zoonotic pathogens from livestock to humans. Researchers and policymakers can develop comprehensive recommendations and guidelines that address the specific conditions observed within the local cattle farming context, enhancing food safety and public health outcomes in the region.

1.5 Aim of Study

Aim: The aim of this study is to investigate the prevalence of *Cryptosporidium* infection among slaughtered cattle at Ikpoba Hill Abattoir, Edo State, Nigeria

1.6 Objectives of The Study

1. To determine the prevalence rate of *Cryptosporidium* infection among cattle slaughtered at the Ikpoba-Hill Abattoir.

2. To identify and analyze epidermiological risk factors associated with *Cryptosporidium* transmission in the cattle population.

3. To assess the public health significance and food safety implication of *Cryptosporidium* infection in cattle.

1.7 Research Questions

To achieve the objectives outlined in this study, the following research questions will guide the investigation:

1. What is the prevalence rate of *Cryptosporidium* infection among cattle slaughtered at the Ikpoba-Hill Abattoir?
2. What are the epidermiological risk factors associated with *Cryptosporidium* transmission in the cattle population at Ikpoba-Hill Abattoir?
3. What is the public health significance and food safety implication of *Cryptosporidium* infection in cattle in the region?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 OVERVIEW OF CRYPTOSPORIDIUM

2.1.1 Taxonomy and Classification

Cryptosporidium belongs to the phylum Apicomplexa, class Conoidasida, order Eucoccidiorida, and family Cryptosporidiidae (Feng *et al*., 2018). The genus comprises over 40 species and genotypes, with varying degrees of host specificity and pathogenicity. In cattle, the most commonly identified species include *Cryptosporidium parvum*, *C. bovis, C. ryanae, and C. andersoni*, each with distinct biological characteristics and zoonotic potential (Esonu *et al*., 2025).

Cryptosporidium parvum is considered the most significant species from a public health perspective due to its broad host range and high zoonotic potential. This species can infect both humans and animals, making it a primary concern in livestock production systems (Adeiza *et al*., 2022). Conversely, *C. bovis and C. ryanae* are generally considered cattle-specific species with limited or no zoonotic potential, though recent molecular studies have challenged some of these assumptions (Esonu *et al*., 2025).

The phylogenetic relationships between Cryptosporidium species have been elucidated through molecular characterization studies, revealing complex evolutionary patterns that influence host adaptation and pathogenicity. Nigerian studies have contributed significantly to understanding these relationships, particularly regarding indigenous cattle breeds and their susceptibility to different Cryptosporidium species (Ayinmode *et al*., 2018).

2.1.2 Morphology and Life Cycle

Cryptosporidium oocysts are spherical to slightly ovoid structures measuring approximately 4-6 μm in diameter, containing four sporozoites that represent the infective stage (Adeiza *et al*., 2022). The oocyst wall is composed of a two-layered structure that provides remarkable resistance to environmental stresses and common disinfectants, enabling prolonged survival in various environmental conditions (Adamu *et al*., 2019).

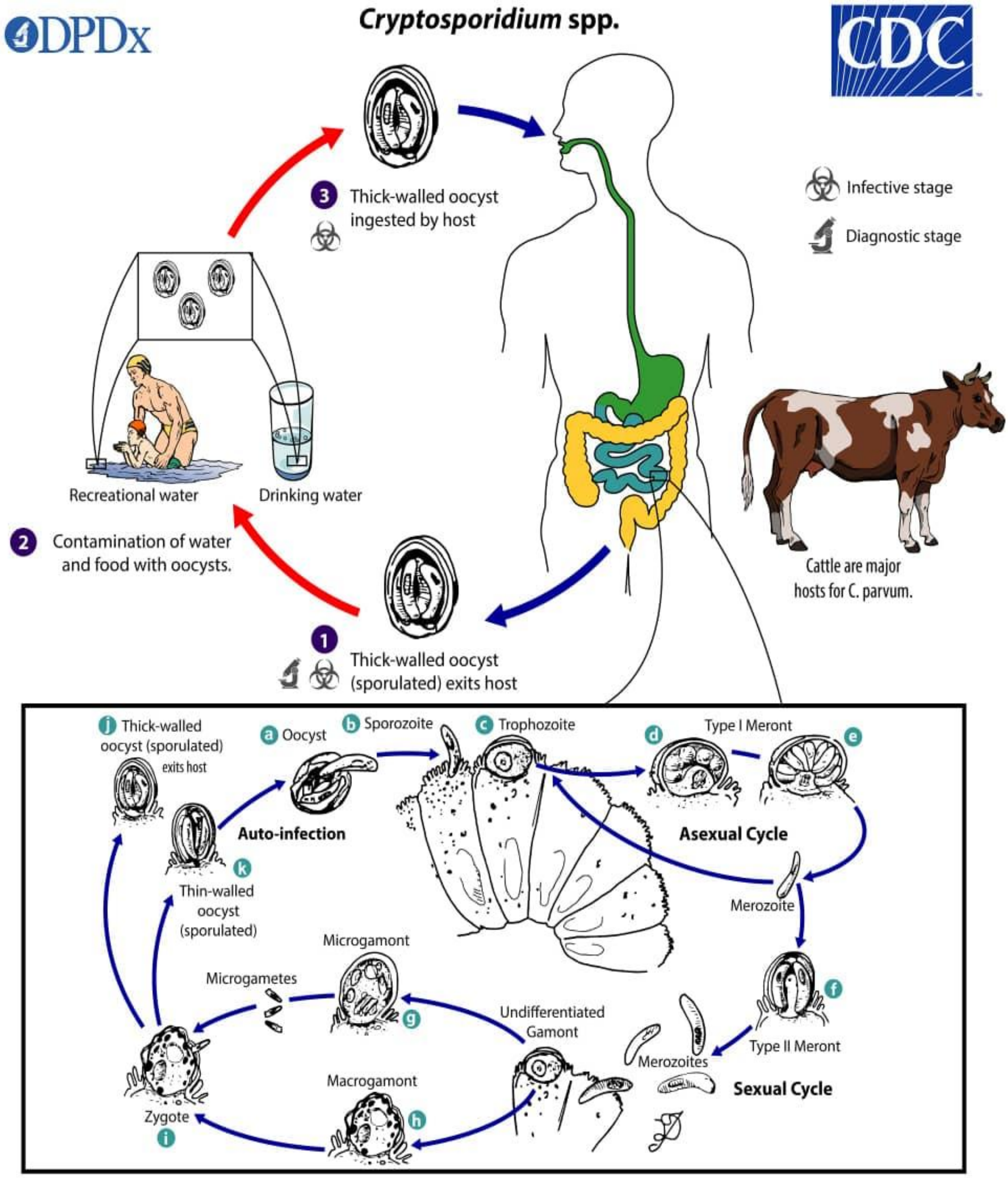

Figure 1: *Cryptosporidium spp*. life cycle (Centers for Disease Control and Prevention, 2025).

The life cycle of Cryptosporidium is complex, involving both asexual and sexual reproduction phases within a single host. Following ingestion of sporulated oocysts, excystation occurs in the small intestine, releasing sporozoites that invade intestinal epithelial cells. The parasite completes its entire life cycle at the apical surface of these cells, in a unique intracellular but extracytoplasmic location (Ola-Fadunsin *et al*., 2020).

The asexual phase (merogony) involves two generations of schizont development, producing merozoites that can either initiate new asexual cycles or differentiate into sexual stages. The sexual phase (gametogony) results in the formation of microgametes and macrogametes, which fuse to form zygotes that develop into oocysts. These oocysts are shed in feces and become immediately infective upon sporulation, which occurs within the host or shortly after environmental release (Adamu *et al*., 2021).

2.1.3 Pathophysiology

The pathophysiology of cryptosporidiosis in cattle involves complex host-parasite interactions that result in varying degrees of gastrointestinal dysfunction. The parasite's attachment to intestinal epithelial cells triggers inflammatory responses and disrupts normal absorptive and secretory functions of the gut (Ibrahim *et al*., 2019). In young calves, infection typically manifests as profuse watery diarrhea, dehydration, and failure to thrive, which can lead to significant economic losses in cattle operations.

Histopathological examination of infected intestinal tissues reveals villous atrophy, crypt hyperplasia, and inflammatory cell infiltration, particularly in the ileum and jejunum. These changes impair nutrient absorption and electrolyte balance, contributing to the characteristic clinical signs of cryptosporidiosis (Musa *et al*., 2020). The severity of clinical manifestations varies with factors such as age, immune status, and concurrent infections.

Age-related susceptibility patterns are particularly pronounced in cattle, with young calves (1-30 days old) showing the highest infection rates and most severe clinical signs. Adult cattle typically develop subclinical infections with intermittent oocyst shedding, though they may serve as important reservoir hosts for environmental contamination (Musa *et al*., 2020). The impact on growth performance and productivity has been documented in several Nigerian studies, demonstrating significant economic implications for livestock production systems.

2.2 EPIDEMIOLOGY OF CRYPTOSPORIDIUM IN CATTLE

2.2.1 Global Distribution and Prevalence

Global prevalence studies of Cryptosporidium in cattle demonstrate significant geographical variation, with reported rates ranging from less than 5% to over 60% depending on the study population, diagnostic methods, and environmental factors (Adamu *et al*., 2019). Developed countries typically report lower prevalence rates in intensively managed dairy systems compared to extensive pastoral systems common in developing countries.

In industrialized nations, prevalence rates in dairy cattle generally range from 5-25%, with higher rates observed in young calves compared to adult animals. The implementation of biosecurity measures, improved husbandry practices, and better veterinary care contribute to lower infection rates in these settings (Silverlås *et al*., 2018). However, even in well-managed systems, cryptosporidiosis remains a significant cause of neonatal calf diarrhea and economic losses.

Developing countries consistently report higher prevalence rates, often exceeding 30-50% in cattle populations. These elevated rates are attributed to factors such as poor sanitation, limited access to veterinary services, overcrowding, and inadequate nutrition (Adamu *et al*., 2019). Seasonal variations are more pronounced in tropical and subtropical regions, with higher transmission rates during wet seasons when environmental conditions favor Oocyst survival and transmission.

2.2.2 African and Nigerian Studies

African studies on Cryptosporidium in cattle reveal a complex epidemiological landscape influenced by diverse ecological, socioeconomic, and management factors. Prevalence rates across the continent vary considerably, with reports ranging from 10% in some East African countries to over 50% in certain West African regions (Dankwa *et al*., 2021).

In West Africa, several studies have documented significant Cryptosporidium prevalence in cattle populations. A comprehensive study in Ghana reported prevalence rates of 32.5% among cattle in the Central Region, with significant associations between infection rates and management practices (Dankwa *et al*., 2021). Similarly, studies in Burkina Faso and Mali have reported comparable prevalence rates, highlighting the regional significance of this parasitic infection.

East African countries have generally reported more variable prevalence rates, with Kenya and Tanzania showing rates between 15-35% in different cattle production systems. The variation is largely attributed to differences in agro-ecological zones, with higher rates observed in humid regions compared to arid and semi-arid areas (Dankwa *et al*., 2021). Ethiopia has reported some of the highest prevalence rates on the continent, with certain studies documenting infection rates exceeding 40% in traditional husbandry systems.

Nigeria has contributed significantly to the understanding of Cryptosporidium epidemiology in cattle through several important studies conducted across different ecological zones. A landmark molecular characterization study in Kaduna State examined 195 native calves and reported an overall prevalence of 16.0% using PCR-based diagnostic methods (Adeiza *et al*., 2023). This study was particularly significant as it focused on indigenous cattle breeds (White Fulani and Sokoto Gudali) rather than exotic breeds commonly studied in other regions.

Subsequent studies in southwestern Nigeria have provided additional insights into the distribution of Cryptosporidium species in local cattle populations. Adeiza *et al*. (2023) conducted a molecular characterization study of 65 diarrheic calves from White Fulani herds, reporting a prevalence of 52.3% with predominant identification of *C. bovis* (27.7%) and *C. ryanae* (7.7%). Notably, mixed infections were observed in 16.9% of positive samples, highlighting the complex epidemiological patterns in Nigerian cattle populations.

The absence of zoonotic *C. parvum* in several Nigerian studies has been a consistent finding that distinguishes the local epidemiological pattern from those reported in other regions. This finding has significant implications for public health risk assessment and control strategies. However, more recent studies have begun to identify *C. parvum* in some Nigerian cattle populations, suggesting either temporal changes in species distribution or improved diagnostic capabilities (Adeiza *et al.*, 2023).

Studies in Ogun State have reported varying prevalence rates depending on the diagnostic method employed. Using enzyme-linked immunosorbent assay (ELISA), researchers reported a prevalence of 37.5% in cattle feces, with the highest infection rates observed in young calves (78.1%) (Adeiza *et al.*, 2023). This study highlighted the importance of age as a significant risk factor for Cryptosporidium infection in Nigerian cattle populations.

2.3 TRANSMISSION DYNAMICS AND RISK FACTORS

2.3.1 Routes of Transmission

The primary transmission route for Cryptosporidium in cattle is through the fecal-oral pathway, involving ingestion of sporulated oocysts from contaminated water, feed, or environmental surfaces. The highly resistant nature of oocysts enables them to survive for extended periods in the environment, facilitating indirect transmission between animals and potentially to humans (Muhammed *et al.*, 2018).

Direct contact transmission occurs through animal-to-animal contact, particularly in crowded housing conditions or communal grazing areas. Young calves are particularly susceptible to infection through contact with infected dams or other cattle in the herd. The shedding patterns of infected animals show considerable variation, with some individuals becoming persistent shedders who serve as important sources of environmental contamination (Muhammed *et al*., 2018).

Waterborne transmission represents a significant pathway for Cryptosporidium spread in cattle operations, particularly where water sources are shared between multiple herds or contaminated by surface runoff. Nigerian studies have demonstrated the presence of Cryptosporidium oocysts in various water sources used for livestock, highlighting the importance of water quality in infection control (Adamu *et al*., 2020).

2.3.2 Host-Related Risk Factors

Age represents the most consistently identified risk factor for Cryptosporidium infection in cattle, with young calves showing significantly higher susceptibility compared to adult animals. Nigerian studies have consistently demonstrated this age-related pattern, with calves under 180 days of age showing infection rates 2-3 times higher than older animals (Ayinmode *et al*., 2016).

Breed differences in susceptibility to Cryptosporidium infection have been investigated in several Nigerian studies, though results have been somewhat inconsistent. Some studies suggest that indigenous breeds may have different susceptibility patterns compared to exotic breeds, possibly due to genetic factors or differences in management systems (Ola-Fadunsin *et al*., 2022). However, more research is needed to definitively establish breed-specific risk factors.

Immunocompromised states, whether due to concurrent infections, nutritional deficiencies, or stress, significantly increase susceptibility to Cryptosporidium infection. Malnourished animals show prolonged oocyst shedding and more severe clinical signs, emphasizing the importance of adequate nutrition in infection control (Ibrahim *et al*., 2020).

Figure 2: Jersey cow (Thompson, 2025).

2.3.3 Environmental and Management Factors

Housing systems and stocking density have been identified as significant risk factors for Cryptosporidium transmission in cattle. Intensive confinement systems with high animal density facilitate rapid spread of infection through direct contact and environmental contamination. Nigerian studies have shown higher prevalence rates in confined feeding operations compared to extensive grazing systems (Musa *et al*., 2021).

Water source contamination represents a critical environmental risk factor, with shared water points and contaminated surface water serving as major sources of infection. The quality of water sources used for livestock has been shown to directly correlate with infection rates in several Nigerian studies (Adamu *et al*., 2021). Poor water treatment and storage practices further compound the risk of waterborne transmission.

Seasonal variations in transmission rates are pronounced in Nigerian cattle populations, with higher infection rates typically observed during the rainy season. Increased humidity and moderate temperatures during this period favor oocyst survival in the environment, while increased animal movement and congregation around water sources may facilitate transmission (Adamu *et al*., 2021).

2.3.4 Socioeconomic Factors

Farmer education and awareness levels significantly influence the implementation of biosecurity measures and infection control practices. Studies in northern Nigeria have demonstrated associations between farmer education levels and prevalence rates in their cattle herds, with better-educated farmers implementing more effective prevention strategies (Adeiza *et al*., 2022).

Economic constraints limiting access to veterinary services, quality feed, and infrastructure improvements contribute to higher infection rates in resource-poor settings. The cost of implementing biosecurity measures often exceeds the financial capacity of smallholder farmers, perpetuating cycles of infection and reinfection (Esonu *et al*., 2025).

Market chain contamination risks are particularly relevant in the context of cattle transportation and slaughtering. The movement of cattle from various production areas to central markets and abattoirs creates opportunities for cross-contamination and spread of infection (Ola-Fadunsin *et al*., 2020).

Figure 3: Beef loin (Chabraszewski, 2025).

2.4 DIAGNOSTIC METHODS FOR CRYPTOSPORIDIUM DETECTION

2.4.1 Traditional Microscopic Methods

Microscopic examination remains the most widely used diagnostic approach for Cryptosporidium detection in Nigerian veterinary laboratories due to its accessibility and relatively low cost. Direct wet mount examination provides rapid results but has limited sensitivity, particularly for low-level infections or chronic carriers with intermittent oocyst shedding (Adewumi *et al*., 2022).

Concentration techniques, including sedimentation and flotation methods, significantly improve the sensitivity of microscopic diagnosis by increasing the number of oocysts per microscopic field. The formal-ether sedimentation technique has been widely adopted in Nigerian studies and has proven effective for routine diagnostic applications (Adewumi *et al*., 2022).

The modified Ziehl-Neelsen (MZN) staining technique represents the gold standard for microscopic diagnosis of Cryptosporidium oocysts. This acid-fast staining method allows clear visualization of oocysts as bright red structures against a blue or green background, enabling differentiation from other fecal elements. Nigerian studies have reported detection rates of 15.8% to 51.2% using this technique, depending on the study population and sample quality (Adewumi *et al*., 2022).

Safranin-methylene blue staining has emerged as an alternative staining method that provides comparable results to MZN staining with potentially improved cost-effectiveness. Some Nigerian laboratories have adopted this technique as a routine diagnostic tool, reporting good correlation with molecular diagnostic results (Muhammed *et al*., 2020).

2.4.2 Advanced Diagnostic Techniques

Immunofluorescence microscopy using fluorescein isothiocyanate-conjugated anti-Cryptosporidium monoclonal antibodies provides enhanced sensitivity and specificity compared to conventional staining methods. This technique enables direct visualization of oocyst walls with characteristic apple-green fluorescence under ultraviolet microscopy (Adamu *et al*., 2019).

Enzyme-linked immunosorbent assay (ELISA) techniques for Cryptosporidium coproantigen detection have been successfully employed in several Nigerian studies. These assays offer high throughput capabilities and can detect both viable and non-viable oocysts, making them suitable for epidemiological surveys (Ibrahim *et al*., 2020).

Rapid antigen detection tests using lateral flow technology provide point-of-care diagnostic capabilities but have shown variable performance in field conditions. While these tests offer the advantage of rapid results without requiring specialized laboratory equipment, their sensitivity may be insufficient for detecting low-level infections (Yakubu *et al*., 2021).

2.5 SPECIES IDENTIFICATION AND CHARACTERIZATION

2.5.1 Zoonotic Species in Cattle

Cryptosporidium parvum represents the most significant zoonotic species found in cattle, capable of causing severe diarrheal disease in both animals and humans. This species shows remarkable genetic diversity with multiple subtypes identified through gp60 gene analysis. However, Nigerian studies have consistently reported a low prevalence or absence of *C. parvum* in indigenous cattle breeds, which has important implications for zoonotic risk assessment (Adeiza *et al*., 2023).

The apparent absence of *C. parvum* in many Nigerian cattle studies contrasts sharply with findings from other regions where this species is commonly identified. This difference may reflect genuine ecological or genetic factors affecting host-parasite interactions in indigenous cattle breeds, or could result from methodological limitations in earlier studies (Adeiza *et al*., 2023).

Cryptosporidium hominis, traditionally considered a human-specific species, has occasionally been detected in cattle, though its significance in livestock remains unclear. Some recent molecular studies suggest that the host range of *C. hominis* may be broader than previously thought, though definitive evidence for cattle infections remains limited (Esonu *et al*., 2025).

2.5.2 Non-zoonotic Species

Cryptosporidium bovis has emerged as the predominant species in Nigerian cattle studies, accounting for 27.7% to 52% of infections in different surveys. This species is generally considered cattle-specific with no zoonotic potential, though it can cause significant clinical disease in young calves (Muhammed *et al*., 2021).

Cryptosporidium ryanae represents another common cattle-specific species identified in Nigerian studies, typically accounting for 7.7% to 15% of infections. This species is associated with milder clinical signs compared to *C. parvum* but can still contribute to reduced growth performance in infected animals (Muhammed *et al*., 2021).

Cryptosporidium andersoni, which primarily infects the abomasum of adult cattle, has been identified in some Nigerian studies but appears to be less common than *C. bovis* and *C. ryanae*.

Mixed infections involving multiple species are frequently observed, occurring in up to 16.9% of positive samples in some studies (Ayinmode *et al*., 2018).

2.6 CONTROL AND PREVENTION STRATEGIES

2.6.1 Livestock Management Practices

Effective biosecurity measures represent the cornerstone of Cryptosporidium control in cattle operations. These measures include proper quarantine procedures for incoming animals, restricted access to cattle areas, and implementation of hygiene protocols for personnel and equipment. Nigerian studies have demonstrated the effectiveness of these measures in reducing infection rates in well-managed farms (Ola-Fadunsin *et al*., 2022).

Water quality management is critical for preventing waterborne transmission of Cryptosporidium. This includes regular testing of water sources, appropriate treatment of contaminated water, and prevention of fecal contamination of water supplies. Several Nigerian studies have emphasized the importance of clean water provision in controlling cryptosporidiosis outbreaks (Adamu *et al*., 2020).

Feed safety protocols focus on preventing fecal contamination of feed and forage. Proper storage of feed materials, prevention of rodent access, and avoidance of feeding on contaminated pastures are important components of feed safety programs. Regular cleaning and disinfection of feeding equipment also contribute to reduced transmission risk (Musa *et al*., 2021).

2.6.2 Treatment Options

Currently available therapeutic options for cryptosporidiosis in cattle are limited in both number and efficacy. Halofuginone lactate represents the only drug specifically licensed for treating cryptosporidiosis in calves in many countries, though its availability and use in Nigeria remain limited (Ibrahim *et al*., 2020).

Supportive therapy focusing on fluid replacement and electrolyte balance correction remains the mainstay of treatment for clinically affected animals. Early intervention with oral rehydration solutions and supportive care can significantly improve outcomes in infected calves (Yakubu *et al*., 2019).

Alternative treatment approaches being investigated include the use of probiotics, immunomodulators, and herbal preparations. Some Nigerian studies have explored the potential of traditional medicinal plants for treating cryptosporidiosis, though rigorous efficacy data remain limited (Muhammed *et al*., 2021).

2.6.3 Vaccination Strategies

Vaccine development for cryptosporidiosis has proven challenging due to the unique biology of the parasite and its intracellular but extracytoplasmic location. Current research focuses on identifying suitable vaccine candidates and delivery systems that can induce protective immunity (Adamu *et al*., 2021).

Experimental vaccination studies have shown variable results, with some promising outcomes using recombinant protein vaccines or live-attenuated vaccines. However, no commercially available vaccines for cryptosporidiosis in cattle currently exist, limiting prevention options to management-based interventions (Esonu *et al*., 2025).

Future prospects for immunization include the development of novel vaccine platforms such as viral vector vaccines or nanoparticle delivery systems. Research in this area continues to advance, though practical applications for field use remain several years away (Adeiza *et al*., 2023).

Policy and regulatory frameworks for controlling cryptosporidiosis in livestock are generally underdeveloped in Nigeria and many African countries. Establishment of surveillance systems, diagnostic standards, and treatment guidelines could significantly improve control efforts. Community-based intervention programs that combine education, improved management practices, and veterinary support have shown promise in reducing infection rates in smallholder farming systems (Ola-Fadunsin *et al*., 2020).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

This study was conducted at the Ikpoba Hill Abattoir located in Ikpoba Okha local government area in Benin City, Edo State, Nigeria. The geographical coordinates of Ikpoba Hill are approximately 6.2956° N latitude and 5.6080° E longitude.

3.2 Materials and Reagents

Formalin solution (10%), Ethanol (100%), Centrifuge (Eppendorf, Model 5804), Olympus BX53 Microscope, Personal Protective Equipment (PPE), Analytical balance, Sterile fecal sample containers, Normal saline solution, Iodine solution, Glass slides and cover slips were used.

3.3 Study Population

The study population consisted of cattle presented for slaughter at Ikpoba Hill abattoir during the study period. The sample included cattle of various ages, breeds, and health statuses, ensuring a representation that facilitated meaningful data insights and strengthened the reliability of the conclusions drawn.

3.4 Sample Size Calculations

The sample size for this study involved calculations based on previous research findings related to the prevalence of Cryptosporidium infection in cattle in Nigeria. Assuming an estimated prevalence rate of 8% as documented in existing literature (Esonu *et al*., 2025; Adeiza *et al*., 2022), the sample size (n) was calculated using the formula:

$$n = \frac{Z2.\ P.(1-P)}{E2}$$

Where:

Z) = Z-value (1.96 for a 95% confidence level)

(p) = estimated prevalence (0.16)

(E) = margin of error (assumed to be 0.05)

Substituting in the values:

$$n = \frac{(1.96)2\ .\ 0.16\ .\ (1-0.16)}{(0.05^2)}$$

$$n = 216.8 \cong 217$$

3.5 Sample Collection and Processing

3.5.1 Sample Collection

The analysis of fecal samples for the presence of Cryptosporidium infections was carried out at the Department of Medical Laboratory Science facilities of the University of Benin, which was equipped with essential laboratory instruments for parasitological examination. Cattle presented for slaughter were selected based on random sampling methods to ensure that all animals had an equal chance of being included in the study. This helped to minimize any biases in selection. Cattle traders were approached in the abattoirs for samples. Fresh fecal samples were collected manually from the rectum of each selected cattle using sterile gloves and directly transferred into sterile containers, ensuring that the integrity of the sample was maintained. Each sample was preserved using 10% formol saline to prevent decomposition and allow for the evaluation of the Cryptosporidium species to be performed accurately 48-72 hours after collection. The collection process took place in the early morning hours between 06:00 and 11:00, and each sample container was meticulously labeled with unique identifiers corresponding to the cattle's ID No, age, breed, and health status. This data was crucial for later correlations during analysis.

3.5.2 Sterilization of Materials

All materials, including collection containers, were adequately sterilized. This entailed thorough washing and rinsing of the equipment followed by autoclaving at 121°C for 20 minutes to eliminate any potential contaminants. Tools used underwent this sterilization process before and immediately after use.

3.5.3 Sample Examination

For accurate detection of Cryptosporidium oocysts, a combination of Microscopy and the modified Ziehl-Neelsen (MZN) staining technique was employed. This was commonly used and had been documented to yield detection rates between 15.8% to 51.2% in various studies (Adewumi *et al*., 2022). Once the samples were collected and transported to the laboratory, the following procedures were employed to analyze the fecal specimens for the presence of gastrointestinal parasites:

Preparation of Specimens for Analysis

Macroscopic Examination: Samples were first visually inspected for consistency and any visible parasites.

Microscopic Examination:

1. Preparation of Wet Mounts:

a) A small amount (approximately 1 g) of feces was placed into a petri dish and mixed with 10 mL of normal saline to create a homogenous solution.

b) The mixture was gently stirred to suspend any oocysts or parasites present and ensure an even distribution.

c) Using a pipette, a drop of this suspension was placed on a glass slide, and a cover slip was applied. This enabled viewing under the microscope.

2. Use of Iodine Solution:

If clarity was required, a drop of iodine solution was added to the wet mount to assist in enhancing the visibility of any cellular structures or parasites, allowing for clearer identification when examining under the microscope.

3. Modified Ziehl-Neelsen (MZN) Staining Technique:

a) The Modified Ziehl-Neelsen staining technique was used as the gold standard for identifying Cryptosporidium oocysts in fecal samples.

b) Fecal samples were first prepared into a smear on a glass slide.

c) The prepared slide was then fixed by passing it through a flame.

d) The slide was stained with the primary stain (carbol fuchsin) and was subjected to heat, followed by rinsing.

e) The slide was subsequently decolorized with an acid-alcohol solution and counter-stained with methylene blue.

f) Oocysts were identified under a microscope at high magnification (100x oil immersion).

g) This stain enabled the visualization of the oocysts, which appeared as bright red against a green or blue background when viewed under a microscope.

Samples were examined under the microscope at various magnifications (initially at 40x and then at 100x oil immersion) to find Cryptosporidial oocysts, observed as round or oval shapes with distinctive structures.

3.6 Concentration of Oocysts (Using Sedimentation Method)

1. The prepared fecal suspension was transferred to conical tubes and centrifuged at approximately 1,500 rpm for 10 minutes. Centrifugation helped to concentrate the oocysts within the sediment.

2. After centrifugation, the supernatant fluid was carefully discarded, leaving behind the sediment containing potential oocysts for further analysis under a microscope.

3. Any Oocyst spotted was counted and identified based on their morphological characteristics.

3.6.1 Identification of the Oocysts

The Oocysts of Cryptosporidium spp were identified through microscopic features, such as size, shape, and color of eggs. This identification followed established protocols (e.g., morphological keys from relevant parasitology texts). The *Cryptosporidium parvum* oocyst was a primary concern when analyzing samples because they were the most prevalent species in cattle found in Nigeria. The Eggs of Cryptosporidium hominis which affects mostly Humans were also identified in this study. The identified Oocysts were measured and coefficients like length and width were noted for accurate species identification.

3.7 Statistical Analysis

Data collected from the fecal sampling and laboratory examination were entered into SPSS statistical software package, which summarized prevalence rates, while inferential statistics (chi-square tests) were employed to assess relationships between prevalence and the identified risk factors. A significance level of $p < 0.05$ was considered statistically significant.

CHAPTER FOUR

4.1 Result

The prevalence of intestinal parasites among cattle slaughtered at Ikpoba-Hill Abattoir, Edo State, is presented in Table 4.1. Out of the 180 cattle examined, Cryptosporidium was the most commonly detected parasite, recorded in 12 animals, representing a prevalence of 6.67%. Other parasites, including *Balantidium coli*, *Strongyloides* larvae, and *Ascaris* ova, were detected at very low frequencies, corresponding to a prevalence of 0.56%.

The distribution of Cryptosporidium infection according to sex and age is summarized in Table 4.2. Male cattle showed a slightly higher prevalence (6.9%) compared to females (5.6%), although the difference was not statistically significant ($p = 1$). When stratified by age, the highest prevalence was observed in cattle aged 1–2 years (11.1%), followed by those aged 2–4 years (5.6%) and >4 years (2.8%). Despite this apparent trend of decreasing prevalence with increasing age, the association between age and Cryptosporidium infection was not statistically significant ($p = 0.251$). The overall mean age of the sampled cattle was 2.95 ± 1.21 years.

Table 4.1 Prevalence of Individual Intestinal Parasites Detected in Cattle Slaughtered at Ikpoba-Hill Abattoir, Edo State

Parasite	**Count**	**Prevalence (%)**
Cryptosporidium	12	6.67%
B. coli	1	0.56%
Strongyloides larvae	1	0.56%
Ascaris (ova)	1	0.56%

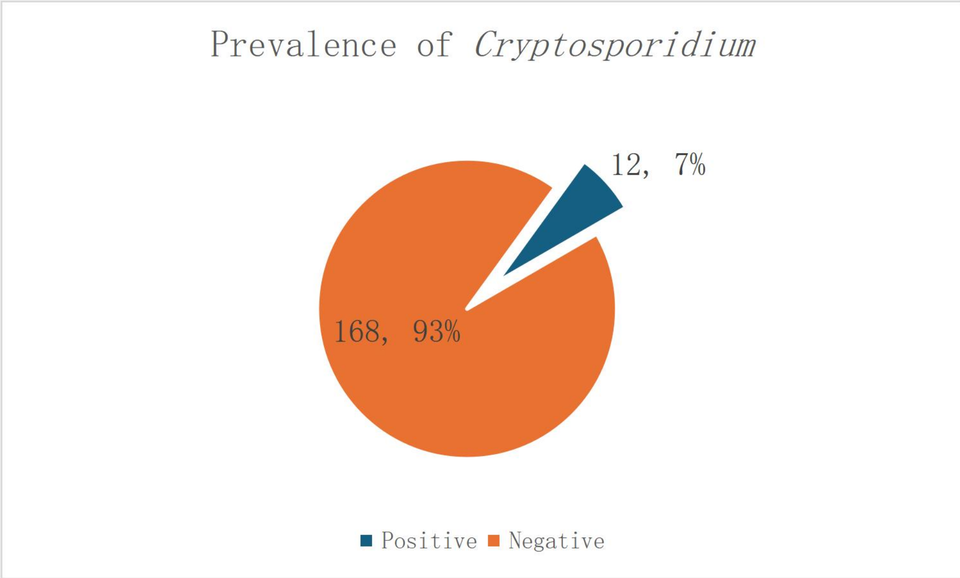

Figure 4.1 Prevalence of Cryptosporidium Infection Among Cattle Slaughtered at Ikpoba-Hill Abattoir, Edo State.

Table 4.2 Distribution and Association of Cryptosporidium Infection among Slaughtered Cattle at Ikpoba Hill Abattoir, Benin City

Variable	Category	Samples	Positive Cases (n)	Prevalence (%)	χ^2 / Fisher's Exact	p-value
Sex	Male	144	10	6.9	0	1
	Female	36	2	5.6		
Age (Years)	1 – 2	54	6	11.1	2.77	0.251
	2 – 4	90	5	5.6		
	> 4	36	1	2.8		
mean age ± SD	2.95±1.21					
Total		180	12	6.7		

Chi-square (χ^2) test of independence was used to assess association between Cryptosporidium infection and age groups, while Fisher's exact test was applied for sex due to the small number of positive cases. No statistically significant associations were observed ($p > 0.05$).

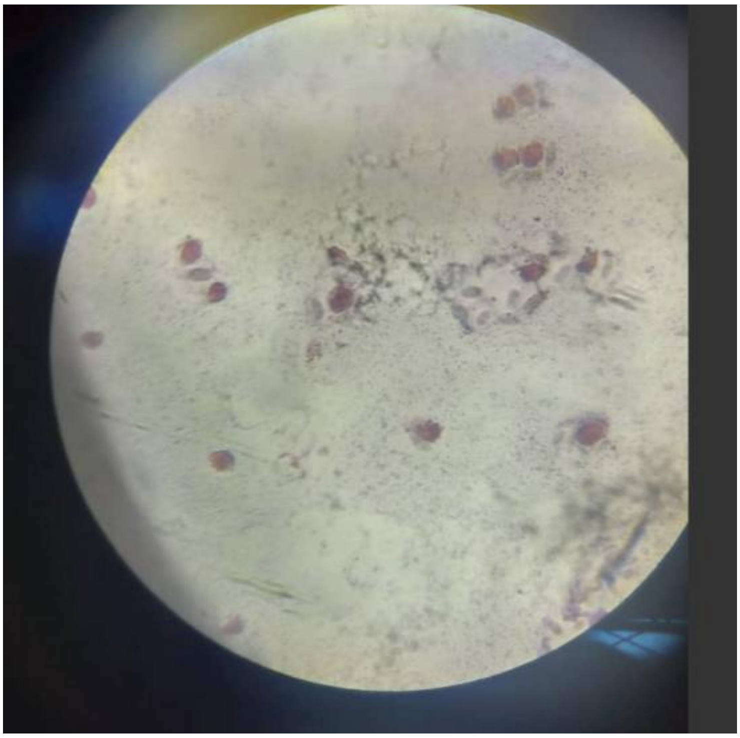

Plate 4.1 Ova of *Cryptosporidium* detected in *cattle* slaughtered at Ikpoba-Hill Abattoir, Edo *State*

CHAPTER FIVE

5.1 Discussion

The study investigated the prevalence of *Cryptosporidium* infection in slaughtered cattle at Ikpoba-Hill Abattoir, Edo State, Nigeria. Out of 180 fecal samples analyzed, 12 were positive for *Cryptosporidium*, yielding a prevalence of 6.67%. Other intestinal parasites were detected at very low frequencies, including *Balantidium coli* (0.56%), *Strongyloides* larvae (0.56%), and *Ascaris* ova (0.56%). This finding indicates that *Cryptosporidium* is present in cattle within the study area but at a relatively low prevalence compared to figures reported in other Nigerian and African studies. The prevalence observed in this study is lower than rates reported in previous. The prevalence observed in this study is lower than the rates of 16.0–52.3% previously reported in various Nigerian regions using molecular and ELISA-based diagnostic methods (Adeiza *et al.,* 2023; Dankwa *et al.,* 2021). Similar trends of lower prevalence have been documented in some West African studies, emphasizing the influence of geographic and management factors on infection dynamics (Dankwa *et al.,* 2021).

The dominance of Cryptosporidium among detected intestinal parasites is consistent with global observations that it is a leading protozoan parasite in cattle (Feng *et al.,* 2018; Esonu *et al.,* 2025). Its environmental persistence, owing to resistant oocysts, allows the parasite to maintain transmission cycles even at relatively low prevalence levels (Adamu *et al*., 2019). This is particularly relevant in abattoir settings where frequent cattle movement, inadequate waste disposal, and potential contamination of water and surfaces can facilitate infection spread.

Although statistical analysis indicated no significant association between Cryptosporidium infection and sex or age of cattle ($p > 0.05$), the highest prevalence was observed in younger cattle aged 1–2 years (11.1%), with a gradual decrease in older age groups. This pattern aligns with previous reports suggesting that younger cattle are more susceptible to infection, while adults may act as asymptomatic carriers shedding oocysts intermittently (Musa *et a*l., 2020). The detection of

Cryptosporidium in slaughtered cattle raises potential public health concerns for abattoir workers, butchers, and consumers due to the zoonotic nature of certain species. Transmission through contaminated water or food remains an important risk, particularly in abattoir environments (Adamu *et al.,* 2020).

Globally, *Cryptosporidium* parvum is recognized as a significant zoonotic species, whereas *C. bovis* and *C. ryanae* are primarily cattle-specific (Adeiza *et al.,* 2023). Although species differentiation was not conducted in this study, the detection of *Cryptosporidium* oocysts suggests potential zoonotic risks. Previous Nigerian studies have increasingly reported the presence of *C. parvum*, indicating changing epidemiological patterns (Adeiza *et al.,* 2023). These findings highlight the importance of continuous surveillance to monitor shifts in species distribution and zoonotic potential.

5.2 CONCLUSION

This study has demonstrated that *Cryptosporidium* infection is present among slaughtered cattle at Ikpoba-Hill Abattoir, Edo State, with a prevalence rate of 6.67%. Although this prevalence is comparatively lower than those reported in other Nigerian and African studies, it confirms the role of cattle as potential reservoirs of *Cryptosporidium* and underscores the public health implications for individuals exposed to abattoir environments.

The findings reinforce earlier reports that *Cryptosporidium* is a resilient and epidemiologically important parasite capable of persisting in diverse environmental conditions and contributing to zoonotic transmission.

5.3 RECOMMENDATIONS

1. Strengthen cleaning and disinfection protocols for slaughter facilities, equipment, and water supplies to reduce environmental contamination by *Cryptosporidium* oocysts.

2. Implement regular screening of slaughtered cattle to monitor infection trends and identify potential public health risks, as highlighted by similar Nigerian studies.

3: Educate abattoir workers, meat vendors, and local consumers about zoonotic risks, safe meat handling, and proper cooking practices to minimize exposure.

These recommendations, if implemented, would help improve food safety standards, reduce the risk of zoonotic transmission, and enhance the overall health of cattle and humans within Edo State and similar contexts.

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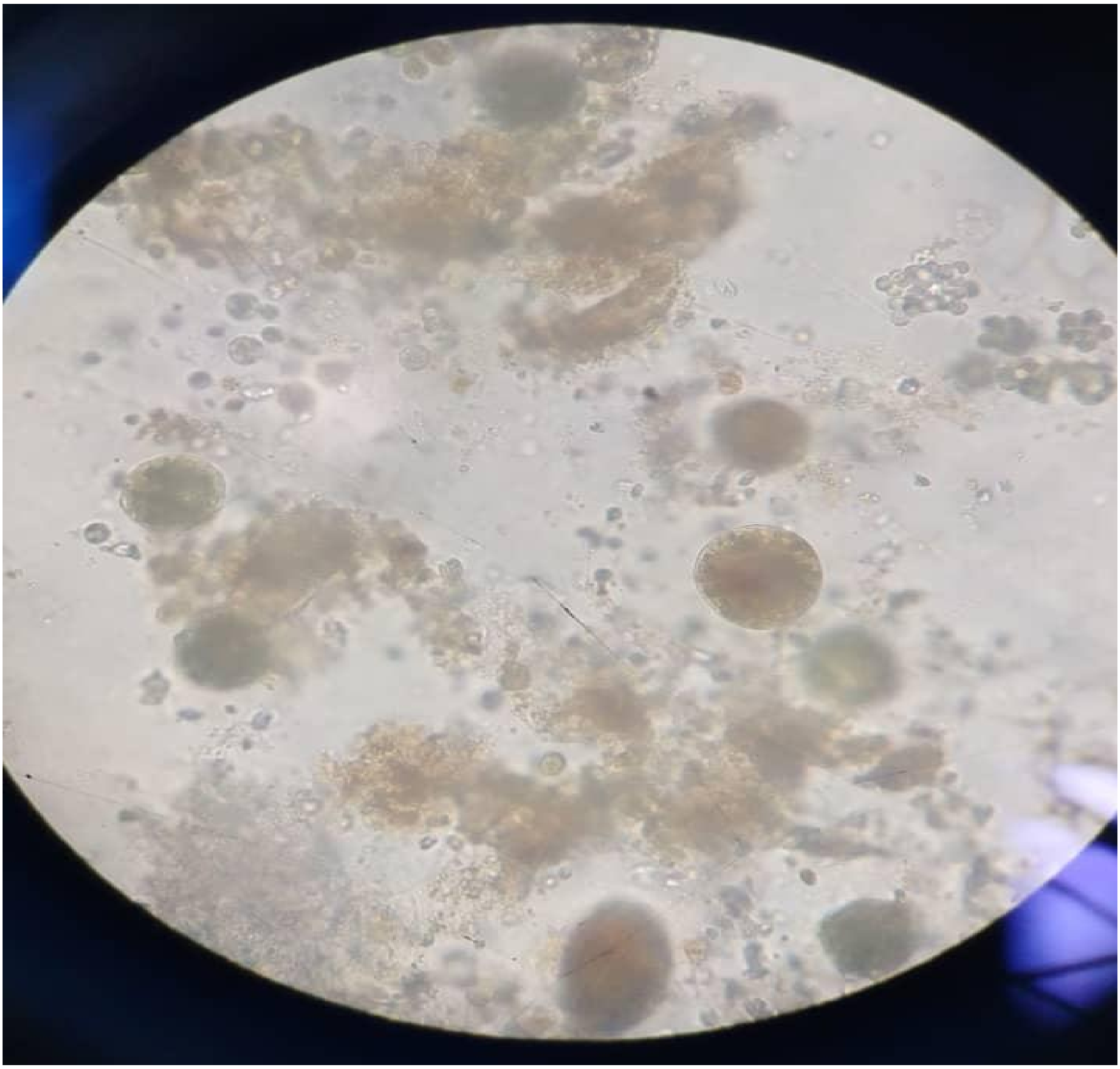
APPENDIX

Larva of *Strongyloides stercoralis*



Ova of *Ascaris lumbricoides*