PREVALENCE AND DIVERSITY OF INTESTINAL PARASITES IN CHICKENS AND TURKEYS SLAUGHTERED IN BENIN CITY, EDO STATE, NIGERIA

BY

EGURE MONDAY ENDURANCE

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DEPARTMENT OF MEDICAL LABORATORY SCIENCE

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THIS PROJECT WAS SUBMITTED TO THE DEPARTMENT OF MEDICAL LABORATORY SCIENCE, UNIVERSITY OF BENIN IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF MEDICAL LABORATORY SCIENCE DEGREE

SUPERVISED BY:

DR. (MRS) Z. OMORUYI

SEPTEMBER, 2025

CERTIFICATION

This is to certify that this project was satisfactorily written and presented by **Egure Monday Endurance**, under the supervision of **Dr. (Mrs) Zainab Omoruyi** and approved in partial fulfillment of the requirements for the award of Bachelor of Medical Laboratory Science (BMLS) degree.

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EXTERNAL EXAMINER **DATE**

DEDICATION

This project work is dedicated to God Almighty for the grace, mercy, wisdom, and knowledge bestowed upon me throughout my stay in the University of Benin. I also dedicate this work to my family who stood by me.

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My deepest appreciation and reverence go to God Almighty for His unconditional love, grace, and protection. Without Him, I could do nothing.

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ABSTRACT

Parasitic diseases are problems wherever poultry are raised whether in large commercial operations or in small backyard flocks, and economic losses caused by parasites on poultry can be significant. This study aimed to investigate the prevalence of intestinal parasites in poultry, focusing on chickens and turkeys slaughtered in Benin City, Southern Nigeria. A total of 150 fecal samples were analyzed, comprising samples from 35 broilers, 30 native fowls, 35 layers, and 50 turkeys. The fecal samples was processed using standard Parasitological techniques, and then viewed microscopically. Prevalence rates varied significantly among the different bird species, with the highest total prevalence observed in Native fowls (143.3%), followed by Broilers (60.0%), Layers (54.3%), and Turkeys (40.0%). Notably, *Ascaridia galli* was the most prevalent parasite overall (60.4%), with the highest prevalence in native fowls (63.3%). The study also found significant geographical variations in parasite prevalence. In broilers, *Ascaridia galli* prevalence was significantly different across the LGAs (p=0.045), with the highest rate in Ikpoba-Okha (33.3%). Similarly, in native fowls, *Strongyloides avium* showed a significant difference (p=0.003), with a high prevalence of 60.0% in Ikpoba-Okha. In turkeys, the prevalence of *Ascaridia galli* varied significantly across the LGAs (p=0.043). The findings highlight that poultry in the study area are widely infected with gastrointestinal parasites, emphasizing the need for targeted management strategies and regular treatment to mitigate infection risks.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF STUDY

Poultry farming, encompassing the rearing of chickens *(Gallus gallus domesticus*) and turkeys (*Meleagris gallopavo*), constitutes a vital component of Nigeria's agricultural sector, contributing significantly to food security and rural livelihoods (Food and Agriculture Organization of the United Nations, 2020). These birds serve as primary sources of animal protein in the form of meat and eggs, addressing the nutritional needs of a rapidly growing population, especially in urban centers (Okoli and Ejiofor, 2022). In Benin City, Edo State, poultry production ranges from small-scale backyard systems to larger commercial operations, reflecting diverse management practices and disease exposure risks (Abebe *et al.,* 2022). The increasing demand for poultry products necessitates robust and sustainable production systems, which are often hampered by various disease challenges, with parasitic infections being a major concern (Abubakar *et al.,* 2021).

Intestinal parasites, comprising a diverse group of helminths (worms) and protozoa, pose significant threats to the health, productivity, and economic viability of poultry enterprises globally (Saif, 2020). These parasites cause a range of clinical signs, from subtle weight loss and reduced feed conversion efficiency to severe morbidity and mortality in heavy infestations (Hauck and Hafez, 2020). Common helminths include economically significant nematodes such as *Ascaridia galli*, *Heterakis gallinarum* , and *Capillaria* species (Nakamura *et al.,* 2020). Protozoan parasites, notably *Eimeria* species (causing coccidiosis), are also widespread and contribute substantially to economic losses due to impaired nutrient absorption and damage to the intestinal lining (Hess *et al.,* 2021). The insidious nature of these infections often leads to chronic disease, which can be overlooked until significant production losses are incurred, highlighting the need for epidemiological surveillance (Shabana *et al.,* 2022).

In tropical and subtropical regions like Nigeria, the warm and humid climatic conditions provide an ideal environment for the survival and propagation of various parasitic stages, facilitating continuous transmission cycles (Okwor *et al.,* 2021). Coupled with prevalent extensive and semi-intensive poultry farming systems, where birds have direct contact with contaminated soil and feed, the risk of parasitic infections is inherently high (Abebe *et al.,* 2022). Even in more intensive systems, poor biosecurity measures and overcrowding can create conducive conditions for parasite proliferation (Saif, 2020). This environmental favorability, combined with varying levels of farm management and veterinary intervention, contributes to the high prevalence of intestinal parasites observed in Nigerian poultry populations (Okwor *et al.,* 2021).

The slaughter points in urban centers, such as Benin City, represent a crucial interface for evaluating the cumulative parasitic burden in poultry destined for human consumption (Abebe *et al.,* 2022). Birds presented for slaughter, irrespective of their farm origin or management system, offer a valuable snapshot of the prevailing parasitic epidemiology within a region (Al-Ankari, 2020). Post-mortem examination of the gastrointestinal tract allows for direct identification and quantification of adult helminths and macroscopic lesions caused by both helminths and protozoa (Merck Vet Manual, 2023). Such an evaluation provides direct evidence of infection, complementing data obtained from fecal examinations (Saif, 2020). It also offers insights into potential public health risks associated with consuming infected birds, particularly in cases of heavy infestation (Amer *et al.,* 2020).

Despite the recognized impact of intestinal parasites on poultry production in Nigeria, localized epidemiological data, particularly for specific urban centers like Benin City, remain fragmented or outdated (Hauck and Hafez, 2020). While general studies on poultry parasites exist across different parts of the country, detailed investigations focusing on the spectrum and prevalence of these parasites in both chickens and turkeys specifically at slaughter points in Benin City are limited (Koinari *et al.,* 2021). This paucity of current and localized information hinders the development of effective region-specific control strategies (Saleh *et al.,* 2021). It also underscores the urgent need for updated baseline data, justifying a comprehensive evaluation of these economically important parasites in poultry (George *et al.,* 2021).

1.2. JUSTIFICATION OF STUDY

Intestinal parasites in chickens and turkeys pose significant challenges to poultry production and public health. Many of these parasites, such as *Ascaridia galli* and *Eimeria* species, impair growth, feed efficiency, and egg production, resulting in economic losses for farmers and the poultry industry. Some parasites also have zoonotic potential, increasing the risk of transmission to humans through improper handling or consumption of undercooked meat. Findings from this research will support evidence-based interventions, inform public health policies, and enhance food safety measures in poultry production and processing.

1.3. AIM OF STUDY

The aim of this study is to evaluate the prevalence and diversity of intestinal parasites in chickens and turkeys slaughtered in Benin City, Edo State, Nigeria.

1.4. SPECIFIC OBJECTIVES

The specific objectives are to;

1. identify and classify the types of intestinal parasites present in chickens and turkeys slaughtered in Benin City, Nigeria.

2. determine the prevalence of these parasites in the sampled birds.

3. determine the risks factors associated with the intestinal parasites.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Overview of Chicken and Turkey Production in Benin City, Edo State

Poultry production in Benin City, the capital of Edo State in southern Nigeria, is a vital component of the local agricultural sector. Chickens and turkeys are widely reared for meat and eggs, contributing significantly to food security, nutrition, and income across rural and urban households (Okoli and Ejiofor, 2022). The practice of poultry farming in the region ranges from traditional backyard systems to intensive commercial operations, depending on resources and production goals (Abebe *et al.,* 2022).

In rural and low-income peri-urban areas, many farmers rely on free-range indigenous chickens, which, while resilient to environmental stress, are susceptible to intestinal parasites due to minimal veterinary oversight (Abubakar *et al.,* 2021). Smallholder turkey producers face similar issues under semi-intensive setups, where hygiene and health management often fall short (Midala, 2025). Commercial poultry farms in Benin City focus on exotic breeds, including broilers like Cobb 500 and Ross 308, layers such as Isa Brown and Lohmann Brown, and Broad Breasted White turkeys. Despite controlled biosecurity, these operations are still prone to parasitic infection by nematodes like *Ascaridia galli*, *Heterakis gallinarum*, and *Capillaria* spp., particularly when deworming and litter management are inadequate (Hauck and Hafez, 2020).

Infection with *Ascaridia galli* often leads to poor weight gain, emaciation, and reduced egg production, posing a major economic burden for poultry farmers (Nakamura *et al.,* 2020). Additionally, the nematode *Heterakis gallinarum* serves as a vector for *Histomonas meleagridis*, which causes blackhead disease—a highly fatal condition in turkeys and a production threat in chickens (Merck Vet Manual, 2023). Studies in Nigeria show helminth infections are endemic, with prevalence rates between 57–66%, linked to environmental factors and suboptimal farm hygiene practices (Okwor *et al.,* 2021). Protozoan parasites like *Eimeria* spp., causing coccidiosis, also significantly reduce productivity, affecting up to 77% of birds in some regions (Saleh *et al.,* 2021), while *Histomonas meleagridis* can cause mortality rates up to 100% in unprotected turkey flocks (Beer *et al.,* 2022).

Given that many poultry producers in Benin City operate on small to medium scales with limited access to diagnostics and veterinary support, the financial and health impacts of parasitic diseases are magnified (Midala, 2025). This situation underscores the importance of surveillance, strategic deworming, enhanced biosecurity, and farmer education—strategies that align with national recommendations by institutions like the National Veterinary Research Institute (NVRI) (NVRI, 2025).

2.2. Classification and Types of Intestinal

Parasites in Chickens and Turkeys

Intestinal parasites affecting chickens and turkeys are broadly classified into two major phyla: Helminths (worms) and Protozoa (single-celled organisms) (Saif, 2020). These diverse groups of parasites inhabit various segments of the gastrointestinal tract, causing a wide spectrum of pathological conditions depending on the species of parasite, the host's age, and the intensity of infection (Al-Ankari, 2020). Understanding their classification and specific types is fundamental for effective diagnosis, treatment, and control strategies in poultry production (Hauck and Hafez, 2020).

I. Helminths

Helminths are multicellular worms that can reside in the intestinal lumen or embed within the intestinal wall (Saif, 2020). In poultry, the most significant helminth classes are Nematodes and

Cestodes (Hauck and Hafez, 2020). These helminths are widespread, with various studies confirming their high prevalence in Nigerian poultry populations (Abubakar *et al.,* 2021).

A. Nematodes (Roundworms):

These are cylindrical, unsegmented worms among the most common and economically important helminths in poultry worldwide (Merck Vet Manual, 2023). They inhabit various parts of the intestine.

Ascaridia galli: Often referred to as the large intestinal roundworm, *Ascaridia galli* is highly prevalent in chickens and turkeys, residing primarily in the small intestine. Heavy infections can lead to stunted growth, reduced feed efficiency, enteritis, and even intestinal obstruction (Hauck and Hafez, 2020). It is considered one of the most detrimental nematodes in poultry (Nakamura *et al.,* 2020).

Heterakis gallinarum: Known as the caecal worm, this nematode primarily inhabits the caeca of chickens and turkeys. While often considered less pathogenic than *Ascaridia galli*, its significance lies in its role as a vector for *Histomonas meleagridis*, the protozoan parasite causing blackhead disease, especially in turkeys (Beer *et al.,* 2022).

Capillaria species (Hairworms): Several species, such as *Capillaria obsignata*, *Capillaria* anatis, and *Capillaria caudinflata*, are thin, thread-like worms that can inhabit various parts of the digestive tract, including the small intestine and caeca. They cause severe enteritis, weight loss, and reduced egg production, particularly in young birds (Abubakar *et al.,* 2021).

Strongyloides avium: This nematode is found in the small intestine and can cause enteritis and diarrhea, especially in young or immunocompromised birds (Saif, 2020).

Trichostrongylus tenius: More commonly associated with waterfowl and game birds, this nematode can also affect chickens and turkeys, inhabiting the caeca and small intestine and causing severe enteritis and emaciation in heavy infestations (Hauck and Hafez, 2020).

Subulura brumpti: A common caecal nematode in poultry, often found without severe clinical signs unless infections are heavy (Hauck and Hafez, 2020).

B. Cestodes (Tapeworms):

These are flattened, segmented worms that attach to the intestinal lining (Hauck and Hafez, 2020). Their life cycles typically require an intermediate host, such as beetles, slugs, or flies.

Raillietina species: This genus includes several common poultry tapeworms like *Raillietina tetragona* and *Raillietina cesticillus*. They are often found in the small intestine and can cause reduced growth, weight loss, and sometimes enteritis in heavy infestations (Merck Vet Manual, 2023).

Davainea proglottina: One of the smallest but highly pathogenic tapeworms, it can cause severe damage to the intestinal mucosa leading to hemorrhagic enteritis and significant mortality (Saif, 2020).

Choanotaenia infundibulum: This common tapeworm typically resides in the small intestine and can lead to emaciation and reduced egg production, especially in younger birds (Hauck and Hafez, 2020).

Hymenolepis species: Less common but can occur, often requiring arthropod intermediate hosts (Merck Vet Manual, 2023).

II. Protozoa

Protozoa are single-celled eukaryotic organisms. In poultry, several intestinal protozoa are significant pathogens, capable of causing a range of clinical signs from mild illness to severe disease and mortality.

Eimeria species (Coccidia): These are obligate intracellular parasites that cause coccidiosis, one of the most economically devastating diseases in poultry globally (Hess *et al.,* 2021). Different *Eimeria* species are host-specific and target distinct regions of the intestinal tract, leading to varying clinical signs and lesions, from mild performance depression to severe hemorrhage and death (Koinari *et al.,* 2021). In turkeys, species like *Eimeria* adenoeides, *Eimeria* meleagrimitis, and *Eimeria* gallopavonis are primary pathogens (Koinari *et al.,* 2021).

Histomonas meleagridis: This flagellated protozoan is the causative agent of histomoniasis, or "blackhead disease," primarily affecting turkeys but also chickens. It causes severe necrotic lesions in the caeca and liver (Beer *et al.,* 2022). Its transmission is often linked to the caecal worm, *Heterakis gallinarum*, as the protozoan eggs are carried within the worm's eggs, making direct ingestion of infected worm eggs a common route of infection (Beer *et al.,* 2022).

Cryptosporidium species: These are obligate intracellular protozoans that can infect the intestinal tract of poultry, particularly young birds. *Cryptosporidium baileyi* and *Cryptosporidium meleagridis* are common species in chickens and turkeys, respectively, causing enteritis, diarrhea, and poor growth (Amer *et al.,* 2020). Infections are often subclinical but can exacerbate other diseases.

Giardlia species: While often considered less pathogenic in poultry than in mammals, *Giardia* species (e.g., *Giardia duodenalis*) can be found in the small intestine of chickens and turkeys

(Moghadam *et al.,* 2020). Their presence may lead to mild enteritis or malabsorption, though severe clinical signs are uncommon (Moghadam *et al.,* 2020).

The presence and severity of these various parasite types are influenced by factors such as farm hygiene, environmental conditions, host immunity, and the type of production system (Hauck and Hafez, 2020). Their accurate identification through diagnostic methods like microscopic examination of intestinal scrapings or contents is crucial for implementing targeted control measures (Merck Vet Manual, 2023).

Table 2.1: Gastrointestinal helminthes and preferred sites of infection in domestic fowl.

Parasite species	Preferred site(s) of infection
Cestodes	
Choanotaenia infundibulum	Small intestine
Raillietina tetragona	Small intestine, Large intestine
Raillietina cesticillus	Small intestine
Raillietina echinobothrida	Small intestine, Large intestine
Davainea proglottina	Small intestine
Nematodes	
Ascaridia galli	Small intestine, Large intestine
Heterakis gallinarum	Caecum
Capillaria caudinflata	Small intestine
Strongyloides avium	Small intestine
Trichostrongylus tenuis	Small intestine
Subulura brumpti	Small intestine

(Saif, 2020).

2.3. Morphological Characteristics

A. Nematodes (Roundworms):

Nematodes are characterized by their unsegmented, cylindrical, and elongated bodies (Poonia *et al.,* 2022). They typically taper at both ends, appearing round in cross-section (Georgi *et al.,* 2021). Their outer covering is a tough, protective cuticle which may have striations or other surface markings (Taylor *et al.,* 2020). The mouthparts, located at the anterior end, can vary, featuring simple openings, lips, or buccal capsules with teeth or cutting plates, depending on the species' feeding habits (Saif, 2020). For instance, *Ascaridia galli* is a large, stout worm, while *Capillaria* species are slender and hair-like (Gomes *et al.,* 2021).

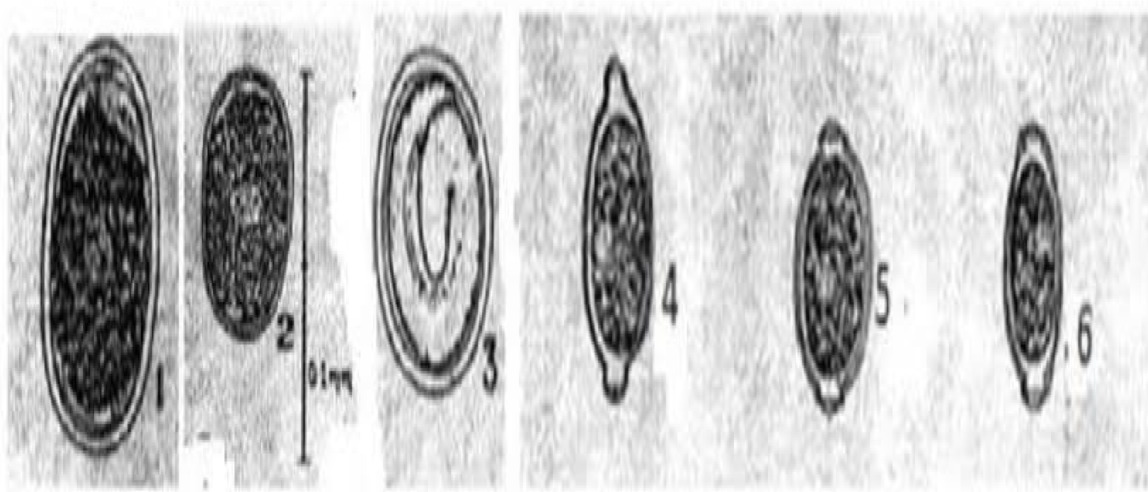


Figure 2.1: Eggs of some nematode parasites of fowls. 1. *Ascaridia galli*, 2. *Heterakis gallinarum* , 3. *Subulura brumpti*, and 4, 5, and 6. *Capillaria* species. (Kassa, 2005).

B. Cestodes (Tapeworms):

Cestodes are distinct from nematodes due to their flattened, ribbon-like, and segmented bodies (Taylor *et al.,* 2020). Their morphology typically comprises three main parts: an anterior attachment organ called the scolex, a short neck region, and a series of proglottids, which are segments that make up the strobila (body) (Poonia *et al.,* 2022). The scolex is equipped with specialized structures for attachment to the host's intestinal lining, such as suckers, hooks, or a rostellum (Georgi *et al.,* 2021). Each proglottid contains both male and female reproductive organs, becoming more mature as they move away from the neck (Saif, 2020).

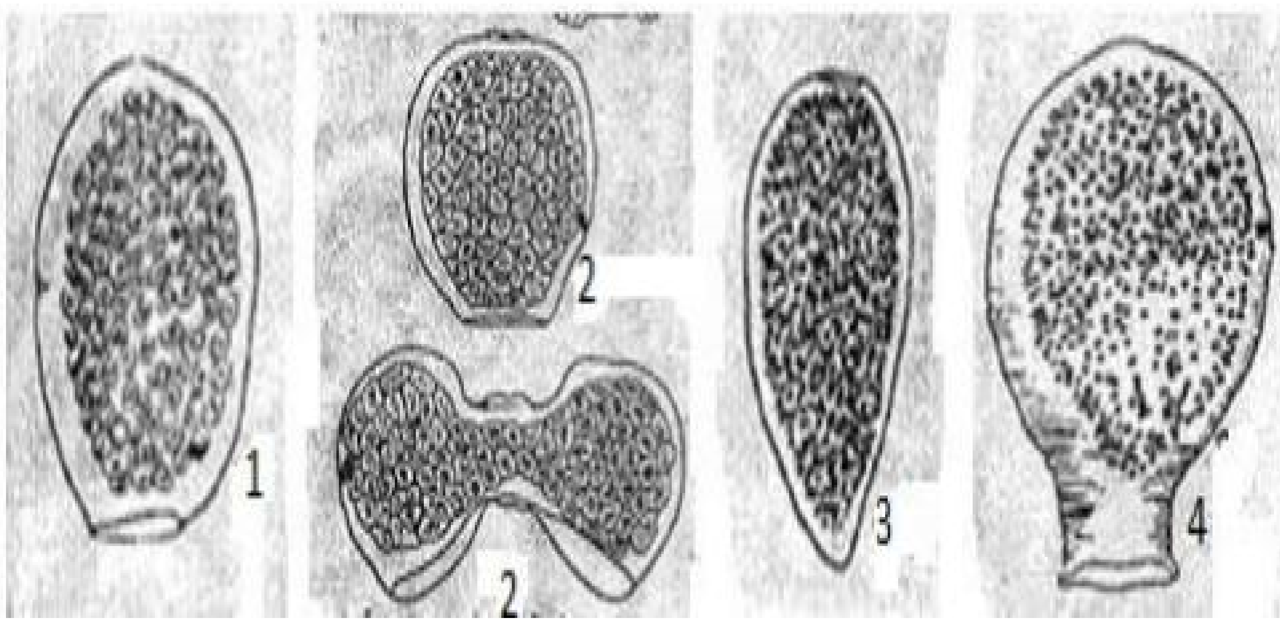


Figure 2.2: Eggs of some cestode parasites of fowls. 1. *Raillietinna cestiocillus* 2. *Raillietina echinobothrida* 3. *Davainea* proglotina 4. *Chaonotaenia infundibulum*. (Kassa, 2005).

Eimeria species (Coccidia):

Eimeria species are characterized by their oocysts, which are the resistant, environmentally stable stage passed in feces (Hess *et al.,* 2021). These oocysts are typically oval or spherical and possess a thick wall (Koinari *et al.,* 2021). When sporulated, the oocyst contains sporocysts, and each sporocyst contains infective sporozoites (Hess *et al.,* 2021). Within the host's intestinal cells, other morphological stages, such as merozoites (banana-shaped) and gametocytes (macrogametocytes and microgametocytes), develop, though these are typically observed within host tissues during diagnosis (Koinari *et al.,* 2021).

Histomonas meleagridis:

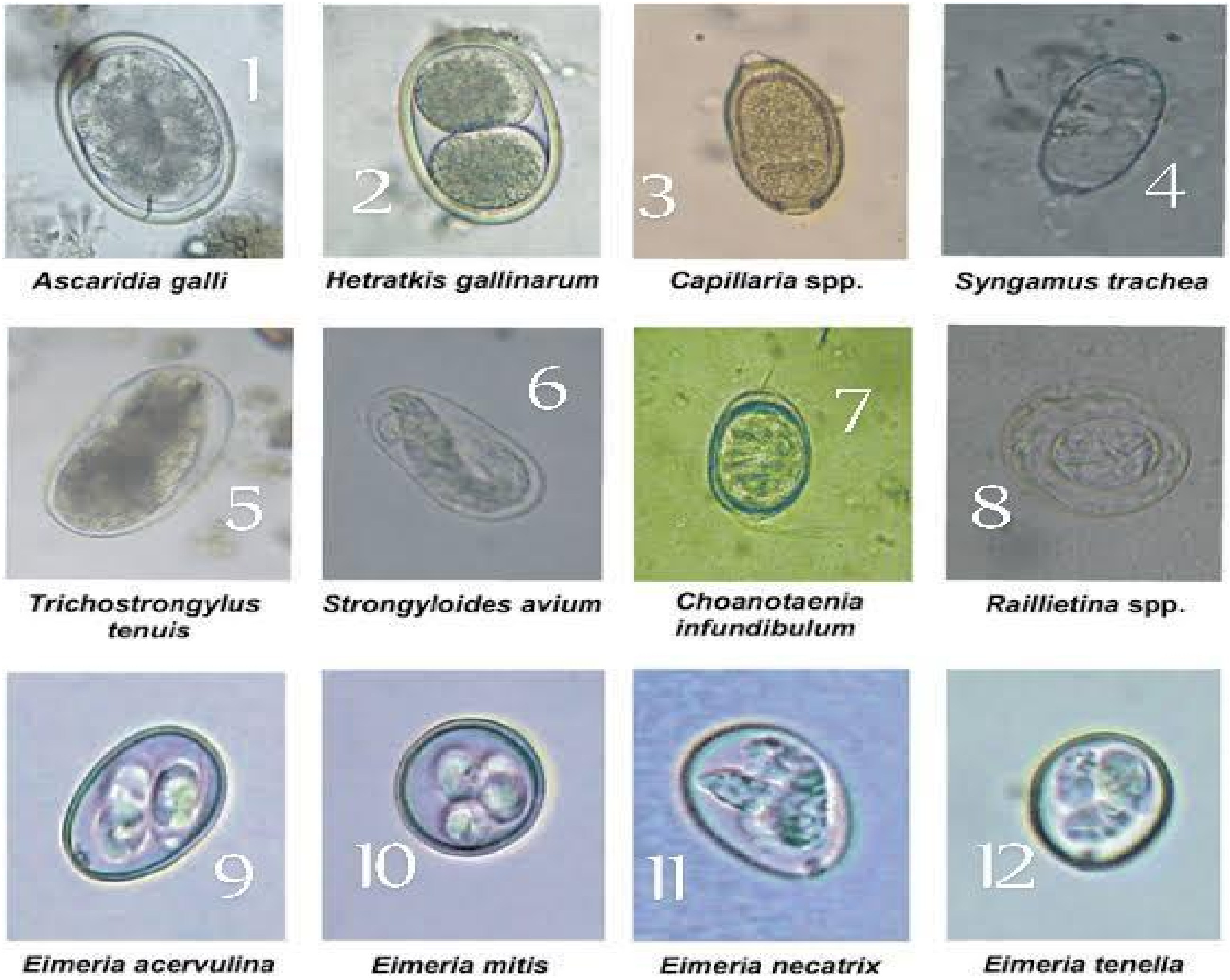
Histomonas meleagridis is a polymorphic protozoan, existing primarily as flagellated and amoeboid forms within the host (Beer *et al.,* 2022). The flagellated form, often observed in the lumen of the caeca or in fresh cultures, is pear-shaped and possesses one to four anterior flagella (Merck Vet Manual, 2023). The amoeboid form, more commonly found within host tissues (caeca, liver), is irregular in shape and lacks flagella, moving by pseudopodia (Beer *et al.,* 2022).

Cryptosporidium species:

Cryptosporidium species are characterized by their very small, spherical oocysts, typically 4-6 micrometers in diameter (Amer *et al.,* 2020). A distinctive morphological feature is that their oocysts are immediately infective upon excretion and already contain four crescent-shaped sporozoites (Merck Vet Manual, 2023). This contrasts with *Eimeria* oocysts, which require an external maturation period. Within the host, these parasites develop as intracellular but extracytoplasmic forms, located within a parasitophorous vacuole just beneath the brush border membrane of intestinal epithelial cells (Saif, 2020).

Giardia species:

Giardia species exist in two main morphological forms: the trophozoite and the cyst (Saif, 2020). The trophozoite is the motile, feeding stage, characterized by its pear-like shape, two nuclei, and eight flagella (Moghadam *et al.,* 2020). It possesses a prominent ventral sucking disc on its flattened ventral surface, used for attachment to the intestinal mucosa (Taylor *et al.,* 2020). The cyst is the resistant, infective stage, which is typically oval or elliptical with a thick wall, containing internal structures, including two or four nuclei, depending on its maturity (Moghadam *et al.,* 2020)



(Kumar *et al.,* 2015).

Figure 2.3: Microscopic images of some helminth and protozoan parasites of poultry, with the exclusion of 4 and 5.

2.4 Life Cycle

The life cycles of intestinal parasites infecting chickens and turkeys vary significantly between helminths and protozoa, influencing their modes of transmission, environmental persistence, and control strategies (Saif, 2020). Understanding these cycles is fundamental for effective parasite management in poultry production (Taylor *et al.,* 2020).

A. Nematodes (Roundworms):

Many economically important nematodes of poultry have direct life cycles (Saif, 2020).

Ascaridia galli: The large intestinal roundworm has a direct life cycle (Poonia *et al.,* 2022). Unembryonated eggs are passed in the feces of infected birds (Saif, 2020). These eggs embryonate in the environment under suitable conditions of temperature and moisture, becoming infective after 10-14 days (Poonia *et al.,* 2022). Chickens and turkeys become infected by ingesting these infective embryonated eggs from contaminated feed, water, or litter (Saif, 2020). The larvae hatch in the small intestine, undergo a brief migration within the intestinal wall, and mature into adult worms in the lumen (Taylor *et al.,* 2020).

Heterakis gallinarum: This caecal worm also has a direct life cycle (Merck Vet Manual, 2023). Similar to *Ascaridia galli*, unembryonated eggs are shed in feces and embryonate in the environment to become infective (Saif, 2020). Birds become infected by ingesting these embryonated eggs (Merck Vet Manual, 2023). Earthworms can act as paratenic hosts, ingesting the eggs and concentrating them, with chickens becoming infected upon eating infected earthworms (Saif, 2020). The larvae develop in the caeca (Merck Vet Manual, 2023).

Capillaria species: The life cycles of *Capillaria* vary by species (Taylor *et al.,* 2020). Some, like *Capillaria obsignata*, have a direct life cycle where embryonated eggs are ingested (Saif, 2020). Others, such as *Capillaria caudinflata* and *Capillaria* anatis, utilize earthworms as obligate intermediate hosts (Georgi *et al.,* 2021). Eggs passed in feces are ingested by earthworms, larvae develop within the earthworm, and birds become infected by consuming these infected earthworms (Taylor *et al.,* 2020).

Strongyloides avium: This nematode had a direct life cycle (Poonia *et al.,* 2022). Infective larvae develop from eggs shed in feces. Infection occurs either by ingestion of larvae or by skin penetration (Saif, 2020).

Subulura brumpti: This caecal nematode has an indirect life cycle involving intermediate hosts such as various beetle species (Taylor *et al.,* 2020). Eggs are passed in bird feces, ingested by beetles, and birds become infected by eating infected beetles (Poonia *et al.,* 2022).

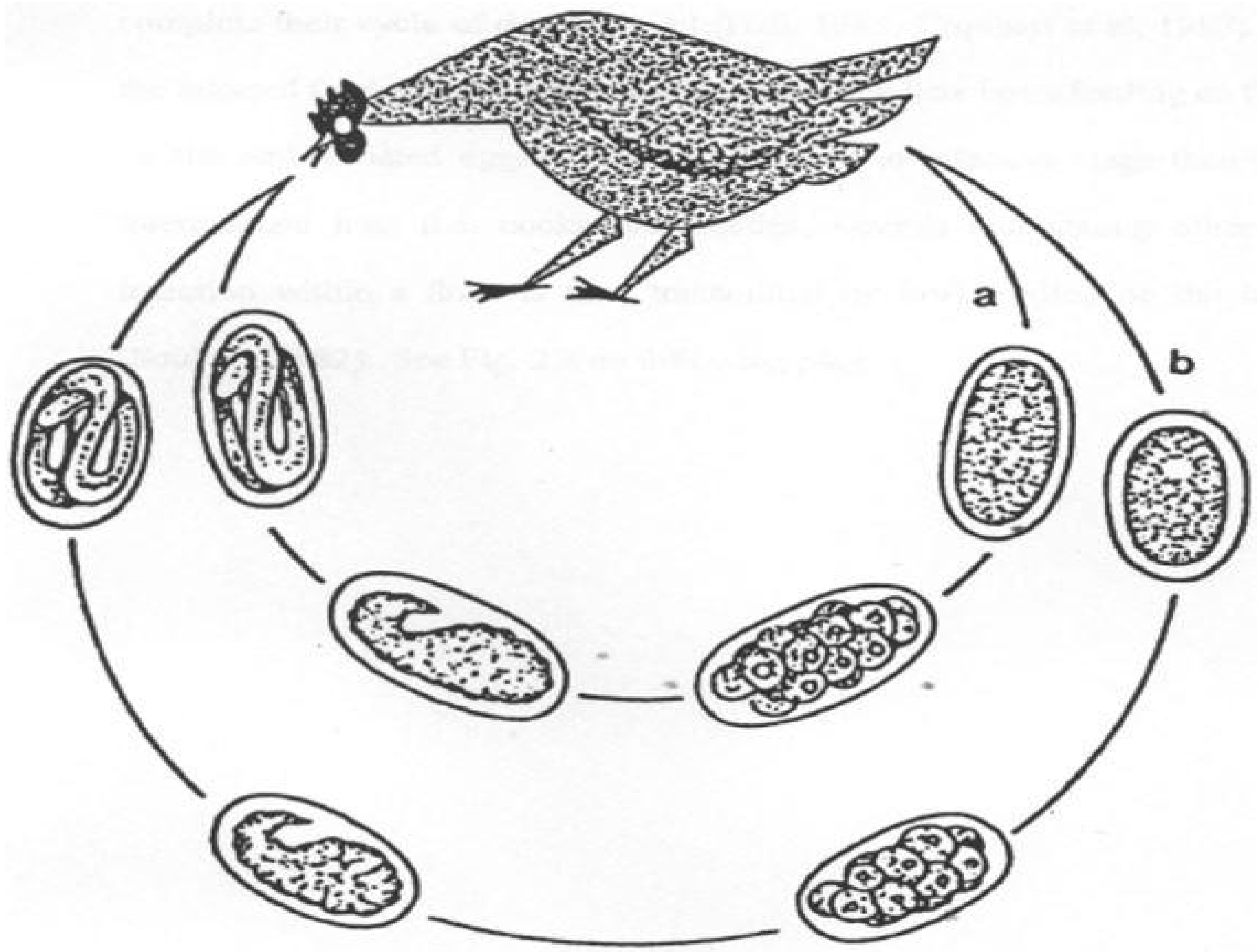


Figure 2.4: Direct life cycle of nematodes. The life cycle of A. *galli* (a) and H.*gallinarum* (b). Eggs are passed with the faeces and embryonation of the eggs takes place in the environment. Susceptible host then ingests infective eggs (with L3 larvae). Occasionally earth worms can act as transport hosts (Permin and Hansen, 1998).

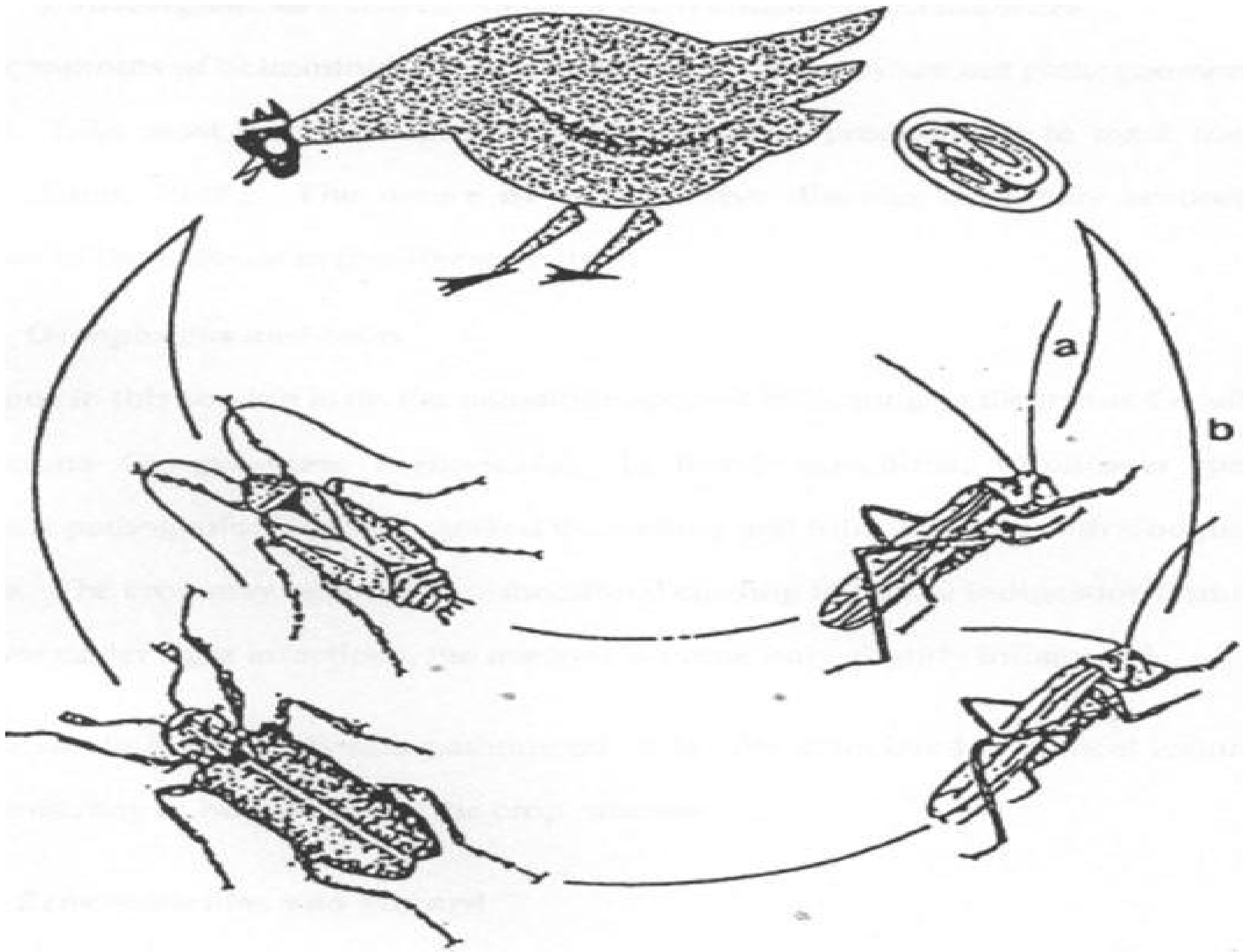


Figure 2.5: Indirect life cycle of nematodes. The life cycle of *Tetrameres Americana* (a) and *Subulura brumpti* (b), with embryonated eggs passed in the faeces. The eggs are ingested by the intermediate host such as cockroach, beetles, weevils among others and within which the larvae undergoes development to the infective stage (L3). When the final host ingests the intermediate hosts, the adult worms develop in the proventriculus of the host (Ziela, 1999).

B. Cestodes (Tapeworms)

All cestodes of poultry have indirect life cycles, requiring one or more intermediate hosts (Taylor *et al.,* 2020).

General Life Cycle: Gravid proglottids (segments containing eggs) are shed in the feces of infected birds (Saif, 2020). These proglottids or liberated eggs are then ingested by a specific intermediate host, typically an arthropod like an insect or slug (Hauck and Hafez, 2020). Within the intermediate host, the oncosphere (larva) hatches and develops into an infective metacestode stage, commonly a cysticercoid (Taylor *et al.,* 2020). Chickens and turkeys become infected by ingesting the infected intermediate host (Poonia *et al.,* 2022). The adult tapeworm then develops and attaches to the intestinal wall (Saif, 2020). Specific intermediate hosts include various beetle species and ants for *Raillietina tetragona* and *Raillietina cesticillus*, and slugs for *Davainea proglottina* (Georgi *et al.,* 2021).

Eimeria species (Coccidia)

Eimeria species have a direct and highly self-limiting life cycle (Hess *et al.,* 2021). Unsporulated oocysts are shed in the feces of infected birds (Saleh *et al.,* 2021). These oocysts are not immediately infective; they must sporulate in the environment, a process requiring warmth, moisture, and oxygen, to become infective sporulated oocysts (Hess *et al.,* 2021). Birds become infected by ingesting sporulated oocysts (Koinari *et al.,* 2021). Once ingested, sporozoites excyst in the digestive tract and invade intestinal epithelial cells (Saleh *et al.,* 2021). Here, they undergo multiple asexual cycles (schizogony), producing merozoites that infect new cells. This is followed by a sexual cycle (gametogony), leading to the formation of oocysts, which are then shed in feces (Hess *et al.,* 2021).

Histomonas meleagridis

The life cycle of *Histomonas meleagridis* is complex and relies heavily on its association with the caecal worm, *Heterakis gallinarum* (Beer *et al.,* 2022). The most common route of infection is the ingestion of embryonated *Heterakis gallinarum* eggs that contain *Histomonas meleagridis* (Merck Vet Manual, 2023). Once ingested, the *Histomonas* parasites are released from the *Heterakis* eggs in the bird's caeca (Beer *et al.,* 2022). *Histomonas* can also be transmitted directly via the ingestion of fresh amoebic forms shed in feces through cloacal drinking, but these forms are fragile and short-lived in the environment (Al-Ankari, 2020). The parasite then invades the caecal tissue and can disseminate to the liver (Beer *et al.,* 2022).

Cryptosporidium species

Cryptosporidium species have a direct life cycle (Saif, 2020). Oocysts are passed in the feces of infected birds and are immediately infective upon excretion (Amer *et al.,* 2020). Infection occurs via the fecal-oral route through ingestion of these oocysts from contaminated feed, water, or environment (Merck Vet Manual, 2023). Once ingested, sporozoites excyst and attach to the brush border of intestinal epithelial cells, where they undergo both asexual and sexual reproduction (Saif, 2020). A unique feature is the production of thin-walled oocysts that can excyst within the same host, leading to auto-infection (Merck Vet Manual, 2023).

Giardia species

Giardia species have a relatively simple, direct life cycle involving two stages: the trophozoite and the cyst (Moghadam *et al.,* 2020). Trophozoites reside and multiply in the small intestine (Saif, 2020). As they move down the gastrointestinal tract, trophozoites encyst, and resistant cysts are passed in the feces (Moghadam *et al.,* 2020). Infection occurs when birds ingest these infective cysts from contaminated feed or water (Taylor *et al.,* 2020). Upon ingestion, excystation occurs in the small intestine, releasing new trophozoites that colonize the gut (Moghadam *et al.,* 2020).

2.5 Pathogenicity and Clinical Effects in Infected Birds (Chickens and Turkeys)

Intestinal parasites cause various detrimental effects on chickens and turkeys, leading to a range of pathological changes and observable clinical signs that impact poultry health and productivity (Saif, 2020). The severity of disease is often dependent on factors such as the parasite species, the intensity of infection, host age, and immune status (Hess *et al.,* 2021).

A. Nematodes (Roundworms):

Ascaridia galli: Infections with *Ascaridia galli* can cause catarrhal enteritis, characterized by inflammation of the intestinal lining (Taylor *et al.,* 2020). Clinically, infected birds may exhibit reduced growth rate, poor feed conversion efficiency, and general unthriftiness (Poonia *et al.,* 2022). In severe cases, large numbers of worms can lead to intestinal obstruction and even mortality, especially in young birds (Saif, 2020).

Heterakis gallinarum: While infections with *Heterakis gallinarum* are often asymptomatic, heavy infestations can cause mild inflammation and thickening of the caecal walls (Merck Vet Manual, 2023). The primary significance of this worm lies in its role as a biological vector for *Histomonas meleagridis*, the protozoan that causes blackhead disease (Beer *et al.,* 2022).

Capillaria species: *Capillaria* infections are notably pathogenic, particularly in young birds (Georgi *et al.,* 2021). They cause severe catarrhal or hemorrhagic enteritis, leading to a thickened and inflamed intestinal wall (Poonia *et al.,* 2022). Clinical signs include emaciation, weakness, dehydration, and a characteristic ruffled feather appearance (Saif, 2020). High mortality rates can occur in severe outbreaks (Hauck and Hafez, 2020).

Strongyloides avium: This nematode causes enteritis and diarrhea in infected birds (Taylor *et al.,* 2020). Clinical signs include emaciation and weakness, particularly in young or stressed birds (Saif, 2020).

Subulura brumpti: Infections with *Subulura brumpti* in the caeca are generally considered to be of low clinical significance (Georgi *et al.,* 2021). Clinical signs are typically absent unless the parasitic burden is extremely high (Hauck and Hafez, 2020).

B. Cestodes (Tapeworms):

All cestode infections in poultry are associated with varying degrees of economic loss due to reduced weight gain, decreased feed efficiency, and general unthriftiness, stemming from nutrient competition and irritation to the intestinal mucosa (Saif, 2020).

Davainea proglottina: This is recognized as one of the more pathogenic poultry tapeworms (Taylor *et al.,* 2020). It causes severe hemorrhagic enteritis, characterized by inflammation and bleeding within the intestinal lining, often leading to nodule formation (Georgi *et al.,* 2021).

Clinically, birds may experience emaciation, weakness, and elevated mortality (Hauck and Hafez, 2020).

Raillietina species: Infections with *Raillietina* species, such as *Raillietina tetragona* and *Raillietina cesticillus*, can lead to unthriftiness and emaciation (Poonia *et al.,* 2022). While typically not highly acute, heavy infestations can result in enteritis and contribute to reduced productivity (Saif, 2020).

Choanotaenia infundibulum: Similar to *Raillietina*, *Choanotaenia infundibulum* can cause emaciation and a decline in egg production, particularly in younger birds, though severe overt clinical signs are less common (Taylor *et al.,* 2020).

Eimeria species (Coccidia)

Coccidiosis, caused by *Eimeria* species, involves extensive destruction of intestinal epithelial cells, severely impairing digestion and nutrient absorption (Hess *et al.,* 2021). Pathological lesions are specific to the *Eimeria* species involved and their predilection sites; for instance, *Eimeria tenella* induces severe hemorrhage and necrosis in the caeca, leading to characteristic bloody droppings (Koinari *et al.,* 2021). Common clinical signs include watery or bloody diarrhea, dehydration, anorexia, weight loss, stunted growth, and ruffled feathers (Saleh *et al.,* 2021). Mortality rates can be substantial in severe, acute outbreaks (Hess *et al.,* 2021).

Histomonas meleagridis

Histomoniasis, also known as blackhead disease, is highly pathogenic, particularly devastating in turkeys (Al-Ankari, 2020). The parasite causes severe necrotic lesions primarily in the caeca and subsequently in the liver (Beer *et al.,* 2022). Caecal lesions typically present as thickened, inflamed, and ulcerated walls with caseous cores (Saif, 2020). Liver lesions appear as characteristic circular necrotic areas that range in color from yellow-green to gray (Beer *et al.,* 2022). Clinically, affected turkeys often show signs of depression, droopiness, ruffled feathers, and characteristic sulfur-yellow colored droppings (Merck Vet Manual, 2023). Mortality rates in turkeys can be exceptionally high (Beer *et al.,* 2022). Chickens, though generally more resistant, can develop mild caecal lesions and serve as asymptomatic carriers, posing a risk for turkeys (Saif, 2020).

Cryptosporidium species

Cryptosporidium infections primarily induce enteritis, characterized by villous atrophy and inflammation of the intestinal lining (Amer *et al.,* 2020). Clinical signs often include watery diarrhea, dehydration, and poor growth (Saif, 2020). While many infections can be subclinical, *Cryptosporidium* can exacerbate other enteric diseases and contribute to general unthriftiness, especially in young or immunocompromised birds (Taylor *et al.,* 2020).

Giardia species

Giardia species infections in poultry are frequently asymptomatic (Georgi *et al.,* 2021). When clinical signs manifest, they are generally mild and non-specific, including intermittent diarrhea, reduced weight gain, and diminished feed conversion (Hauck and Hafez, 2020). Pathological changes in the intestine are often minimal, but in some instances, villous blunting and inflammation can be observed, which may lead to impaired nutrient absorption (Taylor *et al.,* 2020).

The cumulative impact of parasitic diseases can result in significant economic losses within poultry production, attributed to factors such as reduced feed efficiency, decreased egg output, carcass condemnations at processing, and direct mortality (Poonia *et al.,* 2022).

2.6 Epidemiology

Epidemiology is the systematic study of the occurrence, distribution, and determinants of health and disease conditions in specified populations (Saif, 2020). For poultry production, a robust understanding of the epidemiology of intestinal parasites is essential for identifying risk factors, predicting disease patterns, and implementing effective control and prevention strategies (Georgi *et al.,* 2021). The presence and spread of intestinal parasitic infections in chickens and turkeys are influenced by a complex interplay of host, agent, and environmental factors (Taylor *et al.,* 2020).

I. Host Factors

Several characteristics inherent to the host bird can significantly influence its susceptibility to, and the course of, parasitic diseases (Hauck and Hafez, 2020).

Age: Young birds are generally more susceptible to severe parasitic infections, especially protozoan diseases like coccidiosis, due to their still-developing immune systems (Hess *et al.,* 2021). Mature birds may develop acquired immunity following exposure, but they can still become infected and contribute to parasite dissemination (Saif, 2020).

Immunity: Acquired immunity plays a crucial role in modulating the clinical outcome of parasitic infections, often leading to reduced pathology and parasite shedding (Hess *et al.,* 2021).

Even partial immunity can significantly reduce the economic impact of infection (Saleh *et al.,* 2021).

Breed and Genetics: Genetic variations in susceptibility or resistance to specific intestinal parasites have been observed among different breeds and genetic lines of chickens and turkeys (Taylor *et al.,* 2020).

Nutritional Status: Birds experiencing nutritional deficiencies or other stressors are typically more vulnerable to parasitic infection and tend to manifest more severe clinical signs (Poonia *et al.,* 2022).

II. Agent Factors

The inherent biological characteristics of the parasitic agent itself are fundamental to its epidemiological pattern and the dynamics of disease transmission (Saif, 2020).

Life Cycle: Parasites with direct life cycles, such as *Ascaridia galli* and *Eimeria* species, can spread rapidly within a flock primarily through the fecal-oral route (Taylor *et al.,* 2020). In contrast, parasites requiring intermediate hosts, like most cestodes or the nematode *Subulura brumpti*, have transmission dynamics that are dependent on the presence and ingestion of these specific hosts (Hauck and Hafez, 2020). The unique involvement of *Heterakis gallinarum* as a vector for *Histomonas meleagridis* also defines its epidemiological characteristics (Beer *et al.,* 2022).

Environmental Resistance: The infective stages of many intestinal parasites, including nematode eggs (e.g., *Ascaridia galli*) and protozoan oocysts (e.g., *Eimeria* species, *Cryptosporidium* species), are highly resilient to environmental degradation (Saif, 2020). Their ability to survive for extended periods in litter, soil, and water contributes significantly to persistent infection pressure on farms (Hess *et al.,* 2021).

Virulence: Different strains or species within a parasitic genus can exhibit varying degrees of virulence, which directly impacts the severity of disease and overall prevalence within a flock (Saleh *et al.,* 2021).

III. Environmental Factors

The physical environment and prevailing management practices within poultry operations exert a profound influence on the transmission and persistence of intestinal parasites (Poonia *et al.,* 2022).

Climate and Seasonality: Environmental factors such as temperature, humidity, and moisture are critical for the development and survival of infective stages outside the host (Hauck and Hafez, 2020). Warm and moist conditions generally favor the sporulation of coccidial oocysts and the embryonation of nematode eggs (Hess *et al.,* 2021). This often results in distinct seasonal patterns of infection incidence (Georgi *et al.,* 2021).

Litter Management: The condition of the litter is a primary epidemiological determinant, especially in deep litter systems (Saif, 2020). Wet or poorly maintained litter creates an ideal environment for the sporulation of *Eimeria* oocysts and the long-term survival of nematode eggs, leading to continuous exposure and re-infection of birds (Taylor *et al.,* 2020). Regular litter turnover and adequate ventilation are essential for control (Merck Vet Manual, 2023).

Housing System and Stocking Density:

Intensive Systems: High stocking densities characteristic of confined housing systems facilitate rapid transmission of direct life cycle parasites like coccidia and *Ascaridia galli* due to increased bird-to-feces contact (Saleh *et al.,* 2021). Continuous or multi-age production cycles can also lead to a substantial build-up of infective stages over time (Poonia *et al.,* 2022).

Extensive/Free-Range Systems: Birds in free-range or backyard poultry systems are exposed to a broader range of environmental contaminants and intermediate hosts (Hauck and Hafez, 2020). This increases the risk of infection with indirect life cycle parasites such as cestodes transmitted by insects or slugs, and *Capillaria* species transmitted by earthworms (Georgi *et al.,* 2021). Contact with wild birds can also introduce new parasitic species or strains into the flock (Saif, 2020).

Cage Systems: Poultry raised in cage systems typically experience lower exposure to litter-borne parasites like coccidia, as their fecal matter falls through the wire floors, reducing direct contact with infective stages (Hess *et al.,* 2021).

Farm Hygiene and Biosecurity: Inadequate cleaning, disinfection, and general biosecurity measures allow infective parasite stages to persist on surfaces, equipment, and within the farm environment (Poonia *et al.,* 2022). Improper disposal of infected carcasses can also significantly contribute to environmental contamination (Saif, 2020).

Intermediate and Paratenic Hosts: The presence, distribution, and abundance of specific intermediate hosts (e.g., various insects, terrestrial gastropods, earthworms) are critical to the epidemiology of parasites with indirect life cycles (Taylor *et al.,* 2020). Effective control of these hosts is often an integral part of an integrated parasite management program (Saif, 2020).

Presence of Wild Birds and Rodents: Wild birds and rodents can act as mechanical or biological vectors, introducing parasite eggs or oocysts into poultry houses and contaminating feed and water sources (Saif, 2020).

2.7 Diagnoses

Accurate and timely diagnosis of intestinal parasitic infections is fundamental for effective disease management, treatment selection, and implementation of appropriate control measures in commercial chicken and turkey flocks (Saif, 2020). Diagnosis typically involves a combination of clinical observations, post-mortem examinations, and various laboratory analyses (Taylor *et al.,* 2020).

I. Clinical Diagnosis

Clinical diagnosis primarily relies on recognizing general flock health status and specific symptoms, alongside a thorough review of the farm's history (Poonia *et al.,* 2022).

Clinical Signs: Non-specific indicators such as depression, ruffled plumage, reduced feed consumption, and poor growth rates or diminished egg production can suggest the presence of internal parasites (Merck Vet Manual, 2023). More specific signs, depending on the parasite, may include diarrhea (which can vary in consistency or color, such as the sulfur-yellow droppings associated with histomoniasis), and progressive emaciation despite adequate feed availability (Georgi *et al.,* 2021).

Flock History: Detailed records regarding flock age, housing system, stocking density, recent introductions of new birds, feed and water quality, and any previous disease occurrences provide valuable epidemiological context for diagnosis (Saif, 2020).

II. Post-Mortem Examination (Gross Pathology)

Necropsy of affected or culled birds is a crucial diagnostic step, allowing for the direct visualization of adult worms and characteristic gross pathological lesions in the digestive tract (Taylor *et al.,* 2020).

Intestinal Examination: A thorough examination of the entire gastrointestinal tract is performed to identify gross changes such as inflammation, thickening of the intestinal wall, hemorrhages, excessive mucus production, or nodule formation (Poonia *et al.,* 2022).

Parasite Recovery: Larger helminths, including adult nematodes like *Ascaridia galli*, *Heterakis gallinarum*, or various *Capillaria* species, and cestodes such as *Raillietina* species, can often be macroscopically identified within the intestinal lumen or attached to the mucosal lining of the small intestine or caeca (Saif, 2020).

Organ Lesions: Specific protozoan infections induce distinctive lesions; for instance, different *Eimeria* species cause varying degrees of enteritis localized to specific segments of the intestine (Koinari *et al.,* 2021), while *Histomonas meleagridis* leads to characteristic necrotic lesions in the caeca and liver (Beer *et al.,* 2022).

III. Laboratory Diagnosis

Confirmation of intestinal parasitic infections typically necessitates microscopic examination and, increasingly, molecular diagnostic techniques for precise identification (Taylor *et al.,* 2020).

A. Parasitological Examination of Feces:

Direct Smear: A direct microscopic examination of a fresh fecal sample mixed with saline can reveal motile protozoan trophozoites (e.g., *Giardia*) or the small oocysts of *Cryptosporidium* species (Moghadam *et al.,* 2020).

Fecal Flotation: This widely used technique concentrates parasite eggs (nematode and cestode) and protozoan oocysts (e.g., *Eimeria* species) by exploiting their specific gravity using various saturated salt or sugar solutions (Saif, 2020). Quantitative methods, such as the McMaster technique, can provide estimates of eggs or oocysts per gram of feces (EPG/OPG), indicating infection intensity (Abubakar *et al.,* 2021).

B. Microscopic Examination of Tissues/Scrapings (Post-Mortem):

Intestinal Scrapings/Smears: Microscopic examination of scrapings from the intestinal mucosa, particularly from lesioned areas, can reveal various developmental stages of coccidia (e.g., oocysts, merozoites), *Histomonas meleagridis* in caecal contents, or *Cryptosporidium* oocysts (Hess *et al.,* 2021).

Histopathology: Tissue samples from affected intestines, caeca, or liver, after proper fixation and processing, can be stained and examined microscopically (Merck Vet Manual, 2023). Histopathological analysis allows for definitive identification of parasite stages within host tissues, assessment of cellular damage, and characterization of inflammatory responses (Amer *et al.,* 2020).

C. Molecular Diagnostics:

Polymerase Chain Reaction (PCR) and Real-Time PCR (RT-PCR):

Molecular methods offer high sensitivity and specificity for detecting parasite DNA or RNA directly from fecal or tissue samples (Al-Ankari, 2020). These techniques are particularly valuable for differentiating between morphologically similar species (e.g., specific *Eimeria* species), detecting low-level or subclinical infections, and for epidemiological investigations (Saleh *et al.,* 2021).

D. Immunological Methods:

While less commonly employed for routine diagnosis of active intestinal parasitic infections in poultry compared to direct parasitological or molecular tests, serological assays, such as ELISA, can detect host antibodies against specific parasites, indicating previous exposure (Georgi *et al.,* 2021). These methods are often utilized in large-scale surveillance programs (Merck Vet Manual, 2023).

2.8 Treatment, Control, and Prevention

Managing intestinal parasitic infections in chickens and turkeys requires a multi-faceted approach encompassing treatment, rigorous control measures, and proactive prevention strategies (Saif, 2020). An integrated parasite management program is crucial for minimizing economic losses and ensuring flock health in commercial poultry operations (Hauck and Hafez, 2020).

I. Treatment (Chemotherapy)

Chemotherapy involves the use of antiparasitic drugs to reduce or eliminate existing infections (Merck Vet Manual, 2023).

A. Anthelmintics:

These drugs target nematode (roundworm) and cestode (tapeworm) infections. Common anthelmintics include benzimidazoles (e.g., albendazole, fenbendazole), which interfere with parasite metabolism, and levamisole, affecting neuromuscular coordination (Taylor *et al.,* 2020). Piperazine is effective against *Ascaridia galli* (Poonia *et al.,* 2022). Praziquantel is effective against tapeworms (Georgi *et al.,* 2021). Drug administration is typically via feed or drinking water, and careful adherence to withdrawal periods is essential for food safety (OIE, 2021). Resistance to certain anthelmintics can develop with prolonged or improper use, necessitating rotation or combination therapies (van Oosterhout *et al.,* 2020).

B. Anticoccidials:

These drugs are specifically designed to control coccidiosis, caused by *Eimeria* species (Hess *et al.,* 2021). They are broadly categorized into ionophores (e.g., monensin, salinomycin) and chemical compounds (e.g., amprolium, diclazuril, nicarbazin) (Saleh *et al.,* 2021). Anticoccidials are commonly administered in feed as a prophylactic measure (Koinari *et al.,* 2021). To mitigate the development of resistance, shuttle programs (alternating different anticoccidials within a single flock's growth period) or rotation programs (changing anticoccidials between successive flocks) are often employed (Chapman and Hembree, 2021).

C. Other Antiprotozoals:

For histomoniasis (blackhead), historically, nitroimidazoles like dimetridazole were used, but these are now largely prohibited in food animals in many regions due to safety concerns, making treatment challenging (Beer *et al.,* 2022). For cryptosporidiosis and *Giardia*sis, effective and approved treatments for food-producing poultry are limited; paromomycin has shown some efficacy against *Cryptosporidium* in research settings (Amer *et al.,* 2020).

II. Control (Management and Biosecurity)

Effective control focuses on reducing exposure to infective stages and minimizing conditions favorable for parasite development (Poonia *et al.,* 2022).

A. Environmental Management

Litter Management:

Maintaining dry litter is crucial, as moisture promotes the sporulation of coccidial oocysts and the survival of nematode eggs (Saif, 2020). Regular stirring, ventilation, and adequate bedding depth help keep litter dry (Merck Vet Manual, 2023). Complete removal and composting of litter between flocks significantly reduce parasite loads (Hauck and Hafez, 2020).

Cleaning and Disinfection:

Thorough cleaning and disinfection of poultry houses, equipment, and water lines between flocks are vital (Taylor *et al.,* 2020). While many disinfectants are effective against bacteria and viruses, fewer are sporicidal for coccidial oocysts, requiring specific compounds or physical methods like steam (Rode *et al.,* 2021).

Water and Feed Hygiene:

Ensuring clean, uncontaminated feed and water is paramount, as these are primary routes of transmission for many intestinal parasites (Georgi *et al.,* 2021). Elevated feeders and drinkers help prevent fecal contamination (Hauck and Hafez, 2020).

B. Biosecurity Measures:

Restricting Access:

Limiting access of unauthorized personnel and vehicles to poultry houses helps prevent the introduction of parasites (Van Immerseel *et al.,* 2022).

Rodent and Wild Bird Control:

Rodents and wild birds can act as mechanical carriers or paratenic hosts for various intestinal parasites, necessitating robust control programs (Saif, 2020).

Quarantine:

New birds should be quarantined and screened for parasites before introduction into existing flocks (Hauck and Hafez, 2020).

All-in/All-out Systems:

Depopulating and thoroughly cleaning houses between flocks is highly effective in breaking parasite life cycles (Saif, 2020).

C. Intermediate Host Control:

For parasites with indirect life cycles (e.g., most cestodes, *Capillaria* species, *Histomonas meleagridis*), controlling their intermediate hosts (e.g., earthworms, beetles, slugs) is an important control strategy (Georgi *et al.,* 2021). This can involve environmental modifications to reduce host populations (Poonia *et al.,* 2022).

III. Prevention

Prevention focuses on strategies to prevent initial infection or to boost host resistance (Saif, 2020).

A. Vaccination

Coccidiosis Vaccines:

Live attenuated or non-attenuated coccidiosis vaccines are increasingly used to provide immunity against *Eimeria* species (Hess *et al.,* 2021). They typically contain sporulated oocysts of common *Eimeria* species and are administered via spray, gel, or in-feed to young chicks, allowing for controlled exposure and immunity development (Saleh *et al.,* 2021). Recombinant subunit vaccines are also being researched (Bilik *et al.,* 2022).

B. Genetic Resistance:

Research into breeding poultry lines with increased genetic resistance to specific parasitic infections, particularly coccidiosis, offers a promising long-term prevention strategy (Hess *et al.,* 2021).

C. Nutritional Support:

Maintaining optimal nutrition ensures a robust immune system in birds, enabling them to better withstand or recover from parasitic challenges (Hauck and Hafez, 2020).

D. Probiotics, Prebiotics, and Botanicals:

Emerging strategies involve the use of feed additives such as probiotics and prebiotics to promote beneficial gut microbiota, which can enhance gut health and potentially increase resistance to parasitic infections (Sultan *et al.,* 2022). Certain botanical extracts are also being investigated for their antiparasitic or immunomodulatory properties (Al-Ankari, 2020).

An integrated approach combining appropriate chemotherapy, stringent biosecurity, effective environmental control, and strategic vaccination is the most effective way to manage intestinal parasitic diseases in modern poultry production (Van Immerseel *et al.,* 2022).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 STUDY AREA

This study was carried out in three poultry markets in Benin City: New Benin Market in Ikpoba-Okha Local Government Area, Uselu Market in Egor Local Government Area, and Oluku Market in Ovia North East Area, Benin City, Edo State, Nigeria. Benin City, the state capital, is located in the South-South geopolitical zone of Nigeria. Edo State has an estimated population of over 4.2 million people (National Population Commission, 2021). The main occupations of the state's residents include trading, private transport, and farming (Adebayo and Olomola, 2021).

Egor LGA has its headquarters in Uselu town, Benin City. It has a land area of approximately 93 km^2 and a population of 612,790 based on a recent population projection (Edo State Government, 2022). The LGA lies between longitude 5° 34'E and latitude 6° 23'N (Ogie *et al.,* 2021). Residents primarily cultivate crops like cassava, yam, maize, and various vegetables. The people of Egor LGA are predominantly traders, and Uselu Market provides a key platform for a wide variety of goods to be sold (Agbonlahor and Ihenacho, 2021).

Ovia North-East LGA has a projected population of 258,973 and is located between longitude 5° 41'E and latitude 6° 39'N (Edo State Government, 2022). The LGA has a vibrant trade sector and hosts several markets, including Ugbogiobo, Oluku, Ekiadolor, and Okada markets (Adebayo and Olomola, 2021). The major occupations are carving and farming, while other residents engage in livestock farming, small and medium-scale businesses, and various artisanal crafts (Odion *et al.,* 2020).

Ikpoba-Okha is a Local Government Area with its headquarters in Idogbo town, along the Benin-Abraka Road. It is situated between Latitude 6° 21'N and Longitude 5° 39'E (Ogie *et al.,* 2021). The estimated population of Ikpoba-Okha is 505,710 (Edo State Government, 2022). Farming is a prominent feature of the economic life of the area. Trade also flourishes, with several markets such as Oka, New Benin, and Oregbeni providing platforms for the exchange of a variety of goods and services for the area's inhabitants (Agbonlahor and Ihenacho, 2021).

3.2 SAMPLE SIZE

The minimum sample size for this study was determined using the World Health Organization standard sample formula for calculation of sample size (Daniel *et al.,* 1999).

$N = Z^2pq / d^2$

Where:

N= desired sample size when population is greater than 10,000

Z = standard normal deviation, usually set at 1.96 or simply 2.0 (at 95% confidence interval)

p = proportion in the target population estimated to have a particular characteristic.

q= 1.0-p

d= degree of accuracy desired, usually set at 0.05.

From the prevalence of gastrointestinal parasites in poultry birds; (P) of 90% = 90/100 = 0.9 (Maina *et al.,* 2017).

$N = (1.96)^2 \times 0.9 \times (1.0 - 0.9) / 0.05^2$

N = 138.

While the calculated sample size was 138, 150 samples were collected to enhance data accuracy and improve the reliability of the study.

3.3 ETHICAL APPROVAL

Ethical approval for this research was sought from the Ethics and research committee Ministry of Health, Edo State, Nigeria. Informed consent was also sought and obtained from all poultry providers. A well-structured questionnaire was administered to collect data relevant to the study.

3.4 STOOL SAMPLE COLLECTION

A total of 150 fecal specimens were collected from different breeds in the selected study areas. All samples were appropriately labeled, documented, and transported to the laboratory following standardized procedures to maintain the validity and reliability of the study results (Saif, 2020).

3.5. STOOL SAMPLE EXAMINATION

3.5.1. Macroscopic Examination of Stool

Fecal specimens were examined macroscopically for the presence of adult worms, mucus, blood, and to assess their color and consistency (Poonia *et al.,* 2022).

3.5.2. Microscopic Examination of Stool

The fecal samples were processed using the formalin-ethyl acetate sedimentation method and wet mount method (Taylor *et al.,* 2020).

Procedure

Formalin-Ethyl Acetate Sedimentation Method

For each sample, 1g of feces was thoroughly mixed with 10 ml of 10% formalin solution. The suspension was strained through wetted gauze to remove large debris and collected in a centrifuge tube. The mixture was then centrifuged at 500 × g for 10 minutes, and the supernatant was decanted. The sediment was then resuspended with 10% formalin before adding 4 ml of ethyl acetate. The tube was stoppered and shaken vigorously to mix the layers, then centrifuged again at 500 × g for 10 minutes. The mixture separated into four layers. The top three layers were carefully decanted, leaving only the concentrated sediment at the bottom of the tube. A drop of this sediment was transferred onto a microscope slide, covered with a coverslip, and examined under the microscope using X10 and X40 objectives. Eggs were identified on the basis of their morphological features (Saif, 2020).

Wet Mount Method

For each sample, 1g of faeces was put on a slide with a wooden applicator stick, the stool was emulsified with a drop of iodine. Each preparation was covered with a cover slide and examined under a microscope using first 10x objectives and then 40x objectives and the results were recorded (Poonia *et al.,* 2022).

3.6 STATISTICAL ANALYSIS

The data obtained were organized and analysed with Microsoft Excel and SPSS version 20.0. Results were considered significant at $P<0.05$ and not significant at $P>0.05$.

CHAPTER FOUR

4.0 RESULT

Table 4.1 shows the percentage prevalence of intestinal parasites among poultry birds in Benin City. *Ascaridia galli*, *Heterakis gallinarum*, *Strongyloides avium*, and *Eimeria* species were recorded in the poultry birds. There was a significant difference ($p<0.05$) in the prevalence of *Ascaridia galli* ($p=0.000$), *Strongyloides avium* ($p=0.010$), and *Eimeria* species ($p=0.017$) among the various bird species. However, there was no significant difference ($p>0.05$) in the prevalence of *Heterakis gallinarum*. The most prevalent parasite in Native fowls was *Ascaridia galli* (63.3%) while that of Broilers was *Ascaridia galli* (20.0%) and *Heterakis gallinarum* (17.1%). The most prevalent parasite in Layers was *Ascaridia galli* (31.4%), while in Turkeys it was *Ascaridia galli* (20.0%).

The prevalence of intestinal parasites among Broilers in various LGAs in Benin City is shown in Table 4.2. While there was no significant difference in the prevalence of *Heterakis gallinarum* ($p=0.820$) and *Strongyloides avium* ($p=0.970$), there was a significant difference in the prevalence of *Ascaridia galli* ($p=0.045$) and *Eimeria* species ($p=0.047$) among the LGAs. The most prevalent parasites in Ikpoba-Okha were *Ascaridia galli* (33.3%) and *Eimeria* species (20.0%). The most prevalent parasite in Egor was *Ascaridia galli* and *Heterakis gallinarum*, both at 20.0%, while in Ovia North-East the only parasites found were *Heterakis gallinarum* and *Strongyloides avium*, both at 10.0%.

Table 4.1: Prevalence of intestinal parasites among poultry birds in Benin City

Species of birds	**Number examined**	***Ascaridia galli* (%)**	***Heterakis gallinarum* (%)**	***Strongyloides avium* (%)**	***Eimeria* species (%)**	**Total (%)**
Broilers	35	20.0^{b}	17.1	14.3^{ab}	8.6^{b}	**60.0**
Native fowls	30	63.3^{a}	26.7	23.3^{a}	30.0^{a}	**143.3**
Layers	35	31.4^{b}	8.6	0.0^{c}	14.3^{b}	**54.3**
Turkeys	50	20.0^{b}	8.0	6.0^{bc}	6.0^{b}	**40.0**
Total	**150**	**134.7**	**60.4**	**43.6**	**58.9**	**297.5**
P-value	-	0.000	0.084	0.010	0.017	-

Key:

Values in columns with different superscripts differ significantly ($P<0.05$).

a – Highest value

b – Lower than a (lowest where c is absent)

ab – Intermediate between a and b

c – Lowest value

bc – Intermediate between b and c

Table 4.2: Prevalence of intestinal parasites in Broilers in various LGAs in Benin City

LGAs	Number examined	*Ascaridia galli* (%)	*Heterakis gallinarum* (%)	*Strongyloides avium* (%)	*Eimeria* species (%)	Total (%)
Ikpoba-Okha	15	33.3^{a}	13.3	6.7	20.0^{a}	**73.3**
Egor	10	20.0^{ab}	20.0	10.0	10.0^{ab}	**60.0**
Ovia North-East	10	0.0^{b}	10.0	10.0	0.0^{b}	**20.0**
Total	**35**	**53.3**	**43.3**	**26.7**	**30.0**	**153.3**
P-value	-	0.045	0.820	0.970	0.047	-

Key:

Values in columns with different superscripts differ significantly (P<0.05).

a – Highest value

b – Lower than a (lowest where c is absent)

ab – Intermediate between a and b

c – Lowest value

bc – Intermediate between b and c

Table 4.3 shows the prevalence of intestinal parasites among Native Fowls in various LGAs in Benin City. There was no significant difference in the prevalence of *Ascaridia galli* (p=0.866), *Heterakis gallinarum* (p=0.843), and *Eimeria* species (p=1.000) among the LGAs. However, a significant difference (p=0.003) was found in the prevalence of *Strongyloides avium*. The most prevalent parasite in both Ikpoba-Okha and Ovia North-East was *Ascaridia galli* (60.0%) and *Strongyloides avium* (60.0% in Ikpoba-Okha only). The most prevalent parasite in Egor was *Ascaridia galli* (70.0%).

The prevalence of intestinal parasites among layers in various LGAs in Benin City is shown in Table 4.4. Prevalence varied significantly in Egor for *Heterakis gallinarum* (p=0.047), but varied nonsignificantly for *Ascaridia galli* (p=0.974), *Strongyloides avium* (p=1.000), and *Eimeria* species (p=0.535) across all LGAs. The most prevalent parasite in Ikpoba-Okha was *Ascaridia galli* (33.3%), while in both Egor and Ovia North-East the most prevalent parasite was also *Ascaridia galli* (30.0%). Notably, no *Strongyloides avium* was found in any of the three LGAs.

The prevalence of intestinal parasites among turkeys in various LGAs in Benin City is shown in Table 4.5. There was a significant difference in the prevalence of *Ascaridia galli* (p=0.043) among the LGAs. However, there was no significant difference in the prevalence of *Heterakis gallinarum* (p=0.884), *Strongyloides avium* (p=0.055), or *Eimeria* species (p=0.927). The most prevalent parasite in Ikpoba-Okha and Egor was *Ascaridia galli* (30.0% and 20.0%, respectively), while the most prevalent parasite in Ovia North-East was *Strongyloides avium* (13.3%).

Table 4.3: Prevalence of intestinal parasites in Native fowls in various LGAs in Benin City

LGAs	Number examined	*Ascaridia galli* (%)	*Heterakis gallinarum* (%)	*Strongyloides avium* (%)	*Eimeria* species (%)	Total (%)
Ikpoba Okha	10.0	60.0	30.0	60.0^{a}	30.0	**180.0**
Egor	10.0	70.0	30.0	10.0^{b}	30.0	**140.0**
Ovia North-East	10.0	60.0	20.0	0.0^{b}	30.0	**110.0**
Total	**30.0**	**190.0**	**80.0**	**70.0**	**90.0**	**430.0**
P-value	-	0.866	0.843	0.003	1.000	-

Key:

Values in columns with different superscripts differ significantly ($P<0.05$).

a – Highest value

b – Lower than a (lowest where c is absent)

ab – Intermediate between a and b

c – Lowest value

bc – Intermediate between b and c

Table 4.4: Prevalence of intestinal parasites in Layers in various LGAs in Benin City

LGAs	Number examined	*Ascaridia galli* (%)	*Heterakis gallinarum* (%)	*Strongyloides avium* (%)	*Eimeria* species (%)	Total (%)
Ikpoba Okha	15	33.3	13.3^{a}	0.0	20.0	**66.6**
Egor	10	30.0	0.0^{b}	0.0	10.0	**40.0**
Ovia North-East	10	30.0	20.0^{a}	0.0	10.0	**60.0**
Total	**35**	**93.3**	**33.3**	**0.0**	**40.0**	**166.6**
P-value	-	0.974	0.047	1.000	0.535	-

Key:

Values in columns with different superscripts differ significantly ($P<0.05$).

a – Highest value

b – Lower than a (lowest where c is absent)

ab – Intermediate between a and b

c – Lowest value

bc – Intermediate between b and c

Table 4.5: Prevalence of intestinal parasites in Turkeys in various LGAs in Benin City

LGAs	Number examined	*Ascaridia galli* (%)	*Heterakis gallinarum* (%)	*Strongyloides avium* (%)	*Eimeria* species (%)	Total (%)
Ikpoba Okha	20	30.0^{a}	10.0	5.0	5.0	**50.0**
Egor	15	20.0^{ab}	6.7	0.0	6.7	**33.4**
Ovia North-East	15	10.0^{b}	6.7	13.3	6.7	**36.7**
Total	**50**	**60.0**	**23.4**	**18.3**	**18.4**	**120.1**
P-value	-	0.043	0.884	0.055	0.927	-

Key:

Values in columns with different superscripts differ significantly (P<0.05).

a – Highest value

b – Lower than a (lowest where c is absent) ab – Intermediate between a and b

c – Lowest value

bc – Intermediate between b and c

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1. DISCUSSION

The study's fecal examination of poultry birds in Benin City revealed the presence of several intestinal parasites, including the nematodes *Ascaridia galli* (60.4%), *Heterakis gallinarum* (43.6%), and *Strongyloides avium* (43.6%), as well as the protozoa *Eimeria* species (58.9%). The prevalence rates of these parasites varied across different species of birds and local government areas (LGAs), which highlight the influence of various factors like bird species, management practices, and local environmental conditions. The finding of various species of gastrointestinal parasites is similar to reports from Afolabi *et al.,* (2016) who also reported a high prevalence of similar gastrointestinal parasites in poultry birds in Nigeria. This could be attributed to the extensive system of management widely practiced within the study area, lack of veterinary services, and irregular deworming observed in the farms.

The overall prevalence was highest in Native fowls (143.3%), followed by Broilers (60.0%), Layers (54.3%), and Turkeys (40.0%). The study's findings align with reports from other researchers who have observed a similar pattern of high parasitic prevalence in scavenging birds. For instance, Afolabi *et al.,* (2016) reported a prevalence of 37.6% in extensively managed chickens, reinforcing that this management system significantly contributes to parasitic burdens.

This high prevalence in native fowls can be attributed to their free-range management system, which exposes them to a wider range of contaminated environments and potential intermediate hosts.

Among the specific parasites, *Ascaridia galli* was the most prevalent overall, particularly in Native fowls (63.3%), indicating that this parasite is well-adapted to the local environmental conditions and farming systems. The presence of *Eimeria* species in all bird types except Ovia North-East broilers suggests that coccidiosis is a common health challenge in the region, likely exacerbated by poor hygiene and intensive farming conditions, which facilitate the buildup of oocysts.

The prevalence of parasites showed significant geographical variation across the LGAs. For instance, *Ascaridia galli* prevalence was significantly different among broilers across the three LGAs (p=0.045), with the highest prevalence in Ikpoba-Okha (33.3%). Conversely, for Native fowls, the prevalence of *Strongyloides avium* showed a significant difference (p=0.003) with a notably high rate in Ikpoba-Okha (60.0%). These variations underscore that local environmental factors, such as soil type, moisture, and temperature, play a crucial role in the survival and transmission of these parasites. These results are in agreement with a study by Setyowati *et al.,* (2022) who also found a significant difference in endoparasite prevalence in chickens based on geographical elevation, demonstrating that location is a key factor.

In Layers, while the overall prevalence of *Ascaridia galli* was high, there was no significant difference across LGAs (p=0.974), suggesting that management practices in Layer farms might be more uniform across the region than in other poultry types. However, *Heterakis gallinarum* prevalence in Layers did show a significant difference (p=0.047), with the highest rate in Ovia North-East (20.0%). The findings on turkeys also revealed significant differences in *Ascaridia galli* prevalence (p=0.043) across the LGAs, indicating that localized conditions and management are key determinants of parasitic infections in this species. The presence of *Eimeria* species in turkeys was not significantly different across LGAs (p=0.927), which might imply a widespread challenge that is not influenced as much by specific LGA conditions.

5.2 CONCLUSION

The study confirms the high prevalence of gastrointestinal parasites in poultry birds within Benin City, Nigeria. The findings indicate that the distribution and prevalence of these parasites are significantly influenced by the type of bird, the management system (e.g., free-range vs. intensive), and the specific geographical location. The high rates of parasitic infection, particularly in Native fowls, highlight a major health and economic concern for local poultry farmers. The presence of both nematodes and protozoa, with significant differences in prevalence across LGAs, underscores the need for targeted, rather than general, control strategies. The results reinforce that a one-size-fits-all approach to parasite control is ineffective and that successful management must consider the specific environmental and host-related factors that drive parasitic transmission.

5.3 RECOMMENDATION

1. Implement Species-Specific and Location-Based Control Programs: Develop and deploy parasitic control strategies tailored to the specific poultry species and the ecological conditions of each LGA.

2. Promote Enhanced Biosecurity and Hygiene: Educate farmers on the importance of improving farm hygiene, proper disposal of litter, and sanitation to reduce the environmental load of parasitic eggs and oocysts.

3. Conduct Further Research: Carry out additional studies to identify the specific intermediate hosts in the different LGAs and to assess the economic impact of these parasitic infections on poultry productivity in the region.

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APPENDIX

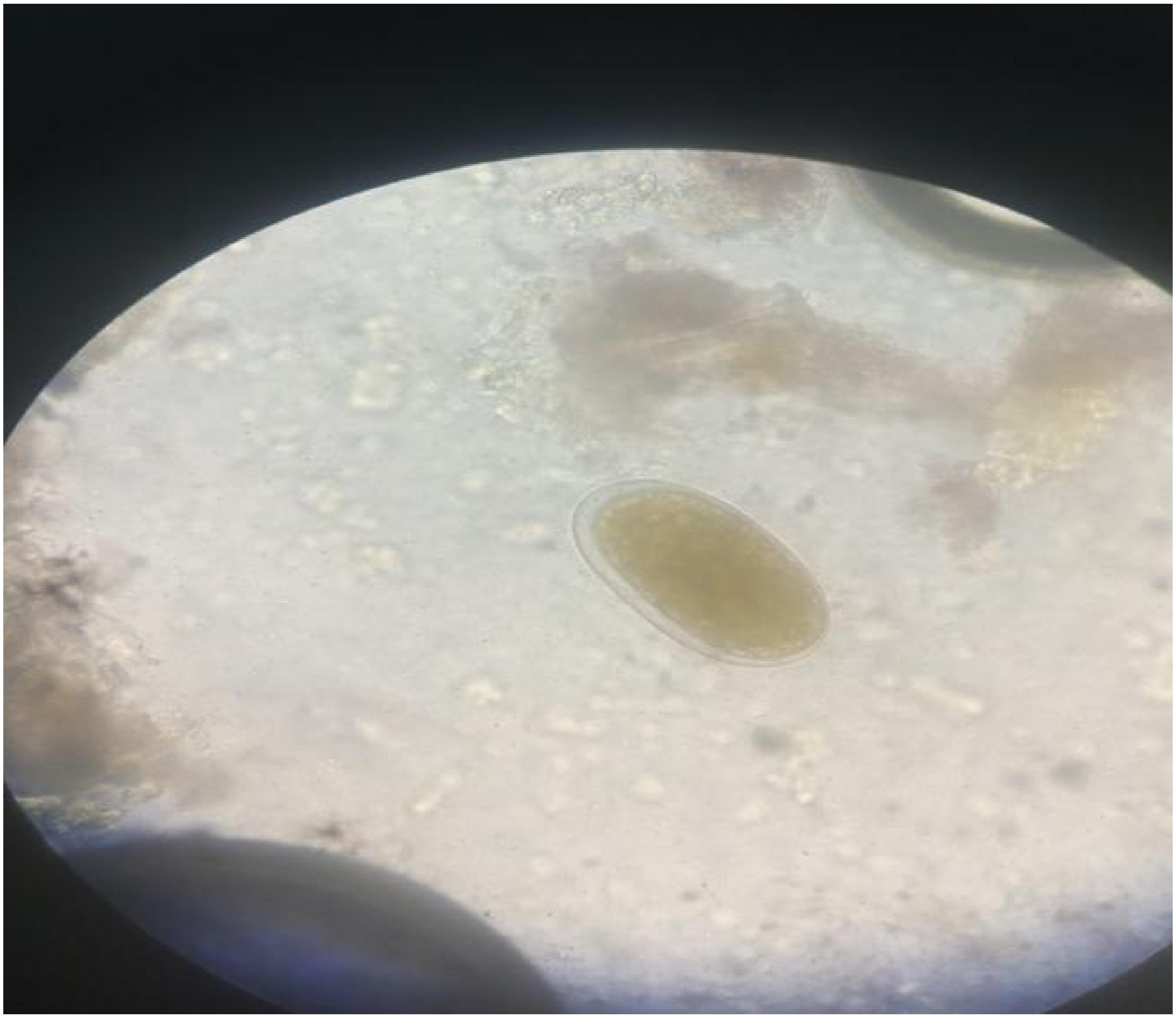

Plate 1: Showing Ova of *Heterakis gallinarum* seen

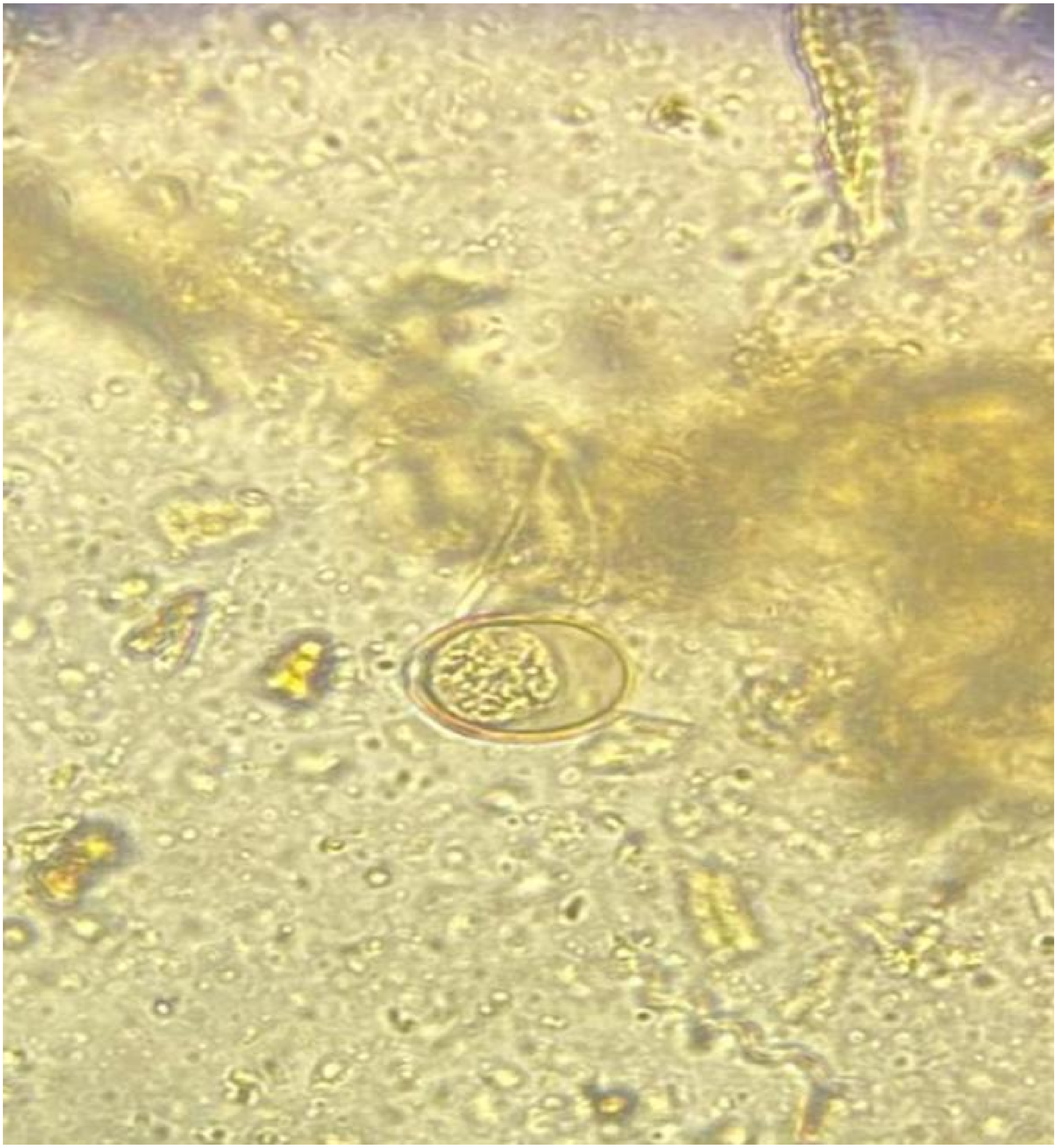

Plate 2: showing Oocyst of *Eimeria* specie seen

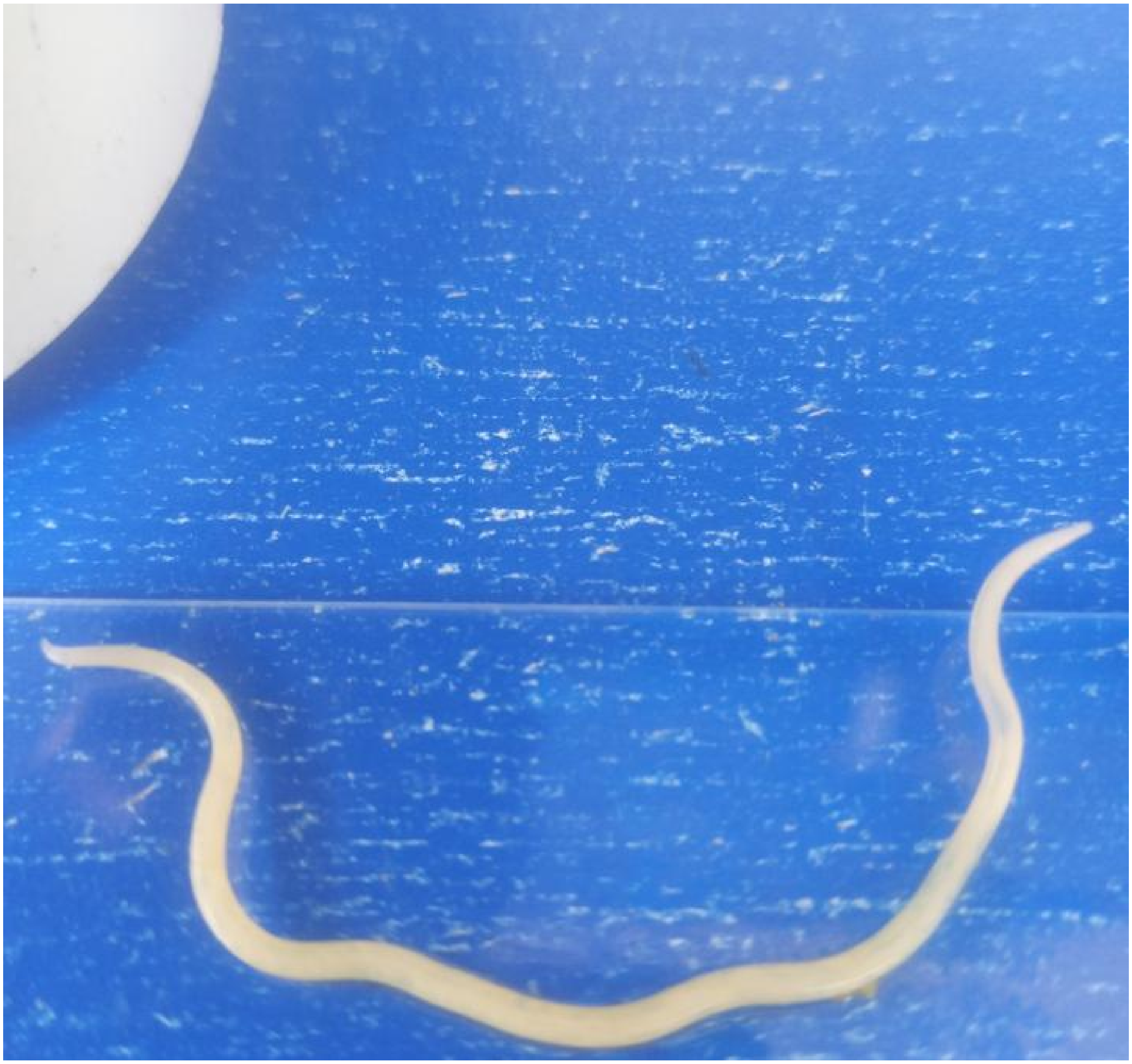

Plate 3: Showing Adult parasite seen

Plate 4: Showing Larva of *Ascaridia galli* seen

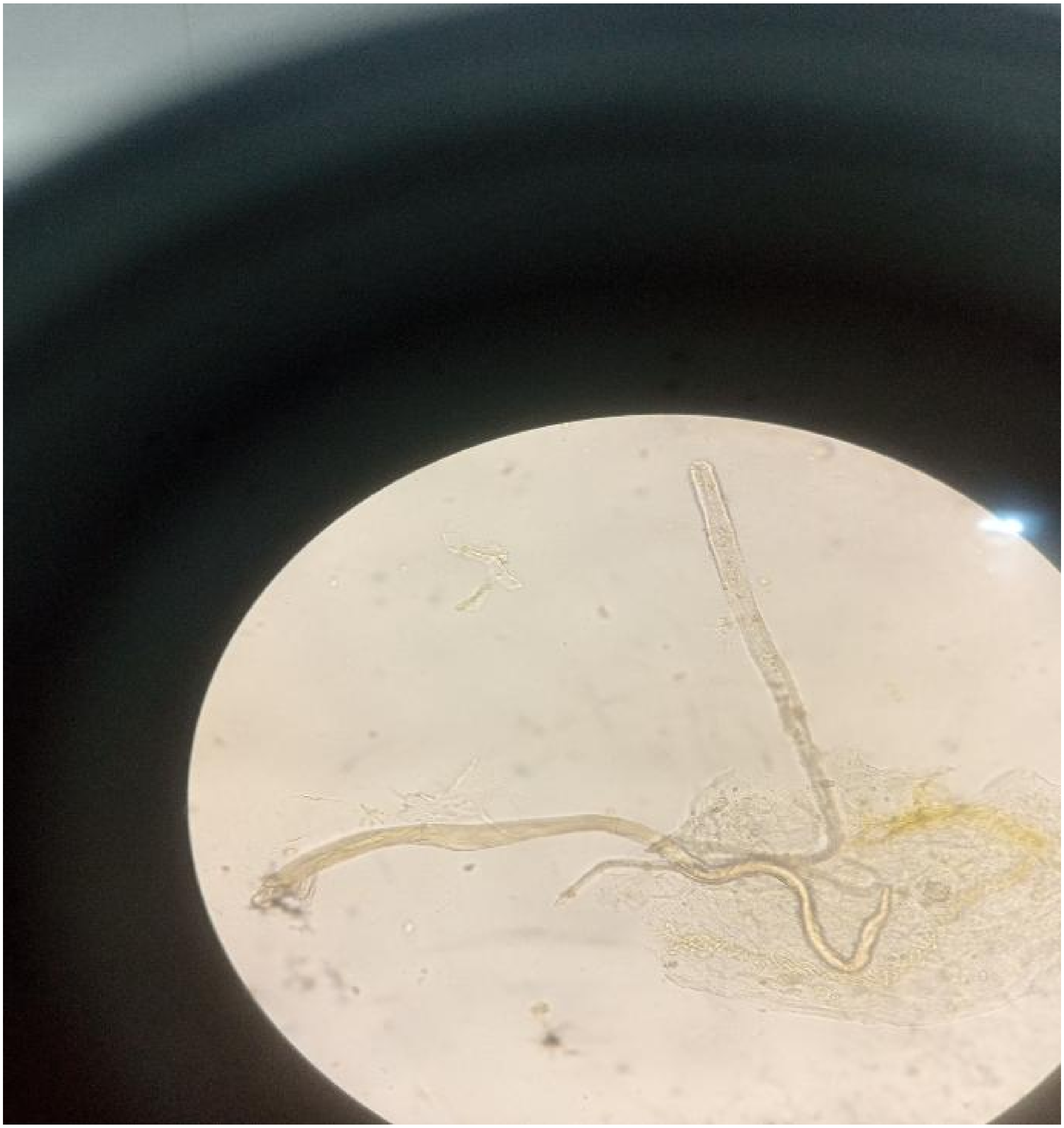

Plate 5: Showing Larva of *Strongyloides avium* seen

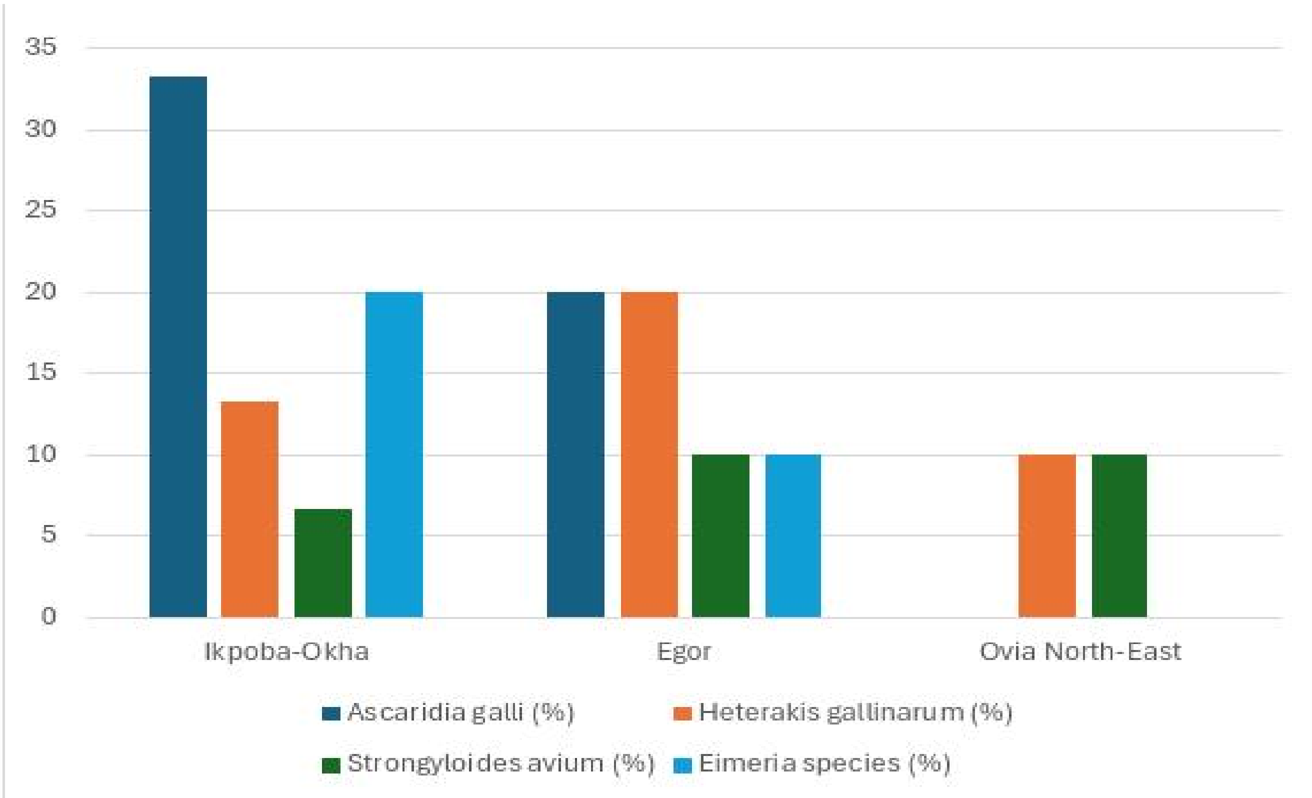

Figure 4.1 Percentage prevalence of intestinal parasites among Broilers in the sampled LGAs in Benin City

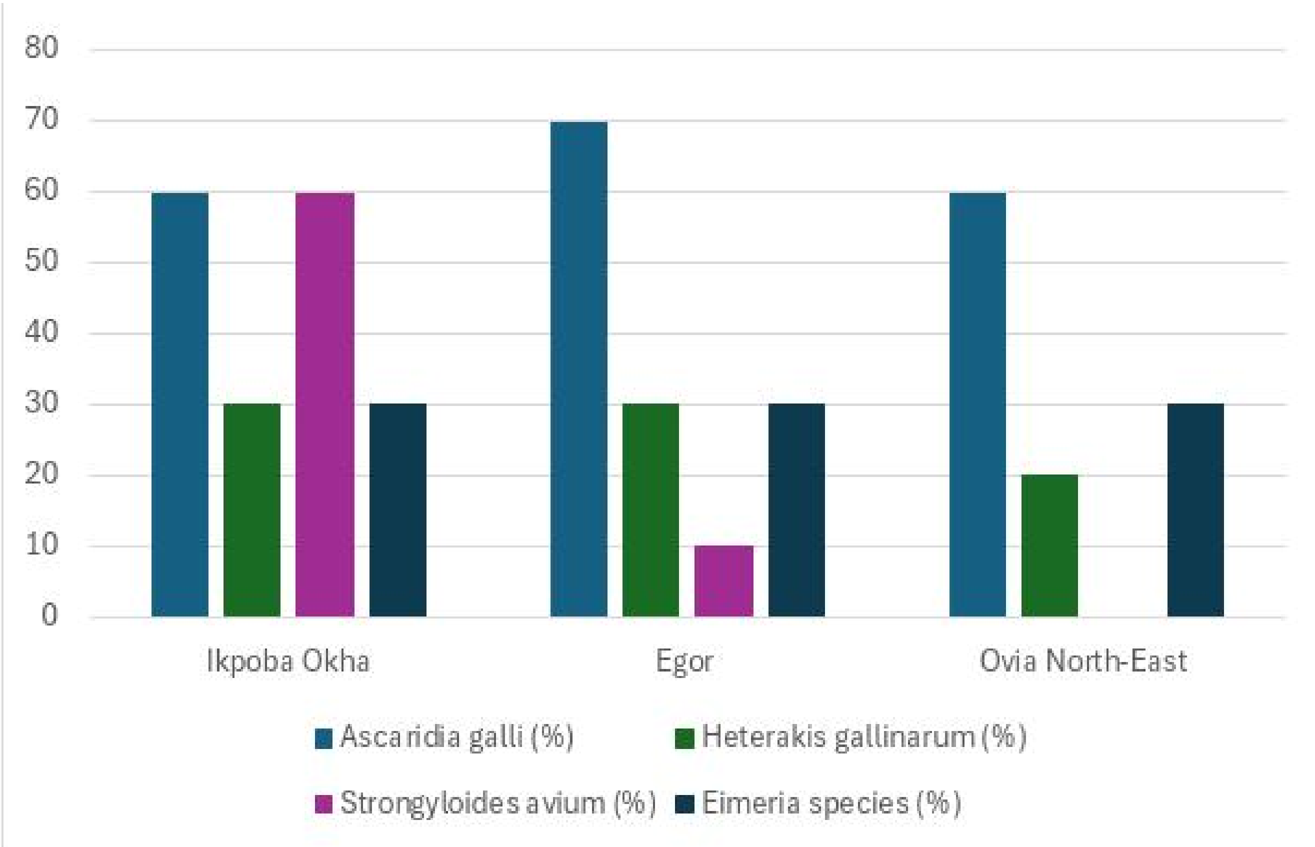

Figure 4.2 Percentage prevalence of intestinal parasites among Native fowls in the sampled LGAs in Benin City

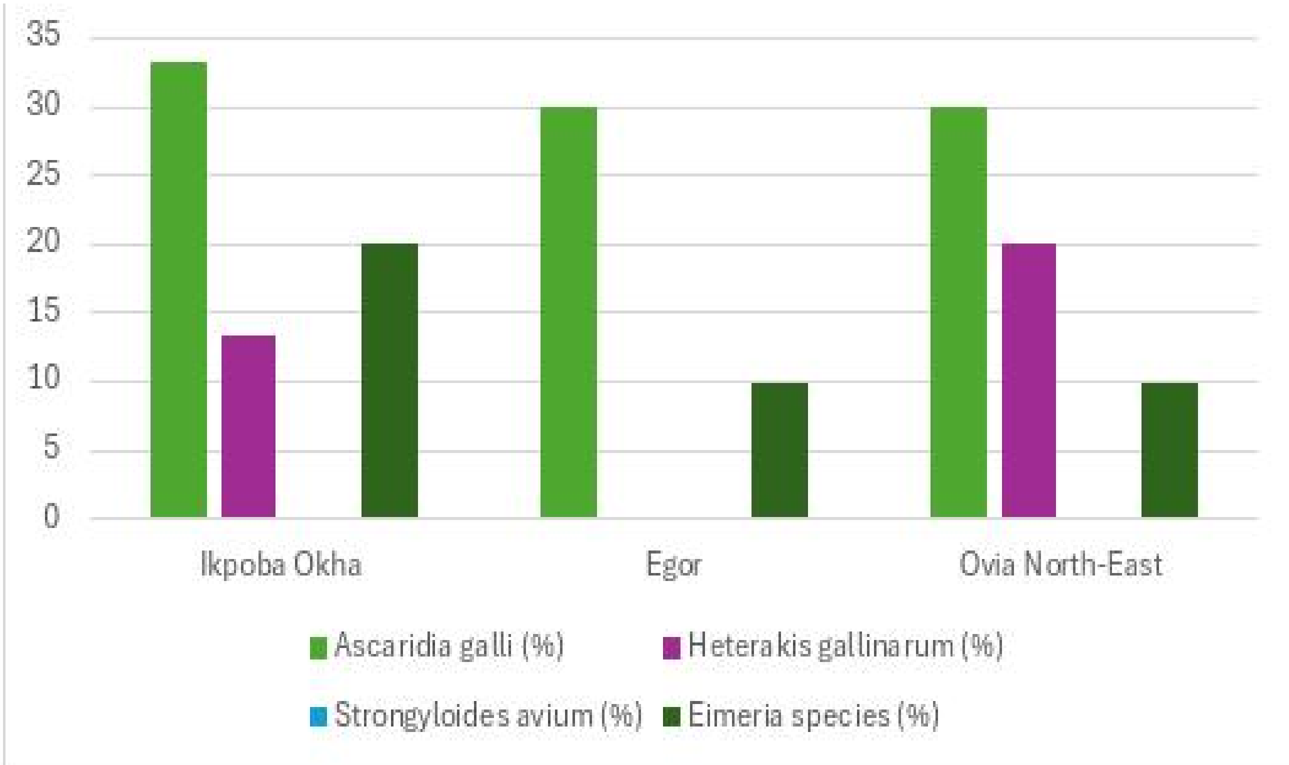

Figure 4.3 Percentage prevalence of intestinal parasites among Layers in the sampled LGAs in Benin City

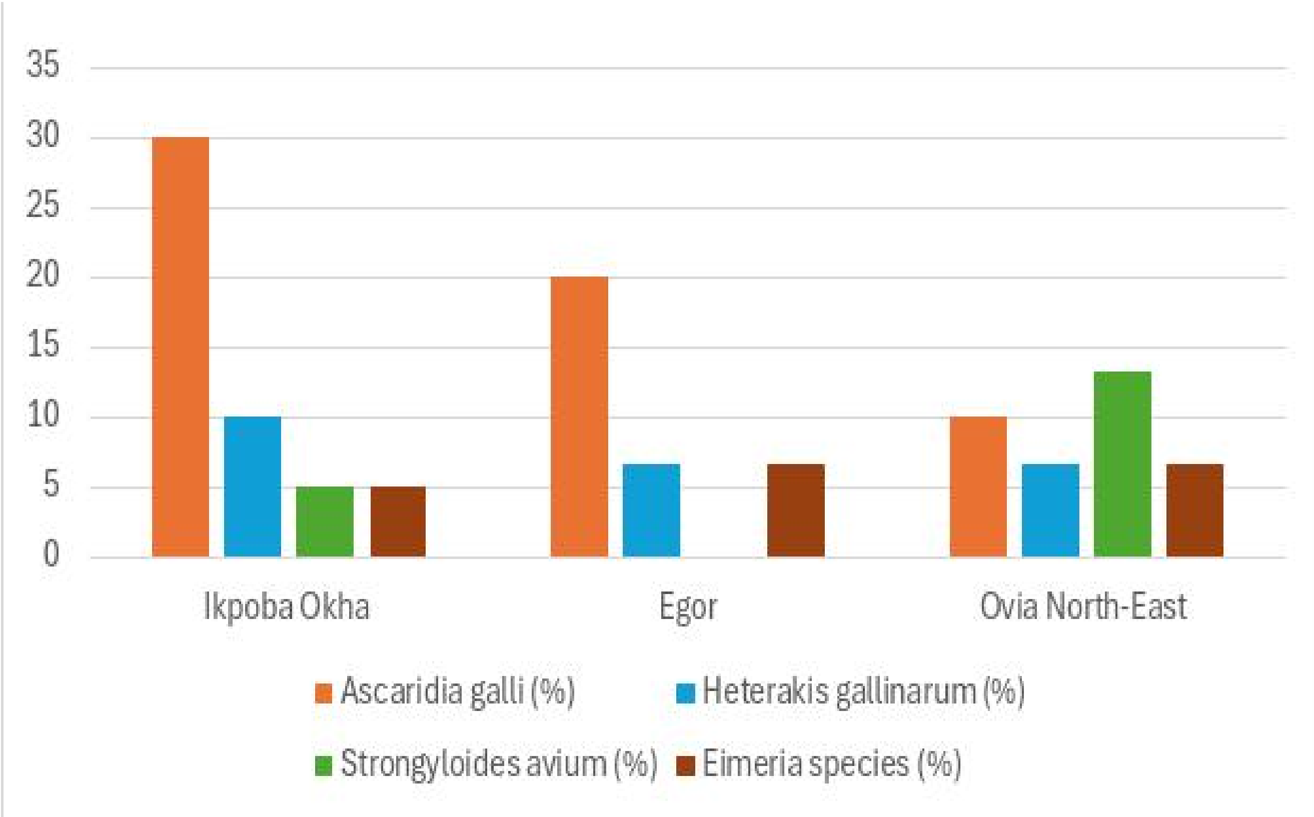

Figure 4.4 Percentage prevalence of intestinal parasites among Turkeys in the sampled LGAs in Benin City