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RESEARCH ARTICLE

Gastro-intestinal Parasites of *Capra hircus* Slaughtered in parts of Ijebu Ogun State, Nigeria

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Abstract

This study investigated the prevalence and species diversity of gastrointestinal (GI) parasites in domestic goats (*Capra hircus*) slaughtered at two (2) major abattoirs in Ijebu-Ode, Ogun State, Nigeria. Out of 104 faecal samples subjected to the sedimentation technique, an overall GI parasite prevalence of 78.8% was detected. Ten parasite species were identified, namely *Bunostoma* spp., *Capillaria* spp., Coccidia spp., *Fasciola hepatica*, *Haemochus contortus*, *Moneiza* spp., *Nematodirus*, *Taenia hydatigena*, *Trichuris ovis* and *Strongyloides* spp. with Coccidia spp. and *Trichuris ovis* being the most common (10.2% each), followed by *Fasciola hepatica* (7.3%). The abattoir located at Imowo-Eleran had the most prevalence with 70.2%. There was no significant relationship between the parasites found in the faecal samples collected and demographic factors (age or sex) ($p = 0.16$; 0.28). Mono-infections predominated (40.4%), but double and triple infections were also observed, indicating polyparasitism. Poor abattoir hygiene and management practices could likely contribute to the infection rates at the two abattoirs. This study underscores the need for improved parasite control strategies and in abattoirs to reduce GI parasite burdens in domestic goats in the study areas.

Keywords: *Abattoirs, Domestic goats, Gastrointestinal, Ogun State, Nigeria, Parasites*

1.0 Introduction

Globally, small ruminants, particularly goats (*Capra hircus*), are vital to livestock production systems. Livestock production accounts for approximately 40% of global agricultural Gross Domestic Product (GDP) and about 1.7% of Nigeria's national GDP [1], [2]. Within the Nigerian livestock systems, goats occupy a distinct economic and ecological niche because they are easy to domesticate, have higher feed conversion efficiency and can survive harsh conditions better than cattle and sheep [3], [4]. According to Akeju et al. [5], goat farming supports livelihoods by providing meat, milk and income. Recent data estimates the population of goats in Nigeria to be 57.3 million [3].

Gastrointestinal (GI) parasitism poses a significant threat to the health of goats and other livestock, imposing economic constraints on smallholder farmers and commercial producers alike [6]. Gastrointestinal parasites that have been reported to affect goats includes a wide range of helminths, including nematodes (such as *Haemonchus contortus*, *Teladorsagia circumcincta*, *Ostertagia ostertagi*, *Cooperia oncophora*), Trematodes/flukes such as *Fasciola hepatica*, *Paramphistomum* spp., *Dicrocoelium* spp., Lungworm (such as *Dictyocaulus viviparu*s), and cestodes (e.g., *Moniezia* spp., *Taenia hydatigena*). Protozoan parasites are also significant, particularly the coccidia such as *Dicrocoelium* spp. *and Eimeria* spp. [7], [8], [9], [10]. Transmission occurs when goats encounter or ingest food contaminated with infective stages of the parasites (e.g., eggs or cysts) [11]. Goats infected with GI parasites may exhibit clinical signs such as anaemia, diarrhoea, weight loss, reduced milk yield, reduced fertility, increased susceptibility to secondary infections, which may also lead to mortality in severe cases [6], [9], [10], [11], [12]. Subclinical effects include reduced feed efficiency, poor carcass quality, and lowered market value, all of which contribute to significant economic losses for farmers [12], [13], [8]. Many of these pathogens e.g., *Cryptosporidium* spp. and *Giardia* spp. carry zoonotic potential and can infect humans, especially through domestic and free-range goats as reported by Ikpe et al. [14] and Hatam-Nahavandi et al. [15] and through consumption of processed meat from goats and other livestock [9].

Globally, the prevalence of GI parasites is often elevated due to geographic and environmental conditions as reported by Adejinmi et al. [16] and Paul et al. [17], poor management practices by Akeju et al. [4], inadequate veterinary care service by Paul et al. [17] and feeding system by Rufino-Moya et al. [6] respectively. Studies by Matsepe et al. [5], Paul et al. [17] and Cai et al. [9] have also reported that infection patterns in goats vary by region, age, sex and husbandry system respectively. Various efforts to control GI parasitism in goats typically rely on anthelmintic treatment, traditional medicines, biological and chemical host control, grazing management and feed supplements and improved shelter sanitation [6], [12], [18]. However, these measures face challenges, such as antihelminth drug resistance, inconsistent implementation, and limited access to veterinary care in rural areas [19]. Unfortunately, while many existing studies have focused on extensive systems or on-farm populations as opined by Matsepe et al. [5] and Sebro et al. [12], abattoir-based surveillance remains underexplored. Currently, for Ijebu-Ode Ogun State, this study will be the first to scientifically document results of GI parasites associated with domestic goats in the study area. Therefore, this study aimed to identify the prevalence of various species of GI parasites and possible risk factors among domestically slaughtered goats across major abattoirs in Ijebu-Ode, Ogun State, Nigeria.

2.0 Materials and Methods

2.1 Description of the Study Area

This cross-sectional study was carried out in Ijebu-Ode Local Government Area (LGA) located in the eastern part of Ogun State Nigeria. The LGA can be described as a sub-urban and has an estimated population of 376,731. Abattoirs that cater to the needs of the general populace living in the parts of Ogun East division where livestock including cows, goats and sheep are slaughtered are situated in this LGA and two (2) of the abattoirs namely Imowo-Eleran and Sabo (Figure 1), were enrolled for the purpose of this study. Based on the existing structures, conditions and

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practices, theses abattoirs have been described by Oduyiga and Oduyiga [20] and Otto [21] to be unhygienic and unsatisfactory.

2.2 Study Design and Population

This cross-sectional study was carried out for a duration of four months between May and August, 2024. During the duration of the study, each study location was visited twice a month, making a total of sixteen visits made. A total of 104 domestic goats of both sexes consisting of 86 females and 18 males of varying age were enrolled into this study.

2.3 Faecal Sample Collection

Using the aid of fresh disposable gloves, fresh faecal samples were retrieved from the rectum of each domestic goat into sterile universal well-labelled samples. The consistency and colour of the samples were observed and documented. Information on the age and sex of each domestic goats were recorded. All samples were transported to the Zoology Laboratory of the Olabisi Onabanjo University, Ago-Iwoye to be processed. Samples not processed immediately were stored in a refrigerator at 4°C.

2.4 Identification of Gastrointestinal Parasites in the Laboratory

The faecal examination was conducted for the presence of helminths eggs, larvae, protozoan oocysts by using the sodium acetate-acetic acid-formalin methods as described by Mogaji et al. [22]. The identification of the various stages of parasites identified were done based on their characteristic morphology with the aid of Soulsby [23].

2.5 Data Analysis

The analysis focused on summarizing demographic characteristics (sex, age), prevalence and species-specific parasitic infections across sampled goats from abattoirs in the study area. Data analysis was conducted using R software (version 4.3.2). Descriptive statistics, including frequencies and percentages, were computed for categorical variables, while prevalence differences between locations were tested using Chi-square test, with P-value set at <0.05. The results were presented in tabular format to highlight comparisons across locations and inform location-specific patterns of parasitic infections.

2.6 Ethical Approval

After the approval for this study was obtained from the Ethics Review Committee of Faculty of Science, Olabisi Onabanjo University, Ago-Iwoye, an introductory letter from the Department of Zoology and Environmental Biology, Olabisi Onabanjo University Ago-Iwoye Ogun State, Nigeria was written to the head of the two abattoirs. Sensitization meetings were held in the presence of leaders of the abattoirs and the goat sellers on the need to carry out the study. The step-by-step procedure on sample collection and what they could stand to benefit from the results from the study was explained to them. Informal consents were given by the head of abattoirs and the consented goat sellers.

3.0 Results

A total of 104 domestic goats were recruited and sampled for this study out of which females 86 (83.0%) comprised the total population (Table 1). Furthermore, the mean age of the domestic goats was 2.85 and the standard deviation was 0.32 months. In terms of the location of the abattoirs, more (57.7%) of the faecal samples were retrieved from the abattoir at Imowo-Eleran. Out of the 104 faecal samples, it was detected that an overall 82 (78.8%) were positive for either cysts, eggs, oocysts or larvae. Across the study locations, Imowo-Eleran had the most prevalence of GI parasites with 70.7% (Table 2). In terms of the type of parasitic infections, mono-infections were detected to occur the most with 42(40.4%). Across the study locations, Imowo-Eleran contributed the more with 66.7%,72.2% and

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100% to mono-infections, double infections and triple infections respectively. There were significant differences across the type of parasitic infections across the study locations (p = 0.003). In relation to sex and age, the female goats from Imowo-Eleran abattoir were more infected than those from Sabo abattoir while goats from Imowo-Eleran who were >24 months were more infected (Figure 2).

In Table 3, a total of ten (10) different parasites were associated with goats slaughtered from the two abattoirs. Variations in prevalence were observed across parasite species, though none of the differences were statistically significant. For mono-infection, Coccidia spp. and *Trichuris ovis* were the most common with 10.2% and 10.2% respectively while the least prevalence was common in *Bunostoma* spp., *Haemochus contortus*, *Taenia hydatigena* and *Strongyloides* spp. with 2.4%, 2.4%, 2.4% and 2.4% respectively. In terms of double infection, *Fasciola hepatica* + Coccidia spp. and *Trichuris ovis* + Coccidia spp. was the most common with 7.3% and 7.3% respectively while *Nematodirus* + *Moneiza* spp + *Trichuris ovis* (the only triple infection) was detected in goats in Imowo-Eleran abbatoir.

4.0 Discussion

Gastrointestinal parasitism (GI) remains a significant constraint to the health and productivity of small ruminants globally. This study presents valuable cross-sectional prevalence data of GI parasites affecting domestic goats slaughtered in major abattoirs in Ijebu-Ode, Ogun State, southwestern Nigeria. The results of this study may reflect broader epidemiological trends in the region. Ten species of GI parasites were identified in this study, namely: *Bunostoma* spp., *Capillaria* spp., Coccidia spp., *Fasciola hepatica*, *Haemochus contortus*, *Moneiza* spp., *Nematodiruss* spp., *Taenia hydatigena*, *Trichuris ovis* and *Strongyloides* spp.

An overall infection rate of 78.8% in the present study indicates a high prevalence of GI parasites among goats in the study area. Although this prevalence is high, it is lower than what was reported in other parts of Nigeria, including 86.7% in Shendam, Plateau State by Gofwan et al. [24], 95.33% in Makurdi by Ikpe et al. [14] and 96.7% in Abeokuta by Ogudo et al. [25] respectively. Conversely, it exceeds the prevalence rates recorded in Ibadan (75.75%) by Adejinmi et al. [16], 66.7% in Akoko, Ondo State by Ajakaye and Ajakaye [26], 75% in Minna by Eke et al. [27], 75.5% in Port Harcourt by Owhoeli et al. [28] and a notably lower prevalence of 23.33% in Akure by Akeju et al. [4]. On a global comparison, the prevalence is also lower than 94.7% reported by Matsepe et al. [5] in Lesotho, 91.6% in China by Cai et al. [9], 87.25% in Nepal by Ghimire and Bhattarai [29], 61.82% in Bangladesh by Bhowmik et al. [30], 70.28% in Ethiopia by Sebro et al. [12], 37.1% in South Africa by Mpofu et al. [31] and 30% recorded in Iran by Hatam-Nahavandi et al. [15]. The high prevalence observed in this study could be attributed to the poor management practices prior to slaughter, ranging from how they were raised, fed and transported as and according to Akeju et al. [4] goats reared under free-range systems are more susceptible to parasitic infections and this confirms that GI parasitism remains a pervasive challenge within goat-rearing systems in Nigeria. The implications of our results imply that the infected goats will shed the various stages of the GI parasites alongside their faeces which in turn contaminate the environment. *Coccidia* spp. and *Trichuris ovis* were the most prevalent parasites (10.2% each), followed by *Fasciola hepatica* (7.3%). The observed 10.2% for *Coccidia* spp. was lower than the prevalences of 38.5% and 48.6% reported in previous studies by Adejinmi et al. [16] and Gofwan et al. [24] in goats sampled respectively at Oyo and Plateau, Nigeria. These results did not corroborate with the result by Ogudo et al. [25], who found strongyle worms to be the most prevalent (93.3%). At any rate, these observations confirm that protozoan and nematode infections are prevalent in goats in Nigeria and worldwide.

The presence of coccidia implies that there are poor hygienic conditions and overcrowding in the studied abattoirs. This also corroborates with the study reported by Adejinmi et al. [16]. *Coccidia* spp. is the causative organism of coccidiosis, which is a protozoan disease of significant economic concern. Pathogenic species includes: *Cryptosporidium parvum*, *Eimeria arloingi*, *Eimeria ninakohlyakimovae*, *Eimeria christenseni, Eimeria caprina*

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amongst others. The severity of the disease depends not only on the species involved but also on the number of oocysts (eggs) ingested, the age of the goat, and its overall health and stress levels. It mostly affects young animals of age less than 12 months old, and transmission occurs via the faecal-oral route [32]. This condition whose clinical sign is severe diarrhoea can lead to dehydration, growth retardation and reduced productivity in goats and other ruminant animals. Although characterization was not done for the Coccidia spp, in addition to the microscopy method, we recommend that modified Ziehl Nelsen method and Polymerase Chain Reaction be used for species identification and confirmation for protozoan parasites.

Trichuris ovis infecting the colon and caecum of ruminant animals and has been reported globally [33]. Although it appears relatively harmless, clinical manifestations include damage to intestinal walls, anaemia, dehydration, jaundice and mortality in severe cases. *Fasciola hepatica* which causes fasciolosis was also found in this study. Its association with damage to the liver and bile ducts of livestock may also increase their susceptibility to other infections. Overall, these collectively results in compromised health, economic loss and production loss for farmers [34]. Similarly, the presence of *Trichuris ovis* and other nematodes, such as *Haemonchus contortus* and *Nematodirus* spp. further highlights the ongoing importance of helminthiasis, which remains a significant GI parasite affecting goats in Nigeria.

The presence of mono-infections (40.4%), double infections (34.6%) and triple infections (3.8%) suggest that while individual parasitic species can establish infections independently, co-infections are not uncommon. This pattern aligns with findings by Gofwan et al. [24] and Ogudo et al. [25], who reported mixed helminthic and protozoan infections among goats respectively in Abeokuta, Ogun State and Shendam, Plateau State both in Nigeria. The presence of polyparasitism complicates clinical symptoms, diagnosis, and control. Interactions between different parasites can exacerbate pathophysiological effects on the host animal. For instance, coinfections of *Fasciola hepatica* and *Coccidia s*pp., *Trichuris ovis* and *Coccidia* spp., both recorded at 7.3% in this study, as well as triple infection with *Nematodirus*, *Moneiza* spp. and *Trichuris ovis* could result in compounded clinical and subclinical manifestations.
Overall, GI parasite prevalence was higher in goats sampled from the Imowo-Eleran abattoir compared to Sabo, with significantly more cases of mono, double, and triple infections detected ($p = 0.003$). These observed differences might be due to various factors including source of animals, holding conditions or pre-slaughter management practices. Previous studies by Oduyiga and Oduyiga [20] and Otto [21] in Ijebu-Ode, Ogun State Nigeria documented suboptimal hygienic practices and poor drainage systems at Imowo-Eleran which could also support transmission. The higher infection rates in older goats (>24 months) and females may suggest chronic exposures over time and possibly a higher susceptibility linked to physiological stresses such as reproduction or lactation. These demographic trends have also been reported in studies by Piratheepan [35] reinforcing the need for age- and sex-specific control strategies.

Current control efforts, particularly reliance on anthelmintics Piratheepan [35], are increasingly undermined by drug resistance and poor application practices [36]. The presence of multiple parasite species and co-infections suggests the lack of or inadequacy of effective mono-therapeutic regimens and emphasises the need for integrated parasite management. Other control methods like grazing management could be explored. Despite these findings, gaps remain in understanding the source of infections, the resistance status of the parasites is warranted.

Conclusion

This study, carried out in Ijebu-Ode, Ogun State Nigeria reaffirms the high burden and species diversity of GI parasites among domestic goats in Nigeria and globally. This study has important implications for animal health, public health (in zoonotic cases), and the economic viability of goat production. From the results from this study, it is important to intensify tailored deworming programs, integrated parasite control measures and strategic improvements in abattoir

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hygiene. Addressing these factors and complementing them with adequate veterinary extension services could substantially reduce the parasitic burden and improve the productivity and welfare of goats in this region and beyond.

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Conflict of interest

The authors declare no conflict of interest.

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APPENDICES:

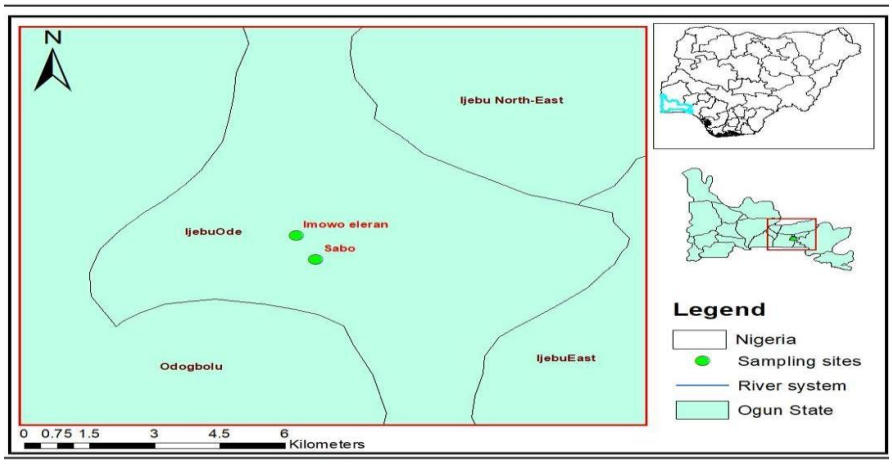

Figure 1: Map showing the studied abattoirs studied plotted using the geographical coordinates in Ijebu-Ode Local Government Area of Ogun State, Nigeria

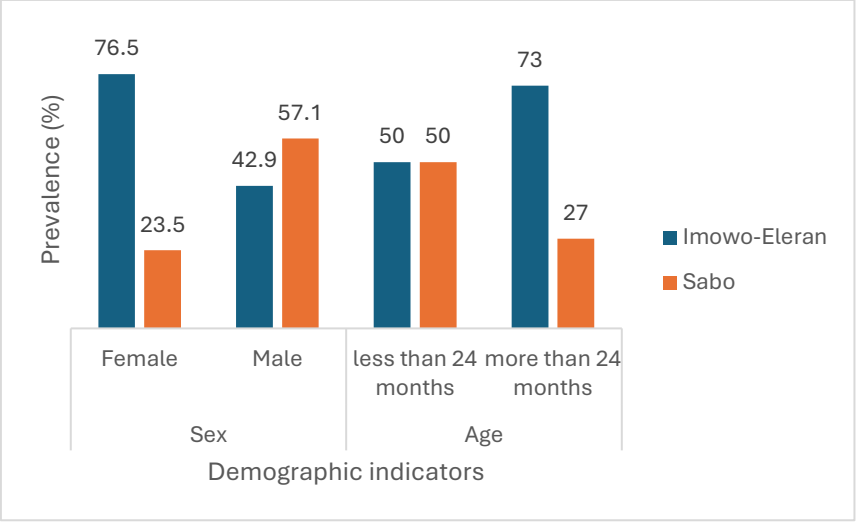

Figure 2: Distribution of positive samples according to sex and age across the two abattoirs in Ijebu-Ode Local Government Area of Ogun State, Nigeria

Table 1: Demographic factors of sampled domestic goats from two abattoirs in Ijebu-Ode Local Government Area of Ogun State, Nigeria

Demographic factors	N = 104 (%)	**Abattoir Locations** **Imowo-Eleran**, N = 60 (57.7)	**Sabo**, N = 44 (42.3)	**p-value**
Sex				0.26
Female	86 (83.0)	54 (62.8)	32 (37.2)	
Male	18 (17.0)	6 (33.3)	12 (66.7)	
Age (in months)				>0.99
≤24 months	20 (19.3)	12 (60.0)	8 (40.0)	
>24 months	84 (80.7)	48 (57.1)	36 (42.9)	

N- Total number of sampled domestic goats; % - Percentage

Table 2: Prevalence of Gastrointestinal parasites in faeces from *Capra hircus* in Ijebu-Ode Local Government Area of Ogun State, Nigeria

Status of infection	**N = 104** (%)	**Abattoir Locations** **Imowo-Eleran**, N = 60 (%)	**Sabo**, N = 44 (%)	**p-value**
				0.38
Negative	22 (100)	2 (9.1)	20 (90.9)	
Positive	82 (100)	58 (70.7)	24 (29.3)	
Total	**104 (100)**	**60 (57.7)**	**44 (42.3)**	

N – Number of samples; % - Percentag

Table 3: Species-prevalence of parasitic infections in goats across abattoirs in Ijebu-Ode Local Government Area of Ogun State, Nigeria

Type of infection	**Name of Parasite**	**Abattoir Locations** **Imowo-Eleran, N = 58 (%)**	**Sabo, N = 24 (%)**	**Total, N = 82 (%)**
Mono infection	*Bunostoma* spp.	2 (3.4)	0 (0)	2 (2.4)
	Capillaria spp	4 (6.8)	0 (0)	4 (4.8)
	Coccidia spp.	2 (3.4)	6 (25.3)	8 (10.2)
	Fasciola hepatica	6 (10.6)	0 (0)	6 (7.3)
	Haemochus contortus	2 (3.4)	0 (0)	2 (2.4)
	Moneiza spp.	4 (6.8)	0 (0)	4 (4.8)
	Nematodirus	2 (3.4)	2 (8.3)	4 (4.8)
	Taenia hydatigena	0 (0)	2 (8.3)	2 (2.4)
	Trichuris ovis	6 (10.6)	2 (8.3)	8 (10.2)
	Strongyloides spp.	0 (0)	2 (8.3)	2 (2.4)
Double infection	*Bunostoma* spp. + *Coccidia* spp.	2 (3.4)	0 (0)	2 (2.4)
	Bunostoma spp. + *Moneiza* spp	4 (6.8)	0 (0)	4 (4.8)
	Capillaria spp. + *Moneiza* spp.	2 (3.4)	0 (0)	2 (2.4)
	Fasciola hepatica + *Coccidia* spp.	6 (10.6)	0 (0)	6 (7.3)
	Haemochus contortus + *Coccidia* spp.	0 (0)	2 (8.3)	2 (2.4)
	Taenia hydatigena + *Coccidia* spp.	2 (3.4)	2 (8.3)	4 (4.8)
	Trichuris ovis + *Coccidia* spp.	4 (6.8)	2 (8.3)	6 (7.3)
	Strongyloides spp. + *Coccidia* spp.	2 (3.4)	2 (8.3)	4 (4.8)
	Fasciola hepatica + *Moneiza* spp.	0 (0)	2 (8.3)	2 (2.4)
	Nematodirus + *Moneiza* spp.	2 (3.4)	0 (0)	2 (2.4)
	Trichuris ovis + *Moneiza* spp.	2 (3.4)	0 (0)	2 (2.4)
Triple infection	*Nematodirus* + *Moneiza* spp. + *Trichuris ovis*	4 (6.8)	0 (0)	4 (4.8)
	Total	**58 (70.7)**	**24 (29.3)**	**82 (100)**

N – Number of samples; % - Percentage