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Haemoparasites and Polyparasitism of Intestinal Helminths among Cattle Slaughtered in Selected Abattoirs in Abeokuta, Ogun State.

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ABSTRACT

Background: Haemoparasites and intestinal helminths are significant constraints to livestock production resulting in substantial economic loss, and some helminth parasites of cattle are of serious public health concern. This study investigated the prevalence of haemoparasites and polyparasitism of intestinal helminths amongst cattle slaughtered in two major abattoirs of Abeokuta metropolis and their implications for public health.

Methods: Blood and faecal samples were randomly collected from 256 cattle less than two and greater than two years of age. Blood samples were screened for Packed Cell Volume (PCV) using the haematocrit centrifuge technique and parasites were detected by microscopy using a wet mount, buffy coat and stained thin smear. Helminth eggs and oocysts were detected using centrifugal sedimentation and centrifugal faecal flotation method.

Results: Results showed prevalence for *Trypanosoma* spp., *Babesia* spp., *Anaplasma* spp. and *Theileria* spp. to be 8.3%, 27.34%, 20.7% and 0.39%, respectively. For intestinal parasites, the prevalence for *Strongyle* eggs is 73.82%, *Neoascaris vitulorum* 0.8%, *Fasciola* spp. 10.15%, *Moniezia* spp. 4.3%, *Eimeria* oocyst 35.94% and *Cryptosporidium* oocyst was 1.17%. The total prevalence of coinfection of haemoparasite and intestinal helminths was 42.6%. Breed-specific prevalence for co-infection of haemoparasites and intestinal parasites showed 55.96%, 37.6% and 6.4% for White Fulani, Red Bororo and Sokoto Gudali, respectively which was statistically insignificant ($p > 0.05$). With regards to sex, females had a higher prevalence of 92 (84.4%) of coinfection of haemoparasites and intestinal helminths than males 17 (15.6%), which was statistically significant ($p<0.05$).

Conclusion: This study revealed a high prevalence of haemoparasites and intestinal parasites in cattle slaughtered in Abeokuta, Nigeria. Therefore, the study recommends strict compliance with meat inspection at abattoirs and the need for immediate operationalisation and implementation of a sustainable Preventive One Health intervention to mitigate against the outbreak of zoonoses in Abeokuta.

Keywords: Prevalence, Haemoparasites, Intestinal helminths, Cattle, Abeokuta

1. INTRODUCTION

In Nigeria, ruminants such as the sheep, goats and cattle constitute the livestock reared mainly by farmers in the agricultural sector of the country, with sheep having a population of 38.5million, 57.4million goats and 19.2 million cattle [1] with a larger population of these animals concentrated mainly in the northern region of the country than the south [2]. Among the ruminants, cattle are regarded as the primary source of animal protein in most households. Their products, such as milk, hoof, bones, blood, hides and skin, have significant economic benefits [3]. About 90% of the cattle population in Nigeria are raised under Fulani herders' pastoral husbandry system [4]. Under the pastoral husbandry system, where cattle are extensively grazed on pastures and forests, cattle may be exposed to various arthropod vectors of haemoparasites [5]. Livestock rearing is faced with many constraints that limit productivity and profitability [6]. A leading constraint to livestock production is animal diseases which constitute a major obstacle to economic development and of importance is parasitism, a leading cause of production losses due to mortality, reduction in weight gain, and low fertility in most countries of the world [4].

Haemoparasites are found in the bloodstream and tissues of vertebrates throughout the world [7]. Haemoprotozoan diseases especially Babesiosis, Anaplasmosis, Trypanosomiasis and Theileriosis are major diseases causing major constraints to the health and productivity of cattle [8]. Even though there is a global distribution of haemoparasites, the distribution of these infections changes continuously due to the migration and transportation of vectors and animals and an increased globalization of both live animals and their products [9]. Several studies have been conducted on haemoparasites in Nigeria. Imalele et al. [10], in their study on the prevalence of haemoparasites in cattle slaughtered for sale in Calabar reported a prevalence of 11.66%. Akande et al. [11] in their study on the prevalence of haemoparasites in Abeokuta reported an overall infection of 51%. In another study by Okwelum et al. [12] in Abeokuta, the prevalence of haemoparasites in slaughtered cattle was reported to be 22%.

Helminthic infection, according to Faye et al. [13], is a cosmopolitan disease that affects ruminants, most particularly in places with poor hygiene and feeding. The gastrointestinal parasites, mainly helminths are responsible for the clinical and subclinical manifestation of diseases in livestock and this has been a major impedance to livestock production in Nigeria [14]. Gastrointestinal parasites of cattle have caused production loss to livestock by retarding the growth, lowering productivity, and increasing the susceptibility of animals to other infections [15]. Lowered fertility, reduced work capacity, involuntary culling and treatment cost are other indirect economic losses due to gastrointestinal parasites [16]. According to Zahid et al. [16], intestinal helminths of ruminants are mostly nematodes such as *Trichuris* species, *Strongylioides* species, *Capillaria* species, *Ostertagia* species; cestodes such as *Moniezia* species, *Taenia* species; and trematodes such as *Fasciola gigantica*, *Dicrocoelium* species. Weakness of the body, abdominal pains, anorexia, diarrhoea, constipation, loss of weight, jaundice, rough hair coat, anaemia, coughing, labour breathing, fever, haemoglobinuria, infertility, abortion and sudden death are clinical manifestations of haemoparasites and gastrointestinal parasites of cattle noted by Otto et al. [17], Love & Hutchinson [18] and Otto [19].

In Ogun state, separate studies on haemoparasites and intestinal helminths have been previously conducted. However, there is a need to continually have updated information on the prevalence of haemoparasites and intestinal helminths, especially in cattle slaughtered in the Abeokuta metropolis. Also, this study became imperative considering the emphasis on food safety and animal health by the Food and Agriculture Organization (FAO). The data from this study will therefore provide important and updated information on the prevalence of haemoparasites and intestinal helminths in cattle slaughtered in Abeokuta, their implications for public health, and epidemiological data for effective surveillance and control of zoonotic diseases in Abeokuta metropolis.

2. METHODOLOGY

2.1 The Study Area

The study was conducted in two major abattoirs in Abeokuta metropolis, the Ogun state capital. The Lafenwa abattoir (70°09'46" N and 3°19'40" E) is located in Abeokuta North local government area of Ogun State, Nigeria and Aladesanmi (Asejere) abattoir in Abeokuta South Local Government (7°09'45" N and 3°22'33" E). These two abattoirs are the major abattoir in the Abeokuta metropolis, with the Lafenwa abattoir slaughtering an average of 100 cattle a day.

2.2 Study Design and Selection of Cattle

The survey of haemoparasites and polyparasitism of in-

testinal parasites in cattle slaughtered in the two abattoirs was carried out between February 2021 and June 2021. 256 cattle were randomly selected and tagged from the lots prepared for daily slaughter. The samples cut across both sexes and different cattle breeds, including White Fulani, Sokoto Gudali, Red Fulani, Crossbreed, and N'Dama. The cattle were grouped into < 2years and > 2years using their dentition. Butchers and cattle owners were interviewed for findings on livestock management practised in study areas.

2.3 Ethical Approval

Approval and permission for the study were given by the ethics committee of the Veterinary Services Unit of the Ogun State Ministry of Agriculture, Abeokuta, Ogun State.

2.4 Blood Sample Collection

About 5ml of blood samples were collected from the animal's jugular vein at the point of slaughtering in a sterile ethylene diamine tetraacetic acid (EDTA) tube, which was labelled immediately with the location, breed, sex and age of the cattle and placed in the ice pack. The samples were then transported within an hour of collection to the laboratory of the Department of Veterinary Microbiology and Parasitology, Federal University of Agriculture, Abeokuta, for laboratory analysis.

2.5 Faecal Sample Collection

100g of faecal samples were obtained directly from the rectum of each animal with the use of a hand glove. The samples were immediately labelled with the location, breed, sex, and age of the cattle before being transferred into a clean disposable polythene bag and transported in an ice pack to the Department of Veterinary Microbiology and Parasitology laboratory at the Federal University of Agriculture, Abeokuta for laboratory analysis.

2.6 Blood Sample Analysis

The Packed Cell Volume (PCV) of the blood samples was done to check for anaemia using the technique of Schalm et al. [20]. The haemoparasites were detected using three techniques. The techniques are wet mount, stained thin blood smear and the buffy coat as prescribed by Cheesbrough [21]. The wet mount specimens and buffy coats were examined using the X10 and X40 objective lens, while the thin blood smears were examined using the X100 objective lens. Haemoparasites were identified using morphologic keys as described by Soulsby [22].

2.6.1 Packed Cell Volume

The EDTA tube containing the blood sample was held at an angle to mix the blood sample, and the index finger was placed on top of the capillary tube to track blood into the capillary tube until it was about ¾ full. The outside of the capillary tube was wiped with clean tissue, and the capillary tube was placed on the plasticine (sealant) and gently pressed into the plasticine. The capillary tubes were placed in the Hawksley haematocrit centrifuge with the plasticine end of the capillary tubes placed against the rubber (outer) edge to stop the blood from spilling out when spun. It was centrifuged at 12000rpm for 5mins. Once the centrifuge came to a complete stop, the lid was opened, and the tubes were checked to ensure there were no leakages. Each capillary tube was then removed and placed on the haematocrit reader. The tube was adjusted on the slider to level the top of the plasticine with the bottom line (0%). The slider was also moved to the top of the plasma fraction levels with the top line. The adjuster on the left was used to align the middle line with the top of the red cells. The PCV was read from the right-hand side scale.

2.6.2 Wet Mount

A drop of blood was dropped on a clean objective glass slide using a plastic pipette. This was then covered with a coverslip and immediately examined under the microscope using the x10 and x40 objective lens.

2.6.2 Buffy Coat Technique

After centrifuging, the blood in the capillary was separated into three distinct layers, plasma at the top, the buffy coat at the middle and the red cells at the bottom. The capillary tube was broken at the red blood cell layer just about 1mm below the buffy coat. This was carefully done by pressing and running the sharp edge of an objective glass slide over the capillary tube. The buffy coat with the adjacent plasma was transferred into an objective glass slide, mixed and covered with a coverslip (18 x 18mm), and examined for motile trypanosomes under a microscope using x10 and x40 objective lenses.

2.6.3 Thin Blood Smear

A capillary tube was used to place a drop of blood on one end of a clean objective glass slide. Using a clean smooth -edged glass objective slide as a spreader, the spreader was drawn back to touch the drop of blood and the blood was allowed to extend along the edge of the spreader. Holding the spreader at about an angle 30°, the drop of blood was spread to make a film about 40–50 mm in

length (two-thirds of the slide). The film was left for a few minutes to air dry, and the specimen number was written on the film for easy identification. The film was placed on a staining rack, fixed in absolute methanol, and allowed to dry. After drying, reverse staining with Field Stain A and B was done and left to dry after which it was viewed under the X100 objective lens.

2.7 Faecal Sample Analysis

Collected faecal materials were subjected to centrifugal sedimentation technique and centrifugal faecal flotation technique according to Zajac & Conboy [23].

2.7.1 Centrifugal Sedimentation Technique

10g of faeces was put in a dish container and emulsified with 100mL of water. The faecal sample was sieved through a tea strainer into a beaker. It was then poured into a 15mL centrifuge tube until three-quarters full. It was centrifuged for 5 minutes at 1500rpm. After centrifugation, the supernatant was discarded, leaving the sediments. Using the Pasteur pipette, a few drops of the sediment were placed on a glass objective slide, covered with a coverslip and viewed under the x10 and x40 objective lens.

2.7.2 Centrifugation Flotation Technique

Salt/sugar solution was used as a flotation solution. It has a specific gravity of 1.28. This was prepared by dissolving 400g of Sodium Chloride in 1000mL of distilled water to make a saturated solution. 500g of sugar was then added to the saturated salt solution and stirred until the sugar was fully dissolved.

Flotation solution was poured into the sediment inside the 15mL centrifuge tube until it was almost full and was centrifuged for 5 minutes at 1500rpm. After centrifugation, the tube was removed from the centrifuge and placed in a test tube rack. Additional flotation solution was added until it formed a reverse meniscus at the top of the tube. Coverslip was immediately placed on the tube and allowed to sit for 5 to 10 minutes before removing the coverslip and placed on an objective glass slide for viewing under the microscope using the x10 and x40 objective lens. Helminth eggs were identified according to the protocols earlier described by Soulsby [22] and Thienpoint [24].

2.8 Data Analysis

The data obtained from the study were analysed descriptively using the IBM SPSS 21 software package. Descriptive statistics were deployed to determine the prevalence estimates and chi-square analysis to compare the demographic variables with prevalence estimates. Geospatial distribution was done using Arc GIS software 9.0 software. The mean Packed Cell Volume (PCV) was ascertained using a t-test. The significant level was set at $P \leq 0.05$.

3 RESULTS

3.1 The demographic information of cattle in the study area

A total of 256 cattle were examined for haemoparasites and intestinal helminths. According to sample distribution, 217 (84.8%) blood and stool samples were collected in Lafenwa, while 39 (15.2%) were collected in Aladesanmi abattoirs. In the sex category, 57 (22.3%) were male, while 199 (77.7%) were female. 246 (96.1%) were above two years by age category, while 10 (3.9%) were below two years. Distribution by breed reflected that 149 (58.2%), 87 (34.0%), 17 (6.6%), 2 (0.8%) and 1 (0.4%) of cattle were white Fulani, Red Bororo, Sokoto gudali, N'dama and crossbreed respectively. (Table 1)

Table 1: Demographic information of cattle in the study area

Location	No examined (%)
Lafenwa	217 (84.8)
Aladesanmi	39 (15.2)
Total (%)	256 (100)
Sex	
Male	57 (22.3)
Female	199 (77.7)
Total (%)	256 (100)
Breed	
White Fulani	149 (58.2)
Red Bororo	87 (34.0)
Sokoto Gudali	17 (6.6)
N'dama	2 (0.8)
Crossbreed	1 (0.4)
Total (%)	256 (100)
Age	
> 2	246 (96.1)
< 2	10 (3.9)
Total (%)	256 (100)

3.2 Prevalence of Haemoparasites in the Study Areas

A total of 138 (53.9%) of the 256 samples examined had one or more haemoparasites. 129 (50.4%) cattle were positive for a single infection, while 9 (3.5%) were positive for coinfection of haemoparasites. The haemopara-

sites detected using the thin stained smear, buffy coat, and wet mount method were *Babesia* spp. 71 (27.7%), *Trypanosoma* spp. 21 (8.2%), *Anaplasma* spp. 53 (20.7%), and *Theileria* spp. 2 (0.8%). *Babesia* spp was the most prevalent single infection 65 (25.4%,) while *Babesia* spp and *Trypanosoma* spp 6 (2.34%) were the most prevalent mixed infection (Table 2).

Table 2: Prevalence of Haemoparasites in Study Area

Haemoparasite	No. +ve (%)
Babesia spp.	65 (25.4)
Trypanosoma spp.	12 (4.7)
Anaplasma spp.	50 (19.5)
Theileria spp.	2 (0.8)
Babesia spp. + *Trypanosoma* spp.	6 (2.3)
Anaplasma spp. + *Tryapanosoma* spp.	3 (1.2)
Total (%)	138 (53.9)

3.3 Cumulative Prevalence of Haemoparasites across breed, sex, age and geo-location in the study area

Regarding sex, females had the highest prevalence of *Babesia* 59 (29.6%), *Trypanosoma* 17 (8.5%), *Anaplasma* 44 (22.1%) and *Theileria* 2 (1.0%). With regards to breed, Sokoto gudali had the highest prevalence of 8 (47.1%) of *Babesia* spp., followed by the while Fulani 41 (27.5%), while the red bororo 8 (9.2%) had the highest prevalence of *Trypanosoma* spp. They were followed by white Fulani 12 (8.1%). However, the differences in prevalence across breed, sex, age, and location for all the haemoparasites were insignificant (p> 0.05). (Table 3)

3.4 Prevalence of co-infecion of haemoparasites

About breed, white Fulani had the highest prevalence 5 (2.0%) of coinfection, followed by the red Bororo 3 (1.2%); however, using statistical analysis, the difference was found to be insignificant (p>0.05). Concerning sex, females had a higher prevalence of 7 (2. of 7%) of coinfection than males 2 (0.8%), and this difference was found to be significant (p<0.05). With respect to location, cattle at the Lafenwa abattoir had a higher prevalence of 9 (3.5%) of coinfection of haemoparasites than the Aladesanmi abattoir, which recorded a 1 (0.4%) prevalence. The difference in prevalence was found to be significant (p<0.05) (Table 4)

3.5 Relationship between haemoparasite infection and the PCV

The mean PCV of the infected was 26.46, while for non-infected was 29.28. The mean PCV of those infected was significantly lower than those uninfected (P<0.05). This means that low PCV could indicate the presence of haemoparasites in cattle. (Fig. 1)

Table 3: Cumulative prevalence of haemoparasites across breed, sex, age and location in the study area

	No examined	*Babesia* spp. (%)	*Theileria* spp. (%)	*Anaplasma* spp. (%)	*Trypanosoma* spp. (%)
SEX					
Male	57	12 (21.1)	0 (0)	9 (15.8)	4 (7.0)
Female	199	59 (29.6)	2 (1.0)	44 (22.1)	17 (8.5)
Total (%)	256	71 (27.7)	2 (0.8)	53 (20.7)	21 (8.2)
P value		P =0.24	P =0.44	P =0.29	P =0.7
AGE					
> 2	246	69 (28.0)	2 (0.8)	51 (20.7)	19 (7.7)
< 2	10	2 (20.0)	0 (0)	2 (20)	2 (20)
Total (%)	256	71 (27.7)	2 (0.8)	53 (20.7)	21 (8,2)
p-value		P =0.57	P =0.77	P =0.95	P =0.16
BREED					
White Fulani	149	41 (27.5)	2 (1.34)	30 (20.1)	12 (8.1)
Red Bororo	87	21 (24.1)	0 (0)	22 (25.3)	8 (9.2)
Sokoto Gudali	17	8 (47.1)	0 (0)	1 (5.9)	1 (5.9)
N'dama	2	0 (0)	0 (0)	0 (0)	0 (0)
Cross Breed	1	1 (100)	0 (0)	0 (0)	(0)
Total (%)	256	71 (27.7)	2 (0.8)	53 (20.7)	21 (8.2)
P value		P =0.13	P =0.83	P =0.38	P =0.97
LOCATION					
Aladesanmi	39	7 (17.9)	0 (0)	6 (15.4)	4 (10.3)
Lafenwa	217	64 (29.5)	2 (0.9)	47 (21.7)	17 (7.8)
Total (%)	256	71 (27.7)	2 (0.8)	53 (20.7)	21 (8.2)
p-value		P =0.17	P =0.54	P =0.37	P =0.61

Table 4: Prevalence of coinfection of haemoparasites

	No. examined	No infected (%)	Single infection (%)	Co-infection (%)
SEX				
Male	57	23 (9.0)	21 (8.2)	2 (0.8)
Female	199	115 (44.9)	108 (42.2)	7 (2.7)
Total (%)	256	138 (53.9)	129 (50.4)	9 (3.5)
P value				$p = 0.02$
AGE				
> 2	246	132 (51.6)	123 (48.05)	9 (3.5)
< 2	10	6 (2.3)	6 (2.3)	0 (0)
Total (%)	256	138 (53.9)	129 (50.35)	9 (3.5)
P value				$p = 0.12$
BREED				
White fulani	149	80 (31.3)	75 (29.3)	5 (2.0)
Red Bororo	87	48 ((18.8)	45 (17.6)	3 (1.2)
Sokoto Gudali	17	9 (3.5)	8 (3.1)	1 (0.4)
N'dama	2	0 (0)	0 (0)	0 (0)
Cross Breed	1	1 (0.39)	1 (0.39)	0 (0)
Total (%)	256	138 (53.9)	129 (50.39)	9 (3.6)
P value				$p = 0.29$
LOCATION				
Aladesanmi	39	16 (6.2)	15 (5.9)	1 (0.4)
Lafenwa	217	122 (47.7)	113 (44.1)	9 (3.5)
Total (%)	256	138 (53.9)	128 (50.0)	10 (3.9)
P value				$p = 0.08$

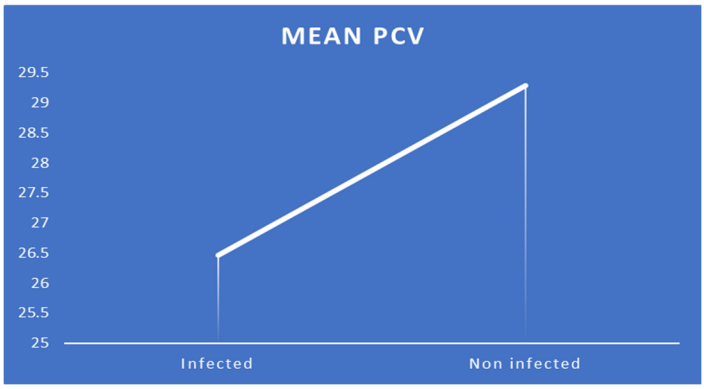

Figure 1: Relationship between haemoparasite infection and PCV

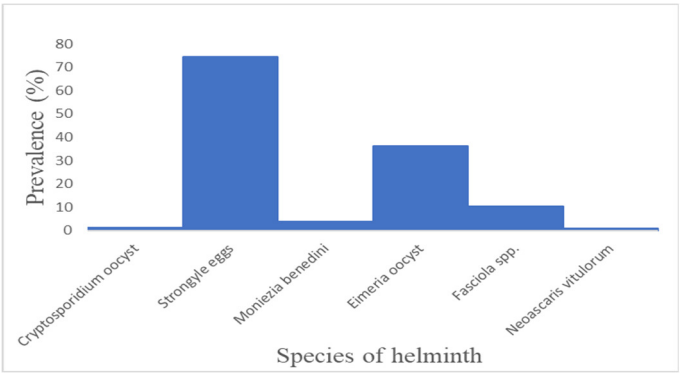

Fig 2: Prevalence of intestinal helminths in study area

3.6 Prevalence of intestinal helminths in study area

Helminths detected include *Strongyle* eggs, *Eimeria* oocyst, *Moniezia benedeni*, *Fasciola* spp., *Neoascaris vitulorum* and *Cryptosporidium* oocyst. Of the 256 samples analysed, *Strongyle* eggs had the highest prevalence, 191 (74.6%), and *Neoascaris vitulorum* had the lowest prevalence, 2 (0.8%). *Moniezia benedeni*, *Eimeria* oocyst, *Fasciola* spp. and *Cryptosporidium* oocyst had a prevalence of 10 (3.9%), 93 (36.3%), 26 (10.2%) and 3 (1.2%), respectively (Fig. 2)

3.7 Distribution of coinfection of intestinal helminths infection in Study Area

The total prevalence of intestinal helminths was 209 (81.64%). A total of 112 (43.8%) had a single infection of an intestinal parasite. 84 (32.81%) had a double infection of the intestinal parasite, while 13 (5.07%) had multiple infections of intestinal helminths (more than two infections of helminth) (Fig. 3).

3.8 Polyparasitism of Intestinal Helminths across breed, sex, age and location

With respect to breed, White Fulani had the highest prevalence of double infection 45 (30.2%), followed by the Red Bororo with the prevalence of double infection 33 (37.9%), but the difference wasn't significant ($p>0.05$). Regarding age, cattle above two years had a higher prevalence of double infection 80 (32.9%) and multiple infections 14 (5.8%) than cattle below two years, with a prevalence of double infections 3 (23.1%) and 0 (0%) multiple infections which were also not significant ($p>0.05$) (Table 5)

3.9 Prevalence of *Fasciola* spp. in study area

The prevalence of *Fasciola* spp. was 26 (10.2%), and all were found at the Lafenwa abattoir. White Fulani had the highest prevalence, 14 (5.5%), followed by Red Bororo 11 (4.3%) and Sokoto gudali 1 (0.4); this difference was

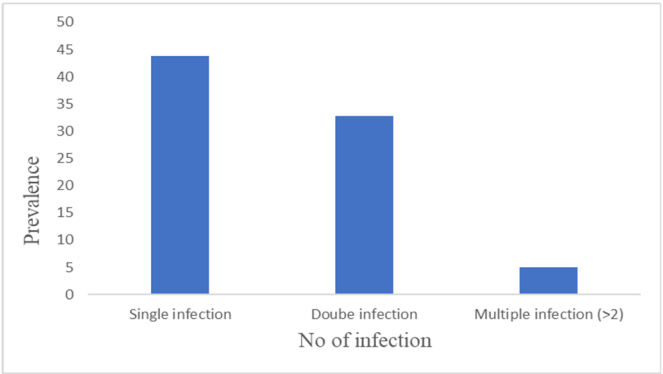

Fig 3: Distribution of coinfection of intestinal helminth

Table 5: Polyparasitism of Intestinal Helminths across breed, sex, age and location

	No examined	Single Infection (%)	Double infection (%)	Multiple infection > 2 (%)	*p*-value
SEX					
Male	57	25 (43.9)	20 (35.1)	0 (0)	$p = 0.55$
Female	199	87 (43.7)	63 (31.7)	14 (7.0)	
Total (%)	256	112 (43.8)	83 (32.4)	14 (5.5)	
AGE					
> 2	246	105 (42.7)	80 (32.5)	14 (5.7)	$p = 0.12$
< 2	10	7 (70.0)	3 (30.0)	0 (0)	
Total (%)	256	112 (43.8)	83 (32.4)	14 (5.5)	
BREED					
White fulani	149	65 (43.6)	45 (30.2)	9 (6.0)	
Red bororo	87	37 (42.5)	33 (37.9)	4 (4.6)	
Sokoto Gudali	17	9 (52.9)	4 (23.5)	1 (5.9)	$p = 0.29$
N'dama	2	0 (0)	0 (0)	0 (0)	
Cross Breed	1	1 (50.0)	1 (50.0)	0 (0)	
Total (%)	256	112 (43.8)	83 (32.4)	14 (5.5)	
LOCATION					
Aladesanmi	39	19 (48.7)	13 933.3)	0 (0)	
Lafenwa	217	93 (42.9)	70 (32.3)	14 (6.5)	$p = 0.94$
Total (%)	256	112 (43.8)	83 (32.4)	14 (5.5)	

insignificant (p>0.05). With respect to sex, females had a higher prevalence of 25 (9.8%) than males, 1 (0.4%), and the difference was found to be significant (p>0.05). Age-specific prevalence, cattle above 2years had a higher prevalence of 26 (10.2%) than those below two years; however, the difference was insignificant (p>0.05) (Table 6)

Table 6: Prevalence of *Fasciola* spp. in study areas

BREED	No examined	No infected (%)	P value
White fulani	149	14 (5.5)	
Red bororo	87	11 (4.3)	
Sokoto gudali	17	1 (0.4)	p = 0.73
N'dama	2	0 (0)	
Crossbreed	1	0 (0)	
Total (%)	256	26 (10.2)	
SEX			
Male	57	1 (0.4)	p = 0.017
Female	199	25 (9.8)	
Total (%)	256	26 (10.2)	
AGE			
> 2	246	26 (10.2)	p = 0.278
< 2	10	0 (0)	
Total (%)	256	26 (10.2)	

3.10 Prevalence of Coinfection of Haemoparasites and Intestinal Helminths in Study Area

The total prevalence of coinfection of both haemoparasites and intestinal helminth was 109 (42.6%). White Fulani had the highest prevalence of coinfection, 61 (23.8%) for both haemoparasite and intestinal helminth, followed by Red Bororo 41 (16.0%), although the difference was found to be insignificant (p>0.05). With respect to age, the prevalence was higher in cattle above two years 103 (40.2%) than those below two years 6 (2.3%) and the difference was also found to be insignificant (p>0.05). However, concerning sex, females had a higher prevalence of 92 (35.9%) for coinfection of both haemoparasites and intestinal helminths than males 17 (6.6%); this difference in prevalence was found to be significant (p>0.05) (Table 7)

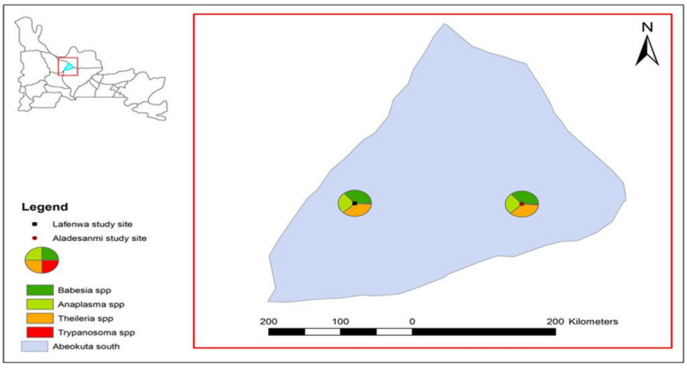

Fig 4: Geospatial distribution of haemoparasites in study areas

3.11 Geospatial Mapping of Haemoparasites and Intestinal Helminths in Study Areas

The geospatial mapping of haemoparasites and intestinal helminths in the study areas are shown in figures 4 and 5, respectively.

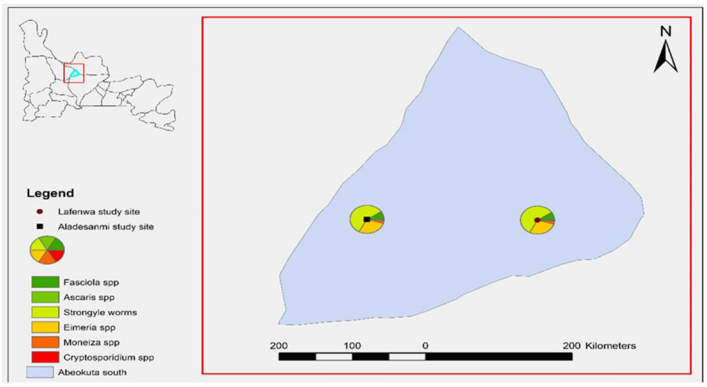

Fig 5: Geospatial distribution of intestinal helminths in study areas

Table 7: Prevalence of Co-infection of Haemoparasites and Intestinal Helminths in Study Area

	No examined	Coinfection of Haem + IH	Prevalence (%)	*p*-value
SEX				
Male	57	17	6.6	$p = 0.02$
Female	199	92	35.9	
Total	256	109	42.6	
AGE				
> 2	246	103	40.2	$p = 0.25$
< 2	10	6	2.3	
Total	256	109	42.6	
BREED				
White fulani	149	61	23.8	
Red bororo	87	41	16.01	
Sokoto Gudali	17	7	2.7	$p = 0.47$
N'dama	2	0	0	
Cross Breed	1	0	0	
Total	256	109	42.6	
LOCATION				
Aladesanmi	39	12	4.7	$p = 0.10$
Lafenwa	217	97	37.9	
Total	256	109	42.6	

Key: Haem= Haemoparasites; IH= Intestinal helminths

4 DISCUSSIONS

Findings from this study show that haemoparasites and intestinal helminths are highly prevalent in the study area. The prevalence of 53.9% of haemoparasites observed in this study is higher than the prevalence observed by Nzeako & Okorafor [25], where a prevalence of 6.67% was reported in their study in Ibadan and also the prevalence of 22% reported by Okwelum et al. [12] in their report on an epidemiological survey of haemoparasitic infection in trade cattle at slaughter in Lafenwa abattoir but similar to the findings of Akande et al. [11] where a prevalence of 51% was reported in their study on haemoparasites in cattle in Abeokuta. This finding is also similar to the findings reported by Talabi et al. [26], where 50.2% was reported in the Transboundary areas of Ogun State, Nigeria and 54% prevalence in sheep at Abeokuta, Ogun State, by Takeet et al. [27]. However, the prevalence of 53.9% reported in this study is slightly lower than the prevalence of 70% reported by Bakre et al. [6] in their study in Igboora. The differences in the prevalence of haemoparasites values in various locations, according to Velusamy et al. [28], could be attributed to differences in geographical location and periods and differences in the distribution of vectors that transmits the parasites. [29]

Breed-specific prevalence showed the highest prevalence in the white Fulani breed (31.3%), followed by the Red Bororo (18.8%) and then Sokoto gudali (3.5%); the difference was, however, not significant ($p>0.05$). This is almost similar to the finding of Bitrus et al. [30] in their study onthe occurrence of haemoparasites in cattle slaughtered at the Jalingo abattoir, where the white Fulani (13.91%) had the highest prevalence, followed by the red bororo (10.94%) and Sokoto gudali (10%). This is most likely because the white Fulani is the dominant breed in the study area. Sex-specific prevalence, the females had a higher prevalence (44.9%) than males (9.0%). The difference in prevalence between sexes was significant ($p<0.05$). This is similar to what was observed by Enwezor et al. [31], Pam et al. [7], Nzeakor & Okorafor [25], Obed & Imafidor [32] and Bitrus et al. [30]. This observable difference could be attributed to the accumulation of parasites by the females due to the extended breeding practices for economic reasons such as calving and milk production [25].

With regards to age, the prevalence was higher in cattle above 2years (51.6%) than those below 2years (2.3%), even though this difference was found to be statistically insignificant ($p>0.05$). The difference is probably due to the higher distribution of cattle above 2years.

The high incidence of haemoparasites recorded in this study, according to Adejinmi et al. [33], could be a result of a favourable environmental condition that helps in the survival and proliferation of the arthropod vectors responsible for the transmission of these parasites. According to oral findings from butchers and cattle owners at the Lafenwa abattoir, it is noteworthy that most of the cattle were brought in from the Northern part of the country. Several studies on infestation of a tick on the cattle population in the Northern part show high prevalence; this may explain the high prevalence of tick-borne diseases

observed in this study. Adejoh et al. [34] reported a 56% tick infestation prevalence on a survey of ticks and tick-borne parasites in commercial cattle at Lafia, Nasarawa State, Nigeria. Tongjura et al. [35] and James-Rugu & Jidayi [36], in separate studies on tick infestation in the Northern part, reported a prevalence of 73.3% and 81.8%, respectively. This may also be responsible for two tick-borne parasites, *Babesia* (27.7%) and *Anaplasma* (20.7%), having the highest prevalence in this study.

The mean PCV of infected cattle (26.46) was significantly lower (p<0.05) than non-infected cattle (29.28). This is in line with the observation of Imalele et al. [10], Akande et al. [11], Zawua et al. [37], Sam-wobo et al. [38] and Bakre et al. [6]. The PCV values in anaemic cattle varied from 14% to 26% [39], and the mean PCV of 26.46 for infected cattle in this study shows that the infected cattle are slightly anaemic, which confirms the findings of Akande et al. [11] that low PCV could be an indicator of the presence of haemoparasites. Zawua et al. [37] opined that the low PCV in infected cattle could result from the biochemical activity of the parasites, which destroys the red blood cells, invariably leading to anaemia.

The high prevalence of haemoparasites in this study has further shown that proper vector control methods need to be implemented to reduce the prevalence of haemoparasites significantly.

This study also provides the current status on the prevalence of intestinal parasites in cattle slaughtered in Abeokuta, Ogun State and their implications for public health. The overall prevalence of intestinal parasites was 209 (81.6%), including helminth eggs and *Eimeria* oocyst. This prevalence is within the range of the finding of Takeet et al. [40], where the prevalence of 95.12% was reported in their study on the prevalence of gastrointestinal parasites of cattle in Abeokuta and also the finding of Yuguda et al. [41] where a prevalence of 74.3% was reported in their study on gastrointestinal helminths of slaughtered cattle in Bauchi Central Abattoir. Okike-Osisiogu et al. [42] also reported a prevalence of 87.4% in their study on the prevalence of the intestinal parasite in cattle slaughtered in Aba. The gastrointestinal nematode was observed to have the highest prevalence (84.8%), similar to Adedipe et al. [43] in their study on gastrointestinal helminths in Ibadan, where a prevalence of 71.7% was reported. According to Jatau et al. [44], prevailing climatic conditions, especially rainfall and temperature, favour parasitic nematode eggs' development and survival to infective stages. This might explain the high prevalence observed as this study was conducted during the early season of rainfall.

High nematode infection significantly affects livestock production by causing a reduction in milk, meat, wool, hide products, and strength of animals [45-46]; it also leads to decreased growth rate, weight loss in young ruminants and late maturity [47].

Neoascaris vitulorum (0.8%) and *Fasciola* spp. (10.2%) are two parasites with zoonotic potential observed in this study. The prevalence of *Fasciola* (10.2%) is lower than the 29.8% prevalence reported by Karshima et al. [48] and 27.68% reported by Magaji et al. [49] but almost inconsonant with the 13.37% prevalence reported by Liba et al. [50] in their study on the prevalence of fascioliasis in cattle slaughtered at Maiduguri.

Breed-specific prevalence for *Fasciola* spp., the white Fulani had the highest prevalence 14 (5.5%), followed by the red bororo 11 (4.3%), and then Sokoto gudali 1 (0.4). However, the difference was not significant. Concerning age, cattle above 2years had a higher prevalence of 26 (10.2) than cattle below two years; the difference was also found not to be significant. The vast disparity seems to be a result of the sample size; however, regarding sex, females had a higher prevalence of 25 (9.8%) than males 1 (0.4%), and this difference was found to be significant (p<0.05). This finding deviates from the findings of Magaji et al. [49] and Jegede et al. [51] but correlates with the reports of Karshima et al. [48], Biu et al. [52] and Aliyu et al. [53], where female cattle had a higher prevalence than male. The observable higher prevalence by females is likely due to stress associated with hormonal imbalances during pregnancy in female animals, which increases their susceptibility to infections, coupled with the fact that female cattle are usually kept longer in herds for breeding [48]. Fasciolosis is a parasitic worm infection of veterinary and medical importance caused by either *Fasciola gigantica* or *Fasciola hepatica*.

In this study, *Neoscaris vitulorum* was also observed with a prevalence of 2 (0.8%). *Neoascaris vitulorum* (also called *Toxocara vitulorum*) is the most important parasite responsible for calf mortality and morbidity under three months of age in tropical countries. The heavy burden of the adult *T. vitulorum* in young calves could result in a high mortality rate and economic losses [54].

Co-infection of haemoparasites and intestinal helminths was also studied. The overall prevalence of co-infection of at least one haemoparasite and at least one intestinal helminth was 109 (42.6%). There was a high prevalence

of co-infection of haemoparasite and intestinal helminths in the white Fulani 61 (23.8%), followed by the red bororo 41 (16.0%) and then followed by the Sokoto gudali 7 (2.7%). Still, the difference was not significant ($p > 0.05$). The prevalence observed is a result of the disparity in sample size. Sex-specific prevalence, females had a higher prevalence of 92 (35.9%) of co-infection of haemoparasite and intestinal parasite than males 17 (6.6%), and this difference was found to be significant ($p<0.05$). This was also observed by Pam et al. [7] in their study on the occurrence of haemoparasite and gastrointestinal parasites of cattle in Jos. The high prevalence in females could be due to long-term exposure as a result of their prolonged stay in herds for production purposes.

According to Pam et al. [7], the high prevalence of co-infection reported may be a result of continued contamination of feed and water these animals consume by their faecal matter and even in advanced countries where disposal of both animals and human excreta to farmland, and on pasture, may lead to direct infection. Poor farming practices such as poor deworming programs and poor control of vectors of blood parasites may also contribute to the high prevalence of infections.

In conclusion, this study reveals a high prevalence of tick -borne diseases and intestinal helminths of veterinary and zoonotic importance in cattle slaughtered in Abeokuta. It also reveals complex cases of polyparasitism of intestinal helminths in cattle slaughtered in Abeokuta. The presence of *Fasciola* spp. at the Lafenwa abattoir, which is the major abattoir for beef sourcing in Abeokuta, shows that there is a need to ensure strict compliance with meat inspection at abattoirs and also a need for immediate operationalisation and implementation of a sustainable Preventive One Health intervention to mitigate against the outbreak of zoonoses in the study areas.

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Conflict of Interest

The authors declare no competing interest.

Authors Contributions

OGD, OS, MR, and SO contributed to the study design, data collection, and manuscript preparation. FA contributed to study design and parasite identification, while SA, KF and MA contributed to study design, data analysis and interpretation. All authors read and approved the final manuscript.

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