



Article Info

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Prevalence and Egg Intensity of *Fasciola spp.* in cattle slaughtered at Sokoto Abattoir, North-Western Nigeria

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This study investigated the prevalence and egg intensity of *Fasciola* species in slaughtered cattle at the Sokoto Modern Abattoir, Northwestern Nigeria, using the formol-ether concentration technique on faecal and bile samples. A total of 170 cattle were examined. The prevalence of *Fasciola* infection was 18.8% in faecal samples and 24.1% in bile samples. Infection was significantly associated with age ($p < 0.05$), with adult cattle showing higher prevalence. Mean egg counts per gram (EPG) were higher in bile (88.6 ± 245.9) than in faeces (36.9 ± 107.9). Although adult cattle showed higher odds of infection than younger animals, binary logistic regression indicated that none of the assessed host factors were significantly associated with *Fasciola* spp. Infection in either faecal or bile samples. Most infections were of low intensity (31.7% in faeces, 38.8% in bile). The study highlights the endemicity of fasciolosis in the region and demonstrates that coprological examination remains a reliable, simple, and cost-effective diagnostic approach. Improved meat inspection and public health awareness are recommended to minimize transmission risks.

Keywords: *Fasciola spp.*, bile, cattle, egg intensity, Sokoto.

1. Introduction

Fasciola species, including *F. hepatica* and *F. gigantica*, are parasitic trematodes transmitted through food and responsible for a liver disease known as fasciolosis, affecting large ruminants as well as humans (Hassan *et al.*, 2025).

Fasciolosis is widespread globally, with approximately 17 million people infected across 61 countries and 180 million at risk (Mas-Coma *et al.*, 2019; McManus, 2020). In Nigeria, several studies have reported the prevalence of the disease in cattle and small ruminants. For instance, Shehu *et al.* (2024) reported 0.97% in small ruminants, Ardo and Aliyara (2014) reported 0.32% and 0.23% prevalence in sheep and goats, respectively, in Yola, while Magaji *et al.* (2014) reported 27.68% prevalence among slaughtered cattle at Sokoto central abattoir. Similarly, Singh and Tsamiya (2017) reported 29.27%, 34.4%, and 24.36% prevalence among slaughtered cattle, sheep, and goats at Sokoto central abattoir. Previous reports from Zaria, Nigeria, ranked fasciolosis among the top pathological conditions encountered in slaughtered animals at abattoirs (Raji *et al.*, 2010; Alawa *et al.*, 2011).

This disease is characterized by liver enlargement, destruction of liver tissues, and other pathological changes to the liver that result in its condemnation. Other economic losses may be associated with

expenses on disease treatment, lower production of milk and wool, weight loss, metabolic diseases, and impaired fertility, a situation that prolongs poverty and denies the livestock farmers the desired income (Festus *et al.*, 2017). Additionally, the disease impacts around 600 million domesticated and wild ruminants, leading to economic losses estimated at \$3 billion annually (Cwiklinski *et al.*, 2016; Hayward *et al.*, 2021).

Typically, definitive hosts become infected with fasciolosis by aquatic plants contaminated with infectious metacercariae or by drinking contaminated water (Howell & Williams, 2020; McManus, 2020). *Fasciola* eggs enter the environment through the feces of definitive hosts, then transform into free-swimming miracidia that actively seek lymnaeid snails as intermediate hosts. Infected snails release cercariae, which encyst as metacercariae on plants, ready to infect the definitive host (Gayo *et al.*, 2020; Hu *et al.*, 2021). Thus, snails serve as indicators of *Fasciola* contamination in the environment. In Nigeria, the primary snail hosts include *Lymnaea natalensis* and *Radix natalensis* also contribute to the spread of fasciolosis (Magaji *et al.*, 2014; Fang *et al.*, 2014; Huang *et al.*, 2019; Qin *et al.*, 2019a).

Nigeria is home to a substantial population of livestock, particularly cattle, sheep, and goats, with

the majority concentrated in the northern regions, emphasizing the country's importance in the livestock sector (Zaki *et al.*, 2023). Previous studies on *Fasciola* spp. in Nigeria have mainly relied on post-mortem liver examination to detect infection, a method that is limited by its inability to provide real-time epidemiological data and often results in outdated and incomplete prevalence estimates (Zaki *et al.*, 2023). Most available studies in the region focus solely on faecal samples with little or no use of bile analyses, which are known to be more sensitive for detecting *Fasciola* infections. This lack of comparative faecal–bile studies limits accurate prevalence estimation, reduces diagnostic reliability, and hides the true epidemiological burden of *Fasciola* spp. in Sokoto. To address these gaps, the present study employs two diagnostic approaches, direct bile sampling and faecal examination, the latter being more convenient and widely used, to compare their relative sensitivity in detecting parasite eggs.

2. Materials and Methods

2.1 Study Area

The study was carried out at the Sokoto Modern Abattoir, Sokoto State (13°03'N, 5°14'E), located in the Sudan savannah zone of Northwestern Nigeria. The region experiences a hot climate with a mean annual temperature of 28.3 °C and a rainy season between June and October.

2.2 Sample Collection

A total of 170 cattle of different breeds (White Fulani, Red Bororo, Muturu, and Sokoto Gudali) were randomly selected. Faecal samples (10 g) were collected directly from the rectum, and bile samples (10 mL) were taken from the gall bladder immediately after slaughter. Sampling lasts for a period of three months from January 2023 to March 2023. Samples were labeled, preserved in 10% formalin, and analyzed in the Parasitology Laboratory, Usmanu Danfodiyo University.

2.3 Sample Size Determination

$$n = \frac{Z^2 Pq}{d^2}$$

The conventional formula for cross-sectional research was used to get the sample size. The minimal sample size was determined to be 137 cattle using a 95% confidence level ($Z = 1.96$), an estimated prevalence of 27.68% given by Magaji *et al.* from an abattoir-based study in northern Nigeria, and a precision of 7.5%. A 25% contingency was included to account for potential sample loss, missing data, and unusable bile or faecal samples,

resulting in a final sample size of about 170 animals evaluated.

2.4 Sample Examination

The formol-ether concentration technique was employed for the detection of *Fasciola* eggs (Allen and Ridley, 1970; Cheesbrough, 1980). Egg identification was based on morphological features (size, operculum, coloration).

2.5 Egg Intensity (EPG)

Egg counts per gram of faeces were determined using Stoll's dilution technique (Soulsby, 1982).

2.6 Data Analysis

Data were analyzed using SPSS v20. Chi-square tests were used to assess associations between infection and animal variables. Statistical significance was set at $p < 0.05$.

2.7 Ethical Approval

Permission for sample collection was obtained from the abattoir management, and ethical clearance was granted by the Usmanu Danfodiyo University, Sokoto. University Research Ethics Committee

3. Results and Discussion

3.1 Results

The results present the findings on the prevalence and egg intensity of *Fasciola* spp. in cattle using both bile and faecal samples. The results are organized according to the study objectives, with data presented in tables to clearly illustrate the distribution of infection and the variation in egg counts among the sampled population.

Table 1: Prevalence of *Fasciola* spp. in faeces of cattle

Variables	Parameter	No. examined (%)	No. infected (%)
Gender	Male	73 (42.9)	12 (16.4)
	Female	97 (57.1)	20 (20.6)
Age	Young	70 (41.2)	8 (11.4)
	Adult	100 (58.8)	24 (24.0)
Breed	SG	31 (18.2)	2 (6.5)
	RB	63 (37.1)	16 (25.4)
	MTR	15 (8.8)	2 (13.3)
	WF	61 (35.9)	12 (19.7)

Keys: WF= White Fulani, RB= Red Bororo, MTR= MUTURU, SG= SOKOTO GUDALI

Chi-square analysis showed a significant association between age and *Fasciola* infection ($\chi^2 = 4.259$, $df = 1$, $P = 0.039$), while gender and breed were not significantly associated ($P > 0.05$).

Out of 170 cattle examined, 32 (18.8%) were found to be infected with *Fasciola* spp. The prevalence was slightly higher in females (20.6%) compared to males (16.4%). Adults had a higher prevalence (24.0%) than young cattle (11.4%). Among the breeds, Red Bororo had the highest infection rate (25.4%), followed by White Fulani at 19.7%, Muturu at 13.3%, and Sokoto Gudali at 6.5% Table 1.

Table 2: Prevalence of Fasciola spp. in the bile of cattle

Variables	Parameter	No. examined (%)	No. infected (%)
Gender	Male	73 (42.9)	16 (21.9)
	Female	97 (57.1)	25 (25.8)
Age	Young	70 (41.2)	12 (17.4)
	Adult	100 (58.8)	29 (29.0)
Breed	SG	31 (18.2)	4 (12.9)
	RB	63 (37.1)	16 (25.4)
	MTR	15 (8.8)	3 (20.0)
	WF	61 (35.9)	18 (29.5)

Keys: WF= White Fulani, RB= Red Bororo, MTR= MUTURU, SG= SOKOTO GUDALI.

Chi-square analysis indicated no significant association between Fasciola spp. infection in bile and gender ($\chi^2 = 0.338$, $df = 1$, $P = 0.561$), age ($\chi^2 = 3.163$, $df = 1$, $P = 0.075$), or breed ($\chi^2 = 3.294$, $df = 3$, $P = 0.348$).

A total of 170 cattle were examined for Fasciola spp. in bile, with 41.8% (71/170) testing positive. The prevalence was somewhat higher in females (25.8%) than in males (21.9%). Adults showed a higher infection rate (29.0%) compared to young cattle (17.4%). Among the breeds, White Fulani had the highest prevalence (29.5%), followed by Red Bororo at 25.4%, Muturu at 20.0%, and Sokoto Gudali at 12.9% Table 2.

Table 3: Intensity of Fasciola spp. infection in faecal samples of cattle

Variable	Category	Low (100-250 EPG) n (%)	Moderate (251-500 EPG) n (%)	High (>500 EPG) n (%)
Age	Young	5 (2.9)	3 (1.8)	0 (0.0)
	Adult	13 (7.6)	9 (5.3)	2 (1.2)
Gender	Male	12 (7.1)	6 (3.5)	2 (1.2)
	Female	6 (3.5)	6 (3.5)	0 (0.0)
Breed	WF	6 (3.5)	6 (3.5)	0 (0.0)
	RB	10 (5.9)	5 (2.9)	1 (0.6)
	SG	1 (0.6)	1 (0.6)	0 (0.0)
	MTR	1 (0.6)	0 (0.0)	1 (0.6)
Total (%)		31.7	21.1	3.5

Keys: WF = White Fulani; RB = Red Bororo; MTR = Muturu; SG = Sokoto Gudali

Most cattle had low to moderate infection intensity, with 31.7% showing low, 21.1% moderate, and 3.5% high intensity. Adults, males, and Red Bororo cattle tended to have slightly higher infection intensities than young, females, and other breeds, as presented in Table 3.

Table 4: Intensity of Fasciola spp. Infection in the bile samples of cattle

Variable	Category	Low (100-250 EPG) n (%)	Moderate (251-500 EPG) n (%)	High (>500 EPG) n (%)
Age	Young	5 (2.9)	4 (2.4)	3 (1.8)
	Adult	17 (10.0)	5 (2.9)	7 (4.1)
Gender	Male	10 (5.9)	3 (1.8)	3 (1.8)
	Female	12 (7.1)	6 (3.5)	7 (4.1)
Breed	WF	9 (5.3)	3 (1.8)	6 (3.5)
	RB	8 (4.7)	4 (2.4)	4 (2.4)
	SG	2 (1.2)	2 (1.2)	0 (0.0)
	MTR	3 (1.8)	0 (0.0)	0 (0.0)
Total (%)		38.8	15.8	17.6

Keys: EPG = eggs per gram of bile; WF = White Fulani; RB = Red Bororo; MTR = Muturu; SG = Sokoto Gudali.

Most cattle had low to moderate infection intensity (38.8% low, 15.8% mild, 17.6% high). Adults, females, and White Fulani cattle generally showed higher infection intensities than young, males, and other breeds, as revealed in Table 4.

Table 5: Logistic regression analysis of factors associated with Fasciola spp. infection in cattle (faecal samples)

Variable	Category	OR (Exp(B))	95% CI	P-value
BREED	RB	0.555	0.108 – 2.849	0.480
	SG	0.468	0.093 – 2.347	0.356
	MTR	2.006	0.249 – 16.169	0.513
SEX	Male	0.872	0.380 – 1.997	0.745
AGE	Adult	2.228	0.907 – 5.471	0.081
Constant		5.597		0.032

Keys: Reference categories: BREED = WF, SEX = Female, AGE = Young. OR = Odds Ratio; CI = Confidence Interval.

The result of the logistic regression (as presented in Table 5) analysis showed that breed, sex, and age were not significantly associated with Fasciola spp. infection in faecal samples ($P > 0.05$). Adult cattle showed higher odds of infection than young cattle, although this association was not statistically significant.

Table 6: Logistic regression analysis of factors associated with *Fasciola* spp. infection in cattle (bile samples)

Variable	Category	OR (Exp(B))	95% CI	P-value
BREED	RB	0.535	0.132 – 2.165	0.380
	SG	0.770	0.189 – 3.136	0.715
	MTR	1.548	0.293 – 8.189	0.607
SEX	Male	0.847	0.400 – 1.796	0.666
AGE	Adult	1.962	0.892 – 4.317	0.094
Constant		3.569		0.065

Keys: Reference categories: BREED = WF, SEX = Female, AGE = Young. OR = Odds Ratio; CI = Confidence Interval.

The analysis revealed no significant link between *Fasciola* infection and the cattle's breed, sex, or age. Although adult cattle had a higher infection rate than younger animals, this difference was not statistically significant, as seen in Table 6.

3.2 Discussion

With major ramifications for control and surveillance tactics, the incidence of *Fasciola* spp. infection in cattle shows notable variability driven by host variables, diagnostic techniques, and geographic context. Due to its zoonotic potential and significant financial losses in livestock productivity worldwide, fasciola infection, also known as fasciolosis, continues to be a significant concern for veterinary public health (Kurnianto *et al.*, 2022).

3.2.1 Prevalence Trends

According to current research, there is a significant incidence of *Fasciola* spp. infection in cattle, with differences seen depending on the host's features. Adult cattle were often more afflicted than young ones, and infection was more noticeable in female cattle than in male calves in faecal samples. Some breeds were more susceptible than others, and some had relatively lower amounts of illness. When comparing bile samples to faecal samples, prevalence patterns were consistently higher across all categories, with adults and females once more exhibiting higher infection. Variations in exposure and other genetic or managerial factors were reflected in the breed-wise variances that were also noticeable. This overall pattern of increased infection in adults and females is consistent with more general epidemiological findings across various geographic areas. Studies conducted throughout Africa and Asia have shown similar trends, with seasonal factors, grazing systems, and environmental conditions all contributing to the spread of parasites and the overall fasciolosis burden (Jaja *et al.*, 2017; Hossain *et al.*, 2025; Zelpina *et al.*, 2023; Prasetyo *et al.*, 2023).

3.2.2 Influence of Host Factors

Host factors, including age, sex, and breed, strongly influence susceptibility to *Fasciola* spp. infection. Female and adult cattle often revealed greater infection levels in both faecal and bile samples, perhaps due to physiological stress during reproduction and prolonged exposure to polluted grazing regions (Takeuchi-Storm *et al.*, 2017; Cai *et al.*, 2023). Due to variances in genetics, grazing habits, and management techniques, breed-related characteristics also had an impact on infection risk (Sun *et al.*, 2020). The intricate interaction between host factors and environmental exposure in fasciolosis epidemiology is highlighted by trends suggesting that adult cattle and specific breeds may have higher inherent risk, even though logistic regression did not show statistically significant associations (Ergin & Koçkan, 2024).

3.2.3 Diagnostic Comparison

The observed prevalence rates are strongly influenced by the diagnostic approach selected. In comparison to faecal analysis, bile testing consistently found more infections across all host categories, showing higher sensitivity, especially for early or low-intensity infections where faeces egg counts may be sporadic or below detection thresholds. This is further supported by intensity analysis, which showed that bile samples had a higher percentage of high-intensity infections than faecal samples, indicating a more accurate depiction of parasite burden. This discrepancy draws attention to the shortcomings of conventional coprological techniques like sedimentation, which may be less sensitive and specific than more sophisticated procedures like PCR or ELISA (Olaogun *et al.*, 2022; Thanasuwan & Tankrathok, 2021; Bostanci & Oğuz, 2017). Additionally, studies conducted in Ethiopia and Vietnam show that incorporating post-mortem examinations or serological tests offers a more thorough evaluation of infection, highlighting the significance of choosing suitable diagnostic techniques for precise epidemiological assessment (Nguyen *et al.*, 2012; Birhanu *et al.*, 2015).

3.2.4 Epidemiological Implications

Important epidemiological trends of *Fasciola* spp. infections in cattle in the research area and comparable semi-arid regions of northwest Nigeria are highlighted by the study's findings. Increased vulnerability and persistent transmission throughout herds may result from extended exposure to infectious phases and physiological stress related to reproduction, as indicated by the higher incidence among adult and female cattle. Rather than innate breed sensitivity, differences between breeds seem to be mostly related to grazing and management approaches. Cattle in Sokoto's extensive and semi-extensive grazing systems are exposed to seasonal water bodies, irrigation channels, and fadama

lands—environments that encourage interaction with infectious metacercariae and raise the risk of infection (Adedokun *et al.*, 2008; Elelu and Eisler, 2018).

The significant difference in prevalence between faeces and bile exams highlights the limitations of using faecal analysis alone to determine the actual fascioliasis burden because light or early infections may go unnoticed. Examinations of the liver and bile offer higher diagnostic sensitivity and may more accurately reflect the true epidemiological condition. Environmental factors like rivers, irrigation systems, and seasonal flooding, which provide ideal habitats for lymnaeid snail intermediate hosts, especially during the rainy season, further encourage transmission in the area. The observed trends indicate that fascioliasis in the region is caused by complex interactions among host characteristics, environmental exposure, and production systems, such as communal grazing and transhumance, which are common in northern Nigeria, even though some host factors were not statistically significant in regression analysis (Ahmad *et al.*, 2020; Agbajelola and Agbajelola, 2025).

3.2.5 Implications for Control and Surveillance

High-risk populations, especially adult female cattle and susceptible breeds like White Fulani and Red Bororo, should be the focus of effective fascioliasis control by regular screening and deworming to lower parasite burden and environmental infection. More sensitive diagnostics, such as bile analysis or PCR-based techniques, can give a more accurate picture of prevalence and intensity because faecal egg counts may underestimate infection (Thanasuwan and Tankrathok, 2021; Duzlu *et al.*, 2020).

Controlling water sources and grazing areas might restrict snail habitats; therefore, environmental management is also essential because transmission depends on intermediate snail hosts (Pan *et al.*, 2020; Martviset *et al.*, 2024). Adaptive control strategies that successfully lessen the economic and public health impact of fascioliasis are ensured by ongoing surveillance that includes diagnostics, host and environmental data, and drug resistance monitoring (Kouadio *et al.*, 2020).

4. Conclusion

This study confirms that fascioliasis is endemic among cattle in Sokoto, with higher detection from bile samples than faecal samples. Adult cattle showed significantly greater infection rates, and most infections were of low intensity. Routine coprological monitoring combined with improved water management and pasture hygiene is recommended to reduce infection risk. Future studies should employ molecular diagnostic tools to identify *Fasciola* species accurately and track transmission dynamics across seasons.

Conflict of Interest

The authors declare no conflict of interest.

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