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Research Article

Incidence and Pathological Lesions of Fascioliasis in Ruminants Slaughtered at Jos Abattoir, Jos South, Plateau State, Nigeria

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Abstract

A cross-sectional study was conducted from May to July 2022 to determine the incidence and pathological lesions associated with *Fasciola* infections in ruminants slaughtered at the Jos Metropolitan Abattoir, Jos South, Plateau State, Nigeria. Fecal and post-mortem examinations were performed on a study cohort of 60 animals, comprising 20 cattle, 20 sheep, and 20 goats. The overall incidence of ruminant Fascioliasis was determined to be 11.7% (7/60). Species-specific incidence rates were 15.0% (3/20) in cattle, 10.0% (2/20) in sheep, and 10.0% (2/20) in goats. Statistical analysis revealed no significant difference in the incidence of infection among the three host species (P = 0.851, Fisher's Exact Test). Regarding age-related variables, adult animals (>3 years) exhibited higher infection rates compared to younger cohorts, with a statistically significant difference observed in sheep (P = 0.008, Fisher's Exact Test), while remaining non-significant in cattle (P = 0.299) and goats (P = 0.521). In terms of sex, female cattle and sheep demonstrated higher infection rates (30.0% and 20.0%, respectively) compared to males (0% in both species), whereas incidence in goats was equal (10.0% for both sexes); however, these sex-specific variations within species were not statistically significant (P > 0.05). *Fasciola gigantica* was the sole liver fluke species recovered during post-mortem inspection. Gross pathological evaluation of affected livers revealed marked hepatic fibrosis. Histopathological examination demonstrated severe hepatocyte necrosis, chronic portal fibrosis, tissue calcification, and the presence of *Fasciola gigantica* cross-sections in the liver parenchyma. These findings demonstrate that Fascioliasis remains a persistent economic and public health concern in north-central Nigeria, emphasizing the critical need for enhanced veterinary inspection at slaughterhouses and improved livestock grazing management.

Keywords: Fascioliasis; Fisher's Exact Test; Incidence; Jos Abattoir; Nigeria; Pathologies; Ruminants

Abbreviations

ASVS: *Acta Scientific Veterinary Sciences*; CBN: Central Bank of Nigeria; FCAH&PT: Federal College of Animal Health and Production Technology; GDP: Gross Domestic Product; H&E: Hematoxylin and Eosin; NVRI: National Veterinary Research Institute; STROBE-Vet: Strengthening the Reporting of Observational Studies in Epidemiology - Veterinary; USD: United States Dollar; WHO: World Health Organization

Introduction

Fascioliasis, a food- and water-borne trematode zoonosis caused by *Fasciola hepatica* and *Fasciola gigantica*, represents a profound threat to global livestock production and public health. While *F. hepatica* is traditionally distributed across temperate regions, *F. gigantica* serves as the primary causative agent of bovine and small ruminant Fascioliasis in tropical and subtropical zones, including sub-Saharan Africa [1]. Globally, the annual productivity losses attributed to livestock infections exceed USD 3.2 billion, driven by animal mortality, liver condemnation, reduced carcass weight, and decreased milk yield [2-4]. Beyond its veterinary impact, human fascioliasis has emerged as a significant public health concern [5-7]; the World Health Organization (WHO) estimates that 2.4 million people are currently infected, with an additional 180 million at risk of infection worldwide [8].

The epidemiology of *Fasciola* is intimately linked to environmental characteristics, as the development of the parasite's life cycle requires access to freshwater bodies harboring compatible snail intermediate hosts of the family Lymnaeidae [9]. In Nigeria, which is among the leading livestock producers in sub-Saharan Africa, livestock production contributes approximately 12.7% to the agricultural Gross Domestic Product [10]. However, ruminant production in northern and north-central Nigeria is heavily characterized by transhumant pastoralism, where animals rely on communal grazing and stagnant water bodies during the dry season [11]. These watering sites serve as transmission hot spots. The resulting nutritional stress and poor body condition of ruminants significantly enhance their susceptibility to chronic trematode infections [12].

Previous slaughterhouse surveys in northern Nigeria have reported varying, yet consistently high, prevalence rates. For example, [13] reported an overall prevalence of 48.0% in ruminants, while [14] recorded a 42.0% infection rate in cattle slaughtered in Niger State. Furthermore, a ten-year retrospective analysis by [15] in north-central Nigeria demonstrated a bovine prevalence of 32.34%, resulting in an economic loss of over USD 766,896 due to liver condemnation. Despite these historical reports, contemporary and localized data on the comparative incidence of Fascioliasis across different ruminant species (cattle, sheep, and goats) under identical regional grazing conditions remain sparse.

Aim of the Study

The aim of this study was to determine the comparative incidence of *Fasciola* infection among slaughtered cattle, sheep, and goats at the Jos Metropolitan Abattoir, Jos South, Plateau State, Nigeria, and to systematically characterize the associated gross and histopathological hepatic lesions.

Materials and Methods

Study area and climatological profile

This study was conducted at the Jos Metropolitan Abattoir, located in the Jos South Local Government Area of Plateau State, Nigeria. The abattoir is situated at an elevation of approximately 1,290 meters above sea level, lying between latitudes 9° 50' and 10° 00' North, and longitude 8° 55' East. The region experiences a temperate highland climate with mean temperatures ranging from 16°C to 19°C during the coolest months (December and January), and 28°C to 31°C during the hottest periods (March and April), with an annual average rainfall of approximately 1,411 mm [16].

Study design and sample selection

The study utilized a cross-sectional design, conducted over a three-month period from May to July 2022, corresponding to the transitional late-dry to early-wet season. To ensure robust reporting, the study design and manuscript preparation strictly adhered to the STROBE-Vet (Strengthening the Reporting of Observational Studies in Epidemiology - Veterinary) guidelines [17]. Given the small targeted sample size (N = 60), equal representative groups of cattle (n = 20), goats (n = 20), and sheep (n = 20) were examined. Systematic random sampling was utilized on trade animals presented for slaughter, where every fifth animal belonging to each ruminant cohort was selected for detailed coprological and post-mortem examination, minimizing potential selection bias.

Recording of host variables (Age and sex estimation)

Prior to slaughter, individual host variables including species, age, and sex were recorded. Biological age was estimated by experienced veterinary officers based on dental eruption and wear patterns. The animals were categorized into three age cohorts: young (6 months to 1 year), sub-adult (1 to 2 years), and mature adults (3 years and above). Animal sex was confirmed via external inspection of the genitalia.

Coprological screening

Fecal samples (approximately 5 - 10g) were collected directly from the rectum of each animal immediately prior to slaughter. Samples were transported in individual chilled containers to the diagnostic pathology laboratories of the National Veterinary Research Institute (NVRI), Vom, for immediate processing. A simple sedimentation technique, optimized for heavy trematode eggs as described by [18,19], was performed. Morphological identification was conducted under light microscopy at x100 and x400 magnifications, targeting yellow-brown, distinctively operculated eggs diagnostic of *Fasciola spp.*

Post-mortem hepatic inspection and fluke recovery

A systematic post-mortem inspection of the liver of all 60 slaughtered animals was carried out in accordance with the established meat hygiene guidelines of [20]. Gross evaluation involved visual inspection, manual palpation, and multiple deep incisions along the diaphragmatic and visceral surfaces, focusing on the main bile ducts and the gallbladder. Recovered adult trematodes were washed in physiological saline, and species identification was performed based on morphological criteria. Adults of *Fasciola gigantica* were differentiated by their characteristic elongated, leaf-like shape and relatively large size (up to 75 mm), as distinguished from the shorter, broader morphology of *F. hepatica*.

Histopathological processing

Representative tissue sections (approximately 5 mm thickness) containing gross lesions or parenchyma surrounding infected bile ducts were collected and immediately fixed in 10% neutral buffered formalin. Following a 48-hour fixation period, tissues were dehydrated in ascending grades of alcohol, cleared in xylene, and embedded in paraffin wax. Thin sections (5 µm) were cut using a rotary microtome, mounted on glass slides, and stained with Hematoxylin and Eosin (H&E) according to the standard staining protocols described by [21,22].

Statistical analysis

All raw field and laboratory records were tabulated in Microsoft Excel before being exported to R statistical software (v1.3.1073). Descriptive epidemiological statistics were calculated. Due to the small sample size and presence of multiple zero-count cells, the standard Pearson's Chi-square test approximation was statistically invalid. Therefore, exact non-parametric analysis via Fisher's Exact Test was strictly applied to evaluate the significance of associations between the incidence of Fascioliasis and host species, age, and sex variables. Values of $P < 0.05$ were considered statistically significant.

Results

Overall and host species-specific incidence

Out of the study cohort of 60 ruminants examined, a total of 7 cases of Fascioliasis were confirmed, yielding an overall incidence of 11.7% (7/60). Species-specific incidence rates were determined to be 15.0% (3/20) in cattle, 10.0% (2/20) in sheep, and 10.0% (2/20) in goats. Statistical analysis using Fisher's Exact Test demonstrated that there was no significant variation in the incidence of infection among the three host species ($P = 0.851$, Table 1). Fecal sedimentation was highly concordant with post-mortem inspection. Adult *Fasciola gigantica* was the sole species recovered during the post-mortem evaluations (Figure 1).

Host Species	Number Examined	Number Positive	Incidence (%)	Statistical Significance
Cattle	20	3	15.0%	Fisher's Exact P = 0.851
Goats	20	2	10.0%	Degrees of Freedom (df) = 2
Sheep	20	2	10.0%	Result: Non-Significant
Total / Overall	60	7	11.7%	P > 0.05

Table 1: Overall incidence of ruminant fascioliasis by host species.

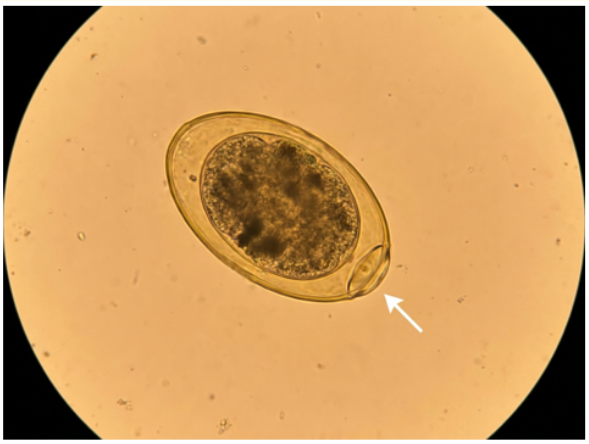

Figure 1: Photomicrograph of sedimented fecal sample showing yellow-brown, operculated Fasciola gigantica eggs (arrow) under light microscopy.

Incidence stratified by age

In all three host species, adult animals (≥ 3 years) exhibited higher infection rates compared to younger age cohorts. Among cattle, the incidence was 33.3% (2/6) in animals ≥ 3 years, 9.1% (1/11) in those aged 1-2 years, and 0.0% (0/3) in animals aged 6 months to 1 year; however, this variation was not statistically significant (P = 0.299, Table 2). For goats, the incidence was 15.4% (2/13) in the 1-2 years cohort, while no infections were recorded in the younger (0/7) or older (0/0) cohorts (P = 0.521, Table 2). Conversely, a highly significant difference was observed in sheep (P = 0.008, Fisher's Exact), where the single animal aged ≥ 3 years was positive (100.0%), compared to a 6.7% (1/15) incidence in those aged 1-2 years, and 0.0% (0/4) in lambs (P < 0.01, Table 2).

Host Species	Age Group	Number Examined	Number Positive	Incidence (%)	Statistical Significance
Cattle	6 months - 1 year	3	0	0.0%	Fisher's Exact P = 0.299
	1 - 2 years	11	1	9.1%	Result: Non-Significant
	≥ 3 years	6	2	33.3%	P > 0.05
Goats	6 months - 1 year	7	0	0.0%	Fisher's Exact P = 0.521
	1 - 2 years	13	2	15.4%	Result: Non-Significant
	≥ 3 years	0	0	0.0%	P > 0.05
Sheep	6 months - 1 year	4	0	0.0%	Fisher's Exact P = 0.008
	1 - 2 years	15	1	6.7%	Result: Statistically Significant
	≥ 3 years	1	1	100.0%	P < 0.01

Table 2: Incidence of fascioliasis stratified by host age group.

Incidence stratified by sex

Female animals consistently demonstrated higher infection rates than males across both cattle and sheep cohorts. In cattle, the incidence was 30.0% (3/10) in females compared to 0.0% (0/10) in males; however, due to small sample sizes, this difference was not statistically significant (P = 0.211, Table 3). Similarly, female sheep exhibited a 20.0% (2/10) incidence compared to 0.0% (0/10) in males (P = 0.474, Table 3). In goats, the incidence was identical between sexes, with 10.0% (1/10) recorded for both males and females (P = 1.000, Table 3). Within each individual host species, these sex-specific differences were not statistically significant (P > 0.05).

Gross and coprological pathology

Gross examination of infected livers revealed severe, widespread lesions. Affected livers exhibited thick, fibrotic bands, and direct dissection of the major bile ducts revealed the presence of large, leaf-like adult *Fasciola gigantica* flukes, accompanied by chronic stenosed bile duct walls and localized necrotic zones. Coprological screening via simple sedimentation revealed distinct yellow-

Host Species	Sex	Number Examined	Number Positive	Incidence (%)	Statistical Significance
Cattle	Male	10	0	0.0%	Fisher's Exact P = 0.211
	Female	10	3	30.0%	Result: Non-Significant (P > 0.05)
Goats	Male	10	1	10.0%	Fisher's Exact P = 1.000
	Female	10	1	10.0%	Result: Non-Significant (P > 0.05)
Sheep	Male	10	0	0.0%	Fisher's Exact P = 0.474
	Female	10	2	20.0%	Result: Non-Significant (P > 0.05)

Table 3: Incidence of fascioliasis stratified by host sex group.

brown, operculated eggs typical of *Fasciola gigantica* (Figure 1). Gross pathological evaluation of affected ruminant's livers revealed marked hepatic fibrosis characterized by distinct white fibrous tissue expansion (Figure 2).

Figure 2: Photograph of the ruminant's liver showing distinct lobulation, calcified and fibrosed with white expanded demarcations.

Histopathological findings

Histopathological examination under H&E staining revealed extensive cellular-level damage. Severe acute and chronic hepatocyte necrosis was observed, characterized by karyolysis, pyknosis, and cell wall disintegration (Figure 3). Furthermore, chronic portal lesions exhibited significant portal fibrosis (Figure 4, marker a), coagulative necrosis (Figure 4, marker b), and dark-blue, basophilic calcium salt calcification deposits (Figure 4, marker c) within the hepatic parenchyma. Distinct diagnostic cross-sections of *Fasciola gigantica* flukes (Figure 5, marker a) were observed within the liver parenchyma, surrounded by severe inflammatory infiltrates predominated by eosinophils, lymphocytes, and histiocytes.

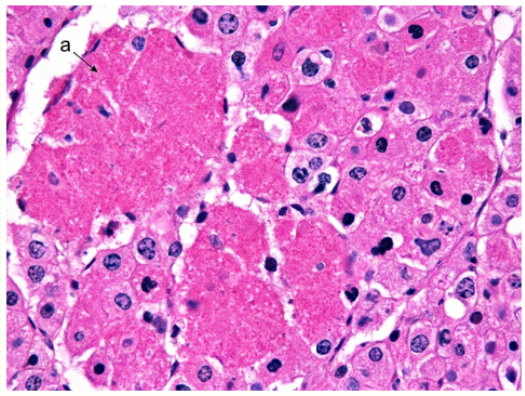

Figure 3: Photomicrograph of the ruminant's liver showing necrosis of hepatocytes (a) under H&E staining, demonstrating diffuse cellular architectural loss (H&E, x400).

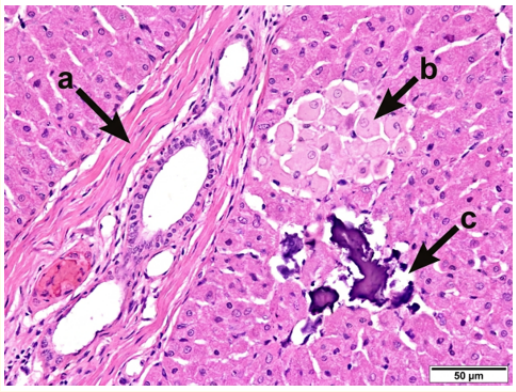

Figure 4: Photomicrograph of the ruminant's liver demonstrating chronic portal fibrosis (a), localized coagulative necrosis (b), and basophilic calcification (c) of hepatocytes (H&E, x400).

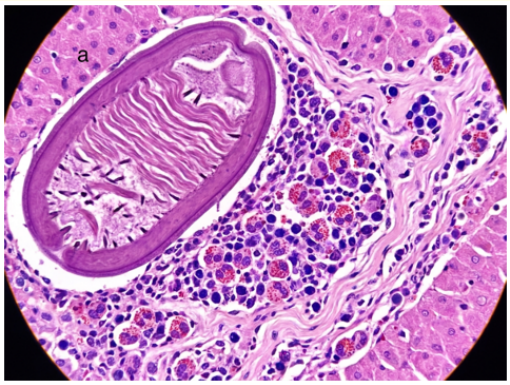

Figure 5: Photomicrograph of the ruminant's liver section demonstrating a diagnostic cross-section of *Fasciola gigantica* (a) embedded directly within the hepatic parenchyma with mononuclear cell infiltration (H&E, x400).

Discussion

The overall incidence of ruminant Fascioliasis recorded in this study was 11.7% (7/60), with species-specific rates of 15.0% (3/20) in cattle, 10.0% (2/20) in sheep, and 10.0% (2/20) in goats. These findings demonstrate that *Fasciola* infection remains enzootic in the region, albeit at a lower rate than previously reported in historical surveys across northern and north-central Nigeria. For instance, [13] reported a substantially higher overall incidence of 48.0% in cattle and small ruminants at slaughter in Northern Nigeria. Similarly, a ten-year retrospective survey of bovine fascioliasis in trade cattle in north-central Nigeria by [15] revealed an overall incidence of 32.34%, [14] observed a 42.0% infection rate among slaughtered cattle at the Minna modern abattoir in Niger State.

Several epidemiological and environmental factors may account for the lower incidence observed in this investigation. First, the study was localized to the Jos main abattoir over a short, three-month cross-sectional period from May to July, which corresponds to the late dry and early wet season. This timing is highly significant because the development of *Fasciola* larval stages and their freshwater snail intermediate hosts is strictly dependent on environmental characteristics, particularly moisture and the availability of stagnant water bodies [9]. In northern Nigeria, stagnant water bodies during the dry season serve as primary grazing and watering sites, driving parasite transmission. Under the traditional transhumant husbandry system, ruminants are grazed with minimal supplementary feeding, leading to poor body conditions and increased susceptibility to trematode infections [10,12]. The unique, cooler temperate climate of the Jos plateau (averaging 16°C to 19°C in cool months) may also influence snail vector dynamics compared to the hotter lowlands of north-central Nigeria [16]. Furthermore, the small sample size in this study (n = 60) limits the direct extrapolation of these rates compared to large-scale retrospective analyses such as that by [15], which analyzed thousands of trade animals.

Our statistical analysis revealed no significant differences in incidence between the three host species (Fisher's Exact P = 1.000), which is in variance with previous studies that often report significantly higher rates in cattle compared to small ruminants [23]. This suggests that under regional grazing conditions, sheep, goats, and cattle face comparable exposure risks to the intermediate snail hosts. Regarding age-related variables, adult animals (> 3 years) exhibited higher infection rates compared to younger cohorts, with a statistically significant difference observed in sheep (P = 0.008, Fisher's Exact Test). This is similar to the findings of [24,25], who documented higher infection rates in older animals due to longer exposure times and chronic accumulation of metacercariae over multiple grazing seasons.

Despite the lower overall incidence, the pathological severity of the positive cases examined highlights a severe economic and public health concern. Consistent with the findings of [15]—who documented massive economic losses from 47,931 condemned bovine livers—the gross and histopathological evaluations in this study showed marked hepatic fibrosis, necrosis, and calcification (Figure 2-4) that necessitated the condemnation of affected organs. This severe tissue damage is consistent with established liver fluke pathologies [26]. Moreover, as [27] noted in their review, that livestock Fascioliasis poses a widespread zoonotic risk in Nigeria. This risk is particularly acute for abattoir workers and butchers in Jos who suffer from direct contact with infected carcasses, contaminated fecal wastes, and compromised meat inspection protocols in debilitated abattoirs [28]. These persistent pathological findings underscore that even when localized incidence appears low, the severe impact on livestock productivity and human public health remains a critical veterinary priority.

Conclusion

This study establishes that ruminant Fascioliasis, caused exclusively by *Fasciola gigantica*, is endemic at an incidence of 11.7% among cattle, sheep, and goats slaughtered at the Jos Metropolitan Abattoir, Plateau State, Nigeria. While the localized incidence is lower than historical regional baselines, the pathological findings of severe hepatic fibrosis, parenchymal necrosis, and calcification in infected animals underscore the substantial, ongoing economic toll due to organ condemnation and reduced animal productivity. Host age was identified as a critical risk factor, with adult ruminants exhibiting significantly higher infection rates, particularly in sheep ($P = 0.008$). Conversely, host species and sex did not show statistically significant associations with infection rates ($P > 0.05$). These findings highlight a critical gap in veterinary extension and farmer awareness regarding subclinical parasitic burdens, which continue to silently erode livestock productivity and pose a persistent zoonotic hazard to abattoir workers and the public.

Recommendations

1. **Enact strategic deworming:** Encourage livestock farmers to implement regular, strategic anthelmintic treatments timed to target fluke populations before seasonal transmission peaks.
2. **Enhance public health education:** Educate pastoralists and abattoir personnel on the transmission dynamics of *Fasciola*, emphasizing the risks of grazing animals near snail-populated water bodies.
3. **Modernize abattoir infrastructure:** Rehabilitate abattoir conditions and strictly enforce standardized meat inspection and condemned tissue disposal protocols.
4. **Establish grazing reserves:** Prioritize the creation of veterinary-fenced grazing reserves equipped with clean, borehole-supplied watering troughs to reduce dry-season exposure to snail-infested water bodies.
5. **Implement trace-back surveillance:** Introduce animal identification systems to trace infected carcasses back to their communities of origin for targeted control.
6. **Review compensation policies:** Formulate compensation frameworks for condemned tissues to incentivize compliance with veterinary public health guidelines among butchers and farmers.

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