

PREVALENCE AND INTENSITY OF FASCIOLIASIS IN CATTLE SLAUGHTERED AT CENTRAL ABATTOIR GOMBE, GOMBE STATE, NIGERIA

ABSTRACT

Background: Fascioliasis is one of the most prevalent and economically significant parasitic illnesses of domestic animals, particularly cattle, sheep, goats, and man. It is particularly widespread in countries with heavy cattle production, especially places with low interest in vector-related diseases. Therefore, the study was designed to investigate the prevalence of this parasitic disease among the cattle slaughtered in central abattoir Gombe, Gombe state of Nigeria.

Materials and methods: A total of three hundred and eighty-four (384) faecal and gall bladder samples were collected at the Gombe municipal abattoir covering two seasons, from June to October 2022 during the rainy season and November to May, 2023 during the dry season and examined using sedimentation techniques to detect *Fasciola* spp eggs. The number of eggs were counted and expressed per grams of faeces.

Results: It was observed that 72.1% were positive for fascioliasis out of the 384 slaughtered cattle examined. The prevalence of the infection based on the sex of the cattle was found to be lowest in males 34.3% and highest in Females 65.7%, although not statistically significant ($p>0.05$). The percentage of fascioliasis depending on the breed of the cattle also indicates high prevalence in white Fulani 69.3%, followed by Red Bororo 16.7%, and least in Sokoto Gudali 14.0% with an insignificant difference ($p>0.05$). Prevalence of fascioliasis based on the estimated age of animals was not statistically significant; however, animals aged 2-4 years had the highest percentage 57.1%, followed by ≥ 5 years 29.2% and least in ≤ 1 year 13.7%. The prevalence was higher in the dry season 72.9% than in the rainy season 27.1%, the analysis implied that there was a strong association between infection and season. Three categories of fascioliasis intensity were based on egg per gram of faeces (epg), 70.03% of the cattle sampled were lightly infected, with moderate infection in 20.57% and 9.38% with heavy infection.

Conclusion: The study concludes that fascioliasis among cattle in Gombe state was high, causing great economic loss to the people rearing the animals. Public enlightenment to the farmers/rarers on the importance of regular de-worming and watering of their animals using clean water for their economic benefit and the health conditions of their consumers is recommended to maximize the welfare of the farmer, improve profit sellers, of meat sellers as improving as the health condition of the consumers. Reduction of worm burden through chemotherapy and eradication should be encouraged.

1. INTRODUCTION

Cattle (*Bos taurus*) are a multipurpose animal of semi-arid and, arid areas kept for a variety of purposes such as milk, meat, wool, transport and Agricultural purposes. Apart from camel no other domestic animal can provide as many variable services to humans as cattle [1]. The most important disease of cattle is fascioliasis a vector borne helminths disease caused by *Fasciola hepatica* and *F. gigantica* with wide distribution throughout tropical and sub-tropical regions of the world [2]. Fasciolosis is an economically important parasitic snail-borne disease of ruminants and animals including cattle, goats and sheep that has public health significance due to the risk of infection transmission to humans. The diseases cause growth retardation, decreased milk, meat and wool production as well as liver damage in infected

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animals. Furthermore, humans may become infected by eating raw meat dishes made from fresh livers infected with immature flukes, since early migrating flukes present in the consumed and infected liver can retain the ability to restart intra-organic migration [3]. The disease is one of the important neglected tropical diseases that have gained significant global attention in recent years as a result of its associated morbidity and socio-economic impact [4].

The growing popularity of the disease is driven by the high prevalence among rural herding communities in resource-poor country and their constant close association with livestock. Although the disease fascioliasis begins as a subclinical disease similar to some bacterial infections, causing poor milk yield (milk volume), and quality, if unattended it may lead to more devastating outcomes such as severe weight loss, diarrhea, swelling under the jaw and sudden death if allowed to progress [5]. It has been reported to directly affect the liver through the migratory action of flukes in ductular tracts, blood-sucking and liver damage leading to metabolic disease. The snails belonging to the general *Lymnaea*, *Amphipela*, *Simimnaea*, *Golba*, *Fassoria*, *Stagnicola* and *Pseudosuccinea* serve as intermediate hosts, with Specific species restricted to different geographical regions of the world [6,7]. In Nigeria the most important snail is *Lymnaea natalensis*. These intermediate hosts are found in shallow water and are capable of migrating for long distance over mud and wet pasture, thereby increasing the chances of exposure of susceptible animals [8, 9]. *Fasciola hepatica* infects more than 300 million cattle and 250 million small ruminants worldwide and together with *F. gigantica*, causes significant economic losses to global agriculture; through lost productivity such as a reduction in milk and meat yields, mortalities [10, 11]. A previous report by [12] estimated a conservative amount of over US\$ 3.2 billion per annum, as losses due to fasciolosis in production animals worldwide, which was slightly higher than the US\$ 3 billion estimated by [13] in Nigeria. According to [2], fasciolosis was limited in the past to specific and typical geographical areas, but is now widespread throughout the world. Human cases occurred occasionally but are now increasingly reported from developing countries with a higher chance of exposure to the infective fluke stage during food preparation, predominantly in Africa, China, Korea, South America, North and South Asia [14].

Sellers and buyers of meat in Gombe are ignorant of the danger of consuming infected livers, due to lack of public health education. The animals are reared under the free-range extensive management system. The animals range freely grazing grasses in the fields. Their feeding on grasses is supplemented with fodder particularly during the dry season when there is a scarcity of grasses. The animals usually graze on grasses and leaves near water holes, rivers, lakes and temporary flooded areas within the grazing area or range. The animals may acquire infections from such areas that are infested with metacercaria. Information on whether or not the animals are treated or dewormed against fascioliasis is unavailable. Thus, untreated or un-dewormed animals will continue to shed *Fasciola* eggs in their faeces and could serve as a source of infection to healthy animals [15].

Among all the livestock, ruminants, comprising sheep, goats and cattle, constitute the largest group reared by farm families in the country's agricultural system. Nigeria has an estimated population of 34.5 million goats, 22.1 million sheep and 13.9 million cattle. However, about 90 per cent of the country's cattle population and 70 per cent of the sheep and goat populations are concentrated in the Northern part of the country [16]. Most studies aimed at determining the prevalence of *Fasciola* spp. conducted in Nigeria: [15,17] in northern Uganda, and [18] in South Africa, have been based on examination of the liver at post-mortem. Hence, comparatively, fewer reports exist on the detection of *Fasciola* by coprology, the traditional detection method in the laboratory, than by post-mortem examination in the abattoir. The exact prevalence of

fasciolosis is most likely underestimated due to the lack of comprehensive epidemiological surveys performed in potentially endemic areas. Furthermore, in some areas where reports exist, there is a time lag of up to a decade or more, thereby making such reports obsolete and probably not in tune with current realities, hence the need for this study in this area.

The present study investigated the occurrence of cattle fascioliasis using parasitological (microscopic) identification techniques. The findings have been properly recorded and will be forwarded to the appropriate channel for planned control strategies. The study was limited to cattle brought to the abattoir however were often supplemented from cattle markets within the State. ~~This study aims~~~~The aim of this study is~~ to determine the prevalence and intensity of *Fasciola* specie, based on sex, age, breed, and season, among cattle slaughtered at Gombe Central Abattoir, by detecting *Ffasciola* eggs in bile and stool samples.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted at the central abattoir of Gombe metropolis located in the North East region of the Country. The abattoir is the major abattoir in Gombe metropolis slaughtering an average of 100% cattle a day. Gombe State is located between latitudes 10°16'N and 6°00'N and longitude 11°09'E. The climate of Gombe is characterized by a cool dry (Harmattan) season with minimum temperature of about 23.48°C from December to February, a hot dry season with annual maximum temperature of about 35.39°C from March-May and warm wet season from June-September, a less marked season after rains during the months of October to November, characterized by decreased rainfall and gradual lowering of temperature [15]. Gombe State has two main vegetation zones. The Guinea Savannah zone is in the southern part of the State and the Sudan Savannah zone in the northern part (Figure 1).



Figure 1: Map of Nigeria showing the location of the study area

2.2 Ethical approval

The study protocol was conducted with the ethical approval of the Animal Ethical Committee (ACE) of the National Veterinary Research Institute (NVRI), Vom, (ACE/20/83/20), and also with the full approval of authorities in the abattoir.

2.3 Study design and selection of cattle

The survey of *Fasciola spp* in cattle slaughtered in the abattoir was carried out between February 2023- January 2024. A total of 384 cattle were selected and tagged from the lots prepared for daily slaughter. The samples cut across both sexes and different breeds of cattle that include white Fulani, Sokoto Gudali and red Bororo.

2.4 Study population.

The Study was conducted on naturally suspected, infected and healthy cattle meant for slaughter in the main abattoir of the State capital. Most of the cattle Slaughtered in this abattoir were from Ngalda, Leggal, Gombe, Dukku and Bayo, however some were often supplemented from the rural cattle market within the state. The ages of the sample animals were estimated as described by [19]. Cattle ≤ 1 year were classified as young, young; 2-4 years adult while ≥ 5 years age were regarded as older. Breeds identification was done according to the identification keys as provided by [20] for traditional livestock breeds of West Africa. Similarly, the sexes were identified on the appearance of the external genitalia, as described by [21].

2.5 Sample size determination

The sample size was determined according to the number of animals presented for slaughter during the study period. The number of samples collected was determined using the formula of [22] with the previous prevalence of 50% [15] was used in calculating the sample size.

$$N = Z^2 P (1-P) / d^2$$

Where:

N=Sample size

Z=2 statistics for a level of confidence,

P= expected prevalence or proportion (50%)

D=Precision (5%, d=0.05)

Z Statistics (2): At a confidence level of 95% is 1.96

Therefore, $N = 3.842 \times 0.5 \times 0.5 \div 0.0025$

$= 0.9604 \div 0.0025$

$= 384.16$

Hence = 384 to the nearest whole number

3.6 Sample collection and transportation

~~Before sampling the abattoir was visited to make preliminary arrangements for collection of samples. Prior to sampling the abattoir was visited in order to make preliminary arrangements toward collection of samples.~~

A total of three hundred and eighty-four (384) of fecal and gall bladder sample were collected at Gombe municipal abattoir covering two seasons from June to October 2022 during the rainy season and November, to May, 2023 during the dry season. Convenient sampling technique was used for the sampling and about 2g of faecal sample was collected directly from the rectum of each animal using hand (manually) with disposable hand gloves into a sample bottle for analysis. For bile collection, the whole gall bladder was removed from animal species through gentle excision from the liver using scalpel blade. Care was taken to prevent spilling of the bile from the gall bladder to the thoracic cavity of the slaughtered animal. The bile was then emptied into a suitable container and 10% formalin solution was added for preservation. The stool and bile samples were taken to Gombe State University parasitology laboratory in a cool box for analysis and identification.

2.6 Sample Processing

2.6.1 Phenotypic detection of *Fasciola* spp. in faeces

The processing was as earlier described by [8]. Four grams (4g) of faeces will be placed into labelled test tubes containing 6 mls of distilled water, and then strained to give a suspension, which was also strained through a tea strainer into a clean labelled Petri dish. The resultant filtrate was poured into a test tube and one millilitre (1ml) of 10% formalin was added, after which the suspension was allowed to stand for 5 minutes, followed by addition of diethyl ether (1ml). The test tube containing the suspension was corked and shaken to mix, then centrifuged at 2000 g for 8 minutes, after which the supernatant was decanted, leaving a drop of it with the sediment. Part of the sediment was placed on a glass slide and covered with cover slip, drops of methylene blue was added and then viewed at $\times 10$ magnification of a stereomicroscope for *Fasciola* eggs, until the entire sediment examined and all eggs counted [23]. Prevalence was determined by expressing the number of positive samples as a % of total sample collected. The number of eggs counted was expressed per grams of faeces [24].

2.6.2 Detection of *Fasciola* spp in bile

Approximately 4 millilitres of the collected bile was poured into a labelled test tube and the procedure used for faecal sample analysis was repeated, followed by addition of 1ml of 10% formalin. After 5 minutes, diethyl-ether (1 ml) was added. The test tube containing the solution was corked, shaken to mix, and then centrifuged at 2,000 g for 10 minutes. The supernatant was decanted leaving few of it with the sediment. Parts of the sediment was placed on a clean glass slide and drops of methylene blue added before being viewed under a microscope using $\times 10$ magnifications for *Fasciola* eggs, until the entire sediment examined [23]. Prevalence was determined by expressing the number of positive samples as a % of total samples collected. The number of eggs counted was expressed per millilitres used [24].

2.7 Data analysis

The data were analyzed and presented using descriptive statistics such as means and tables. Chi-square was used to establish association between fluke infection and ANOVA to determine the significant of difference in mean distribution of the flukes between the variables.

RESULTS

3.1 Prevalence of Fascioliasis based on location of cattle studied

Among the five different locations examined in this study, the highest prevalence of *Fasciola* spp was recorded in Gombe (53.8%) followed by Dukku (15.6), Ngalda (12.6%), Leggal (10.1%) and the lowest prevalence was recorded in Bayo which had a prevalence of (7.9%). as shown in table 1.

Table 1: Distribution of Fascioliasis based on location of cattle in this study

| Location | No. Examined | No. positive | Prevalence (%) |
|----------|--------------|--------------|----------------|
| Gombe | 184 | 149 | 53.8 |
| Dukku | 67 | 43 | 15.6 |
| Leggal | 41 | 28 | 10.1 |
| Bayo | 40 | 22 | 7.9 |
| Ngalda | 52 | 35 | 12.6 |

| | | | |
|--------------|------------|------------|------------|
| Total | 384 | 277 | 100 |
|--------------|------------|------------|------------|

p>0.05

3.2 Prevalence of Fasciola Infections in Relation to Sex of Cattle Examined

Two hundred and ~~sixty-four~~sixty-four female (264) and one hundred and twenty male (120) cattle were sampled and examined for the presence of *Fasciola* spp. ~~Ninety-five~~Ninety-five 95(34.3%) male cattle examined were infected while one hundred and ~~eighty-two~~eighty-two (65.7%) of the female cattle examined were found to be infected with Fascioliasis as shown in table 2. The prevalence of infection among male and female cattle was found not to be statistically significant (p>0.05).

Table 2: Prevalence of Fascioliasis based on sex of cattle examined during the study

| Sex | No. Examined (n=384) | No. Positive | Prevalence (%) |
|--------------|-------------------------|--------------|----------------|
| Male | 120 | 95 | 34.3 |
| Female | 264 | 182 | 65.7 |
| Total | 384 | 277 | 100 |

p>0.05

4.3 Prevalence of Fascioliasis based on age of cattle examined

Age prevalence among cattle examined in this study showed that, the prevalence of *Fasciola* spp was higher in adult cattle aged 2-4 years (57.1%) and the lowest prevalence was recorded in young cattle age less than 1 year ≤1 (13.7%). While older cattle age ≥5 had a prevalence of (29.2%) as shown in table 3. The prevalence of infection based on the ages of cattle examined was found not to be statistically significant (p>0.05)

Table 3: Distribution of Fascioliasis based on age of cattle in this study

| Age (years) | No. Examined (n=384) | No. Positive | Prevalence (%) |
|--------------|-------------------------|--------------|----------------|
| ≤1 | 56 | 38 | 13.7 |
| 2-4 | 196 | 158 | 57.1 |
| ≥5 | 132 | 81 | 29.2 |
| Total | 384 | 277 | 100 |

p>0.05

3.4 Prevalence of Fascioliasis based on breed of cattle in the study

Among the three different cattle breeds examined in this study, the prevalence of *Fasciola* spp was highest in White Fulani (69.3%) followed by Red Bororo (16.7%) and the lowest prevalence was recorded in the Sokoto Gudali breed which had a prevalence of 14.0%. as shown in table 4.

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Table 4: Distribution of Fascioliasis based on breed of cattle

| Breed | No. Examined (n=384) | No.Positive | Prevalence (%) |
|---------------|-------------------------|-------------|----------------|
| White Fulani | 272 | 192 | 69.3 |
| Red Bororo | 65 | 46 | 16.7 |
| Sokoto gudali | 47 | 39 | 14.0 |
| Total | 384 | 277 | 100 |

p>0.05

4.5 Prevalence of fascioliasis based on the body condition of cattle in the study

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Prevalence among body condition of the cattle examined in this study showed that, the prevalence of *Fasciola* spp was higher in cattle with poor body condition (44.1%) and the lowest prevalence was recorded in good body condition (16.6%). while cattle with moderate body condition had a prevalence of (39.3%) as shown in Table 5. The prevalence of infection based on the ages of cattle examined was found to be statistically significant (p<0.05)

Table 5: Distribution of fascioliasis based on body condition of cattle studied

| Body condition | No. examined | No. infected | Prevalence (%) |
|----------------|--------------|--------------|----------------|
| Poor | 130 | 122 | 44.1 |
| Fair | 143 | 109 | 39.3 |
| Good | 111 | 46 | 16.6 |
| Total | 384 | 277 | 100 |

(p<0.05)

3.6 Seasonal variation of infection among cattle

Distribution of infection with Fascioliasis based on the months in which samples were collected shows that prevalence was higher in the rainy (72.9%) season than the dry season (27.1%) as shown in Table 6.

Table 6: Seasonal variation of infection among cattle

| Season | No.Examined | No.positive | Prevalence (%) |
|--------------|-------------|-------------|----------------|
| Dry | 115 | 75 | 27.1 |
| Rainy | 269 | 202 | 72.9 |
| Total | 384 | 277 | 100 |

p<0.05.

3.6: Intensity of infection with *Fasciola* spp. among infected cattle from Gombe state

Three categories of fasciolosis infection intensity were based on epg. 194 (70.03%) of the 277 cattle sampled were lightly infected, with moderate infection in 20.57% (57/277) and 9.38% (26/277) with heavy infection (Table 7).

Table 7: Intensity of infection with *Fasciola spp.* among infected cattle from Gombe state

| Factor | Category | Frequency | Intensity of infection, frequency (%) | | |
|---------------|---------------|-----------|---------------------------------------|------------|------------|
| | | | Light | Moderate | Heavy |
| Gender | Male | 95 | 69(72.63) | 20 (21.05) | 6(6.31) |
| | Female | 182 | 125(68.68) | 37 (20.32) | 20(10.98) |
| Age | 1-2 years | 47 | 28 (59.57) | 12 (25.53) | 7 (14.89) |
| | 3-5 years | 162 | 119 (73.45) | 30 (18.51) | 13 (8.02) |
| | 6 and above | 68 | 47(69.11) | 15 (22.05) | 6 (8.82) |
| Breed | White Fulani | 192 | 141 (73.43) | 32 (16.66) | 19(9.89) |
| | Red Bororo | 46 | 30 (65.21) | 13(28.26) | 3(6.52) |
| | Sokoto gudali | 39 | 23(58.97) | 12 (30.76) | 4 (10.25) |
| Season | Rainy season | 202 | 142 (70.29) | 39(19.30) | 21 (10.39) |
| | Dry season | 75 | 52 (69.33) | 18 (24.0) | 5 (6.66) |

5. DISCUSSION

Fascioliasis is an infection of cattle and humans due to the consumption of meat by human beings. The total prevalence of Fasciola infections obtained in this research work on cattle slaughtered at Gombe market abattoir from five different locations was 277(72.1%). The high prevalence obtained in this work can be attributed to the high number of disease reservoirs (cattle, goat and sheep) and climatic conditions of Gombe which favours the survival of the intermediate hosts, the snail. This intermediate host prefers swampy areas with slowly moving water and small streams which also allow sufficient moisture for the survival of the infective metacercaria. This may not be unconnected with the fact that, north-eastern Nigeria is a zone of rampant uncontrolled grazing, with no clean water sources for the animals except open ditches and ponds which are factors aiding transmission.

High prevalence of infection may also be due to poor herd sanitary conditions, host susceptibility to infection as a result of poor feed quality, ill-treated tributaries, careless attitude of both herdsman and health supervisors, and lack of proper control programs, as well as poor veterinary services in the study area against the disease. Both cattle and people may suffer substantial economic consequences as a result of this high incidence. Such economic loss could include; costs of anthelmintics, drenches, labour, liver condemnation during meat inspection, and production losses owing to mortality, including reduced meat, milk, and wool output, as well as reduced growth rate and fertility. The disease could be public health significance, causing human fascioliasis.

This prevalence was generally high and approximately agrees with findings from similar studies by [25] who recorded a prevalence of 70% among cattle in the study performed at Yenagoa, Bayelsa state of Nigeria and 80% prevalence rate reported from cows slaughtered at Maiduguri, north-eastern Nigeria. Also, study by [26] at Kampala City Abattoir, Central Uganda reported a prevalence of 84%. Despite several studies reporting high rates of prevalence, low prevalence was reported in several other studies as well. For example, a low prevalence of 29.8% was reported by [27] in Bauchi, 18.0% was reported by [28] in Cameroon.

A prevalence of 34.3% and 65.7% was recorded for male and female cattle respectively. The distribution of the illness by sex indicated that female cattle were considerably more infected with Fascioliasis than male cattle in this investigation. This might be because more female animals were slaughtered at the slaughterhouse or because more females were sampled than males. Another reason for the discrepancy might be because females stay in the herd longer (for reproduction, breeding, and milk production), resulting in a larger illness load. The result is consistent with findings from research by [29] in Kwara and [30] in Taraba of Nigeria. However, this finding conflicts with the findings of [15, 31] in Nigeria, who found greater prevalence in males than females.

Adult cattle had a larger number of instances than younger animals, according to the age distribution of the illness. However, chi-square statistical analysis for significance ($P > 0.05$) revealed that infection rate and age have no relationship. The increased incidence in adults compared to younger cattle may be due to the young animals' reduced exposure to the parasite and the type of feed they consume. Adults graze on grasses, leaves, and other flora, primarily in regulated pastures, especially along river banks, while young animals are given milk and chaff near the base of Fulani houses. During the dry season, they are also pushed from place to place in quest of lush pastures and water. In permanent water bodies, there is frequently a significant concentration of snail intermediate hosts, which can pollute the water and neighboring flora with encysted metacercariae. Also, Most of the cattle slaughtered at the abattoir are adults, while the young ones are being retained for fattening to adult size before slaughtering. This finding is consistent with [32] in Maiduguri, [33] in Adamawa and [34] in Bauchi. However, this conclusion conflicts with [35] findings in South Africa, where they found higher infection in young animals than adult animals.

In this investigation, it was found that the White Fulani cattle breed had the highest prevalence of fasciolosis ($P < 0.05$) compared to the other breeds studied, followed by the Red Bororo and the Sokoto Gudali cattle breeds. This suggests that some breeds are more prone to infection than others. This might be due to the large quantity of these breeds reared in abattoirs. It is also possible that variations in genes, the environment, and human intervention are possible factors for these results. However, the management techniques used with specific cow breeds may have had an impact on the risk of exposure and subsequent transmission. This result is consistent with research from different authors in Nigeria such as [15, 33 and 36]. In contrast to the findings of this study, [37] in Birninkebbi Nigeria reported that prevalence was observed to be higher in Sokoto Gudali than in any other breed, while there was a statistically significant association observed between prevalence and breeds of cattle slaughtered.

The result of the present study indicates that body condition of animals has a significant association with the occurrence of *Fasciola* infection. The prevalence was significantly higher ($P < 0.05$) in poor body conditioned animals than in fair and good body condition groups. A similar observation was made by [38 and 27] in Taraba and Bauchi but is in contrast with the

result of [39]. Poor body conditioned animals resulting from nutritional or other health challenges are often associated with low resistance to parasitic infections; such animals when infected with liver flukes often end up with an exacerbated condition. This is because helminths-infected animals give priority to the reversal of the pathophysiological consequences of parasitism over other body functions and growths. Nutrients are thus not effectively utilized for body maintenance and growth. This results in cachexia, particularly at the chronic stage of bovine fasciolosis.

This study found that bovine fasciolosis is more common during the wet season. The association between bovine fasciolosis and the season was statistically significant. The reason for the high prevalence in the rainy season could be due to the existence of a positive relationship between the prevalence of fascioliasis and environmental characteristics such as rainfall, humidity and temperature. The rainfall determines the prevalence and intensity of fluke's infection more than any other factor. Studies by [40] in Zamfara State, [34] in northern Bauchi State, and [41] in Niger State all show similar patterns, lending credence to these findings. However, [42] reported that prevalence was higher in dry season (15.3%) than the rainy season (12.0%) although not statistically significant ($p > 0.05$). Similarly, [43] found a higher frequency in Makurdi during the dry season of the year than in the rainy season.

The intensity of infection in this study was determined based on the total number of epg in feces, and the data revealed a low infection rate in the animals studied. The capacity of *Fasciola* spp. to survive and infect a host depends on the interaction between host and parasite factors, which are related to immunological systems [44]. The ability of the parasite to establish infection in a mammalian host depends on its ability to manipulate the host's physiological milieu by producing and releasing a complex of regulatory proteins, glycans, and microRNAs. The parasite's tegument also serves a vital function in defending it from assaults by the host immune system. The result is similar to with the finding of [45] in Indonesia who found Sixty-one (92.42%) of the 66 cattle sampled were lightly infected, with moderate infection in 6.06% (4/66) and 1.52% (1/66) with heavy infection.

6. CONCLUSION

The study concludes that fascioliasis among cattle is prevalent in Gombe state causing high economic loss to the people rearing the animals. This is due to the system of rearing in the study area extensive management which influenced the risk of fasciolosis grazing animals in swampy areas, where there is availability of snail intermediate hosts, watering animals using open water bodies as well as lack of routine deworming. Public enlightenment to the farmers/rarer on the importance of regular de-worming and watering of their animals using clean water for their economic benefit and the health conditions of their consumers are recommended to maximize the welfare of the farmer, improving the profit of meat sellers as well as the health condition of the consumers. ~~Public enlightenment to the farmers/rarer on the importance of regular de-worming and watering of their animals using clean water for their economic benefit and health conditions of their consumer are recommended with the aim of maximizing the welfare of the farmer, improvement on profit of meat sellers as well as health condition of the consumers.~~ Reduction of worm burden through chemotherapy and eradication should be encouraged.

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REFERENCE

1. Arenal A, García Y, Quesada L, Velazquez D, Sanchez D, Pena M. et al. Risk factors for the presence of *Fasciola hepatica* antibodies in bulk-milk samples and their association with milk production decreases, in Cuban dairy cattle. *BMC Vet Res.* 2018;14(1). doi:10.1186/s12917-018-1654-2
2. de Waal T. Parasites, internal: Liver flukes. In: *Encyclopedia of Dairy Sciences.* Elsevier; 2016:451-458. doi:10.1016/b978-0-08-100596-5.00741-1
3. Mas-Coma S, Bargues MD, Valero MA. Human fascioliasis infection sources, their diversity, incidence factors, analytical methods and prevention measures. *Parasitology.* 2018;145(13):1665-1699. doi:10.1017/S0031182018000914
4. Nyindo M, Lukumbagire AH. Fascioliasis: An ongoing zoonotic trematode infection. *Biomed Res Int.* 2015:786195. doi:10.1155/2015/786195
5. Howell A, Mugisha L, Davies J, LaCourse EJ, Claridge J, Williams DJL. et al. Bovine fasciolosis at increasing altitudes: parasitological and malacological sampling on the slopes of Mount Elgon, Uganda. *Parasit Vectors.* 2012;5(1):196. doi:10.1186/1756-3305-5-196
6. Smyth JD. *Introduction to Animal Parasitology (Classic Reprint).* Forgotten Books; 2022.
7. Bhatia BB, Pathak KML, Banerjee DP. *Textbook of Veterinary Parasitology.* Kalyani Publishers; 2006:61-67.
8. Magaji AA, Ibrahim K, Salihu MD, Saulawa MA, Mohammed AA, Musawa AI. Prevalence of fascioliasis in cattle slaughtered in Sokoto metropolitan abattoir, Sokoto, Nigeria. *Adv Epidemiol.* 2014:1-5. doi:10.1155/2014/247258
9. Taylor MA, Coop RL, Wall RL. *Veterinary Parasitology.* 4th ed. (Taylor MA, Coop RL, Wall RL, eds.). Wiley-Blackwell; 2015. doi:10.1002/9781119073680
10. Mas-Coma S, Bargues MD, Valero MA. Fascioliasis and other plant-borne trematode zoonoses. *Int J Parasitol.* 2005;35(11-12):1255-1278. doi:10.1016/j.ijpara.2005.07.010
11. Nyirenda SS, Sakala M, Moonde L, et al. Prevalence of bovine fascioliasis and economic impact associated with liver condemnation in abattoirs in Mongu district of Zambia. *BMC Vet Res.* 2019;15(1):33. doi:10.1186/s12917-019-1777-0
12. Mehmood K, Zhang H, Sabir AJ, et al. A review on epidemiology, global prevalence and economical losses of fasciolosis in ruminants. *MicrobPathog.* 2017;109:253-262. doi:10.1016/j.micpath.2017.06.006
13. Elelu N, Eisler MC. A review of bovine fasciolosis and other trematode infections in Nigeria. *J.Helminthol.* 2018;92(2):128-141. doi:10.1017/s0022149x17000402
14. Zerna G, Spithill TW, Beddoe T. Current status for controlling the overlooked Caprine fasciolosis. *Animals (Basel).* 2021;11(6):1819. doi:10.3390/ani11061819
15. Adang LK, Kela SL, Kashere MB. Fascioliasis in cattle slaughtered at Gombe abattoir, Nigeria. *Int J Biol Chem Sci.* 2015;9(2):783. doi:10.4314/ijbcs.v9i2.18
16. Lawal-Adebawale OA. Dynamics of ruminant livestock management in the context of the Nigerian agricultural system. In: *Livestock Production.* InTech; 2012. doi:10.5772/52923
17. Opio LG, Abdelfattah EM, Terry J, Odongo S, Okello E. Prevalence of fascioliasis and associated economic losses in cattle slaughtered at lira municipality abattoir in northern Uganda. *Animals (Basel).* 2021;11(3):681. doi:10.3390/ani11030681
18. Mpisana Z, Jaja IF, Byaruhanga C, Marufu MC. Body condition scores, fluke intensity, liver pathology, and carcass quality of different dairy cattle genotypes infected with

- Fasciola species at high throughput abattoirs in South Africa. *Parasitol Res.* 2022;121(6):1671-1682. doi:10.1007/s00436-022-07504-9
19. Chibuzo GA. *Ruminant Dissection Guide: A Regional Approach in Goats.* Beth-Bekka Academic Publishers. 2006:59-60.
 20. Anderson N, Luong TT, Vo NG, Bui KL, Smooker PM, Spithill TW. The sensitivity and specificity of two methods for detecting Fasciola infections in cattle. *Vet Parasitol.* 1999;83(1):15-24. doi:10.1016/s0304-4017(99)00026-6
 21. Thrusfield M, Christley R. *Veterinary Epidemiology.* 4th ed. John Wiley & Sons; 2018. doi:10.1002/9781118280249
 22. Ortiz P, Cabrera M, Jave J, Claxton J, Williams D. Human fascioliasis: Prevalence and treatment in a rural area of Peru. *The Infectious Disease Review - Microbes of man, animals and the environment.* 2000;2:42-46.
 23. Cheesbrough M. *District Laboratory Practice in Tropical Countries: Part 1.* 2nd ed. Cambridge University Press; 2019. doi:10.1017/cbo9780511581304
 24. Gbeghebo AJ, Dominic AA, Sarah SE, Prevalence of fascioliasis among cattle and goats slaughtered in abattoirs within Sagbama community and Yenagoa metropolis, Bayelsa State. *International Journal of Pharmaceutical and Bio-Medical Science.* 2023;03(06). doi:10.47191/ijpbms/v3-i6-06
 25. Joan N, Stephen M, Bashir M, et al. Prevalence and economic impact of bovine fasciolosis at Kampala city abattoir, central Uganda. *Br Microbiol Res J.* 2015;7(3):109-117. doi:10.9734/bmrj/2015/15274
 26. Karshima SN, Maikai BV, Kwaga JKP. Helminths of veterinary and zoonotic importance in Nigerian ruminants: a 46-year meta-analysis (1970–2016) of their prevalence and distribution. *Infect Dis Poverty.* 2018;7(1). doi:10.1186/s40249-018-0438-z
 27. Takang EE, LeBreton M, Ayuk CE, MacLeod ET. A socio-economic study of Fasciola infections in cattle and sheep at the Etoudi slaughterhouse, Yaoundé, Cameroon. *J Helminthol.* 2019;94(e92):e92. doi:10.1017/S0022149X19000890
 28. Elelu N, Ambali A, Coles GC, Eisler MC. Cross-sectional study of Fasciola gigantica and other trematode infections of cattle in Edu Local Government Area, Kwara State, north-central Nigeria. *Parasit Vect.* 2016;9(1). doi:10.1186/s13071-016-1737-5
 29. Obialigwe TF, Pindar HM, Uko IB, Ekechukwu KC. Prevalence of bovine fasciolosis in Jalingo abattoir, Taraba State, Nigeria. *Microbes Infect Dis.* 2024;5(2):830-839.
 30. Eze NC, Briggs AA. Prevalence of Fascioliasis and histopathology of the liver in cattle slaughtered in Port Harcourt Abattoir, Rivers state Nigeria. *World News of Natural Sciences.* 2018;16:105-116.
 31. Mbaya AW, Shingu P, Luka J. A retrospective study on the prevalence of Fasciola infection in sheep and goats at slaughter and associated economic losses from condemnation of infected liver in Maiduguri abattoir, Nigeria. *Niger Vet J.* 2011;31(3). doi:10.4314/nvj.v31i3.68970
 32. Ardo MB, Aliyara YH. Prevalence of fasciolosis in small ruminants slaughtered at Yola modern abattoir, Adamawa state, Nigeria. *Bayero Journal of Pure and Applied Sciences.* 2014;7(2):783-792.
 33. Isah UM. Studies on the prevalence of fascioliasis among ruminant animals in northern Bauchi state, north-eastern Nigeria. *Parasite Epidemiol Control.* 2019;5(e00090):e00090. doi:10.1016/j.parepi.2019.e00090

34. Jaja IF, Mushonga B, Green E, Muchenje V. Financial loss estimation of bovine fasciolosis in slaughtered cattle in South Africa. *Parasite Epidemiol Control*. 2017;2(4):27-34. doi:10.1016/j.parepi.2017.10.001
35. Alaba A, Praise O, Olayiwola J. Prevalence of Fasciola Infection in Cattle-Ready-for - Slaughtering at some Abattoirs in Oyo. *Appl. Sci. Biotechnol Journal for Advanced Research*. 2023;(2):11-17.
36. Zaki K, Mahmuda A, Yakubu Y, et al. Prevalence of Fasciola species from cattle slaughtered at Birnin Kebbi Modern Abattoir. *International Journal of Science for Global Sustainability*. 2023;9(1):6. doi:10.57233/ijsgs.v9i1.420
37. Shinggu PA, Olufemi OT, Nwuku JA, Baba-Onoja EBT, Iyawa PD. Liver flukes egg infection and associated risk factors in White Fulani Cattle slaughtered in Wukari, southern Taraba State, Nigeria. *Adv. Prev. Med.* 2019;2671620. doi:10.1155/2019/2671620
38. Pfukenyi DM, Mukaratirwa S. A retrospective study of the prevalence and seasonal variation of Fasciola gigantica in cattle slaughtered in the major abattoirs of Zimbabwe between 1990 and 1999. *J Vet Res*. 2004;71(3):181-187. doi:10.4102/ojvr.v71i3.258
39. Ahmad I, Yakubu Y, Chafe UM, Bolajoko BM, Muhammad U. Prevalence of fasciolosis (Liver flukes) infection in cattle in Zamfara, Nigeria: A slaughterhouse surveillance data utilizing post-mortem examination. *Vet. Parasitol.: Regional Studies and Reports*. 2020;22
40. Yatswako S, Alhaji NB. Survey of bovine fasciolosis burdens in trade cattle slaughtered at abattoirs in North-central Nigeria: The associated predisposing factors and economic implication. *Parasite Epidemiol. Control*. 2017;2(2):30-39.
41. Njoko-Tony RF. Bovine fasciolosis among slaughtered cattle in selected abattoirs in Imo State, Nigeria. *Nig. World Rural Obs*. 2011;3(1):59-63.
42. Ejeh EF, Paul BT, Lawan FA, Lawal JR, Ejeh SA, Hambali IU. Seasonal prevalence of bovine fasciolosis and its direct economic losses (del) due to liver condemnation at Makurdi abattoirs north-central Nigeria. *Sokoto J. Vet. Sci*. 2015;13(2):50-56.
43. Kurnianto H, Ramanoon SZ, Aziz NAA, Indarjulianto S. Prevalence, risk factors, and infection intensity of fasciolosis in dairy cattle in Boyolali, Indonesia. *Vet World*. 2022;15(6):1438-1448. doi:10.14202/vetworld.2022.1438-1448
44. Piedrafita D, Spithill TW, Smith RE, Raadsma HW. Improving animal and human health through understanding liver fluke immunology. *Parasite Immunol*. 2010;32(8):572-581. doi:10.1111/j.1365-3024.2010.01223.x

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