Assessing the prevalence of fasciolosis among ruminants slaughtered in abattoirs of Niger state

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Received 7 Jun 2023; Accepted 18 Jul 2023; Published 24 Jul 2023

Abstract

A study was carried out to investigate the prevalence of fasciolosis among slaughtered ruminants in abattoirs of Niger state. A total of one thousand one hundred and fifty-two (1152) samples of fecal, bile and liver were collected. A formal-ether technique was employed to analyze the samples. The results obtained indicated higher rate of infection among sheep (13.8%) than cattle and goats. The breed, sex and age of the animals influenced the prevalence of the fasciolosis with Sokoto Gudali having the highest value (18.9%) than other cattle breed; and Uda have the highest rate (20.2%) than other sheep breed. Sahel goat has the highest (60%) than another goat breed. Higher rate of infection was observed among the male across the experimental species; cattle (25%); sheep (25.8%); and goat (12%) than the female ruminants. Young ruminants were more infected across the experimental species; cattle (13.6%); sheep (16.4%); and goat (6.5%) than the older ones. The impact of fasciolosis can be seen in the loss of weight, reduction of meat quality and quantity, economic loss to farmers and butchers and the zoonotic effect to the consumers. There should be an adequate animal inspection at ante-mortem level and grazing of animals should be avoided along swampy areas.

Keywords: fasciolosis, ruminants, Niger state

Introduction

There are approximately 150 distinct species of ruminants such as cattle, sheep, goats, deer, buffalo, bison, giraffe, moose, and elk (Ministry of Livestock and Fisheries Development (MLFD), 2014) [26]. Ruminants are distinguished by their four stomach chambers and their stomach is complex, with four compartments labelled rumen, reticulum, omasum, and abomasums (Adebayo *et al*., 2012) [1]. The rumen compartment is the largest of the four compartments and contains microbes capable of digesting the high fiber content of the roughages consumed by ruminants (DanWake *et al*., 2013) [14]. Ruminant species are further sub-divided into grazers, browsers, and intermediates. Sheep, cattle, and buffalo eat mostly lower quality grasses, whereas moose and mule deer stay in the woods and eat highly nutritious twigs and shrubs. Intermediates, such as goats and white-tailed deer, have nutritional needs that fall somewhere between those of grazers and browsers (Adebayo *et al*., 2012) [1].

DanWake *et al*. (2013) [14], noted that maintaining domestic animals in good health is necessary to get the greatest benefits. On the other hand, if there are any deviations or changes from the body's normal physiological condition, the animal is considered to be ill health. In general, other disease-related signs and symptoms include gait, bottle jaw, rough hair coat, discharge from the natural orifices (bloody, diarrheal, mucous, etc.), and recumbent posture. Ruminants' health deviates from normal primarily due to the invasion of parasites or pathogenic microorganisms, the toxin they produce, and the tissue reaction to these invaders' present (Dunn, 2008) [16]. Worms, fleas, cysts, and ticks are examples of parasitic organisms, while bacteria, viruses, protozoa, rickettsia, and fungi are pathogenic micro-organisms (Dunn, 2008) [16].

Fasciolosis is a parasitic infection that mostly affects ruminants, such as cattle, sheep, and goats, and is worldwide. (World Health Organization of United State (WHO), 2017) [37]. Fasciolosis, also known as liver rot, is an important parasitic infection of farm animals caused by two main species of trematodes: *Fasciola gigantica*, and *Fasciola hepatica* (Rana *et al*., 2014) [30]. In Europe, the Americas, and Oceania, only *Fasciola hepatica* is a concern, but the distributions of both *Fasciola* species overlap in many areas of Africa and Asia (Mas-Coma *et al*., 2005) [24]. The *Lymnaea* snails living along the riverbanks are suitable intermediate hosts for *Fasciola* spp. (Magaji, *et al*., 2014) [22]. Fasciolosis is transmitted by ingestion of metacercaria-infested forage or drinking water containing floating metacercariae (Arjona *et al*., 2014) [4]. Among many parasitic problems of farm animals, fasciolosis is a major disease which imposes direct and indirect economic impact on livestock production particularly cattle, sheep and goat (Keyyu *et al*., 2016) [21]. Walker *et al*. (2008) [34] indicated that the life cycle of fasciola worms involved snail as an intermediate host. There are two snail species that are intermediate host for fasciola; *Lymnae natalensis* for fasciola gigantica and *Lymnae trucatula* for fasciola hepatica. The species of snails involved in their life–cycles vary according to geographical distribution and climatic differences (Bhatia *et* *al*., 2014) [5]. The life cycles of fasciola involves five larval stages commencing with eggs which hatches into meracidium, sporocyst, radia, cercaria and metacercariae (Anawat *et al*., 2015) [3].

In Nigeria, fasciolosis is enzootic and has significant economic importance, particularly in the northern region where bogs and stagnant water (*fadama*) are used as watering and grazing areas during the dry season (Biu *et al*., 2006) [6]. The pathological manifestations of fasciolosis depend mainly on the number of metacercariae of fasciola ingested; these may result in acute, sub-acute or chronic fasciolosis (Bhatia *et al*., 2014; Walker *et al*., 2008) [5, 34]. Waterlogged and poorly drained highland areas with acid soils are frequently endemic for fasciolosis. Niger state is one of the States that have recently expanded its small-scale traditional irrigational activities; this creates favourable conditions for fluke transmitting snail vectors, favouring the disease's life cycle progression (Idris *et al*., 2020) [19]. It is against this background that this study was designed to elucidate the prevalence of fasciolosis among cattle, sheep and goat slaughtered in three selected abattoirs in Niger State.

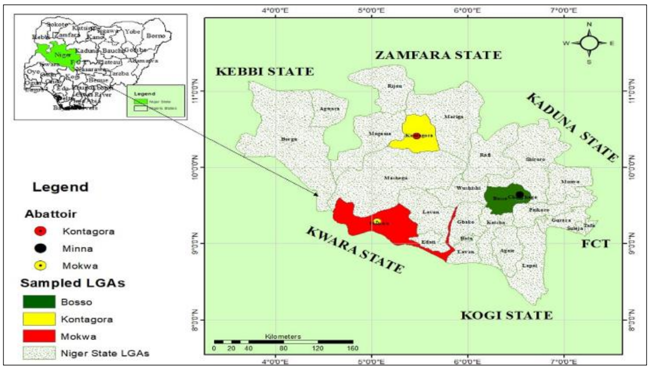
Material and methods

Description of the study areas

This study was conducted in abattoirs of Niger State namely; Minna abattoir, Kontagora abattoir and Mokwa abattoir. The Minna (Minna Modern Abattoir) abattoir is the largest abattoir located in the capital city of the State. It has all the trapping of modernity through which it derived its name when it was commissioned by the Col. Lawal Gwadabe military administration somewhat around 1990. The town is situated at latitude 9˚21"65.9˚N and longitude 6˚23"53.50˚E of the equator. The mean annual rainfall of the town is 1247 mm with duration of about 143.35 rainy days. It has humidity of 53.4% and average lowest and highest temperatures of about 27 °C and 37 °C, respectfully. The total human population in the city as 2021 was estimated to be 479,699 (National Bureau Statistic 2021).

Kontagora slaughter slab is a local abattoir located near the old market of the town, 35 km northwest of Tungan Kawo village. The town is situated at latitude 10° 24' 25.7256" N and longitude 5° 28' 11.7012" E. The mean annual rainfall of the town is 1258 mm with duration of about 142.2 5 rainy days. It has an average relative humidity of 34 % and lowest and highest temperatures of about 27 °C and 39 °C, respectfully. The estimated population of Kontagora is put at 151,236 inhabitants with the majority of the populace in the area (85%) are farmers while the remaining15% are involved in other vocations such as white-collar jobs, business, craft and arts (NBS, 2021).

Mokwa abattoir was established in 1964 under the bilateral agreement between the German and Nigerian Government. Later it was handed over to Nigerian Livestock and Meat Authority (NLMA) in1971. Later it was handed over to Niger state Government. Its core goal was to increase the meat production mainly around the town. The town is situated at latitude 9° 17' 41.35" N and longitude 5° 03' 14.83" E. The annual temperature of the town is 28 °C and 39 °C. The total human population in the city was 244,937 (2006 census). The major occupations of the people in Mokwa are predominantly farmers, hunters, and traders and have remained so for years (Suleiman *et al.*, 2017) [32]. Figure 3 below shows the location of the study abattoirs.



Source: Remote Sensing/ Geographical information system (GIS) laboratory, Geography department, FUTMINNA (2022)

Fig 3: Map of the three Selected Abattoirs in the State

Sample size determination

The open-source epidemiologic statistics for Public Health Open 2.3 software (Thrusfield's, 2005) [33] was used to calculate the sample size for the proportion of the infinite population with power set at 50% and a 5% margin of error at a 95% confidence level due to the irregularity in the numbers of daily slaughtered ruminants. As a result of selecting full experimental animals (cattle, sheep, and goats) from the three abattoirs throughout the survey, a sample size of 128 per animal species was obtained, resulting in 384 samples from each slaughterhouse and a total of 1,152 samples from the entire experimental animals. The major slaughterhouses known as abattoirs were specifically selected from the study areas. The slaughtered animals were selected using a systematic random sampling technique, with a sample interval of two (Thrusfield's, 2005) [33].

Sample collection

A total of 13 thirteen (13) visits on fortnight bases were carried out for the collection of fecal and bile samples and also for the examination of liver from slaughtered animals within the locations.

Fecal samples collection procedure

Following the slaughtering of each ruminant being sampled, feces were promptly removed from the rectum and placed in a vacuum stool test tube with clear labels. When collecting fecal samples, hand gloves were used, and the samples were either analyzed immediately or kept with a 10% formalin solution for later analysis (Cheesbrough, 2005) [12].

Bile sample collection procedure

Bile was drawn directly from the gallbladder using an 18-gauge hypodermic needle. The bile samples were then taken to the laboratory for analysis after being poured into a well-labeled test tube and arranged in a test tube rack (CDC, 2013) [9].

Liver sample collection procedure

The livers of individual animals were visually inspected, palpated, and incised for nodules, white spots, cysts, discoloration, and other abnormalities as part of post-mortem examination, this followed conventional meat inspection protocols (FAO, 2003) [18].

Laboratory preparation for fecal samples analysis

A test tube with clear labels that contained 10 ml of normal saline solution and 2ml of 10% formalin was filled with two grams (2g) of collected feces using an applicator stick. The suspension was corked and shaken until a thick, homogenous emulsion was created and then transferred into a clean, well-labeled centrifugal test tube using a tea strainer and it was centrifuged at 1000 revolution per minute (rpm) up to 5minutes. Supernatant fluid was carefully decanted leaving the sediment at the bottom of the test tube; the sediment was rinsed with normal saline solution. This process of rinsing was repeated 3times until clean and clear sediment was achieved which is free from plug and debris and the sediment got down at the bottom of the test tube. Following rinsing a fresh ethyl alcohol 2ml was added and centrifuged at 1000 rpm for 5minutes. The suspension was carefully drained off leaving the sediment at the bottom of the test tube (Cheesbrough, 2005) [12].

Laboratory preparation for bile samples analysis

An 18-gauge hypodermic syringe and needle were used to inject 1 ml of 10% formalin into the bile sample, which was then left to stand for 5 minutes. A separate 18-gauge hypodermic syringe and needle were used to introduce diethyl-ether (1 ml) to the test tube after 5 minutes. The solution was then mixed after being corked and shaken in a test tube. The solution was then centrifuged for 15 minutes at 2000 revolutions per minute (rpm). The parasites' eggs were sediment at the bottom of the solution, while a supernatant fluid made of diethyl-ether and some fat rose to the top. After draining the supernatant, only a little amount of the sediment remained at the bottom of the test tube (Suleiman *et al.,* 2017) [32].

Microscopic examination of samples

Fecal samples examination

With the aid of different Pasteur pipette, a few drops (1-2) of the sediments, Lugols' iodine and normal saline were collected, put onto a grease glass slide, and covered with cover slip, and viewed under a low power microscope at a magnification of ×40 before switching to a high-power microscope at a magnification of ×100. If a fasciola egg with the proper morphology of an ellipsoidal and operculated structure was observed, the sample was judged positive (Cheesbrough, 2005) [12].

Bile samples examination

With the aid of a Pasteur pipettes, a few drops (1-2) of the sediments, Lugols' iodine and normal saline solution were collected, put onto a grease glass slide, covered with cover slip, and viewed under a low power microscope at a magnification of ×40 before switching to a high-power microscope at a magnification of ×100. The sample was considered positive if a fasciola egg with the required morphology of an ellipsoidal and operculated structure was observed (Food Agriculture Organization of United Nation (FAO), 2003) [18].

Liver samples examination (visual)

After palpation and liver incision, a visual examination of the organ was also performed. Fasciola infection was determined based on liver enlargement with bumpy, raised and/or depressed areas, dark blue to black discoloration, perforation, hardness in consistence, and during diagnosis when liver flukes were seen with morphological structures of flat bodies, oval shapes, and suckers on the ventral sides. (CDC, 2013) [9].

Parasites identification

Using a veterinary parasites identification chart, the physical characteristics of the fasciola parasite eggs were determined (FAO, 2003) [18].

Data analysis

International Business Machine Statistical Package for Social Science (IBM SPSS) Version 28.0 was used to do descriptive statistical analysis on the generated data using percentages. Chi-square analysis was used to calculate the prevalence rates for the various types of ruminants under research, with a p-value of 0.05 being suggestive of a statistically significant difference.

Results

The detailed information of evaluate the prevalence of fasciolosis among ruminants in the study locations is shown in Table 4.1. A grand total of 1152 samples were examined for fasciolosis infection in the current research, out of which 9.46% (109/1152) were positive of the parasite infection. The prevalence rate among ruminants slaughtered in three study abattoirs in Niger State was 9.46%. The results obtained in this study from the prevalence rate of fasciolois among ruminants in Mokwa abattoirs indicates that fasciolosis occurred with cases being higher in sheep 26.2% (07/130) followed by cattle 8.59% (11/128) and lowest in goats 5.38% (08/126). The prevalence rate in Kontagora municipal abattoir the infection rate tends to be higher in sheep 14.10% (18/128) followed by cattle 8.70% (08/128) and lowest in goats 6.90% (08/128). The result recorded from Minna abattoir, sheep has higher prevalence rate of 20.89% (28/134) and followed by cattle 10% (11/128) and the least infectious rate were recorded in goat 3.33% (04/120). The prevalence rate of liver fluke infection among ruminants' species in the current study was 9.46% (109/1152). The prevalence rate of fasciolosis was significantly higher ($p < 0.05$) in sheep from all the study locations.

Table 1: Evaluate the prevalence of fasciolosis among ruminants in all the study locations

Study Location	Hosts	No. Examined	No. Positive	Prevalence (%)	Chi square	*p* value
KNTA	Cattle	128	12	8.70	24.53	0.012
	Sheep	128	18	14.0		
	Goats	128	08	6.90		
	Total	384	38	9.89		
MINNA	Cattle	130	13	10.00	52.94	0.001
	Sheep	134	28	20.89		
	Goats	120	04	3.33		
	Total	384	45	11.72		
MKWA	Cattle	128	11	8.59	62.10	0.000
	Sheep	130	07	26.2		
	Goats	126	08	5.38		
	Total	384	26	6.77		
Grand Total	Cattle	384	36	9.4	20.53	0.012
	Sheep	384	53	13.8		
	Goats	384	20	5.2		
	-	1152	109	9.46		

Keys: KNTA=Kontagora Abattoir, MNNA= Minna Abattoir, MKWA= Mokwa Abattoir

Table 2: Assess the prevalence of fasciolosis based on breed, sex, and age of cattle, sheep and goats slaughtered in Abattoirs of Niger State

	Category	Cattle			Category	Sheep			Category	Goat		
		No. examined	No. positive (%)	X^2 (*p* value)		No. examined	No. positive (%)	X^2 (*p* value)		No. examined	No. positive (%)	X^2 (*p* value)
Breed	WF SG RB Total	313 53 18 384	25 (7.10) 10 (18.9) 01 (5.6) 36(9.4)	1.855 (0.173)	Yankasa UDA Total	300 84 384	36(12) 17(20.2) 53(13.8)	2.773(0.157)	SRG WADG SG Total	293 76 15 384	11(3.8) 08(10. 5) 09 (60) 28 (7.3)	1.650(0.143)
Sex	M F Total	92 292 384	23 (25) 13 (4.5) 36 (9.4)	3.000 (0.083)	Total	89 295 384	23(25.8) 30(2.3) 53 (10.2)	4.545(0.046)	Total	50 334 384	06 (12) 14 (4.2) 20 (5.2)	2.500(0.023)
Age	Y A Total	88 286 384	12 (13.6) 21 (7.3) 42(10.9)	5.000(0.025)	Total	134 250 384	22(16.4) 31(12.4) 53 (13.8)	6.667(0.014)	Total	107 277 384	07 (6.5) 11 (3.10) 18 (4.7)	4.510(0.034)
Grand Total - 1152												

Keys: WF= White Fulani, SG= Sokoto Gudali, RB-=Red Bororo, Y-=Young, A= Adult, SRG= Sokoto Red Goat, WADG= West African Dwarf Goat, SG= Sahel Goat

Table 3: Compare the prevalence of fasciolosis among the small and large ruminants

Category	Hosts	No. Examined	No. Positive	Prevalence (%)	Chi square	*p* value
SR	Sheep	394	53	13.5	0.871	0.021
	Goats	374	20	5.3		
	Total	768	73	9.5		
LR	Cattle	384	36	9.4	0.542	0.001
	Total	384	36	9.4		
Grand Total		1152	109	9.5		

Keys: LR= Large Ruminant, SR= Small Ruminant, No= Number, %= percentage

Discussion

Evaluate the prevalence of fasciolosis among ruminants in all the study locations. The results show that Mokwa abattoir had a least infection rate than Kontagora and Minna abattoirs. This could be as a result of the animals' exposure to contaminated pastures and the difference in the grazing areas. According to Abdulhakim and Addis (2012), who carried out a study on prevalence of fasciolosis among ruminants, reported a higher prevalence in sheep and cattle and lower in goats, from DebreZeit, Central Ethiopia. The variation of the infection among the ruminants could also be due to differences in their immunological response to the fasciola parasite, as sheep acquire low resistance as reported by Phiri *et al*., (2006). Ekwenife, *et al*. (2006), in Onitsha abattoir reported prevalence of 10.51%, which is much higher than the value obtained in the present study, also Kasseye and Yehualashet (2012), reported a higher value of 20.3 %.

The differences among the geographical locations in the study areas could be attributed mainly due to the variation in the climatic and ecological conditions such as altitude, rainfall and temperature. The ecological condition is favorable for the survival and development of the intermediate host for specie of fasciola as it was observed by Kasseye and Yehualashet, (2012). However, the results of the current study contradict the findings of Magaji *et al*. (2014) [22], who reported the prevalence of fasciolosis in cattle and sheep slaughtered at the Sokoto metropolitan abattoir and found a higher prevalence rate in cattle than in sheep.

Assess the prevalence of fasciolosis base on breed, sex and ages of ruminants. In this current study, considerably higher prevalence of fasciolosis was detected among the breeds of cattle and sheep when compared to that of goat. This confirms with the report of Yilma and Mesfin, (1998) that carried out a study on the prevalence of fasciolosis among the breeds of ruminants in the upland regions. The result shows that favorable environmental condition tends to boost the intermediate host, (snails) which affect the breeds. This is in line with the previous reports of (Kedir *et al*., 2012; Bayu *et al*., 2013). The difference in the breed's suitability to the diseases could also be responsible for the higher prevalence of fasciolosis in cattle and sheep than in goats. Furthermore, poor attitude of herders for deriving the herd to pasture land early in the morning before the unset of the dew as metacercaria prefer a moist environment, this could be a great possibility of acquiring contaminated metacercaria pasture (Kantzoura *et al*., 2011; Abdulhakim and Addis, 2012). It could also be due to differences in their immunological response to the parasite, as sheep acquire low resistance as reported by Phiri *et al*., (2006). Hambal *et al.* (2013) reported that the level of susceptibility in sheep is higher than that of cattle and goats. Furthermore, Mazeri *et al.* (2017), reported on Indonesian thin–tailed sheep are more resistant to induced infections of *F. gigantica* compared to Merino sheep in terms of the smaller number of worms found in the liver and differences in immune response.

Based on sex, the male ruminants had the higher infection rate (25.8%) than their female counterparts (2.3%). This present study is in agreement with the report of Adua and Hassan (2016) who reported that gender had direct influence on the epidemiology and distribution of fasciolosis among ruminants. The present of gender difference in the parasitic infection is also consistent with other reports of Keyyu *et al*. (2016) [21] and Hassan *et al*., (2013). However, this finding was not in agreement with the observation of Dagnachew *et al*. (2011) who reported that gender has not significant effect upon the prevalence of fasciolosis infections in ruminants. However, the variation of fasciolosis affects both sexes equally as reported by Birhanu *et al*. (2015) from the Addis Ababa abattoir enterprise.

In respect to age of the animals studied, young ruminants recorded the higher number of fasciolosis than the adult ones. This finding agrees with the reports of Nwosu *et al*., (2007) and Ntonifor *et al.* (2013), who observed that young animals were more susceptible to infection than the adult ones. This assertion is in conformity with the report of Yesmirach and Mekonen (2012), in their finding, the prevalence was significantly higher in young cattle (39.8%) than in adult ones (23.3%) due to the fact that the young animals have relatively less developed immune system to fight off infection. Furthermore, ruminants, like other vertebrates possess both innate and adaptive immune responses, but the adaptive component is only effective against infections following exposure as reported by Ntonifor *et al.*, (2013). Since young animals are less likely to have prior exposure to many parasitic infections, they are expected to be more susceptible. However, this study contradicts the report of Mebrahtu and Beka (2013) that reported higher prevalence in adult ruminants.

Compare the prevalence of fasciolosis among the small ruminants (sheep and goat) and large (cattle) ruminant. The results examined in this study revealed the value in (9.5%) small ruminants and in (9.4%) large ruminants respectfully. This could be due to small ruminants are more prone to the infection since they graze more often in areas with contaminated pasture along shores areas of rivers, lakes and flood plains where contact with metacercaria encysted grass blade is common. This is in agreement with the finding of (Ademola 2003; Ardo *et al.* 2013) who reported on prevalence of *Fasciola gigantica* among cattle and sheep in some parts of Nigeria.

The fasciolosis prevalence rate in the study areas occurred as a result of the swampy environment where grazing of animals is carried out most. The swampy environment favored the multiplication of the secondary host to the disease which in turn contaminated the available pasture. This observation agreed with the report of Magaji *et al*. (2014) [22], who reported that intermediate host prefers swampy areas with slowly moving water and small streams which also allow sufficient moisture for the survival of the infective metacecaries. Studies were carried out by: Abebe, *et al.* (2011), who reported prevalence of fasciolosis to be 29.1%; Oladeleke and Odetokun (2014) reported 37.8% prevalence of bovine fasciolosis at Ibadan Municipal abattoir; Biniam, *et al.* (2012) reported 41.41% prevalence in a study of bovine fasciolosis in and around Woreta, Northwestern Ethiopia. However, Ekwenife, *et al.* (2006), in Onitsha abattoir reported prevalence of 6.51%, which is much lower than the value obtained in the present study. These current findings show that fasciolosis is prevalence among small and large ruminants in the study areas. Their values were higher the one obtained in this study.

Conclusion

The results of fasciolosis were more common in sheep than in cattle or goats among ruminants that were slaughtered at all the abattoirs, with prevalence rates of 9.89% (38/384), 11.72% (45/384) and 6.77% (26/384) in the Kontagora, Minna, and Mokwa abattoirs, respectively.

The results indicate that the prevalence rate varied among the ruminant species. The prevalence rate observed in cattle, sheep, and goats were; 9.4% (36/384), 13.8% (53/384) and 7.3% (28/384) respectively.

The results also showed that age and sex of ruminants were also a factor. With male becoming more exposed than female and young being more susceptible than the adult ones.

The results revealed that both small and large ruminants are susceptible to the disease.

Acknowledgement

Thanks to the entire staff of abattoirs of Kontagora, Minna and Mokwa for their support during this research. Appreciation goes to the laboratory personal of Biological department of Federal College of Education, Kontagora for their assistance.

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