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Prevalence of Hydatid Cysts in Slaughtered Sheep and Goats in Katsina, Katsina Sate, Nigeria

[1]Jaafar, S., [2]Saidu, S. N. A., [3*]Babashani, M. and [4]Ahmad, A.

[1]Ministry of Agriculture and Rural Development, Katsina State
[2]Department of Veterinary Medicine, Ahmadu Bello University, Zaria
[3]Veterinary Teaching Hospital, Ahmadu Bello University, Zaria
[4]Ministry of Agriculture and Rural Development, Katsina State

[*] *Author for Correspondence: mbabashani@abu.edu.ng*

ABSTRACT

Hydatidosis, caused by the larval stage of *Taenia* and *Echinococcus* species, is a significant zoonotic disease affecting livestock and humans, leading to public health concerns and economic losses in endemic regions. A cross-sectional study conducted from July to August, 2024 at the Katsina Metropolitan abattoir using purposeful sampling approach to determine the prevalence and hydatid cysts in small ruminants. A total of 250 sheep and goats comprising 74 sheep and 176 goats, presented for slaughter at the abattoir daily were considered as subjects for the study. Among these, 87.9% of sheep and 66.5% of goats were female. The overall prevalence of hydatid cysts was 12.8%, with 9.5% of sheep and 14.2% of goats infected. Prevalence by sex showed 2.0% in males and 10.8% in females, with no significant difference ($p > 0.05$). Age-specific prevalence ranged from 1.6% in animals 6–12 months to 6.4% in those 25–36 months, with no significant differences amongst age groups ($p > 0.05$). Similarly, there was no significant difference in breed-specific prevalence, with Balami and Yankasa sheep showing 9.5% and 9.4%, and Red Sokoto, Kano Brown, and Sahel goats showing 17.5%, 9.1%, and 15.4%, respectively. Cyst distribution was significantly higher ($p < 0.05$) in intestines (80.0%) and livers (42.9%) in both species. Fertility of cysts was 100% in goat lungs and 75.0% and 66.6% in sheep and goat livers, respectively. Viability was 25.0% in sheep and 50.0% in goats, with no significant difference ($p > 0.05$). The study concludes that sheep and goats in Katsina are infected with *Taenia* parasites, resulting in fertile and viable cysts of public health and economic concern. Recommendations include further studies to identify tapeworm species and public education on disease prevention to mitigate health and economic losses in the region.

Key words: Hydatid cysts; Goats, Katsina abattoir; Sheep; Nigeria; Prevalence

INTRODUCTION

Sheep and goats serve as intermediate hosts for tape worms of dogs and cats (Kahn and Line, 2010; Saidu *et al*., 2018). Such tapeworms include *Taenia ovis*, *T. multiceps*. and *Echinococcus* sp. The cultural setting in Northern Nigeria, including Katsina state, where sheep and goats and to a certain extent dogs are allowed to roam around in town and rural settings, slaughter facilities and markets make it possible for the disease to flourish as all avenues for the transmission of the disease avail (Kaltungo, 2013, Yakubu, 2016; Saidu *et al*., 2018; Muhammad, 2021).

Studies conducted have reported the prevalence hydatid cysts in different region in Nigeria. In Kano State reported a prevalence of 11.4% in sheep and 26.5% in goats based on abattoir inspections (Magaji *et al*., 2011). In Kaduna State, palpable cysts were observed in 27.1% of sheep and 30.9% of goats, but serological testing using ELISA revealed even higher infection rates, with 41.5% in sheep and 58.0% in goats (Ibrahim *et al*., 2018). Oge *et al*. (2016) from the Niger Delta reported higher rates of 24% in sheep and 42% in goats over a 10-month period, with hypothesised unique parasite strains contributing to the high cyst viability.

The fact that dogs that are owned by butchers are also seen at slaughter facilities makes it also possible for the disease, hydatid disease, to exist freely since these dogs will have access to meat from small ruminants and other animal species being slaughtered at these abattoirs (Lawan *et al*. 2010; Muhammad, 2017). Furthermore, cats that are always close to housewives can pick from kitchen wastes that could include hydatid cysts and therefore facilitate the spread of the disease (Saidu *et al*., 2018). The disease, hydatid disease, has economic and public health importance (Kahn and Line, 2010). Thus, there is the need to investigate, through the routine ante mortem and post mortem inspection being conducted at the Katsina abattoir on the extent of the occurrence of the disease in the sheep and goats being slaughtered daily with a view to advise livestock and dog owners and the Public Veterinary Services in the State as to which actions they should take with a view to reduce or even eliminate the disease in the State where most of the meat products from the abattoir

reach consumers. The aim of the study was to determine the prevalence and distribution of hydatid cysts in small ruminants presented for slaughter in the Katsina State abattoir.

MATERIALS AND METHODS

The study was carried out at the State Abattoir, Katsina. Katsina is the capital of Katsina State in North Western Nigeria (Fig. 1). The State is made up of 34 Local Government Areas (LGAs) and is located between latitude 11^0 49'N and $16^0$59'N and longitude 6^0 30'W and 9^0 40'E within the semi-arid Sudan Savannah zone of West Africa (Katsina, 2009).

Study Design

A cross-sectional study was conducted from July to August, 2024 at the Katsina Metropolitan abattoir using purposeful sampling approach. Sheep and goats presented for slaughter at the abattoir daily were considered as subjects for the study irrespective of age, sex and breed. The ages of the animals were determined by dentation as described by Hassan and Hassan (2003) while sex and breed of the animals were determined as per the sex organs and physical characteristics as described by Hassan and Hassan (2003).

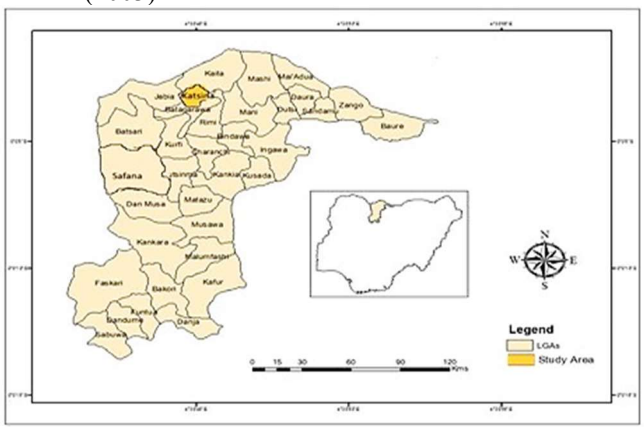

Figure 1: Map of Nigeria showing Katsina State and the study location (Source: Katsina State Ministry of Agriculture annual Report, 2023)

During postmortem inspection, the carcasses and organs of these animals were systematically examined for the evidence of cestode cysts in the peritoneum or attached to the visceral organs like intestines, lungs, liver and spleen during routine meat inspection procedures. The identified cysts were carefully removed, recorded, placed in sample bottles, with the bottles fully identified with respect to the animal species and details recorded in a log book. The sample bottles containing the samples were then transported to Veterinary Parasitology Laboratory, Ahmadu Bello University, Zaria for full identification of their characteristics using the method described by Saidu *et al.* (2018) and the result recorded.

In the laboratory, individual cysts were grossly examined for degeneration. Individual cysts were punctured using separate scalpel blades and the content fluid being emptied into petri dish. The fluid for each cyst was examined for characterization of protoscolices in the Hydatid fluid. The cysts which contained no protoscolex were considered as infertile cysts while the presence of protoscoleces was considered as indication of fertility (Macpherson *et al*., 1985). The identified fertile cysts were further subjected to viability test in which a drop of fertile cyst fluid was placed on a microscopic glass slide, covered with cover slip and then observed for motility. When doubtful for motility, a drop of 0.1% of aqueous eosin solution was added and examined under the microscope for taking the dye as described by Dalimi *et al.* (2002).

RESULTS

Demography of the study animals

A total of 250 small ruminants comprising 74 sheep and 176 were examined for the presence of cysts. Of the 74 sheep, 9 (12.2%) were rams while 65 (87.8%) were ewes. Also, of these sheep 26 (15.1%) were within the age group of 6 to 12 months old while 29 (35.1%), 14 (18.9%) and 5 (6.8%) were aged 13 to 24 months, 25 to 36 months and 37 to 48 months old (Table 1). Furthermore, 54 (73.0%) and 20 (27.0%) were Yankasa and Balami breeds of sheep, respectively (Table 1).

Similarly, of the 176 goats examined, 59 (33.5%) were bucks and 117 (66.6%) were does. Furthermore, 59 (33.5%) of the goats were aged between 6 and 12 months while 102 (40.8%), 37 (21.0%) and 7 (4.0%) were aged 13 to 24 months, 25 to 36 months and 37 to 48 months respectively (Table 1). In addition, there were 97(55.1%) Red Sokoto goats, 66 (37.5%) Kano Brown and 13 (7.4%) Sahel goats in the study (Table 1).

Prevalence and Distribution of Hydatid cysts

The overall prevalence of hydatid cysts in the study was 12.8% with 7 (9.5%) of the sheep and 25 (14.2%) of the goats infected (Table 2). By sex, the overall prevalence was 2.0% for males and 10.8% for female small ruminants. There was no significant difference by sex (χ^2=0.012; df =1; P=0.912). Furthermore, by age, the overall prevalence for the animals between 6 and 12 months was 1.6% while for animals 13 to 24 months, 25 to 36months and 37 to 48months were 2.8%, 6.4% and 2.0%, respectively as shown in Table 2. Again, there was no statistically significant difference in the prevalence by age (χ^2=1.311; df=1; P=0.726).

Prevalence by breed indicated that Yankasa sheep had 9.4% prevalence while Balami sheep had a prevalence of 9.5% (Table 3). Here too, there was no statistically significant difference in the prevalence by breed of sheep (X^2=0.00; df=1; P=0.991). In addition, Red Sokoto goats had a prevalence of 17.5% while Kano Brown and Sahel goats had prevalences of 9.1% and 15.4% respectively (Table 3). There was no significant difference in the prevalence by the breed of goats (χ^2=2.309; df=2; P=0.315).

With regard to distribution of hydatid cysts in organs, no cysts were observed in the lungs of all the sheep studied while only 2 (8.0%) lung samples of goats were having cysts (Table 4 and Figure 2). Here there was statistically significant difference in the distribution of cysts in the organs (χ^2 = 6.981; df=2; P=0.024). Similarly, 4 (57.1%) of the 7 positive sheep had cysts in the liver with 3 (12.0%) of the 25 livers of goats being positive for cysts (Table 4 and Figure 2). Furthermore, 3 (42.9%) and 20 (80.0%) of

the intestines of sheep and goats that were positive for cysts had cysts in them (Table 4 and Figure 2).

Fertility of the cysts

With regard to fertility of these cysts, all the cysts (100.0%) in the lungs of the goats were fertile while 3 (75.0%) of the livers of the sheep and 2 (66.6%) of those for goats were also fertile and that 1 (33.3%) of the intestines of the sheep that were positive for hydatid cysts were also fertile while 12 (60.0%) intestines from the 25 positive goats were similarly fertile (Table 5). There was statistically significant difference in the distribution of fertile cysts in the organs (χ^2=5.354; df=2; P=0.035). Only 1 (25.0%) of the fertile cysts from sheep was viable while 8 (50.0%) of the 16 cysts from goats were also viable (Table 5). There was no statistically significant difference in the viability of cysts (χ^2=0.808; df=1; P=0.591).

Table 1: Demographic features of small ruminants sampled at Katsina main abattoir, Katsina State

Variables	No. Sampled	Sex		Age			
		Male	Female	6-12 Months	13 – 24 Months	25-36 Months	37-48 Months
Sheep	74(29.6%)	9(12.1%)	65(87.9%)	26(35.1%)	29(39.1%)	14(18.9%)	5(6.8%)
Goats	176(70.4%)	59(33.5%)	117(66.5%)	59(33.5%)	73(41.5%)	37(21.0%)	7(4.0%)
Total	250(100.0%)	68(27.2%)	182(72.8%)	85(34.0%)	102(40.8%)	51(20.4%)	12(4.8%)

Table 2: Prevalence of hydatid cysts in small ruminants sampled at Katsina main abattoir, Katsina State

Animal species sampled	No. Sampled	Over all Prevalence n (%)	Prevalence by Sex		Prevalence by Age			
			Male n (%)	Female n (%)	6-12 Months n (%)	13-14 Months n (%)	25 – 36 Months n (%)	37 – 48 Months n (%)
Sheep	74	7(9.5)	1(1.4)	6(8.1)	1(1.4)	1(1.4)	3(4.2)	2(2.8)
Goats	176	25(14.2)	4(2.3)	21(11.9)	3(1.7)	6(3.4)	13(7.4)	3(1.7)
Total	**250**	**32(12.8)**	**5(2.0)**	**27(10.8)**	**4(1.6)**	**7(2.8)**	**16(6.4)**	**5(2.0)**

Table 3: Prevalence of hydatid cysts by breed of small ruminants sampled at Katsina main abattoir, Katsina State

Variables	Sheep breeds, n (%)			Goat breeds, n (%)			
	Yankasa	Balami	Species Prevalence n(%)	Red Sokoto	Kano Brown	Sahel	Species Prevalence n(%)
No sampled	53(71.6)	21(28.4)		97(55.1)	66(37.5)	13(7.4)	
No. Positive	5(9.4)	2(9.5)	**7(9.5)**	17(17.5)	6(9.1)	2(15.4)	**25(14.2)**
No. Negative	48(90.6)	19(90.5)		80(82.5)	60((90.9)	11(84.6)	
Total	53(100.0)	21(100.0)		97(100.0)	66(100.0)	13(100.0)	

Table 4: Cysts distribution in sheep and goat organs sampled at Katsina main abattoir, Katsina State

Animal species	No. Sampled	No. Positive (%)	No. Organs Positive (%)		
			Lungs	Liver	Intestine
Sheep	74	7(9.5)	0(0.0)	4(57.1)	3(42.9)
Goats	176	25(14.2)	2(8.0)	3(12.0)	20(80.0)
Total	**250**	**32(12.8)**	**2(6.3)**	**7(21.8)**	**23(71.9)**

Table 5: Fertility and viability of *Taenia* cysts from infected small ruminants sampled at Katsina main abattoir, Katsina State

Animal species	No. sampled	No. positive (%)	Fertility Cysts Distribution, n(%)			Cysts Viability, n(%)	
			Lungs	Liver	Intestines	Viable	Non-viable
Sheep	74	7(9.5)	0(0.0)	3(75.0)	1(33.3)	1(25.0)	3(75.0)
Goats	176	25(14.2)	2(10.0)	2(66.6)	12(60.0)	8(50.0)	8(50.0)
Total	**250**	**32(12.0)**	**2(100.0)**	**5(71.4)**	**13(56.5)**	**9(42.9)**	**11(57.1)**

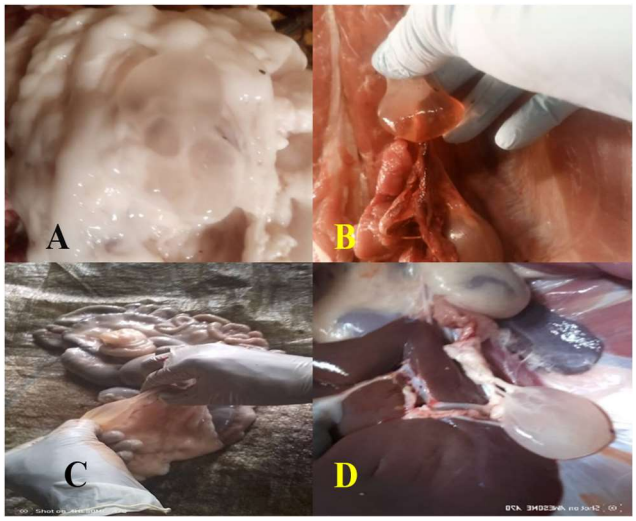

Figure 2: showing cysts in the Peritoneal fat (A), Lung (B), intestine (C) and liver (D)

DISCUSSION

From the study, a total of 250 sheep and goats were examined with goats being mostly slaughtered at the abattoir. In addition, female sheep and goats were similarly more slaughtered than male ones. The fact that more goats were seen to be slaughtered could mean that the populace had greater flare for goat meat than sheep mutton. This can be explained in the sense that goat meat is used more for 'Balangu' and 'Suya', especially in rural areas of Northern States of Nigeria as reported by Kaltungo (2018a) in Katsina and Sokoto States, Nigeria. The fact that more females were presented for slaughter could be that such females were sick and the owners were rushing to send them for slaughter to avoid losses and this can be of serious public health concern should such animals being rushed for slaughter having zoonotic diseases as Kaltungo (2013; 2018a), Dahiru (2017) and Muhammad (2021) and Buhari (2019) have reported small ruminants having zoonotic diseases like brucellosis and tuberculosis in Katsina and other states of Nigeria. Furthermore, Abdulazeez (2018) reviewing a five-year incidence of ruminant diseases in Funtua Clinic, Katsina State and reported high incidences of helminthosis among the cases handled. Also, Salisu (2023) reported isolating *E coli* (48.9%), *Salmonella* (18.1%) and *Staphylococcus* (27.5%) in the respiratory tracts of small ruminants in Katsina State while Kaltungo (2018b) reported identifying *Brucella melitensis* in camels in Katsina State. All these reports tend to indicate the need to look more closely on the health of small ruminants in the state as this will in turn improve the health of the populace in the state since small ruminants make up over 35.0% of the meat being consumed in the State (Bayer, 1982; 2016).

The economic trends in the country could also be the cause small ruminant keepers sending their female animals for slaughter as Yakubu (2016) and Kaltungo (2018) reported flocks being mainly composed of females since the males were mainly sent out of flocks to avoid fights whenever a female was on heat. Another reason that could be advanced for sheep and goats being sent for slaughtered could be as reported by Bayer (1982; 2016) that about 35% of the meat being consumed in the semi-arid zone of Nigeria comes from sheep and goats. Not only that Mustapha *et al*. (2024) reported that one of the uses of small ruminants is selling them by their owners for ready cash to execute family needs whenever such needs arise.

The overall prevalence of hydatid cysts from this study was shown to be 12.8% with prevalence for sheep being 9.5% and 14.2% for goats. The prevalence being higher in females could be because there were far more females than male sheep and goats sampled. Furthermore, females stay much longer in flocks than male ones as reported by Kaltungo (2013) in Katsina State and Yakubu (2016) in Kaduna State. Their being retained in farms/homes could be as they contribute more in flock size increase through breeding with some of them giving up to four young per gestation (Mustapha *et al*., 2024).

Furthermore, the prevalence of hydatid cysts by age showed that those within the age range of 25 to 36 months old had the highest prevalence of 6.4% followed by those 13 to 24 months old. The reason that could be advanced here is that those younger than 13 months might still be having maternal antibodies as to resist active infection with the parasites and that they might not have actively started feeding on grasses where they could feed on the infective forms of the parasite. As for those older than 12 months, they have reached the age of weaning and therefore feed mainly on grasses and such other feeds and therefore capable of coming in contact with infective forms of the parasites. Another reason could be that such animals could be having closer contact with where dogs pass on their faeces and the developmental stages that are infective for ruminants come in contact with these ruminants.

The prevalence of hydatid cysts in this study is high compared to the report of 0.07% for sheep and 0.01% for goats in Yobe State, Nigeria by Tijjani *et al*. (2010). In another study of helminthosis in 19 states of Nigeria by Karshima *et al*. (2018) they recorded 7.48% prevalence of helminthes of Veterinary and zoonotic importance among ruminants in Nigeria. This again is lower than seen in this study. Furthermore, Muhammad *et al*. (2017) reported a lower prevalence of 9.4% in Gindir Municipal abattoir of Ethiopia. All these seem to indicate a high prevalence in this study. The reason that can be advanced here could be as there may be more presence of dogs that interact with small ruminants due to the extensive and semi-intensive management system being applied by the keepers as Lawan *et al*. (2010) and Kaltungo (2013; 2018a,b) reported. Similarly, Fake (1990) reported a prevalence of 30.2% for *Taenia hyatigena* in Eastern Nigeria. Certainly, this is much higher than the prevalence recorded in this study. The reason could be there are more dogs that freely interact with small ruminants in his study area than obtained in this study.

The prevalence by breed indicated that Yankasa breed of sheep had prevalence of 9.4% while Balami breed had a prevalence of 9.5%. Similarly, the Red Sokoto breed of goats had a prevalence of 17.5% while Sahel and Kano brown breeds of goats had prevalences of 15.4% and 9.1% respectively. The breeds of goats had far more prevalence of hydatid cysts than the breeds of sheep under the study. The reason could be that goats, especially Red Sokoto goats tend to be freer than sheep in terms of ability to fend for themselves compared to sheep that have to be grazed

under supervision, especially in pastoralist herds (Kaltungo, 2018a). Another reason here is that there are far more Yankasa and Red Sokoto goats in Katsina State than other breeds of sheep and goats (Dahiru, 2017; Kaltungo, 2018a).

The study has also shown that hydatid cysts were identified in the lungs (6.3%), liver (21.8%) and intestines (71.9%) of sheep and goats. The public health risks here is that offal (visceral organs that comprise of the lungs, liver, kidney, heart and intestines among others) are commonly used for delicacies in homes and commercial outlets on a daily basis in Katsina State and other States of Nigeria. Thus, the possibility for human infections is high. Furthermore, the existence of fertile hydatid cysts in all the lung samples along with 71.4% and 56.5% of the liver and intestine samples respectively along with viable cysts in 42.9% of the fertile cysts is highly significant. In a similar study, Sultana (2022) demonstrated hydatid cysts in the liver of 3 goats with the liver having cirrhosis as indicated by histopathology.

In conclusion, the study has shown that hydatid cysts exist in sheep and goats in Katsina State with prevalence of 12.8% and that the cysts were demonstrated in the lungs, liver and intestines of these animals. The study has further shown that some of the cysts were fertile and even viable. There is therefore the need to conduct year-round study with a view to determine the role of seasons in the epidemiology of the disease in these animals. There is also the need to carry out studies on the role of dogs and cats in the epidemiology of hydatidosis in the state along with molecular work to fully identify the tape worms infecting ruminants, dogs, cats and human with a view to carry out efficient control programmes against the disease.

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Conflict of Interest

The authors have no conflict of interest to declare.

Authors Contribution

Field work, sample collection and processing; JS and BM. Result interpretation and manuscript draft writing: SSNA, BM and AA.

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