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Prevalence and evaluation of liver loss due to fasciolosis in sheep and goats slaughtered on the Gao slaughtering area in Mali

Ibrahima MARIKO [1,*], Alpha Seydou YARO [2,4] and Saidou TEMBELY [1,3]

[1] *Diagnostic and Research Department of the Central Veterinary Laboratory, Bamako, Mali.*
[2] *Department of Biology, Faculty of Science and Technology, University of Sciences, Techniques and Technologies of Bamako, Mali.*
[3] *Academy of Sciences of Mali (ASM), Bamako, Mali.*
[4] *National Center for Scientific and Technological Research (CNRST), Bamako, Mali.*

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Abstract

This study aims to update data on fasciolosis in sheep and goats by determining its prevalence and assessing liver losses caused by this disease in the Gao slaughter area in Mali. The samples were taken from 644 fecal samples and 8826 liver samples. Two techniques for direct diagnosis of the parasite were used: the sedimentation technique, which involves successive washes to search for parasite eggs and sanitary inspection of the livers of slaughtered animals to search for the parasite. The estimation of financial losses due to fasciolosis was made by counting all livers seized for fasciolosis during the three months of study. The total obtained per animal species was multiplied by the sale price of the organ on the Gao markets (3500 FCFA). Coprological prevalence and liver infestation rates revealed that sheep were more parasitized (10% for feces and 11.4% for livers) than goats were (6.5% for feces and 6.2% for livers), p = 0.15. Among the n= 2966 livers inspected in sheep, 340 were seized in sheep, representing an infestation rate of 11.4%. Among the 5860 goats whose livers were inspected, 366 were seized, representing an infestation rate of 6.2%. The market value of the seizures of sheep and goats amounts to 2,471,000 FCFA (two million four hundred and seventy-one thousand CFA francs) ; this amount represents the value of the losses suffered by the slaughter butchers over a period of 03 months in the Gao slaughter area.

Keywords: Fasciolosis; Sheep; Goat; Slaughter Area; Gao; Mali.

1. Introduction

Mali's economy is essentially agroforestry-pastoral. Livestock farming is the main source of subsistence for more than 30% of the Malian population and contributes 15% to GDP, 24% to rural sector production, approximately 80% to rural income and almost 20% to export earnings [1]. The national livestock population is ranked first in the WAEMU area and second in the ECOWAS area. In 2022, it was estimated that 12,848,696 cattle, 21,149,809 sheep, 29,201,079 goats, 1,291,233 camels, 607,786 horses, 1,190,567 donkeys, 88,262 pigs and 54,703,373 poultry [1].

Despite the efforts made by the State and its partners, the livestock subsector faces many difficulties, including those linked to animal diseases, especially parasitosis.

Fasciolosis is a helminthosis of the liver, caused by trematodes of the genus *Fasciola* with two species known worldwide: *Fasciola hepatica* and *Fasciola gigantica*. It is a disease that occurs enzootically in several West African countries (Benin, Ghana, Mali, Niger, Nigeria, Senegal, etc.), and its prevalence by region or season is very little known [2].

* Corresponding author: Ibrahima MARIKO.

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The economic importance of fasciolosis is very high considering the losses of milk and seizures of parasitized livers in slaughterhouses in endemic areas. Several studies have been conducted throughout the world to determine the importance of hepatic infestation by *Fasciolas sp*: in Nigeria [3], Ivory Coast [4], Ethiopia [5, 6] and Sudan [7]; on the estimation of the monetary value of losses caused by seizures of livers, they amount per year in a study conducted in Ethiopia to 3700 US dollars in sheep versus 245 US dollars in goats [8]; 27100.85 US dollars over 15 years in a study conducted in Kenya in cattle, sheep and goats [9]; 552,448 US dollars in Nigeria in sheep and goats [10] and still in Nigeria, 1882.50 US dollars of overall economic loss observed in one year in cattle, sheep and goats [14].

In Mali, fasciolosis is endemic in the Niger River basin, especially in water retention areas such as lakes and rivers, which at certain time of the year constitute real concentration points for animals. Few studies have been carried out on this problem in small ruminants and they date back more than thirty years. They have made it possible to count between 20 and 639 adult and immature Fasciola on sentinel calves that died of subacute fasciolosis after autopsy [11] ; and have shown a more significant infestation of sheep than goats [12].

This study aims to update data on fasciolosis in sheep and goats by determining its prevalence and assessing liver losses caused by this disease in the Gao slaughter area in Mali.

2. Materials and methods

2.1. Study site

The study took place at the Gao slaughterhouse in Mali (Figure 1).

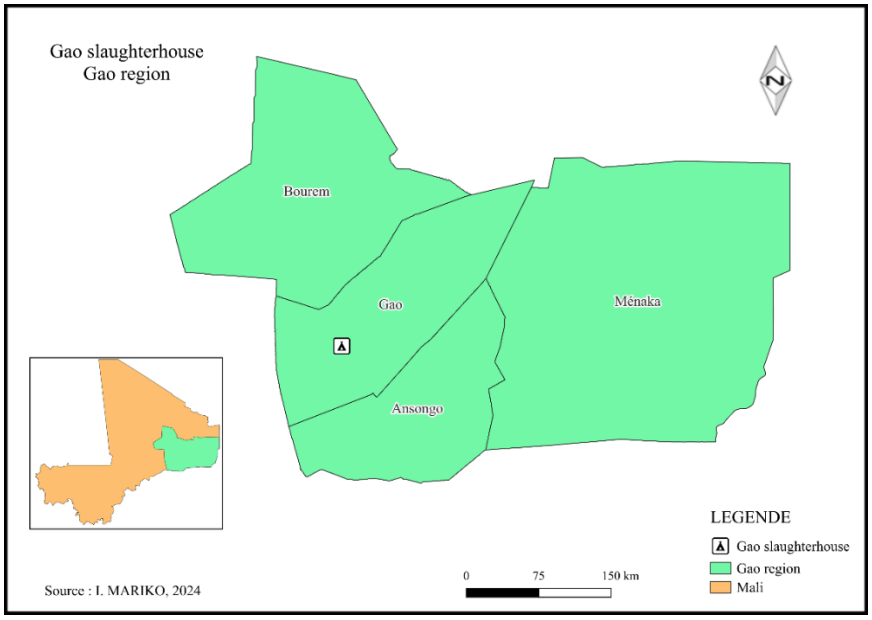

Figure 1 Map of the Gao region with the geographical position of its slaughter area

The Gao region has been the seventh administrative region of Mali since June 7, 1960. Located in the east of the country, it covers 94,484 km2 and its capital is the city of Gao In 2011, when new regions were established, it increased from an area of 40,020 km2 to its current area benefiting the regions of Menaka.

2.1.1. Geography

The Gao region borders three Malian regions and limited to the East by Menaka region, North by Kidal region, and West by Timbuktu region.

The Gao region has 4 classified forests covering an area of 4,020 ha.

In the region, Ansongo Ménaka partial wildlife reserve and two areas of interest hunting are located (Tidermène-Alata and Inékar).

2.1.2. Hydrography

The region is located in the watershed of the river Niger and crosses Niger River.

2.1.3. Demographics and population

The region had 544,120 inhabitants in 2009.

The population has increased by almost 1.4 times since 1998, representing an average annual growth rate of 3.0% between 1998 and 2009.Ansongo circleexperienced the highest population increase (+58%), followed by those of Gao and Bourem (+40% and +35% respectively).

Women represent 49.8% of the population.

The Gao region has become, over the course of migratory movements, multiethnic, composed of: Songhais, Bozos, Tuaregs, Bambaras, Arabs (Kounta, Lamhar, Tajakant) and Fulani (Gabéro, Sidibé, Wani, Baazi, Fafa, etc.).

The choice of the Gao region for this study is explained as follows :

Large numbers of small ruminants (1st region of the country) : 3,080,175 heads (20.34%) for sheep and 4,076,100 heads (19.33%) for goats [15] ;

The presence of the Niger River and numerous watercourses;

To understand know the situation of the disease in the northern part of the country ;

The geographical coordinates of the Gao slaughterhouse are as follows :

Latitude : 16°15'38.6'' N

Longitude : 0°03'25.4'' W

2.2. Material

2.2.1. Animal material

It consists of sheep and goats. These animals were of different weights, sexes and ages.

2.2.2. Biological material

It consisted of feces and livers taken from slaughtered sheep and goats.

2.2.3. Inclusion criteria

All sheep and goats slaughtered in the slaughter area during the sampling periods;

Consent and agreement of managers (administrative and technical) and slaughterhouse butchers to participate in the study.

Non inclusion criteria

Sheep and goats slaughtered elsewhere than in the Gao slaughter area;

Refusal of managers and slaughterhouse butchers to participate in the study.

2.3. Methods

This descriptive cross-sectional study was conducted at the Gao slaughterhouse during the months of August, September and October 2022.

2.3.1. Sample size and collection

Feces

It was determined via the formula of SCHWARTZ

$$\boldsymbol{n = \frac{Z^2 \times p(1-p)}{m^2}}$$

n = sample size

z = confidence level according to the reduced centered normal distribution (for a 95% confidence level, z = 1.96)

p = expected or estimated at 30%

m = permissible margin of error (5%)

The calculation yielded 322 feces to be collected from sheep and 322 feces to be collected from goats during the three (03) months of the study (August, September and October 2022).

Fecal samples were taken from slaughtered sheep and goats at random. Fecal samples were collected from the rectum of the animals (recto), placed in plastic bags and then transported in a cooler to the veterinary laboratory in Gao for analysis.

The livers

The examination covered all the livers of the sheep and goats slaughtered during the study period.

In sheep : 2966 livers were examined

In goats : 5860 livers samples were collected and inspected.

2.3.2. Laboratory analysis of feces

The successive wash sedimentation method was used to search for and identify *Fasciola gigantica* eggs.

A quantity of 5 g of feces was collected via a spatula. This quantity was disintegrated and then triturated in a beaker and 10 times its volume of plain water. The mixture was filtered into another beaker via a tea strainer (approximately 0.5 mm in diameter). The resulting filtrate was left to stand for 45 minutes, after which 2/3 of the supernatant was poured. Then, the same quantity of plain water was added, and the mixture was left to stand for the same amount of time. This operation was repeated three (03) times in a row. Finally, the supernatant was discarded, and the sediment was blended with a small remainder of the supernatant to homogenize it well. Using a ball pipette, a drop of the mixture was placed on a slide, covered with a coverslip and examined under a binocular microscope with a 10x objective.

Examination of livers for adult flukes

Livers taken from slaughtered sheep and goats were examined on the slaughter floor for the parasite (*Fasciola gigantica*).

The procedure began with an examination of the general appearance of the liver, and then, the hepatic parenchyma was incised using a knife. Manual pressure was applied to the parenchyma to extract the large flukes (*Fasciola gigantica*) lodged in the bile ducts. Thus, all livers containing at least one parasite were considered positive. The rate of liver infestation was estimated on the basis of the number of parasitized livers × 100 divided by the total number of livers examined during the study period (August, September and October 2022).

2.3.3. Data analysis

The data resulting from the analysis of feces by sedimentation (coprology) and those obtained from the examination of the livers of slaughtered sheep and goats were subjected to descriptive analysis via the Excel Stata spreadsheet version 12 and R4.3.1 to determine the prevalence rates of hepatic infestation and the levels of significance between the different variables (animal species and sex). The significance threshold considered is α = 5%.

$$\textbf{Coprological prevalence} = \frac{\text{number of positive fecal samples}}{\text{total fecal samples analyzed}} \times 100$$

$$\textbf{Liver infestation rate} = \frac{\text{number of livers inspected positive}}{\text{total livers inspected}} \times 100$$

3. Results

3.1. Number of sheep and goats taken from the Gao slaughter area

The situation of the samples of feces and livers examined in sheep and goats in the Gao slaughter area is given in Table 1.

Table 1 Number of livers examined in sheep and goats in the Gao slaughter area.

Animal species	**Nature of samples**	
	Number of feces examined	Number of livers examined
Sheep	322	2966
Goats	322	5860
Total	644	8826

3.2. Prevalence of Fasciola gigantica in the feces of sheep and goats according to sex

The results of the analysis of feces collected from the two species according to sex are presented in Table 2.

Table 2 Coprological prevalence according to sex in sheep and goats.

Genders	**Sheep**			**Goats**		
	Number of fecal samples examined	Positive feces count	Prevalence in %	Number of fecal samples examined	Positive feces count	Prevalence in %
Males	23	4	17.4	40	2	5
Females	299	28	9.4	282	19	6.7
Total	322	32	10	322	21	6.5

An analysis of the data in Table 2 revealed that the number of females examined was greater (n=581) than that of males (n=63). In terms of infestation, male sheep were more likely to be parasitized than females (17.4% vs. 9.4%) were; however, in goats, females were more likely to be parasitized (6.7% vs. 5%). The highest prevalence rates were observed in sheep.

3.3. Prevalence in feces according to animal species

We have presented in Table 3 the prevalences, we present the prevalence rates obtained byvia the analysis of feces byvia the successive washing sedimentation method.

Table 3 Average coprological prevalence according to animal species in the Gao slaughter area.

Animal species	**Number of feces collected**	**Positives**	**Prevalence in % P = 0.15**
Sheep	322	32	10
Goats	322	21	6.5
Total	644	53	8.2

The analysis of 644 fecal samples collected from the two animal species revealed that sheep were more parasitized (10%) than goats were (6.5%) ; however, the statistical analysis revealed that this difference was not significant (p = 0.15). The average coprological prevalence of the two species was 8.2%.

3.4. Infestation rate of inspected livers according to animal species

The results of the health and safety inspection of the sheep and goat livers are presented in Table 4.

Table 4 Comparison of liver infestation rates in sheep and goats.

Animal species	Livers inspected	Seared livers	Infestation rate in %
Sheep	2966	340	11.4
Goats	5860	366	6.2
Total	8826	706	7.9

Among a total of 8826 livers inspected in the 02 species, the average infestation rate was 7.9%; considering the animal species variable, the highest rate was observed in sheep (11.4% with n= 2966) and goats with a significant number of livers inspected (n= 5860), were less infested (6.2%). This difference between the 02 species was significant with a value of P < 2.2e-16.

3.5. Monetary values of livers seized by animal species over 3 months

To determine the financial losses due to liver seizures during the collection period in the two animal species, the quantity obtained was multiplied by the price per kg of liver in the Gao markets (Table 5).

Table 5 Estimated value of livers seized in the Gao slaughterhouse for the two species.

Species	Number of heads slaughtered	Number of livers seized	Quantities seized in kg	Values in FCFA
Sheep	2966	340	340	1,190,000
Goats	5860	366	366	1,281,000
Total	8826	706	706	2,471,000

An analysis of the data in Table 5 revealed that the numbers of livers collected from the two species were similar despite the large difference between the numbers slaughtered. The total number of livers seized was 706 out of 8,826 sheep goats slaughtered and examined, i.e., an average infestation rate of 7.9%. The value of seizures due to fasciolosis amounted to 2,471,000 FCFA (two million four hundred and seventy-one thousand CFA francs); this amount represents the value of losses suffered by slaughtering butchers over a period of 03 months in the Gao slaughter area.

4. Discussion

The results of this study are close to those obtained in Nigeria, for a coprological prevalence of 12% in sheep compared with 9.1% in goats [3] ; in Mali, prevalence of 10% in sheep and 3.1% in goats were observed in the rainy season [12] ; and they are much lower than those obtained in sheep in Ethiopia, which were 35.95%, 48.21% and 48.4%, respectively [5, 6, 13]. In goats in Sudan, the coprological prevalence is 12.5% [7].

In terms of the level of liver infestation, sheep were more parasitized than goats were, with a statistically significant difference between species (P < 2.2e-16). The same observations have been made in studies conducted in Kenya : 6.6% in sheep versus 5.2% in goats [9]. Studies conducted in 2018 on the Ivory Coast in sheep reported liver infestation rates ranging from 8.3% to 12.2% [4].

For the level of liver damage, 340 livers were seized from sheep, representing an infestation rate of 11.4% (n= 2966 livers inspected), and 366 livers were seized from goats, representing an infestation rate of 6.2% (n= 5860 livers inspected).

Considering the epidemiology of this disease, many studies have demonstrated that the animal species is a risk factor. The animals most susceptible to parasitic infestation are sheep and goats, followed by cattle and other herbivorous animal species. The difference in the level of contamination between sheep and goats is certainly due to their feeding method: sheep may feed on grassy pastures, whereas goats, if they have the possibility, prefer aerial fodder; therefore, there is less risk of contamination by the infesting forms of parasites.

The estimated liver loss recorded during the three months (August, September and October) was 706 kg (340 kg in sheep and 366 kg in goats).

The monetary value of this loss was 2,471,000 FCFA (two million four hundred and seventy-one thousand CFA francs) or 4,404.87 US dollars. Our meat losses due to liver seizures are significantly greater than those obtained in sheep (117 kg) and goats (108 kg) in Nigeria over a period of one year and for an estimated financial loss of 562.5 US dollars [14] ; the difference may be due to better health monitoring of animals in this country. In any case, these sums represent a loss of earnings for those involved in the livestock-meat sector.

5. Conclusions

In this study, the results of fecal analyses and liver inspections showed that sheep were more heavily parasitized than goats, thus confirming the findings of other studies that have demonstrated that animal species is a risk factor. Sheep were more susceptible to parasitic infestation than goats, followed by other herbivorous animal species. The way sheep graze on our pastures also exposes them to greater contamination by infective forms of parasites than goats. Goats, when given the opportunity, prefer to consume aboveground forage. The study highlighted significant economic losses due to liver seizures for stakeholders in the livestock and meat industry.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare that they have no financial or personal relationships that could inappropriately influence or bias the results presented in this study.

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