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Prevalence of Bovine Fasciolosis and its Associated Financial Loss in Trade Cattle Slaughtered at Areka Municipal Abattoir, South Western Ethiopia

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Abstract: Fascioliasis is an economically important parasitic snail-borne disease of ruminant animals including cattle, sheep and goats that have public health significance due to the risk of infection transmission to humans. The disease causes growth retardation, decreased milk and meat production and liver damage in infected animals. A cross-sectional study was carried out between October 2019 and July 2020 with the aim of determining the abattoir prevalence and financial loss due to bovine fasciolosis at Areka municipal abattoir, Areka, Ethiopia. From the total of 601 examined cattle, 9.7% (58/601; 95% CI: 7.4%-12.3%) were positive for fasciolosis by postmortem liver inspection. Among 58 infected livers with *Fasciola* species, *Fasciola hepatica* was found to be the most prevalent species (74.14%) compared to *Fasciola gigantica* (25.86%). Statistical analysis of the data showed the absence of a statistically significant difference (P>0.05) in the prevalence of bovine fasciolosis among the different age groups, sex, breed, body conditions. Analysis of the abattoir data indicated a total annual liver condemnation which resulted in 45,495 Ethiopian birrs (2,067 USD) loss. Similarly, the average carcass weight loss was confirmed to be 311,186 Ethiopian birr (14,145 USD) due to fasciolosis in cattle. The overall total annual financial loss due to fasciolosis in cattle at Areka municipal abattoir was calculated to be 356,681 Ethiopian birr (16,212 USD) indicating that the disease is economically important. Thus, it warrants the immediate need for prevention and control of the parasite in the study area and the country.

Key words: Abattoir · Prevalence · Economic Loss · Fluke Infection · Cattle · Areka Town

INTRODUCTION

Ethiopia has diversified agroecological characteristics which suit the production and productivity of livestock [1]. However, the productivity of this sector is constrained by several factors, including poor genetic potential that results in low production and reproductive performance, poor quality and varying seasonal availability of feed, high disease challenges, low accessibility of services and inputs and lack of a well-organized marketing system [2]. Out of diseases causing serious problems, parasitism represents a major drawback to livestock production in the tropics [3]. Among the parasitic diseases, Fasciolosis is an important parasite that imposes direct and indirect economic losses on livestock particularly sheep and cattle by lowering the productivity of cattle in addition to losses from condemnation of affected organs [4].

Fasciolosis is caused by trematodes of the genus Fasciola that migrate in the hepatic parasitic parenchyma and establish and develop in the bile duct. It is commonly recognized as liver flukes and they are responsible for the widespread morbidity and mortality in cattle characterized by weight loss, anemia and hypo-proteinemia [4].

There are various species of these but the economically important ones are *Fasciola hepatica* in the temperate region and *Fasciola gigantica* in the tropics. Thus, these two fasciola species often overlap in many African and Asian countries and sometimes in the same country, although in such cases the ecological requirements of the flukes and their snail intermediate host are distinct [5]. *F. hepatica* is found in the area above 1800 meters above sea level and in between these altitude limits, both species coexist where ecology is conducive for both snail hosts and mixed occurrence [6].

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The overall annual economic loss attributed to fasciolosis infection in Ethiopia has long been estimated at about 350 million Ethiopian Birr [7]. Furthermore, the direct and potential losses associated with liver fluke infection and associated risk factors were reported by similar research previously conducted at Sodo [8], selected districts of Oromia regional state [9, 10] and Hossana municipal abattoir of south Ethiopia [11]. However, there is a lack of information on the occurrence of bovine fasciolosis and financial loss due to liver condemnation in the Areka city administration. Thus, the objective of the present study was to determine the prevalence and estimate the magnitude of financial loss attributed due to liver fluke infections at the Areka municipal abattoir.

MATERIALS AND METHODS

Study Area: The present study was conducted from October 2019 to July 2020 in Areka town municipal abattoir. Areka town (6°54 N latitude and 36°45 longitude) is located approximately 300 km South West of the capital city Addis Ababa and lies within 700 to 2900 meters above sea level. The average monthly temperature varies from 26°C in January to 11°C in August. The average annual rainfall fill is bimodal, the average amount being about 1000 ml. The climatic condition of the zone is conducive to livestock production [12].

Study Design and Sampling Methods: A cross-sectional type of study was carried out to determine the prevalence and financial loss associated with bovine fasciolosis in the study area. Study populations were trade cattle that originated from three Agro-geographical zones namely lowland, midland and highland. They were aged less than five years and above, of both sexes (bulls and cows) and available breeds (Zebu, Cross) brought from livestock markets to the abattoirs and slaughtered. Animals purchased records indicated that they were bought at Boloso Bombe, Kindo koiysha, Damot Fulasa, Hadaro and Shinshicho livestock markets, which are located in the three agro-geographical zones of the area. However, animals were usually allowed to rest for at least 24 h before being slaughtered. The systematic random sampling technique was the sampling strategy used to collect all the necessary data from the abattoir survey of the study animals brought to the Areka municipal abattoir.

Sample Size Determination: The sample size was calculated according to Thrusfield [13] by considering 50% expected prevalence since there was no previous work in the study area and 5% absolute precision at 95 % confidence interval using the following formula:

$$N = \frac{1.96^2 pexp\ (1\text{-}pexp)}{d^2}$$

where,
N=required sample size,
Pexp =expected prevalence,
d=absolute precision.

Based on this formula, the sample size was supposed to be 384. However, in order to increase precision the number was maximized to 601.

Study Population: The study was conducted on indigenous zebu and cross cattle slaughtered at Areka municipal abattoir brought from different surrounding localities including Boloso Bombe (Lowland), Kindo koisha(Lowland), Damot Fulasa (Highland), Hadaro and shinshicho (Midland). A total of 601 cattle destined for slaughter were inspected during *Ante-mortem* and *post-mortem* inspections with their specific identification numbers and recorded accordingly on a format prepared for this purpose.

Study Methodology

Ante Mortem Inspection: Ante-mortem inspection was carried out in adequate lighting where the animals can be observed both collectively and individually at rest and motion. The age of the cattle was determined based on dentition [14, 15]. Body condition for each cattle was estimated based on Nicholson and Butterworth [16]; ranging from score 1 (emaciated) to score 5 (obese). For our case, two classes of scoring were used, medium (Score 3 and 4) and Good or fat (score 5). There was no animal slaughtered at scores 1 and 2.

Postmortem Examination: During meat inspection, the previously identified animals and their livers were carefully supervised and examined. The fluke recovery was conducted as follows: the gall bladder was removed and washed to screen out mature flukes. The liver was cut into slices about 1cm thick and was put in a metal trough of warm water to allow mature flukes lodged in smaller bile ducts to escape and then the heads of the flukes were counted. Identification of the fluke species involved was carried out based on the morphological features of the agent [4].

Assessment of Economic Loss

Direct Economic Loss: Direct economic loss was calculated from liver condemnation as the result of fasciolosis. Generally, all infected livers with fasciolosis were unfit for human consumption. Through interviews made with local butcher men in Areka town, the average market price of one liver was calculated to be 350 ETB i.e. approximately 16 USD (1 USD= 22 ETB). The direct loss was thus computed according to the formula by Ogunrinade and Ogunrinade [17] as follows:

$$ALC = \Sigma SR \text{ X } LCX \text{ P}$$

where

ALC = Annual loss from liver condemnation

ΣSR = Mean annual cattle slaughtered at Areka municipality abattoir (estimated from retrospective abattoir record)

LC = Mean cost of one liver in Areka city administration.

P = Condemnation rates of cattle liver due to fasciolosis

Indirect Economic Loss: Indirect economic loss was associated with carcass weight reduction due to fasciolosis. An estimated 10% carcass weight loss due to fasciolasis was adopted based on Cawdery *et al*. [18] estimates. Average carcass weight of indigenous cattle was taken as 126 kg [19]. The annual carcass weight loss due to bovine fasciolosis assessed using the following formula set by Ogunrinade and Adegoke [20].

$$ACW = \Sigma SR \text{ XCL XBC X PX 126 Kg}$$

where

ACW = Annual loss from carcass weight reduction.

ΣSR = Average No cattle slaughtered per annual at the study abattoir.

CL = Carcass weight loss in individual cattle due to fasciolosis.

BC = An average price of 1kg beef at Areka city administration

P = Prevalence rate of fasciolosis at the study abattoir. 126 kg = Average carcass weight

Data Management and Analysis: The collected data were coded and entered into Microsoft Excel spread sheet. STATA 14 Version was used for logistic regeression analysis. The prevalence of fasciolosis was calculated as the number of cattle found infected with Fasciola species expressed as a percentage of the total number of previously selected cattle. Statistical significance was set at $P < 0.05$ to determine the presence of significant differences between occurrence of fasciolosis and risk factors.

RESULTS

Out of 601 slaughtered animals examined during study period, 58 liver were found positive for liver fluke infection with an overall prevalence rate of 9.65%. Among these, 43 liver (74.14%) harbored *F. hepatica* while the remaining 15 liver (25.86%) infected with *F. gigantica* species.

Overall prevalence of liver condemnation was compared for cattle in different age groups, sex category, body condition scores, breed and significance difference was not observed (Table 1).

CI-confidence Interval: The estimated direct economic loss of the Areka municipal abattoir was calculated using the condemnation rate of the liver as 9.65%. The average

Table 1: Estimated odds ratio (OR) from logistic regression model for the association between fascioliasis infestation (Yes, No) and explanatory variables (sex, body condition, age and breed)

					95% CI		
Variable	n	Prevalence	Odds Ratio (OR)	SE	Lower	Upper	P-value
Sex							
Male	586	9.3%(56/586)	referent	1.10	0.31	6.53	0.648
Female	15	1.3%(2/15)	1.45				
Body condition							
Medium	340	11.5%(39/340)	referent	0.35	0.34	1.07	0.085
Good	261	7.3%(19/261)	0.61				
Age							
3-5 years	289	8.7%(25/289)	referent	1.13	0.70	2.15	0.435
>5 years	312	10.6%(33/312)	1.25				
Breed							
Local	586	9.3%(56/586)	referent	0.17	0.31	6.70	0.630
Cross	15	1.3%(2/15)	1.45				

annual slaughter rate was calculated to be 1347 in the study abattoir and the average market price of the liver was 350 ETB. Thus, the direct economic loss due to the condemnation of liver from the local market was 45495 ETB (2,067 USD) annually.

The annual economic loss from carcass weight reduction due to bovine fasciolosis was 311,186 ETB (14,145 USD). The total annual economic loss was 356681 ETB (16,212 USD). This was the summation of the losses from organ condemnation (direct loss) and carcass weight reduction (indirect loss).

DISCUSSION

Fasciolosis has been still one of the major constraints for livestock development by inflicting remarkable direct and indirect loss, where suitable biotypes for the development of intermediate hosts prevail. In the present study, the overall prevalence of bovine fasciolosis 9.65% (n=601) recorded based on *post-mortem* liver inspection in this study is fairly comparable with the report from Wolaita Sodo[8] abattoir (14%) and at Hawi (14.05%), Tanzania[21]. On the contrary, the prevalence of bovine fasciolosis in the present study is lower as compared with the previous reports of 46.58% in Jimma [22], 46.15% in Gondar ELFORA abattoir [23], 30.43% in Adwa municipal abattoir [24], 30.1% in Asella municipal abattoir [25], 90.7% in Gondar abattoir [26], 24.32% in Mekelle [27] and 21.16% in Gamo Gofa Zone [28]. The variation in the overall prevalence of bovine fasciolosis among different study areas may depend on some factors such as snail population, size of study population, choice of diagnostic method, livestock management system and agro-ecological condition favorable for survival and distribution of the parasite as well as the intermediate host might have played their own role in such differences [29, 30].

This study recorded a statistically no significant association of bovine fasciolosis (OR=1.25; 95% CI [0.70-2.25]) with increasing age in cattle where cattle of age greater than 5 years had slightly higher prevalence (5.49%). This statistically insignificant finding among age groups was in agreement with reports from the Asella municipal abattoir [25] and contradicts study results from the upper Blue Nile basin [6] and the northwestern part of Ethiopia [26]. Similarly, the study showed that there was no significant variation among the sex of animals (OR=1.45; 95% CI [0.31-6.53]) which was the same as the report from Jimma abattoir [31] and Lira Municipality Abattoir in Northern Uganda [32]. This may be due to the management system which is similar for both sexes which means they have equal exposure to contaminated grass and in this study area the management and treatment are the same for all animals.

The current work was similar to the recent report from Wolaita Sodo [33], no significant variation (OR=0.61; 95% CI [0.34-1.07]) was also observed in the prevalence of fasciolosis whether the animal slaughtered is in medium or good body condition. This could be because body condition deterioration in cattle is manifested when fasciolosis reaches its chronic stage [6].

In relation to the breed of slaughtered animals, the prevalence was higher in local zebu cattle than in the cross. There was also no statistically significant association between the body conditions of the animals and the prevalence of Fasciola infection (OR=1.45; 95% CI [0.31-6.70]).

Species identification revealed that *F. hepatica* was more prevalent (74.1%) as compared to *F. gigantic* (25.86%). The higher prevalence of *F. hepatica* might be associated with the existence of favorable ecological biotopes for the intermediate host *Lymnaea truncatula.* In support of the present study, Gebretsadik *et al*. [27] also reported that 56.42% of cattle were infected with *F. hepatica* and 9.17% with *Fasciola gigantica*. Similarly, earlier investigations in Hossana [11], Mekelle [27] and Jimma [34] reported that *F.hepatica* was the predominant Fasciola species. However, in another study, Fufa *et al*. [8] stated that the most common liver fluke species affecting cattle at Wolaita Sodo was *F. gigantica*.

The monetary loss in the present study was higher than the report from Jimma municipal abattoir [22] and Nekemte municipal abattoir [35] where the calculated monetary loss of bovine fasciolosis was 54,063 ETB (3,180 USD) and 63,072 ETB respectively. The difference in the estimated economic losses could be attributed to the increase in the price of liver and meat in the global market in general and in Ethiopia in particular.

One limitation of this study was the cross-sectional design, implemented at a single time point. Any projections of prevalence estimate for *Fasciola* infestation and associated financial losses could be affected by seasonal variations in infection rates. In addition, animal trade and movements are common within the study area, but we only recorded the last reported area of origin of the slaughter animals prior to transportation to the abattoir.

CONCLUSIONS

The present study indicate that bovine fasciolosis is the most common and economically significant disease affecting health and productivity of cattle in the study area. It inflicted remarkable losses from liver condemnation and carcass weight reduction. Thus, it warrants the needs for appropriate and feasible control measures in the study areas including community based control programs such as drainage of swampy areas and fencing of watering points should be adopted in the study areas.

Data Availability: The raw data used to support the findings of this study are included within the supplementary information file(s).

Additional Points: I, the undersigned, declare that this research is original work, has not been submitted for publication anywhere and all sources of materials used for this research have been duly acknowledged.

Ethical Approval: Ethical clearance is not needed for this particular research.

Competing Interests: The authors have not declared any conflict of interest.

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