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Assessment of prevalence and its direct financial loss due to liver condemnation of bovine fasciolosis on beef cattle slaughtered at municipal abbatoir of mudulla, Tembaro woreda, SNNPR, Ethiopia

Abstract

Bovine *fasciolosis* is an important parasitic disease which imposes direct economic loss due to condemnation of affected organs mainly liver. A cross sectional study design based on active abattoir survey was conducted from November 2017 to February, 2018 with the aim of determining the prevalence and associated direct financial loss of bovine *fasciolosis* in Municipal abattoir of Tembaro district. A total of 384 liver of indigenous male cattle slaughtered during the study period were considered and 180(46.87%) were found to be positive for *Fasciola* species. Out of these positive samples; *Fasciola hepatica* was the predominant (58.2%) species followed by *Fasciola gigantic* (31.66%) and mixed (9.44 %) respectively. The highest prevalence of fasciolosis was recorded in beef cattle those with poor body conditioned (82.35%) and the least in good conditioned (18.51%) and the difference in the prevalence was statistically significant (P<0.05).Relatively the higher prevalence was recorded in age group of >10 years (61.6%) and the low in 3-5 years (35%), and there was a statistical significant association (p<0.05) between age group and occurrences of fasciolosis. The infection rates in different market origins of animals was also analyzed and found to be statistically non-significant. The total annual economic loss from fasciolosis due to liver condemnation during the study time was estimated to be 39,370.8 Ethiopian Birr ($USA1236.52). Finally, the abattoir based prevalence recorded in this study area suggests that bovine fasciolosis is an economically important parasitic disease of cattle in the study area. Therefore, a detailed epidemiological study as well as assessment of the overall indirect economic loss incurred due to fasciolosis is required to implement systematic disease prevention and control methods in the study area.

Keywords: abattoir, bovine, fasciolosis, indigenous, prevalence

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Niguse Tesfaye Chamiso
Jimma University College of agriculture and veterinary medicine, Ethiopia

Correspondence: Niguse Tesfaye Chamiso, Jimma University College of agriculture and veterinary medicine, Ethiopia, Tel 0912786254/0954213261, Email niguseyel3@gmail.com

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Introduction

Ethiopia has the largest livestock population in Africa, with a total cattle population of 59.5 million. Out of this total cattle population, the male cattle constitute about 44.5% and the remaining 55.5% were female cattle.[1] The livestock sector in Ethiopia has substantial contribution to the economy; however, there are constraints that hindered the potential of livestock production include; the presence of infectious and non-infectious diseases, traditional management system, limited genetic potential, lack of appropriate disease control policy and veterinary services. Out of the diseases causing serious problem, parasitism represents major drawback on livestock production in the tropics.[2,3]

Among the parasitic diseases bovine *fasciolosis* is important parasite which imposes direct and indirect economic losses cattle by lowering the productivity, wide spread of morbidity and mortality, and direct economic loss due to condemnation of affected organs. The cattle serve as the definitive host to these liver flukes.[4] Among various species of the parasite, the two most economically important ones are *Fasciola hepatica* in the temperate region and *Fasciola gigantic* in the tropics. Both species coexist where ecology is conductive for both snail hosts, and mixed infections prevailed in elsewhere and Ethiopia.[5–7]

The complete life cycle of Fasciola is realized by the presence of suitable intermediate host under favorable condition. Snail is the essential intermediate host for the development of Miracidium through Metacercariae which is an infective stage for the final host. There are three main factors influencing the production of the large numbers of Metacercariae necessary for outbreaks of Fasciolosis. Those are availability of snail habitat (marshy or swampy area), temperature (10°C and above) and moisture for the breeding of snail and for the development of the parasite.[4]

The snail of the genus *Lymnae natalensis* and *lymanae truncatula* are known as intermediate host in life cycle of *f.gigantica* and *f. hepatica* respectively. Infection with *f. hepatica* is usually associated with herds and flocks grazing wet marshy land. *Lamnea natalensis* is fresh water snail and infection with this species is associated with livestock drinking from snails infected watering places as well as with grazing wetland, which is seasonally is undated.[7]

Meat inspection is conducted in the abattoir for the purpose of screening animal products with abnormal pathological lesions that are unattractive and unsafe for human consumption and it also assists in detecting certain diseases of livestock and prevents the distribution of infected meat that could give rise to disease in animal and human being and to ensure competitiveness of products in the local market.[8]

Therefore, meat inspection based on Abattoirs survey play an important role in surveillance of various diseases of human and animals. The data obtained from can be a source of valuable information on the incidence and epidemiology of different animal diseases. This can help to know to what extent the public is exposed to certain zoonotic diseases and estimate the financial losses incurred through condemnation of affected.[9,10]

Parasites in the tropics are responsible for far greater loss to meat industry than any other diseases. Flukes in liver were among the others are mainly.[11–13] Apart from its veterinary and economic importance throughout the world, fasciolosis recently been shown to be a re-emerging and wide spread zoonosis affecting many people.[14,15] *Considerable work on Abattoir Prevalence of bovine Fasciolosis* and associated economic loss of animals was broadly studied in Ethiopia, but studies are limited and mainly located in central high lands and in some parts of Eastern and Northern parts of the country.[15,16] Although, it is greatly responsible for high economic loss, the research done on the abattoir prevalence, and relative burdens due to identified species in and around Tembaro wereda is nil. So, this study was designed to investigate the magnitude of fasciolosis and its direct financial loss attributed due to liver condemnation and assesses associated potential risk factors in mudulla municipal abattoir, Tembaro woreda.

Materials and methods

Description of study area

The study was conducted in Southern Ethiopia, kembata tembaro zone, Tembaro district. Topographically the woreda lies within an elevation range of 1700 to 2500 meters above sea level. The woreda has three agro- ecological zones, Dega (60%), Weyna dega (30%) and Kolla (10%). The area has a bimodal rainy season ''Kiremt'' covering from June to September with long rain and ''Belg'' extending from March to May with short rainy season. The annual average temperature of the woreda is 22.02°Cand the mean annual rainfall is 1300-1600 mm. Mudulla town is the administrative and trading center of the woreda (Kambata Tembaro Zone Agricultural Development Department socio Economic Data, 2014).

According to the basic livestock information record carried out by Tembaro woreda livestock and fishery resource Development office in 2018 G.C, the livestock population of the area comprises of 67,727 Bovine, 12991 Ovine,78121 caprine, 5432equine, and 31070 poultry and the woreda has one municipal abattoir where slaughtering and meat inspection of beef male cattle only is carried out.

Study population

The study was conducted on male beef cattle brought from different localities and livestock markets in vicinity to be slaughtered at municipal abattoir.

Study design and sampling methods

The cross sectional type of study was under taken from November 2017 to February 2018. The study was conducted on conveniently selected male animals brought from different localities and livestock markets in vicinity to be slaughtered at municipal abattoir.

Sample size determination

Since there was no earlier study done on abattoir prevalence of bovine *fasciolosis*at the study area, it is determined by taking 50% of expected prevalence of fasciolosis at 95% confidence interval, and 5% precision; given by the formula[17] as follows.

$$N = (1.96)^2 P_{exp}(1 - P_{exp})$$

d^2 Where:-

N= Number of sample

95%= confidence interval=1.96

D= Desired absolute precision=5%

Pexp= expected prevalence

Accordingly384 heads of male cattle were considered for abattoir survey.

Study methodology

Abattoir survey

Ante mortem inspection: Ante-mortem inspection carried out in adequate lighting where the animals can be observed both collectively and individually at rest and motion. Pre slaughtering, the age, origin and body condition was recorded. The age of the cattle was estimated based on dentition. The body condition of each cattle also was scored before slaughtering of the animal according to Thompson & Meyer.[18]

Postmortem examination

During post mortem inspection, liver of a total of 384 male cattle identified during ante mortem inspection were examined through inspection, palpation and systematic incision of bile duct to recover adult Fasciola species according to meat inspection manual prepared for this purposes.[19]

Species identification: For species identification, the flukes were collected by using different universal bottle containing 5% formalin as a preservative, and brought to veterinary clinic and species were easily identified based on morphological characters such as shape, size. Based on Urquhart et al.,[4] they were classified as *Fasciola hepatica* (relatively small sized), *Fasciola gigantica* (relatively large sized and more leaf like), mixed forms (both adult and immature *Fasciola hepatica* and *Fasciola gigantica*).

Estimation of direct economic loss due to liver condemnation

The direct financial loss was analyzed on the basis of liver condemnation due to bovine fasciolosis at Tembaro woreda municipal abattoir. It was analyzed by considering the average number of annually slaughtered cattle in the abattoir from retrospective recorded data, the current mean selling price of one healthy liver from at mudula town and overall prevalence of bovine fasciolosis in tembaro municipal abattoir from the present study. The information on the current price of one normal liver was obtained from the different butcher houses in the town. Hence, direct economic loss was calculated on annual basis according to the formula adopted from Ogunrinade & Ogunrinade.[20]

$$ALC = MCS \times MLC \times P$$

Where ALC=Annual loss from Liver Condemnation

MCS= Mean annual Cattle Slaughtered at woreda municipal abattoir

MLC= Mean cost of one Liver at town and

P= current abattoir prevalence of the bovine fasciolosis at Tembaro municipal

Data management and analysis

The data collected were entered and managed in MS Excel. SPSS version 24 statistical software's was applied for the data analysis. The overall abattoir prevalence of bovine *fasciolosis* was alculated using the number of infected individuals divided by the number of male cattle examined x 100. Chi-square (χ^2) wasused to evaluate the association between *fasciolosis* with risk factors like age, season, body condition and origin of the Animals. Direct economic loss was computed using the formula adopted by Ogunrinade & Ogunrinade.[20]

Results

Overall abattoir prevalence of bovine fasciolosisin study area

In this study, a total of 384 livers of local breed male cattle were inspected by using post mortem examination for bovine fasciollosis problem during the study periods. Out of 384 liver inspected at Mudulla municipal abattoir, 180(46.87%) were found positive for fasciolosis as shown in the table (Table1).

Table 1 Overall abattoir level prevalence of bovine fasciolosis in the study area

Total number of animal / liver examined	Total Number of animal infected	Prevalence (%)
384	180	46.87

Relative prevalence of fasciola species

In the study, all the Fasciola species observed in the infected livers were identified as *F. hepatica, F. gigantic* and mixed. The occurrence of *F. hepatica, F. gigantica* and mixed infection with both species at the abattoir were 58.33%, 31.66% and 9.44%, respectively as shown in the Figure 1 below.

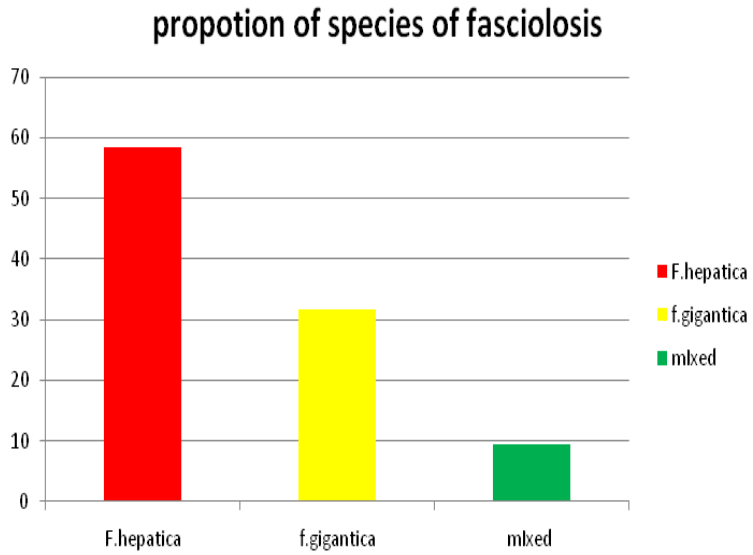

Figure 1 Relative Prevalence of Bovine Fasciola species of parasite at abattoir survey.

Association of risk factors with fasciolosis problem

In this study among other risk factors age, market origin and body condition were considered to assess its association with the occurrence of fasciolosis problems as shown on the table below. The result of this study indicated that there was statistical association ($p<0.05$) of body condition on the occurrence of the fasciolosis problems. Highest prevalence was found in cattle with poor body conditioned (82.35%) followed by medium body condition (43.42%) and the least in with good body conditioned (29.4%). The age of the animals also had statistically significant association ($P<0.05$) on the prevalence of fasciolosis in this study, an animal with the age of more than 10 years had the higher prevalence rate (61.76%) than those with age of six up to ten and three up to five years with the prevalence rate of 46.62% and 35% respectively (Table 2).

Table 2 Prevalence of Bovine Fasciolosis based on different risk factor of Animals at abattoir of study area

Risk factors	Level	Total examined	Positive for fasciolosis	Prevalence (%)	P value
Age	5-Mar	20		35	0.004
	10-Jun	326		46.62	
	>10	54		61.76	
Bcs	Poor	17		82.35	0.001
	Medium	340	152	43.42	
	Good	27		18.51	
Origin	Mudulla	256	122	47.65	0.828
	Keleta	128	58	45.31	

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Estimated financial loss due to fasciolosis

The overall prevalence of bovine fasciolosis found in this study is 48.6%. The average current market price of one normal liver was estimated 120.00ETB during the study periods and the average annual slaughter rate from retrospective data was estimated 700 cattle, therefore using this findings in the equation described on methodology section, the total annual economic loss from fasciolosis during the study time was estimated to be 39,370.80 Eth. Birr.

ALC =700x46.87%x120.00 = 39,370.80ETB ($USA1236.52)

Discussions

The current study was carried out at Mudulla municipal abattoir, kembata tembaro zone, southern Ethiopia, from November2017 to February, 2018using postmortem examination with the objectives of to determine the current abattoir level prevalence of bovine *Fasciolosis,* asses the major risk factors, identify predominant species of Fasciola, and estimating of direct financial loss due to liver condemnation respectively.

The overall abattoir prevalence result of the present study (46.87%) was in line with the finding of overall prevalence of bovine fasciolosis 46.58% by Tadela & Worku,[16] and 47% by Tolosa & Tigre[16] in different abattoirs of Jimma. On the other hand, the overall prevalence of bovine fasciolosis (46.87%) observed in this study was higher than the reports of Gebretsadik et al., who reported prevalence of 14%, 24.3%, and 28% at Wolaita Soddo abattoir, Mekelle area, Haramaya abattoir and Kombolcha Industrial Abattoir, Ethiopia respectively. However, this prevalence was much lower than that of 90.7% in cattle slaughtered at Gondar abattoir reported by Yilma & Mesfin,[21] 74% at Sheno abattoir reported by Nigus et al.,[22] and 82.5% in Western Shoa abattoir reported by Yadeta.[23] The variations in the findings with the earlier reports might be due to the difference in the sample size, sample selection method, breed of animals, period and place of study, climatic conditions of the study area, meat inspector ability, availability of veterinary services and drug usage, management factors and the availability of the infected snail intermediate hosts and the likes.[24]

The present study findings of species identification revealed that *F. hepatica* was more prevalent (58.33%) as compared to *F. gigantic* (31.66%); and certain proportion of animals (9.44%) harbored mixed infestation. This more prevalent finding of *f. hepatica* was very close to the finding of 65.625% by Shiferaw et al.,[25] from Assela, 68.8% by Niguset al.,[22] from Sheno, 55.65% by Eyob et al.,[11] from Angecha, and 63.3% by Tolosa and Tigre, (2007) from Jimma abattoir respectively. The high prevalence of *F. hepatica* in the study area may be associatedto the existence of favorable ecological condition for *L.truncatula* (intermediate host of *F.hepatica)* such as small swampy marshy area around lamo river, the availability of irrigational and drainage ditches in the study area and most animals may come from high land areas from different part of the surrounding districts such as Dawuro, Wolaita and Areka.

However, the result of this finding (higher prevalence of *F.hepatica*) was in contrary from the result of Aseffa, et al., at Guduru and Abaychomen municipal abattoir who reported higher prevalence for *F. gigantica* (47.2%) and lower for *F. hepatica* (39.2%) when compared to the present study result. This variation in the prevalence probably due to difference in climatic condition (altitude, rain fall, temperature) of the area, origin of animals and the existence of unfavorable ecological condition for *L.natalensis* (intermediate host) of *F.gigantica* in the current study area.

The finding of relatively small proportion of mixed (9.44%) infestation with both species was also in line with the reports of 10.29% by Abegaze,[26] 13.17% by Ayelign M & Alemneh T,[27] and; slightly lower than with finding of 17.75% by Eshetu et al. Mixed infection by both species of *Fasciola* might be due to cattle for slaughter normally comes from different marketing areas of the region having different weather conditions and altitude known to be suitable for the existence of both species of *Fasciola* and intermediate host and the lower prevalence mixed infection might be due to the unfavorable condition for *L. natalensis* and drainage ditches are favorable habitat.[4]

Moreover the study conducted by Graber[28] indicated the Ethiopian *F. hepatica* found in areas situated over 1800-2000 m.a.s.l and *F. gigantica* up to 1200 m.a.s.l. and mixed infection with both species in areas between1200-1800m.a.s.l. This is true in the study area also. For the analytical statistic, different variables such as body condition, market origin, and age of animals were considered as risk factors. This study indicated the prevalence of the parasites in different age group was found to be 35%, 46.62% and 61.76% among age groups 3-5 years, 6-10 years and >10 years, respectively. A statistical significant association ($p<0.05$) was recorded in the prevalence between different age groups, with higher in >10 years age group while the lower was observed in age group of 3-5 years. This finding revealed the infection rate increased with the increase of age. This result was in agreement with the earlier findings of Kalim et al., who reported the highest level of infection in older group i.e., above 5 years (76.43%) followed by in age groups of 3-5 years (68.69%) and 1-3 years (48.62%). The higher prevalence in older animals could be due to long time exposure to disease entity and their grazing habit close to submerge areas; and the lower infection rate in young may be attributed (most probable) because of few number of young animals presented for postmortem examination and this may again attributed to the fact that young animals were not often driven far with older age groups to grazing and watering points. They were mostly kept at a nearby village where the sources of feeding sites are not contaminated. This practice naturally reduces the chance of exposure in this age class. The more the age of the young increases, the possibility of moving towards new environment happens, which leads to an exposure with *Fasciola* contaminated pasture lands and water points.

The result of this study indicated that higher prevalence of fasciolosis was recorded in beef cattle those with poor body conditioned (82.35%) than medium(43.42%) and good conditioned animals(18.51%) and there was statistically significance difference infection rate among different group ($P<0.05$). These finding was in agreement with Hagos and Abel et al., who reported as the highest infection rate in poor conditioned animals followed by medium and good conditioned respectively. The higher infection rate of poor conditioned animals might be those cattle with thin body conditions may have less resistance to overcome infection than medium and good due to the various reasons such as scarcity of animal feed and co-infection with the other parasites, the effect of the parasite in the animal as *Fasciola* species are blood and tissue fluid suckers and even damage the parenchyma of the liver (immature *Fasciola)* and causes bleeding while the adult parasites are in the bile ducts, which ultimately deplete protein from the[4] which leads to poor body condition. Furthermore, cholangitis and liver cirrhosis might be caused by chronic fasciolosis and could reduce the bile flow to the duodenum and hence reduced lipid emulsification, digestion and absorption of

fatty acid and lipid soluble vitamins. This might also associate with the rationale that animals with poor body condition may have poor immunity and hence may be susceptible to any infectious diseases, in this case fasciolosis.

This study reveals there was no statistical significance difference of prevalence of fasciolosis between the market origins of animals those brought to the abattoir, and relatively low prevalence was encountered in those animals came from market of keleta (45.31%) than Mudulla (47.67%).This implies infection rate of fasciolosis is relatively higher in keleta than Mudulla. Relatively high prevalence and absence of statistical variation may be due to the similarity in agro ecology of the two vicinities. The direct economic loss due to liver condemnation in Mudulla municipal abattoir (39,370.80ETB) was relatively higher when it compared with 3,360.00ETB from Harar abattoir, 12,414.47 ETB by Dejene, from Arsi and in line with the records of 33,509.97 ETB by Ayelegn & Alemneh,[27] from Amhara region, 37,767.6 ETB by Shiferaw et al.,[25] from Assela, and 48,744ETB by Eyob et al., from Angecha respectively. However, The financial loss recorded in the present study was found to be lower when compared with the previous findings of 106,400 ETB by Rahmeto et al.,[7] from Hawassa, 236,516.00ETB by Eyakem, from Adama town, and 726,561.50ETB from Arbaminch respectively. The variation of economic loss in different study areas may be due to the variation in number of cattle slaughtered in the study abattoirs, the average market price of one healthy liver, and the overall prevalence of fasciolosis, the ecological and climatic difference between the localities.

Conclusion

The current finding showed that bovine fasciolosis is the prevalent and economically important parasitic disease affecting the health and productivity of animals in the study area. It causes economic losses as a result of condemnation of infected livers. This survey also revealed that *f.hepatica* was the predominant species identified followed by *f.gigantica* and mixed one in the study period. Independent variables such as body condition, market origin, and age of animals were considered as risk factors but the statistical analysis indicated that bovine fasciolosis had statistically significant association with age and body condition of the animals. Therefore, the risk factors responsible for the occurrence of fasciolosis problems identified were age and body condition.

Therefore based on the above findings the following recommendations are forwarded:

Since the current study was only abattoir survey and short period, further study using alternative techniques such as serology in combination with fecal test (coprological) surveys need to be conducted in order to generate more complete data on the prevalence of bovine fasciolosis and indirect economic losses due to carcass and weight. It was difficult to indicate the effect of seasonal variation on the prevalence of bovine fasciolosis since the study period was too short without incorporating wet months of the season. An accurate description of seasonal occurrence requires long term epidemiological investigation over several seasons. Liver affected by *Fasciola* species of cattle slaughtered at mudulla municipal abattoir should be registered and appropriately disposed to prevent the distribution of the disease in the study area. Farmers who rear cattle should improve provision of feeds to their animals so that the animal can have good body condition that confers some level of resistance against fasciolosis. Appropriate strategic deworming has to be designed and implemented in the study area to minimize the effect of the disease on livestock productivity. Strategic vectors Control through different techniques should be undertaken so that minimize the risk of fasciolosis in the area in order to improve or boosting the livestock productivity of the area by usually community based control programs such as drainage of swampy area and fencing of watering points should be adopted in the area, Collaboration between different sectors should be done so as to control both disease and vectors of an area especially while building of ponds and irrigation canals. Policy makers and economy analysts have to be provoked to put their relentless effort in the control of such disease that has serious impact on the country economy.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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