Global Journal of Medical research
Volume 11 Issue 3 Version 1.0 September 2011
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 Print ISSN: 0975-5888

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Abstract – A cross-sectional study was carried out from November 2009 to march 2010 on bovine fasciolosis in and around Assela and at Assela municipal abattoir to assess its prevalence and economic importance. From total of 400 cattle examined coprlogically 45.25 % (181) were found positive for fasciolosis. The prevalence of bovine fasciolosis was higher in male cattle than females and also higher in younger cattle (> 3 yrs) than older ones (> 5 yrs). The prevalence of bovine fasciolosis in the study sites was significantly ($p<0.05$) affected by sex, age and months of the year, however, its prevalence was not significantly ($p>0.05$) affected by body conditions. Post mortem examination was done on a total of 183 cattle and 34.97% were found infected with Fasciola at Assela municipal Abattoi. F. hepatica was found to be the predominant facsiola species causing bovine fasciolsis in the study areas. The economic significance of bovine fasciolosis was also assessed from condemned liver and carcass weight loss. Thus based on the retail value of bovine liver and 1kg of beef the total annual economic loss from fasciolosis during the study time was estimated to be 698,700.6 Eth. Birr (51,909.4 USD).

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GJMR-G Classification : *NLMC Code: WA 671, WA 672*

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Abstract - A cross-sectional study was carried out from November 2009 to march 2010 on bovine fasciolosis in and around Assela and at Assela municipal abattoir to assess its prevalence and economic importance. From total of 400 cattle examined coprlogically 45.25 % (181) were found positive for fasciolosis. The prevalence of bovine fasciolosis was higher in male cattle than females and also higher in younger cattle (> 3 yrs) than older ones (> 5 yrs). The prevalence of bovine fasciolosis in the study sites was significantly ($p<0.05$) affected by sex, age and months of the year, however, its prevalence was not significantly ($p>0.05$) affected by body conditions. Post mortem examination was done on a total of 183 cattle and 34.97% were found infected with Fasciola at Assela municipal Abattoi. F. hepatica was found to be the predominant facsiola species causing bovine fasciolsis in the study areas. The economic significance of bovine fasciolosis was also assessed from condemned liver and carcass weight loss. Thus based on the retail value of bovine liver and 1kg of beef the total annual economic loss from fasciolosis during the study time was estimated to be 698,700.6 Eth. Birr (51,909.4 USD).

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I. Introduction

Fasciolosis is an economically important parasitic disease, which caused by trematodes of the genus *Fasciola* that migrate in the hepatic parenchyma, and establish and develop in the bile ducts (30). *Fasciola* is commonly recognized as liver flukes and they are responsible for wide spread of morbidity and mortality in cattle characterized by weight loss, anemia and hypoproteinemia. The two most important species, *Fasciola hepatica* found in temperate area and in cooler areas of high altitude in the tropics and subtropics and *Fasciola gigantica*, which predominates in tropical area. *Fasciola hepatica* is found in area above 1800 m.a.s.l. In between these altitude limits, both species coexists where ecology is conductive for both snail hosts, and mixed infections prevailed (35). The snail of the genus *Lymnae natalensis* and *Lymnae truncatula* are known as intermediate host in life cycle of fasciolosis.Infection with *Lymnea truncatula* is usually associated with herds and flocks grazing wet marshy land. On the other hand, *Fasciola gigantica* is a 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 may be seasonally in undated (22). Fasciolosis is an economically important disease of domestic livestock, in particular cattle and sheep and occasionally man Ahmed *et al*. (3). The disease is responsible for considerable economic losses in the cattle industry, mainly through mortality, liver condemnation, reduced production of meat, milk, and wool, and expenditures for anthelmintics (11) and (19). The world-wide losses in animal productivity due to fasciolosis were estimated at US $200 million per annum, to rural agricultural communities and commercial producers (8), with over 600 million animals infected Ramajo *et al*. (26). In developed counties, the incidence of *F. hepatica* can reach up to 77%. In tropical countries, fasciolosis is considered the single most important helminth infection of cattle, with reported prevalence of 30-90% Spithill *et al*. (28). The prevalence of fasciolosis in many parts of Africa has been determined mainly at slaughter. However estimation of economic loss due to fasciolosis at national or regional level is limited by lack of accurate estimation of the prevalence of disease Phiri *et al*. (23).

The presence of fasciolosis due to *F. hepatica* and *F. gigantica* in Ethiopia has long been known and its prevalence and economic significance has been reported by several workers (17), (16), (5), (35), (36), (29), Fufa *et al*. (15). Available published reports have indicated that bovine fasciolosis causes economic losses of roughly 350 million Birr per annum due to deceased productivity alone (5). More recently, (29) and Fufa *et al*. (15) have reported financial losses of 6300 USD and 4000 USD per annum, respectively due to liver condemnations at slaughter houses.

Assela is one of town in Ethiopia, located in the South-east of Addis Ababa where huge livestock populations are found. The major land cover is thus used for grazing which support on an average 27 livestock per hectare. Livestock are major agricultural resource in the area. Assela is one of the areas where the environmental conditions and altitude of the area is conducive for the occurrence of fasciolosis. However; little information is available about its prevances and its economic significance in the study area. Therefore, the

objectives of this study were to study the prevalence of bovine fasciolosis and assess direct (liver condemnation) and indirect (carcass weight) economic losses caused by fasciolosis in the study area.

II. Materials and Method

a) Description of the Study Area

Topography and climate: Assela is situated at $6^0 59^1$-$8^0 49$ N latitude and $38^0 41^1$-$40^0 44^1$ E longitude in central Ethiopia, 175 km south cast of Addis Ababa. The altitude of the area ranges from 1780-3100 m.a.s.l and characterized by mid subtropical temperature ranging from 5^0c-28^0c. The annual average rainfall is 1200 mm and mostly with clay type of soil and in rare case black soil. The area covers 23674.72 km square and topographically has highland escapement and lowland areas. The high land areas are found centrally and the low lands dominate the periphery of the area (4).

b) The study sites

Tiyo Woreda has 18 Peasant Aassociations (PA) and out of these only three representative PAs (*Dosha, Kobolcha area*, and *Kulumsa*) were selected by considering their similarity in production system, their differences in altitude and livestock populations.

c) Study population

During sampling of the study animals in the present study, sexes, ages and body conditions of all the sampled cattle from the selected three PAs of Tiyo woreda were recorded.

d) Sample size Determination

Since there was no previous study in Tiyo woreda to establish the prevalence and economic significance of bovine fasciolosis, the sample size was determined by taking the prevalence of 50% fasciolosis using the formula given by (31).

$$n = \frac{1.96^2 . P_{exp} (1\text{-}Pexp)}{d^2}$$

Where n = required sample size
P_{exp} = expected prevalence= 50%
d = desired absolute precision=5%
Hence, d = 0.05 and p= 0.5 (50%).

Accordingly 384 animals were supposed to be sampled but in order to increase the precession a total of 400 study animals were used.

e) Study Design and Sampling Method

A cross-sectional investigation of the prevalence of bovine fasciolosis in the three PAs of Tiyo woreda was carried out from November 2009 to March 2010. Simple random sampling technique was the sampling strategy used to collect all the necessary data from feacal samples and abattoir survey of the study animals.

f) Study Methodology

i. *Coprological Examination*

Faecal samples for parasitological examination were collected directly from the rectum of each animal and freshly defected faeces in to plastic bottles with gloved hand. The samples were clearly labeled with universal bottles preserved with 5% formalin and each sample was clearly labeled with animal's identification, date and place of collection. Samples were packed and dispatched in cool box to avoid development of eggs and hatching. In the laboratory, coprospic examination was performed to detect the presence of fasciola eggs using the standard sedimentation techniques (18).

ii. *Abattoir Survey*

Active abattoir survey was conducted based on cross sectional study during routine meat inspection on randomly selected cattle slaughtered at Assela municipal abattoir. A total of 183 cattle were examined during the study. During ante-mortum examination detail records about the species, breeds, sexes, origins and body conditions of the animals were performed. The origin of the animal and age whenever possible while body condition scoring based on (20). During post-morton inspection, each liver visually inspected, palpated and incised based on routine meat inspection by (14). All livers having *Fasciola* species condemned were registered and flukes were conducted for species identification.

iii. *Species Identification*

After making systematic incision on liver parenchyma, and bile ducts, flukes were collected in the universal bottle containing 10% formalin in preservative and examined to identify the involved species. *Fasciola gigantica* (20 - 75 mm x 3.12mm) resembles *Fasciola hepatica* (20 - 30mm x 10mm) but readily recognized by its larger size, the shoulders are not prominent and the body is more transparent. It is grayish- brown in color changed to grey when preserved (27).

iv. *Economic loss assessment* .

The total economic loss due to fasciolosis in cattle slaughtered from the summation of annual liver condemnation cost (direct loss) and cost due to carcass weight reduction (indirect loss) was assessed.

v. *Direct Economic loss*

Direct economic loss was resulted from condemnation of liver affected by fasciolosis. All livers affected with fasciolosis were totally condemned. The annual loss from liver condemnation was assessed by considering the overall annually slaughtered animal in the abattoir and retail market price of an average zebu liver. Annual slaughtered rate was estimated from retrospective abattoir records of the last three years, while retail market price of an average size zebu liver was determined from the information collected from butcheries in Assela Town. The information obtained

was subjected to mathematical computation using the formula set by (21).

ALC = CSR X LCX P
Where ALC = Annual loss from liver condemnation
CSR = Mean annual cattle slaughtered at Assela municipality abattoir
LC = Mean cost of one liver in Assela Town.
P=Prevalence rate of the disease at the study abattoir

vi. *Indirect Economic loss*

Indirect economic loss was associated with carcass weight reduction due to fasciolosis. A 10% carcass weight loss in cattle is due to fasciolosis. Average carcass weight of an Ethiopian Zebu was taken as 126 kg (20). The annual carcass weight loss due to bovine fasciolosis assessed using the following formula set by (21).

ACW = CSR XCL XBC X PX 126 Kg

Where ACW = Annual loss from carcass weight reduction.

CSR = Average No cattle slaughtered per annual at annual at the study abattoir.
CL = Carcass weight loss in individual cattle due to fasciolosis.
BC = An average price of 1kg beef at Assela town
P=Prevalence rate of fasciolosis at the study abattoir.
126 kg = Average carcass weight of Ethiopian Zebu.

vii. *Data Management Analysis*

All the data collected during the study period were stored in excel spreadsheet for statistical analysis and were analyzed using intercooled stata 7.0 for windows (2001) to determine prevalence and analyze the associations with risk factors.

III. Results

a) Coprological finding

From a total of 400 faecal samples examined from cattle during the study period, 181 (45.25%) samples were found positive for fasciolosis.

The prevalence of bovine fasciolosis between the two sexes in the current study (table 1) revealed 62.73% (female) and 11.67% (male) and differ significantly ($p<0.05$). From the result of the present study on the prevalence of fasciolosis between different age groups showed an inverse correlation (table 1) and also the prevalence of fasciolosis was statistically significant difference ($p <0.05$) between cattle of different age groups.

b) Fasciola species Identification

From the total of 183 slaughtered animals whose liver were inspected in the abattoir, 64 livers were found to be positive for liver fluke infection (table 2) and from these 42 livers (65.625%) harbored with *F. Hepatica,* 16 livers (25%) harbored with *F.gigantica* and the remaining 6 livers (9.375%) harbored mixed infection.

Table 3 of the present study shows that there was no a statistical significant difference ($p>0.05$) in the prevalence of fasciolsis in cattle with different body conditions. But the higher prevalence (75%) was observed with cattle whose body conditions were thin and the lowest prevalence (40%) was recorded for cattle whose body conditions were good.

The prevalence of Bovine *Fasciolosis* between the three different study sites in the present study (table 4) showed the presence of variability on the prevalence of Bovine *Fasciolosis* between them. The highest (54.13%) and the lowest (39.61%) prevalence Bovine *Fasciolosis* were observed Kulumsa and Dosha, respectively.

The prevalence of bovine fasciolosis in each month of the study periods was also indicated in table 5. The table shows the presence of significant difference ($p<0.05$) in the prevalence of bovine fasciolosis between each month of the study periods. The highest (69.767%) and the lowest (32.18%) prevalence were observed in March and November, respectively.

c) Economic loss assessment

i. *Direct Economic loss*

Direct economic loss was resulted from liver condemnation as the result of fasciolosis. Generally all infected livers with fasciolosis are unfit for human consumption. The 64 fasciolosis infected livers of cattle were corresponding to an estimated total loss of about 805.71 ETB. In the study abattoir the average annual cattle slaughtered rate was estimated to be 3000 while mean retail price of bovine liver in Assela town as 36 ETB. Prevalence of fasciolosis in Assela municipality abattoir estimated as (34.97%). Therefore the estimated annual loss form organ condemnation is calculated according to the formula:

ALC = CSR X LC X P
= 3000 X 36 X ETB X 34.97%
= 3000 X 36 ETB X 0.3497
= 37,767.6 ETB

ii. *Indirect Economic loss*

Indirect economic loss was due to carcass weight reduction as result of *Fasciola* infection. In the study area the average price of 1kg beef was 50 ETB. The annual economic loss from carcass weight reduction due to bovine fasciolsis is calculated by using the formula: ACW

= CSR X CL X BC X P X 126kg
= 3000 X 10% X 50 ETB X 34.97% X 126kg
= 3000 X 0.1 X 50 ETB X 0.3497 X 126kg
= 660, 933 ETB

Therefore, the total annual economic loss due to bovine fasciolosis in the study abattoir is the summation of the losses from organ condemnation (direct loss) and carcass weight reduction (indirect loss) and thus a total of 698,700.6 ETB (51, 909.4056 USD).

NB: 1 USD was equivalent to 13.4600

IV. Discussions

Fascioliosis is an important parasitic disease of domestic ruminants caused by two liver fluke species: *Fasciola hepatica* and *F. gigantica* (Trematoda). *Fasciola hepatica* has a cosmopolitan distribution, mainly in temperate zones, while *F. gigantica* is found in tropical regions of Africa and Asia.

Bovine fasciolsi exists in almost all region of Ethiopia. However, the prevalence, epidemiology and *Fasciola* species involved vary with locality. This is mainly attributed to the variation in the climate and ecological condition such as altitude, rainfall, temperature and livestock management system (17), (5). The result of present study indicated that bovine fasciolsis relatively spread with moderate prevalence of 45.25% in the study area as compared to high prevalence of 86% in Keffa (5), 80% in and around Debre Berhan (9), 88.57% and 82.5% in western shoa (33). Moreover, (5), (34) and (13) have reported prevalence of 61%, 52% and 62.2% in Gonder, around Tan, and around Bahir Dar, respectively. The result of these workers are relatively higher than the present finding and this variation might be attributed to the difference in the infestation, level of study area and the present study were conducted during the dry period of the year when the infections rate of fasciolsis is expected to be low. The result of the present study is similar with the prevalence of bovine fasciolosis reported at Jimma. Sodo and Ziway abattoirs by (29), (1) and (2), respectively but higher than that of (10) from Dire Dawa municipality abattoir. This is probably due to the ecological and climatic difference between the two localities.

The results of the present study revealed that sex and age have significant effect on the prevalence of bovine fasciolosis. However, the work done by (25) and (9) concluded that sex has no impact on the infection rate and hence both male and female are equally susceptible and exposed to the disease. The significant effects of sex on the prevalence of bovine fasciolosis might be attributed to the management system with longer exposure of male outdoor when females are kept indoor at the beginning of lactation (6).

Different works reported similar finding with the present work and clearly justified that the decrease in infection rate (prevalence) as age increase is the result of acquired immunity which is manifested by humeral respond and tissue reaction in bovine liver due to previous challenge (21), and Dwinger *et al.* (12). They also reported that the increase resistance (low prevalence) as age increase is most likely related to the high level of tissue reaction seen in bovine liver, server fibrosis which impedes the passage of immature fluke, acquired resistance, thickening, stenosis and calcification of bile ducts, assumed unfavorable site for adult parasites and consequently fasten their explosion. Additionally the experimental result by (27) and Radostits *et al.* (24) confirmed the occurrence of higher infection rate in younger animals. Moreover, inverse co-relation of prevalence and age of cattle were also reported by (13), (25), (9) and (7).

Post mortem examination on the 64 *Fasciola* infected livers of the current result indicated that *F. hepatica* and *F. gigantica* were the main fasciola species in the study areas, however, *F. hepatica* were found to be the predominant facsiola species causing bovine fasciolsis in the study areas. Similar study conducted at Jimma and Zeway abattoir reported 63.3% and 60.3% of the liver harbored F. hepatica (29), (2), respectively. This is attributed mainly due to the variation in the climatic and ecological conditions such as altitude, rainfall, temperature and livestock management system (35). Moreover, Garber and Daynes reported that; in Ethiopia F. hepatica and F. gigantica infections occur in areas above 1800 m.a.s.l. and below 1200 m.a.s.l. respectively. The high prevalence rate of F. hepatica may be associated with the existence of favourable ecological biotops for L. truncatula. Relatively small proportion of cattle were found infected with F. gigantica alone or mixed infection with both spp. This may be explained by cattle coming for slaughter from highland and middle altitude zone flood prone areas, drainage ditches are favourable habitat to natalensis Urquhart *et al.* (32).

Infection rate of bovine fasciolsis was statistically analyzed on the base of body condition to study the impact of the disease in debilitating (emaciating) infected animals. The result of study indicated that infection rate has no significant difference ($p>0.05$) on the prevalence of fasciolsis weather the animal in thin, moderate or good body conditions. This body condition in cattle manifested when fasciolsis reaches at its chronic stage even though there is a difference in infection rate between thin (75%), moderate (49%) and good (40%) body conditions. The monthly/seasonal/ variation in the prevalence of fasciolosis has been studded for 5 dry months in the study area. 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 years. In this study high infection rate (69.767%) was encountered in March while lower infection (32.18%) in November having statistical significant difference ($p<0.05$). However, (29) reported October was when the highest

prevalence rate was analyzed during, when the wet ecological conditions still prevailed. It has been described that the bionomic requirements for breeding of the Lymnaea snails and development of the intramolascan stages of the flukes often reach the optimum threshold during the wet months of the year. During the dry periods, breeding of the snails and development of the larval flukes slow down or stops completely and snails undergo a state of aestivation (35).

(21) emphasized on the statement that even if it is realized estimating the actual economic loss due to individual parasitic disease is difficult, this should not be medicate against an attempt to emphasize the cause of the disease. The direct economic loss incurred during this study as a result of condemnation of liver of cattle was estimated about 37, 767.6 ETB per annum and indirect economic loss due to carcass weight reduction was estimated about 660, 933 ETB per annum. Therefore, the total annual economic loss due to fasciolsis in the study abattoir is the summation of losses from organ condemnation and carcass weight reduction which is equal to 698,700.6 ETB. This finding is by far lower than the result reported by (29), (2) and (10) a total economic loss of about 55,080.00, 154, 188 and 215,000 Ethiopian birr per annum in cattle due to fasciolosis at Jimma, Ziway and Dire Dawa municipal slaughterhouses, respectively. This is probably due to the ecological and climatic difference between the two localities.

v. Conclusions

The present study revealed that although a moderate prevalence of bovine fasciolosis in the study sites recorded; the prevalence was significantly affected by sex, age and months of the year. Higher prevalence of bovine fasciolosis was recorded in male cattle than females and in younger cattle (> 3 yrs) than older (> 5 yrs) ones. *F. hepatica* was found to be the predominant. facsiola species causing bovine fasciolsis in the study

Finally the total annual economic losses due to bovine fasciolosis in the study abattoir from organ condemnation (direct loss) and carcass weight reduction (indirect loss) were high.

vi. Acknowledgments

The authors acknowledge Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) for financing the project in the period from November 2009 to March 2010. We are also grateful to staff members of Assela Regional Veterinary Laboratory for their valuable advice, encouragement and provision terials during this research work. Finally the authors extend their gratitude to all those who were contributing directly/indirectly to finalize this piece of

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Table 1 : Prevalence of bovine fasciolosis on sex basis.

Sex	No of sample examined	No of sample Positive	No of sample Negative	Prevalence (%)	χ^2	P-value
M	263	165	98	62.73	18.575	0.00
F	137	16	121	11.67		
Age						
<3	69	35	34	50.72	1.271	0.00
3-5	191	118	73	61.78		
>5	140	28	112	20		

Table 2 : Species of *Fasciola* identified during post mortem examination of slaughtered animals.

Species of fasciola	No. of lives condemned	Percentage (%)
F. hepatica	42	65.625
F. gigantic	16	25.00
Mixed	6	9.375
Total	64	100

Table 3 : Prevalence of fasciolsis in different body condition groups

Body condition	No of animals examined	No of positive cases	Prevalence (%)
Thin	8	6	75
Moderate	202	99	49
Good	190	76	40

$X^2 = 1.456$ $p = 0.483$

Table 4 : Prevalence of Bovine *Fasciolosis* by Study Sites

Study Sites	No of sample examined	No of sample positive	No of sample negative	Prevalence (%)
Dosha	154	61	93	39.61
Kombolha	113	48	65	42.47
Kulumsa	133	72	61	54.13

Table 5 : Monthly Prevalence of fasciolosis

Month	No. of animals examined	No. of positive sample	Prevalence (%)	χ^2	P- value
November	87	28	32.18	17.273	0.01
December	105	35	33.33		
January	83	42	50.60		
February	82	46	56.097		
March	43	30	69.767		