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Epidemiological study on bovine fasciolosis: Coprological, abattoir survey and its economic impact due to liver condemnation at Debre Berhan municipal abattoir, Ethiopia

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Abstract

A cross-sectional study was carried out from November 2011 to March 2012 on bovine fasciolosis at Debra Berhan municipal abattoir to assess its prevalence and economic importance. From total of 400 cattle examined by postmortem 49.5 % (194) and coproscopic examination 23.5% (94) were found positive for fasciolosis. The prevalence of bovine fasciolosis was slightly higher in female cattle than male and also higher in older cattle (> 10 yrs) than younger ones (< 5 yrs). The prevalence of bovine fasciolosis in the study sites was significantly ($p<0.05$) affected by origin and body condition of the cattle. However, its prevalence was not significantly ($p>0.05$) affected by sex, age and breed of the cattle. Post mortem examination was done on a total of 194 cattle and 49.5% were found infected with Fasciola at Debra Berhan municipal Abattoir. F. hepatica was found to be the predominant fasciola species causing bovine fasciolosis 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 Eth. Birr . 631,125 .00

INTRODUCTION

In Ethiopia ruminant livestock are important sources of income for rural communities and is one of the nation major sources of foreign currency from export. However, this great potential no properly exploited mainly due to prevailing traditional management, limited genetic potential, and rampant diseases. Out of the diseases causing serious problem, parasitism represents major drawback on livestock production in the tropics (Bekele *et al*., 1992;Oqunrinade and Adegoke,1982; Rahmeto *et al.,* 2010).Among the parasitic diseases fasciolosis is important parasite which imposes direct and indirect economic losses of livestock particularly, in sheep and cattle. The most commonly affected organ by fasciolosis is liver. In addition to economic loss of another dimension is added by the fact that several helminthes infections could be transmitted to man (Radostits *et al*., 2007).

Fasciolosis is an economically important parasitic disease, which is caused by trematodes of genus *fasciola* that migrate in the hepatic parenchyma, and establish and develop in the bile ducts (Urquhart *et al.,* 1996; Troncy,1989). 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 hypo-proteinemia. The two most important species, *fasciola hepatica* found in temperate area and in cooler areas of high altitude in the tropics and sub tropics and *Fasciola gigantic*, which predominates in tropical areas. *Fasciola hepatica* is found in area above 1800 m.a.s.l. in between these altitude limits, both species coexist where ecology is conducive for both snail hosts, and mixed infections prevailed (Solomon and Abebe, 2007;Graber, 1975; Yilma and Malone, 1998). The snail of the genus *Lymnae natalensis* and *Lymnae truncatula* are known as intermediate host in life cycle of fasciolosis. Infection with *Lymnae truncatula* is usually associated with herds and flocks grazing wet marshy land. On the other hand fasciola gigantic 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 wet land, which is seasonally in undated (Payne,1990). Both fasciola hepatica and fasciola gigantic are found in most African countries such as Ethiopia. Fasciola hepatica is the most important fluke species in Ethiopia livestock with the distribution over three quarters of the nation except in arid north eastern of Ethiopia. The highest risk areas of fasciola gigantic were found to be localized in the western humid zone of the country that encompasses one third of the nation. High risk

of fasciola gigantic infection was indicated only at a small focus along the Blue Nile River (highlands of Ethiopia and Kenya) were identified as such able for fasciola gigantic (Malone *et al*.1998).

In Ethiopia among many prevalent livestock diseases, parasitism particularly fascilosis is one of the major entity exerting its direct and indirect effects to the economy of the nation. The two species mentioned above are found in different places of the country. The presence of fasciolosis in Ethiopia has a long history and is responsible for causing considerable losses in livestock production. According to Yilma and Malone (1998) varying degrees of fasciola hepatica risk, occur in all areas of Ethiopia except in the arid north east and eastern part of the country. The highest risk areas were localized in western humid zone. Fasciola gigantic endemic areas occur in entire western zone of the country with localized foci in south and east zones. High risk of fasciola gigantic infection was indicated only at a small focus of along the Blue Nile River. It is true that seasonal strategic application of effective anthelmentics specific for trematodes as well as timely prophylactic and curative treatments play an important role in the control of liver fluke infections. Strategic treatments have been developed for several regions of the world based on meteorological data (Jorgen, 1994).

The status of Fasciolosis in Ethiopia and other countries

Fasciolosis exists in almost all regions of Ethiopia. However, the prevalence, epidemiology, and fasciola species vary with locality. This is mainly attributed to the variation the climatic and ecological condition (Michael, 2004). In Ethiopia, the presence of both *L.truncatula* and *L.natalensis* has been reported (Graber, 1975). Mixed infection of both species of fasciola may occur in areas where the ecology is conductive for replication of snail intermediate host. *F.hepatica* is wide spread in areas with altitude above 1200-2560 m.a.s.l. while *F.gigantica* appears to be the most common species in areas below 1800 m.a.s.l (Yilma and Malone, 1998). Both species co-exist in areas with altitude ranging between 1200-1800 m.a.s.l. (Mulugeta *et al*., 1998). It is reported that water logged and poorly drained areas with acidic soils in the high lands are often endemic areas for fasciolosis (Mulugeta *et al*.,1998) varies studies conducted in different corners of the country showed that the disease is most prevalent and economical important. These studies indicate that infection prevalence of fasciolosis varies from region and reported prevalence of 49%in Holeta(yilma,1985),30.2% around Ziway (Adem, 1994),70.2% in western Shoa and Nekemte (Mezgebu,1995), 81%in Debra Berhan(Tsegaye.1995),26.1%in Mekelle abattoir (Tekele,1995).

It was also indicated that fasciolosis is the most prevalent parasitic disease of sheep in the highland of Ethiopia and reported the existence of the intermediate host, *L.truncatula* in marshy areas. The existence of this intermediate host, is also reported in Illubabor, Shoa, Jimma, Sidamo, Harar, Wello, and Bale (Graber, 1978 and Dagne, 1994)

Economic Significance

Fasciolosis causes major economic losses in sheep, goats, buffaloes, and cattle (FAO, 1994). It is the cause of tremendous loss to growers of these animals. In addition to rendering the liver unsuitable for human consumption, it causes loss through death, reduction in meat and milk inhibited reproduction, morbidity, impaired growth and reduction in carcass weight, reduction in wool growth and quality, decreased feed intake, conversion and lowered resistance (Olsen, 1991). In Ethiopia a rough estimate of economic loss due to decreased production has been to be over 300million Ethiopian birr per year (Getachew, 1984) and Abunna *et al.,* (2009) and Rahmeto *et.al* (2010) have also reported financial losses of US$ 6300 per annum and US$ 4000 per annum, respectively due to liver condemnation at slaughter houses.

Therefore, the objective of this study were;

- To determine the prevalence of fasciolosis in slaughtered cattle at Debra Berhan municipal abattoir.
- To compare the efficacy of fecal examination and abattoir survey for diagnosis of fasciolosis.
- To assess its direct economic impact due to liver condemnation.
- To determine the most prevalent species of liver fluke in indigenous cattle slaughtered in the abattoir.

MATERIALS AND METHODS

Study area and population

The Debre Berhan town municipal abattoir was considered for the determining prevalence and economic importance of bovine fasciolosis at the municipal abattoir level, which was conducted from November 2019 to March 2020. Debre Berhan town is located in North Shoa zone that is 130km far from capital city Addis Ababa in northeast direction. The cattle, which are reared under extensive management system, bought from highland and lowlands areas surrounding Debre Berhan town such as Debresina, Kotu, Keyit, Mehalmeda, Tagwuelet, Aliyuamba, Ankober, and Shewarobit were brought to the abattoir. North Shoa zone has an altitude of 2,780m a.s.l., and the area has a bimodal rainy season that covers from June to September and short rainy season extends from February to March. The annual rainfall of the area is 956mm and an average minimal ambient temperature is 12.6°C (CSA, 1998). The animal and human population of the zone according to Zonal Agricultural and Rural Development Offices (2009) is stated as the livestock population of the area comprises of 163,558 bovine, 133,472 ovine, 47,970 caprine, 39,038 equine, and 32,9 45 poultry and the total human population estimated about 145,037 people.

Study design

A cross-sectional study was used to determine the prevalence of bovine fasciolosis, and simple random sampling technique utilized to collect the data. The origin, breed, sex, body condition, and age of cattle were recorded and faecal samples were collected at the ante-mortem inspection. Age of the animal and body conditions scored according to Mari Heinon (1989). The same cattle subjected for ante-mortem inspection were deliberated for post-mortem inspection of fasciola spp. in the liver organ. Economic assessment carried out on the condemned liver organ because of fasciola infestation.

Sample size determination

There was no reported bovine fasciolosis prevalence in study area and the sample size was determined by taking the prevalence of 50% bovine fasciolosis using Thrusfield (1995) formula.

$N= (1.96^{2*}) Pexp (1-Pexp)/d^2$

Where

N=required sample size

Pexp=expected prevalence

d=desired absolute precision

Hence, d=0.05 and Pexp=0.05(50%)

Accordingly, 384 animals were supposed to be sampled; however, to increase the precision 400 animals were sampled.

Coprological Examination

Fecal samples for parasitological examination were collected directly from the rectum of each animal and freshly defecated feces into universal plastic bottle with gloved hands. The samples preserved with 5% formalin and clearly labeled with animal's identification, and date of collection. Samples were packed and transported to Bedelle Regional Veterinary Laboratory Center. In the laboratory, coproscopic examination was performed to detect the presence of fasciola eggs using the standard sedimentation techniques (Hansen and Perry, 1994).

Abattoir Survey

Active abattoir survey was conducted on cattle previously identified and their faecal sample was collected and at the post-mortem their liver subjected to assess presence of fasciola in the organ. During postmortem inspection, each liver was visually inspected, palpated, and incised based on routine meat inspection (FAO, 2003). All organs having fasciola species condemned were registered and flukes were conducted for species identification.

Fasciola species Identification

After making systemic 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. Based morphological characteristics as *Fasciola gigantica* (20-75mmx3.12mm) resembles *Fascilola hepatica* (20-30mmx10mm) but readily recognized by its larger sizes, the shoulders are not prominent and the body is more transparent. It is grayish-brown in color changed to grey when preserved (Soulsby, 1982; Troncy, 1989; Urquhart *et al*, .1994).

Economic Loss Assessment

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

Direct Economic Loss

Direct economic loss resulted from condemnation of liver affected by fasciolosis. All live 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 two years, while retail market price of an average size zebu liver determined from the information collected on butcheries in Debre Berhan town. The information obtained was subjected to mathematical computation using the formula set by (Ogunirade *et al*., 1982).

ALC=CSR x LC x P

Where ALC= annul loss from liver condemnation

CSR=mean annual slaughtered at Debre Berhan municipal abattoir

LC= mean cost one liver in Debre Berhan town.

P =prevalence rate of the disease at the study abattoir

Indirect Economic Loss

Indirect economic loss was associated with carcass weight reduction due to fasciolosis. A 10% carcass weight loss occur due to fasciolosis in cattle. Average carcass weight of an Ethiopian zebu was taken as 126kg (ILCA, 1982). The annual carcass weight loss due to bovine fasciolosis is assessed using the following formula set by Ogunirade *et al*., (1982).

ACW=CSR x CL x BC x P x 126Kg

Where ACW=annual loss from carcass weight reduction

CSR=average number of 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 Debre Brehan town.

P=prevalence rate of fasciolosis at the study abattoir.

126kg=average carcass weight of Ethiopian zebu.

Data Management and Analysis

Data were stored in Microsoft Excel spread sheet program and were analyzed using intercooled STATA version 11 for windows (2007) to determine prevalence and the association with risk factors. The statistical method used descriptive statistics. Body condition and origin was considered as potential risk factors for group prevalence of the diseases.

RESULTS

Coprological Findings

From 400 liver sample inspected by post mortem examination during the study period, 194 samples were found positive for fasciolosis with an overall prevalence of the study area was 49.5% and 94 samples were positive for fasciolosis under coproscopic examination with prevalence of 23.5%. Prevalence between male and female animals were compared and the revealed 48.42 % and48.69 % prevalence respectively showed insignificant differences ($p>0.05$) (table 2). Analysis of the prevalence between age group showed a direct correlation i.e., the infection increase as age increase. And these were also statistically insignificant difference ($p>0.05$) among cattle of different groups.

Fasciola species identification

Among the 400 slaughtered animals that liver was inspected in the abattoir 194 livers were found positive for liver fluke infection where 126 livers (64.948 %) harbored with *F. hepatica*, 50 livers (25.773 %) harbored with *F. gigantica* and mixed infection18 livers (9.278%).

Economical loss Assess

Direct economic loss: Direct economic loss resulted from liver condemnation as the result of fasciolosis. Generally all infected livers with fasciolosis are unfit for human consumption from 194 infected livers of cattle were condemned due to fasciolosis corresponding to an estimated total loss of about Eth. Birr 7,425 in this study .

In the current study abattoir, the average annual cattle slaughtered rate was estimated to be 4000 while mean retail price of bovine liver in Debre Berhan town was 7,425 ETB. The prevalence of fasciolosis in Debre Berhan municipal abattoir estimated (49.5 %). Therefore, the estimated annual loss from organ condemnation is calculated according to the formula (Ogunirade et al., 1982).

ALC=CSP x Lx P

=6000x25ETBX49.5%

=7425ETB

Indirect economic loss: Indirect economic loss was due to carcass weight reduction as a result of fasciola infection. In the study area, the average price of 1kg beef was 70 ETB. The annual economic loss from of carcass weight reduction due to bovine fasciolosis is calculated by using the formula (Ogunirade *et al*., 1982).

ACW= CSR XCLXBC XPX 126KG.

=6000x10%x34ETB49.5%x126kg

=4000x0.1x25ETBx0.495x126

=623700ETBirr.

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) which is ETH. Birr 631,125.00

DISCUSSION

Bovine fasciolosis 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 management system of the livestock (Graber, 1975; Bahiru and Ephrem, 1979). The finding of present study revealed the prevalence of fasciolosis to be 48.5% based on postmortem study alone, 23.5%by coproscopic study. The present study result indicated that bovine fasciolosis relatively spread with moderate prevalence of 49.5% in the study area lower than study conducted by Dagne (1994) and Tsegaye (1995) who reported 80% and 81% on postmortem examination of livers from the same study area. This may be due to the deworming of animals regularly and good management of the animals by the farmers currently. Contrary to the present finding, Bahiru and Ephrem(1997), Yehenew, (1984) and Fekadu(1998) have reported the prevalence of 61%,52% and 62.2% in Gonder, around Tana, 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 study period of the year/ season.

Table 1: Over all prevalence of fasciolosis in Debre Berhan.

No. of animals examined	No. of positive animals	No. of negative animals	Prevalence (%)
400	194	206	49.5

During the dry period, the majority of the eggs do not have the opportunity to hatch and develop because they are trapped with the faeces mass and there is no sufficient moisture for the development and hatching. The survival of metacercaaria on the herbage and the availability of the moisture, because of the drying of temporary habitats during the dry period, snail are force to undergo aestivation deep in the mud and only those snails in permanent water source have the opportunity to shed cercaria (Radostits *et al.,*1994). Therefore, only minimum metacercaria on herbage, which accounts for low infection rate during the dry period (Brook, 1985)

Prevalence of 48.42% and 48.69% were recorded in male and female animals respectively show difference between two sex groups which is statistically insignificant. This indicated that as there is no statically difference between the two sexes. This signifies that sex has no impact on the infection rate and both male and female are equally susceptible and exposed to the disease (Rahmato, 1992; Dagne, 1994).

This study reveals there is no significant difference in prevalence of fasciolosis between the origins of the animals those brought to the abattoir. High prevalence was encountered in highland (54.11%) and in lowland (38.62%) site this is due to the period of study which is dry period of and most of marshy areas used for grazing.

Statistical analysis of infection rate on the basis of age indicates a direct correlation. There was insignificance difference infection rate (P≥0.05) among different age groups.

In relation to body condition of the animals, the prevalence was higher in those animals with poor body condition than in those with medium and good body conditions 63.83, 50.25 and 41.77% respectively and there was significant difference infection rate (P<0.05) among different groups. This is due to the fact that animals with poor body condition are usually less resistant and are consequently susceptible to infectious diseases Hagos (2007).

Species identification revealed that *F. hepatica* was more prevalent (64.95%) as compared to F. *gigantic* (25.77%); certain proportion of animals (9.27%) harbored mixed infestation. The predominant species involved in causing bovine fasciolosis in the study area is *F. hepatica* and is associated to the existence of favorable ecological condition for *L. truncatula* (intermediate

Table 2: Prevalence of bovine fasciolosis on sex basis.

sex	No. of sample examined	No. of sample positive	Prevalence (95%CI)	X^2	(p_value)
M	285	138	48.42 (42.51, 54.38)	4.881	(0.181)
F	115	56	48.69 (39.33, 58.14)		

Table 3: Prevalence of bovine fasciolosis on age basis.

Age (year)	No. of sample examined	No. of positives	Prevalence (95%CI)	X^2	P-value
≤5	70	29	41.43 (29.98, 53.82)	5.33	0.50
5-10	245	119	48.57 (42.18, 55.00)		
≥10	85	46	54.12 (43.01, 64.86)		

Table 4: Species of fasciola identified during postmortem examination of slaughtered animals.

Species of fasciola	No. of lives condemned	Prevalence
F. hepatica	126	64.948
F .gigantica	50	25.773
Mixed	18	9.273
Total	194	100

Table 5: Prevalence of fasciolosis in different body condition groups.

Body condition	No. of animals examined	No. of positive cases	Prevalence	95%CI	X^2	(P_value)
Thin	47	30	63.83	48.48, 76.96	31.00	0.00
Moderate	195	98	50.25	43.04, 57.45		
Good	158	66	41.77	34.06, 49.88		

Table 6: Prevalence of bovine fasciolosis on breed.

Breed	No. of sample examined	No. of positives	Prevalence	95%CI	X^2	(p. value)
Cross	51	22	43.14	29.63, 57.68	2.48	0.479
local	349	162	46.42	41.11, 51.811		

Table 7: Prevalence of fasciolosis on origin.

Origin	No. of sample examined	No. of positives	Prevalence	(95%CI)	X2	p. value
Highland	255	138	54.11	47.78, 60.31	128.49	0.00
Lowland	145	56	38.62	30.76, 47.09		

host) of F. hepatica in the study area such as swampy and marshy area around Debre Berhan and different parts of the region, and low lying plain and shallow pond provide favorable habitat for *L. truncatula* and allow the existence of *F. hepatica* in the area. The lower prevalence of *F.gigatica* was due to the unfavorable condition to the existence and multiplication of the snail *L. natalensis* in the study area, the favorable condition for *L. natalensis* was border of lakes, flood prone area and low lying marshy and drainage ditches are favorable habitat (Troncy, 1989).

Ogunirade *et al*., (1982) emphasized on the statement of 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 ETH. Birr 7425.00 per annum and indirect economic loss due to carcass weight reduction was estimated about ETH. Birr 623,700 per annum. Therefore, the total annual economic loss due to fasciolosis in the study abattoir is the summation losses from organ condemnation and carcass weight reduction which is equal to ETH. Birr 631,125.00

CONCLUSION AND RECOMMENDATIONS

Fasciolosis is one of the most wide spread disease that has resulted enormous direct and indirect loss in livestock production in Ethiopia. It may affect all domestic animals and man but its economic importance is considerable only in sheep

and cattle. Fasciolosis accounts for serious economic losses in Africa; Asia and other parts of the world due to condemnation of liver as unfit or unsuitable for human consumption, losses through death, reduction in productivity (meat, milk, wool), decreased production (infertility), retarded growth rate, lowered resistance to other disease. The present study conducted on bovine fasciolosis for a period of four months in Debre Berhan, North Shoa Zone indicate that fasciolosis has been and still one of the major constraints to the livestock development in Ethiopia by inflicting remarkable direct and indirect losses in various parts of the country, where suitable biotopes for the development and breeding of snail intermediate host prevail.

Therefore based on the above remarks the following points are recommended;

- Detailed epidemiological studies on the prevalence of fasciolosis should be conducted by taking into consideration of agro ecological situation of this study.
- Strategic anti-helminthic treatments with appropriate flukicidal drugs should be practiced two times a year; i.e., after the end of dry season (March – April) and after the end of rainy season (October –November). Regularly cleaning of aquatic vegetation and fencing of all local snail habitats should be done accordingly
- Giving awareness to the owners and all public about the situation and transmission of the fasciolosis.

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