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Original article

Prevalence of bovine fasciolosis and economic loss due to liver condemnation at Debre Markos Municipal Abattoir, Northern Ethiopia

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ABSTRACT

The study was carried out from November 2012 to May 2013 to determine the prevalence of fasciolosis and the economic loss incurred due to liver condemnation in cattle slaughtered at Debre Markos municipal abattoir. From 384 faecal and liver samples tasted, a prevalence of 43.23% and 90.88% was found respectively. There was also an association ($p < 0.05$) among age and BCS groups of bovine fasciolosis prevalence. According to the intensity of pathological lesions in affected livers, 60 (61.89%) constituted severely affected; the rest, 100 (28.65%) and 33 (9.46%) were moderately and lightly affected respectively. The number of flukes recovered in moderately affected livers was higher (Mean = 90.84) than in either severely (Mean = 33.17) or lightly (Mean = 47.33) affected livers. Species identification revealed that Fasciola hepatica was more prevalent (36.10%) than Fasciola gigantica (1.72%), mixed (1.43%) and unidentified (immature) fluke (3.72%). The average economic loss because of liver condemnation was 13,268,480 Ethiopian Birr (698,341.05 USD) per annum, indicating that the disease has high economic importance. It is therefore concluded that fasciolosis causes significant losses to farmers, butchers and consumers. Finally, the abattoir based prevalence recorded in the

study area and the loss incurred suggest that a detailed epidemiological study as well as assessment of the overall economic loss due to fasciolosis is required to implement systematic disease-prevention and control methods.

1. Introduction

In sub-Saharan African countries, livestock plays a crucial role both for the national economy and the livelihood of rural communities. Animal production has been considered as the main component of agricultural development in most parts of sub-Saharan Africa (ILCA, 1992).

Ethiopia has the largest livestock inventories in Africa, including more than 38,749,320 cattle with livestock ownership currently contributing to the livelihoods of an estimated 80% of the rural population (CSA, 2009). The CSA of Ethiopia estimated in 2005 show that farmers in Amhara had a total of 9,694,800 head of cattle (representing 25% of Ethiopia's total cattle). The dominant economic feature of the country is the agriculture sector, of which livestock is a very important and essential component (CACC, 2003). Even though, the livestock sub-sector contributes much to the national economy; its production in Ethiopia is functioning under several constraining factors: diseases, feed shortage, institutional and policy related constraints (Zelalem Tamirat, 2007).

Animal diseases are widely distributed and one of the major causes of livestock mortality (EARO, 2000). Parasitism represents a major obstacle to the development of sub-sectors of livestock (Malone et al., 1998); of which, fasciolosis is one of the major disease of cattle, which are the natural hosts for Fasciola (Urquhart et al., 1996).

Fasciolosis is a disease of sheep, cattle, goat and occasionally human beings (Andrews, 1999) and thus considered as zoonotic infection (WHO, 1995). Members of the genus Fasciola, commonly known as liver flukes. The two species of the greater veterinary importance for the disease fasciolosis are Fasciola hepatica and Fasciola gigantica (Hansen and Perry, 1994). Fasciolosis, caused by Fasciola hepatica and F. gigantica, is one of the most prevalent helminth infections of ruminants in different parts of the world (Soulsby, 1982).

The presence of fasciolosis in Ethiopia has long been known and its prevalence and economic significance has been reported by several workers in bovine (Daniel Ferrede, 1995; Yilma Jobre and Malone, 1998; Yilma Jobre and Mesfin Ali, 2000; Tadelle Tolesa and Worku Tigre, 2007; Fufa Abunna et al., 2009; Gebretsadik Berhe et al., 2009; Mihreteab Bekele et al., 2010; Nuraddis Ibrahim et al., 2010; and Rahmeto Abebe et al., 2010).

As previously reported (Tadelle Tollesa and Worku Tigre, 2007; Nuraddis Ibrahim et al., 2010), fascioliasis is one of the major disease that causes great economic losses in livestock productivity, particularly in cattle in Ethiopia. A review of available literature suggest that fasciolosis exists in almost all parts of Ethiopia. The significant economic losses incurred each year in different abattoirs in Ethiopia are due to condemnation of liver at slaughter (Gebretsadik Berhe et al., 2010; Mihreteab Bekele et al., 2010).

Prevalence of bovine fasciolosis so far examined in different parts of Ethiopia shows 33.42% in North Gondar Adminstrative Zone (Yilma Jobre and Mesfin Ali, 2000), 46.58% in Jimma municipal abattoir (Tadele Tollesa and Worku Tigre, 2007), 24% in Mekelle (Gebretsadik Berhe et al., 2009), 14% at Soddo (Fufa Abunna et al., 2009), 12.4% in Kombolcha industrial municipal abattoir (Nuraddis Ibrahim et al., 2010) and 28.63% at Hawassa municipal abattoir (Rahmeto Abebe et al., 2010).

No studies have been conducted on bovine fasciolosis in cattle slaughtered at Debre Markos municipal abattoir and economic loss due to liver condemnation. Therefore, the objectives of this study were to determine the prevalence of bovine fasciolosis and economic loss due to liver condemnation at Debre Markos municipal abattoir.

2. Materials and methods

2.1. Description of the study area

The study was conducted from November, 2012 to May, 2013 at Debre Markos Municipal Abattoir. Debre Markos is the capital of East Gojjam Adminstration Zone in the Amhara National Regional State (ANRS). It is located in the north west of the capital city of Ethiopia, Addis Ababa at a distance of 300Km and 265Km to the capital of Amhara National Regional State, Bahir Dar. Debre Markos is located at 10021' longitude to the North and 37043' latitude to the East. The core city has an estimated area of 6,160 hectares. According to Meteorological Agency, Debre Markos has a mean annual rainfall of about 1380mm and mean annual temperature of 18.50C. (Ayen Mulu, 2004).

2.2. Study animals

The study was conducted on cattle slaughtered at Debre Markos Municipal abattoir from November, 2012 to May, 2013. Most were trade animals, brought to the abattoir from different localities. It was also difficult to precisely trace back the geographical origins of cattle slaughtered due to lack of reliable animal identification method to relate the findings to a particular locality.

2.3. Sample size

To determine the prevalence and direct economic loss of fasciolosis, 384 cattle that came to the abattoir were used during the study period.

2.4. Study methodology

Abattoir survey was used to determine positivity of the animals for fasciolosis, but coproscopy was used to show the diagnostic efficiency of the disease with necropsy.

2.5. Study design

Cross sectional study were used in this study. All cattle were male and the age category (adult and old) was based on eruption of one or more incisor teeth and the method described by Nicholson and Butterworth (1986). Body *condition scoring* was used after some modification. Study animals were examined by ante mortem and post mortem examination.

2.6. Abattoir survey

2.6.1. Ante mortem inspection

Pre-slaughter examinations of cattle were conducted in the lairage. A total of 384 cattle were selected randomly that pass for slaughter at Ante mortem inspection for faecal and post mortem examination.

2.6.2. Faecal examination

Faecal samples for egg examination were collected directly from the rectum of each animal, using disposable plastic gloves and placed in clean universal bottle and each sample was clearly labelled with animal identification, age and body condition score. Faecal samples were preserved with 10% formalin solution to avoid the eggs moulting and hatching. In the laboratory, sedimentation technique was used. To differentiate between eggs of Paramphistomum and Fasciola species, a drop of methylene blue solution was used and the eggs of Fasciola stains yellowish while eggs of Paramphistomum species stain blue (Hansen and Perry, 1994).

2.6.3. Post mortem examination

Livers of cattle that examined by coproscopy were also examined by post mortem examination to determine the presence of fasciola from liver parenchyma and major bile ducts and gall bladder to recover the young flukes and adult parasites, respectively.

Post mortem examination of liver and associated bile duct was carefully performed by visualization and palpation of the entire organ followed by transverse incision of the organ across the thin left lobe in order to confirm the presence of the parasites (Urquhart et al., 1996).

2.6.4. Liver fluke burden and degree of pathological lesions

Fluke burden was determined by counting the recovered Fasciola parasite following the approach of Hammond and Sewell (1974) cited in Rahmeto Abebe et al. (2010), as follows: the gall bladder was removed and

washed to screen out mature flukes. The liver was cut into slices of about 1cm thick and put and then the heads of the flukes were counted.

Pathological lesion categorization of the affected livers was undertaken on the basis of the intensity of lesions. Affected livers were grouped into three categories as per the criteria described by Ogunrinade and Adegoke (1982) and (FAO, 1994). Lightly affected if a quarter of the organ is affected, and only one bile duct is prominently enlarged on the visceral surface of the liver, Moderately affected if half of the organ is affected and two or more bile ducts are hyperplastic and severely affected almost the entire organ is involved, the liver is cirrhotic and triangular in outline as the right lobe is often atrophied.

2.6.7. Fasciola species identification

Identification of the species was carried out using the size parameters described by Soulsby (1982). For Fasciola species identification; one or more samples of the worms were collected from condemned livers which had active infection. Species identification was conducted on recovered Fasciola based on morphological features of the agents and classified into Fasciola hepatica, Fasciola gigantic, mixed and unidentified (immature) forms of liver fluke (Urquhart et al., 1996).Assessment of direct economic loss due to liver condemnation

A number of parameters were used to estimate the losses attributable to liver condemnations in slaughtered cattle. Such parameters included the annual slaughter rate at the abattoir, condemnation rates of cattle liver due to fasciolosis, the average weight (expressed as Kg) of liver in adult cattle; and average cost of each cattle liver (expressed as ETH Birr/Kg of liver). The average selling price of livers was established through a survey which was conducted in various meat shops during March, 2013. Through interview made with local butcher men in Debre Markos town, the average prices per kilogram were calculated to be 10 Ethiopian Birr.

A total of 10 livers for each adult cattle were weighed immediately after slaughter using weighing balance to get average weight. The average weights of bovine livers were found 4 kg. Daily condemnation records for cattle liver at Debre Markos Municipal Abattoir were used to establish the prevalence of liver diseases and lesions involved. Records of total number of animals slaughtered and the liver lesions observed and condemned were collected.

All affected livers were rejected, since partial approval was not practiced in the abattoirs and the analyses were based on the annual slaughter capacity of the abattoir, average prices in local market and rejection rate of the liver. Average numbers of animals slaughtered annually were found 3,650. The economic losses due to condemnation were estimated by the formula set by Ogunrinade and Ogunrinade (1980) cited in Mihreteab Bekele et al. (2010) as follows:

EL = ΣCS x Coy x Roz; where:

EL = Annual financial loss estimated due to liver condemnation

ΣCS = Average number of animals slaughtered at the abattoir annually

Coy = Average cost of each bovine liver in the town

Roz = Condemnation rates of cattle liver due to fasciolosis. Liver condemnation information was summarized from the prevalence of fasciolosis obtained from the present study.

2.7. Data analysis

All raw data generated from this study were coded and entered in MS Excel 2010 database system. Using SPSS version 19.0 computer program, data were analysed. Categorical data were analysed with the Pearson's Chi-square ($\chi 2$) test for independence whereas; one-way ANOVA was used to examine the differences between degrees of liver lesion with its fluke burden. Identification of the dominant Fasciola species was calculated using percentage. Statistical significance was set at $P < 0.05$ to determine whether there are significant association between the parameters measured.

3. Results

3.1. Faecal examination

Out of 384 cattle faecal samples examined, 166 (43.23%) were found positive for fasciola eggs.

3.2. Post mortem examination

From 384 cattle livers examined, 349 (90.88%) were found positive for different fasciola species.

3.3. Prevalence of bovine fasciolosis based on body condition

Prevalence of fasciolosis with poor body condition was 21 (100%). However, animals with medium and good body conditions showed the prevalence of 303 (96.19%) and 25 (52.08%), respectively. There was an association ($\chi 2 = 62.951$; $p = 0.000$) between BSC and the prevalence of the Fasciolosis (Table 1).

Table 1
Prevalence of bovine fasciolosis based on body condition score.

BSC	Examined	Prevalence (%)	χ 2-value	p-value
Poor	21	100		
Medium	315	96.19	62.951	0.000
Good	48	52.08		
Total	384	90.88		

3.4. Prevalence of bovine fasciolosis based on age

Prevalence of fasciolosis in adults was 181 (84.58%). However, the prevalence of the disease in old cattle was 168 (98.82%). There was an association ($\chi 2 = 23.204$; $p = 0.000$) in the prevalence of fasciolosis between age groups (Table 2)

Table 2
Prevalence of bovine fasciolosis by age.

Age	Examined	Prevalence (%)	χ 2-value	p-value
Adult	214	84.58	23.204	0.000
Old	170	98.82		
Total	384	90.88		

3.5. Fasciola Species Identification

The predominant fluke species found from the total of 349 infected livers was F. hepatica which is 285 (81.66%); while infections with F. Gigantic, mixed and unidentified species (immature fluke) were 10 (2.86%), 11(3.15%) and 43 (12.33%), respectively (Figure1).

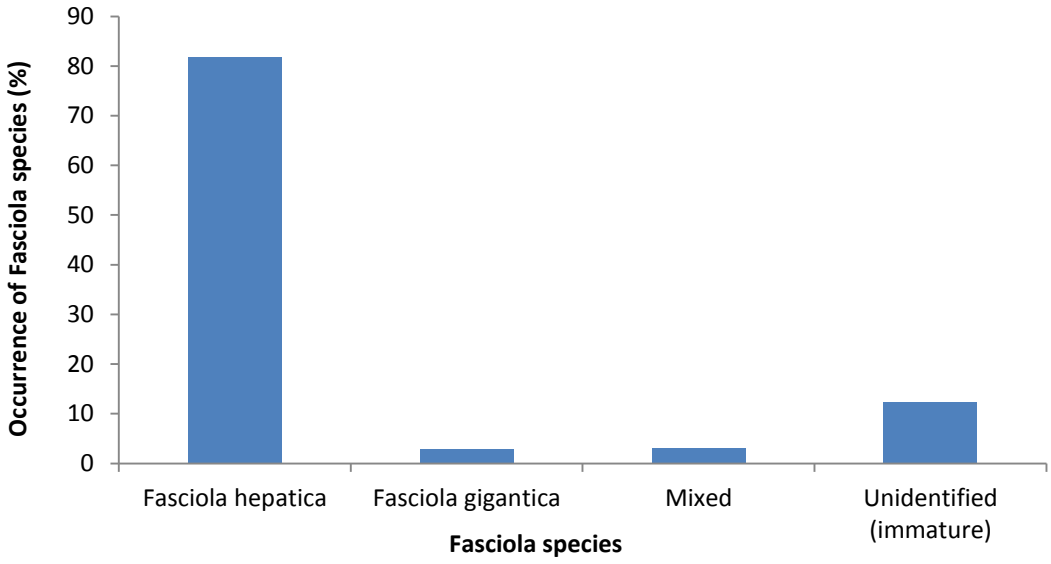

Fig. 1. Identified Fasciola species and their relative abundance in bovine infected livers.

3.6. Severity of liver lesions

From the total of 384 cattle slaughtered, 349 (90.89%) were found positive for fasciolosis. Of these, 33 (9.46%), 100 (28.65%) and 216 (61.89%) were affected lightly, moderately and severely, respectively (Figure 2).

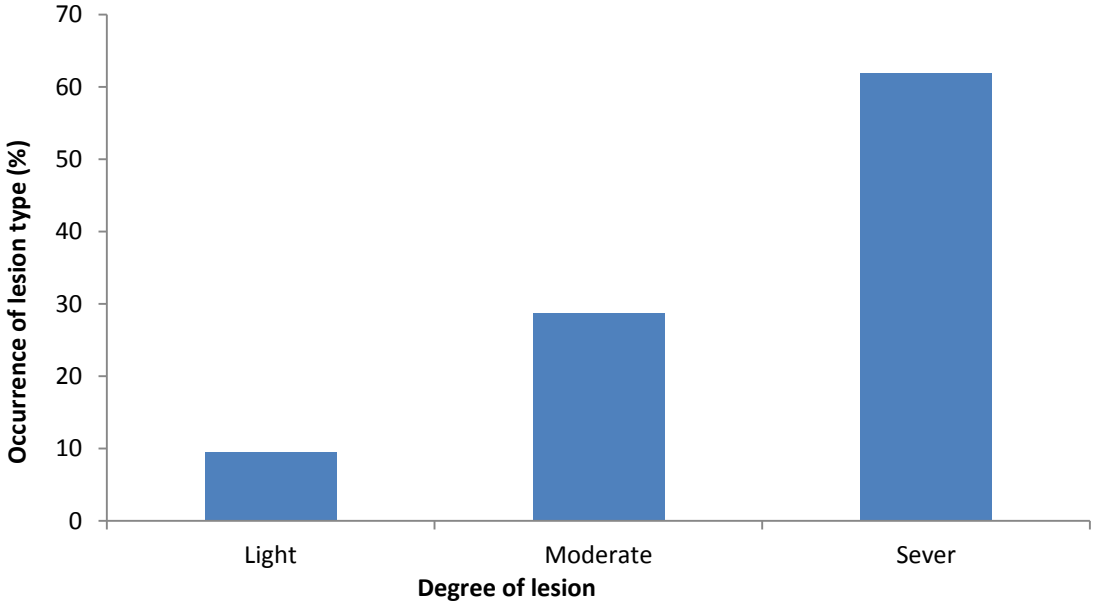

Fig. 2. The severity of liver lesion in bovine.

3.7. Liver fluke burden and degree of pathological lesions

A total of 17,694 flukes were recovered from the 349 infected livers examined. The overall mean count being 50.70. The mean fluke counts in severely, moderately and lightly infected livers were 33.17, 90.24 and 47.33, respectively. There was significant variation (p = 0.000) between lesion types with their respective mean worm count. Moderately affected livers showed the highest mean count (90.24) while severely affected ones revealed the least value (33.17) (Figure 3).

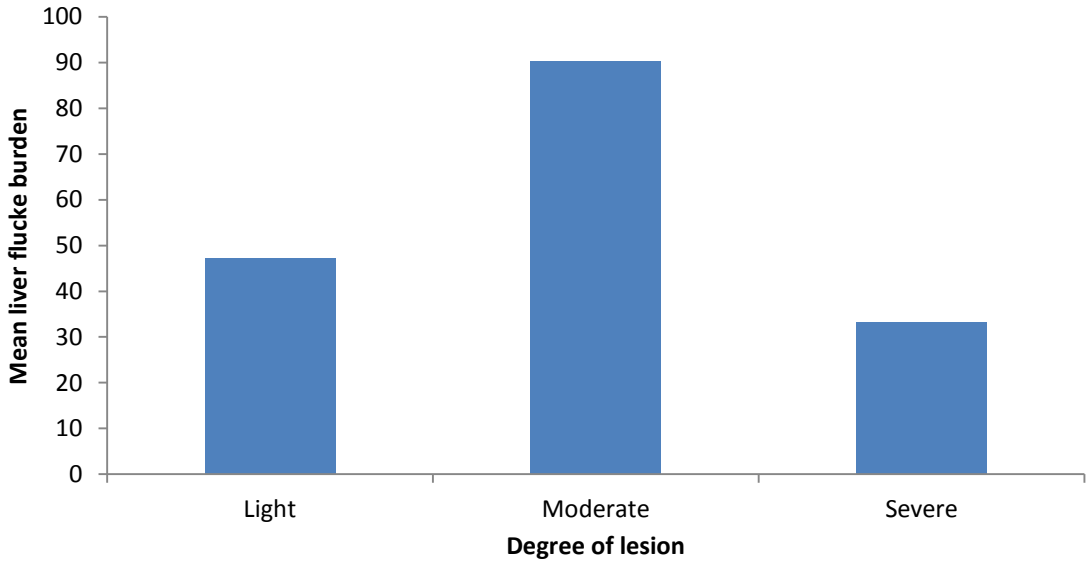

Fig. 3. Relationship between mean fluke count and the corresponding liver lesions.

Assessment of Direct Economic Loss due to Bovine Liver Condemnation

Based on the formula mentioned above, the cost associated with condemnations of Fasciola-infected livers were estimated to be 13,268,480 ETH Birr (698,341.05 USD, calculated based on 1 USD = 19 ETH Birr assuming constant exchange rate throughout 2005 E.C) annually.

4. Discussion

4.1. Post-mortem examination

The present study showed that the prevalence of fasciolosis to be 90.88% (349) in cattle slaughtered in Debre Markos Municipal Abattoir. In the present study, higher prevalence of fasciolosis (90.88%) was obtained when compared with the prevalence of 14.4%, 24.32%, 28.63%, 32.3% and 45.3% in Dire Dawa Municipality Abattoir (Daniel Ferrede, 1995), Mekelle Municipal Abattoir (Gebretsadik Berhe et al., 2009), Hawassa Municipal Abattoir (Rahmeto Abebe et al., 2010), Adwa Municipal Abattoir (Mihreteab Bekele et al., 2010) and Bahir Dar Municipal Abattoir (Ayalew Sisay and Endalkachew Nibret, 2013), respectively. These Fasciola prevalence variations within the country might be attributed mainly due to the ecological and climatic differences between these localities. Moreover, the management systems in practice could also be the probable reason for the variation. From other African countries, the lowest prevalence rates of 53.9%, 52.6% and 64.2% were reported from Zambian abattoirs (Phiril et al., 2005), the municipal abattoir in Arusha region,Tanzania (Nonga et al., 2009) and Lake Victoria basin, Kenya (Kanyari et al., 2010), respectively.

In relation to body condition of the animals (bovine), the prevalence was higher (100%) in animals with poor body condition than those in medium (96.19%) and good body condition (52.08%). There was a statistically significant association between body condition of animals and the prevalence of Fasciola infection. In support of this finding, a study conducted in Adwa (Mihreteab Bekele et al., 2010) indicated that the association between the prevalence of fasciolosis and body condition of the animals was also statistically significant. Obviously, this could be due to the fact that animals with poor body condition are usually less resistant and are consequently susceptible to infectious diseases.

The present bovine fasciolosis study also indicates that higher infection rates were found in older cattle 98.82% than adult 84.58%%. This study revealed that prevalence of fasciolosis was higher in animals with increase of age. Similar finding was reported at Kombolcha Elfora Abattoir (Nurit Mohammed et al., 2012). The younger the age of the animal, the lower the prevalence; and the older the age, the higher the prevalence of fasciolosis. Moreover, it could be suggested that the higher exposure risk of old compared to the adult might be due to physiological differences, such as stress, and infectious diseases (Ahmed et al., 2007). As the age of the animal increases, the possibility of being exposed to Fasciola increases and hence high prevalence of fasciolosis was observed.

4.2. Fasciola species identification

Species identification revealed that F. hepatica was more prevalent (81.66%) than F. gigantica (2.86%), mixed (3.15%) and unidentified or immature fluke (12.33%) in infected livers. This might be explained by the fact that most cattle for slaughter came from high land and middle altitude zones. Similar study conducted on bovine fasciolosis at Jimma, Kombolcha, Adwa, Hawassa and Mekelle Municipal Abattoirs reported 64.5%, 60.3%, 63.6%, 13.9%, 58.9% and 56.42%; of livers harboured F. hepatica while 24.8%, 23.85%, 24.3%, 7.7%, 10.6% and 9.17% of livers harboured F. gigantica and 12.04%, 7.14%, 4.7%, 28.53% and 15.8% of livers harboured immature or unidentified form of Fasciola species (Tadelle Tollesa and Worku Tigre, 2007; Nuraddis Ibrahim et al., 2010; Mihreteab Bekele et al., 2010; Gebretsadik Berhe et al., 2010; and Rahmeto Abebe et al., 2009). This result is not in agreement with the finding of Fufa Abunna et al. (2009) with the highest prevalence of F. gigantica in Soddo Municipal Abattoir. This high prevalence of F. hepatica might be due to favourable habitat to Lymnaea truncatula and allow the existence of F. hepatica in the study area (Troncy, 1989). Studies in other countries of Africa showed that F. gigantica was the predominant species encountered (Kithuka et al., 2002; Phiril et al., 2005; Phiri et al., 2006; Yabe et al., 2008). The prevalence of fasciolosis and the occurrence of a parasite type of Fasciola were known to vary with locality. In Ethiopia, F. hepatica and F. gigantica infections occur in areas above 1800 m.a.s.l. and below 1200m.a.s.l, respectively, which has been attributed to variations in the climatic and ecological conditions such as altitude, rainfall, temperature and livestock management system (Yilma Jobre and Malone, 1998). Relatively small proportions of cattle were found infected with F. gigantica. This might be explained by

cattle coming to abattoir from lowlands, and flood-prone areas and therefore drainage ditches are favourable habitat to L. natalensis (Urquhart et al., 1996).

4.3. Liver fluke burdens and degree of pathological lesions

Analysis of mean worm burden with bovine liver pathology showed significant variation; however, no direct relationship between the number of flukes recovered and pathological lesions of livers was observed. The average fluke count in moderately affected livers exceeded than obtained from severely affected ones. Soulsby (1982) stated that the presence of more than 50 flukes per liver indicates high pathogenicity. In the present study, the findings of an average 50.70 flukes per affected livers imply the presence of high pathogenicity of flukes in the studied animals. This finding agrees with that of Yilma Jobre and Mesfin Ali (2000), Mihreteab Bekele et al. (2010), and Rahmeto Abebe et al. (2010) who reported a relatively less flukes in severely affected livers of cattle. According to these authors, severe fibrosis impedes the passage of immature flukes and acquired resistance, and calcification of bile ducts play a role by creating unfavourable micro-environment which results in the expulsion of flukes.

4.4. Assessment of direct economic loss due to liver condemnation

The total financial loss encountered due to infected livers condemnation was found to be 13,268,480 ETH Birr (698,341.05 USD) annually in Deber Markos Municipal Abattoir. The present financial loss in bovine-infected livers in the study area was higher than the reports of Taddele Tollesa and Worku Tigre (2007), Fufa Abunna et al. (2009), Gebretsadik Berhe et al. (2009), Mihreteab Bekele et al. (2010), Nuraddis Ibrahim et al. (2010) and Rahmeto Abebe et al. (2010) that reported financial losses of 6,300 USD from Jimma Municipal Abbatoir, 4,000 USD at Soddo Municipal Abbatoir, 95,355.20 ETH Birr at Mekelle Municipal Abbatoir, 4,672 USD at Adwa Municipal Abbatoir, 1,833 USD at Kombolcha industrial and Municipal Abbatoir and 106,400 ETH Birr at Hawassa Municipal Abbatoir and 198,457.80 ETH Birr at Bahir Dar Municipal Abattoir, respectively. This is probably due to differences in prevalence and liver cost in different localities.

5. Conclusion

In present study, high prevalence of fasciolosis was obtained when compared with prevalence reported by different researchers at different areas. Animals with poor body condition were found highly infected by fasciolosis than animals with good body condition. Regarding age, the prevalence of fasciolosis in old cattle was found higher than adults. The most prevalent Fasciola species obtained in condemned livers was Fasciola hepatica in Debre Markos Municipal Abattoir. The level of infection observed in this study suggests the existence of favorable climatic conditions throughout the year for the development and survival of the parasite in the area of origin of the study animals. The financial loss related with the condemnation of Fasciola infected livers at the abattoir also indicated the economic importance of fasciolosis in the study area. It is therefore concluded that fasciolosis causes significant economic losses to farmers, butchers and consumers. Therefore, Emphasis should be given for the control of Fasciolosis by deworming of cattle at both wet and dry season, in order to foster planning and implementation of sustainable control strategy, further detailed studies need to be conducted to generate a complete data set on the epidemiology of fasciolosis and studies about fasciolosis should include the identification of the dominant intermediate snail hosts of liver fluke species in the study area for the strategic application of fluckicide.

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