Prevalence and Financial Losses Associated With Bovine Fasciolosis at Assela Municipal Abattoir, Ethiopia

Tizazu W. and Ahmed H.

College of Veterinary Medicine, Jigjiga University, Jigjiga

Abstract- A cross-sectional study was conducted from November, 2014 to March, 2015 at Assela municipal abattoir to assess prevalence and economic significance of bovine fasciolosis. Out of 349 cattle examined at post mortem, 30.1% (105) were positive for fasciolosis. Age, Sex and body condition of the animal was not found as a significant factor ($p > 0.05$) affecting the prevalence of disease. The prevalence of *F. hepatica* was 69.5% (73), which was predominant among *Fasciola* species, causing bovine fasciolosis in the study areas. Whereas, the prevalence of *F. gigantica* was 15.24(16), and 15.24% (16) animals harboured mixed infection. There was a statistically significant association ($P=0.000$) between the different mode of affection of liver and fasciolosis prevalence. According to mode of affection, 16(15.24%) constituted severely affected livers; the rest, 43(41%) and 46(43.8%) were moderately and mildly affected, respectively. The present study showed that there was statistically significant difference ($P=0.000$) in prevalence of *Fasciola* species. 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 2,340,576 ETB (114678 USD). It is concluded that fasciolosis is still prevalent in cattle in the study area. Hence, strategic parasite control method with an integrated approach should be implemented to improve the health and productivity of cattle in the area.

Index Terms- Fasciolosis, Prevalence, Economic Significance, Bovine, Assela, Ethiopia.

I. INTRODUCTION

Ethiopia is an agricultural country with over 85% of its population engaged in agricultural activity. It has diverse agro-ecological zones which contributes to the evolution of different agricultural production systems. Animal production forms an integral part of agricultural system in almost all ecological zones of the country (Tegegne and Crawford, 2003).

The animal production systems are extensive, semi-intensive and intensive in Ethiopia and the population of Cattle was estimated about 53 million heads (Central Statistical Agency, 2012). They serve as source of food, hides and important draught power for crop production. However, the productivity of these animals is severely reduced by malnutrition, low management system, low genetic potential and health problems. Among the livestock health problem, parasitism is major obstacle to the development of sub-sector (Malone *et al*., 1998).

Bovine fasciolosis is one of the most important parasitic diseases of cattle causing mortality and production losses in various parts of Ethiopia. It is the priority disease in the highland as well as in lowland areas of Ethiopia (Solomon and Abebe, 2007). It is caused by two liver fluke species, which are: *Fasciola hepatica* and *Fasciola gigantica*. *F.hepatica* has cosmopolitan distribution, mainly in temperate zones, while *F.gigantica* is found in tropical regions of Africa and Asia. Thus, the two *Fasciolid* species overlap in many Africa and Asian countries (Abebe *et al*., 2010).

The disease is found generally in vast water lodged and marshy grazing field condition anticipated to be ideal for the propagation and maintenance of high prevalence of fasciolosis. In Ethiopia, the highlands contain pockets of water logged marshy areas. These provide suitable habitats year round for the snail intermediate hosts which are required to complete transmission to a new ruminant host (Solomon and Abebe, 2007).

In Ethiopia, the prevalence of bovine fasciolosis has shown to range from 11.5% to 87% (Malone *et al*., 1998). *F. hepatica* was shown to be the most important fluke species in Ethiopian livestock with distribution over three quarter of the nation except in the arid northeast and east of the country. The distribution of *F. gigantica* was mainly localized in the western humid zone of the country that encompasses approximately one fourth of the nations (Tadele and Worku, 2007; Malone *et al*., 1998).

Fasciolosis causes a substantial economic loss which includes; death, loss in carcass weight, reduction in milk yield, condemnation of affected liver, decline in productive performances, cost of treatment expense and predisposes animals to other disease. Both *F. hepatica* (high land) and *F. gigantica* (low land) type of liver flukes cause severe losses in Ethiopia where suitable ecological conditions for the growth and multiplication of intermediate host snails are available (Anne *et al*., 2006; Walker *et al*., 2008). Infected cattle can exhibit poor weight gain and dairy cattle have lower milk yield, and possibly metabolic diseases (Mason, 2004). Apart from its great veterinary important throughout the world, *F. hepatica* has recently been shown to be a re-emerging and wide spread zoonosis affecting numerous human populations in the world (Phiri *et al*., 2005).

There is no vaccine against the disease, and hence chemotherapy is the only viable control method available today. Triclabendazole being the drug most commonly used due to its effectiveness against both mature and immature forms of the parasite (Brennan *et al*., 2007).

Many researchers have reported the prevalence of fasciolosis in cattle as 90.7% (Yilma and Mesfin, 2000), 37.2% (Solomon and Abebe, 2007) and 46.58% (Tadele and Worku,

2007) in different parts of Ethiopia. Assela is one of the areas where the environmental conditions and altitude is conducive for the occurrence of fasciolosis. However, little information is available about its prevalence and economic significance in the study area. Therefore, the objectives of this study were:

- To determine the prevalence of bovine fasciolosis in cattle slaughtered at Assela municipal abattoir
- To assess the various risk factors associated with fasciolosis and to identify its species
- To determine economic loss due to liver condemnation and carcass weight loss in cattle slaughtered at Assela municipal abattoir.

II. MATERIALS AND METHODS

2.1. Description of Study Area

The study was carried out in Assela municipal abattoir. Assela town is situated at 60591-8049 N latitude and 380411-400441 E longitude in central Ethiopia, 175 km south east 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 1,200 mm and the area has a bimodal rainfall occurring from March to April (short rainy season) and July to October (long rainy season). 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. The livestock population of the area is 85,893 cattle, 57,118 sheep, 10,725 goats, 7841 horses, 15,642 donkeys, 517 mules and 35,489 poultry. The farmers in the area practice mixed crop-livestock farming system (APEDO, 2007).

2.2. Study Animals

The study animals were cattle that were slaughtered at Assela municipal abattoir. The cattle slaughtered in the abattoir were collected from different parts of the country which is characterized by different climato-ecological conditions mainly due to altitudinal differences. It is often difficult to trace the origin of the animals as they usually pass a chain of markets. Some animals come directly to the abattoir from grazing while others pass through feedlots where they are routinely de-wormed.

2.3. Sample size determination

The desired sample size was calculated using the standard formula described by Thrusfield, (Thrusfied, 2005). The expected prevalence was 35% according to Shiferaw *et al*., 2011. Therefore, the sample size in this study was:

$$n = \frac{(1.96)^2 \times p(1-p)}{d^2}$$ (Thrusfield, 2005)

Where;

n = Sample size

p = Expected prevalence (35%)

1.96 = the value of Z at 95% confidence level

d = Desired absolute precision = 5%. Therefore, the sample size was 349 cattle.

2.4. Sample collection and examination procedure:

Complete ante-mortem examination of the animals was carried out shortly prior to slaughter. Inspection of the animals was made while at rest or in motion for any obvious sign of disease. The body condition for each cattle was estimated according to Mari, (1989) and the age of animal was scored according to Del-Lahunta and Habel, (1986) as; adult (2 to 5 years) and old (above 5 years). A total of 349 slaughtered cattle liver were incised and grossly checked for the presence and identification of *Fasciola* parasite. The liver of each study animal was carefully examined for presence of lesions suggestive of *Fasciola* infection externally and sliced for confirmation. Each mature fluke was identified to species level according to its shape and size (Urquhart, *et al*., 1996). Besides, identification of the fluke species, assessment of the severity of liver lesions was carried out. Pathological lesions were judged to be condemned based on Herenda *et al*. (2000) guidelines on meat inspection for developing countries.

2.5. Study Design

A cross-sectional abattoir based survey was conducted from November 2014 to April 2015 on randomly selected cattle to investigate the prevalence of fasciolosis in bovine slaughtered at Assela town municipal abattoir and post- mortem inspection of liver was carried out. Economic loss was assessed using formula set by Ogunrinade and Adegoke (1982). Generally, all infected livers with fasciolosis were considered to be unfit for human consumption and if any liver was infected by *Fasciola* at the Assela municipal abattoir, it was totally condemned. Economic losses were calculated based on condemned livers due to fasciolosis.

2.5.1. 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:

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

2.5.2. 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 (Mari, 1989). The annual carcass weight loss due to bovine fasciolosis assessed using the following formula set by Ogunrinade and Adegoke (1982).

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

Where ACW = Annual loss from carcass weight reduction.

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

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

BC = an average price of 1kg beef at Assela town

P=Prevalence rate of fasciolosis at the study abattoir.

126 kg = Average carcass weight of Ethiopian Zebu

2.6. Data Management and Analysis

The raw data that was inserted in to Microsoft excel spread sheet to create a data base. Then this data was further analyzed by using SPSS version 20 software program. Finally, the data was summarized with tables in accordance to the different age groups, sex, *Fasciola* species, mode of affection and body condition. Chi-square test was used to determine the variation in infection prevalence between sex, age, body condition, *Fasciola* species and mode of affection. Statistical significance was set at $P < 0.05$ to determine the presence of significant differences between occurrence of fasciolosis and risk factors. The total prevalence was calculated by dividing the number of *Fasciola* positive animals by the total number of animals tested or sampled.

$$\text{Prevalence (\%)} = \frac{\text{Total number of animal infected}}{\text{Total number of animal examined}}$$

III. RESULT

In this study, out of the 349 cattle examined, 105(30.1%) revealed the presence of *Fasciola* species. Among these, 73(69.6%) were infested with *F. hepatica*, 16(15.2%) by *F.gigantica* and 16(15.2%) had mixed infection. Among examined cattle 347 were male, from these, 104 (29.8%) were positive for fasciolosis and 2 of them were females from which only 1(0.3%) showed prevalence of fasciolosis.

3.1. Prevalence of Bovine Fasciolosis based on Age.

Of the total 349 examined animals, 297 were adult and 52 were old. *Fasciola* was detected in all age groups and a higher prevalence of fasciolosis was recorded in old animals (36.54%) than adult (28.95). However, statistically significant difference in prevalence of *Fasciola* was not observed among the different age groups ($p>0.05$).

Table 1: Prevalence of Bovine fasciolosis in different age groups

Category	Examined	Positive	Prevalence (%)	χ2	p-value
Adult	297	86	28.95	1.209	0.174
Old	52	19	36.54		
Total	**349**	**105**	**30.1**		

3.2. Prevalence of Bovine Fasciolosis based on sex.

The prevalence of *Fasciola* in male cattle was 29.8% and in female was 0.3% which is almost similar and the difference is not statistically significant ($P>0.05$).

Table 2: Prevalence of Bovine fasciolosis based on sex category

Category	Examined	Positive	Prevalence (%)	χ2	p-value
Male	347	104	29.8	0.379	0.512
Female	2	1	0.3		
Total	**349**	**105**	**30.1**		

3.3. Prevalence of Bovine Fasciolosis based on body condition score

Approximately the same prevalence was observed with cattle whose body conditions were poor (42%) and medium (38.9%). The lowest prevalence (28.75%) was recorded for cattle whose body conditions were good. The study shows that there was no significant variation.

Table 3: Prevalence of bovine fasciolosis based on body condition scores

Body condition	Examined	Positive	Prevalence (%)	χ2	p-value
Good	306	88	28.75	2.12	0.402
Medium	36	14	38.9		
Poor	7	3	42.85		
Total	**349**	**105**	**30.1**		

3.4. Distribution of *Fasciola* species found in infected liver

Table 4: Species of *Fasciola* identified during post mortem examination of slaughtered animals

Fasciola species	No of liver infected	Prevalence (%)	χ2	p-value
F.he	73	20.91		
F.gi	16	4.3	349.0	0.000
Mixed	16	4.3		
Total	**105**	**30.1**		

3.5. Distribution of *Fasciola* species according to mode of affection

The study shows that there was significant variation in the prevalence of fasciolosis and mode of affection conditions (P=0.000).

Table 5: Distribution of *Fasciola* species according to mode of affection

Fasciola species	Mode of affection(%)			Percentage (%)	χ2	p-value
	Mild	Moderate	Severe			
F.he	30(34.28)	32(30.47)	11(10.48)	20.91	377.79	0.000
F.gi	11(10.48)	5(4.67)	0(0)	4.3		
Mixed	5(4.67)	6(5.71)	5(4.67)	4.3		
Total	**46(43.8)**	**43(41)**	**16(15.24)**	**30.1**		

3.6. Economic loss assessment

3.6.1. 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. In the study abattoir the average annual cattle slaughtered rate was estimated to be 4000 while mean retail price of bovine liver in Assela town as 180 ETB. Prevalence of fasciolosis in Assela municipality abattoir estimated was (30.1%). Therefore the estimated annual loss form organ condemnation is calculated according to the formula:

ALC = CSR X LC X P
= 4000 X 180 ETB X 30.1%
= 4000 X 180 ETB X 0.301
=216,720 ETB (10618.32 USD).

3.6.2. 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 140 ETB. The annual economic loss from carcass weight due to annual economic loss reduction due to bovine fasciolosis is calculated by using the formula:

ACW = CSR X CL X BC X P X 126kg
= 4000 X 10% X 140 ETB X 30.1% X 126kg
= 4000 X 0.1 X 140 ETB X 0.301 X 126kg
=2123856 ETB (104059.6 USD)

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 2340576 ETB (114678 USD). NB: 1 USD was equivalent to 20.41 ETB

IV. DISCUSSION

In this study a prevalence of 30.1% (n=349) reported and this was in line with the report of Mihreteab *et al*., (2010) at Adwa municipal abattoir, Mulat *et al*., (2012) at Gondar ELFORA abattoir, Pfukenyi and Mukaratirwa, (2004) from Zimbabwe and Hailu, (1995) at awasa 30.43%, 29.75% 32.3% and 31.7%, respectively; and a bit higher than a work reported by Gebretsadik *et al*., (2009) at Mekelle (24.32%) and it was significantly higher than the prevalence of bovine fasciolosis reported by Fufa *et al*. (2009) at Wolaita Sodo (12.7%) , Swai and Ulicky, (2009) at Hawi, Tanzania (14.05%), Daniel, (1995) at Diredawa municipal abattoir (14.4%) and Abunna *et al*., (2009) at Wolaita Soddo abattoir (14.0%). The reason for this might be attributed to the variation in agro-ecological conditions favourable to both the parasite and the intermediate host.

The prevalence of bovine fasciolosis in the present study was lower as compared with the previous reports in different parts of Ethiopia (Tadele and Worku, 2007 at Jimma (46.58%), and Mulualem, (1998) in South Gondar (83.08%)). Similarly, Yilma and Mesfin (2000) reported a 90.7% prevalence of fasciolosis in cattle slaughtered at Gondar abattoir which higher than present study. This wide gap might be due to the variation in sampling time which result higher prevalence in certain months and awareness of cattle owners and a wide use of antihelminthics.

This study indicates a prevalence of 28.95% and 36.54% in age group of adult and old animals, respectively. Statistical analysis however showed the absence of significant variation ($P>0.05$) in the occurrence of fasciolosis among the different age groups of animals. This indicates that there is no difference in acquiring *Fasciola* infection between adult and old which

contradicts the works of Solomon and Abebe, (2007); Yilma and Mesfin, (2000).

In the current work, no significant variation (*P>0.05*) was observed in the prevalence of fasciolosis whether the animal slaughtered is in a poor, medium or good body condition. This could be because body condition deterioration in cattle is manifested when fasciolosis reaches its chronic stage as (Solomon and Abebe, 2007).

Both species of *Fasciola* were identified during the study period; however, *F. hepatica* was the most prevalent (69.5%) species compared to *F. gigantica* (15.24%) and mixed infection (15.24%). This finding is lower when compared with that of Fikirtemariam *et al*., (2009) at Bahir Dar. Similarly, several abattoir studies in different parts of Ethiopia reported the predominance of *F. hepatica* to *F. gigantica* (Tadele and Worku, 2007); Ibrahim *et al*., (2010); Berhe *et al*., (2009). Abunna *et al*., (2009) however, recorded higher prevalence of *F. gigantica* than *F. hepatica* in cattle slaughtered at Wolaita Soddo abattoir in southern Ethiopia.

The high prevalence rate of *F. hepatica* may be associated with the existence of favourable ecological biotopes for *L. truncatula*. Relatively small proportion of cattle were found infected with *F. gigantica* alone or mixed infection with both species. Flood prone areas and draining ditches are favourable habitats to *L. natalensis* (Urquhart *et al*., 1996).The finding of mixed infection with the two species of *Fasciola* indicates that there are places in the country where the climato-ecological conditions favour the existence of the intermediate snail hosts for both species. The present study showed that there was statistically significant difference (*P=0.000*) in prevalence of *Fasciola* species which is further supported by the findings of Gebretsadik *et al*., (2009); Tadele and Worku (2007); Mebratu and Beka, (2011).

The result of present study showed that age has no significant (*p >0.05*) effect on the prevalence of bovine fasciolosis. This showed that age groups have no effect for the presence or prevalence of fasciolosis; hence, both animals were equally exposed to infection which contradicts with the work of Alula *et al*., (2013), Solomon and Abebe (2007); Yilma and Mesfin, (2000).

The mode of affection of liver due to fasciolosis was mild (43.8%), moderate (41%) and severe (15.24%) in which the variation was statistically significant (*P=0.000*). As present study revealed *F.hepatica* affects liver moderately than severely and mildly which agrees with report of Mihreteab *et al*., (2010).

The total annual economic loss due to bovine fasciolosis in Assela town was calculated as 2,340,576 ETB (114,678 USD). The present finding is by far higher than the results reported by Abdul (1992), Daniel (1995) and Alula *et al*., (2013), who reported a total economic loss of 154,188 USD (2,891,025 ETB), 215,000 USD (4,031,250 ETB), and 63,072 USD(1,182,600 ETB) annually in cattle due fasciolosis at Ziway , Dire Dawa municipal abattoir and Nekemte municipal abattoir, respectively. These higher values may be due to higher number of animals slaughtered at the Assela and increment of cost of liver and beef.

V. CONCLUSION AND RECOMMENDATIONS

As cattle slaughtered at Assela municipal abattoir originate from almost every corner of the town it could be concluded that fasciolosis is still prevalent in cattle in Assela which causes great economic losses as a result of condemnation of infected livers. The total annual economic losses due to liver condemnation and carcass weight loss due to fasciolosis was estimated to be 2,340,576 ETB (114,678 USD). The study has also confirmed *F. hepatica* was found to be the predominant *Fasciola* species causing bovine fasciolosis in the study area which in turn results in largest proportion of liver condemnation at Assela municipal abattoir.

In order to alleviate the existing problem and to promote the status of the livestock dependent people living in this area, the following recommendations were forwarded:

- ✓ Combined approach of chemotherapy with vector control should be considered more practically and economically.
- ✓ Farmers should be aware and informed about the importance of disease control programs and good management system if bright future and improvement in livestock production is needed.
- ✓ Further studies on the epidemiological conditions and seasonal dynamics of parasites in the study area should be conducted to implement integrated control strategies.

REFERENCES

[1] Abdul, J.K. (1992): Economic significance of bovine fasciolosis in Soddo municipal abattoir. DVM thesis, Faculty of veterinary medicine, Addis Ababa University, DebreZeit, Ethiopia.

[2] Abebe, R., Fufa, A., Mulugeta, A. H., Solomon, M., Bekele, M. and Alemayew, R. (2010): Prevalence, and financial losses due to liver condemnation and evaluation of a simple sedimentation diagnostic technique in cattle slaughtered at Hawasa Municipal Abattoir. Ethiop.Vet. J., 14(1):39-51.

[3] Abunna, F., Asfaw, L. Megersa, B. and Regassa, A. (2010): Bovine fasciolosis: coprological, abattoir survey and its economic impact due to liver condemnation at Soddo municipal abattoir, Southern Ethiopia. Trop. Anim. Health Prod, 42:289–292.

[4] Alula, P., Addisu, K. and Amanuel, W. (2013): Prevalence and economic significance of bovine fasciolosis in Nekemte Municipal abattoir. J. Vet. Med. Anim. Health. Vol. 5(8):202-205.

[5] Anne, M., Zajac, Gray, A.C. (2006): Veterinary clinical Parasitology, 7thed. American Association of the Proctolohist, Pp 185-210.

[6] Arsi Plan and Economic Development Office (APEDO) (2007): Socio Economic on Arsi Zone; Assela, Arsi Pp 1-105.

[7] Berhe, G., Berhane, K. and Tadesse, G. (2009): Prevalence and Economic Significance of Fasciolosis in Cattle in Mekelle area of Ethiopia. Trop. Anim. Health Prod. 41:1503-1405.

[8] Brennan, G.P., Fairweather, I., Trudgett, A., Hoey, E., McCoy, McConville, M., Meaney, M., Robinson, M., McFerran, N., Ryan, L., Lanusse, C., Mottier, L., Alvarez, L., Solana, H., Virkel, G. and Brophy, P.M. (2007): Understanding triclabendazole resistance. Exp. Mole. Path., 82: 104-109.

[9] CSA (2012) : Central statistical agency of the federal democratic republic of Ethiopia, Agricultural sample survey of 2011/12 (2004 E.C), Volume II. Report on livestock and livestock characteristics (private peasant holdings), central statistical agency, Addis Ababa, Ethiopia.

[10] Daniel, F. (1995): Economic Importance of organs condemnation due to Fasciolosis and Hydatidosis in cattle and sheep slaughtered at Dire Dawa Abattoir, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University DebreZeit, Ethiopia.

[11] Del-Lahunta, A. and Habel R.H. (1986): Teeth applied veterinary anatomy, W.B. Saunders Company. Pp 4-6.

[12] Fikirtemariam, A., Jemere, B., Yeshwas, F. and Mussie, H. (2013): Study on the prevalence of bovine fasciolosis in and around Bahir Dar, Ethiopia. Ethiop.Vet. J., 17(1):1-11.

[13] Fufa, A., Loma, A., Bekele, M. and Alemayehu, R. (2009): Bovine fasciolosis coprological and abattoir survey at Soddo municipal abattoir. Trop. Ani. Hlth. Prod, 42:289-292.

[14] Gebretsadik, B., Kassahun, B. and Gebrehiwot, T. (2009): Prevalence and economic significance of fasciolosis in cattle in Mekelle area of Ethiopia. Trop. Ani. Hlth. Prod, 41:1503–1504.

[15] Hailu, D. (1995): Bovine Fasciolosis at Awassa Municipal Slaughter House Prevalence and Economic loss, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University. DebreZeit, Ethiopia.

[16] Herenda, D, Chambers, P.G, Ettriqui A, Seneviratna, P. and da Silvat, J.P. (2000): Manual on meat inspection for developing countries, Food and Agricultural Organization of the United Nations (FAO), Rome, Italy.

[17] Ibrahim, N., Wasihun, P. and Tolosa, T. (2010): Prevalence of Bovines Fasciolosis and Economic Importance due to Liver Condemnation at Kombolcha Industrial Abattoir, Ethiopia. Int. J. Vet. Med., 8(2).

[18] Malone, J. B., Gommes, R., Hansen, J., Jobre, Y., Slingenberg, J., Snijders, F., Nachtergeale, F. and Ataman, E.(1998): A geographic information system on the potential distribution and abundance of F. hepatica and F. giganticain east Africa based on Food and Agriculture Organization databases. Vet. Parasitol.78:87-101.

[19] Mari, H. (1989): Body conditions scoring, as of cattle in Ethiopia. MOA, Pp 45-46.

[20] Mason, C. (2004): Fasciolosis associated with metabolic disease in a dairy herd, and its effects on health and productivity. Cattle Practice 12: 7-13.

[21] Mebratu G., Beka K. (2011): Prevalence and Economic Significance of Fasciolosis in Cattle Slaughtered at Dire Dawa Municipal Abattoir, Ethiopia. J. Vet. Adv. 3(12):319-324.

[22] Mihreteab B, Haftom T. And Yehenew, G. (2010): Bovine Fasciolosis: Prevalence and its economic loss due to liver condemnation at Adwa Municipal Abattoir, North Ethiopia. Ethiop, J. Appl. Sci. Tech., 1(1):39-47.

[23] Mulat, N., Basaznew, B., Mersha C., Achenef, M. and Tewodros, F. (2012): Comparison of Coprological and Postmoretem Examinations Techniques for the Deterimination of Prevalence and Economic Significance of Bovine Fasciolosis. J. Ad. Vet. Res. 2:18-23.

[24] Mulualem, E. (1998): Epidemiology of bovine fasciolosis in weredas of South Gonder administrative Zone bordering Lake Tana. J. Ethiop. Vet. Assoc. 2:1-14.

[25] Ogunrinade, A. and Adegoke, G.O. (1982): Bovine fasciolosis in Nigeria. Inter current parasitic and bacterial infection. Trop. Anim. Health Prod. 14:121-125.

[26] Pfukenyi, D.M. and Mukaratirwa, S. (2004): A retrospective study of the prevalence and seasonal variation of Fasciola gigantica in cattle slaughtered in the major abattoirs of Zimbabwe between1990-1999. Onderstepoort J.Vet. Research, 71:181-187.

[27] Phiri, A.M., Phiri, I.K., Sikasunge, C.S. and Monrad, J. (2005): Prevalence of fasciolosis in Zambia cattle observed at selected Abattoir with emphasis on age, sex, and origin. J. Vet. Med. 52:414-416.

[28] Shiferaw, M., Feyisa, B., Ephrem, and T. (2011): Prevalence of Bovine Fasciolosis and its Economic Significance in and Around Assela, Ethiopia. Global J. Med. Res., 11(3).

[29] Solomon, W. M. and Abebe, W. (2007): Prevalence study of ruminant fasciolias is in areas adjoining upper Blue Nile basin, north western Ethiopia journal of Ethiopia veterinary association, 11:67-8.

[30] Swai, E.S. and Ulicky, E. (2009): An evaluation of the economic losses resulting from condemnation of cattle livers and loss of carcass weight due to Fasciolosis: a case study from Hai town abattoir, Kilimanjaro region, Tanzania. Livestock Research for Rural Development 21(11):186.

[31] Tadele, T. and Worku, T. (2007): The Prevalence and Economic Significance of Bovine Fasciolosis at Jimma, Abattoir, Ethiopia. The Int J.Vet Med. 3:15.

[32] Tegegne, A. and Crawfold, T.W. (2003): Draft animal power in Ethiopia, Draft animal news, 33. Center of Tropical Veterinary Medicine, 3rd edition, Blackwell Ltd, London, UK.

[33] Thrusfield, M.T. (2005): Veterinary Epidemiology, 2nd edition, UK. Blackwell Sci., Pp 228-247.

[34] Urquhart, J. M., Armour, J., Duncan, J. L., Dunn, A. M. and Jennings, F.W. (1996): Veterinary parasitology, 2nd edition, Blackwell science, the facility of veterinary medicine, the university of Grasgaw Scotland, Pp 47-103 ,411-429.

[35] Yilma, J. M. and Mesfin, A. (2000): Dry season bovine fasciolosis in northwestern part of Ethiopia. Revue de Vet. Med., 151:493-500.

[36] Walker, S.M., Makundi, A.E., Namuba, F.V., Kassuku, A.A., Keyyu, J, Hoey, E.M., Prodohl, P, Stothard, J.R. and Trudgett, A. (2008): The distribution of Fasciola hepatica and Fasciola gigantica within southern Tanzania-constraints associated with the intermediate host. Parasitology 135(4):495-503.

AUTHORS

First Author – Tizazu W, College Of Veterinary Medicine, Jigjiga University, Jigjiga
Second Author – Ahmed H, College Of Veterinary Medicine, Jigjiga University, Jigjiga