Acta Parasitologica Globalis 7 (3): 126-131, 2016
ISSN 2079-2018

DOI: 10.5829/idosi.apg.2016.126.131

Prevalence of Bovine Fasciolosis and its Economic Significance in Bonga Abattoir, Kafa Zone, Southwestern Ethiopia

[1]Wondimu Abebe, [1]Migbaru Keffale and [2]Simegnew Adugna

[1]College of Veterinary Medicine, Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia
[2]Ministry of Agriculture, Mizan Agricultural Technical
Vocational Education Training College, P.O. Box 217, Mizan Teferi, Ethiopia

Abstract: The aim of this study was to determine the prevalence of fasciolosis in cattle and to estimate the financial loss attributed to fasciolosis as a result of liver condemnation. The study was conducted from October 2013 to May 2014 at Bonga municipal abattoir. The study was based on post mortem inspection of livers of slaughtered animals and coprological examination using sedimentation technique on fecal samples collected from animals of Bonga and surrounding areas. Of 384 liver and 192 fecal samples examined, 63 (16.4%) and 41 (21.33%) were positive for fasciolosis respectively. Total liver found to be positive for fasciolosis were infected with *F. hepatica* (61.9%), *F. gigantica* (11%) and mixed infection (17.46%) and immature or unidentified form of *Fasciola* species (9.5%). This result indicate that *F. hepatica* was the most common liver fluke species that lead to high liver condemnation rates in cattle slaughtered, resulting high financial loss in the study area. Annual financial-loss from organ condemnation at the abattoir was estimated to be about 66,420 Ethiopian Birr. From the result obtained in this study, it can be concluded that fasciolosis is one of the most economically important disease in which it needs serious attention.

Key word: Coprology · Disease · Post Mortem

INTRODUCTION

Ethiopia has enormous livestock resources with a total contribution of 15% Gross Domestic Product (GDP) and 33% of the agricultural output. Parent estimate show that there are 49.3 million heads of cattle, 25.02 million sheep, 27.88 million goats, 8.41 million equines, 1.06 million camels, 20,000 pigs and 58 million chickens, which stands first in Africa and tenth in the world. But this huge livestock resource is not fully utilized because of various constraints of which poor animal production and management and livestock diseases are the most important. Loss due to parasitic diseases is of great interest to many tropical countries [1].

Among many prevalent parasitic problems of domestic animals, fasciolosis is one of the major disease entities incurring huge direct and indirect losses in the livestock productivity in Ethiopia. Economic losses of several million dollars per year due to fasciolosis, expressed in terms of mortality, liver condemnation at slaughter house, poor weight gain, infertility, reduction in traction power of oxen and low calf weight at birth have been reported [2].

Fasciolosis is a parasitic disease mainly of cattle, sheep, goats, buffaloes and occasionally humans caused by two major species namely *F. gigantica* and *F. hepatica* which are responsible for the disease in cattle and sheep, characterized by weight loss, anemia and hypoproteinemia. *F. hepatica* has worldwide distribution, but predominates in the temperate zones and areas of high altitude in the tropics and subtropics whereas *F. gigantica* mostly located in tropical area [3]. The geographical distribution of *F. hepatica* and *F. gigantica* is determined mainly by the distribution patterns of the snails that have a role as intermediate hosts. In Ethiopia, both the species co-exist at different altitude. The prevalence and the distribution of fasciolosis vary from 11% in the rift valley to 100% in the central lands of Ethiopia [4].

Corresponding Author: Simegnew Adugna, Ministry of Agriculture, Mizan Agricultural Technical Vocational Education Training College, P.O. Box 217, Mizan Teferi, Ethiopia.

F. hepatica has been shown to be the most important fluke species in Ethiopia livestock with distribution over three quarter of the nation except in the arid northeast and east cost 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 nation [5].

Essentially the disease entity can be divided in to acute form and a chronic form. Acute hepatic fasciolosis occurs five up to six week after ingestion of large number of metacercariae and is due to the sudden invasion of the liver by masses of young flukes. Chronic fasciolosis develops slowly and is due to the activity of the adult flukes in the bile ducts which is characterized by progressive loss of condition, development of anemia and hypoalbuminemia, emaciation, pallor of the mucus membrane, sub mandibular edema and ascites [3]. These cause cholangitis, biliary obstruction, destruction of hepatic tissue and fibrosis and anemia [6].

Fasciolosis causes a wide range of clinical symptoms, depending on the number of metacercariae ingested. Chronic fasciolosis is the most common in cattle, sheep and other hosts. The symptoms of chronic fasciolosis are generally associated with hepatic fasciolosis and hyperplastic cholangitis. Anemia, edema (bottle jaw), digestive disturbance (constipation and diarrhea) and cachexia develop gradually. Acute fasciolosis is less common than the chronic diseases and occurs mainly in sheep. It is basically a hepatitis caused by the simultaneous migration of large number of immature flukes. In case of cattle, the most characteristic signs are digestive disturbance constipation is marked and the faeces are passed with difficulties, being hard and brittle. Diarrhea is seen only in the extreme stages. Emaciation rapidly, while dullness and weakness soon lead to prostration, especially in calves. In heavy infection where anemia and hypoalbuminemia are severing, sub-mandibular edema frequently occurs. Diarrhoea is not a feature of bovine fasciolosis unless it is complicated by the presence of *Ostertagia* species [3].

Both *F. hepatica* and *F. gigantica* can infect man. Sporadic human causes occur throughout the world. Those cases are associated with primarily with eating of water cress contaminated with metacercariae and are most common after wet season when water cress or other vegetable bed may be become over run with water draining from wet or swampy animal pasture.

The annual loss due to endo-parasitism including fasciolosis in Ethiopia is estimated at 700 million birr [7]. The economic significance of fasciolosis is considerable. It brings death, loss of carcass weight, reduced milk yield, condemnation of affected liver, decline in reproductive performance, predispose animals to other diseases and additional costs due to treatment expenses. The direct impacts of fasciolosis are liver lesions, reduction in feed utilization efficiency, deprivation of the animal of digestive nutrients and reduced feed intake through loss of appetite and discomfort leading to reduced feeding time. *Fasciola* infected livers are damaged and not palatable and so most livers are condemned at slaughter causing monitory losses to the owner [3].

Despite the huge economic losses incurred and widespread distribution of fasciolosis in the country, significant control measures have not yet been developed at the national and at the regional level. Routine treatment of clinical illness is the normal rather than prevention of infection. More rational prophylactic programs based on epidemiological information are needed for sound fasciolosis control strategies in Ethiopia [8].

Therefore, the objectives of this study were to determine prevalence of bovine fasciolosis and most prevalent species of liver flukes in indigenous adult cattle and to assess the economic importance of bovine fasciolosis due to liver condemnation in Bonga municipal abattoir.

MATERIALS AND METHODS

Study Area: The study was conducted in Bonga town municipal abattoir. Bonga is the capital town of Kafa Zone in the Southern Nations Nationalities and Peoples Regional State, which is located 449 kilometers south west of Addis Ababa. The Zone has a latitude and longitude of 7°16'N36°14'E with elevation of 1500-2500 above sea level. It receives an annual rain fall of 1500-2000 mm with annual mean temperature of 6°C /minimum/, 15.75 °C /medium/ and 25.50°C /maximum/. The agro-ecological description includes 15% lowland and 75% midland and 10% highland [9].

Sample Size Determination: Since there was no previous study in Bong at own 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 [10].

$$n = \frac{1.962.P_{exp}(1 - P_{exp})}{d^2}$$

where
n = required sample size
P_{exp} = expected prevalence= 50%
d = desired absolute precision=5%
Accordingly 384 animals were supposed to be sampled.

Study Design and Sampling Method: A cross sectional study was employed to examine animals which were slaughtered in the abattoir and observation of every individual animal were both ante-mortem and postmortem examination. Complete ante-mortem examination of the animals was carried out a day before or shortly prior to slaughter. Inspection of the animals was made while at rest or in motion to observe for any obvious sign of disease like emaciation, submandibular edema and each and every animal were tagged with identification number before the slaughter commences. During postmortem examination, the liver of the animals were examined for detection of the presence of adult fluke parasites from the bile ducts in the abattoir.

Coprological Survey: A total of 192 faecal samples for coprological examination were collected directly from the rectum of each animal and freshly defecated faeces in to plastic bottles with gloved hand. The samples were clearly labeled with universal bottles preserved with 10% 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, microscopic examination the presence of *Fasciola* eggs using the standard sedimentation techniques [11].

Postmortem Examination: Active abattoir survey was conducted based on cross sectional study during routine meat inspection of slaughtered cattle at Bonga municipal abattoir. A total of 384 cattle were examined during the study. During ante-mortem examination detail records about the species, breeds, sexes, origins and body conditions of the animals were performed. Cattle for slaughter purpose were usually brought mainly from Bonga and surroundings woreda to supply Bonga abattoir and thus animals were purchased and slaughtered. During post-mortem inspection, each liver visually inspected, palpated and incised based on routine meat inspection. All livers having *Fasciola* species condemned were registered and flukes were conducted for species identification [12].

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. In many studies, gross morphology is used to differentiate the two species. *F. gigantica* is typically longer at approximately 28-52 mm and has a narrower body while *F. hepatica* has more pronounced 'shoulders' and is considerably shorter at around 12-29 mm [13].

Financial Loss Assessment: 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, while retail market price of an average size zebu liver was determined from the information collected from butcheries in Bonga. The information obtained was subjected to mathematical computation using the formula set by Ogunrinade and Adegoke [14].

$$ALC = CSR \times LC \times P$$

where
ALC = Annual loss from liver condemnation
CSR = Mean annual cattle slaughtered at municipality abattoir
LC = Mean cost of one liver in Bonga town
P=Prevalence rate of the disease at the study area

Data Analysis: The data were collected from the study area and entered in to Micro Soft Excel spread sheet. Data analysis was carried out by using computer based Statistical package for social sciences (SPSS version 20). Descriptive statistics was used to determine the prevalence of the parasite and Chi-square (x^2) test was used to assess the association of the prevalence of fasciolosis and its associated risk factors such as origin and body condition score of the animals and $P < 0.05$ was considered as significant.

RESULTS

Coprological Finding: A total of 192 adult indigenous cattle were examined by taking faecal samples to laboratory in tightly closed universal bottles and examined for *Fasciola* eggs. From 192cattle, 41 were positives for fasciolosis (Table 1).

Table 1: Prevalence of bovine fasciolosis based on faecal sample from Oct 2013 – May 2014

Month	Oct	Nov	Dec	Jan	Feb.	Mar	Apr	May	Total
Nº of faecal sample examine	15	22	26	34	28	14	9	44	192
Nº of positives for fasciola eggs	6	9	5	4	3	2	1	11	41
Prevalence%	40	40.9	19.2	11.8	10.7	14.3	11	25	21.35

Table 2: The prevalence of fasciola species encountered in postmortem examination of slaughtered animals

Species *fasciola*	No. of positive livers	Proportion (%)
F. hepatica	39	61.9
F. gigantica	7	11.1
Mixed	11	17.46
Immature fluke	6	9.52
Total	63	100

Table 3: Risk factor identification related to BCS and origin.

Risk factor		No of examined animals	No of Positive (%)	χ^2	P-value
Origin	Highland	286	16.4%	0.001	0.980
	Lowland	98	16.3%		
	Total	384	16.4%		
Body condition	Good	373	15.1%	6.967	0.008
	Medium	11	45.5%		
	Total	384	16.4%		

Postmortem Examination: A total of 384 adult indigenous cattle were slaughtered at Bonga municipal abattoir and examined for fasciolosis. Of the total cattle slaughtered and examined (N=384), 16.4% (N=63) of them were found to be positive for lesions of fasciolosis.

Species Identification: From a total of 63 livers found positive for fluke infection during post-mortem inspection of slaughtered animals, 39 livers harbors' *F. hepatica*, 7 livers harbor *F. gigantica* and 11 and 6 livers infected with mixed infection and unidentified species due to immature flukes respectively (Table 2).

The prevalence of fasciolosis with good body condition is 15.1%. However, with medium body condition showed the prevalence of 45.5%. The result indicates that prevalence is higher in medium body condition animals than good body condition animals. There was an association between body condition score and prevalence of fasciolosis. On the other hand the prevalence of fasciolosis with origin of the animal indicates that 16.4% for highland and 16.3% in lowland and there was no association between origin and prevalence of the disease.

Economic Loss Assessment: 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 was estimated to be 9000 while mean retail price of bovine liver in Bonga town as 45 ETB. Prevalence of fasciolosis in Bonga municipality abattoir estimated as (16.4%), the total number of liver in a year was calculated to be 1476 which resulted in the financial loss of 66,420 ETB due to liver condemnation annually.

DISCUSSION

In the current study the prevalence (21.35%) indicated by faecal examination was relatively higher than 4.9% recorded in Soddo [15], 14.2% at Bishoftu [16] and 12.5% in Kombolcha industrial abattoir [17] and much lower than 80% recorded in Debre Berhan [18], 45.25% at around Assela [19] and 41.41% in Woreta [20].

The overall abattoir prevalence of fasciolosis obtained from the present study (16.4%) is comparable to previous reports in Ethiopia like, 15.58% in the Mizan-Aman municipal abattoir [21], 20.3% at Addis Ababa abattoir [22] and 14.4% at Soddo municipal abattoir [15]. However, it is much lower than several study conducted at different abattoirs in the country, 28% at Kombolcha Industrial abattoir [17], 46.58% at Jimma abattoir [23], 90.65% at Gondar abattoir [24] and56.6% at Ziway abattoir [25]. In other African countries higher prevalence is also reported by different researchers such as 64.2% from Lake Victoria basin in Kenya [26], 53.9% from Zambian abattoirs in Zambia [27] and 52.6% from Arusha region in Tanzania [28]. This difference might be due to the geographical variation which is important for the multiplication of the intermediate host. Similarly, variation in climatic-ecological conditions such as altitude, rainfall, temperature, livestock management system and suitability of the environment for survival and distribution of the parasite as well as the intermediate host might have played their own role in such differences.

Post mortem examination on the 63 *Fasciola* infected livers of the current result indicated that *F. hepatica* and *F. gigantica* were the main *Fasciola* species, however, *F. hepatica* were found to be the predominant *Fasciola* species causing bovine fasciolosis in the study area which was agreed with the finding of Tolosa and Tigre [23] that is 64.5% for *F. hepatica* and 24.8% for *F. gigantica* at Jimma, Mihreteab *et al.* [29], 63.6% for *F. hepatica* and 24.3% for *F. gigantica* at Adwa municipal

abattoirs. The result is not agreed with other findings like Fufa *et al*. [15] 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* [30].

The monthly/seasonal/ variation in the prevalence of fasciolosis has been studied for 8 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 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 the lowest infection rate (10.7%) was encountered in February whereas the highest prevalence rate 40% and 40.9% was recorded in October and November respectively 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 [5].

The direct economic loss incurred during this study as a result of condemnation of liver of cattle was estimated about 66,420 ETB per annum. This finding is by far lower than the result 154,188 ETB reported by Adem [25] at Ziway, 106,400 ETB [31] at Hawassa Municipal Abattoir, 232,232 ETB per annum [16] at Bishoftu and 513,720.00 ETB [32] at Mettu municipal abattoir. But it is relatively higher compared with other findings which includes 54,063.34 ETB per annum reported by Tolosa and Tigre [23] at Jimma municipal abattoir and 37,767.60 ETB per annum [19] around Assela. This is probably due to the difference between the prevalence of the disease in different agro-ecological zones and the capacity of the abattoirs annual slaughter rate.

CONCLUSION

Fasciolosis is a serious health problem of cattle which causes liver condemnation in the abattoir, reduction in the production of the animals. In the current finding the abattoir prevalence of the parasites showed the disease is common in most parts of the zone as most of the animals were originated from the different sites of the zone. The most predominant *Fasciola* in the zone was *F. hepatica* which might be due to suitability of the environment for multiplication of the intermediate hosts. Therefore, standard regulations and formulation of functional meat inspection policies and reduction of the intermediate host by drainage of swampy area is recommended. Further epidemiological surveillance should be conducted to assess the distribution and the indirect economic losses due to the disease.

REFERENCES

1. CSA, 2008. Central Statistical Authority. Agricultural Sample survey. Report on livestock and Livestock characteristics Addis Ababa. Ethiopia.
2. Radostits, M.O., C.C. Gay, W.K. Hinchcliff and D.P. Constable, 2007. Diseases associated with leptospira species. In: Veterinary Medicine. A text book of the diseases of cattle, horses, sheep, pigs and goats. 10thedn, pp: 1576-1580.
3. Urquhart, G.M., J. Armour, J.L. Duncan, A.N. Dunn and F.W. Jenninh, 1996. Veterinary Parasitology. ELBS Long Many.
4. Graber, M., 1975. Helminthes and helminthiasis of domestic and wild animals of Ethiopia. Bulletin of Tropical Animal Health and Production in Africa, 23: 57-86.
5. Yilma, J. and J.B. Malone, 1998. A geographical information system forces model for strategic control of fasciolosis in Ethiopia. Veterinary Parasitology, 78: 103-127.
6. Blood, D.C., O.M. Radiostits and J.A. Henderson, 1993. Veterinary Medicine: A textbook of the Disease of cattle, sheep, pigs, Goats and Horses. 6th ed. Bailliertindal. London, pp: 974-984.
7. Mulugeta, H., T. Getachew, M. Taffesse, W. Getachew, G. Kinfe and Y. Teshome, 1989. The significance of Helminthic parasite in livestock production. In: The 3rd livestock improvement Conference, Addis Ababa, Ethiopia, pp; 34.
8. Bahiru, G. and M. Ephrem, 1997. A preliminary survey of bovine fasciolosis in Ethiopia. Journal of Agricultural Science, 1: 5-12.
9. KZAO, 2010. Kafa Zone Agriculture Office, Bonga, Ethiopia.
10. Thrusfield, M.V., 2005. Veterinary Epidemiology second edition, University of Edinburgh, Blackwell Science, pp: 180-188.
11. Hanson, J. and P. Brian, 1994. The epidemiology, diagnosis and control of helminthes parasites of ruminants. A handbook Rome: Food and Agricultural Organization of the United Nations. pp: 72. Press).

12. FAO, 1994. Manual on meat inspection for developing countries. http:// www.phsource.us/ PH/ PDF/ FBI/ Manual%20on% 20meat% 20inspection% 20for%20developing%20countries.pdf
13. Periago, M.V., M.A. Valero, M. Panova and S. Mas-Coma, 2006. Phenotypic comparison of allopatric populations of F. hepatica and F. gigantica from European and African bovines using a computer image analysis system (CIAS). Parasitology Research, 99: 368-378.
14. Ogunrinade, A. and G.O. Adegoke, 1982. Bovine Fasciolosis in Nigeria Inter-current Parasitic and Bacterial infection. Tropical Animal Health and Production, 14: 121-125.
15. Fufa, A., A. Loma, M. Bekele and R. Alemayehu, 2009. Bovine Fasciolosis: coprological, abattoir survey and its economic impact due to liver condemnation at Soddo municipal abattoir, Southern Ethiopia. Tropical Animal Health and Production (In press).
16. Alemayehu, R., W. Tefera, D. Sebl, M. Nebyou, A. Dinka and A. Fufa, 2011. Bovine Fasciolosis: Coprological, Abattoir Survey and Financial Loss Due to Liver Condemnation in Bishooftu Municipal Abattoir, Central Ethiopia. European Journal of Biological Sciences, 4: 83-90.
17. Ibrahim, N., P. Wasihun and T. Tolosa, 2010. Prevalence of Bovine Fasciolosis and Economic importance due to liver condemnation at Kombolcha Industrial Abattoir, Ethiopia. Journal of Veterinary Medicine, 8(2).
18. Dagne, M., 1994. Survey on prevalence and economic significance of Bovine Fasciolosis at Debre Berhan region. DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
19. Shiferaw, M., B. Feyisa and T. Ephrem, 2010. Prevalence of Bovine Fasciolosis and its Economic Significance in and Around Assela, Ethiopia. Global Journal of Medical Research, 11(3).
20. Biniam, T., A. Hanna and G. Sisay, 2011. Study on coprological prevalence of bovine fasciolosisin and around Woreta, Northwestern Ethiopia.Journal of Veterinary Medicine and Animal Health, 4(7): 89-92.
21. Dokito, M., B. Desta and W. Cherinet, 2012. Prevalence of Bovine Fasciolosis in Southwestern Ethiopia; Mizan-Aman Town of Bench Maji Zone. Lambert Academic Publishing (In press).
22. Kassaye, A., N. Yehualashet, D. Yifat and S. Desie, 2011. Fasciolosis in Slaughtered Cattle in Addis Ababa Abattoir, Ethiopia. Global Veterinaria, 8: 115-118.
23. Tolosa, T. and W. Tigre, 2006. The prevalence and economic significance of Bovine Fasciolosis at Jimma Abattoir, Ethiopia. Journal of Veterinary Medicine, 3(2).
24. Yilma, J. and A. Mesfin, 2000. Dry season bovine fasciolosis in northwestern part of Ethiopia. Revue de Médicine Véterinaire, 156: 493-500.
25. Adem, A., 1994. Prevalence of Bovine and Ovine Fasciolosis: A Preliminary Survey Around Ziway Region (Showa), DVM Thesis, Faculty of Veterinary Medicine Addis Ababa University Debre Zeit, Ethiopia.
26. Kanyari, P.W.N., J.M. Kagira and R.J. Mhoma, 2010. Prevalence of endo-parasites in cattle with zoonotic potential within urban and peri-urban areas of Lake Victoria Basin, Kenya. African Journal of Animal and Biomedical Sciences, 4: 26-33.
27. Phiri, A.M., I.K. Phiri, C.S. Sikasunge and J. Monrad, 2005. Prevalence of Fasciolosis in Zambian Cattle Observed at Selected Abattoirs with Emphasis on Age, Sex and Origin. Journal of Veterinary Medicine 52: 414–416. http:// onlinelibrary.wiley.com/ doi/ 10.1111/ j.1439-0450.2005.00872.x/full
28. Nonga, H.E., M.F. Mwabonimana, H.A. Ngowi, L.S.B. Mellau and E.D. Karimuribo, 2009. A retrospective survey of liver fasciolosis and stilesiosis in livestock based on abattoir data in Arusha, Tanzania. Tropical Animal Health and Production, 41: 1377-1380.
29. Mihreteab, B., T. Haftom and G. Yihenew, 2010. Prevalence and its economic loss due to liver condemnation at Adwa Municipal abattoir, north Ethiopia. Ethiopian Journal of Applied Sciences and Technology, 1: 39-47.
30. Troncy, P.M., 1989. Fasciolosis of ruminants. In Manual of Tropical Veterinary Parasitology. CTA, C.A.B. Internat, pp: 63-74.
31. Rahmeto, A., A. Fufa, B. Mulugeta, M. Solomon, M. Bekele and R. Alemayehu, 2010. Prevalence, financial losses due to liver condemnation and evaluation of a simple diagnostic technique in cattle slaughtered at Hawassa Municipal abattoir, southern Ethiopia. Ethiop. Veterinary Journal, 14: 39-51.
32. Manyazewal, A., G. Mengistu and T. Tsegaye, 2009. Economic Significance of Fasciolosis at Mettu Municipal Abattoir, Southwest Ethiopia. Journal of Advanced Veterinary Research 4:53-59.