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Study on Prevalence of Bovine Fasciolosis and Its Economic Importance at Jitu Slaughter House

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Abstract: A cross sectional study was conducted from December 2022 to April 2023 on a total sample of 384 cattle slaughtered at Jitu slaughter house to estimate prevalence of fasciolosis and its economic importance. Study animals were selected using systematic random sampling from cattle presented for slaughter before antemortem inspection. Sex, body condition score and geographical origin of the study animals were considered as associated risk factors. At postmortem based detail liver fluke infection was also investigated. The current study showed an overall prevalence of 35.79 % postmortem based bovine fasciolosis with significantly higher ($p < 0.05$). Liver fluke infection in cattle with poor body condition 35/63 (55.55%) was higher than in animals with medium 71/193 (36.78%) and in good body conditions 32/128 (25 %). However, this study indicated statistically there were no differences in occurrence of bovine fasciolosis as well as prevalence of fasciola species among different woredas of the study area though animals from Haru district showed higher proportion of fasciolosis. The overall occurrence of *Fasciola hepatica* is higher accounting 93/138 (66.67%) while the prevalence of *Fasciola gigantica*, mixed infection fluke were 37/138(23.41%) and 8/138(5%), respectively. On the other hand, the number of fasciola parasite and type of lesion encountered in liver inversely related with duration of infection. Among fasciola positive animals 23/138 (16.67%) were harboring hydatid cyst whereas the probability of fluke infected liver to develop cirrhosis and Cholangitis was 38/138 (27.53%) and 77/138 (55.80), respectively. Finally, $9778.33 USD monetary loss per annum incurred due to condemnation of cattle livers infected with fasciola spp. in Jitu slaughter house was much higher. In conclusion, bovine fasciolosis is important parasitic disease associated with loss of body condition at the study area. Therefore, concerned professionals and local stakeholders should give due attention towards the control of the parasite. Beside abattoir based study, we also recommend further studies focusing on field and clinic based prevalence determination of bovine fasciolosis at the study area.

Key words: Bovine · Ethiopia · Jitu · Liver fluke · Prevalence · Slaughterhouse

INTRODUCTION

Ethiopia owns huge number of ruminants having high contribution for meat consumption and generates cash income from export of live animals, meat, edible organs and skin. In spite of the presence of huge ruminant population, Ethiopia fails to optimally exploit these resources due to a number of factors such as recurrent drought, infrastructures problem, rampant animal diseases, poor nutrition, poor husbandry practices and shortage of trained man power and lack of government policies for disease prevention and control [1]. With an estimated cattle population of 52 million, sheep population of 25.5 million and goat population of nearly 24 million. Cattles are the most economically important livestock species with high estimated population and the majorities are indigenous zebu breed [2]. Among many parasitic problems of farm animals, fascioliasis is a major disease, which imposes direct and indirect economic impact on livestock production, particularly of sheep and cattle [3]. *Bovine fasciolosis* is an economically important parasitic disease of cattle caused by Fasciolidae, which are trematode of the genus *Fasciola*. The two most important species of this genus are F. *hepatica* and *F.gigantica* [4-7]. In Ethiopia both and *fasciola gigantica* have the greatest risk occurred in areas of extended high annual

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rainfall associated with high soil moisture and surplus water, with risk diminishing in areas of shorter wet season or lower temperature. Arid areas were generally unsuitable (except where irrigation, water bodies or flood occur) due to soil moisture deficit and or, in the case of *Fasciola hepatica* high average annual mean temperature. For *Fasciola gigantica* regions in the high lands of Ethiopia and Kenya were identified as unsuitable due to in adequate thermal regime [8]. The economic losses due to fasciolosis are caused by mortality, morbidity and reduced growth rate, condemnation of liver, increased susceptibility to secondary infections and the expense of control measures [8]. Diagnosis is based primarily on clinical signs and seasonal occurrence in endemic areas but previous history of fasciolosis on the farm or identification of snail habitats; postmortem_examinations commonly employed to diagnose bovine fasciolosis, when much of liver damage has already occurred [9]. Even though, it is impossible to detect fasciola in live animals, liver examination at slaughter or Necropsy was found to be the most direct, reliable and cost effective technique for diagnosis of fasciolosis [10]. The disease is found 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 [11]. More rational prophylactic programs based on local epidemiological information are needed for sound fasciolosis control strategies in Ethiopia [5]. Though the problem due to Fasciola was reported from different parts of the country, information on the current status from different locations need to be attained. This study aims to fill such gap and hence been carried out in cattle in and around Jitu.

Therefore, the objective of this study was:

- To determine the prevalence of bovine fasciolosis and its economic importance at Jitu slaughter house.

MATERIALS AND METHODS

Study Area: The study was conducted at slaughter house, in Jitu town which is located in the western wallaga zone of the Oromia region, Haru is bordered on the south by Nole Kaba, on the south west Dale Lalo, on the west by Yubdo, on the north by Gimbi, on the east by an exclave of the Benishangul Gumuz and on the southeast by the Illubabor Zone. This town has a latitude and longitude of 9°48'N and 35° 06'E with an elevation of 1583 meters above sea level. The average annual rainfall of the area is between 1500 to 2200mm and the area has average maximum and minimum annual temperature of 31°C and 10.5°C [12]. According to the reports on January 17, 2023, from Haru livestock office, there were about 107,123 of cattle population [13].

Study Animal: The study animals were 384 local cattle breeds brought from different markets to Jitu town. The bovine destined for slaughter was males originated from different parts of kebeles and neighboring woredas including, Nole kaba, Homa and Haru. During sampling, age, origin of animals (place) and body conditions of all the sampled cattle were recorded to estimate the prevalence of fasciolosis and to determine the most prevalent species of liver flukes.

Study Design and Sample Size Determination: A cross-sectional study was conducted to estimate the prevalence with associated risk factor and economic importance of fasciolosis among systematically sampled cattle using post-mortem examination of liver. The sample size required for this study was determined by using the Thrusfield formula, Thrusfield [14]. The prevalence in a large (theoretically infinite) population at 95 % confidence interval and 5 % precision. In this study, 50% prevalence was considered to calculate the sample size using the following formula.

$N = 1.962\ Pexp\ (1- Pexp)/d2$

where:
N = required sample size
P_{exp} = expected prevalenced = desired absolute precision $N = (1.96)^2 x\ P_{exp}\ (1- P_{exp})/d^2$, P_{exp}= expected prevalence d^2 =desired absolute precision $n= (1.96)^2 x\ 0.5(1-0.5)/(0.05)^2 = 384$ animals.

Study Methodology

Ante-mortem Inspection: Data collected during ante-mortem examination included age, sex, body condition score and origin of animals. In addition animals also classified in to three groups based on their body condition score (BCS) as poor, medium and good [15].

Post Mortem Examination: Animals examined during the ante mortem examination further supervised and their livers and associated bile duct was carefully examined by visualization and palpation of the entire organ followed by incision along the bile ducts of the lobes [16]. Matured

flukes were collected into the universal bottles containing 5% formalin and examined to identify the involved species. The liver flukes collected were classified as *F. hepatica*, *F. gigantica*, mixed and immature flukes based on morphological features described by Urquhart [17].

Data Management and Analysis: All raw data collected from this study were recorded and entered in Micro Soft Excel spread sheet for data analysis; Statistical Package for Social Science (SPSS) software version 20 was used. Descriptive statistics was used to determine the prevalence of the parasite and Chi-square ($\chi 2$) test was used to assess the association of the prevalence of fasciolosis and its associated risk factors such as sex, age and body condition score of the animals. Statistical significance was set at $P < 0.05$.

Direct Financial Loss Analysis: The total financial loss incurred due to fasciolosis in Jitu slaughter house was calculated based on rate of liver condemnation. The economic loss due to liver condemnation was estimated through interview made with local butcher men in Jitu town, the average cost of each cattle liver was calculated to be 900 Ethiopian Birr. The direct loss was thus computed according to the formula adopted by Ogunrinade [18]. Using the market price of a bovine liver, the monetary loss occasioned by condemnation of *Fasciola* infected livers was calculated as follows:

$$EL = \Sigma CS \times Coy \times Roz$$

where:

EL = Annual loss estimated due to liver condemnation
ΣCS = Annual slaughter rates at the abattoir (estimated from retrospective abattoir record)
Coy = Average cost of each cattle liver
Roz = Condemnation rates of cattle liver due to fasciolosis

RESULTS

Out of 384 sample animals examined at Jitu slaughter house the post mortem resulted indicated livers of 138 (35.79%) animals were infected with liver fluke. The result also indicated the infection prevalence was significantly higher ($p < 0.05$) in cattle with poor body condition than in animals with medium and good body conditions which held 55.56%, 36.78%, 25 % respectively. Statistical analysis of the current study showed there were no differences in occurrence of fasciolosis among geographical origin of animals and sex group at the study area (Table 1).

Table 1: Prevalence of bovine fasciolosis based on body condition of cattle's at Jitu slaughter.

Bsc	No examined	No of positive	Percentage (%)	Chi square	P value
Poor	63	35	55.56	18.564	0.005
Medium	193	71	36.78		
Good	128	32	25%		
Total	384	138	35.79		

Table 2: Prevalence of Fasciolosis with respect to animal origin

	Fasciola species					
Origin	negative	*F. hepatica*	*F. gigantica*	mixed	Chi square	p-value
Homa	66	22	7	1	3.03	0.805
Haru	99	41	18	5		
Bube	81	30	12	2		
Total	246	93	37	8		

Table 3: Prevalence of fasciolosis based on fasciola species and lesion encountered at Jitu slaughter house

Species of fasciola	Total infected liver	Percentage fasciola species encountered (%)
F. hepatics	93	67.39
F. gigantica	37	23.41
Mixed infection	8	5
Total	138	35.79
Cyst	23	16.66
Cirrhosis	38	27.53
Cholangitis	77	55.79
Total	138	35.79

Table 4: Prevalence of fasciolosis based on the age.

Age	No examined	No of positive	Percentage (%)	Chi square	P-value
Young	128	46	35.93	12.583	0.006
Adult	256	92	35.93		
Total	384	138	35.79		

From examined young (1-3 years) cattle 46 (35.93%) and among 256 adult cattle examined, 92 (35.93%) were positive.

Direct Economic Loss: The economic significance of *fasciolosis* was analyzed based on the information obtained during post mortem examination and interview. Annual loss due to liver condemnation = ΣCS * Coy * Roz= 1700 * 900 * 35.79= 547,587.6 Ethiopian Birr ($9778.33) was annual lost due fasciola cases at Jitu slaughter house.

DISCUSSION

Fasciolosis is an important parasitic disease of domestic ruminants caused by two liver fluke species: *Fasciola hepatica* and *F. gigantica* (Trematode). *Fasciola hepatica* has a cosmopolitan distribution mainly in temperate zones, while *F. gigantica* is found in tropical regions of Africa and Asia. Bovine fasciolosis involved vary with locality. This is mainly attributed to the variation in the climate and ecological condition such as altitude, rainfall and temperature and livestock management system [19].

In the present study 35.79% prevalence of fasciolosis was found based on slaughter house post mortem examination was agreed with report of Rahmeto which was 34% in Walliso [20]. However, this finding was much higher than the reports at Soddo abattoir and Bedelle abattoir which is 4.9% and 8.33% respectively [21, 22]. However; more than by half lower than reports of Dagne, from Debreberhan, which is 80% from Debreberhan, the highland areas in Ethiopia [7]. This may be due to agro ecological difference which leads to the better survival of *Fasciola* and its vector, snail in some of the ecology while limiting in others. It may be also due to seasonal differences in which these different researches were conducted in different areas of the country. The total prevalence is 35.79% by post mortem examination, which was relatively high with the report by Aragaw *et al.*, petros *et al.*, Yusuf, Gebretsadik *et al*., Amsalu *et al.* Nuraddis *et al*. and Meshesha M and Tesfaye W who reported prevalence of 20.3, 21.9, 24.4%, 24.3%, 27.22%, 28% and 30.47, at Addis Ababa Nekemte, Haramaya, Mekelle area, Kombolcha and Hossaina Industrial Abattoir respectively [23 - 30]. On the other hand, this result is relatively lower than the findings of Tolosa and Tigre recorded prevalence of 46.2% at Jimma abattoir [31]. In addition to this, it is much lower than that of many other studies from different abattoirs in the country. Yilma and Mesfin reported 90.7% prevalence of fasciolosis in cattle slaughtered at Gondar abattoir [32]. On the other hand, a lower prevalence of fasciolosis (14.0%) has been observed in slaughtered cattle at Wolaita Soddo abattoir [21].

All the above comparisons of the prevalence of fasciolosis in this study with other reports may be associated majorly with the variation in the study seasons. The difference in management system is another factor for the difference. Factors like altitude, difference in climatic conditions and presence of favorable condition for the growth of snail in different study areas should also be considered for variation between different reports and relative to this study. The result of present study revealed that the sex not considered in the study because of sex of animal has no significant effect on the occurrence of bovine fasciolosis; this agrees with the reports of Rahamato *et al.* [20], Aregay *et al*. [23] and Petros *et al*. [25] who concluded that sex has no impact on the infection rate and hence bot h male and female are equally susceptible and exposed to fasciolosis.

The results of the present study indicated that body condition of the animal has significant association with the occurrence of fasciolosis ($P<0.05$) (Table 1). The prevalence was higher in poor body conditioned animals than that of medium and good body conditioned animals which were 55.56, 36.78 and 25% respectively. The prevalence of fasciolosis was higher in the animals with poor body condition because this body condition in cattle is manifested when fasciolosis reaches at its chronic stage. This study agrees with the report of Aragaw *et al.*[23], Meshesha and Tesfaye [24] and Yusuf *et al.* [26] W but contradicts with report of Aregay F. *et al.* who indicated that there was statistically significant difference between animals having good and poor body condition ($P<0.05$).

Postmortem examination on the 138 *Fasciola* infected livers of current results indicated that the prevalence of *F. hepatica* 67.39% was higher than that of *F. gigantica* 23.41% and certain proportion of animals 5% harbored

mixed infection (Table 2). Similar study conducted at Haramaya indicated that the prevalence of *F. hepatica* (59%) was higher than that of *F. gigantica* (26%) and certain proportion of animals (15.4%) harbored mixed infection reported by Yusuf *et. al.* [26] and the same study at Jimma municipal abattoir reported 60.3% of liver harbored F.hepatica, 23.85% of liver harbored *F. gigantica* species were recorded by Tolosa and Worku [7]. The high prevalence of F. hepatica may be associated with the presence of favorable ecological biotypes for its snail vector *Lymnaea truncatula*. In support of the present study, Gebretsadik *et al*. reported that 56.42% of cattle were infected with Fasciola hepatica and 9.17% with *Fasciola gigantica* [27]. However, in another study, Abunna *et al.* stated that the most common liver fluke species affecting cattle at Wolaita Sodo was *Fasciola gigantica* [21]. Yilma and Malone indicated that *Fasciola gigantica* in Ethiopia is found at altitudes below 1800 meters above sea level. While *Fasciola hepatica* is found at altitude of 1200- 2560 meters above sea level. Mixed infections by both species can be encountered at 1200-1800 meters above sea level. According to Yilma and Malone, such discrepancy is attributed mainly to the variation in climatic and ecological conditions such as altitude, rainfall and temperature as well as livestock management system [5].

On the other hand, the number of fasciola parasite and type of lesion encountered in liver was inversely related with duration of infection. Among fasciola positive animals 23/138 (16.67%) were harboring hydatid cyst whereas the probability of fluke infected liver to develop cirrhosis and Cholangitis were 38/138 (27.53%) and 77/138 (55.80%) respectively (Table 3). This pathological lesions were increased at acute stage and then decreased at chronic form which was in agreement with the findings of Rahmeto *et. al.* [20]. This was due to severe fibrosis, which impedes the passage of immature flukes and calcification of bile ducts that play a key role by creating unfavorable microenvironment in chronic cases resulted in decrement of cirrhosis and hydatid cyts to be developed.

In the present findings, the risk of infection by fasciolosis in young was significantly higher when compared with adult cattle. This might be due to the result of acquired immunity against this disease increased with age which is manifested by humoral immune response and tissue reaction in bovine liver due to previous challenge; increased resistant against fasciolosis through development of fibrosis which impedes passage of immature fluke cases to occur. This agreed with findings of Nota and Dima; Bekele *et. al*. [33, 34].

Finally, $9778.33 USD monetary loss per annum incurred due to condemnation of cattle livers infected with fasciola spp. in Jitu slaughter house was much higher with finding of Abunna *et al.,* at Soddo municipal abattoir who reported 4000 USD loss per annum [21] and higher than report of Jimma and Hawassa municipal abattoir who reported 6300 and 5300 USD loss per annum respectively [7, 28]. The current finding is six times higher than the report of Mwabonimana *et al*. [29] at Arusha abattoir, Tanzania and Nuraddis *et al.* [30] at Kombolcha industrial abattoir (1833 USD). The ecological conditions and the number of intermediate host found around the area may also be another factor contributing to the decrement of the economic loss. To this end, it is economically important disease that requires special attention.

CONCLUSION AND RECOMMENDATIONS

Fasciolosis is a major parasitological disease which causes direct and indirect economic impacts on livestock production and productivities, particularly of sheep and cattle in Ethiopia. Most of economic losses of caused by fasciolosis in cattle farm industry are: mortality, liver condemnation, reduced production (meat, milk) and expenditures of different costs for treatment, prevention and control.

In this study higher prevalence of bovine fasciolosis was obtained when compared with the prevalence reported by different researchers from different areas of Ethiopia. The dominant fasciola species revealed in the study area was *F. hepatica* with the prevalence rate of 67.39% and followed by *F. gigantica* with the prevalence rate of 23.41%. Those fasciola species had significant difference in their prevalence due ecolological habitant that favors reproduction of *F. hepatica* rather *F. gigantica* species. Therefore, based on the above conclusion; the following recommendations are forwarded:

- Community based control programs or practices such as regular deworming of animals should be implemented.
- Drainage of marshy areas and fencing of watering points that were thought to be snail habitat in order to restrict the accessibility of animal.
- Strategic use of anthelmintics should be performed to reduce grassing pasture contamination with fluke eggs.
- Use of anti molluscide to kill intermediate hosts in order to interrupt life cycle of fasciola.
- Further clinic based prevalence determination of bovine fasciolosis at the study area should implemented.

REFERENCES

1. ILRI, 2009. (International Livestock Research Institute). Management of Vertisols in Sub Saharan Africa, proceedings of a conference post-mortem differential parasite count FAO corporate document repository.
2. Wamae, L.W. and M.K. Ihiga, 1991. Fascioliasis as a limiting factor in livestock productivity, Bulletin Animal Health Production Africa, 39: 257-269.
3. Menkir, M.S., A. Uggla and P.J. Waller, 2007. Prevalence and seasonal incidence of nematode parasites and fluke infections of sheep and goats in eastern Ethiopia, Tropical Animal Health and Production, 39(7): 521-531.
4. Tadelle, T. and T. Worku, 2007. The prevalence and economic significance of bovine fasciolosis at Jimma, Abattoir, Ethiopia, The Internet Journal of Veterinary Medicine, 3: 15.
5. Yilma, J.M. and J.B. Malone, 1998. A Geographic Information System forecast model for strategic control of fasciolosis in Ethiopia, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia, Veterinary Parasitology, 78: 103-123.
6. Daniel, F., 1995. Economic importance of organs condemnation due to fasciolosis an hydatidosis in cattle and sheep slaughtered at Dire Dawa Abattoir, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University Debrezeit, Ethiopia.
7. Dagne, M., 1994. Survey on prevalence and economic significance of bovine fasciolosis in Debre Berhan Region, DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University. Debrezeit, Ethiopia.
8. Malone, J.B., B. Gommes, J. Hansen, J.M. Yilma, J. Slingenberg, F. Nachtergalle and E. Ataman, 1998. A geographic information system on the potential distribution and abundance of fasciola hepatica and fasciola gigantic in east Africa based on food and agriculture organization data bases. Veterinary Parasitology, 78: 87-101.
9. Rokni, M.B., J. Massoud and E.B. Kia, 2003. Comparison of adult somatic and cysteine proteinase antigens of Fasciola gigantica in Enzyme Linked Immunosorbent Assay for diagnosis of bovine fasciolosis, OIE seminar.
10. Urquhart, G.M., J. Amour, J.L. Duncan, A.M. Dunn and F.W. Jennings, 1996. Veterinary Parasitology 2nd Edn, Oxford, Longman Scientific and Technical Press, UK, pp: 100-109.
11. Solomon, W. and W. Abebe, 2007. Effects of a strategy anthelmintic treatment intervention bovine fasciolosis. A conducted in facilities in endemic area in north western Ethiopia, Ethiop. Veterinary Journal 11(2): 59-68.
12. NMA, 2020. National metrology agency. Revised meteorological station master plan for 2021-2030.
13. HDAO, 2015. Haru districts agricultural office monthly reports.
14. Thrusfield, M., 2005. Veterinary Epidemiology, 3rd ed., Blackwell Synergy, published Company UK, pp: 228-238.
15. Nicholson, M.T. and M.H. Butterworth, 1986. A Guide to condition scoring of zebu cattle. International livestock center for Africa, Addis Ababa, Ethiopia, pp: 3-29.
16. FAO, 2003. Diagnostic Manual on Meat Inspection for Developing Countries, pp: 12-38. Fikirtemariam, A., B. Jemere, F. Yeshwas, H. Mussie and M. Fikirte,2009.Veterinary Clinics, Study on the prevalence of bovine fasciolosis in and around Bahirdar, Ethiopia, pp: 1-26.
17. Urquhart, G., J. Armour, J.L. Duncan, A.M. Dunn and F.W. Jennings, 2007. Veterinary Parasitology, 2nd edition. Singapore; Longman.
18. Ogunrinade, A. and B.I. Ogurinade, 1980. Economic Importance of Bovine Fasciolosis in Nigeria. Tropical Animal Health and Production, 12(3): 155-159.
19. Graber, M., 1978. Helminthes and Helminthiasis of Domestic and wild animal of Ethiopia. Bull. Animal health production in Africa, 23: 57-86.
20. Rahmeto, A., A. Fufa, B. Mulugeta, M. Solomon, M. Bekele and R. Alemayehu, 2009. Fasciolosis: Prevalence, financial losses due to liver condemnation and evaluation of a simple Sedimentation diagnostic technique in cattle slaughtered at Hawassa Municipal abattoir, southern Ethiopia. Ethiopia Veterinary Journal, 14(1): 39-51.
21. Abunna, F., L. Asfaw, B. Megersa and A. Regassa, 2009. Bovine Fasciolosis: Coprological, Abattoir Survey and its Economic Impact due to Liver Condemnation at Soddo Municipal Abattoir, Southern Ethiopia. Tropical Animal Health Production, 42: 289-292.
22. Danboba Tengase, Assefa Kebede and Etsegenet Taqaba, 2016. Comparison on Sensitivity of Coprological and Post Mortem Examination in Diagnosis of Bovine Fasciolosis: Prevalence of the Disease in Bedelle Municipal Abattoir. African Journal of Basic & Applied Sciences, 8(1): 63-72.

23. Aragaw, K., Y. Negus, Y. Denbarga and Desse Shiferaw, 2012. Fasciolosis in Slaughtered Cattle in Addis Ababa Abattoir, Ethiopia. Global Veterinaria, 8(2): 115-118.
24. Meshesha and Tesfaye, 2017. Prevalence of fasciolosis in cattle slaughtered in Hosanna municipal abattoir southern Ethiopia. International journal of advanced research in biological sciences. 4(2): 40-46
25. Petros, A., A. Kebede and A. Wolde, 2013. Prevalence and economic significance of bovine fasciolosis in Nekemte Municipal abattoir. Journal of Veterinary Medicine and Animal Health, 5(8): 202-205
26. Yusuf, M., N. Ibrahim, W. Tafese and Y. Deneke, 2016. Prevalence of Bovine Fasciolosis in Municipal Abattoir of Haramaya, Ethiopia. Food Science and Quality Management, pp: 48.
27. Gebretsadik Berhe, Kassahun Berhane and Gebrehiwot Tadesse, 2009. Prevalence and economic Significance of fasciolosis in cattle in Mekelle Area of Ethiopia. Tropical Animal Health and Production, 41(7): 1503-1504.
28. Amsalu, Y., B. Desta, A. Ataro and T. Andualem, 2017. Prevalence of Bovine Fasciolosis: Coprological, Abattoir Survey and its associated financial losses due to liver condemnation at Hawassa municipal abattoir, southern Ethiopia Global Veterinarian, 18(2): 124-131.
29. Mwabubonimana1, M.F., AA. Kassaku, H.A. Ngowi, Mellau, S.B. Ngahe and E.D. Karimuribo, 2009. Tanzania Veterinary Journal, 26(2).
30. Nuraddis, I., P. Wasihun and T. Tolosa, 2010. Prevalence of Bovines Fasciolosis and Economic Biomedical Medical Research, 11: 278-285.
31. Tolosa, T. and W. Tigre, 2007. The Prevalence and Economic Significance of Bovine Fasciolosis at Jimma Abattoir, Ethiopia. The Internet J. Vet. Med., 3(2).
32. Yilma, J. and A. Mesfin, 2000. Dry Season Bovine Fasciolosis in Northwestern Part of Ethiopia. Revue de Médicine Vétérinaire., 151: 493-500.
33. Nota, K. and F.G. Dima, 2022. Prevalence of bovine fasciolosis in dello mena woreda bale zone south eastern Ethiopia. J. Bacteriol. Infec. Dis., 6(1): 103-109.
34. Bekele Chakiso, Sisay Menkir and Mulugeta Desta, 2014. On farm study of bovine fasciolosis In Lemo Districts and its economic loss due to liver condemnation at Hossana municipal abattoir, Southern Ethiopia. Int. J. Curr. Microbiol. App. Sci., 3(4): 1122-1132.