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Prevalence and Associated Risk Factors of Small Ruminant Fasciolosis in Haramaya District, Eastern Ethiopia

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Abstract: Study was conducted to assess the prevalence of fasciolosis, associated risk factors, identification of *Fasciola* species and sensitivity estimation of direct smear and sedimentation technique for detection of *Fasciola* eggs. An overall prevalence of 13.88 % (23.26% in sheep and 4.12% in goats), 16.91% (27.22% in sheep and 6.1% in goats) and 22.22% (16.91% in sheep and 6.7% in goats) was obtained up on direct smear, sedimentation and postmortem examination respectively. Statistically significant difference (P<0.05) was observed in occurrences of *Fasciola* between animals species, body condition and among the origin of animals. The prevalence of fasciolosis was higher in sheep than goats and poor conditioned compared to those with good body condition score. There was statistically significant difference (P<0.05) between different place of origin, highest prevalence was observed in animals brought from Harar (57.14%) than Jigjiga (7.24%). Both species of *Fasciola* were recovered from sheep and goats of all study areas*; F. hepatica* being predominant (69.31%) compared to *F. gigantica* (19.31%) and mixed infection (11.36%).The sensitivity of the direct smear and sedimentation technique was 62.5% and 76.13% respectively in relation to postmortem examination of fresh liver and substantial agreement between direct smear and post mortem tests (k = 0.722) and there was also a substantial agreement between sedimentation and post mortem tests (k=0.832). This study indicates fasciolosis to be the major parasitic health problem in the area. Reducing impacts of the disease on animal production with implementations of successful intervention strategies is highly recommended.

Key words: Fasciolosis · Prevalence · Ruminants · Sensitivity · Haramaya · Direct Smear · Sedimentation · Risk Factors

INTRODUCTION

Small Ruminants fasciolsis is an economically important parasitic disease which is caused by digenean trematodes of the genus *Fasciola* commonly referred to as liver fluke. The two species most commonly implicated as the etiological agents of fasciolosis are *Fasciola hepatica* or temperate liver fluke and *F. gigantica* or tropical liver fluke [1]. In Ethiopia, the prevalence of fasciolosis is as high as 62.7% [2] in sheep and 17.2 % [3] in goats.

Fasciolosis is known to be one of the most important parasitic diseases in Ethiopia that lowers productivity in ruminants. The snails of the genus *Lymnae* are mainly involved as an intermediate host in the life cycle of fasciolosis. The epidemiology of fascilosis is dependent on the ecology of the intermediate host. *Lymnae truncatula* is the most common intermediate host for *Fasciola hepatica* in different part of the world including Ethiopia [4]. The most important intermediate hosts of *Fasciola gigantica* are *Leptodactylus natalensis* and *Leptodactylus auriallaria* [5]. In Ethiopia, *F. gigantica* is found at an altitude below 1800 m above sea level while *F. hepatica* is found at altitude between 1200 to 2560 m above sea level. Mixed infection encountered at 1200 to 1800 m above sea level [6].

Diagnosis of fascilosis may consist of tentative and confirmatory procedures. Confirmatory diagnosis of fascilosisis based on demonstration of *Fasciola* eggs through standard examination of fecal samples in the laboratory, post mortem examination of infected animals and demonstration of mature flukes in the liver [5, 7].

Haramaya is found in suitable geo ecological zone with several water reservoirs which are important factors for occurrence of fasciolosis. However little information is available regarding the coprological and

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abattoir prevalence of fasciolosis which, serve as a base line data if control measure based on sound scientific evidence is to be initiated. Therefore, the objectives of the current study were to determine the prevalence of small ruminant fasciolosis, associated risk factor, *Fasciola* species identification and to determine the sensitivity of sedimentation and direct smear diagnostic method over post-mortem.

MATERIALS AND METHODS

Study Area: The study was conducted in Haramaya Town at Haramaya municipal abattoir. Ecologically the zone is part of Ethiopian highland system and lies in the semi-arid tropical belt of eastern Ethiopia in Oromia Regional State. Geographically the town is located at about 511 km away from Addis Ababa in Eastern direction altitude of about 9°24'N and 42°01'E longitude, with altitudes ranging from 1600-2100 meter above sea level. The area has an annual rainfall ranging from 118-866 mm at which short rainy season in February and long rainy season noticed extending from July to September. The monthly minimum and maximum temperature of the area is 9.4 and 24°C, respectively with 64.5 relative humidity. Mixed crop livestock farming is the predominant production system in the rural area. Haramaya district have livestock population of 98, 090 bovine, 120, 145 caprine, 69, 950 ovine, 480 camels and 28, 250 Equine. Animals for slaughter were coming from different areas surrounding the town [8].

Study Animals: The study was conducted on a total of 396 apparently healthy small ruminants, of 202 sheep and 194 goats slaughtered at Haramaya municipal abattoir from a total of 808 sheep and 776 goats slaughtered during the study period. The animals were local breeds originated from different agro-ecological zones, which are managed under extensive management system. Even though, the study animals were kept under broad range of management, animals in most of the rural areas were kept to graze pasture on grassland and supplementary feedings of crop residue when pasture is scarce especially during long dry season. The means by which animals transported to abattoir is by vehicles and driven.

Study Design: A cross sectional study was conducted from February to May 2016 to determine the prevalence of small ruminant fasciolosis brought for slaugheter at haramaya municipal abattoir from different areas, namely, Haramaya area, Babile, Jigjiga and Harar by using both antimortem fecal examination and postmortem examination of the liver. Data on the potential risk factors associated with the occurrence of Fasciolosis were collected by using recording formats and assessed. Age of the animals was estimated based on Cringoli *et al.* [9] dental table and the animals were grouped into two age categories: < 2 years (young) and > 2years (adult). Grouping also made by their body condition based on Suiter [10].

Sampling Method and Sample Size Determination: The animals were selected using systematic random sampling using regular interval to study the prevalence and species of fasciola involved in small ruminants both by fecal examination before slaughter and postmortem examination. The total number of animals required for the study was calculated using the formula given by Thrusfield [11] for simple random sampling methods,

$$N = \frac{1.96^2 P\exp(1 - P\exp)}{d^2}$$

where: N= required sample size.
P_{exp} = Expected Prevalence.
d = desired absolute precision

The previous prevalence of fasciolosis report of Mulatu and Addis [12] around Hirna town on small ruminant at the study area was 11.6 %, this entails the expected prevalence and by using a desired absolute precision of 0.05, the total number of sample population required to undertake the study was calculated to be 150. However, to increase the precision and to simultaneously compare different tests like direct smear and sedimentation with post mortem examination as a diagnostic tool on small ruminant fasciolosis a total of 396 animals were used in the study.

Study Methodology

Ante Mortem Data Collection and Fecal Sample Collection: All information such as identification, origin, sex, breed and age of the animal was collected from the owner/attendant when animals were brought to the slaughter house. The fecal sample was collected per rectum from the animals using disposable glove in to clean universal bottle and preserved by 10% formalin after labeling. Then the sample was transported to Haramaya University Veterinary Parasitology Laboratory, direct smear and sedimentation techniques were used to detect egg of the parasite following the standard procedure [13].

Postmortem Examination: All the 396 animals from which fecal sample were taken was followed for postmortem examination particularly emphasizing to liver. During the postmortem examination, general examination like palpation and inspection was conducted followed by transverse incision of the liver across the thin left lob in order to confirm as indicated by David [14] for further examination. Gross identification of affected organ had been conducted depending on color change, consistency and shape. The parasites were collected from liver and bile ducts of the animals and identified by naked eye using identification key, such as leaf-shape, Pointe of the posterior and widens at the front or interiorly and oral sucker in to *F. hepatica* and *F. gigantica* as that of Soulsby [7].

Data Management and Statistical Analysis: The data collected during sampling and laboratory findings were entered in MS-excel 2013 spreadsheet. SPSS 16 statistical software package was used to perform the statistical analysis. Fasciolosis prevalence was calculated as percentage by dividing the number of animals positive up on each test (Direct smear, sedimentation and post mortem examination) to the total animals sampled. Pearson chi-square (χ^2) was employed to assess the existence of association between occurrence of Fasciolosis and different potential risk factors considered in the study.

Kappa coefficient was used to determine the agreement of the tests (Sedimentation and direct smear techniques with post mortem examination, which was considered as gold standard test) for diagnosis of Fasciolosis. Cohen's Kappa is measure of agreement between the two individuals when two binary variables are attempts by two individuals to measure the same thing and Kappa of 1 indicates perfect agreement, where as a kappa of 0 indicates agreement equivalent to chance. Kappa value was interpreted as: agreement by chance (K<0), slight agreement (K = 0.01- 0.20), fair agreement (K= 0.21-0.40), moderate agreement (K= 0.41-0.60), substantial agreement (K= 0.61-0.80) and almost perfect agreement (K=0.81-0.99) [15]. For this analysis, P values <0.05 were considered significant whereas P values >0.05 considered non-significant at 95% confidence interval. The sensitivity and specificity of the direct fecal smear and sedimentation technique was calculated as given by Thrusfield [11].

RESULTS

Prevalence: From the 396 sheep and goats tested, 55 (13.88%), 67 (16.91%) and 88 (22.22%) was positive for fasciolosis where 47 (23.26%), 55 (27.22%) and 67 (16.91%) was obtained in sheep and 8 (4.12%), 12 (6.1%) and 13 (6.7%) was obtained from goat up on direct smear, sedimentation and postmortem, respectively (Table 1).

Table 1: Prevalence of small ruminant fasciolosis by different tests and their sensitivity

	Techniques	No. examined	Positive	Prevalence%	Sensitivity%
Overall	Direct smear	396	55	13.8	62.5
	Sedimentation	396	67	16.9	76.13
	Postmortem	396	88	22.22	100
Sheep	Direct smear	202	47	23.26	62.6
	Sedimentation	202	55	27.22	73.33
	Postmortem	202	75	37.12	100
Goat	Direct smear	194	8	4.12	61.5
	Sedimentation	194	12	6.18	92.3
	Postmortem	194	13	6.7	100

Table 2: Prevalence of detected Fasciola species

Species of animal	Species	No examined	Positive	Prevalence from positive cases (%)
Sheep	*F. hepatica*	202	55	62.5
	F. gigantica	202	13	14.77
	Mixed	202	7	7.95
Goat	*F. hepatica*	194	6	6.81
	F. gigantica	194	4	4.54
	Mixed	194	3	3.40
Sheep and goat	*F. hepatica*	396	61	69.31
	F. gigantica	396	17	19.31
	Mixed	396	10	11.36

Table 3: Prevalence of small ruminant fasciolosis with respect to different possible risk factors

		No. of examined, No. of positive animal (in bracket), Prevalence as % from each area					
Factors	Classification	Harar	Babile	Jigjiga	Haramaya area	Total	P value
Age	Young	7(4)57.14	47(13)27.6	37(4)10.8	118(32)27.1	209	0.112
	Adult	7(4)57.14	45(7)15.5	32(1)3.1	103(23)22.3	187	
Species of animal	Ovine	9(8)88.8	38(16)42.1	15(1)6.6	140(50)35.7	202	<0.001
	Caprine	5(0)0	54(4)7.4	54(4)7.4	81(5)6.1	194	
Body condition	Good	9(5)55.5	57(7)12.2	46(0)0	139(19)13.6	251	<0.001
	Medium	1(0)0	24(5)20.8	19(2)10.5	50(13)26	94	
	Poor	4(3)75	11(8)72.2	4(3)75	32(23)71.8	51	
Species of fasciola	*F. hepatica*	14(4)28.5	92(14)15.2	69(0)0	221(43)19.45	61	<0.001
	F. gigantica	14(3)21.4	92(4)4.3	69(4)5.7	221(6)2.71	17	
	Mixed	14(1)7.14	92(2)2.17	69(1)1.4	221(6)2.71	10	

Table 4: Comparison of tests agreement with gold standard test (post mortem examination)

		Post mortem examination			
Tests		Negative	Positive	Sub-total	Kappa value
Direct smear	Negative	308	33	341	0.722
	Positive	0	55	55	
	Sub-total	308	88	396	
Sedimentation	Negative	308	21	329	0.832
	Positive	0	67	67	
	Sub-total	308	88	396	

Highest prevalence was recorded due to *F. hepatica* 61 (69.31%) than *F. gigantica*17 (19.31%) and 10 (11.36%) mixed infestation of the two parasite.

There was statistically significant difference (P<0.05) of infection between the two species in which higher infection rate was observed in ovine than caprines.

The result of present study showed a significant difference among body condition score (P<0.05). Infection rate of fasciolosis in poor body condition group was significantly higher than that in good body condition group (Table 2). Analysis of prevalence rates on age basis showed insignificant difference between different age groups (P >0.05).

Comparison of Tests Agreement with Gold Standard Test (Post Mortem Examination): From the 396 small ruminants that had Flukes in their livers, only 55 and 67 *Fasciola* eggs were observed in their feces by direct smear and sedimentation technique, respectively. The sensitivity of coprological examination was 62.5% and 76.13% for direct smear and sedimentation, respectively. There was substantial agreement between direct smear and post mortem tests (k = 0.722) (Table 4) and there was also a substantial agreement between sedimentation and post mortem tests (k=0.832) (Table 4).

DISCUSSION

In this study, a total of 396 animals brought from different areas were examined at antimortem and postmortem examination for fasciolosis. Of these, 75(37.12%) sheep and 13(6.70%) goat, over all 88(22.22%) were found positive for *Fasciola*. This finding is in agreement with the report of Sirajudin Kedir *et al*. [3] 24.0%. This might be due to the same epidemiology of the disease. However, the result of this study is not in agreement with that of Yilma and Malone [16] 49% in DebreZeit abattoir and Tesfaheywet and Negash [17] 45.6% in Odabultum destrict western harerghe, this may be due to implementations of control strategies over the periods in this study areas and difference in ecology of animal. Prevalence Study made by abattoir survey and coprologic examination can also contribute to the variation in prevalence of small Ruminants fasciolosis, as evidenced by the current study. But, higher than the findings of Hawassa zuria [18] 9.8% and 14.6% in and around Hirna town [12] which is directly depends on the presence of favorable environments for the existence, multiplication and spread of intermediate host snails and the parasite [3].

The result of the present study showed significantly higher prevalence of fasciolosis in sheep when compared to goats. Similar results were reported by Mulatu and Addis [12], Endris *et al.* [19] and Michael *et al*. [20]. This could be due to the difference in the feeding behavior of the two species of animals and the nature of their immunological reaction to the parasite.

Prevalence rate of 24.88, 21.73, 57.14 and 7.24% percent was recorded in Haramaya area, Babile, Harar and jigjiga area, respectively. There was statistically significant difference ($P< 0.05$) between the four areas this signified district seems have impact on the infection rate and the areas have difference with the availability of water reservoir for the multiplication of intermediate host. This result is not in agreement with Rahmeto Abebe *et al.* [18] in Hawassa Zuria and Gebreyohannes *et al.* [21] Menz Gera Midr Woreda of North Shoa Zone, Ethiopia.

Both species of *Fasciola* are infecting sheep and goats from all study areas with single or mixed infections as proved in the present study. In Ethiopia, *F. hepatica* is common in areas above 1800 meters above sea level, while *F. gigantica* is predominant in those areas having altitude bellow 1200 meters. This result is in agreement with Dawit and Adem [22] in which, the co-existence of both species was reported in areas with altitude ranging from 1200 to 1800 meters above sea level. Haramaya town and surrounding areas have altitudes ranging from 1600-2100 meter above sea level which is favorable for co-existence of both species of *Fasciola*. The predominant species involved in causing small ruminants fasciolosis in the study area is *F. hepatica* and similar result were reported by Troncy [23] and this is associated to the existence of favorable ecological condition for the study area [23].

The results of the study indicated that the infection rates in poor body condition animals were significantly higher ($P< 0.05$) than that of the good body condition animals. The result was in agreement with Mulatu and Addis [12], Mathewos Temesgen *et al.* [24] and Desta *et al.* [25]. This signifies the importance of fasciolosis in causing weight loss and is the characteristic sign of the disease [22].

In the current study, the sensitivity of Sedimentation and direct smear technique to detect *Fasciola* eggs were 76.13% and 62.5%, respectively. This is in agreement with the reports of 56.7% in Vietnam [26] 60% in Switzerland [27] 56.28% report from Jima [3] this is because of there is substantial agreement between the tests.The decrease in sensitivity of direct smear and sedimentation method may be attributed partly to the fact that *Fasciola* eggs only appear in feces 8-15 weeks post infection [28]. Furthermore, detection of *Fasciola* eggs is not reliable during the prepatent period as eggs are expelled intermittently depending on the evacuation of the gall bladder [29].

CONCLUSION

The present study concluded that fasciolosis is the most wide spread and prevalent parasitic disease affecting the health and productivity of animals in the study area. The high prevalence of fasciolosis obtained in the present study clearly indicates the high risk the parasite poses to the economy and public health in the east harerghe zone.

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