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Coprological Examination of Ovine Fasciolosis in Horro District Community Based Sheep Breeding Program, Horro Guduru Wollega Zone, Western Ethiopia

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Abstract

A cross-sectional study was conducted from November 2017 to March 2018 to determine the prevalence of ovine fasciolosis in the Community Based Horro Sheep Breeding site at Horro district, Horro Guduru Wollega zone, Ethiopia. Coprological examination was performed on a total of 390 sheep at the study area. Age, sex, body condition score and peasant association were taken into consideration as rik factors. An overall prevalence of fasciolosis 45.4% [95% CI (40.41, 50.36] was found on the basis of coprological examinations. The prevalence of fasciolosis findings according to PAs were (41.5%) in Laku Ingu and (48.2%) in Gitilo Dole. Statistical analysis of the prevalence among study site (PAs) showed insignificant difference P=0.102 (P>0.05), but significant difference (P<0.05) was observed between animal age groups (P=0.032, with a prevalence of 37.2% in young and 49.8% in adult) and body condition scores (P=0.001, with a prevalence of 57.9%, 43.5% and 29.9% in sheep with poor, medium and good body condition score, respectively. There was insignificance difference (P>0.05) in sex group of study animals in which the prevalence was 47.6% in female and 38.8% in male. Therefore further studies on the epidemiology, seasonal dynamic of the disease, the snail intermediate host and impacts of the infection in animal production with implementations of strategic intervention is necessary.

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Introduction

Ethiopia is believed to have the largest livestock population in Africa with estimated population of 59.5 million cattle, 30.70 million sheep, 30.20 million goats, 2.16 million horses, 8.44 million donkeys, 0.41 million mules, and 1.21 million camels. The livestock sub-sector contributes about 12% of the total and over 45% of the agricultural GDPs. Small ruminants are the dominant livestock providing up to 63% of cash income and 23% of food substance value obtained from livestock production [1].

In Ethiopia, sheep is the second most important species with diverse breeds and ecotypes distributed from cool alpine climate of the mountains to the arid pastoral areas of the lowlands [2]. Small ruminants provide about 46% of the national meat consumption and 58% of the value of hide and skin production. They have many advantages over large ruminants for most smallholder farmers, including among others: less feed costs, easy management and appropriate size at slaughter [3].

However, the Country has rich potential from the livestock sector is not efficiently exploited due to several constraints including suboptimal nutrition, traditional management and most importantly high prevalence of diseases [4]. Endo-parasite infection and management problems are known to be the main factors that affect productivity. The various species of gastrointestinal and pulmonary nematodes, trematodes and cestodes are known to be prevalent in Ethiopia. Among the many parasitic problems of small ruminants, fasciolosis was found to be the major one [5].

The Fasciolosis occurs world-wide and causes substantial economic losses in animal production [6, 7]. Fasciolosis due to *F. hepatica* and *F. gigantica* was found to be prevalent and economically important in many parts of Ethiopia [8 & 9]. In Ethiopia, the prevalence of fasciolosis was reported to be in the rage of 11.5% to 87.0% in small ruminants (Incorporate reference). Fasciolosis was reported to cause significant economic loss associated to mortality, morbidity, reduced growth rate, condemnation of fluky liver, increased susceptibility to secondary infections and expenses for control measures [8].

In addition to its tremendous effects on livestock production and their productivity, fasciolosis also has a public health importance. It has been reported that currently, the number of humans thought to be infected is 2.4 to 17 million with further 180 million people being at risk for infection [10].

Diagnosis of fasciolosis is based primarily on clinical sign, examination of feces for fluke eggs, postmortem examination, identification of snail habitats and hematological tests [5]. Knowledge on the prevalence of the disease and associated risk factors as part of the epidemiology of the disease is crucial for any attempt of prevention and control of the disease in question. Estimation of the economic significance of the disease is important for decision making, planning, development and implementation of control strategies [7].

When these are an evident on its endemicity in the country, there is no any assessment and report regarding the prevalence, and associated risk factors of ovine also the agro ecological condition of the area seems to be favorable for the parasite like communal grazing land using practice for all livestock in the area. Moreover, estimation of prevalence and associated risk factors of the disease is important for decision making, planning, development and implementation of control and prevention strategies. Therefore, the present study was carried out to investigate the prevalence of ovine fasciolosis in the Horro Sheep Breeding site in Horro district, Oromia regional state, Ethiopia; where sheep are important assets to the community and at the location that believed to be the home tract to the Horro sheep breed [11].

Therefore, the objectives of this study were:to estimate the prevalence of ovine fasciolosis,and to assess the associated risk factors at Community Based Horro Sheep Breeding site in Horro district, western Ethiopia.

Materials and Methods

Study Area

The study was conducted from November 2017 to March 2018 in Horro district, Horro Guduru Wollega zone, Oromia Regional state, west part of Ethiopia; at the sites of community based Horro sheep breeding

program of Bako agricultural research centers. Horro district is located 64 kms North West of Bako research center and 310 kms West of Addis Ababa. It lies at an altitude range of 1800 to 2835 m.a.s.l. and the area has one long rainy season extending from March to mid-October with mean annual precipitation of about 1800 mm with mean maximum, minimum and average annual temperatures of about 22.67, 11.75°C and 13.3°c, respectively [11]. Horro district consists of 37.89% highland, 54.75% mid altitude and 7.86% lowland [12]. The season is divided into three: the main rainy season (June-October), dry season (November-February) and short rainy season (March-May). In this study two PAs were included namely, Laku-Ingu which has 66 small holder members, whereas Gitilo-Dole has 69 small holder members. The Horro sheep community based breeding program is carrying out in Horro district at the location that believed to be the home tract to the Horro sheep breed and mixed crop-livestock agriculture is the main stay of the farming communities.

Study Animal

The study animals were indiginous Horro Sheep breed. In the population there are animals of different age groups and body condition and sex groups. The animals were managed under extensive management system.

Study Design

A cross-sectional study was conducted from November 2017 to March 2018 in the selected study area to determine the prevalence of ovine fasciolosis.

Sample Size Determination and Sampling Method

The required sample size was calculated based on the expected prevalence of 55.7% according to the previous study at the neighbor district (Jimma Rare) by [13] and absolute desired precision of 5% at confidence level of 95% according to the methods provided [14].

The calculated sample size was 379; however in order to increase the accuracy, the numbers of sampled sheep have been elevated to 390 in this study for coprological examination. The study animals were randomly selected with no recent treatment history with anthelmintic.

Sampling Technique

Within the two PAs namely: Laku-Igu and Gitilo Dole where the community based Horro sheep breeding program is ongoing there, were selected by considering the population size of sheep in the area. Simple random sampling technique was the sampling strategy used to collect all the necessary data from fecal samples of the study animals. Therefore, out of the total 390 sheep selected for the study, 164 were from Laku-Igu and 226 were from Gitilo Dole. Table 1.

Potential Risk Factors

In this study PAs, sex, body condition and age are considered as animal risk factors. Body condition of each animal was determined based on the criteria set by [15]. However, for suitability, in this study sheep were classified into groups with poor, medium and good body conditions. The body condition was classified into three categories as poor (condition 1 and 2), medium (condition 3) and good (condition 4 and 5) in accordance with the score card given by [15]. Age was determined based on the dentition [16] and the owner's information. In this study the age was suitably categorized as adults and young. Sheep up to the age of 1year was considered as young and the rest, as adult.

Sample Collection, Transportation and Examination

Fecal samples for parasitological examination

Table 1. Study sites (PA) versus distribution of sheep in the study.

Peasant Association	Sheep population size	Proportional allocation
Laku Ingu	1214	226
Gitilo Dole	881	164
Total	2095	390

were collected directly from the rectum of each animal, using disposable plastic gloves and placed in clean screw capped plastic bottle. During every sampling, data on the location of the animal, age, sex and body condition score was recorded on a format prepared for this purpose. The samples were transported by ice box to Bako Agricultural Research Center, Animal Health Laboratory for coprological examinations; after labeling with animal ID, age, sex, body condition score and site where sample collected.

Carpological examination was performed to detect *Fasciola* eggs in the faeces by using the standard sedimentation technique described by [17]. During coprological examinations, samples were identified into positive and negative for Fasciola egg and results were registered. Samples that were not processed within 24 hours from collection were stored in a refrigerator at 4°C.

Study Methodology

Coprological Examination

Fresh fecal sample was collected directly from the rectum of each animal. Using disposable plastic gloves and placed in clean screw capped plastic bottle and each sample was clearly labeled with animal identification, place of collection, body condition score, sex and age of sheep. The collected fecal samples was placed in ice box and transported to the Bako Agricultural Research Center, Animal Health Laboratory for examination.

In laboratory the samples were processed by sedimentation technique and the eggs of Fasciola species was identified under compound microscope after staining the sample with 1% methyl blue [17]. To differentiate eggs of *Paramphistomum* and *Fasciola*, A drop of 1% methylene blue solution will be added to the Sediment. Eggs of *Fasciola* species showed yellowish Color while eggs of *Paramphistomum* species stain by Methylene blue [17].

Data Management and Statistical Analysis

All the data generated during sample collection and laboratory findings were entered and coded in Microsoft Excel 2010 program and were stored for statistical analysis. The data were analyzed using Statistical Package for Social Sciences (SPSS) software version20. The overall prevalence of fasciolosis was calculated by dividing the total number of animals positive to the total number of animals examined. For inferential analysis multivariate logistic regression was used to assume on the level of strength of association of explanatory variables hypothesized with the outcome variable after calculating the odds ratio. A 95% confidence interval of the OR and p-values were used to describe statistical significance associations. The association is judged as significant when p- value is less than 0.05.

Results

From the total of 390 examined sheep for fasciolosis through coprological examination 45.4% (177/390; 95% CI (40.41, 50.36)) were positive for Fasciola eggs. The logistic regression analyses of the risk factors indicated the presence of strong statistical association of fasciola infections with the body conditions (P=0.001) and animal age (P=0.032) while variables like animal location and sex are not significantly associated with the risk of acquiring *fasciola* infection.

The prevalence of ovine fasciolosis recorded in both study sites (PAs) were 68 (41.5%) and 109 (48.2%) in Laku Ingu and Gitilo Dole, respectively. Although the prevalence rate 109 (48.2%) in Gitilo Dole was relatively higher than 68 (41.5%) in Laku Ingu. But, as indicated in table 2, no statistically significant difference P=0.102 (P > 0.05) was observed among the sites of sampled animals with the occurrence of ovine fasciolosis.

The coprological examination revealed that the prevalence of ovine fasciolosis was highest in sheep with poor body condition (57.9%) followed by medium body conditioned animals (43.5%) and good body conditioned (29.9%). Strong statistical association (P = 0.001) was observed between body condition scores and occurrence of ovine fasciolosis (Table 2). Sheep with poor and medium body condition scores had 3.136 and 1.833 times more likelihood to harbor ovine fasciolosis than sheep with good body condition score, respectively.

Based on the sex group the prevalence fasciolosis was 38.8% and 47.6% in male and female respectively. Although the prevalence was relatively

higher in female; the differences in infection probability is not statistically significant (P=0.713). In regards to the age group of study animals, the prevalence was lower in young (37.2%), versus (49.8%) in adult indicating the OR of ovine fasciolosis to be 1.603 more likely in adult than the young age group as indicated in Table 2. Statistically significant difference (P=0.032) was observed among age groups with occurrence of ovine fasciolosis. Table 2

Discussion

Coprological examination of the fecal samples collected from 390 sheep revealed overall fasciolosis prevalence 45.4% (177/390; 95% CI (40.41, 50.36)). This is important because quantitative assessment. So, this disease provided good evidence to look for its economic burden. Accordingly, the present study revealed that ovine fasciolosis is found to be an important sheep disease in Horro sheep breed, community based breeding site at Horro district.

The result of the present study was relatively comparable to other workers in different region of country such as: [7] 49% prevalence in Kemissie; [18] 46.6% prevalence in and Around Motta Town; [19] 49% prevalence in Holeta; [20] 50.8% prevalence in and around Chole and [21] 48.21% prevalence in Debre Berhan Sheep Breeding and Forage Multiplication Center.

This result is higher when compared with previous findings of [22] 30.7% prevalence in Sherka Woreda Arsi; [4] 39.5% prevalence in Adigrat; [23] 33.85% prevalence in North Wollo. The variation in prevalence might be due to the presence of stagnated water bodies and marshy pasture land, agro-ecological factors like irrigation practices, husbandry (management) practice of ovine like freely grazing or tied, health care of animals.

However, this finding is lower than the previous studies conducted in upper Awash river basin by [24] 56.56% prevalence; in Jimma Rare by [13] 55.7% prevalence; in Menz Lalo Midir District by [25] 70.2% prevalence.

The coprological examination result showed the prevalence of ovine fasciolosis in the study animals at the site of Gitilo Dole was relatively higher than in the

Table 2. Final multivariable logistic regression model output of factors associated with fecal shedding of fasciola eggs.

Risk factors	Categories	No	(Prevalence %)	OR	95% CI	P-value
PA	Laku Ingu	164	68 (41.5%)	0.701	ref.	
	Gitilo Dole	226	109 (48.2%)		(0.458, 1.073)	0.102
Sex	Male	98	38 (38.8%)	0.911	ref.	
	Female	292	139 (47.6%)		(0.552, 1.501)	0.713
Age	Young	137	51 (37.2%)		ref.	0.032
	Adult	253	126 (49.8%)	1.603	(0.417, 1.018)	
BCS	Poor	114	66 (57.9%)	3.136	(0.339, 0.891)	0.001
	Medium	209	91 (43.5%)	1.833	(0.161, 0.600)	
	Good	67	20 (29.9%)		ref.	
Total		390	177 (45.4%)			

OR= Odds Ratio, No= Number of animal examined, CI= Confidence Interval, ref=reference cell

Laku Ingu, however it was not statistically significant (P>0.05) (table 2). However, this minor difference might be the presence of a river and ponds in around the communal grazing land in Gitilo than in Laku. Similar differences due to the presence of water bodies were also observed by [19, 8 &18].

This study correlated that prevalence of ovine fasciolosis become high as the age of the sheep increase. In other word, the younger the age the lower the prevalence and the older the age the higher it will be (table 2). So, that significant difference in prevalence of ovine fasciolosis of different age group were observed (P<0.05).This is certainly because of that adult animal have repeatedly exposed to flukes infection than young's. Related results have been reported by [20, [25] and [26]. This might be young animals are not usually allowed to go far with adults for grazing. So the chance of exposure to infective metacercaria was lower as compared with adult animals.

According to statistical analysis of infection rates on the basis of sex group, coprological prevalence of ovine fasciolosis was almost similar in female and male sheep in the study areas. This study supports the [27] reports, both sexes have been equally affected with fasciolosis and a higher prevalence of parasitic infection was not associated with sex (P> 0.05). The result also shares with [23]. The sex of sheep has no impact on the prevalence of fasciolosis. The sheep exposed to graze and parasitic infection with equal ratio. Sex did not show significant variation on the prevalence of *Fasciola (*table 2*)*. Parallel finding was also shown by [28] and [29]. This might also be due to grazing of both sex groups in similar *Fasciola* contaminated pasture land have equal chance for infection.

In this coprological examination results showed that ,the highest prevalence observed in animals with poor body condition (54.4%) followed by medium body condition (43.1%); while the lowest was observed in cattle with good body condition (37.3%), in which the difference was statistically significant (table 2). In accord with our finding, [30]; [31] and [29] also reported, prevalence in poor body conditions higher than in good body conditions. This could be due to the fact that animals' with poor body conditions are usually less resistant and are therefore susceptible to infectious diseases. This result indicates that fasciolosis causes reducing of body weight gains.

Conclusion and Recommendations

Fasciolosis is a major complication for sheep production and productivity by imposing remarkable direct and indirect losses at different parts of the country. The examination has investigated the high prevalence of ovine fasciolosis in reared sheep under extensive farming system in Laku Ingu and Gitilo Dole PAs, both member of community based Horro sheep breeding program at the site in Horro district of the Oromia regional state, western Ethiopia. This parasitic infection is distributed in many parts of the country and considered as one of the major obstacles to sheep production causing direct and indirect losses. The findings of this examination revealed that fasciolosis is still a health problem in the study area. Using communal grazing land for sheep with other livestock, presence of favorable conditions like marshy area, stagnant water bodies and poor management practices can facilitate the infectivity of the parasite in the area.

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References

1. Gizaw, S., Komen, H., Windig, J.J., Hanotte, O. and van Arendonk, J.A.M., (2008). Conservation priorities for Ethiopian sheep breeds combining threat status, breed merits and contribution to genetic diversity. Genet. Sel. Evol. 40:433 – 447.
2. CSA (Central Statistical Agency), (2016/17). Federal Democratic Republic of Ethiopia, Central Statistical Agency, Agricultural Sample Survey. Addis Ababa, Ethiopia.
3. Abegaz, S., Duguma, G., Galmessa, U., Soboqa, B. and Terefe, F., (2005). Small ruminant production system in East Wollegga and West Shoa zones.

Research Report, Oromia Agricultural Research Institute, Bako Agricultural Research Center, Bako, Ethiopia, Pp.31.

4. Eyerusalem G., Zgabeher, Y.A., Mihreteab B., (2012).Prevalence of Ovine Fasciolosis in Adigrat, North East Ethiopia. Jimma University, P. O. Box 307, Jimma, Ethiopia. IDOSI Publications: 9 (1): 92-96
5. Steyl J.A.C. (2010): Severe necrohaemmorhagic tracts in liver due to migrating immature flukes. DVM Thesis, Faculty of Veterinary Science, Onderstepoort. Pp 1-7.
6. Pfister, K., (2010). Serodiagnosis of fasciolosis in ruminants 2010. *Rev. sei. Tech. Off. Int. Epiz,* 9 (2): 511-518
7. Bitew, M. Ibirahim, N. and Abdela, A., (2010). Study on prevalence of ovine fasciolosis in and around Dawa-Chaffe, Kamissie. *Afr.J. Agric. Res.*5 (21): 218-234.
8. Malone J B., Gommes R., Hansen J., Yilma J M., Slingenberg J., Snijders F., Nachet O F and Ataman E., (1998). A Geographic Information System on the potential Distribution and abundance of *Fasciola hepatica* and *F. gigantica* in East Africa based on food and agriculture organization databases, Elev, Vet Parasitol, Pp. 87-101.
9. Dawit K., and Adem H., (2011). Abattoir survey on the prevalence and monitory lossassociated with Fasciolosis in sheep and goats. *International Journal of Livestock Production.* 2(9):138-141.
10. Soliman, M. F. (2008). Epidemiological review of human and animal fascioliasis in Egypt. *The Journal of Infection in Developing Countries*, *2*(03), 182-189.
11. Edea, Z. (2008). Characterization of Bonga and Horro indigenous sheep breeds of smallholders for designing community based breeding strategies in Ethiopia (Doctoral dissertation, Haramaya University).
12. HARDO (Horro District Agricultural and rural Development Office), (2006). Socio-economic Survey report. Horro, East Wollega, Ethiopia.
13. Shanko and Olgira., (2016). The Prevalence Study of Ovine Fasciolosis in Jima Rare District, Horo Guduru Wollega Zone, Oromia Regional State, Western Ethiopia. Haramaya University, Collage of Veterinary Medicine, P.O.Box 138, Dire Dawa, Ethiopia. *Journal for Veterinar Sci Technol*, 7(1): 1-13
14. Thrusfield, M. (2005): Survey, in Veterinary Epidemiology, 2nd edn. Blackwell science ltd, Oxford, Pp. 178–198.
15. Thomson E.F, Orita G (1988). Seasonal Prevalence of Protostrongylid and Dictyocaulus Species of Lungworms in Awassi Sheep in North-West Syria. Tropical Animal Health Production, 20: 187-189.
16. Sanchez-Andrade, R., Paz-Silva, A., Sua´ rez, J.L., Panadero, R., Pedreira, J., Lo´ pez. C, Dı´ez-Banos, P., Morrondo, P., (2002). Influence of age and breed on natural ovine fasciolosis in an endemic area (Galicia, NW Spain). *Vet. Res. Commun.*26:361–370.
17. Hansen, J., & Perry, B. (1994). Techniques for parasite assays and identification in fecal samples in the epidemiology, diagnosis and control of helminth parasites of ruminants. *Inter. Lab. Res. Anim. Dis.*, *3*: 3-1
18. Endeshaw Demil, Adugnaw Mekonnen, Takele Adugna, Wogayehu Assefa and Tiliksew Bialfew., (2017).Prevalence of Ovine Fasciolosis in and Around Motta Town, North-West Ethiopia. University of Gondar, P.O.Box 196, Gondar, Ethiopia.
19. Jobre Y, (1985). Study on Ovine fasciolosis and other Helminth Parasites at Holeta DVM Thesis, Addis Ababa University, Debre Zeit, Ethiopia. Pp. 45.
20. Hubad Hussein, Seifudin Kasim, Sufian Abdo, Kemer Kadi, Mukarim Abdurahaman., (2017). Study on Prevalence of Ovine Fasciolosis in and Around Chole Woreda, Ethiopia. Jimma University, Jimma Town, Ethiopia. International Journal of Research Studies in Biosciences (IJRSB): 5(1): 1-5
21. Jarso D, Alemayehu F, Teka G and Tesfaye A., (2016). Breeding, D.B.S., Study on Prevalence of Ovine Fasciolosis in and Around Debre Berhan Sheep Breeding and Forage Multiplication. Department of Veterinary Medicine and Agriculture, Addis Ababa University, Ethiopia. *Open Access Journal of Veterinary Science & Research*, 1(3): 1-7.
22. Yoseph Cherinet Megerssa, Tafa Bekele Jima,

Yemsrach Miressa Diriba and Fanos Tadesse W/ Mariyam., (2017). Burden of Ovine Fasiolosis in Sherka Woreda Arsi, Ethiopia. Journal of Veterinary Science & Technology, 8(1):3-12

23. Chekol B. and Girma Y., (2018). Study on the Prevalence of Ovine Fasciolosis in Wadla Woreda, North Wollo, Ethiopia.Ministry of Livestock and Fisheries, Addis Ababa, Ethiopia.Open Access Journal of Veterinary Science & Research: 3(1):5
24. Michael, A., (2004). Infection prevalence of ovine fasciolosis in irrigation schemes along the upper Awash River basin and effects of strategic anthelminthic treatment in selected up stream areas. MS thesis. Addis Ababa University. School of graduate studies, Ethiopia. Pp.79
25. Chanie and Begashaw, (2012). Assessment of the Economic Impact and Prevalence of Ovine Fasciolosis in Menz Lalo Midir District, Northeast Ethiopia. Vet World 5(1): 261-264
26. Ibrahim A, Nölkes D, Gezahegn E, Taye M., (2017). Prevalence of Ovine Fasiolosis in Jimma and Selected Rural Kebeles near Jimma, Southwest Ethiopia. *J Vet Sci Technol*. 8(5): 424.
27. Solomon W., (2005). Effect of strategic anthelmintic treatment on ruminant fasciolosis in Upper Blue Nile Basin, North Western Ethiopia, Addis Ababa University, Msc. thesis, Pp: 78.
28. Gebreyohannes, M., Y. Demeke and E. Kebede., (2013). Ovine Fascioliasis Prevalence and Associated Risk Factors in Menz Gera MidrWoreda of North Shoa Zone, Ethiopia. J. Anim. Prod. Adv., 3(6): 203-207
29. 29. Mohammed, S., (2010). Prevalence and economic importance of ovine fasciolias is in and around kombolcha, DVM thesis, Gondar University, Gondar, Ethiopia
30. Mulugeta, T., Geremew, B., & Molalegne, B. (2010). Prevalence of gastrointestinal parasites of sheep and goats in and around Bedelle, South-Western Ethiopia. *Internet Journal of Veterinary Medicine*, 8 (2).
31. Yemisrach, A. and A. Mekonnen, 2012. An abattoir study on the prevalence of fasciolosis in cattle, sheep Global cattle, sheep, pigs, goats and horses (8 Ed), Veterinaria, 8(3): 308-314.