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Research Article

Study on Prevalence and Economic Importance of Bovine Fasciolosis in Three Districts of North-East Amhara Region, Ethiopia

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Abstract

A cross sectional study was carried out to determine the prevalence and economic importance of Bovine Fasciolosis in three districts of North-East Amhara Region, Ethiopia. The prevalence and species identification of Fasciola was determined based on coprological examination, abattoir survey and also was estimated its annual financial loss at Kombolcha ELFORA abattoir. Out of the total 380 faecal samples collected from cattle, 179 (47.10%) were positive for Fasciolosis. The highest infection rate was detected in Harbu, 79 (55.24%) and the lowest 42 (37.5%) in Kombolcha. However, there was no statistically significant difference ($p>0.05$) among the three study sites. The infection rate between males (47.09%) and females (47.11%) was not significant. There was statistically significant difference among age groups ($p<0.05$) which is higher in 1-5 years (52.25%) and lower in <1 year (37.5%) of age groups. Results of abattoir survey showed that, out of the 380 livers inspected, 205 (53.97%) were positive for Fasciolosis. Of these 50.24%, 36.58% and 13.17% were infected with Fasciola hepatica, Fasciola gigantic and mixed infection, respectively. The direct and indirect annual loss incurred due to Fasciolosis in Kombolcha ELFORA abattoir was estimated about 1,601,776.71 Ethiopian Birr (US$ 68,627.97). It is concluded that the prevalence of Fasciolosis was higher in cattle. Hence, this disease deserves serious attention of various stakeholders in order to promote the beef industry in the study areas and the country.

Keywords: Abattoir; Amhara region; Bovine; Economic importance; Ethiopia; Fasciolosis; Prevalence

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Introduction

Ethiopian livestock rising is an important economic activity from which food (milk and meat) and non food commodities (manure, traction, hide and skin) and cash income are derived. Livestock plays a key role in the daily life of the population particularly the peasant who owns over 95% of the countries livestock [1]. The rich potential from the livestock sector is not efficiently exploited, however, due to several constraints including malnutrition, traditional rearing and disease [2]. The presence of Fasciolosis in Ethiopia has a long history and is responsible for causing considerable losses in livestock production. The prevalence and economic significance of Fasciolosis in Ethiopia has been reported by several workers [3,4]. A rough estimate of the economic loss due to decreased productivity caused by bovine Fasciolosis is about 350 million birr [5].

Among the many parasitic problems of the domestic animals Fasciolosis is a major disease which imposes direct and indirect economic impact on livestock production in ruminants which are the natural hosts for *Fasciola*. Infestation is highest in cattle and sheep [6]. Fasciolosis is an economically important disease of domestic livestock, in particular cattle and sheep and occasionally man. The disease 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 *F. hepatica* and *F. gigantica*. *Fasciola hepatica* has a worldwide distribution but predominates in temperate zones while *F. gigantica* is found on most continents primarily in tropical regions [7].

Infection of domestic ruminants with *F. hepatica* (temperate liver fluke) and *F. gigantica* (tropical liver fluke) cause significant economic loss estimated at mover US $ 2000 million per annum to the agricultural sector worldwide with over 600 million animals infected [8,9]. In addition, Fasciolosis is now recognized as an emerging human disease. World Health Organization (WHO) has recently estimated 2.4 million people are infected with *Fasciola* and a further 180 million at risk of infection [10]. High prevalence of human Fasciolosis has been reported in Bolivia and Peru where Fasciolosis is regarded as an important human health problem [9,10].

In tropical regions, Fasciolosis is considered the single most important helminthes infection of cattle with prevalence of 30-90% in Africa [11,12]. Fasciolosis occurs commonly as a chronic disease in cattle and the severity often depends on the nutritional status of the host [2]. It is responsible for the wide spread morbidity and mortality especially in cattle and sheep characterized by weight loss, anemia and hypoproteinemia. It is also expressed in terms of liver condemnation at slaughter houses, infertility, reduction in traction power and low weight at birth has been reported [13].

The snails of the genus *Lymnaea* are mainly involved as intermediate hosts in the life cycle Fasciolosis. *L. natalensis* aquatic snail is an important host of *F. gigantica* in Africa. *Lymnaea truncatula*, amphibious snail with a wide distribution throughout the world, is the most common intermediate host of *F. hepatica* [6,14]. Both *F. hepatica* (the highland) and *F. gigantica* (the low land) liver flukes cause severe losses in parts of Ethiopia where suitable ecological conditions for the

growth and multiplication of intermediate host snails are found. Areas with seasonally flooded pastures, grazing areas of lakeshores, slowly flowing water ways and banks of rivers are among the conducive environments for breeding of snail vectors of Fasciolosis. In Ethiopia, the presence of both *Lymnaea truncatula* and *Lymnaea natalensis* has been reported [2].

Mixed infections by both species of *Fasciola* may occur in areas where the ecology is conducive for replication of snail intermediate host. In Ethiopia, *F. hepatica* is wide spread in areas with altitude above 1800 to 2000 meters above sea level while *F. gigantica* appears to be the most common species in areas below 1200 meters above sea level. Both species co-exist in areas with altitude ranging from 1200 to 1800 km above sea level [15]. The areas around Lake Tana and Fogera plane are generally considered as one of the most affected and endemic areas of Fasciolosis in the country or region wise. However, there are no detail studies that have been conducted on the prevalence, species identification and the economic importance of the disease under field and abattoir survey in selected sites of Eastern Amhara Region. Therefore, the major objectives of the present study were to determine the prevalence and economic importance of Bovine Fasciolosis, to identify the species of fasciola through abattoir survey in the study areas and to recommend appropriate control and preventive strategies pertinent to the local situation.

Material and Methods

Study area

The study was conducted in three districts (Kombolcha, Harbu and Kemissie) of Northeast Amhara Region. Kombolcha and Harbu are located in South Wollo Zone and Kemissie in Oromia Zone; North East of Addis Ababa at an altitude ranges from 1500-3500m asl the annual rain fall an average 750-1500 millimeter with annual mean temperature of 280˚C maximum and 11.70˚C minimum. The districts fall in to three agro-climatic zones: low land, medium high land and high land. The relative humidity of the areas varied from 23.9-79%. The districts are characterized by two main seasons in the year. The dry season (Bega) extends from January to April and the long rainy season (Kiremt) from July to the end of September. The vegetation in the area ranging from scattered tree bushes to dense shrubs. The farming system in the area is a mixed type (crop livestock production). The major crops grown in the area include sorghum, wheat, teff, barely, maize, grains, oats and other. The grazing land comprises water logged areas, forest margins; hill tops mountain sides, stony land and road sides [16]. Based on figures from the Central Statistical Agency, Kombolcha, Harbu and Kemissie have an estimated total cattle population of 22, 455, 11, 565 and 15, 476 respectively [17].

Study animals

The study was conducted in cattle slaughtered at the Kombolcha ELFORA abattoir and field areas of Kombolcha, Harbu and Kemissie. The study population comprises of 380 indigenous breeds of cattle at different age and sex category found under traditional management and extensive grazing system. The ages of study animals were determined based on their dental eruption patterns and three conventional age groups were formed: <1 year of age, 1-5 years of age and >5 years of age [18].

Study design

Coprological examination: 380 faecal samples were collected directly from the rectum of each animal using plastic gloves, put in to a screw capped glass bottles, preserved with 10% formalin, labeled with the required information, kept cool and transported to the laboratory where they were examined for the presence of *Fasciola* eggs using sedimentation technique [15].

Abattoir survey: Post-mortem examination was conducted at Kombolcha ELFORA abattoir. 380 livers of slaughtered animals were examined by thorough inspection, palpation and systematic incision to recover *Fasciola* species. Those livers condemned as unfit for human consumption due to *Fasciola* infection during post-mortem examination were registered.

Financial loss analysis: The financial loss incurred due to Fasciolosis at the ELFORA Kombolcha abattoir was estimated based on liver condemned and reduction in beef production. The mean retail price of one liver and one kilogram of meat in Kombolcha town was taken as 14 birr and 52 birr respectively. The average number of cattle slaughtered at the abattoir were 4, 435 per year based on three consecutive years recorded data. A 10% estimated carcass weight loss mentioned by German workers and Heenderson due to Fasciolosis was the parameter used for calculating carcass weight loss. 126kg is estimated average carcass weight of Ethiopian Zebu [19].

Therefore, the total annual financial loss incurred as a result of liver condemnation and carcass weight loss due to Fasciolosis was estimated by using the formula set by Ogunrinade and Adegoke [20].

- Annual estimated value of condemned liver = NALx CL x % condemnation, where NA = Average number of cattle slaughtered at Kombolcha ELFORA abattoir; CL = Mean coast of one liver in Kombolcha town; % cond. = Percentage of liver condemned due to Fasciolosis.
- Indirect actual loss due to reduction in meat production = NAL x CL x PA x Prev. in meat production, where NAL = Average number of cattle slaughtered in the meat factory per year; CL = Carcass weight loss in individual animal due to Fasciolosis; PA = Average market price of one kilogram of beef in Kombolcha tow; Prev. = Prevalence rate of Fasciolosis in the meat factory.

Sampling methods and sample size determination

The study was a cross sectional study type with random sampling technology. The sample size for this study purpose was determined according to Thrusfield [21]. As there was a similar study performed in the study areas, the expected prevalence in field animals faecal sample and Kombolcha abattoir ELFORA was 50.26 and 55.21 respectively is considered in sample size determination. The other determinants considered in sample size determination are 95% confidence interval and 5% desire absolute precision.

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

Where N = The required sample size; P_{exp} = The expected prevalence rate; Z_{χ} = The value of the required confidence interval (1.96); d = the desired absolute precision (5%). Therefore, 380 heads of cattle were to be considered for both field and abattoir study.

Data Analysis

Data obtained from the study was subjected to the chi-square (χ^2) statistical test to determine the significance of the variations in prevalence between age, sex categories and study sites. A 95% confidence interval and 5% significance level was used to determine where there are significance differences in the parameters measured Thrusfield [21].

Results

Coprological examination

Out of the total 380 faecal samples collected and examined, 179 (47.10%) were found positive for *Fasciola* eggs. The infection rate of bovine Fasciolosis in Harbu, Kombolcha and Kemissie were 55.24%, 37.5% and 46.4%, respectively. However, there was no statistically significance difference among the study sites in the infection rate (χ^2 = 7.974, p>0.05) (Table 1 and Figure 1).

Factor Studied	No. of Animals		Prevalence (%)	Chi-square (χ^2)	P-value
	Examined	Positive			
Study Site					
Kombolcha	112	24	37.50	7.974	P>0.05
Harbu	143	79	55.24		
Kemissie	125	58	46.40		
Age					
<1 year	54	15	27.77	9.888	0.007
1-5 years	155	81	52.25		
>5 years	171	83	48.53		
Sex					
Male	172	81	47.09	0.000	P>0.05
Female	208	98	47.11		
Total	380	179	47.10		

Table 1: The prevalence of Bovine Fasciolosis based on study site, sex and age categories.

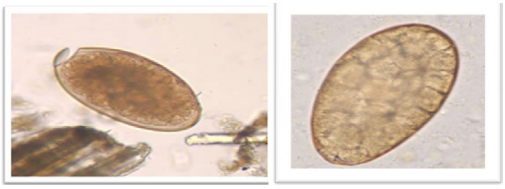

Figure 1: Eggs of *Fasciola* isolated from cattle faeces by sedimentation technique in the study areas.

Results of coprological examination of animals from different age groups showed variation in infestation rate. The prevalence in <1 year, 1-5 years and >5 years age groups were 27.77%, 52.25% and 48.53%, respectively. There was statistically significant difference in the prevalence of the disease among age groups (χ^2 = 9.888, P = 0.007) in which higher in 1-5 years and lower in <1 year (Table 1). Results of faecal examination revealed a prevalence of 47.09% (n = 81) and 47.11% (n = 98) in males and females, respectively. There was no significant difference between sex groups (χ^2 = 0.000, p>0.05) in the prevalence of fasciolosis (Table 1).

Abattoir survey

A total of 380 livers of cattle were inspected at Kombolcha ELFORA abattoir and 205 (53.97%) were found positive for fasciolosis in the study period (Table 2). All the Fasciola species observed in the infected livers were identified as *F. hepatica and F. gigantica*. The occurrence of *F. hepatica, F. gigantica* and mixed infection with both species at the abattoir were 50.24%, 36.58% and 13.17%, respectively (Table 3).

Factor Studied	No. of Animals		Prevalence (%)	Chi-square (χ^2)	P-value
	Examined	Positive			
Month					
December	117	60	51.28	3.975	P>0.05
January	136	73	53.67		
February	127	72	56.69		
Total	380	205	53.97		

Table 2: Monthly prevalence of Bovine Fasciolosis based on abattoir survey.

Factor Studied	No. of Livers Positive	Prevalence (%)	Chi-square (χ^2)	P-value
Species of Parasite				
F. hepatica	103	50.24	11.614	P>0.05
F. gigantica	75	36.58		
Mixed infection	27	13.17		
Total	205	53.97		

Table 3: Prevalence of Bovine Fasciolosis based on species of parasite at abattoir survey.

Financial loss analysis

The total financial loss due to fasciolosis was calculated using the following formula:

- Annual estimated value of condemned liver = NAL x CL x %condemnation, where NAL = Average number of cattle slaughtered at Kombolcha ELFORA abattoir; CL = Mean cost of one liver in Kombolcha town; % cond. = Percentage of liver condemned due to fasciolosis
  = 4,435 x 14 x 53.97%
  = 33,509.97 Ethiopian Birr (US$ 1,435.73)
- Indirect annual due to reduction = NAL x CL x PA x Prev. in meat production, where: NAL = Average number of cattle slaughtered in the meat factory per year; CL = Carcass weight loss in individual animals due to Fasciolosis; PA = Average market price of one kilogram of beef in Kombolcha town; Prev. = Prevalence of Fasciolosis in the meat factory
  = 4,435 x (126 x 10%) x 52 x 53.97%
  = 1,568,266.74 Ethiopian Birr (US$ 67,192.23)

The total annual financial loss due to fasciolosis in the meat factory of the study area is therefore; 1,601,776.71 Ethiopian Birr (US$ 68,627.97).

Discussion

The result of coprological examination revealed that the overall prevalence of Bovine Fasciolosis in the three study sites was 47.10%. In this survey, the higher prevalence of Bovine Fasciolosis was recorded in Harbu (55.24%) followed by Kemissie (46.4%); with lowest in Kombolcha (37.5%). There was no statistically significant difference (p>0.05) in the infection rate among study sites. The difference in the prevalence of fasciolosis in the study sites probably associated with the presence of different environmental conditions (rain fall, water logged marshy areas) for the existence and development of intermediate host snails and parasite. This result is relatively close to the result of Yehenew around Lake Tana (52%) [22]. On the contrary, the results reported by Bahru and Ephraim at Gondar (61%) and Fekadu around Bahir Dar (62.2%) were relatively higher than this study finding [5,23].

The results of faecal examination in males and females were 47.09% and 47.11%, respectively. There was no significance difference ($p>0.05$) in susceptibility to fasciolosis suggesting sex seems to have no impact on the infection rate of fasciolosis. Both male and female animals were equally exposed to the disease. Similar results that support the present findings were reported by Dagne and Rahemato [24,25]. On the contrary, Balock and Arthur revealed high prevalence in males than females [26]. This might probably related to the management system with longer exposure of male outdoor while females are kept in-door during pregnancy and lactation. This study indicated a prevalence of 27.77%, 52.25% and 48.53% among age groups <1 year, 1-5 years and >5 years, respectively. A significant variation ($p<0.05$) was recorded in the infection rate between different age groups, with higher in 1-5 years age group while the lower was observed in age group of <1 year. This finding agreed with the work of Solomon and Abebe [27]. This may be attributed to the fact that young animals were not often driven far with older age groups to grazing and watering points. They were mostly kept at a nearby village where the sources of feeding sites are not contaminated. This practice naturally reduces the chance of exposure in this age class. The more the age of the young increases, the possibility of moving towards new environment happens, which leads to an exposure with *Fasciola* contaminated pasture lands and water points. According to Rahemato, similar results indicated inverse correlation of prevalence and age of cattle in different parts of Ethiopia [25].

The result of Kombolcha ELFORA abattoir survey revealed the prevalence of 53.97% Bovine Fasciolosis. This result seems to be lower compared to the results of previous reports in other parts of the country; such as 86% in Keffa and 70% in Illubabur Administrative Region, 80% in and around Debre Berhan and 82.5% in Western Shoa, 71% at Addis Ababa abattoir, 75% at Gondar municipal Industrial abattoir and 77.8% at Dembidolo abattoir [4,5,24,27-29]. This variation in the prevalence probably due to difference in climatic condition (altitude, rain fall, temperature) of the area, management system of animals and availability of veterinary services and drug usage.

However, the result observed at Kombolcha ELFORA abattoir is relatively close to those obtained at Debre Zeit abattoir 49%, at Jimma municipal abattoir, 47% and at Gondar municipal abattoir, 49% [3,22,30]. All the *Fasciola* species observed in the infected livers were identified as *F. hepatica* and *F. gigantica*. The occurrence of *F. hepatica*, *F. gigantica* and mixed infection by both species at the abattoir is 50.24%, 36.58% and 13.17%, respectively. This result was very close to Abegaz where 50.07% of *F. hepatica*, 39.63% *F. gigantica* and 10.29% mixed infection at Kombolcha ELFORA abattoir [31]. On the other hand, result of Mitiku at Bedele municipal abattoir was higher for *F. hepatica* (64.5%) and lower for *F. gigantic* (24.8%) when compared to the present study result [32]. Mixed infection by both species of *Fasciola* might be due to cattle for slaughter normally comes from different marketing areas of the region having different weather conditions and altitude known to be suitable for the existence of both species of *Fasciola* and intermediate hosts. The study conducted by Graber indicated the Ethiopian *F. hepatica* found in areas situated over 1800-2000 m asl, *F. gigantica* up to 1200m asl and mixed infection with both species in areas between 1200-1800m asl [2].

Although it was difficult to evaluate the actual financial loss incurred due to individual parasitic diseases, because of the occurrence of polyparasitism in the natural case, financial loss analysis due to Fasciolosis was made at Kombolcha ELFORA abattoir. This was done using the number of livers condemned per year and carcass weight loss which is indirectly associated with liver pathology. In doing so a sum of money amounting 33,509.97 Ethiopian Birr (US$ 1,435.73) was lost due to liver condemnation and 1,568,226.74 Ethiopian Birr (US$ 67,192.23) as a result of reduction in meat production with a total loss of 1,601,776.71 Ethiopian Birr (US$ 68,627.97) annually due to Fasciolosis. Financial loss analysis reported from other part of the country include Mulugeta in Kombolcha 287,911.32 Ethiopian Birr, Wondoson in Arsi (159,704.00 Ethiopian Birr) and Mitiku in Jimma per annum [32-34]. These results showed that fasciolosis cause significant lose in different parts of Ethiopia at large. Considering the prevalence of the disease and its economic significance in different parts of the country, one can strongly conclude that Fasciolosis is one of the most important livestock parasitic diseases which impose huge carcass condemnation.

Conclusion

The present study showed that Bovine Fasciolosis was a widely distributed disease with high infection rate in the three study sites. This is due to the presence of favorable environmental conditions and snail intermediate host. The abattoir study demonstrated significant economic impact of the disease directly and indirectly affecting cattle productivity. Therefore, integrated approach with a combination of chemotherapy and vector control should be considered more practically and economically.

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