



Prevalence and Monetary Loss of *Stilesia Hepatica* among Small Ruminants Slaughtered at ELFORA Industrial Abattoir

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Abstract

Stilesia hepatica is the cestode parasite that has sheep, goats, other livestock and numerous wild ruminants as final hosts. Although it is non-pathogenic even in massive infection, it causes marked economic loss due to liver condemnation at abattoir. Across sectional study was conducted at ELFORA abattoir, Bishoftu town, central highlands of Ethiopia from November 2015 to April 2016 on 384 sheep and goats (184 sheep and 200 goats) originated from different areas of Ethiopia. The objectives of the study were to determine the prevalence of *Stilesia hepatica* and to assess the magnitude of economic loss incurred due to liver condemnation in sheep and goats brought to the abattoir from different parts of Ethiopia. Pearson's chi Square (χ^2) test was calculated to determine the degree of association of *Stilesia hepatica* infection with species (sheep and goats), origin, body condition and age (young and adult) of the animals. P-value less than 0.05 were considered to be statistically significant. The overall prevalence of *Stilesia hepatica* in sheep and goats was 35.9% (66/184) and 29% (58/200), respectively. The difference in the prevalence of *Stilesia hepatica* between sheep and goats was statistically insignificant ($P > 0.05$). The prevalence of *Stilesia hepatica* among poor, medium and good body condition were 30.8%, 30.5% and 41.4% respectively. There were no statistically significant differences ($p > 0.05$) values with respect to body condition. The prevalence of *Stilesia hepatica* in young and adult sheep and goats was 30.6% (77/252) and 35.6% (47/132), respectively. Statistical insignificant difference ($P > 0.05$) was recorded between the respective young and adult age groups of sheep and goats. The prevalence of *Stilesia hepatica* for sheep and goats originated from Hararghe, Arbaminch and Borana was 38.5% (37/96), 29.8% (37/124), 30.5% (50/164) respectively. Statistically no significant difference ($P > 0.05$) was recorded in the prevalence of *Stilesia hepatica* in sheep and goats originated from different areas of Ethiopia. The total annual financial loss due to condemnation of *Stilesia hepatica* affected livers was estimated to be 22820 USD or 498872.58 ETB. *Stilesia hepatica* causes significant loss to farmers, butchers and consumers and it is also major cause of concern in the trade of small ruminants. Therefore, the disease should be investigated further to determine the epidemiology and prevalence in animals of various ages, Species and breed and develop economic strategies for disease control.

Keywords: Goats, Prevalence, Sheep, *Stilesia hepatica*, ELFORA abattoir, Bishoftu

Introduction

Ethiopia is home for diverse indigenous sheep and goat populations, numbering 25,017,218 and 21,884,222 heads respectively, parallel to its diverse ecology, production systems and ethnic communities (CSA, 2009). The total annual meat production comes from cattle (63%), sheep (25%) and goats (12%). At the national level, sheep and goat account for about 90% of the live animal/meat and 92% of skin and hide export trade value (FAO, 2004). In the lowlands, sheep with other livestock are the mainstay of the pastoral livelihoods. The current levels of contributions of the livestock sector in Ethiopia, at either the macro or micro level is below potential. The levels of foreign exchange earnings from livestock and livestock products are also much lower than would be expected, given the size of the livestock population (Berhanu *et al.*, 2007). This is due to many prevailing socio-economic, values and attitudes or traditional management methods, limited genetic potential, government policies and rampant diseases and parasitism. In order to alleviate the multi-faceted problems that limit productivity and off-take rates and improve marketing success of farmers and pastoralists, characterization of the production and marketing systems is essential (Solomon *et al.*, 2010).

Slaughter surveys have been conducted in most sub Saharan African countries to estimate the prevalence and economic significance of fasciolosis in various ruminant production systems. Unfortunately, the impact of *Stilesia hepatica* on productivity of ruminants has not been elucidated through these surveys. Abattoir surveys have estimated the condemnation rates of 56% and 47% of the total livers in slaughtered sheep and goats respectively (Mungubeet *et al.*, 2006).

The highest liver condemnation rate 40% and 48% was recorded due to *Stilesia hepatica* in goats and sheep respectively in Kenya in 1989. Economic losses associated with liver condemnation due to *Stilesia hepatica* infestation in ruminants contributed to 14807 USD of which 876 USD, 9720 USD and 4210 USD was attributed to cattle, goats and sheep, respectively. *Stilesia hepatica* causes significant loss to farmers, butchers and consumers. It is also a major cause of concern in the trade of small ruminants (Mungube *et al.*, 2006). Previously there was not any documented data on prevalence of the *Stilesia hepatica* in small ruminants in the study area with respect to ELFORA abattoir. Therefore, this study was designed with the aims to determine the prevalence of *Stilesia hepatica*

in small ruminants slaughtered at ELFORA abattoir and estimate the magnitude of economic loss incurred due to liver condemnation and carcass weight loss.

Materials and Methods

Study Area and Abattoir

The study was conducted at ELFORA abattoir, Bishoftu, from November, 2015 to April, 2016. The abattoir is a privately owned export abattoir exporting mutton, lamb, chevon and edible organs like liver, kidney of small ruminants to Middle East countries. This abattoir is found in Bishoftu town, which is located at 90N and 400E with an altitude of 1880 meters above sea level in the central highlands of Ethiopia at 47km South East of Addis Ababa. It has annual rain fall of 1151.6mm of which 84% falls during the long rainy season that extends from June to September; and the remaining during the short rainy season that extends from March to May. The mean annual minimum and maximum temperature are 8.5 °C and 30.7 °C, respectively and the mean relative humidity is 61.3% (CSA, 2009).

Study Design and Study Animals

A cross-sectional study using systematic random sampling technique was conducted from November 2015 to April 2016 to determine the prevalence and associated risk factors of *Stilesia hepatica* in small ruminants slaughtered at ELFORA abattoir. These small ruminants were originated from Borana, Hararghe, and Arba Minch. They were all males and indigenous breeds which were categorized by place of origin, body condition, species and age group during the study period.

Sample Size Determination and Sampling technique

The sampling procedure was carried out using systematic random sampling during antemortem inspection in such a way that sampling units were selected at equal intervals with the first animal being selected randomly. The sample size was determined based on expected prevalence of 50%, confidence interval of 95% and desired level of precision of 5%. The total number of small ruminants required for the study was calculated based on the following formula (Thrusfield, 2005).

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

When: N = required sample size; P = expected prevalence; d = desired absolute precision. Accordingly, the sample size was calculated to be 384.

Study Methodology

The animals were identified systematically using regular interval (every 10th animal) with the first animal selected randomly. Then ropes which have different colors for age of the animals were tied. After the removal of the head and skinning the ropes were tied on one of the hind leg of the animals and after evisceration the ropes were tied on the liver of the identified animals. Livers which have rope were identified separately and inspected by visualization and making systematic longitudinal incision on the bile ducts to detect the presence of *Stilesia hepatica* parasite.

Statistical Analysis

The prevalence of *Stilesia hepatica* was calculated by dividing the number of positive sheep and goats for *Stilesia hepatica* by the total number of animals (sheep and goats) examined and multiplied by 100 to express in percentage. Data generated from post-mortem inspection of the livers was entered to Microsoft excel 2010. Descriptive statistics, such as percentage and chi-square test were calculated with SPSS software for windows version 20. Pearson’s chi-Square (χ^2) test was used to determine the degree of association of *Stilesia hepatica* infection with species (sheep and goats), origin, body condition (poor, medium and good) and age (young and adult) of the animals. P-value less than 0.05 were considered to be statistically significant.

Assessment of Direct Financial Loss

Two factors have acted as constraints on the study of pathogenicity and epidemiology which have made it difficult to assess accurately the losses to this parasite.

First the life cycle is not fully known, although, it is generally considered that the intermediate cysticeroid stage occurs in orbatid mite in pasture and the definitive hosts become infected by ingesting the infected mites. Secondly no suitable diagnostic method existed to detect infection in live sheep (Nginyi, 1993) and due to the above reason only direct economic loss was taken into consideration in this study.

The analysis was based on annual slaughter capacity of the abattoir considering market demand, average market price on international market and in the town of Bishoftu and the rejection rate of liver. The annual slaughter rates were estimated from retrospective data recorded in the past three years. Average market price of liver was determined from interviews made with personnel of the abattoir and marketing department. Financial loss was then computed mathematically by using the formula of Ogurinate and Ogurinate(1980) liver rejection as follows:

$$EL = Srx.Coy.Roz$$

Where: EL- estimated annual economic loss due to organ and carcass condemnation from international or domestic market.

Srx- annual sheep/goat slaughter rate of the abattoir,
 Coy- average cost of each sheep/goats liver/lung/heart/kidney/brain/carcass.
 Roz- condemnation rates of sheep/goats liver/lung/heart /kidney/brain/carcass.

Results

Totally 384 sheep and goats (184 sheep and 200 goats) were inspected at post-mortem by categorizing them according to species, body condition, origin and age of sheep and goats. The prevalence of *Stilesia hepatica* in sheep and goats was found to be 35.9% and 29% respectively (Table1).

Table 1: Prevalence of *Stilesia hepatica* in sheep and goats

Species	Examined	Positive	Prevalence (%)	χ^2	P value
Sheep	184	66	35.9	2.068	0.15
Goat	200	58	29		
Total	384	124	32.3		

Analysis of the data showed that there was no statistically significant difference (P>0.05) on the prevalence of *Stilesia hepatica* between sheep and goats.

The prevalence of *Stilesia hepatica* was found to be 35.6% and 30.6 % in adult and young respectively (Table 2).

Table 2: Prevalence of *Stilesia hepatica* in adult and young sheep and goats

Age category	Examined	Positive	Prevalence (%)	²	P value
Young	252	77	30.6	1.011	0.315
Adult	132	47	35.6		
Total	384	124	32.3		

Analysis of the data showed that there was no statistically significant difference ($P>0.05$) on the prevalence of *Stilesia hepatica* between young and adult sheep and goats.

Among 384 sheep and goats examined at postmortem, 124 from Arbaminch, 96 from Hararghe, 164 from

Borana. The prevalence was found to be 29.8%, 38.5%, 30.5% respectively (Table 3).

Table 3: Prevalence of *Stilesia hepatica* in sheep and goats among origins

Origin of animals	Examined	Positive	Prevalence (%)	²	P value
Hararghe	96	37	38.5	2.300	0.317
Arbaminch	124	37	29.8		
Borana	164	50	30.5		
Total	384	124	32.3		

The prevalence of *Stilesia hepatica* in small ruminants slaughtered at ELFORA abattoir showed statistically insignificant difference ($P>0.05$) among the different places of origin.

The animals (Sheep and goats) which were slaughtered during study period had different body condition. Among 384 sheep and goats examined at

postmortem 159,167 and 58 were poor, medium and good respectively. The prevalence was found to be 30.8%, 30.5% and 41.4% respectively (Table 4).

Table 4:Prevalence of *Stilesia hepatica* in sheep and goats according to body condition

Body condition	Examined	Positive	Prevalence (%)	²	P value
Poor	159	49	30.8	2.583	0.275
Medium	167	51	30.5		
Good	58	24	41.4		
Total	384	124	32.3		

The prevalence of *Stilesia hepatica* in sheep and goats slaughtered at ELFORA abattoir among the different body conditions showed no statistically significant difference ($P>0.05$).

The average annual slaughter rate of the abattoir was estimated to be 121184 small ruminants. The average liver condemnation rate of the current study was 32.3 (124/384). The average cost of a kilogram of liver was 1.75 USD and on average 3 pieces of liver could weigh 1kg. Thus, the average cost of one liver is 0.583

USD or 12.74 ETB. Therefore, by substituting these values in the formula of Ogurinate and Ogurinate (1980) the annual financial loss due to liver condemnation was estimated to be 22820 USD or 498872.58 ETB.

Table 5: Annual direct monetary loss due to rejection of *Stilesia hepatica* affected livers

Organ examined	Slaughter capacity of the abattoir	Rejection rate	Average cost per Kg	Annual loss
Liver	121184	32.3%(124/384)	0.583USD/ 12.74 ETB	22820 USD or 498872.58ETB

Discussion

The overall prevalence of *Stilesia hepatica* in sheep and goats slaughtered at ELFORA abattoir in the present study was found to be 35.9% (66/184) and 29% (58/200) respectively. This prevalence was in agreement with the prevalence reported by Ashenafi (2010) who reported prevalence of 31.04% and 27.02% in sheep and goats respectively. The higher prevalence of *Stilesia hepatica* in sheep than goats may be attributed to greater exposure of sheep during grazing.

The prevalence of *Stilesia hepatica* in adult and young sheep and goats in the current study was found to be 35.6% (47/132) and 30.6% (77/252), respectively. This prevalence was in agreement with Taye (2008) who reported a prevalence of 30.6% and 25.8% in adult and young respectively and Ashenafi (2010) who reported a prevalence of 27.5% and 24.5% in adult and young, respectively. The higher prevalence of *Stilesia hepatica* in adult than young small ruminants may be attributed to the greater exposure of adult than young ones during life time.

The prevalence of *Stilesia hepatica* in slaughtered sheep and goats at ELFORA abattoir which were brought from different areas of the country was found to be 29.8% (37/124) Arbaminch, 38.5%(37/96) Hararghe, 30.5%(50/164) Borana. Even though the origin of animals was not described the study conducted at four abattoirs found in Jijjiga, Haramaya, Dire Dawa and Harar by Sissay(2007) revealed a prevalence of 42%,28% ,35% and 41% for wet season and 32%,33%,41% and 39% for dry season respectively. The prevalence of the current study was in agreement with prevalence reported by Sissay (2007) as above. There was no significant difference in the prevalence of *Stilesia hepatica* among small ruminants from different sites of origin. This may be due to the similarity in the distribution of intermediate hosts and reservoirs among the different places from which the animals were brought.

Other studies have reported *Stilesia* parasites in the liver of sheep and goats in impala Kenya and Southern

Africa (Mungubeet *al*, 2006).The frequency of the occurrence has not been quoted, since little work has been conducted on this parasite. However, *Stilesia* prevalence is high (60%) especially considering post mortem liver inspection (Mungubeet *al*, 2006).This estimate was higher than current study. Losses due to *Stilesia hepatica* liver condemnation was mainly observed in small ruminants rather than in bovine. Out of 5124 and 2226 livers inspected in goats and sheep 61% and 85% were condemned due to *Stilesia hepatica* in goats and sheep respectively (Mungubeet *al*., 2006).The direct annual loss in ELFORA abattoir due to rejection of affected livers due to *Stilesia hepatica* infection was estimated to be 22820 USD or 498872.58 ETB from international market. This estimate was lower than the estimate of Zelalem*etal*., (2015) who recorded annual loss of 860,453.58 ETB due to liver condemnation in small ruminants. This may be due to slaughtering capacity of abattoir and difference in foreign currency.

Conclusion

The overall prevalence of *Stilesia hepatica* in both sheep and goats was 32.3% and this study demonstrated that *Stilesia hepatica* is prevalent in both sheep and goats in study area. The study has also confirmed that *Stilesia hepatica* accounts for the largest proportion of the causes of sheep and goats' liver condemnation at Bishoftu ELFORA abattoir.

Competing Interests

The authors declare that they have no competing interests.

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