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Prevalence of bovine Fasciolosis and associated economic loss in cattle slaughtered at Kombolcha industrial abattoir

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Abstract

A cross sectional study was conducted from October 2013 up to March 2014 to determine the prevalence of bovine fasciolosis and associated economic loss in cattle slaughtered at Kombolcha industrial Abattoir. In this study, a total of 409 cattle from the abattoir were randomly selected and topologically examined by sedimentation techniques and postmortem examination for fluke identification and count. Abattoir retrospective data were retrieved and analyzed. The overall prevalence of bovine fasciolosis on coprology and postmortem study was 25.4% and 35% respectively. Based on post mortem findings, the highest percentage (18.8%) was due to Fasciola hepatica. Similarly, Fasciola gigantica (6.8 %), immature fluke (3.9 %) and mixed infections (5.4 %) were also noted in the study areas. Comparisons were also made among examined animals based on their age, sex, origin, and body condition score. The result showed that there was statistically significant difference in prevalence among animals of different origin (p=0.000). However, the difference in prevalence between animals of different age, sex, and body conditions was not statistically significant ($p>0.05$). A direct economic loss identified in cattle due to liver condemnation by fasciolosis at Kombolcha industrial abattoir was estimated 72,360 Ethiopian birr Per annum. Bovine fasciolosis was a prevalent parasitic disease and cause a considerable economic loss in the study area. Therefore, careful ecological studies should be applied to control snails which have been the major facet of fluke control.

Keywords: Kombolcha, fasciollosis, bovine, abattoir

1. Introduction

Ethiopia has a large livestock population in Africa, and has divers' topography, a wide range of climatic feature and multitude agro-economical zones which make the country suitable for different agricultural production systems. These interns contribute to the existence of the large diversity of farm animals' genetic resources in the country. The livelihood of both rural and urban communities in the country is to a large extent associated with output drown from this sector [35].

In the high lands of Ethiopia, agriculture is the pillar of economy and is basically a subsistence crop-livestock mixed farming system with considerable dependence on natural rain. It is evident that water resources can play a role in improving food security and house hold income. An effective method to minimize vulnerability of climatic irregularities is to use irrigation for agricultural production. Wrongly planed irrigation, however, impedes production and results in wasted effort by favoring the incidence and spread of common water born diseases such as fasciolosis which is known to cause significant economic loses. [24] In fact the shift from a rain-fed to irrigation agriculture favors the development and propagation of water born infection to both human and livestock [44].

Fasciolosis is economically important disease of domestic livestock in particular cattle and sheep and occasionally man thus considered as a zoonotic infection. The disease is caused by digenean trematodes of the genus Fasciola commonly referred as liver fluke. The two species most commonly implicated, as etiological agents of fasciolosis are *Fasciola hepatica* and *Fasciola gigantica*. *Fasciola hepatica* has a worldwide distribution but predominates in temperate zones while *Fasciola gigantic* found on most continents primarily in tropical region [2].

The risk factor of *Fasciola* is determined by the number of infected limned sails in the grazing area. The disease has a predictable seasonal pattern in regions where sails are active for only parts of some limned sails more aquatic habitat than other but all are restricted to damp or wet environment. In general they prefer non acidic low-lying swampy area with slowly moving water. But land with small streams, springs, drainage or spillages, for example, water troughs may also be potential hazardous infecting grounds; land irrigated frequently is also highly suitable for infection to take place [30]. The economic loss throughout the world is enormous as a result of widespread morbidity and mortality in sheep and cattle. Infection of domestic ruminants with *F. hepatica* and *F. gigantica* causes significant economic loss. They accounts for serious economic losses in Africa and other parts of the world due to condemnations of liver as unsuitable for human consumption, losses through death, reduction in productivity (meat, milk, and wool), inhibited reproduction, retarded growth rate, lowered resistance to other diseases [7].

Therefore the objectives of this study were:

- To determine the prevalence of bovine fasciolosis,
- To assess the economic importance of bovine fasciolosis due to liver condemnation in the abattoir.

2. Literature Review
2.1 Bovine Fasciolosis
2.1.1 Etiology
Fasciolosis is caused by two species of liver fluke i.e. *Fasciola hepatica* and *Fasciola gigantica*. Among these, *F. hepatica* is cosmopolitan in distribution and has the capacity to infect variety of host species. Its intermediate host is adapted to a wide range of ecological niches [3]. *F. gigantica* has a more restricted distribution because of reduced ability of the aquatic snail to invade new niches and it is found in warmer climates (Asia, Africa) in which it is responsible for chronic fasciolosis [3].

Adult flukes of both species are localized in the bile ducts of the liver or gallbladder. *F. hepatica* measures two to three cm and has flat body, an oval shape, a pink-grayish to dark red color. Have two suckers, both in the ventral side. The body surface is covered with numerous spines. Eggs are about 80x140 micrometers, with an oval form, operculated and of a yellowish to greenish color derived from the host's bile. *F gigantica* is similar in shape to *F hepatica* but is longer (75 mm), with less clearly defined shoulders, and is 12 mm wide [30].

2.1.2 Epidemiology
Human and animal fasciolosis occurs worldwide while animal fasciolosis is distributed in countries with high cattle and sheep production. *F. hepatica* is distributed worldwide and has a broad host range, including people. The complex nature of the lifecycle and epidemiology of this snail-borne disease presents challenges for predictive mapping at the herd-level, as well as disease management and animal husbandry at the individual-level Fasciola *gigantica* and *Fasciola hepatica* can infect a wide variety of domesticated animals, wildlife and people [14]. Thus the disease-endemic zone can be difficult to define from parasitological data alone and so consideration of the distribution of associated snail intermediate hosts can be important. *F. gigantica* is the most common liver fluke in sub-Saharan Africa, being adapted to warmer conditions likely due to the widespread distribution of its intermediate host *Lymnaea (Radix) natalensis*. On the other hand owing to a more limited distribution of its intermediate host *Lymnaea (Galba) truncatula*, *F. hepatica* can exist in zoonotic foci which are more restricted to cooler regions of Africa, including Kenya, Ethiopia and Tanzania [13]. F*asciola* has an indirect life cycle with amphibious snails as intermediate hosts, typically from the genus *Lymnaea*. Adult flukes produce eggs in the biliary ducts of their hosts. These eggs reach the gall bladder and are passed to the host's gut when the gall bladder is emptied.

They are passively transported to the anus and are expelled with the feces. A single liver fluke can produce up to 25'000 eggs a day! Once outside the host, the larvae called miracidia hatch out of the eggs in seven to fifteen days [33]. These larvae can survive for weeks off a host provided there is enough humidity. They die quickly in a dry environment. Miracidia can swim and penetrate actively into the snails where they remain for four to eight weeks and develop successively to sporocysts, rediae and cercariae, the usual larval stages of most fluke species. A single miracidium can asexually produce up to 600 cercariae [33].

Mature cercariae leave the snail, attach to the vegetation, lose their tail and produce cysts of about 0.2 mm, the so-called metacercariae, which are infective for the final host. Such cysts can survive for months in the vegetation, even under dry conditions, even in hay! Livestock becomes infected by grazing contaminated pastures or hay, i.e. animals kept indoors can also become infected if they are fed contaminated hay. Inside the final host young immature flukes hatch out of the cysts and within a few hours they cross the intestinal wall and get into the peritoneal cavity where they migrate towards the liver, which they reach in about 3 weeks. To reach the biliary ducts they have to cross the hepatic tissue, a particularly harmful process for the host that lasts 6 to 8 weeks. Once in the biliary ducts they complete their development to adult flukes and start producing eggs [18].

The prepatent period of *f. hepatica* is nine to fifteen weeks, while *F. gigantica* is about nine to twelve weeks, depending on the host and other factors. The entire life cycle can be completed in a minimum of 16 weeks. Left untreated liver flukes can live up to 20 years on sheep, usually not more than one year in cattle.

Livestock grazing in regions with a high water table or frequently flooded are at high risk of becoming infected with liver fluke. The reason is that the snails acting as intermediate hosts are amphibious and need humid habitats that are periodically submerged or flooded. Relatively small humid habitats (e.g. irrigation channels, ditches, ponds, watering holes, etc.) offer suitable conditions for the development of such snails and keep the surrounding pastures infected. Permanently stabled livestock can also become infected through contaminated hay. Humans and carnivores such as dogs and cats are infected mainly ingesting aquatic plants or drinking water contaminated with cercaria. There is also evidence that consumption of raw liver contaminated with juvenile flukes can be contagious for humans [16].

2.1.3 Pathogenesis
Liver flukes are very harmful for their hosts, particularly for sheep. Young immature flukes migrating through the liver tissues and crossing the wall of the bile ducts cause the major harm. This process destroys the tissues and causes bleeding [30, 2].

The spines in the surface of the flukes irritate the tissues that become inflamed. All this leads to cell death and fibrosis, i.e. the formation of excessive connective tissue that replaces the dead liver cells, which impairs the normal functioning of the liver. Affected livers increase in size and become fragile. Some flukes can become encapsulated in the liver tissues and build cysts as large as walnuts. The bile ducts are also damaged: they become thickened and can be calcified and even obstructed. Infections with secondary bacteria can also happen, mainly due to the general weakness of the host that debilitates its own immune system. In addition, flukes produce own toxins that impair the normal function of the liver [4]. The bottom line is that the numerous vital physiological processes that run in the liver are disturbed and the affected animals become sick in a degree that depends on the number of flukes that infect them [17].

2.1.4 Clinical signs

There are no really typical and easily recognizable symptoms of a liver fluke infection in livestock or other animals. The major symptoms are related with the inflammation of the liver and of the bile ducts. Other vital organs are usually not affected. Infections with a few dozen adult flukes may not cause clinical signs other than general weakness and reduced productivity [30]. Chronic fasciolosis is the more common form in sheep, goats and cattle. It develops along the gradual establishment of adult flukes in the bile ducts. It is characterized by the progressive development of such symptoms as anemia, edema, often as "bottle jaw", digestive disturbances (diarrhea, constipation etc.), and cachexia (wasting, i.e. weight loss, fatigue, weakness, loss of appetite, etc.). Acute fasciolosis is seldom in cattle but can occur in sheep. It is caused by the sudden migration of many immature flukes through the liver, which leads to complete organ failure. It can develop in healthy animals that may be killed in a few days [19].

2.1.5 Diagnosis

Diagnosis of fasciolosis during the early stages of disease is based upon the epidemiological data (high risk year) and raised liver enzymes in blood samples. Chronic fasciolosis is diagnosed by demonstration of fluke eggs in faecal samples although these may be scarce and difficult to find. Diagnosis in dead animals relies on seeing mature or immature fluke in the liver. Necropsy will also identify other conditions that may be contributing to the problem. A serological test, an enzyme-linked immunosorbent assay (ELISA) test is also available for fasciolosis. It detects infection with both immature and adult fluke in a flock or herd, but it is not sensitive enough for diagnosis in individual animals. ELISA tests can detect anti-hepatica antibodies in serum and milk, but new ones especially intended for use on fecal samples are being developed. Proteases secreted by *F. hepatica* also have been used experimentally in immunizing antigens. Specific diagnosis depends on finding eggs in the stool.

A false record can result when the patient has eaten infected liver and egg passes through the feces [27, 26].

2.1.6 Treatment

The treatment recommended will depend on the nature of the disease. Some of the available anthelmintics are not effective against immature fluke and so are not recommended in acute fluke outbreaks. Also, they are less efficient for the strategic control of fasciolosis. The best prevention and control can be achieved with drugs such as triclabendazole, which are effective against early immature and adult fluke [4].

2.1.7 Zoonotic importance

Human *Fasciola* infection is determined by the presence of the intermediate snail hosts, domestic herbivorous animals, climatic conditions and the dietary habits of man [11]. The number of reports of humans infected with Fasciola increased significantly since 1980, and several geographical areas has been described as endemic for the disease in humans, in humans, the infection begins with the ingestion of watercress or contaminated water containing encysted larva [11]. The larva exist in the stomach, penetrate the duodenal wall, escape into the peritoneal cavity, and then pass through the liver capsule to enter the biliary tree Human fascioliasis has two phases. The hepatic phase of the disease begins one to three months after ingestion of metacercariae, with penetration and migration through the liver parenchyma toward the biliary ducts. Common signs and symptoms of the hepatic phase are abdominal pain, fever, eosinophilia, and abnormal liver function tests. The biliary phase of the disease usually presents with intermittent right upper quadrant pain with or without cholangitis or cholestasis [19].

The course of fasciolosis in humans has 4 main phases [21]. *Incubation phase*: from the ingestion of metacercariae to the appearance of the first symptoms; time period: few days to 3 months; depends on number of ingested metacercariae and immune status of host. *Invasive or acute phase*: This phase is a result of mechanical destruction of the hepatic tissue and the peritoneum by migrating juvenile flukes causing localized and or generalized toxic and allergic reactions. The major symptoms of this phase are: Fever: usually the first symptom of the disease; 40-42°C, Abdominal pain, gastrointestinal disturbances (loss of appetite, flatulence, nausea, diarrhoea), Urticaria, Respiratory symptoms (very rare): cough, dyspnoea, chest pain, hemoptysis, Hepatomegaly and splenomegaly, Ascites, Anaemia, Jaundice [50]. *Latent phase* can last for months or years. The proportion of asymptomatic subjects in this phase is unknown. They are often discovered during family screening after a patient is diagnosed. Chronic or obstructive phase: This phase may develop months or years after initial infection. Adult flukes in the bile ducts cause inflammation and hyperplasia of the epithelium.

The resulting cholangitis and cholecystitis, combined with the large body of the flukes, are sufficient to cause mechanical obstruction of the biliary duct. In this phase, biliary colic, epigastric pain, fatty food intolerance, nausea, jaundice, pruritus, right upper-quadrant abdominal tenderness, etc., are clinical manifestations [21]. Triclabendazole (TCZ) is the only WHO-recommended medicine for treatment of human fascioliasis. The recommended dosage is 10 mg/kg, 2single administration. A double dose (20 mg/kg) can be administered in case of treatment failures [49].

2.1.8 Control

Control measures ideally should involve removal of flukes in affected animals, reduction of the intermediate host snail population, and prevention of livestock access to snail-infested pasture. In practice, only the first of these is used in most cases. While molluscicides can be used to reduce limned snail populations, those that are available all have drawbacks that restrict their use. Copper sulfate, if applied before the snail population multiplies each year, is effective but toxic to sheep, which must be kept off treated pasture for 6 wk after application. Other such chemicals are generally too expensive and have ecologically undesirable effects. Prevention of livestock access to snail-infested pasture is frequently impractical because of the size of the areas involved and the consequent expense of erecting adequate fencing [41].

2.1.9 Economic importance
Among many parasitic problems of farm animals, fasciolosis is a major disease, which imposes direct and indirect economic impact on livestock production, particularly of sheep and cattle [22]. Fasciolosis causes economic losses in livestock as a result of mortalities, abortions retarded growth, reduced meat and milk production, condemnation of infected livers and emaciated carcasses, and cost of animal treatment. Infections with *Fasciola* also predispose animals to other infections [20].

3. Materials and Methods
3.1 The Study Area
The study was conducted in kombolcha ELFORA abattoir, South Wollo, zone of Amhara national regional state. Kombolcha is located in North Eastern part of Ethiopia, at 11º4' 37"N and 39º44'42"E at a distance of about 375km from Addis ababa. The area has an altitude range of 1500-1840 meter above sea level and marked by numerous mountains, hilly, and sloppy areas, plateaus, rivers, and streams with three topographic categories high altitude(14%-Dega), mid high land (34%-weina dega), and low altitude (52% -kola). The vegetation in the area changes with the altitude ranging from scattered trees and bushes to dense shrubs and bushes. The soil is mainly fertile soil which is deep clay soil. The area experiences a bimodal rain fall with a minimum annual rain fall of 750-950 mm and a relative humidity of 23.9-79%. The average monthly recorded minimum and maximum temperature was 11.7º and 23.9º respectively. Live stock population of the area comprises 100,386 cattle, 12,975 sheep, 31,041 goats, 2,540 horses, 634 mules, 7,758 donkeys, 1,865 camels, 119,347 poultry (CSA, 2008).

3.2 Study Population
The study population was animals presented to kombolcha ELFORA originated from different agro-ecological zones (Dega, Woyna Dega, and Kola) with different management systems.

3.3 Study Design
Cross sectional and retrospective method of study with simple random sampling method were conducted from October, 2013 to March, 2014 both for the prevalence and economic importance of the disease. Age (adult 2-5years, and old >5years), sex, breed (local, cross and exotic), body condition (poor, medium and good), and origin (Dega, Woyna Dega, and Kola) of the study animals were recorded at recording sheet.

3.4 Sample Size Determination
The study was carried out by determining the sample size according to Thrusfield (2005).
Since there was a work before the expected prevalence of 28%, the sample size was calculated with 95% confidence level and 5% desired absolute precision as follows [43].

$$n = \frac{(1.96)^2 \, p_{exp} (1-p_{exp})}{d^2}$$

n = required sample size
Pexp = expected prevalence
d = desired absolute precision

According to Thrusfield (2005) a total of 310 animals were examined for bovine fasciolosis. But to increase the precision, the sample size was increased and a total of 409 cattle were examined.

3.5 Study Methodology
3.5.1 Ante-mortem examination
For each individual animal, ante mortem examination was conducted for the assessment of sex, age, breed, origin, and body condition. During the examination each factor of the study was carefully recorded.

3.5.2 Coprology
Fecal sample was collected for parasitological examination, directly from the rectum of each animals by using disposable gloves and placed in a clean screw capped universal sampling bottle, and clearly labeled with animal identification (age, breed, sex, origin, body condition, and date of collection). The sample was transported by preserving with 10% formalin solution to avoid the egg from being hatching, developing, distorting, and destroying. In the laboratory microscope was used to detect the presence of Fasciola eggs using standard sedimentation technique. Methylene blue was also used to differentiate the Fasciola egg from other parasite eggs [14].

3.5.3 Postmortem examination
In the postmortem examination, liver was examined immediately after slaughter by visualization, palpation and incision. Fluke burden was determined by counting the recovered Fasciola parasite following the approach of Hammond and Sewell (1974). The gall bladder was removed and washed to screen out mature flukes and the liver was cut into slices of about 1cm thick and put in a metal trough and then the heads of the flukes were counted.
Identification of the species was carried out using the size parameter described by Soulsby (1986).

3.6 Data Entry and Analysis
Obtained data was recorded, entered and managed into MS Excel work sheet and analyzed using SPSS version 16.
The prevalence of fasciolosis was calculated using the number of infected individuals divided by the number of cattle examined times 100. Chi-square was used to evaluate the association between fasciolosis with sex, age, body condition, and location. In all statistical analysis, confidence level was held at 95% and P-value is <0.05 (at 5% level of significance) was considered as significant.

4. Results
Prevalence of Fasciola: From the total 409 cattle slaughtered at Kombolcha industrial abattoir 143 (35%) were found infected with Fasciola at postmortem examination as tabulated in table 1.

Table 1: Prevalence of Fasciola species in cattle slaughtered at Kombolcha industrial abattoir

Fasciola spp.	No. of infected livers	Prevalence (%)
Fasciola hepatica	77	18.8
Fasciola gigantic	28	6.8
Immature	16	3.9
Mixed infection	22	5.4
Total	143	35

From 143 livers found positive for fluke infection during post-mortem meat inspection of slaughtered animals, 77(18.8%), 28 (6.8%), 22(5.4%) harbour *F. hepatica*, *F. gigantica*, and mixed infection respectively. On the other hand 16 (3.9%) livers infected with unidentified species of immature flukes (Table 1).

Table 2: Prevalence of bovine fasciolosis at postmortem associated with sex, age, body condition, and origin of the slaughtered animals at Kombolcha industrial abattoir

Factors		No. of animals examined	No. of positive (%)	x^2 (p. value)
Sex	Male	313	110 (35.1)	0.448 (0.978)
	Female	96	33 (34.4)	
	Total	409	143 (35)	
Age	Adult	200	63 (31.5)	4.321 (0.364)
	Old	209	80 (38.28)	
	Total	409	143 (35)	
Body condition	Poor	49	23 (46.9)	14.966(0.60)
	Medium	197	66 (33.5)	
	Good	163	54 (33.1)	
	Total	409	143 (35)	
Origin	Dega	107	49 (45.8)	45.475 (0.000)
	Woyna Dega	148	71 (48)	
	Kola	154	23 (14.9)	
	Total	409	143 (35)	

Association of fasciolosis with sex, age, body condition, and origin

As it is shown in the table two above, there were no statistically significant association between sex, age, and body condition (*p*> 0.05) with *Fasciola* infestation while there was statistically significant association between origin and *Fasciola* infestation (p=0.000).

From the total of 409 livers examined, 49 (45.8%), 71 (48%), 23 (14.9%), were infected by *Fasciola* from Dega, Woyna Dega, and Kola respectively. From these higher infection was recorded at Woyna Dega (48%) while lower infection was recorded at Kola (14.9%).

Table 3: Prevalence of bovine fasciolosis at fecal sample associated with sex, age, body condition, and origin of the slaughtered animals at Kombolcha industrial abattoir

Factors		No. of animals examined	No. of positive (%)	x^2 (p. value)
Sex	Male	313	79 (25.2)	0.025 (0.875)
	Female	96	25 (26)	
	Total	409	104 (25.4)	
Age	Adult	200	47 (23.5)	0.767 (0.381)
	Old	209	57 (27.3)	
	Total	409	104 (25.4)	
Body condition	Poor	49	15 (30.6)	0.818 (0.664)
	Medium	196	48 (24.6)	
	Good	163	41 (25.2)	
	Total	409	104 (25.4)	
Origin	Dega	107	36(33.6)	24.591 (0.000)
	Woyna Dega	148	50 (33.8)	
	Kola	154	18 (11.7)	
	Total	40	104 (25.4)	

A total of 409 fecal samples were topologically examined from selected areas for the occurrence of fasciolosis, of which, 104 were found infected with fasciolosis, resulting in an overall prevalence of 25.4% (Table 3). Analysis indicated that, there were no statistically significant association between prevalence of fasciolosis and sex, age, and body condition of study animals (*p*>0.05). But there was statistically significant association between infestation of Fasciola with origin of the animal (p=0.000) with the prevalence of 33.6% from Dega, 33.8% from Woyna Dega, and 11.7% from Kola.

Table 4: Prevalence of Fasciola species associated with origin of the animals at kombolcha industrial abattoir

Spp. of Fasciola	Origin	No. of animals examined	No. of positive (%)	x^2(p-value)
F. hepatica	Dega	107	26 (24.3)	45.475 (0.000)
	Woyna Dega	148	40 (27.0)	
	Kola	154	11 (7.1)	
	Total	409	77 (18.8)	
F. gigantica	Dega	107	11 (10.3)	45.475 (0.000)
	Woyna Dega	148	12 (8.1)	
	Kola	154	5 (3.2)	
	Total	409	28 (6.8)	
Immature	Dega	107	4 (3.7)	45.475 (0.000)
	Woyna Dega	148	8 (5.4)	
	Kola	154	4 (2.6)	
	Total	409	16 (3.9)	

Mixed	Dega	107	8 (7.5)	45.475 (0.000)
	Woyna Dega	148	11 (7.4)	
	Kola	154	3 (1.9)	
	Total	409	22 (5.4)	

The prevalence of Fasciola species were statistically significant with the origin of slaughtered animals at the abattoir (x^2=45.475, p=0.000) and have prevalence of 18.8%, 6.8%, 3.9%, and 5.4% for *f. hepatica*, *f. gigantica*, immature and mixed infection respectively, as indicated in table 4. *F. hepatica* was more prevalent at Woyna Dega (27%) than Dega (24.3%) and Kola (7.1%) while *f. gigantica* was more prevalent at Dega (10.3%) than Woyna Dega (8.1%) and Kola (3.2%).

Table 5: Prevalence of bovine fasciolosis between 2010/11-2012/13

Year	No. of cattle slaughtered	Distomatosis	Prevalence (%)
2010/11	4,390	1230	28
2011/12	4,620	2,152	46.6
2012/13	3950	955	24.18
Total	12960	4337	33.5

Estimation of economic losses due to distomatosis

The calculation on direct economic loss of bovine fasciolosis was based on the average number of cattle slaughtered per year, mean selling price of the cattle livers at Kombolcha town and the prevalence of fasciolosis in the retrospective study (33.5%).

The average market price of 1kg of meat and one liver at Kombolcha town was taken as 120 and 50 Ethiopian birr, respectively. The mean number of cattle slaughtered in this abattoir was 4,320 per year according to the two years recorded data. The direct economic loss was calculated according to the mathematical formula derived by Ogunrinade (1980) as follows:

ALC = MCS x MLC x P

Where ALC=Annual loss from Liver Condemnation

MCS= Mean annual Cattle Slaughtered

MLC= Mean cost of one liver and

P= Prevalence rate of the fasciolosis at the retrospective study.

ALC = MCS x MLC x P = 4320 x 50ETB X 33.5% = 72,360Ethiopian birr (ETB).

5. Discussion

Prevalence of bovine fascioliasis in slaughter house was determined by liver and coprological examination for adult fluke and egg recovery respectively. Prevalence of fascioliasis was found to be 25.4% by coprological examination and 35% through liver postmortem examination. Significantly higher prevalence was found by postmortem as compared to coprological findings. The lower prevalence of fasciolosis reported using coproscopy indicates that the lower sensitivity of this procedure in detecting the disease due to the intermittent nature of the expulsion of the eggs through the faeces. A period of eight to fifteen weeks after infection is needed for the appearance of *Fasciola species* [15]. The current prevalence (25.4%) indicated by faecal examination was higher than 4.9% recorded in Soddo (Fufa *et al*., 2009), and much lower than 80% recorded for Debre Berhan (Dagne 1994) which is the high land of Ethiopia.

From the total of 409 cattle slaughtered at Kombolcha industrial abattoir, 143 (35%) were found positive for Fasciola on postmortem examination. The result of this study was relatively higher when compared with the previous findings of (24.32%) by Gebretsadik *et al.* (2009) from Mekelle, (12.7%) by Fufa *et al*. (2009) at Welaita Sodo, 30.43% by Hailu (1995) from Hawassa, 29.75% by Rahel (2009) from Alaba, 31.5% by Wakuma (2009) from Bedele, 32.3% by Mihreteab *et al*. (2010) from Adwa, 28.63% by Rahmeto *et al*. (2010) from Hawassa, 29.75% by Mulat *et al.* (2012) from Gondar, and 14.4% by Daniel (1995) from Hossana municipal abattoir. The overall prevalence (35%) of bovine fasciolosis in this research was in agreement with the earlier findings including (34.9%) by Rehman (2011) from Pakistan, 34% by Rahmeto (1992) around Wolliso. However, the current result was lower than the previous reports such as 50.98% by Dejene (2008), (46.58%) by Tadele and Worku, (2007) at Jimma, and (83.08%). by Mulualem, (1998) in South Gondar.

The variation in overall prevalence of bovine fasciolosis among different areas of the study may depend on snail population, choice of diagnostic method, livestock management system and suitability of the environment for survival and distribution of the parasite as well as the intermediate host [51, 34]. Climate-ecological conditions such as altitude, rainfall, temperature, livestock management system, and suitability of the environment might have played their own role in such differences. One of the most important factors that influence the occurrence of fasciolosis in a certain area is availability of suitable snail habitat. In addition, optimal base temperature to the levels of 10 ºC and16ºC is necessary for snail vectors of *F. hepatica* and *F. gigantica*, respectively. These thermal requirements are also needed for the development of Fasciola with in the intermediate host. The ideal moisture conditions for snail breeding and development of larval stages within the snails are provided when rainfall exceeds transpiration and field saturation is attained.

Such conditions are also essential for the development of fluke eggs, miracidiae searching for snails and dispersal of cercariae [44, 25]. Species identification revealed that *Fasciola hepatica* was more prevalent (18.8%) as compared to *Fasciola gigantic* (6.8%); some proportion of animals (5.4%) harbored mixed infection and others unidentified immature fluke (3.9%). The higher prevalence of *Fasciola hepatica* might be associated with the existence of favorable ecologibiotopes for the intermediate host *Lymnaea truncatula.* In support of the present study, Gebretsadik *et al*. (2009) reported that 56.42% of cattle were infected with *Fasciola hepatica* and 9.17% with *Fasciola gigantica.* However, in another study, Fufa *et al*. (2009) stated that the most common liver fluke species affecting cattle at Welaita Sodo was *Fasciola gigantica. 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.

There was statistically significant variation of fluke burden of affected liver and origin of the slaughtered animals (x^2= 45.475; p=0.000). The average mean fluke count encountered during the study was 31.5 flukes per affected liver and it were higher as compared to the report by Bekele *et al*. (2012) who reported 27.48 flukes per affected liver; but lower than Dechasa *et al.* (2012) who reported 50 flukes per affected liver.

The direct economic loss that may result due to liver condemnation by Fasciola species in cattle was estimated to be 72,360 Ethiopian birr (3749.22USD) per annum. The financial loss recorded in the present study was found to be lower when compared with the previous findings of 726,561.50ETB (Abayneh, 2010) from Arbaminch, 88,806 ETB (Bekele *et al.*, 2012) from Hosana and 106,400 ETB [32] from Hawassa and relatively higher when compared with 12,414.47 ETB (Dejene, 2008) from Arsi and 32,075.41 ETB [26] from Gondar. The variation of economic loss in different study areas might be attributed to the variation in number of cattle slaughtered in the study abattoirs and the average market price of one liver.

6. Conclusion and Recommendations

The result of the present study revealed that fasciolosis was major cause of liver condemnation at Kombolcha industrial abattoir resulting in considerable financial loss in cattle production which remain the most important disease warranting serious attention for prevention and control actions. The direct economic loss that may result due to liver condemnation by Fasciola species in cattle was estimated to be 72,360 Ethiopian birr (3749.22USD) per annum. Species identification indicated that *Fasciola hepatica* was more prevalent (18.8%) as compared to *Fasciola gigantic* (6.8%). Hence the current study may be valuable locally and nationally by providing status of fasciolosis at this study area.

Therefore the following recommendations are forwarded

- Careful ecological studies should be applied to control snails which have been the major facet of fluke control.
- Strategic antihelmentics treatment with appropriate flukicide drug should be practice twice a year, before and after rainy seasons to eliminate fluke burden of the host of animals and minimize pasture contamination by faecal egg shedding thus interrupting the life cycle.
- Emphasis should be given for the prevention and intensive management should be practiced with good pasture management system
- The local community should be aware of the importance of the disease and be ready to take action in order to reduce the economic losses
- To control infection of farm animals with metacercaria, grazing on wet pasture favorable to snails or on margins of pools or slow running streams should be prevented either by keeping the animals off these areas or by fencing oe dangerous areas
- To develop protection against infection of cattle with Fasciola, immunization of calves with irradiated metacercaria should be practiced

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