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Cross-sectional study on bovine fasciolosis: prevalence, coprological, abattoir survey and financial loss due to liver condemnation at Areka Municipal Abattoir, Southern Ethiopia

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A cross-sectional study was carried out from November 2013 to April 2014 on bovine fasciolosis at Areka municipal abattoir to estimate the prevalence of bovine fasciolosis, associated risk factors, evaluate the sensitivity of coprological test and estimate direct annual financial loss due to liver condemnation. From 400 sampled cattle's during the study period, 67 (16.75%) of their fecal samples and 120 (30%) of their livers were positive during antemortem and postmortem inspection, respectively. The prevalence of bovine fasciolosis was higher in older (>10 years [36.5%]) than younger ones (<5 years [20.8%]). The prevalence of bovine fasciolosis in study sites was significantly associated with age and body condition of cattle (P<0.05). From species comparison, *Fasciola hepatica* (14.75%) was found to be the predominant species causing bovine fasciolosis. The direct financial analysis due to liver condemnation was made based on retail price/value of bovine liver and estimated to be 47,124 ETB (2,406.74 USD). In general, fasciolosis is more prevalent in the study area and cause loss in economic impact from liver condemnation. The fact of parasitic existence and associated economic loss warrant the need of control and prevention systems to be designed and implemented at the study site.

Key words: Areka municipal abattoir, bovine fasciolosis, coprology, liver condemnation, postmortem examination.

INTRODUCTION

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 (Keyyu et al., 2005; Menkir et al., 2007). *Fasciola hepatica* and *Fasciola gigantica* are the two liver flukes commonly reported to cause fasciolosis in ruminants. The life cycle of these trematodes involves snail as an intermediate host (Walker

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et al., 2008). Infected cattle can exhibit poor weight gain and dairy cattle have lower milk yield, and possibly metabolic diseases (Mason, 2004). Significant financial losses due to this parasite were recorded by different researchers at different sites of the globe like in United Kingdom and Ireland greater than 18 million Euros per year by Mulcahy and Dalton (2001), in Kenya 0.26 million USD per annum by Kithuka et al. (2002). In general, infection of domestic ruminants with *F. hepatica* and *F. gigantica* causes significant economic loss, estimated at over 200 million USD per annum to the agricultural sector worldwide, with over 600 million animals' infected (Ramajo et al., 2001). In addition to economic loss, another common dimension is added by the fact that several helminthes infections could be transmitted to man (Radostits et al., 2007; Chhabra and Singla, 2009).

In Ethiopia among many prevalent livestock diseases, parasitism in particular is one of the major entities exerting its direct and indirect effects to the economy of the nation. The two species of *Fasciola* (*F. gigantica* and *F. hepatica*) are found in different places of the country. The presence of these parasites in the country has a long history and is responsible for causing considerable losses in livestock production. Its prevalence and economical significance has been reported by several researchers in different parts of the country (Petros et al., 2013; Regassa et al., 2012; Miheretab et al., 2010; Manyzewal et al., 2014).

Even though different researchers in the country investigate the parasite, detail abattoir as well as coprological examination with their financial impact in southern part of the country specially, Areka area was very limited. With this, the current study was designed to determine the prevalence of fasciolosis and assessment of its direct economic impact due to both partial and total liver condemnation in slaughtered cattle of Areka municipal abattoir.

MATERIALS AND METHODS

Study area

The study was conducted from November, 2013 to April, 2014 in Areka municipal abattoir. Areka (also known as Areka Ancheto) is a town in southern part of Ethiopia, located in the Wolaita Zone of the Southern Nations, Nationalities and Peoples region, about 300 km southwest of the capital, Addis Ababa. This town has a latitude and longitude of 7°4'N37°42'E and in elevation of 1774 m above sea level. The rain fall pattern is bimodal, short rainy season which runs from March to May, followed by long rainy season which runs from June to September. Mean annual rain fall of Areka is about 1300 mm and the average annual temperature is 24°C. This town has an estimated total population of 22,277.

Study population

The study population was all cattle slaughtered at Areka municipal abattoir brought from Areka and its surrounding.

Study design and sampling method

A cross sectional study was used to determine the prevalence of bovine fasciolosis, and animals were selected with systematic random sampling method (after the first animal was selected randomly, then with equal interval while animals in larraige was selected) (Thrusfield, 1995).

Sample size determination

The sample size was determined by taking the prevalence of 47% (Abdul, 1992) fasciolosis using the formula given by Thrusfield (1995). Accordingly, 382 animals were supposed to be sampled; however, to increase the precision, 400 animals were sampled.

Experimental

Coprological examination

Fecal samples for parasitological examination were collected directly from the rectum of each animal and freshly defecated feces into plastic bottle with gloved hands. The samples were early labeled with universal bottles preserved with 5% formalin and each sample was clearly labeled with animal's identification and date. Samples were packed and dispatched into cool box to avoid the eggs developing and hatching, and were brought to Soddo Veterinary Regional Laboratory. In the laboratory, coproscopic examination was performed to detect the presence of *Fasciola* eggs using the standard sedimentation techniques (Hansen and Perry, 1994).

Abattoir survey

Active abattoir survey was conducted based on cross-sectional study during routine meat inspection on systematically selected cattle slaughtered at Areka municipal abattoir. A total of 400 cattle were examined in the current study. During ante mortem examination, detail records about the ages, breeds, origin and body condition of animal were performed. The origin of animal was obtained from asking owners, while body condition scoring was based on Mari (1989). During postmortem inspection, each liver was inspected, palpated, and incised based on routine meat inspection (FAO, 2003). All organs having *Fasciola* species condemned were registered and flukes were collected for species identification.

Fasciola spp. identification

The liver of each study animal was carefully examined for the presence of lesions suggestive of *Fasciola* infection externally and sliced for confirmation. Liver flukes were recovered for differential count by cutting the infected liver into fine, approximately 1 cm slices with a sharp knife. Each mature fluke was identified to species level according to its shape and size. Investigation and identification of *Fasciola* was done according to their distinct morphological characteristics following the standard guidelines given by Urquhart et al. (1996).

Direct financial loss

Direct economic loss resulted from condemnation of liver affected by fasciolosis. All liver affected with fasciolosis were either partially or totally condemned depending on the severity of parasite distribution in the liver. The annual financial loss from liver condemnation

Table 1. Coprological and postmortem results of *Fasciola* in Areka municipal abattoir during the study period (n=400).

Result		No. of positive animals	Prevalence (%)
Coprology		67	16.75
	F. gigantica	20	5
Postmortem finding	*F. hepatica*	59	14.75
	Mixed (*F. gigantica* and *F. hepatica*)	41	10.25
Total		120	30

Table 2. Logistic regression analysis of the association of the prevalence with risk factors by coprology.

Risk factor		No. examined	No. positive (%)	Crude OR (95% CI)	AOR (95% CI)	P-value
Age (year)	≤5	77	13 (16.88)	1	1	
	5-10	197	33 (16.75)	1.01 (0.5, 2.2)	1.02 (0.5, 2.08)	0.963
	≥10	126	21 (16.67)	1.02 (0.47, 2.2)	1.04 (0.48, 2.25)	0.924
Breed	Local	351	57 (16.24)	1	1	
	Cross	49	10 (20.41)	1.32 (0.62, 2.8)	1.46 (0.67, 3.16)	0.337
BCS	Poor	52	14 (26.92)	1	1	
	Moderate	120	25 (20.83)	1.4 (0.66, 2.94)	1.4 (0.67, 3.1)	0.358
	Good	228	28 (12.28)	2.63 (1.3, 5)	2.78 (1.33, 5.88)	0.007

was assessed by considering the overall annually slaughtered animals of the abattoir and average retail market price of liver from butcheries in Areka town. Annual slaughtered rate was estimated from retrospective abattoir records. The information obtained was subjected to mathematical formula set by Ogunrinade and Adegoke (1982).

$$ALC = CSR \times LC \times P$$

where ALC is the annual loss from liver condemnation, LC is the mean cost of a liver in Areka town, CSR is the mean annual slaughtered at Areka municipal abattoir, P is the prevalence rate of disease at the study abattoir.

Data management and analysis

Data was stored in Microsoft Excel spread sheet program and was analyzed using intercooled STATA Version 11 for windows (2007) to determine the prevalence and the association with risk factors. The statistical method used was descriptive statistics. Body condition, age and breed were considered as potential risk factors for the prevalence of the diseases.

RESULTS

Prevalence

From 400 animals selected during study period, 67 (16.75%) animal fecal samples were positive for *Fasciola* eggs under coproscopic examination, whereas 120 (30%) of livers were found to be positive for *Fasciola* during detail postmortem inspection (Table 1).

Coproscopic findings

From 400 animal feces sampled, proportional positive results were detected between different age groups (16.88, 16.75 and 16.67% in <5, 5-10 and >10 years old cattle). More cross breeds (20.41%) were found positive for coproscopic finding than local (16.24%). The other risk factors were body score condition (BCS) in which fecal sample from animals with poor BCS (26.92%) were found to be higher positive values in coproscopic (egg) examination than in good BCS (12.28%). Statistical analysis showed that BCS was statistically associated with the existence of parasitic egg ($p = 0.007$) (Table 2).

Abattoir survey

Among the 400 livers inspected during postmortem inspection, 120 (30%) were found to be positive for liver fluke. Out of this, a dominant liver were infected with *F. hepatica* 59 (14.75%) followed by mixed infection of both (*F. gigantica* and *F. hepatica*) 41 (10.25%) and *F. gigantica* 20 (5%). Moreover, those identified species were correlated with different risk factors. In relation to age of the animals, the prevalence was higher in those

Table 3. Abattoir prevalence of bovine fasciolosis proportion with risk factors.

Risk factor		No. examined	No. positive	Prevalence	FG (%)	FH (%)	Mixed (%)	Crude OR (95% CI)	AOR(95%CI)	P-value
Age (year)	<5	77	16	20.8	4 (5.19)	7 (9.09)	5 (6.49)	1	1	
	5-10	197	58	29.4	12 (6.09)	32 (16.24)	14 (7.11)	1.59 (0.85, 2.99)	1.75 (0.91, 3.39)	0.096
	>10	126	46	36.5	4 (3.17)	20 (15.07)	22 (17.47)	2.19 (1.13, 4.24)	2.55 (1.27, 5.12)	0.008
Breed	Local	351	101	28.8	17 (4.84)	50 (14.25)	34 (9.69)	1	1	
	Cross	49	19	38.8	3 (6.12)	9 (18.37)	7 (14.29)	1.57 (0.84, 2.91)	1.79 (0.92, 3.5)	0.089
BCS	Poor	52	28	53.8	5 (9.62)	15 (28.85)	8 (15.38)	1	1	
	Moderate	120	48	40	6 (5)	25 (20.85)	17 (14.17)	1.67 (0.91, 3.33)	1.85 (0.9 ,3.57)	0.078
	Good	228	44	19.3	9 (3.95)	19 (8.33)	16 (7.02)	5 (2.5, 10)	5 (2.86, 10)	0.000

FG: *Fasciola gigantica*, FH: *Fasciola hepatica*, AOR: Adjusted odds ratio.

animals with age of ≥10 years than in those with age 5 to 10 and ≤5 years with the prevalences of 36.51, 29.44, and 20%, respectively. In cases of breeds, prevalence were higher in cross (38.78%) than local breed (28.77%). The other risk factors were body condition score, in which poor body condition score animal livers (54.9%) were infected dominantly followed by moderate (40%) and good body (19.3%) conditioned animal livers, respectively. Furthermore, the analysis showed significant differences among different age groups and body condition scores of animals ($P < 0.05$) (Table 3).

There were no fecal samples of examined animals found to be positive in coproscopic examination as well as negative for postmortem inspection in liver inspection. These showed that postmortem examination was the golden test for diagnosis of fasciolosis when compared with coprology. The sensitivity and the specificity of fecal examination were found to be 55.8 and 100%, respectively. The calculated Kappa value (kappa = 0.6) indicated the presence of moderate agreements between the two techniques (Table 4).

Direct financial loss assessment

Generally, all livers with fasciolosis were to be condemned proportionally (either partially or totally) which are unfit for human consumption. During financial analysis, partially trimmed organs were taken and calculated in kilograms. From 120 infected livers of cattle, 89.75 livers were condemned due to fasciolosis (Weight of one bovine liver = 5 and 1 kg of liver = 14 ETB/0.7 USD) (Table 5).

In the current abattoir, the average annual cattle slaughtered were calculated from retrospective record and found to be 3,000, while average retail price of liver in Areka town was 70 ETB (3.58 USD). To estimate annual abattoir loss due to liver condemnation, a formula derived by Ogunrinade and Adegoke (1982) of Nigeria was adapted. But in this study, partial condemnation got attention and approximated in terms of numerical value of livers, that is, 163.75 kg of livers. So 163.75 kg of livers were found to be condemned partially and 285 kg of liver were found to be condemned totally for annual loss calculation, it was converted by considering average kilogram of individual livers (One average weight of bovine liver = 5 kg). Therefore, the estimated annual abattoir loss due to liver condemnation was 47,124 ETB (2406.74 USD) (Current exchange of 1 USD = 19.58 ETB).

DISCUSSION

Bovine fasciolosis exists in almost all region of Ethiopia with its economic effects due to indirect causes, while it is in host related to production loss and the direct loss is associated with affected organs condemnation. The prevalence of fasciolosis observed in this study was 30% which appear to be higher than the prevalence's recorded by Gebretsadik et al. (2009) (24.3%) at Mekele area, Northern Ethiopia, Regassa et al. (2012) (21.9%) in Bishoftu Central Ethiopia and Petros et al. (2013) (21.6%) in Nekemte Western Ethiopia. However, the current finding was lower than that of Yilma and Mesfin (2000) (91%), Abebe et al. (2011) (53.7%), Manyazewal et al. (2014) (47.1%) and Phiri et al. (2005) (53.9%), at Northwest, Southwest Ethiopia and Zambia,

Table 4. Specificity, sensitivity of coproscopy and post mortem finding.

Parameter	Postmortem positive	Postmortem negative	Total
Coprology positive	67	0	67
Coprology negative	53	280	333
Total	120	280	400

Table 5. Economic loss assessment for liver condemnation.

Judgment in ratio	No. Positive	Condemned organs (number)	Condemned organs (kg)	Estimated economic loss in ETB/USD
T. condemned (1)	57	57	285	3990/203.78
P. condemned (3/4)	23	17.25	86.25	1207.5/61.67
P. condemned (1/2)	22	11	55	770/39.33
P. condemned (1/4)	18	4.5	22.5	315/16.09
Total	120	89.75	448.75	6282.5/320.86

T.: Totally, P.: Partially.

respectively. The significant variation in the prevalence of fasciolosis was mainly attributable to the variation in the climatic and ecological conditions such as altitude, rainfall, and temperature as well as the livestock management system among the study areas. On the other hand, the current result was in agreement with the findings of Mulat et al. (2012) (29.6%) and Miheretab et al. (2010) (32.3%) in Adwa, Northern Ethiopia.

In relation to risk factors, there was a significant difference in the infection rate ($P<0.05$) among the age >10 years ($p=0.008$, OR=2.55, CI (1.27, 5.12)) and good body scores condition (BSC) groups ($p=0.00$, OR=5, CI (2.86, 10)) in their postmortem findings. In support of this finding, a study conducted in Adwa by Miheretab et al. (2010) and in Mekelle by Yohannes (2008) indicated that the association between the prevalence of fasciolosis and body condition of the animals was also statistically significant. This could be due to the fact that animals with poor body condition are usually less resistant and are consequently susceptible to infectious diseases.

Species identification revealed that *F. hepatica* was more prevalent (14.75%) followed by mixed infestation (10.25%) and *F. gigantica* (5%). The predominant species involved in causing bovine fasciolosis in the study area was *F. hepatica* and is associated to the existence of favorable ecological condition for *Ligia truncatula* (intermediate host) of *F. hepatica* in the study area such as swampy and marshy area around Areka and different parts of the region, low lying plain and shallow pond provide favorable habitat for *L. truncatula* and allow the existence of *F. hepatica* in the area. The lower prevalence of *F. gigantica* was due to the unfavorable condition to the existence and multiplication of snail *Ligia natalensis* in the study area. The favorable condition for *L. natalensis* was border of lakes, flood prone area and low lying marshy and drainage ditches for favorable habitat (Troncy, 1989).

The direct economic loss incurred during this study as a result of liver condemnation of cattle was estimated about 47,124 ETB/2,406.74 USD per annum. This result was found to be lower than the findings of Manyzewal et al. (2014) (47,570 ETB) and Petros et al. (2013) (63,072 ETB) at Mettu and Nekemte abattoirs, respectively. The existed variation might be correlated with slaughter capacity and number of condemned organs at those specific areas.

CONCLUSION AND RECOMMENDATION

The present study conducted on bovine fasciolosis in Areka municipal abattoir, Southern Ethiopia indicate that fasciolosis has been one of the major constraints to the livestock development in the area by inflicting remarkable direct economic losses.

The risk of socio-economic impacts of the parasite was required to implement systematic disease prevention and control methods.

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Conflict of interest

The authors declare that there is no conflict of interest.

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