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Prevalence and Economic Loss of Cyst Echinococcosis of Small Ruminants Slughtered at Modjo Modern Export Abattior

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Abstract

Hydatidosis is a neglected cyclozoonotic disease affecting both humans and livestock population. Cross-sectional study was carried out from December 2022 to February 2023 at mojo modern export abattoir with the objective to compare the prevalence and estimate the finical losses of small ruminants Hydatidosis. A cross-sectional study involving systematic random sampling was conducted to estimate the prevalence of CE in 433 small ruminants (125sheep and 308 goats) slaughtered at Mojo modern export Abattoir from December 2022and February2023. CE was observed in 11 (8.8%) sheep and 62 (20.1%) goats. In sheep 4 (36.3%) of the lungs, 6 (54.5%) livers and in goat 28(45.1%), lung, 32(51.6%) liver. Involvement of lung and liver in goats was found to be 2 (3.2%). Of the total of 62 and 11 cysts encountered goat andsheep There was significant difference in the prevalence of Hydatidosis in between the two species with different age, body condition and origin of the animals in the study, the total annual economic loss due to organ condemnation caused by a cyst of Hydatidosis in modjo modern export abattoir was estimated to be 22,251.936 Ethiopian birr. Therefore, good hygienic practice and to avoid backyard slaughtering practice are essential to limit the spread of infection.

Keywords: Economic Loss, Goats, Hydatidosis, Sheep, Prevalence

Introduction

Hydatidosis/Echinococcosis is a cosmopolitan zoonosis caused by larval stages of cestode belonging to the genus Echinococcus (family taeniidae). Larval infection (hydatidosis) is characterized by long term growth of metacestode (hydatidcysts) in the intermediate host. In Ethiopia, livestock production is a major component ofthe agricultural economy, contributing about 30% to the agricultural gross domestic product (GDP) and 17% to export earnings [1]. Additionally, livestock supports rural and urban population with milk and meat, employment, investment opportunities and draft power for crop production [2].

Despite their huge potential resource, Ethiopian livestock productivity is lower than the African average.As a result, the contribution of livestock sector to the national economy in general and to the improved living condition of the people in particular is minimal. The major biological and economical constrains contributing to low productivity include low genetic potential of animal poor nutrition and the prevalence of various disease including Hydatidosis/echinococcosis. Factor governing the prevalence of Hydatidosis in a given locality may be associated with prevailing specific social, cultural, environmental and epidemiological, and the dynamics of transmission differ between the dog and its intermediate host and human [3].

The public health and economic significances of Hydatidosis lies on the cost of hospitalization, medical and surgical fees, loss of income and productivity, permanent or temporary incapacity to work social consequence Hydatidosis of disability and mortality [3]. In food animal Hydatidosis has an adverse effecton production causing decreased production of meat, milk, wool, reduction in growth rate and predisposition to other diseases (Hubbert et al., 1975).

The disease incurs economic losses in meat sector, effective control and prevention measures should be introduced to minimize the risk of public health hazard and curb the incurred economic losses. The current first drug of choice is praziquantel, which is recommended for goats and sheep. The drug is highly effective against immature and mature intestinal stages, but the drug is not ovicidal [4].

Effective control of hydatid diseaseis based on presentation by breaking the cycle between definitive and intermediate hosts. This has been demonstrated in a number of well documented control campaigns concerned with Echinococcus granulosus maintained in domestic life cycle patterns [5]. The key to success is health educations that elicit community participation [6]. In view ofthis, the objectives of this study were to determine the prevalence of Hydatidosis and to estimate the direct economic losses due to hydatid cyst in various organs insmall ruminants slaughtered in MMEA.

Materials and Methods

Study Area

The study was conducted in Modjo modern export abattoir. Mojo is found in the Central Ethiopia, East Shoa zone of the Oromia region. This town exists at latitude and longitude of 8°N 39°E with an elevation between1788 and 1825 m above the sea level. The abattoir is special abattoir for the export of Fresh, Hygienic, Organic and Quality Chilled mutton. It is located in Lumee Woreda, Oromia regional state, East shoa zone, 73 km east of Addis Ababa. This location enables livestock to be easily sourced as the abattoirs is placed in the vicinity of Goat Sheep and Cattle grazing areas. All the animals slaughtered at mojo modern export abattoir are strictly Sharia compliance under the supervision of Supreme council for Islamic affairs, Oromia, Ethiopia and expert veterinarians. All product processed at the abattoir is exported to various locations around the Middle East. All meat and meat product shipments are accompanied by international sanitary certificates issued by the veterinary authorities of the Ministry of Agriculture.

Study Animals

All local breeds of sheep and goats that originated from high land, midland and low land area of the country for slaughter in mojo modern export abattoir were included in the study population. Consequently, all male sheep and goats were subjected for the study by simple random sampling technique which sampling and age of the animals were grouped based on dentition, for those which have not erupted permanent incisor teeth, are classified as young, while those with pair or more permanent incisor teeth erupted were classified as adult [7].

Study Design and Sample Size

A cross-sectional study type was carried out from December, 2022 to February, 2023. By using simple random sampling technique, the total numbers of animals required for the study were calculating based on the formula given by Thrusfield [8]. $n= 1.96^2P_{exp}\ (1\text{-}P_{exp})\ /\ d^2$, where n= required sample size, P_{exp}=expected prevalence, d= Absolute precision. Data relating to origin, sex, age and body condition of each study animal were recorded

Study Methods

Active abattoir surveys were conducted on sheep and goat before animals was slaughtered based on simple random sampling technique. During ante-mortem examination of each study animal were given an identification number based on species of animals age, origin, weight, body condition was recorded. Cyst characterization is based on the collection of cysts from infected organs of positive animals.

Assessment of Direct Economic Loss

The direct loss from cost of offal condemnations and indirect cost due to carcass weight loss were considered. To calculate the financial loss parameters such as: Mean market price of lung and liver Cost of 1kg sheep and goats' meat andAverage annual slaughter rate of small ruminants at modjo modern. Average carcass weight of sheep and goats was 15 kg estimated by Bersissa [9]. 5% estimated carcass weight losses due to hydatidosis were considered [10]. Direct financial losses are losses due to condemned organs. Organs positive for CE were totally condemned. Direct financial losses were assessed with the formula: DL = (NAS x PH x PHlu x CPlu) + (NAS x PH xPHli x CPli) + (NAS x PH x PHs x CPs) + (NAS x PH x PHk x CPk) + (NAS x PH x PHh x CPh).

Data Management and Analysis

The data generated were stored in Microsoft excel spreadsheet and analyzed using STATA version 11.0. Percentage, chi square test, univariable logistic regression analysis were performed, Only the independent variables showing collinearity <50% and P<0.25 were included to final model analysis.95% CI and P<0.05 were considered statistically significant value

Results

Prevalence of CE in Small Ruminants

In the current study total of 433 animals comprising 308 Goatand 125 sheep slaughtered in Modjo modern export abattoir were examined for the presence of CE.Out of the total 433 small ruminants examined for the presence of CE an overall prevalence of 16.7%. Out of 308 goats examined for coenurosis62 (20.3%) were positive. Similarly, out of the 125 sheep examined 11 (8.8%) were positive.

Table 1: The overall prevalence of CE in small ruminants slaughtered at two abattoirs of central Ethiopia

Species of animals	No animals examined	No of positive	Prevalence (%)
Goat	308	62	20.3
Sheep	125	11	8.8

Association of Risk Factors with the Prevalence of CE

The results of the association of different risk factors with the prevalence of CE using chi square(X2) test. Slightly higher prevalence of CE infection was recoreded in goat than sheep. prevalence of CE infection was significantly associated at species level ($P < 0.05$). also CE was significantly associated risk factors; age, origin and body condition ($p< 0.05$)

Table 2: The association between prevalence of cystic echinococcosis and the risk factors of small ruminants slaughtered at selected abattoirs of Ethiopia.

Factors		No examined	No positive	Perveance	X2	p- value
Species	Goats	308	62	20.3	32	0.00
	Sheep	125	11	8.8		
Age	young	285	46	16.1	1.7	0.001
	Adult	145	27	18.6		

Body condition	Fat	177	13	3.9	26.5	0.002
	Medium	192	24	7.3		
	Lean	63	36	57.14		
Origin	Lowland	320	23	7.1	26.9	0.000
	Highland	113	50	44.2		

Logistic Regression Analysis for Hypothesized Risk Factors of CE

Univariable Logistic Regression for Hypothesized Risk Factors

During the univariable logistic regression analysis, for all the risk factors, the first level of each independent variable (the category of a risk factor with lowest prevalence) was used as a reference category for measuring the degree of association between the disease and risk factors. The prevalence of small ruminants CE was significant different ($p < 0.05$) between the origin, and species level no significant association between body condition and age. Univariable logistic regression analysis showed that the odd of infection in adult was1.3 times higher than in young. The odd CE infection in lean was 4.01 times higher than in fat. The odd of CE infection in high land was 2.78 times higher than in lowland area of study animals(Table 3).

Table 3: Univariable logistic regression of hypothesized risk factors for CE in small ruminants slaughtered in Mojo export abattoir

Risk factors		No examined	No positive	Prevalence	OD	95%CL	P-value
Species	Sheep	125	11	8.8	1		
	Goat	308	62	20.3	3.24	2.12-4.9	0.00
Age	Young	285	46	16.1	1		
	Adult	145	27	18.6	1.3	0.8-1.92	1.89
Body condition	Fat	177	13	3.9	1		
	Medium	192	24	7.3	1.54	0.68-3.49	0.29
	Lean	63	36	57.1	4.01	1.75-9.15	0.001
Origin	Lowland	320	23	7.1	1		
	Highland	113	50	44.2	2.78	1.86-4.13	0.000

Multivariable Logistic Regression Analysis

For multivariate analysis all variable were entered into the multivariate model because the independent variables were showing colinearity<50% and P<0.25. Multivariate logistic analysis showing all independent variables were statistically significant between species and origin but no significant between age and BC (Table 3).

Table 4: Multivariable logistic regression analysis of risk factors

Risk factors		No examined	No positive	prevalence	OD	95%CL	P-value
Species	Sheep	125	11	8.8	1		
	Goat	308	62	20.3	2.8	1.75-4.50	0.00
Age	Young	285	46	16.1	1		
	Adult	145	27	18.6	0.77	0.47-1.25	0.032
Body condition	Fat	177	13	3.9	1		
	Medium	192	24	7.3	-		0.29
	Lean	63	36	57.1	2.06	1.33-3.18	0.001
Origin	Lowland	320	23	7.1	1	-	
	Highland	113	50	44.2	1.8	0.45.1.22	0.001

Cyst Characterization

Distribution of cysts on organs of small ruminants' lung and liver were the only organs affected in both species during the study (Figure 1). From a total of 73 positive animals 48.3%, 52% and 4.1% of them harbored CE infection in their in the liver, lung and in both. The distribution of the cysts was higher on the liver than the lungs.

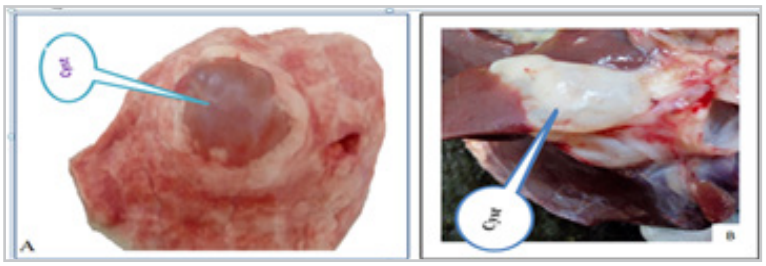

Figure 1: CE on lung (A) and on liver (B) of sheep

Table 5: Distribution of cysts in different organs

Species	No of positive	Affected organs					
		Lung		liver		lung + liver	
		no positive	%	no positive	%	no positive	%
Sheep	11	4	36.3	6	54.5	1	9
Goat	62	28	45.1	32	51.6	2	3.2
Total	73	32	43.8	38	52	3	4.1

Finical Loss Estimation

Total finical loss due to CE was estimated based on data from mojo export abattoir. During study period, 308 goat and 125 sheep were examined, of these, totally 16.8 % were found infected with CE. The condemned organs Liver 38(52%), Lung 28(45.1%)respectively. Observation during this study revealed that offal's from 62(20.1%) goat and 11(8.8%) sheep were condemned. Theaverage retail market price of both species was 10ETB/kg livers, 5ETB/KG lung from market. The losses from organs condemned were calculated by using the formula described by [11]. LOC= (NAS × Ph × Plu × Cplu) + (NAS × Ph × Phr ×Cphr) + (NAS × Ph × Pli × Cpli) + (NAS × Ph × Psp ×Cpsp) + (NAS × Ph × Pkid × Cpkid). Based on these data, direct annual finical loss was determined by considering mean of annual slaughter rate of goat and sheep to be 22,251.936ETB (Table 10).

Table 6: Number of organs examined, condemned, percentage involvement and their current average price

Organ condemned	No organ examined	No of organ condemned	Percentageinvolvement	Average priceETB
Liver	433	40	9.23%	10
Lung	433	33	7.62%	5

Discussion

CE is known to be of importance in the health of both livestock and humans, which is not apparent to farmers. Most studies on prevalence of CE in domestic animals have relied on postmortem examination in abattoirs, as this is an economical way of collecting and analyzing information on livestock diseases, particularly in subclinical cases [12, 13]. Hydatid cysts usually persist for the lifespan of the animal, so infection status can be determined during postmortem examination [14].

The study conducted at Modjo modern export Abattoir indicated that there weresignificant difference in the prevalence of CE in sheep (8.8%) and goats (20.1%). In Ethiopia the prevalence of CE in small ruminants has also been reported, viz. 22.2% in sheep in Nekemte, 19.9% in sheep in Addis Abeba, 16% in goats in Addis Ababa, 17.7% in sheep and 6.8% in goats in Harmaya, 29.3% in sheep and 6.7% in goats in central Oromia, 8.05% in sheep and 8.99% in goats in Modjo Modern Export Abattoir, and (29.5%) in sheep and (24.8%) in goats in Jimma Town [15, 13, 16, 17, 18, 19]. The difference in the prevalence of CE in sheep and goats in different parts of Ethiopia indicated above might be due to variations in agro-ecology at different study sites, age, stocking rates, movements of animals, animal husbandry systems, culture and religion of the society, and number of dogs in different regions of the country [15].

For similar reasons the prevalence of CE in sheep and goats differs in other countries of the world; sheep: goat prevalence was reported to be 11%:6% in north central Chile (Acosta-Jamett et al. 2010), 12.61%:6.56% in Al Baha region, Saudi Arabia, 45.52%:10.0% in southern Iran, 8.85%:6.21% in Pakistan and 16.42%:2.88% in Tunisia [12, 20, 21]. The difference in prevalence rates in the countries could also be associated with factors such as control measures put in place, level of community awareness about the disease, education and economic status of the population and the farming community [12].

The prevalence of hydatid cysts in the present study was found to be lower than previous findings (19.94% in sheep) at the same abattoir [16]. This may partly be attributed to greater awareness amongst farmers, antihelminthic treatment of dogs, better control measures adopted, grazing areas for the animals and controlled slaughtering measures to avoid stray dogs coming to eat offal. However, no such improvement in awareness, treatment or practices was apparent in reality. Also, in recent years several programmes have been initiated to control rabies, with large numbers of stray dogs eliminated in the region.

Liver and lung were the most commonly infected organs, and this could be due to the fact that these are the first large capillary fields encountered by the blood-borne oncospheres before any other peripheral organ is involved (Kebede et al. 2009a). Location of cysts and cyst morphology is influenced not only by host factors but also by parasite factors, such as the strain of E. granulosus involved [22]. All of the cysts encountered in both sheep and goats were unilocular, indicating the cystic stage of E. granulosus, which is by far the most common found in food animals [23].

In the present survey adult animals (with a broken mouth) were found to have significantly higher infection rates than young. This finding agrees with the results of Azlaf and Dakkak (2006) and Kebede et al. (2009a). This could mainly be due to the fact that old animals will have had longer exposure to the eggs of E. granulosus, in addition to weak immunity due to old age (Himonas 1987). Also, the chances of detecting cysts during meat inspection are higher in older animals due to the larger size of the cysts (Baswaid 2007). The significantly high prevalence of CE in small ruminants of highland origin may be due to the low environmental temperatures that favour survival of eggs of the parasite. Changes in the environment and epidemiological factors can also affect rate of transmission of CE [19].

The endemic nature of CE in small ruminants in Ethiopia could be attributed to a high population of carnivores, particularly stray dogs, in the grazing area of domestic ruminants, and lack of proper efforts to segregate domestic and wild carnivores from livestock or their grazing areas. The habit of feeding ruminant offal to dogs also enhances completion of the life cycle of the parasite. Wild carnivores, especially hyenas, jackals and foxes, may also play a role in the transmission dynamics of E. granulosus, particularly in the highland areas where large populations of these animals are found scavenging around human settlements.

The financial loss incurred during this study as a result of condemnation or rejection of organs of ovine and caprine species was estimated at about 69,139.77 ETB in Modjo modern export abattoir. Similarly, in Adama municipal abattoir, 51,544.2 ETB was reported (Getaw, 2008), in Haramaya municipal abattoir, 17,100.98 ETB was reported, in East Shoa, 10,898.64 ETB was reported (Yemane, 1990) and in Nekemte, 14,755.34 ETB was reported [17, 24]. According to Getaw, the total annual economic loss incurred due to hydatidosis in ruminants slaughtered at Adama municipal abattoir was estimated to be to 22,251.936ETB [18].

Conclusion

In conclusion it was found that CE is endemic and relatively prevalent in sheep, goats in Ethiopia, and also that the high fertility and viability of CE in the liver and lungs suggests that sheep and goats play an important role in the life cycle of this zoonosis. Control programmes based on integrated preventive approaches involving improved surveillance of the disease, establishment of well-equipped and standardized abattoirs, use of vaccine in sheep to prevent development of E. granulosus cysts, and improving public awareness by means of education, should be implemented for effective prevention of disease transmission. These initiatives will require additional funding from the government and ther agencies to reduce the infection rates in humans and animals. However, the costs and source of funding in developing countries such as Ethiopia constitute a major challenge in implementation of such a CE control programme.

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