Prevalence and Economic Importance of Hydatidosis in Small Ruminants Slaughtered at Modjo Export Abattoir

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ABSTRACT

A cross-sectional study was conducted at Modjo Modern Export Abattoir from November 2011 to April 2012 to determine the prevalence of hydatidosis on 1180 small ruminants (299 sheep and 881 goats) using detail post mortem inspection and retrospective study. Based on these methods the overall prevalence recorded was 7.2% (84/1180) and the magnitude of the cyst was higher in sheep (11.7%) and also it was highly significant at 95% CI (χ^2 = 12.7; P= 0.00). The intensity of the disease among the origins of animals was also highly significant (χ^2 = 43.4; P= 0.00) with higher prevalence from Borena (12.9%) and Bale (15%). Examination of lung, liver, kidney, heart and muscle was conducted with detail postmortem procedures and the organ distribution of hydatid cyst in sheep were 23/35 (65.7%) in lung, 10/35 (29.7%) in liver and 2(5.4%) in muscle. In goats, hydatid cysts were recovered from 29/49 (59.18%) in lung, 15/49 (30.6%) of the liver, 2/49 (4.08%) of the kidney, 1/49 (2.04 %) of the heart and 2/49 (4.08%) of the muscle. Based on 2007 – 2011 period retrospective study the prevalence 5.2% and 10.8% in sheep and goats was recorded, respectively. With a total of 536890 small ruminants slaughtered, 54550 of lung and5537 of the liver were found infected with hydatidosis.The direct financial loss from organ and carcass condemnation due to sheep and goats hydatidosis was estimated to be 11,216.25USD/197,718ETB losses Per annum. Hydatidosis is highly prevalent in small ruminants during the study period. Therefore, appropriate control measures should be implemented to reduce the burden of the disease and decrease the economic loss.

Key words: *Goat, Hydatid Cyst, Modjo Modern Export Abattoir, Prevalence, Sheep*,

1. INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country, and still promising to rally round the economic development of the country. It is well-known that livestock products and by-products in the form of meat, milk, honey, eggs, cheese, and butter supply etc. Provide the needed animal protein that contributes to the improvement of the nutritional status of the people. Livestock also plays an important role in providing export commodities, such as live animals, hides, and skins to earn foreign exchanges to the country. The estimated numbers of sheep and goats in the country are 25.5 million and 22.78 respectively (CSA, 2011) .The country has great potential for increased livestock production, both for local use and for export. However expansion was constrained by inadequate nutrition, diseases and lack of supportive service (Thomase and Laverel, 2004).

Of the disease that cause serious problem, parasitism represents a major impact on livestock production in the tropic. Among the parasitic diseases, hydatidosis in domestic ruminants inflicts enormous economic damage due to the condemnation of affected organs and lowering of the meat, milk and wool production (Melkamu, 1985). The most commonly affected organs due to hydatidosis are liver and lung. The other major significance of echinococcosis is the risk of human infection. In human the major organs that are affected by the disease are liver (60-70%) and lung (10-15%) and involvement of other organ is possible but rare (Jenkins and Thompson 2005). The most serious consequence of hydatid disease is when the cyst ruptures and causes anaphylactic reactions, which may be fatal (Hendrix and Robinson, 2006).

However, humans can become accidentally infected and hydatid cysts may develop throughout the body. Therefore, cystic echinococcosis (CE) or hydatidosis is a disease caused by the metacestode stage of *Echinococcus granulosus*. The disease is not apparent to farmers but is of considerable economic and public health importance (Budke and Torgerson, 2003; Ahmadi and Meshkehkar, 2011). Human hydatidosis occurs commonly as two forms which differ in pathology, morphology, clinical manifestations and epidemiology. One is cystic hydatid disease (CHD), caused by infection with the larval stage of *Echinococcus granulosus*. The other form is alveolar hydatid disease (AHD), caused by *Echinococcus multilocularis* (Wen *et al* 1993).

At present, four species of the genus *Echinococcus* under the family Taenidae are recognized and regarded as taxonomically valid: *Echinococcus granulosus* (cystic hydatidosis), *Echinococcus multilocularis* (multivesicular hydatidosis), *Echinococcus vogeli* (polycystic hydatidosis) and *Echinococcus oligarthrus* (Soulsby, 1986). These four species are morphologically distinct in both the adult and the larval stages. In addition, several different strains of *Echinococcus granulosus* and *Echinococcus multilocularis* are recognized .The development of strains may be a result of the fact that tapeworms are hermaphrodites, which reproduce themselves through cross- or self-fertilization. A single mutant can therefore produce large genetically identical populations that differ from the original genus (FAO, 1982).

The *E. granulosus* tapeworm consists of 3–4 segments (proglottids) and is only about 6 mm long when fully grown. Because it is small, thousands of these tapeworms can inhabit the intestine of dog without causing any ill effects, and are usually very difficult to see in gut contents because they resemble intestinal villi. A dog, fox can become infected with these tapeworms only by eating tapeworm heads, called protoscolices, contained in cysts or in food contaminated with cyst fluid that contains protoscolices. When swallowed by a dog, the tapeworm head embeds in the lining of the dog's intestine and begins to grow, taking about 6 weeks to reach maturity. When mature, the last segment of the tapeworm may contain a thousand eggs. A segment containing eggs is shed by the tapeworm every 14 days. A new segment, filled with eggs, then develops to take its place (King and Hutchinson 2007).

There are no reliable methods for the routine diagnosis of infections in living animals, but in rare cases cysts have been identified by ultrasonography alone or in conjunction with serum antibody detection (Eckert *et al*., 2001). The most reliable diagnostic method is cyst detection during meat inspection or at post-mortem examination (Kittelberger *et al*., 2002).

Hydatid disease is a significant health care problem in underdeveloped countries where animal husbandry is common but veterinary control is absent (e.g., parts of South America, Meaditerranean region, Middle East, Africa, and Australia) (Molavipour *et,al* 2010). In Ethiopia hydatidosis has been known and documented as early as 1970s. It is the major cause of organ condemnation in most Ethiopian abattoirs and slaughterhouses

(Mersie, 1985; Gessesse, 1991; Lobago, 1994; Hagos, 1997). Several reports are available as to the impact of hydatidosis in cattle of various part of the nation (Yimer et *al.,* 2002). Yet information pertinent to the hydatidosis of small ruminants is limited even if small ruminants are intermediate hosts to the disease. In connection to these it is essential to investigate the extent of the problem and the financial losses due to condemnation of organs such as liver and lungs.

Therefore, the main objectives of this study were to:

- Determine the prevalence of hydatidosis in small ruminants slaughtered at Modjo, Modern Export abattoir.
- Determine the direct financial losses due to organ and carcass condemnation.
- To characterize hydatidosis in organ and carcass

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted from November 2011to April 2012 in privately owned, Modjo Modern Export Abattoir at Modjo town, Luma District in Easter Shewa of Oromia Region. Modjo is located 73km away from Addis Ababa in the south east direction at latitude and longitude of 8^0 35'N and 39^0 10'E respectively .The total area of Lume districted is 752.2km^2, of this 60km^2 is covered by water. The climatic condition of the area including; dega (highland 30%), woina dega (medium land, 45%) and kola (lowland, 25%). The altitude of the area ranges from 1500-2300 mm with an average of maximum and minimum temperature of 28^0c and 18^0c, respectively (LDSP, 2007).

2.2. Study Animals

The study population were apparently healthy male sheep and goats slaughtered at Modjo Modern Export Abattoir that were brought from different part of the country including Nagele Borana,, Jinka, , Afar, Bale (Elkere), Meki, Matehara, Measso and Arsi.

2.3. Study Designs and Sample Size Determination

A cross- sectional study was conducted and the study animals were small ruminants (299 sheep and 881goats) slaughtered at Modjo Modern Export Abattoir from November 2011 to April 2012. The required sample size was determined as described by (Thrusfield, 2005).

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

Where,n =Sample size

P_{exp} = Expected prevalence

d = desired level of precision (5%)

By taking the expected prevalence of hydatidosis from previous work of Abyiote *et al* (2010) in sheep and goats slaughtered at Modjo export abattoir with overall prevalence of 8.7 at 95% confidence interval and 5% desired level of precision, the sample size was calculated. By substituting the value in the above formula sample size was calculated to be 122 but 300 sheep and 881 goats were sampled so as to increase the precision of the study.

2.3.1. Post mortem

Examination was conducted three days per week where large numbers of animals were slaughtered during those days. Visual inspection, palpation and systematic incision of each visceral organ particularly the liver, lung, heart, kidney and carcass were carried out according to procedures recommended by (FAO, 1994).

2.3.2. Cyst measurement

Cyst sizes were determined by measuring the diameter of each individual cyst in centimeters using a measuring tape. Sizes were then categorized as follows: small cyst, <2 cm; medium cyst, 2–4 cm; large cyst, 5–7 cm.

2.3.3. Financial losses assessment

Financial loss due to condemnation of organ where considered in the study period. The financial loss estimated was based on the annual slaughtered capacity of the abattoir considering market demand, average market price in the locality and rejection rates of specific organs. The total financial loss of condemned organs of sheep and goat at Modjo Modern Export Abattoir was estimated using the following formula set by Ogunrinade and Ogurinade (1980) as follows:

EL = Σsrx X Coy X Roz

Where:

EL = Annual loss estimated due to organ condemnation from local market.

Σsrk = Annual sheep/ goats slaughter rate of the abattoir

Coy = Average cost of each sheep or goats liver/ lung/ heart/ kidney and carcass.

Roz = Condemnation rates of sheep/goats/liver/lung/heart/kidney/ and carcass.

From the abattoir record of 2011, the annual slaughter rat was 427,036 goat and 109,854sheep and these numbers were used for calculating the loss. From the present study the condemnation rate of organ and carcass values were used to calculate the financial loss using the above formula.

2.3.4. Retrospective study

An attempt was made to collect data on hydatid cyst recorded in the abattoir from 2007 to 2011which was used to see the previous existence of the disease during that periods (Table 6).

2.4. Date management

Data were transferred to M-excel. Frequency and descriptive statistics were used in determining the number of hydatid cyst. SPSS 16 version was used to determine Pearson's chi-square and p-value for the risk factors.

3. RESULT

3.1. Study on Small Ruminant Intermediate Hosts

3.1.1 Prevalence

A total of 299 sheep and 881 goats were examined at slaughter for the presence of hydatid cyst. The prevalence of the cyst in sheep was 35/299 (11.7%) and in goats 49/881(5.6%) and the overall prevalence was 7%. The disease was statistically significant between the species and origins of animals ($P < 0.05$) (Table 1).

Table 1: Association of hydatid cyst with various host-related risk factors

Variables	No Examined	No Positive	% Positive	χ^2	P-value
Species	1180	84	7	12.7	0.000
Sheep	299	35	11.7		
Goat	881	49	5.6		
Origin				43.4419	0.000
Borena	341	44	12.90		
Shashemene	31	2	6.45		
Meki	156	5	3.21		
Bale	66	10	15.15		
Meiso	143	4	2.8		
Metehara	150	6	4		
Arsi	103	10	9.71		
Jinka	190	3	1.58		

3.2. Distribution of Cyst in Different Organs

By organ distribution hydatid cyst was found more often in lung and liver (Table 2 and 3). Out of 35 sheep with hydatid cysts, 23 (62.2 %) harbored hydatid cysts in lung, 10 (29.7 %) in liver. Similarly in goats, out of 49 with hydatid cysts, lungs accounted for 29 (59.18 %), liver 15(30.61%). Among the examined organs heart, kidneys were found list affected (Table 2).

Table 2: Incidence of hydatid cyst in different organs in goat and sheep

Organs	**Lung**	**Liver**	**Kidneys**	**Heart**	**Muscles**
No. positives	52	25	2	1	4
Species					
Sheep	23 (65.7%)	10 (29.7%)	0	0	2 (5.4%)
Goats	29 (59.2%)	15 (30.6%)	2 (4%)	1 (2%)	2(4%)

N.B: The percentage was calculated from each positive animal

Table 3: Total and average number of cyst per organ and per species of animal examined

Species	**Organs**	**Number of positive cyst**	**Prevalence**	**Total number of cyst**	**Average**
Goat	Lung	29	3.29	34	1.17
	Liver	15	1.70	19	1.26
	Heart	1	0.11	1	1
	Kidney	2	0.23	7	3.5
	Muscle	2	0.23	2	1
Sheep	Lung	23	7.69	26	1.13
	Liver	10	3.34	12	1.2
	Muscle	2	0.66	2	1

3.3. Cyst Characterization

Out of the total hydatid cysts recorded in goat 17, 14, 18 were small, medium cyst, large cyst respectively and also in sheep, 10, 16, 9 recorded as small cysts, medium cysts and large cysts respectively. The total number of large and medium cysts was higher in goat and sheep respectively (Table 4).

Table 4: Distribution of cysts in different organs based on their size in sheep and goat

Species	Organ	Small cyst (2cm)		Medium cyst (2-4cm)		Large cyst 5-7cm		Calcified	
		No	%	No	%	No	%	No	%
Goat	Lung	14	82.3	7	50	8	44.4	8	50
	Liver	3	17.6	7	50	5	27.8	8	50
	Kidney	0	0	0	0	2	11.1	0	0
	Heart	0	0	0	0	1	5.5	0	0
	Muscle	0	0	0	0	2	11.1	0	0
	Total	17	100	14	100	18	100	16	100
Sheep	Lung	8	80	11	68.8	4	44.4	5	71.4
	Liver	2	20	5	31.2	3	33.3	2	28.6
	Kidney	0	0	0	0	0	0	0	0
	Heart	0	0	0	0	0	0	0	0
	Muscle	0	0	0	0	2	22.2	0	0
	Total	10	100	16	100	9	100	7	100

3.4. Assessment of Direct Loss

Annual loss was estimated using the slaughter rate of the year 2011 and the condemnation rate of the present study. The annual loss from domestic and international Market due to organ or carcass condemnation at Modjo Modern export Abattoir was estimated to be 11,216.25, 196,817.5 in USD and ETB respectively Using all the formula set by Ogunriade and Ogurinade (1980),

Table 5 Estimation of annual financial loss due to hydatidosis in Modjo Modern Export Abattoir

Animals	Organs	Estimated number of organs condemned per year	Cost of each organs	USD/Year	ETB/Year
Sheep	Lung	9,174	0.5 ETB	262.11	4587
	Liver	549	1.75 USD	960.75	16813.12
Goat	Lung	45,376	0.5 ETB	1270.52	22688
	Liver	4,988	1.75 USD	8729	153,630
Total		60087		11,216.25	197,718

N.B The exchange rate (1USD=17.50) during the study period at commercial bank of Ethiopia was used

3.5. Retrospective Results

Based on the retrospective study higher prevalence was recorded during 2008 and lower magnitude in 2009 in both species (Table 6)

Table 6: Retrospective study results from 2007-2011 G.C at Modjo Modern Export Abattoir

			Organ on which hydatid cyst found				
Year	**Species slaughtered**	**No of Animal slaughtered**	**Lung**	**Liver**	**Muscle**	**Total Affected Organs**	**%**
2007	Sheep	43,226	5,971	216	2	6,189	14.30
	Goat	214,693	22,813	2,508	3	25,324	11.80
2008	Sheep	13,861	1,662	492	0	2,154	15.5
	Goat	72,283	6,507	2,846	1	9,354	13.12
2009	Sheep	357,792	2,913	1,796	1	4,710	1.32
	Goat	241,893	12,894	7,303	16	20,213	8.36
2010	Sheep	50,560	6,984	253	0	7,237	14.31
	Goat	330,654	30,134	3,862	3	33,999	10.28
2011	Sheep	109,854	9,174	549	1	9,724	8.85
	Goat	427,036	45,376	4,988	8	50,372	11.79
	Sheep	575,293	26,704	3306	4	30,014	5.2
Total	Goat	1,286,559	117,724	21,507	31	139,262	10.8

4. DISCUSSION

Cystic echinococosis is a zoonotic disease affecting mainly various species of livestock and humans and is considered an emerging disease in many parts of the world, in some regions re-emerging after initially successful control (Ibrahim *et al*., 2011).

In this study the prevalence of hydatidosis in small ruminants was recorded (7.1%). The prevalence in sheep was 11.71 % and in Goats 5.56 %. The results are in agreement with the previous reports from different parts of Ethiopia 11.87% in sheep and 4.9% in goats by Abebe and Jobert (2011); 8.05 % and 8.99%, Modjo by Abiyot *et., al.* (2011), 13.9% and 3.1% in Addis Ababa by Marshet *et., al* (2011); 10.8% of sheep in Jima abattoir by Abduljewad, (1988); 4.6 % in Goat in Gonder abattoir by Tamane, (1986). In addition to above the result in sheep is in consistent with report from Jordan 12.9% by Kamhawi *et al.,(*1995); 10.6% in sheep Surhio *et al.,* (2011). However, the present results are different from the report from Turkey 26.6% of sheep and 22.1% of goats by Umur (2002); 12.7% in Goat by Kamhawi *et al., (*1995), and 10.2% in goat Surhio *et al.,* (2011). Different country have different prevalence rate this could be associated with different factors like control measures put in place, the level of community awareness created about the disease, education and economic status of the population and the farming systems. The dogs that move along sheep herds pass *E. granulosus* eggs all their way in faeces, hence causing pasture contamination. Accordingly, important factors in persistence and re-emergence of *E. granulosus* are presence of large number of dogs with high prevalence of *E. granulosus;* easy access of dogs to livestock organs infected with *E. granulosus;* insufficient anthelminthic treatment for dogs, restricted number or lack of small municipal slaughterhouses, inefficient inspection of meat, inefficient facilities for destruction of infected viscera, home slaughter of livestock animal and lack of adequate health education Schantz (1977). The rate of infection of goats was less than that of sheep the difference in infection rates between two species of animals might be explained mainly as a result of the involvement of different strains of *E. granulosus*, variations in feeding behaviors of the animals and animal husbandry practices (Soulsby, 1986).

Present study revealed that, hydatidosis was found among small ruminants brought from Borena, Shashemene , Meki , Bale ,Meassio ,Methra and Jinka. Among these areas there was statically significant difference ($p>0.05$) with higher prevalence from Borena and Bale. The spreading of infection is an

indication of environmental contamination with the egg of the adult tapeworm from dogs and the origin of small ruminant's majority of animal come from and Borena and the high prevalence of it can be justified by the fact that pastoralists move from place to place in search of feed for their livestock. Therefore, the animals may contract the infection in their ways. Similarly, high prevalence were obtained by various workers in different regions of Ethiopia, such as from Modjo by Abiyot *et al.,* (2011) in Hararge region, 9.38% in sheep and 6.51% in goats (Wubet, 1987) and in Konso 9.3% and in sheep (Lobago, 1994).

In the present study, lungs were found to be more affected by the disease in both species 62.2%, 59.18% respectively followed by liver These findings are in consistent with facts by Khan *et al.,* (2001) he reported that lungs were the most affected organ compared to liver. Other workers had also found results in support of the present findings (Koshy, 1984; Islam *et al*., 2003; Kebede *et al*., 2008). The reason for higher prevalence of cysts in lung might be due to softer consistency of lungs. The other reason is probably due to that both organs are the first large capillary filled encountered by the blood born oncosphre. The great capillary bed in lung than other organ and soft consistency of it might also allow easy growth of the cyst (Urquhart *et al*., 2003). High prevalence in liver might be due to the reflection of the route of parasite entry and seem to support the hypothesis of hepatic portal distribution of onchosphers leading firstly to liver infection (Schwabe, 1986).

The proportion of large cyst in lung is higher than in the livers. Similar finding were obtained by various researchers (Abiyoit *et al*., 2011 and Mohamed 2008). This might be related to the fact that softer consistency of lung services for persistent of parasite which is already mentioned above in this discussion.

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 196,817.5,ETB/11,216.25 USD

5. CONCLUSION AND RECOMMENDATIONS

Hydatidosis is one of the major parasitic infections with public health significance in Ethiopia warranting serious attention. It causes considerable economic loss on livestock production due to condemnation of

organs and associated live weight loss. In the present study moderate prevalent hydatidosis in small ruminants was recorded at Modjo Modern Export Abattoir. In addition, the disease was identified as main cause of organs and carcass condemnation. Liver and lung were frequently affected organs throughout the course of this research work.

Based on the above conclusive remarks, the following recommendations were forwarded:

- Appropriate control and prevention of hydatidosis in small ruminants and controlling of stray dog
- Construction of modern abattoir to facilitate proper meat inspection procedures
- Proper disposal of organ or carcass that infected with hydatid cyst and the disposed organ or carcass should not be fed to dogs
- Public awareness should be conducted about the transmission and the life cycle of hydatid cyst.
- Promoting the establishment of intensive farm should be encouraged; since the management system practiced in the region is one factor in the predisposing small ruminant to hydatidosis

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