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The Prevalence and Possible Risk Factors of Bovine Hydatidosis in Debremarkos Municipal Abattoir, Northwest Ethiopia

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Abstract
Bovine hydatidosis is a public health problem and economically important cestode parasite prevalent in Ethiopia. A cross sectional study was conducted from April 2017 to June 2017 with the objectives of determining the prevalence of bovine hydatidosis, the distribution of cysts in different organs in cattle slaughtered at Debremarkos Municipal abattoir. Out of 420 cattle examined, 66(15.7%) were infected with hydatid cysts. Out of the 66 animals infected with hydatid cysts 32(48.5%), 20(30.3%), 4(6.1%), 3(4.5%), 2(3.0%), 3(4.5%), 1(1.5%), 1(1.5%) contain the hydatid cysts in their lung, liver, spleen, kidney, heart, liver and lung, spleen and liver, and lung and spleen, respectively. Out of 179 haydatid cysts 98(54.7%), 45(25.1%), 7(3.9%), 5(2.8%), 2(1.1%), 13(7.3%), 5(2.8%) and 4(2.2%) were from lung, liver, spleen, kidney, heart, liver and lung, lung and spleen and spleen and liver, respectively. The results of this study revealed that hydatidosis was economically important disease of cattle which necessitate serious attention for prevention and control actions in Debremarkos municipal abattoir. Hence, establishment of wellequipped standardized abattoirs, creation of public awareness, and control of stray dogs are of paramount importance.
Keywords: Abattoir, Bovine, Cattle, Hydatidosis, Prevalence, Debremarkos

1. INTRODUCTION

Echinococcosis is a parasitic zoonotic disease caused by infection with the larval stage of cestodes of the genus *Echinococcus*. There are three forms of the diseases – cystic, caused by *E. granulosus*, alveolar, caused by *E. multilocularis,* and polycystic caused by *E.vogeli*, respectively. Hydatidosis (cystic echinococcosis or unilocular hydatid disease), caused by the larval stage of *E. granulosus*, is recognized as being one of the world's major zoonoses (Torgerson and Budke, 2003). Humans become infected by ingestion of eggs passed in the feces of dogs (Budke *et al*., 2006) and infection with *E. granulosus* typically results in a slowly growing parasitic disease most frequently seen in the liver in 52-77% of cases (Timothy *et al.,* 2001).

The parasite *E. granulosus* requires 2 mammalian hosts to complete its life cycle. The life cycles of *E. granulosus* can be classified as either domestic, which involves the domestic dog as definitive host and typically domestic ungulates (sheep, goats and cattle) as intermediate hosts, or sylvatic, involving wild carnivores and a variety of wildlife as intermediate hosts. Man can also become the unwitting intermediate host in both life cycles of this parasite. Within the cycles, the specific role of various host species may differ considerably between regions of endemic infection. In many areas, domestic and sylvatic life cycles coexist or overlap (Rausch, 1995). The definitive hosts become infected when they ingest cysts (metacestodes) lodged in the tissues of the intermediate hosts. The cysts develop into tapeworms, which mature in the definitive host's small intestine. Adult tapeworms are very small, less than 6 mm and they shed gravid proglottids or eggs in the faeces of canids. The intermediate and aberrant hosts become infected by ingesting the eggs which are shed in this manner. The definitive host range is restricted to one or few species of canids, but the intermediate host range is very broad and often include humans (Torgerson and Budke, 2003; Eckert and Deplazes, 2004; Budke *et al.,* 2006).

The pathogencity of hydatidosis depends on the extent and severity of infection and the organs on which it is situated. Occasional rupture of hydatid cysts often leads to sudden death due to anaphylaxis, hemorrhage and metastasis (White *et al.,* 2004). Echinococcal cysts can grow in various organs, particularly the liver, lungs and heart, and occasionally the CNS. In the CNS, cysts may grow primarily, from direct implantation of oncospheres, or secondarily, from metastatic dissemination of a visceral cyst. The adult *Echinococcus* is considered to be harmless to the definitive host, except when it occurs in large numbers, which may cause severe enteritis.

There are few available data on the clinical effects of the cystic hydatid disease in animals since the cyst is slow in growing and animals are often slaughtered before it manages to create sufficient pressure on the tissue or organs (Eckert and Deplazes, 2004). The fertility of hydatid cysts is one of the important factors in the epidemiology of *Echinococcosis*. It varies depending on the intermediate hosts and geographical situation.

During the past four decades, considerable advances have been made in understanding the epidemiological key factors and the transmission dynamics of *E. granulosus* and other members of the family Taeniidae. For *Taenia species*, the following key factors have been identified (Gemmell *et al.,* 2001): (i) biotic potential of the parasite, (ii) immunity acquired by the intermediate host as a density-dependent constraint, and (iii) environmental factors as densityindependent constraints in the free-living egg-phase. Key factors associated with persistence, emergence, or reemergence of cystic echinococcosis have recently been described (Battelli *et*

*al.,*2002). They include (i) the presence of large numbers of dogs (especially stray dogs) infected with *E. granulosus*, (ii) easy access of dogs to organs of livestock infected with *E. granulosus* cysts, (iii) insufficient facilities for slaughter and destruction of infected viscera, (iv) illegal or uninspected home slaughter, (v) a close association of dogs and other animals on small rural lots of land, (vi) uncontrolled animal trade and movements within and between countries, (vii) poor living conditions (especially lack of tap water), (viii) lack of adequate health education, and (ix) economic instability and financial restrictions in control and prevention.

Despite the large efforts that have been put into the research and control of echinococcus, it still remains a disease of worldwide significance. In some areas of the world, hydatidosis is a reemerging disease in places where it was previously at low levels (Torgerson and Budke, 2003).

Hydatidosis is still endemic in sheepherding areas of the world and is inflicting public health problems in the Mediterranean, Middle East Asia, South America and Africa, including Ethiopia (Magambo *et al.,* 2006). It also imposes enormous economic losses in the livestock industry due to condemnation of edible organs and lowering the quality of meat, milk and wool production (Craig *et al*., 2007). These losses are of special significance in countries with low economic outputs where livestock production is of particular importance.

Hydatidosis, caused by the metacestodes of *Echinococcus granulosus*, is prevalent in Ethiopia and studies from various parts of the country indicate that the infection ranges from 25.7% to 63% and 4.4% to 18.8% in cattle and sheep, respectively (Tamene, 1986; Mohammed, 1988).

Several other reports from different parts of Ethiopia also indicated that hydatid cyst is prevalent in livestock (Fikre, 1994; Mussie, 1995; Fekadu, 1997; Hagos, 1997; Kebede *et al.,* 2009*)*. These reports showed that Hydatidosis is prevalent in cattle and small ruminant population of Ethiopia in a range of 3.1 to 72.44%. The prevalence rate reaches up to 30.8% in camels and 25% in dogs.

Considering the economic significance due to hydatidosis in Ethiopia, significant degrees of monetary losses were estimated at various levels in different locations. Such reported estimates indicate annual losses of 25,608 ETB (2,807.89 US$) by Kebede *et al*., (2009d) in Tigray; 1,791,625.89 ETB (131,737.19 US$) in cattle slaughtered at the Hawassa municipal abattoir (Regassa *et al*., 2010); 473,173.75 ETB (51,883 US$) by Kebede *et al*., (2009b) in cattle slaughtered at the Debre Markos abattoir; and 52,828 ETB (5,869.8 US$) in cattle slaughtered at the Adama abattoir (Getaw *et al*., 2010).

A number of studies have concluded that cystic hydatid disease can result in a 10% decrease in the whole of the life performance for infected animals (reduction in quality of meat, production of fiber, production of milk and in number of surviving offsprings). Very few retrospective and case reports of cystic human hydatidosis also indicated the relevance of the disease in the human population of the country. Therefore, the scarcity of reports, the slow growing nature of disease development may result in underestimation of the situation. Lack of well-equipped standardized abattoirs, low level of public awareness, and availability of many uncontrolled stray dogs are of paramount importance for contributing for prevalence of hydatidosis in many parts of Ethiopia.

Infact, these mentioned factors are also prevailing in the Debremarkos town where hydatidosis is expected to be prevalent.

In Debremarkos town, northeast Ethiopia, environmental sanitation and hygienic conditions are poor and raw beef consumption is common. Backyard slaughtering of domestic animals, particularly, cattle, sheep and goats; and feeding stray dogs with condemned organs are common practices. These habits would promote the transmission of both cestode infections in Debremarkos town. However, the status of the problem is not known. Hence, the purpose of this study was to determine the prevalence, distribution of cysts on examined organs and economic significance of bovine hydatidosis in cattle slaughtered at Debremarkos municipal abattoir.

The general objective of this study was to determine the prevalence of bovine hydatidosis among cattle slaughtered in the municipal abattoir of Debremarkos Northeast
Ethiopia.

The specific objectives were:

1. To determine the prevalence of bovine hydatidosis in Debremarkos municipal abattoir, Northeast Ethiopia.
2. To determine the distribution of hydatid cysts in different organs among cattle slaughtered at Debremarkos municipal abattoir.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The study was conducted from April 2017 to June 2017 at Debremarkos Municipal abattoir in East Gojjam Zone. DebreMarkos is the capital of East Gojjam Administrative Zone, which is located in the north west of the capital city of the Federal Democratic Republic of Ethiopia, Addis Ababa at a distance of 300 Km and 265 Km to the capital of AmharaNation Regional State Bahir Dar. The Geographical location of the study area is located between 10°17'00" to 10°21'30" N Latitudes and 37°42'00"to 37°45'30" E longitudes and its elevation ranges in altitude from 2350-2500 m above sea level. The town has 1380 mm average annual rainfall and the average temperature of 18.5°C. The livestock population of the area comprises of 13, 771 cattle, 1604 equine, 7439 shoat,

15, 025 poultry and 724 beehives. (DoARD, 2009). Debremarkos town is divided into twelve Kebles and one woreda. The total population of Debremarkos is 102,929 people. Of these 53,180 and 49,749 are males and females, respectively (Debremarkos Town Finance and Economic Development Bureau, 2012). Debremarkos town has only one abattoir which is administered by the Debremarkos town Municipal. The Debremarkos municipal abattoir provides fresh meat for different organizations such as hotels, hospitals, University, college and butcheries.

2.2.Study Design

Abattoir based cross-sectional study was conducted to determine the prevalence of bovine hydatidosis from April-June, 2017 in cattle slaughtered at the Debremarkos municipal abattoir.

2.3.Study Animal

The study animals were cattle (mainly oxen) which were slaughtered in Debremarkos Municipal abattoir and presented for routine meat inspection. The study animals were mainly from all districts of East gojjam zone, nearby districts West Gojjam, South Wollo.

2.4.Sample size determinations and sampling method

Sample size was calculated according to Thrusfield (1995) by considering 50% expected prevalence and 95% confidence interval with a 5% desired absolute precision. Thus,

$$N=\frac{1.96^2\,[Pexp*(1-Pexp)]}{d^2}$$

$$=\frac{1.96^2[\,(50\%)*(1-50\%)]}{(5\%)^2}$$

$$=\frac{3.84*0.25}{0.0025}$$

$$=\frac{0.96}{0.0025}$$

$$=384$$

Where: N= is the required sample size
P^{exp} = the expected prevalence (50%)
d =is the desired absolute precision (0.05)
z=value at 95% (1.96)

An expected prevalence of 50% was used to increase the degree of precision and considering a 5% absolute precision and 95% confidence level was given 384 sample sizes. To minimize errors arising from the likelihood of missing organs, 10% of the sample size was added to the normal sample. Therefore, 420 cattle were sampled and examined in the study. These sample sizes were selected by simple random sampling method during the antemortem inspection.

2.5 Methods of Data Collection

2.5.1.Abattoir survey

Regular visits (3 days per week) were made to Debremarkos municipal abattior during the period from April 2017 to June 2017. On average 20, animals were examined per visit. Study animals were selected during antemortem inspection and animal information such as age, sex, breed, body condition scoring and origin of the animals were recorded and carcass and offal examinations were conducted at postmortem inspection. Based on the body condition, animals were grouped as poor, medium and good (Nicolson and Butterowrth, 1986). Animals' ages were categorized into adult (3 to 5 years) and old (>5 years) based on the dental eruption (De Lahuntaand Habel, 1986). However, animals less than three years old were not slaughtered during the study period. During abattoir survey, detail meat inspections were conducted at the abattoir on the 420 selected cattle.

2.6. Study methodology

2.6.1 Meat inspection procedures

During post mortem inspection, visual inspection and palpation, followed by multiple incisions of the organs were made to examine the presence of hydatid cysts according to the guideline by Ministry of Agriculture (1972).

The hearts were incised from base to apex to open the pericardium and incise also made in the cardiac muscle for detailed examination. Deep, adjacent and parallel incisions were made above the point elbow in the shoulder muscle. Examinations of the kidneys, liver, spleen, and the lung were also conducted by the principal investigator assisted by a veterinarian.

2.7.Data Analysis

Data obtained from postmortem findings in the abattoir was coded and uploaded into Microsoft Excel 2007 spread sheet computer program. Then, it was analyzed by using SPSS version 16. Chi-square ($\chi 2$) test was applied to determine the prevalence of hydatid cysts with host information such as age, origin, breed and sex. Statistical significance was established with P value less than 0.05.

2. RESULTS AND DISCUSION

2.1.Description of Study Animals

The distribution of study animals and infection in their organs at Debremarkos Municipal Abattoir during the study period are summarized and presented in the following manner. Out of the total 420 examined cattle, all (420) cattle were in the age group of 5 years and above. From the total of 420 examined cattle, 406 (96.7%) and 14 (3.3) were male and female, respectively.

Out of the total 420 examined cattle, 402 (95.7%) and 18 (4.3%) were local and cross breed, respectively. Out of the total 420 examined cattle, based on body condition score, 240(57.1%), 137(32.6%) and 44(10.2%) were good, medium and poor, respectively. All animals slaughtered during the study period originated from in and around the town and were above five years old.

From each 420 examined cattle, the following organslike, liver, lung, kidney, spleen, heart, were collected and inspected for the presence of hydatid cyst infection and diseases. The above organs were examined in the study area from April to June, 2017

2.2.Prevalence of Bovine Hydatidosis in Debremarkos Municipal Abattoir

The prevalence of cystic hydatidosis was estimated by taking the percentage of infected cattle from the total slaughtered cattle in the study period. As the result shown in table 4, out of the total 420 examined and inspected cattle, 66(15.7%) cattle were found harboring one or more hydatid cyst in their organs. The prevalence of hydatidosis was 23.3%, 15.3% and 14.2% in those cattle whose body condition scores were poor, medium and good, respectively. However, there was no statistically significant difference (P>0.05) in the prevalence of hydatidosis among different body condition scores of animals (Table 4). The prevalence of hydatidosis was 50.0% and 14.5% among examined female and male cattle, respectively. There was statistically significant difference (P<0.05) in prevalence of hydatidosis between female and male cattle, in which the prevalence in female cattle was higher than that of male cattle (Table 4). The prevalence of hydatidosis was 27.8% and 15.2% in cross and local cattle, respectively. There was no statistically associated significance (P>0.05) between breed of animals. (Table 4)

Table 4 Prevalence of bovine hydatidosis by sex, breeds and body condition scoring of sluaghtered cattle in Debremarkos Municipal Abattoir Southern Ethiopia, April-June, 2017

Character	No of cattle examined	No of positive	percent (%)	Chi-square	P-value
Sex					
M	406	59	14.5		
F	14	7	50.0	18.473	0.001
Breed					
Local	402	61	15.2		
Cross	18	5	27.8	7.352	0.118
Body condition scores					
Good	240	**34**	**14.2**		
Medium	137	**21**	**15.3**	8.421	0.393
Poor	43	**10**	**23.3**		

The present study revealed that the prevalence of hydatidosis in cattle slaughtered at Wolayita Sodo municipal abattoir was 15.7%. This finding agreed to that reported as 15.4% by Regassa *et al*. (2009) and 16% by Kebede *et al*. (2009a). However, it disagreed with the findings from different places in Ethiopia 61% in Assela (Koskei, 1998), 52.69% in Hawassa (Regassa *et al*., 2010), 48.9% in Debre Markos (Kebede *et al*., 2009b), 46.5% in Debre Zeit (Jobre *et al.,* 1996), 34.05% in Bahir Dar (Kebede *et al*., 2009c), 32.1% in Mekelle (Berhe, 2009), and 22% in Tigray (Kebede *et al*., 2009d). Factors like difference in culture, social activity, animal husbandry systems, lack of proper removal of infectious offals, and attitude to dogs in different regions

might have contributed to the variation in prevalence in different areas of a country (Garippa *et al*., 2004; Arbabi and Hooshyr, 2006). The proportions of hydatidosis infection was slightly higher in cattle having poor (lean) body condition (23.3%) followed by medium (15.3%) and good (fat) (14.2%). Polydrous (1981) explained that in moderate to severe infections, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss.

4.3. Distribution of Hydatid Cysts among Visceral Organs of Cattle

Out of the total 66 cattle harboring hydatid cysts in their organs, single and multiple infections of organs were recorded. Out of these, 61 cattle were infected at only a single organ and the remaining 5 had infections in two organs. Of the total examined organs, the highest proportions of hydatid cysts were observed in lungs and liver. Out of 66 infected organs, lungs (48.5%), followed by liver (30.3%), spleen (6.1%) kidney (4.5%) and heart (3.0%) were found to harbor hydatid cysts at only single organ. But, lung and liver (4.5%), spleen and liver (1.5%) and lung and spleen (1.5%) cattle harbor hydatid cysts infection at both organs, respectively (Table.6). In this study, it was shown that hydatid cysts occurred most commonly in the lung (48.5%) followed by the liver (30.3%), spleen (6.1%), kidney (4.5%) and heart (3.0%). This was in agreement with the findings of Njoroge *et al*. (2002) and Eckert and Deplazes, (2004), who showed that the lungs and liver to be the most common sites of hydatid cyst in domestic animals.

This is due to the fact that the lung and liver possessed capillaries that were first encountered by the migrating echinococcus oncosphere (hexacanth embryo), which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ was involved (Eckert and Deplazes, 2004).

In this study, the lung was the most frequently affected organ followed by the liver, which was in agreement with other studies in cattle in Ethiopia (Mohammed, 1988).

Table 6 Distribution of hydatid cyst infections among examined organs of slaughtered cattle in Debremarkos Municipal Abattoir, Northeast Ethiopia, April-June, 2017.

Organs inspected	No of positives	Percent
Liver	20	30.3
Lung	32	48.5
Kidney	3	4.5
Spleen	4	6.1
Heart	2	3.0
Liver & lung	3	4.5
Spleen &liver	1	1.5
Lung &spleen	1	1.5
Total	66	

4 CONCLUSION AND RECOMMENDATION

The current study based on bovine hydatidosis was conducted at Debremarkos Municipal Abattoir from April 2017 to June 2017with the aim of determining the prevalence, distribution of hydatid cyst in different organs. The study was conducted by post mortem examination of lungs, liver, heart, spleen, kidney of cattle slaughtered at Debremarkos Municipal Abattoir.

All the total of 420 cattle slaughtered at Debremarkos Municipal Abattoir was included in the present study. Estimation of age was done by the examination of the teeth eruption. Two age groups of cattle were considered: above 5 years and below 5 years, but in the study area during the study period almost all slaughtered cattle were above 5 years old. The sample size wascalculated by considering 50% expected prevalence, and 5% accepted error at 95% confidence interval.

To study the prevalence, distribution of hydatid cysts among organs of cattle by post mortem examination through visual inspection, palpation and incision of lung, liver, kidney, spleen and heart was made to identify hydatid cyst infected organs and deep and multiple incision of masseter muscles, tongue and shoulder muscles was made to identify *C. bovis* cyst infected carcasses.

In the present finding, out of the total 420 cattle examined 66 (15.7%) were found to be infected with bovine hydstodosis, in the Abattoir. From 66 infected cattle 32(48.5%), 20(30.3%), 4(6.1%), 3(4.5%), 2(3.0%), 3(4.5%), 1(1.5%), 1(1.5%) contain hydatid cyst/s in their lung, liver, spleen, kidney, heart, liver and lung, spleen and liver and lung and spleen, respectively. The prevalence of hydatid cysts was significantly varied ($P<0.05$) with different sex groups of animals. Out of 179 haydatid cysts 98(54.7%), 45(25.1%), 7(3.9%), 5(2.8%), 2(1.1%), 13(7.3%), 5(2.8%) and 4(2.2%) were from lung, liver, spleen, kidney, heart, liver and lung, lung and spleen and spleen and liver, respectively and 51 (28.5%) were fertile, 95 (53.1%) were sterile, and 33 (18.4%) were calcified. Of the 51 fertile cysts subjected for viability test, 17(33.3%) were viable while 34 (66.7%) were non-viable.

Bovine hydatidosis is zoonotic disease which has great economic importance resulting in losses due to condemnation of infected organs and downgraded carcasses in Debremarkos Municipal abattoir. Considering the current result, bovine hydatidosis was an important disease of cattle in East Gojjam zone and its surroundings, causing substantial visible and invisible losses. Bovine hydatidosis has considerable economic and veterinary importance in Debremarkos Municipal Abattoir. Therefore, the present study was showed that prevalence of bovine hydatidosis relatively high in Debremarkos municipal abattoir, Northeast Ethiopia and hence, it remains one of the most important disease warranting serious attention for prevention and control actions.

The findings of the present study indicate that the health consequences of these zoonotic diseases and their economic impacts deserve serious attention by the various stakeholders in order to safeguard the well-being of the public.

Therefore:

- proper meat inspection and disposal of condemned organs are essential to reduce the financial losses and safeguard the public
- Enforcement of legislation that will put an end to backyard and roadside slaughtering practices is essential.
- Establishment of policy on dog keeping and handling including registration, and treatment and elimination of stray dogs are essential.
- Moreover, promoting the construction of abattoirs with their appropriate disposal pits particularly in rural areas and conducting obligatory meat inspection services and further detailed investigation into the basic local epidemiological factors governing the spread of bovine hydatidosis in the area to establish regional control strategy are recommended.

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7. APPENDIX

7.1. Appendix I:

Table.1 Debre Markos municipal abattoir amtemortem data collection sheet during the study period. (Use: Luh=lung cyst, Lih=liver cyst, Heh=heart cyst, Sph=spleen cyst and Kih=kidney cyst for hydatidosis of positive animals)

I.No	Age	Sex	origin	breed	Body con.	Expected result(+ve for)

Name of Veterinarian in charge----------Qualification----------
Signature----------
Date---------- Seal

7.2. Appendix II:

Table.2 Debre Markos municipal abattoir postmortem data sample collection sheet during the study period (Judgment: A=approved, TC=total condemned, PC=partial condemned and CA=conditional approved).

I.No	Sample ID	Organ from where sample taken	No. of cyst recovered	judgments

Name of Veterinarian in charge----------Qualification----------
Signature----------Date----------

Seal