

## Bovine Hydatid Cyst: Prevalence, Characterization, Public Health and Economic Importance at Adama Abattoir, Central Ethiopia

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### ABSTRACT

A purposive study was conducted from November 2011 to April 2012 with the objective of determining the characteristics of hydatid cysts and to assess the current status of economic losses of hydatidosis in cattle slaughtered at Adama municipality abattoir. Hydatid cysts were characterized on the basis of their size, fertility and viability. Routine meat inspection procedure was conducted on organs namely lung, liver, kidney and spleen involving visualization and palpation to detect the presence of hydatid cysts. Out of the total of 2276 hydatid cysts counted, 1126 (49.5%), 913 (40.1%) and 237 (10.4%) were found to be small, medium and large size respectively. Out of the total of 300 cysts examined for the fertility test, 29 (9.6%), 188 (62.6%) and 83 (27.6%) were found to be fertile, sterile and calcified, respectively. The rate of cyst calcification was higher in the liver than in the lung while fertility rate was higher among the cysts of the lung. The direct financial loss during the study period was 8,749 ETB. This result was assessed from the mean retail market price of each organs multiplied by the total number of organs condemned at Adama abattoir during the study period.

**Keywords:** Abattoir, Adama, Cattle, Economic importance, Hydatid cyst

**Abbreviations:** ADAO: Adama District Agricultural Office; DVM: Doctor of Veterinary Medicine; ETB: Ethiopian Birr; FVM: Faculty of Veterinary Medicine; FAO: Food and Agricultural Organization; NMSA: National Meteorological Service Agency; WHO: World Health Organization

### INTRODUCTION

Ethiopia is one of the countries with huge livestock population in Africa. Ethiopian livestock productivity remains marginal due to high prevalence of animal diseases, malnutrition, limited genetic potential, and parasitism and management constraints. Among these, parasitism represents a major obstacle to development of the livestock sector, which affects the poverty alleviation programs in livestock farming system in the country [1].

Among the parasitic diseases, hydatidosis is important parasitic infection, which causes direct; and indirect economic losses on the livestock sub sector particularly in sheep and cattle. In addition to economic losses, another dimension is added by the fact that several helminthes infection including hydatidosis could be transmitted to man [2].

Echinococcosis or hydatidosis is a cosmopolitan zoonosis caused by the larval stage of cestode belonging to the genus *Echinococcus*, family Taeniidae, class Cestoda, Order Cyclophillidae and species *E. granulosus*, which is important in ruminant animals and human beings [3].

Genus *Echinococcus* exhibits certain unique characteristics that set it apart from the other major genus in the family Taeniidae. An adult *Echinococcus* is only a few millimeters long (rarely more than 7 mm) and usually has no more than six segments; whereas species of *Taenia* can grow to several meters in length and consists of thousands of segments. Like all tapeworms, *Echinococcus* has no gut and metabolic interchange take place across syncytial outer covering [4].

Hydatidosis caused by the larval stage of *E. granulosus* is recognized as being one of the world's major zoonosis. Its distribution is normally associated with under developed countries especially in rural communities where man

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maintains close contact with dog (definitive host) and various domestic animals, which may act as intermediate hosts [5].

In intermediate hosts, infection with the metacestode (hydatid cyst) develop predominantly in visceral organs especially in liver and lung. Larval stage of *E. granulosus* infection in intermediate hosts like sheep, Cattle, goat, pig, etc., is typically asymptomatic. In intermediate host, hydatid cyst found in the liver or lung is usually tolerated without any clinical signs and the majority of infections are only detected at the abattoir [6].

The importance of hydatidosis can be evaluated from both the public health and economic losses point of view. The economic significance of hydatidosis in livestock leads to considerable economic losses due to condemnation of edible offals, primarily liver, lung and other organs or even whole carcasses. In severe infection, the parasite may cause retarded performance and growth, reduced quality and yield of meat, milk or wool [7].

The life cycle of *Echinococcus* involves two mammalian hosts. The definitive host of parasite, *E. granulosus*, is dog which harbor adult tapeworms in the small intestine excrete the parasite eggs along with their feces while livestock and human are the main intermediate hosts [8].

After ingestion of egg by an intermediate hosts the oncosphere penetrates the wall of the small intestine. A secretion from oncosphereoids is penetrated in to the intestine. Up on gaining access to a venule, the oncosphere is passively transported to the liver, where some retained, others reach the lung, and few may be transported further to the kidney, spleen, muscle, brain and other visceral organs. Once the oncosphere has reached its final location, it develops in to the metacestode stage (hydatid cyst) [9].

Protoscoleces containing hydatid cysts is ingested by a suitable definitive host, due to the action of pepsin in the stomach, they evaginated in the upper duodenum in response to a change in pH, exposure to bile and to increased temperature. Then they develop into sexually mature adult tapeworm, approximately four to six weeks after infection, depending on the species and strain, and on the susceptibility of the host [6].

In Ethiopia, hydatidosis is one of the major infectious zoonotic diseases especially where sheep, goat, cattle, camel and pig are slaughtered traditionally and offals are easily accessible to scavenging dogs and wild carnivores. About 85% Ethiopian population are rural inhabitant and mostly practiced backyard slaughtering with improper disposal of affected organ with hydatid cyst. As a result, stray dog have a free accesses to infected organs of slaughtered animals. The absence of proper meat inspection procedures, presence of large population of stray dogs and lack of public awareness about the disease contribute significantly to the high prevalence of the disease in Ethiopia.

Therefore, the objective of this study was to assess the characteristics of hydatid cysts and to determine the economic importance of organ condemnation due to hydatidosis in cattle slaughtered at the Adama Municipal Abattoir.

## MATERIALS AND METHODS

### Study area

The study was conducted in Adama district, East Shoa zone of Oromia Regional State which is located about 94 km East of Addis Ababa with an altitude of about 1850 meters above sea level. The main rain season is from June to September with an average annual rainfall 800 ml. the annual average temperature ranges from 12.3°C with an average of 17.7°C and highest temperature is reached in May [10].

Adama is one of the most populous from the regional states and is located at an important multi directional trade route. Farmers around the town are practiced a mixed crop-livestock farming system. The numbers of livestock on the basis of species are 70,662 cattle, 36,142 sheep and 42,968 goats. The town has one municipality abattoir, the sanitary facilities such as water and electricity supply and removal of effluent are minimal and the working environment in the abattoir is not conducive for proper meat inspection. Drainage is not good and carcass is dragged on unhygienic floor to transfer from one section to the other. The abattoir is giving local community service rather than exporting meat and meat products and its design is the old fashioned pattern and badly designed system. Each day on average 50 heads of cattle originate from Arsi, Harar, Bale, Borana and Adama are slaughtered in the abattoir starting from mi night [1].

### Study animals

The study was undertaken on both sexes of local breeds of cattle and on some exotic breeds brought from different agro ecologic zones of Ethiopia that were slaughtered at Adama municipality abattoir. Most of cattle's slaughtered at the abattoir were adult males of local breeds. A few exotic females were culled due to old age, poor performance and reproductive problems were also slaughtered.

### Sample size determination

The sample size for the study was determined according to the method described by Habtamu [11]. Considering 95% confidence interval at a desired accuracy level of 5% and with expected prevalence of 29% and hence, a total of 316 positive animals were included in this study.

## STUDY DESIGN AND METHODOLOGY

### Cross sectional

A cross sectional study was performed to assess the characteristics of hydatid cyst in Adama municipality abattoir through meat inspection conducted on 316 positive

cattle's during the study period from November 2011 to April 2012.

### Anti-mortem inspection

A study was made for anti-mortem inspection on individual animals for assessment of animal origin, body condition and age determination. During anti-mortem inspection each of the study animal was given an identification number based on enumerates mark on its body tagged before slaughter.

### Post mortem inspection

During post mortem inspection procedure was conducted on organs namely lung, liver, heart, kidney and spleen involving visualization and palpation to detect the presence of hydatid cysts. Number of hydatid cysts that were found per organ and per animal was registered. Further laboratory examination was carried out in the veterinary parasitology laboratory of the school of veterinary medicine and the cysts were transported using ice box to determine the fertility and viability of the cysts.

### Cyst characterization

**Cyst size:** The size of the hydatid cyst was measured and classified as small if the diameter is less than 4 cm, medium if the diameter is between 4 cm and 8 cm and large if the diameter is greater than 8 cm [12].

**Cyst fertility:** Presence or absence of protoscolex in hydatid fluid was assessed and cysts are classified as fertile and infertile, respectively. Fertile cysts were subjected to viability test. A drop of sediment containing the protoscolex was placed on the microscopic glass slide and a drop of 0.1% eosin solution was added to protoscolex in hydatid fluid on microscopic slide and covered with cover slip and then examined under a high power microscopy (40x) with the principle that viable protoscolex should

completely or partially exclude the dye while the dead ones take it up [13].

### Direct financial loss assessment

Organ condemned due to hydatidosis was properly recorded then; the total number of organ condemned was multiplied by retail market price of each organ (Ethiopian birr). Accordingly; the direct economic loss assessment due to hydatidosis was measured.

All livers, lungs, hearts, kidneys and spleens which were positive for hydatidosis, were totally condemned. The total annual economic losses associated with condemnation of these organs due to hydatidosis was assessed according to standard method described by Ogunrinade and Adegoké [14].

### DATA ANALYSIS

Data collected from anti-mortem and laboratory findings were entered in to MS Excel program (Microsoft Corporation, USA) and the data was analyzed using SPSS (Statistical Package for Social Science) 15 version. One way ANOVA was used to determine the association between the dependent and independent variables.

### RESULTS

#### Cyst characterization

Over all 2276 hydatidcysts were encountered in 316 cattle slaughtered at Adama abattoir. Out of these 237 (10.4%) were large sized, 913 (40.1%) were medium sized and 1126 (49.5%) were small in size. The results of occurrence of cyst of different size in different organs are presented in **Table 1**. Cyst size have significant association with organ, age and body condition ( $p < 0.05$ ) but no significant association with origin of the animal at ( $p > 0.05$ ). The highest proportions of large cysts were observed in lung.

**Table 1.** Cyst size and count observed in different organs in infected cattle slaughtered at Adama abattoir.

Organ	No of cyst examined	Large	%	Medium	%	Small	%	Total
Lung	1888	210	11.1	802	42.5	876	46.4	1888
Liver	378	26	6.9	106	28	246	65.1	378
Heart	3	0	0	0	0	3	100	3
Kidney	2	0	0	1	50	1	50	2
Spleen	5	1	20	4	80	0	0	5
<b>Total</b>	<b>2276</b>	<b>237</b>	<b>48</b>	<b>913</b>	<b>200.5</b>	<b>1126</b>	<b>261.5</b>	<b>2276</b>

In this study, 300 cysts were collected from different infected organs and subjected to fertility and viability tests. Of these 29 cysts (9.67%) were fertile cysts, while the remaining ones were non fertile. Of the fertile cysts 18 (6%) were viable and 11 (3.6%) were nonviable. Fertility has

significant association with age and organ ( $p < 0.05$ ). The highest proportions of fertile cysts were observed in lungs while highest proportions of calcified cysts were observed in liver (**Table 2**).

**Table 2.** Results of fertility and viability tests on hydatid cysts from cattle slaughtered in Adama abattoir.

Organ	Total no of cysts examined	Viable	%	Fertile	%	Sterile	%	Calcified	%	Total
Lung	194	16	8.2	6	3.1	158	81.4	14	7.2	194
Liver	96	2	2.1	5	5.2	20	20.8	69	71.9	96
Heart	3	0	0	0	0	3	100	0	0	3
Kidney	2	0	0	0	0	2	100	0	0	2
Spleen	5	0	0	0	0	5	100	0	0	5
<b>Total</b>	<b>300</b>	<b>18</b>	<b>10.3</b>	<b>11</b>	<b>8.3</b>	<b>188</b>	<b>402.2</b>	<b>83</b>	<b>78.1</b>	<b>300</b>

#### Direct financial losses

The average annual numbers of slaughtered cattle at the Adama abattoir were 18,000. Due to cattle hydatidosis lung, liver, kidney and spleen were condemned during the study period with an economic loss of 3070 ETB, 45 ETB, 4 ETB and 10 ETB, respectively. This result was assessed from the

mean retail market price of each organs multiplied by the number of organs condemned during the study period. Annual financial losses were estimated by considering annual slaughter rate of cattle and percentage of hydatidosis per each organ and current market price. The overall estimated financial loss due to hydatidosis in Adama abattoir was 496,340.16 ETB per year (**Table 3**).

**Table 3.** Financial loss assessment in cattle due to hydatid cyst at Adama abattoir during the study period.

Organ	No of organ Condemned	Price per organ	Total price (ETB)
Lung	307	10	3070
Liver	112	50	5600
Heart	3	15	45
Kidney	2	12	24
Spleen	5	2	10
<b>Total</b>	<b>429</b>	<b>89</b>	<b>8749</b>

#### DISCUSSION

The present study showed that overall 2276 hydatid cysts were encountered out of these 10.4% were large, 40.1% medium and 49.5% small in size. Out of this 300 cysts were taken for laboratory test, 6% were viable, 3.6% sterile and 27.6% were calcified. The variation of results among different workers is probably due to difference in sample size, age of slaughtered animals and strain of *E. granulosus*.

The characterization of hydatid cysts were obtained from different studies was: 48.7% were small, 34.3% medium and 17.1% large size, 9% viable, 1.8% nonviable, 20.4% sterile and 21.3% calcified [15], 40% were small, 9.17% medium and 3.55% large, 71.43% viable, 28.5% nonviable, 73.4% sterile and 24.66 calcified [11], 68.3% sterile, 22.6% calcified and 9.1% fertile [16], 84.96%, 10.27% and 4.77% were small, medium and large size, respectively, 61.47%, 0.92% and 37.61% were sterile, fertile and calcified cysts, respectively [17], 77.3% were small, 12.4% medium and 10.3% large, 25.7%, 33.3.% and 41.1% were fertile, sterile

and calcified cysts, respectively [18], 39.4% were small, 15.5% medium and 7.9% large, 39.8% sterile and 54.2% were viable among fertile cysts [19].

In the present study it has been found that hydatid cysts occurred dominantly in the lung and liver in all examined animals. This is explained by the fact that lung and liver possess the first great capillaries sites encountered by the migrating *Echinococcus oncosphere* that adopt the portal vein rout before any other peripheral organ is involved. This finding agrees with the observation of other workers like [20]. In general, the percentage of occurrence of cysts higher in lung than liver, the reason for higher percentage of cysts in lung is due to softer consistency of the lung. The other reason might be due to the fact that most cattles are slaughtered at older age. During this period the liver capillaries are dilated and most cysts directly pass to the lungs. Additionally it is possible for the hyacinth embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and lungs and lungs in such a way that the lung may be infected before the liver, while the percentage of calcified cysts in this study in found to be higher in the liver this may be associated with the relatively higher reticulo-endothelial cell and abundant connective tissue reaction of the organ [21]. Similar findings were reported by Fikadu [22].

The result of the current study indicates that the rate occurrence small size cysts are higher than the occurrence of medium and large size cysts; this is in agreement with Habtamu [11], Tilahun [15], Asaffa [17], Hagos [18] and Fikre [19]. The higher proportion of small size cysts may indicate infection of animals as a result of heavy rain fall and continuous grazing in the past rainy season or due to immunological response of the host which might have reduced the expansion of cyst size. Moisture and rain fall favor the survival of eggs of *E. granulosus* species and at the same time eggs may get chance to be disseminated by flood [23-25].

The rate of occurrence of fertile cysts that are found in the current study is agreed with Tilahun [15] and Getahun [16] disagree with Habtamu [11] and Fikre [19]. The variation of results among fertility may be due to difference in geographical location, nature of infected host and the site of infection. The result of the present study revealed that lung is the most common organ which harbored fertile cysts. This result is similar to other workers such as Himona [26]. It has been stated that the relatively softer consistency of the lung allow easier development of cyst; and fertility of hydatid cysts may show a tendency to increase in advanced age of the host. This may also be to reduction in immunological compatibility of hosts at their old age of infection [27].

Animal with more than 5 years of age were highly affected. The difference in infection rate could be mainly due to longer exposure time to *E. granulosus*. This finding is similar to the finding of Fikre [19]. Most of slaughtered

animals at Adama abattoir were old and hence they were exposed to the disease (parasitic ova) over a long period with an increasing possibility of acquiring the infection. In addition, the wide spread tradition of offering un cooked infected offal to pet animals around home stead, or public awareness about the disease, the absence of fencing and disposal pits for slaughtered houses (where dog and other carnivores get an easy access) and the habit of disposing dead wild or domestic animals, un buried and left open for scavenging carnivores creates favorable condition for environmental contamination by *Echinococcus granulosus* by maintaining the life cycle in stray dogs and wild carnivores.

In this study, high economic loss was incurred due to hydatid disease with an estimated annual loss of 496,340.16 ETB in cattle industry per year. This finding is disagreeing with Habtamu [11] who reported the annual economic loss of 215,588.17 ETB in the same study area. Previous workers also estimated the annual financial losses associated with hydatidosis from other parts of the country. For example, Yilma [28] reported financial losses of about 813,526.46 ETB from DebreZeit abattoir; Roman [29] estimated annual financial losses of 90,646.95 ETB from Gonder; Moges [30] reported financial loss of 131,190.45 ETB from Jimma and reported financial loss of about 77,587.02 ETB attributable to hydatidosis from Nekemte abattoir. The result obtained in this study varies from the others which may be due to number of animals slaughtered and variation in the retail market price of the affected organs.

## CONCLUSSION AND RECOMMENDATIONS

Echinococosis or hydatidosis is a disease of considerable importance from both public and economic importance point of view. The present study has shown that bovine hydatidosis is a major cause of organ condemnation at Adama abattoir. This is relatively higher prevalence of hydatidosis and the associated economic losses calls for serious attention. Therefore; the following recommendation is forwarded:

- Stray dogs should be eliminated by strychnine poisoning or any suitable means and persons who own dogs should be advised to confine their dogs within their premises to reduce the rate of contamination of the pasture with the eggs of the parasite.
- Prohibit back yard and road side slaughter activities and construction of fenced abattoirs in towns and villages controlled by properly trained meat inspector.
- Public should be aware about the rout of infection, to maintain personal hygiene, especially to wash hands after handling dogs and their feces.
- Further detailed investigation in to the basic local epidemiological factors governing the spread of

hydatidosis must be carried out in the region to establish regional control strategy.

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