



## Prevalence, Cyst Characterization and Direct Financial Loss Associated with Bovine Hydatidosis in Hawassa Municipal Abattoir, Ethiopia

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### Abstract

A cross-sectional study was conducted from November 2018 to April 2019 on cattle slaughtered at Hawassa Municipal Abattoir. The objectives of the study were to estimate the prevalence of Bovine Hydatidosis, characterize the cysts, and estimate direct financial loss associated with condemnation of organs due to Bovine Hydatidosis. A total of 400 animals were selected systematically and subjected to both antemortem and postmortem examinations including by visualization, palpation and incision of organs such as lung, liver, spleen, kidney, and heart. Of the total 400 animals examined, 145 (36.3%) were found to be infected by one or more hydatid cysts. Statistically significant variation was seen in distribution of Hydatidosis among animals with different body condition scores ( $\chi^2=9.135$  and P-value = 0.010). Highest distribution of Hydatidosis was recorded in animals with poor body condition score (59.4%) followed by animals with medium (38.3%) and good body condition scores (32.6%). One or more organs per animal were found to be infested and totally condemned: 30% (120/400) lungs, 12.5% (50/400) livers, 5.5% (22/400) spleens, 1.8% (7/400) kidneys and 0.8% (3/400) hearts were infested with the cysts and subjected to a total condemnation. About 282 cysts were collected for characterization, and the laboratory examination revealed that 94 (33.3%) fertile, 143 (50.71%) sterile, 45 (15.96%) were found calcified. Based on size, 99 (35.11%), 124 (43.97%), and 59 (20.92%) cysts were large, medium, and small, respectively. From the fertile cysts subjected to viability test 43 (12.25%) were viable whereas 51 (18.1%) were non-viable. In the current study, a total direct financial loss of 293,595.00 ETB per year was estimated resulting from Bovine Hydatidosis in the cattle slaughtered at Hawassa municipal abattoir. This study revealed that Hydatidosis has high prevalence and has led to significant direct financial loss due to condemnation of organs. Therefore, emphasis should be given to the control and prevention of the disease.

**Keywords:** Abattoir; Bovine; Hawassa; Hydatidosis; Prevalence

### Introduction

Ethiopia has the greatest livestock population in Africa, with an estimated 57 million cattle, 29 million sheep, and 29 million goats in the country's animal population. Local breeds account

for 98.95 percent of the entire cattle population, with hybrid and exotic breeds accounting for the remainder. Local breeds account for 99.8% of the sheep population and practically all of the goat

population in the country [1]. Despite the large number of animals, the sector contributes very little to the national economy. Animal productivity and output in Ethiopia are hampered by malnutrition, poor management, low genetic performance, and animal illnesses such as Bovine Hydatidosis [2].

The frequency of Bovine Hydatidosis in a given location is influenced by social, cultural, environmental, and epidemiological factors [3]. Its high frequency is linked to the continued widespread use of traditional ruminant-raising techniques (extensive or semi-extensive grazing), illegal animal slaughter, and the presence of a large number of dogs [4].

The Hawassa Municipal Abattoir has a backyard slaughterhouse, and it is normal practice in Hawassa to feed stray dogs condemned organs. As a result, these could play a key role in the transmission of Bovine Hydatidosis from slaughtered cattle to dogs. The objectives of this study were to estimate the prevalence of Bovine Hydatidosis, characterize the cysts, and quantify the associated financial loss in cattle slaughtered at the Hawassa municipal abattoir in Ethiopia.

## Materials and Methods

### Study area

The study was carried out in the Hawassa Municipal Abattoir, which is located in Hawassa city. Hawassa is around 275 kilometers south of Addis Ababa. It is located between 4°27' and 8°30' north latitude and 34°21' and 39°01' east longitude. It is located between 1500 and 2000 meters above sea level. The area's annual rainfall and temperature range from 800 to 1000 mm and 20.1 to 25°C, respectively [5].

### Study animals

The study animals were cattle slaughtered at Hawassa Municipal abattoir for local consumption. They were originated from different agro-ecological zones which have different management system. The study animals brought from different districts Tula, Hawassa, Tikur-wuha, Negele Arsi, Dimtu and Shamana. The breed of animals was local, cross or exotic. These animals were kept under extensive and semi-intensive farming systems. A total of 400 head of animals were examined for the presence of Bovine Hydatid cysts by considering different risk factors like origin, age, sex, breed and body condition of study animals. Almost all the cattle

presented for slaughtering in the study area were males and the estimation of age of examined animals were carried out by dentition methods and two age groups were considered; greater than or equal to 5 years and less than 5 years old based on procedures given by Gatenby [6].

### Study design

Across-sectional study was conducted from November 2018 to April 2019 on cattle slaughtered at the Hawassa Municipal Abattoir with the objectives to estimate disease prevalence, cystic characterization, and direct financial loss associated with Bovine Hydatidosis.

### Sample size determination

Sample size was calculated based on the formula given by Thrusfield [7] by considering 41% of the expected prevalence of Bovine Hydatidosis in cattle, which was taken from the previous work of Haregawi, *et al.* [8] with 95% confidence interval with a 5% desired absolute precision.

$$n = \frac{1.962 P_{exp} (1 - P_{exp})}{d^2}$$

Where: n = required sample size,  $P_{exp}$  = expected prevalence, and d = desired absolute precision. Therefore, by using the above formula, a minimum of 372 head of cattle was intended to be sampled, but to increase the accuracy of the study, the total number of samples was increased to 400 heads of cattle.

### Study methodology

A total of 400 heads of cattle were chosen using a systematic random sample technique, and frequent visits (two days per week) were conducted to conduct antemortem and postmortem examinations on animals delivered to the Hawassa municipal abattoir for slaughtering.

### Antemortem examination

Individual animals were subjected to antemortem inspections before being allowed to enter the slaughterhouse, according to Gracey's [9] standard of antemortem examination techniques. Risk factors such as breed, sex, age, origin, and body condition of each study animal were documented during regular antemortem examination visits.

### Postmortem examination

Visual inspection, palpation, and systematic incision of each visceral organ, particularly the lung, liver, spleen, kidney, and heart, were used in the postmortem examination of the animals, as indicated by the FAO [10]. All organs with hydatid cysts were partially or completely condemned and graded based on meat inspection guidelines for underdeveloped nations [11].

### Hydatid cyst distribution and characterization

The total number of hydatid cysts in each damaged organ was counted and recorded. According to Dalimi, *et al.* [13], hydatid cysts were measured with conventional rulers and classified as tiny cysts (less than 2cm), medium cysts (2-4cm), and big cysts (more than 4cm).

### Examinations of fertility and viability of hydatid cysts

The collected cysts were taken to laboratory and the pressure of the cyst fluid was reduced by using a sterile needle. Then cysts were incised with a sterile scalpel blade and the content was poured into a glass Petri dish to be examined. After that the cysts were identified and classified as fertile – fluid filled cyst contain Protoscoleces, and infertile – fluid filled cyst without any Protoscoleces [13].

The Protoscoleces presented as white dots on the germinal epithelium or brood capsule or hydatid sands within the suspension and the cyst categorized as fertile. Then the fertile cysts further subjected for viability test. For clear vision a drop of the sediment consisting of Protoscoleces placed on microscope glass slide and a drop of 0.1% aqueous eosin solution added and covered by coverslip and observed under microscope (40×), with principle that viable Protoscoleces exclude the dye while dead ones take it up [14].

### Estimation of direct financial loss

The direct financial loss was estimated based on the condemned organs (lung, liver, spleen, kidney and heart) due to the disease in cattle. Different meat sellers were interviewed randomly to establish the price per unit organ and the collective price of lung, liver, spleen, kidney and heart was determined. Annual cost of the condemned organs due to Bovine Hydatidosis was assessed by the formula set by Ogunrinade and Ogunrinade [15].

Annual economic loss due to organ condemnation =  $(P_{llu} \times T_k \times Cl_u) + (P_{lil} \times T_k \times Cl_l) + (P_{lIs} \times T_k \times C_s) + (P_{lIk} \times T_k \times C_k) + (P_{lIh} \times T_k \times C_h)$ .

Where:

- $P_{llu}$  = Percent involvement of lung out of the total examined
- $P_{lil}$  = Percent involvement of liver out of the total examined
- $P_{lIs}$  = Percent involvement of spleen out of the total examined
- $P_{lIk}$  = percent involvement of kidney out of the total examined
- $P_{lIh}$  = percent involvement of heart out of the total examined
- $Cl_u$  = Average market cost of lung;  $Cl_l$  = Average market cost of liver
- $C_s$  = Average market cost of spleen;  $C_k$  = Average market cost of kidney
- $C_h$  = Average market cost of heart;  $T_k$  = Average annual kill of cattle

### Data management and analysis

Data generated from antemortem, postmortem and laboratory findings were entered into Microsoft Excel® 2007 spreadsheet and analyzed using SPSS version 21. Hydatidosis prevalence, cyst distribution in different organs and cyst characterization were calculated as percentage. Pearson chi-square ( $\chi^2$ ) test was employed to assess the existence of association between the result and different risk factors. The significance level was set at 0.05.

## Results

### Prevalence of hydatid cysts and risk factors

Out of 400 cattle examined at Hawassa Municipal abattoir, 145(36.3%) were positive for hydatid cysts at different organs. The infection rate for male, 32.3%, 4% for female and the prevalence of sex has shown no statistically significant variation ( $p > 0.05$ ) with male having higher infections. The prevalence was also assessed for age and it found that 14% for animal less than five and 22.3% for greater or equal to five. It was not show statistically significant variation ( $p > 0.05$ ). The prevalence was also calculated for different breeds of examined animals, 33.8% for local, 2.5% for cross and 0.0% for exotic animals and breeds has not shown statistically significant variation with ( $p > 0.05$ ). The infec-

tion rate for different body conditions scores were assessed found 21.3%, 10.3% for medium and 4.8% for poor body condition score of study animals. Body condition scores of study animals were statistically significant ( $p < 0.05$ ). Based on origin, the rate of infection was assessed and it revealed that statistically insignificant variation with in groups. During the postmortem examination

282 cyst were counted from 202 infected organs. The highly infected organs and high number of cysts counted, 120 (30%) were lungs and 169 (59.9%) cysts were counted from infected lungs and the lowest number of infected organs and the lower number of cysts counted, 3(0.75%) were hearts and 3 (1.1%) cysts were counted from hearts.

Organs	No of infected organs	Rate of condemnation (%)	Number of cysts counted	Proportion (%)
Lung	120	30.0	169	59.9
Liver	50	12.5	70	24.8
Spleen	22	5.5	31	11.0
Kidney	7	1.75	9	3.2
Heart	3	0.75	3	1.1
Total	202	50.5	282	100.0

**Table 1:** Distribution of Hydatid Cysts in Different Organs of Cattle Examined at Hawassa Municipal Abattoir during 2018-2019.

Risk factors	Categories	Examined animals	Positive animals	prevalence %	Number of infected organs					Chi- square	p- value
					Lung	Liver	Spleen	Kidney	Heart		
Sex	Male	364	129	32.3	107	45	22	6	3	1.150	0.284
	Female	36	16	4	13	5	0	1	0		
Age	< 5 years	153	56	14	45	23	7	2	0	0.013	0.908
	≥ 5 years	247	89	22.3	75	27	15	5	3		
Breed	Local	362	135	33.8	112	48	19	7	2	2.769	0.250
	Cross	35	10	2.5	8	2	3	0	1		
	Exotic	3	0	0.0	0	0	0	0	0		
BCS	Good	261	85	21.3	76	30	12	2	2	9.135	0.010
	Medium	107	41	10.3	33	12	5	4	1		
	Poor	32	19	4.8	11	8	5	1	0		
Origin	Tula	88	38	9.5	29	12	7	2	0	3.750	0.586
	Hawassa	96	31	7.8	29	6	3	2	0		
	Tikur wuha	40	14	3.5	9	9	2	0	0		
	Negele Arsi	64	20	5	16	9	2	2	2		
	Shamana	58	20	5	17	6	4	1	1		
	Dimtu	54	22	5.5	20	8	4	0	0		

**Table 2:** Prevalence of bovine hydatid cysts with regard to different risk factors during 2018-2019.

**Characterization of hydatid cysts**

During post-mortem examination, 282 hydatid cysts were collected from 202 infected organs. Out of 282 hydatid cysts, 99(35.1%), 124(44%), 59(20.9%) were large, medium and small cysts at different organs respectively. And the animal examined at post-mortem for presence of hydatid cysts and the sample taken to laboratory to examine the fertility, viability, sterility and calci-

fication of the cyst. The cysts that examined at laboratory, 94 (33.3%), 143 (50.7%), 45 (16%) were fertile, sterile and calcified cyst respectively. hence from fertile hydatid cysts, 43 (15.2%), 51 (18.1%) were viable and non-viable respectively, by examining the viability of Protoscoleces of hydatid cyst from total infected study animals.

Organs examined	Number of cysts	Size of cysts			Fertility of cysts			Viability of cysts	
		Large(%)	Medium(%)	Small(%)	Fertile(%)	Sterile (%)	Calcified (%)	Viable(%)	Non-Viable(%)
Lung	169	86 (50.9)	58 (34.3)	25 (14.8)	64(37.9)	86(50.9)	19(11.2)	27(42.2)	37(57.8)
Liver	70	12 (17.1)	41 (58.6)	17 (24.3)	21(30)	36(51.4)	13(18.8)	10(47.6)	11(52.4)
Spleen	31	1 (3.2)	15 (48.4)	15 (48.4)	7(22.2)	13(41.9)	11(35.5)	4(57.1)	3(42.8)
Kidney	9	0 (0.0)	7 (77.8)	2 (22.2)	0(0.0)	7(77.8)	2(22.2)	0(0.0)	0(0.0)
Heart	3	0 (0.0)	3 (100)	0 (0.0)	2(66.7)	1(33.3)	0(0.0)	2(100)	0(0.0)

**Table 3:** Characterization of Hydatid cysts of cattle slaughtered at Hawassa Municipal abattoir during 2018-2019.

**Estimation of direct financial loss**

In the current study the total condemned organs were 120 (30%) lungs, 50 (12.5%) livers, 22 (5.5%) spleens, 7 (1.8%) kidneys and 3 (0.8%) hearts. Average number of animals slaughtered

annually at Hawassa municipal abattoir were 23,000. Then the direct annual financial loss due to organ condemnation is estimated to be 293,595 Birr.

Organs Condemned	Number organcondemned	Rate of organs condemnation (%)	Average cost of organs inBirr (ETB)	Total costin Birr
Lung	120	30	15.00	103,500.00
Liver	50	12.5	60.00	172,500.00
Spleen	22	5.5	3.00	3,795.00
Kidney	7	1.8	20.00	8,280.00
Heart	3	0.8	30.00	5,520.00
Total	202	50.6	128.00	293,595.00

**Table 4:** Direct financial loss associated with organ condemnation due to Bovine Hydatidosis in cattle slaughtered at Hawassa Municipal abattoir.

**Discussion**

Prevalence of Bovine Hydatidosis varies from country to country or even within the country and has been reported by various researchers from developing countries under extensive production system. Based on the data collected in this cross-sectional

study, the prevalence of Bovine Hydatidosis was found to be 36.3%, which was relatively comparable with the findings of Solomon., *et al.* who reported 35.7% at Debre Berhan [16]. Yimer., *et al.* were also reported 36.3% prevalence at Addis Ababa [17], and similarly Kebede., *et al.* [11] reported a prevalence of 34.05% in Bahir

Dar. But the prevalence of this study was lower than from the findings of Alemayehu who reported a prevalence of 54.8% in Arsi municipal abattoir [18], Getaw., *et al.* reported a prevalence of 48.5% in Adama municipal abattoir [19]. and whereas Fromsa and Jobre reported a higher prevalence of 72% at Assela [20]. However, the prevalence of Bovine Hydatidosis the current study was higher than the findings of Kebede., *et al.* who reported 15.2% at Birre Sheleko [2], Bekele and Butako who reported 16.85% at Wolaita Sodo [21], and Alemu., *et al.* who reported 17.5% at Dessie [22]. This variation in infection rate within the same species of animals could be due to the differences in environmental conditions, livestock stocking intensity and livestock movement from place to place, standard measure taken at Municipal Abattoirs, seasonal variation, geographical locations and strain differences. Beside of these factors like difference in culture, social activity and attitude to dog in different regions might have contributed to this variation.

The prevalence of Bovine Hydatidosis in the present study showed statistically significant association ( $\chi^2 = 9.135$  and  $P$ -value = 0.010) with body condition scores of the slaughtered animals. Accordingly, the prevalence of 21.3%, 10.3% and 4.8% was found in animals with poor, medium and good body condition scores, respectively. Animals having poor body conditions were found to have high infection rate. Haregawi., *et al.* [8] reported that the high prevalence rate for poor body condition scores was due to the fact that the disease is chronic and cause high live weight loss if the animal exposed to moderate to severe infection and the animal became poor through time. Moreover, animals with poor body condition have high risk of infection due to low immunity.

Polydoros [23] explained that in moderate to severe infection of the parasite may cause retarded performance and growth, reduced quality and yield of meat and milk as well as live weight loss. Hydatid cysts was detected with a proportion rate of 59.4%, 24.8%, 10.9%, 3.5%, and 1.5% on the lung, liver, spleen, kidney and heart respectively. In addition, higher numbers of large sized cysts were found in the lung of cattle than the rest other organs with prevalence of 50.9% due to softer consistency of the lung [19]. The distribution of cyst, on the lung and liver were infected higher than spleen, kidney and heart. The reason for high prevalence of the cyst in lung is, the immature parasites have no selective affinity for any particular organ and location of hydatid cyst in animal. It is controlled by filtering action of capillaries, due to the fact that

lungs and liver possesses the first great capillaries sites encountered by the migrating *Echinococcus* oncosphere which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved, but oncospheres which traverse these will reach the systemic circulation and the hydatid cyst were found in many organs and tissue [19].

Out of collected hydatid cysts from different organs, fertility percentage was 33.3%, 50.7%, and 16% of them were fertile, sterile and calcified respectively, similarly out of fertile cysts 45.7% and 54.3% were viable and non-viable, respectively. In the current study, the annual financial loss due to bovine hydatidosis in Hawassa municipal abattoir from direct financial loss was estimated as 293,595 Ethiopian birr (ETB), which is a significant amount of money for the country like Ethiopia, where the per capita income is very low. In different abattoirs different financial losses were reported from different part of the country. When comparing with others finding, it is higher than a loss reported by Kibruyesfa and Worku (80,892 ETB) at wolliso municipal abattoir [24] and Solomon., *et al.* [16] (92,830.8 ETB) at Debre Berhan municipal abattoir. The difference in direct financial loss from different abattoirs were due to difference in the mean annual slaughter rate, variation in the average market price of the condemned organs and difference in involvement of infected organs and difference in the prevalence of hydatid cyst in the among these study sites.

## Conclusion

In Ethiopia, bovine hydatidosis is one of the most common parasite infections affecting cattle. The high prevalence of the disease (36.3%) in the current study reflects the potential threat to public health in the area. The disease could also result in significant direct economic losses due to organ condemnation at abattoirs. The lungs, liver, spleen, kidneys, and hearts were the most often infected organs with hydatid cysts in cattle in the current study, and condemnation of these vital organs with a single or multiple hydatid cyst is a great loss. According to the distribution of hydatid cyst infection in animals with varied body condition scores, animals with poor body conditions were shown to be more infected with cysts than those with good or medium body conditions. The high frequency of the disease in a given area is due to a number of socioeconomic factors. Among other things, a lack of standardized abattoirs could be a major cause. Dogs' access to improperly disposed of offal could possibly play a part in the disease's prevalence.

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