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**Original article**

**Study on bovine hydatidosis and its economic significance at Shashemene municipal abattoir, Southern Ethiopia**

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ABSTRACT

This cross-sectional study was carried out from November 2015 to March 2016 to assess prevalence and associated factors of bovine hydatidosis and also to estimate its financial loss in cattle slaughtered at Shashemene municipal abattoir. Out of 400 examined cattle by meat inspection 199(49.75%) were infected by hydatid cyst in one or more of their visceral organs. The prevalence of hydatidosis in this study was significantly higher ( $P<0.05$ ) in cattle with age group of more than 10 years (56.8%) and in animals having poor body condition (62.02%). Of the total 199 infected cattle, 109(54.77%) of them had hydatid cysts only in their lung, 42(21.1%) in liver, 5(2.51%) in spleen, 3(1.5%) in heart and 2(1%) in their kidney while the rest 28(18.08%) had multiple organs infection. Of the 721 cyst counted in viscera harboring hydatid cysts, the highest (57.56%) was in lung followed by liver (40.36%), spleen (1.38%), heart (0.41%), and kidney (0.27%). Out of the total 721 cysts collected, 24.18% were fertile, 46% sterile, and 29.82% calcified cysts. From the 175 fertile cysts, 60.57% cysts were found to be with viable protoscolics. Significantly the highest viability rate ( $P<0.05$ ) was observed in fertile cysts of lung origin, 62.2% followed by 57.8% cysts of livers. Based on this study, the estimated annual financial loss due to direct and indirect effects of hydatidosis was 4, 158, 559.03ET=202, 955.54USD per annum based on the local market price in the study period. Hydatidosis was highly prevalent and economically important parasitic disease

of cattle in the study area. The high percentage of viable cyst in this result indicates that the risk of its transmission with implication of public health importance. Public health measures such as control of stray dogs and strengthening of meat inspection services at abattoirs should be practiced.

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## 1. Introduction

Cystic echinococcosis (Hydatidosis) is a severe zoonosis caused by ingestion of onchspher of the cestode *Echinococcus granulosus* and then development of its larval stage (hydatid cyst) in different organs and tissues of the intermediate hosts including humans (Eckert and Deplazes, 2004; McManus et al., 2003). The disease has a worldwide distribution, with endemic regions in many countries of the Mediterranean basin, North and East Africa, Western and Central Asia, China, South America and Australia (Jenkins, 2005; Romig et al., 2006). Although *Echinococcus granulosus* is considered to be distributed in the world, it is highly prevalent in developing countries, especially in tropics and subtropics, where rural communities have close contact with dogs (definitive host) and various domestic animals which are intermediate host (Eckert and Deplazes, 2004). The public health and economic importance of hydatidosis is not only considered in areas of endemicity but also in some western, nonendemic, countries, the disease is considered as a reemerging zoonosis due to its resurging prevalence in previously disease free areas due to the migration of infected people and livestock exchange which promotes emergence (Mamuti et al., 2002).

The prevalence of hydatidosis in a certain area mainly associated with factors related to specific socio-cultural, environmental and epidemiological conditions of a given locality. The disease has greater public health significance and socio economic impact in developing countries where livestock industry is an important segment of the agricultural sector and when livestock production is based on mainly extensive grazing system (Berhe, 2009). Ethiopia has Africa's largest livestock record with an estimated total cattle population of 57.83 million (CSA, 2015). Currently, livestock has been contributing to the livelihoods of the rural community of the country estimated 80% of the population in jeop creation and income generation (Yacob et al., 2008). In spite of having the largest livestock population in Africa, the contribution for the economic aspect of the country is still lowest and livestock disease can be considered as major constrain (Nejash, 2016). Parasitic diseases are among the major constraint factors considered as the main obstacle in the health and production performance of livestock in Ethiopia (CSA, 2009).

In Ethiopia hydatidosis has been noted and reported since 1970 in animals and in 1972 in humans (Yimer et al., 2005) the study showed that bovine hydatidosis occurs all over the country. However, the situation of hydatidosis in humans is not well studied and documented and so far in the country. An older report of Clinical and serologic tests conducted in southern western part of the country revealed the prevalence of 31.7% for hydrated skin test (Fuller and Diane, 1981). Similarly certain abattoir studies currently conducted in various regions of the country indicate that *Echinococcus granulosus*, a causative agent of hydatidosis, is wide spread in Ethiopia with great economic and public health significance (Nigatu et al., 2009; Sissay et al., 2008). Several other reports from different parts of Ethiopia also showed that hydatidosis is prevalent in livestock and these reports indicated that hydatid cyst prevalence range of 3.1-72% in cattle and small ruminant of the country (Fekadu, 1997; Fikre, 1994; Hagos, 1997; Kebede, 2010; Mussie, 1995).

Hydatidosis in domestic animals causes significant economic loss due to condemnation of edible organs carcass weight loss. Significant losses of meat and milk production and fleece values from infected farm animals may also cause considerable economic loss. These losses become significant in poor countries of low economic outputs, especially where sheep and cattle production is of particular importance (Torgerson et al., 2001). In addition to backyard slaughter of animals without strict the meat inspection procedures, the common habit of the community feeding domestic dogs and wild carnivores with condemned offal and the subsequent contamination of pasture and grazing fields contributes the higher distribution of the disease more than the expected prevalence in developing countries (Jobire et al., 1996).

Fragmentary works have been done on the prevalence and economic importance of hydatidosis in Ethiopia; however, there is longstanding practice of backyard slaughtering of domestic animals, raw beef consumption and feeding stray dogs with condemned organs in the study area. However, there is no recent report on the prevalence and economic significance of hydatidosis in farm animals in southern Ethiopia. Hence, it would be mandatory to have information about the current situation of the disease, cyst characterization and economic importance of hydatidosis before setting any control scheme at regional or country level keeping in view the public health significance of hydatidosis. There for the objective of this study was to assess the status of hydatidosis in cattle slaughtered at Shashemene municipal, to estimate the annual financial losses due to the disease and to identify risk factor that is likely to influence the occurrence of the disease.

## **2. Materials and methods**

### **2.1. Study area**

The study was conducted at Shashemene municipal abattoir, Oromia Regional State, South Ethiopia, which was located at 250 km south of Addis Ababa. The study area found within the rift valley, which is located at 7 °N and 38 °E with an altitudes ranging from 1700 to 2600 masl (SWARDO, 2006). It has mean annual rainfall of about 1,343 mm of which 84% falls during the long rainy season that extends from June to September and the remaining is during the short rainy season that extends from October to May. The mean annual minimum and maximum temperatures are 9 °C and 24 °C respectively, and the mean relative humidity is about 75% (CSA, 2009).

### **2.2. Study animals**

The study animals were indigenous zebu and exotic cross breed cattle brought, at Shashemene municipal abattoir in Shashemene town for slaughtering, from different localities during the study period. All the slaughtered animals were male originated from different localities mainly from market origins of Arsi nagelle, Kofale and Shashemene districts.

### **2.3. Study design and sampling method**

Abattoir based cross sectional study was performed from December 2015 to April 2016 to assess the current status of bovine hydatidosis among cattle slaughtered and to estimate the magnitude of direct monetary loss due to organs condemnation and indirect carcass loss at Shashemene municipal Abattoir. Systematic random sampling technique was used for selection of sampled animals. To calculate the total sample size, the following parameters were used: 95% level of confidence, 5% desired level of precision and 50% prevalence of cattle haydatidosis among cattle in the abattoir in the previous study, the sample size was determined using the formula given in (Thrusfield, 2005). Accordingly, 384 cattle were the calculated sample size. However, the sample size was increased to 400 cattle for maximizing the precision of the study under taken.

### **2.4. Study methodology**

Regular visits of the abattoir on two slaughtering days per week were performed to carry out both ante mortem and post mortem inspection of cattle slaughtered at the study abattoir during the study period.

### **2.5. Ante mortem examinations**

During pre-slaughter examination the cattle were randomly selected and examined clinically both at rest and in motion. Each of the selected animals were tagged with identification number, sex, age, body condition scoring and the origin of the animals was recorded. The age of the animals was determined by dental eruption formula according to de Lahunta and Habel (1986) and the animals were categorized into three age groups less than 5 years, 5-10 and greater than 10 years. Body condition score was ranked as good, medium and poor as described by Nicholson and Butterworth (1986).

### **2.6. Post-mortem examination**

A total of 400 cattle presented for slaughter at Shashemene municipal abattoir, which are passed the ante mortem examination for slaughter, post mortem examinations were carried out through visualization, palpation and incision of visceral organs (lung, liver, heart, spleen and kidney) for the presence of hydatid cyst following the

routine meat inspection procedures according to FAO/WHO (1994). The organ distribution and rate of infection of hydatidosis were recorded. Hydatid cysts were removed from each organ and collected in separate clean petridish for cyst characterization.

## **2.7. Hydatid cyst characterization**

### **2.7.1. Determination of cyst fertility and viability**

The individual cysts collected from different organs were grossly examined for the evidence of degeneration and calcification. Each hydrated cysts were collected in ice box and taken to Hawassa University school of Veterinary Medicine, Parasitology Laboratory for conducting cyst count of fertility test and viability of protoscolices. The pressure of the cyst fluid was reduced by using sterile needle. Then the cyst was incised with a sterile scalpel blade and the content was poured into a glass petridish and examined microscopically (40X) for the presence of protoscolices. Cyst that contained protoscolices was considered as fertile (Parija, 2004). Fertile cysts were further subjected to viability test. A drop of fluid from cyst congaing the protoscolices was taken on microscope slide to observe the presence of amoeboid like peristaltic movements with (40X) objective lenses. The viability of protoscolices was characterized by the presence of amoeboid movement. For clear vision of doubtful cases, a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydrated fluid on microscope slide with the principle that viable protoscolices completely or partially exclude the dye while the dead ones take it up (Parija, 2004). The infertile cysts were also further classified as sterile (fluid filled cyst without any protoscolices) or calcified (Cyst produced a gritty sound feeling up on incision) as per the procedure given by Parija (2004).

## **2.8. Financial loss analysis**

Annual economic loss due to hydatidosis in cattle was estimated as the summation of cost of offal condemned plus the cost of carcass weight losses due to the disease (Getaw et al., 2010; Kebede et al., 2009b). The Shashemene municipal abattoir usually slaughtered an average of 25 heads of cattle each day. The average annual slaughter rate of cattle at the abattoir was estimated based on two years recorded retrospective data analysis. Likewise, the annual slaughter rate of the study abattoir was estimated to be 9125 cattle per year.

### **2.8.1. Direct monetary loss**

The direct economic loss was calculated on the basis of number of condemned organs like (lung, heart, kidney, liver and spleen), annual slaughter rate of the abattoir for cattle, prevalence of bovine hydatidosis and average market prices for each of the organs. The mean retailer prices of each visceral organs at Shashemene town were obtained from the butcher during the study period. The annual cost of the condemned organs due to bovine hydatidosis was calculated by the formula described by Ogunirale (1980) as follows.  $LOC = (NAS \times Ph \times Plu \times Cplu) + (NAS \times Ph \times Pli \times Cpli) + (NAS \times Ph \times Phr \times Cphr) + (NAS \times Ph \times Psp \times Csp) + (NAS \times Ph \times Pkid \times Cpkid)$  Where: LOC = loss due to organs condemnation, NAS = average number of cattle slaughtered annually, Ph = prevalence of hydatidosis, Plu = percent involvement of lung, Pli = percent involvement of liver, Psp = percent involvement of spleen, Phr = percent involvement of heart, Pkid= percent involvement of kidney, Cplu = current average market price of lung, Cpli = current average market price of liver, Csp = current average market price of spleen, Cphr = current average market price of heart and Cpkid = current average market price of kidney.

### **2.8.2. Indirect financial loss**

Indirect losses were assessed on the basis of live weight reduction due to hydatidosis, the average annual slaughter rate of cattle at Shashemene abattoir, average carcass weight of local adult zebu cattle which is 126 kg (Zewdu et al., 2010), the average carcass weight loss of 5% due to hydatidosis, prevalence of bovine hydatidosis and average retail market price of 1 kg beef at Shashemene town during the study period using the formula set by Ogunirale (1980).  $ACW = CSR \times CL \times BC \times P$ , Where: ACW = annual cost from carcass weight loss; CSR = average slaughtered cattle per annual in the abattoir; CL = the average carcass weight loss of 5% due to hydatidosis in the individual (126 × 5%); BC = average price of 1 kg carcass at Shashemene town = 140 ETB; P = prevalence rate of hydatidosis at Shashemene abattoir. Therefore, the total financial loss due to hydatidosis was the sum of organ condemned (LOC) and the cost of carcass weight (LCWL) losses.

### 3. Data analysis

Data collected from ante-mortem and post mortem findings in the abattoir servia and cyst characterization laboratory results were coded in Microsoft excel database system and subjected to descriptive statistics in order to assess the magnitude of the difference of comparable variables using SPSS version 20 for windows software. Statistically significant association between variables was considered to exist if the p-value is less than 0.05. Chi-square test was applied to compare the infection status with regard to the hypothesized risk factors like origin, age and body condition score.

### 4. Results and discussion

#### 4.1. Overall prevalence

Out of the total 400 cattle passed for slaughter and examined on post mortem examination, 199(49.75%) were infected with hydatid cyst, harboring one or more cysts in different visceral organs (lung, liver, spleen, heart and kidney) (Table 1). Age related hydatidosis prevalence significantly increased ( $X^2=7.9$ ,  $P=0.019$ ) with age of the animal from 32.6% in less than 5 years group, 49.3% in 5-10 years group and cattle more than 10 years old group having the highest infection rate of 56.8%. According to this result prevalence also significantly associated with body condition score of the animal ( $X^2=7.25$ ,  $P=0.027$ ). The highest prevalence was observed in animals with poor body condition (62.5%) followed by, 54% in medium and 43% in good body condition score respectively (Table 1).

**Table 1**

The prevalence of bovine hydatidosis among different risk factors.

Variable	Number of examined	Number of positive	Prevalence (%)	$X^2$	P value
<b>Age</b>					
<5 year	46	15	32.6	7.907	0.019
5-10 year	229	113	49.3		
>10 year	125	71	56.8		
<b>Body condition</b>					
Poor	40	25	62.02%	7.25	0.027
Medium	174	94	54.02%		
Good	186	80	43.01%		
<b>Breed</b>					
Local	336	174	51.8%	3.481	0.062
Cross	64	25	39.2%		
<b>Animal origin</b>					
Arsi nagelle	117	50	42.73%	2.95	0.118
Kofale	142	79	55.63%		
Shashemene	141	71	49.64%		
Total	400	199	49.75		

According to this result breed of cattle was no significantly associated with hydatidosis prevalence ( $X^2=3.48$ ,  $P=0.062$ ). However, relatively higher prevalence was observed in indigenous zebu cattle (51.8%) compared with exotic cross breeds (39.2%). Similarly prevalence also insignificantly different ( $X^2=2.95$ ,  $P=0.118$ ) related to the origins (localities) of the cattle slaughtered, however the prevalence was relatively lower (42.7%) in cattle brought from Arsi Nagelle, while prevalence of 49.64% and 55.63% was found in cattle originated from Kofale and Shashemene districts respectively (Table 1).

#### 4.2. Hydatid cyst distribution

Over all distribution of hydatid cyst in different visceral organs of cattle slaughtered at the study abattoir was shown in (Table 2). From the total 199 infected cattle, 109(54.77%) had cyst in the lung, 42(21.1%) in the liver, 5(2.51), 3(1.5%) in heart, 2(1%) in kidney and the other 38(19.09%) infected cattle involved multiple organ infection.

**Table 2**

Distribution of hydatid cyst in different visceral organs in infected cattle slaughtered at Shashemne municipal abattoir.

Organs examined (n=400)	Number of infected organs	Prevalence (%)	Relative proportion from infected animals (%)
Lung only	109	27.25	54.77
Liver only	42	10.5	21.1
Lung and liver	35	8.75	17.58
Spleen only	5	1.25	2.51
Lung, liver and spleen	3	0.75	1.5
Heart only	3	0.75	1.5
Kidney only	2	0.5	1
Total	199	49.75	100

A total of 240 different visceral organs were found to be affected by hydatid cyst. Among different visceral organs infected lung (61.25%) and liver (33.33%) attributed almost 94.58% (227/240) of the overall organs infection. Of the total 721 cysts counted, the highest number was counted from lung 147(57.56%), followed by 291(40.36%), 10(1.38%), 3(0.41%) and 2(0.27%) counts from liver, spleen heart and kidney respectively (Table 3).

**Table 3**

Number and distribution of hydatid cyst within the affected organs.

Organs	No Infected organ	Number of cyst counted	Proportion of cyst obtained (%)
Lung	147	415	57.56
Liver	80	291	40.36
Spleen	8	10	1.38
Heart	3	3	0.41
Kidney	2	2	0.27
Total	240	721	100

#### 4.3. Cyst characterization

A total 721 hydatid cysts collected, 147 cysts of lung, 80 cysts of liver, 8 cysts of spleen 3 cysts of heart and 2 cysts of kidney origin were taken and examined for cyst characterization. Out of the total 721 cysts subjected to fertility test, 175(24.18%) were fertile, 331(46%) sterile and 215(29.82%) were found to be calcified. Fertility status of cysts from different organ origin was found significant different ( $X^2=25.6$ ,  $P=0.002$ ), with 125(30.6%) cysts of lung found highly fertile (Table 4).

**Table 4**

Fertility/sterility status of hydatid cysts collected from different organs of cattle slaughtered at Shashemene municipal abattoir.

Organs	Number of cysts	Type of cysts			$X^2(P)$
		Fertile (%)	Sterile (%)	Calcified (%)	
Lung	415	127(30.6)	216(52)	72(17.35)	
Liver	291	45(15.46)	103(35.4)	143(49.1)	
Spleen	10	3(30)	7(70)	-	
Heart	3	-	3(100)	-	
Kidney	2	-	2(100)	-	
Total	721	175(24.18)	331(46)	215(29.82)	25.61(0.002)

Out of the 175 fertile cysts, 106(60.57%) cysts were found to be with viable protoscolics. Significantly the highest viability rate ( $X^2=21.4$ ,  $P=0.034$ ) was observed in fertile cysts of lung origin, 79(62.2%) followed by 26(57.8%) cysts of livers and 1(33.3%) cyst of spleen while, the rest 68(39%) cysts were non-viable cysts (Table 5).

**Table 5**

Viability rate of fertile hydatid cysts collected from different organs of infected cattle slaughtered at Shashemne abattoir.

Organs	No of fertile cysts	Type of cysts		X <sup>2</sup> (P)
		Viable (%)	Non-viable (%)	
Lung	127	79(62.2)	48(37.8)	
Liver	45	26(57.8)	19(42.2)	
Spleen	3	1(33.3)	2(66.7)	
Total	175	106(60.57)	69(39.43)	21.4(0.034)

#### 4.4. Estimation of economic loss

Due to the aesthetic value, zoonotic importance and to control the transmission of echinococcus parasites all infected organs are condemned at the study abattoir (Table 6). A total of 147 lungs, 80 livers, 8 spleens, 3 hearts and 2 kidneys were condemned due to hydatidosis. Accordingly the annual economic loss due to bovine hydatidosis at Sheshemene abattoir from organ condemnations was estimated to be, LOC = 154, 554.69 ETB/7542.93USD/ annually.

**Table 6**

Different organ condemnation rate due to hydatidosis and the current average retail price of each organ marked in Shashemene town (2015-2016).

Organ	Hydatid cyst prevalence	Average market price in (Birr)
Lung	36.75	15
Liver	20	55
Spleen	2	5
Heart	0.75	25
Kidney	0.5	25
Total	58.75	125

The indirect monetary loss encountered due to carcass weight loss was estimated as, LCWL = 400, 4004.34/195412.61USD. Total loss = direct loss + indirect loss = 4, 158, 559.03ET/202, 955.54USD/. Therefore the annual monetary losses were 4,158, 559.03 ETB per annum. The total annual economic loss encountered at Sheshemene abattoir due to bovine hydatidosis was estimated to be 4,158,559.03 Ethiopian Birr/202,955.54 USD/. This result indicates that hydatidosis cause higher indirect monetary loss due to carcass weight redaction than the direct loss due to organ condemnation.

According to the present study the total prevalence of hydatidosis in cattle slaughtered at Shashemene municipal abattoir was 49.75%(199/400). This finding was comparable with previous reports by different researchers in the country, 48.5% at Adama municipal abattoir by Getaw et al. (2010); 46.8% in Debre Markos by kebede et al. (2009c); 46.5% in Debre Zeiet by Jobre et al. (1996) and 47.2% prevalence by Kebede et al. (2012) at Southern region of Ethiopia. Higher prevalence rate oh hydatidosis compared to this finding was reported, 72% by Fromsa and Jobre (2011), 62.96% by Woubet (1988), 61% by Koskei (1998) and 52.69% by Regassa et al. (2010). However, the prevalence obtained in this study was much higher than the reports, 13.3% by Melaku et al. (2012); 11.26% by Jemere et al. (2013); 11.6% by Yitbarek et al. (2012) in different regions of the country. Similarly, very low level of hydatidosis prevalence in cattle (2.8%) was reported by Sahar and Atif Elam (2011) in Sudan. The variation in prevalences of cattle hydatidosis discussed above may be due to the changes in the environmental and epidemiological factors, which could affect the rate of transmission of echinococcosis/hydatidosis. The distribution of hydatidosis could associated with the strain difference of *Echinococcus granulosus* that exist in different geographical areas, the breed of cattle involved as intermediate host, dog population and their management, including deworming practices, condemned offal disposal habits, body condition score and age of slaughtered animals and other factors socio-economic related activities in different region of the country (Arbabi and Hooshyar, 2006; McManus, 2006).



Among factors considered as a risk factors age and body condition were statistically significant ( $P < 0.05$ ) with the prevalence of bovine hydatidosis. Accordingly, the prevalence significantly increase as the age of the animal increased. Higher prevalence of hydatidosis was observed in slaughter cattle with age of above 10 years old (56.8%) compared to animals with less than 5 years age (32.6%). The finding is in agreement with previous results where a higher prevalence rate was reported in older animals (Azlaf and Dakkak, 2006). This could be mainly due to increased risk of infection and reinfection in older animals because of their longer exposure time to *Echinococcus granulosus* eggs and weaker immunity to resist the infection (Alemeante, 2009). The other factor may be related to the longer time required by hydatid cysts to develop and grow in different organs at detectable size during post mortem inspection techniques. Hence, cattle slaughtered at their adult and old age have a great chance of developing large detectable hydatid cyst by the inspection methods of used at abattoirs (Assefa and Tesfay, 2012). Consequently the sensitivity of hydatid cyst detection by slaughterhouse inspection methods increased in accordance with the age of slaughtered (Gemmel et al., 2001).

In the present study breed of cattle was not significantly associated with prevalence of hydatidosis ( $P > 0.05$ ). In agreement with this result, breed of cattle was not significantly associated with prevalence rate in cattle slaughtered at Addis Ababa and Tigray abattoirs (Gebretsadik, 2009; Terefe et al., 2012). Similar result was also reported by Assefa and Tesfay (2012) at Adgirat municipal abattoir. This may be due to similarity of cattle management system and animal exposure to the diseases, because of similar dog handling practises in different regions of the country.

Body condition score of cattle was significantly associated with bovine hydatidosis ( $P < 0.05$ ), higher prevalence was observed in animals with poor body condition score. Our finding was in agreement with previous reports of Zelalem et al. (2012), Melaku et al. (2012) and Miheret et al. (2013) from different regions of the country. The possible reason for higher prevalence in animal with poor body condition may be because of cattle with poor body condition score have lower response to hydatid cyst infection, moderate to severe infection of the parasite also cause retarded growth and weight loss (Polydrous, 1981). Prevalence of hydatidosis in relation to the origin of slaughtered cattle was not significantly associated ( $P > 0.05$ ), this is may be due to the similarity of the main determinant factors for the distribution of the disease in certain area, such as of socio economic status of the population, animal husbandry practice and awareness about the disease by the community in all areas where animas were bought for slaughter were similar.

In this study, it has been found that hydatid cyst occurred most commonly in lung, 147(61.25%) and 80(33.33%) in liver, similarly high proportion of cyst was counted in lung (75%) followed by in liver (40.36%). This result was in agreement with previous report of Getaw et al. (2010) who observed that lung was highly affected organ at prevalence of 55.2% followed by liver at 37.1% prevalence. Similarly, Bekele and Butako (2011) also reported comparable result with the current finding lung of cattle were commonly affected with hydatid cyst than the liver. This could be due to the fact that cattle are slaughtered at older age, during which period the liver capillaries become dilated and most of the oncospheres (hexacanth embryo) of *Echinococcus* directly pass to the lung and established in the lung tissue, in addition to this the oncosphere also enter to the lymphatic circulation and passed through the duct of the thoracic cavity to the heart and lung in such a way the lung could be infected before the liver even instead of the liver (Arene, 1985). The lung and liver are the first capillary beds by which the migrating oncospheres via the portal vein encountered before any other visceral organs and this fact could be one of the reason for lung and liver are mostly infected organs by hydatid cyst (Eckert and Deplazes, 2004).

According to the current study, the total percentage of fertile hydatid cysts was 24.18%. While the rest 46% and 29.82% of the tested cysts were found sterile and calcified respectively. This finding was comparable with previous report of Solomon (2011), who reported 24.4% fertility rate of hydatid cyst at Addis Ababa municipal abattoir. This finding was also comparable with the work of Regassa et al. (2010) who reported from Hawassa municipal abattoir, Ethiopia (26.89%) fertile, (47.25%) sterile and (25.86%) calcified cysts. In contrast to this result very low fertility rate of 9.85% in Nekemt by Berisa (1994) and 10.9% in Gonder ELFORA abattoir by Adane and Guadu (2014) were reported in different regions of the country. However, comparing to the present study very high fertility rate of 79.7% was reported by Mihret et al. (2013). The variation of fertile cyst prevalence in different study areas might be due to the difference in the strain of *Echinococcus granulose* in different geographical areas and also the size, site of the cyst (Parija, 2004). This result also showed that the lungs were the most common organ which harbored fertile cysts (30.6%) than the livers (15.46%). In agreement with this result Regassa et al. (2010) reported that higher fertility rate of hydatid cysts in lung (31.4%) followed by liver (24.6%). This could be due to the fact that various metabolic reactions that take place in hepatic cells, compared to pulmonary cells,

which could prevent the earlier growth and fertility of hydatid cysts found in the liver, consequently the cysts in the liver become calcified (George and Diame, 1981; Hubber, 1975; Symth, 1994). The softer consistency of the lungs also allows earlier development of the cyst and the percentage of cysts fertility rate increase in advanced age of the host (Adane and Guadu, 2014).

The viable protoscoleces from the fertile cysts in this study were 60.57% (62.2% of lung cysts and 57.8% of liver cysts). Comparably, Regassa et al. (2010) reported that cyst viability rate of 56.2% in cattle slaughtered at Hawassa municipal abattoir. On the contrary, Berhe (2009) reported lower viability rate of 10.7% in cattle in Tigray region of Ethiopia. The variability of cyst viability rate in different localities might be due to the difference in immunological response by infected individual hosts to the cyst and also the difference in animal management by owners, mainly deworming practice of animals by using antihelmintics (Daryani et al., 2007). Generally, significantly higher percentage of viable cyst finding ( $P < 0.05$ ) in this study showed that the high risk of the final hosts, special dogs exposure to Echinococcus infection if infected offals are not properly disposed in the study area.

In the current study, the annual economic loss incurred due bovine hydatidosis at Shashemene municipal abattoir from visceral organs condemnation and carcass weight losses was assessed. On average about 4,158,559.03 Ethiopian Birr (1USD=23 Ethiopian Birr) financial losses were estimated. Comparable financial losses of 5,544,591.74 ETB were reported by Zelalem (2008) at Addis Ababa abattoir. In contrast very low estimate of 674,093.038 ETB, losses were reported by Endalew and Nuraddis (2013) at Gondar municipal abattoir. The variation in economic losses estimates in different study areas might be related to the difference in prevalence rate of bovine hydatidosis in various localities, the average number of cattle slaughtered annually in different abattoirs and the variation in retail market price of visceral organs and carcass (Zelalem et al., 2012).

## **5. Conclusion**

Considering the high prevalence rate and the huge economic loss estimated in this study, bovine hydatidosis is considered to be among the major parasitic diseases of cattle in the study area. In light of the higher percentage of viable hydatid cysts finding at Shashemene municipal abattoir and its surroundings, condemned organs should not be freely accessed for dogs or other wild carnivores and infected organs should be properly disposed (either buried or incinerated) at the abattoir. Furthermore, responsible governmental bodies and other stakeholders should give attention towards building standard abattoirs, strictly control backyard slaughtering practices, reducing of stray dog population, creation of public awareness regarding hydatidosis and conducting strict meat inspection services should be exercised in Shashemene town. The prevalence of hydatidosis in different host species, including its status in human should be studied in order to launch a successful control program in and around the study area.

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