Prevalence of Small Ruminants Hydatidosis and Its Economic Impact at Asella Municipal Abattoir

Tahir Edo Assefa Kebede Tsegay
School Of Veterinary, College Of Agriculture And Veterinary Medicine, Jimma University, P.O.Box:307, Jimma, Ethiopia

Abstract
A cross-sectional study was conducted from November, 2013 to March, 2014 to determine the prevalence and economic loss incurred due to hydatidosis in small ruminant at Asella municipal abattoir. Routine ante-mortem and post-mortem inspection was conducted on 384 randomly selected animals. Out of these, 36(9.4%) of them were found to harbor hydatid cyst (s) in one or more of their offal's. The prevalence of hydatidosis in relation to species, sex and age were found to be 10.8% in ovine and 0% in caprine; 12.9% in female and 2.9% in male, 0% in young and 11.1% in adult animals. The difference in prevalence among species, sex, and age were statistically significant ($p<0.05$). In addition to that the distribution of the disease was 14.7% in poor, 9.4% in medium and 5.8% in good body conditioned animals, however, it was not statistically significant ($P>0.05$). Furthermore, the prevalence of disease in different origins of the animals was 14.3%, 8.4% and 7.1% in Tiyo, Digalu Tigo, and Hetosa respectively and was statistically significant. Out of the total infected animals, 7 (19.4%) were harboring hydatid cysts only in their liver and 5 (13.9%) in their lungs; however, 24(66.7%) were harboring hydatid cysts in both their liver and lungs. From 158 cysts examined for fertility status; 69(43.7%), 45 (28.5%) and 44 (27.8%) were found fertile, sterile and calcified respectively. A total of 69 fertile cysts sampled from lung and liver were tested for viability and 37(53.6%) of them were viable and 32 (46.4%) no-viable. The estimated annual financial loss due to direct organ condemnation and indirect carcass weight loss from small ruminant's hydatiddosis in the area was estimated to be 58,755.1 ETB ($2,797.9). In conclusion, this study indicated that hydatidosis is an important disease of small ruminants that causes great economic losses due to organ condemnation and weight loss in the study area. Due to these, improvement of awareness of the communities about the transmission mechanism and economic importance of the parasite and hence reducing the incidence and economic loss incurred by the disease via regular treatment of dogs are highly recommended.
Keywords: Abattoir; Asella; Cystic echinococcosis; Economic Loss; Goat; Sheep

INTRODUCTION

Ethiopia has the largest livestock population in Africa, with an estimated 52 million of cattle, 63 million sheep and goats, 7.55 million equines and 2.3 million camels [1]. However, the contribution from these huge livestock resources to the national income is insignificance due to several factors. Among them, parasitic diseases are considered as a major obstacle in the health and product performance of livestock. These parasitic diseases are distributed throughout the world and affect animal health resulting into a low working potential and reduced productivity. Amongst these parasitic diseases, hydatidosis is one of the most important parasitic diseases, which affects the efficiency of both animals and human being [2, 3]. The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries. hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughter houses [4]. Hydatidosis caused by the larval stage (metacestode) of *Echinococcus granulosus* is the most widespread parasitic zoonoses [5, 6]. Dogs are the usual definitive hosts whilst a large number of mammalian species are intermediate hosts, including domestic ungulates and man. It is a cosmopolitan zoonotic infection [7]. Despite the large efforts that have been put into the research and control of echinococcosis, it still remains a disease of worldwide significance. In some areas of the world, cystic echinococcosis caused by *E. granulosus* is a re-emerging disease in places where it was previously at low levels [8, 9].

E. granulosus infection is endemic in East and South Africa, Central and South America, South Eastern and Central Europe, Middle East, Russia and China. The highest incidence is reported mainly from sheep and cattle rearing areas [10]. The disease is most important in livestock production which is based mainly on extensive grazing system. Several reports from different parts of Ethiopia indicate that hydatid cyst is prevalent in livestock population of the country [11, 12]. Its distribution is higher in developing countries especially.

in rural communities where there is close contact between dogs (definitive host) and various domestic animals intermediate hosts [13]. By affecting many different animal species, intermediate hosts including humans, hydatid cyst causes tremendous economic losses worldwide and specially in those areas where the parasite is endemic [8]. Knowledge about the prevalence of the diseases together with associated risk factors as part of the epidemiology of the disease is crucial for any attempt of prevention and control of the disease in question. Moreover, determination of the economic significance of the disease is important for decision making, planning, development and implementation of local control strategies. It is also important to study the fertility of hydatid cysts as it will help to understand the risk of spreading of the disease both to domestic animals and humans. Even though there were several works done in bovine species, little attention is paid to investigate the prevalence and economic significance of hydatidosis in small ruminants in Asella. In view of addressing the problem, the objectives of the present research is to bridge the information on prevalence and economic importance of hydatidosis of small ruminant slaughtered at Asella municipal abattoir; so as to generate base line data that may assist for control of the disease. Therefore, the objective of this study was to estimate the prevalence of hydatidosis and assess the economic significance of the disease in small ruminants.

MATERIALS AND METHODS

Study Area and Period

The study was conducted from November, 2013 to March, 2014 in Asella town, the capital city of Arsi zone, in Oromia regional state. The town is located south East of Addis Ababa at a distance of 175 km. About 37% of the total area is highland (>2400m), 52% mid-land (1800-2400m) and 11% is lowland (<1800m) [14] within $6^0$59'and $8^0$49' latitude and $40^0$44'East longitude while the climatic condition of the area is mainly midland". The area receives an annual range of rain fall from 700-1658 mm and annual average humidity ranging from 43-60%. The annual temperature ranges from 10-22.6^0c. There is mixed farming of crop production and animal breeding. According to CSA [15], the town has an estimated total human population of 84,645. Lastly, livestock estimation of the year 2010/11 was given by the agricultural bureau of Tiyo woreda indicates that the woreda has 50,347 bovines, 16, 964 equines, 19,453 ovines, 6,884 caprines, and 2, 2485 poultry.

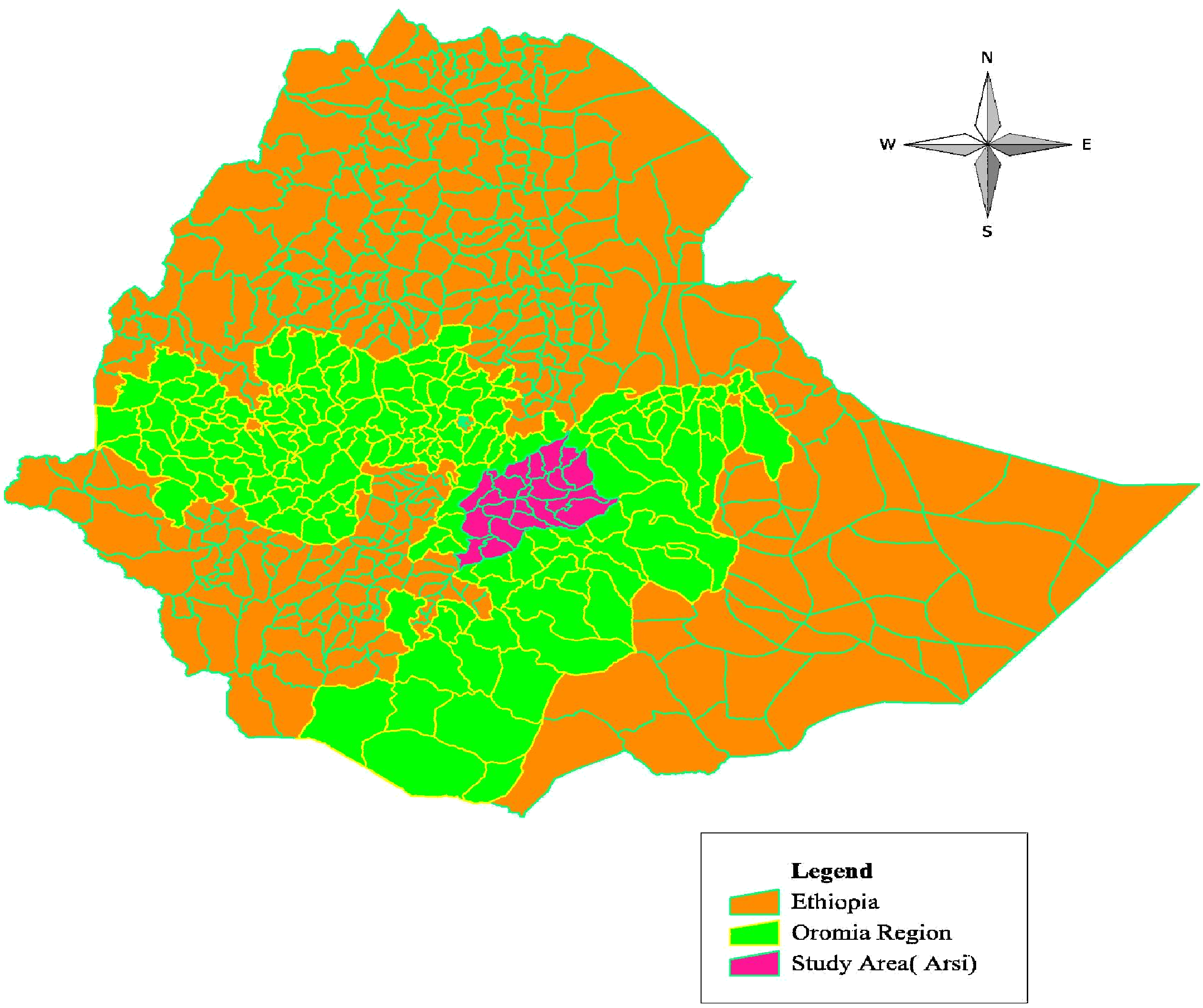

Figure 1: Map showing where research was conducted

Sample Size Determination

The sample size for the study was calculated using the formula given by Thrusfield [16]. Accordingly, 384 animals were considered for this study.

Study Methodology

Cross-sectional study, through simple random sampling method was conducted at Asella Municipal abattoir to determine the prevalence of small ruminant's hydatidosis and its economic importance. The following methods were followed to undertake the study:

Ante and Post mortem Inspections

During ante-mortem examination, age, sex, origin and Body Condition Score (BCS) of the animals identified for post-mortem examination was recorded. The age was determined by dentition formula according to the method described by SanchezAnrade *et al.* [17] and animals categorized into two age groups (≤1years=young and >1years=adult). BCS of animals were classified into three as lean (score 1-2), medium (score 3) and fat (score 4-5) according to Thompson and Meyer [18]. In the abattoir, organs inspection was carried out on different organs of each of the slaughter animals particularly lung, liver, heart, spleen, and kidney. Each organ was examined macroscopically by visual inspection and palpation.

Cyst characterization

After the post-mortem results, cysts were collected from the infected organs, and cyst harbored by a particular organ was counted. Individual cysts were grossly examine for evidence of degeneration or calcification and was transported to Asella Regional Veterinary Laboratory in ice box for fertility and viability tests. The content of the fluid was aspirated using 18G needle and 20ml syringe into sterile cylinder container to reduce pressure and risk of spill over the eye. After being punctured, the pressure was reduced and the cysts were incised using scalpel blade and the whole content was transferred into beaker. Then about 10 ml was poured to the test tube and centrifuge at 500rpm for 5 minutes to separate the contents clearly from the liquid part. The supernatant is discarded and the sediment with some fluid was left in the test tube. The contents were examined under a microscope of x40 magnification for the presence of protoscolices in the cyst. Cysts with no protoscolices were classified as unfertile cysts [19].

The viability of the protoscolices was assessed by staining with 0.1% aqueous eosin solution and examine under light microscope. Live protoscolices were not able to take the dye up whereas the dead ones dyed [20]. Sterile cysts are characterized by their smooth inner lining usually with slight turbid fluid in its content. Calcified cysts were having a gritty sound feeling up on incision [21].

Determination of economic losses due to hydatid cyst

An attempt was made to estimate losses from hydatidosis in small ruminants taking into account the direct loss from cost of offal condemnations and from carcass weight loss. To calculate the economic loss, the following parameters were taken into consideration: The mean market price of lung, liver, heart, kidney and spleen and cost of one kilogram sheep and goats meat were estimated based on information gathered from hotels and restaurants in the area. Average annual slaughter rate of small ruminants at Asella was estimated based on observation during study period together with the judgment of meat inspector of the area. Average carcass weight sheep was 15 kg estimated by Bersissa [20] and a 5% estimated carcass weight loss due to hydatidosis would be taken into account [22].

Direct loss

All organs namely lung, liver, heart, spleen and kidney which were positive for hydatidosis were totally condemned. The economic loss due to condemnations of organ was assessed using the following formula developed by Abebe [23]: Direct loss (DL) = (NAS x PH x PHlu x CPlu) + (NAS x PH xPHli x CPli) + (NAS x PH x PHs x CPs) + (NAS x PH x PHk x CPk) + (NAS x PH x PHh x CPh). Where NAS- average number of animals slaughter annually, PH- prevalence of hydatidosis, PHlu- percentage of lung condemnation due to hydatidosis, CP- current average price of lung, PHli- percentage of liver condemnation due to hydatidosis, CPli- current average price of liver, percentages of spleen condemnation due to hydatidosis, CPs-current average price of spleen, PHk-percentage of kidney condemnation due to hydatidosis, CPk-current average price of kidney, PHh- percentage of heart condemnation due to hydatidosis and CPh-current average price of heart [20].

Indirect loss

A 5% carcass weight loss due to hydatidosis in animals has been described by Torgerson *et al*. [22]. So the annual economic loss due to carcass weight reduction because of hydatidosis was calculated as: IL=5% x PH x NAS x CPB x 15kg. Where IL- indirect loss, 5%- estimate carcass weight loss due to hydatidosis, NAS- average number of animal slaughter annually, PH- prevalence of hydatidosis, CPB- current average price of 1kg of sheep and goat, 15kg- average carcass weight of sheep and goats.

Total economic loss
Total economic loss due to hydatidosis was the sum of direct and indirect loss.
Total economic loss (TL) = direct loss (DL) + indirect loss (IL).

Data Analysis
The data collected from ante-mortem, post-mortem and laboratory findings were entered in to MS Excel spread sheet and analyze by using SPSS statistical software package version 16. Chi-Square ($\chi 2$) was used to measure the association among different risk factors contributing to the prevalence of hydatidosis and any result with p-value < 0.05 was considered as statistically significant difference and influence of organ nature on cyst distribution was also analyzed with same statistical method.

RESULTS
Over all Prevalence
From the total of 384 small ruminants examined 36 (9.4%) of them were found harboring hydatid cyst (s) in one or more of their offal's. Prevalence was determined based on species, age, sex, origin and BCS of the study animals. Prevalence of hydatidosis between two species show statistically significant ($P<0.05$, $X^2=6.084$). It was higher in ovine (10.8%) than caprine (0%). Rate of infection in different age groups (young and adult) was assessed and age prevalence has shown statistically significant ($P<0.05$, $X^2=7.356$) with adult group having higher infections. The prevalence was also assed in terms of sex and it was found that female have higher infection (**12.9%**) than male (**2.9%**). It was statistically significant variation ($P<0.05$, $X^2=10.446$). There was no significant difference revealed between body condition scores with regard to cyst detection ($P>0.05$, $X^2=3.802$). Rate of infection based on origin was assessed and has shown statistically significant ($P<0.05$, $X^2=6.477$) as summarized in table 1.

Table 1: Overall prevalence of small ruminant's hydatidosis

Variable	No. examined	No. positive	prevalence(%)	95%CI	X^2	P-Value
Species						
Ovine	333	36	10.8	7.9-14.6	6.084	.014
Caprine	51	0	0	0-7		
Age						
Young	60	0	0	0-6.02		
Adult	324	36	11.1	8.13-15	7.356	.003
Sex						
Female	247	32	12.9	9.33-17.72	10.446	.001
Male	137	4	2.9	1.14-7.27		
BCS						
Lean	68	10	14.7	8.9-25		
Medium	213	20	9.4	6.16-14.06	3.802	.149
Fat	103	6	5.8	2.7-12.14		
Origin						
Digalu tijo	286	24	8.4	5.7-12.18		
Hetosa	28	2	7.1	1.98-22.64	6.477	.021
Tiyo	70	10	14.3	7.95-24.34		
Total	**384**	**36**	**9.4**	**6.85-12.7**		

4.2. Organ Involvement and Distribution of Cysts
From the total of 384 small ruminants examined during post-mortem inspection, 60 different visceral organs were found to be affected by hydatid cysts and from these organs, 158 cysts were obtained. In line with their distribution among the infected visceral organs, 84(53.2%) and 74(46.8%) cysts were obtained from liver and lung respectively. The distribution of hydatid cysts by organs affected is presented in table 2.

Table 2: Distribution of hydatid cyst by organs affected (N = 158)

Organ	No obtained	% obtained
Liver	84	53.2
Lung	74	46.8
Total	**158**	**100.0**

Out of the total infected animals 7(19.4%) and 5(13.9%) of them had hydatid cysts on their lung and liver alone, respectively while 24(66.7%) animals had hydatid cysts on both liver and lung.

Table 3: Hydatid cysts distribution with single and multiple organs infected (N = 36)

Organ	No .of animal affected	% affected
Liver only	5	13.9
Lung only	7	19.4
Lung + liver	24	66.7
Total	**36**	**100.0**

From the total of 158 cysts characterized for their fertility status, 69(43.7%), 45(28.5%) and 44(27.8%) were found fertile, sterile and calcified respectively. Summary of the fertility status of the cysts obtained from the different offal is shown in table 4.

Table 4: Type and distribution of the hydatid cysts obtained

Cyst type	**Organ distribution**		**Total**
	Liver (%)	**Lung (%)**	
Sterile	19(22.6)	26(35.1)	45(28.5)
Fertile	28(33.3)	41(55.4)	69(43.7)
Calcified	37(44.1)	7(9.5)	44(27.8)
Total	**84(100)**	**74(100)**	**158(100)**

A total of 69 fertile cysts originating from lung and liver were detected and tested for viability, accordingly**,** 37(53.6%) viable and 32(46.4%) nonviable were identified. Therefore, the viability rate of cysts was 23.4 (37/158).

Table 5: Association between number of viable cysts and organ involvement

Organ	**Number and viability status of fertile cysts**		**Total**
	Viable (%)	**Non-viable (%)**	
Lung	24(58.5)	17(41.5)	41(100)
Liver	13(46.4)	15(56.7)	28(100)
Total	**37(53.6)**	**32(46.4)**	**69(100)**

Economic Loss Estimation

The average mean annual small ruminants slaughter rate was estimated to be 4914 and the average market price of lung and liver was 20 and 25 birr respectively. In addition, the price of 1kg of sheep and goat meat was 140 birr in Asella. So direct and indirect losses were calculated as follows:

Direct economic loss

Both infected lung and liver were totally condemned. So the direct loss due to organ condemnations is calculated as follow:

DL= (NAS x PH x PHlun x CPlu) + (NAS x PH x PHli x CPli).

DL= (4914 x 9.4% x 51.7% x 20) + (4914 x 9.4% x 48.3% x 25)

DL= 4711.5 + 5542.9

DL= 10,253.99 ETB

Table 6: Number of organs condemned, percentage involvement and their current average price of organs

Organ condemned	**Number of organ examined**	**Number of organ condemned**	**Percentage involvement**	**Average price of organ (ETB)**
Lung	384	31	51.7%	20
Liver	384	29	48.3%	25

Indirect loss

The average price of sheep and goat was thus the annual economic loss from carcass weight reduction due to hydatidosis is calculated as

IL= 5% x NAS x PH x CBP x 15kg

IL= 5% x 4914 x 9.4% x 140 x 15

IL= 48,501.2 ETB

Total economic loss

Total economic loss due to hydatidosis was the sum of direct and indirect loss.

TL= direct loss + indirect loss

TL= 10,253.9ETB + 48,501.2ETB

TL=58,755.1ETB

Therefore, the annual loss due to hydatidosis was estimate as 58,755.1ETB. The result implies that loss due to carcass weight reduction was greater than loss due to organ condemnation.

DISCUSSION

In the present study the overall prevalence of small ruminant hydatidosis in Asella municipal abattoir was found to be 9.4% which is comparable with the findings 11.6% in Mekele [24]; 8.6% in Addis Ababa abattoir [25]; 7.7% in Luna export abattoir, central Ethiopia [26]; 10.6% in Morroco [7] and 7.2% from Turkey sheep in New Taif abattoir Saudi Arebia [27]. However; it was lower than studies undertaken 26.7 %, in Ambo municipal abattoir western part of Oromia Regional State of Ethiopia [28] and 19.9% in Addis Ababa abattoir [12]. The occurrence of such a low prevalence in the current site might have been happened due to reduced backyard slaughter practice and decrease in the population of stray dogs. Much higher prevalence (83%) was reported **by** Ripoche *et al*. [29] in Sardinia. The discrepancy and similarity in the prevalence between the various areas might be attributed principally to strains difference and relationship in *E. granulosus* that exist in different geographical situations [10]. Moreover, additional reasons could be the difference in the level of awareness of the community with regard to methods of its transmission as people used to slaughter small ruminants at home and throw the offal's to the dogs around their villages. Furthermore, difference in culture, social activity and attitude to dog in different regions might have contributed to such inconsistency [30]. Similar to the present finding, it was reported that cystic echinococcosis infection was higher for older animals [7, 31]. Animals with more than one years of age were found to be highly infected that statically significant (P value = 0.003). This could be mainly due to the fact that aged animals have longer exposure time to *Echinococcus granulosus* eggs. In addition, older animals might have weaker immunity to combat against infection [32]. With regarding to sex it was significant (P value=0.001). It was higher in female. A similar finding has been reported by Blancas *et al*. [33]. The reason might be associated with keeping of female longer than males for reproductive purposes. Infection rate in sheep was 10.8% while it was 0% in goats. Accordingly sheep were seen to suffer high risk of infection compared to goats. Perhaps this could be attributed to the browsing nature of goats that made them feed on relatively parasite free bushes, twigs and leaves of tree and their selective grazing nature [34].

During the study, the body condition score of the studied animals were also included in the risk factors which show statistically non-significant (P-value >0.05). The prevalence of hydatidosis by origin of slaughtered cattle was assessed and statistically significant difference (P value = **0.021**) was indicating the geographical regions play an important role in distribution of the cysts. This could be due to the difference in the socio-economic status and animal husbandry practices of community in all areas from where animals were brought for slaughter.

The prevalence of hydatidosis among different organs involved in harboring of the cyst was (51.7%) and (48.3%) in lung and liver respectively. Number of cysts collected from liver is greater proportion (53.2%) than lung (46.8%). This finding was similar to the findings by Yitbarek *et al.* [24], [35], [7], [29] and [6] who reported larger number of cysts from liver compared to other organs. The liver infection may be a reflection of the route of parasite entry and seems to support the hypothesis of hepatic portal distribution of the onchospheres leading to the liver infection [8].

The majority of infected sheep (66.7%) had hydatid cysts in both liver and lungs, as reported also by Yildiz and Gurcan [36]. This could be due to the fact that lungs and livers posses the first great capillaries of sites encountered by migrating Echinocooccus onchosphere (hexacanth embryo) which adopt the portal vein route. The first large capillaries encountered by migrating blood borne onchospheres and primarily negotiate pulmonary and hepatic filtering system sequentially before any other organ is involved. However, development of hydatid cysts occur occasionally in other organs like spleen, kidney and heart and other organs and tissues when onchosphers escaped into general systemic circulation [8].

Liver harbored highest number (44.1%) of calcified and this could attribute to relatively high reticulo-endothelial cells and abundant connective tissue reaction of the liver [37]. The overall percentage of fertile cysts in this study was **69%** which is substantially higher compared to what has been observed (17%,) in palestine [6]; (38.1%) in Jordan [38]; (46.8%) in Yemen [39] and (52.5%) in Ethiopia [26]. The variation in fertility rates among different species and in different geographical zone could be due to difference in strain of *Echinococcus granulosus* [40]. Strain of the parasite and the host can modify the infective pattern of the parasite [37].

In comparison of the fertility of the cyst from different organs, it was higher for lung (41%) than liver (28%). This may be due to the softer consistency of the lung tissue that allows the easier development of the cyst hence providing good environment for the fertility of hydatid cysts [32]. The variation between tissue resistances of the affected organs may also influence the fertility rate of cysts, in the liver hosts reaction may limit fertility rate of hydatid cysts. The variation in fertility, sterility and calcification in different areas were also described as strain difference [41].

The overall prevalence of viable protoscolices was 53.6% and greater number of viable protoscolices (58.5%) was found in lung and followed by liver (46.4%). This indicates small ruminants are an important intermediate host for the perpetuation of the life cycle of the parasite.

In the current study, it was emphasized to carry out an assessment on annual economic loss due to small ruminants hydatidosis at Asella municipal abattoir. Losses from offal condemnation and carcass weight loss (meat production loss) in infected small ruminants were assessed and estimated to be 58,755.1 ETB ($2,797.9). The current estimate was comparable with 52,828 ETB that estimated by Getaw *et al*. [5] in Adama. However, it is lower than 77,587.02 ETB that estimated by Bersissa [20] in Nekemte and 90,646.95 ETB by Roman [42] in Gondar. The direct monetary loss associated with livestock hydatidosis in Kenya of two districts namely, Kisumu East/West and Isiolo district during five years was reported to be US$ 24,878 and US$ 20,272. The average per year was reported to be US$ 4,976 and US$ 4,054, respectively [43]. The difference in economic loss estimates in various abattoir/regions may be due to the variations in the prevalence of disease; mean annual number of sheep slaughtered in different abattoirs and/or the amount of US$ refers to over all livestock slaughtered in case of Kenya, and variation in the retail market price of organs in different localities and countries.

CONCLUSION AND RECOMMENDATIONS

However, the overall prevalence in the study is low it is an important disease of economic causing organ condemnation and weight loss in area. The high fertility and viability rates of hydatid cysts obtained from the study area together with the existing socio-economic situations of the community makes hydatidosis an important parasitic disease in the area. These warrant preservation and control of the parasite.
Based on these facts, the following recommendations are forwarded:

- Public education on means of transmission, prevention and control strategies of *E. granulosus* is crucial.
- Disposal of affected offal freely for dogs and wild canids (the usual practice in the community) should be stopped and all the condemned organs should be either buried or incinerated.
- Backyard and road side slaughtering practices should be prevented by putting the law and regulation of meat inspection into action.
- Regular testing and treatment of dogs should be practiced throughout the country and avoid stray dogs are important.

ACKNOWLEDGMENTS

The authors like to thank to Jimma University for financial and logistic support and for Asella Regional Veterinary Laboratory for their cooperation to the researcher to perform his laboratory activities in their laboratory.

REFERENCES

1. Central Statistical Agency (2009): Agricultural sample survey 2008–09(2001 E.C.), Report on livestock and livestock characteristics (private peasant holdings), Statistical Bulletin 446, Addis Ababa, Ethiopia, Pp. 188.
2. Francias, E. (2004): Manual of diagnostic tests and vaccines for terrestrial animals. Echinococcosis/hydatidosis, Pp. 62-73.
3. Cringoli, G., Rinaldi, L., Musella, V., Veneziano, V., Maurelli, M.P., pietro, F., Frisiello, M. and Pietro, S. (2007): Geo-referencing livestock farms as tool for studying cystic Echinococcosis epidemiology in cattle and water buffaloes from southern Italy, Geospatial, 2:105-111.
4. Ernest, E., Nonga, H.E., Kassuku, A.A. and Kazwala, R. R. (2008): Hydatidosis of Slaughtered Animals in Ngorongoro district of Arusha region, Tanzania, *Trop. Anim. Health Prod.* DOI 10.1007/s11250-008-9298-z
5. Getaw, A., Beyene, D., Ayana, D., Megersa, B. and Abunna, F. (2010): Prevalence of Hydatidosis and its economic importance in ruminants slaughtered at Adama municipal Abattoir, Central Oromia, Ethiopia, *Acta Tropica.,*113: 221– 225.
6. El-Ibrahim, J.H. (2009): Prevalence of Sheep Hydatidosis in North West Bank- Palestine. MSc Thesis, An-Najah National University, Nablus, Palestine.
7. Azlaf, R. and Dakkak, A. (2006): Epidemiological study of the cystic echinococcosis in Morocco, *Vet. Parasitol*, 137: 83-93.
8. Urquhart, A.M, (1996): Veterinary parasitology, 2nd edn, Blackwell Science puplishing, Pp. 27-130.
9. Kebede, W., Hagos, A., Girma, Z. and Lobago, F. (2009b): Echinococcosis/hydatidosis: its prevalence, economic and public health significance in Tigray region, North Ethiopia, *Trop. Anim. Hlth. and Prod*., 41:865-871.
10. Arene, F.A.I. (1995): Prevalence of hydatidosis in domestic livestock in the Niger Delta,*Trop. Anim. Health Prod,* 17:3-5.
11. Jobre, Y., Lobago, F., Tiruneh, R., Abebe, G. and Dorchies, P. (1996): Hydatidosis in three selected regions in Ethiopia, an assessment trial on its prevalence, economic and public health importance, *Revue Méd. Vét.,* 147:797-804.
12. Kebebe, E., Girma, Z. and Bersissa, K. (2010a): Hydatidosis of sheep and goats slaughtered at Addis Ababa

Abattoir: prevalence and risk factors. *Tropical Animal Health and Production*, 42: 803-805.
13. Eckert, J. and Deplazes, P. (2004): Biological, Epidemiological, and Clinical Aspects of Echinococcosis, a Zoonosis of Increasing Concern. *Clin. Microbio, Rev.*17:107-135.
14. CPA (1994): Central planning Authority
15. CSA (2013): Central Statistical Agency of Ethiopia, available at: http://www.citypopulation.de/Ethiopia.html, retrieved September, 28/2015.
16. Thrusfield, M. (2005): Survey, in Veterinary Epidemiology, 2nd edn. Blackwell science ltd, Oxford, Pp. 178–198.
17. Sanchez-Andrade, R., Paz-Silva, A., Sua´ rez, J.L., Panadero, R., Pedreira, J., Lo´ pez. C, Dı´ez-Banos, P. and Morrondo, P. (2002): Influence of age and breed on natural ovine fasciolosis in an endemic area (Galicia, NW Spain). *Vet. Res. Commun.* 26:361-370.
18. Thompson, J. and Meyer, H. (1994): Body condition scoring of sheep and goats
19. Daryani, A., Alaei, R., Arab, R., Sharif, M., Dehghan, M.H. and Ziae, H. (2007): the prevalence intensity and viability of hydatid cysts in slaughtered animals in the Arable province of North West Iran, *Journal of helminthology*, 8:13-17.
20. Bersissa, K. (1994): Hydatidosis in Nekemte: prevalence in slaughtered cattle and Sheep, estimated economic loss and incidence in stray dogs, DVM Thesis, AAU, FVM, DZ, Ethiopia, Pp.15.
21. Taylor, M., A, Coop, R., L. and Wall, R. (2007): Veterinary Parasitology: Wiley- Blackwell, Pp. 847.
22. Torgerson, P. R., Dowling, P. M. and Abo-Shehada, M. N. (2001): Estimating the economic effects of cystic echinococcosis. Part 3: Jordan, a developing country with lower-middle income. *Ann. Trop. Med. Hyg*. 95: 595–603.
23. Abebe, M. (2007): Prevalence, Economic importance and Public Health Significance of hydatidosis/Echinococcusis at Bahir-Dar, Aklilu Lema Pathology Institute, Addis Ababa University. Pp. 20.
24. Yitbarek, D., Mulugeta, T. and Mihreteab, B. (2011): Prevalence of Hydatidosis of Sheep Slaughtered at Abergelle Export Abattoir, Mekelle, Northern Ethiopia
25. Getachew, H., Guadu, T., Fentahun, T. and Chanie, M. (2012b): Small ruminant Hydatidosis: Occurrence and Economic Importance in Addis Ababa Abattoir. Global Veterinaria, 8: 160-167.
26. Getachew, D., Almaw, G. and Terefe, G. (2012a): Occurrence and fertility rates of hydatid cysts in sheep and goats slaughtered at Modjo Luna. Export Slaughter House, Ethiopia. Ethiop. *Vet. J.*, 16: 83-91
27. Ismail, M., Shalaby, Abdulah, A., Banaja and Manal, B. (2011): A comparative study on the prevalence of some parasites in animals slaughtered at New Taif Abattior.
28. Zewdu, E., Teshome, Y. and Makwoya, A. (2012): Bovine Hydatidosis in Ambo Municipality Abattoir, West Shoa, Ethiopia. Ethiop. *Vet. J.* 14: 1-14.
29. Ripoche, M., Varcasia, A. and Scala, A. (2009): Prevalence of hydatidosis in sheep in Sardinia. Épidémiologie et Santé Animale, 56: 227-232.
30. Arbabi, M. and Hooshyr, H. (2006): Survey of Echinococcosis and hydatidosis in kashan region, central Iran, *Iranian public health J.,* 35:75-81.
31. Alembante, M. (2009): Study on Prevalence and Economic Significant of Hydatidosis in Cattle Slaughtered at Hawassa Abattoir, DVM Thesis, JUCAVM, Jimma, Ethiopia. Pp. 24.
32. Himonas, C. (1987): The Fertility of Hydatid cyst in Food Animals in Greece, Helmenth, Zoonosis, Martin, Nijohoft, Publisher, Neitherland, Pp.12-18.
33. Blancas MM, Herrera ER, Rodrguez PC, Tavizn JP, Mercado RM, Badillo AV, Echavarra F, Lpez SA, Mondragn C (2007) Gender as a factor of susceptibility to infection in experimental hydatidosis. *Rev Latinoam Microbiol.,* 49(1–2):31–37.
34. Dalimi, A., Motamedi, H., Hosseini, M., Mohammadian, B., Malaki, H.Ghamari, Z. and Ghaffarifar, F. (2002): Echinococcosis/hydatidosis in western Iran, *Vet. Parasitol*, 105:161-171.
35. Zelalem, F. (2008): prevalence and economic impact of hydatidosis in Addis Ababa abattoir, DVM Thesis, School of veterinary Medicine, JUCAVM, Jimma, Ethiopia, Pp. 38.
36. Yildiz, K. and Gurcan, S. (2003): Prevalence of hydatidosis and fertility of hydatid cysts in sheep in Kirikkale (Turkey). *Acta Veterinaria Hungarica,* 51: 181–187.
37. Gemmel, M. A., Roberts, M.G., Beard, T. C., Campanods, S., Lawson, J. R. and Nonnomaker, J. M. (2002): control of Echinococcosis, WHO/ OIE manual in Echinococcosis in humans and animals, Pp. 53-95.
38. Kamhawi, S., Hijjawi, N., Abu-Gazaleh, A. and Abbass, M. (2006): Prevalence of hydatid cysts in livestock from five regions of Jordan. *Parasitol Int.,* 55:197-202.
39. Baswaid, S. H. (2007): Prevalence of hydatid cyst in slaughtered sheep and goats in Hadramout (Yemen). *Ass. Univ. Bull. Environ*. Res. 10: No. 2.
40. McManus, D. P. (2006): Molecular discrimination of hydatid cestodes, *parasitol Int*, 55: 531-532.
41. Acosta-Jamett, G., Cleaveland, S., Cunningham, A.A., Bronsvoort, B.M.C. and Craig, P.S. (2010): *Echinococcus granulosus* infection in humans and livestock in the Co- quimbo region, north-central Chile.

Vet. Parasitol., 169: 102-110.
42. Roman, T. (1987): Study on economic significance of bovine fasciolosis and hydatidosis at Gondar abattoirs. DVM Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia, Pp.36.
43. Joseph, O., Japhet, M., Eberhard, Z., Helen, K., Lucy, N., Francis, N., Peter, K. (2015): Thomas Romig prevalence of cystic echinococcosis and its economic significance in slaughtered livestock in Kisumu east/west and Isiolo districts of Kenya international journal of information research and review 2 (5):719-725.