Acta Parasitologica Globalis 14 (1): 09-15, 2023
ISSN 2079-2018

DOI: 10.5829/idosi.apg.2023.09.15

Prevalence of Bovine Hydatidosis and Associated Risk Factors at Ambo Municipal Abattoir, West Shoa Zone, Ethiopia

[1]Shellema Hirpa, [1]Zelalem Abera and [2]Obsa Chanyalew

[1]School of Veterinary Medicine, College of Medical and Health Sciences, Wollega University, Ethiopia
[2]Guto Gida District Livestock and Fisheries Development and Resource office,
East Wollega Zone, Oromiya Regional State, Ethiopia

Abstract: A cross-sectional study aimed at determining the prevalence and risk factors due to cystic echinococcosis (hydatidosis) in cattle slaughtered at Ambo Municipal Abattoir was conducted from November 2018 to April 2019. Out of 321 cattle examined, 109 (34%) were found to harbor visible hydatid cysts. Significantly higher infection was detected in cattle's with poor body conditions ($P<0.05$) than animals with medium and good body condition score. No significant variation was observed with regard to sex and age of animals. Regarding organ distribution, infections of the lung, liver, kidney, spleen, heart and multiple organ were (12.1%), (7.5%), (2.5%, (2.2%), (4%), and 5.7%, respectively. Of the total 109 hydatid cysts counted, 63 (19.6%), 23 (7.2%), and 23(7.2) were found to be small-sized, medium-sized, and large-sized, respectively. Despite the high magnitude of infection detected currently, there seems to be an existing socioeconomic situation favorable for bovine hydatidosis, and hence, it remains one of the most important diseases warranting serious attention for prevention and control actions in Ambo district. Hence, establishment of well-equipped standardized abattoirs, creation of public awareness, and control of stray dogs are of paramount importance.

Key words: Abattoir · Ambo · Bovine · Hydatidosis · Prevalence

INTRODUCTION

Ethiopia has the largest livestock population in Africa, with an estimated 49.5 million of cattle, 47.1 million sheep and goats, 7.58 million equines and 2.3 million camels [1]. However, the contribution from these huge livestock resources to the national income is disproportionately small, owing to several factors. Among them, parasitic diseases are considered as a major obstacle in the health and product performance of livestock. 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 animals [2, 3]. The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries. Hydatidosis causes 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 while 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 (CE) caused by *E. granulosus* is a re-emerging disease in places where it was previously at low levels [8, 9].

Echinococcus 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

Corresponding Author: Zelalem Abera, Department of Clinical Studies, School of Veterinary Medicine, Wollega University, P.O. Box 395, Nekemte, Ethiopia.

prevalent in livestock population of the country [11, 12]. According to [13] a prevalence of 72.4%, 37.72%, 33.78% and 13.7% in cattle slaughtered at Asella, Adama, Gonder, and Dire Dawa was documented, respectively indicating its importance in the livestock industry. 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 [14]. By affecting many animal species, intermediate animal hosts and 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. Despite the above studies, in Ethiopia, the disease has not been investigated sufficiently, and information related to its prevalence and effects of risk factors are still limited especially in Ambo. It is assumed that the problem (Hydatidosis) is a challenge in the study area like the other parts of the country and with this hypothesis the main objectives of this study were to determine prevalence of Hydatidosis and to investigate the effects of risk factors on prevalence of the disease at Ambo Municipal Abattoir.

MATERIALS AND METHODS

Study Areas: This study was undertaken from November 2018 to April 2019 in Ambo town, Western Shoa zone of Oromia regional state, located at 114 km west of Addis Ababa and has altitude of 2,185 meter above sea level (masl). The geographical location of Ambo town is approximately between 8°5630-N and 8°59-30-N latitude and between 37°4730E and 37°55-15-E longitude. The mean annual temperature, the annual maximum and the annual minimum temperatures of the area were about 18.8, 26 and 10.76°C, respectively. The mean annual rainfall is about 1,143 mm and the highest rainfall occurs from June to September. Agriculture is the main occupation of the population of the area. The agricultural activities are mainly mixed type with cattle rearing and crop production under taken side by side (Figure 1).

Study Population: The study population includes all Cattle from the farms of selected peasant association of Ambo district and also cattle purchased from different cattle markets (Guder) of the study area and brought to the ambo municipal abattoir for slaughtering purpose.

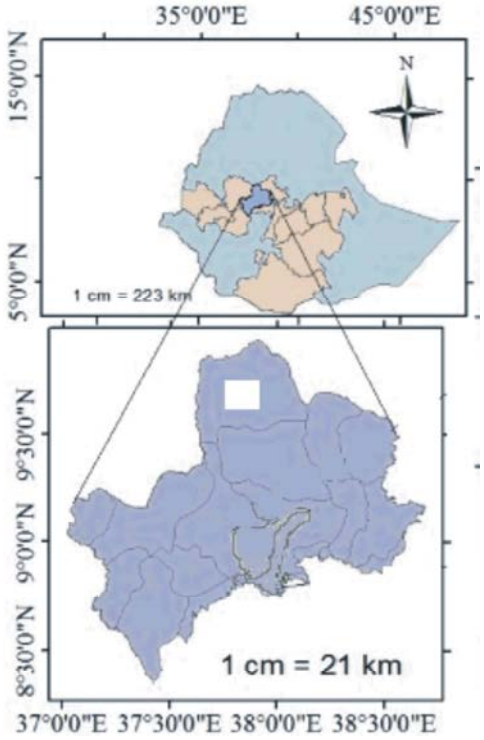

Fig. 1: Map of study area

Study Design: A cross sectional observational study design was carried out to assess the prevalence of hydatid cyst and to investigate the effects of risk factors on prevalence of the disease at Ambo municipal abattoir in slaughtered cattle and the sampling procedure used was a simple random sampling.

Sample Size Determination: The study animals were selected from the slaughter line using simple random sampling technique. The required sample size was determined based on prevalence of 29.69% [15] using the formula given by [16]. The study considered 95% confidence interval and 5% precision level.

$$n = \frac{(1.96)^2 * Pexp\ (1\text{-}pexp)}{d^2}$$

where: n= required sample size; Pexp = expected prevalence (29.69%) d= desired absolute precision. Accordingly a total of 321 animals were calculated.

Study Methodology

Ante Mortem Examination: During ante mortem inspection, each of the study animals was given an identification number (with a paint mark on their body). Age, sex, and body condition scoring of the study animals were also recorded. Estimation of age was carried

out by examination of the teeth eruption using the approach forwarded by [17]. Two age groups were considered; less or equal to 5 years and above 5 years old. Since almost all the cattle presented to slaughtering in the study area were male, infection rate regarding sex variation was not included. The body condition scoring was classified into three categories as poor, medium, and good according to [18].

Post Mortem Examination: To study the prevalence of bovine hydatidosis post-mortem examination through inspection, palpation and incision of internal organs such as lung, liver, heart, spleen and kidney was made and the organ distribution and rate of infection of hydatidosis were recorded. The total numbers of mature cysts obtained per organ were counted in different organs. The size (diameter in centimeters) of each and individual cysts randomly selected was measured, and the number of cysts per organ was counted and recorded. According to their size, hydatid cysts were then classified as small cyst (<4cm), medium cyst (4-8 cm) and large cyst (>8cm) [19].

Data Analysis: The data obtained was coded in Microsoft excel and subjected to descriptive statistics and odds ratio in order to assess the magnitude of the difference of comparable variables using SPSS version 20.0 software. Statistically significant association between variables is considered to exist if the p-value is less than 0.05.

RESULTS

Overall Prevalence: During the study period, from November, 2018 to April, 2019, a total of 321 heads of cattle slaughtered at Ambo municipal abattoir were examined for the presence of hydatid cyst. Out of the total 321 heads of cattle slaughtered and examined, 109 (34%) were infected with hydatid cyst, harboring one or more cysts involving different visceral organs (lung, liver, heart, spleen, and kidney).

Prevalence of Hydatidosis Based on Age and Body Condition Score: Prevalence of hydatidosis was determined based on age and Body condition score of the study animals. Of these risk factors age was statistically non significant and p value>0.05. Prevalence was also assessed in terms of body condition score. It was found that cattle having poor body condition had the highest prevalence (65.5%) followed by medium (39 %) and good (5.3%) (Figure 2 and Table 1).

Out of 109 cattle infected, 39 (12.1 %) have hydatid cyst in their lungs, 24 (7.5%) in livers, 8 (2.5%) in kidney and7 (2.2%) in spleen and the other was mixed infections (Table 2).

Higher numbers of large and medium sized cysts were found in lungs, while higher numbers of small and calcified cysts were found in liver (Table 3).

DISCUSSION

Hydatidosis is known to be important in livestock and public health in different parts of the world and its prevalence and economic significance has been reported by different workers in different geographical areas. The prevalence may however vary from country to country or even within a country. The current study revealed a prevalence of 34% was in agreement with previous work of [20] who reported a prevalence of 27.2% in the Gondar town and [15] who reported a prevalence of 29.69% in Ambo area and higher than observations made by [9] in Tigray region (22.1%) and by [7] in Morocco (22.9%) and very lower prevalence were also reported by [9] in Shire (7.5%) and by [21] in Debre Birhan (7.2%).

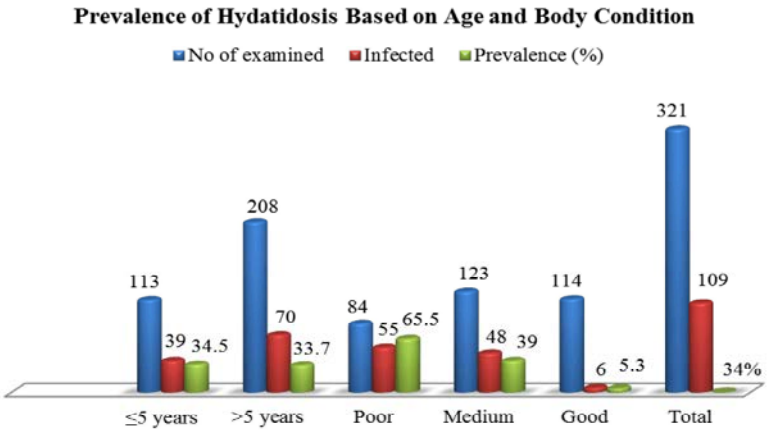

Fig. 2: Prevalence of hydatidosis based on age and body condition score

Table 1: Prevalence of hydatidosis based on age and body condition

Factors	№ of examined	Infected	Prevalence (%)	P-value	OR	95% CI	
						Lower	Upper
Age							
≤5 years	113	39	34.5	0.88	0.96	0.59	1.56
>5 years	208	70	33.7	-	-	-	-
Body Condition							
Poor	84	55	65.5	0.00	0.03	0.01	0.08
Medium	123	48	39	0.00	0.09	0.04	0.21
Good	114	6	5.3	-	-	-	-
Total	321	109	34%				

Table 2. Hydatid cysts distribution with single and multiple organs infected

Organs infected	Number of animal		
	Examined	№ of cases	%
Heart only	321	13	4
Lung only	321	39	12.1
Liver only	321	24	7.5
Spleen only	321	7	2.2
Kidney only	321	8	2.5
Lung and heart	321	1	0.3
Heart and liver	321	1	0.3
Heart and spleen	321	2	0.6
Heart and kidney	321	2	0.6
Lung and liver	321	9	2.8
Lung and spleen	321	2	0.6
Lung and kidney	321	1	0.3
Total	321	109	34

Table 3: Distribution of cysts based on size

Organs Examined	Large cyst (%)	Medium cyst (%)	Small cyst (%)	Total (%)
Heart	2 (15.4)	1(7.7)	10 (79.9)	13(4)
Lung	21(53.8)	17(43.6)	1 (2.6)	39
Liver	-	3(12.5)	21(87.5)	24
Spleen	-	-	7(100)	7
Kidney	-	-	8(100)	8
Lung and heart	-	-	1(100)	1
Heart and liver	-	-	1(100)	1
Heart and spleen	-	-	2(100)	2
Heart and kidney	-	-	2(100)	2
Lung and liver	-	1(11.1)	8(88.9)	9
Lung and spleen	-	1(50)	1(50)	2
Lung and kidney	-	-	1(100)	1
Total	23 (7.2)	23(7.2)	63(19.6)	109

Higher prevalence was registered in other areas of which 72.44% in Asella [22], 59.9% in Bahir Dar [23], 62.96% around Bale Robe [24], 52.69% around Hawassa [25]. However, the extent to which results were documented from different locations tends to show variable scales. The variation in prevalence from different areas of a country might be attributed mainly to the difference in strains of *E. granulosus* that exist in different geographical situations [26] and other factors like difference in culture, social activity, and attitude to dog in different regions [27].

In this study, an assessment was made to establish relationship between body condition scores and hydatid cyst count. Animals with poor body condition were found to have higher hydatid cyst count and the poor condition among animals is probably a reflection of the effect of relatively high cyst burden [28] explained that in moderate to severe infection, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss. It was difficult to precisely indicate the geographical origin of all animals slaughtered at the abattoir and relate the findings on

hydatidosis to a particular locality. Nevertheless, the attempts made in this regards have disclosed that the majority of them were drawn from market oriented areas (Guder market). Since, almost all the cattle presented for slaughtering in the study area were males; infection rate regarding sex variation was not included.

In this study, it has been shown that hydatid cysts occurred most commonly in the lung (12.1%) followed by the liver (7.5%), heart (4%), spleen (2.2%), kidney (2.5%), and other with multiple organ (5.7%). This is in agreement with the findings of [14] and [29] which show that the lung and liver are the most common sites of hydatid cyst in domestic animals. It is due to the fact that the lung and liver posses first great capillaries encountered by the migrating echinococcus oncosphere (hexacanth embryo), which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved.

Likewise, due to older age of slaughtered cattle, during which time the liver capillaries are dilated and most oncosphere pass directly; additionally, it is possible for the hexacanth embryo to enter the lymphatic circulation and be carried through the thoracic duct to the lungs in such a way the lung may be infected before or instead of the liver [14]. Hydatid cyst condition tends to follow size dependent pattern in that most of the small cysts were calcified. This can be due to the host defense mechanisms of killing more efficiently with parasitic larvae at the early stage of development [30].

A greater frequency of medium-sized and large-sized cysts was found in the lung than in the liver, while the liver harbored a large number of small-sized and calcified cysts. The reason for the higher percentage of medium and large cysts in the lungs is the softer consistency of the lung tissues allowing easier development of the pressure of the cyst [31, 32]. This finding is an agreement with finding of [33-37] while the higher number of calcified cysts in liver could be attributed to relatively higher reticuloendothelial cells and abundant connective tissue reaction of the organ. The higher proportion of small cysts may be due to immunological response of host which might preclude expansion of cyst size [38]. Hydatid disease is generally considered to be a rural disease because of its way of transmission cycle, which involves domestic herbivorous animals (cattle, sheep, pigs and so on) and dogs. However, it is possible that urban residents may have been in contact with *Echinococcus granulosus* eggs, in this matter backyard slaughtering and inappropriate disposal affected organs plays major role for the continuity of parasite life cycle.

CONCLUSION AND RECOMMENDATIONS

The overall prevalence observed in the study indicated relatively high and an important zoonotic disease in the area and this could be due to several factors of which keeping dogs in close association with cattle. Hydatidosis also causes substantial visible and invisible economic losses in cattle of the study area as a result of condemnation of edible offal and carcass weight loss. The most preferred predilection sites of hydatid cyst in cattle like liver, kidney, heart and lungs and condemnations of these important organs having a single or multiple hydatid foci is really a huge loss. From the result obtained in the present study and considering the reality at Ambo municipal Abattoir and its surrounding. Therefore, to alleviate the spread and reduce its economic impact, recommendations like proper disposal of affected offal and all the condemned organs should be either buried or incinerated; the existing abattoir should be fenced properly to stop access of some wild candies (particularly hyenas) and stray dogs; thorough meat inspection should be there; the veterinarians should strictly examine the organs like lung and liver of the slaughtered animals; reduction of stray dog population should be practiced to prevent the risk of hydatidosis to farm animals; awareness should be created on the knowledge of the public about the role of dogs in transmitting Echinoccosis of animal and backyard and roadside slaughtering practices should be prevented by putting the law and regulation of meat inspection into action were forwarded.

ACKNOWLEDGMENTS

We are very much grateful to the inhabitants of all staff members of Wollega University, School of Veterinary Medicine. Next to that, our sincere appreciation is extended to all researchers or authors included in this review for their provision of information and constructive knowledge through their different findings to write and make this review paper fruit full.

REFERENCES

1. CSA, 2012. Agricultural sample survey 2011-2012, 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., L. Rinaldi, V. Musella, V. Veneziano, M.P. Maurelli, F. Dipietro, M. Frisiello and S. Di Pietro, 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., H.E. Nonga, A.A. Kassuku and R.R. Kazwala, 2008. Hydatidosis of Slaughtered animals in Ngorongoro district of Arusha region, Tanzania, Trop. Anim. Hlth Prod. DOI 10.1007/s11250-008-9298-z.
5. Ibrahim, M.M., 2010. Study of cystic echinococcosis in slaughtered animals in Al Baha Region, Saudi Arabia, and Interaction between some biotic and abiotic factors, Acta Trop., 113: 26-33.
6. Getaw, A., D. Beyene, D. Ayana, B. Megersa and F. Abunna, 2010. Prevalence of Hydatidosis and its economic importance in ruminants slaughtered at Adama municipal Abattoir, Central Oromia, Ethiopia, Acta Tropica., 113: 221-225.
7. Azlaf, R. and A. Dakkak, 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, E., 2009. Study on prevalence, Economic and Public Health importance of bovine hydatidosis in slaughtered Animals at Addis Ababa abattoir, Ethiopia, Msc Thesis, AAU, FVM, Bishoftu, Ethiopia, pp: 17-23.
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., F. Lebago, R. Tirnch, G. Abebe and P.H. Drchles,1996. Hydatidosis in the selected regions of Ethiopia an assessment trail on its prevalence, economic and public health important. Rev. Med., 147: 797-804.
12. Kebede, N., 2010. A retrospective survey of bovine hydatidosis in three abattoirs.
13. Abebe, F. and J. Yilma, 2011. Infection prevalence of hydatidosis (Echinococcus granulosus, Batsch, 1786) in domestic animals in Ethiopia, A synthesis report of previous surveys, JUCAVM, Jimma, Ethiopia, Vet. J., 15: 11-3.
14. Eckert, J. and P. Deplazes, 2004. Biological, epidemiological, and clinical aspects of echinococcosis a zoonosis of increasing concern. Clin Microbiol Rev., 17: 107-135.
15. Zewdu, E., Y. Teshome and A. Makwoya, 2010. Bovine Hydatidosis in Ambo Municipality Abattoir, West Shoa and Ethiopia .Ethiop Vet. J., 14: 1-14.
16. Thursfield, M., 2005. Veterinary Epidemiology. 3rd ed., Singapore, Uk. Blackwell sciences, pp: 233.
17. De-Lahunta and R.E. Habel, 1986. Teeth, applied veterinary anatomy. W.B. Saunders Company, pp: 4-6.
18. Nicholson, M. and M.H. Butterworth, 1986. A Guide to Body condition scoring of Zebu cattle. International live stock center for Africa, Addis Ababa, Ethiopia.
19. Oostburg, B.F., M.A. Vrede and A.E. Bergen, 2000. The occurrence of polycystic echinococcosis in Suriname. Ann Trop Med Parasitol, 94: 247-252.
20. Yetnayet, S., 2010. Prevalence and economic significance of bovine hydatidosis in slaughtered at Gonder ELFOR Abattoir, North Gondar, Amhara region. DVM thesis FVM, University of Gondar, Gondar, Ethiopia.
21. Tsehaye, T., 1995. Epidemiology of Bovine Faciolosis and Hydatidosis in Debre-Brahan region. DVM Thesis, FVM, AAU, Bishoftu, Ethiopia.
22. Fekadu, O., 1997. Study on the prevalence and economic significant of hydatidosis in ruminants, E. granulosus in dogs in around Assela. DVM Thesis, FVM, AAU, Bishoftu, Ethiopia.
23. Nebiyou, G., 1990. Study of hydatidosis/ Echinococcosis in cattle slaughtered at Bahir-Dar Municipal Abattoir. DVM Thesis, FVM, AAU, Bishoftu, Ethiopia.
24. Woubet, S., 1988. Revalence of cattle hydatidosis and its economic significance in Bale Robe municipal abattoir.
25. Regassa, F., A. Molla and J. Bekele, 2010. Study on the prevalence of cystic hydatidosis and its economic significance in cattle slaughtered at Hawassa Municipal abattoir, Ethiopia. Tropical Animal Health and Prodaction, 42: 977-984.
26. Garrippa, G., Varcasia and A. Scala, 2004. Cystic Echinococcosis in Italy from the 1950's to present, Parasitologia, 46: 387-391.
27. Macpherson, L.N.L., 1985. Epidemiology of hydatid disease in Kenya. A study of domestic intermediate hosts in Masaialand. Transac. Royal Soc. Trop. Med. Hyg., 79: 209-217.
28. Polydorou, K., 1981. Animal health and economics. Case study: echinococcosis with reference to Cyprus. Bulletin, Office International des Epizooties, 93: 981-992.

29. Njoroge, E.M., P.M. Mbithi, J.M. Gathuma, T.M. Wachira and P.B.Gathura, 2002. A study of cystic echinococcosis in slaughter animals in three selected areas of northern Turkana, Kenya. Vet Parasitol,104: 85-91.
30. Himonas, C., 1987. The fertility of hydatid cysts in food animals in Greece. Helminth Zoonoses. Amsterdam, The Nether lands: Martinus Nijhoff Publishers.
31. Hubbert, W.T., 1975. Disease Transmitted from Animal to Man. 6th edn, USA, Charles Thomas Publishers, pp: 690-1206.
32. Smyth, J.D., 1985. Introduction to Animal Parasitology, London, Hodder and Stoughton, pp: 101-105.
33. Alemayehu, L., 1990. The prevalence of hydatidosis in Cattle, Sheep and Goats Echinococcus granulosus in dogs in Arsi Administrative region, DVM Thesis, FVM, AAU, Bishoftu, Ethiopia.
34. Yechale, T., 2008. Prevalence and economic significant of bovine hydatidosis in Ambo Municipal abattoir and rate of infection of dogs, DVM Thesis, JUCAVM, Jimma, Ethiopia.
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. Alembante, M., 2009. Study on Prevalence and Economic Significant of Hydatidosis in Cattle Slaughtered at Hawassa Abattoir, DVM Thesis, JUCAVM, Jimma, Ethiopia.
37. Haftay, G., 2008. Study on prevalence and Economic importance of bovine hydatidosis at Mekelle municipal abattoir. DVM Thesis, JUCAVM, Jimma, Ethiopia.
38. Thompson, R.C.A. and D.P. Mc Manus, 2002. Towards a taxonomic revision of the genus Echinococcs, Trends Parasitol, 18: 452-457.

ANNEXES:

Annex 1: Age determination based on dental table

Estimation of age by dental eruption	
Age	Characteristic changes
1½ -2	I1 erupts
2-2½	I2 erupts
3	I3 erupts
3½ -4	I4 erupts
Estimation of age by wear	
5	All incisors and canine are in wear
6	I1 is leveled and the neck has emerged from the gum.
7	I2 is leveled and the neck is visible
8	I3 is leveled and the neck is visible, I4 may be level.
9	I4 may be leveled and the neck is visible.
10	The dental star is squire in I, and in all teeth by 12 years.
15	The teeth that are not fallen out are reduced (small round per's).

Source: [17]. Note: Canine of ruminant is usually considered as fourth incisor

Annex 2: Body condition score protocol of cattle

№	Score	Condition Futures
1	L-	Marked emaciation (animals would be condemned at anti mortem examination)
2	L	Transverse processes prominently, dorsal spines appear sharply
3	L+	Individual dorsal spines are pointed to the touch, hips, pins, tails head ribs are prominent. Transverse processes visible, usually individually
4	M-	Ribs, hips and pins clearly visible, muscle mass between hook and pins sharply concave slightly more flesh above the transverse processes that in L+
5	M	Ribs usually visible, little fat covered dorsal spines barely visible
6	M+	Animal smooth and well covered, dorsal spines cannot be seen, but are easily felt
7	F-	Animal smooth and well covered, but fat deposits are not marked. Dorsal spines can be felt with firm pressure but feel rounded rather than sharp
8	F	Fat covers in critical areas can be seen or felt. Transverse processes cannot be seen or felt
9	F+	Heavy deposits of fat clearly visible on tail, head, brisket and dorsal spines, ribs, hooks and spines fully covered and cannot be felt even with firm pressure

Source: [18].