# Infection prevalence of hydatidosis (*Echinococcus granulosus*, Batsch, 1786) in domestic animals in Ethiopia: A synthesis report of previous surveys

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## Abstract

Hydatidosis/echinococcosis (***Echinococcus granulosus*, Batsch, 1786**) is considered to be a serious problem for both public health and the livestock economy in Ethiopia. The present paper reviews and summarizes available data on the disease. Abattoir survey data collected over a period of 15 years (1985-1999) were analyzed to assess the infection prevalence of hydatidosis in domestic animals in three different agroecological zones of Ethiopia. Accordingly, 8036/22,863 (35.15%) cattle, 768/6518 (11.78%) sheep, 36/1753 (4.9%) goats, 70/417 (16.79%) camels and 0/150 (0%) pigs slaughtered in 21 different abattoirs located in various parts of the country were found harbouring hydatid cysts. A statistical discernible significant difference ($p<0.001$) was observed in the overall hydatidosis infection prevalence between the different species of animals, and in infection prevalence of bovine hydatidosis in the three agroecological zones where the slaughtered cattle were believed to originate from. Similarly, a statistically significant difference ($p<0.01$) in the prevalence of ovine hydatidosis was observed between mid-altitude and lowland agroecologies. Conversely, there was no significant difference ($p>0.20$) in the infection prevalence of caprine hydatidosis between mid-altitude and lowlands. The present study reconfirms that hydatid disease is widespread and highly prevalent in ruminant livestock in Ethiopia and warrants institution of a nation-wide control measures. Considerations on experiences of other countries with respect to the economic benefits that hydatid disease control programs may bring to livestock producers and combining such efforts with other zoonosis control schemes in view of the 'one health' initiative is worthy for animal health planners and policy decision-makers. The paper also serves as a quick reference source on hydatidosis in the country and basis for future studies.

**Keywords:** Hydatidosis, infection prevalence, domestic animals, agroecology, Ethiopia

## Introduction

Hydatid Disease is the name given to the condition caused by the zoonotic tapeworm *Echinococcus granulosus*. The tapeworm spends most of its adult life in the intestine of its definitive host, namely canids and in particular the dog. The tapeworm eggs become voided in the canids' faeces and as a result of ingesting the eggs, infection passes to the intermediate host, commonly herbivores while grazing. However, humans can become accidentally infected and hydatid cysts may develop throughout the body. Therefore, cystic echinococcosis (CE) or hydatidosis is a disease caused by the metacestode stage of *Echinococcus granulosus*. The disease is not apparent to farmers but is of considerable economic and public health importance (Torgerson and Budke, 2003; Ahmadi and Meshkehkar, 2011). In farm animals, it causes considerable economic loss due to condemnation of edible organs, decreased meat and milk production, reduced hide and fleece value and decrease in fecundity (Polydorou, 1981; Romazanov, 1983).

The incidence of human hydatid disease in any country is closely related to the prevalence of the disease in domestic animals and is highest where there is a large dog population and high sheep production (Khuroo, 2002). The most frequent strain associated with human cystic echinococcosis (hydatidosis) appears to be the common sheep strain (G1) (Arambulo III, 1997; Torgerson and Budke, 2003; Wani *et al.*, 2007). Recent molecular characterization of human and animal *Echinococcus granulosus* isolates demonstrated that the 'camel' strain (G6) is also equally important source of infection to humans (Shahnazi *et al.*, 2011; Magambo, 2006). The possible occurrence of the disease in humans in Ethiopia was indicated earlier by Graber, 1978. Besides, clinical and serologic tests conducted among the Dassanetch and Nyangatom pastoralist tribes of the south western part of the country revealed the prevalence of 4.8% palpable abdominal cysts, 15% hepatomegaly and 31.7% positive hydatid skin test (Fuller and Diane, 1981). A prevalence of 0.5% - 0.7% was also reported in Hamar pastoralist tribes of southwest Ethiopia (Macpherson *et al.*, 1989; Klungsøyr, 1993). During 1995 and 2005, 234 patients were operated for hydatid disease at Tikur Anbessa Hospital in Addis Ababa (Mesfin Minas *et al.*, 2007). In addition, a retrospective survey conducted between 2002 and 2006 revealed the registration of 24 hydatidosis cases out of the total of 36,402 patients, giving a mean annual incidence of 2.3 human hydatid cases per 100,000 people per year in north-western Ethiopia (Nigatu Kebede *et al.*, 2010).

Data on the prevalence of hydatidosis in animals will also provide a reliable indicator of the extent of environmental contamination with eggs from definitive carnivore hosts. Several studies have been conducted on livestock hydatidosis in different parts of the Ethiopia, particularly through the externship program of the Faculty of Veterinary Medicine (FVM), Addis Ababa University (AAU). However, most of these works were unpublished and not readily available to the wider national and international readership (Getaw *et al.*, 2010; Lemu Golassa *et al.*, 2011). As hydatidosis is considered a serious problem for public health and the livestock economy in Ethiopia, the present paper reviews and summarizes available data on the disease in the country. The present meta-analysis on livestock hydatidosis is based on FVM/AAU surveys (1985-1999), which allowed the depiction of long-term infection prevalence of the disease in domestic animals in different agroecologic zones, hence provide a clearer picture of the magnitude of the problem to animal health planners and decision makers. In addition, the paper serves as a quick reference source on hydatidosis in the country and basis for future studies.

## Materials and Methods

### Database management

The present study is based on surveys carried out on hydatidosis by graduating students of FVM/AAU between the periods 1985-1999 in 21 slaughterhouses located in different parts of the country, namely Addis Ababa, Arba Minch, Assela, Bahr Dar, Bale Robe, Debre Berhan, Dire Dawa, Dollo Oddo, Gondar, Harrar, Jijiga, Jimma, Kombolcha, Konso, Mekele, Melgue Wondo, Nazareth, Negele, Nekempte, Wolisso and Wollaita Soddo (Fig. 1). Individual survey data were carefully compiled, database organized by location (assumed origin) and species of animals (bovine, ovine, caprine, dromedary and swine). Infection prevalence of hydatidosis and levels of edible organ involvement were then determined.

### Prevalence study

Prevalence was depicted by species of animals and agroecology of the study areas (Fig. 2). The latter are conventionally classified as highland (>2500 masl), mid-altitude (2500-1500 masl) and lowland (<1500 masl) zones. Debre Birhan and Bale Robe abattoirs are supplied from the highland whereas Arbaminch, Dire Dawa, Dollo Oddo, Konso, Negelle and Jijiaga abattoirs from Lowland and the remaining abattoirs from mid-altitude. It is generally assumed that animals raised in a radius of 50km are the ones feeding the nearby slaughterhouses.

Even if there are animals brought from outside of a given agroecological zone where the abattoir is located, it's again assumed that they constitute a very small proportion, hence do not alter the inferences drawn from the results.

### Statistical Analysis

Chi-Square ($\chi^2$) statistics at $p<0.05$ was employed to depict the presence of significant difference between the prevalence of hydatidosis in various species and three agro-ecological zones (Fig. 2).

## Results

### Prevalence of hydatidosis

The surveys considered in this study reported that a total of 22863 cattle were slaughtered in the 18 abattoirs. Of these, 8036 (35.15%) were found harboring hydatid cysts. Besides, in 6397 (27.98%), 4211 (18.42%), 392 (1.71%) and 190 (0.83%) of the cases, hydatid cysts were located in lungs, liver, spleen, kidneys and heart, respectively. High prevalence (>61%) was observed at Bale Robe and Assela abattoirs. Additionally, the recorded prevalence in Assela was higher in the most recent report of 1997 (72.44%) than in 1990 (54.84%) and 1992 (50.29%). However, no increment was seen in the prevalence of the most recent years from Bahir Dar, Gondar, Kombolcha and Wallaita Sodo. The lowest (7.2%) prevalence reported was from Debre Berhan slaughterhouse. In most abattoirs, hydatidosis prevalence exceeded 30% (Table 1).

A total of 6518 sheep were slaughtered in 9 abattoirs, of which 768 (11.78%) were found infected with hydatid cysts. Furthermore, 531(8.15%) had hydatid cysts in the lungs, 483 (7.41%) in the liver, 21 (0.3%) in the spleen, 8 (0.12%) in the kidneys and hearts. In most of the abattoirs, the infection prevalence reached 10%. In Assela, the recorded prevalence was higher in the most recent report of 1997 (53.5%, 130/243) than in 1990 (2.18%, 3/137). Similarly, in Kombolcha, the recorded prevalence was higher in 1996 (15.1%, 93/617) than in 1989 (4.4%, 39/888). The aggregated highest prevalence (35%) was recorded in Assela and the lowest prevalence (6.63%) in Nazareth abattoirs (Table 2).

Of the examined 1753 goats from 7 abattoirs, hydatidosis was confirmed only in 86 (4.9%) of the cases. The highest prevalence (9.3%) was recorded in Konso abattoir. There were no positive cases recorded from Assela and Kombolcha abattoirs. In terms of organ involvement, 37 (2.1%), 60 (3.42%), 3 (0.17%)

and 1(0.06%) of the cysts occurred in lungs, liver, spleen, heart and kidneys, respectively (Table 3).

Five of the surveyed abattoirs were handling camels and another two were handling swine. A total of 417 camels were examined and 70 (16.79%) were found harbouring hydatid cysts in their visceral organs. Organs infected include 59 (14.15%) lung and 13 (3.12%) liver (Table 4). None of the 150 pigs (110 from Addis Ababa and 40 from Kombolcha abattoirs) were infected with hydatid cysts (Table 4)

**Variation in hydatidosis infection prevalence**

The highest prevalence (35.15%) was recorded in cattle followed by dromedary (16.79%), ovine (11.87%), caprine (4.9%) and swine (0%). Statistical analysis revealed the presence of a significant difference ($p<0.001$) in hydatidosis infection prevalence between the different species of examined animals (Table 5).

Further analysis showed a significant variation ($p<0.001$) in infection prevalence of bovine hydatidosis along altitude zones. The highest prevalence (40.08%) of bovine hydatidosis occurred in the highlands followed by mid-altitude (38.09%) and lowland (18.95%). There was no data on the occurrence of ovine and caprine hydatidosis in the highlands. Ovine hydatidosis was significantly higher in the mid-altitude zone ($p<0.01$) than in lowlands. Conversely, no significant difference ($p>0.20$) was depicted in the prevalence of caprine hydatidosis along altitude zones. All camels slaughtered in the five studied abattoirs were originated from lowland areas (Fig. 3).

Table 1. Infection prevalence of bovine hydatidosis and edible organs condemned (1985-1999) in 18 slaughterhouses located in different parts of Ethiopia (Source: FVM/AAU)

| Slaughterhouse location | No of animals examined | No. (%) positive cases | No. of organs with hydatid cysts (condemned as unfit for human consumption) | | | | | No of studies considered | Reference (source) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Lungs | Liver | Spleen | Kidney | Heart | | |
| Addis Ababa | 825 | 121(14.67) | 103 | 73 | 6 | - | - | 1 | Gemeda, 1988. |
| Assela | 380 | 133(35.00) | 108 | 99 | 3 | 2 | - | 2 | Alemayehu, 1990; Fekadu, 1997 |
| Dire Dawa | 1515 | 150(9.90) | 107 | 79 | - | - | - | 1 | Dainel, 1996 |
| Dire Dawa, Harrar & Jijiga | 565 | 53(9.38) | 41 | 56 | - | 1 | - | 1 | Woubet, 1987 |
| Gondar | 623 | 54(8.67) | 30 | 39 | - | - | - | 1 | Tamene,1986 |
| Jimma | 227 | 28(10.12) | 16 | 21 | - | - | - | 1 | AbdulJewad, 1988 |
| Kombolcha | 1505 | 132(8.77) | 72 | 66 | 4 | 3 | 3 | 2 | Asrat, 1996; Yilkal, 1989 |
| Konso | 345 | 65(18.80) | 35 | 41 | 1 | - | - | 1 | Fikre, 1994 |
| Nazareth | 483 | 32(6.63) | 19 | 9 | 4 | 1 | 3 | 1 | Yemane,1990 |
| Total No. (%) | 6468 | 768 (11.87) | 531 (8.15) | 483 (7.41) | 21 (0.3) | 8 (0.12) | 8 (0.12) | 11 | |

Table 2. Infection prevalence of ovine hydatidosis and edible organs condemned (1985-1999) in 9 surveyed abattoirs located in different parts of Ethiopia (Source: FVM/AAU)

| Slaughterhouse location | No of animals examined | No. (%) positive cases | No. of organs with hydatid cysts (condemned as unfit for human consumption) | | | | | No of surveys considered | References |
|---|---|---|---|---|---|---|---|---|---|
| | | | Lungs | Liver | Spleen | Kidney | Heart | | |
| Addis Ababa | 1027 | 217(21.13) | 201 | 94 | 4 | 18 | 6 | 1 | Gemeda, 1988 |
| Arbaminch | 568 | 147(25.88) | 124 | 64 | 1 | 4 | 1 | 1 | Mohammed, 1988 |
| Assela | 2325 | 1430(61.51) | 1223 | 1032 | 88 | 95 | 35 | 3 | Alemayehu, 1990; Dessie, 1992; Fekadu, 1997 |
| Awassa | 1020 | 350(34.30) | 270 | 81 | 19 | 2 | - | 1 | Getachew,1991 |
| Bahr Dar | 1907 | 851(44.63) | 613 | 403 | 23 | 63 | 50 | 2 | Musie, 1995; Nebiyou, 1990 |
| Bale Robe | 764 | 481(62.96 ) | 302 | 240 | 45 | 25 | 21 | 1 | Woubet, 1988 |
| Debre Berhan | 531 | 38(7.2 0) | 23 | 17 | 1 | 4 | 2 | 1 | Tsegaye, 1995 |
| Dire Dawa | 2224 | 305( 13.70) | 204 | 241 | - | - | - | 1 | Dainel, 1996 |
| Dire Dawa, Harrar and Jijiga | 854 | 239(27.99) | 170 | 134 | 13 | 6 | 4 | 1 | Woubet, 1987 |
| Gonder | 1697 | 478(28.17) | 366 | 203 | 18 | 6 | 12 | 2 | Roman, 1987; Tamene, 1986 |
| Jimma | 1010 | 340(33.66) | 268 | 79 | 16 | 1 | - | 1 | Abduljewad, 1988 |
| Kombolicha | 1670 | 599(35.87) | 467 | 337 | 33 | 9 | 21 | 2 | Asrat, 1996; Yilkal, 1989 |
| Konso | 447 | 115(25.70) | 52 | 93 | 1 | 1 | - | 1 | Fikre, 1994. |
| Mekele | 548 | 176(32.12) | 144 | 95 | 8 | - | 1 | 1 | Hagos, 1997. |
| Melgue wondo | 1878 | 807(42.90) | 670 | 481 | 53 | 11 | 9 | 1 | Getahun, 1987 |
| Nekemet | 1978 | 617(31.19) | 572 | 238 | 4 | 19 | 7 | 1 | Feyessa, 1987 |
| Nazareth | 1185 | 447(37.72) | 424 | 205 | 33 | 10 | 21 | 1 | Yemane,1990 |
| Wallaita | 1230 | 399(32.43) | 304 | 174 | 32 | 6 | 3 | 2 | Abdul, 1992, Abel, 1985 |
| Total (%) | 22863 | 8036 (35.15) | 6397 (27.98) | 4211 (18.42) | 392 (1.71) | 280 (1.22) | 190 (0.83) | 24 | |

Table 3. Prevalence of caprine hydatidosis and edible organs condemned (1985-1999) in 7 surveyed abattoirs located in different parts of Ethiopia (Source: FVM/AAU)

| **Slaughterhouse location** | **No of animals examined** | **No. (%) positive cases** | **No. of organs with hydatid cysts (condemned as unfit for human consumption)** | | | | | **No of studies considered** | **Reference (source)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | Lung | Liver | Spleen | Kidney | Heart | | |
| Addis Abeba | 170 | 12(7.05) | 4 | 11 | - | - | - | 1 | Gemeda, 1988. |
| Assela | 124 | 0(0) | - | - | - | - | - | 2 | Alemayehu, 1990 & Fekadu, 1997 |
| Dire Dawa, Harrar & jijiga | 184 | 12(6.50) | 4 | 10 | - | - | - | 1 | Woubet, 1987 |
| Gonder | 194 | 9(4.64) | 5 | 7 | - | - | - | 1 | Tamene, 1986 |
| Kombolcha | 60 | 0(0) | - | - | - | - | - | 1 | Asrat, 1996 |
| Konso | 389 | 36(9.30) | 19 | 21 | - | - | | 1 | Fikre, 1994. |
| Nazareth | 632 | 17( 2.7) | 5 | 11 | 3 | 2 | 1 | 1 | Yemane, 1990 |
| Total | 1753 | 86(4.9) | 37 (2.1%) | 60 (3.42%) | 3 (0.17%) | 2 (3.11%) | 1 (0.06%) | 8 | |

Table 4. Prevalence of hydatidosis in swine and camel and edible organs condemned (1985-1999) in 4 surveyed abattoirs located in different parts of Ethiopia (Source: FVM/AAU)

| Slaughterhouse location | Species examined | No of animals examined | No. (%) positive cases | No. of organs with hydatid cysts (condemned as unfit for human consumption) | | | | | No of studies considered | Reference (source) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lungs | Liver | Spleen | Kidney | Heart | | |
| Addis Ababa | Swine | 110 | 0(0%) | - | - | - | - | - | 1 | Gemeda, 1988. |
| Kombolicha | Swine | 40 | 0(0%) | - | - | - | - | - | 1 | Yilkal, 1989 |
| Dire Dawa, Harrar & Jijiga | Dromedary | 296 | 43(14.53%) | 36 | 8 | - | - | - | 2 | Ahemed, 1998; Woubet, 1987 |
| Dollo Oddo and Nagelle | Dromedary | 121 | 27(22.3%) | 23 | 5 | - | - | - | 1 | Balako, 1999 |
| Total | Dromedary | 417 | 70 (16.79%) | 59 (14.15%) | 13 (3.12%) | - | - | - | 3 | |
| | Swine | 150 | 0(0%) | - | - | - | - | - | 2 | |

Table 5. Prevalence of hydatidosis in different species of examined animals

| Animal species | No. examined | No. (%) positive | No. of studies considered | $X^2$ (p-value) |
|---|---|---|---|---|
| Bovine | 22863 | 8036 (35.15) | 24 | 1963 (<0.001) |
| Ovine | 6468 | 768 (11.87) | 11 | |
| Caprine | 1753 | 86 (4.90) | 7 | |
| Dromedary | 417 | 70 (16.79) | 3 | |
| Swine | 150 | 0 (0) | 2 | |

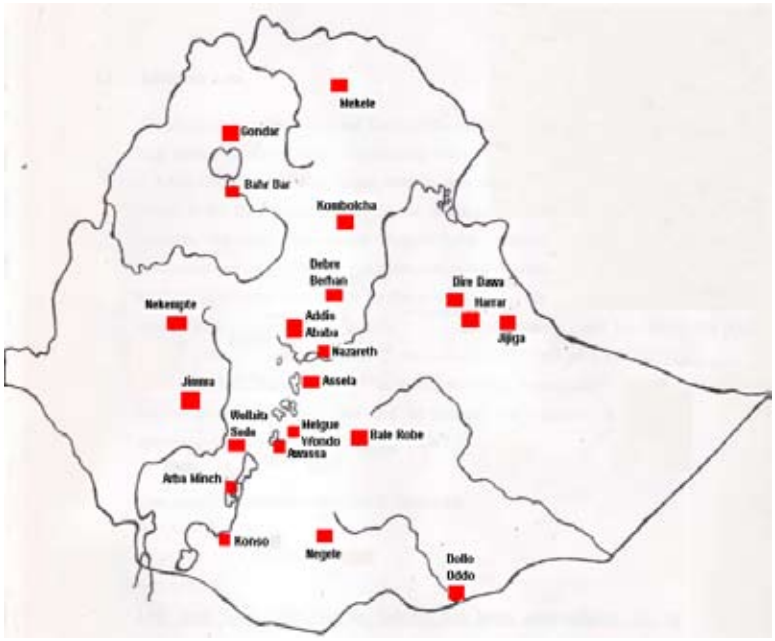


Figure 1: Map of Ethiopia showing the locations of abattoirs where the surveys were carried out.

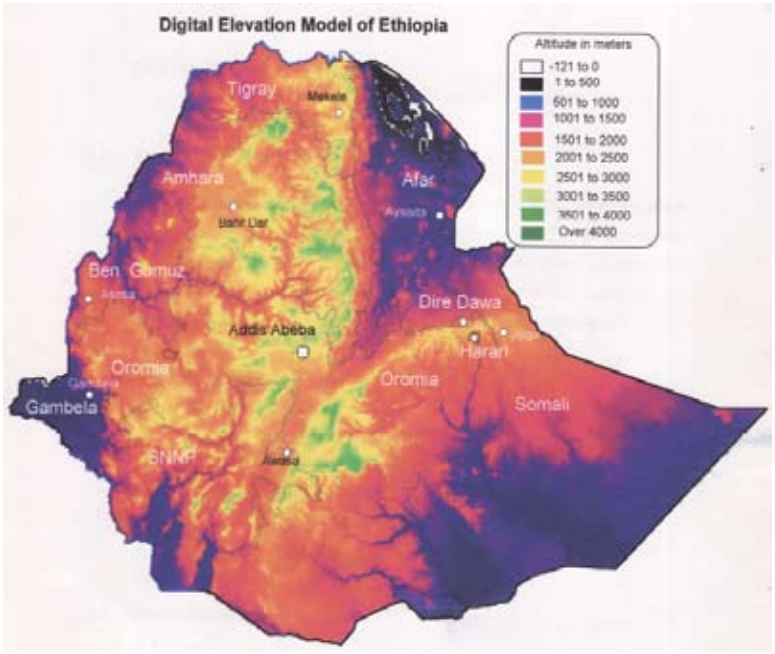


Figure 2. Elevation map of Ethiopia showing altitude ranges from -121m below sea level to over 4000m above sea level (Source: Berhanu Bedane)

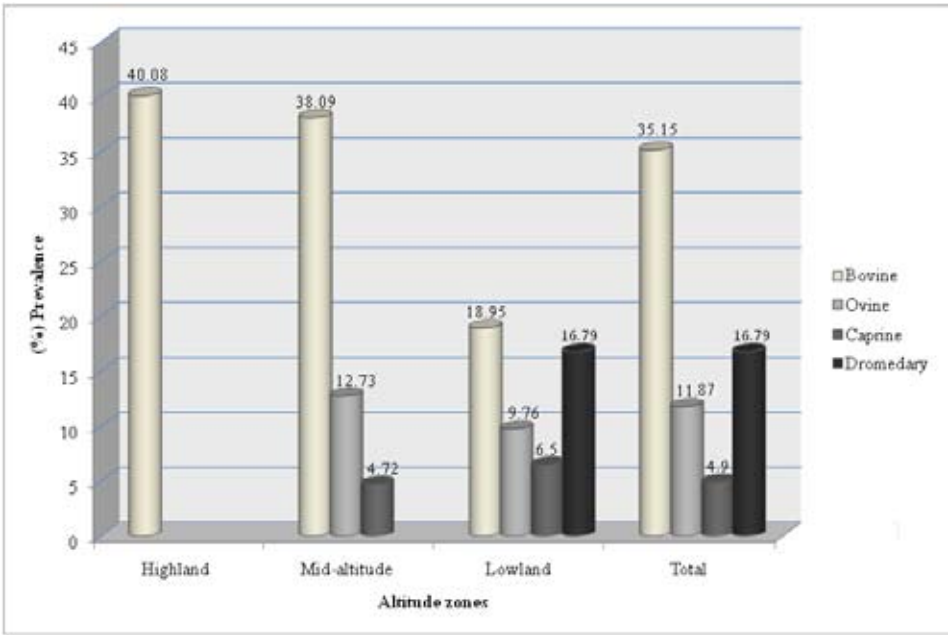


Figure. 3. Infection prevalence of hydatidosis in different animal species versus altitude zones.

## Discussion

Echinococcosis is one of the most geographically widespread zoonotic diseases that occur in all inhabited continents, including sub-arctic, arctic, temperate, subtropical and tropical zones, especially in undeveloped and developing countries. The disease is endemic to hyperendemic in agricultural countries of Europe, northern, eastern and southern Africa, southern and northern America, Middle East and Asia (Matossian, *et al.*, 1977; Wen and Yang, 1997; Arambulo III, 1997; Torgerson and Budke, 2003; Budke *et al.*, 2006; Dakkak, 2010). In Ethiopia, the Faculty of Veterinary Medicine of Addis Ababa University served as one of the leading organizations in collecting baseline information on various animal diseases in the country. As a result, it has accumulated a wealth of information on the status of hydatidosis in animals collected from various parts of the country. However, most of this information is unavailable to wider national and international readership. Consequently, in an attempt to fill-in the prevailing information gap, the present work reviewed and summarized the abattoir survey data, collected over a period of 15 years (1985-1999) through the externship programme of the Faculty of Veterinary Medicine, Addis Ababa University.

The analysis revealed a hydatidosis prevalence rate of 34.15% in cattle, 11.87% in sheep, 4.9% in goats, 16.79% in camels and 0% in pigs. In Assela, where there are multiple records, higher prevalence of bovine and ovine hydatidosis was observed in the most recent report than in the older ones. The mean prevalence value reported in the present work concords with the recently reported prevalence of 34.05% in cattle and 10.6% in sheep from Bahir Dar (Nigatu Kebede *et al.*, 2009c), 32.11% in cattle from Mekelle (Gebretsadik Berhe *et al.*, 2010) and 29.69% in cattle from Ambo (Endrias Zewdu *et al.*, 2010). Slightly higher prevalence of 48.9% in cattle from Debre Markos (Kebede Nigatu, *et al.*, 2009a), 46.8% in cattle, 29.3% in sheep, and 6.7% in goats from Nazareth (Getaw *et al.*, 2010) and 52.69% in cattle from Hawassa (Feyessa Regassa *et al.*, 2010) were also reported. A retrospective survey of bovine hydatidosis conducted in Gondar, Injibara and Finote Selam municipal abattoirs during 2002 to 2007 revealed an increasing trend from year to year in prevalence of bovine hydatidosis that caused the condemnation of 79.5% organs (Nigatu Kebede, 2010). This might be attributed to backyard slaughter practice, an increase in the population of stray dogs and the absence of control program. Bovine hydatidosis prevalence of 22.1% was reported from Tigray region (Kebede, *et al.*, 2009), 13.86% from 7 export abattoirs (Solomon Hailemariam, 1975), 15.2% from Birre-Sheleko and Dangila abattoirs (Nigatu Kebede *et al.*, 2011), and 16.85%, 16.0% and 15.4% from Wolayita Sodo by Jemere Bekele and Berhanu Butako (2011), Nigatu Kebede *et al.*, (2009b) and Regassa, *et al.*, (2009) respectively. Varying prevalence rates were also reported by different authors from diverse countries in different intermediate hosts. For example, an infection prevalence of 48% in cattle, 63.8% in sheep and 34.7% in goat from Ngorongoro district (Ernest *et al.*, 2004) and 6.02% in shoats and 4.2% in cattle from Arusha area of Tanzania (Nonga and Karimuribo, 2009), 19.4% in cattle, 3.6% in sheep, 4.5% in goats and 61.4% in camels from Kenya (Njoroge *et al.*, 2002), 6.6% in cattle, 4.3% in sheep and 27.2% in camels from Libya (Mohammed, 1985), 31.6% in cattle, 24.4% in sheep, 42.2% in goats and 59.9% in pigs from Niger (Arene, 1985), 8.28% in cattle, 12.61% in sheep and 6.56% in goats and 32.85% in camels from Saudi Arabia (Ibrahim, 2010), 3% in cattle, 7% in sheep and 45% in camels from Sudan (Elmahdi *et al.*, 2004) and 18.3% in sheep from Argentina (Larrieu *et al.*, 2001). Sotiraki *et al.*, (2003) reported a prevalence of 82% in cattle, 80% in sheep, 24% in goats and 5% in pigs from Greece before the introduction of control program in 1984 which reduced the occurrence of the disease to 0% in cattle, to 31.3% in sheep, to 10.3% in goats and to 0.6% in pigs. A decrease in annual prevalence of camel liver hydatidosis from 24.1% in 2004 to 6.8% in 2010 and a corresponding decrease in annual

prevalence of camel lung hydatidosis from 28.7% in 2004 to 7.1% in 2010 were also reported from Iran as a result of greater awareness created about echinococcosis among farmers (Borji, 2011).

The difference in infection prevalence rate between countries could be associated with different factors like control measures put in place, the level of community awareness created about the disease, education and economic status of the population and the farming community. The absence of hydatid cyst infection in pigs in Ethiopia could be mainly attributed to the absence of extensive swine farms in the country. All farms are under intensive husbandry practices where farm facilities are fenced and animals provided with concentrate feed and industrial byproducts.

The result of this study revealed the existence of statistically significant association ($p<0.001$) between bovine/ovine hydatidosis prevalence rates and the altitude zones, the highest prevalence reported in highlands followed by mid altitude zones. This difference might be ascribed to the differences in the socio-economic factors and animal husbandry practices that may facilitate close contacts between domestic animals and village dogs, the latter being allowed free access to hydatid infected offals. The distribution may also be influenced by temperature and humidity (Wen and Yang, 1997). Similar spatial variation in the infection prevalence in livestock was previously reported by Yilma Jobre *et al.*, (1996); Kebede, *et al.*, (2009); and Ibrahim, (2010). Caprine hydatidosis prevalence rates of 4.72% and 6.5% were recorded in mid-altitude and lowland areas, respectively. There was no statistically significant difference ($p>0.20$) in hydatidosis prevalence between the two agroecological zones.

The distribution may also be influenced by

Statistical analysis of hydatidosis infection rates on the basis of species, indicated that there exists a significant difference ($p<0.001$) between cattle, sheep, goats, camels and pigs. This finding is in agreement with previous study by Yilma Jobre *et al.*, (1996) and Nigatu Kebede *et al.*, (2009c). The difference in infection rates between different species of animals might be explained mainly as a result of the involvement of different strains of *E. granulosus*, variations in feeding behaviors of the animals and animal husbandry practices. There is an evidence that indicates the existence of a number of strains of *E. granulosus*, which differ morphologically and biochemically. These include strains, which utilize sheep/dog, horse/dog, Camel/dog, pig/dog, buffalo/dog, goat/dog, cattle/dog and man/dog cycles (Soulsby, 1986). High prevalence rate of hydatidosis

in cattle and camel in Ethiopia could be ascribed to age factor and method of husbandry. Cattle and camels are generally slaughtered at an older age than sheep and goats and consequently are exposed to infection over a longer period of time. Ibrahim (2010) and Cabrera *et al.*, (2003) reported an increase in prevalence of the disease with increase in age. Study conducted in Uruguay by Guorino *et al.*, (1981) also showed the impact of age on the incidence of the disease and an increase in prevalence of the disease (reaching 46-50%) in in older subjects as compared to 9.4% in lambs. In the same study a prevalence rate of 81.2% in bulls and older bullocks, 69.7% in fattening bullocks and 51.1% in cows were reported in contrast to 7% in calve. A survey made in New Zealand also showed that the incidence increased with age from 9% in cattle of 1-2 years old to 74% in cattle of 5 years or older (Gracy, 1994).

This report indicated that lungs and liver were the most commonly affected organs by hydatid cysts in cattle, sheep, goats and camels. This is in fundamental agreement with literature, which states that hydatid cysts are most commonly found in the liver and lungs of ungulates (Soulsby, 1986; Urguhart *et al.*, 1988; Yilma Jobre *et al.*, 1996; Getaw *et al.*, 2010; Ibrahim, 2010; Nigatu Kebede, 2010). This could be justified by the fact that lungs and liver posses the first greater capillary fields which acts as partial barriers for the ingested oncosphere which adopt the portal vein route and primarily negotiates the hepatic and the pulmonary filtering action sequentially before any other peripheral organ is invaded (Matosain, 1977). In this report percent involvement of the lungs is higher than the liver in cattle, sheep and camel and the vice versa holds true in goats. Literature reveals that in older cattle and sheep, the liver sinosoides permits the embryos to traverse the sinosoides and reach the lungs. It is also possible for embryos to enter the hepatic circulation and be carried, via the thoracic duct and heart, to the lungs so that lungs will be infected before or instead of the liver (Gracy, 1994). The same may hold true in case of camels. In goats the sinosoides of the liver might be narrow so that the majority of hydatid embryos are arrested in that organ. Similar higher percent involvement of the liver than the lungs was recorded in pigs and humans (Wen and Yang, 1997; Khuroo 2002; Torgerson and Budke, 2003).

There is no doubt that the Faculty of Veterinary Medicine of the Addis Ababa University has made extensive studies and serves as repository of baseline information for the country. However, there are obvious gaps in terms of geographic coverage. For instance, no studies on the prevalence of hydatidosis were carried out in Afar, Beneshangul Gumuz and Gambela. The different veterinary schools should consider the case of hydatidosis as just one example

and plan to undertake a harmonized and well plan animal health investigation plans in such a way that the veterinary autorities will make good use of the research outputs in animal health programs planning and decision-making.

The control of diseases such as hydatidosis must consider its economic feasibility of intervention without forgetting the huge direct and indirect loss due to it. In addition, possibility of amalgamating hydatid disease control planning with other zoontotic disease control programs is essential. The current FAO initiative – one health – approach for sustainable animal health contained animal-related human health risks is worth while considering. FAO's strategic vision is "a world in which risks to animal and animal-related human health due to a wide range of high-impact emerging and re-emerging zoonotic and non-zoonotic diseases, and their associated impacts on food security, livelihoods, trade and economic development are minimized through prevention, early detection, rapid response, containment and elimination. The main goal of the strategy is to establish a robust global animal health system that effectively manages major animal health risks, paying particular attention to the animal-human-ecosystem interface, and placing disease dynamics into the broader context of agriculture and socio-economic development and environmental sustainability" (FAO, 2011).

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