ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCE
SCHOOL OF VETERINARY MEDICINE,

STUDY ON PREVALENCE, ECONOMIC AND PUBLIC HEALTH IMPORTANCE OF HYDATIDOSIS IN SLAUGHTERED SMALL RUMINANTS AT THREE SELECTED EXPORT ABATTIORS OF EAST SHOWA ZONE OF OROMIA REGIONAL STATE.

BY
TESHOME BEKELE

JUNE 2010
DEBRE ZEIT, ETHIOPIA

STUDY ON PREVALENCE, ECONOMIC AND PUBLIC HEALTH IMPORTANCE OF HYDATIDOSIS IN SLAUGHTERED SMALL RUMINANTS AT THREE SELECTED EXPORT ABATTIORS OF EAST SHOWA ZONE OF OROMIA REGIONAL STATE.

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirement of the Degree of Master of Science in Tropical Veterinary Public Health

JUNE, 2010

DEBRE ZEIT, ETHIOPIA

STUDY ON PREVALENCE, ECONOMIC AND PUBLIC HEALTH IMPORTANCE OF HYDATIDOSIS IN SLAUGHTERED SMALL RUMINANTS AT THREE SELECTED EXPORT ABATTIORS OF EAST SHOWA ZONE OF OROMIA REGIONAL STATE.

BY

TESHOME BEKELE

Board of Examiner	**Signature**
1.Dr. Berhe G/Egziabhare	.....
2. Dr .Mesfin Sahle	.....
3. Dr. Karim Tounkara	.....
4. Dr. Nigussie Deyessa	.....

Academic advisers

Dr.Mosses Kyule [BVM, MSc,MVPM,PhD]	----------
Dr.Yacob Hailu [DVM, MVSc, PhD]	----------
Dr.Akafete Teklu [DVM,MVSc]	----------

ACKNOWLEDGMENT

First of all I would like to extend my Best gratitude to Dr. Mosses Kyule, Dr.Yacob Hailu and Dr.Akafete Teklu my academic advisors, for their kind cooperation, guidance and encouragement through out the study period and their fruitful suggestions for the fulfillment of this thesis.

Much of my heart felt thanks goes to the Ministry of Agriculture and Rural Development (MoARD) for sponsoring me to undertake the postgraduate study program and I sincerely appreciate the financial support of research USAID Ethiopian sanitary and phytosanitary and livestock and meat marketing (SPS- LMM) program.

I would like to express my sincere thanks to the management stuff, Meat inspectors, and workers of Hashim Ethiopian live and meat export, Mojo modern export abattoir and ELFORA export abattoir for their technical assistance.

Thanks is also accorded to Adama animal Quarantine staffs for their full cooperation during the study period.

Finally I would like to extend my special thanks to my wife Dr. Redeat Belayneh my daughters Kidan, Betel and Ruth Teshome for their moral support and their love.

TABLE OF CONTENT **Page**

LIST OF TABLE

Page

LIST OF FIGURES Page

LIST OF ABBREVATIONS

AAU	Addis Ababa University
AE	Alveolar Echinococcosis
CE	Cystic Echinococcosis
CDC	Center for Disease Control and prevention
Cm	Centimeter
DVM	Doctor of Veterinary Medicine
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization of the United Nation
HELMEX	Hashim Ethiopian Live and Meat Export
MMEA	Mojo Modern Export Abattoir
OIE	Office International des Epizootics
%	Percent
Spp	Species
SPSS	Statistical Package for Social Sciences
USD	United State of American Dollar
WHO	World Health Organization
X-Ray	Radiography

LIST OF ANNEX

ABSTRACT

The study was conducted from October 2009 to April 2010 with the objectives to determine the prevalence of hydatidosis in small ruminants slaughtered, in three selected export abattoirs Hashim Ethiopian live and meat export abattoir at Debere Ziet, Mojo modern export abattoir at Mojo and ELFORA export abattoir at Methara, and asses the economic losses and public health significance of the disease. In all study export abattoir routine meat inspection procedure was conducted where by lung, heart, liver, kidney and spleen palpation incised, and visualized to detect the presence hydatid cysts. The sizes of the cysts were determined by measuring the diameter in cm. Fertility was evaluated by observing the presence of protoscolices under the microscope and viability was determined. Out of 1150 small ruminants consisting 450 sheep and 700 goats slaughtered and inspected 39 (8.6%), and 48 (6.7%) sheep and goats respectively were found harboring hydatid cyst. In the current study the prevalence of hydatid cyst in sheep and goat at Hashim Ethiopian live and Meat export abattoir was 7.3 % (11) and 6 % (18) respectively ,while the respective figure at Mojo modern export abattoir was 12% (24) and 10 % (25). Moreover, in ELFORA export abattoir prevalence of 4% (4) and 3.3 % (5) was recorded in sheep and goat respectively. Over all hydatid cyst infection in sheep heart, lung, liver, kidney and spleen were found to be 15.3 %(13), 41.2 % (35), 27.1 %(23), 11.8% (10) and 4.7 % (4) respectively. Similarly 12.5% (12), 34.4 % (33), 42.7 %(40), 5.2 % (5) of infection were recorded in goats heart, lung, liver, kidney and spleen respectively. In general out of 180 examined hydatid cyst 42.5% (77), 21.5% (39), 15.4% (27) and 20.5% (37) were fertile viable, non viable, sterile and calcified cyst respectively. The direct and indirect economic losses per annum due to hydatidosis in sheep and goats slaughtered in the Hashim Ethiopian live and meat Export abattoir, Mojo modern export abattoir and in ELFORA export abattoir were calculated and found to be 242,045.08ETB, 497,285.23ETB and 62,589 ETB respectively. Thus, the overall annual economic loss in all abattoirs was estimated to be 801,919.31 ETB which is equivalent to 59,844 USD. Out of the total 19 stray dogs that were euthanized and examined in the study area, 2 (10%) of them revealed the occurrence of adult *Echinococcus granulosus* in their small intestine. Human hydatidosis, survey was conducted in Debereziet zonal hospital, in Adama referral hospital and Metehara sugar factory hospital. During this study one active case was recorded in 10 years old female coming from Arsi Zone Dera Town. Questioner survey presented to the three hospitals showed that during the last five years (2005-2009)

a total of 53 patients were found to be infected by hydatidosis among which 37 were male and 16 were female belong to different age groups.

Keyword: Export abattoir, hydatidosis, prevalence, economic losses, public health importance, sheep and goat.

Hence the objectives of the present study were:

- To determine the prevalence of hydatidosis in three selected export abattoirs.
- Assesses the economic impacts of the hydatidosis in the three selected export abattoir.
- Asses the occurrence of hydatidosis among human population in Debre Zeit, Adama and Methara hospitals.

2. LITERATURE REVIEW

2.1. Taxonomy

Hydatidosis/echinococcosis is a zoonotic infection caused by adult or larval (metacestode) stage of cestodes belonging to the genus *Echinococcus* and the family Taeniidae. At present, four species of *Echinococcus* are recognized: *Echinococcus granulosis, Echinococcus multilocularis, Echinococcus olgarthus and Echinococcus vogeli.* Among these, *Echinococcus granulosis* and *Echinococcus multilocularis* are the most important species in domestic animals and humans (Chandler,1961; Soulsby, 1986; Seimens, 2003).Two new species have recently been identified: *Echinococcus shiquicus* in small mammals from the Tibetan plateau and *Echinococcus felids* in Africa lion, but their zoonotic transmission potential is unknown (Pedro and Peter, 2009).

2.2. Morphology

2.2.1. Adult parasite

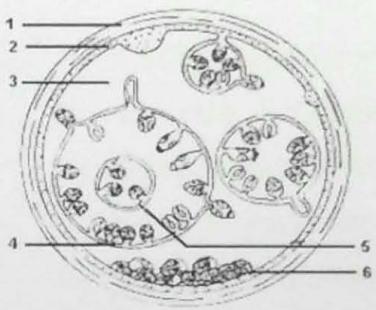
Adult *Echinococcus* is a very short tapeworm only rarely more than 7 mm long and usually has no more than six segment. Like all tapeworms, *Echinococcus* has no gut and all metabolic interchange takes place across the Syncytial outer covering tegument. Anteriorly, the adult *Echinococcus* possesses an attachment organ, the scolex, which has four muscular suckers and two rows of hooks, only large and one small, on the rostellum (Thompson, 1986).The body or strobila is segmented and consists of a number reproductive unit (proglottids), which may vary in number from two, to six. The adult worm is hermaphrodite with reproductive ducts opening at a common, lateral, genital pore, the position of which may vary depending on species and strain. There is a prominent cirrus sac, which may be horizontal or titled anteriorly and the vitellarium is globular. The uterus dilates after fertilization, eventually occupying most of the terminal segment when the eggs are fully developed (Urquhart e*t al*, 1996)

2.2.2. The egg

The eggs are ovoid (30μm-40μm diameter) consisting of hexacanth (six hooks onchospheres) they have highly resistant keratinized embryophore which gives the eggs dark striated appearances, the outer capsule quickly disappear once the egg is liberated.(Thompson *et al*, 1986). At a relative humidity of 25%, eggs of *Echinococcus granulosus* were killed with in 4 days and at 0%wihtin 1 day. Heating to 60^0C-80^0C killed eggs of *E. granulosus* is less than 5 minutes. On the other hand *Echinococcus* eggs can survive at freezing temperature (Reinecke, 1989).

2.2.3. The metacestode

The metacestode consists of a bladder with an external cellular laminated layer and an inner nucleated germinal layer, which gives rise asexual budding to brood capsules (Soulsby, 1982). The protoscolices arise from the inner wall of the brood capsule.



1. Fibrous tissue of host; 2. Germinal membrane of cyst;
3. Hydatid fluid; 4.Daughters cyst (brood capsule);
5. Grand daughter cyst; 6. Hydatid sand (protoscolices)

Figure1: *Echinococcus granulosus cyst*
Source: Pedro and Peter, 2009.

Figure 2: protoscolices from hydatid brood capsule
Source: Pedro and Peter, 2009.

The structure and development of the metacestode differs among the four species of *Echinococcus.* In the liver and lungs the cyst may have diameter of up to 20 cm but in rare sites such as abdominal

cavity, where unrestricted growth is possible, they may be very large and contain several liters of fluid (Charles and Hendrix, 1998). The cystic capsule consists of an outer membrane and an inner germinal epithelium when the cyst growth is complete in mature cyst broad capsules each containing a number of protoscolices buds off. Many of these broad capsules become detached and exist free in the hybrid fluids collectively, these detached broad capsules and scolices are often referred to as hydatid sand (Urquhart *et al*, 1996).

2.3. Life cycles

Echinococcus spp. requires two mammalian hosts for completion of its life cycle. Gravid Proglottids or free eggs are passed along with the feces of the definitive host, a carnivore. The eggs are ingested by intermediate hosts like cattle, sheep, goats, pigs and camel in which the metacestode develops (Pedro and Peter, 2009).The intermediate hosts, represented by a wide range of mammals, acquire the infection by the ingestion of eggs. Following the action of enzymes in the stomach and small intestine, the onchospheres are released from the keratinized embryophore (Thompson, 1986).

The onchospheres penetrates the wall of the small intestine. A hormonal secretion from the onchospheres aids the penetration in to the intestine. Upon gaining access to a venue, the onchospheres is passively transported to the liver, where some are retained, others reach the lungs, and a few may be transported further to the kidney, spleen, muscles, brain and other visceral organs. Once the onchospheres has reached its final location, it develops into the metacestode stage (hydatid cyst). The time of development is variable and it may take several months before protoscolices are produced (Soulsby, 1982).

Protoscolices containing hydatid cysts are ingested by a suitable definitive host, due to the action of pepsin in the stomach, they evaginate in the upper duodenum in response to a change in pH, exposure to bile and to increased temperature. Then they develop into sexually mature adult tapeworm, approximately four to six weeks after infection, depending on the species and strain, and on the susceptibility of the host (Eckert *et al.*, 2001).

The life cycle is completed when a dog ingests hydatid cysts containing protoscolices. Following ingestion, protoscolices evaginate, penetrate deeply between the villi in to the crypts of LieberKuhn and develop to maturity in about 47 days (Pedro and Peter, 2009). The domestic life cycles of *Echinococcus granulosus* strains involve the domestic dog as the principal definitive host and various species of domestic ungulates as intermediate hosts. The sylvatic cycles involve wild carnivores and ungulates (Rausch, 1995).In each of the cycles the specific role of various host may differ considerably among regions (McPherson, 2001; Seimenis, 2003).

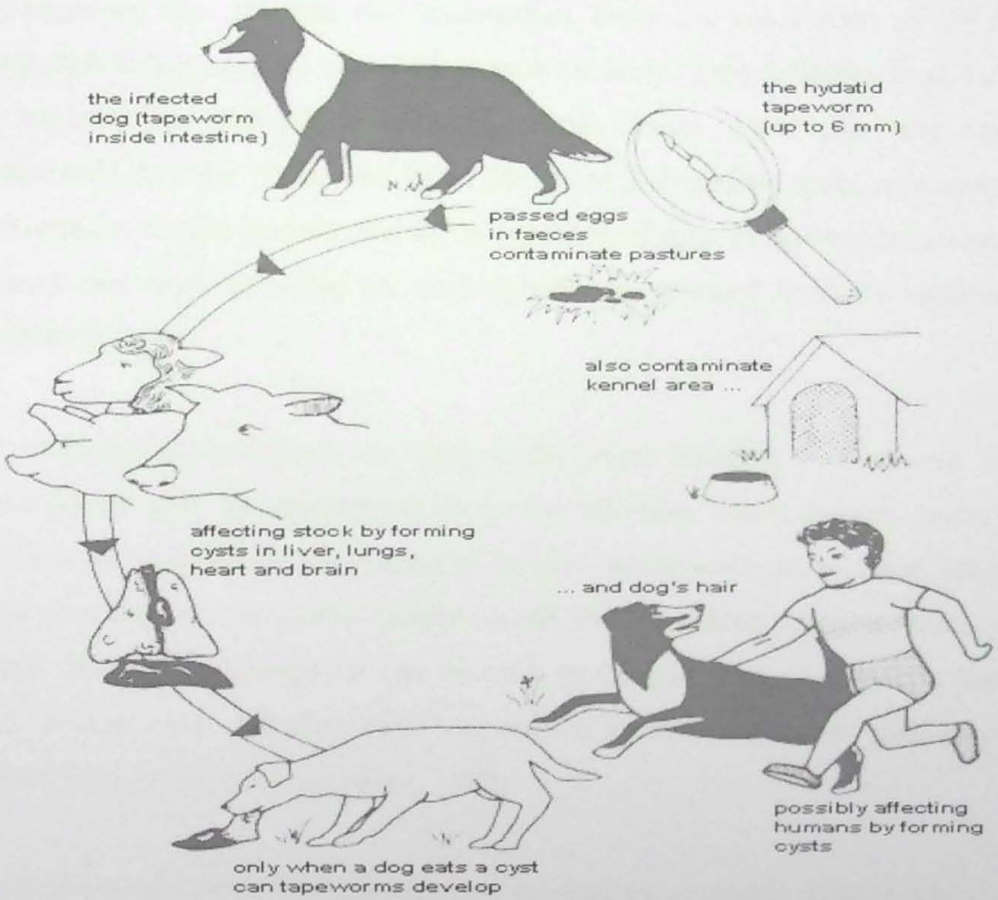


Figure 3: The hydatid life cycle

Source: Pedro and Peter, 2009

2.4. Epidemiology

The life cycle of *Echinococcus* spp. is complex involving two hosts and a free-living egg stage. The dynamics of transmission of the parasites are determined by the interaction of factors associated with these two hosts and with the external environment. Dispersion of eggs occurs within a short time of deposition and to a considerable distance from the fecal mass. This dispersion is radial and irrespective of the prevailing winds. However, birds, flies, beetles, ants, earth worms and flooding water are the most important factors involved in dispersion of the eggs (Gemmell *et al.*, 1987). The degree of infectivity and availability of egg in the environment and the feeding behavior of the intermediate host determine the number of infective organisms entering the host (Gemmell *et al.*, 2001; Torgerson *et al.*, 2002).

Human acquire primary cystic Echinococcosis by oral route ingestion of *E. granulosus* egg which are excreted by infective carnivores. The transition may be acquired by handling infected definitive hosts faces or eggs contaminating plant or soil followed by direct hand to mouth transfer. Also, drinking water contaminated with *Echinococcus* egg by the feces of infected carnivores is a potential source of infection (Eckert *et al.*, 2001).

Factors contributing to the transmition dynamics of *Echinococcus granulosus* in the farm situations are environment temperatures, environmental humidity, and agents to disperse egg from feces in to environment, level of awareness of human population, farming practice, feeding behavior of definitive and intermediate host, biotic potential, legistelation, meat inspection, innate and acquired immunity (Gemmell and Lawson, 1986).

2.4.1. Geographical distribution

The distribution of echinococcosis/hydatidosis is considered to be worldwide; a few areas such as Island, Ireland, and Greenland believed to be free of autochthonous human CE. For example, the united state has few cases in livestock and most human cases are imported. The same is true for regions of western and central Europe. In many parts of the world, CE is considered to be an

emerging disease. For example in the former Soviet Union and Eastern Europe, the number of observed case has dramatically increased in recent years (CDC, 2010)

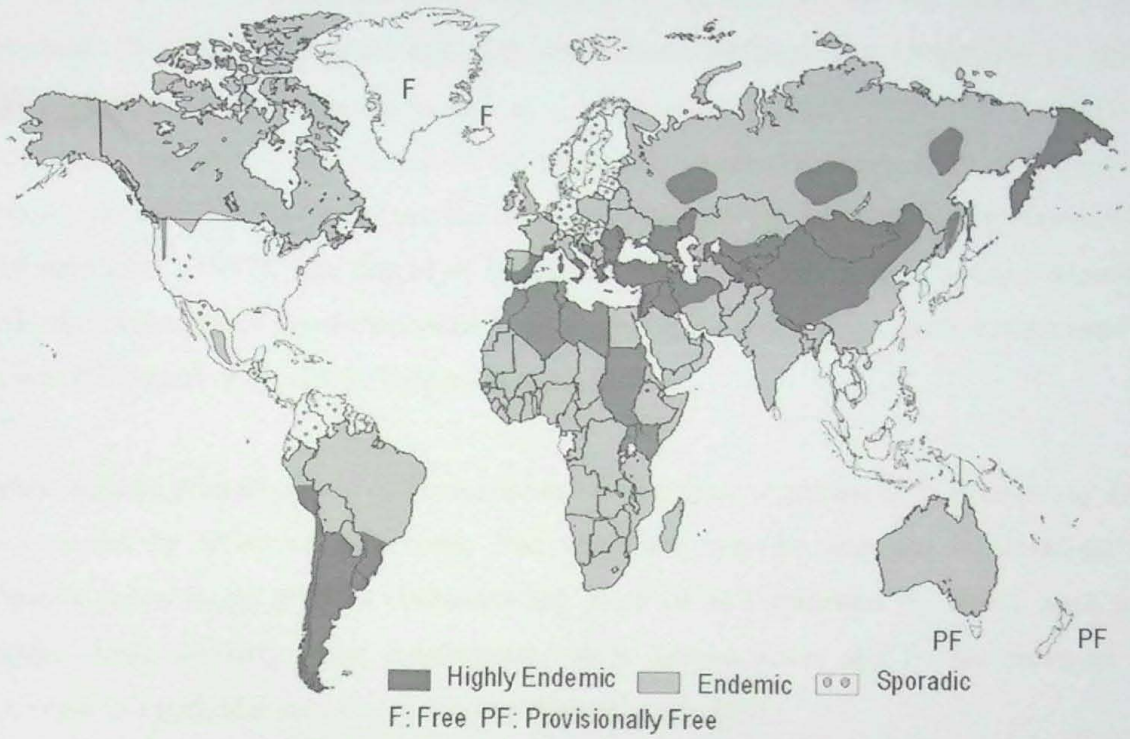


Figure 4: Global distribution of zoonotic strain of *Echinococcus granulosus*.
Source: (CDC, 2010)

In other regions of the world, Such as part of china, the geographical distribution and extent of CE are grater than previously believed (Chai, 1995). *Echinococcus granulosus* has a global distribution; *E. multicularis* occurs in wide areas of the Northern Hemisphere, *E. shiquicus* is found in the People's Republic of china and *E. Oligarthrus* and *E. vogeli* are confined to the central and south America (WHO/OIE, 2001).

2.4.2 Prevalence

High prevalence of cystic echinococcosis in human and animal host is found in countries of the temperate zones including South America, southern and central part of former Soviet Union,

central Asia, china, Australia and part of Africa (Pedro and Peter, 2009).The occurrence of *Echinococcus granulosus* is sporadic or has not been reported from other regions, including counters in Northern and Central Europe, in the pacific Region, and in the Caribbean (Urquhart *et al.*,1996). *Echinococcus granulosus* has been recorded from most of the Sub-Sahara African countries over a vast area stretching from the shale zone to South Africa areas of high endemicity are known to occur in east Africa, including at least part of Sudan, Ethiopia Kenya and Uganda (Craig *et al*, 1996).

In Ethiopia, it is one of highly prevalent diseases causing significant economic losses. The prevalence of hydatidosis in Ethiopia in different food animals recorded by different Authors in regions and Abattoirs are summarized in Table 1 (Yilma, 1985; Yelikal, 1989; Berssisa, 1994; Hagos, 2007; Kebede, 2008).Human CE is one of the most important endemic infectious diseases in Uruguay in 1973, the mortality rate of was estimated to be between 25and 42 per year (Perdno *et al.*, 2009). In the Mediterranean region human case of alveveolar echinococcosis are recorded (Raush 1995; Anderson *et al.*, 1997). In human, several ultra sound surveys have confirmed high prevalence of cystic hydatidosis in certain population group and areas. In 1985-1987 periods, a study was performed in semi desert regions of Sudan, Ethiopia, Kenya and Tanzania involved 18,565 humans of various ethnic groups.

The average prevalence hydatidosis was 1.8% with ranges between 0 to 5.6 in various regions and population group (MocPherson *et al*, 2001).High prevalence was also reported from northeast Turkana in Kenya with approximately 7.5% before 1983 and 3.1 % in 1992, 10 years after the initiation of control measures (McPherson and Wachira, 1997).

Table1. Prevalence and distribution of hydatidosis in different animal Spp. slaughtered in different Abattoir in Ethiopia.

Prevalence					
Cattle	sheep	goat	Study area	Author	Year
46.5	12.5	12.5	Debre Zite	Yilma	1984
21.5	14.7	7.1	Addis Ababa	Gemeda	1988
-	4.4	-	Desse	Yilikal	1989
37.7	6.6	2.7	Baherdar	Yemane	1990
25.5	18.8	9.3	Sodo	Fikere	1994
34.9	22.2	-	Nakamte	Bersissa	1994
28.3	15.1	-	South Wollo	Asrat	1996
31.1	-	-	Mekele	Hagos	2007
31.85	-	-	Mekele	Kebede	2008
21	19.9	16	Addis Ababa	Kebede	2008

2.5. Cystic echinococcosis in intermediate host

2.5.1. Cystic echinococcosis in sheep, goat and cattle

In cattle, cysts are often multiple and unicellular and the liver and lung are organs most commonly affected less frequently, cyst have been recorded in the Spleen, heart, brain and marrow cavity of bones (Dalimi *et al*., 2002; Umur, 2003). Sheep are typically infected with multiple polymorphic *Echinococcus granulosus* cyst mainly localized in the liver and lung but, the spleen, heart, kidney the Omentum and other organs can also be affected. Similarly, in goats, the liver and the lung are the main sites of predilection less frequently cysts have been recorded in the spleen heart, brain and marrow cavity of bone (Thompson *et al*, 1983). Hydatid cysts grow slowly and usually take several

years to develop to a size, where they may cause disease and symptom in animals. Fertile cyst may occur within about 6month in mice, 10-12 month in pig, but a bout 2-4years in sheep (Thompson, 1986).

2.5.2. Cystic echinococcosis in wildlife

Cystic *Echinococcus* has been recorded in a large number of wild animals. About 90 % of all the hydatid cysts recovered from buffaloes are sterile. Cysts have been recovered most commonly from the lungs, but they have also been reported in the liver, spleen, kidneys, heart, brain, diaphragm and uterus (Thompson, 1979**).** It has been shown the moose heavily infected with hydatid cyst in their lungs are caught more frequently by timber wolves and are usually the first to be shot by hunters (Ozcel *et al*, 1966)

2.5.3. Cystic echinococcosis in human

Hydatidosis in human is an infection, caused by a larval hydatid cyst stage of the tape worm *E. granulosus* or *E. multilocularis* (Aletras and Symbas, 2000). Although hydatid cyst may be asymptomatic for many years, more commonly, the disease is solely progressive, and pressure effect symptoms and complication eventually arise (Timothy *et al.,* 2001). The metacestode of all the four recognized *Echinococcus* species can infect human and cause various form of echinococcosis. Among these forms cystic and alveolar echinoccosis are of special medical importance (WHO, 1996)

Cystic hydatid disease is an important and widespread Zoonosis, especially in sheep-raising area of Europe (Mediterranean Countries) Asia (Russia, China), North and East Africa, Australia, and South America (Peru, Bolivia, Argentina, Chili Uruguay, and Brazil). It Affect the liver (52-77%) of case, lung (9-44%) and other organs such as brain, heart and bones. Cystic hydatid disease is a major public health problem in Peru, with a prevalence of 6-9% in many areas of the country and numerous human cases reported every year (Timothy *et al.,* 2001).

From epidemiological point of view, it might be useful to differentiate between intermediate host which play a role in the perpetuation of the cycle and aberrant or accidental host which represent

blind alley for the parasite as latter are not involve in disease transmission. This may be because metacestode stage do not become fertile in there hosts or because such hosts do not interact in the transmission cycle, with a few rare exceptions, human belong to the group as aberrant host (Smith, 1994).

Human acquire hydatidosis by ingesting of *Echinococcus* egg which are exerted by infected carnivores (Ecert *et al*, 2001). The infection may be acquired ether by handling infected definitive host, feces containing egg, eggs contaminated plant or soil followed by directed ingestion of the eggs. Egg can also be ingested along with vegetable, salads, fruit and other plants which have been contaminated with *Echinococcus* egg. The following have been also incremented in transmission wind birds, beetles, flies and drinking water contaminated with *Echinococcus* eggs by the feces from of infected carnivores (Craig *et a*l., 2007).

The identification of risk factors in generally difficult for various reasons such as long time interval between infection and diagnosis of hydatidosis and high mobility of patients and migrations of definitive host (Eckert *et al*., 2001). Metacestode develop in various site of the human body from onchospheres liberated from ingested eggs of *Echinococcus* Spp. In cystic *Echinococcus* parasite cysts may establish in the lung are the most frequently affected Organs. In alveolar *Echinococcus*, the liver is involved in 98% to 100% of the case as primary site of metacestode development (WHO/OIE, 2002).

Metacestode material spreads from primary site to the adjacent or distant organs and proliferates. In CE this form occurs after release of viable parasite material (protoscolices, small daughter cysts) during invasive treatment procedure or after spontaneous or trauma induced cyst rapture. Secondary cystic *Echinococcus* is caused by the tumor like prolongation of the metacestode with direct infiltration of adjacent organ or by metastasis formation in distant organs due to spreading of parasite cell via lymph and blood vessels. The initial phase of primary infection is always asymptomatic, and small less than 5cm well in capsulated cysts located in organ sites where they do not induce major pathology, may remain a symptomatic for many years or permanently. After an undefined incubation period of several months or years, the infection may become symptomatic if cysts exert pressure on

When human are involved as the intermediate hosts, hydatid cysts in the lungs and livers result in clinical signs. The liver is the most common site of the *Echinococcus* cysts of the pastoral strains (>65% Figure 3) followed by the lungs (25%) the cysts is seen less frequently in the spleen, kidneys, heart, bone, and central nervous system. The clinical manifestations of cystic echinococcosis are variable and are determined by the site, size, and condition of cysts (Pedmoro and Peter, 2009).

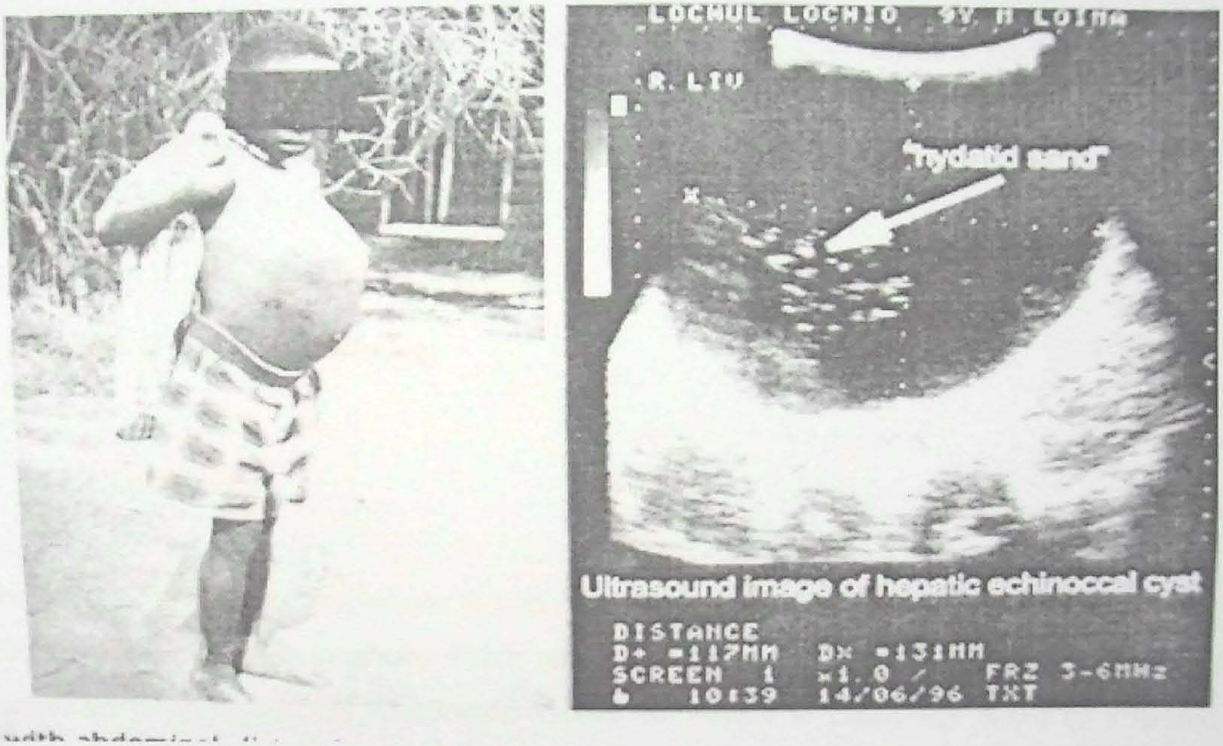


Figure 5: Abdominal distention due to cystic echinococcosis of the liver

Source: (Pedmoro and Peter, 2009)

In humans clinical signs may occur after a highly variable incubation period of several month or year The liver cysts may remain asymptomatic for periods of 10-12 years. But they cause pain in the upper abdominal region, hepatomegaly, biliary cirrhosis portal hypertension, ascites and a variety of other manifestations (Amman and Eckert, 1995).

2.6.2. Pathology

In the small intestine *Echinococcus* penetrates deeply between the villi into the crypts of Lieberkühn attaching with the suckers and rostellar hooks to the epithelium. This intimate parasite host relationship normally does not cause significant pathology. Minor changes may occur, such as local flattening of epithelial cell slight cellular infiltration of the mucosa and increased mucus production. Excretory products released from the scolex region of the parasite may induce the production circulatory antibodies (Thompson *et al.*, 1986).

The cyst of *Echinococcus granulosus* vary greatly in size and shape (typically unilocular, but sometimes multilobed or multilocularis), and may be present in large numbers in one or several organs the location of cysts and cyst morphology is controlled not only by the host factors, but also by parasite factors such as the strain of *Echinococcus granulosus* involved. Usually the host and the metacestode of *Echinococcus* coexist well. Initially, following infection, there is a cellular response from the host (Thompson and Allsopp, 1988).This resolves and causes to develop a fibrous capsule (adventitial layer) around the parasite, which enlarges to accommodate the cyst as it grows.

Under certain circumstances, the cellular response from intermediate host is protracted resulting in the death of the parasite (Thompson and Allsopp, 1988). Displacement of the lung or liver tissue and fibrous of the area surrounding the cyst, as well as pressure placed on the organs as a result of the hydatid cyst increasing in size during the life of intermediate host results in pathological tissue changes. Occasionally larvae localize in kidney, spleen or brain tissue where their effect are more sever and often fatal (DNR, 2009).

2.7. Diagnosis

2.7.1. Diagnosis *Echinococcus* egg (fecal sample)

Eggs can be detected in faecal sample using routine flotation technique or on the principal skin using clear adhesive tape, which is pressed to the skin, transferred to a microscopic slide and examined (Charles, 1998).

2.7.2. Immunodiagnosis

Immunodiagnosis involves the following alternative approaches: Detection of parasite antigens in faeces (Coproantigen) and serum antibody detection. Coproantigen detection by (ELISA): several groups have described ELISA for the detection of coproantigens released by cestodes, including *Taenia* species of dogs and humans (WHO/OIE, 2002).

In several studies detection of *Echinococcus granulosus* coproantigens was highly specific, and significant cross-reactions have not been observed in experimental *Taenia* spp. using faecal samples from necropsid stray dogs /with *Taenia* spp or intestinal nematodes or helminth- tree involving 183 animals over all specificity was 97 % (Smith, 1994). When *Echinococcus granulosus* worm burdens are greater than 100, the sensitivity of coproantigen tests approaches 92 % to 100 % when post mortem worm counts or arecoline purge counts are below 100 worms then sensitivity is variable (29 % -70 %) with the current coproantigen ELISA. Despite an over all sensitivity for coproantigen tests of 63 % to 77 %, more than 90 % of the biomass of adult *Echinococcus granulosus* present in a target dog population will be detectable (WHO/OIE, 2002). For coproantigen tests, faecal samples are directly taken from the rectum or the ground and mixed with buffer solution. Such samples can be stored for some days in the refrigerator or they may be deep frozen (- 20 ^{0}C) until use. The coproantigen test can be used for identifying pregnant bitchs, old dogs and young puppies (Smith, 1994).

Serum antibodies (IgG, IgA, Ig E) can be detected in experimental canine echinococcosis using a *Echinococcus granulosus* protoscolex antigen preparation in ELISA and *Echinococcus granulosus* ant body could be detected by 2-3 weeks post infection. However, while sensitivity was reported to be hig

(73 %) for natural canine *Echinococcus granulosus* infection in southeast Australia, there was no correlation with worm burden. Further application of the *Echinococcus granulosus* protoscolex ELISA in endemic areas of Kenya and Uruguay indicated poor correlation (sensitivity 35 % - 40 %) with positive worm identification at necropsy.

2.7.3. Diagnosis of adult parasite in carnivores

Proglottids of *E. granulosus* spontaneously discharge by dogs are detected mostly on the surface of faecal samples, may allow a correct morphological diagnosis, if they are in a good condition. Necropsy is invariably employed in studies of *Echinococcus* in wildlife and is useful if dog are humanly culled. The small intestine is removed as soon as possible after death, and tied at both end. If the material is not frozen or formalin fixed (4-10%). it should be examined quickly, as the parasite can be digested within 24 hour (OIE, 2008).

The standard method currently used for surveys of *Echinococcus granulosus* infection in dog the population is arecoline purging. It involves the application of arecoline to dogs and the examination of fecal material discharged after purging. Arecoline is the chief alkaloid of the areca nut, the seed areca catechu. Arecoline hydro bromide is a parasympathomimetic drug with a major action on the smooth muscle of the small intestine, as well as paralyzing the worm itself. The subsequent purification carries the worms out with the faces. For this activity, the drug must be given by the oral route or occasionally per rectum (WHO/OIE, 2002).

2.7.4. Diagnosis of larvae echinococcosis

Although surveillance for *E. granulosus* in domestic animals may take place in licensed slaughter house that for *Echinococcus* species in wild life must be done by field surveys. Specimens should be preserved by removal of tissue and fixation in 4 % formal saline or keep cool at $+4^0$c or deep frozen at -20^0c for subsequent examination. Hydatid cyst in intermediate host occur most frequently internal organs including the CNS, the skeletal muscles and in the marrow cavity of bone. Larvae can be

observed in many organs, but in large animals, such as sheep and cattle, palpation and incision should be done (OIE, 2008).

2.7.5. Diagnosis of human hydatidosis

Immunodiagnostic tests are commonly used in the diagnosis of human hydatid disease. Tests such as indirect haemaglutination, indirect Immuno- florescence, latex agglutination and enzyme linked immunosorbant assay (ELISA) are highly sensitive in detecting circulating antibodies in sera from patients with hydatid diseases (WHO, 1996). In many cases, a diagnosis can be made by detecting the characteristic structure and size of *Echinococcus granulosus* cyst visualized by various imaging techniques, including Ultrasonogeraphy (US), computed tomography (CT), standard radiology (X-ray) and magnetic resonance imaging (MRI) in specialized centers (WHO/OIE, 2002).

2.8. Treatment of hydatidosis

2.8.1. Treatment in dog

Treatment in definitive host can be accomplished by giving praziquentel or arcoline. Dose rate have varied between 1.75mg/kg and 3.5mg/kg body weight. The drug may be given in tablet or liquid form (Chandler *et al*., 1961).

2.8.2. Treatment in intermediate host

At present, there is no routine treatment of domestic animals against hydatidosis. Several groups of drugs including cytostatics, antibiotics, sulphonamides, and antiprotozoal compound and several antihelminthic drugs have been tested for their efficacy against the metacestode stage of *Echinococcus*, the efficacy trials for these drugs have been mostly carried out in rodents, but some have also been tested in domestic livestock species. The most promising results were obtained with antihelminthics of the Bezimidazole group (WHO/OIE, 2002).However the application of Bezimidazoles in effective dosages would be too expensive. Extensive trials with Bezimidazole

have also been carried out in rodents infected with metacestode of *Echinococcus multilocularis*. In trials using long term treatments with Albendazole (60 days), Flubendazole (60 - 200 days) and Mebendazole (60 - 300 days) at 30 mg/kg - 50 mg/kg .b.w there was up to 99 % reduction in metacestode weight, as compared with untreated controls (WHO/OIE, 2002). Studies suggest that Praziquentel may be effective in the treatment of CE in domestic animals (Gonzales *et al*., 1996; Erica *et al*, 1999).

2.8.3. Treatment in human

The most common form of treatment for *Echinococcus* cyst is surgical removal of the cyst with avoidance of the adverse consequences of spelling the contents. Although removal of the parasite mass is not usually 100% effective, surgery may be impractical in patients with multiple cysts of localization in several organs and if surgical facilities are inadequate (WHO, 1996).Long term treatment with mebendazole (50mg/kg/day) or albendazole (15mg/kg/day) inhibits growth of larvae *Echinococcus Multiloculars*, reduces metastasis, and enhance both the quality and length of survival; prolonged therapy can eventually be larvicidal in same patients (Peter and Schantz, 2008).

2.9. Economic significance of hydatidosis

Cystic echinococcosis is a serious zoonosis with economic impact and its public health importance and CE is currently re-emerging some countries (Buishi *et al*., 2005). The economic losses due to CE infections in animals include reduced value of fleece, milk and meat production the cost of CE in humans were due to medical treatment , surgical operation and were due reduced quality of life following the surgery, morbidity due to undiagnosed CE and loss of productivity for the affected people (Azlaf and Dakkak, 2006; Torgerson, 2003).

2.9.1. Cost due to disease in livestock

There are five major costs from cystic Echinococcosis infection in livestock which includes Condemnation of viscera /organs of infected animals, distraction of infected viscera reduced yield quality of milk, meat and wool/hides, and reduction in working power of animal. In Ethiopia the

economic lose in curried by hydatidosis is not well studied. However the most study reports it is shown the economic lose due to the disease is significant. Also the compiled study on the domestic animals from 1985-2008 on cystic *Echinococcus* at Debre Zeite, AAU, and FVM has shown that the disease causes considerable economic and socio economic problems (Bersissa, 1994; Yilma, *et al*, 1996; Fikadu, 1997; Hagos, 2007; Kebede, 2008).

2.9.2. Cost due to alternative control program

Effective control of *Echinococcus*/hydatidosis can be achieved with multi phase programs and to accomplish the program it needs budget allocation, for every activities the program implication that includes planning the program, cost of education services to be given for the community cost for drugs to doe worm dogs regularly, cost for surveillance of the disease in animals and humans travel allowance, purchasing materials and equipment for the program cost data collection, entering and analysis and other total cost can be registered as cost due to alternative control programs of the diseases (Anderson *et al*, 1997).

2.10. Public health importance

In developing countries, lack of effective meat inspection and practice of backyard slaughter where hydatid cyst infected viscera are left for home dogs and stray dogs play a major role in the maintenance of the disease in domestic ruminants and human.This particularly true in sub-Saharan Africa including Ethiopia. Human infection occurs, because of contact with faecal contaminated material from infected dogs. The highest prevalence of hydatid disease around the world is always in the cattle and sheep herding population with high level of human dog contact (WHO, 1996).

The economic significance of hydatidosis in the public health sector include medical and surgical fees and cost of hospitalization, nursing, drugs and convalescence, loss of income and productivity, absence from work, reduced capacity for work or permanent incapacity, losses due to mortality and social consequences of disability and mortality (WHO / OIE, 2002).

2.11 Control and prevention

Hydatidosis can be controlled by avoiding dog access to infected raw offals through proper disposal of condemned offals at Abattoirs, local slaughterhouses and on farms. Further control methods include introduction of appropriate meat inspection, establishment of local slaughterhouses, education of the people, effective implementation of legislative measures, burning or burial of condemned offal's and sterilization of offals, if it is to be used as dog food (Craig *et al*., 2007). The reduction in the parasite bio mass forms the second important measure in the control of hydatidosis.The methods that can be applied include, control of dogs by registration (collar/ tattoo); reduction of dog population through banning of dogs from restricted areas, mass killing of stray dogs and reduction of tapeworm population by mass drug treatment or test and penalize (FAO/WHO, 1982).

3. MATERIAL AND METHODS

3.1 The study area

The study was conducted in Hashim Ethiopian live and Meat Export abattoir, Mojo modern Export Abattoir and ELFORA Export abattoirs at Debre Zeit, Mojo and Methara respectively in East Showa Zone of Oromiya regional State (Annex 6).The study area located with different types of altitude ranging from 1000-3100 above seal level. The mean annual rainfall of the Zone is 500- 1200 mm and the daily mean maximum and minimum temperature is 30^0C-42^0C and 10^0C-28^0C, respectively. The human population of the zone is 1,428,250 million. The livestock population is estimated to be 865,106 Bovine, 447,050 Ovine, 549,993 Caprine, 216,174 equine and 63,331camel (East Showa Zone Agricultural office, 2008).

3.2 Study Animal

The study was undertaken in small ruminant (sheep and goat) male local breeds from deferent region of Ethiopia that were slaughtered in Hashim Ethiopian live and meat export (HELMEX),Mojo modern export (MMEA), and ELFORA export abattoirs at Deberezite, Mojo and Metehara town respectively, stray dogs to assess the status of *E.granulosus*. The information obtained from all study export abattoirs indicate that the average annual slaughtering capacity is 150,000-200,000 small ruminants. Due to the working condition of the export abattoirs it was difficult to trace back the specific origin of the animals. But 95% were brought from lowland or pastoral area (Oromiya, Afar and SNNPA).

3.3 Study design and sampling method

The study design employed was a cross sectional type with the objective of determining the prevalence and economic loss due to hydatidosis in sheep and goat by post mortem examination of visceral organs like lung, heart, liver, kidney and spleen systematic random sampling method was employed in selection of the sample unit at all export abattoirs.

the principle that viable protoscolices should completely or partially exclude the dye while the dead one take it up (McPherson *et al.*, 1985).The technique differentiate between dead (red stained) and alive (unstained) protoscolices (FAO/WHO,1982). Furthermore, infertile cysts were further classified as sterile or calcified. Sterile hydatid cysts were characterized by their smooth inner lining usually with slightly turbid in its content. Typical calcified cysts produce a gritty sound feeling up on incision (Soulsby, 1982).

3.3.4. Monetary losses

The monetary losses due to hydatidosis in slaughtered sheep and goat were estimated in three export abattoirs. The annual loss of liver, kidney and heart condemnation due to hydatid cyst was estimated. In current study spleen and lung was not considered because they have no significant local or export market. The financial losses estimation was described as follow:

The selling price of edible offals (Heart, liver, and kidney) 1 kg of mutton and goat meat were estimated based on information collected by structured questioner survey from the export abattoir (Annex 1). Average annual slaughtering rate of sheep and goat were obtained from registered meat inspection record book of study export abattoirs from 5 years retrospective data (2005-2009) for Hashim Ethiopian live and meat export and Mojo modern export abattoir similarly from 3 year data (2007-2009) for ELFORA export abattoir (Tables 9, 10, 11).

Tropical breeds of sheep posses live weight from 20-45 kg at maturity and the average dressing out percentage range 40-48 % (Williamson and Payne, 1978). The average carcass weight of black head sheep estimated 14.5 kg, and Ethiopian breed goat like afar and Somali have dressing percentage on a slaughter body weight in the range of 42.5%-46.6% and the average carcass weight of goat estimated 13.5 kg. (Sebesebe *et al.*, 2007).Therefore the average export price of 1kg mutton and goat meat is 3.5 USD in all three export abattoirs and edible offal's like (liver, kidney, heart) 2.50 USD per kg. Redaction in dressing carcass weight of infected small ruminant due to hydatidosis carcass loss of sheep and goats 2.5 % was computed in this study based on method by (Polydorous, 1981)

The annual loss of heart, livers and kidney condemnation and carcass weight loss due to hydatid Cyst was estimated using the following formula set by (Ogunrinade *et al.*, 1980*)* as follows:

$$ACHLK = (CSR \times PL_1C \times L_1C) + (CSR \times PL_2\,C \times L_2C) + (CSR \times PL_3\,C \times L_3\,C)$$

Where:

ACHLKC = Annual Cost of Heart, Liver and kidney Condemned.

CSR = Average number of slaughtered animals per annum in the study export abattoir

PL_1C = Percent of heart Condemned

$L_1\,C$ = Price of one kg of heart in the study export abattoir.

PL_2C = Percent of Liver Condemned.

L_2C = Price of one Kg of Liver in the study export abattoir.

P L_3C =Percent of kidney condemned.

$P_3\,C$ =Selling price of kidney in the study export abattoir.

The annual carcass weight loss due to hydatid cyst was estimated by using the following formula set by (Polydorous, 1981*)* as follows:

$$ACW = CSR \times CL \times BC \times P$$

Where:

ACW = Annual loss from Carcass Weight due to hydatidosis

CSR = Average number of Slaughtered animal per annum in the study export abattoir.

CL = Carcass weight Loss in individual due to hydatidosis.

BC = Average selling price of 1 kg mutton or goat meat / in the study export abattoirs

P =Prevalence rate of hydatidosis in study export abattoirs

Using these two formulae the direct and indirect economic losses due to condemnations of heart, liver and kidney and indirect losses due to carcass weight losses from hydatid cyst infection was estimated by summation of annual condemned of edible offal (heart, liver and kidney) by average selling price for each organs /kg and cost of carcass due to weight loss.

3.3.5 Public health significance study

In order to asses the occurrence of human cystic echinococcosis among human population during the last 5 yeas (2005-2009), the structured questionnaire survey developed was distributed to Adama referral hospital, Deberezite zonal hospital and Methara Sugar factory hospitals (Annex 2). In addition Adama and Deberezite hospital surgeons were interviewed to check for the presence of any active case in the hospitals to asses the current infection rate of human hydatid cyst in the East Showa zone.

3.4 Data Analysis

All the data collected from the abattoir were recorded and entered in to Ms excel sheet. The data were analyzed using SPSS 15.0 window software. The economic loss of condemned organs in the three export abattoirs was made by taking the current selling price of the organs (liver kidney and heart) in to consideration organ due to organ. Descriptive statistics such as percentages and frequency distributions were used to describe the nature and the characteristics of the data. Chi square (x^2) statistical test was applied to see the differences in the prevalence of hydatid cyst in animal slaughtered among the three export abattoir. A statistically significant association between variables were said to exist if the P-value was less than 0.05.

4 .RESULTS

4.1 Prevalence of hydatid cyst in slaughtered sheep and goat in three export abattoirs

In this study in Hashim Ethiopian live and meat export abattoir (HELMEX) 450, Mojo modern export (MMEA) 450 and ELFOR 250 export abattoir a total of 1150 small ruminant (sheep and goat) were slaughtered and examined for the presence of hydatidosis (Table 2). Based on this assement the prevalence of hydatid cyst in the above mentioned export abattoirs 6.4 % (29), 10.8% (49) and 3.6% (9) respectively.

Table 2: Prevalence of hydatid cyst in three study export abattoir

Abattoirs name	Sheep	Goat	Total Examined	Prevalence %	
HELMEX	150	300	450	29	6.4
MMEA	200	50	450	49	10.8
ELFORA	100	150	250	9	3.6
Total	450	700	1150	87	7.5

Chi- square (X^2) =13.53; P = 0.001 df =2

These prevalence were significantly different (P=0.001) in animals slaughtered in the study export abattoirs. In current study the prevalence of hydatid cyst in Hashim Ethiopian live and meat export abattoir 11 (7.3 %) and18 (6 %) were recorded in sheep and goat respectively. There was no significant variation (P = 0.58) in two species (Table 3). Similarly, in Mojo modern export abattoir the prevalence of hydatidosis were (12 %) 24 and (10 %) 25 in sheep and goat respectively. In this

abattoir the study also record there was no statistical significant variations (P=0.54). Likewise the prevalence of hydatid cyst in ELFORA export abattoir 4 (4%) and 5 (3.3%) were observed in sheep and goat respectively (Table 3) similarly in this abattoir also no statistical significant variation in two specious (P= 0.78)

Table 3: Prevalence of hydatidosis in slaughtered sheep and goat in three study export abattoir.

Name of the abattoir	Sheep			Goat		
	No. of Examined sheep	No. of infected		No. of Examined goat	No. of infected	
		No	%		No	%
HELMEX	150	11	7.3	300	18	6
MMEA	200	24	12	250	25	10
ELFORA	100	4	4	150	5	3.3
Total	450	39		700	48	

Chi- square (X^2) = 1.2, DF =1, P = 0.25

4.2 Distribution, intensity and size of hydatid cyst

In this study lung and liver were the most affected organ in both species of animals (Tabel 6) there was significant variation (P= 0.000).Lungs were the most affected organs than the other examined organs. In the current study total of 85 cysts from sheep and 95 cysts from goat were collected from infected organs and differentiated as small, medium or large size (Table 6).

Table 4: (see page34) Cyst sizes and count in different organs in infected sheep and goats slaughtered in the three export abattoirs.

Name of the Abattoir.	Spp.	Organ	No. of Cyst Count	Cyst count in terms of size					
				Large		Medium		Small	
				No	%	No	%	No	%
MMEA	Sheep	Heart	12	3	25	6	50	3	25
		Lung	19	2	10.5	8	42	9	47.3
		Liver	14	3	21	8	57	3	21.4
		Kidney	5	0	0	3	60	2	40
		Spleen	3	2	66	1	33.3	0	0
		Total	**53**	**10**	**1.8**	**26**	**4.9**	**17**	**32**
	Goat	Heart	8	1	12.5	4	50	3	37.5
		Lung	19	3	15.7	5	26.3	11	57
		Liver	23	5	21.7	12	52	6	26
		Kidney	3	0	0	2	66.6	1	33.3
		Spleen	4	0	0	2	50	2	50
		Total	**57**	**9**	**15.7**	**25**	**43.8**	**23**	**40.3**
HELMEX	Sheep	Heart	2	0	0	1	50	1	50
		Lung	8	1	12.5	7	87	0	0
		Liver	5	0	0	3	60	2	40
		Kidney	3	0	0	0	0	3	100
		Spleen	1	0	0	0	0	1	100
		Total	**19**	**1**	**4.3**	**11**	**47**	**7**	**30**
	Goat	Heart	6	1	16.6	1	16.6	4	66.6
		Lung	13	3	18.7	8	61.5	2	15.3
		Liver	11	1	7.6	7	53.8	3	23
		Kidney	1	0	0	0	0	1	100
		Spleen	2	0	0	0	0	2	100
		Total	**33**	**5**	**14**	**16**	**45.7**	**12**	**34.2**

Table 4: (see page 33) Cyst sizes and count in different organs in infected sheep and goats slaughtered in the three export abattoirs.

Name of the Abattoir.	Spp.	Organ	No of Cyst Count	Cyst count in terms of size					
				Large		Medium		Small	
				No.	%	No.	%	No.	%
ELFORA	Sheep	Heart	1	0	0	0	0	1	100
		Lung	8	2	25	5	62.5	1	12.5
		Liver	4	1	25	3	75	0	0
		Kidney	0	0	0	0	0	0	0
		Spleen	0	0	0	0	0	0	0
		Total	**13**	**3**	**23**	**8**	**61**	**2**	**15.3**
	Goat	Heart	0	0	0	0	0	0	0
		Lung	0	0	0	0	0	0	0
		Liver	5	1	25	1	25	3	60
		Kidney	0	0	0	0	0	0	0
		Spleen	0	0	0	0	0	0	0
		Total	**5**	**1**	**25**	**1**	**25**	**3**	**80**

Table 5: (see page 36) Type of hydatid cyst in different organs of infected sheep and goats slaughtered in three export abattoirs.

Name of the Abattoir.	Spp.	Organ	No of Cyst Examined	Cyst condition							
				Fertile				Sterile		Calcified	
				Viable		Non viable					
				No	%	No	%	No	%	No	%
MMEA	Sheep	Heart	12	5	41.6	3	25	1	25	1	10
		Lung	19	5	26.3	4	21	6	31.5	4	21
		Liver	14	3	21	4	28.5	4	28.5	3	21.4
		Kidney	5	3	60	1	20	2	33.3	0	0
		Spleen	3	2	66.6	1	33.3	0	0	0	0
		Total	**53**	**18**	**34.6**	**13**	**25**	**13**	**25**	**8**	**15.3**
	Goat	Heart	5	1	25	2	40	3	60	0	0
		Lung	12	5	41.6	5	41.6	2	16.6	7	58.3
		Liver	25	9	36	9	36	3	12	4	16
		Kidney	4	1	25	2	40	0	0	1	25
		Spleen	3	1	33.3	0	0	0	0	2	66. 6
		Total	**57**	**17**	**17.5**	**18**	**31.5**	**8**	**14**	**14**	**24**
HELMEX	Sheep	Heart	2	1	50	0	0	1	50	0	0
		Lung	8	4	50	1	12.5	1	12.5	2	25
		Liver	3	0	60	3	40	0	0	0	0
		Kidney	4	3	75	1	25	0	0	0	0
		Spleen	2	2	100	0	0	0	0	0	0
		Total	**19**	**13**	**61.9**	**4**	**19**	**2**	**9.5**	**2**	**9.5**
	Goat	Heart	5	3	60	0	0	2	40	0	0
		Lung	14	8	57	0	0	2	14.2	4	28.5
		Liver	11	7	63	2	18	0	0	2	18
		Kidney	1	1	100	0	0	0	0	0	0
		Spleen	2	2	100	0	0	0	0	0	0
		Total	**33**	**21**	**63**	**2**	**6**	**4**	**12.1**	**6**	**18**

Table 5: (see page 35) Type of hydatid cyst in different organs of infected sheep and goats slaughtered in three export abattoirs.

Name of the Abattoir.	Spp.	Organ	No of Examined Cyst.	Cyst condition							
				Fertile				Sterile		Calcified	
				viable		Non viable					
				No.	%	No.	%	No.	%	No.	%
ELFORA	Sheep	Heart	1	0	0	0	0	0	0	1	100
		Lung	8	4	50	0	0	0	0	4	50
		Liver	4	3	75	1	25	0	0	0	0
		Kidney	0	0	0	0	0	0	0	0	0
		Spleen	0	0	0	0	0	0	0	0	0
		Total	**13**	**7**	**53.8**	**1**	**7.6**	**0**	**0**	**5**	**38.4**
	Goat	Heart	1	0	0	0	0	0	0	1	100
		Lung	0	0	0	0	0	0	0	0	0
		Liver	4	1	40	1	25	1	25	1	25
		Kidney	0	0	0	0	0	0	0	0	0
		Spleen	0	0	0	0	0	0	0	0	0
		Total	**5**	**2**	**40**	**1**	**25**	**0**	**16.6**	**2**	**33.3**

Table 6: Overall Cyst counts and cyst sizes in different organs examined in sheep and goats in three export abattoirs.

Species of Animal	Sample Type (Organ)	Total	Meat inspection result				Cyst Size					
			Negative		Positive		Large		Medium		Small	
			No	%	No	%	No	%	No	%	No	%
Sheep	Heart	450	437	97	13	2.8	3	8.5	7	53.8	5	38.4
	Lung	450	415	92	35	7.7	5	14.5	20	57.1	10	28.5
	Liver	450	427	95	23	5.1	4	1.7	14	60.8	5	21.7
	Kidney	450	440	98	10	2.2	0	0	3	30	5	50
	Spleen	450	446	99	4	0.8	2	50	1	25	1	25
	Total	2250	2165		85		14		45		26	
Goat	Heart	700	688	20.2	12	1.7	2	16.6	5	41.6	7	58.3
	Lung	700	667	95	33	4.8	6	50	13	39.3	13	39.3
	Liver	700	660	94	40	5.7	7	17.5	20	50	12	30
	Kidney	700	695	99	5	0.7	0	0	2	40	2	40
	Spleen	700	695	99	5	0.7	0	0	2	40	4	40
	Total	**3500**	**3405**		**95**		**15**		**42**		**38**	

4.3 Fertility Viability and sterility of hydatid cyst

In current study, a total of 85 cysts from sheep and 95 in goats were found in infected organs these cysts were examined for viability and the results are presented in (Table 7). Overall viability of cysts without considering animal species are shown in (Table 8).

Table 7: Overall type of hydatid cyst (fertile, sterile, and calcified) in different organs in infected sheep and goat slaughtered in three export abattoirs.

Spp.	Organ	Cyst condition								Total
		Fertile				Sterile		Calcified		
		Viable		Non viable						
		No	%	No	%	No.	%	No.	%	
Sheep	Lung	13	37	5	14	7	20	10	28.5	35
	Heart	6	46	3	23	2	15.3	2	15.3	13
	liver	9	39	7	30.4	4	19	3	14.2	23
	Kidney	6	60	2	20	2	18.1	0	9	10
	Spleen	4	100	1	25	0	0	0	0	4
	Total	37		18		15		15		85
Goat	Lung	13	39.3	5	15	4	12.1	11	33.3	33
	Heart	4	33.3	2	16.6	5	38.4	1	7.6	12
	liver	18	45	12	30	4	10	7	17.5	41
	Kidney	2	40	2	40	0	0	1	20	5
	Spleen	3	60	0	0	0	0	2	40	5
	Total	40		21		13		21		95

Table 8: Overall Type of hydatid cyst (fertile, Sterile and calcified) in different organs infected sheep and goat slaughtered in three export abattoirs.

Sample Type (Organ)	No of Cyst in Examine	Cyst condition							
		Fertile				Sterile		Calcified	
		Viable		Non viable					
		No	%	No	%	No	%	No	%
Heart	25	10	40	5	20	7	28	3	12
Lung	68	26	38.2	10	15	11	16.2	21	1.8
liver	63	27	42.2	19	30	8	12.5	10	16
kidney	15	8	53.3	4	27	1	13.3	1	0.1
Spleen	9	6	67	1	11	0	0	2	22.2
Total count	180	77	42.5	39	21.5	27	15.4	37	21

In general out of 180 examined hydatid cyst 77 (42.5%), 39 (21.5%), 27 (15.4%) and 37 (20.5%) were fertile viable, non viable, sterile and calcified cyst respectively.

4.5 Financial losses

The financial losses due to hydatidosis in slaughtered sheep and goat were included in this study. The direct and indirect losses due to infection by hydatidosis in all the export abattoir were calculated.(Table 9,10 and 11) For both direct and indirect economic loss estimated in five year data were collected from Hashim Ethiopian live and meat export abattoir, Mojo modern export abattoir (2005-2009) and three year data (2007-2009) from ELFORA export abattoir meat inspection records. From the data, the annual average of slaughtered sheep and goat, the average number per annum of condemned edible offal (Hearts, livers and kidneys) are also shown in the (Tables 12). The average export price of edible offal like liver, kidney and heart in all study abattoirs was 33.50 ETB which is equivalent to 2.5 USD /kg. The price of mutton and goat meat was 47.00 ETB equivalent to 3.5USD/kg.during the study period.

Table 10: Five year (2005-2009) retrospective data on condemned organ due to hydatidcyst in sheep and goat slaughtered in Mojo modern export abattoir.

Year	Species	Total Slaughtered	Organ condemned due to hydatidcyst				
			Lung	Heart	Liver	Kidney	Spleen
2009	Sheep	35,797	2820	186	1267	53	3
	Goat	251,893	4959	249	1819	128	6
2008	Sheep	41,158	3325	670	960	102	2
	Goat	200,100	2658	366	1520	68	8
2007	Sheep	43,226	789	167	1962	35	0
	Goat	214,693	1697	493	2311	168	5
2006	Sheep	20,529	2137	221	789	107	3
	Goat	313,611	2866	354	1996	123	3
2005	Sheep	25,814	1462	178	758	108	1
	Goat	257,012	3675	235	1214	159	0

Source: Meat inspection record book at Mojo modern export abattoir (2010)

From (Table 10) the annual averages of slaughtered sheep and goat, the number of average annum condemned organs of heart, livers and kidneys as well as the percentage of condemned organs were determined. Based on this the annual average of slaughtered sheep and goat at Mojo modern export abattoir were 33,304 and 247,461 respectively. The annual average of condemned heart, livers and kidney due to hydatid cyst were 284 (0.85%), 1147 (3.44), and 81 (0.24%) for sheep, 340 (0.13%), 1172 (0.17%), and 129 (0.05) for goat respectively (Table 12).

Table 11: Three year (200 - 2009) retrospective data of condemned organs due to hydatid cyst in Sheep and goats slaughtered in ELFORA export abattoir.

Year	Species	Total Slaughtered	Organ condemned due to hydatidcyst				
			Lung	Heart	Liver	Kidney	Spleen
2009	Sheep	23,556	1752	335	757	38	8
	Goat	71,735	1506	671	1516	72	14
2008	Sheep	38,128	911	391	717	58	3
	Goat	103,793	2733	781	2152	107	7
1997	Sheep	5,463	1934	59	592	23	4
	Goat	17,677	3631	72	1330	64	10

Source: Meat inspection record book at ELFORA export abattoir (2010)

Similarly from data the annual average slaughtered sheep and goats at ELFORA export abattoir were 22,382 and 64,401 respectively. The annual average of condemned heart, livers and kidney due to hydatid cyst were 261(1.16%); 668 (2.98%) and 40 (0.17%) for sheep, 508 (0.78%); 1666 (2.58%) and 79 (0.12%) for goat respectively (Table 12).

Table12: Average Annual slaughtered small ruminant, organ condemned due to hydatid cyst and current selling Price of edible offals mutton and goat meat/kg in study export abattoir.

Abattoir	Average annual Slaughtered animals			No of organs condemned						Average selling price			
				Heart		Liver		kidney		Heart	Liver	Kidney	Mutton &
	Spp	No	preval-ence	No	%	No	%	No	%	/kg	/kg	/kg	Goat meat /kg
HELMEX	Sheep	52,936	7.3	162	0.30	1342	2.53	19	0.03	33.50	33.50	33.50	47.00
	Goat	119,174	6	188	0.15	1338	1.12	44	0.03	33.50	33.50	33.50	47.00
MMEA	Sheep	33,304	12	284	0.85	1147	3.44	81	0.24	33.50	33.50	33.50	47.00
	Goat	247,461	10	340	0.13	1772	0.71	129	0.05	33.50	33.50	33.50	47.00
ELFORA	Sheep	22,382	4	261	1.16	668	2.98	40	0.17	33.50	33.50	33.50	47.00
	Goat	64,401	3.3	508	0.78	1666	2.58	79.	0.12	33.50	33.50	33.50	47.00

One USD = 13.40 ETB Source: National Bank of Ethiopia during survey time.

Table 13: Overall the financial losses per year due to hydatidosis in sheep and goat slaughtered in Three exports abattoirs.

Name of the Abattoir	Direct economic loss Per year (ETB)	Indirect economic loss Per year (ETB)	Total financial loss (ETB)
HELMEX	31,391.42	210,653.66	242,045.08
M.M.EA	35,660	461,625.23	497,285.23
ELFORA	13,625	48,964	62,589
Total	80,676.42	721,242.89	801,919.31

The periodic financial losses were 242,045.08 ETB at HELMEX, 497,285.23 ETB at M.M.E.A and 62,589.33 ETB at ELFORA. Overall the financial losses in three export abattoirs were approximately 801,919.61 ETB which was equivalent to 59.844 USD.

4.6 Public health impact assement

In the current study human hydatidosis survey was conducted from November1/2009 to /March 2010 E.C in Adama referral hospital, Debre Zeit Zonal hospital and Methara Sugar factory hospital. Based on five year retrospective data and analysis of available case records from those hospitals showed that a total of 53 patients hydatidosis during a five year period (Table 14). During this study one active clinical case was recorded in Adama referral hospital on 17/03/2010 E.C in a 10 year old girl. The patient comes from Oromiya Regional State at Arsi Zone, Dera Town. According to information obtained from Adama referral hospital she was born in Arsi zone in Bekoji and lived there until 2006. Later she moved Dera town. The diagnostic method used ultrasound and she appointed in order to remove the cyst by surgery for the coming August 2010.

In this study at Adama referral hospital, and Metehara sugar factory hospital, between (2005 -2009) 18 and 35 cases were recorded respectively. Out of this total of 53 patients, 37 and 16 were males and females respectively of different age groups. Overall 15 cases were surgically treated at Adama hospital

and 3 patients were referred to Tikur Anbesa hospital (Addis Ababa).Twenty one patients were referred to Tikur Anbesa hospital. In Debere Zit hospital no case was reported during the five year period.

Table 14: Five year retrospective data of human hydatidosis from Adama referral hospital, Debere Zite Zonal hospital and Metehara Sugar factory hospital (2005-2009 E.C).

Hospital	Year	Total Patient Registered in Hospital	No of Patient Affected by Hydatid cyst		Diagno-stic method	Age group						Treatment
						Child		young		Adult		
						M	F	M	F	M	F	
			No	%								
Adama referral Hospital	2009	61,635	2	0.003	U/S	1	1	-	-	-	-	Surgery
	2008	41,556	6	0.01	U/S	1	-	-	3	1	1	"
	2007	36,079	3	0.008	U/S	-	1	-	1	1	-	"
	2006	32,122	3	0.009	U/S	-	-	1	-	2	-	"
	2005	26,647	4	0.015	U/S	1	-	1	2	-	-	Referred toTikur Anbesa hospital
	Total	**198039**	**18**			**3**	**2**	**2**	**6**	**4**	**1**	"
D/Z Zonal hospital	2009	45,725	0	0	0	0	0	0	0	0	0	"
	2008	26,894	0	0	0	0	0	0	0	0	0	"
	2007	30,050	0	0	0	0	0	0	0	0	0	"
	2006	29,635	0	0	0	0	0	0	0	0	0	"
	2005	45,725	0	0	0	0	0	0	0	0	0	"
	Total	**178,029**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	"
Methara sugar factory hospital	2009	136,020	0	0	U/S	0	0	0	0	0	0	Referred to Tikur Anbessa hospital
	2008	204,448	5	0.002	U/S	3	0	0	2	0	0	"
	2007	243,532	0	0	U/S	0	0	0	0	0	0	"
	2006	245,518	13	0.005	U/S	1	2	3	3	4	0	"
	2005	234,257	17	0.007	U/S	0	0	0	0	17	0	"
	Total	**1,063,775**	**35**	**3.2**		**4**	**2**	**3**	**5**	**21**	**0**	

U/S = Ultrasound

5. DISCUSSTION

The overall prevalence of hydatidosis in small ruminants were 6.4 %, 10.8 % 3.3% at Hashim Ethiopia live and meat export abattoir, at Mojo modern export abattoir, and ELFORA export abattoi respectively. In sheep the occurrences of hydatidosis were11 (7.3 %,) 24 (12 %) and 4 (4%) in Hashin Ethiopian live and meat export abattoir, in Mojo modern export abattoir and ELFORA export abattoi respectively. Theses findings are comparable with the findings of 10.2% (Abduljelal, 1988) at Jimma 22, 2% (Bersissa ,1994) at Nekamte and 4.4% (Yilkal, 1989) at Desse respectively. And in goats the findings of were 18(6%), 25(10%), and 5(3.3%) at Hashim Ethiopian live animal and meat expor abattoir, in Mojo modern export abattoir and ELFORA export abattoir. These prevalences are highe than those of 12.2 % (Yilma,1984), 4.6 % (Tamene, 1986) and 2.2% (Alemayehu, 1990) at Debere zite Gonder and Arsi respectively.

Probably the main reason for this could be most of the slaughtered goats during this study were adults and hence they were exposed to the disease (parasitic ova) for long period of time. Their longevity might also have increased possibility of acquiring the infections. Also previous studies strongly suggest prevalence is heavily influenced by age (WHO, 2001). In addition the variation in the prevalence may be due to the difference in the origin of animals brought for slaughter and also due to change in environmental and epidemiological factors, which could affect the rate of transmission of echinococcosis/hydatidosis. However, the present study is lower than the observation of Ernest (2004) who reported higher prevalence of 63.8% in sheep and 34.7% of goats.

The study also established that predominately hydatid cysts occurred in the lungs and livers and less in hearts, kidneys and spleens. In general in all three study export abattoirs the distributions of cysts in sheep were 35 (41.2%), 23 (27.1%), 13 (15.3%), 10 (11.8%) and 4 (4.7%) in lungs, hearts, livers, kidneys and spleens respectively and the distributions of cysts in goats were 33 (34.7%), 40 (42.1%), 12 (12.6%), 5 (5.2%) and 5 (5.2%) in lungs livers, hearts, kidneys and spleens respectively. This is probably due to the fact that lungs and livers possess high numbers of capillaries that are the first encountered by the migratory *Echinococcus* onchospheres via the portal vein before any other peripheral organs (Pandey *et al*., 1988).

In present study higher number of medium and large size of cysts were recorded in the lungs of sheep and goats and small sized ones in hearts, kidneys and spleens. The condition viability the fertility rates were in goats (61%) than in sheep (56%).These observations different from finding of Umur (2003) who report 28.6%in sheep and 26.1% in goats. Lower fertile cyst were reported from different studies such as 0.7% in Australia (Bank *et al*., 2006), 2.6% in Sardinia (Scala *et al*., 2004) and 4.0% in Sicily (Giannetto *et al*., 2004).

The fertility of cysts is an important factor that can influence the transmission of *E granulosus* (Mc Manus, 2006). In comparison of the fertility rates by organs it was higher in lungs than in livers in both sheep and goats. It has been stated that the relatively softer consistency of lung tissue allows the easier development of the cyst and the fertility rate of hydatid cyst may show a tendency to increase with advancing ages of the hosts (Himonas, 1987).

The difference between tissue resistances of the infected organs may also affect the fertility rate of cyst, in the liver, host reaction may limit fertility rate of hydatid cysts. The difference in fertility rate among different species and in different geographical zones could be due to the variation in strain of *E .granulosus* (Mc Manus, 2006).

In this study the financial losses due to condemnation of organs as a result of hydatid cysts in slaughtered animals in Hashim Ethiopian live and meat export, in Mojo modern export abattoir and in ELFORA export abattoir were 242,045 ETB, 497,285.23 ETB and 62589.33ETB. Overall annual loss was estimated at 801,919.69 ETB which was equivalent to 59,844.75 USD in three export abattoir.

Different amount of financial losses due to hydatidosis in ruminant have been reported from different parts of Ethiopia and other countries. For instance reports from Ethiopia indicated the annual loss of 10,683,711.00 ETB (Kebede, 2008) at Addis Ababa abattoir, and 25,607.89 ETB (Kebede, 2008) in abattoir of Tigray regional state. Men while, other studies from abroad Budke *et al* (2006) reported that the annual CE- associated global economic losses is at least over USD 2 billion. The total financial losses of 192,457 USD was recorded in Turkey between the year of 2000-2006 due to condemnation of sheep and goat livers (Kaplan and Baspiner,2009). Polydrous, (1981) reported losses due to

hydatidosis reaching up to 10 % in milk yield 5 %in live weight gain, 40 % in wool harvest and 25% in birth weight of calves from infected dams.

In the current study overall 19 stray dogs that were examined in the study area 2 (10%) were found positive for *Echinococcus granulosus.* A relatively similar finding was observed in other studies (5-15 % prevalence) at a necropsy in endemic area of Sichuan, Qinghai and Gansu Provinces of china (Craig *et al.*, 2007).According to (Gemmell *et al.*, 2001) 8470 eggs were shed from average infected dog per day. The high prevalence of echinococcosis in dogs either in rural or in Peri-urban areas and the high proportion of stray and free roaming dogs lead to very high density of *Echinococcus granulosus* eggs in the environment (Dakkak,1992). Therefore, the dissemination of eggs, the contamination of water and food and the risk contamination of farm animals and human are very high.

Human hydatidosis is common in rural communities of Ethiopia particularly in Oromiya and SNNP Regional states due to large number of livestock production in these regions. In this study active human case was recorded in Addama referral hospital in the liver of a 10 year old girl, the origin of the patient was Arsi zone. Probably main factor that may contributes to the occurrence of hydatid cysts in human that area is the habit of keeping dogs and sheep together. Farther more, dogs and sheep are much closer even at the grazing areas, watering point and shelter. Also it is a common practice of slaughtering sheep and goats in residential areas and at fields. Moreover, organs or offals with cases are routinely left to dogs. In addition, patients with hydatid disease have no knowledge about the sources of infection.

Thus human hydatidosis is confined to geographic areas in which there is intimate contact of human and domestic dogs and some ungulates of food animals including cattle sheep, goat camel pig and buffalo (Schantz *et al.*, 1993). Other studies suggested that ethnic and cultural taboo have been reported as responsible for the high transmission rate for hydatidosis among Eskimos , Bisques in California and Turkana in Kenya. The highest human incidence was reported in Kazakhstan, although Almaty and south Kazakhstan oblast had comparable figures for the year 2000 (Torgerson, (2002).

Almost in all part of Ethiopia owing to cultural and religious taboo dogs are kept in close association with the family and farm animals. In additions to this the dogs are not normally dewormed. Apart from this, the higher number of stray dogs and practice of back-yard slaughtering luck of public awareness

about the disease, the absence of proper fencing and disposal pits for condemned offals due to hydatid cysts at slaughter houses, dog and other carnivores get easy access to them. The habit of leaving dead domestic animals unburied and leaving them open for scavenging carnivores create favorable condition of maintaining the life cycle.

It is well known that an efficient meat inspection service should function as an important monitoring agent in the control of animal diseases with considerable economic and public health significance mainly in cases of chronic and ill-defined conditions which are not apparent either to the stockowner or veterinary surgeon (Blamier *et al.,* 1980). More importantly a feedback from the slaughterhouses to the individual farm is of great value in the field of preventive medicine. Therefore, it needs considerable attention, to control the distribution of hydatid disease in both public health sectors as well in livestock production development in the country. Further, a community- based study is required to know the actual magnitude of hydatid disease of human in Ethiopia.

6. CONCLUSIONS AND RECOMMENDATIONS

The current study clearly demonstrated that Hydatidosis is highly prevalent in slaughtered animals at export abattoirs causing enormous annual financial losses resultant from condemnation of infected edible offals. Cystic echinococcosis or hydatidosis significantly contribute to enormous financial losses and public health hazard in the study area.

Vital internal organs such as lung, liver, heart, kidney and spleen were among infected organs in both sheep and goats. More fertile cysts are found in liver and lung than heart, kidney and spleen. Similarly higher number of medium and large size of cysts was recorded in the lungs of sheep and goats and small sized ones in hearts, kidneys and spleens.

Out of 19 killed stray dogs in the study area two of them were found to be infected by *Echinococcous granulosus*. Retrospective data from the three hospitals in the study area indicate that the presence of one active case harboring hepatic cyst in 10 years old girl and during the last five years a total of 53 patients were found to be infected by hydatidosis. In addition the, knowledge of the people about the role of dogs in transmitting echinococcosis to humans and animals is very low.

Based on the above conclusive remarks, the following recommendations are forwarded:

- Detailed investigation into the basic local epidemiological contributing to the spread of hydatidosis.
- Effective control measures need to be introduced to curb the direct and indirect economic losses.
- Animal identification system should be put in place.
- Awareness of people should be created about the routes of infection, transmission of disease, personal hygiene, especially to wash hands after handling of dogs and or contacts with their feces.
- Enforcement of legislation that will put an end to back yard and road side slaughtering practices.
- Establishment of policy on dog keeping and handling including registration, treatment and elimination of stray dogs.

7. REFERENCE

Abdulajewad, A. (1988): Hydatidosis Prevalence at Jimma Abattoir, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p 19.

Abduljelal, R. (1992): Economic significance of bovine fasciolasis and hydatidosis at Soddo Abattoir, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p 20.

Aletras, M. and Symbas, P. N. (2000): Hydatid disease of the lung. In: Shields TW, Lo Cicero J, Ponn RB, editors. General thoracic surgery, 5th ed. Philadelphia: Lippincott Williams and Wilkins, p_p 1113-1122.

Alemayehu, L. (1990): Prevalence of hydatidosis in cattle, sheep and goats, and *E. granulosus* in dogs in Arsi Administrative region, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p 18.

Andersen, F.L., Ouhelli, H. and Kashani, M. (1997): Compendium on cystic echinococcosis. Brigham Young University, Provo, UT 84602, USA.

Amman, R. W.and Eckert, J. (1995): Clinical diagnosis and treatment of echinococcosis in humans Echionoccus and hydatid disease (R.C.A Thompson and A.L Lymbery eds). CAB International, Allingford, Oxon, Pp 411-463.

Andersen, F. L., Ouhelli, H. and Kashani, M. (1997): Compendium on cystic echinococcosis. Brigham Young University, Provo, UT 84602, USA.

Asrat, G. (1996): Prevalence and economic significance of hydatidosis in slaughtered cattle and sheep in South Wollo, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p 18-19.

Azlaf, R. and Dakkak, A. (2006): Epidemiological study of the cystic echinococcosis in Morocco. *Vet Parasitol*. **137**: 83-93.

Banks, D. J., Copeman, D.B., Skerrant, L.F. and Molina, E.C. (2006): *Echinococcous granulosus* in northern Queensland: 1, Prevalence in cattle, *Aust. Vet. J.* **84**; 303-307

Baronet, D., Waltner, T. D., Craig, P. S. and Joshi, D. D. (1994): *Echinococcus granulosus* infections in the dogs of Katmandu, Nepal. *Ann. Trop. Med. Parasitol.*, **88**: 485 - 492.

Blamier, R. V., Good hand, R.H. and Taylor, K.C. (1980): Review of some animal disease encountered at meat inspection in England and Wales.**Vet. Rec. 106**, 195-199.

Bersissa, K. (1994): Hydatidosis in Nekmt: Prevalence in slaughtered cattle and sheep estimated economic loss and incidence in stray dogs, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p

Budke, C. M, Deplazes, P. and Torgerson, P.R. (2006): Economic effects of echinococcosis on a highly endemic region of the Tibetan Plateau.www.cdc.gov/eid.**12**:2

Buishi, W., T., Guildeaz, Craig, P. and Palmer, S. (2005): Re-emergency of canine *Echinococcus granulosus* infection, Wales. Emerge. *Infect. Dis.* 11(4), 568-571.

CDC (2010): Global Socioeconomic impact of cystic echinococcosis [online]. Available at: http// *www.cdc.gov/ncidod/dpd/_parasites/.*

Chai, J .J. (1995): Epidemological studies on cystic echinococcosis in china- *a review. Biomed. Environ. Sic.*1995; **8**:122-136.

Chandler, A. S. A. C. Read, P. and Clark. (1961): Introduction to Parasitology with special Reference to the parasite of man 10th edition. Jon Wiley and Sons, Inc, New York, 361- 367.

Charles, M. and Hendrix (1998): Diagnostic Veterinary Parasitology 2nd edition. Mosby, Inc. London, 128-143.

Craig, P. S., Rogan, and M. T and Allan, J. C. (1996): Detection, Screening and community epidemiology of taeniid cestod Zoonoses: Hydatidosis, alveolar ecinoccocosis and neurocysticercosis.*Adv. Parasitol.* **38**:169-250.

Craig, P. S., McManus, D.P., Lightowlers, M.W., Chabalgoity, J.A., Garcia, H.H., Gavidia, C.M., Gilman, R.H., Gonzalez, A.E., Lorca, M, Naquira, C. Nieto, A. and Schantz, P.M. (2007): Prevention and control of cystic echinococcosis. *Lancet. Infect. Dis.* **7**: 385-394.

Cringoil, G., Rinaldi, L., Musella, V., Veneziano, V., Maurelli, M.P., Dipietro, F., Frisiello, M. and DiPietro, 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.

Dakkak, A. (1992): Echinococcosis- hydatidosis in North Africa; geographical distribution of species and strains and prevalence in man and animals. In: Vet Public Health (Eds), Guidelines for Diagnosis, Surveillance and Control of Echinococcosis; World Health Organization Geneva, Switzerland.

Dalimi, A., Motamedi, G., Hosseini, M., Mohammadian, B., Malaki, H., Ghamari, Z. and Ghaffari Far, F. (2002): Echinococcosis/hydatidosis in western Iraq. *Vet. Parasitol,.* **105**: 161-171

Deplazes, P., Gottstein, B., Eckert, J., Jenkins, D. J., Ewald, D. and Jimenez Palacios, S. (1992): Detection of *Echinococcus* coproantigens by enzyme-linked immunosorbent assay in dogs, dingoes and foxes. *Parasitol. Res.*, **78**: 303-308.

DNR (Department of Natural Resource) 2009: Echinococcosis (Cystic Hydatid disease), Pp 2-4.

Eckert, and Deplazes, P. (2004): Biological, Epidemiological, and Clinical aspect of echinococcosis, a Zoonosis of incising concern *Clin. Microbiology Rev.***17**: 107-135.

Eckert, J. Gemmell, M. A, Meslin, F. X. and Pawlowski, Z. S. (2001): WHO/OIE Manual on Echinococcosis in humans and animals.

Elmahadi,I. E, Ali ,Q.M., Magazub, M. M.,Ali Abreham A.M.,saad, M.B.,Roming.T.,(2004): Cystic echinococcosis of livestock and human in central Sudan.Ann.Trop,Med .Parasitol .**98**:473-479.

Erica, L., Pedro, L, M. and Robert, H.G. (1999): Oxfendazole treatment of sheep with naturally acquired hydatid disease. *Antimicrob. Agents Chemothe*.**43**:2263-2267.

Ernest, E., kassuku, A. and Kazwala, R. (2004): Studies on the epidemiology of echinococcosis/hydatidosis in Ngorongoro district, Arusha region, Tanzania. *Int Arch Hydatid,* **23**: 35-43.

FAO/WHO(1982):Guidelines for surveillance Prevention and control of echinococcosis /hydatidosis j. Prod and Health paper., **29**:1-147.food and Agriculture Organization of the United Nation Rome.

Fikere, L. (1994):Ecinoccocosis/Hydatidosis in konso (Southern Ethiopia), An Assement trial of its Prevalence, Economic and public Health Importance, DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre-Zeit, Ethiopia.Pp20-21.

Fiqadu, O. O. (1997): Study on the prevalence and economic significance of hydatid in ruminants and *Echinococcus granulosus* in dog and around Asella Ethiopia, DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre-Zeit, Ethiopia Pp19-20.

Gatenby, R M. (1991): Sheep in the Tropical Agriculturalist, Macmillan, TCTA, p_p 6-10.

Gemeda, B. (1988): A preliminary survey on echinococcosis/ hydatidosis in livestock (Cattle, Sheep, Goats and Pigs) Slaughtered at Addis Ababa Abattoir, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p 22.

Gemmell, M. A. and Lawson, J. R. (1986): Epidemiology and control of hydatid disease. The biology of *Echinococcus* and hydatid disease (R. C. A. Thompson, ed.). Allen and Unwin, London, p_p 189-216.

Gemmell, M. A., Robert, M.G. and Lawson, J.R.(2001):Quantitative epidemiology and transmit ion dynamics with special reference of *Echinococcus granulosus,* In:J, Eckert, M. A Gemmell F.X Meslin and Z.S Pawlowski (eds)WHO/OIE manual on echinococcosis in human and animal: a public health problem of global concern. WOAH, Paris France, Pp. 143-156.

Gemmell, M. A., Lawson, J. R. and Roberts, M. G. (1987): Towards global control of cystic and alveolar hydatid diseases. *Parasitol. Today.,* **3**: 144-151.

Giannetto, S. Poglayen, G. Barianti, E. Sorgi, C. Gaglio, Canu, S. and Virga, A. (2004): An epidemiological up dating on cystic echinococcosis in cattle and sheep in Sicily, Italy ,*Parassitologia*.46:423-423.

Gonzales A. E., Garcia H.H., Gilman R.H., Tsang, V.C., Bernal, and T.and Lopez, M.T. (1996): Effective single dose treatment for porcine cysticercosis With Oxfedazole Am. J. Trop. Med. Hyg. **54**:391-394.

Hagos, B., Mesfin, M. and Abebe, B. (2006): Hydatid disease of the liver: A 12 year experience of surgical management. *East and Central Africa Journal of Surgery*, **11**: 54-59.

Hagos, A. (2007): Study on prevalence and economic impacts of bovine fasiolosis and hydatidosis at Makale municipality Abattoir, Makale, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, p_p 10-12.

Himonas, C. (1987): The fertility of hydatid cyst in food animals in Greec. Helminth zoonosis, Martinus, Nijjh of Publishers, Netherlands.

Jenkins, D. J., Roming, T. and Thompson, R. C. A. (2005): Emergence/re-emergence of *Echinococcus* Spp.a global update. *Int. J. Parasitol*. **35**:1205-1219.

Jober, 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. *Rev. Méd. vét.*, **147**: 797-804

Kebede, E (2008): Study on prevalence, Economic, and public health importance of hydatidosis in slaughtered Animals at Addis Ababa abattoir Msc Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre-Zeit, Ethiopia.Pp40.

Kebede, W. (2008): Zoonotic importance of Hydatidosis in cattle and humans in selected areas of Tigray regional state Msc Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre-Zeit, Ethiopia.Pp33.

Khuroo, M.S. (2002): Hydatid disease, current status and recent advances. *Ann. Saudi Med.* **122**: 56-64.

Kaplan, M. and S. Baspinar (2009): Prevalence and Economic Significance of cystic Echinoccosis among the slaughtered animals in Elazing J. Animal Vet. Advances, **9**:1842-1845.

McManus, D. P. (2006): Molecular discrimination of taeniid cestodes. *Parasitol. Int.* **55**: S31- S37.

McPherson, C N. L. (2001):Epidemiology of *Echinococcus granulosus* in transhumant Situations, In: J, Eckert, M. A. Gemmell, F. X. Meslin and Z. S. Pawlski (ed),WHO/OIE manual on echinoccosis in human and animals: a public health problem of global concern, Paris, France, Pp. 156-163.

McPherson, C. N. L., French, C. M., Stevenson, P., Karstad, L. and Arundel, J. H. (1985): Hydatid disease in the Turkana District of Kenya.The prevalence of *Echinococcus granulosus* infections in dogs and observations on the role of the dog in the life style of the Turk Ana. *Ann. Trop. Med. Parasitol.*, **79**: 51-61.

Macpherson, C. N. L. and Wachira, T. W. M. (1997): Hydatidosis in Africa south of the Sahara. In Compendium on Hydatidosis in Africa and in Middle Eastern Countries with special, reference to Morocco (F. L. Andersen, H. Ouhelli and M. Kachani, eds). Brigham Young University, Print Services, Provo, Utah, p_p 245-277.

Mesfin, M., Hagos, B., Abebe, B. and Mulubrhan, A. (2007): Surgical management of 234 patients with hydatid disease, The Tikur Anbessa Hospital experience, *Ethiopian Med. J.* **45** :257-263.

Mike, S. (1996): Goats In the Tropical Agriculturalist; Macmillan, TCTA, p_p 79-83.

Njoroge, E. M., Mbith, P. M., Gathuma, J. M., Wachira, T. M. ,Magambo, J. K., Zeyhle, E., (2002) : A study of cystic echinococcosis in slaughter animals in three selected area of northern Turkana Kenya.Vet Parasitol., **104**: 85- 91

Oostburg, B. F. J., Vrede, M.A. and Bergen, A.E. (2000): The occurrence of polycystic Echinococcosis in Suriname. *Ann. Trop. Med. Parasitol.* **94**: 247-252.

Ogunrinade, A.F., Bola, I. and Ougrinade (1980): Economic importance of bovine fasciolais in Nigeria. *Trop. Anim. Hith. Prod.* **12**: 155-160.

OIE, (2008): Echinococcosis /hydatidosis Terrestrial manual Pp 175-189.

Ozcel, M., Ali. Alkan, M.and Ziya (1966): Parasitology for the 21st Century CAB international, 225-232.

Pedro, M, and M. Schantz, (2009): Echinococcosis a review *Inte. Jou. Infect. Dis* **13:** Pp 125-133.

Pandey, G.S. (1988): A study of condemned bovine liver at Lusaka Abattoir (Zambia).*Indian J. vet. Pathol.*, **11**: 18-22.

Polydrous, K. (1981): Animal health and economic case study; echinococcosis with reference to Cyprus. *Bull. Int. Epz.* **93** (5): 981-992.

Rausch, R. L. (1995): Life cycle patterns and geographic distribution of *Echinococcus* species. In *Echinococcus* and hydatid disease (R. C. A. Thompson and A. L. Lymbery, (eds). CAB International, Wallingford, Oxon, Pp 88-134.

Reinecke, R.K. (1989): Veterinary Helminthology Butterworths Durban, 319-320.

Scala, A., Canu, S., Tanda, B., Basciu, M., Polinas, L., Sanna Coccone, GN., Pilloni, S., Canu, S.,Varcasia, A. and Garippa, A. (2004): An epidemiological and biomolecular survey of cystic echinococcosis in Cattle in Sardinia. *Parasitologia.* **46**: 443-444.

Schantz, P. M. (1993): Surveillance and surveys for hydatidosis. *In* Compendium on hydatidosis with special reference to the Xinjiang Uygur Autonomous Region, the People's Republic of China (F.L. Andersen, J. Chai and F. Liu, eds). Brigham Young University Press, Provo, Utah, p_p 74-84.

Sebsibe, A., Casey, N., Niekerk, W. A., Tegane, A., and Coertze, R. J. (2007): Growth performance and carcass characteristics of three Ethiopian goat breeds fed grainless diets varying in concentrate to roughage ratios. *South African Journal of Animal Science.* **37**: 221-232.

Seimenis, A. (2003): Overview of the epidemiological situation on echinococcosis in the Mediterranean Region. *Acta Trop.* **85**:191-195

Smith, J. D. (1994): Introduction to Animal Parasitology 3rd edition Cambridge University press, 334-340.

Soulsby, C. J. C. (1982): Helminthes, arthropods and protozoa of domestic animals. 7th edition.U.S.A, Philadelphia, Lea and Febiger, 123.

Soulsby, E. J .L (1986): Helminth, Arthropods and Protozoa of domesticated animals 7th edition. Baillere Tinidall London, 119- 124.

Tamene, M. (1980): Prevalence study of Echinococcosis in Livestock in Gonder.DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre- Zeit, Ethiopia.

Thompson, R. C. A. (1979): Biology and speciation of *Echinococcus granulosus*. *Australian Veterinary Journal,* **93**-149.

Thompson, R.C.A.and Eckert, J. (1983): Observations on *Echinococcus multilocularis* in the definitive host. Z. *Parasitenkd.* **69**: 335-345.

Thompson, R. C. A. (1986): The biology of *Echinococcus* and hydatid disease. Allen and Unwin, London, p_p 290-230.

Thompson, R. C. A. and Allsopp, C. E. (1988): Hydatidosis Veterinary perspectives and annotated bibliography. C. A. B. International, Wallingford, Oxon, p_p 246.

Thrusfield, M. (2005): Veterinary Epidemiology, 3rd ed., Blackwell Synergy, published Company UK 228-238.

Timothy, D., Taylor, B R. and Langer, B. (2001): Recurrence of hydatid disease. World. J. Surg., **25:** 83-6.

Torgerson, P.R., Dowling, and P. M.and Abo- Shehada, M.N (2001): Estimating the Economic effects of cystic echinococcosis.Jordan, a developing country with lower middle income. A*nn. Trop. Med. Hyg.* **95**:596-602.

Torgerson, P.R.(2002): Transmission dynamics of taeniid parasite in animal hosts, In: Craig. P.,Pawlowski; Z, (Eds) Cestod Zoonosis; Echinococcosis and Cysticercosis. IOS Press, 221-235.

Umur, S. (2003): Prevalence and economic importance of cystic echinococcosis in slaughtered ruminants in Burdur, Turkey. JVet Med B, **50**; 247-252.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W. (1996): Veterinary Parasitology 2nd Edition. Black well Science Ltd, UK, **122**: 128-129.

WHO, (1996): Guidelines for treatment of cystic and alveolar echinococcosis. WHO Informal Working Group on Echinococcosis. *Bull. WHO*. **74**: 231-242.

WHO/OIE (2002): WHO/OIE Manual on Echinococcosis in Humans and Animals: A Public Health problem of Global Concern, Edited by, J. Eckert, M. A. Gemmell, and F-X. Meslin and Z. S. Pawlowski.

WHO/OIE (2001): Manual on echinoccosis in humans and animals: a public health problem of global concern WHO, Paris, France Pp.1-265.

Williamson, G. and Payne, W. J. A (1978): An Introduction to Animal Husbandry in the Tropics, 3rd edition. The English Language Book Society and Longmans, Printed in Great Britain by Butler and Tanner Ltd, pp 679-707.

Yemane, G. (1992): Preliminary study on echinococcosis/hydatidosis in Ruminants slaughtered at Nazreth Abattoir, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, pp 23.

Yilikal.(1989): Hydatidosis in cattle, sheep and pigs, cysticercus tenuiollis in sheep around Dessie and the Efficacy of Hagenia abyssinca (kosso) on *Taneia hydatigena*, Ethiopia. DVM Thesis, FVM, AAU, Debre Ziet, Ethiopia, pp 21.

Yilma, J. M. (1985): Preliminary study on Echinococcosis /Hydatidosis in Ruminant slaughtered at Nazerate Abattoir.DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, and Debre-Zeit, Ethiopia.

8. ANNEXES

8.1 Questioner survey format to estimate economic losses study.

Date ----------

Name of the export Abattoir----------

Location (address) ----------

When did the abattoir established? ----------

1. Most common slaughtered Animal's in the abattoir
   a. Cattle----------
   b. Sheep ----------
   c. Goat ----------
   d. Sheep and goat ----------
2. From where did you bought the slaughtered animals?
   a. Highland □
   b. Lowland □
   c. From both □
3. Daily slaughtering capacity of the abattoir ----------
4. Where do you export the product? ----------
5. Type of product you export?
   a. Child carcass □
   b. Frozen meat □
   c. Edible Offal's □
      Heart ----------
      Liver ----------
      Kidney----------
      Others----------
6. The selling price of the product /kg
   a. Chilled carcass ----------
   b. Frozen meat ----------

c. Offal's:

Heart (1kg) ---------- Kidney (1kg) ----------

Liver (1kg) ----------

7. No of Trained meat inspector in the abattoir?

Veterinarian----------

Ass.Vet ----------

Lab. technician----------

8. What are the most common Zoonotic parasitic disease Occur during meat inspection? -----

---

9. Which organ commonly affected?

Lunge □ Kidney □

Heart □ Spleen □

Liver □ other □

10. How do you dispose the infected organ?

Burning ----------

Burring ----------

Processing to by product ----------

11. Is any possibility dogs access to the condemn organ? Yes --------no----------

If yes describe----------

12. Where do you sale the detained organ? ----------

13. What are the most common reason for the detention of carcass?

Annex 2: Questionnaire survey format to assess the public health importance of hydatidosis for different Hospitals (Adama, Debre Ziet, Methara) of east Showa Zone of Oromiya Regional state.

Date ----------

Name of hospital ----------

1. What are the most common zoonotic disease occur?

   Parasitic ----------non parasitic----------

2. If parasitic describe type of zoonotic parasitic disease----------

   ---

3. Do you know any parasitic disease, which is transmitted to human through contact with dog or contaminated food? Yes---------- No----------

   If yes describe

   1. ----------
   2. ----------
   3. ----------

4. If the answer is yes and the disease is hydatidosis describe the sign and symptoms of the disease --

   ---

5. Patients regarding hydatidcyst in which age and sex group commonly occur

   Male---------- age----------

   Female ----------age----------

6. Describe sign and symptom of the hydatidcyst? ----------

   ---

7. Which organ mostly affected by the disease?

   Heart ----------

   Liver----------

   Kidney ----------

   Lung ----------

   Others ----------

7. Diagnostic tool ----------

8. Number of patient during the last 5 years

    1. 2009----------
    2. 2008 ----------
    3. 2007 ----------
    4. 2006 ----------
    5. 2005 ----------

9. Treatment of the disease----------

---

10. Cost for the surgical treatment of hydatidosis in your hospital ----------

11. Your advice to the family of your patient ----------

8.3. Dentition formula for sheep, and goat

1. Dentations formula to estimate the age of the goat (Mike steel, 1996)

Age group	Teeth condition
Kid under 1 year	Eight sharp incisor (no permanent teeth)
Yearling(1-2 year)	Central pair of baby teeth replaced by permanent once
Yang adult (3-4 years)	4 permanent teeth
Adult (4-5 years)	8 permanent teeth
Older adult(>5 years)	Worn teeth and some are missing.

2. Estimation of age of sheep based on dentations formula (Gatenby, 1991)

Age of sheep	Teeth condition
Less than 1 year and 3months	None
1 year and 3 months up to (<1years and 10 months)	1 pair
1 year and 10 months up to <2 years	2 pairs
2 years and 4 months up to 3 years	3 pairs
More than 3 years	4 pairs

8.4 Different Photos

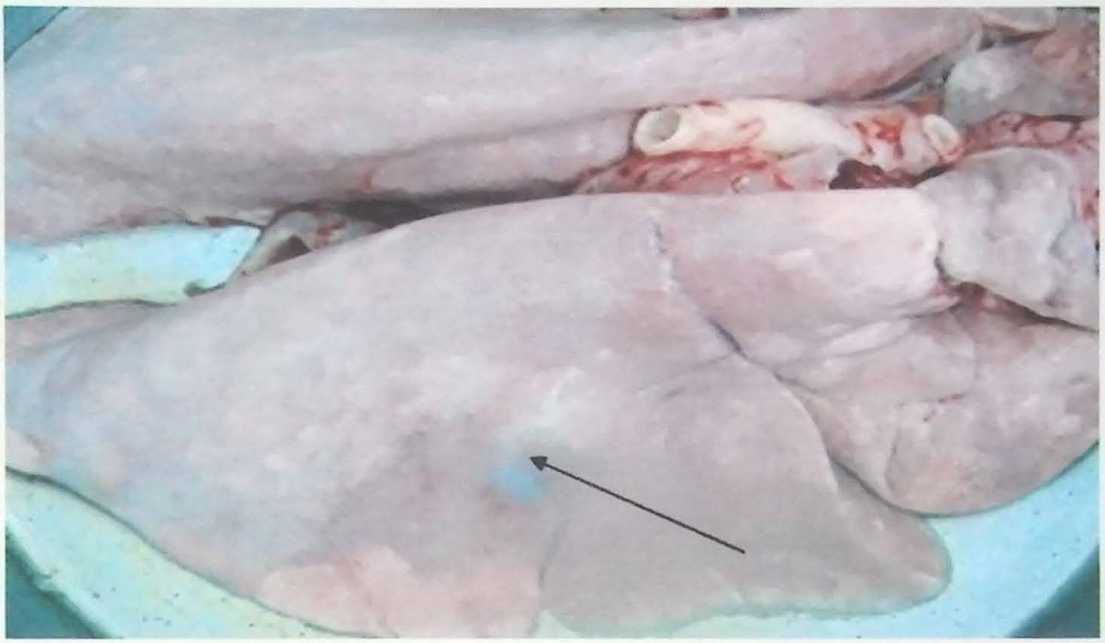


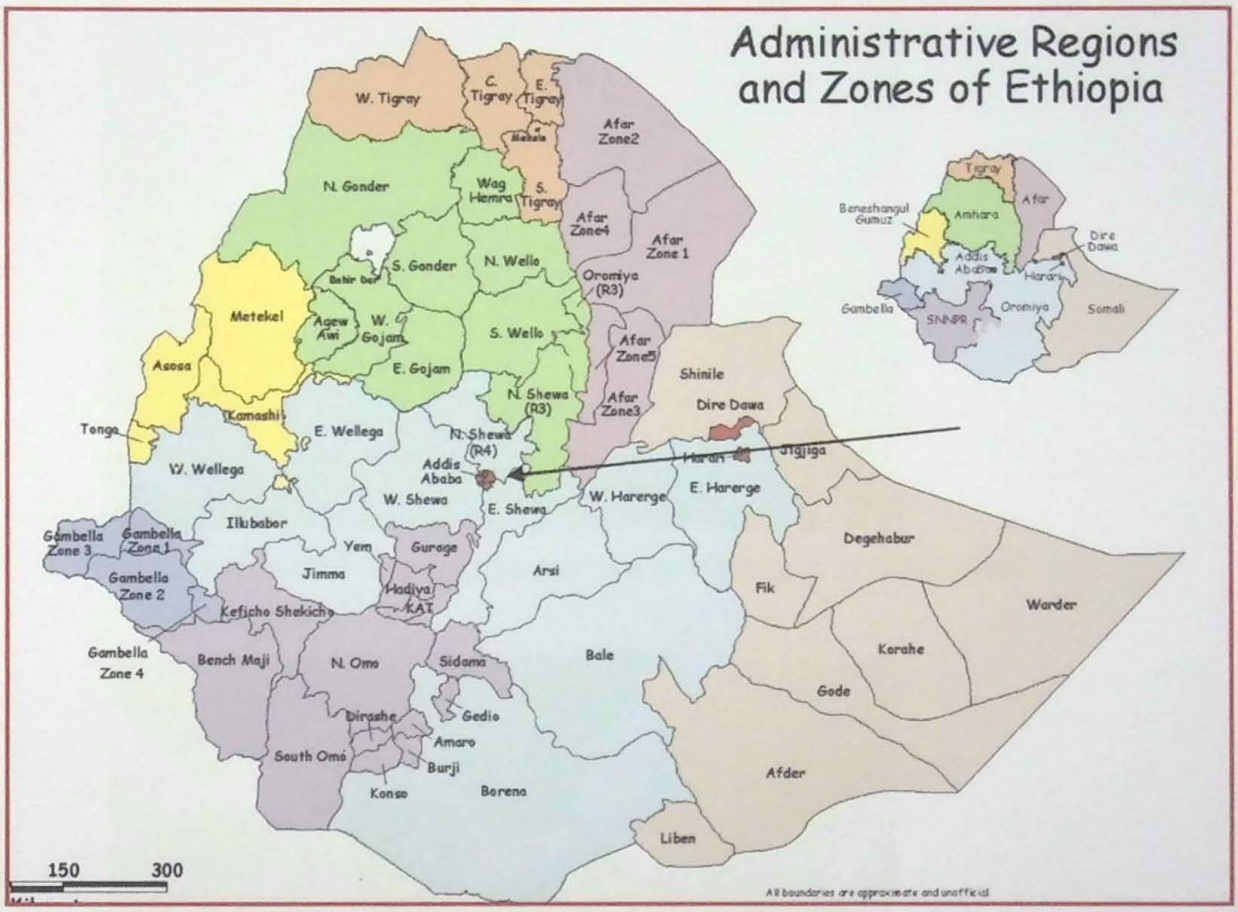
Figure 6: Hydatid cyst lesion from sheep lung slaughtered at Mojo modern export abattoir.

Figure 7: Hydatid cyst lesion from goat liver slaughtered in ELFORA export abattoir at Methara.

Figure 8: Euthanized stray dogs for post mortem finding of echinococcosis at Deberezeit

Figure 9: Sampling of the small intestine of euthanized stray dogs at Debere zeit

8.5. Map of Ethiopia



Study areas

CURRICULUM VITAE

Personal Data

Name- Teshome Bekele

Date of birth- 28 Jan 56

Place of birth- Addis Ababa

Marital status- married

Nationality- Ethiopian

Profession- Veterinarian

Educational background

- 1966 - 1968: Felegeyordanos Secondary School Addis Ababa (6-8 Grade)
- 1969 - 1972: Minilik 2nd High School Addis Ababa (9- 12 Grade) School living Certificate
- 1974 - 1979: Former USSR in Ukraine (DVM)
- 26/1981: Six month course on tropical Animal production and Health at the FVM (Certificate
- 16/1983: One month refresher course in Veterinary public health at the FVM (Certificate)
- 13/2004: HACCP Auditors Training organized by the United Nation Industrial Development Organization (Food safety project) Certificate
- August / 2010: Addis Ababa University Faculty of Veterinary Medicine (MSc fellow)

Work experience:

- 1980 : 3rd livestock development project (Negele Borena) : Veterinarian
- 1982 : Melge Wondo export abattoir (Sidamo) : Veterinarian
- 1986: East Showa Zoon Agricultural office of Oromiya Regional State: Meat inspection and Quarantine head.
- 1995 -2002 : Minstery of Agriculture and rural development :Veterinarian

Special skill:

Basic computer Application Software courses

Papers:

- DVM Thesis: Non surgical method of bovine embryo transfer
- The Prevalence of CBPP in Melge Wondo export abattoir.
- Post graduate Seminar paper: Study on zoonotic, Economic and public health importance of Hydatidosis.
- MSc Thesis : Study on prevalence , economic and public health importance of hydatidosis in Slaughtered Small ruminants at three selected export abattoir of east showa zoon of Oromiya Regional State.

Languages:

Oremifa : leasing , speaking and writing.

Ameharik : leasing ,speaking and writing.

English: leasing, speaking and writing

Russian: leasing, speaking and writing

Membership

Ethiopian veterinary association

Contact Address

Mobil: 251 –0911360659

E- mail: Teshe.mdv26@ yahoo.com

SIGNED DECLARATION SHHET

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any university and that all source of materials used for the thesis have been duly acknowledge.

Signature

Teshome Bekele ----------

Date of submission: ----------

This thesis has been submitted for examination with our approval as University advisors.

Academic Advisors:

Dr. Mosses Kyule (BVM, MSc,MVPM,PhD) ----------

Dr.Yacob Hailu (DVM, MVSc, PhD) ----------

Dr. Akafete Teklu (DVM, MVSc) ----------