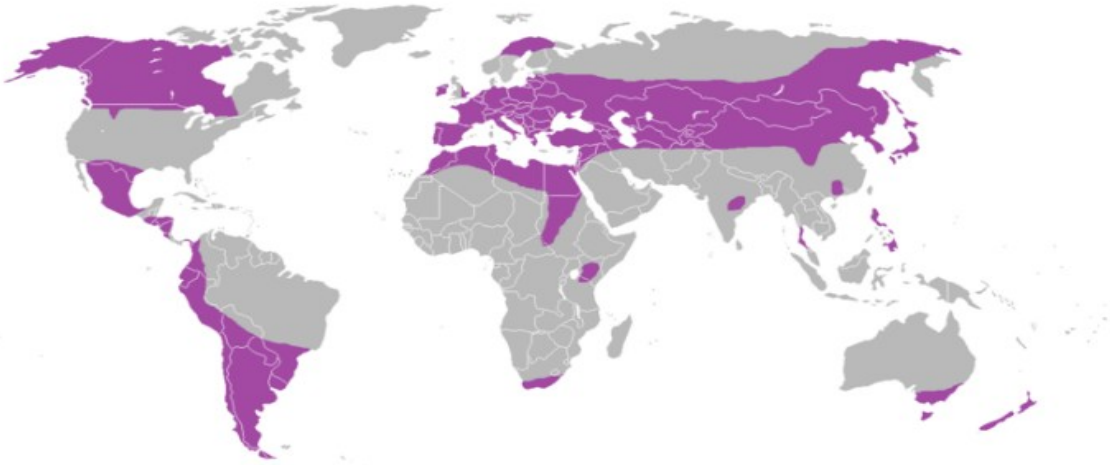

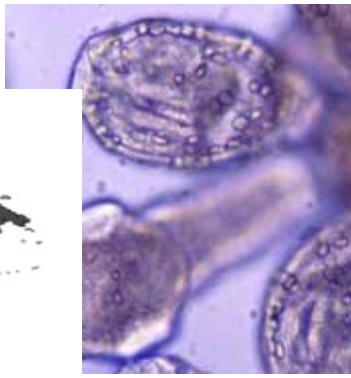

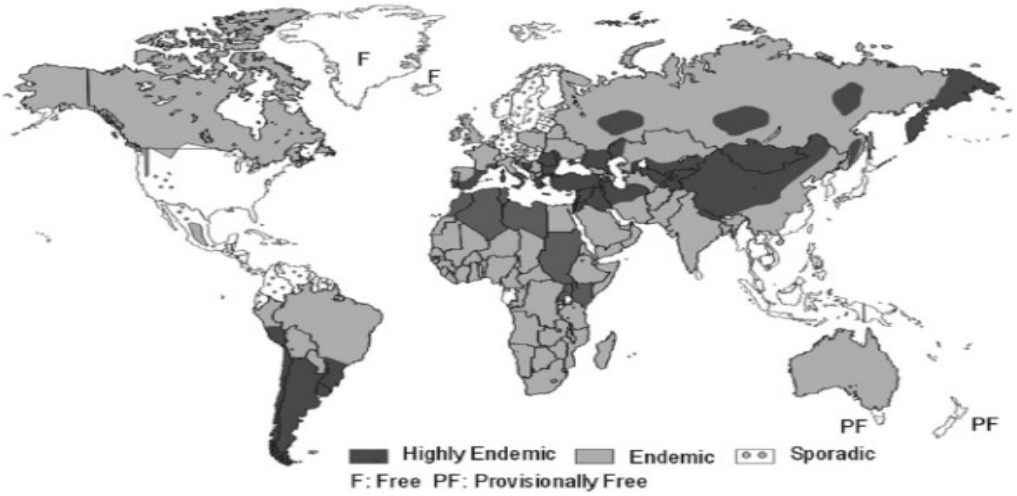
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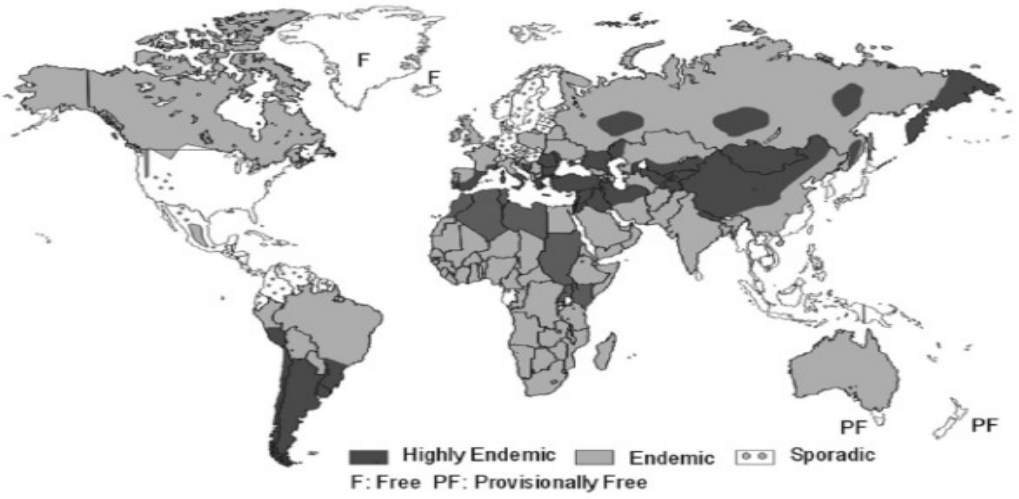
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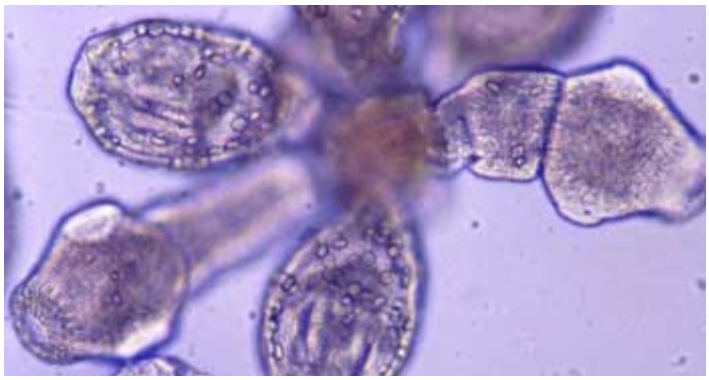
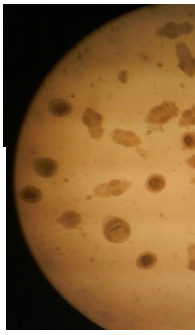
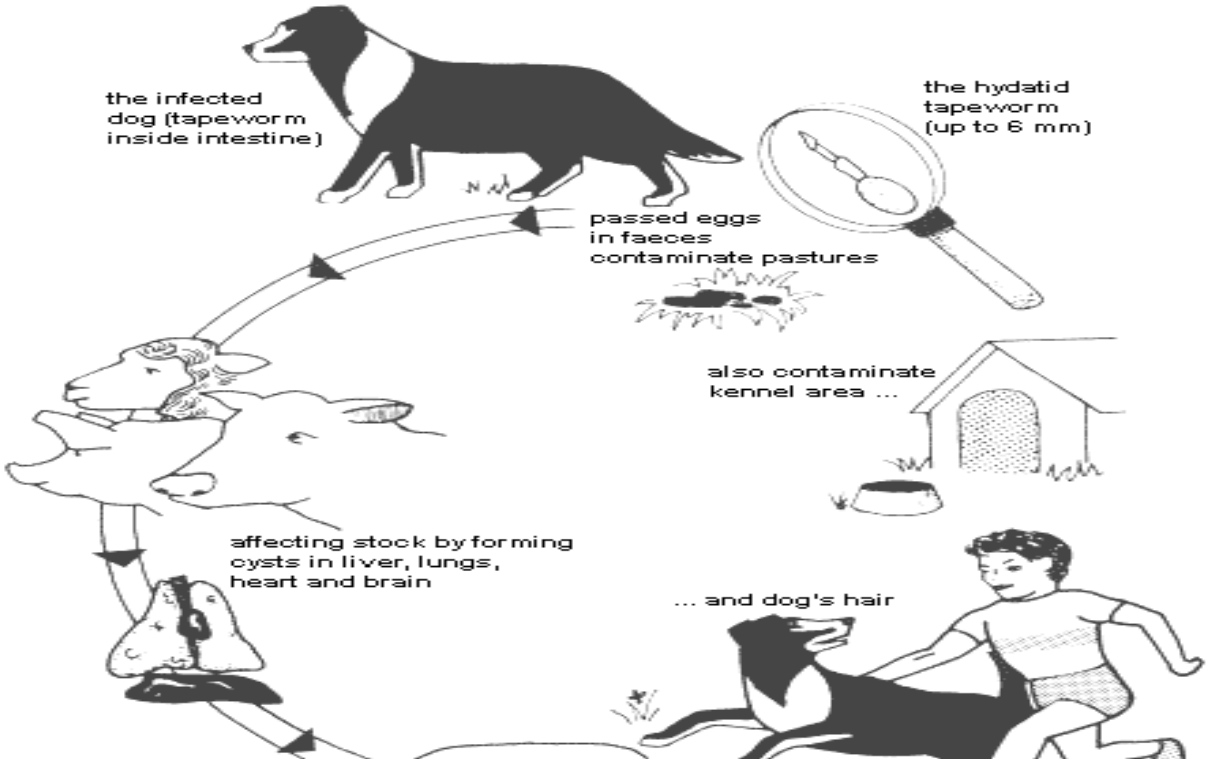
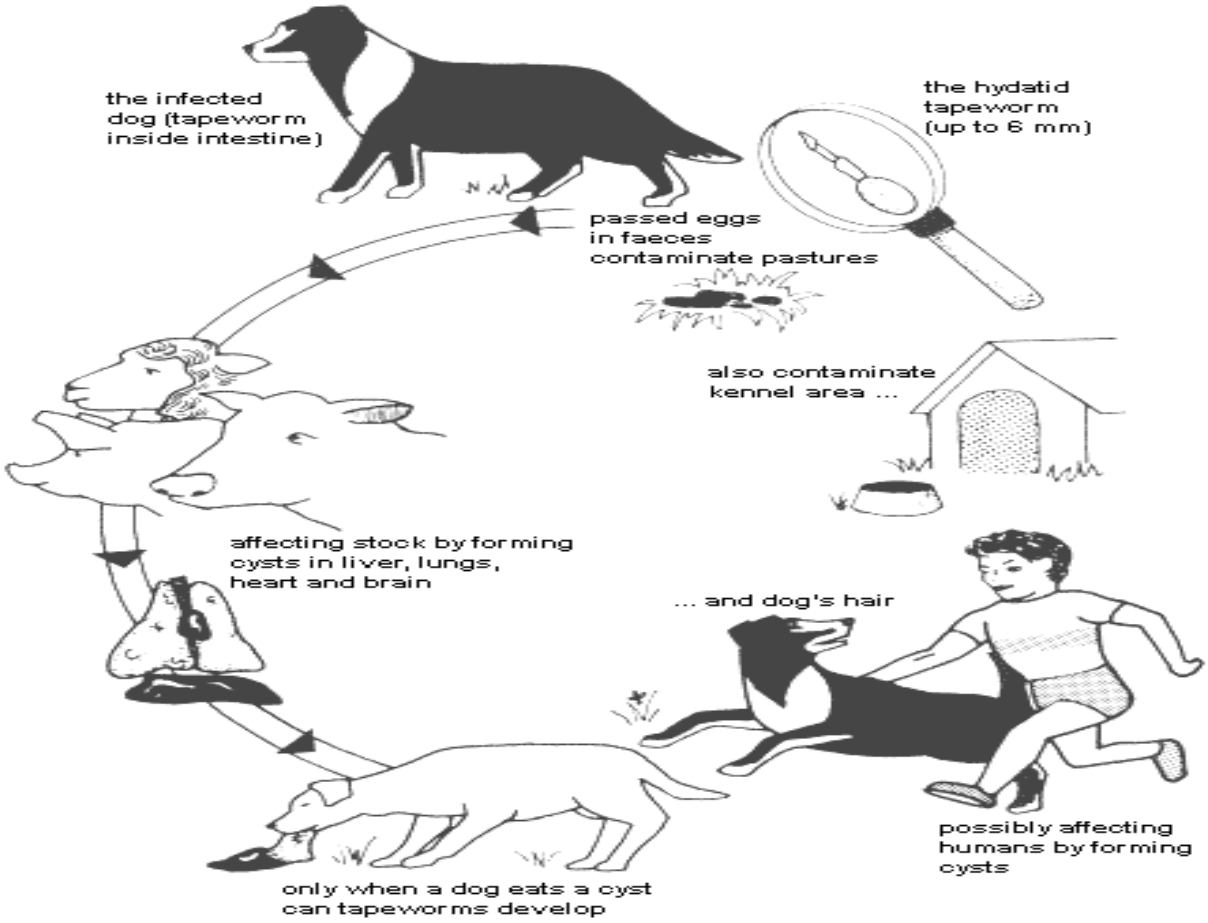
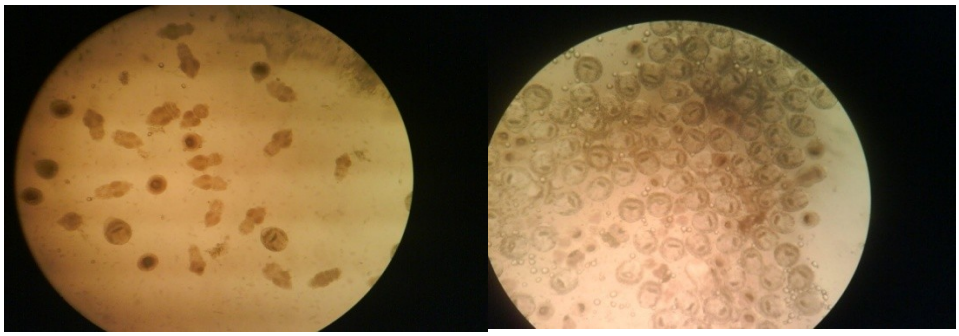
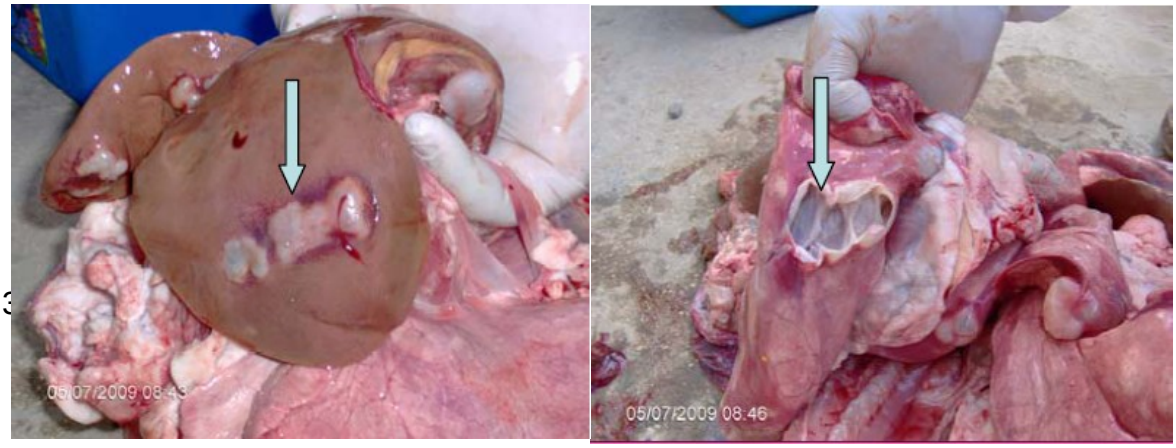





the infected dog (tapeworm inside intestine)
the hydatid tapeworm (up to 6 mm)
passed eggs in faeces contaminate pastures
also contaminate kennel area ...
affecting stock by forming cysts in liver, lungs, heart and brain
... and dog's hair


the infected dog (tapeworm inside intestine)
the hydatid tapeworm (up to 6 mm)
passed eggs in faeces contaminate pastures
also contaminate kennel area ...
affecting stock by forming cysts in liver, lungs, heart and brain
... and dog's hair
possibly affecting humans by forming cysts
only when a dog eats a cyst can tapeworms develop

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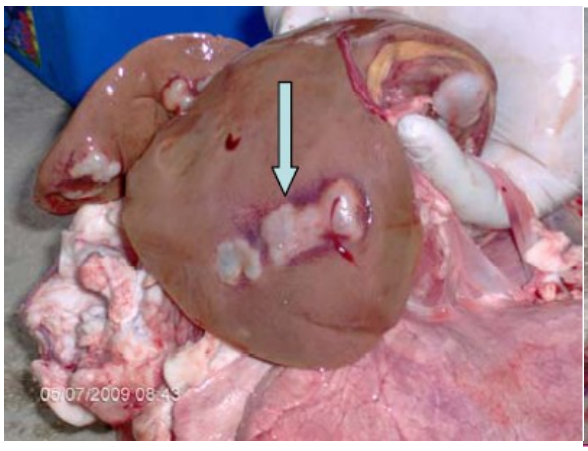

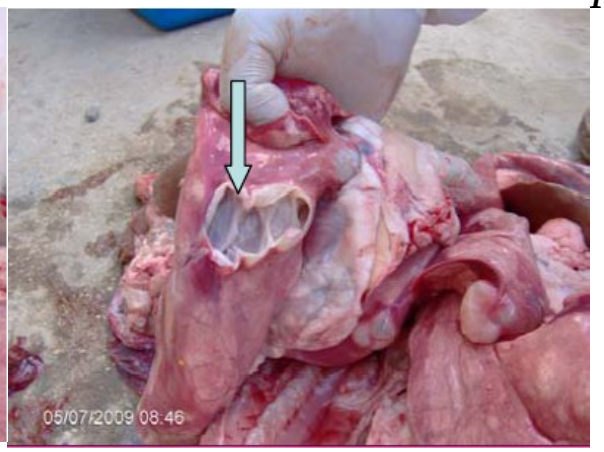

oduction

Background:-

The importance of camels (*camelus dromedaries*) stems from the fact that it is sustainable agricultural resources for millions of nomads and pastoralists in the arid and semi-arid zone (Musa *et al*., 1989).Camel population in sudan exceeds three millions, distribuated in Northern Kurdofan and Darfour in the west and Red sea, Kassala and Buttana in the east(Musa *et al*., 1989). investigation and research on camels since 1905-2005 are complied in the bibliography of camel entitled "The one –humped camel(*camelus dromedaries*) in the sudan(Musa *et al*., 1989).

Sudan is one of the largest camel populated countries in the world. population of camels was estimated as 3.2 millions (FOA., Its 2002). Sudan and Somalia have 70% of the total of African camels and 55% of that of the world camel's population (Wilson., 1984).

Hydatidosis is a term used to describe infection of animals and human with metacestode stage of *Echinococcus* species . Dogs and other canids are definitive hosts for the parasite while livestock are intermediate hosts. Man is an occasional host. The outcome of infection in livestock and man is

hydatid cyst development in lung, liver or other organs.Hydatid cyst causes severe disease and death in humans and results in economic loss for treatment costs, lost wages and livestock annual production loss. The fertility of hydatid cysts occurring in various intermediate host species is one of the most important factors in the epidemiology of the disease. The fertility of hydatid cysts varies depending on intermediate host species and geographical areas (Fikire., *et al* 2012).

Hydatidosis is a zoonotic disease caused by the larval stage (metacestode) of the tapeworm *Echinococcus granulosus*. Dogs and other carnivores are the definitive hosts for the parasite while a wide range of mammalian species including domestic ungulates and man act as intermediate hosts. Food animals such as sheep, goats, cattle, camels and pigs acquire the infection by ingestion of eggs from grass and water. Upon ingestion, the oncospheres penetrate the intestinal wall and reach visceral organs such as the liver, lung, heart, and kidney of animals and humans .Condemnation of edible offal unfit for human consumption is the major economic loss incurred by hydatidosis(Erbeto.,*et al*2010).

Echinococcus granulosus is one of the smallest cestode parasites that cause cystic echinococcosis,which is of major public health importance worldwide. The distribution of *E. granulosus* is higher indeveloping countries especially in rural communities where there is close contact between the dogs,and the definitive hosts, and various domestic animals, which may act as intermediate hosts. The outcome of infection inlivestock is hydatid cyst development in the lung, liver or other organs It has been suggested that *E. granulosus* may be maintained in an independent wildlife cycles in EastAfrica (Ernest., *et al* 2009).

Echinococcosis (hydatidosis) are the terms usually applied interchangeably to the cyclozonootic infection caused by the adult and larval stage (metacestode) of cestodes of the genus *echinococcus* family taenidae of the four accepted species in the genus *Echinococcus*, namely *Echinococcus granulosus*, *Echinococcus multicelularis*, *Echinococcus vogeli* and *Echinococcus oligan*, the first two species are of veterinary medicine and public health significance. *E. granulosus* is found in the small intestine of carnivores (particularly the dog) and the metacestode (hydatid cyst) is found in a wide variety of ungulates (sheep, cattle, pigs, goats, horse and camels) and man. Morphologically adult *Echinococcus* is only a few millimeters long (rarely more than 10 mm) and usually has no more than six segments Anteriorly, an adult *echinococcus* possesses a specialized attachment organ. The scolex that has four muscular suckers and two rows of hooks, one large and one small; on the rostellum, the body or strobila is segmented and consists of reproductive units (proglotids), which may vary in number from two to six (Terefe., *et al* 2012)

Hydatid Disease is the name given to the condition caused by the zoonotic tapeworm *Echinococcus granulosus*. The tape worm spends most of its adult life in the intestine of its definitive host, namely canids and in particular the dog. The tape worm eggs become voided in the canids' faeces and as a resultof ingesting the eggs, infection passes to the intermediate host, commonly herbivores while grazing. However, humans can become accidentally infected and hydatid cysts may develop throughout the body. Therefore, cysticechinococcosis (CE) or hydatidosis is a disease caused by the metacestode stage of *Echinococcusgranulosus*. The disease is not apparent to farmers but isofconsiderableeconomic and public health importance. In farm animals it causes considerable economic loss due to

condemnation of edible organs, decreased meat and milkproduction, reduced hide and fleece value and decrease in fecundity (Fromsa., *et al* 2011).

Hydatidosis (Cystic echinococcosis) caused by the larval stage (metacestode) of *Echinococcus granulosus*is the most wide spread parasitic zoonoses. Dogs are the usual definitive hosts whilst a large number of mammalian species can be intermediate hosts, including domestic ungulates and man. The disease occurs throughout the world and causes considerable economic losses and public health problems in many countries ,Hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughterhouses (Zewdu., *et al* 2010).

Hyadatidosis is a cyclozoonotic infection of cosmopolitan distribution . It is one of the main forms of parasitic disease in farm animals caused by the larval stage of *Echinococcus* tape worms which utilize canines as definitive host and various herbivores or rodent as intermediate host . Species under genus *Echinococcus* are small tapeworms of carnivores with larval (metacestode) stages known as hydatids proliferating asexually in various mammals including humans. There are five morphologically distinct species in this genus ; *E. granulosus*, *E.multilocularis*, *E.oligarthus*, *E.Vogeli* and *E. shiquicus*(El-Ibrahim., 2009). The adult worm of *E. granulosus* consist of 3 to 4 segments and exhibits two hosts in its life cycle , a carnivore as a definitive host and one species of various domestic herbivorous animals as an intermediate host. Human can be infected with the larval stage if he ingests the eggs of the parasite with either his food or drink (El-Ibrahim., 2009)

Burden of hydatid disease:

The epidemiology of the disease is based on two cycles,pastoral (synanthropic) in which the dog is always involved and sylvatic cycle which occurs in wild canids based on predation or carrion feeders. Synanthropic and sylvatic cycles me be dependent or interlinked (spill over situation).The spectrum of *E.granulosus* hosts species in thse cycles depends on the regional or local differences in the availability of various hosts species and strains of the parasite in the southern region of the sudan but no further studies were conducted to demonstrate the role of various wild animals in maintaing the transmission cycle of the disease.Burden in humans and live stock is important and should be part of any cost-benefit programme for the control of parasitic zoonoses (Mohamed., 2012).

History:

Hydatid disease has been known as a clinical entity since ancient times. Its parasitic nature was recognized as early as 1684 by Redi, Harmann and others. Goeze in 1782 pointed out that the scolices were of teanial origin and differentiated the hydatid cyst from cysticercus and the coenurus. The adult worm was observed in the intestine of dogs in 1808 by Rudolphi, but it was not until 1850 that it was recognized by Van benden as distinct species which he later named Taenia nana. In 1852 Von Siebold recovered the adult worm from dogs that had eaten echinococcal cysts of cattle (Omer, 2013).

Justification :

Echinococcosisis an important disease but it is a neglected public health problem in Africa, especially in rural communities . In Buttana area , hydatidosis may be one of the major infectious zoonotic diseases becuase most abattoirs in Buttana is not well qualified , where sheep , camels and goats are still slaughtered traditionally and carcass wastes are easily accessible to scavenging dogs and other wild carnivores, which are roaming freely and in large groups every where, due to absence of control programs for killing stray dogs by veterinary services. This study is therefore undertaken to determine the extent of spread of animal hydatidosis among slaughtered animals. It is clear that hydatidosis is considered a major public health problem in Sudan . Many animals are infected with hydatid cyst disease . Since the animals share the same life cycle as man , therefore determination of the prevalence of the disease in Buttana is very important in order to explore the size of the problem which helps to control the disease .

Objectives:

1/ To estimate the prevalence of camel hydatidosis in tambul region.

2/ To investigate risk factors associated with the disease.

Chapter One

Literature review

1.1 Classification:

According to Solusby (1982) *E. granulosus* was classified as follows:

Kingdom: **Animalia**

Phylum: **Platyhelminths**

Class: **Eucestoda**

Order: **Taenidea**

Family: **Taenidae**

Genus: ***Echinococcus***

Species: ***E. granulosus***

Subspecies: ***E. gr.granulosus E. gr.canadesis***

1.2 Genus: Echinococcus

At present, four species of the genus *Echinococcus* are rcognized on the basis of the standard taxonomic criterion by which cestodes are specifically distinguished. Thes are *E.granulosus, E.multiocularis , E.oligarthus* and *E.vogeli*, these four

species of *Echinococcus* are differentiable in the strobilar as well as the larval stages (Mohamed, 2012).

1.3Morphology of cyst :

The adult of *Echinococcus* varies between 2 and 11 mm in length and usually possesses from two to seven segments, averaging from three to four segments. The larval stage is a fluid-filled bladder or hydatid cyst that is unilocular, although communicating chambers also occur (WHO,2001) .

Growth is expansive, and endogenous daughter cysts may be produced .
Individual cyst may reach up to 30 cm in diameter and occur most frequently in liver and lungs, but may develop in other internal organs . The infection with this stage is referred to as cystic hydatidosis (WHO, 2001). Hydatid cyst of *E. granulosus* is unilocular . Its growth is expansive by concentric enlargement . A well developed cyst contains three layers; fibrous capsule of host origin . The middle one is the laminated membrane which is secreted by the thin (germinal) layer and therefore is of parasite origin . The germinal layer gives rise to the broad capsule and daughter cysts (Thompson, 1986) . The cysts are mainly found in the liver (and every possible organ: spleen, kidney, bone, brain, tongue and skin) and asymptomatic until their growing size produces symptoms or accidentally discovered . Cysts are full of fluid and its brood capsules containing protosculex on its inner walls. The fertility of the cysts depends on presence of protoscolices in the fluid, it is one of the important factors in the epidemiology of *E. granulosus* . The fertility of cycts varies depends on the intermediate hosts and geographical situation **(**Farah, 1987).
The hydatid cyst, after 3 weeks, measures 250 µm in diameter and has central cavity. Around the fifth months, it measures approximately one- cm and it is

apparent that its wall consist of two layers : An external cuticular, or laminar layer, formed by numerous thin lamina that resembles the cross-section of an onion, and another internal layer germinative or proligerous, which is delicate cellular syncytium . Larval form of *E. granulosus* typically consists of single cavity (unilocular). The interior of a hydatid cyst is filled with fluid. During the same period , brood capsule buds off from the germinative layer, and forming an invaginated protoscolices (Omer, 2013).

(A) (B)

Figure 1 : Hydatid cysts in lung (A) and liver (B) (El-Ibrahim, 2009)

Fresh samples photographes of camel hydatid cysts

Figure (2-A) Figure (2-B)

Viable hydatid sand from camel lung Viable hydatid scolex from camel lung

Figure2: Microscope film photographes of camel hydatid cysts Samples (A and B)

1.4 The biology of *Echinococcus granulosus*:

The adult worm (3-6 mm long) inhabits small intestines of carnivore definitive hosts such as dogs, wolves,jackals, or foxes; and the meta- cestode (hydatid cyst) occurs in various domestic ungulates (camels, cattle, sheep, goates, pigs and horses) and wild ungulates (wildebeest, buffalo, grant gazelles, zebra, giraffe and warthog) in some parts of the world.The adult worm possesses 3-4 proglottids.The terminal one is gravid and usually about half the length of the worm.The hydatid

cyst is a fluid-filled unilocular bladder with an outer a cellular laminated layer and an inner nucleated germinal layer, from which fluid is secreted and brood capsules containing protoscolices develop.The brood capsules me become detached and float freely in fluid of the cysts, being named hydatid sands. Occasionally daughter cysts develop within the hydatid cyst.The size of the cysts and number of protoscolices they contain vary with host and organ involved.The eggs are typical taeniid eggs and are radially infective when passed in the definitive hosts. The eggs are highly resistant to environmental factors but are sensitive to desiccation and high tempretures (Mohammed., 2012).

1.5Life cycle :

Definitive hosts of *E. granulosus* are domestic dogs and some wild canids . Adult cestodes live attached deep inside mucosal crypts of definitive hosts small intestine of dogs. After being shed in faeces, the segments rupture, scattering the eggs which can be moved about by wind and water. They are highly resistant to weathering and can remain infective for several months, particularly in cool climates. Contamination of the dog's kennel area, playgrounds, vegetable gardens, pastures and the dog's coat can easily occur (see Figure 3).The eggs cannot continue their life cycle until swallowed by a susceptible animal – sheep, pigs, goats, camels, deer, cattle, kangaroos and humans. When the egg is swallowed, it hatches to release a small, hooked embryo which burrows its way through the gut wall. It is then picked up by the bloodstream and transported to the liver, lungs or, less frequently, to another organ such as the brain. Once lodged, the embryo develops into a hydatid cys whichis a fluid-fill sac.

Figure 3: Life cycle of *Echinococcus species*(Solusby, 1982)

Figure 4 : Photograph of protoscolices from hydatid brood capsule(King *et al*., 2005).

1.6 Diagnosis:

The diagnosis of Echinococcosis in dogs or other carnivores requires thedemonstration of the adult cestodes and eggs of Echinococcus spp. Intheir faeces or the small intestine . While diagnosis in intermediate hosts occurs by necropsy finding . Whereas surveillance for *E. granulosus* in domestic animals may take place in licensed slaughterhouses, that for *Echinococcus* sp. in wildlife must be done by field surveys. In livestock intermediate hosts, molecular methods are, however, important in identification of isolates or strains of *E.granulosus* for epidemiological purposes. Serological or immunological tests, useful in humans, are less sensitive and specific in livestock. And at present cannot replace necropsy . Antibodies directed against oncosphere, cyst fluid and protoscolex antigens can be detected in the serum of infected sheep, but this approach is presently of limited practical use as it does not distinguish between current and previous infections . Copro antigen tests based on a faecal antigen-detection antibody can be detected shortly after infection (10–14 days) (El-Ibrahim, 2009)

DNA recognition methods is currently used mainly for confirmatory testing of coproantigen-positive samples or for identification of taenid eggs recovered from faeces using the different PCR primers from faeces in definitive hosts of genus *Echinococcus*(Acha and Szyfres, 2001).

Diagnosis of human hydatidosis is suspected based on the clinical symptoms and epidemiological circumstances. Imaging methods such as radiography, computerized tomography, ultrasonography and scintigraphy are usually used.

While they do not confirm the diagnosis, they are very helpful to the specialist Ultrasonography is the first choice because it is economical, non invasive, simple, and accurate and reveals developing cysts that generally cannot be found with Xrays . Numerouimmunobiologic tests have been used in the diagnosis of human hydatidosis by *E. granulosus*, among them Casoni's intradermal test, complement fixation, indirect hemagglutination, latexagglutination electrosyneresis, and double diffusion to detect antibodies against the arc 5 antigen. Practically all have been displaced by ELISA and the immune-electrotransfer or Western blot test. Casoni's intradermal test is not very sensitive and is nonspecific for the diagnosis. While it was once used for epidemiological surveys, the collection of drops of blood on filter paper now makes it possible to use serologic techniques that are much more sensitive and specific on a large scale. The complement fixation, indirect hemagglutination, and latex agglutination tests have no operational advantage over ELISA and are much less specific or sensitive. The techniques based on observation of arc 5 were abandoned when it was found that the respective antigen was specific not for *Echinococcus* but for many cestodes. ELISA diagnosed 96.6% of hydatidosis patients but cross-reacted with taeniasis and ascariasis, indirect hemagglutination diagnosed 86% of patients but also gave cross-reactions, and the double diffusion test for arc 5 diagnosed 79% of patients but did not give false positives. Only ELISA gave false positives. Moreover, the test with selected antigens is not only highly sensitive and specific but can also distinguish among infections caused by different species of *Echinococcus*. ELISA for *E. multilocularis*, for example, showed a sensitivity of 93% and a specificity of 97%, in contrast to another ELISA for *E. granulosus* that showed a sensitivity of 89% and a specificity of 99%. But there seem to be wide variations in the sensitivity and specificity of the test among different laboratories. For example, in Valdivia, Chile, that 28 of 29 patients (96.5%) with hydatidosis confirmed by

surgery showed positive reactions to ELISA, and taeniasis and ascariasis patients showed false positives. More recent reports compared ELISA with antigen electrotransfer and attributed an 82% specificity to ELISA and a 94% to 97% specificity to the transfer test. More recently, the polymerase chain reaction (PCR) has also been used to detect nucleic acids from the parasite in patients' bloodstreams (Acha and Szyfres, 2001).

1.7 Treatment :

In animal experiments, it has been shown that efficacy of mebendazole against *Echinococcus* metacestodes was positively correlated with drug concentration in the serum and duration of treatment (Eckert, 1986).

Over 2,000 well documented cases of cystic echinococcosis in humans have been treated with benzimidazoles, to date. When evaluated up to 12 months after initiation of chemotherapy, 10% to30% of patients show cyst disappearance (cure), 50%-70% show degeneration of cysts and/or significant size reductions (improvement), but 20%-30% exhibit no morphological changes in cysts . Chemotherapy is apparently more effective among young rather than older patients. Small cysts that have thin walls without infection or communication, aswell as secondary cysts (even when multiple) are most susceptible to chemotherapy. Chemotherapy may, however, be less effective for thin-walled daughter cysts within a mother cyst. Some of the treated patients exhibit relapses, but these are usually sensitive to retreatment in a high proportion of cases (up to 90%). The rate of relapses after chemotherapy is relatively high (14%-25%). Chemotherapy is indicated for patients with primary liver echinococcosis and for patients with multiple cysts in two or more organs. Cysts localized in bones are less susceptible to chemotherapy. Since radial surgery is often impossible (e.g. cyst localization in spine or pelvis), long-term chemotherapy may be needed. Another important indication for chemotherapy is the prevention of secondary

echinococcosis. The pre-surgical use of benzimidazoles (ABZ or MBZ) may reduce the risk of recurrence of cystic echinococcosis and/or facilitate the operation by reduction of intracystic pressure, but this is not well documented. Two benzimidazoles have been extensively evaluated using animal models and used on over 2,000 patients:

• Albendazole (ABZ) (Eskazole®, Zentel®, 400 mg tablets and 4% suspension, SmithKline Beecham, England)

• Mebendazole (MBZ) (Vermox®, 500 mg tablets, Janssen Pharmaceutica, Belgium).

These drugs show definite efficacy against cystic echinococcosis , and are generally well tolerated. Studies with different groups of cystic echinococcosis patients, have shown that 48% of 665 cysts disappeared, and further 24% improved after chemotherapy with ABZ, compared to 28% of 516 cysts disappeared and 30% improved after treatment with MBZ. MBZ is apparently more effective against cysts in the lungs than in the liver, whereas such a difference was not observed for ABZ. Exact comparative efficacy of the drug is difficult to assess, as treatment protocols were variable in the different groups of patients (Eckert., 2001)

For treatment of cystic echinococcosis in humans the following oral dosages are recommended:

• Albendazole: 10 mg/kg-15 mg/kg bw per day in two divided doses postprandially. In practice, adults receive 800 mg/day in two single doses of 400 mg each . The division of the daily dose is supported by pharmacokinetic data . Cyclic treatment with intervals of 14 days was originally recommended by the manufacturer, and 3- to more than 6-monthly courses have been regarded as necessary for treating patients with single or multiple cysts. However, recent data have shown equal or improved efficacy of continuous treatment for 3 to 6 months or longer without an increase of adverse effects. In a recent comparative study, this type of treatment

was more effective than chemotherapy with mebendazole. Therefore, cyclical albendazole treatment seems to be no longer advisable.

• Mebendazole: the usual oral dosage of mebendazole is 40 mg/kg-50 mg/kg bw per day in three divided doses for at least 3-6 months.

In animal experiments, it has been shown that efficacy of mebendazole against *Echinococcus* metacestodes was positively correlated with drug concentration in the serum and duration of treatment (Eckert, 1986).

In human patients, serum drug levels of MBZ and ABZ may vary widely in individual patients, and correlation with oral doses and drug efficacy is inconsistent. Drug dosing in conjunction with a fatty meal improves intestinal absorption of benzimidazoles . The use of praziquantel (PZQ) (Biltricide®, Bayer, Germany), a heterocyclic pyrazinoisoquinoline derivative, has been proposed at a dose of 40 mg/kg bw once a week concomitantly with benzimidazoles. The PZQ might also be useful in cases of cyst content spillage during surgery. A recent study has shown that a combined treatment with albendazole (10 mg/kg/day) and praziquantel (25 mg/kg/day) given during the month prior to surgery increased the number of patients with nonviable protoscoleces as compared to monotherapy with albendazole . However, further studies are needed for evaluating the efficacy of the combined treatment. According to the manufacturer, the plasma levels of albendazole metabolites (sulphoxide) are increased 4.5 times if praziquantel is given simultaneously, and this may increase the rate of side effects . Hospitalisation is usually not necessary, but regular follow-up examinations are required. Costs of anthelmintics and repeated medical examinations may be considerable (Franchi *et al.,* 1999).

1.8 Control :

Any approach to the control of echinococcosis should recognize the multiplicity of interacting extrinsic and intrinsic factors as well as the impact of socioecological factors on the dynamics of transmission. The established control measures were directed towords prevention of dogs gaining access to raw infected organs and the reduction of parasite biomass by reducing the tapeworm population or reducing the dog population. The control of stray dogs and health care of domestic ones will help in eliminating the source of human and livestock infection. Other methods used to reduce the dog and tapeworm population include spaying of bitches, mass killing and mass dog treatment progam. The effective control relies on active cooperation and participation of target groups which include political decision-makers, butchers, and slaughter houses workers. By contrast with the predominant domestic animal transmission cycles that sustain *E. granulosus* worldwide, the closely related species *E. multilocularis* is transmitted only in the northern hemisphere and mainly within wildlife cycles. A number of fox species are highly susceptible to infection with the adult tapeworm, and awide range of rodents (especially microtine voles) and small mammals can act as intermediate hosts. Human infection with the larval stage, alveolar echinococcosis, is consequently a rarer zoonosis than cystic echinococcosis. However, the greater pathogenicity, treatment difficulty, and higher mortality risk of alveolar echinococcosis has led to consideration of its control by intervention trials/programmes in endemic areas of Alaska (St Lawrence Island), Europe (southern Germany and northern Switzerland), northern Japan (Hokkaido), and southwest China . In China, both human alveolar echinococcosis and cystic echinococcosis are coendemic in several western regions, and therefore

combinedcontrol of both these *Echinococcus* species may be warranted . Control of the wildlife transmission cycles of *E multilocularis* would be very difficult in most regions. In many alveolar echinococcosis endemic areas, however, it seems that the domestic dog probably has an important role in zoonotic risk . There are three main options for control of *E multilocularis* and reducing or eliminating alveolar echinococcosis as a public-health problem: (1) eliminate the fox population, (2) treat the fox population with anthelmintic baits, and/or (3) treat the rural dog population with anthelmintic (Praziquantel). (Mohamed.,1992).

Application of an effective vaccine to reduce hydatid infection in livestock would be likely to have a substantial impact on the rate of transmission of the disease to humans (Lightowlers, 2006) . As *E.granulosus* belongs to the Taeniid family, many aspects of its immunological relationship with its intermediate host are similar to that occurring in Taenia species . Moreover, it was considered that the vaccine development approach used in Taenia species such as the native host 8 protective antigens of T. ovis would also be successful for E. granulosus (Lightowlers *et al.*, 1996).

1.9 Geographic distribution :

Hydatid cyst disease has world-wide distribution which found in various countries including : Mediterranean region, South America, Africa, the Middle East, Russia, Central Asia, China and Europe .**(Microblog, 2009)**

Figure5:

World distiribuation of *Echinococcus* .(Microblog, 2009)

Infection with *E. granulosus*

No infection

Figure 6 :
Global distribution of *Echinococcus granulosus* (Isradiology, 2011)

1.10 Epidemiolog :

The prevalence of hydatid cyst in sheep in Greece, China, İtaly, Ethiopia, India, Azerbaijan and Pakistan have been reported to be 100% . In Iran many studies have been performed ; in Sanandaj area, western Iran and Kashan area, results indicated an infection rate of 51.9% (Acha and Szyfres, 2001).

A three - year (2005-2007) retrospective study was carried out to investigate the occurrence of cystic echinococcosis in cattle and sheep slaughtered at Arusha municipal abattoir, Tanzania(Nonga and Karimuribo, 2007). A total of 115186 cattle and 99401 shoats were slaughtered. Cattle liver, lungs, spleen and heart condemnation rate was 16.35%, 13.04%, 2.09% and 3.06% respectively, while 17.63%, 7.63%, 0.38% and 0.04% of shoats liver, lungs, spleen and heart respectively condemned. Highly significant ($P<0.001$) cystic echinococcosis infection rate was recorded in shoats (6.05%) than in cattle (40.2%) probably because of differences in grazing pattern .(Nonga and Karimuribo, 2007).

In another study carried out in Tunisia cattle lungs were more affected by CE (22.5%) than liver (19.7%). Three hundreds seventy cysts coming from 50 humans, 166 cattle, 155 sheep and 3 camels were collected in order to establish some epidemiological molecular information in Tunisia for the first time. The analysis by PCR-RFLP of I+SI sequence showed that all the human, ovine and

bovine cysts were due to the common sheep strain by *E.granulosus* .(M'rad *et al.*, 2005).

Another study was conducted from October 2009 to March 2010 at Akaki sub city municipal abattoir in Addis Ababa to determine the prevalence of hydatidosis in camel slaughtered for human consumption.Out of a total of 460 camels slaughtered 104 (22.6%) were found harboring hydatid cysts. The degree of prevalence between males (19.01%) and females (49.09%) was statistically significant (P2=25.4, $p<0.05$). The highest rate of infection (27.77%) was observed in camel from Harar while the lowest (20.62%) was found in animal from Kereyu. The infection rate were significantly different among the three age groups (P2 =8.8, DF=2, $p<0.05$). The prevalence was found to be high (28.63%) in animal greater than 10 years. The organ distributions of the cysts were 67.3% in lung alone, 25% both liver and lungs, 6.73% in liver only and 0.96% in heart (Salih., *et al* 2011).

Camel hydatidosis was studied at Addis Ababa abattoir, Ethiopia to determine the prevalence and financial losses associated with the disease(Gizachew.,*et al* 2013). From 501 camels slaughtered, 328 (65.47%) were found harboring hydatid cyst. The prevalence between females and males was statistically significant (P=0.000). Additionally, the disease was significantly different among the age groups (P=0.00) revealing higher prevalence in older animals. In respect to origin, the highest prevalence was observed from Borena (65.67%). The lung was the most frequently affected organ(47.90%). Majority of the cysts identified were non calcified cysts, 57.78 and 39.10% of the cysts were found to be fertile in the lung and liver, respectively. Of these fertile cysts 68.27 and 60% were viable in the lung and liver, respectively.(Gizachew.,*et al* 2013)

Another study was conducted from November 2009 to April 2010 with a purpose to assess the prevalence and economic significance of hydatid cyst in slaughtered sheep and goats at Modjo Modern Export Abattoir (MMEA), Ethiopia. The result of this study revealed that a total of 1115 small ruminants (348 sheep and 767 goats) were randomly sampled and examined after slaughter for the presence of hydatidcysts in the visceral organs (lungs, livers and hearts) and on muscles of the animals using the standard meat inspection procedures, where 97 (8.7%) were positive. The positive samples were taken to the laboratory for the cyst identification; fertility and viability test were performed. The study indicated that the prevalence of the hydatid cyst in the study area was 28 (8.05%) in sheep and 69 (8.99%) in goats which showed no significant variation between the two species. The distribution of cysts in the internal organs showed little significant variation between two organs (Lung and liver) in both animal species ($c2 = 0.272$, $P>0.05$). From the total examined sheep, 22 (78.6%) of the lung, 9 (32.1%) of liver and 1 (3.6%) of the heart which in goats was, 37 (53.6%) for lung, 27 (39.1%) liver, 0 (0%) heart and 4 (5.6%) muscles, respectively. Lung was the most commonly affected organ both in sheep and goats (Abiyot., *et al* 2011).

In an attempt to establish the prevalence of cystic echinococcosis, a study was conducted in slaughter animals in three divisions of Northern Turkana, Kenya (Njorge *et al.*, 2002). A total of 5752 goats, 588 sheep, 381 cattle and 70 camels were examined at slaughter. Hydatid cyst were found in 19.4% of the cattle, 3.61% of sheep, 4.5% of goats and 16.4% of camels. The prevalence of cystic echinococcosus in cattle, sheep and goats was higher in Lokichogio than in either Kakuma or central divisions. The differences in prevalence rates in different study areas are attributed to differences in environmental conditions *(*Njoroge *et al.*, 2002*)*.

Another study was conducted to estimate the infection rate of hydatidosis caused by *E. granulosus* in cattle and sheep as intermediate hosts in slaughter houses of Khartoum State (Mohamadin and Abdelgadir, 2011). An abattoir survey was carried out in 849 cattle and 3850 sheep slaughtered in the study area during January 2010 to June 2010. The highest infection rate (2.8%), was found in cattle followed by sheep (1.4%). The most affected organs in cattle were the lung and liver (37.5% for each). In sheep, the liver was the most infected organ (65.2%), followed by mesentery (21.7%). The records of abattoirs in Khartoum state indicated that hydatidosis was one of the most frequently encountered parasites during the last six months in Khartoum State (Mohamadin and Abdelgadir., 2011).

The prevalence of cystic echinococcosis was studied among the livestock slaughtered in abattoir of Sirte, Libya during the period July 2004 to May 2005. The overall infection rate of 4.9% in sheep, 2.4% in goats, 2.7% in camels and 15% in cattle were observed. The increase in prevalence with age of the animals was statistically significant in the four species. In female goats, examined infection was higher in the male. Liver had higher hydatid cysts than lungs in sheep, goat whileinfected lungs had higher in camel.(Kassem *et al.*, 2013).

An study was conducted in order to determine the prevalence of hydatidosis and the fertility/sterility rates of hydatid cysts in cattle and sheep slaughtered in Addis Ababa Abattoir, Ethiopia (Fikire *et al.*, 2012) . Postmortem examination, hydatid cyst characterization and questionnaire survey were conducted. In the study, 19.7% cattle and 13.47% sheep were found harboring hydatid cyst. Though it was difficult to know the exact origin of the animals, cattle brought from Harar 36%, northern Shewa 28%, Nazareth 22%, Arsi 10% and others 4% were infected. The occurrences of hydatid cyst were 48, 31.7, 16.3, 1.7 and 2.4% in cattle and 41.7, 56.7, 0.8 and 0.8% in sheep, lung, liver, kidney, spleen and heart, respectively. Of the total of 1479 hydatid cysts in cattle and 175 in sheep counted 38.2, 29.8, 7.3,

and 24.7% in cattle and 64, 11.4, 1.7 and 22.9% in sheep were found to be small, medium, large and calcified cysts, respectively. Among the hydatid cysts, 55.4, 19.3 and 25.3% in cattle (n = 1479) and 22.5, 59.1 and 18.5% in sheep (n = 175) were sterile, fertile and calcified, respectively. Viability rates of 60.5% in cattle and 78.3% in sheep were observed. The rate of calcification was higher in the liver than in the lung while fertility rate was higher among the cysts of the lung for both cattle and sheep (Fikire *et al.,* 2012).

A cross-sectional study on bovine hydatidosis was conducted in Ambo municipality abattoir from November 2007 to March 2008 with the aim of investigating the prevalence, intensity, fertility and economic losses in cattle slaughtered for human consumption. Stray dogs killed with strychnine baited meat piece were also examined for the presence of adult *Echinococcus granulosus*. Out of the total 384 cattle examined 114 (29.69%) were found infected with hydatidosis. From the examined animals 61 (15.89%), 19 (4.95%) and 26 (6.77.3%) contained hydatid cyst in their lungs, livers, and in both lung and liver, respectively. Age related infection was significant in that older animals were more infected ($P<0.05$, $x2 = 15.64$, $df =1$). In the sphere of size determination there were 471 (69.26%) small, 140 (20.59%) medium and 69 (10.15%) large sized cysts. Concerning the fertility test, 31.39%, 53.28% and 15.33% were fertile, sterile and calcified cysts respectively. About 58.14% of fertile cysts were viable (Zewdu.,*et al* 2010).

In another study, the prevalence and biometry of hydatidosis was studied in 5000 cattle of either sex. The prevalence of hydatidosis was 35.0 %. The hydatid cysts were found in liver (25.31 %), lungs (47.31 %), and spleen (1.83 %). Mixed infection of hydatid cysts was found both in male (23.72 %) and female (26.18 %) cattle in liver, lungs and spleen. Lungs were the most commonly infected organ

both in males (29.32%) and females (49.55%). Irrespective of sex, lungs had the highest fertility rate (76.93%) with the highest number and largest size of cysts (Anwer*et al.*,2000).

A cross-sectional study was conducted from December 2008 to March 2009 to assess the status of cystic hydatidosis in cattle slaughtered at Hawassa Municipal abattoir(Regassa et al 2010). Out of the total 632 cattle examined visually and manually (palpation and incision), 333 (52.69%) were found harboring hydatid cysts. A significantly higher infection was detected in older cattle ($P<0.05$, $\chi2=4.36$) than young. Regarding body condition score, no significant variation ($P>0.05$, $\chi2=2.148$) was observed as the prevalence was 54.55% for lean cattle followed by medium (53.83%) and fat (46.88%). Of the total 333 infected, 123(36.9%) had hydatid cysts only in the lung, 23 (6.9%) in the liver, 12 (3.6%) in the spleen, five (1.5%) in the heart, and three (0.9%) in the kidney while the rest 167 (50.2%) had multiple organ infections. Of the 530 viscera harboring hydatid cysts, the highest (52.83%) was lung followed by liver (34.15%), spleen (9.06%), heart (3.39%), and kidney(0.56%). Size assessment made on 874 cysts indicated that 308 (35.3%) were small, 251 (28.7%) medium, 89 (10.2%) large, and 226 (25.9%) were calcified. The distribution of characterized cysts in different organs based on their size was found to be statistically significant ($P<0.05$). Inaddition, out of the total 874 cysts collected, 26.9% were fertile, 47.3% sterile, and 25.9% calcified or purulent cysts. There was a significant difference in fertility of cyst from different organs ($P<0.05$, $\chi2=27.96$), those of lung origin being highly fertile. Likewise, out of the 121 fertile cysts subjected for viability test, 68 (56.2%) were viable.(Regassa *et al.,* 2010).

A previous study was conducted to determine the prevalence of hydatid cyst disease in cattle, camel, sheep and goats, over a one year period (Oct 2003- Sept

2004) (Abdullahi *et al.,* 2011). Forty six thousand two hundred and twenty three (46223) cattle , 3545 camel, 16345 sheep and 14134 goats were examined at post mortem for evidence of hydatid cyst lesions. Prevalences of 0.07%, 8.97%, 0.14% and 0.03% were found for cattle, camel, sheep and goats, respectively. Locations of the cyst lesions in the examined animals shows liver was the most predominant site in cattle 61.76%, sheep 78.26% and goats 75.0%. For camels, lungs showed the most number of CE lesions 91.51%. Overall, the least number of hydatid cyst lesions were observed in the heart. There was significant association ($p < 0.001$) between the species of animals and infection. In this study the public health importance of the disease and the findings were discussed (Abdullahi *et al.,* 2011).

Also,aprevious study was conducted to determine the prevalence of hydatidosis in dogs in Mauritania (Salem *et al.,* 2011). The prevalence rate was 14%. The average number of *E. granulosus* per dog was 172 and 1227 on the positive dogs. Concerning the livestock, hydatid cysts found in 30.1% of the dromedary , 5.5% of the cattle and 6.5% of the sheep. The fertility rate of hydatid cysts in humans 75% and camels 76% was significantly higher than that of sheep 24% and cattle 23% ($P<0.0001$). Hydatid cyst infestation is characterized globally by the dominance of pulmonary localizations in humans 50% and camels 72.7% and in the liver in sheep (76.1%) and cattle (82.3%).(Salem *et al.,* 2011).

Chapter Two

Materials and Methods

Study area:

The study was conducted at Tambul abattoir in Butana Area, The Butana plains refer to the whole region between the main Nile, the Blue nile and the River Atbra . the Butana covers an area of approximately 120,000 km^2 and lies between latitude 13-50 , 17 – 50 north and longitude 32 - 40 , 36 – 00 east the climate of area gradually changes from a desert type in extreme north to semi desert and savannah as we move south. In the northern side of Butana the rain fall ranges from 100 – 200 mm per year and increase to above 500 mm in the southern part. The natural grasses in rainy season are the main feed in source for the camels and goats. Tambul region it lies in Central, Sudan and its geographical coordinates are 14° 56' 0" North, 33° 24' 0" East.(Marf,2011**)**.

Figure 7: Map of Tambul area(Kahabioa, 2011)**.**

Sample Size:

The expected prevalen of camel hydatidosis for calculation of sample size was taken from the study was done in Ethiopia in which the prevalence of hydatidosis in camel was 22% (Salih *etal.*, 2011).Sample size was calculated according to the formula by(Martin *et al.* 1987).

$$n = \frac{(1.96)^2 \hat{P}\hat{Q}}{L^2}$$

Where:

n ≡ Required Sample Size

$\hat{P}$ ≡ Expected prevalence = 22%

$\hat{Q} \equiv 1 - \hat{P} = 0.96$

L ≡ Allowable error

$$N = \frac{4 \times 0.22 \times 0.78}{0.0025} = 256$$

Study Animals

A total of 256 indigenous camel breeds slaughtered at Tambul slaughter house were included in the study. During ante-mortem examination each study animal was given an identification number; and age was determined. Estimation of age was done by the examination of the teeth eruption (De Launtaand Habel, 1986). Three age groups were considered: less than 5 years,5-10 years and above10 years. It was difficult to precisely indicate the geographical origin of all animals slaughtered at the abattoir and relate the

findings on hydatidosis to a particular locality. Nevertheless, the attempts made in this regards have disclosed that the majority of them were drawn from different areas of the country to Tambul market. The majority of the camels presented for slaughtering in the study area were female,most of them reared in pasture but small number kept under sedentary system.most of inspected camels was in good body condition and the remain in poor body condition.

Study design and data collection:

A cross-sectional study was conducted in 256 camels slaughtered at Tambool slaughter house,usingasystematic random sampling by random selection of camels slaughtered 2days among a week by aconstant interval.

The selected camels on ante-mortem marked for examination for presence of hydatid cyst when slaughtered, the study was done in Tambool region of Buttana area(Elgazeera state-sudan) from April 2013 to June2013. All marked camels slaughtered during each visit day were sampled.

Ante and post-mortem inspection:

Regular visits were made to conduct ante and post-mortem examination of slaughtered camels in abattior during the survey period. During the ante-mortem inspection, theage,source of animal,sex, body condtion,breed and management system was assessed and recorded.Animals were identified by marking in the loin region.

During the post-mortem examination, through visual inspection,palpation and systematic incision of each visceral organs particularly the liver,lungs,spleen, heart and kidneys were carried out according to procedures recommended by (FAO/UNEP/WHO.1994).palpable nodules

deeper in the lungs (suspected hydatid cysts cases) were collected for examination. Fresh samples photo graphs of the camelhydatid cysts in different organs were taken.Thehydatid cysts found were removed carefully by dissection from the affected organs and the surrounding tiusses using sharp knives and scalpels.The cysts collected were counted and placed in propably identified plastic bags then taken to the laboratory in clean buckets for further examination. Allhydatid cysts found in the organs were collected to conduct cyst count, cyst size,cyst fertility test and viability of protoscolices.Thorough post mortem examination was carried out by visual inspection, palpation and systematic incision on visceral organs; lung, liver, heart, kidney and spleen according to procedures recommended by Food and Agricultural Organization (FAO, 1994). All organs harboring cysts were partially or totally condemned and were judged according to the guidelines on meat inspection for developing countries (FAO, 1994). Whenever and wherever the hydatid cysts appeared, the number and the size of the cysts per organ and per animal were counted,measured and recorded. Accordingly, the size of cysts were measured systematically and classified into three categories based on their diameter as small (<5 cm), medium (5 to 15 cm) and large (>15 cm) . The cysts were randomly selected and collected from different organs and were taken to regional laboratory (Buttana University, Prasitology Labratory) for fertility and viability tests.

Laboratory examination of samples:

The infected organs from each positive animal were collected and recorded including the cyst location, morphology and volume of the fluid contents. Of the collected samples, individual cyst was carefully opened and examined to identify whether it was a hydatid cyst and whether it was fertile,

sterile or calcified. After opening in a petri dish the cyst fluid was aspirated by using a 20 ml syringe to measure the volume of the cyst fluid.

A drop of the cyst fluid was placed on the microscope glass slide and covered with cover slip and observed for presence of protoscolices on light microscope with X10 to X40 objective. For clear vision a drop of 0.1% aqueous eosin solution was added to equal volume of cyst fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead ones take it up. Infertile cysts were further classified as sterile. Sterile hydatid cysts were characterized by their smooth inner lining usually with slightly turbid fluid in its content with dead or without protoscolices. Typical calcified cysts produced a gritty sound feeling up on incision (Ernest et al.,2009)

Laboratory examination of samples was carried out at the labratory in Tambul Veterinary Collage(parasitology laboratory).The volume of cyst fluid was measured with a 10-ml and 20-ml syring and the diameter of cyst was measured using and ordinary ruler taking the avareage of two diameters at right angels across the cyst.

Few drops of cyst fluid aspirate were placed on a glass slide and examined micoroscopically for the presence of protoscolices.Cysts without protoscolices were cut open and the walls scraped, the membranous material found was pressed between glass slide and examind microscopically . The biological status of the cysts was evaluated grossly and microscopically according to (FAO,UNEP,WHO 1981) as fertile and sterile.

Examination of cyst fertility and viability of protoscolices:

The viability of protoscolices from fertile hydatid cysts was determined by morphology and movement on glass slide up on microscopic examination by the following criteria:

1.Fertile : containing protoscolices.

2.Sterile : not containing protoscolices

The viability of protoscolicesfrom fertile hydatid cysts were determined according to (FAO, UNEP, WHO. 1981) by the following criteria:

Morphology and movement : Afew drops of hydatid fluid from each fertile hydatid cysts were placed on a glass slide and examined microscopically for morphology . Viable protoscolices appear oval or ovoid in shape, well invaginated, greenish in colouration, have rosteller hooks and have peristaltic-like movement in hydatid fluid. Dead ones appear yellow-brown in color and immotile (Eckert, et al. 2001).

Statistical analysis :

Results of the study were analyzed using statistical package of social science (SPSS).

First: Descriptive statistical analysis was displayed in frequency distribution and cross tabulation tables .

Univariate analysis was conducted using the Chi-square for qualitative data .

P-value of 0.25 was considered as significant association and the riskfactor was then selected to enter the multivariate analysis. Multivariate analysis: Forward stepwise logistic regression was usedto analyse the data and to investigate association between a potential risk factor and the prevalence of camel hydatidosis. A p-value of 0.05 indicated significant association between hydatidosis and the risk factors.

Chapter Three

Results

3. Descriptive statistical analysis frequency tables, cross tabulation and association tables between the disease and risk factors:

3.1 Prevalence of hydatid cyst:

Of the total 256 camels inspected, only 22 animals were positive, and the rest were negative, this gives a prevalence of 8.6 % (table 3.1).

Table 3.1: Distribution of hydatid cyst infection among 256 camels examined inTambul slaughter house:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-ve	234	91.4	91.4	91.0
	+ve	22	8.6	8.6	100.0
	Total	256	100.0	100.0	

3.2 Sex of animals:

The results of this study showed the distribution of 256 camels examined for hydatid cyst according to sex. Total number of male examined was 59(23%) animals, while the total number of female examined was197(77%)(table3.2). Among males, 2 animals were found infected. Rate of infection within males was 3.8%. While among females 20 animals was found infected. The rate of infection within females was 10.1% (table 3.3).

The Chi-square test showed no significant association between hydatid cyst infection and sex of animal (p-value = 0.104), (table 3.4).

3.3 Age of animals:

Two hundred fifty six camel of various ages were examined in this study. The presence of hydatid cyst in various organs was investigated. The result shows the age distribution of camel, 41(16%)of the camels were less than 5years,166 (64.8%) of camels were from 5 to 10 years and 49(19.1%) of the camels were more than 10 years, (table 3.2). Among less than 5 yearsone animal were found infected. Rate of infection within less than 5 years animals were 2.4 %. However among animals from 5 to 10 years 13 animals were found infected. Rate of infection within animals from 5 to 10 was 7.8% ,and among animals more than 10 years 8 animals were found infected. Rate of infection within animals more than 10 years were 16.3% (table 3.3).

The Chi- square test showed a significant association betweenhydatid cystinfection and age of animal (p-value = 0.054),(table 3.4).

3.4 Body condition:

The body condition of animals and the presence of infection were investigated. One hundred thirty seven (53.5%) of camels were found to be in good condition, while 119 (46.5%) of camels were found to be in poor condition (table 3.2). Among good condition12animalswere found infected. The rate of infection within good animals was 8.7%. However 10 animals were found infected among poor condition animals. The rate of infection within poor animals were 38.4% (table 3.3).

The Chi- square test showed no significant association between the infection and body condition (p-value = 0.91),(table 3.4).

3.5 Source of animals:

Of the total 256 camels inspected, 97(37.9%) animals were from Darfur,17 animals were from Kordofan , 49 (19.1%) animals were from Gadarif,12 (4.7%) animals were from Kassala , 66 (25.8%) animals were from Butana,9 (3.5%) animals were from Sennar, 2 (.8%) animals were from White Nile and 4 (1.6%) animals were from Managil(table 3.2). Among these animals from Darfur 9 animals were found infected. The rate of infection within animalsfrom Darfour was 9.2%, Among these animals from Kordofan 3 animals were found infected. The rate of infection within animals from Kordofan was 4.2% , Among these animals from Gadarif 2 animals were found infected. The rate of infection within animals from Gadarif was 4% , Among these animals from Kassala 0 animal was found

infected. The rate of infection within animals from kassala was 0%, Among these animals from Butana 6 animals were found infected. The rate of infection within animals from Butana was9% , Among these animals from Senar 2 animals were found infected. The rate of infection within animals from Senar was 100%, Among these animal from White Nile 0 animal was found infected. The rate of infection within animal from White Nile was 0% , However Among these animals from Mangil 0 animal was found infected. The rate of infection within animals from Managilwas 0% (table 3.3).

The Chi-square results showed that there is no significant association between the infection and source of animal (p-value = 0.435), (table 3.4).

3.6 Breed:

The results of study showed distribution of hydatid cystinfection in Tambul slaughterhouse according to breeds. Total number of Rezegat breed was 97 (37.9%) animals, Total number of kabashi breed were 17 (6.6%) animals , Total number of Shokri breed were 92 (35.9%) animals, Total number of Rufaee breed bwere 34 (13.3%) animals, Total number of Bneaamer breed were 12 (4.7%) animals and Total number of Kuahla breed were 4 (1.6%) animals, Among these Rezegat breed, 9 animals were found infected. The rate of infection was 9.2%, Among thesekabashi breed3 animalswere found infected.The rate of infection was 17.6%,Among theseShokri breed 6 animals were found infected.The rate of infection was 6.5%, Among theseRufaee breed 4 animals were found infected.The rate of infection was 11.7%, Among theseBneaamer breed 0 animal was found infected.The rate of infection was 0%, and Among theseKuahlabreed 0 animal was found infected.The rate of infection was 0%.(table3.3).

The Chi- square test showed no significant association between the infection and breed (p-value = 0.51), (table 3.4).

3.7 Management:

The results of study showed distribution of hydatid cystinfection in Tambul slaughter house according to management. Total number of animals in pasturalmanagementwere229 (89.5%)animals. Among these 229 animals, 22 were found infected. The rate of infection was 9.6%. Total number of animals in sedentary management examined were27 (10.5%) animals. Among these.there was no infection. The rate of infection was 0% (table 3.3).

The Chi- square test showed no significant association between the infection and management (p-value = 0.09), (table 3.4).

Table 3.2: Summary of frequency tables for potential risk factors of hydatid cystin 256 camels examined at Tambul slaughterhouse:

Risk Factors	Frequency	Relative Frequency %	Cumulative Frequency %
Sex			
Female	197	77	77
Male	59	23	100.0
Age			
>5	41	16	16.0
5-10	166	64.8	80.9
<10	49	19.1	100
Body condition			
Poor	119	46.5	46.5
Good	137	53.5	100.0

Source			
Darfour	97	37.9	37.9
Kordufan	17	6.6	44.5
Gadarif	49	19.1	63.7
Kassala	12	4.7	68.4
Butana	66	25.8	94.1
Sennar	9	3.5	97.6
White Nile	2	.8	98.4
Managil	4	1.6	100.0

Table 3.2 : continued

Risk Factors	Frequency	Relative Frequency %	Cumulative Frequency %
Breed			
Rezegat	97	37.9	37.9
Kabashi	17	6.6	44.5
Shokri	92	35.9	80.5
Rufaee	34	13.3	93.8
Bneaamer	12	4.7	98.5
Kuahla	4	1.5	100.0
Management			

Pastural	229	89.5	89.5
Sedentary	27	10.5	100.0

Table 3.3: Summary of cross tabulation for potential risk factors of hydatid cyst in 256 camels examined at Tambulslaughterhouse:

Risk factors	No.inspected	No.affected (%)
Sex		
Female	197	20(10.1)
Male	59	2(3.8)
Age (years)		
>5	41	1(2.4)
10-5	166	13(7.8)
10<	49	8(16.3)
Body condition		
Poor	119	10(8.4)
Good	137	12(8.7)
Source		
Darfour	97	9(9.2)
Kordufan	17	3(17.6)

Gadarif	49	2(4)
Kassala	12	0(0)
Butana	66	6(9)
Sennar	9	2(22.2)
White Nile	2	0(0)
Mangil	4	0(0)

Table 3.3 continued

Risk factors	**No.inspected**	**No.affected (%)**
Breed		
Rezegat	97	9(9.2)
Kabashi	17	3(17.6)
Shokri	92	6(6.5)
Rufaee	34	4(11.7)
Bneaamer	12	0(0)
Kuahla	4	0(0)
Management		
Patsural	229	22(9.6)
Sedentary	27	0(0)

Table 3.4: Summary of univariate analysisfor potential risk factors of hydatid cyst in 256 camels examined at Tambul slaughterhouse using the Chi- square test:

Risk factors	No. inspected	No. affected (%)	d.f	Chi-square value	p- value
Sex			1	.119	.104
Female	197	20(10.1)			
Male	59	2(3.4)			
Age			2	5.830	.054
>5	41	1(2.4)			
10-5	166	13(7.8)			
10<	49	8(16.3)			
Body condition			1	.010	.919
Poor	119	10(8.4)			
Good	137	12(8.7)			

Source			7	6.943	.435
Darfour	97	9(9.2)			
Kordufan	17	3(17.6)			
Gadarif	49	2(4)			
Kassala	12	0(0)			
Butana	66	6(9)			
Sennar	9	2(22.2)			
White Nile	2	0(0)			
Mangil	4	0(0)			

Table 3.4: Continued

Risk factors	No.inspected(%)	No.affected(%)	d.f	Chi-square value	p-value
Breed			5	4.274	.511
Rezegat	97	9(9.2)			
Kabashi	17	3(17.6)			
Shokri	92	6(6.5)			
Rufaee	34	4(11.7)			
Bneaamer	12	0(0)			
Kuahla	4	0(0)			
Management			1	2.834	.092
Patsural	229	22(9.6)			
Sedentary	27	0(0)			

Table 3.5: Multivariate analysisof potential risk factors ofhydatid cyst in 256 camels examined at Tambul slaughterhouse:

Risk factors	No. inspected	No. affected (%)	Exp(B)	p-value	95.0%C.I for Exp(B)	
					Low	High
Sex				.104		
Female	197	20(10.1)	1.789		0.382	8.383
Male	59	2(3.8)	Ref			
Age				.054		
>5	41	1(2.4)	Ref			
10-5	166	13(7.8)	0.180		0.020	1.606
10<	49	8(16.3)	0.477		0.172	1.62

Management				**.012**		
Pastural	**229**	**22(9.6)**	**1.18**		**0**	**0.092**
Sedentary	**27**	**0(0)**	**Ref**			

3.8 Location of cysts :

The location of cysts in different organs has been investigated . Our results showed that the lungs was the most infected organ with hydatid cyst where 21 cases (95.5 %) were found infected in lung only. that means liver alone was not affected . Table (3.6) summarizes the distribution of hydatid cyst in organs.

Table 3.6: Frequency table for distribution of infection among 256 camel examined in tambul abattoir according tolocation of cysts in organs

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid				
No infection	234	91.4	91.4	91.4
Lung	21	8.2	8.2	99.6
Lung+Liver	1	0.4	0.4	100.0
Total	244	100.0	100.0	

3.9 Number of cysts :

Distribution of single and multiple cysts in organs is listed in table 3.9.1 . Single cyst has been found in eight cases (3.1%) , while multiple cysts have been found in 14 cases , 2 cysts in 10 cases (3.9%), 3 cysts in 3 cases (1.2%), and 4 cysts in one case (0.4%).

Table 3.7 : Frequency table forDistribution of hydatid cyst infection among256 camels examined in Tambul abattoir according to numbers of cysts in the organs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One cyst	8	3.1	3.1	3.1
	Two cyst	10	3.9	3.9	7.0
	Three cyst	3	1.2	1.2	8.2
	Four cyst	1	0.4	0.4	8.6
	No cyst	234	91.4	91.4	100.0
	Total	256	100.0	100.0	

3.10 Fertility and viability of cysts :

Microscopic examination of cyst revealed total of 41 cysts , 20 cysts present in ten cases were fertile viable,7 cysts in six cases were fertile non viable and 14 cysts in six cases were sterile. (table 3.8).

Table 3.8 : Distribution of 41 cysts observed in 22 affected camels according to fertility and viability

		Frequency	Percent	Cumulative Percent
Valid	Fertile viable	9	3.5	3.5
	Fertile non-viable	4	1.6	5.1
	Sterile	9	3.5	8.6
	No cyst	234	91.4	100.0
	Total	256	100.0	

3.11 Volume of cysts :

Distribution of less than 20 ml, 20-50 ml and more than 50 cysts volume in organs is listed in table 4.11.1 . More than 3 ml size cysts has been found in two cases (0.8%) , while small than or equal to 3 ml cysts have been found in 4 cases (1.6%) (table 3.9).

Table 3.9 : Distribution of hydatid cysts observed in 22 affected camel according to volume of cyst

Volume		Frequency	Percent	Cumulative Percent
Valid	< 20 ml	11	4.3	4.3
	20-50 ml	10	3.9	8.2
	>50 ml	1	0.4	8.6
	no cyst	234	91.4	100.0
	Total	256	100.0	

3.12 Size of cysts :

Distribution of less than 5 cm,5-15 cm and more than 15 sizecysts in organs is listed in table 3.12.1 . less than 5 cm sizecysts hasbeen found in eleven cases (4.3%) , also 5-15 cm has been found in ten cases (3.9) , while more than 15 cm size cysts has been found in one case (0.4%) (table 3.10).

Table 3.10 : Distribution of hydatid cysts observed in 256 affected camelaccording to Size of cyst

Size		Frequency	Percent	Cumulative Percent
Valid	< 5 cm	11	4.3	4.3
	5-15 cm	10	3.9	8.2
	>15 cm	1	0.4	8.6
	no cyst	234	91.4	100.0
	Total	256	100.0	

Chapter Four

Discussion

Hydatidosis is known to be important in livestock and public health in differentparts of the world and its prevalence has beenreported by different workers in different geographical areas. The prevalencemay however vary from country to country or even within a country (Zewdu *et al*., 2010).

The real magnitude of the disease in domestic animals, wild animals and man in the Sudan still in need for further investigation . Slaughtered animals may pass through several owners on their way to the slaughterhouse, this may create difficulty to trace infected animals.In the present study the prevalence of hydatidosis in Camle slaughtered in Tambul slaughterhouse, Butana area, Sudan was 8.6%.The prevalence of hydatid cyst in this study (8.6%) was is lower than the prevalences in other studies in different countries, which was 65.5% in Ethiopia (Gizachew *et al*., 2013), also22.6% in Ethiopia (Salih *et al*., 2011), it was about similar to the prevalence in Nigeria (8.9%) (Abdullahi *et al.*, 2011), and a bit higher than the prevalencein Libya (8.4%) (Kassem *et al.*,2013).This might be due to the variation in environmental condition because; the eggs survive for only short

periods of time if they are exposed to direct sunlight and dry conditions (OIE, 2005), and under ideal conditions, *E. granulosus* eggs remain viable for several months in pastures or gardens and on household fomites. The eggs survive best under moist conditions and in moderate temperatures. Viable eggs have been found in water and damp sand for 3 weeks at 30°C, 225 days at 6°C and 32 days at 10-21°C (OIE, 2005). In addition, the difference in hydatidosis prevalence rate between countries could be associated with different factors like control measures applied in place , the level of community awareness created about the disease, education and economic status of the population, variation in the temperature, environmental conditions, the nature of the pasture and the way of raising these animal, levels of exposure and the maturity and viability of eggs (Njoroge *etal.,* 2002). Moreover, the environmental condition in Butana area is not suitable for the eggs to survive for long period of time and this strengthens our study and support that, why our prevalence was lower than other studies. However, recent studies showed prevalences lower than our prevalence, 2.7% in Libya (Kassem *et al.,*2013).

The prevalence of hydatid cyst infection according to source of investigated animals (origin) has been estimated in this study. The rate of infection in animals from Darfur was 9.2%, in animals from Kordofan was 4.2%, in animals from Gadarif was 4%, in animals from Kassala was 0%, in animals from Butana was 9%, in animals from Senar was100%, in animals from White Nile was 0% and in animals from Managil was 0%.There was no significant association between the hydatidosis and origin of the animals (p-value = 0.435). The higher rate of infection was found in animals from Senar(100%) ,then animals from Darfour (9.2%) followed by animals from Butana (9%). The reason could be attributed to the geographic location, outdoor rearing in open grazing areas, dense dog

population (camel dogs and wild carnivores) and no hygienic elimination of camel offal which leads to environmental parasite contamination. Regarding the source of animals, hydatidosis infection rate showed no significant association(p-value=.435) between disease and source of animals, that is in a greement with study done in Ethiopia, that explain there is no association between hydatidosis and source of animals (p-value= 0.60) (Abiote*et al*., 2011). Among source of animals, camels from Sinnar area more affected with hydatidosis (100%), I think that camels during jurney from Sinnar to Tambul market were in close contact to wild canids which raised in Dinder National Park who considred the natural reservoir of hydatidosis followed by animals from Darfur (9.2%) who under less exposure and similar exposure to hydatidosis in animals originated from other regions.

This study showed that female she-camel have ahigly rate of infection than male camel. The rate of infection in female animals was 10.1%, while in male animals was 3.8%. There was significant association between hydatidosis and sex of animals (p-value = 0.104).

Logically, females have a high rate of infection than males, because the female remain longer for reproductive purposes so the cysts have a chance to develop. For this reasons female animals have more time to be exposed to the disease. Although female animals are more affected with hydatid cyst compared to male, there is a significant association was observed between sex and hydatid cyst infection in this study in agreement with previous study done in Ethiopia (Gizachew *et al.*,2013).

With regards to rate of infection of hydatidosis in different age group of Camel, asignificant association (p-value = 0. 054) was observed. Animals with less than five years of age were less affected (2.4%) compared with animals from five to ten years (7.8%) and animals more than ten years were highly affected(16.3%). The difference in infection rate could be attributed mainly to the fact that aged animals

have longer exposure time to *E. granulosus.*and this in agreement with study in Ethiopia (Zewdu *et al.*, 2010).

The results of this study showed that the prevalence of hydatid cyst infection within 2 categories of body condition of the animals was: 8.7% in good body condition and 38.4% in poor body condition. However, there was no significant association between hydatid cyst infection and body condition of animals (p-value = 0.36). This could be attributed to the fact that, the hydatid cyst infection is a mild disease which may not affect the general health of the affected animals. Also lack of variability in relation to body condition might be due to the little tendency of excluding emaciated animals form being slaughtered.

Regarding the management of animals, more over the pastorlists in Sudan moves with their livestock animals from place to place in search of feed where wild canids are found. This may favor the transmission of infection between infected canids and susceptible camels. This is in agreement with study done in Ethiopia (Zewdu *et al.*, 2010). In our my study regarding the management system of animals in association to camel hydatidosis reveal no significant association (p-value= 0.012) between animals graze in pasture and animals raised in sedentary system and this in a greement with study done in Ethiopia (Erbeto *et al*., 2009).

Among hydatidosis positive camels, lung (95.5%) was found to be most frequently infected visceral organ in infected camels, following by both lung and liver(4.5%) but other organs were found to be not harboring any hydatid cyst, this result is in agreement with study done in Ethiopia that reveal the infection in lung was high (63.7%) , followed by both liver and lung (6.7%) (Salih *et al.*,2011).

Lung harboured higher number of large and medium size cysts, while liver was found to be harbor higher number of small and calcified cysts, the high number of large and medium size cysts in lung may be due to relatively softer consistency.

The higher number of calcified cysts in the liver could be attributed to reticulo-endothelial and connective tissue of the organ. This findings is similar to findings in study done in Ethiopia(Zewdu *et al* ., 2011).

Regarding the fertility of hydatid cysts from the lung (95.5%)shoed a higher fertility proportion as compared to cysts collected from liver and also from both lung and liver , this result in agreement with result of study in Ethiopia (Salih *et al* .,2011).

Conclusion

- The output of this study indicates that the overall prevalence of hydatid cyst was 8.6%.
- The distributionofprevalence of hydatid cysts infection by age showed that the prevalence in less than five years animals was (2.4%) which is less compared to prevalence in five to ten years animals which was (7.8%) and more than ten years animals in which prevalence was (16.3%) and this is higher one.
- For body condition the prevalence is higher in animals in poor body condition (38.4%) and low in animals in good body condition (8.7%).
- Theprevalenceof hydatid cyst infection according to the source of animals was higher in Sennar (100%), Darfour (9.2%) and no infection in Kassala, White Nile, and Managil.
- Distribution by sex the prevalence of hydatid cyst infection was 3.8% in male and 10.1% in females.

- Significant association was observed in the univariate analysis between hydatidosis and the age of animals (p-value = 0.118) , Sex of animals (p-value= 0.104), and management system (p-value = 0.09).

Recommendations

More elaborate studies on *Echinococus granulosus*cyst were recommended in order to reveal:

- Its prevalence in other states.
- Economic importance of the disease.
- Stages of development of cyst to calcification.

- Enhancement of awarenessof people about the economic and public health importance of the disease.

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Appendices

Appendix 1

Frequency tables for distribution of infection among 256 camels examined at Tambul abattoir according topotential risk factors:

Appendix 1.1:Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Female	197	77	77	77
	Male	59	23	23	**100**
	Total	**256**	**100**	**100**	

Appendix 1.2:Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	<5	41	16	16	16
	5-10	166	64.8	64.8	80.9
	>10	49	19.1	19.1	**100**
	Total	**256**	**100**	**100**	

Appendix 1.3: Body condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Poor	119	46.5	46.5	46.5
	Good	137	53.5	53.5	**100**
	Total	**256**	**100**	**100**	

Appendix 1.4: Source of Animal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Darfour	97	37.9	37.9	37.9
	Kordofan	17	6.6	6.6	44.5
	Gadarif	49	19.1	19.1	63.7
	Kassala	12	4.7	4.7	68.4
	Butana	66	25.8	25.8	94.1
	Senar	9	3.5	3.5	97.6
	White Nile	2	0.8	0.8	98.4
	Managil	4	1.6	1.6	**100**
	Total	**256**	**100**	**100**	

Appendix 1.5: Breed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Rezegat	97	37.9	37.9	37.9
	Kabashi	17	6.6	6.6	44.5
	Shokri	92	35.9	35.9	80.5
	Rufaee	34	13.3	13.3	93.8
	Bnee aamr	12	4.7	4.7	98.5
	Kuahla	4	1.5	1.5	**100**
	Total	**256**	**100**	**100**	

Appendix 1.6: Management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Pastural	229	89.5	89.5	89.5
	Sedentary	27	10.5	10.5	**100**
	Total	**256**	**100**	**100**	

Appendix 2

Distribution and prevalence of Hydatidosis in 256 camels examined at Tambul slaughterhouse according to potential risk factors:

Appendix 2.1: Sex

	Sex of animal		Total
	Female	**Male**	
Results	177 177/197x100	57 57/59x100	234 234/256x100
- ve	89.9%	96.6%	91.4%
	20 20/197x100	2 2/59x100	22 2/256x1002
+ ve	10.1%	3.4%	8.6%
Total	**197** **100%**	**59** **100%**	**256** **100%**

Appendix 2.2:Age

	Breed			Total
	<5	**5-10**	**>10**	
Results	40	153	41	234
	40/41x100	153/166x100	41/49x100	234/256x100
- ve	97.6%	92.2%	83.7%	91.4%
	1	13	8	22
+ ve	1/41x100	13/166x100	8/49x100	2/256x1002
	2.4%	7.8%	16.3%	8.6%
	41	**166**	**49**	**256**
Total	**100 %**	**100%**	**100%**	**100%**

Appendix 2.3: Body Condition

	Body condition		Total
	Poor	**Good**	
Results	109	125	234
	109/119x100	125/137x100	234/256x100
- ve	91.6%	91.3%	91.4%
	10	12	22
	10/119x100	2/185x100	2/256x1002
+ ve	8.4%	8.7%	8.6%
Total	**119**	**137**	**256**
	100%	**100%**	**100%**

Appendix 2.4:Source

	Source								Total
	Darfour	**Kordofan**	**Gadarif**	**Kassala**	**Butana**	**Snr**	**Wh.Nl**	**Managil**	
Results	88 88/97x 100	14 14/17x 100	47 47/49x 100	12 12/12x 100	60 60/66x 100	7 7/9x 100	0 0/2x 100	4 4/4x 100	234 234/256x 100
- ve	90.8%	82.4%	96%	100%	91%	77.8%	0%	100%	91.4%
+ ve	9 9/97x 100	3 3/17x 100	2 2/49x 100	0 0/12x 100	6 6/66x 100	2 2/9x 100	0 0/2x 100	0 0/4x 100	22 2/256x 1002
	9.2%	17.6%	4%	0%	9%	22.2%	0%	0%	8.6%
Total	**97** **100 %**	**17** **100%**	**49** **100%**	**12** **100%**	**66** **100%**	**9** **100%**	**2** **100%**	**4** **100%**	**256** **100%**

Appendix 2.5:Breed

	Breed	Total

	Rezegat	Kabashi	Shokri	Rufaee	Bn.amr	Kuahla	
Results	88 88/97x100	14 14/17x100	86 86/92x100	30 30/34x100	12 12/12x100	4 4/4x100	234 234/256x100
- ve	90.8%	82.4%	93.5%	88.3%	100%	100%	91.4%
+ ve	9 9/97x100	3 3/17x100	6 6/92x100	4 4/34x100	0 0/12x100	0 0/4x100	22 2/256x1002
	9.2%	17.6%	6.5%	11.7%	0%	0%	8.6%
Total	**97** **100 %**	**17** **100%**	**92** **100%**	**34** **100%**	**12** **100%**	**4** **100%**	**256** **100%**

Appendix 2.6: Management

	Management		**Total**
	Pastural	**Sedentary**	
Results	207 207/229x100	27 27/27x100	234 234/256x100
- ve	91.4%	100%	91.4%
	22 22/229x100	0 0/27x100	22 2/256x1002
+ ve	9.6%	0%	8.6%
Total	**229** **100%**	**27** **100%**	**256** **100%**

Appendix3

Association between cysticercus bovis infection and potential risk factors using the Chi- square test:

Appendix 3.1:Sex

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	2.6	1	0.1
Likelihood Ratio	3.17	1	0.07
N of Valid Cases	256		

Appendix 3.2: Age

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	5.8	2	0.05
Likelihood Ratio	5.8	2	0.05
N of Valid Cases	256		

Appendix 3.3: Body Condition

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	0.01	1	0.91
Likelihood Ratio	0.01	1	0.91

N of Valid Cases	256		

Appendix 3.4:Source of Animal

	Value	**df**	**Asymp.sig** (2-sided)
Pearson chi- square	6.9	7	0.43
Likelihood Ratio	7.8	7	0.35
N of Valid Cases	256		

Appendix 3.5: Breed

	Value	**Df**	**Asymp.sig** (2-sided)
Pearson chi- square	4.3	5	0.51
Likelihood Ratio	5.3	5	0.38
N of Valid Cases	256		

Appendix 3.6: Management

	Value	**df**	**Asymp.sig** (2-sided)
Pearson chi- square	2.8	2	0.09

Likelihood Ratio	5.1	2	0.02
N of Valid Cases	256		