Introduction

Bovine cysticercosis refers to the infection of cattle with metacetods of human tape worm (Oladele et al., 2004).

Taenia*saginata* known as beef tapeworm because infected beef is the main source of infection and it has a cosmopolitan distribution. The economic significance of*Cysticercus bovis* on the livestock industry may be considerable especially in developing countries (Basem et al.,2009).

Cysticercosis is more important in the livestock industry because of economic implication of down grading and condemnation of the affected carcasses (*sQadeeral.,2008*).Theannuallossesincattle feedlots in South Africa due to cysticercosis may reach to 3,300,000 US$ per year (Megersaet al., 2009).

Globally, there are 77 million human carriers of *Taenia saginata*out of which about 40 percent live in Africa. Infection of cattle by *cysticercus bovis* result in a condition refered to as "measly beef" due to appearance of the cysts on the beef resembling measles lesions the presence of the measly beef would be indicative of a human health problem(Dzoma et al., 2011).

The effect on human health is generally slight and symptoms may be vague or absent. Taeniasis has debilitating effect on people who already have live of protein deficiency diets suffer from iron deficiency and infested by hook worm *(FAO, 2004).*

T.saginata in small intestine of humans absorbs digested food and its proglottids migrate to different organs causing different signs (Urquhart etal., 1996).

*T. saginata*infectionisusually asymptomatic. However, heavy infection often results inweight loss, dizziness, abdominal pain, diarrhea, headaches, nausea, constipation or chronic indigestion, and loss of appetite. There can be intestinal obstruction in humans and this can be

alleviated only by surgery. The tapeworm can also expel antigens that can cause an allergic reaction in the individual. It is also rare cause of pancreatitis, cholecystitis and cholangitis *(WHO, 2013); FAO (2004)* states that the disease can also cause obstruction of the bowel, stomach-ache and migrating proglottids cause inflammation of the appendix, inflammation of the bile duct.In some instances the appearance of gravid segment in the faeces can cause unpleasant surprise when seen in the feces; whereas *Teka (1997)* stated that taeniasis in humans causes anal pruritis due to emerging tapeworm segments and with severe infection humans may experience increased appetite or loss of appetite, abdominal discomfort and digestive upset.

Justification:

Bovine cysticercosisis ameat borne parasitethat remains an important causeof illnessand economicloss.*Taenia saginata* /*Cysticerci* are importantfrom the standpoint of thehealthof cattle because of consequences for the meat supply and more importantly, from their direct effects on the well-being of humans who almost universally, consume beefas a source ofprotein andother minerals. Bovine Cysticercosishas little effect on animal health, but it is an economically important disease as it causes carcass condemnation arising from heavy infestation with the cysticerci of *Taenia Saginata*as well as the cost of inspecting meat, the necessity to freezeor boil infected meat and losses may also occur from restriction of exports of live animals and animalproducts.

Therefore determination of the prevalence of the disease in Dilling slaughter house in South Kordofan states is very important in order to explore the size of the problem which helps to control the disease in animals and prevent humans from infection.

Objectives:

This study aimed to:

- Estimatetheprevalenceof*Cysticercusbovis*in Dilling slaughter house.
- Investigatethe potential risk factorswhich could be associated with *Cysticercus bovis*.
- Determine the distributionof cysts in organsand tissues within the infected animal.

Chapter One

Literature Review

1.1 Classification:

Kingdom: Animalia

Phylum: Platyhelminths

Class: Cestoda

Order: Cyclophyllidea

Family: Taeniidae

Genus: Taenia

(Thurs field. 2007)

1.2 Etiology:

Bovine Cysticercosis is infection of beef caused by thelarvalstageofthe humantapeworm*Taeniasaginata*. *Cysticercus bovis* is the larval stage of *Taenia Saginata* of the small intestine of humansas a larvaeorcysts in cattle (*C. bovis*), man acquires infection only by eating poorly cooked or raw beef(Rabi'u et al., 2010).

1.3 Life cycle:

The life cycleand transmissionof the parasite in humansoccurs most commonly in environments characterized by poor sanitation, primitive livestock husbandry practices, inadequate meat inspection management and control policies.

Most incidents arise in cattle as a result of direct exposure to proglottids shed from humans, but there have been some reports of large scale outbreaks resulting from sewage-contaminated feed or forage (*Tesfaye et al., 2012*).

If the eggs in the segments find their way onto pasture , cattle may ingest the eggs which then hatch in the small intestine. Small embryos develop and penetrate the bowel wall. They are carried through the blood stream to various muscles where they develop into cysts, the muscles most commonly affected by *Cysticercus bovis* cysts are the heart , tongue , diaphragm and muscles of the jaw. The cysts may remain infective for up to 2 years (NSW., 2012).

Human are the obligate final host and they become infected by ingesting infected meat with *cysticercus bovis* that has been inadequately cooked or frozen. The tapeworm occurs in the small intestine of humans, and although it is generally 4-8 meters long , it can reach 15 meters. Like all tapeworms , its scolex (head) attached to the bowel wall and it has up to 2000 body segments. Each segment contains up to 80,000 eggs. The end segments of the tape worm detach and are passed with faeces, They look like white fleshy capsules similar to a grain of rice (NSW., 2012).

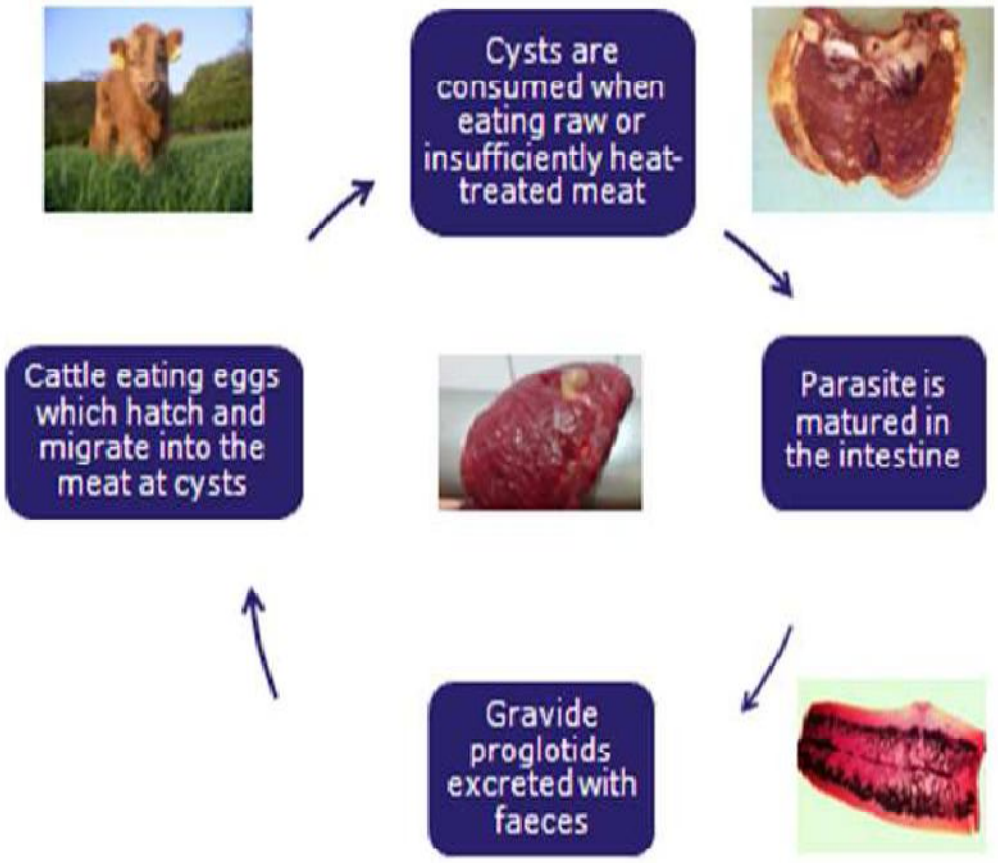

Figure 1: Life cycle of *The parasite c.bovis.*
(University of Copenhgen2013)

1.4Morphology of cyst:

Thelarval stages, or metacestodes also referred to as “measly beef” are found in all striated muscles in addition to visceral organofthe cattlle intermediate host.*C.bovis* is a small (pea-sized) oval in shape, semi-translucent cyst filled with dense white fluid containingan invaginated scolex(WUBIE.,2004).

Themetacestodeismorphologicallysimilartothe adulttapeworm. It measures about 10 mm in diameter and 6 mm in length. When incised,viable cyst is seencontaininga thin fibrinouscapsule,while the degenerate showingcream orgreencoloredcalcification. The cysticerciare formed over a period of 3 - 4 months after the egg is ingested.

The cyst may remain viable inthehostfor up to 9 months or even up to theentire life of the host. Inthecarcass*Cysticercus bovis*can surviveforabout 15 daysat-5^{o}c, 9 days at -10^{o}c or 6 days at-15^{o}c to -30^{o}c. Ifa carcassisfoundtocontain cysts, it is required tobefrozen at -10^{o}c for 10 days, or if the lesions are extensive, the entire carcass is condemned (WUBIE.,2004).

1.5 Modes of infection:

Cattle, intermediate host, become infectedafter eatingTaenia *Saginata*egg. Once cattle are infected, cysticerci develop inthe muscles and subsequentlybecome infective to humans after approximately 10 weeks. A person infected with a single *Taenia saginata*tapeworm is capable of contaminating the environment with up to half a million eggs per day over the course of Infection, which if left untreated, can persist for years.

Eggscontaminating the environment via defecation or spontaneous dischargeof proglottids.The egg can be disseminated by water, wind, scavenging birds such as gulls feeding on raw sewage, oribatid mites, flies, earthworms, or fomites such as boots or farm machinery (*Kandil et al., 2012*).Infective taeniaeggs can persistunder a variety of environmental

conditionsas with most parasites, cool and moist conditionsfavorlong-term survival. They can also survive in sewage and in sludge for up to several months, and are resistant to most conventional chemical and disinfecting agents (Kandil et al., 2012).

Transmission to animals occurs by contamination offoodor water by faeces of infected humans. Thecontaminatedmaterialcan derive directlyfrom humanfaeces orvia sewage plantsafter flooding or sewage sediment discharged on pastures. Directtransmission of eggs, resultingfrom handrising of suckling calves bytapeworm carriers has been reported,but appears to be rare(Allepuz et al., 2009). Lack of awareness aboutraw meat consumption, existence of highest population density, poor hygiene and sanitary facilities are some of the factorsthat facilitatethe transmission (Belachew et al., 2012).

1.6 Diagnosis:

Diagnosis in animals is usually based on the host and the location of the metacestode when identified atmeat inspection ornecropsy. In live animals*Taenia Saginata*metacestodes mightbe palpable in the tongue but, both in the living animal and on post-mortem examination or meat inspection, tongue palpation is ofa diagnostic value only incattle heavily infected with metacestodes(*WUBIE.,2004*).

Predilection sitesareheart,tongue, masseters anddiaphragm, presumably becausetheyreceive the greatestcirculation. Nonetheless, cysts may befound inanymuscleof thebody (*OIE,. 2008*).

Cattle with cysticercosis areunlikely to exhibit clinical signs, and detection is made during post-mortem carcassexamination. In most parts of the world where regulated post-mortem screening for these parasites occurs, examination of so-called “predilection sites” is conducted during routine meat inspection. However, such procedures are insensitive, particularly for lightly infected carcasses.

Despite its limitations, visualinspection of carcassesremains the most common method of diagnosingbovinecysticercosis.

The metacestodes are readily visible in the organs or musculature at autopsy and thereforediagnosis of *bovine cysticercosis*is usually made during postmortem examination in abattoirs and packing plants. The effectiveness of meat inspection in the detection of *C.bovis* depends on the procedure used (*WUBIE,.2004*).

The routine inspection of carcass is to be done as per the procedure stated below(*Kumar et al., 2011*):

- Visual inspectionandpalpation of the surfaces and a longitudinal ventralincision of the tongue from the tip ofthe root.
- One deep incisioninto thetricepsmusclesof both sides of the shoulder.
- Extensive deep incision into external and internal muscles of masseter parallel to the plane of the jaw.
- Visual inspectionand longitudinalincision of the myocardium from the baseto the apex. Butmore incision can be made when necessary.
- Visualinspectionand 3 parallel incisions into long axes of the neck muscles on both sides.
- Two parallel incisions on the thigh muscles of both hind legs.
- Careful inspection, palpation and two parallel incisions into the diaphragmaticlobesofthe lungthroughthe lung substances.
- Visual examination ofintercostalsmusclesandincisions when necessary.
- One extensive incision into the fleshy part of diaphragm, visual examination, palpationand Incision of kidneys, liver, esophagusand associated lymph nodes.

However, minor infections are difficultto detect irrespective of the skillof the inspector. Ifa*Cysticercus* is found in any of these sites andorgans,

thoroughinspectionofthe whole carcass and offal should be done. The location,natureandnumberofcysts shouldberecorded (*Kumar et al., 2011*).

Serologicaltest,e.g., Enzyme-linked Immunosorbent Assay (ELISA) was availablefor use on live animals. The immune responseagainst taeniid parasites is reported tobe antibody-mediated. A positive antibody ELISA indicates that the animals have been exposedto the infection, but may not necessarily have a current infection. However, itis a useful method for epidemiologicalstudies to indicate the spreadof the infection in outbreaks or high-infected areas (*Kandil et al., 2012).*

Severalstudies have shown that the true prevalence of *bovine cysticercosis* as detected by the classical meat inspection techniques (carried out properly) is underestimated by at least a factor of 3–10, diagnosis by serology in cattle has been done with varyingsuccesses.

Studies have indicated that antigen detection by ELISA (Ag-ELISA) is 2–10 times more sensitive than routine meat inspection and that this technique may therefore be recommended for epidemiological surveys. The sensitivity of Ag-ELISA has been shown to vary with the live cyst burden, in addition due to its unexplained false positive and negative reactions it can atbest be used asa screening test and not as a diagnostic test (*Asaava et al., 2009*).

1.7 Differential diagnosis :

In cattle *Cysticercus bovis*shouldbe differentiated from:

- *Cysticercus dromedaries* (*C.cameli*) :

The larvalform of*Taenia hyaenae*. The identification of *C.cameli* is by double row of hooks on the lateral invaginated scolex and its length being twice as large as *C.bovis* measuring 12-18 mm in length and pearly white in color (*WUBIE., 2004*).

- *Sarcocystis bovifelis* (*Sarcocystis hirusta*) :

Is a soft bradizoite cyst which is very large and visible to the naked eye whitish streaks running in the direction of the muscle

fibers. The cyst ranges from 0.5 mm to 5mm in length, localized in the esophagus, heart, in different muscular tissue (*Minozzo et al., 2002*).

- *Onchocerca dukei*:

The cyst ranges from3mm to 6mm in diameter, forms intra-muscular and subcutaneous nodules that are firm to touch and reveals worms surrounded by pus when sectioned (*WUBIE.,2004*).

1.8 Treatment:

In animals, treatment with compounds such as*albendazole*(50mg per kg), *praziquatel*(50mg per kg), *mebendazole*(50mg per kg) can be given but they are considered not to be fully effective.

*Praziquantel*is effective at 50mg/kg/day for four days but this treatment is impractical because of its high cost (*WUBIE.,2004*).

1.9 Control and prevention:

Lack of and improper use of latrine or open field defecation leads to contamination of grazing lands by human faeces. The use oflatrine reducesspread of*Taenia Saginata* eggs. Controlled grazing, avoidinguse of sewage effluent to fertilize pasture, prevents infection in cattle (*Symth., 1994*).

Adequate meat inspection, abstinence from eating raw or inadequately cookedbeef(thorough cooking of meat at a temperature of 56 – 60 ^{0}c) and freezing the infected carcass at -10^{0}c for 10 days prevent human infection. Chemotherapy in humans reduces the spread of eggs and infection in cattle (*Solusby., 1982*).In Africa, inadequate health education and scarcity of Taenicides are the major obstacles for the control of the disease (*Rabi'u et al., 2010*).

The inspectionof meat, whichisthemostimportant public health control measure,identifies only a minor fraction of heavily infected animals, and also only whenit is too late to avoid losses.

An ante-mortemdiagnostic test that reflectsthenumber oflive cysticerciwouldbe desirable because as it could assist in identifying highly infected animals before slaughter. A reliable ante -mortemdiagnostic test has yet to be defined. However, there have been endeavorto develop an enzyme-linked immunosorbent assay (ELISA) that can be used for the diagnosis of*Taenia Saginata*cysticercosis infection under natural and controlled conditions.Resultsfrom antibody-ELISA were foundto beunreliableandinsensitive due to failure of the test todistinguish between animals harboring live and deadcysticerci (*Wanzalaa et al., 2002*).

During meatinspectionheavily infected carcass, all meat, offal and blood must be condemned. The description of a heavy infection varies, but generally it is the detection of cysts at two of the predilection sites plus two sites in the legs. In thecaseof a lesser infection, the infected parts andsurrounding tissues are removedandcondemned. Even a single dead cyst requires that the carcass and edibleviscera must then be treated andthis is justifiable as about 10% of lightly infected carcasses were found on dissection to have both dead and viable parasites within them (*OIE 2008*).

1.10Management of Cysticercus bovis infected beef:

Treatment of cysticerci varies withcountryand facilities available. According to(*OIE 2008*) they include:

i) Freezing of carcassat lowerthan–10°Cfor 10 or 14 days, or lower than ⁻7°C for 21 days.

ii) Boxes of boned meat are frozen at less than ⁻10°C for 20 days.

iii) Heating to above 60°C throughout.

iv) Steamingatmoderatepressure (0.49 kg/cm2), heated at 95–100°C for 30 minutes.

v) Pickling in salt solution for 21 days at 8–12°C.

1.11Vaccines against bovine cysticercosis:

Vaccination, when available, is undoubtedly themost cost effective means of preventing and controlling, and even eradicating, infectious diseases. A vaccine against sheepcysticercosishas been developed experimentallyand may leadtothedevelopment of similar vaccines to control*bovinecysticercosis* and thus controling*Taenia Saginata*infestation in humans.

Sheibaand ZeinEldin., (*1987*)vaccinatedfourZebu calves subcutaneously with hatched ovaof*Taenia saginata.*The immunity elicited protected the animals from subsequent oral infections with this cestode as manifested bythe early degenerationofthemetacestodes and failure to attain maturity in three of four animals.

Lightowlerset al., (*1996*) used the recombinant antigens in vaccine trials in cattle. Vaccination with a combination of two antigens, designated TSA-9 and TSA-18, induced up to 99.8% protection against experimental challenge infection with *Taenia Saginata* eggs (*Kumar and Tadesse 2011*).

More recently, an *18kDaT. saginata* oncosphere secreted and surface expressed adhesion molecule *HP6* was used to successfully vaccinate calves against oral challenge with *T. saginata* eggs. However, no vaccine is currently marketed (Blancou *et al.*, 2010).

1.12 Economic loss:

While ill-health caused by the adult worms in humans give rise to high medical costs, the economiclosses dueto bovinecysticercosisaremainlydue to condemnation, treating beefand downgrading of infected carcasses. Economiclosses from cysticercosis are determined by disease prevalence, gradeof animalsinfested, potentialmarkets, prices of cattle and treatment costs for detained carcasses. For the African continent, an annual loss was reported to be US$ 1.8 billion underan overall infestation rateof 7% (*Kumar and Tadesse., 2011*).

Khaniki et al., 2010 reported that theeconomiclosses of infected carcasses were calculatedfrom the treatment of carcasses and the carcasses condemnations. The costs of carcasses treatment included the expenses of freeze storage and the weight loss during freezing.

Bovine cysticercosishas little effect on animal health, but it isan economicallyimportantdiseaseas it causes carcass condemnation arising fromheavy infestation with thecysticerciof *Taenia Saginata*as well as the cost of inspectingmeat, the necessity to freeze or boil infected meat and losses may also occur from restriction of exports of live animals and animal products (*Belachew and Ibrahim., 2012*).

In the meat industry, economic losses are closely associated with the statusofinfection. In a heavy infestation or generalizedcysticercosiscarcass, must be totallycondemned. Light infection or localized cysticercosis leads to condemnation of the infected parts, furthermore, the carcass must be kept in cold storage at a temperature not exceeding -7°C for up to 3 weeks to inactivate exssting parasites(Abuseir et al., 2006).

In England, the costsofrefrigeration, handling and transport are estimated at£100 per carcass, or £4.0millionannually. Africa suffersgreat lossesdueto bovinecysticercosis which is estimatedto be $1.8 billion annually (*Abuseir et al., 2006*).The annual lossesin cattle feed lots in South Africa due to cysticercosis may reach to 3,300,000 US$ per year . In Assiut Governorate, the economic losses in cattle and buffaloes feed lots during 1989-1992 due to*Cysticercus bovis* were 112000 L.E (Livre egyptienne - Egyptian pound)(Basem et al., 2009).

1.13 Epidemiology:

Taenia saginata of humans causes*bovine cysticercosis*, which occurs virtually world-wide, but particularly in Africa, Latin America, South/Central Asian and eastern Mediterranean countries and the infection occurs in many countries in Europe (*OIE 2008*).

Globally, there are 77 million infectedhuman by*Taenia saginata*tapeworm out of which about 40% live in Africa.In developed countries, evenif the disease has a very low prevalence, the problem with the removal and treatment facilities in their sewage system plays a role in the distribution of eggs, since it was recorded that the egg can survive in sewage (Megersa et al., 2010).

The disease has been reported in 15 Latin American countries ,and it is estimated that 400 thousand people are infected in South America. However, the prevalence of this disease in humans is highly variable within a country and between countries, and can bedirectly related to the differences of hygienic conditions, quality of meat inspection, and culinary habits(Dutra et al, .2012).

According to meat inspection data, the prevalenceof*bovine cysticercosis* varies between 0.01 and 6.8% in various European countries, but the actual prevalence is expected to be between three and ten times higher(Abuseir et al., 2006).

In Sudan, Sid-Ahmed reported a prevalence of 0.3% in Atbara(Sid-Ahmed.,1995). In Ethiopia, Florava reported a prevalence of 100% which is the highest in Africa and also in the word, due to habit of eating raw or under cocked beef dishes (Kowt and kitto). In other East Africa countries, prevalence rate about (30-80%) has been reported (Ibrahim and Zerihun.,2012). In many developing countries this disease constitutes a serious but less recognized public health problem (Ibrahim and Zerihun., 2012).

Habit of eating raw beef dishes, low level of toilet used by human population, backyard slaughter, low availability of taenicides, free access of cattle to surface water, and proximity of wastewater are important causes for transmission of*bovine cysticercosis*to a herd of cattle and *taeniasis*in human population (Kumar and Tadesse.,2011).

Cysticecosis issignificantlymore prevalent in feedlots and in traditional farming systems thanindairy farms. It is suggested that the continuous contact between man and animal and the use of causal workers in feedlots may be factors that are conducive to*Taenia saginata* transmission (Ibrahim and Zerihun., 2012).

A cross-sectional study was conducted on 200 cattle slaughtered at Elobied slaughterhouse in North Kordofan state, Sudan, during the period extended from April to June 2013 to estimate the prevalence of *Cysticercus bovis* infection in slaughtered cattle and to investigate potential risk factors associated with the disease.

Routine meat inspection procedure was employed to detect the presence of *Cysticercus bovis* cysts in predilection sites, which were shoulder muscle, heart, masseter (cheek) muscle, diaphragm, tongue and liver. The study showed that the overall prevalence was 1%.

A univariate analysis was performed using the chi-square as a test of significance for the association between the infection and the investigated potential risk factors. No significant association was detected between *cysticercus bovis* infection and each of sex (p-value = 0.45), age (p-value = 0.32), body condition (p-value = 0.69), breed (p-value = 0.95), animal source (p-value = 0.92) and grazing type (p-value = 0.86).

Our study showed that the liver was the only infected organ, while no infection was found in the rest of the organs.

Macroscopic examination of the 18 cysts (found in 2 affected animals) revealed that 9 cysts (50%) were viable, while 9 cysts (50%) were calcified (Ahmed Yasir., 2013).

Mostincidentsarise in cattle as a result of direct exposure to proglottids shed from humans, but there have been some report of large scale out breaks resulting from sewage contaminated feed or forage. In developed countries,

even if the disease has a very low prevalence, the problem with removal and treatmentfacilitiesin theirsewage system plays a role in the distribution of eggs, since it was recorded that the egg can survive in sewage (Tesfaye et al.,2012).

A cross sectional study on Taenia saginata cysticercosis was carried out in slaughtered cattle in Iran in order to determine the infection rate during a three-years period , from 2005 to 2007. A total of 4,534,105 cattle were examined by routine meat inspection. The results showed that 11,410 cattle (0.25%) were infected with Cysticercus bovis, among those 1,041 carcasses (0.02%) were condemned. In such carcasses the metacestodes caused extensive damage in the vicinity of cysts in infected cattle. The rejected carcasses had an average of 410 thousands USD loss annually (Khaniki et al.,2010).

A cross sectional study was conducted on 540 of cattle from October 2012 to march 2013 to determine prevalence and associated risk factors of cysticercosis at Adigrat municipal Abattoir. The overall prevalence of cysticercosis was 5.73% (29). Infection prevalence of cysticercosis was significantly associated with age, body condition and breed of cattle ($P < 0.05$). Infection rate of cysticercosis with respect to age group showed that higher prevalence was in cattle 5 and above years (8.47%) than below 5 years (2.96%) ($\chi2= 7.949$, $p =0.003$) and infection rate with respect to body condition revealed the highest prevalence (13.5%) was in poor followed by medium and good body condition scores 4.6 and 1.66, respectively ($\chi2= 23.1$, $p = 0.000$). Related to breed of cattle highest prevalence (6.31%)was in Holstine- Fresian followed by local (5.2%) and barka breeds (4.91%) ($\chi2= 0.211$, $p = 0.036$). However, no significant variation was observed with related to sex of cattle ($p > 0.05$). Heart (35.56%) was the most infected organ by large number of cysts followed by tongue (23.3 %), masseter

muscle (14.4 %), tricept muscle (10 %), liver (8.8 %)and thight muscle (7.7%), respectively(Haylegebrilel and Alembrhan et al 2014).

Another cross sectional study on the prevalence of bovine cysticercosis in Hawassa municipal abattoir was conducted from October 2011 to March 2012 with the objectives of determining the prevalence of cysticercus bovis, cysts, their viability and cyst distribution in different organs/tissues and public health implication of Taenia Saginata cysticercosis. Questionnaire survey and inventory of pharmaceutical drug shops were also used to determine human taeniasis and associated financial losses. Ante and post mortem examination of 384 cattle at the abattoir showed a prevalence of 22.9% for cysticercosis. Of the total cysticerci collected, 55 (62.5%) were found to be viable while 33 (37.5%) were non-viable. The percentage of Cysticercus bovis cysts in different organs was observed as 67.74% in tongues, 52% in shoulders, 60% in hearts and 75% in masseter muscle, respectively. Result indicated that only age groups are highly significant effect ($p<0.003$), But sex, body condition, origin and breed of animals didn't have significant effect ($p>0.05$) on prevalence of cysticercosis. The prevalence of taeniasis among interviewed respondents of Hawassa town was 44%. Result indicated that the sex , occupation , educational level, eating habit and martial status showed highly significant effect ($p<0.05$). But age groups and religion didn't have significant effect ($p>0.05$) on prevalence of the disease. However, statistically significant difference was observed in the disease prevalence between raw and cooked meat eaters. For the years 2008 and 2009, a total worth of 184,406 ETB was estimated from a sale of 92,203 adult taenicidal drugs. The result of this study revealed that taeniasis was a widespread public health problem In the study area

which needs attention to safeguard the public (Belachew and Ibrahim., 2012).

In another study, data from slaughtered cattle was used to generate a bovine cysticercosis database for all states and municipalities of Brazil, in order to analyze and create epidemiological maps using the GIS software. During the period analyzed, 75.983.590 cattle were slaughtered and the prevalence of bovine cysticercosis in Brazil was 1.05%, with the Southeast region presenting the majority of cases. The highest amount of bovine cysticercosis cases occurred in the state of São Paulo (400,834) followed by Mato Grosso do Sul (151,735), and Paraná (94,046), while there was no observation of occurrence in nine states (Dutra et al., 2012).

From March 2005 to December 2007, 284 animals from 67 cattle farms (24 dairy and 43 beef) affected by bovine cysticercosis were detected in the region of Catalonia (North- Eastern Spain), (Allepuz et al., 2009). Dairy farms were almost twice more likely to be affected than beef farms (OR = 1.79, 95% CI = 1.08–2.96, $p < 0.05$), and infected premises have a statistically significant ($p < 0.05$) larger number of animals when compared to uninfected farms in Catalonia. The geographical distribution of the infected farms was evaluated and two statistically significant clusters were identified. The most likely cluster was located in the western part of the study region, with 8 out of 10 farms infected. Epidemiological investigations revealed that the 8 farms belonged to the same company. The second cluster was located in Eastern Catalonia with 12 infected farms out of 167 cattle farms. No epidemiological links were found among the 12 infected premises. A questionnaire, based on the EFSA risk assessment, was used to assess the most likely route of introduction into each affected farm. Water

supply for animals was the route with the highest score in 41.8% of the cases (Allepuz et al., 2009).

In another study aimed to determine the occurrence of cysticercosis in cattle and buffaloes in Assiut Governorate, Upper Egypt. the occurrence of cysticercosis among examined cattle and buffaloes was 1.6 % and 0.8 % respectively. Female cattle and buffaloes were more susceptible to bovine cysticercosis (2.7% and 1.3%) than males (1.4% and 0.5%), respectively. There was a positive relationship between the age of the examined animals and the occurrence of bovine cysticercosis. The higher occurrence was recorded among cattle and buffaloes above 2 years (2.7% and 0.9%) than those below 2 years (1.1% and 0.6%), respectively. Detailed meat inspection showed to be sensitive (1.6%) than routine meat inspection (1.4%) (Basem et al., 2009).

Another cross sectional study was conducted during October 2010 to March 2011 to estimate the prevalence of bovine cysticercosis in cattle slaughtered at Addis Ababa municipal abattoir with the objectives of determining the prevalence of *Taenia saginata* cysticercosis, cyst viability and cyst distribution in different body tissues. The abattoir survey was carried out by routine inspection of carcasses and viability test methods. Post -mortem examination of 535 slaughtered cattle was conducted on examined from randomly selected animals of which 19 (3.6%) were infected with *Taenia Saginata* metacestodes (Ibrahim and zerihun., 2012). Of the total of 24 Cysticercus bovis cysts collected during the inspection, 11 (46%) were found to be alive while others (54.0%) were degenerative cysts. The tongue, masseter muscles, heart muscles, triceps muscles, diaphragm and liver were the main predilection sites of the cysts. Anatomical distribution of the cyst showed that the highest proportions of Cysticercus bovis cyst were observed in triceps muscle 10 (1.9%), followed by tongue 5

(0.95%), masseter muscle 4 (0.7%), heart 2 (0.4%), diaphragm 2 (0.4%) and liver 1 (0.2%). Out of 477 male cattle, examined, 14 (2.9%) had cysts of bovine cysticercosis while 5 (8.6%) of the 58 investigated female animals were infected. The prevalence varied significantly between sex ($P<0.05$), but not varied between age groups and breed of the animals. The proportion of viablecysts in the inspection sites was triceps muscles (70%), masseter (50%), heart (50%), tongue (20%) and liver (0%) diaphragm(0%). The current study suggests that high prevalence of *Taenia saginata*metacestodes throughout the edible organs, and therefore sufficient emphasis should be given to this problem so as to improve health, quality and quantity of beef that may satisfy the domestic requirements of the counry (Ibrahim and Zerihun., 2012).

Another cross sectional study was conducted during November 2008 to March 2009 to estimate the prevalence of Cysticercosis in animals, Taeniasis in human and estimate the worth of taeniasis treatment in Jimma town, Ethiopia (Megersa et al., 2010).

Active abattoir survey, questionnaire survey and inventory of pharmaceutical shops were performed to accomplish the study. Of the total of 500inspected animals, 22animals had varying number of Cysticercus bovis giving an overall prevalence of 4.4% (22/500). Anatomical distribution of the cyst showed that highest proportions of Cysticercus bovis cyst were observed in shoulder muscle , followed by tongue, heart and masseter muscle. Of the total of 114 Cysticercus bovis collected during the inspection, 49 (42.9%) were found to be a live while others (57.1%) were degenerative cyst. Of the total 60 interviewed respondents, 56.7% (34/60) had contracted Taenia Saginata infection , of which , 95% and (5%) cases reported using modern drugs and traditional drugs, respectively. The majority of the respondents had an experience of raw meat consumption as a result of traditional and

cultural practice. Human Taeniasis prevalence showed significant difference ($p<0.05$) with age groups, meat consumption, sex and use of spice. Accordingly adult individual (OR=47.4), frequent raw meat consumers (OR=18.4), spice users (OR=7.0) and male (OR=5.0) had higher odds acquiring Taeniasis than children, occasional meat consumer, non-spice users and females, respectively. In this analysis there was no significance difference between religion, education status, occupational risks and marital status ($p>0.05$), (Megersa et al., 2010). An inventory of pharmaceutical shops (pharmacies, drug stores and rural drug vendors) revealed a total of 103, 596 adult taeniacidal drug doses worthing a total of 222,706 Eth. Birr (22,270.6 USD) during two years of 2007 and 2008. Vermox and Niclosamide were the most frequently sold drug for the treatment of taeniasis, while Praziquantel was least sold drug. The findings of this study including prevalence of C.bovis, questionnaire survey of taeniasis prevalence and the pharmaceutical shops inventory indicated the importance of Cysticercosis and Taneniasis both in public health and economical aspects (Megersa et al., 2010).

A cross-sectional study to determine the prevalence ofbovine cysticercosis was conducted from October 2007 to March 2008 in cattle slaughtered at the Jimma municipal abattoir. Cyst distribution and viability of bovine cysticercosis were determined. A total of 512 carcasses were inspected of which 15 (2.93%) were infected with *Taeniasaginata* metacestodes. From a total of 109 cysticerci collected from infected carcasses, 47 (43.12 %) were viable. The anatomical distribution of the cysticerci was, shoulder muscle (39.5 %), heart (33.9 %), neck muscle (13.8 %), tongue (10.1 %), masseter muscles (1.8 %) and diaphragm (0.9 %) (Tolosa et al., 2009).

Also a combination of retrospective and cross-sectional study was employed to estimate the economic and public health significance of *Taenia saginata*. A total of 540 carcasses were examined during the study period. Of which, 14 (2.59%) were infected with *Taenia saginata* cysticerci. Prevalence of Cysticercus bovis based on the various anatomical locations was: 2.22% in tongue, 1.66% in masseter muscle, 1.11% in heart, 0.92% In shoulder muscle and 0.32% in the diaphragm. Taenia Saginata was found to be a widespread public health problem in the study area with an overall prevalence of 62.5%. Taenia Saginata infection rate among the respondents showed significant difference ($p<0.05$) with age groups and different levels of raw meat consumers. Adult individuals had higher odds of acquiring taeniasis (OR=31.8) than young age groups. However, there was no significant difference ($p>0.05$) in the infection rate of the parasite between sex, religion and educational status groups. Albendazole and menbendazole were the most frequently sold drugs for the treatment of taeniasis. The finding indicates the importance of cysticercosis and taeniasis both in economic and public health aspects (Tesfaye et al., 2012).

The examination of various organs of 500 cattle in Meshkinshahr Abattoir in Iran showed that 15(3%) were infected with *Taenia saginata* cysticercosis. The tongue, masseter muscles, cardiac muscles, triceps muscles and thigh muscles were the main predilection sites of the cysts. The cysts of bovine cysticercosis were also identified on the spleen, intercostal muscles, diaphragm and liver. Out of 460 male cattle, examined, 14 (3%) had cysts of bovine cysticercosis while 1 (2.5%) of the 40 female animals investigated were infected. No significant difference in prevalence rates was recordedbetween the sexes. The

prevalence of bovinecysticercosis was higher in local Sarabi cattle breeds than Holstein-Frisian cattle (Garedaghi et al., 2011).

Another survey was carried out in Northern Turkana District, Kenya to estimate the prevalence of cysticecosis through both serology and meat inspection, to determine the prevalence of the adult tapeworm in the human definitive host, and to determine risk factors for cattle seropositivity. The seroprevalence of cysticercosis in cattle was estimated at 16.7% (95% CI 13–20.9%) using a secretory–excretory antigen detection ELISA. There was a poor agreement between meat inspection and serology ($k = 0.025$; $p = 0.2797$). The prevalence of taeniosis was estimated as 2.5% (95% CI 0.8–5.6%) by microscopy. A backwards elimination logistic regression analysis indicated that the grazing unit (Adakaar), the deworming history of household members and the distance (>2 km) of grazing fields from the homestead were significant explanatory variables for cattle being found to be positive on serology. An intra-cluster correlation coefficient (ICC) of 0.07 (0.02–0.12), $p < 0.0001$ was calculated for bovine cysticercosis in this area (Asaava et al., 2009).

A prevalence study was conducted to investigate Cysticercus bovis at Jos abattoir during post mortem examination conducted on 14,372 slaughtered cattle over a period of two years (January 1997 – Dec.1999). Out of 14,372 carcasses examined 1924 (13.4 %) tested positive for C. bovis. The sites of the location of the larvae varied from one organ to another with the heart having the highest 48 (30.0 %) and the least affected were the visceral organs livers, lungs and esophagi. There is a positive correlation between the number of Cysticercus bovis cyst and the percentage frequency of the organ affected ($P<0.05$) (Qadeer., 2008).

A retrospective study covering the period 2000-2010 was conducted using post mortem meat inspection records of the Provincial Veterinary Department to determine the prevalence , seasonal and sex related variations in the occurrence of Cysticercus bovis infections. Monthly and annual records from three randomly selected abattoirs in the Northwest province were examined with regards to total cattle slaughtered and post mortem inspection results. Between 2000 and 2010, a total of 393858 cattle were slaughtered at the 3 abattoirs. The overall prevalence of Cysticerusbovis was 0.2%. 52% of the positive animals were female although the difference was not significant ($p>0.05$). The prevalence was significantly ($p<0.05$) higher (0.3%) at low throughput abattoirs (>20 adult cattle/day) than at high throughput abattoirs (<20 adult cattle/day), (0.2%). The prevalence decreased slightly from 0.2% to 0.1% after 2005 although the decrease was not significant. The dry season also had a non-significantly higher prevalence of 0.2% than the 0.1% over the wet seasons. Only abattoir type had influence on prevalence, with the low throughput (>20 adult cattle/day) abattoirs recording a significantly higher rate (Dzoma et al., 2011).

The records of meat inspection carried out for 24 consecutive days at the Awka main abattoir in Anambra State, South-Eastern Nigeria , was used to estimate the direct economic loss in carcass condemnation due to bovine cysticercosis. Among the 614 cattle slaughtered 306 (49.8 %) were examined, out of which cystcerci were detected in 61.1 % , 61.1 % , 46.2 % , 45.2 % and 50.7 % of the masseter , tongue , inter-costal, diaphragmatic and pectoral muscles from 221 (72.2 %) of infected cattle. This amounted to an estimated loss of N186892.38 in terms of condemnation of cysticerci-infected carcasses. Condemnation due to generalized infection of the specified organs amounted to N109467.50 (58.6 %) , while moderately and locally

infected organs contributed N28435.08 (15.2 %) and N48989.8 (26.2 %) to the total loss, respectively. This loss was equivalent to 4 heads of cattle in 24 days at N50000 per head , which translated to an annual loss of N2842321.61 or 57 heads of cattle at the Awka main abattoir alone. Since 10000 to 20000 trucks of beef cattle are reported to be daily transported to abattoirs in different parts of Nigeria, the direct economic loss of revenue in the beef industry on account of cysticercosis would run into billions of naira (Ikpeze et al., 2008).

The incidence of Cysticercus bovis infection in Kano abattoir located in Fagge local government area (LGA) of Kano state, Nigeria was studied. Out of the 11,804 cattle which were examined , 315 (2.67%) were found to be infected. The highest rate of infestation was found in tongue (76%), heart muscle (66%) and masseter (63%). There was no significant difference ($p>0.05$) in the distribution of the cysticerci in the organs of cattle slaughtered at the abattoir. The results also show 205 (0.37%) and 304 (0.55%) head and heart condemnations respectively. This information is considered useful for government authorities to direct control strategies as well as for farmers to take measures tailored to local situations (Rabi'u and Jegede., 2010).

In another study, post-mortem examination of 3711 cattle done at three municipal abattoirs at Mekelle, Wukro and Adigret in Tigray region, Ethiopia for detecting infection of Cysticercus bovis revealed 308 (8.29%) cattle positive for this infection. The cysts were observed either at one or more than one sites in the carcass with variable numbers. The sites showing cysts included tongue 0.61%, masseter muscles 0.59%, shoulder muscles 0.26%, heart 0.26% and liver 7.45%. The economic loss calculated for six months period of this study on account of condemnation of carcass/organs was about 31952 Birrs. The presence of cysts of Cysticercus bovis in beef

may be a public health problem as the practice of eating raw or undercooked meat is not uncommon in the area of this study (Kumar and Berhe., 2008).

An ante mortem antigen-ELISA-based diagnosis of *Taenia saginata* cysticercosis was studied in artificially (n = 24) and naturally (n = 25) infected cattle with the objective of further validating the assay as a field diagnostic test. Based on total dissection as the definitive method of validity, the assay minimally detected 14 live cysticerci in artificially infected calves and 2 in naturally infected steers. In natural infections , the minimum number of live cysticerci consistently detected by Ag-ELISA was 5 while in artificial infections it was above 14. However , other animals with 12 and 17 live cysticerci in artificially infected calves, and 1 and 2 live cysticerci in naturally infected steers , escaped detection for unknown reasons. Animals harboring dead cysticerci gave negative reactions in the assay as was the case in non-infected experimental control calves. There was a statistically significant positive linear correlation between Ag-ELISA optical density values and burdens of live cysticerci as obtained by total dissection of both artificially infected calves ($r = 0.798$, $n = 24$; $P < 0.05$) and naturally infected steers ($r=0.631$, $n = 25$; $P < 0.05$). These results clearly show the potential effectiveness of ante-mortem monoclonal antibody-based antigen detection ELISA in the diagnosis of bovine cysticercosis in cattle. Its value lies in the diagnosis of infection in cattle as a screening test in a herd, rather than as a diagnostic test at the individual level, due to false positive and negative reactions. In a herd of heavily infected cattle, the assay may, however, provide for individual diagnosis (Wanzalaa et al., 2002).

In another study a total of 267 cysts were collected from March to December 2004 from two main abattoirs in northern Germany. The cysts were classified by the usual organoleptic methods during meat inspection as *Cysticercus bovis*. The reported prevalence of cysticercosis in the 2 abattoirs was 0.48 and 1.08%. The cysts were examined

macroscopically for description of their morphology and constituents and classified as viable or degenerating (dead). The DNA was extracted from these cysts and subjected to polymerase chain reaction (PCR) for evaluation of the detection methods used and to make certain that the cysts did indeed belong to *Cysticercus bovis* , as indicated at the slaughterhouses. Two sets of primers were used with different sensitivity levels. The first , HDP1, was able to detect 200 fg of *Taenia saginata* DNA and 100 pg of Cysticercus bovis DNA. The other primer set, HDP2, was able to detect 1 pg of *Taenia saginata* DNA and 1 ng of Cysticercus bovis DNA. No more than 52.4% of the samples tested positive for *Cysticercus bovis* in the PCR using both primers , while 20% of the viable cysts and 49.2% of the degenerating cysts tested negative with both primers (Abuseir et al., 2006).

Chapter Two

Materials and Methods

2.1 Study area:

The study was conducted in Dilling slaughterhouse in South Kordofan State.The state is located in the southern part of Sudan between longitude 29.68 and 32.51 E and latitude 12.76 and 9.85 N.it is bordered North Kordofan state to north, White Nile state to east, and west

Kordofan state to west. From Southern Sudan country, Upper Nile state

To south east, and Unity state to south. The state covers an area of 79,470sq Km with total population of 1,722,222 and grouth rate 2.5 ,animal raised are cattle, sheep, goatsand horses(FAO,2014).

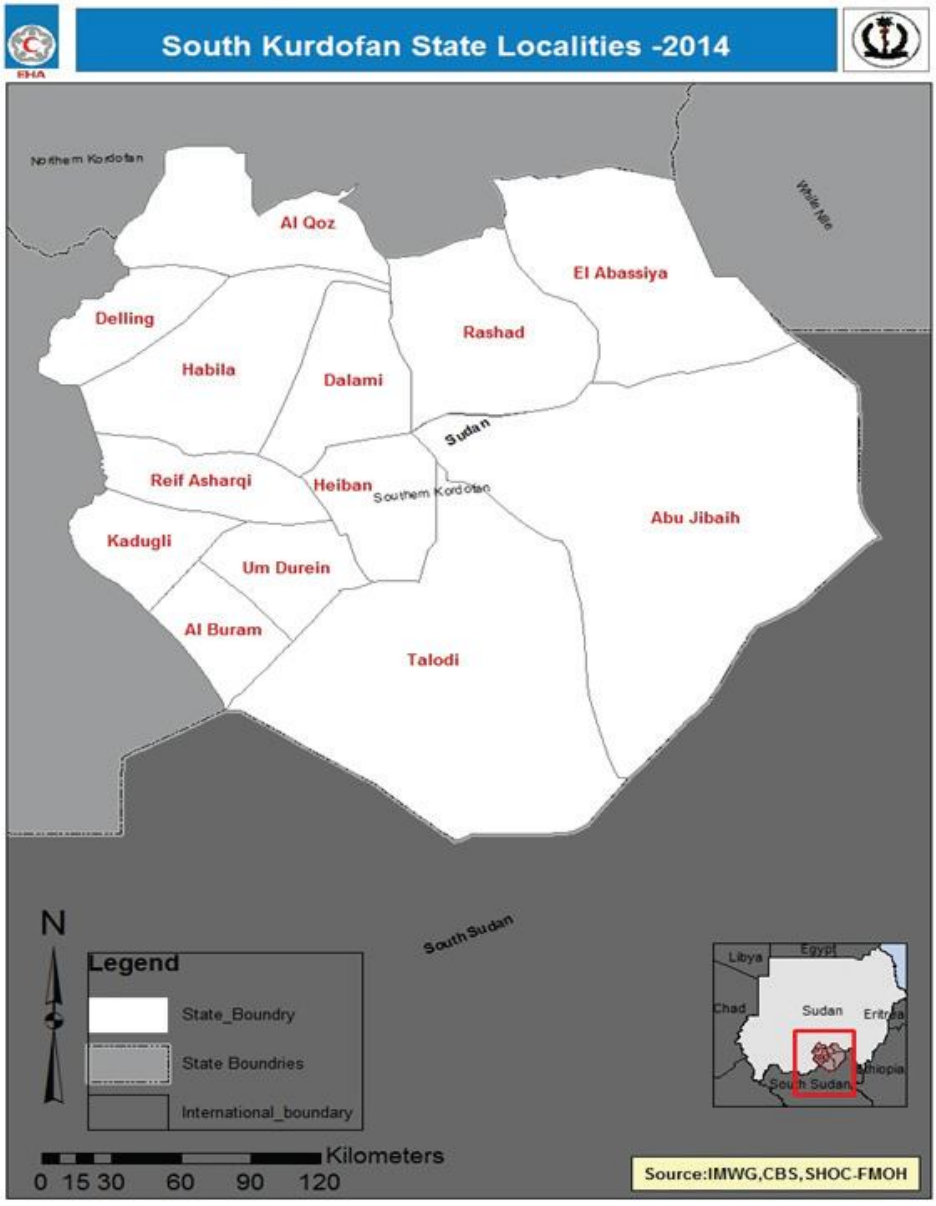

Figure2: Map of South Kordofan State.

(2-2)Criteria for selecting the area:

- Animals come from different States.

- Largenumbersofanimals.

- Easily accessible.

- There was no previous epidemiological studies to estimate the prevelance and investigate the risk factors of *cycticercos boivis* in the area.

(2-3) Dillig Slaughter house:

Dillingslaughterhouse is located near a residential area . Thus, constitutesnuisanceand endangers the health of the community in the immediate surrounding environment. It is a small low-walled open-air slaughterhouse with an impermeable slopedkillingfloor. Carcasses are cut into parts and hanged on fixed hooks for inspection.

(2.4) Study Population:

The study population consistsofcattle at different ages, sex, origins and breeds, grazing type, body condition categories in the study area.

2.5 Sampling:

2.5.1 Sampling Method:

The animalsin the slaughterhouse were selected by randomsampling method. Animals were selected randomly during ante-mortem and each selected animal was given an ear tag (number).

2.5.2 Sample Size:

Theexpectedprevalence of bovinecysticercosisforcalculation of samplesize was taken from thestudy in Ethiobia (Public Health and EconomicSignificance of *Bovine Cysticercosis* inWolaita Soddo,Southern Ethiopia) in which the prevalenceofCysticercosis in cattle was 2.59% (Tesfaye et al., 2012).Sample size was calculated according tothe followingformulabyMartin et al., (1987).

$$n = \frac{4\,\hat{P}\hat{Q}}{L^2}$$

Where:

n ≡ Required Sample Size $\hat{P}$ ≡ Expected Prevalence

$\hat{Q}$ ≡ 1- $\hat{P}$ L ≡ Allowable Error (0.05)

$\hat{P}$ = 2.59% (0.0259) $\hat{Q}$= 0.9741

$$n = \frac{4 \times 0.0259 \times 0.9741}{0.0025} = \mathbf{40}$$

The small sample size calculated (40) was multiplied by 5 to increase precision of the results (Thursfield., 2007).Im inspect 300 animal to increase pression of the result.

2.6 Study Design:

The study design was a cross sectional study which provides snapshot information onoccurrenceof a disease (Martin *et al* , 1987). A Cross-sectional study was conducted at Dillig slaughterhouse on three randomly selected days, the animals in these days selected by systematic random sampling method,From each five animals, one was selectedfor examination.

2.6.1 Ante-mortem examination:

Regular visitsweremade bythe investigator to Dilling slaughterhouse in Sunday, Monday and Thursday to conduct ante-mortemexamination of slaughter animals. A totalof 300 cattle were examined in the Dilling slaughterhouse during the survey period which extended from November 2014 to January 2015.

Duringtheante mortem inspection, the age, sex, breed, origin, body conditionand type of grazing of each animalswere determined . The age ofanimals was determined by Incisors of animals teeth, body condition ofeachindividualanimalwas assessed and recorded depending on their body condition score,wereranked as poor or good , animal originwas also recorded as the state,from which the animal came.

2.6.2 Post-mortem examination:

Thestudywas based on routine meat inspection for randomlyselected cattle slaughtered at theslaughterhouse. Visual inspection ofall exposed surfaces was done to shoulder muscles, hearts, masseters (cheek muscle), diaphragms, tongues, lungs and livers. This is followed by incision ofmasseters,tongues , hearts ,and liverstobeexamined for*Cysticercusbovis*cysts.The incision procedure for each organ was for the masseter muscle, two deep linear incisions were doneparallel to the mandible from its upper muscular insertion , the tongue wasincised longitudinally from the apex to the root on the lower surface (also was examined by palpation). The heart was split from the base to the apex andfurther incisionswascarried outinto its muscle. The other organs were also

examined based on the standard methods of the meat inspection and the findings were recorded. Carcasses which had one cyst or more in any of these organs was subjected to detailed meat inspection (including shoulder muscle). An animalwasconsidered heavilyinfected if lesions were discovered in two of theusual inspection sites. Generalized infection accordingto FAO regulations means 2 or 3 cysts found oneach cut into the muscles of mastication, heart,diaphragm and its pillars, and also in muscles exposedduring dressing procedures(*Herenda et al. 2000*).In parallel, the following data were recorded: Serial number, infectionand infected organs. Tissue organs containing cysts were collected in plastic containers and taken to the laboratory of University of Dilling to conduct cyst count and cyst viability.

2.6.3 Examination of the cysts:

Infected tissue organs containing cysts were transportedto the laboratory of University of Dilling werefurtheranalysed to determine the cysts account and viability .

2.7 Statistical analysis:

Results of the study were analyzed using statistical package of social science (SPSS) version 16. At first, descriptive statistical analysis was displayed in frequency distributionand cross tabulation tables. Then, univariate analysis usingthe Chi-square for qualitative data was carried out. P-value < 0.25 was consideredas significant association and the risk factors was then selectedto enter the multivariate analysis .Logistic regression was used to analyze the data and to investigate association between a potential risk factors and the occurrenceof cysticercosis. A p-value of<0.05 indicated significant association between cysticercosis 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 Results:

Out of 300 cattle inspected,only 27 (9%) animals were positive, and the rest were negativefor cysticercus bovis (table 3.1.1).

Table 3.1.1: Frequency tablefor distribution of*Cysticercus bovis* infection among 300 cattle examined in Dilling abattoir:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	+ve	27	9.0	9.0	91.0
	-ve	273	91.0	91.0	100.0
	Total	**300**	**100.0**	**100.0**	

3.2 Age of animals:

Three hundred cattle ofvarious ages were examined in this study. The presence of*Cysticercus bovis* in various organs was investigated. The result showed the age distribution of cattle, 103 of the cattle were less than4 years (young) and 197 of cattle were more thanor equal to 4 years (old), (table 3.1.2). Among young animals 3 animals were found infected. Rate of infection within young animals was 2.9% (3/103). However among adult rate of infection was 24% (12/.2), (table3.1.3).

The Chi- square test showedasignificant association between*Cysticercus bovis* infection and age of animal (p-value = 0.08),(table 3.1.4).

3.3 Sex of animals:

The results of this study showed the distribution of 300 cattle examined for *Cysticercus bovis* according to sex. Total number of male examined was 167 animals, while the total number of female examined was133(table 3.1.2). Among males, 11 animals were found infected. Rate of infection within males was 6.6% (11/167). While among females, 16 animals was found infected. The rate of infection within females was 12% (16/133), (table 3.1.3).

The Chi-square test showed a significant association between *Cysticercus bovis* infection and sex of animal (p-value = 0.102), (table 3.1.4).

3.4 Breed:

The results of study showed distribution of *Cysticercus bovis* infection in Dilling slaughterhouse according to breed. Total number of Bgara breed was 297 animals. Among these 297 animals, 27 were found infected. The rate of infection was 9.1% (27/297). Total number of Kenana breed examined was 2. Among these, there was no infection. Total number of Nylotic breed examined was 1. Among these, there was no infection (table 3.1.3).

The chi- square test showed no significant association between the infection and breed (p-value = 0.861), (table 3.1.4).

3.5 Body condition:

The body condition of animals and the presence of infection were investigated. Towhundred forty seven of cattle were found to be in good

condition,while 53 of cattle were found to be in poor condition (table 3.1.2). Among good animals, 18 were found infected. The rate of infection within good condition animals was 7.3% (18/247). However the infection among poor animals was, 9. The rate of infection within poor animals was 17.0%(table 3.1.3).

The chi- square test showed a significant association between the infection and body condition (p-value = 0.026),(table 3.1.4).

3.6 Source of animals:

Of the total 300 cattle inspected, 297 animals were from Kordofa, 1 animal were from South Sudan and only 2 animals were from White Nile (table 3.1.2). All infected animals found in this study (27 animals) were fromKordofan. The rate of infection inKordofan was 9.1% (27/297). On the other hand there was no infection found in White Nile and South Sudan (table 3.1.3).

The chi- square test showed no significant association between the infection and source of animal (p-value = 0.861), (table 3.1.4).

3.7 Grazing type:

The grazing type of animals and the presence of*Cysticercus bovis*infection were investigated. two hundred ninety five of cattle were found to be in opengrazing type,while 5 of cattle were found to be in close grazing type (table 3.1.2). Among opengrazing type animals, 24 were found infected. The rate of infection within open grazing type animals was 8.1% (24/295). However 3 animals was found infected among close grazing type animals.The rate of infection is 60% (table 3.1.3).

The chi- square test showed a significant association between the infection and grazing type (p-value = 0.00),(table 3.1.4).

Multivariate analysis usingthe logistic Regression shoed thatthere were two potential risk factors significantlyassociated withcysticercus bovis (p-value < 0.05). Therewere ageof the animal (p-value = 0.049) and grazing type (p-value = 0.002) .(table 3.1.5).

3.8Nomber of cysts:

The number of cysts among the 300 animal examined, 597 cysts were determined.580 cysts were found in the liver and 17 in the lung.

3.9 Location of cysts:

The location of cysts in different organs was investigated. Our results showed that liver and lung were the only infected organs with *Cysticercus bovis* where 27 cases (9.1%) were found infected, 2 cases of these 27 cases has a cyst in liver and lung . No infection was found on tongue, masseter muscle, heart, diaphragm and shoulder (table 3.6.1).

3.9 Viability of cysts:

Viability ofthe cyst was determined by cyst translucence, cysts which contain translucent fluid with visible white scolex were classified as viable and those which contain bluish-green caseous masses or necrotic patches were classified as dead or calcified (Qadeer.,2008). Macroscopic examination revealed that out of 580 cysts present in the liver, 325 cysts were found viable (56.03%) and out of 17 cysts present in the lung 10 were found viable (58.8%) (table 3.6.1).

Table 3.1.2: Summary of frequency tables for potential risk factors of *Cysticercus bovis* in 300 cattle examined at Dilling slaughterhouse

Risk Factors	Frequency	Relative Frequency %	Cumulative Frequency %
Age			
Young (<4)	103	34.3	34.3
Old (≥4)	197	56.7	**100**
Sex			
Male	167	55.7	55.7
Female	133	44.3	**100**
Breed			
Bgara	297	99.0	99.0
Kinana	2	.7	.7
Nylotic	1	.3	**100**
Body condition			
Good	247	82.3	82.3
Poor	53	17.7	**100**
Source			
Kordofan	297	99.0	99.0
White nyle	2	.7	92
South sudan	1	.3	**100**
Grazing type			
Open	295	98.3	98.3
Close	5	1.7	**100**

Table 3.1.3: Summary of cross tabulation for potential risk factors of *Cysticercus bovis* in 300 cattle examined at Dilling slaughterhouse

Risk factors	No.inspected	No.affected (%)
Sex:		
Male	167	11 (6.6)
Female	133	16 (12)
Age:		
Old(≥4)	197	24 (12.2)
Young (<4)	103	3 (2.9)
Body condition:		
Good	247	18 (7.3)
Poor	53	9 (17.0)
Breed:		
Bgara	297	27 (9.1)
Kenana	2	0 (0)
Nylotic	1	0 (0)
Source:		
Kordofan	297	27 (9.1)
White Nile	2	0 (0)
South Sudan	1	0 (0)
Grazing Type:		
Open	295	24 (8.1)
Close	5	3 (60.0)

Table 3.1.4: Summary of univariate analysisfor potential risk factors of *Cysticercus bovis* in 300 cattle examined at Dilling slaughterhouseusing the Chi- square test

Risk factors	No.inspected	No.affected (%)	d.f	X2^	p- value
Sex:			**1**	**2.678**	**0.102**
Male	167	11 (6.6)			
Female	133	16 (12.0)			
Age:			**1**	**7.097**	**0.08**
Old(≥4)	197	24 (12.2)			
Young (<4)	103	3 (2.9)			
Body condition:			**1**	**4.958**	**0.026**
Poor	247	18 (17.0)			
Good	53	9 (7.3)			
Breed:			**2**	**0.300**	**0.861**
Bgara	297	27 (9.1)			
Kenana	2	0 (0)			
Nylotic	1	0 (0)			
Source:			**2**	**0.300**	**0.861**
Kordofan	297	27 (9.1)			
White Nile	2	0 (0)			
South Sudan	1	0 (0)			
Grazing Type:			**1**	**16.148**	**.000**
Open	295	24 (8.1)			
Close	5	3 (60.0)			

Table 3.1.5: Multivariate analysisof*Cysticercus bovis*and potential risk factors in 300 cattle examined at Dillig slaughterhouse

Risk factor	No.inspected	No.affected(%)	(OR)	**P-value**	**CI**
Sex:					
Male	167	11(6.6)	Ref	**0.366**	**.078 -.995**
Female	133	16(12.0)	.278		
Age:					
Young (<4)	103	3 (2.9)	Ref	**0.049**	**.278 -1.603**
Old (≥4)	197	24 (12.2)	.667		
Body condition:					
Good	247	18 (7.3)	Ref		
Poor	53	9 (16.9)	.478	**0.478**	**.188 – 1.218**
Grazing type:					
Open	295	24(8.1)	Ref		
Close	5	3 (60.0)	21.303	**0.002**	3.**027-149.927**

Table 3.1.6: Anatomical distribution and viability of cysts among inspected

Organ	No. tested	No. positive (%)	No. of cysts	No. of viable cysts (%)	No. of dead cysts (%)
Tongue	300	0	0	0	0
Masseter	300	0	0	0	0
Heart	300	0	0	0	0
Liver	300	27 (9)	580	325 (56.03)	255 (43.96)
Lung	300	2(0.6)	17	10(58.8)	7
Shoulder	300	0	0	0	0
Total	1800	29 (10)	597	335 (56.11)	262 (43.86)

Figure 3: Translucent *Cysticercus bovis* on the surface of the diseased liverat Dillig slaughter house.

Figure4: Calcified *Cysticecus bovis* on cut surface of the diseased liver at Dillig slaughter house.

Chapter Four

Discussion

Results of the present study have increased knowledge on the epidemiology of *Cysticercus bovis*in cattle slaughtered in South Kordofan state of the Sudan. Meat inspection conducted on slaughtered cattleshowed that the prevalence rate of *Cysticercus bovis* was considerably higer in the study area. While there is a lack in the studies conducted on *Cysticercus bovis* in the Sudan, except one stundy conducted in North Kordofan state therefore, this study was conducted to estimate the prevalence rate of *Cysticercus bovis* in cattle slaughtered in Dilling slaughterhouse, south Kordofan and to investigate potential risk factors associated with the infection.

In the present study the prevalence of *Cysticercus bovis*in cattle slaughtered in Dilling slaughterhouse, south Kordofan state, Sudan was 9%. This result is higher than the findings of Yasir *etal.*, (2013) who reported aprevalence of 1% in north kordofan,Dutra *et al.,* (2012), who reported a prevalence of 1.05% in Brazil, Basem *et al.,* (2009) who reported a prevalence of 1.6% in Egypt andAbuseir *et al.,* (2006) who reported a prevalence of 1.08% in Germany. However the result of the present study was higher than the prevalence reported by Dzoma *et al.,* (2011)who reported a prevalence of 0.2% in South Africa and Khaniki *et al.,* (2010), who reported a prevalence of 0.25% in Iran, the prevalence reported in Nigeria of 2.67% by Rabi'u and Jegede., (2010), Ethiopia of 2.93% byTolosa *et al.*, (2009), Iran of 3% by Garedaghi *et al.*, (2011), Ethiopia of 3.6% by Ibrahim and zerihun., (2012), Ethiopia of 4.4% by Megersa et al., (2010).but this study agree with the prevalence inEthiopia 8.29% by Kumar

and Berhe., (2008).The prevalence in this study was lower than the prevalence reported in Nigeria of 13.4% by Qadeer., (2008), Ethiopia of 22.9% by Belachew and Ibrahim., (2012), and Nigeria of 72.2% by Ikpeze *et al.,* (2008). This variation of prevalence may be due to personal and environmental hygiene, variation in the method and quality of meat inspection, management of animals, experience and diligence of inspector and other factors may have contributed for the change of prevalence of *Taenia saginata* cysticercosis.

The prevalence of *Cysticercus bovis* infection according to sex of investigated animals has been estimated in this study. This study showed that female cattle have higher rate of infection than male cattle. The rate of infection in female animals was 12,03% (16/133), while in male animas infection was 6.6(11/167) . There was a significant association between *Cysticercus bovis* infection and sex of animals (p-value = 0.102). This result is disagree with report of Belachew and Ibrahim., (2012) in Ethiopia, Garedaghi *et al.,* (2011) in Iran and Dzoma *et al.,* (2011) in Nigeria. But this finding is agree with study carried out in Ethiopia where the p-value was0.027 *(Ibrahim and Zerihun., 2012*), and ap-value of <0.05 reported in Nigeria (*Qadeer., 2008*).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.

With regards to rate of infection of *Cysticercus bovis* in different age groups of cattle, the rate of infection among animals with more than or equal 4 years of age was 12.2% (24/196), while the rate of infection among animals less than 4 years was 2.9(3/103). There was a significant association observed between *Cysticercus bovis* infection and age of animals(p-value = 0.08). This result is in contrary with report ofIbrahim and Zerihun., (2012) in Ethiopia. But this result is in accordance with finding of study carried out in

Ethiopia where the p-value was 0.003 (*Belachew and Ibrahim., 2012*). This significant variation in prevalence of *Cysticercus bovis* might be due to age dependent immunity.

The results of this study showed that the prevalence of *Cysticercus bovis* infection within 2 parameters of body condition of the animals was: 7.3% (18/247) in good body condition and 17.0% (9/53) in poor body condition. However, there was a significant association between*Cysticercus bovis* infection and body condition of animals(p-value= 0.026) this in the univariat ,but in multivariate analysis there was no significant association between Cysticercus bovis infection and body condition of the animal(p-value =.122). This could be agree to the fact that, *Cysticercus bovis*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 from being slaughtered. This finding is in line with finding ofBelachew and Ibrahim., (2012) in Ethiopia.

The prevalence of *Cysticercus bovis* infection related to breed of investigated animals was: 9.1% (27/297) in Bgara breed, while there was no infection found among Kenana and foreign breeds.However, there was no significant association between*Cysticercus bovis* infection and body breed of animals(p-value= 0.861). This result is in agreement with report of Belachew and Ibrahim., (2012) in Ethiopia, and another observations reported in Ethiopia *(Ibrahim and zerihun., 2012*).

The prevalence of *Cysticercus bovis* infection according to source of investigated animals was estimated in this study. The rate of infection inKordofan was 9.1% (27/297), and there was no infection found in White Nileand South Sudan. There was no significant association between the

*Cysticercus bovis*infection and sourceofthe animals (p-value= 0.861).This result is comparable to the finding of Belachew and Ibrahim.,(2012) in Ethiopia, and Tesfaye *et al.,* (2012) in Ethiopia.

According to the current study, the cysts were found at two site (liver and lung), while there was no infection found at shoulder muscle, heart, masseter (cheek muscle), and tongues. This could be attributed to that infection might be in the early stage, and cysts did not reach the other organs yet. This result is in line with the finding ofKumar and Berhe., (2008) in Ethiopia, who reported a highest infection in the liver.But this result is in contrary with finding of Belachew and Ibrahim., (2012) in Ethiopia, Ibrahim and zerihun., (2012) in Ethiopia, Megersa *et al.,* (2010) in Ethiopia, Tolosa *et al.,* (2009) in Ethiopia, Tesfaye *et al.,* (2012) in Ethiopia, Garedaghi *et al.,* (2011) in Iran, Rabi'u and Jegede., (2010) in Nigeria andQadeer., (2008).

Of the total cysts collected, 56.11% (335/597) were viable while the rest 43.86% (262/597) were calcified, which is in agreement with the report of Ibrahim and zerihun., (2012) in Ethiopia(46%alive and 54% dead), Megersa *et al.,* (2010) in Ethiopia and Tolosa *et al.,* (2009) in Ethiopia(43.12%viable and56.88%calcified).But this result dis agree with finding of study carried out in Ethiopia where the viable cysts were 62.5%, while calcified one were 37.5% (Belachew and Ibrahim., 2012).

Conclusions

The output of this study in the univariate analysis the risk factors were statisticallay significantly associated with*Cysticercus bovis* infection (p-value<0.25%): Age of the animal, Body condition, Grazing type and sex of the animal. There was no significant difference in the occurrence of recurrence of Cysticercus *bovis* infection and source of the animal and breeds(Kenana, Butana, Nylotic).

Multivariate analysis using logistic regression there were two risk factors associated with *Cysticercus bovis* (p-value<0.05).

*Age(p-value 0.049).

*Grazing (0.002).

Microscopic examination of the cyst found that 332(56.11) out of 597cyst were viable while 262 (43.86) were dead cyst.

Recommendations

- There should be public awareness about the health and economic importance of the disease through social and public media.
- Avoid eating of raw meat that is not inspected by well experienced meat inspector.
- Infected meat and meat products must be undergoing the processes of freezing and boiling.
- There should be strong and close collaboration between medical and veterinary professionals to reduce impact of the disease both in humans and animals.
- The community should use latrines to improve personal as well as environmental hygiene.
- Untreated human feces should not be used as fertilizers.
- Strict routine meat inspection of slaughtered animals should be carried out.
- Further researches should be conducted on the epidemiology and control strategies of cestodes in South kordofan state.

5. References

Abuseir, S. ; Epe, C. ; Schnieder, T. ; Klein, G. and Kühne, M. (2006). Visual Diagnosis of *Taenia saginata* Cysticercosis During Meat Inspection: is it unequivocal?. Parasitol Res., 99, pp: 405–409.

Ahmed Yasir (2014). Prevalence and Risk Factors of Cysticercus bovis in North Kordofan State, Sudan**.**A Thesis Submitted to the College of Graduate Studies in Partial Fulfillment of the Requirements for the Degree of Master of Preventive Veterinary Medicine (MPVM) Sudan University Of Science and Technology.

Allepuz, A. ; Napp, S. ; Picado, A. ; A. ; Panades, J. ; Domingo, M. and Casal, J. (2009). Descriptive and Spatial Epidemiology of *Bovine Cysticercosis* in North-Eastern Spain (Catalonia). Veterinary Parasitology, 159, pp:43–48.

Asaava, L.L. ; Kitala, P.M. ; Gathura, P.B.; Nanyingi, M.O.; Muchemi, G. And Schelling, E. (2009).A survey of *Bovine cysticercosis*/Human Taeniosis in Northern TurkanaDistrict, Kenya.Preventive Veterinary Medicine, 89, pp: 197–204.

Basem, R.N. ; Sayed, S.M. ; Hussein, A.A. and Arafa, M.I. (2009). Occurrence of Cysticercosisin Cattle and Buffaloes and *Taenia saginata* in Man in Assiut Governance of Egypt. Veterinary World, 2 (5), pp: 173-176.

Belachew, M. and Ibrahim, N. (2012). Prevalence of *Cysticercus bovis* in Hawassa Municipal Abattoir and its Public Health Implication. American-Eurasian Journal of Scientific Research, 7(6), pp: 238-245.

Blancou, J., Uilenberg, G., Lefevre, P-C, and Charmette, R.(2010): Infectious and Parasitic Diseases of Livestock. Lavoisier. vol. 2s, P. 1646.

Dutra, L.H. ; Girotto, A. ; Vieira, R.F. ; Vieira, T.S. ; Zangirolamo, A.F ; Marquês, F.A. ; Headley S.A. and Vidotto O. (2012). The Prevalence and Spatial epidemiology of Cysticercosis in Slaughtered Cattle from Brazil Semina: Ciências Agrárias, Londrina, 33(5), pp: 1887-1896.

Dzoma, B.M. ; Setlhodi, E.K. ; Molefe, M.M. ; Motsei, L.E. ; Bakunzi, F.R. ; Ndou, R.V. and Nyirenda, M.(2011). Prevalence of Bovine Cysticercosis in the North West Province of South Africa from 2000 to 2010. Kamla-Raj J Hum Ecol, 36(1), pp: 9-12.

FAO.(2014) Emergency and Humanitarian Action South Kordofan State EMERGENCY PROFILE 1st Edition (2014).

FAO. (2004)veterinary Public Health Disease Fact Sheet: Cysticercosis.

Garedaghi, Y. ; Saber, A.P. and Khosroshahi, S.M.(2011). Prevalence ofBovine Cysticercosisof Slaughtered Cattle in Meshkinshahr Abattoir. American Journal of Animal and Veterinary Sciences, 6(3), pp: 121-124.

Haylegebriel Tesfay and Alembrhan Assefa.(2013).Cysticercosis bovis in Eastern Tigray, Northern Ethiopia.International Journal of Innovation and Scientific Research ISSN 2351-8014 Vol. 10 No. 2Oct. 2014, pp. 522-526.

Herenda; P.G. ; Ettriqui, A. ; Seneviratna, P. and da Silva, T.J. (2000). Manual on Meat Inspection for Developing Countries. Food Agriculture Organization (FAO). FAO Animal Production and Health Paper 119. http://www.fao.org/docrep.

Ibrahim, N. and Zerihun, F. (2012). Prevalence of *Tania saginata* Cysticercosis in Cattle Slaughtered in Addis Ababa Municipal Abattoir, Ethiopia. Global Veterinaria, 8(5), pp: 467-471.

Ikpeze, O.O. ; Eneanya, C.I. and Ekechukwu, W. (2008). Significance of Meat Inspection in The Estimation of Economic Loss due to Bovine Cysticercosis. Animal Research International, 5(3), pp: 896-899.

Kandil, O.M. ; Mahmoud, M.S. ; Shalaby, H.A. ; Namaky, H.E. ; Hendawy, H.M. and Arafa, M.I. (2012). Value of *Taenia Saginata* Crude Antigen in Diagnosis of *Bovine Cysticercosis* with Reference to its Characterization. Global Veterinaria, 9(4), pp: 474-478.

Khaniki, G.R. ; Raei, M. ; Kia E.B. ; Haghi, M.A. and Selseleh, M. (2010). Prevalence of *bovine cysticercosis* in slaughtered cattle in Iran. Trop Anim Health Prod, 42, pp: 141–143.

Kumar, A. and Berhe, G. (2008). Occurrence of Cysticercosisin Cattle of Parts of Tigray region of Etidopia. Haryana Vet, 47, pp: 88-90.

Kumar, A. and Tadesse, G. (2011). A review of Bovine Cysticercosisin Ethiopia. Ethiop.Vet. J, 15(1), pp:15-35.

Lightowlers, M.W. ; Rolfe , R. and Gauci, C.G. (1996). *Taenia saginata*: Vaccination Against Cysticercosis in Cattle with Recombinant Oncosphere Antigens. Expl.Parasitol, 84, pp: 330-338.

Iis, A.; Francisco, C. ; A. ; and Liza, R.(2013).Modernisation of bovine Meat Inspection. Faculty of Health and Medical Sciences, University of Copenhagen.

Martin, S. W. ; MEEK, A.H. and Willeberg, P. (1987)**.** Veterinary Epidemiology, Principles And Methods, pp: 26-27. Lowa State Universiry Press , Ames.

Megersa, B. ; Tesfaye, E. ; Regassa, A. ; Abebe, R. and Abunna, F. (2010). Bovine Cysticercosisin Cattle Slaughtered at Jimma Municipal Abattoir, South Western Ethiopia: Prevalence, Cyst Viability and its Socio-Economic Importance. Veterinary World, 3(6), pp: 257-262.

Minozzo, J.C. ; Gusso, R.L. ; Castro, E.A. ; Lago, O. and Soccol, V.T. (2002). Expermental Bovine Infection with *Taenia saginata* eggs: Recovery Rates and Cysticerci Location. Brazilian Archives of Biology and Technology, 45(4), pp: 451-455.

NSW: State of New South Wales through Department of Trade and Investment, Regional Infrastructure and Services (NSW Trade & Investment) 2012.

OIE: OIE Terrestrial Manual. (2008). Chapter 2.9.5.

Oladele, O. ; Gracey, G. Stanny and B. Jef.(2004). "Bovine Cysticercosis: Preliminary Observations on the Immuno Histochemical Detection of *T. saginata* Antigens in Lymph Nodes of an Experimentally Infected Calf," Canada Veterniary Journal, vol. 45, pp. 852 – 855.

Osegboka, I.O. ; Ifeoma, E.C. And Winniebert, E. (2008). Significance Of Meat Inspection In The Estimation Of Economic Loss Due To *Bovine Cysticercosis*. Animal Research International, 5(3), pp: 896 – 899.

Qadeer, M.A. (2008). Prevalence of BovineCysticercosis In Jos Abattoir, Nigeria. Animal Research International, 5(1), pp: 777 – 779.

Rabi'u, B.M. and Jegede, O.C. (2010). Incidence of BovineCysticercosis in Kano state, north western Nigeria. Bayero Journal of Pure and Applied Sciences, 3(1), pp: 100 – 103.

Parasitol, 1, pp: 389-392.

Sheiba, B.H. and ZeinEldin, El.S. (1987). Preliminary Observations on Vaccination Against Bovine Cysticercosis in the Sudan. Vet. Parasitol, 24, pp:297-300.

Sid-Ahmed, M. E. (1995). Some Studies on Liver and Gastro-IntestinalParasites of Cattle atAtbara, Northern State. A Thesis

Submitted to the Faculty of Veterinary Medicine, University of Khartoum in Partial Fulfillment of the Requirements for the Degree of Master.

Solusby, E.J. (1982). Helminthes, Arthropods and Protozoaof Domestic Animals. 7th.ed. BailliereTindal, London. Lead and Febiger. Philadelphia.

Symth, J. D. (1994). Introduction to Animal Parasitology (Book), 3rd edition. Published by Cambridge University Press.

Teka, G. (1997): Food Hygiene Principles and Food Borne/ Disease Control with Special Reference to Ethiopia. Addis Ababa University, Faculty of Medicine, Department of Community Health, Addis Ababa, Ethiopia.

Tesfaye, D. ; Sadado, T.; and Demissie T. (2012). Public Health and Economic Significance of BovineCysticercosis in Wolaita Soddo, Southern Ethiopia. Global Veterinaria, 9(5), pp: 557-563.

Thrusfield, M. (2007)**.**Veterinary Epidemiology, E (3), 13, pp: 246. United Kingdom, Black Well Science ltd.

Tolosa, T. ; Tigre, w. ; Teka, G. and Dorny, P. (2009). Prevalence of BovineCysticercosisand Hydatidosis in Jimma Municipal Abattoir, South West Ethiopia. Onderstepoort Journal of Veterinary Research, 76, pp: 323–326.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W. (1996): Veterinary Parasitology. 2nd ed. London, Blackwell Science, pp. 121-124.

Wanzalaa, W.; Abujeb, J.A.; Kang'ethec, E.K.; Ochandaa, H. ; and Harrisond, L.J. (2002). Sero-Diagnosis of Bovine Cysticercosisby Detecting Live *Taenia saginata* Cysts Using a Monoclonal Antibody-Based Antigen-ELISA. S.Afr.Vet.Ass, 73(4), pp: 201–206.

WHO. (2013). Taeniasis/Cysticercosis. WHO Fact Sheet N376**.**

WUBIE N.K. (2004). Development and Evaluation of Serological Tests and Prevalence at Addis Ababa Abattoir. A Thesis Submitted to the Faculty of Veterinary Medicine, Addis Ababa University, in Partial Fulfillment of the Requirements for the Degree of Master of Science in Tropical Veterinary Medicine.

Appendix I

Frequency tables for distribution of infection among 300 cattle examined at Dillig abattoir according topotential risk factors:

Table 3.2.1:Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Female	133	44.3	44.3	44.3
	Male	167	55.7	55.7	**100**
	Total	**300**	**100**	**100**	

Table 3.3.1:Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Young	103	34.3	34.3	34.3
	Old	197	65.7	65.7	**100**
	Total	**300**	**100**	**100**	

Table 3.4.1: Body condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Poor	53	17.7	17.7	17.7
	Good	247	82.3	82.3	**100**
	Total	**300**	**100**	**100**	

Table 3.5.1: Breed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Bgara	297	99	99	99
	Kenana	2	.7	.7	.7
	Nylotic	1	.3	.3	**100**
	Total	**300**	**100**	**100**	

Table 3.6.1: Source of Animal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Kordofan	297	99	99	99
	White Nile	2	.7	.7	.7
	South Sudan	1	.3	.3	**100**
	Total	**300**	**100**	**100**	

Table 3.7.1: Grazing Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Close	5	1.7	1.7	1.7
	Open	295	98.3	98.3	**100**
	Total	**300**	**100**	**100**	

Appendix II

Cross-tabulation of the prevalence of *cysticercus bovis* in 300 cattle examined at Dillig slaughterhouse according to potential risk factors:

Table 3.2.2: Sex

	Sex of animal		Total
	Female	**Male**	
Results **-ve**	117 117/133x100 **88.0%**	156 156/167x100 **94.4%**	273 273/300x100 **91.0%**
+ ve	16 16/133x100 **12.0%**	11 11/167x100 **6.6%**	27 27/300x100 **9%**
Total	**133** **100%**	**167** **100%**	**300** **100%**

Table 3.3.2: Age

	Age of animal		Total
	Young	**Old**	
Results **-ve**	100 100/103x100 **97.1%**	173 173/197x100 **87.8%**	198 198/200x100 **99%**
+ ve	3 3/103x100 **2.9%**	24 24/197x100 **12.2%**	27 27/300x100 **9%**
Total	**103** **100%**	**197** **100%**	**300** **100%**

Table 3.4.2: Body Condition

	Body condition		Total
	Poor	**Good**	
Results	44	229	273
-ve	44/53x100	226/247x100	273/300x100
	83.0%	**92.7%**	**91.0%**
+ ve	9	18	27
	9/53x100	18/247x100	27/300x100
	17.0%	**7.3%**	**9%**
Total	**53**	**247**	**300**
	100%	**100%**	**100%**

Table 3.5.2:Breed

	Breed			Total
	Bgara	**Kenana**	**Nylotic**	
Results	270	2	1	273
-ve	270/297x100	2/2x100	1/1x100	273/300x100
	90.9%	**100%**	**100%**	**99%**
+ ve	27	0	0	27
	27/297x100	0/2x100	0/1x100	27/300x100
	9.1%	**0%**	**0%**	**9%**
Total	**297**	**2**	**1**	**300**
	100 %	**100%**	**100%**	**100%**

Table 3.6.2:Source of Animal

	Animal source			Total
	Kordofan	**White Nile**	**South Sudan**	
Results	270	2	1	273
-ve	270/297x100	2/2x100	1/1x100	198/200x100
	90.9%	**100%**	**100%**	**99%**
	27	0	0	27
+ ve	27/297x100	0/2x100	0/1x100	27/300x100
	9.1%	**0%**	**0%**	**9%**
	297	**2**	**1**	**300**
Total	**100 %**	**100%**	**100%**	**100%**

Table 3.7.2: Grazing Type

	Grazing type		Total
	Close	**Open**	
Results	2	271	273
-ve	2/5x100	271/295x100	273/300x100
	40.0%	**91.9%**	**91.0%**
	3	24	27
+ve	3/5x100	24/295x100	27/300x100
	60.0%	**8.1%**	**9%**
	5	**295**	**300**
Total	**100%**	**100%**	**100%**

AppendixIII

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

Table 3.2.3:Sex

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	2.678	1	0.102
Likelihood Ratio	2.660	1	0.103
Linear by Linear Association	2.669	1	0.102
N of Valid Cases	300		

Table 3.3.3: Age

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	7.097	1	0.008
Likelihood Ratio	8.397	1	0.004
Linear by Linear Association	7.073	1	0.008
N of Valid Cases	300		

Table 3.4.3: Body Condition

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	5.007	1	0.025
Likelihood Ratio	4.291	1	0.038
Linear by Linear Association	4.990	1	0.025
N of Valid Cases	300		

Table 3.5.3: Breed

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	0.300	2	0.681
Likelihood Ratio	0.569	2	0.752
Linear by Linear Association	0.276	1	0.599
N of Valid Cases	300		

Table 3.6.3: Source of Animal

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	0..300	2	0.861
Likelihood Ratio	0.569	2	0.752
Linear by Linear Association	0.276	1	0.599
N of Valid Cases	300		

Table 3.7.3: Grazing Type

	Value	Df	Asymp.sig (2-sided)
Pearson chi- square	16.148	1	.000
Likelihood Ratio	8.372	1	.004
Linear by Linear Association	16.094	1	.000
N of Valid Cases	300		

Appendix IV

Multivariate analysis of potential risk factors of cysticecosis in 300 animal inspected in Dillig slaughter house.

Table 3.2.4:Multivariate Analysis

	Df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
				Lower	Upper
age(1)	1	.049	.278	.078	.995
sex(1)	1	.366	.667	.278	1.603
bcs(1)	1	.122	.478	.188	1.218
grazing(1)	1	.002	21.303	3.027	149.927
Constant	1	.000	.246		