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Review On Prevalence, Public Health And Economic Significance Of Bovine Metacestodes

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Abstract: Metacestode infestations in animals are the most important parasite of livestock and humans because most of these parasites are zoonotic causing cysticercosis and hydatidosis both in man and animals. It causes economic and production losses in livestock. Bovine cysticercosis is a parasitic infection of cattle caused by the larval stage (cysticercus) of the cestode Taenia saginata. It is a cosmopolitan disease occurring in industrialised as well as developing countries. Humans are the definitive host and harbour the adult form of the parasite in their intestines. In cattle, natural infections are normally asymptomatic but they cause financial losses to the cattle industry due to downgrading, condemnation, extra handling, refrigeration and transport of the infected carcasses. The prevalence of the disease both in human and animals is high and economically significant. Nowadays, since there are accustoms of eating raw meat, lack of knowledge about ways of disease transmission, backyard slaughtering of animals especially during holydays, ignorance incision of meat by meat inspectors and lack of sanitation can give a great favour for continual existence of the parasite within the human and animal population. Strict routine meat inspection of slaughtered animals should be carried out and there should be public awareness about the health and economic importance of the disease.

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1. INTRODUCTION

1.1. Background

Taeniidae is the largest family of flatworms (tapeworms) representing the order cyclophyllidae. It comprises numerous tapeworms with medical and veterinary importance (Qingling M *et al*.,2014). Tapeworms 4154(Cestode) of the family Taeniidae are transmitted from the definitive host such as carnivores to the intermediate hosts including herbivores or omnivores and human beings via oral-fecal cycle (Rawson PD, Burton RS.,2006). Taenia saginata and Taenia solium are the two taeniids of greatest economic and medical importance, causing bovine and porcine cysticercosis and taeniasis in humans (Flisser A., 1988). Echinococcosis, also called hydatidosis, is a zoonosis and in humans, it occurs as a result of infection by the larval (metacestode) stages of taeniid cestodes of the genus Echinococcus. It is characterized by long-term growth of Metacestode (larval) stages (hydatid cysts) in internal organs (mainly the liver and lungs) of intermediate host animals (Oryan A *et al*., 2012).

Taeniosis and hydatidosis are parasitic zoonoses that present major public health problems in lower income countries (Taylor *et al*., 2007). Bovine cysticercosis refers to the infection of cattle with metacestodes of the human tapeworm Taenia saginata (Oladela *et al*., 2004).

Bovine Cysticecrosis is a major problem for producers in sub Saharan Africa. The clinical effect of cysticercosis on infected animal is not significant, however, in addition to the effect on human health, economic losses may be high due to the condemnation of heavily infected carcasses and the necessity to freeze or boil infected meat, restriction of export and herd quarantine. Hydatidosis is a zoonotic infection caused by adult or larval stage of cestode belonging to the genus Echinococcus. Hydatid disease (Hydatidosis) is characterized by cyst containing numerous tiny protoscolices that most often develop in the liver and lungs and also develop in the kidneys, spleen, nervous tissue, bone and other organs. As per an estimate, 50 million cases of such infestation occur worldwide with 50,000 people dying from this problem annually (WHO, 1996). It causes significant economic impact in many parts of the world, particularly developing country by hindering the exports of animals and animal products. Financial losses can be considerable when large numbers of animals are affected. Most incidences arise from direct exposure to proglottids shed from farm workers, but there have been some reports of large scale outbreaks resulting from sewage contaminated feed or forage (Wayne, L *et al*., 2002).

Hence, bovine cysticercosis is an important public health and economic problems caused by its consequences on public health, nutritional and economy of some countries (Wanzalaw *et al*., 2006). In developing countries, taeniasis or bovine cysticercosis constitutes a serious, but less recognized public health problem (Minnozz JC *et al*., 2002). Taeniasis caused by taenia saginata is well known disease in Ethiopia with a prevalence ranging from 10% to 70% (Mamo E, 1998).

Bovine cysticercosis and taeniasis are common where hygienic conditions are poor and the inhabitants traditionally eat raw meat or insufficient cocked or sun cured meat (Minnozz JC *et al*., 2002). Inadequate health education and low availability of taenicides are the major obstacles for the control of such infections (Pawloski ZS, 1996). Due to this reasons, taeniasis is more common in developing countries including Ethiopia where meat is an important component of human diet and traditionally it is consumed as raw in many occasions.

Cystic echinococcosis is an important problem for public health and the economy in many parts of the world. It is one of the most important zoonotic diseases and it is of great social importance (Benito, A *et al*.,2000) and Garippa, G *et al*.,2004). Hydatidosis caused by the larval stage (matacestodes) of Echinococcus granulose is the most wide spread parasitic zoonosis. Dogs are the usual definitive hosts while large number of mammalian species can be intermediate hosts, including domesticating ungulates and man Eckert, J and Deplazes, P. (2004) and (Torgerson, P.R. and Budke, C.M. (2003). The cystic echinococcosis occur throughout the world and causes considerable economic losses and Public health problems in many countries (Ansari, M. (2005) and Torgerson, P.R. (2003).

Hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughter houses (Azlaf, R, Dakkak, A. (2006) echinococcus granulosus infection is endemic in East and south Africa, central and south America, South eastern and Central Europe, Middle East, Russia and China. The highest incidence is reported mainly from sheep and cattle rearing area (Sobhash, C.P, (2004).

The economic importance of echinococcosis in livestock is due to condemnation of edible carcasses and offal such as liver, lung and heart. In severe infection the parasite may cause retarded performance and growth, and reduce quality and yield of milk and meat. For example, in the Yugoslavia 10% reduction in milk yield and 5% carcass weight due to hydatidosis is described condemned organs even the whole carcass represent high financial loss in many countries Sariozkan, S. Yalcin, C. (2009).

Several reports from different part of Ethiopia indicated that hydatid cyst is prevalent in livestock (Fikre L, 1994 and Olika, 1997). In Ethiopia studies conducted in different abattoirs indicated that cystic hydatidosis is the prevalent and considerable economic loss is associated with it. Certain deep rooted traditional activities have been described as factors associated with the spread and high prevalence of the diseases in some areas of the country. These can include the wide spread the backyard slaughter of animals, the corresponding absence of rigorous meat inspection procedures, long standing habit of feeding domesticated dogs with condemned offal and the subsequent contamination of pasture and grazing fields. This can facilitate the maintenance of the life cycle of echinococcus granulosus which is the causative agent of cystic hydatidosis and consequently the high rate of infection of susceptible host (Jobire, Y *et al*.,1996).

Human echinococcosis is much more common in the rural areas of Ethiopia where dogs and domestic animals live in very close association (Fikre L, 1994). Human behavior plays significant role in the epidemiology of echinococcosis and the dynamics of transmission differs between dogs and its normal intermediate host and human hosts. In Ethiopia, cattle are mainly raised under extensive husbandry practice by rural communities. Existence of higher population density, raw meat consumption, low awareness and poor hygiene and sanitary infrastructures may facilitate transmission of the between animals and human beings in the rural areas.

The Diagnosis of taeniasis is based on the detection of eggs by microscopic observation of fecal samples. This technique lacks both sensitivity and specificity since the eggs of most members of the family. Taeniidae are morphologically indistinguishable (McManus DP *et al*., 2012). Similarly, differentiation of T. solium and T. saginata is based on the morphological characteristic of the scolex or gravid proglottids. Recovery of scolices after treatment is uncommon for T. solium and in many cases, both the scolex and proglottids can be recovered only after special treatment (Jeri CRH *et al*., 2004). Detection of *T.solium* coproantigen by the enzyme-linked immunosorbent assay (ELISA) technique is used. The method is more sensitive than microscopy but cross-reacts with *T. saginata*.

At present, the most practical way of detecting metacestodes are by postmortem inspection of the exposed prediction site. Although there were some research works carried out in certain part of the country, the status of metacestodes in livestock and economic and public health impact of these parasites

were not so far studies in the study area. Therefore, this review was under taken to overviewand highlight the prevalence, public health, and economic importance of bovine cysticercosis and hydatidosis (metacestodes) in Bovine.

1.2. Objectives

- To provide the concise review on Bovine metacestodes
- To highlight public health and economic importance of Bovine metacestodes

2. LITERATURE REVIEW

2.1 Etiology and Taxonomy

Kingdom: Animalia
Phylum: platehelminths
Class: Cestode
Order: Cyclophyllidea
Family: Taeniidae
Genus: Taenia (*Figure 1*: Taxonomic classification of taenia (Source: Urquhart *et al.*, 1996).

Morphology of the adult tapeworm of *T. saginata* is a large ribbon shaped, multi segmented and white flat worm usually 4-15 m long consisting of thousands of segments (proglottids) arranged in a chain (Andrews *et al*., 2003). Its body divided in to three distinct parts consisting of head (scolex), neck and strobilla. The head or scolex bearing attachment organs, a short unfermented neck and chain of segments. The chain is known as strobilla and each segment as proglottids. Unlike other taeniids, the head (scolex) has no rostellum or hooks. The proglottids are continually budded from the neck region and become sexually mature as they pass down the strobilla. Each proglottid is hermaphrodite with one or two sets of reproductive organs. Gravid segments usually leave the host singly and often migrate spontaneously from the anus (Blancou *et al*., 2010).

Taeniid eggs passed in the stool or discharged from ruptured segments are sub-spherical to spherical in shape and very resistant, remaining viable for 6 months in pasture and vegetables, 5 weeks in water, 10 weeks in stool or hay and 12 weeks in silage sludge. Taeniid eggs measure about 30-45 µm in diameter; contain an oncosphere (hexacanth embryo) bearing three pairs of hook; have a thick, brown, radially striated embryophore or „shell" composed of hooks; and there is an outer, oval, membranous coat, the true egg shell, that is lost from fecal eggs. The larval stage, or metacestode also referred to as "beef measles", are found in all striated muscles of the intermediate host. Cysticercus bovis is a small, pea-sized oval in shape translucent and contains a single white scolex that is morphologically similar to the scolex of the future adult tapeworm. They are contained in a thin, hostproduced fibrous capsule (OIE, 2008).

2.2 Major Metacestodes

There are six types of metacestodes, in increasing order of complexity.

i.**Cysticercus**: this is a simple metacestodes consisting of a fluid filled bladder containing a single inverted scolex.

ii. **Cysticercoid**: this is a simple metacestodes that is only found in invertebrates. It is small, pinhead sized, and instead of abladder has apotential space containing single scolex that is not inverted.

iii. **Strobbilocercu**s: this metacestode is only formed by the cat tapeform Taenia taeniaeformis and is similar to a cysticercus however; the single scolex is attached too the containing bladder by a chain of segments.

iv. **Coenurus**: similar in form to the cysticercus, however the coenurus contains multiple inverted scolies.

v. **hydatid cyst**: this metacestode consists of a fluid filled bladder that can grow to a considerable size. It is lined by a germinal epithlium that buds off to form brood capsules. These brood capsules contain multiple inverted scolices and are termed hydatid sand. The response from the host is to wall off the cyst with fibrous tissue around the germinal layer.

Iiv. **Allveolar cyst**: similar to the hydatid cyst however the alveolar cyst forms daughter cysts, these bud off from the internal and external surface of the germinal layer. These buds enable the invade into the tissue of the organ rather like a tumor (Source: lab of parasitology,University of Pennsylvania school of Vet. Med, 2023).

Metacestodes present as a significant threat to both veterinary and public health. Specifically, the prevalence of metacestodes is often concentrated among consumers of raw meat and underdeveloped countries. Cysticercosis, Echinococcosis (CE), Taeniosis and hydatidosis are parasitic zoonoses that present major public health problems in lower income countries (Taylor *et al*., 2007) and are caused by cestode parasites and the infection is acquired after ingestion of the parasite's egg which contains an infective oncosphere(Aaron G.,2006; Garoma A., 2022).

2.2.1 Hydatid Cyst (*Echinococcus)*

Hydatidosis (Cystic echinococcosis) caused by the larval stage (metacestode) of Echinococcus granulosis's the most widespread parasitic zoonoses.

The larval stage (Metacestode) of this tapeworm has both public health and economic significance. Despite the great efforts that have been put into the research and control of echinococcosis, it still remains a disease of worldwide significance. Dogs are the usual definitive hosts whilst a large number of mammalian species can be intermediate hosts, including domestic ungulates and man (Tadesse B ., 2014).

Cystic Echinococcosis or cystic hydatidosis is a chronic helminthic zoonotic disease with a cosmopolitan distribution (Dutra, L H.; 2012) and is especially prevalent in the sheep-raising countries. The causative organism, the dog tapeworm Echinococcus granulosus is transmitted cyclically between canines and numerous herbivorous livestock animals, which can serve as intermediate hosts. In herbivorous animals and in people who become infected by accidentally ingesting E. granulosus ova, the cystic larval form (Hydatid Cyst) develops and can cause serious morbidity (Eckert J, Conraths FJ, 2000).

Morphology of hydatid cyst:

The larval stage of Echinococcus is a fluid-filled bladder or hydatid cyst that is unilocular, although communicating chambers also occur. 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. 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. 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 (Fufa A (2011; Gebretsadik K (2016).

2.2.2 Cysticercus bovis

Cysticercus bovis is caused by the metacestode stage of *Taenia saginata*, a zoonotic tapeworm of cattle and humans. Adult tapeworm develops in humans who consume undercooked beef infected with viable Metacestodes (Cuttell L *et al*., 2013) tapeworm develops in humans who consume undercooked beef infected with viable Metacestodes (Cuttell L L *et al*., 2013; Silva VC., 2010).

Diagnostic tools are capable of detecting exposure to eggs and infection levels in a population through antibody and antigen detection, respectively. Understanding the epidemiology of cysticercosis in endemic regions will help expose information on the transmission, which could in turn be used to design appropriate control programs (Minnozz JC *et al*.,2002). The cyst is round or oval in shape, and when fully developed, consists of a scolex, invaginated into a fluid-filled vesicle (tail bladder), which is surrounded by connective tissue capsule formed by the reaction of the tissue of the host. The cyst is seen as small whitish vesicle and is found between muscle fibers. It is transparent and contains translucent fluid. The invaginated scolex is visible in the form of whitish spot at one end of the pole of the cyst. As in the adult tapeworm, it has neither rostellum nor hooks (OIE, 2004; Mamo E, 1998).

2.2.3 Taenia solium (Cysticercus cellulosae)

Adult Taenia solium reach 3-5m in length. The scolex has an armed rostellum with two rows of hooks, followed by a strobila consisting of up to 1000 proglottids each with 7-16 uterine branches and measuring up to 10 mm in breadth at maturity. The oval cysticerci can be the largest of the three zoonotic Taenia spp., reaching approximate dimensions of ≥ 0.5 -1 x 0.5 cm and have a scolex bearing a rostellum armed with hooks similar to that of the adult tapeworm (OIE, 2004).

T. solium causes Cysticercosis in pigs and as for *T. saginata*, humans are the obligate definitive host. Unlike *T. saginata*, the eggs from the adult *T. solium* that are present in the faeces of a tapeworm carrier can infect not only the natural animal intermediate host (pigs) but are infective the person who might accidentally ingest the eggs. In humans the cysticerci may encyst in the brain, causing neurological disease (Hoberg E., 2002).

Eggs passed in feces or discharged from ruptured gravid segments are sub spherical to spherical in shape. The egg consists of the hexacanth (6-hooked) embryo (oncosphere) thick dark brown to yellow in color. There is an outer oval membranous coat, the true eggshell, which is lost in fecal eggs. It measures 30- 41 micrometers in diameter and 46 to 50 micrometers in length. The eggs survive up to 200 days in moist manure, 33 days in river water, 154 days on pasture and are resistant to moderate desiccation, disinfectants and low temperature (4-5 °C) (Aaron G .,2006).

2.2.4 Taenia Hydatigena/Cysticercus Tenuicollis

Cysticercus tenuicollis is the metacestode of canine tapeworm Taenia hydatigena, which has been reported in domestic and wild ruminants, pigs,

monkeys (Kassai T.,1999). Metacestodes are found attached to the omentum, mesentery, and occasionally on the liver surface, however, unusual location of C.tenuicollis have been described as lungs, kidneys, brain, ovaries, uterine tubes, uterus, cervix, and vagina. An aberrant location of C.tenuicollis vesicle inside the chorioallantoic membrane of a goat foetus was reported (Payan-Carreira R *et al*.,2008).

Pathogenicity of adult parasites is not high for the definitive hosts. However, a large number of developing cysticerci migrate contemporaneously in the liver of intermediate hosts, producing "hepatitis cysticercosa" a condition whose gross pathology resembles acute fasciolosis and which is often fatal (Urguhart G *et al*., 1996).

2.3 Life Cycle

In the life cycle, T. saginata has two different stages in which larval stage (Cysticercus bovis) occurs in heart and skeletal muscles of cattle as intermediate host and adult worm locates in intestine of human as final host (Garedaghi *et al*., 2012).

Bovine cysticercosis refers to the infection of cattle, while the adult tapeworms in the human small intestine cause taeniasis. Cattle are infected after ingestion of feed or water containing the eggs expelled by the human faeces. Although cysticercosis in cattle often has no clinical features, however, heavy infection may cause myocarditis. Human infection that occurs through consuming of infected raw or semi-cooked beef, may results in epigastric pains, diarrhea, nausea, weakness or loss of appetite (Lees *et al*., 2002).

The life cycle and transmission of the parasite occurs most commonly in environments characterized by poor sanitation, primitive livestock husbandry practices, inadequate meat inspection management and control policies. Humans are the obligate final host and they become infected by ingesting infected meat that has been inadequately cooked or frozen. 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).

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. 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).

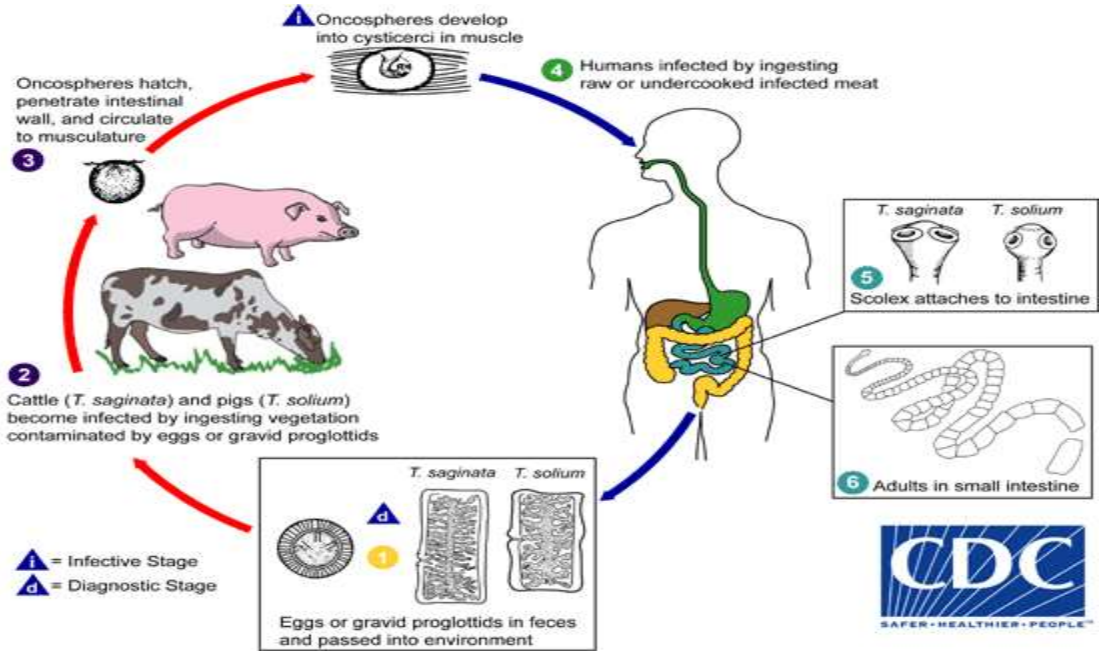

***Figure2*: The Life cycle of Taenia saginata Source: adopted from (CDC, European Commission, 2000)**

3. Epidemiology of Metacestodes

3.1 Distribution

The distribution of T. saginata is wider in developing countries where hygienic conditions are poor and where the inhabitants traditionally eat raw meat or insufficiently cooked meat. Forty percent (40%) of the cases were reported in Africa (Ezeddin A., 2016). Taenia saginata has worldwide distribution, albeit at a very low prevalence in the developed countries. The moderate prevalence level is seen in southern Asia, while African countries have the highest prevalence rates and the parasite causes an important economic loss due to condemnation of meat in these countries (Cabaret *et al*., 2002). Globally, there are 77 million human carriers of Taenia saginata out of which about 40% live in Africa. In developed countries, even if 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). In many developing countries this disease constitutes a serious but less recognized public health problem (Ibrahim and zerihun, 2012).

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 be directly related to the differences of hygienic conditions, quality of meat inspection, and culinary habits (Dutra *et al*, .2012). 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. In other East Africa countries, prevalence rate about (30-80%) has been reported (Ibrahim and zerihun, 2012).

The prevalence of *T. saginata* in humans can be roughly classified into three groups: highly endemic regions with prevalence that exceed 10%; those with moderate prevalence; and those with prevalence below 0.1% or free from T. saginata taeniosis. Highly endemic areas include Central and East African countries (Ethiopia, Kenya, and Zaire), Argentina, Caucasian and South-Central Asian republics of the former USSR and in the Mediterranean Region (Syria, Lebanon and Yugoslavia) (Oladele O *et al*., 2004).

In developing countries, cattle are reared on extensive scale, human sanitation is of comparatively lower standards and the inhabitants traditionally eat raw or inadequately cooked beef. The prevalence of Taeniasis is over 20% in certain areas of these countries. Based on routine carcass inspection the infection rate of bovine cysticercosis is often around 30-60% although, the real prevalence is considerably high. *T. saginata* infections also occur in developed countries, where standards of sanitation are high and meat is carefully inspected and generally thoroughly cooked. Taeniasis/cysticercosis spreads in developed areas of the world through tourists enjoying the consumption of lightly grilled meat, mass migration of labor and the export of meat unreliably passed by ‘’eye or knife’’ inspection or from live animals imported from endemic areas. Prevalence in these parts of the world is less than 1%. Occasionally, however, cysticercosis “storms” have been reported on particular farms. The cause of the storm has been attributed to the use of human sewage on pasture and the use of migrant labor (Magambo J *et al*.,2006).

Distribution of C. bovis:

In developing countries, taeniasis/ bovine cysticercosis constitutes a serious but less recognized public health problem. Due to the habit of eating raw or undercooked beef dishes such as kourt and kitffo, taeniasis in human is common in Ethiopia. A high (89.41%) prevalence of human infection in different agro-climatic zones of the country has been reported. Low availability of taenicides is a constraint and the use of herbal drugs do not eliminate this parasite from human population and the proglottids are passed out with the faecal matter resulting in cysticercosis in the cattle. In Ethiopia prevalence rate changing between 13.7 to 72.44% in cattle and 9.9 to 35% in sheep was described. Ethiopia is divided into nine ethnically based administrative regions and three chartered cities and bovine cysticercosis has been reported from different parts of the country (**Table 1)** (Christine B (2009).

Distribution of Hydatid cyst:

The prevalence of hydatid cyst in sheep in Greece, China, İtaly, Ethiopia, India, Azerbaijan and Pakistan have been reported to be 100% (Christine B (2009).

In Iran many studies have been performed; in Sanandaj area, western Iran and Kashan area, results indicated an infection rate of 51.9% (Oladele O *et al*., 2004). In some areas of the world, cystic echinococcosis caused by E. granulosus is a reemerging disease in places where it was previously at low levels. Hydatid disease is a problem in Asia, the Mediterranean, South America and Africa and also the prevalence of the disease has increased in Europe and North America in recent years. In Africa E. granulosus has been recognized from most countries including Ethiopia (Tadesse B.,2014).

Study conducted in 2010 at Modjo Modern Export Abattoir (MMEA), Ethiopia, from a total of 1115 small ruminants (348 sheep and 767 goats) for the presence of hydatid cysts in the visceral organs (lungs, livers and hearts) and muscles of the animals using the standard meat inspection, revealed that, 97 (8.7%) were positive. 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. 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 (Aaron G (2006); Scandrett B *et al*.,2009).

3.3 Source of infection and Tranismtion

Cattle, intermediate host, become infected after eating Taenia saginata eggs (proglottids) from infected humans (Final host). Once cattle are infected, cysticerci develop in the muscles and subsequently become 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. Eggs contaminating the environment via defecation or spontaneous discharge of proglottids can be disseminated by water, wind, scavenging birds such as gulls feeding on raw sewage, oribatid mites, flies, earth worms, or fomites such as boots or farm machinery (Kandil *et al*., 2012).

Infective taenia eggs can persist under a variety of environmental conditions as with most parasite environmental stages, cool and moist conditions favor long-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 of food or water by faeces of infected humans. The contaminated material can derive directly from human faeces or via sewage plants after flooding or sewage sediment distributed on pastures. Direct transmission of eggs, resulting from hand rising of suckling calves by tapeworm carriers has been reported, but appears to be rare (Allepuz *et al*., 2009). Lack of awareness about raw meat consumption, existence of highest population density, poor hygiene and sanitary facilities are some of the factors that facilitate the transmission (Belachew and Ibrahim, 2012).

3.4 Host range

Cattle are intermediate and humans are the finalhosts of T. saginata. In all age of cattle are susceptiblefor this parasite whereas young age groups are more susceptible than the others. Sometimes Parasitism is observed inother ruminants like sheep, goats, antelopes, gazelles and buffaloes, but the development of Cysticercus is unlikely to the others (Assefa, 2015). Man cannot spread taeniasis to his own species. Management of animals in their natural environment predisposes them to infection. Cattle grazing communally have a higher risk of picking up T. saginata eggs since they are frequently in contact with human feces compared to commercial herds, the risk of cattle coming into contact with T. saginata eggs is much higher when cattle are at pasture (Harrison and Sewell, 1991).

3.5 Risk factor

It was reported that several factors, such as activity of the muscles, age, and the geographical location determine largely the predilection sites for C. bovis in slaughtered cattle (Opara *et al*., 2006). Differences in geographical isolates of the parasite and in the breed and age of cattle have been suggested as possible factors affecting the distribution of C. bovis (Pawlowsk and Murrell, 2001).

The prevalence of Taeniasis is associated with different risk factors. The potential risk factors of Taeniasis are the habit of raw meat consumption, age, sex, educational level, presence and usage of sanitary facilities especially toilets. Different scholars have controversies regarding to disease prevalence in association with such risk factors. There is higher prevalence of Taeniasis in those who but no significant variations were observed between sex and religion. Megersa *et al*. (2010) reported that Taeniasis has significant association with ages of individuals and indicating higher prevalence of infection in adult people. The possible suggestion is that adults‟ humans are associated with the habit of raw meat consumption than younger through consuming raw meat like Kurt which may be expensive for young individuals.

Hailu (2005) reported that there is highly significant variation among raw meat and cooked meat eaters, in which prevalence is high in those eating raw meat. But no significant variations were observed between age, sex and religion. Megersa *et al.* (2009) reported in such a way that taeniasis has significant association with ages of individuals, indicating higher prevalence of infection in adult people. The possible suggestion for this case is that adults has habit of raw meat consumption than younger, as young are not allowed to consume raw meat, and adults have income that afford in consuming raw meat like Kurt which may be expensive for young individuals. Abunna *et al*. (2008)

reported taeniasis has significant association with sex. Prevalence is higher in males than females. This could be due to economic reasons and cultural practices in that males do not prepare their dish at home, rather consume at restaurants and butcheries.

4. Clinical Manifestations

4.1 In Humans

The clinical manifestations in humans include abdominal pain, nausea, debility, weight loss, flatulence and diarrhea or constipation. A patient may have one or several of these symptoms and a high percentage of patients experience gastric hyposecretion. Individual reactions to the infection differ and may be influenced by psychogenic factors, since patients often notice symptoms only after they see proglottids (Symth, 1994). Signs like those of epigastric discomfort, hunger sensations and irritability were also observed in infested individuals (Harrison and Sewell, 1991).

4.2 In Animals

Light or moderate cysticercosis in cattle is not usually associated with any defined clinical picture. Heavy infections, those induced experimentally by 200, 000 to 1, 000, 000 T. saginata eggs, may give rise to fever, weakness, profuse salivation, anorexia, increase heart and respiratory rate and a dose of one million or more eggs may cause death between 14 to 16 days due to a degenerative myocarditis (Oryan *et al*., 1998).

5. Status of Bovine Cysticercosis in Ethiopia

The cultural habit of eating raw meat in form of “Kourt” meat cubes and “Kitffo” minced meat in Ethiopia, has favoured the spread of this disease (Fufa, 2006). The reported prevalence of bovine cysticercosis in cattle populations across various regions of Ethiopia was reported to range between 2.2% to 26.3% (Kumar and Tadesse, 2011).

Belachew and Ibrahim (2012) in Hawassa municipal abattoir in 2012, from 384 ante and post examinated cattle, 22.9% of bovine cysticercosis were recorded. 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 tongue, 52% in shoulder, 60% in heart and 75% in masseter muscle, respectively. The prevalence of taeniasis among interviewed respondents of Hawassa town was 44%. For the years 2008 and 2009, a total worth of 184, 406 ETB was estimated from a sale of 92, 203 adult taenicidal drugs.

Another study was conducted in 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). Of the total of 500 inspected animals, 22 animals had varying number of Cysticercus bovis, an overall prevalence was 4.4%. Anatomical distribution of the cyst showed that highest proportions of Cysticercus bovis 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 (Megersa *et al*., 2010).

Tolosa *et al*. (2009) condiucted study to determine the prevalence of bovine cysticercosis from October in 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 Taenia saginata 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 %).

In another study, post-mortem examination of 3711 cattle done at three municipal abattoirs at Mekelle, Wukro and Adigret in Tigray region 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% (Kumar and Berhe, 2008).

Teklemariam *et al*., (2015) studied bovine cysticercosis in 2015 on 384 zebu cattle slaughtered at Batu municipal abattoir to estimate the prevalence and associated risk factors. Out of 384 inspected animals, 10 animals had variable number of Cysticercus bovis giving an overall prevalence of 2.6%. Anatomical distribution of the cyst showed that the highest proportions of Cysticercus bovis cyst were observed in tongue 10 (41.66%) followed by heart 7 (29.17%), masseter 5 (20.83%) and triceps muscle 2 (8.33%).

Table 1: Status of Bovine Cysticercosis in different part of Ethiopia

Location /place	Prevalence in %	Reference
Batu municipal abattoir	2.6	Teklemariam *et al*., 2015
Jimma municipal abattoir	2.93	Tolosa *et al*. 2009
Hawassa municipal abattoir	22.9	Belachew and Ibrahim, 2012
Jimma	4.4	Megersa *et al*,2010
Awassa	26.25	Abunna et al. 2008
Central Ethiopia	3.1	Tembo, 2001
East Shoa	17.5	Hailu, 2005
Gonder meat factory	9.7	Amsalu, 1989
Gonder	4.9	Dawit, 2004
Luna export abattoir in East Showa	27.6	Hailu, 2005
Nekemte	21.7%	Ahemed, Ibrahim, 1990
North westen Ethiopia	18.49	Negatu, 2008
Tigray	21	Berhe, 2009
Wolaita Soddo (Southern Ethiopia)	11.3 %	Alemayehu Regassa et al., 2009
Bahir Dar (Amhara region)	19.4%	Alemu Mulugeta, 1997
Ethiopia	18.49%	Nigatu Kabede, 2008
People's Region (Southern Ethiopia) Amhara National Regional State,	26.25%	Fufa Abunna et al., 2008
Mekelle (Tigray region) Southern Nations Nationalities	7.23%	Abay Getachew, 2008
Mekelle, Adigrat, Wukro (Tigray region)	8.29%	Kumar and Gebretsadik Berhe, 2008
DebreZeit, Oromia	13.85%	Getachew Belayneh, 1990
Addis Ababa, Ethiopia	2.2%-3.3%	Gebro-Emanuel Teka, 1997 Mulageta Alemu, 1997
Addis Ababa, Ethiopia Nigatu	13.3%	Kebede et al., 2009

6. Diagnostic Techniques for Cstodes and Metacestodes

6.1 Meat inspection

Diagnosis in animals is usually based on the host and the location of the metacestode when identified at meat inspection or necropsy. Adults in definitive hosts are acquired by the ingestion of viable metacestodes in meat and offal that has not been adequately cooked or frozen to kill the parasite. In live animals Taenia saginata metacestode might be palpable in the tongue but, both in the living animal and on post-mortem examination or meat Inspection, tongue palpation is of diagnostic value only in cattle heavily infected with metacestode (Wubie, 2004).

Predilection sites are heart, tongue, masseters and diaphragm, presumably because they receive the greatest circulation. Nonetheless, cysts may be found in any muscle of the body (OIE, 2008). Cattle with cysticercosis are unlikely to exhibit clinical signs, and detection is made during post-mortem carcass examination. 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, visual inspection of carcasses remains the most common method of diagnosing bovine cysticercosis. The metacestode are readily visible in the organs or musculature at autopsy and therefore diagnosis of bovine cysticercosis 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).

According to Meat Inspection Regulation Notice Number 428, 1972 by Government of Ethiopia (MoA, 1972), the routine inspection of carcass is to be done as per the procedure stated below:

- Visual inspection and palpation of the surfaces and a longitudinal ventral incision of the tongue from the tip of the root.
- One deep incision into the triceps muscles of both sides of the shoulder.

- Extensive deep incision into external and internal muscles of masseter parallel to the plane of the jaw.
- Visual inspection and longitudinal incision of the myocardium from the base to the apex. But more incision can be made when necessary.
- Visual inspection and 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 diaphragmatic lobes of the lung through the lung substances.
- Visual examination of intercostals muscles and incisions when necessary.
- One extensive incision into the fleshy part of diaphragm, visual examination, palpation and Incision of kidneys, liver, oesophagus and associated lymph nodes.

However, minor infections are difficult to detect irrespective of the skill of the inspector. If a Cysticercus is found in any ofthese sites and organs, thorough inspection of the whole carcass and offal should be done. The location, nature and number of cysts should be recorded (Kumar and Tadesse, 2011).

6.2 Detection of antibodies by ELISA Serological test

Enzyme-linked Immunosorbent Assay (ELISA) was available for use on live animals. The immune response against taeniid parasites is reported to be antibody-mediated. A positive antibody ELISA indicates that the animals have been exposed to the infection, but may not necessarily have a current infection. However, it is a useful method for epidemiological studies to indicate the spread of the infection in outbreaks or high-infected areas (Kandil *et al*., 2012).

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 at best be used as a screening test and not as a diagnostic test (Asaava *et al*., 2009).

Immunodiagnosis is a useful complementary diagnostic tool for the identification of infection and disease (Zhang W, Li J, McManus DP.,2003). Nevertheless, infections with different taeniid species and antigenic cross-reactivity between these related parasites and the low level of specific antibody response to infection problems with poor specificity and sensitivity of serological tests (Ogunremi O, Benjamin J.,2010; Siles Lucas MM, Gottstein BB.,2001).

6.3 Molecular Diagnosis of Cestodes and Metacestodes

In Bovine and Porcine Cysticercosis, the most widely used approach for DNA identification of Taenia taxa has been to target the nucleotide sequences of fragments of selected genes using pairs of concerned PCR primers (Cuttell L *et al*., 2013). The variable segment between the primers is PCR amplified for a particular Taenia sample and then directly sequenced(Rawson PD, Burton RS., 2006).

7. Differential Diagnosis

In cattle Cysticercus bovis should be differentiated from the following parasites.

7.1 Cysticercus dromedaries (C. cameli):

The identification of C. cameli by double row of hooks on the lateral invaginatedscolex and its length being twice as large as C. bovismeasuring 12-18 mm in length and pearly white in color (Wubie, 2004).

7.2 Sarcocystis bovi felis (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].

7.3 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).

8. Control and Prevention of Bovine Cysticercosis

Improper use of latrine or open field defecation leads to contamination of grazing lands. The use of latrine reduces spread of Taenia saginata eggs and public education to avoid consumption of raw meat, improve standards of human hygiene (Kebede et al., 2009). Farmers should be awared of the life cycle of T. saginata and potential risk factors for cattle to become infected (Boone *et al*., 2007).

Controlled grazing, avoiding use of sewage effluent to fertilize pasture, prevents infection in cattle (Engels D, *et al*., 2003; Worku E., 2017).

Adequate meat inspection, abstinence from eating raw or inadequately cooked beef (thorough

cooking of meat at a temperature of 56 - 60 0C) and freezing the infected carcass at-100 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 inspection of meat, which is the most important public health control measure, identifies only a minor fraction of heavily infected animals, and also only when it is too late to avoid losses. (Wanzalaa *et al.,* 2002).

During meat inspection heavily 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 the case of a lesser infection, the infected parts and surrounding tissues are removed and condemned. Even a single dead cyst requires that the carcass and edible viscera must then be treated and this is justifiable as about 10% of lightly infected carcasses were found on dissection to have both dead and viable parasites within them (OIE, 2008). Treatment varies with country and facilities available and includes (OIE, 2008):

- Freezing at lower than - 10°C for 10 or 14 days, or lower than - 7°C for 21 days.
- Boxes of boned meat are frozen at less than - 10°C for 20 days.
- Heated to above 60°C throughout.
- Steamed at moderate pressure (0.49 kg/cm2), heated at 95-100°C for 30 minutes.
- Pickled in salt solution for 21 days at 8-12°

Vaccines against Bovine Cysticercosis:

Vaccination, when available, is undoubtedly the most cost effective means of preventing and controlling, and even eradicating, infectious diseases. A vaccine against sheep cysticercosis has been developed experimentally and may lead to the development of similar vaccines to control bovine cysticercosis and thus Taenia saginata infestation in humans (Paul-Pierre, 2009).

Lightowlers M 2000 and Rickard and Adolph, (1976) vaccinated calves with antigens collected during cultivation of the larval stages of Taenia saginata. In-vitro, and challenged 4 weeks later with 4, 000 Taenia saginataeggs. Calves vaccinated with Taenia saginata antigen were highly resistant to the challenge infection.

Sheiba and Zein Eldin, (1987) vaccinated four Zebu calves subcutaneously with hatched ova of Taenia saginata. The immunity elicited protected the animals from subsequent oral infections with this cestode as manifested by the early degeneration of the metacestodes and failure to attain maturity in three of four animals. Lightowlers *et al.,* (2000) 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.

9. Treatment (Chemotherapy)

The drug of choice in treating Taeniasis is niclosamide (Niclocide, Yomesan). Adult dose rate of 2000 mg is effective in damaging the worm to such an extent that a purge following therapy often produces the scolex. Praziquantel (Bilitricide) at a dose rate of 5 to 10 mg per kg also has been reported highly effective (Wanzala *et al*., 2002; Boone et al., 2007) but the scolex is partially digested and often not recovered (Lightowlers *et al*., 2000). Other drugs used in the treatment of T. saginata are mebendazole (Doyle *et al.,* 2000).

In animals, treatment with compounds such as albendazole (50mg per kg), praziquatel (50mg per kg), and 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 (Desta w, 2004). In Ethiopia people used traditional medicaments to cure from T. saginata infection. Kebede *et al*., 2009 ; Ahmed, (1990) reported that most people, especially rural inhabitants use different types of traditional herbal drugs to routine self-de worming practices.

10. Judgments for Bovine Cysticercosis

The final judgement exercised by member countries of the European Union, Canada, United States of America, South Africa and Australia have been described by Gracey *et al*. (1999). The Kenyan Meat Control Act, 1977 recommended that only carcasses with no cyst should be passed on directly for human consumption, 1–5 cysts should be retained, frozen at −10°C for at least 10 days and released "unconditionally", 6–20 cysts should be similarly treated as above but released conditionally to schools/institutions where proper cooking is expected to be practiced, those with over 20 cysts should be totally condemned.

Developed countries are stricter than developing countries in putting the judgement for bovine cysticercosis. In United States of America, there is a recommendation of total condemnation of carcass if the infestation is extensive (cysts are found in at least two of the sites viz. heart, tongue, muscles of mastication, diaphragm and its pillars, oesophagus

and musculature that is exposed during dressing operations and in at least two of the sites exposed by incision into the rounds and forelimbs) during routine primary inspection while slightly infested carcass(infestation lesser than extensive infestation) may be passed for human food after removal and condemnation of the lesions with surrounding tissues. From less infested carcasses, the cysts and surrounding tissues shall be removed and condemned while the carcass or the meat derived there from shall be held in a freezer under inspectional control at a temperature not exceeding -10o C for not less than 10 days; or the meat is heated throughout, under inspectional control, to a temperature of at least 60o C. Edible viscera and offal shall be disposed off in the same manner as the rest of the carcass from which they were derived, unless any lesion of C. bovis is found in these by-products, in which case they shall be condemned (Gracey *et al*., 1999).

Though Meat Inspection Regulation Notice Number 428, 1972 by Government of Ethiopia has described the technique of routine meat inspection for bovine cysticercosis, yet final judgement is perhaps followed on the same lines as in other African countries.

11. Economic Importance

Veterinary world to estimate the annual economic losses from hydatidosis, cysticercosis and taeniasis in cattle/beef/ considering losses from cost of organ and offal condemnation and from carcass weight (Tadesse B.,2014). The retail market price of average size offal (lung, liver, kidney, heart and spleen) and the cost of one kg beef were obtained from information gathered from local butchers. Annual economic loss due to organ condemnation was determined by considering annual slaughter rate of cattle and prevalence of hydatidosis per organ and an estimated 5 % carcass weight loss was considered. Average carcass weight of Ethiopian local breed cattle is estimated as 108 kg. The total economic loss was calculated as the summation of cost of offal condemned plus the cost of carcass weight losses (Christine B.,2009).

The economic significance due to hydatidosis in Ethiopia, significant degrees of monetary losses was estimated at various levels in different locations. Such reported estimates indicate annual losses of 25,608 ETB (2,807.89 US$) by Kebede in Tigray; 1,791,625.89 ETB (131,737.19 US$) in cattle slaughtered at the Hawassa municipal abattoir (Regassa *et al*., 2010); 473, 173.75 ETB (51,883 US$) by Kebede in cattle slaughtered at the Debre Markos abattoir; and 52,828 ETB (5,869.8 US$) in cattle slaughtered at the Adama abattoir (Kebde *et al*., 2008).

Bovine Cysticercosis has little effect on animal health, but it is economically important disease as it causes carcass condemnation arising from heavy infestation with the cysticerciof Taenia saginata as well as the cost of inspecting meat, 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).

Evaluation of the economic impact of taeniasis / cysticercosis is very difficult particularly in developing countries like Ethiopia, where necessary information is so scant and considerable proportions of infected people treat themselves with traditional herbal drugs like “kosso” and others. (Abuna *et al*., 2007). While ill-health caused by the adult worms in humans gives rise to high medical costs, the economic losses due to bovine cysticercosis are mainly due to condemnation, treating beef and downgrading of infected carcasses. Economic losses from cysticercosis are determined by disease prevalence, grade of animals infested, potential markets, prices of cattle and treatment costs for detained carcasses. For the African continent, an annual loss was reported to be US$ 1.8 billion under an overall infestation rate of 7% (Kumar and Tadesse, 2011).

Khaniki *et al*., (2010) reported that the economic losses of infected carcasses were calculated from 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.

The economic impact of the disease in the cost implication can be broken down in to those involved in treating human taeniosis and cattle carcasses (cost of freezing, boiling) or condemned, as well as the costs involved in the inspection procedures amount to millions of dollars (Nunes, 2003). In the meat industry, economic losses are closely associated with the status of infection. In a heavy infestation or generalized cysticercosis carcass must be totally condemned. 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 existing parasites (Abuseir *et al*., 2006).

In Ethiopia Megersa *et al*. (2010) 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. The economic loss calculated for six months period of study by Kumar and Berhe. (2008) due to condemnation of carcass/organs account about 31952 Birr.

11. Public Health Significance

Cysticercus bovisis of great public health significance especially in developing countries where it invades the tissues of the eye as well as brain and spinal cord causing ocular and neurocysticercosis respectively (Engels *et al.,* 2003). A number of reports in Ethiopia indicated that, certain groups who had easy access to raw meat and meat products (Butchers and abattoir workers) and those people with low level of formal education were reported to be more infected with parasitic zoonosis than those who had low access to raw meat and those with better education. This implies that the frequency of raw beef consumption is higher in these groups of people (Nigatu *et al*., 2009; Adugna *et al*., 2012).

The tongue, masseter muscles, cardiac muscles, triceps muscles and thigh muscles are the main predilection sites of the cysts. The cysts of bovine cysticercosis can alsobe identified on the spleen, intercostal muscles, diaphragm and liver (Garedaghi *et al*., 2011). Sometimes the gravid proglottids of Taenia saginata migrate to different organs appendix, pancreatic duct, nasopharyngeal pathways and bile ducts producing obstruction and inflammation of the affected organs (Adugna *et al*., 2012).

Tapeworms can also cause intestinal obstruction (Doyle *et al*., 1997). The most noticeable symptom is the spontaneous discharge of one or several proglottids, which often show individual muscular activity. These may creep out of the anus onto the perianal skin and even migrate over clothes of the distraught host or on the ground, shedding eggs as they go (Oryan *et al*., 1998). Taenia saginata in the small intestine of man absorbs digested food (Kebede *et al*., 2009). From the day the cysticercus is ingested it may take 2-3 months for the parasite to produce ripe segments. As long as the scolices are attached to the intestinal mucosa of the victim new segments will continually grow to replace those, which are being detached from the worm (Teka, 1997). Generally, according to WHO (2013), adult Taenia parasites located in the intestinal tracts of people can pose a variety of problems including:

- Non-specific intestinal disturbances-tapeworms can produce some non-specific signs of intestinal discomfort and pain (e. g. colic signs) in humans. Vomiting may also result.
- Non-specific appetite changes-tapeworms can cause some people to go off their food or to become fussy or picky about their eating habits (this appetite loss is possibly the result of such factors as abdominal pain and nausea). In contrast, certain other individuals develop a ravenous appetite in the face of heavy tapeworm infestations because they are competing with the parasite/s for nutrients (they need to physically eat more to provide enough nutrition for both themselves and the worms).
- Body weakness, headaches, dizziness, irritability and delirium
- Malnutrition-very large numbers of adult Taenia tapeworms present in the intestinal tracts of man can result in the mal-absorption of nutrients. This can cause the tapeworm-parasitized individual to not receive the nutrition it needs (i. e. to not absorb its food properly), resulting in malnourishment, weight loss, ill-thrift and poor growth.
- Poor hair quality-severe malnutrition and malabsorption of vitamins, minerals and proteins can result in reduced quality of the hair.
- Intestinal irritation-when an adult tapeworm inhabits the small intestine of human, it finds a suitable site along the lining of the intestinal lumen and grasps on to it using suckers. This spiky tapeworm grip is irritating to the wall of the small intestine, creating discomfort for the host and alterations in intestinal motility. Note that T. saginata, sometimes called the 'unarmed tapeworm', lacks a spiny rostellum so is not quite so damaging to the human intestine.
- Intestinal blockage-it is possible for massive tapeworm infestations to block up the intestines of children, producing signs of intestinal obstruction (e. g. vomiting, shock and even death). This is not common, but it can occur if worm burdens are large and/or if someone deworms the infested children, killing all of the worms in one hit (the tapeworms all die and let go of their intestinal attachments at the same time, resulting in a vast mass of deceased tapeworms flowing down the intestinal tract all at once and causing blockage)
- .Intestinal perforation-rarely, adult Taenia saginata can perforate the intestinal wall, ending up inside of the host's abdominal cavity. This can result in lifethreatening abdominal inflammation and infection and septicemia.
- Appendicitis, biliary obstruction, and pancreatitisrarely, adult Taenia saginata (beef tapeworms) can migrate up into the

duct systems of the pancreas and biliary tract (bile duct), producing blockages and painful inflammation of these regions. Some may even enter the appendix and cecum, causing nasty inflammation of these regions (termed appendicitis and typhlitis respectively). This can result in life-threatening complications that may require surgical correction.

- Perineal or anal irritation-the migration of tapeworm segments from the anuses of infested individuals can result in itching and irritation of the anus.

12. CONCLUSION AND RECOMMENDATIONS

The infection of cestode and metacestode of Veterinary importance such as hydatidiosis Cysticercosis and Taeniasis contribute to a high-level of human and livestock production losses and morbidity. That is, Taenia saginata, Taenia solium, and Echinococcus cause production loss in bovine, sheep, goat, and pig respectively. Bovine cysticercosis is one of the most important parasitic diseases caused by the metacestode stage of the human tapeworm Taenia saginata. The public health and economic consequences of this parasite may be considerable due to downgrading and the condemnation of carcasses. The adult stage of Taenia saginata occurs in the small intestine of humans who are the final host of this tapeworm. Humans get infected by eating raw or under cooked meat containing viable cysticerci. Nowadays, since there are accustoms of eating raw meat, lack of knowledge about ways of disease transmission, backyard slaughtering of animals especially during holydays, ignorance incision of meat by meat inspectors and lack of sanitation can give a great favour for continual existence.

Based on the above conclusion, the following recommendations are forwarded.

- Competent meat inspection must be strictly implemented at every abattoir of the country.
- Infected meat and meat products must be undergoing the processes of freezing and boiling.
- Strict routine meat inspection of slaughtered animals
- The community should use latrines to improve personal as well as environmental hygiene.
- There should be public awareness about the health and economic importance of the disease through social and public media.
- Public education to avoid consumption of raw meat must be made compulsory at different education levels.
- There should be strong and close collaboration between medical and veterinary professionals to reduce impact of the disease both in humans and animals.
- Untreated human feces should not be used as fertilizers.
- Competent meat inspection must be strictly implemented at every abattoir of the country.
- Immunodiagnostics must be developed to supplement meat inspection procedures.
- Cysticercosis free husbandry should be encouraged
- Vaccination and chemotherapy must be encouraged to control the infection

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