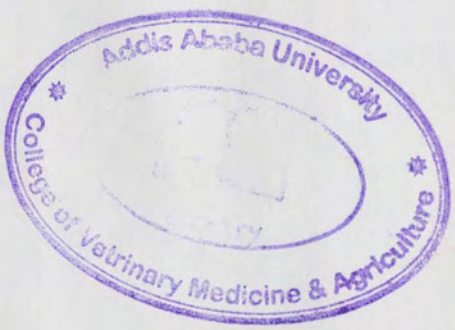
Thesis Ref No _____

CYSTICERCUSBOVIS and *TAENIA SAGINATA:* PREVALENCE, PUBLIC HEALTH SIGNIFICANCE AND COMMUNITY PERCEPTION ABOUT MEAT BORNE ZOONOSIS IN THREE SELECTED DISTRICTS OF WEST SHOA ZONE OF OROMIA REGION, EHIOPIA

MSc Thesis



By

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JUNE, 2014

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Addis Ababa University

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As member of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the Thesis prepared by: Abate Worku entitled a study on prevalence, public health significance and community perception about meat borne zoonosis in three district of west shoa zone of Oromiya Region, Ehiopia and recommend that it be accepted as fulfilling the thesis requirement for the degree of master of Science in Veterinary Public Health.

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ABREVATIONS

CTA	Technical Center for Agriculture
CDC	Center for Disease Investigation and Control
FAO	Food and Agricultural Organization of the United Nations
OIE	Office Internationales Des Epizooties
WHO	World Health Organization
MOA	Ministry of Agriculture
IHT	Indirect Haemaglutination Test
HARC	Holata Agricultural Research Center

ABSTRACT

A cross-sectional study was conducted from November 2013 to March 2014 on bovine cysticercosis in cattle slaughtered at Holata, Addis Alem and Ginchi municipal abattoirs in west Shoa zone of Oromia Regional State with the objective of estimates the prevalence of *Taenia saginata*/cystiercosis, organ distribution, viability of the cysts, associated risk factors and community knowledge about meat-borne zoonosis. Routine meat inspection method and questionnaire survey on conveniently selected respondents in the study areas were used. Out of 600 carcasses examined during the study period in three municipality abattoirs 2.5 % (15/600) were infected with *C. bovis*. A prevalence of 2.5% (95% CI: 0.3%-4.7%) (5/200), 1.6% (95% CI: 0.2%-3.5%) (3/180), and 3.2% (95% CI: 0.9%-5.5%) (7/220) in Holeta, Addis Alem and Ginchi were observed, respectively. Cysts were found in heart (46.6%), tongue (33.33%) and shoulder muscle (20%). Out of the cysts 46.6 % (7/15) were viable, while 53.3% (8/15) were non-viable. The questionnaire survey revealed that *T. saginata*/taeniosis is a wide spread problem in these three towns and surrounding rural areas. Out of 110 respondents 63.6% (70/110) had contracted *T. saginata*. Age, sexe, religion, occupation, education status, raw meat consumption, knowledge about the disease and presence or absence of the latrine was found as potential risk factors of taeniosis. The present study indicate that *Taenia saginata*/cysticercosis is highly distributed in the study areas warranting professional intervention and community based control programs should be introduced.

Key words: Addis Alem, Bovine, Cysticercosis, *C. bovis,* Holata, Ginchi, *T. saginata*

1. INTRODUCTION

In Ethiopia, the livestock sector contributes about 30% of the agricultural GDP and 19% to the export earnings. In Sub-Saharan Africa, livestock diseases, negatively affect the public health and impede economic growth by incurring direct (morbidity, mortality) and indirect economic losses (Sachs, 1999; Perry *et al.*, 2002). In humans, the disease is called as taeniasis which is accompanied with symptoms like nausea, abdominal discomfort, epigastric pain, diarrhea, excessive appetite or loss of appetite, weakness, loss of weight and intestinal blockage (Neva and Brown, 1994).

Parasitic diseases are highly prevalent in Sub–Saharan Africa and incur severe economic losses by reducing productivity. *Taenia saginata* taeniasis/bovine cysticercosis is one of the major parasitic diseases, which does not only lead to economic loses, but also adversely affect public health. The distribution of *Taenia saginata* is wider in developing countries, where hygienic conditions is poor and where the inhabitants traditionally consume raw or insufficiently cooked or sun cured meat (Larry, 2009).

Meat- borne diseases are common in developing countries including Ethiopia because of the prevailing poor food handling and sanitation practices, inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in safer equipments, and lack of education for food-handlers (WHO, 2004). National Hygiene and Sanitation Strategy Program (WHO/FAO, 2005) reported that about 60% of the disease burden was related to poor hygiene and sanitation in Ethiopia. In realizing the severity of food safety problems and control of parasitic meat-borne zonoosis in Africa, the Food and Agricultural Organization (FAO) and the World Health Organizations (WHO) of the United Nations (UN), passed a resolutions to improve the food safety situation in Africa (FAO/WHO, 2005).

The problem of food borne parasitic zoonoses could be further complicated in Ethiopia by lack of efficient inspection at critical control points in abattoirs, lack of awareness and knowledge on the mode of transmission and public health hazard of these diseases as well as due to presence of widespread habit of raw meat consumption both in rural and urban

communities. 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 adult tapeworm, *T. saginata* occurs in the small intestine of the definitive host, man and the metacestode (*Cysticercus bovis*) is found in cattle that serves as main intermediate host (Soulsby, 1982). Globally, there are 77 million human carriers, out of which about 40% live in Africa (Fralova, 1985).Its prevalence is high in developing countries particularly in sub-Saharan Africa (WHO, 1995). In East African countries, prevalence rates of 30-80% have been recorded (Tembo, 2001). In developing countries, the incidence of human infection with *T. saginata* is usually high, with the prevalence of over 20 %; whereas in developed countries, the prevalence of cysticercosis is low, usually less than 1 % (Urquhart *et al.*, 1996).

Even though, *T. saginata* has worldwide distribution, its prevalence is particularly high in Sub-Saharan Africa (WHO, 1995). In Ethiopia several authors have reported the prevalence of *T. saginata* taeniasis and cysticercosis with in a wide range of 2.5 % to 89.41 % and 3.11 % to 27.6 %, respectively (Dawit, 2004; Hailu, 2005, and Abunna *et al.*, 2008). The cultural habit of eating raw meat in form of "Kourt" meat cubes and "Kitffo" minced meat in Ethiopia, has favored the spread of this disease (Dawit, 2004; Fufa, 2006).

Taenia has a debilitating effect on people who live on protein deficient diets those suffering from iron deficiency infected by hookworm (Mann, 1984). Some patients lose their appetite and thus lose weight. Sometimes, the gravid proglottids migrate to different organs such as the appendix, pancreatic duct, nasopharyngeal pathways and bile ducts producing obstruction and inflammation of the affected organs (Ortega, 2006).

Economic losses due to bovine cysticercosis are associated with total condemnation of carcasses with generalized infestation and reduced value of carcasses which are subjected

to refrigeration, in addition to the cost of refrigeration and extra handling transport (WHO, 1995). In general, *Cysticercus bovis* has an impact on meat trade. It increasingly becomes important in view of the drastic measures and very strict regulations from importing countries on exporting countries. The treatment cost for human taeniasis and costs of manufacturing of drugs have significant contribution in estimation of economic loss (Feseha, 1995).

Taenia saginata taeniosis/cysticercosis has high economic and public health impacts in Ethiopia; as a result control and prevention of the disease has great importance. One of the prerequisite for implementing control and prevention action is information on prevalence and associated risk factors throughout the country, in central Oromiya, in Oromiya Regional State east Shoa Zone there is no any work that indicates the status, risk factors and public health importance of *T. saginata* taeniosis/ Cysticercosis. Hence, the current study was designed to attain the following objectives:

GENERAL OBJECTIVE

To determine the prevalence of *T. saginata/ Cysticercus bovis* and assess the community perception about meat borne parasitic zoonosis in west shoa zone of Oromiya regional state.

Specific objectives:

- To estimate the prevalence of *T. saginata/* cysticercosis in Addis Alem, Holata and Ginchi municipality abattoirs,
- To assess the community perception about meat-borne zoonoses using risk factors an indicators
- To estimate the economic impact of the disease through inventories of pharmaceutical and drug shops.

2. LITERATURE REVIEW

2.1. Description of the parasite

2.1.1. Taxonomy

Taenia saginata and its metacestode *Cysticercus bovis*, the unarmed beef tapeworm, belong to the class Cestoda order Cyclophyllidea Family Taeniidae and Genus Taenia (Soulsby, 1982; Symth, 1994; Urquhart *et al.*, 1996).

2.2. Morphology

2.2.1 *Taenia saginata (Cysticercus bovis)*

Taenia saginata, the beef tapeworm, is a large worm measuring 3-10 meters in length rarely the adult measures up to 15m (Soulsby, 1982; Urquhart *et al.*, 1996). It resides in the small intestine of humans where it attaches using its scolex and can survive for many years. The adult is ribbon-shaped, multi-segmented and hermaphroditic flatworm its body divided into three distinct parts consisting of scolex (head), neck and strobila (Soulsby, 1982). The scolex, measuring 1mm to 2mm in diameter, has four strong hemispherical suckers. There is no rostellum and hooks and the predilection site in the intestinal mucosa is in the proximal part of the jejunum (WHO/FAO/OIE, 2005; OIE, 2012). The neck is short unsegmented with a germinal structure immediately behind the scolex, which continuously produces proglottids (Urquhart *et al.*, 1996).

The strobila is a chain of segments made up of sexually immature, mature gravid segments in linear sequence. Each segment is called progllotid, strobilization occurs at the distal part of the neck (Soulsby, 1982). An adult *T. saginata* tapeworm has 600 to 2000 segments each of which is hermaphroditic with one set of reproductive organs and genital pores which open on the lateral margin(s) of the segment (Maeda *et al.*, 1996; Doyle *et al.*, 1997).

Self and cross fertilization between and among proglottids is possible. The gravid proglottids are 15 to 35mm long and 5 to 7mm wide and filled with eggs which detach from the strobila singly and leave the host via anus (Teka, 1997; Doyle *et al.*, 1997). This

implies that coproscopic examination has a limited value in the diagnosis of *Taenia saginata* infection (Doyle *et al.*, 1997).

The graved segments, each containing branched uterus, are filled with thousands of eggs. The number of segments increase constantly as the tapeworm grows, forming long chains. The segments, which are formed first, are pushed towards the end leaving space for the new ones. The segments, which are found at the rear, are the oldest. These old segments periodically detached from the worms and discharged from the host's body with feces or independent of defecations (Teka, 1997; Maeda *et al.*, 1996).

Each segment has a complete set of male and female reproductive organs in which eggs mature and develop (Symth, 1994). The mature proglottid/segement had vaginal sphincter muscle (Symth, 1994; O.I.E., 2000). It is estimated that each graved segment can contain as many as 80,000 to 100,000 eggs and an infected person may shed about 24 - 50 million eggs daily (Gracey, 1992; Teka, 1997). The ova from small number of carriers of the tapeworm can be widely distributed and infect large number of cattle (Harrison and Sewell, 1991). Once the mature eggs are excreted with the feces, they are capable of infecting the intermediate host, bovine (Teka, 1997; Minozzo *et al.*, 2002).

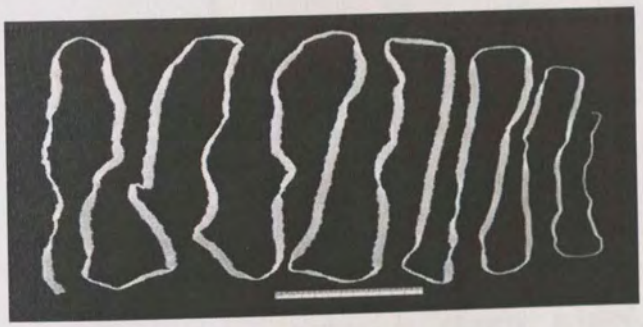

Figure 1: Adult *Taenia saginata*

Source: Ortega, Ynes R. (2006).

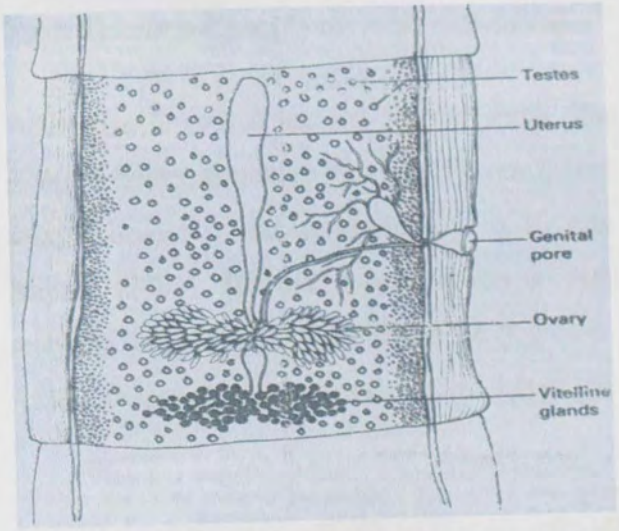

Figure 2: Mature segment showing reproductive organs

Source: (Urquhart *et al.*, 1996)

Figure 3: Gravid proglottid of *Taenia saginata.*

Source: (Doyle *et al.*, 1997).

Taenia saginata asiatica is closely related to *T.saginata*, but genetically and morphologically distinct from, *T. saginata* (Blazek S. and Schramlova (1983). The adult tapeworm has a scolex with a hookless sunken rostellum, and proglottids with posterior protuberances and 11-32 uterine branches. The cysticercus is relatively small (approximately 2 mm) with a rostellum usually bearing two rows of rudimentary hooklets (Fan *et al.*, 1995).

2.2.2. *Taenia solium* (*Cysticercus cellu*losae)

Adult *Taenia solium* reach 3-5 m 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 (Pawlowski and Murrel, (2001). 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).

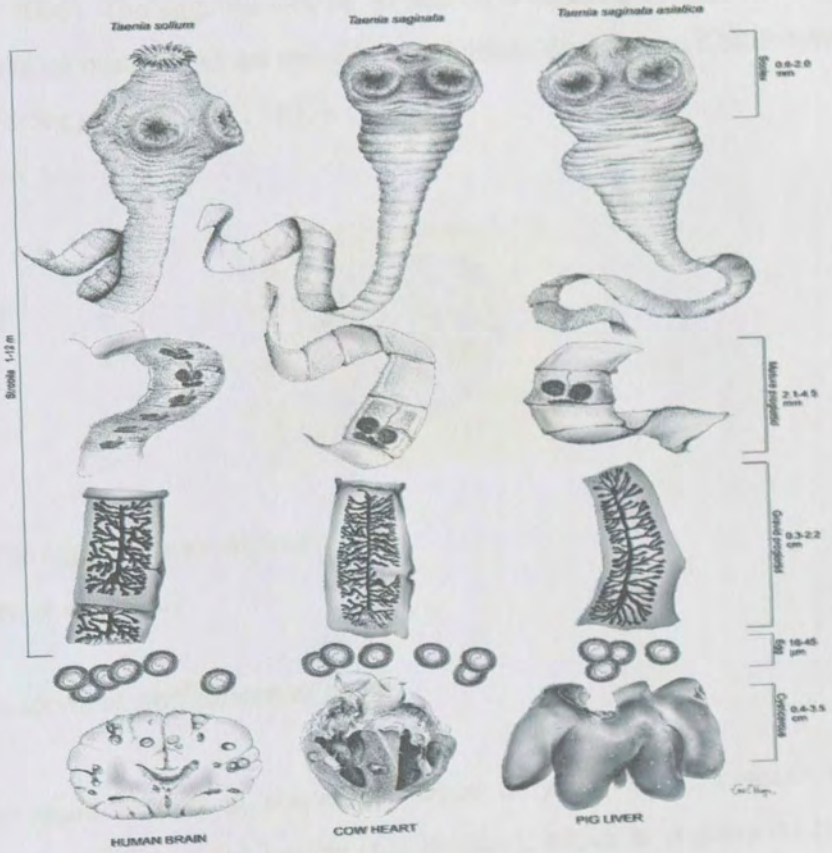

Figure 4. Morphology of the three zoonotic *Taenia* cestodes

Source: (Symth, 1994).

2.2.3. Developmental stages

2.2.3.1. *The eggs*

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 egg shell, which is lost in fecal eggs (Harrison and Sewell, 1991; Brown and Neva, 1983). It measures 30-41 micrometers in diameter and 46 to 50 micrometers in length (Soulsby, 1982; O.I.E., 2000). 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 (4-5oc) (Doyle *et al.*, 1997).

Figure 5. The egg of T*aenia saginata*
Source: (Wen *et al.*, 1993)

2.2.3.2. *The larval stage/Cysticercus bovis/*

The cyst is round or oval in shape, and when fully developed, consists of a scolex, invaginated in to a fluid-filled vesicle (tail bladder), which is surrounded by connective tissue capsule formed by the reaction of the tissue of the host (Gracey, 1992). The cyst is seen as small whitish vesicle and is found between muscle fibers (Fig 6). 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 (Troncy, 1989). As in the adult tapeworm, it has neither rostellum nor hooks (Soulsby, 1982; Urquhart *et al.*, 1996).

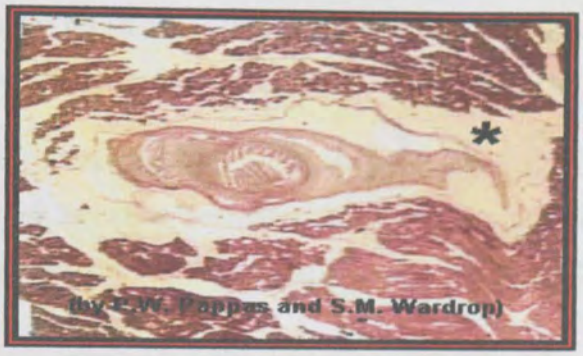

Figure 6: *Cysticercus bovis* in muscle (histology)
Source: (Troncy, 1989).

2.2.4. Life Cycle of the zoonotic *Taenia*

These tapeworms have an indirect life cycle and are relatively host specific for both larval and adult stages. Humans are the only natural definitive hosts of the adult tapeworm. The adult tapeworm is fully developed and reproductively mature as early as 10-12 weeks (depending on species) after infection of the host (Lloyd *et al.,* 1998). Once mature, the tapeworm regularly sheds its most posterior segments, called gravid proglottids, which are discharged from infected humans spontaneously or with defecation. These proglottids contain thousands of immediately infective eggs that can remain in the proglottid or be expelled free into the surrounding fecal matrix or environment (WHO/FAO/OIE, 2005). On average, a single *T. saginata* tapeworm releases six to nine proglottids daily (Pawlowski and Murrel, 2001).

Although multiple and mixed species infections can occur, most taeniosis infections involve a single tapeworm. Upon ingestion by a suitable intermediate host, a hexacanth embryo, or oncosphere, hatches from the egg and uses its six hooklets to penetrate the intestinal mucosal within a few hours to enter the circulatory or lymphatic system. It eventually reaches the tissue site (such as the lymphatic space in skeletal muscle) where it eventually develops into a cysticercus which is infective to a human final host after about 10-12 weeks (Jenkins D.J. (2005). or as early as 4 weeks for *T. saginata asiatica* (Fan *et al.,* 1990). The intermediate hosts for *T. saginata* and *T. saginata asiatica* cysticerci are

domestic cattle and swine,respectively. Reindeer (*Rangifer tarandus tarandus*) have also proven suitable intermediate hosts for *Cysticercus bovis* (Scandrett *et al.*, 2009)

In cattle, cysticerci are found predominantly in cardiac and skeletal musculature, and occasionally in other sites including liver, lung, kidneys and lymph nodes (Scandrett *et al.*, 2009). There is evidence that pre-natal infection of calves can occur (McManus, 2006).

Taenia saginata asiatica cysticerci localize primarily on the serosal surface and within the Parenchyma of the liver of pigs (Fan, 1999), and occasionally in extrahepatic peritoneal sites (Boone *et al.*, 2007). Experimental infections have also been reported for cattle, goats and monkeys (Lloyd, 1998).

The normal intermediate host of *T. solium* is domestic swine, although a variety of other species, including humans and dogs, can serve as intermediate hosts (Lloyd, 1998). The cysticerci localize in the tissues of the tongue, skeletal muscle (particularly thighs), subcutis, and central nervous system of pigs. Human consumption of infected pork or beef completes the cycle.

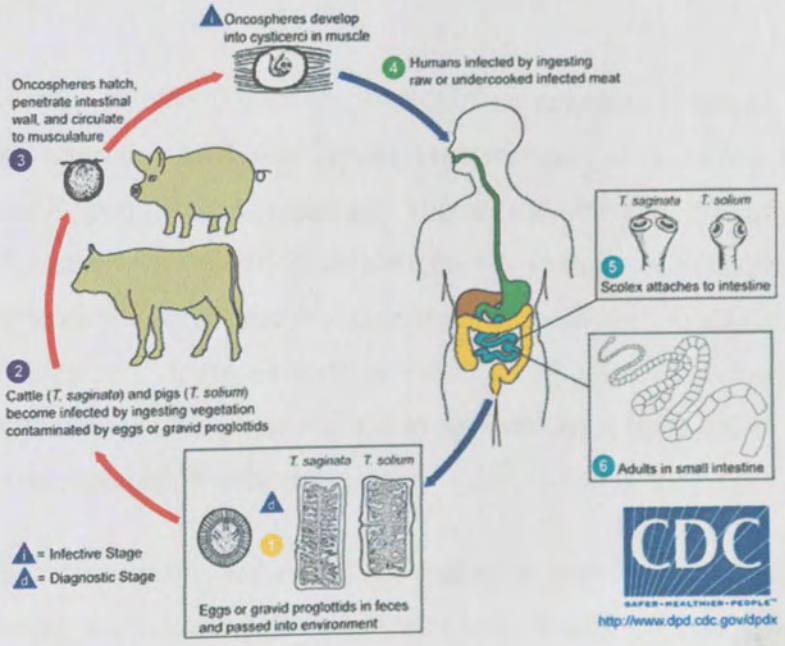

Figure 7: Life cycle of *Taenia saginata* and *T. solium*

Source: (CDC, 2000)

3. EPIDEMIOLOGY

3.1. Distribution

In most countries, *T. saginata* is more common than *T. solium*. It is associated with areas of poor sanitation and high consumption of beef. Many of the cases seen in the United States are from immigrants who came from a country that has higher rates of beef tapeworm. The number of cases in the United States is much higher than that of *T. solium*. Eggs may remain viable in human feces for several weeks such that cattle who ingest them will become infected (Doyle *et al.*, 1997).

Taenia saginata is distributed globally but the infection is particularly important in Africa, Latin America, and Asia as well as in some Mediterranean countries (Walker J.M. (1996). 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 (Doyle *et al.*, 1996; Minozzo *et al.*, 2002).

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) (Florova, 1982). In some parts of Serbia and Montenegro, up to 65% of children have been reported to harbor *T. saginata* (Florova, 1982). Moderate prevalence is encountered in South East Asia (Thailand, India, Vietnam and Philippines), Japan as well as countries of Western Europe and South America while Canada, the USA, Australia and some countries of the Western Pacific have low prevalence (Harrison and Sewell, 1991).

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 (Tembo, 2001).

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 (Jeon and Eom, (2006).

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 (O.I.E., 2000). In developed countries, cattle of any age, are susceptible to infection since they generally posses no acquired immunity (Yoder *et al.*, 1994).

A high prevalence of *T. saginata/Cysticercus bovis* occurrs in Africa where cattle are kept in community grazing lands. The parasites appear to be specific to cattle, while wild animals play no part as intermediate hosts (Symth, 1994).

Table 1: The prevalence of *C. bovis* in some selected African countries shows significant variation

Country	**Prevalence %**	**Source**
Zambia	6.1	Dorny, 2002
Nimibia	6.2 communal, 2.3 commercial	Kumba, 2001
Egypt	0.23 in native cattle, 7.25 in imported cattle	Haridy, 1999
Kenya	33.02	Onyango-Abuje, 1996
	14-18.2	Florova, 1982
Zaire	22.3	Florova, 1982
Chad	6.67	Florova, 1982
Nigeria	10.2	Florova, 1982
Ethiopia	2.2-3.2	Teka, 1997
	3.2	Tembo, 2001; Adugna, 2012)

3.2. Status of Cysticercosis in Ethiopia

In Ethiopia, the rural communities mainly raise cattle under extensive husbandry practices. Existence of higher population density, raw meat consumption, low awareness, poor hygiene and sanitary infrastructures may facilitate transmission of the disease between animals and human beings in the rural areas. The prevalence reports of cysticercosis in Ethiopia showed variable results with localities. Relatively lower prevalence of 3.1% in Central Ethiopia (Tembo, 2001), 4.9% at Gondor (Dawit, 2004) and 7.5% in Addis Ababa (Nigatu, 2004) were reported. A prevalence of 9.7% out of 1168 at Gonder meat factory (Amsalu, 1989). Have been recorded; while others reported as high as 17.5% in East Shoa (Hailu, 2005), 21% at Tigray (Berhe, 2009) 26.25% at Awassa (Abunna *et al.*, 2007) and 30% from different abattoirs in the country (Fikire and Adugna, 2012).

Therefore, attention must be given to routine meat inspection, public awareness on improving personal and environmental hygiene and teaching school children on the danger of raw meat consumption is a reliable means of bringing cultural change in the country. Further studies on prevalence and public health importance of bovine cysticercosis should be encouraged to establish clear epidemiological pictures, prevalence and economic importance of the disease.

Table 2: Status of *Cysticercosis* in Ethiopia

Location	Prevalence in %	Source
Central Ethiopia	3.1	Tembo, 2001
Gondor	4.9	Dawit, 2004
Addis Ababa	7.5	Nigatu, 2004
Gonder meat factory	9.7	Amsalu, 1989
Tigray	21	Berhe, 2009
Awassa	26.25	Abunna *et al.*, 2008
Awassa	30	Fikire, 2012
Wolaita Soddo (Southern Ethiopia)	11.3	Alemayehu *et al.*, 2009
East Shoa	17.5	Hailu, 2005
Tigray	21	Berhe, 2009
North westen Ethiopia	18.49	Kebede, 2008
Nekemte	2	Ahmad, 1990
Luna export abattoir in East Showa	27.6	Hailu, 2005; Adugna, 2012).

3.3. Host range

Cattle are the preferred intermediate hosts and humans are the only final hosts of *T. saginata.* Cattle of all ages are susceptible; however young age groups are more susceptible. Parasitism is sometimes observed in other ruminants (sheep, goats, antelops, gazelles, buffaloes) but *Cysticercus* development is unlikely. 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).

In developing countries are readers on extensive scale, human sanitation is poorly developed which makes the incidence of *T. saginata* infection in humans very high. Calves are infected usually in early life, often with in the first few days after birth from infected stockmen whose hands are contaminated with *Taenia* eggs. In Africa inadequate education of population and low accessibility to safe taenicides has favored the spread of *Taenia saginata* (Fertig and Dorn, 1985).

3.4. Mode of infection

Human feeding habits and modes of life are responsible for the spread of *T. saginata* infections. Man's customs and traditions of consuming raw, sun-cured, inadequately cooked beef dishes like *steak tartar* in Europe, *shish kebab* and *tikka* in India, *shashlik* in the former USSR, *Ihab* in Thailand, *Yukhoe* in Korea and *kourt and kitffo* in Ethiopia containing viable bladder worms perpetuate human infection. Cattle are infected by ingestion of pasture and drinking water contaminated with *T. saginata* eggs, (Florova, 1985).

According to Symth, (1994), dispersion of *T. saginata* eggs is favored by the following factors:

- Man's indiscriminate defecation.
- The use of sewage effluents and sludge as fertilizer on pasture, the use of immigrant labor from countries with high prevalence of infection in feedlots. Scavenger birds
- Earthworms, dung beetles, blowflies, mites, flooding water, etc.
- (Age of the animal

4. CLINICAL MANIFESTATIONS

4.1. In man

In man, there are usually no clinical disturbances except for pruritis ani, the patient being aware of discomfort in the perianal region. *T. saginata* taeniosis is a non-fatal infection in man caused by the adult meat tapeworm, *T. saginata* (WHO, 1995). Humans seldom show symptoms, but in some cases suffer abdominal pain, nausea, debility, weight loss, flatulence and diarrhea, or constipation may occur. A patient may have done or several of those symptoms. A high percentage of patients experience gastric hypo secretion (Hendrix, 1998). T*aenia saginata*, like all other human helminthes, may induce variable symptoms or may cause an unrecognized infection. However, asymptomatic *T. saginata* infection may within a short time, change into a life-threatening condition when proglottids are vomited and aspirated or when proglottid enters the appendix (WHO, 1995).

Table 3: Summary of different symptoms and percentage of their clinical occurrence

Symptoms	Percent	Symptoms	Percent
Abdominal pain	35.6	Constipation	9.4
Nausea	34.4	Daffiness	8.2
Weakness	24.8	Diarrhea	5.9
Loss of weight	21.5	Pruritis ani	4.5
Increased Appetite	17.0	Excitation	3.4

Source: (Hendrix, 1998).

4.2. In Animal

Light or moderate cysticercosis in cattle is not usually associated with any defined clinical pictures. 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. DIAGNOSIS

5.1. In Human

Adult cestodes can be expelled from human using and an antehelmithcs followed by a saline purgative and are identified based on scolex and proglottid morphology (OIE, 2004). In human beings, the diagnosis is established by examination of the eggs in the stools or gross examination of the proglottids or segments passed in the stool (Ghai, 2000). Diagnosis is based on symptoms, faecal examination and rectal swabs, although it is difficult to discover the disease during the first 3 months. A person should not be considered uninfected before having three negative tests completed over a 2-3 day intervals (OIE, 2004).

It is difficult in live animals to diagnose the presence of *C. bovis* in the muscles. Thus diagnosis can be performed only at postmortem examinations by direct observation of *C. bovis* in the muscles (Gracey *et al*., 1999). Taeniosis is most difficult to diagnose during the first 3 months of infection, before the eggs are produced and the proglottids discharged (WHO, 1983). Since there is no characteristic clinical picture of infection, the diagnosis must be based on laboratory findings of stool examination, serology and skin tests to determine whether a tapeworm infection exists. Confirmatory diagnosis is made by examination of the scolex or those proglottids that show typical morphological characteristics (Rodr´ıguez-Hidalgo *et al.*, 2003). Eggs are distinguishable by morphological feature on; examination should be repeated if the results are negative (Hendrix, 1998). Recently researchers are suggesting PCR standardization that can be applied on human stool samples for taeniosis diagnosis by the extraction of deoxyribonucleic acid (DNA) from the sample (Nunes *et al*., 2003).

Live cattle show on symptoms, so that it becomes extremely important to identify the cysts during meat inspection. A previous history of infestation on the animal premises also acts as a valuable diagnostic tool. Serological tests are also available to detect the disease in live animals.

The IHAT with 100% sensitivity and 91-100% specificity can be used as a diagnostic test for epidemiological survey, to map infected and disease free areas and to estimate the natural prevalence of the disease (Nigatu Kebede, 2004).

5.2. Diagnosis in living animals

Diagnosis of cysticercosis in bovine is usually only made by post-mortem examination i.e. by observation of the cysts (Sewell and Brocklesby, 1990). Postmortem inspection of carcasses during meat inspection is subject to certain laws that are specific to each country, and these laws attempt to reconcile the interests of owners so that carcasses are not mutilated (CTA, 1989). Cysts can occur anywhere in the striated muscles and heart; although there are no typical predilection sites, cysts tend to occur more frequently in muscles which have an intensive blood supply such as the tongue, masseters, heart, diaphragm,etc (Kassai, 1999).

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The metacestodes are readily visible in the organs or musculature at autopsy and therefore; diagnosis of bovine cysticercosis is usually made during postmortem examination in abattoirs and packing plants (Ziukovic *et al.*, 1996; Gracey, 1999). Individual countries have different regulations regarding the inspection of carcasses, which usually attempts to reconcile the interests of owners and those of the consumers (Eom and Rim (1999).

Meat inspection relies exclusively on visual examination of the intact and cut surfaces of the carcass (eye-and-knife method) in the slaughterhouse by meat inspectors who follow officially laid-down procedures (Yoder *et al.*, 1994). Individual countries have different regulations regarding the inspection of carcasses, but invariably the masseter muscle, tongue, and heart are incised and examined. Several of these are also the sites at which the largest concentration of metacestodes is found in experimentally infected animals. Diaphragm, muscles of the hind limb, liver, esophagus, lungs, kidneys, spleen and intercostal muscles are potential sites for cyst location (Dorny *et al.*, 2004). Classical meat inspection techniques cannot detect all of the carcasses infected with cysticerci (Dorny *et al.*, 2004).

The effectiveness of meat inspection in the detection of *C. bovis* depends on the procedure used. The following are laid as normal routine inspection of carcasses by the Ministry of Agriculture in Ethiopian Meat Inspection Regulation Notice Number 428 of 1972 by Government of Ethiopia (MoA, 1972) is not followed strictly at most of the abattoirs.

- 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 base to 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, esophagus and associated lymph nodes.

However, minor infections are difficult to detect irrespective of laws and the skill of the inspector. If a *Cysticercus* is found in any of these sites and organs, thorough inspection of the whole carcass and offal should be done. The location, nature and number of cysts should be recorded (MoA, 1972).

5. 3. Differential diagnosis

It is difficult to differential *T. saginata* and *T. solium* by parasitological examination because their eggs are indistinguishable. Correct identification is important because the consequences of human infection by these two parasites arte very different. *T. saginata* is relatively innocuous, since only the intestinal tapeworm phase occurs in man, whereas infection with *T. solium* has major health effects due to extra intestinal infection by the larval or cyst phase in the central nervous system (CNS) (WHO, 1983).

Differentiation of human *Taenia* species is based on the number of uterine branches present in well-preserved gravid proglottids or on the absence or presence of hooks in the scolex of the tapeworm (Mayta *et al.*, 2000). *C. dromedarius*, the metacestode of the hyaenae which is twice as long as *C. bovis* measuring 12 to 18 mm in length, pearly white in color and possess double row of hooks on the lateral part of scolex. Hailu (2005) and Amsalu Demessie (1989) have reported this cyst in this country. The diagnosis of *Onchocerca dukei*, *C. bovis*, *Sarcocystis*, and *C. dromedares* can be confusing. There is a possibility for these parasites to co-exist on a single carcass. White soft nodules are formed by *Sarcocystis* measuring 4 to 6mm long in the esophagus and sometimes in other muscle. *O. dukei* measures 3 to 6mm in diameter which form intra-muscular and subcutaneous nodules, that are firm to touch and reveal worms surrounded by pus when sectioned (CTA, 1989). Fat globules and lesions of actinobacillosis (especially in the tongue) must be considered (Gracey *et al.*, 1999).

A number of characteristics are employed for differentiation such as scolex in the adult, *Cysticercus*, number of the lateral branches of the uterus in the gravid proglottids, ovary, and vagina, site of *Cysticercus* development, preferred intermediate hosts and egg size. However, some of the above mentioned characteristics are not fully reliable. For example, an egg of *T. solium* and *T. saginata* can't easily be distinguished since the scolex of

intestinal tape warm remains in the gut even after treatment hence this is not always available for differentiation. A much-used criterion is the number of lateral benches of the uterus in the gravid proglottids, observed by simply pressing them between two glass slides and examined (Pawlowski, 2001). Understanding the morphological differences between adult *T. solium* and *T. saginata* is of great clinical and epidemiological importance's to be able to distinguish between patients infected with *T. solium* and *T. saginata*. Sometimes the only material available is a few expelled proglottids that may be in poor state of preservation, in recent times the identification of the different *Taenia* species using multiplex PCR yielded differential products unique for *T. saginata, T. asiatica* and *T. solium* based on their molecular sizes (Yamasaki *et al.*, 2004). *T.solium* (the pork tapeworm) is smaller than *T. saginata* being up to 3-5 meters. The scolex has an armed rostellum bearing two rows of hooks; the number and size of hooks can aid differentiation of *Taenia* species (Yamasaki *et al.*, 2004).

The salient feature of this third form of tapeworm is that it is an intermediate between the two classically known species, *T. solium* and *T. saginata*. Morphologically, the adult Asian *Taenia* is similar to that of the adult *T. saginata*, although the inconsistent presence of both marked and unarmed rostellum on the scolex can differentiate the adult forms (Eom and Rim, 1993; Fan *et al.,* 1995); moreover, the intermediate host involved is not cattle, but swine (Fan, 1999; Fan *et al.*, 1995). In this context, the larval stage of the Asian taeniid exhibits a liver tropism, though other organs may also be affected (Scandrett *et al.*, 2009). In the intermediate host, the parasite has a cysticercus more similar to that of *T. solium* because the scolex possesses hooks; however, the cysticerci of the Asian *Taenia* are clearly smaller than those of *T. solium*. Cysticerci that have already lost their hooks may also be detected in swine (Fan, 1999; Fan *et al.*, 1995; Ito *et al.,* 1998). Jeon and Eom (2006) conducted a deferential identification of *T. asiatica* and *T. saginata*, through the mapping of mitochondrial genomes and the sequencing of genes and found that designation of *T. asiatica* as a separate species from *T. saginata.* It has wart like formations on the larval bladder surface, posterior protuberance in the gravid proglottids and the large number of uterine twigs.

Economic losses from cysticercosis are determined by disease prevalence, grade of animals' infested, potential market price of cattle and treatment cost for detained carcasses. Annual losses in Botswana now approach 0.5 million pounds, while in Kenya it is about 1 million pounds. The loss per animal slaughtered is 2.25 pounds in Botswana and 1-50 pound while in Kenya. The important reason for condemned meat at abattoirs in Central Africa Republic and Burundi is due to cysticercisis (Pagot, 1992). East Africa where the development of profitable meat industry is hampered by high prevalence of *C. bovis*. In general, *C. bovis* has an impact in meat trade is increasingly becoming important in view of the drastic measures and very strict regulations importing countries such as the European Economic community and the gulf states (Feseha, 1995).

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 freeing, boiling) or condemned, as well as the costs involved in the inspection procedures amount to millions of dollars (Nunes, 2003). Conventional meat inspection technique is less sensitive (pick only 7-5% of infected cases) and time consuming. Lightly infected carcasses can be easily missed and passed for human consumption, thus the infection transmission is maintained between human and cattle. Thus taenisosis (cysticercosis) is remaining a wide spread zoonosis that affects human health and economy through condemnation, quality degradation of frozen meat, cost of refrigeration, cost of human therapy, lowering productivity of infected workers who may be absent from or reduce their working efficiency by creating uneasiness (Nigatu, 2004). In Ethiopia, there is a wide usage of both traditional and modern taenicidal drugs (Feseha, 1995), which is an indication and diclorophen production in the drug factories in this country (Table 4) between 1996 and 2000 was 31,814,833 (Tembo, 2001).

The annual expenditure for the modern drugs in three areas of west Shoa (Holata, Addis alem and Ginchi) was estimated at 380,032 Eth. Birr (Table 11) during the year 2005

Table 4: Taenicidal drugs doses produced in Ethiopia pharmaceutical company

Year	Niclosmide	Diclorophen	Total
1996	2,548,500	2,225,667	4,774,167
1997	4,484,000	538,500	50,022,500
1998	9,418,125	2,665,333	12,083,458
1999	4,484,000	416,8000	4,900,833
2000	5,033,875	-	5,033,875
Total	25,968,500	5,846,333	31,814,833

Source: Tembo (2001).

7. ZOONOTIC IMPORTANCE OF TAENIASIS

Man is the only final host where the adult *Taenia saginata* resides in the small intestine. The size reached by the adult worm is related to the number of worms present (Maeda *et al.,* 1996). In a single worm infection, a worm can develop longer and produce large number of proglottids (Smith, 1994). Multiple infections up to 20 tapeworms in one host are often occurring in developing countries (Mann, 1984). The effect on human health is generally slight and symptoms may be vague or absent. Taenia has a debilitating effect on people who already have live of protein deficient diets suffer from iron deficiency and infected by hookworm (WHO/FAO/OIE, 2005).

Taeniasis causes various symptoms, which probably depend very much on the psychological and physical characteristics of the host. Some patients lose their appetite and thus lose weight while others tolerate the infection (Florova, 1982). 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 (Florova, 1982). 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. 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).

8. TREATMENT

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 (Doyle *et al.,* 1997) but the scolex is partially digested and often not recovered (Symth, 1994). Other drugs used in the treatment of *T. saginata* are mebendazole (Soulsby, 1982; Doyle *et al.*, 1997).

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 (Symth, 1994; Soulsby, 1982). Praziquantel is effective at 50mg/kg/day for four days but this treatment is impractical because of its high cost (Desta, 1995). Apart from conventional drugs as it is described by Berhanu and Ermias, 1978; Desta, 1995, in Ethiopia people used traditional medicaments to cure from *T.saginata* infection and some of the traditionally used medicaments presented in Table-5.

Table 5: Major Taenicidal herbs used in Ethiopia

Local Name	*Scientific name*	*Parts uses*
Enkoko	*Embelia schimper*	Fruits
Duba fre	*Cucurbita pepo*	Seeds
Ttosigne	*Thymus serrulatus*	Dn#
Kosso	*Haginia abyssinica*	Flower
Kechemo	*Myrsiae Africana*	Dn#
Kkeleum	*Maesa lanceolta*	Dn#
Serdo	*Cynadon dactylon*	Dn#
Ddendera	*Echinaps gigantean*	Dn#
Mettere	*Glinus lattoides*	Dn#
Gorrteb	*Plantago lancceolata*	Dn#
Bisana	*Croton macrostchys*	Seeds

Dn# = Do not know

Source: (Desta, 1995).

9. MATERIALS AND METHODS

9.1. Study area

The study was conducted in Holata, Addis Alem and Ginchi districts west Shoa Zone, which represents the Central of Oromiya Regional State. West Shoa zone is located at an altitude of 2400 meters above sea level, 09° 03'N latitude, and 38°30' E longitude. The area is located at a distance of about 29 km west of Addis Ababa along the Nekemt road. The area is characterized by a mean annual rainfall of 1100 mm, mean relative humidity of 60.6%. The main rainy season is from June to September which accounts for about 70% of the rainfall while the remaining 30% is from February to April. The average annual maximum and minimum temperatures are 22.1^{0}C and 6.2^{0}C, respectively (HARC, 2005).

The three abattoirs, namely Addis Alem, Holata and Ginchi municipality abattoirs have almost the same design and construction. The three have more or less slaughtering facilities, good light for carcasses inspection, and hooks for hanging carcasses, special site for offal and drainage tunnels for disposal of blood and other waste materials.

Holata, Addis Alem and Ginchi municipal abattoirs have a similar capacity of slaughtering about 10 to 25 local beef cattle at one shift.

9. 2. Study population

The study animals were beef cattle coming mainly from central of Oromiya, Meta Robe, Dandi and Ilu districts. During the study period a total of 600 beef cattle (200 from Holata 180 from Addis Alem and 220 from Ginchi) were examined for the presence of *C. bovis*.

For questionnaire survey the target population was people living in Ginchi Addis Alem and Holata towns. The later mainly considered as high production of beef cattle. The study populations were people of one kebele in Ginchi town, one kebele in Addis Alem town, two kebeles in Holata town and seven kebeles from rural area, from a total of 11 kebeles, 110 respondents were interviewed during this study.

9.3. Study design and sampling methodology

Active abattoir survey was conducted in Holata, Ginchi and Addis Alem municipal abattoirs on slaughtered cattle using postmortem examination for the presence of *C. bovis*.

In addition cross sectional type of study design was employed using questionnaire survey to assess the prevalence of *T. saginata*, associated potential risk factors and its public health importance.

Both surveys were supported with retrospective data collected from concerned agricultural, public health organizations, veterinary clinics and government offices in Holata, Addis Alem and Ginchi.

9.4. Sample size

The sample size for all abattoirs and questionnaire survey was determined using the formula described in Thrusfield (2005) the prevalence in a large (theoretically infinite) population at 95% confidence interval and 4% absolute precision with an expected prevalence of 30%. With this assumption 504 cattle were required. To increase the possible chance of getting cysts 10% of the sample size were added getting a total of 554 cattle that could be inspected. In due course of time enough cysts were not obtained and within the study time frame additional 46 cattle were inspected.

$N = 1.96^2 \text{ pexp } (1\text{-pexp})/d^2$; Where:

N = required sample size

Pexp = expected prevalence

d = desired absolute precision

9.4.1. Abattoir survey

Prior to sampling each animal was given an identification code like name of the owner and the color of the cattle. During meat inspection, each organ of an animal was strictly and separately examined to avoid mixing up of organs. The butcher and meat inspector also gave due attention to avoid mixing up of organs from different animals. On visiting days of each abattoir all slaughtered cattle were examined.

The predilection sites such as heart, tongue, masseter diaphragm, oesophagus, triceps, liver and lung were inspected for the presence of *C. bovis* (OIE, 2004). Meat inspection was made as per the procedures of Ethiopian ministry of agriculture meat inspection regulation (1972) for the detection of *C. bovis*. The heart, tongue, masseter, diaphragm, esophagus, triceps brachi, thigh muscles, liver, lung, kidney and spleen of all slaughtered beef cattle were assessed by visual inspection, palpation and followed one to three incisions except for oesophagus for the detection of *T. saginata* cysticercus. Live and dead cysticerci were carefully dissected from the tissues and the number in each organ recorded for each animal. At the end of the examination, the cysts were collected properly labeled and brought to Debre zeit parasitology laboratory for further investigations. The viability of cysts were examined by placing them in a normal saline solution with 30% Ox bile and incubated at 32^{0c}. evagintion of the un armed scolex in viable cysts normally takes place within 1-2 hours (Gracy, 1999). The cysts were then identified as *C. bovis* if they lack hooks and rostellum on the evaginated scolex with four suckers (Opara, 2006).

9.4.2. Questionnaire survey

In the selected study areas 110 voluntaries were selected as convenient and participated to assess the community perception. Socio-demographic information, occupation and educational level were included in this particular study.

10. Data analysis

All the data obtained from the study were entered into MS Excel data sheets, coded and analyzed using SPSS (15.0 versions). The data were described using percentages to determine *C. bovis* infection in examined carcass; Chi square test (χ^2) was used to see the strength of association; Odds Ratio (OR) was used to determine the effect of different risk factors and logistic regression analysis was used to determine the most significant independent variables

11. RESULTS

11.1. Abattoirs survey results

In the present study an overall prevalence of 2.5% (95%CI: 1.3%-3.7.0%) *C. bovis* was recorded. Out of this 2.5% (95%CI: 0.3%-4.7%), 1.6 % (95%CI: 0.2%-3.5%) and 3.2% (95%CI: 0.9%-5.5%) prevalence in Holata, Addis Alem and Ginchi municipality abattoirs were recorded, respectively (Table-6).

Table 6: Prevalence of *C. bovis* in the three municipal abattoirs **(N=600)**

Abattoirs	No. of inspected carcass	No of negatives	No of positive	Prevalence (%)
Holata	200	195	5	2.5
Addis Alem	180	177	3	1.7
Ginchi	220	213	7	3.2
Total	600	585	15	2.5

χ^2= 0.93; df 2 (n-1) p=0.63: Fisher's exact test.

The monthly inspection indicated that, in Ginchi municipality abattoir, a relatively higher prevalence was recorded in December and the least in November and March. Similarly, in Holata abattoir, the highest prevalence of *C. bovis* was found in December and the least was in November and February while it was in November, February and March in Adis Alem (Table-7)

Table 7: Monthly occurrence of *C. bovis* in Holata, Addis alem and Ginchi abattoir

Abattoir		Months				
	Number(n)	**Nov**	**Dec**	**Jan**	**Feb**	**March**
Holata	Slaughtered cattle	10	80	47	18	45
	C. bovis	0	3	1	0	1
	Prevalence (%)	0	3.75	2.1	0	2.2
A.Alem	Slaughtered cattle	17	72	61	20	30
	C. bovis	0	2	1	0	0
	Prevalence (%)	0	2.7	1.6	0	0
Ginchi	Slaughtered cattle	45	62	49	32	12
	C. bovis	1	3	2	1	0
	Prevalence %	2.2	4.8	4.0	3.1	0
Total	Slaughtered-cattle	72	214	157	70	87
	C. bovis	1	8	4	1	1
	Prevalence %	1.3	3.7	2.5	1.4	1.1

Table 8: Status of cysts in different organs of inspected cattle

Organs affected	**No. of viable cysts**	**No. of non viable cysts**
Tongue	3	2
Heart	3	4
S. muscle	1	2
Total	7(46.6)	8(53.33)

Table 9: Proportion of infected, viable and non-viable cysts in different organs

Infected organs	Tongue	Heart	S. muscle	Liver
Percentage (%)	33.3	46.6	20	0
Viable cyst (%)	60.0	42.9	33.3	0
Non- viable cyst (%)	40	57.2	66.6	0

In the present study out of the total 15 affected organs, *Taenia saginata* cysticerci occurred in the proportion of 46.6% in heart, 33.3% in tongue, and 20.0% in masseter. The heart was the most frequently affected organ; this observation is in agreement with the work of Abuna *et al.* (2008) who reported *C. bovis* in Hawassa with proportion of 43% and Dawit at Gondor abattoir (37.84%). However, it is slightly higher than the findings of Hailu (2005), 21.54% in East Showa zone.

The current study showed that tongue, heart and shoulder muscle were organs infected with *Cysticerus bovis* with the prevalence of 33.3%, 46.6% and 20%, respectively (Table 9). An overall proportion of 8 (53.3%) viable and 7 (46.6%) non viable *C. bovis* cysts were exposed (Table 8). During the present survey cysts were not encountered in other organs like liver, kidney, lung and diaphragm. Even though butchers were not allowed to incise some important muscles during inspection, the shoulder muscle and the tongue were the most infected organs with *C. bovis*.

11.2. Questionnaire survey results

In the selected study areas 110 voluntary respondents participated which have different occupation and educational level; farmers, merchants civil servants, students, butchers and abattoir workers were included in this particular study. Convenient sampling method was used during the survey. Out of 110 respondents 70 (63.64%) was positive for *Taenia saginata*.

Age

There was strong association (P=0.003 and χ^2 = 14.17) between prevalence of *Taenia sagenata* infection and age distribution. Among the respondents age groups of 27-40 years old (73.91%) had relatively higher infection rates than youngsters.

Table 10. The risk factors for Taenia *saginata/* taeniosis infections in human respondents

Variables	No. of Respondents	No.Infected (%)	χ^2	*P*-Value	OR	95% CI)
Sex						
Male	65	50(76.92)	10.76	0.001	4.17	1.7-10.4
Female	45	20(44.44)				
Age						
<15 years	12	2 (16.67)				
15-26 years	38	26(68.42)				
27-40 years	46	34 (73.91)	14.17	0.003	----	--
>40 years	14	8 (57.14)				
Religion						
Muslim	18	6 (33.33)				
Christian	92	64 (70.33)	7.05	0.008	0.22	0.06-0.71
Marital Status						
Single	38	24 (63.15)	0.02	0.9	0.97	0.4-2.37
Married	72	46 (63.89)				
Occupation						
Low risk	50	23 (46.0)				
High risk	60	47 (78.3)	10.96	0.0009	0.24	0.09-0.58
Educated						
Informal	20	17(85.00)	0.08	0.008	3.95	1.45-3.7
formal	90	53 (58.88)				
Meat eating						
Cooked meat	51	21 (41.18)				
Raw meat	59	49 (83.05)	18.96	0.000	0.14	0.05-0.4
Spices usage						
No spices	63	46 (73.02)	4.7	0.03	2.6	1.1- 6.24
Use spices	47	24 (51.06)				

Among the respondents age groups of 27-40 years old (73.91%), raw meat consumers (83.05%, Christian (70.33%), male (76.92%), married (63.89%), people who were not educated (85%, those who were not using spices (73.02%) and High risk (78.3%) were showing higher percentage of *T.saginata* infections. Comparing from spices users the higher percentage of *T. saginata* infections in non spices users could serve as an indicator as to the possible role of using spices while eating raw meat in the prevention of *T. saginata* infection.

Sex

The prevalence on sex basis indicated that males (50%) were more prone than females (20%) and the difference was statistically significant, (χ^2, 10.76; $p<0.05$, 0.001). The analysis indicated that males were more than 4 times (95% CI: 1.7-10.4) at a higher risk than females for *Taenia saginata* infections.

Religion

The prevalence on religion basis indicated that Christians were more affected with the disease (70.33%) and the difference was significant, ($\chi^2$7.05; $p<0.05$, 0.008) and they were having 22% of higher infections compared to Muslims.

Occupation

The respondents were classified in two working environments i.e. high risk (farmers, animal handlers, butchers and abattoir workers and (low risk) students and civil servants. Accordingly, two groups were formed. Analysis showed there was significant statistical association between occupation so that high risk (78.3%) were contracting taeniosis higher than low risk (46%) ($P< 0.05$, 0.0009 and $\chi2$ 10.96)

Education level

For the purpose of statistical analysis, the education level were divided in to two categories i.e. those who did not attend school were coded as informal, those who attended from elementary up to senior high school and who graduate from colleges and universities were

coded as formal. In this particular study, education level had statistical significance ($P<0.05$, 0.008 and $\chi^{2=}$ 0.08) on prevalence of *Taenia saginata* infection (Table-10)

Meat consumption habits

The present study showed that the majority of the respondents had consumed raw meat. Eating raw meat is usually traditional and cultural practice in the study area. Among interviewed, 49 (83 .05%) indicates the respondents had the practice of consuming raw meat and had contracted taeniosis more than once in their life time. It was observed that raw meat consumption and prevalence of taeniosis had strong association ($\chi 2=18.96$ and $p=0.000$).

11. 2. Drug Inventory

Drug inventories of seven from ten requested drug shops and pharmacies revealed that human *Taenia saginata* taeniosis is an important disease among the residents of Holata, Addis Alem and guinchi. Four taenicidal drugs were used in the study areas and the total amount of money invested for the treatment of *T.saginata* in human for the year 2013 was estimated about 380,032 Ethiopian birr for 68,181doses.

Table 11: Inventory of annual taenicidal drug doses and their worth in the study area

Taenicidal Drugs	Holata		Addis Alem		Ginchi		Total	
	Doses	Price in (Birr)	Doses	Price in (Birr)	Doses	Price in (Birr)	Doses	Price in (Birr)
Albendazole	1,460	8,760	3,825	22,950	4,526	27,576	9,811	59286
Mebendazole	9,711	58,587	3,442	20,652	11,187	67,092	24,340	146,331
Niclosamide	10,219	51,095	7,720	38,600	6,882	34,410	24,821	124,105
Praziquantel	853	8,530	4,278	21,390	4,078	20,390	9,209	50,310
Total	22,243	126,972	19,265	103,592	26,673	149,468	68,181	380,032

Source: Collected and summarized by investigator

Four taenicidal drugs were used in the study areas and the total amount of money invested for the treatment of *T.saginata* in human for the year 2013 was estimated about 380,032 Ethiopian birr for 68,181doses.

Table 12: Taeniacidal traditional medicaments used in the study area

N= 100

Name of the Medicament in Amharic	Scientific name	Part used	No of respondents	%
Kosso	*Hagenica abyssinica*	Fruits	70	70
Enkoko	*Embelia schimperi*	Seeds	62	62
Meterie	*Glinus lattoides*	Flower	58	58
Duba Frie	*Cucurbita pepo*	Seed	42	42
Tosigne	*Thymus serrulantus*	Leaf	20	20

Source: from respondents

Of these traditional herbs, Kosso, Enkokko and Meterie were commonly used; in addition, Duba-fre (pumpkin seed) and Tosigne were also used.

12. DISCUSSION

2.1. Abattoirs survey of Cysisercosis in the study areas

The highest recorded prevalence might be due to slaughter of large number of cattle in holydays that is Christmas in December and Ethiopian Epiphany in January months.

Abattoir survey result of the present study revealed an overall prevalence of 2.5% cysticercosis in slaughtered cattle in all three abattoirs. The prevalence of cysticercosis was found to be 2.5%, 1.6% and 3.2% in Holata, Addis alem and Ginchi municipality abattoir, respectively. Statistical analysis showed that there was no statistical significant variation between these three abattoirs in the prevalence of cysticercosis. The possible reason for relatively higher number of cystcicerci in Ginchi and Holata than Addis alem may be due to more number of examined carcasses, better lighting, cleanness of the abattoirs and very good facilities compared to Addis Alem abattoir. This fact is confirmed with the work in Victoria where the marked increase in the number of cases of *Taenia sagianta* cysticerei were found, due to the correction of few simple inspection procedures, such as checking and correcting the amount of light available at inspection stations, to ensure that the heart and head could be properly inspected. Staff employed on inspecting heads had to be trained in the desired method of incision of the master muscle (Tolosa *et al*., 2009).

The majority of the findings in Ethiopia were based on surveys carried out on carcasses subjected to the routine meat inspection procedures. Hence the same limitations with which meat inspection shares globally were reflected in the results of the present study, the present finding is similar to reports from different parts of Ethiopia, such as, 3.1% in central Ethiopia (Tembo, 2001); 4.9% at Gonder (Dawit, 2004); 7.5% in Addis Ababa (Nigatu, 2004).

Higher prevalence was reported from other abattoirs in the country; 18.49% in north westen Ethiopia (Kebede 2008), 21% in Nekemt (Ahmad, 1990) 26.25% in Hawassa (Abunna *et al.*, 2008) and 27.6% in Luna export abattoir in East Showa (Hailu, 2005).

Out of a total of 600 *C. bovis* cysts that were collected from different organs harboring them, 46.6% in heart, 33.3% tongue and shoulder muscle 20%. The Heart was the most frequently affected organ; this observation is in agreement with the work of Abuna *et al.* (2008) who reported *C. bovis* in Hawassa with proportion of 43% and Dawit at Gondor abattoir (37.84%). However, it is slightly higher than the findings of Hailu (2005), 21.54% in East Showa zone. The viability tests of cysts revealed that it was the tongue, which harbored the highest number of viable cysts (60%) and this is in agreement with the reports of Amsalu (1989) at Gondor abattoir. The present study indicated that *Taenia saginata* cysticerci occurred in the proportion of 14.3% in masseter which coincided with the work of Opara *et al.*, (2006) 15.6%.

The present findings in the viability of cyst is in agreement with the work of Abunna *et al* (2008) who reported 44.2% live and 65.8% dead cysts in Hawassa abattoir. On the other hand, it is not in agreement with the work of Kebede (2008) who recorded 85.6% viable cysts.

12. 2. Perception and risk factors

The quality of questionnaire is an important tool in individual cases and in mass investigation for the detection of *Taenia saginata* in carrier individuals (Fralova, 1985).

A cross sectional questionnaire survey revealed that the overall prevalence of *Taenia saginata* in respondents during the interview was 70 (63.64%). Prevalence of present study slightly was close to the findings of Abunna *et al.*, (2008) who reported 64.2%, Dawit 2004 (69.2%), Tembo (2001) 68%. On the other hand this findings is greater than the reports of Woldemichael *et al.*, (1990) 13.5% in Wonji Showa and *Wondimagnehu et al.*, (1992) in Wonji 2.5%. Study sites as risk factor have no significant effect on the occurrence of *Taenia saginta*. The present Study showed that there was strong association between age of the respondents and the prevalence of *Taenia saginta* infection (P=0.000) and it is in agreement with the finding Hailu (2005), Dawit (2004), Mulugeta (1997) and Abunna *et al.*, (2008) who reported higher prevalence in adults with age more than twenty. The probable explanation could be the chance of contracting the infection in this age category is higher since they frequently visit butchers for raw beef which is the favorite dish for the

most respondents. The rest of respondents with the age less than twenty even they do not have the chance to visit butchers, because of financial constraints and to some extent due cultural restriction.

Among the different age groups, those between 15 and 26, 27 and 40, and above 40 years were 68.42 % (95% CI = 53.6-83.21), 73.91% (95% CI = 61.2-86.6), 57.14 % (95% CI = 31.2-83.1) more infected, respectively than those below 15 years 16.67% (95% CI = 4.4-37.8). In conformity with this finding, Regassa *et al.*, (2009), Taresa *et al.*, (2011) and Tesfaye *et al.*, (2012) have reported that the disease is more common in adults than in children and youth. The possible explanation for the presence of age-wise variation in the prevalence of taeniosis is attributed to frequent raw meat eating habit of adults as compared to those below 15 years (Megersa *et al.*, 2010). Nevertheless, Abunna *et al.*, (2011) and Bedu *et al.*, (2011) didn't observe age-wise variation in the proportion of taeniosis (Adugna, 2012).

In this study the interaction between sex and the prevalence of *Taenia saginata* was slightly statistically significant (P=0.046) this is in agreement with the findings of Hailu (2005), Dawit (2004) and Temb (2001) in Ethiopia. The possible explanation for the present finding was that male frequently visit butchers and there is cultural limitation for females especially, for those who lived in the rural area (Megersa *et al.*, 2010).

Statistical analysis showed that there was an association between the prevalence of taeniosis and religion. The study revealed that the proportion of taeniosis infection was higher in the Christian community. This finding is in Agreement with findings of Hailu (2005), Dawit (2004), Tembo (2001), Abunn *et al.*, (2008), Regassa *et al.*, (2009) and Taresa *et al.*, (2011). Regassa *et al.*, (2009) and Taresa *et al.*, (2011). The higher proportion of infection in Christian Community could be due to the fact that raw meat (beef) is their favorite dish. During festivals and holidays, they prefer beef to mutton; therefore they are prone to *T.saginata*. Properly cooked meat is very popular among Muslims and they prefer mutton and goat meats to beef.

High risk groups that have frequent exposure too cattle meat and their products, raw meat eaters, and those who no use spice showed 72%, 83.05% and 80.85% respectively more

infected with *C. bovis* than low risk groups, cooked meat eaters and those who use spice respectively. Groups who had close contact with meat and meat products were infected more than those who had low access to meat and meat by products. The result of this study was in agreement with findings of Hailu (2005), Endris and Negussie (2011), Dawit (2004), Tembo (2001), Abunna *et al.*, (2008), Taresa *et al.*, (2011) and Tesfaye *et al.*, (2012) in Ethiopia and majority of researches in most countries this is due to the fact that those who eat raw or undercooked meat had the chance to easily be infected with *Taenia saginata*. Those, who have low level of education, do not consider taeniosis as a disease, so that the prevalence of taeniosis was higher in this group than those in higher level of education.

Analysis of the results of the present study demonstrate that there was very strong association between raw meat eaters and infection of taeniosis (P=0.000) that is coincide with the findings of Hailu (2005), Dawit (2004), Tembo (2001) and Abunna *et al.*, (2008).

Annual drug inventory (2013) at three district of Oromia has showed that niclosamide, mebendazole, praziquantel and Albendazole were the most frequently used drugs at three district of West central Oromia. The worth of taenicidal drugs used in the one year period of 2013 was 68.181doses that worth 380.032 Eth. Birr. Bedu *et al.*, (2011) indicated that the utilization of 74,614 adult taeniacidal drug doses with an estimated cost of 110,560 Eth. Birr in two years' time in Zeway town and Tesfaye *et al.*, (2012) also revealed the consumption of 29,952 adult doses which worth 40,201.8 Eth. Birr (2407.2 USD) per annum in Wolaita Soddo. All the existing reports in Ethiopia revealed that a huge sum of family and country money is spent for the purchase of taenicidal drugs that would have been spent on other important items.

Of these traditional herbal medicines, Kosso (70%), Enkokko (62%) and Meterie (58%) were commonly used at a higher percentage followed by Duba-fre (pumpkin seed) (42%) and Tosigne leaf (20%).

13. CONCLUSIONS AND RECOMMENDATIONS

Although the prevalence was lower compared to other studies, the current study showed that *Taenia saginata/Cysticercus bovis* is an important zoonotic parasitic disease in the study areas. Consumption of raw meat, open air defecation, poor waste disposal, low level of public awareness and presence of backyard slaughtering practices were the factors associated with the disease. Apart from its zoonotic significance taeniosis/cysticercosis causes an economic loss through condemnation of edible offal and whole carcasses as well as incurring cost for therapeutic use for infected humans.

Conventional meat inspection technique, which is less sensitive, was practiced in the study area and the detection of bovine cysticecosis was influenced by minimized number of cuts in inspected predilection sites, lack of transportation facilities and lack of equipments and level of qualification offered to the meat inspectors. By conventional meat inspection techniques infected carcasses can be easily missed and passed for human consumption thus favoring the infection transmission. Based up on the findings of the present study, the following points are recommended:-

- Infected meat and meat products must undergo the proper process of freezing, boiling or destruction based on the intensity of infection with cyticerci.
- Offals found infected with the cyst must be properly disposed via through burying or incineration.
- Improve the working conditions of meat inspectors and up-grade their skills.
- Public awareness about the health and economic significance of the disease with special reference to the danger of consumption of either raw or undercooked meat and usage of latrines should be made.
- Detailed meat inspection is suggested.
- Further studies should be conducted in other neighboring administrative zones.

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5. ANNEX

Questionnaire set to study Epidemiology of *T saginata*

ode _____ Date _____

istrict _____

illage/Kebele _____

1. In which of the following age categories do you place yourself?

1.1. ☐ 15

1.2. ☐ 16-20

1.3. ☐ 26-30

1.4. ☐ 31-45

1.5. ☐ Above 46

2. Sex: ☐ Female ☐ Male

3. Religion ☐ Christian ☐ Moslem

4. Occupation: _____

5. Do you own livestock? Yes ☐ No ☐

6.Reasons for keeping cattle:

Source for food ☐ source of income ☐ others (specify?)_____

7.How do you manage your cattle?

Source for food ☐ source of income ☐ others (specify?) _____

8. Are there any latrines in the areas where cattle are grazed?

☐ Yes ☐ No

9. Do you have latrine in the areas where cattle are grazed?

☐ Y ☐ No

10. Is meat inspection done when you slaughter cattle at home?

☐ Yes ☐ No

11. Which of the following statements best fits your situation with regard to raw be consumption?

☐ Never tasted raw beef or pork used to eat but currently quieted

☐ Stopped but restarted Might decide to stop in the future

☐ Never dared to stop and have no intentions to do so

12 Have you ever been advised in the past not to eat raw beef

Yes ☐ No ☐

13. When did you stop eating raw beef/pork (if applicable)?

☐ A few months ago ☐ a year ago ☐ 2-5 years ago ☐ more than 5-years ago

14. Please rank in order of your preference (i.e. 1= best and 8-least), the following foodstuffs (the same rank could be given for more than one time).

- Semi-roasted minced beef (Leb-leb Kitfo)

- Properly cooked minced beef (Yetetebese Kitfo)

- Raw minced beef (Tibs)

15. Sewage disposal system:

Latrine in house Yes ☐ No ☐

Defections in open are ☐Yes ☐No

Defecation in pigsty Yes ☐ No ☐

16, Consumptions of untreated water (water from rivers or non-controlled water sources Yes ☐ No ☐

Have you ever suffered from taeniasis Yes ☐ No ☐

Have you observed symptoms of illness whenever you get infected with tapeworms?

☐Yes ☐ No

17. If yes which one (s) of the following symptoms of illness whenever you get infected with tapeworms?

☐ Diarrhea ☐ Hunger pain ☐Constipation ☐Epigastric pain

Nausea ☐ Increased appetite ☐ ☐Decreased appetite

☐ Chronic headache ☐mental disorders Epileptic crisis ☐

☐ Subcutaneous nodules ☐Dizziness

☐ Disturbance by crawling segments

18. How many people in your household have suffered from tapeworm infection(s)?

_____

19. Which one of the following taenicidal drugs (tapeworm treatments) have you used in the past to treat yourself

a. From the modern drugs available in pharmacies

☐ Vermox (Mebendazole)☐ Kosofsrm (Niclosamide) ☐ Dichlorophene

☐ Praziquantel ☐ others (specify) _____

b. From the traditional herbs commonly used in Ethiopia

Koso ☐ Enkoko ☐ Meterie ☐Other (Specify) ☐

20. How you have a latrine at your homestead

_____

21. Is meat inspection done when you slaugter cattle at home?

Yes No

22. Approximately, how many times in your lifetime have you taken this tapeworm treatment?

Modern drugs: _____

Traditional herbs: _____

23. Which drugs do you think are more effective to treat tapeworm infection(s)?

_____ _____

_____ _____

_____ _____

24. Do you know the cause of tapeworm infection(s)

☐ Yes ☐ No

25. In your opinion, which food animal species serves as source of humans infection?

☐ Cattle ☐ Sheep ☐ Goats ☐ Pig ☐ Camel ☐ Poultry
Fish ☐

26. In the identified animal above, which organs, or tissues or parts of flesh do you think contain the infective form of the parasite?

_____

_____

29. How do the animals get the cyst?

_____

_____

30. Do you recognize the tapeworm infective form in meat? ☐ Yes ☐ No

31. Do you believe that butchers inform their customers on whether the meat is infected or not

Yes ☐ ☐No

32. State your opinion as Yes or No to the following assertions?

A. Backyard and home cattle slaughter tradition in Ethiopia is one of the major factors for the high prevalence of human tapeworm infection in the Country

Yes ☐ No ☐

B. Institution of a nationwide and rigorous (through) meat inspections procedure helps to dramatically reduce tapeworm infection prevalence in Ethiopia

Yes ☐ No ☐

C. Prohibition of backyard and home slaughter or cattle is one of the perquisites if a rational control of taeniasis/cysticerosis is envisaged (Contemplated) in Ethiopia.

Yes _____ No _____

D. Do you intend to stop eating raw and/or under cooked beef/pork just because of the tapeworm infection?

☐ Yes No ☐

CURRICULUM VITAE

Personal information

Name: Abate Worku Belachew (Dr)

Place birth: Addis Ababa

Date of birth: Jun 10, 1960 E.C

Sex: Male

Marital Status: Married

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Educational background

- 1964_1971 E.C Nesanet Berihan primary and junior high school
- I972_1977 Karamara Secondary school in Cuba
- 1978_ 1983 Bayamo University (Faculty of veterinary medicine)

Work experience

1984_1997 Head of veterinary service at Woreda level in Amhara regional state

1987_2005 I Working as instructor at BKako ATVET COLLEGE

Membership: member of the Ethiopian vet Association

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