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Study on Prevalence of Cysticercus Bovis in Cattle at Municipal Abbatoir of Kofale District, West Arsi Zone, Oromia Regional State, Ethiopia

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Abstract
Bovine cysticercosis caused by the larval stage of the human tapeworm *Taenia saginata* is a Zoonotic disease of great public health significance especially in developing countries The Present study was conducted on 768 slaughtered cattle at kofale municipal abattoir in south Eastern Ethiopia between September 2015 to April 2016 to determine prevalence of bovine cysticercosis. The overall prevalence of the parasite was 4.94%. The distribution of parasite in adult cattle was (3.38%) where as in old cattle was 1.56%. The rate of the parasite in adult and old cattle didn't vary significantly ($p>0.05$). The rate of the parasite in male and female was 4.03% and 0.91% respectively where there is sex wise significant variation ($p<0.05$). At the Same time, there is significance ($p<0.05$) variation of the parasites in different organs with highest rate of the parasite in heart muscle (1.69%, n=13), followed by tongue (1.04%, n=8), masseter muscle (1.04%, n=8), Liver (0.78%, n=6) and diaphragmatic muscle (0.39%,n=3). This indicates the presence of the parasites in the study area so that great attention toward meat inspection, good animal health management and deworming of animals to reduce the burden of the parasites in the study area should be in place.
Keywords: Abattoir; Cattle; *Cysticercus bovis;* Prevalence; Kofale

1. INTRODUCTION

Bovine cysticercosis is a muscular infection of cattle by the larvae of the human intestinal cestode, *Taenia saginata*. The parasite is cosmopolitan in its distribution (Minozzo, *et al.,* 2002) with varying of prevalence (Reinecke, 1983; Doyle, *et al.,* 1997). The adult Taenia infection in man is referred to as Taeniasis and that due to the larval stage cysticercosis (Hancok, *et al.,* 1989). The distribution of *Taenia saginata* is wider in developing countries where hygienic conditions are poor and where the inhabitants traditionally eat raw or insufficiently or sun-cured meat (Florova, 1982; Symth, 1994; Minozzo, *et al.,* 2002). The infection is also a problem in developed countries where considerable "rare" (i.e. undercooked) beefsteak is consumed. It is important to note that eggs have been demonstrated to survive almost all stages of sewage treatment. It is significant; too, that even the high standard of meat inspection in abattoirs of highly developed countries that are expected to identify measly beef carcasses has not succeeded in eliminating this parasite (Florova, 1982; Symth, 1994).

Cysticecosis was significantly more prevalent in feedlots and in traditional farming system than in dairy. It is suggested that the continuous contact between man and animal and the use of causal workers may be factors that are conducive to *Taenia saginata* transmission (Dorny, *et al.,* 2000).

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 serve 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).

In Ethiopia, there are different reports regarding the prevalence of taeniasis. Example are 89.41% reported by Tembo (2001), 64.2% by Abunna *et al.* (2008), 51.1% by Regassa *et al.(*2008), 56.7% by Megersa *et al.* (2009) and 64.44% by Taresa *et al.* (2011) based on questionnaire surveys.

On the other hand the prevalence of cysticercosis reported was between 3.1 and 4.9% in central Ethiopia, Jimma and Gondar (Tembo, 2001; Dawit, 2004; Megersa *et al.,* 2009; Taresa *et al..* 2011), and 13.3-26.3% in Hawassa and WolitaSoddo (Abunna *et al.,2008* and Regassa *et al.,* 2008), based on Abattoir survey. However, none of the reports addresses the direct risk of human to *Taenia stagnata* though consumption of infected carcasses and the associated factors for exposure. Assessing the magnitude of risks associated with consumption of raw meat from known infected carcasses' is essential to estimate the possible infection prevalence of *T.saginata* and design acceptable control strategy.

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).

In foreign trade, although the country is ideally placed to export live animals to the big markets of the Middle East and substantial markets of North and West Africa, export earning is relatively low. This is mainly due to the presence of a number of unimproved animal problems, among which *Taenia saginata/cysticercus bovus* remains a major public and animal health problem (EARO, 2000) and sufficient emphasis must be given to increase the foreign export revenue. Thus, the current study was carried out to indicate the prevalence of C. bovis at Kofale town Municipal Abattoir and to determine the distribution of cysts in organs and tissues of infected animals.

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). It resides in small intestine of humans where it attaches using its scolex and can survive for many years.

2.1.2. Morphology

The adult is ribbon-shaped, multi segmented and hermaphroditic flatworm its body divided into three distinct parts consisting of scolex (head), neck and strobila (Gracey, 1981; 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 (O.I.E., 2000). The neck is short unsgemented 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 and mature gravid segments in linear sequence. Each segment is called progllotid and 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 (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. This implies that coproscopic examination has a limited value in the diagnosis of *Taenia saginata* infection (Doyle *et al.,* 1997). 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, 1981; Teka, 1997).

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 (4-5^{0}c) (Doyle et al., 1997).

Figure4: The egg of *Taenia saginata*
Source: Wen *et al.,* (1993)

The larval stages (*C. bovis,),* or metacestodes also referred to as “beef measles” are found in all striated muscles of the intermediate host. *C bovis* is a small (pea-sized) oval in shape (O.I.E., 2000), semi-translucent

cyst filled with dense white fluid containing an invaginated scolex. The metacestode is morphologically similar to the future adult tapeworm. It measures about 10mm in diameter and 6mm in length (Doyle *et al.,* 1997). When incised, the cyst may be viable containing a thin fibrinous capsule or degenerate showing cream or green colored calcification (O.I.E., 2000). The cysticerci are formed over a period of 3-4 months after the egg is ingested. This form may remain viable in the intermediate host for up to 9 months or even up to the entire life of the host. In the carcass, *C bovis* can survive for up to 9 months or even up to the entire life of host. In the carecass *C. bovis* can survive for about 15 days at 5^0C, 9 days at 10^0C and 6 days at -15^0C to -30^0C (Harrison and Sewell, 1991). If a carcass is found to contain cysts, it is required to be frozen at -10^0C for 10 days, however if the lesions are extensive, the entire carcass is condemned (Yoder *et al.,* 1994).

2.2. Epidemiology

Taenia saginata, Taeniasis occurs throughout the world with variable degree of prevalence (Harrison and Sewell, 1991). Its prevalence could be classified into three groups: high prevalence with Taeniasis exceeding 10%, moderate infection rates (0.1-10%) and Low infection rate less than 0.1% (Doyle *et al.,* 1997; Minozzo *et al.,* 2002). Poor hygiene, poor sanitation, poor livestock husbandry practices and inadequate meat inspection and control and also eating raw or insufficiently cooked meat can be risk factors for the spread f the disease (Caparet *et al.,* 2002, 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 counties 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 in 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 of 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 (Mann, 1984). 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/Cyticercus bovis* 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
Namibia	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

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), and higher 30% from different abattoirs in the country (Fikire and Adugna *et*

al., 2012).

Table 2: Status of *Cysticercosis* in Ethiopia

Location	Prevalence in %	Source
Central Ethiopia	3.1	Tembo, 2001
Gondar	4.9	Dawit, 2004
Addis Ababa	7.5	Nigatu, 2004
Gondar 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
North Western Ethiopia	18.9	Kebede, 2008
Nekemte	2	Ahmad, 1990
Luna export abattoir in East Shoa	27.6	Hailu, 2005; Adugna, 2012

2.3. Life cycle

Humans get infected by eating inadequately prepared beef that is contaminated with viable cysts (Allepuz *et al.,* 2009; Dorny *et al.,* 2010). A single cyst is normally sufficient to establish an infection, but multi-infections do occur (Dorny and Praet, 2007). There are estimates that one infected bovine carcass could infect on average 8-20 human individuals (Dupuy *et al.,* 2010). The adult tapeworm will develop in the small intestine of its human host. These tapeworms reach maturity in two to three months and can be quite remarkable in size with a length of 3.12 meters (FAO/WHO, 2014). In the absence of treatment the tapeworm can occupy human intestines for 20-25 years (Hoberg, 2002).

Adult tapeworms will release gravid proglottids that contain 30,000-50,000 eggs (Flisser *et al.,* 2005). Between three and seven proglottids are released every day (Dorny *et al.,* 2010). These proglottids will leave the body of host by active migration through the anus or within the stools. In the stools proglottids are usually locate on the surface of the faces (Cabaret *et al.,* 2002). The released eggs contain oncosphere (a larva) that is infective immediately after being released by the host. Cattle become infected by grazing on a contaminated pasture. The pasture can become contaminated directly with human faeces containing *Taenia* eggs, or indirectly via sewage sediment or flooding (FAO/WHO, 2014).

Eggs hatch in the digestive system of cattle and the oncospheres are released. They penetrate though the intestinal wall and start circulating in lymphatic system and in the blood. After the migration in the body the larvae will develop into cysts. This will take place in eight to ten weeks, after what they are already infective to humans (Flisser *et al.,* 2005). The cysts lodge itself in to the smooth muscle tissue, including heart, masseter muscles, tongue and diaphragm (FAO/WHO, 2014). Approximately nine months after infection most cysts have died and calcified (Flisser *et al.* 2005) but some remain viable in the muscles. After eating raw beef that is containing 12 viable cysts humans get infected and the cycle begins again. Previously described life cycle is illustrated in Figure 2 (picture courtesy of CDC-DPDX)

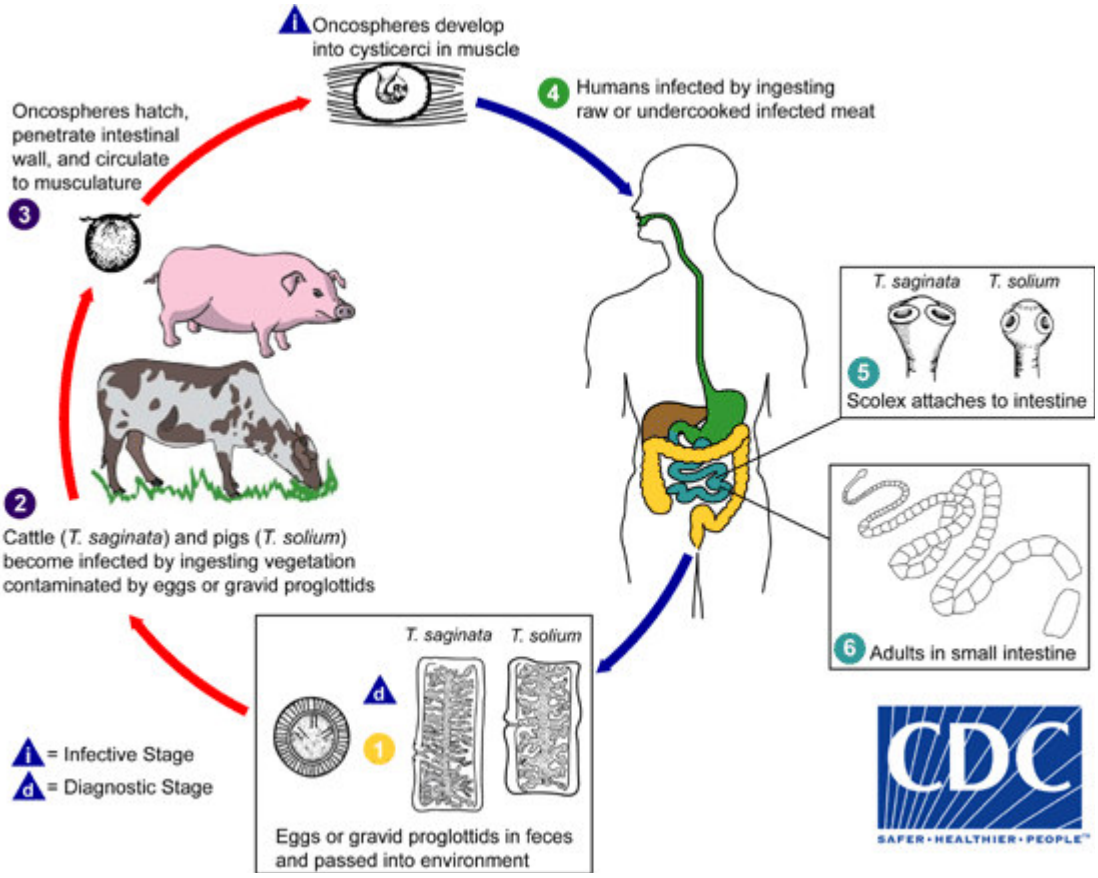

Figure 2: Life cycle of *Taenia saginata* and *Taenia solium*

2.4. Clinical manifestations

Usually humans are infected by single T. saginata tapeworm (Dorny and Prate, 2007) .In humans the adult *T.saginata* tapeworm lives in the digestive system, in small intestine. Most frequently infected people are asymptomatic or suffer from anal pruritis and discharge of faecal proglottids (FAO/WHO, 2014). With voluntary self-infection experiments with *T.saginata* the researchers found that shedding of the proglottids happen spontaneously and actively, and humans shed five to fifteen proglottids per day (Craig and Ito, 2007). They also found that this shedding can start as early as ten weeks after infection and by that time the tapeworm was found to be approximately three meters long. Humans can shed *Taenia* eggs with faeces even without any symptoms present. Sometimes there is non-specific symptoms present, such as vomiting, nausea, diarrhea, epigastric pain and weight loss. Rarely this tapeworm can cause ileus, pancreatitis, cholecystitis or cholangitis (FAO/WHO, 2014). Even more rarely *T.saginata* can cause bowel obstruction (Karanikas *et al.,* 2007). There is one case report published with *T. saginata* causing acute cholangitis-this is not normally in the nature of this parasite (Uygur-Bayramicli *et al.,* 2012).

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 death between 14 to 16 days due to a degenerative myocarditis (Oryan *et al.,* 1998)

2.5. Diagnosis

Definitive diagnosis is based on identifying the proglottid, since the eggs of *T. saginata* cannot be distinguished from those of other species of Taenia. The gravid proglottid of *T. saginata* has 15to 35 lateral branches of the uterus on each side of the main uterine stem (Harrison and Swell, 1991; Teka, 1997). If the gravid proglottid is treated with 10% formaldehyde and injected with Indian ink the uterine branches are very prominent. Uterine branches also can be seen by gentle pressing the proglottid between two microscope slides and holding them in front of a bright light (O.I.E., 2000). If the scolex is present, the four characteristic hookless suckers can be used as a distinguishing feature for identification (Symth, 1994).

The development of DNA probes has made it possible to distinguish T. saginata from T.solium. Sensitivity of serological tests varies depending on the particular method and the clinical form of infection (Doyale *et al.,* 1997). A"deep stick" technique based on an antigen capture ELISA, to detect copro-antigens in feces has been

developed for Taenia species in humans (Zarlenga and Rhoods 1999).

The metacestodes are readily visible in the organs of musculature at autopsy and therefore; diagnosis of bovine cysticercosis is usually made during postmortem examination in abattoirs and packing plants (Brown and Neva, 1983 Zivkovic *et al.,* 1996; Moreira *et al.,* 2001; Kumba *et al.,* 2001; Reis *et al.,* 2000;Al-Sultan *et al.,* 1998; Manhoso, 1996, Gracey, 1981).

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 intercostals muscles are potential sites for cyst location (Dorny *et al.,* 2000; Maeda *et al.,* 1996). Classical meat inspection techniques cannot detect all of the carcasses infected with cysticerci (Dorny *et al.,* 2000; Harrison *et al.,* 1997).

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 and the Meat Control Act of Kenya (MOA, 1972).

These are:

- 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 three 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, through inspection of the whole carcass and offal should be done. The location, nature and number of cysts should be recorded (MOA, 1972).

2.6. Prevention and control

Lack of and improper use of latrine or open field defecation leads to contamination of grazing lands. The use of latrine reduces spread of *T. saginata* eggs. Controlled grazing, avoiding use of sewage effluent to fertilize pasture, prevents infection in cattle (Symth, 1994). Adequate meat inspection, abstinence from eating raw or inadequately cooked beef (through cooking of meat at a temperature of 56-60 ^{0}c) and freezing the infected carcass at - 10^{0}c for 10 days prevents human infection. Chemotherapy in human reduces the spread of eggs and infection in cattle (Solusby, 1982).

There are a number of taenicidal drugs available in the market. However 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 (Doyale *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 (Doyale *et al.,* 1997) followed by purgatives such as magnesium sulphate to expel the dead worms. In animals treatment with 50mg/kg of compounds such as albendazole, praziquantel or mebendazole can be given but they are considered not fully effective (Symth, 1994; Solusby, 1982). Praziquantel at this dose for for days is reported effective but this is proved impractical because of high cost (Reinecke, 1983).

Recombinant vaccines have been developed using non-living antigens of the parasite, host. Protective responses that can be induced readily in the intermediate hosts may be used to control the infection in cattle (Lightowlers *et al.,* 1996).

Improvement of an effective control programme has to include actions intervening at various points of the *T. saginata* life cycle. It will require a coordinated approach among all stakeholders: consumers, medical doctors and pharmacists, directors of sewage treatment plants, meat inspectors, veterinary practitionars and farmers (Kyvsgaard and Murrell, 2005; Cheruiyot and Onyango-Abuje, 1984; WHO, 1983).

2.7. Public health importance

Taenia saginata is very long (3-15 meters in length) tapeworm parasite whose adult form is found attached to the small intestinal tracts of human beings. In man it has been known to live for 20 years with in single individual. Therefore, it is an intestinal parasite of cattle and humans, causing taeniasis in humans. It is found globally and most prevalent where are raised and beef is consumed. It is relatively common in Africa, Eastern Europe, Southeast Asia and Latin America. Humans are infected by result of poor hygiene (Abilo *et al*., 2006). Taeniasis has debilitating effect on people who already have live of protein deficiency diets suffer from iron deficiency and infested by hook worm (FAO, 2004). *T.saginata* is found in small intestine of humans which computed through the absorption of the digested food and its proglottids migrate to different organs causing different signs (Kebede N. *et al*., 2008). *T. saginata* infection is usually asymptomatic. However, heavy infection often results in weight loss, dizziness, abdominal pain diarrhea, headaches, nausea, constipation or chronic indigestion and loss of appetite. There can be intestinal obstruction in humans and this can be alleviated by surgery. The tape worm can also expel antigens that can cause an allergic reaction in the individual. It is also rare cause of pancreatitis, cholecystitis and cholangitis (WHO,2013) and (FAO, 2004) stated that the disease can also cause obstruction of the bowel, stomach-ache and migrating proglottids cause inflammation of the appendix, inflammation of the bile duct, unpleasant surprise from the faces; whereas (Teka G.,1997) stated that taeniasis in humans causes anal purities due to emerging tapeworm segments but with severe infection humans may experience increased appetite or loss of appetite, abdominal discomfort and digestive upset. Generally, (WHO, 2013), stated that adult *Taenia* parasite is located in the intestinal tracts of humans with 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 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 computing with the parasites for nutrients (They need to physically eat more to provide more enough nutrition for both themselves and the worms).
- Body weakness, headaches, dizziness, irritability and delirium.
- Malnutrition- very large numbers of adult Taenia tapeworms in the intestinal tracts of man resulted 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 life-threatening abdominal inflammation and infection and septicemia.
- Appendicitis, biliary obstruction and pancreatitis-rarely, adult *taenia saginata* (Beef tapeworm) 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-threating 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.

2.8. Economic importance

While ill-health caused by the adult worms in humans give rise to high medical costs (Fan, 1997),the economic losses due to bovine cysticercosis are mainly due to condemnation, refrigeration 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 cost for detained carcasses (Grindle, 1978). For the African continent, an annual loss was reported to be US$1.8 billion (Mann, 1984) under an overall infestation rate of 7%. In South America, where an overall infestation rate was estimated at 2.0%, bovine together with porcine cysticercosis caused an annual loss of US$420million(Fan,1997). Annual losses in Botswana and Kenya approached £0.5 million and about £1 million respectively with the loss per animal slaughtered is £2.25 in Botswana and £1.50 in Kenya (Grindle, 1978). 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). However, country's high cattle population, poor hygiene, and common occurrence of bovine cysticercosis reflect heavy losses.

3. MATERIALS AND METHODS

3.1. Study area

Kofele district is located in the West Arsi zone of the Oromia Region; this District has a Latitude and Longitude of 7A45E Longitude with an elevation of 2695 meters above sea level.

The study was conducted in Kofale town 279 km South of Addis Ababa. It located at a Latitude and Longitude of 7A45 East longitudes. The area is lowland and found in Oromia Regional State, Ethiopia at an altitude of 2695 meters above sea level with a bimodal rainfall pattern consisting of along rainy season "kiremit" from June to September and short rainy season "belig" extending March to May. The mean annual temperature 15^0c (10^0c -24^0c), rainfall 1300mm and relative humidity 59.6 were recorded (CSA, 1998). In the area, excessive extensive management system is dominant, while semi intensive and intensive systems are rarely practiced.

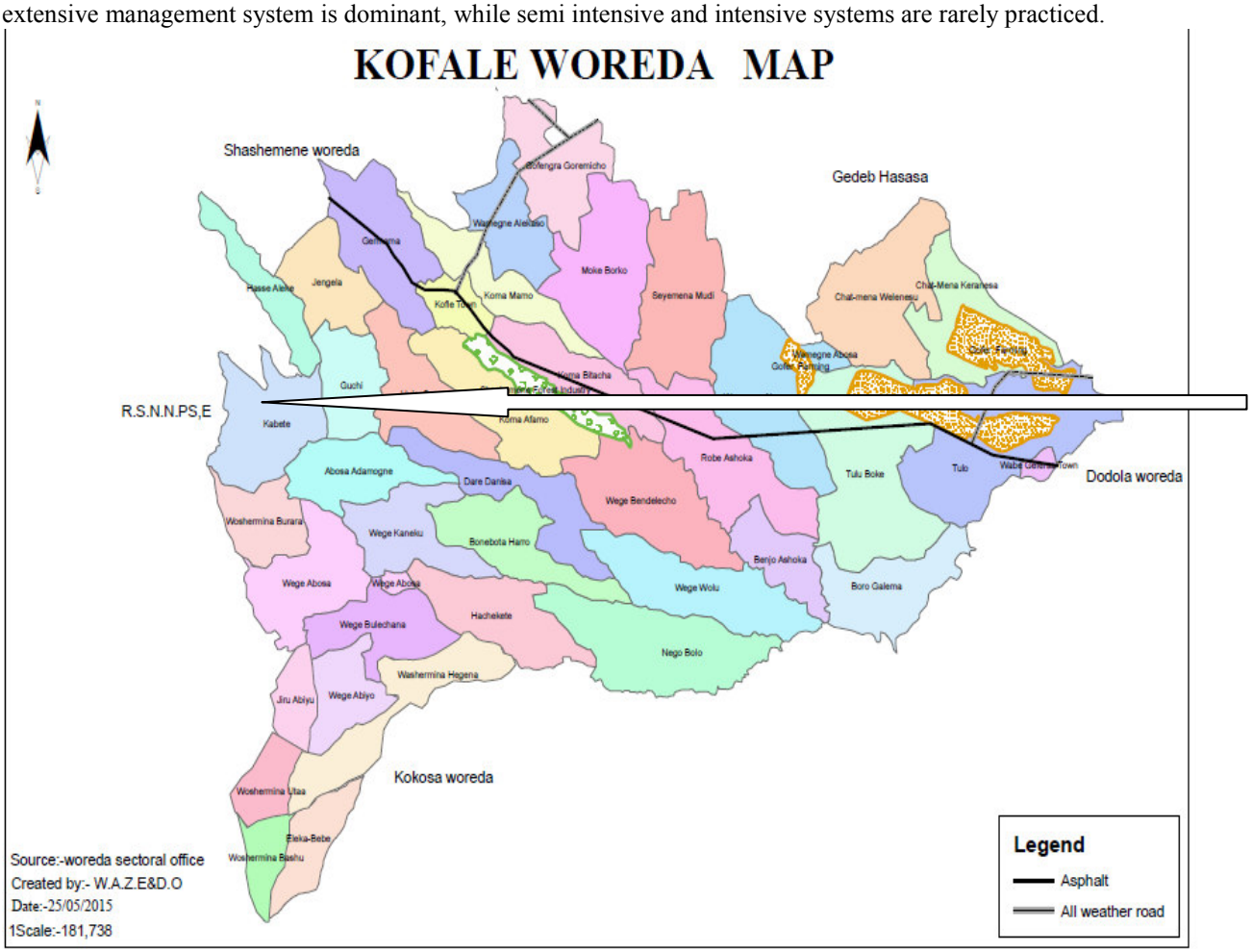

Figure 3*:* Map of Kofale and study area

Study population

The study population consists of cattle at different age and sex categories originated from Kofale and the surrounding districts.

3.2. Method of examination

The animal were examined before slaughter (anti-mortem inspection) and after slaughter (post-mortem

inspection) was carried out on the different predilection sites of the parasites.

Ante-mortem inspection

Anti-mortem inspection of the animal was done day before slaughter to assess body condition, disease condition and place of origin of the animals. The main categorization was divided in to two categories based on their age (4-7 years as adult and great or equal to 8 years as old).

Post-mortem inspection

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 the 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 abattoir all slaughtered cattle were examined.

During post-mortem inspection, examination was made by making an incision on different muscles and organs to assess the presence of *Cysticercus bovis.* The various sites examined were liver, heart, tongue, masseter muscle and diaphragmatic muscle. Palpation and visualization of organs followed by incision of organs was made to examine for the presence of *Cysticercus bovis.* For masseter muscle, deep line incision were made parallel to the mandible, the heart were incised from base to apex to open the pericardium and incision were made for liver, shoulder muscle, diaphragm and longitudinal incision for tongue(MOA, 1972).

3.3. Sample size determination

Sample size was determined according to Thrusfield, (2005) using 95% confidence level, 5% precision. The 50% expected prevalence of *Cysticercus bovis* was used since there was no published prevalence *Cysticercus bovis* in the study area.

The formula used for sample size determination was:

$$N = \frac{(1.96)^2 * Pexp * (1-Pexp)}{d^2}$$

Where:

n=required sample size

Pexp=expected prevalence

D=desired absolute precision

Using the above formula, the minimum sample size required for the study was about 384. However, to increase the precision, the sample size was increased two-fold and 768 cattle's were sampled in kofale District.

3.4. Data management and analysis

Micro soft excel was used for data entry and logistic regression Stata Version 12 Special Edition USA for data analysis used. The effects of different epidemiological risk factors, such as age and sex were considered on the prevalence of cysticercosis were tested using chi-square (X^2) and P-value less than 0.05 was considered as significant and P>0).05 non significance. Prevalence of *C. bovis* infection was calculated by dividing the number of animals examined having cyst by the total number of animals examined

4. RESULTS

In the study period a total of 768 cattle were inspected in Kofale municipal abattoir from September 2015 to April 2016. From a total of examined cattle, 38(4.94%) were found to be infected to *Cysticercus bovis*. Regarding to age group higher prevalence was in adult 26(3.38%) and lower in 12(1.56%) old but there was no statistical variation (p=0.668) among age groups and the prevalence (p>0.05) as indicated in Table 3. Cysticercus with respect to sex revealed that higher prevalence 31(4.03%) in male and lower prevalence 7(0.91%) in female. Statistically significant (p=0.017) difference was found among different sex groups as indicated in Table 4.

Table 3: **Prevalence of *C. bovis* in relation to age**

Age	Number of animals examined	Number of positive	X^2	P-value
Adult	549	26(3.38%)		
Old	219	12(1.56%)	0.18	0.668
Total	768	38(4.94%)		

Table 4: **Prevalence of *C. bovis* in relation to sex**

Sex	Number of animals examined	Number of positive	X^2	P-value
Male	708	31(4.03%)		
Female	60	7(0.91%)	4.750.017	
Total	768	38(4.94%)		

Heart was the most frequently infected organ with a prevalence of (1.69%) followed by tongue (1.04%), masseter (1.04%), liver (0.78%) and 0.9% diaphragm. There is significance difference in the distribution of the

parasite in different organs ($p<0.05$) as indicated in Table 5.

Table 5: **Anatomical distribution of *C. bovis* in different organs**

Organs affected	Number of positive	X^2	P -value
Heart	13(4.03%)		
Tongue	8(1.04%)		
Masseter muscle	8(1.04%)	0.00	0.000
Liver	6(0.78%)		
Diaphragmatic muscle	3(0.39%)		

5. DISCUSSION

In the current study it was found that the overall prevalence of the parasite was 4.94%. the distribution of the parasite in adult animals were higher (3.38%) compared to that of old animals having the rate of 1.56%. but there is no statistical significance difference between these two age groups($p>0.05$). The current overall prevalence of the parasite was high compared to the finding of Onyango *et al. (*1996) who stated that the prevalence rate of cysticercosis is generally low in developed countries, being less than 1% of the carcasses inspected. However it is lower compared to the finding of Fikire, (2012) who reported prevalence of 30%. On the other hand the current finding is higher compared to the result of Tembo, (2001) who reported prevalence of 3.1% in central high land of Akaki, Bishoftu and Adama. Moreover the present finding is low compared to the prevalence of 9.7% in Gonder reported by Demissie (1989). But it is higher compared to the report of (Ahmad, 1990) who indicated prevalence of 2%. Similarly, the present result was also lower compared to the study conducted by (2009), Alemayehu *et al.(* 2009) Abunna *et al.* (2008) Hailu, (2005) and Kebede, (2008) in Tigray, in Wolaita Soddo (Southern Ethiopia), Awassa, East Shoa and North Western Ethiopia with the rates of 21%, 11.3%, 26.5%, 17.5% and 18.4% respectively. The higher difference in the total prevalence recorded with the current study might be due to the differences on agro-climatic conditions, number of animal sampled and their origins of animals. The other reason is hygiene and eating habits differences and in addition to this postmortem inspection is less sensitive when the infection is at initial stage.

In the present study there is statistically significant difference ($p<0.05$) between both sexes. This is in contrary with report of Gomol *et al., (*2011) Kebede *et al.,* (2008) Jemal and Haileleul, (2011) and of Garedaghi *et al.,* (2011). The possible reason is that, the sample size of female cattle is not comparable to that of male cattle slaughtered at Kofale municipal abattoir.

At the same time there is significance variation of the parasites in different organs (masseter muscle, tongue, heart, liver and diaphragm), ($p<0.05$) with the highest prevalence in heart (1.69%) in agreement with Dawit Tessfaye *et al.,* (2012) and Hylegebriel Tesfaye and Alembrehan Assefa (2014); and contradicts with (Nuraddis,I. and Frew, Z.(2012) which is tongue was the most affected organ. This is due to blood kinetics and activity of muscle. *C. bovis* mostly found in muscles that have high blood supply and frequently movement. In confined animals *C. bovis* found in muscle of mastication, heart and diaphragm. Masseter muscle and tongue have equal prevalence (1.04%), muscle of mastication particularly masseter mussle and tongue equally important as a predilection site to cysticerci (wanzala *et al.,* 2003). Diaphragm is the least prevalence recorded (0.39%), this is in line with (Abunna *et al.,* 2007; Dawit Tessfaye *et al.,* and Lielt Emiru *et al.,* 2014), and this disagrees with (Bekele Megerssa *et al.,* 2010). This variation occurs due to imperfect incision of organs generally.

The socio-economic and environmental factors that contribute to this prevalence of the disease in cattle is explained by absence of public latrines around the roads and markets and by the availability of grazing pasture that brings cattle together during grazing thereby exposing them to the infection. Rainfall washes large land areas that might have been contaminated with human waste to grazing land thus contaminating the grazing areas. Public education on the use of latrines and improved standards of human hygiene are recommended.

6. CONCLUSION AND RECOMMENDATIONS

The current finding indicates the presence of the parasite in the study area which needs high attention by the veterinarians of the study area. At the same time there was variation of the prevalence of the disease in male and female cattle as well as in the adult and old animals which were slaughtered in the municipal abattoir. Similarly, the rate of the disease in different organs also varies from one organ in other organs with high rate of the parasite in heart. Even if the present study showed the existence of lower prevalence of cysticercosis, there is deep-rooted tradition of raw meat consumption which magnifies the public health hazard of taeniasis in the study area. Based on the above conclusion the following recommendations forwarded.

- Public education should be given at all levels to increase public awareness and bring cultural changes so as to avoid the consumption of raw beef.
- Public should be made aware to use latrines, not to contaminate the environment with proglottids of Taenia eggs by defecating on pastures where cattle graze.

- Back yard slaughtering of cattle should be avoided.
- Construction of slaughter house which fulfills the necessary facilities and hiring of well qualified meat inspectors is highly paramount**.**
- Attention must be given to routine meat inspection. Meat inspectors should be vigilant to detect *C. bovis* in beef carcasses.
- Proper deworming of cattle is essential.
- Further research on the prevalence of Cysticercosis and the economic importance of the parasite should be conducted.

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