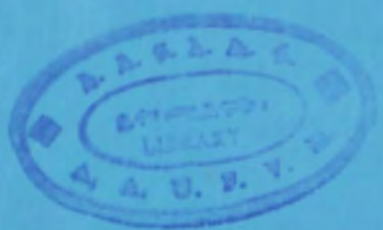
ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

PREVALENCE OF BOVINE SYCTICERCOSIS AND HUMAN TAENIAIS IN SOUTHWEST SHOA ZONE, OROMIA REGION

BY
ADUGNA TADESSE



JUNE, 2009
DEBRE ZEIT, ETHIOPIA

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PREVALENCE OF BOVINE SYCTICERCOSIS AND HUMAN TAENIAIS IN SOUTHWEST SHOA ZONE, OROMIA REGION

A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Tropical Veterinary Parasitology

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ABBREVIATIONS

AAU	Addis Ababa University
CTA	Technical Center for Agriculture
^0C	Degree Celsius
DVM	Doctor of Veterinary Medicine
FAO	Food and Agricultural Organization of the United Nations
KGy	Kilo gray
OIE	Office International des Epizootics
PCR	Polymerase Chain Reaction
WHO	World Health Organization

ABSTRACT

A cross-sectional study was conducted from October 2008 to April 2009 on bovine cysticercosis in cattle slaughtered at Sebata, Tulubolo and Woliso municipal abattoirs in south west Shoa zone of Oromia regional state, central highland of Ethiopia, with the objective to determine the prevalence of *Taenia saginata* cystiercosis, organ distribution, viability of the cysts and the associated risk factors. The study was conducted using routine methods of meat inspection, questionnaire survey on continently selected respondents in the study areas. OF 1216 carcasses examined during the study period in three municipality abattoirs, 4.6 %(56/1216) were infected with *C. bovis*. A prevalence of 4.25% (17/400) in Sebata 5.3% (23/430) in Waliso and 3.9% (16/386) in Tulubolo were observed. The distribution of organs/tissues infected with *C. bovis* (the proportion of cysts per organ) was, Heart (39.3%), tongue 30.4%, diaphragm 10.7% and liver 3.6% in descending orders. Out of positive cases 39.3 %(22/56) were viable and 60.7% (34/56) were non-viable. Based on the questionnaire survey, *T. saginata* taeniosis is a wide spread problem in these three towns and surrounding rural areas. Out of 392 respondents 55.1% (216/392) had contracted *T. saginata*. The potential risk factors of taeniosis are namely; age, sex, religion, occupation, education status, raw meat consumption, knowledge about the disease and presence or absence of the latrine were considered. The prevalence of taeniosis was not significant by site where the respondents lived (urban of rural) (P=0.272 and χ^2 = 1.208). There was strong association between the prevalence of taeniosis and age (P=0.000 and χ^2 = 14.700) and slightly significant association in prevalence between the sex of respondents (P=0.046 and χ^2 = 3.988) were observed. Among Muslim and Christian communities, it was found that there was a statistical significant difference in prevalence of taeniosis at (P=0.011 and χ^2 =6.452). Similarly, higher significant differences (P=0.000 and χ^2 = 53.028) in the prevalence between occupation of the respondents was revealed. The association was highly significant (P=0.00 and χ^2 =62.94) in raw meat consumers as compared to those respondents which were never tasted or consume only well cooked or roasted meat. There was also strong association (P=0.001 and χ^2 =13.972) between the prevalence and education status. The present study also showed that there was slightly association between the knowledge of the respondents and prevalence of the disease (P=0.024 and χ^2 =5.062). However, there was no association (P=0.157 and χ^2 = 2.00) between the prevalence of and the availability of latrine.

Key words: Cattle, Human, *Cysticercus bovis,* Cysticercosis, Prevalence, Risk factor, *Taenia saginata,*Taeniasis, Tapeworm

1. INTRODUCTION

Livestock play crucial role in the livelihoods of the majority of African countries. The proportion of people relying on livestock for their livelihood in Africa ranges from 20 to 90% depending on the type of livestock production system and country (Mc Dermott and Armi, 2002). 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).

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 the 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 (Fralova, 1982; Smyth, 1994).

The adult tapeworm, *T. saginata* occurs in the small intestine of the definitive host, man and the metacestode (*Cysicercus bovis*) is found in cattle that serves as main intermediate host (Soulsby, 1982). Globally, there are 77 million human Taenia 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 (Weldemichael *et al.*, 1990; Wondimagnehu *et al.*, 1992; Tembo, 2001; 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 (Tembo, 2001; Dawit, 2004 and Fufa, 2006).

The effect of *Taenia saginata* taeniais on human health is considerable and symptoms may be vague or absent (Merial, 2001). 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 (Fralova, 1982; Bessenov, 1982). Some times, 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 (Fralova, 1982).

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 (Gracey, 1981). 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 order to asses the economic impact of the disease, drug inventory has been conducted in central Ethiopia and according to this study it was demonstrated that the amount of nicolosamide and diclorophene production in two drug factories in Ethiopia between 1996 - 2000 was 31, 814, 833 doses; the annual expenditure for the modern drugs in three areas of Shoa (Akaki, Debre-Zeit and Nazareth) was estimated at 1, 471, 281 Eth. Birr during the year 2000 (Tembo, 2001).

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 through out the country, in central high lands of Ethiopia, in Oromia Reginal State South West Shoa Zone there is no any work that indicates the status & risk factors of *T. saginata* taeniosis/ cysticercosis. Hence, the current study was designed to attain the following objectives:

- To determine the prevalence of *T. saginata* cysticercosis in Sebeta, Woliso and Tulu bolo municipality abattoirs,
- To determine organ distribution and viability of the cyst
- To identify the major risk factors associated with *T. saginata* taeniosis/ cysticercosis in the study area.

2. LITERATURE REVIEW

2.1. Classification

Taenia saginata, the unarmed beef tape worm of human and its metacestode, *cysticercus bovis* belong to the class of Cestoda, order Cyclophyllidea, family Taeniidae and genus Taenia (Smyth, 1975). *T. saginata* and *T. asiatica* are sister species and distantly related to *T. solium* (Hoberg, 2006).

2.2. Morphology

2. 2. 1. The Adult Parasite

The adult worm is 4-8 m, rarely up to 25 m long (Soulsby, 1982); 4 -10 m long and 12 mm wide (Jurasek, 1987); can reach lengths of 30 m or more (Gracey, 1999). Its body is divided into three distinct parts, scolex /head/, neck and storobila (Gracey, 1981; Soulsby, 1982).The scolex (the head) measuring 1mm to 2mm in diameter has four strong hemispherical suckers, without rostellum and hooks (Gracey, 1981). The strobilla consists of 1000-2000 proglottids. The neck is short unsegmented with a germinal structure immediately behind the scolex, which continually produces proglottids. The anterior proglottids are wider than long, while the posterior matured proglottids are three times longer than its width (Jurasek, 1987). The gravid Proplottids are 10-20 mm long (Fig 1) and are usually shaded singly and may leave the host spontaneously or crawl on the body, clothes and beds of human beings (Pawlowski and Schultz, 1972). The uterus of the gravid segment has 15-30 lateral branches on each side of the central stem in contrast to that of *T. solium*, which has only 7-12 lateral branches (Urqhuart *et al*., 1996).

Figure 1: Adult *Taenia saginata*

Source: http://www.healthinplainenglish.com/health/infectiousdiseases/tapeworm

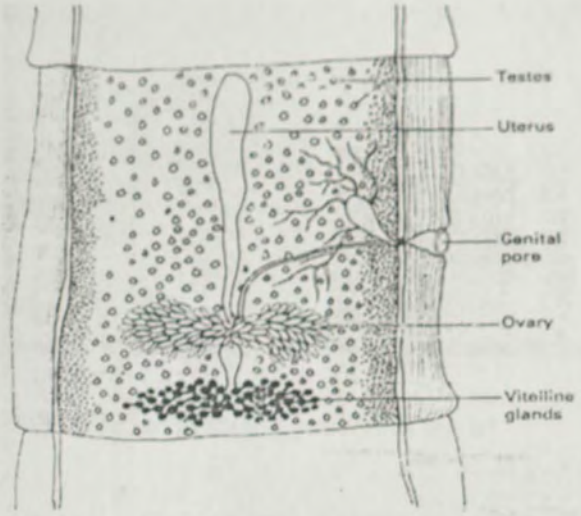

Figure 2: Mature segment showing reproductive organs
Source; (Urquhart *et al.*, 1996)

Figure 3: Gravid proglottid of *Taenia saginata.*

Source: http://aapredbook.aappublications.org/cgi/content/full/2003/1/3.125

2.2.2. Eggs

Eggs are roughly spherical in shape and measure 30-50 by 20-30 micrometer (Urquhart *et al,* 1996). The egg (Fig 4) consists of an oncosphere or hexacant embryo, bearing three pairs of hooks; have a thick brown radially striated embryophore or shell composed of blocks; and there is an outer, oval, membranous coat, the true egg shell, which is lost in feces (OIE, 2004).

Figure 4: Eggs of *Taenia saginata*
Source: http://aapredbook.aappublications.org/cgi/content/full/2003/1/3.125

2.2.3. 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, 1981). The cyst is seen as small whitish vesicle and is found between muscle fibers (Fig 5). 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 (Smyth, 1975; Soulsby, 1982; Urquhart *et al.*, 1996).

Figure 5: *Cysticercus bovis* in muscle (histology)
Source: (http://www.dpd.cdc.gov/dpdx)

2.3. Life cycle

An infected human may pass millions of eggs daily, either free in the faeces or as intact segments each containing about 250,000 eggs, and these can survive on pasture for several months (Urquhart *et al.*, 1996).

When suitable intermediate host (cattle) ingests eggs, together with grass they hatch in the duodenum under the influence of gastric juice and intestinal secretions. The released hexacanth embryos rapidly penetrate the gastrointestinal mucosa and are carried to all parts of the body through blood vessels and incyst in striated muscle (tongue, maseters, triceps brachii, the shoulder, esophagus, heart and occasionally in fat, liver, lungs and lymph nodes), where they develop into *cysticercus bovis*, containing scolex. 12 weeks later, the larvae (*Cysticercus bovis*) become infectious commonly; these larvae leave the capillary blood vessels and enter into muscles, and develop into infective cysticerci (Cheng, 1986).

The metacestode becomes grossly visible for the first time at about two weeks later as a pale, semi-transparent spot about 1.0 mm in diameter, but it is not infective to man until about 12 weeks later when it has reached its full size of 1.0 cm and by then it is enclosed by the host in a thin fibrous capsule (Urquhart *et al.*, 1996). Infection in man occurs through consumption of raw and/or undercooked beef containing viable cysticerci (Smyth, 1994; Khalil, 2009). Following infection, an adult tapeworm develops in the intestine within three months (Hansen and Brian, 1994). Fig. 6 shows the detailed life cycle of *Taenia saginata* and the probable mode of transmission of the parasites.

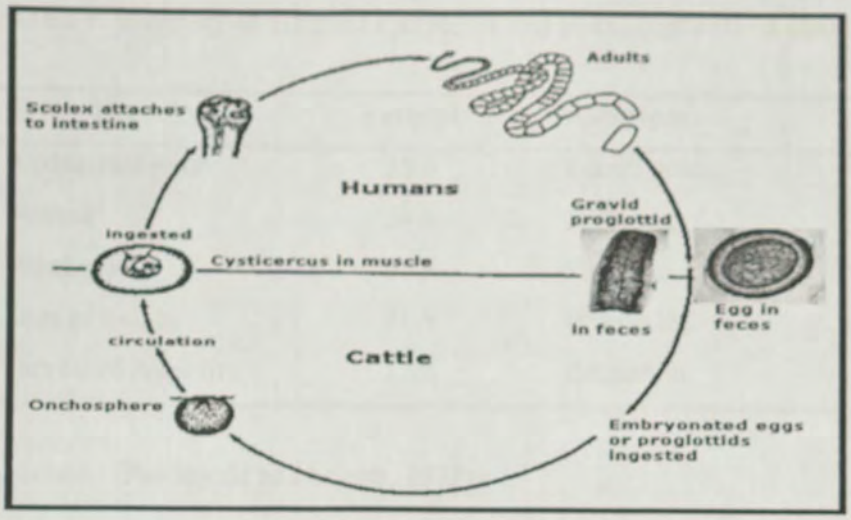

Figure 6: The life cycles of *Taenia saginata*
Source: (http://www.dpd.cdc.gov/dpdx)

2.4. Clinical signs

2.4.1. In Humans

Taenia saginata induces variable symptoms or may cause unrecognized infection. However, an asymptomatic *Taenia saginata* infection, may within a short time, change in to a life-threatening condition, when proglottids are vomited and aspirated or when proglottid enter the appendix. The most frequently observed symptom is the discharge of proglottids. These may creep out of the anus on to the peri anal skin and may even migrate over clothes or on the ground, shedding eggs as they move. Other symptoms observed include abdominal pain, nausea, and weakness, loss of weight, headache, constipation, cramps and diarrhea (Pawlowski and Schultz, 1972; Smyth, 1994; Hendrix, 1998). Signs like those of epigastric discomfort, hunger sensations and irritability were also observed in infested individuals (Khalil, 2009).Table 1 shows the percentages of these clinical occurrences in descending order.

Table 1: 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: (Pawlowski and Schutz, 1972)

2.4.2. In cattle

In cattle and other animals, cases of cysticercosis are usually asymptomatic except when severe infections occur when there may be diarrhea and some loss of condition (Gracy, 1999). Information on the symptoms of cysticercosis is very scanty; even with very heavy infections (30000 cysticerci) there are no clinical signs (CTA, 1989). Under experimental infection of calves with oncospheres, it has been observed that migration of oncospheres may cause alteration of triads: increased temperature (40-41^{0}C), respiration and pulse rates. Further symptoms observed include weakness, diarrhea, anemia, myositis and heart failure. Mortality in severely infected calves may reach 10 % (Jurasek, 1987), although experimentally infected calves have developed severe myocarditis and heart failure due to the development of cysticerci in the heart (Urquhart *et al.*, 1996). According to (Oryan *et al.*, 1998) a dose rate of one million or more eggs may cause death between 14 to 16 days due to a degenerative myocarditis.

2. 5. Diagnosis

2.5.1. In Humans

Since there is no characteristic clinical picture of infection, the diagnosis must be based on fecal examination and anal swab will help to find out whether a tapeworm infection exists, however, the exact species identification (Table 2) of *Taenia saginata* is made by examination of the scolex or proglottids that show typical species characteristics (Pawlowski and Schultz, 19972; Smyth, 1994). The uterine branch of gravid proglottids of *Taenia saginata* is 15 to 35 (G/Emanuel, 1997) 14-32 for *Taenia saginata asiatica*, 7-11 and for *Taenia solium*. However, since these ranges overlap, they can not be relied on absolutely, a proglottid with 10 branches or fewer can be considered likely to be *Taenia solium* and one with more than 16 branches to be *Taenia saginata* (WHO, 1983). Uterine branches can be seen by gentle pressing the proglottid between two microscope slides and examining this under light microscope. Uterine branches also can be seen by treating the proglottid with 10% formaldehyde and injecting with Indian ink (OIE, 2000). Eggs are distinguishable by morphological features (Table 2). Examination should be repeated, if the results are negative (Hendrix, 1998). If the scolex is present, the four characteristics hookless suckers can be used as a distinguishing feature for identification (Smyth, 1994).

A PCR-RFLP assay using primers derived from the 12S rDNA fragment is a reliable tool for subspecies identification of *Taenia*. In contrast to morphological examination, PCR-RFLP allowed differentiation between *T. saginata* and *T. s. asiatica* and could also be performed on disintegrated samples (Somers *et al.*, 2007)

2.5.2. Diagnosis in cattle

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). In general, meat inspection procedures consist of visual inspection of the carcass; its cut surfaces and the organ within it. It is recommended to inspect the following organs:

- The external and internal masseter muscles
- The pterigoid muscles
- The tongue
- The pericardium and heart
- Muscles of the diaphragm
- The esophagus

In African countries, in particular the triceps brachii and may be the gracillus muscle are incised in bovine carcass during post-mortem inspection (OIE, 2004). The following types of cysts can be found during meat inspection:

1. Small white lesions in muscle tissue (2-3 weeks old cysticerci),
2. Clear transparent bladders 5-10 mm (12-14 weeks old infective cysticerci), and
3. Opaque and pearl like cyst (over 15 weeks old cysticerci) (FAO, 2004).

In general, the commonly used palpation and incision techniques at routine meat inspection cannot be considered as an accurate indicator of the true occurrence of *T. saginata* cysticercosis (EFSA, 2004.).

Several studies showed that in spite of the time and effort taken by meat inspectors for looking for cysticerci at predilection sites, this method is very insensitive. One obvious reason is that cysticerci may easily be missed because they may not be on the cuts of heart or masseter muscles (Dorny *et al.*, 2000). To effectively improve meat inspection procedures, there is need to increase the area and number of predilection sites observed during meat inspection (Wanzala *et al.*, 2003).

The development of an automated sensitive and specific diagnostic test would greatly reduce the costs of damage to the carcass and the costs of labor, but serological tests for animals have not reached the stage where commercialization for individual diagnosis or large-scale detection of infected carcasses in slaughter house (OIE, 2004).

In practice, Ag-ELISA, is at least twice as sensitive as meat inspection and has proved useful as a sero-epidemiological tool, and will also facilitate field-based epidemiological studies on live herds since it allows ante mortem diagnosis. Finally, the Ag-ELISA affords the

opportunity for farmers to make decisions over the management of their known infected stock and their farms (Onyango-Abuje *et al.*, 1996). In Belgian cattle the prevalence of bovine cysticercosis was more than 10 times higher with the antigen detection ELISA than by classical meat inspection (Dorny *et al.*, 2000).

The IHAT / Indirect Heamagglutination Test / with 100 % sensitivity and 91-100 % specificity, can be used as a diagnostic test for epidemiological surveys, to map infected and disease free areas and to estimate the national prevalence of the disease. The test is relatively cheaper and can be conducted in most laboratories. The IHAT with further improvement and evaluation can be used to qualify animals for international movement or the test can serve for the diagnosis of *T. saginata* cysticercosis within the local setting for import or export of animals (Nigatu, 2004).

2. 6. Differential diagnosis

2.6.1. In Humans

There are a number of methods used to differentiate between *Taenia species*. These are: morphological characteristics of the scolex in the adult tapeworm, numbers of lateral branches of the uterus in the gravid proglottids ovary and vagina, size of egg and cysticerci (Smyth, 1976; Smyth, 1994). Table 2 depicts the difference between *Taenia saginata, Taenia saginata asiatica* and *Taenia solium.*

Table 2: Differentiation between *Taenia saginata, Taenia saginata asiatica* and *Taenia solium*

Characteristic	*Taenia saginata*	*Taenia saginata asiatica*	*Taenia solium*
Intermediate host	Cattle, reindeer	Pig, and wild boar, cattle, goat, monkey	Pig wild boar
Development site	Muscle	Mainly liver	Brain, skin, muscle
Scolex			
Suckers	4	4	4
Rostelum	Absent	Present	Present
Hooks	Absent	Present	Present
Mature proglottids			
Ovary	2 lobes	2 lobes	3 lobes
Vaginal sphincter	Present	Present	Absent
Egg size	40x50mm	33x28mm	40x50mm
Cysticercus size	10 mm by 6 mm	1,320mm by 3, 219 mm	20 mm by 10 mm
Gravid proglottids			
Uterine branches	23(14-32)	17(12-26)	8(7-11)
Passing of proglottids	spontaneously , singly	spontaneously, singly	Passively in groups

Source: (Smyth, 1994)

2.6.2. In Cattle

Sarcocystis, Onchocerca dukei and *Cysticercus dromedary* can confuse, with diagnosis of *Cysticercus bovis* during meat inspection. There is a possibility for these three parasites to co-exist in a single carcass. *Sarcosystis* form white soft nodules, are c 4 to 6 mm long and are found in the esophagus. *Onchocerca dukei* measures 3 to 6 mm in diameter. They form intra-muscular and sub-cutaneous nodules, that are firm to touch and the worms are surrounded by pus when sectioned (CTA, 1989).

Cysticercus dromedarius, the metacestode of Taenia hyaenae, which is twice as long as *Cysticercus bovis* measuring 12 to 18 mm in length, is pearly white in color and possess double row of hooks on the lateral part of scolex. This cyst has been reported by Amsalu in (1989) in Ethiopia.

2.7. Treatment

Currently good selections of safe anthelmintics are available, some with broad-spectrum activity and others with activity against specific helminthes infections. Many pharmaceutical drugs are effective against both adults and larval stages and an increasing number are efficacious against arrested or dormant larvae (Hansen and Brian, 1994).

2.7.1. In Humans

Treatment of people against taeniosis kills the worms but does not make the eggs present in the intestinal lumen uninfective. The treatment will cause the worm to disintegrate releasing thousands of eggs; thus when people are treated their faeces should be disposed carefully for a period of time (48 hours) due to these 'egg showers' (EFSA, 2004).

Some times emergency surgical treatment may be required, which indicate that taeniasis of the gastrointestinal tract can be the cause of the most unusual complications, such as mechanical obstruction of the bowel and consequently necrosis or volvulus (Karanikas *et al.*, 2007).

Ill-health complications associated with taenicidal drug usage were more frequently experienced after treatment with traditional herbs than with modern drugs (Tembo, 2001). Hailu (2005) reported that among respondents who took taenicidal drugs 82.2 % of them encountered complication that manifested by vomiting, diarrhea, epigastric pain, weakness and dizziness.

Pharmaceutical drugs

Praziquantel and niclosamide are very effective, simple to administer and comparatively free from side effects. Surgery is indicated only for the treatment of complications (Karanikas *et al*, 2007).

The drug, niclosamide blocks glucose uptake by intestinal tapeworms. Tablets should be chewed thoroughly before swallowing and washed down with a little water; as a single morning dose on an empty stomach (Weatherall *et al*., 1996). The dosage is 2g for adult; for children <10 Kg: 0.5g and for 10-35 Kg: 1g as a single dose. The dose is divided into two and taken each half in one hour apart and there are no known contraindications to the use of niclosomide (WHO, 1995).

The drug, praziquantel: as a single dose after a light breakfast (Weatherall *et al*., 1996), kills both adult and larvae; *T. saginata* rapidly contract and disintegrate in the intestine. For intestinal taeniasis, a single dose of 5-10 mg/ Kg is suitable for adults and children over 4 years (WHO, 1995). Failure of proglottids to reappear within 3 to 4 months indicate cure (Weatherall *et al*., 1996).

Traditional drugs

In Ethiopia, many people especially in the rural inhabitants use different types of traditional herbal drugs described in the table 2 as a routine self-deworming practice (Berhanu and Ermias, 1978; Desta, 1995).

Table 3: Major Taenicidal herbs used in Ethiopia

Local Name	Scientific name
Enkoko	*Embelia schimper*
Duba fre	*Cucurbita pepo*
Ttosigne	*Thymus serrulatus*
Kosso	*Haginia abyssinica*
Kechemo	*Myrsiae Africana*
Kkeleum	*Maesa lanceolta*
Serdo	*Cynadon dactylon*
Ddendera	*Echinaps gigantean*
Mettere	*Glenus lotoides*
Gorrteb	*Plantago lancceolata*
Bisana	*Croton macrostchys*

Source: (Berhanu and Ermias, 1978; Desta, 1995; Feseha, 1995).

Of these traditional herbs, Kosso, Enkokko and Meterie were commonly used; in addition, Kechemo, dif-dife (highly concentrated alcohol), Duba-fre (pumpkin seed) and Benzene were also used (Tembo, 2001).

2.7.2. In Cattle

Drugs, which have shown efficacy against *C.bovis,* include praziquantel, mebendazole, and albendazole; however, at present it is not feasible to treat animals, due to the high cost and the possible public health significance of dead calcified cysts in meat and organs (Hansen and Brian, 1994). Praziquantel kills both the adult and larvae. Most of the larvae are killed, even when encysted and disintegrate completely within 5 months (WHO, 1995). Under experimental conditions Praziquantel destroys the cyst at three doses of 50 mg / Kg BW for three consecutive days. There is no licensed drug available which will destroy all cysticerci in the muscles of cattle (Urquhart *et al.*, 1996).

2. 8. Epidemiology

2.8.1. Prevalence

Taenia saginata taeniosis occurs throughout the world with variable degree of prevalence. In the world there are 77 million bovine Taenia carriers including 32 million in Africa, 11 million in Asia (Excluding the former USSR), (Fralova, 1982). Even though *Taenia saginata* occurs worldwide, its prevalence is particularly high in sub-Saharan Africa (WHO, 1995). The prevalence of *Taenia saginata* varies from country to country and even within a country from area to area (Fralova, 1982).The prevalence of *Taenia saginata* in Ethiopia ranges between 13.5 % and 89.41 % (Table 4)

Table 4: Prevalence of Taeniosis in Ethiopia

Province/Town/Area/	Prevalence (%)	Author
The whole Ethiopia	up to 100%	Fralova, (1985)
Wonjii-showa	13.5	Weldemicheal, (1990)
Akaki and Nazareth	89.41	Tembo, (2001)
North Gondor	69.2	Dawit, (2004)
East Shoa	79.5	Hailu, (2005)
Awassa	64.2	Abuna *et al., (2007).*

According to Pawolowski and Schultz (1972), the prevalence of *Taenia saginata* can be roughly classified in to three groups:

A) Highly endemic areas in countries, where prevalence exceeds 10%. These include Central and East African countries (Ethiopia, Kenya and Zaire)

B) Endemic areas with moderate infection rate, which include Caucasian and South Central Asia / Republics of former USSR/ and some Mediterranean countries (Syria, Lebanon, Yugoslavia).

C) Very low endemic areas, where the prevalence is below 0.9% or even free from taeniasis and this include Europe, North America, Australia, and New Zealand.

The prevalence of *Cycticercus bovis* in some African countries lies between 0.75 % in Gambia and 36 % in Kenya (Table 5), whereas in Ethiopia it ranges from 0.92% to 26.25% (Table 6).

Table 5 Table 5: **Prevalence of Bovine Cysticercosis in some African Countries**

Country	Prevalence %	Author
Sudan	> than 10	Fralova,(1982)
Nigeria	10.2	Fralova,(1982)
Botswana	12-15	Mosienyane,(1986)
Kenya	30-36	Pagot,(1992)
Burundi	31	Pagot,(1992)
Rawanda	15	Pagot,(1992)
Guinea	20	Pagot,(1992)
Zambia	6.2	Dorney *et al.* (2002)
Gambia	0.75	Unger *et al.* (2008)

Table 6: Prevalence of Bovine Cysticercosis in Ethiopia

Province/Town/Area	Prevalence (%)	Author
Gondar	9.7	Amsalu, (1989)
Debre Zeit	13.85	Getachew, (1990)
Nekemt	21	Ahmed, (1990)
Asella	2.7	Dessie, (1992)
Bahirdar	2.7	Mulugeta, (1997)
Central Ethiopia	19.5	Tembo, (2001)
Nazareth	0.92	Shiferaw, (2002)
North Gondar	4.9	Dawit, (2004)
Addis Ababa	7.5	Nigatu, (2004)
East Shoa	17.5	Hailu, (2005)
Awassa	26.25	Abuna *et al., (2008)*

2.8.2.

Host related factors

Man (definitive host)

Gender was reported as one of the very important risk factors of taeniosis. For instance Tembo (2001) reported that males had 3.95 fold odds of suffering from taeniosis compared to females. The habit of consumption of raw or under cooked beef and occupation were among the most important factors of taeniosis infection in Ethiopia (Dawit, 2004; Fufa, 2006).

Cattle (intermediate host)

The preferred intermediate hosts are cattle, especially young animals, since older animals are more resistant to infection. Infection with *C.bovis* is sometimes observed in other ruminants (sheep, goats, antelope, gazelles, buffalo and dromedaries), but cysticerci development is unlikely (CTA, 1989). Although other bovine species have been known to harbor the cysts the contribution of wild species towards the epidemiology of taeniasis is insignificant because man heavily depends on cattle for his proteins (Cheruiyot and Onyango-Abuje, 1984). The pattern of infection following the months showed that most of the local breeds were more infected than the exotic cattle (Opara *et al*, 2006).

Cattle with less than 2.5 years of age were more infected (28.2 %) than those greater than 2.5 years of age (17.3 %) (Hailu, 2005). The infection of cattle with *C. bovis* was more prevalent in younger animals than older ones irrespective of the breed (Opara et al, 2006). But the reverse was reported in Belgium by where significant positive relationship between ages of the cattle and the sero-prevalence of cysticercosis was demonstrated. The incidence and intensity of infections and the subsequent development of immunity may affect this relationship between age and prevalence. In areas where transmission of *T. saginata* between man and cattle is frequent, cattle are usually infected at a young age and develop immunity against re-infection. In contrast, in areas such as Western Europe where transmission is more hazardous, exposure time may be more important (Dorny *et al*., 2000).

2.8.3. Agent related factor

Taenia saginata egg

The survival of the eggs is strongly influenced by climatic conditions: In wet and moist conditions, eggs may survive for months, exposing animals to a source of infection for a prolonged period of time, and eggs are very susceptible to dry conditions and are rapidly destroyed during the dry season (Hansen and Brian, 1994). Eggs of *T. saginata* can stay alive in human excrement for 71 days, in sewage for 16 days, in clean water for 33 days and on grasses for 160 days (Jurasek, 1987).

Teania saginata cysticercosis

Cysticerci commence to degenerate 4-6 months after infection and by 9 months, a substantial number may be dead; however, the longevity of the cysticerci is dependent on the degree of infection and the age of the animal at infection. A portion of cysticerci can remain viable for a prolonged period (perhaps for the life of the host) following infection of neonatal calves (Soulsby, 1982). The cysticerci can survive for 10 to 15 days after the death of the host if the carcass is kept at 10^0C and for more than one month at 0^0C (Feseha, 1995).

2.8.4. Environmental factors

Environment is a transmitter of infection, the most common way being indirect transmission. The spread of taeniid is facilitated by the movement of the definitive host, by water and wind as well as by passive transport by vertebrates and invertebrates (Feseha, 1995).

In a recent study in Belgium, the logistic regression analysis indicated three important environmental risk factors related to water for the detection of *T. saginata* in a herd: free access of cattle to surface water (rivers, lakes, canals) (OR = 1.91), flooding of pastures (OR = 1.76) and the proximity of the farm with a source of waste water effluent (OR = 1.55). This supports the hypothesis that water plays a role in transmission of *T. saginata* eggs (Boone *et al.*, 2007).

In the study conducted in Southeastern Nigeria an upsurge of infection during the dry season months was reported (Opara *et al*, 2006). The viability and resistance of *T. saginata* cysticercus varies according to geographical areas; therefore, it is assumed that, there exists local strain of cysticercus with different biological characteristics (Jurasek, 1987).

2. 8.5. Transmission between man and cattle

Infection in man occurs, when the larval form (*C. bovis*) is eaten live in raw or under cooked beef (WHO, 1995). The cultural habit of eating raw meat in the form of "Kourt"-meat cubes and "Kitffo"-minced meat in Ethiopia, has promoted the spread of human taeniasis in Ethiopia (Tembo, 2001; Dawit, 2004; Fufa, 2006).

The source of infection in cattle with *T. saginata* cysticercus is human (CTA, 1989). Poor personal hygiene and infected human populations is responsible for the spread of cysticercosis. In some societies such as nomads, there is a high risk of cattle being exposed to stool harboring poroglottids. Abnormal feeding habits, for instance mineral deficiencies (pica) may prompt cattle to ingest stools harboring proglottids (Hansen and Brian, 1994). Cattle get access to human stool on farms, at campsites and recreation areas, and on railway lines, and infected stock attendants can initiate epizootics (Weatherall *et al*., 1996). An important epidemiological feature of *T. saginata* is the active expulsion of the proglottids, which leave the host also in-between defecations (Boone *et al*., 2007).

2. 9. Economic importance

The metacestodes frequently present economic problems to the beef industry (Urquhart *et al*., 1996). Economic losses resulting from food borne parasitic zoonoses are difficult to assess. Estimating the global economic impacts of these diseases is handy-capped by inadequate information on the prevalence of parasitic zoonoses (Murell, 1991). Economic losses from 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, extra financial losses due to transport etc (Gracey, 1981). The important reason for condemned meat at abattoirs in central Africa Republic and Burundi is due to cysticercosis (Pagot, 1992).

In general *Cysticercus bovis* has an impact in meat trade. It increasingly becomes important in view of the drastic measures and very strict regulations importing countries apply when importing beef (Feseha, 1995). The treatment cost for human taeniasis and costs of manufacturing of drugs have significant contribution in estimation of economic loss. In Africa, bovine cystrcercosis accounts for an economic loss of one to two billion USD per year (Murell, 1991). Annual losses in Botswana now approaches 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 pounds in Kenya (Pagot, 1992; Wanzala *et al.*, 2003). Table 7 gives further data on economic losses incurred in some countries.

Table 7: Data on the financial loss caused by Bovine Cysticercosis

Country	Financial loss
Botswana	500,000 Pound sterling
Denmark	1-3 million coronas
Kenya	1 million pound sterling
Latin America	over 30 million USD
France	30 million Francs

Source: (Bessonov, 1982)

According to Abunna *et al.*, (2007) despite the fact that a large proportion of Ethiopian population frequently takes taenicidal drugs, there are limited systematic studies under taken so far to evaluate the economic losses resulting from importation of taenicidal drugs. The yearly taenicidal dose was estimated to be 4,913,346 and these dose was valued at 820,343 USD (7,219,021.00 Eth. Birr.) The average cost per single dose, of 0.17 USD (1.50 Eth. Birr) was so small and economically insignificant at individual level. However, there exists an enormous annual economic loss, when the whole population of Awassa town and its surrounding are taken in to consideration the incurred financial losses amounted to 164, 068.6 USD (1,443,804.20 Eth. Birr). The loss in addition to modern drugs, considerable proportion of the respondents (28.6), particularly resource poor households reported to have used traditional herbal remedy called "Kosso".

In Ethiopia a wide usage of both traditional and modern taenicidal drugs are used in the therapy of *Taenia saginata* taeniosis (Feseha, 1995). Annual expenditure for the modern drugs in three areas of Shoa (Akaki, Debre Zeit and Nazareth) was estimated at 1,471,281.00 Eth. Birr during the year 2000 (Tembo, 2001). The cost implication can be broken down in to those involved in treating human taeniasis and cattle, costs resulting from carcass condemnation and its treatment (freezing) as well as the costs involved in the inspection procedures amount to dollars (Mann, 1984).

2.10. Control and Prevention

Taenia saginata and *cysticercus bovis* infection can be controlled by meat inspection, avoiding consumption of raw beef and defecation on pasture, construction of latrines, deworming of carriers, declaring *Taenia saginata* as notifiable disease (Urquhart, 1996;), sanitation and hygiene on cattle farms, and proper sewage treatment and disposal (Weatherall,1996).

2.10.1. In Cattle

Public education showed principally is oriented to diminish the number of tapeworm carriers and consequentially lowering the egg output, change the attitudes, socio-cultural and behavioral factors that favor a high infection pressure from carriers. This is a key factor in the prevention of infection in cattle (CTA, 1989; WHO, 1983). Controlled grazing, avoiding use of sewage effluent to fertilize pasture (use in cultivated land) prevents infection in cattle (Smyth, 1994). In the prevention of infection from man to animals' special attention should be paid to social groups, such as, farmers, agricultural workers, hunters' tourists. They should strictly be informed about the life cycle of the parasite (CTA, 1989).

Immunity to larval tapeworm infection plays an important role in the dynamic of transmission. Extensive studies have been under taken to characterize the immune response to cysticercosis in cattle (Lightowler, 2003).

2.10.2. In Humans

According to Wanzala *et al.*, (2003) in spite of the time and efforts taken by meat inspectors to detect cysticercii at specified predilection sites of carcasses, the method is insensitive and inaccurate. For this reason, they suggest that, in order to effectively improve meat inspection procedures, there is a need to increase the number of predilection sites observed during inspection, based on type of the animal, husbandry, history and the target of human population for consumption. Since other new potential approaches (vaccination, chemotherapy and immunodiagnostics) have not been well developed for use, meat inspection method is therefore still the most important public health measure practiced in controlling the transmission cycle of the parasite. However, predilection sites may not be the only sites in the carcass with the highest number of cysticerci as there could be great variations in terms of distribution of cysticerci between preferred sites. Since meat inspection method is still the method of choice deployed in the control of human taeniosis at all the slaughterhouses, it is very necessary to re-evaluate it, so as to assess its state of reliability, and hence the current study.

Human infection can be prevented by meat inspection, abstinence from eating raw or inadequately cooked beef, through cooking of meat at temperature above 56-60 ° C and freezing of the infected carcass at - 10 ° C for 10 days. Although the judgment of carcasses varies from country to country, it has been recommended by WHO (1983) that, slight or moderately infected carcasses should be thoroughly cooked, pickled in brine or frozen. Heat treatment is also very important control measure for cyst of *Taenia saginata* (Jay, 2000). Irradiation is also used in very low doses of 0.5-0.6 KGy which is sufficient for inactivation of the metacestode (Eckert, 1996).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in Sebata Awas, Becho and Woliso districts, south west Shoa zone, which represents the central high land of Oromia regional state as well as the country.

South west Shoa zone is located between 80°31' and 52° latitude and 37° 58' and longitudes and an altitude ranging from 1600 to 3576 meters above sea level (m.a.s.l). It has an area of 648, 310.5 km^2 and about 1,242,284 human population of which 1098162 (88.4%) live in rural area and 144122 (11.6%) in urban area of the zone. The livestock population of the zone is 11, 34,481 cattle, 209,814 sheep, 186,268 goats, 47,415 horse, 1,927 mules, 121,248 donkeys and 434,672 poultry (SWSZARDO).

Agro-ecologically, the zone is divided into high land and mid land category. The annual maximum rain fall is 1400mm and minimum 900mm. The annual temperature ranges between 9.1 and 20.7°c respectively. The zone has a total land area of 553,777.5 hectares, cultivated land 71.24%, forest 5.55%, grazing land 9.63% and others 13% respectively.

Woliso district is situated at the center of the zone 114 km a way from Addis Ababa has an area of 67916 km^2. The livestock of the district is 163555 cattle, 19028 sheep 27849 goats, 3710 horses, 1148 mules, 16458 donkeys, 74,000 poultry and 13853 bee colonies (WDARD).

Becho district is situated 80 km away from Addis Ababa in south west direction. It has a total land area (hec) of 44,775 and human population of 103,000. The livestock population of the district is 66,416 cattle, 13820 sheep, 10937 goats 1891 horses 863 mules, 9896 donkeys, 31539 poultry and 2378 bee colonies (BDARDO).

Sabeta Awas district is located 23 kms away from Addis Ababa at extreme eastern part of the zone. It has 87,532 hectares of land area and 173,965 human populations. The Livestock population of 132,743 cattle, 17,405 sheep, 2,006 goats, 4,519 horses, 3,691 mules, 24,000 donkeys, 52,734 poultry and 19,373 bee colonies (SDARDO).

Of the three abattoirs, two of them, namely Sebata and Woliso municipality abattoirs have almost the same design and construction materials. Both 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. Concerning the third abattoir which is located in Tulubolo town lacks some slaughtering facilities and poor light for inspection of samples and to identify the smaller cysts.

Woliso and Sebata municipality abattoirs have a capacity of slaughtering about 20 to 25 local beef cattle, while Tulubolo municipality abattoir enables slaughtering 1,418 local beef cattle at one shift.

3. 2. Study population

The study animals for the abattoir survey were beef cattle coming mainly from central highland of south west Shoa, west Shoa , Horo-Guduru, Jimma and Gurage zones. During the study period (from the beginning of October up to the end of April a total of 1,216 beef cattle (400 from Sebata 430 from Woliso and 386 from Tulubolo) were examined for the presence of cystiercus bovis.

For questionnaire survey the target population was people living in Woliso, Tulubolo and Sebata towns. The later mainly considered as high production of beef cattle. The study populations were people of three kebele in Sebata town, two kebeles in Tulubolo town, 4 kebeles in Woliso town and 6 kebeles from rural area in Sebata Awas, Becho and Woliso Liban districts, from a total of 15 kebeles, 392 respondents were interviewed in this study

3.3. Study design and sampling

Active abattoir survey was conducted in sebata, tulubolo and woliso municipality 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* taeniosis, associated potential risk factors and its public health importance.

Both surveys were supported with retrospective data collected from concerned agricultural and public health organizations and government offices in sebata ,woliso and tulubolo veterinary clinics, respective health centers and red-cross pharmacy.

3.3.1. Active abattoir survey

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 5% absolute precision. Since there is no previous data on the prevalence of *T. saginata* cysticercosis/taeniosis in the study area 50% prevalence was taken as expected prevalence.

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

N = required sample size

Pexp = expected prevalence

d = desired absolute precision

Accordingly, a sample size of 1,152 head of beef cattle slaughtered in Sebata, Tulubolo and Woliso municipality abattoirs was obtained. To increase the precision of the study the calculated sample size was increased to 1216.

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 brachi, 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 care fully 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 Sebata 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).

3.4. Data analysis

All the data obtained from the study were entered into MS Excel data sheets.,coded and analyzed using SPSS (15.0 version). The data were analyzed using percentage to determine *C.bovis* infection in examined carcass; Chi square test (χ^2) was used to investigate 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

4. RESULTS

4.1. Abattoirs survey

In present study an overall prevalence of *C. bovis* was found to be 4.6%. Out of this 4.25%, 5.3 % and 3.9% prevalence in Sebata, Woliso and Tulubolo municipality abattoirs were recorded, respectively (Table 8).

Table 8: Prevalence of *C. bovis* in Sebata, Woliso and Tulubolo municipality abattoirs

Abattois	No. of inspected carcass	No of positive	Prevalence (%)
Sebata	400	17	4.25%
Woliso	430	23	5.3%
Tulubolo	386	16	3.9%
Total	1216	56	4.6%

$\chi^2 = 1.208$; $p = 0.272$

(Table 9) Shows the monthly distribution of the prevalence of *C. bovis* in Sebata, Woliso and Tulubolo abattoirs. In Woliso municipality abattoir, a relatively higher prevalence was recorded in January and the least in November and February 2009. Similarly, in Sebat abattoir, the highest prevalence of *C. bovis* was found in December and the least was in November. In addition, in Tulubolo, the highest prevalence was in December and the least in November. 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.

Table 9: Monthly occurrence of *C. bovis* in Sebata, Woliso and Tulubolo abattoirs

Abattoir	Number(n)	Months					
		Oct.	Nov.	Dec.	Jan.	Feb.	April
Sebata	Slaughtered cattle	52	47	103	91	38	69
	C. bovis	2	1	6	3	2	3
	Prevalence (%)	3.8	2.1	5.8	3.3	5.3	4.3
Woliso	Slaughtered cattle	82	71	112	119	57	89
	C. bovis	3	2	4	7	2	5
	Prevalence (%)	37	2.8	3.6	5.9	3.5	5.6
Tulubolo	Slaughtered cattle	37	77	93	70	41	68
	C. bovis	0	2	4	4	3	3
	Prevalence %	0	2.6	4.3	5.7	7.3	4.4
Total	Slaughtered-cattle	171	195	308	280	136	226
	C. bovis	5	5	14	14	7	11
	Prevalence %	2.9	2.7	4.5	5	5.1	4.9

The current study showed that heart, tongue, masseter, diaphragm and liver were organs infected with *Cysticerus bovis* with the prevalence of 41%, 30.4%, 14.3%, 10.7% and 3.6%, respectively (Table 11). An overall proportion of 22 (39.3%) viable and 34 (60.7%) non viable *C. bovis* cysts were revealed (Table 10). During the present survey cysts were not encountered in other organs like esophagus, kidney, lung and spleen. Even though butchers were not allowed to incise some important muscles during inspection, the heart and the tongue were the most infected organs with *C. bovis*.

Table 10: Distribution and condition of *C. bovis* cysts indifferent organ in slaughtered cattle

Organs affected	No. of viable cysts	No. of non viable cysts
Tongue	7	10
Heart	9	14
Liver	1	1
Masseter	3	5
Diaphragm	2	4
Total	22	34

Table 11: Proportion of infected, viable and non-viable cysts in different organs

Infected organs	Tongue	Heart	Liver	Masseter	Diaphragm
`Percentage (%)	30.4	41.0	3.6	14.3	10.7
Viable cyst (%)	41.2	39.1	50.0	37.5	10.7
Non- viable cyst (%)	58.8	60.9	50.0	62.5	66.7

4.2. Questionnaire survey

In the selected study areas 392 voluntary respondents were 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 questionnaire survey. Out of 392 respondents 216 (55.1%) was positive for *Taenia saginata*.

4.2.1. Age

There was strong association (P=0.000 and χ^2 = 14.70) between prevalence of *Taenia sagenata* infection and age distribution. Respondents above twenty years had relatively higher infection rates than youngsters.

4.2.2. Sex

The interaction of sex and prevalence was also evaluated during interview. Accordingly, it was found that sex had statistically slight significant difference (P=0.046 and χ^2 = 3.988) on the prevalence of *T. saginata* taeniosis. The prevalence was higher in male (58.4%) as compared to female (25.9%) respondents.

4.2.3. Religion

Based on the religion, the chi square (χ^2) analysis showed there was signficant statistical association between religions so that Christians were contracting taeniosis higher than Muslim communities (P=0.011 and χ^2 =6.452).

Table 12: The prevalence of *T. saginata* among Muslims and Christens

	Taeniosis		
Religion	Contracted	Not contracted	Total
Muslims	34	46	80
Christians	182	130	312
Total	216	176	392

4.2.4. Occupation

The respondents were selected from different working environments i.e. farmers, merchants, butchers and abattoir workers, students and civil servants. Accordingly, five groups were formed. Statistical analysis should that occupation had strong association with the prevalence of taeniosis P= 0.000 and χ^2 = 53.028).

Table 13: Prevalence of *T. saginata* by occupation

	Taeniosis		
Occupation	Contracted	Not contracted	Total
Farmer	94	48	149
Merchants	27	20	47
Butchers & Abattoir	20	0	20
Civil servants	57	51	108
Students	18	57	75
Total	216	176	392

4.2.5. Education level

For the purpose of statistical analysis, the education level were divided in to three categories i.e. those who did not attend school were coded as formal education, those who attended from elementary up to senior high school as middle level and respondents who graduate from colleges and universities as high level. In this particular study, education level had statistical significance (P=0.001 and χ^2= 13.972) on prevalence of *Taenia saginata* infection (Table14).

Table 14: Prevalence of *Taenia saginata* between education levels

	Taeniosis		
Education level	Contracted (n)	Not-contracted	total
Formal	66	26	92
Middle	98	92	190
High	52	58	110
Total	216	176	392

4.2.6. Raw meat consumption

The present study showed that the majority of the respondents had consumed raw meat. Eating raw meat is usually normal traditional and cultural practice in the study area in particular and as a whole in the country. The statistical analysis indicated that raw meat consumption and prevalence of taeniosis had strong association (P=0.000 and χ^2 = 63.939). 311 (79.3%) respondents had the practice of consuming raw meat and 203 (65.3%) had contracted taeniosis.

Table 15: Prevalence of *T. saginata* in relation to consumption of raw meat

	Taeniosis		
Status of raw meat consumption	Contracted	Not contracted	Total
Raw meat	203	108	311
Cooked meat	13	68	81
Total	216	176	392

4.2.7. Knowledge about the prevention of Taeniosis

In present study the interview was conducted whether they had or not, the knowledge of prevention of *Taenia saginata*. Statistical analysis showed that knowledge about the

prevention of the disease and prevalence of taeniois had slight association at P=0.024 and χ^2=5.062.

4.2.8. Latrine facility

The infection rate was almost similar in both group of respondent; to had toilet facilities or not had not statistically significance on the prevalence of Taenia infection (P=0.157 and χ^2= 2.000).

With the logistic regression analyses the independent variables consumption of raw meat, occupation age, religion and sex have their association (p<0.1) with *T.saginata* occurrence in descending order (Table 16).

Table 16: Logistic regression analysis of questionnaire survey

Variable	Coefficient	df	p	OR	95% CI for OR	
					Lower	Upper
Consumption of raw meat	2.286	1	0.000	9.832	5.197	18.601
Occupation	1.825	1	0.000	6.201	3.290	9.366
Age	1.008	1	0.000	2.740	1.617	4.643
Religion	.639	1	0.012	1.894	1.152	3.114
Sex	.441	1	0.046	1.554	1.007	2.398

df=degree of freedom, OR= odds ratio, CI= confidence interval

Beef eating habit (OR= 9.832) and occupation were the most significant explanatory variables for *T. saginata taeniosis* occurrence in respondents interviewed during questionnaire survey.

4.3. Inventories of pharmaceutical shops

Even though the pathogenic significance of *C. bovis* is considered to be very low (Soulsby, 1982), taeniosis has economic and aesthetic importance in human. Evaluating economic aspects is very difficult, to get some highlights about the economic feature of this disease, it was essential to carry out inventories of pharmaceutical shops and drug stores. To carry out inventories by itself is not easy task, there is no organized data in public health establishments and drug shops, some infected people use traditional herbal drugs to treat themselves. One of the organized pharmacies in the study area was the Woliso Red Cross pharmacy. Cost of dispended taenicidal drugs from 2003-2007 is listed on (table 17).

Table 17: Retrospective study on cost of taenicidal drugs dispended by Red Cross pharmacy during 2003-2007

	Types of drug/costs				
Year	Niclosamide	Albendazole	Mebendazole	Prazigeuantel	Sub total
2003	1420	3400	666	118	5604
2004	840.60	1251	997.56	190	3279.16
2005	958.40	2819	650.16	312	4769.56
2006	762.80	812	1813.62	178	3566.43
2007	1073.60	874	3005.64	249	5202.24
Total	5055.40	9156	7132.98	1047	22391.38

5. DISCUSSION

5.1. Abattoirs survey

Abattoir survey result of the present study revealed an overall prevalence of 4.6% cysticercosis in slaughtered cattle in all three abattoirs. The prevalence of cysticercosis was found to be 4.25%, 5.3% and 3.9% in Sabeta, Woliso and Tulubolo municipality abattoir, respectively. Statistical analysis showed that there was no statistical significant variation between these three abattoirs in the prevalence of cysticercosis. The probable reason for this observation might be the origin of cattle, as animals slaughtered in the three abattoirs originated from the same area.

The possible reason for relatively higher number of cysteicerci in Woliso and Sebata than Tulubolo may be due to more number of examined carcasses, better lighting, cleanness of the abattoirs and very good facilities compared to Tulubolo 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 (Fewster, 1967).

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 (Kerbed 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).

Variation of prevalence in different district Abattoirs were reported in Kenya by several workers with a range of 0 to 31.47% by inspection and by serology 13.33% to 80.42% prevalence (Onyango-Abuje *et al*., 1996). These results reported in Kenya have similar

picture in Ethiopia as well, where different prevalence rate were reported from different abattoirs. This variation was probably due to the difference in the personal and environmental hygiene, culture, religion, habit of eating raw meat method and quality of meat inspection, population density, agro-ecology and climate, management practice, sample size and sampling method used and the number of cuts made by the researchers.

In Gambia, low prevalence of 0.75% was reported by post mortem examination while higher prevalence 19.2% was reported by Ag (ELISA) (Unger *et al.*, 2008). In Belgium, *Taenia saginata* was detected by veterinary inspectors; out of 1164 carcasses (0.26%) circulating antigen was detected in 36 of the corresponding blood samples (3.09%) (Dorny *et al.*, 1999). The two studies indicate the low sensitivity of postmortem inspection in detecting *C. bovis*.

In the present study out of the total 56 affected organs, *Taenia saginata* cysticerci occurred in the proportion of 41% in heart, 30.4% in tongue, 14.3% in masseter 10.7% in diaphragm and 3.6% in liver. 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 (41.2%) and this is in agreement with the reports of Amsalu (1989) at Gondor abattoir. The present study indicated that *Taenia saginata* cystierei occurred in the proption of 14.3% in masseter which coincided with the work of Opara *et al.* (2006) 15.6%.

In present study the proportion of viable and non viable cysts was in agreement with Gracy *et al.* (1999) who reported that *C. bovis* usually occurs singly or in small numbers; mostly in degenerated forms. Viable cysts accounted only for some 15% of the total cysts identified.

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 and 14.4% degenerated or calcified cysts. There was no statstical significant difference in monthly occurrence of *Taenia saginata*, but greater number was obtained due to slaughtering of large number of cattle in December and January.

5.2. Questionnaire survey

1. 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, 1982). The respondents who were interviewed in the present study disclosed finding of proglottids in their feces and under wear. This finding is also supported by the reports of OIE (2004) and WHO (1983). The supporting evidence for the occurrence of *Taenia saginata* among respondents was, because of the religious and cultural reasons of the residents in the study area does not have the habit to eat pork meat. This helps eliminating possible differential diagnosis of *Taenia solium* and *Taenia asiatica*.

2. A cross sectional questionnaire survey revealed that the overall prevalence of *Taenia saginata* in respondents during the interview was 55.1%. 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, Ethiopia. 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.

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 Tomb (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 areas.

Statistical analysis showed that there was an association (P=0.011) 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) and Abunn *et al.* (2008) in Ethiopia. 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 *Taenia saginata*. Properly cooked meat is very popular among muslims and they prefer mutton and goat meats to beef.

Cornering occupation, interview was conducted by dividing respondents in to five groups; farmers, merchants, butcheries and abattoir workers, civil servants and students. The study revealed that there was a significant difference among these groups (P=0.000). 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), Dawit (2004), Tembo (2001) and Abunna *et al.* (2008) 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). From the result one can conclude that consumption of raw meat is the main risk factor for human beings.

Knowledge about the prevention of the disease has statistically very low association with prevalence and slightly significant (P=0.024). This is due to the facts that whether or not the respondent knows the disease is contracting by eating raw beef.

There was no variation in the occurrence of taeniosis among the people who had latrine and who lacks latrine facilities (P=0.157) .This is due to fact that both groups equally visit the butcher, and shared meat. The chance of infection by *Taenia saginata* is equal in both groups.

However logistic regression analysis indicated that age, occupation and raw meat were the most risk factors associated with the occurrence of taeniosis.

Inventories of pharmaceutical shops

From the questionnaire survey revealed that preferences of the available drugs among the respondents were niclosanide 61% mebendazole 28% Alebendazole 9% and praziquantel 2%. The respondent preferred nucleoside that they assume more effective and cheaper in price than others, For proaziquatel there was low demand, because of its expensive price and some complication such as disturbance in gastrointestinal tract.

The annual taenicidal drug treatment cost in one of the study area, Waliso Red Cross pharmacy which is the only pharmacy which has organized data on drug usage. The inventory demonstrates the economic significance of taeniosis.

Despite the above mentioned drugs, 2.2% of the respondents use traditional herbal medicine and 3.1% use both modern drugs and herbal medicine. The most common herbal medicine used in study area are Koso (Haginia abyssinica)) and mattere (Glenus lotiodes) especially, Koso has high purgative effect and cheaper in price.

6. CONCLUSIONS AND RECOMMENDATIONS

The distribution of *Taenia saginata/Cysticercus bovis* is associated with several factors. The main important factors are the culture of majority of residents consuming raw beef, defecation in open air, especially in rural area, poor waste disposal, poor sludge and swage treatment system, backyard slaughter ring practice in the country sides, where there is no slaughter houses and also in urban area during festivals and holidays. In addition to these in sufficient knowledge of the public about the prevention and control of taeniosis.

Even though the current prevalence is comparatively lower than other works in different part of the country, taeniosis/cysticercosis, remains a wide spread zoonosis that affects human health and economy, through condemnation of edible offal and whole carcasses, cost of human therapy, disturbance in gastrointestinal tract of human and other complications may lowering the productivity of infected workers and working efficiency.

Since conventional meat inspection technique is practiced in the study area and as a whole in the country, the efficiency to detected bovine cysticecosis is influenced by availability of adequate light, number of cuts in predilection sites inspected, level of qualification offered to the meat inspector and his dilegency. The existing recording systems of three abattoirs do not include the source of the cattle, the causes for condemned organs or tissues.

From the questionnaire survey, consumption of raw meat, age and occupation were the most important risk factors involved in the occurrence of the disease.

Based on the findings of the present study, the following recommendations are suggested:

- Public education: The health extension workers of ministry of health are very keen in educating the public especially in rural area about the advantage of using latrine, personal hygiene, environmental protection from diseases and their vectors disadvantages of eating raw meat and back yard slaughter. So these activities should be strengthening in collaboration with extension workers of ministry of agricultural and rural development, especially veterinary professionals and other concerned pertinent bodies.
- Recording the origin of the slaughtered cattle should be practiced in the abattoirs in order to trace back the source of animals infected with cysticecosis.
- Improve the working conditions of the inspectors and up-grade their skills, by offering them short term and on-job training is very essential.
- Further studies should be conducted in other neighboring administrative zone from which slaughtered cattle are introduced to the study area, to obtain information about factors influencing the epidemiology of this disease in different socio-economic, cultural and agro-climactic conditions.
- In the future government should pay due attention to the rural area by improving standards of human hygiene and sanitation. The rural community should be initiated to construct toilets/latrine in order to break the life cycle of this parasite.
- Research on the application of appropriate serological tests for diagnosis of bovine cysticercosis should be encouraged
- Reinforce the existing legislation and regulations for meat inspection shall be worked out

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8. ANNEX

Annex 1. Structure Questionnaire

Questionnaire set to study Epidemiology of Tsaginata

Code _____ Date _____

District _____

Villege/Kebele _____

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

1.1. ☐ 0-15

1.2. ☐ 16-20

1.3. ☐ 26-30

1.4. ☐ 31-40

1.5. ☐ Above 40

2. Sex: ☐ Female ☐ Male

3. Religion ☐: Christian ☐ Moslem

4. Occupation: _____

5. What was the last school you attended?

☐ No formal education

☐

Elementary

☐ College University

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 latrine in the areas where cattle are grazed?

☐ Yes ☐ No

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

☐ Yes ☐ No

11. How you have a latrine at your homestead?

_____

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

☐ Yes ☐ No

13. 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

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

☐ Yes ☐ No

15. 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

16. 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)

17. Sewage disposal system:

Latrine in house ☐ Yes ☐ No

Defection in open are ☐ Yes ☐ No

Defecation in pigsty Yes ☐ No ☐

Consumptions of untreated water(water from rivers or non-controlled water sources

☐ Yes ☐ No

18. Have you ever suffered from taenisasis? ☐ Yes ☐ No

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

☐ Yes ☐ No

20. 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

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

_____

22. 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)

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

Modern drugs: _____

Traditional herbs: _____

24. Which drugs do you think are more effective

To treat tapeworm infection(s)?

_____ _____

_____ _____

_____ _____

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

☐ Yes ☐ No

26. In you opinion, which food animal species serves as source of humans infection?

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

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

_____

_____

_____

28. How do the animals get the cyst?

_____

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

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

☐ Yes ☐ No

31. 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 nation wide and rigorous (through) meat inspections procedure helps to dramatically reduce tapeworj 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

Annex 2 : Recording sheet for abattoir survey of T.saginata Cysticercus

----------Abattoir

Date	Total No. slaughtered	Total No Examined	No. of infected cattle	Infected organ	No. of live cysts	No. of dead cysts	No. of calcified cysts	Total cysts found

1. CURRICULUM VITAE

A. Personal details

Name. Adugna Tadesse Woyecha

Birth date: May 10, 1956

Birth place: west Arsi zone, Dagaga

Sex : Male

Marital status: Married

Profession: Veterinarian

Nationality: Ethiopian

B. Education Back ground

1962- 1965 elementary education dagaga elementary school

1966-1968- Junior high school- Arsi Negele junior secondary school

1969d-1972 :- Shashemene high school certificate (ESLC)

1974-1979 :- Moscow veterinary Academy Degree Of Veterinary Medicine(DVM)

C. Work experience

1980-1981:-Veterinarian in Bage Ranch

19821983:- veterinarian and coordinator of Fourth Livestock Development Project(FLDP) at jima Zone agricultural and Rural development office

1984-1985:- Head of diagnostic unit National Tsetse and Trypanosomiasis Investigation and Control Center (NTTICC) Bedele

1986-1999:- Head of Bedele Regional veterinary laboratory.

D. Conference, seminars, work shops and trainings

- Sero epidemiological diagnostic training course Berlin, federal Republic of Germany 01 July 2000-30 august 2000.
- Study four concerning live stock breeding and veterinary research – To Kenya , Zambia & Zimbabwe for one month
- Training on tsetse control- In Tanzania, Janga for 15 days
- Study tour for 13 days- livestock disease control activity in

Nambia.

Participated in different work shops seminars prepared by governmental and non governmental organizations, Particularly on Topics concerning Tsetse and trypanosomiasis, Avianflu, CBPP, CPPP Rift valley fever, Rinder pest and Gumboro disease.

E. Language skills

Language	Speaking	Read & write	Remark
Afan Oromo	Excellent	Excellent	Mother tongue
Amharic	Excellent	Excellent	
English	Very good	Excellent	
Russian	Very good	Excellent	

F. Hobby

Like to watch films and foot ball

References

1. Dr. Yacob Hailu, DVM. MSE, PhD (Associate Professor), head of parasitology and pathology department Faculty of veterinary medicine, Addis Ababa university, Debre Zeit Tel No, 0911476007

1. Dr, Dinka Ayana, DVM, MSC (Assistant professor))

Department of parasiticlogy and pathology, faculty of veterinary medicine, Addis Ababa University, Debre Zeit Tel No,

THE SINED DECLARATION SHEET

The under signed, declare that this thesis is my original work and has not been presented for a degree in my university

Name Adugna Tadesse _____

Signature_____

Date of submission_____

This thesis has been submitted for examination with our approval as an academic advisor.

Name _____

Signature _____

Name _____

Signature _____