

# Bovine cysticercosis in Ethiopia: a review

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## Abstract

Bovine cysticercosis is an infection of cattle caused by *Cysticercus bovis*, the larval stage of *Taenia saginata*. It is an infection of public health significance as eating of raw or undercooked beef results taeniasis in human population and an important cause of economic loss mainly due to condemnation, refrigeration and downgrading of infected carcasses. Bovine cysticercosis is prevalent in cattle population of various regions of Ethiopia in a range of 2.2% to 26.25%. The reported rates of prevalence may be an underestimate because employment of the latest diagnostic methods is uncommon and the routine meat inspection is the only method in use. Habit of eating raw beef dishes, low level of toilet use by human population, backyard slaughter, low availability of taenicides, free access of cattle to surface water, and proximity of wastewater are important causes for transmission of bovine cysticercosis to a herd of cattle and taeniasis in human population and such practices are not uncommon in Ethiopia. Competent meat inspection procedure supported by immunodiagnosics, chemotherapy and vaccination are the recommended approaches to prevent bovine cysticercosis and therefore such approaches along with the current status of bovine cysticercosis in Ethiopia are highlighted in the present review.

**Keywords:** Bovine cysticercosis, meat inspection, immunodiagnosics, ELISA

## Introduction

Bovine cysticercosis is an infection of cattle caused by the larval stage, *Cysticercus bovis*, of the human intestinal cestode, *Taenia saginata*. This parasite is universally distributed in developing as well as in developed countries. (Gracey and Collins, 1992; Cabaret *et al.*, 2002). As per an estimate, 50 million cases of such infestation occur worldwide with 50,000 people dying from this problem annually (WHO, 1996). In humans, the disease is called as taeniasis which is accompanied with symptoms like nausea, abdominal discomfort, epigastric pain, diarrhea, excessive appetite or loss of appetite, weakness, loss of weight and intestinal blockage (Neva and Brown, 1994). Sometimes, the mobile gravid segments may make their way to unusual sites such as the appendix and biliary

tract and may cause serious disorders. Live cattle having *C. bovis* shows no symptoms, however, heavy infestation by the larvae may cause myocarditis or heart failure (Gracey and Collins, 1992). Cysticerci can remain alive in cattle anywhere from weeks to years and such infection in cattle is a public health problem as the infected raw or undercooked beef causes taeniasis in human. It has economic significance as well as the economic losses accruing from the condemned and downgraded carcasses and due to treatment of carcasses before human consumption are substantial (Dewhirst *et al.*, 1967; Yoder *et al.*, 1994; Onyango-Abuje 1996b; Giesecke, 1997).

Bovine cysticercosis and taeniasis are common where hygienic conditions are poor and the inhabitants traditionally eat raw or insufficiently cooked or sun-cured meat (Frolova 1982; Minozzo *et al.*, 2002). Inadequate health education and low availability of taenicides are the major obstacles for the control of such infections (Pawlowski, 1996). Due to these reasons, taeniasis is more common in developing countries including Ethiopia where meat is an important component of human diet and traditionally it is consumed raw on several occasions. About 45% of Ethiopia's domestic meat consumption comes from cattle, but this income is affected due to various unimproved animal health problems, among which, *T. saginata/C. bovis* is one (EARO, 2000). It is, therefore, important that sufficient emphasis be given to this problem so that quality and quantity of beef may satisfy the domestic requirements, increase the foreign export revenue and improve the public health. Several studies on this infection in cattle have been undertaken by staff and students in various universities and research institutes in Ethiopia but most of the available literature is limited to detection of bovine cysticercosis by the routine post-mortem inspection. The present review is aimed to highlight present status of bovine cysticercosis in Ethiopia, limitations of routine meat inspection procedure, latest diagnostic tools available, methods of control and economic losses due to this infection in bovines.

## **Prevalence of bovine cysticercosis in Ethiopia**

In developing countries, taeniasis/bovine cysticercosis constitutes a serious but less recognized public health problem (Minozzo *et al.*, 2002). Due to the habit of eating raw or undercooked beef dishes such as *kourt* and *kitffo*, taeniasis in human is common in Ethiopia (Gebro-Emanuel Teka 1997). A high (89.41%) prevalence of human infection in different agro-climatic zones of the country has been reported (Tembo, 2001). Low availability of taenicides is a constraint and the use of herbal drugs do not eliminate this parasite from human

population and the proglottids are passed out with the faecal matter resulting in cysticercosis in the cattle (Shibru Tedla, 1986). Ethiopia is divided into nine ethnically-based administrative regions and three chartered cities and bovine cysticercosis has been reported from different parts of the country (Table 1).

Table 1. Bovine cysticercosis in different parts of Ethiopia

Place	Percent Prevalence	Reference
Addis Ababa, Ethiopia	13.3%	Nigatu Kebede et al., 2009
Addis Ababa, Ethiopia	2.2%-3.3%	Gebro-Emanuel Teka,1997, Mulageta Alemu,1997
DebreZeit, Oromia	13.85%	Getachew Belayneh, 1990
Wolaita Soddo (Southern Ethiopia)	11.3%	Alemayehu Regassa et al., 2009
Mekelle, Adigrat, Wukro( Tigray region)	8.29%	Kumar and Gebretsadik Berhe, 2008
Mekelle(Tigray region)	7.23%	Abay Getachew, 2008
Southern Nations Nationalities People's Region( Southern Ethiopia)	26.25%	Fufa Abunna et al., 2008
Amhara National Regional State, Ethiopia	18.49%	Nigatu Kabede, 2008
Bahir Dar (Amhara region)	19.4%	Mulugeta Alemu, 1997
Nekemta, Oromia	21.7%	Ahemed,Ibrahim,1990
Gonder, ( Amhara region)	-	Amsalu Demissie, 1989);Shimelis Dawit, 2004
Shoa, Ethiopia	-	Hailu Degefu, 2005

The metcestodes were found throughout the edible parts of the carcass which included masseter muscles, cardiac muscles, triceps muscles, thigh muscles, shoulder muscles, diaphragm, intercostal muscles, liver, heart, tongue, lung and kidney, (Nigatu Kebede *et al.*, 2009; Alemayehu Regassa *et al.*,2009; Fufa Abunna *et al.*, 2008; Abay Getachew , 2008; Nigatu Kabede, 2008, Kumar and Gebretsadik Berhe, 2008). The tongue, masseter muscles, heart muscles, triceps muscles and thigh muscles were the main predilection sites of the cysts (Nigatu Kebede, 2008). Fufa Abunna *et al.* (2008) reported these cysts in heart (29.2%),shoulder muscle (25.3%), masseter muscle (26.7%), tongue (10.4%), diaphragm (5.4%), liver(1.4%), lung (0.9%) and kidney(0.5%) while Kumar and Gebretsadik Berhe (2008) reported cysts from tongue (0.61%), masseter muscles (0.59%), shoulder muscles( 0.26%), heart (0.26% )and liver (7.45%).

The prevalence of bovine cysticercosis reported by various researchers may be an underestimate since many infections go undiagnosed as reporting was

exclusively based on routine meat inspection and the procedure described under Meat Inspection Regulation Notice Number 428, 1972 by Government of Ethiopia(MoA,1972) is not followed strictly at most of the abattoirs.

### **Routine meat inspection procedure**

Postmortem inspection is the most common method in use to detect bovine cysticercosis. *C. bovis* is round or oval in shape and when fully developed consists of scolex invaginated into small fluid filled vesicle (Gracey *et al.*, 1999). The cystic stage is infective in about 10 weeks post-infection and can remain viable for up to 9 months. Differentiation of viable and dead cysts is important as only the former is infective to man. Dead degenerated or calcified cysticerci clearly form identifiable spots of white and have fibrotic lesions, while the viable cysticerci are pinkish-red in colour. True viability of the cyst has been ascertained by keeping the cysts in bile of cattle overnight (Wanzala *et al.*, 2003). Viable cysts evaginate while the dead ones remain intact. Throughout the world the inspection techniques adopted and the final judgements exercised vary greatly. Gracey *et al.* (1999) have described the procedures followed by member countries of the European Union, Canada, USA, South Africa and Australia. According to Directive 64/433/EEC as last amended (Anonymous, 2000), routine meat inspection on bovines over six months of age includes two deep cuts in the external and one deep cut in the internal muscles of mastication. The cut surfaces of the muscle and the tongue are inspected visually. The pericardial surface of the heart is inspected, then the heart muscle incised lengthwise to open the ventricles and to cut through the intraventricular septum. When one or more cysts are found, there is a requirement for further cuts with specific reference to predilection sites e.g. diaphragm and inspection of offal. If a carcass has a generalized infestation, the carcass and the offal are declared unfit for human consumption. With a localized infestation there is a requirement to store the carcass at a temperature not exceeding -7°C for not less than 21 days or at a temperature not exceeding -10°C for not less than 14 days before release for human consumption. According to Meat Inspection Regulation Notice Number 428, 1972 by Government of Ethiopia (MoA, 1972), the routine inspection of carcass is to be done as per the procedure stated below.

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

- Extensive deep incision into external and internal muscles of masseter parallel to the plane of the jaw.
- Visual inspection and longitudinal incision of the myocardium from base to apex. But more incision can be made when necessary.
- Visual inspection and 3 parallel incisions into long axes of the neck muscles on both sides
- Two parallel incisions on the thigh muscles of both hind legs
- Careful inspection, palpation and two parallel incisions into the diaphragmatic lobes of the lung through the lung substances.
- Visual examination of intercostals muscles and incisions when necessary
- One extensive incision into the fleshy part of diaphragm; visual examination, palpation and incision of kidneys, liver, oesophagus and associated lymph nodes. However, minor infections are difficult to detect irrespective of the skill of the inspector. If a *Cysticercus* is found in any of these sites and organs, thorough inspection of the whole carcass and offal should be done. The location, nature and number of cysts should be recorded.

### **Judgments for bovine cysticercosis**

The final judgement exercised by member countries of the European Union, Canada, United States of America, South Africa and Australia have been described by Gracey *et al.* (1999). The Kenyan Meat Control Act, 1977 recommended that only carcasses with no cyst should be passed on directly for human consumption, 1–5 cysts should be retained, frozen at  $-10^{\circ}\text{C}$  for at least 10 days and released “unconditionally”, 6–20 cysts should be similarly treated as above but released conditionally to schools/institutions where proper cooking is expected to be practiced, those with over 20 cysts should be totally condemned. Developed countries are stricter than developing countries in putting the judgement for bovine cysticercosis. In United States of America, there is a recommendation of total condemnation of carcass if the infestation is extensive (cysts are found in at least two of the sites viz. heart, tongue, muscles of mastication, diaphragm and its pillars, oesophagus and musculature that is exposed during dressing operations and in at least two of the sites exposed by incision into the rounds and forelimbs) during routine primary inspection while slightly infested carcass (infestation lesser than extensive infestation) may be passed for human food after removal and condemnation of the lesions with surrounding tissues. From less infested carcasses, the cysts and surrounding tissues shall be removed and condemned while the carcass or the meat derived there from shall be held in a freezer under inspectional control at a temperature

not exceeding -10°C for not less than 10 days; or the meat is heated throughout, under inspectional control, to a temperature of at least 60°C. Edible viscera and offal shall be disposed off in the same manner as the rest of the carcass from which they were derived, unless any lesion of *C. bovis* is found in these by-products, in which case they shall be condemned (Gracey *et al.*, 1999). Though Meat Inspection Regulation Notice Number 428, 1972 by Government of Ethiopia has described the technique of routine meat inspection for bovine cysticercosis, yet final judgement is perhaps followed on the same lines as in other African countries.

### **Limitations of routine meat inspection procedure**

The diagnosis of bovine cysticercosis by meat inspection depends very much on the skills and motivation of the meat inspector, which results in important differences in the efficacy of the meat inspection from one slaughterhouse to the other (Anonymous, 2000). Secondly, a substantial number of infected carcasses are not detected because incisions in the so called sites of predilection cannot be many due to country regulations/economical reasons (Castoldi, 1994). Several studies ( Dorny *et al.*, 2000; Onyango-Abuje *et al.*, 1996a, b; De Giovanni *et al.*, 1985; Geerts *et al.*, 1981a) have shown that the true prevalence of bovine cysticercosis as detected by the classical meat inspection techniques is underestimated by at least a factor of 3-10. The rate of failure to detect bovine cysticercosis in field infected animals has also been shown to be 27% (Walther and Koske, 1980), 28% (Dewhirst *et al.*, 1967) and 51% (McCool, 1979). These observations were reinforced by a probabilistic model developed by Kyvsgaard *et al.* (1990) which showed that over 85% of infected animals may be missed during routine meat inspection. To effectively improve meat inspection procedures, Wanzala *et al.* (2003) suggested an increase in the area and number of predilection sites (hind limbs, fore limbs, liver, chest, heart, lumbar, pelvis, tongue, lungs, neck and back, head and diaphragm) to be observed and concluded that all the parts of various carcasses were equally important as predilection sites for cysticerci and could be equally inspected during routine meat inspection at slaughterhouses. Development of an efficient sero-diagnostic test in the live animal would obviate much of unnecessary mutilation and transform current meat inspection procedures (Gracey *et al.*, 1999; Wanzala *et al.*, 2003).

## **Bovine cysticercosis and immunodiagnostic methods**

Cattle acquire humoral type of immunity to *C. bovis* as a result of contact with the parasite (Peel, 1953). Antibodies against these cysts reach detectable concentrations in serum approximately one month after experimental infection (Flisser *et al.*, 1979). In another study, antibodies were detectable as of 3 weeks post-infection, and reach to peak concentration 10-12 weeks post infection and it was evident until 1 year post infection (Onyango-Abuje *et al.*, 1995). The production of antibodies by infected animals implies the possibility of diagnosing the disease serologically. Immunodiagnostic methods, like indirect-haemagglutination test (Walther and Grossklaus, 1972), indirect immuno-fluorescence (Euzebey and Dubra, 1971), skin reaction (Froyd, 1963; Kosminkov, 1965; Shekhovtson *et al.*, 1972), radioimmunoassay (Flisser *et al.*, 1979), complement fixation test (Frick and Susse, 1970) and ELISA (Geerts *et al.*, 1981a, b; Smith *et al.*, 1991; Brandt *et al.*, 1992; Onyango-Abuje *et al.*, 1996a; Wanzala *et al.*, 2002; Ferrer *et al.*, 2003) have, therefore, been evaluated to diagnosis this infection in cattle with varying successes (Harrison *et al.*, 1986, 1989; Hughs *et al.*, 1993). Among these techniques, ELISA has been a widely used procedure and was carried out on serum samples from live animals (Kerckhoven *et al.*, 1998; Bøgh *et al.*, 1995; Smith *et al.*, 1990; Harrison and Sewell, 1981; Albert and Höchner, 1979; Walther and Sanitz, 1979). This method has been used to detect both antibodies and antigens of this parasite and has gained acceptance as a tool for sero-epidemiological surveys (Onyango-Abuje *et al.*, 1996b; Dorny *et al.*, 2000, 2002). The skin reaction had also been studied extensively in the past where it was successful in 85-100% cases (Froyd, 1963; Kosminkov, 1965; Shekhovtson *et al.*, 1972). Serological diagnosis of cysticercosis/taeniasis is based on detection of either antibody or antigen. Detection of serum antibodies against the cyst/adult parasite is indicative of exposure of infection but cannot be taken as proof of current infection while detection of serum antigens from viable cysticerci or tapeworm is indicative of presence of viable cysticerci or adult tapeworms and has prognostic value in terms of decisions over treatment with drugs (Anonymous, 2000).

### **Detection of antibodies by ELISA**

Eggs, oncospheres, taenia and cysticerci contain many antigens, apparently mainly proteins, and carbohydrates, some of which cross react with other cestodes (Flisser *et al.*, 1979). However, some of the antigens of young cysticerci and oncospheres exclusively belong to cysticerci (Heath, 1976). Reasonably useful ELISA assays for the diagnosis of bovine cysticercosis by detecting antibodies

have been developed and used to monitor experimental and natural infections with the parasites (Harrison *et al.*, 1996; Ito *et al.*, 1998). Ferrer *et al.* (2007) have successfully employed enzyme-linked immunosorbent assays (ELISAs) by using *T. saginata* oncosphere adhesion protein (HP6-Tsag) and sera from *T. saginata* infected cattle while Abuseir *et al.* (2007) used two peptides, HP6-2 and Ts45S-10 as antigens for the detection of antibodies against *T. saginata* cysticercosis in serum and meat juice samples. Sensitivity and specificity of HP6-2 using serum were calculated as being 100 and 98%, respectively, which was higher than the values for the other antigens used ( Abuseir *et al.*, 2007). According to Bøgh *et al.* (1995), anti-*T. saginata* IgG1 antibodies are a better predictor of *T. saginata* infection than IgG2 or total immunoglobulins. Based on this principle, Ogunremi, and Benjamin (2010) used the excretory-secretory (ES) antigens of *T. saginata* metacestodes to identify animals infected with *T. saginata* using ELISA by detecting specific immunoglobulin G1 (IgG1) activity in heat-treated, bovine sera. By testing sera obtained from the inoculated animals 84days post-inoculation, test sensitivity was estimated to be 92.9% and test specificity estimated from a herd of field animals was 90.6%. The test performance characteristics of the ELISA suggested that it is adequate for field application in bovine cysticercosis outbreaks.

### **Detection of antigen by ELISA**

Detection of antibodies against cysticerci/taenia has the problem of specificity with the use of crude antigen preparations especially where animals are exposed to other cross reacting infections. Therefore, assay for detection of parasitic (cyst/adult) antigens in serum was developed. While using polyclonal sera, this technique has the disadvantage of poor sensitivity and poor signal to background field in the test (Harrison *et al.*, 1996). Subsequently, monoclonal antibodies reactive with carbohydrate epitope present on the surface and the secretions of the parasite were used to diagnose viable *C. bovis* in live cattle (Harrison *et al.*, 1989). The antigen assay has found wide applications in several countries because it has been shown to be two to three times more sensitive than the other current alternative test (Onyango-Abuje *et al.*, 1995) and has been exploited as an assay for sero-epidemiological survey (Kerckhoven *et al.*, 1998; Hughes *et al.*, 1993; Onyango-Abuje *et al.*, 1996b)

### **Polymerase Chain Reaction(PCR) assay**

Contrary to the meat inspection that found 0.3% of the animals infected with cysticercosis, the ELISA detected 3.1% positive, i.e. animals carrying living

cysts (Dorny *et al.*, 2000). Animals with dead cysts are not detected using carefully designed antigen ELISA's (Harrison *et al.*, 1989, Brandt *et al.*, 1992). Since the detection level of the ELISA is about 30 and 50 cysticerci respectively per animal, most of the cattle with a cyst burden below 30-50 do escape, which means that 3.1% is certainly an underestimation of the real prevalence. Reports of employing Polymerase Chain Reaction assay to diagnose bovine cysticercosis are therefore other alternatives. Hiroshi *et al.* (2004) has attempted DNA differential diagnosis of taeniasis and cysticercosis by multiplex PCR. Abuseir *et al.* (2006) used polymerase chain reaction (PCR) to make certain that the cysts did indeed belong to *C. bovis*, as indicated at the slaughterhouses. The cysts were examined macroscopically for description of their morphology and constituents and classified as viable or degenerating (dead). The DNA was extracted from these cysts and subjected to polymerase chain reaction (PCR) to make certain that the cysts did indeed belong to *C. bovis*, as indicated at the slaughterhouses. Two sets of primers were used with different sensitivity levels. The first, HDP1, was able to detect 200 fg of *T. saginata* DNA and 100 pg of *C. bovis* DNA. The other primer set, HDP2, was able to detect 1 pg of *T. saginata* DNA and 1 ng of *C. bovis* DNA. No more than 52.4% of the samples were tested positive for *C. bovis* in the PCR using both primers, while 20% of the viable cysts and 49.2% of the degenerating cysts were tested negative with both primers. Geysen *et al.* (2007) developed a PCR for the detection of *T. saginata* DNA in muscle lesions. Based on the laboratory classification of lesions, almost 97% of viable cysts were confirmed by PCR, while for dead cysts, the percentage was approximately 73%.

Very limited literature is available on application of immune-diagnostic tests for bovine cysticercosis in Ethiopia. Wubie (2004) evaluated indirect hemagglutination test (IHAT), indirect Enzyme-Linked-Immuno-Sorbent Assay (ELISA) and fecal examination techniques for the diagnosis of *C. bovis* in live animals in Addis Ababa Abattoir, Ethiopia. Live *C. bovis* cysts were used for antigen preparation. IHAT had 100% and above 91% sensitivity and specificity respectively and when compared with ELISA it showed better specificity. Postmortem inspection for *C. bovis* was less sensitive when compared with the serological tests. Application of sero-diagnostic tests to detect bovine cysticercosis in cattle is open for research in this country.

### **Bovine cysticercosis and economic losses**

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 costs for detained carcasses (Grindle, 1978). For the African continent, an annual loss was reported to be US\$ 1.8 billion (Mann, 1983) 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\$ 428 million (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.

### **Bovine cysticercosis and chemotherapy**

Chemotherapy of cattle for bovine cysticercosis is not common in Ethiopia. However, such treatment has been tried in other countries and treatment with a drug was suggested to be economical where prevalence of bovine cysticercosis is very high (Grindle, 1978). Blazek *et al.* (1981) reported striking vacuolization of *C. bovis* by applying droncit and oxichloron in total doses of 100 (50 mg/kg for two days) and 300 mg/kg (100 mg/kg for three days) of body weight. Nodules with dead larvae were separated from the surrounding tissue by connective tissue. Onyango *et al.* (2002) used praziquantel. and found that the level of circulating *T. saginata* antigen detected by Ag-ELISA in seropositive treated steers decreased more than in the untreated ones. As compared to no chemotherapy against cysticercosis in cattle, considerable proportions of infected people are treated against taeniasis in Ethiopia. Niclosamide that has been a well known taenicial drug among the people was found to be the drug of first choice and the highest dose sold where as praziquantel which is less familiar to residents was the least (Abunna *et al.*, 2007). The preference of the respondents to taenicial drugs were 46.8%, 24.7%, 15.6%, and 13% for niclosamide, mebendazole, albendazole and praziquantel, respectively. 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'.

### **Vaccines against bovine cysticercosis**

Vaccination, when available, is undoubtedly the most cost effective means of preventing and controlling, and even eradicating, infectious diseases. A vaccine against sheep cysticercosis has been developed experimentally and may lead to the development of similar vaccines to control bovine cysticercosis and thus *T. saginata* infestation in humans (Paul-Pierre, 2009). Wikerhauser *et al.* (1971) in his preliminary attempt to immunize calves against bovine cysticercosis by intramuscular injection of artificially hatched homologous or heterologous oncospheres, observed that three of five calves were completely protected against the oral challenge and in the other two only one and two cysticerci respectively were found in the sites of election. Rickard and Adolph (1976) vaccinated calves with antigens collected during *in-vitro* cultivation of the larval stages of *T. saginata*, and challenged 4 weeks later with

4,000 *T. saginata* eggs. Calves vaccinated with *T. saginata* antigen were highly resistant to the challenge infection. Sheiba and Eldin (1987) vaccinated four Zebu calves subcutaneously with hatched ova of *T. saginata*. The immunity elicited protected the animals from subsequent oral infections with this cestode as manifested by the early degeneration of the metacestodes and failure to attain maturity in three of four animals. Lightowlers *et al.* (1996) used the recombinant antigens in vaccine trials in cattle. Vaccination with a combination of two antigens, designated TSA-9 and TSA-18, induced up to 99.8% protection against experimental challenge infection with *T. saginata* eggs

### **Control of bovine cysticercosis**

- In Ethiopia bush defecation, the habit of eating raw beef dishes such as kitfo and kourt and backyard slaughter might have contributed for the high prevalence of bovine cysticercosis. Therefore, to reduce the transmission of taeniasis/ bovine cysticercosis, public education to avoid consumption of raw meat, and use of latrines and improved standards of human hygiene were recommended (Kebede *et al.*, 2009). Farmers should be fully supported and informed of the life cycle of *T. saginata* and potential risk factors for cattle to become infected (Boone *et al.*, 2007).
- A logistic regression analysis revealed that the location (province), the number of slaughtered cattle, the flooding of pastures, free access of cattle

to surface water and the proximity of wastewater effluent were significant explanatory variables for transmission of bovine cysticercosis to a herd (Boone *et al.*, 2007). Water streams and surface water are potentially polluted with *T. saginata* eggs and it is difficult, especially for the farmers to prevent pastures to be accidentally flooded with wastewater containing *T. saginata* eggs. Prevention of cysticercosis could, however, be possible by restricting the access of the cattle to surface drinking water and by supplying them with fresh water instead (Boone *et al.*, 2007).

- 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, the FASFC, veterinary practitioners and farmers (Kyvsgaard and Murrell, 2005; Cheruiyot and Onyango-Abuje, 1984; WHO, 1983). Control measures should be elaborated in accordance with the EU zoonosis legislation Directive 2003/99/EC (Anonymous, 2003).
- Competent meat inspection must be made compulsory and location of farms supplying infected cattle must be known to improve sanitation and elimination of human carriers.
- Use of ovicides against *T. saginata* eggs, by active or passive immunization of cattle and by anthelmintic treatment of infected cattle with praziquantal were the suggested methods of control of bovine cysticercosis (Wikerhauser as cited at [www.cabi.org](http://www.cabi.org)) . Premises disinfection with 0.5% halamis and pasture herbage by ensilaging were the other preventive approaches
- Freezing (<-5°C for >360 hr or <-10°C for >216 hr or <-15°C for >144 hr), heating (>56°C core temperature >1 sec), irradiation (100Krad death, 40Krad inhibition for development), pickling meat in 25% salt solution for 5 days) causes death while cutting or mincing has no effect on cysts( Alfonso, 1997; Anonymous, 2000).
- Vaccination, chemotherapy and immunodiagnosis, are other potential approaches (Dorny *et al.*, 2000; Harrison *et al.*, 1984; Lightowlers *et al.*, 1996, 2000; Wanzala *et al.*, 2002).

## Conclusions

Routine Meat Inspection is the only diagnostic procedure in use in Ethiopia for the diagnosis of bovine cysticercosis. This method is insensitive and inaccurate and thus the reported prevalence of this infection in different regions of the country may be an underestimate. To effectively improve meat inspection

procedures, there is a need to increase the area and number of predilection sites observed during inspection. Vaccination, chemotherapy and immunodiagnosis against cysticercosis are lacking in this country. Economic losses are difficult to estimate because necessary information on this infection in cattle is scanty.

## Recommendations

- Competent meat inspection must be strictly implemented at every abattoir of the country.
- Immunodiagnosics must be developed to supplement meat inspection procedures.
- Public education to avoid consumption of raw meat must be made compulsory at different education levels.
- Cysticercosis free husbandry should be encouraged
- Vaccination and chemotherapy must be encouraged to control the infection.

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