

Prevalence of Cysticercosis Bovis in Eastern Shoa of Oromia, Ethiopia

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Abstract

Bovine cysticercosis is an infection of cattle caused by the larval stage, *Cysticercus bovis* of the human intestinal cestode, *Taenia saginata*. It is an infection of public health significance as eating of raw or undercooked beef results in taeniasis in human population and an important cause of economic loss mainly due to condemnation and downgrading of infected carcasses. A cross sectional study was conducted during April 2016 to August 2016 to estimate the prevalence of bovine cysticercosis in cattle slaughtered at Meki municipal abattoir. Routine inspection of carcasses and viability test were amongst the methods employed during data collection. Post mortem examination of 876 slaughtered cattle showed that 269 (30.7%) were infected with *T. saginata*. Out of the total 447 cysts detected, 216(48.3%) were found to be viable, while 231(51.7%) were died cysts. The tongue, lung, masseter muscles, heart and triceps muscles were the main predilection sites of the cysts. Anatomical distribution based analysis of the cyst showed that highest proportions were observed in tongueas (15.5%) followed by lung (14.4%), masseter muscle 90(10.3%), heart 61(6.9%) and triceps muscle 34(3.9%). Out of the 785 male cattle examined, 237 (30.2%) had cysts of bovine cysticercosis while 32 (35.2%) of the 91 female were infected. The prevalence varied significantly ($P<0.05$) between age groups, origin of animals and body condition score of animals, but no significant variation between sex of the animals. With respect to viable cysts, it was revealed that lung (51.1%), tongue (48.9%), heart (28.6%), masseter muscle (19.5%) and triceps muscle (14.3%) were infected in decreasing order. The current study suggests that high prevalence of *T. saginata* metacestodes were observed in the source of animals and therefore sufficient emphasis should be given to this problem so as to improve health, quality and quantity of bovine that may satisfy the domestic requirements of the area and the country as general.

Keywords: Bovine, cysticercosis bovis, prevalence, Meki abattoir, Ethiopia

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Introduction

In Ethiopia, meat inspection was started in 1910's with the aim of improving productivity and trade of livestock and their products as well as protecting the public from zoonotic diseases. Meat inspection as part of the veterinary public health activities ensures the delivery of hygienically processed meat for public consumption while preventing the transmission of infectious and zoonotic diseases to humans (Fufa *et al.*, 2010; Fufa *et al.*, 2011; Malaku *et al.*, 2012). The activity also provides vital data and valuable information on the incidences and prevalence of animal diseases and conditions within any country (Ansari-Lari and Moazzeni, 2006; Phiri, 2006, Jibat *et al.*, 2008; Yifat *et al.*, 2011). The disease causes extensive financial wastes as a result of direct and indirect economic losses, is the major concern to the livestock industry.

Bovine cysticercosis is a parasitic zoonoses, which is caused by the zoonotic tapeworm *Taenia saginata* (Oladele, 2004). The occurrence of the larvae (*cysticercus bovis*) in cattle musculature causes bovine cysticercosis while the adult worms in human small intestine cause taeniasis (Neva and Brown, 1994; WHO, 1996; Minozzo *et al.*, 2002). The life cycle of the parasite involves humans and cattles as final and intermediate hosts, respectively (Brown *et al.*, 2012). An infected animal releases gravid segments that are shed by the adult fall to the ground and release eggs on the ground. Animals acquire infection from ingestion of segments and eggs contaminating herbage through faeces while grazing. Most incidents in cattle arise as a result of direct exposure to proglottids shed from farm workers, but there have been some reports of large scale outbreaks resulting from sewage contaminated feed or forage (Flutsch *et al.*, 2008). The clinical effect of cysticercosis on infected animals is generally not significant, but it is economically important as it causes carcass condemnation as well as the cost of inspecting meat, the necessity to freeze or boil infected meat and losses may also occur from the restriction of live animal and animal products (Soulsby, 1982).

Globally, there are 77 million human carriers of the *T. saginata* out of which about 40% live in Africa. The average annual loss due to taeniocidal drugs for treatment in Ethiopia was estimated to be 4,937,583.21 Ethiopian birr (Ahmed, 1990; Dawit, 2004; Fufa, 2006).

In Ethiopia, cysticercosis was identified as a major health problem and production losses in domestic ruminants. Several studies have been conducted on the epidemiological distribution of bovine cysticercosis in different parts of Ethiopia (Megersa, 2010; Abunna, 2011; Fekadu, 2012). It has a worldwide distribution and the prevalence of *cysticercus bovis* is low in developed countries, being less than 1% in carcasses by inspection (Lumumba *et al.*, 1996) and very common in Africa reaching a level of 30-36% in Kenya, 20% in Guinea, 18%

in Sierra Leone and 20% in Cameroon (Gebreab, 1995). In African continent an annual loss was reported to be 1.8 billion USD under an overall infestation rate of 7%. In South America, where an overall infestation rate was estimated at 2%, caused an annual loss of 428 million USD (Mann, 1983; Fan, 1997). It is more important with regard to high economic losses due to the condemnation of heavily infected carcasses. Even though various investigations have been conducted through abattoir survey to determine the prevalence and economic losses resulting from organs condemnation in Ethiopia. Most of the survey focused on parasitic case such as hydatidosis, fasciolosis and cysticercosis (Jembere, 2002; Aseffa, 2005; Tolosa et al, 2009; Gomol, 2010; Zilalu, 2010; Kassa, 2012). In foreign trade, although the country is ideally placed to export live animals to the big markets of middle east and substantial markets of north and west Africa, export earnings is relatively low. This is mainly due to the presence of a number of unemployed animal health problems, among which, *Cysticercus bovis* is one that remains a major public and animal health problem (EARO, 2000). The number of abattoirs increase in demand of the carcass and organ supply, but the supply is decreasing due to disease, production and other various constraints. In view of this, the current status of organ condemnation and the evaluation of the prevalence of cysticercosis from various abattoirs including Meki municipal abattoirs are needed.

Based on abattoir survey, the prevalence reports of bovine cysticercosis in Ethiopia showed variable results with localities. Relatively lower prevalence was reported 2.59% in Wolaita Soddo (Dawit et al., 2012), 3.1% in central Ethiopia (Tembo, 2001), 4.9% in Gondar (Dawit, 2004) and 7.5% in Addis Ababa (Nigatu, 2004) were reported, while higher prevalence of 17.5% in East Shoa (Hailu, 2005), 21% in Nekemte (Ahmed, 1990), and Hawassa (22.9%) (Mesfin and Nuraddin, 2012) and (26.25%) (Abunna et al., 2007).

In Oromia, particularly in the East Shoa zone, livestock raising is an important activity from which food and non-food commodities are produced. Among the prevalent livestock diseases; zoonotic represents major constraints to the development of livestock productivity in the country. Among zoonotic diseases, bovine cysticercosis is the disease that remains a major public health problem in lower income and some industrialized countries (Utulas et al., 2007). It is, therefore, important that due attention be given to this disease to improve the quality and quantity of meat cattle so as to satisfy the domestic consumption. But the productivity remains very low due to lack of disease control, farmers and butchers in Meki area pay very little attention to this disease and poor husbandry practice. And previously there were no any data on the study area to determine the prevalence of the disease and its rate in different organs. Hence, the objective of this paper was to determine the prevalence of *Cysticercus bovis* of cattle slaughter at Meki municipality abattoir.

Materials and Methods

Study area

The study was conducted in Meki, East Shoa Zone of Dugda district, at Meki municipal abattoir in Oromia regional state, located in the central Rift Valley of Ethiopia. Meki is the capital of Dugda district, located at 8°01'N latitude and 38°31'E longitude. It has 95,945 km² of land inhabited by about 157818 people of which more than 85% are living in the rural areas. The town is 134 km far away from capital Addis Ababa and 86km from Adama, head town of East Shoa Zone with an altitude ranging between 1600 and 2020 masl and average annual rainfall ranges from 650-750mm and the distribution is highly variable between and within years. Agro ecologically, the area is categorized under the semi-arid, with minimum mean temperature of 22°C and maximum mean temperature of 28°C with relative humidity of 60%. Vertisol is the predominant soil type with sandy-loam-clay in the portion of 33:48:18; respectively and has a pH of 7.88. Crop-livestock mixed farming system characterizes agriculture in the district. Livestock production continues to be the major economic activity and is still the status symbol for farmers in Dugda district. Cattle, sheep, goats, equines and chickens are important livestock species reared. Maize, haricot bean, teff, wheat barley, cereals and pulses and sorghum are grown under rain fed condition by peasant farmers (DWADB, 2016). Livestock population of the district has a total head of 228686 of cattle, 70263 of sheep, 62705 of goats, 20017 of donkeys, 5193 of horses, 2166 of mules and 183665 of poultry (DWLDH, 2016).

Study design

A cross-sectional study was conducted on *Cysticercus bovis* from April 2016 to August 2016 at the Meki municipal abattoir. The explanatory variables considered were age, sex, body condition and source location of the host as related factors.

Sample size determination

The required sample size for the study was determined with 5% desired level of precision and 95% confidence interval. Since there was no record of previous prevalence assumption of 50% expected prevalence of *Cysticercus bovis* in slaughtered cattle was taken in the study area. By substituting the value in the below formula by (Thrusfield, 2005); the minimum sample size of 384 animals was considered.

$$n = \frac{(1.96)^2 P \exp(1 - P \exp)}{d^2}$$

Where; (n) is required sample size, (Pexp) is expected prevalence, (d) is desired absolute precision.

By using the above formula, the required sample size was calculated to be 384. But to increase Precision, 492 animals were added and a total of 876 cattle destined for slaughter were taken as and inspected. Every animal during the study period was examined after and before slaughter and data was recorded.

Sampling methods

Ante mortem inspection (AMI): Pre-slaughter examination of cattle will be conducted in the lairage by grouping the animals based on species, sex, age, body condition score and place of origin. The age grouping will be based on dentition. Those which have not erupted permanent incisor teeth will be classified as young, while those with one pair or more permanent incisor teeth will be classified as adults (Vatta et al., 2006). Ante mortem inspection was conducted on individual animals, while the animals were entered into the lairage in mass. Both sides of the animals will be inspected at rest and in motion. Moreover; the general behavior of the animals, gait, structure, body condition scoring and signs of disease and abnormalities of any type were registered according to the standard of ante mortem examination procedures given by Gracey (1986). Following these, judgments were passed based on FAO (2004).

Post mortem examination (PME): Animals that undergo post mortem examination will be those which passed ante mortem inspection. During postmortem inspection liver, lungs, heart, kidney, tongue, brain, muscles and carcasses will be thoroughly inspected by visualization, palpation and making systemic incisions where necessary for the presence of cysts, parasites and other abnormalities.

Data analysis

The data recorded was entered into Microsoft excel and the statistical (SPSS) version 20 was used to analyze the data. The prevalence was calculated as the number of positive samples divided by the total number of examined samples. Chi-square (χ^2) test was used to assess the association between the prevalence of cysticercus bovis and host related risk factors such as sex, age, origin and body score of the animals. P-value < 0.05 was considered as significant.

Results

The overall prevalence of cysticercosis bovis on the inspected bovine in the present study was 30.7% (269/876). There was a statistical difference ($P < 0.05$) between body condition and origin of animals with the prevalence of infection, but there was no statistical difference ($P > 0.05$) between age and sex groups of animals.

Occurrence of cysticercus bovis in different organs of bovine

Masseter muscles, tongue, triceps muscles, lungs and heart are the organs that were inspected for the presence or absence of cysticercus bovis. The abattoir survey analysis clearly indicated that there was a significant variation with regard to degree of infestation in the inspected organs of slaughtered animals. Cysticercosis bovis was found with higher number of cysts encountered in the tongue 15.5%, followed by lungs, masseter muscles, heart and triceps muscles (Table 1).

Table 1. The overall prevalence of cysticercosis bovis infection in different organs of the cattle examined (n = 876), Meki abattoir, Ethiopia.

Organs inspected	Number of positive	Prevalence %
Tongue	136	15.5
Lungs	126	14.4
Masseter muscles	90	10.3
Heart	61	6.9
Triceps muscles	34	3.9
Total	447	61.6

Regarding to origin of animals, the highest prevalence was observed in cattle from Habura (53.3%) followed by Batu, Alemtena, Arsinagele and the least compared to other was from Meki (Table 2).

Table 2: The overall prevalence of bovine cysticercosis infection based on the basis of age, sex, origin place and body condition scores of the cattle examined (n = 876), Meki abattoir, Ethiopia.

Risk factors		No. inspected	No. infected	Prevalence %	X ² (P-value)
Age	Young	292	105	36	5.676(0.017)
	Adult	584	164	28.1	
	Total	876	269	30.7	
Origin of Animals	Meki	632	167	26.4	23.605(0.000)
	Arsi Nagele	86	32	37.2	
	Batu	63	27	42.9	
	Alemtena	50	19	38	
	Habura	45	24	53.3	
	Total	876	269	30.7	
Body condition score	Medium	103	59	57.3	38.738(0.000)
	Good	773	210	27.2	
	Total	876	269	30.7	
Sex	Male	785	237	30.2	0.948(0.330)
	Female	91	32	35.2	
	Total	876	269	30.7	

A total of 447(61.6%) cysts were recovered from 269 cysticercosis positive animals during the study period. Out of the total of 447 cysts detected, 48.3% were found to be viable, while 51.7% were died cysts (Table 3).

Table 3: Frequency of cysticercus bovis in different organs and tissues of the cattle examined in Meki abattoir, Ethiopia.

Organs inspected	Viable cysts (%)	Dead cysts (%)	Total cysts (%)
Tongue	65(48.9%)	71(9.6%)	136(15.5%)
Lungs	68(51.1%)	58(7.8%)	126(14.4%)
Masseter muscles	26(19.5%)	64(8.6%)	90(10.3%)
Heart	38(28.6%)	23(3.1%)	61(7.0%)
Triceps muscles	19(14.3%)	15(2.0%)	34(14.4%)
Total	216(48.3%)	231(51.7%)	447(61.6%)

Discussion

Taeniosis/cysticercosis occurs most commonly in the environments characterized by poor sanitation, primitive livestock husbandry practice and inadequate meat inspection and control. Bovine cysticercosis usually does not cause much morbidity or mortality among cattle, but it does cause serious economic problems in the endemic areas due to the condemnation of meat or downgrading of carcasses contributing to constraint in food security and safety (Lumumba et al., 1996; Kyule et al., 2003). The results of the present study also reflect both the economic and zoonotic importance of this disease, which is in agreement with the above statements. In the current study, the prevalence of bovine cysticercosis was 30.7%, which was in line with the report of Abunna et al. (2007) in Hawassa abattoir (26.25%) and Mesfin and Nuraddis (2012) who reported cysticercus bovis prevalence of 22.9%. The current finding was relatively higher than previous findings of Addisu and Wondimu (2015) which implies prevalence of bovine cysticercosis was 2.6% in and around Batu, Tembo (2001) in central Ethiopia (3.11%), Nuraddis and Frew (2012) in Addis Ababa municipal abattoir (3.6%), Dessie (1992) in Assela (2.7%), Tolosa et al. (2009) and Gomol et al. (2011) in Jimma municipal abattoir with a prevalence of 2.93% and 3.6%, respectively, of Dawit et al. (2012) in Wolaita Soddo (2.59%) and of Teka (1997), in which the prevalence was 2.2%.

Association of cysticercus bovis with potential risk factors revealed a significant relationship ($p < 0.05$) with age being higher in young (36%) as compared to that of old aged animals (28.1%). This finding was in agreement with the reports of Hailu (2005), Tembo (2001) and Nuraddis and Frew (2012). However, it contradicts with the findings of Gomol et al. (2011), Jemal and Hailuel (2011), Dawit et al. (2011) and Mesfin and Nuraddis (2012). This significant variation might be due to age dependent immunity of an animal that had an important role to play in fighting against infestation and re-infestation of cysticercus bovis. The re-stimulation of animal's immunity following the continuous invasion of oncospheres would explain the development of a

strong immunity, which did not allow further development of more cysticerci from invading onchospheres, but spared viable cysticerci from the initial infestation (Jemal and Haileleul, 2011; Nuraddis and Frew, 2012). In addition, this might be due to that any age groups of animal have a close susceptibility to *T. saginata* (Nuraddis and Frew, 2012).

There was no statistical difference ($P > 0.05$) with sex associated with cysticercus bovis infection. This was in line with the report of Gomol et al. (2011), Jemal and Haileleul (2011), Dawit et al., (2012), Mesfin and Nuraddis (2012) and Haylegebriel and Alembrian (2012). Nevertheless; this finding was in contrary to that of Nuraddis and Frew (2012) who reported that statistically significant difference was observed between sexes of slaughtered animals. The possible reason for the non-significant difference between male and female slaughtered animals might be due to the fact that most of the animals brought to the abattoir had similar husbandry systems (the same type of livestock management) and both sexes were equally exposed to the disease in all districts, which leads to equal exposure of animals to *T. saginata* eggs. Regarding the predilection sites of the cyst, the current finding revealed that the highest number of cysts was found on the tongue (15.5%) followed by lungs (14.4%), masseter muscles (10.3%), heart (6.9%) and triceps muscle (3.9%). This finding was in agreement with the report of Ahmed (1990), Hailu (2005), Solomon (1994), Amsalu (1989), Abunna et al. (2007) and Mesfin and Nuraddis (2012) who reported that tongue was the most frequently affected organ and in contrary to this Dawit et al. (2012), Haylegebriel and Alembrian (2012) and Nzeyiman et al. (2015) who reported that heart as being frequently affected by the cyst. Similarly, the current finding contradicts with the earlier finding of Minozzo et al. (2002) who reported that higher populations of cysts were found in the masseter muscles. However, this result was not in line with Gracey (1986), Getachew (1990), Tolosa et al. (2009), Gomol et al. (2011), Jemal and Haileleul (2011) and Nuraddis and Frew (2012) indicated that the triceps being the most frequently affected muscles by cysticercus bovis.

The variation between organs of the slaughtered animals might be due to blood kinetics and animals daily activities. Any geographical and environmental factors affecting the blood kinetics in the animal affect the distribution of onchospheres as well and hence the predilection sites varies during meat inspection. Most of these organs, except the heart are consumed raw or under cooked and could be a potential public health hazard in contracting taeniasis.

The above difference in prevalence of infection might be associated with many reasons, including time of occurrence (higher in dry season than rainy season) (Jemal and Haileleul, 2011; Nigatu, 2004), sample size, type of re-infection, status of the people in the environment, the practical limitation to the number of incisions allowed in skeletal muscles, limit to the number and intensity of the incisions made during meat inspection (as this will reduce market price of the carcass) and the knowledge and ability of researchers (Jemal and Haileleul, 2011). Differences in the skills and motivation of meat inspectors, the speed of slaughter activity and the meat inspection facilities are among the many other contributory factors. The observations showed that the lungs, tongue, masseter muscles, triceps muscle and heart among others were the preferred organs (predilection site) for the cysts of bovine cysticercosis similar to earlier reports in various endemic areas (Pawlowski and Schultz, 1972; Okafor, 1988; Moreira et al., 2001; Opara et al., 2006). It appears that several factors such as activity of the muscles, age and the geographical area concerned determine largely the predilection sites in slaughtered cattle (Petrovic, 1976; Minozzo et al., 2002; Opara et al., 2006).

Conclusion

Bovine cysticercosis is one of the major zoonotic diseases that remain a major health problem of animals and humans causing serious socio-economic impact. Since the prevalence found in the current study was relatively high (30.7%), its significance on the health of both animals and public should not be underestimated. Therefore; special attention should be given so as to prevent and control the spread of this disease in animals and in humans.

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