

Studies on the Prevalence, Cyst Viability, Organ Distribution and Public Health Significance of Bovine Cysticercosis at Cattle Slaughtered in Nekemte Municipality Abattoir, East Wollega, Ethiopia

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Abstract

A cross-sectional study was conducted from October 2012 to April 2013 on cattle slaughtered in Nekemte municipal abattoir with the objective of determining the prevalence, cyst viability, organ distribution and its public health significance of bovine cysticercosis. Interview was conducted on 180 residents using a structured questionnaire to know the public health significance of the disease. A total of 600 carcasses were inspected and 93 (15.5%) were infected with cysticerci. A total of 122 cysts were collected of which 95 (77.87%) were viable while others 27 (22.13%) were degenerated. The anatomical distribution of cysticerci were; 41 (85.4%) in shoulder muscles, 11 (78.6%) in masseter muscles, 17 (77.3%) in thigh muscles, 14 (73.68%) in heart, 7 (70%) in tongue, 4 (66.67%) in liver and 1 (50%) in intercostal muscles. The prevalence of cysticercosis varied significantly ($P < 0.05$) with sex, age, breed and origin of animals. Forty eight (60%) out of 80 respondents from Nekemte town, thirty four (68%) out of 50 respondents from Guto Gida woreda and twenty three (46%) out of 50 respondents from Sassiga woreda had contracted the disease at least once in their life time and maximum infestation frequency was two times per year. The infestation varied significantly ($P < 0.05$) with sex, age, place of respondents, habit of raw meat consumption, religion, marital and educational status. This study indicated that the prevalence of bovine cysticercosis and public health significance in the area was well established. Therefore, the disease deserves due attention to safeguard the public and further promote beef industry in the country.

Keywords: Nekemte, Bovine, Cysticercosis, Cyst Viability, Sassiga, Guto Gida, Prevalence, Public Health

INTRODUCTION

Ethiopia is one of the countries in Africa with huge livestock resources that play a crucial role in the livelihoods of the majority of Ethiopians. The cattle population for the country is estimated at 50.8 million out of which females constitute about 54.87 percent and the remaining 45.13 percent are males (CSA, 2010). Despite the huge resources, Ethiopia livestock productivity remains a below being adequate. The major biological constraints contributing to low productivity includes the low genetic potential of the animals, poor nutrition and prevailing disease like parasitosis (CSA, 2010).

Among the many prevalent livestock diseases parasitism represent a major drawback to livestock development in the tropic in general and *Cysticercus bovis*, which is the larvae stage of the human tapeworm, *Taenia saginata* causes significant economic losses to the beef industry and public health hazard (Pal, 2007).

Bovine cysticercosis refers to the infection of cattle with metacestodes of the human tapeworm (Wanzala *et al.*, 2003). Ingested eggs develop into cysticerci, which can often be detected during meat inspection at the routinely inspected localization sites of the parasite, including, the skeletal muscle, heart and diaphragm. The matured cyst is grayish white vesicle about one cm in diameter. It is filled with fluid, in which the scolex is usually visible, like the adult parasite, it has no hooks and rostellum (Radostits *et al.*, 1994; Gracey *et al.*, 1999). Several authors reported that the metacestode of *T. saginata* is common in organs like the tongue, heart, masseter muscle, thigh muscle, shoulder muscle, liver, diaphragm, intercostals and kidney (Gracey *et al.*, 1999).

The adult tape worm, *T. saginata* occurs in the small intestine of the final host, man and the metacestode (*C. bovis*) is found in cattle that serve as main intermediate host (Endiras, 2011). The epidemiology of the disease is associated with the cattle rearing system, age of cattle, meat inspection practice, and habit of consumption of raw and under cooked meat. Low awareness and poor hygiene and sanitary infrastructures may facilitate transmission of the disease between animals and human beings in the rural areas.

As per an estimate, 50 million cases of such infestations occur worldwide with 50,000 people dying from this problem annually (WHO, 2006). In humans, the disease is called as taeniasis which is accompanied by symptoms like nausea, abdominal discomfort, epigastric pain, diarrhea, excessive appetite or loss of appetite, weakness, loss of weight and intestinal blockage (Brown and Neva, 1994; Pal, 2007; Deressa *et al.*, 2012). Sometimes, the mobile gravid segments may make their way to unusual sites such as the appendix and bile tract and may cause serious disorders.

Cattle infected with *C. bovis* show no symptoms, however, heavy infestation may cause myocarditis or heart failure (Gracey *et al.*, 1999). Cysticerci can remain alive in cattle from weeks to years. Infection in human is a public health problem as the infection is acquired through consumption of raw or undercooked beef. The

economic losses result from condemnation and downgrading of carcasses and due to treatment of carcasses to make it fit for human consumption (Yoder *et al.*, 1994; Onyango-Abuje *et al.*, 1996; Dewhirst *et al.*, 1997; Giesecke, 1997).

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).

The prevalence rate is excess of 20% in developing countries, where as in developed countries the prevalence of cysticercosis is low usually less than 1% (Urquhart *et al.*, 1996; Pawlowski and Murrell, 2001). Even though, *T. saginata* has a worldwide distribution, its prevalence is particularly higher in Sub-Saharan Africa (WHO, 2006). Taeniasis caused by *T. saginata* is a well known helminthic zoonotic disease in Ethiopia with prevalence ranging from 10% to 70% (Wanzala *et al.*, 2003). However, to my knowledge in the last decades the prevalence and distribution *Cysticercus bovis* was not report for implementing control and prevention program throughout the country. Hence, the research work is aimed to determine the prevalence, cyst viability, organ distribution and public health significance of bovine cysticercosis at Nekemte municipality slaughter houses.

MATERIALS AND METHODS

Study area and animal

The study was conducted in Nekemte town which was found in East Wollega zone of Oromia regional state, Ethiopia. The 600 cattle originated from neighboring marketing areas such as from Sassiga *woreda*, Guto Gida *Woreda* and from Nekemte areas were selected and slaughtered at Nekemte municipal abattoir. Then Postmortem inspection was conducted to determine the presence of *Cysticercus bovis*.

Sample size determination

The study was cross sectional abattoir survey which includes cattle brought from different livestock markets to Nekemte municipality abattoir. The totals of 600 cattle were purposefully recruited for the study.

Cyst identification

During the study period, 600 cattle carcasses were examined for the presences of *C. bovis* during meat inspection according to the procedures given by Meat Inspection Regulation (1972). During meat inspection of each organ of an animal was strictly and separately examined to avoid mixing up of organs. The tongue, heart, liver, masseter muscles, triceps, thigh muscles, diaphragm and intercostals muscles of all slaughtered beef cattle were assessed by visual inspection, palpation followed by incisions for the detection of *C. bovis*.

Cyst evaluation (viability test)

The cyst which was found at meat inspection was removed with the surrounding tissue and taken to laboratory for viability test. The viability of the cyst were examined by placing them in a normal saline solution with 40% ox-bile and incubated at 37°C⁰ for 1-2 hrs. A cyst was regarded as viable if the scolex evaginated during this period (Gracey *et al.*, 1999).

Questionnaire survey for public health significance

In order to assess the extent of human taeniasis, 180 voluntary respondents were randomly selected from three distinct *woredas*; namely, Nekemte, Guto Gida and Sassiga, and interview were made individually using semi-structured questionnaire. The potential risk factors like age, habit of raw meat consumption, religion, sex, marital status and educational level was recorded.

Methods of data collection and Variable used

In order to conduct the study, ante mortem and postmortem examinations and laboratory characterizations of the cysts was employed. Data on species, sex, age, and origin of the study animals was collected during ante mortem examination of the animals. Data on infestation status of the animals, organs affected, cyst number and distribution were collected or recorded from postmortem examination results. Information on characteristics of each of the cysts examined in the laboratory was obtained and recorded.

Data management and analysis

The data collection from the study area was recorded in the format developed for this purpose and later on entered into Micro Soft office Excel 2007 spreadsheet computer program and analyzed using SPSS statistical software version 17.0. The prevalence of cysticercosis was calculated as the number of cattle found to be infected with *C. bovis* against to total number of examined animals expressed as a percentage of the total number of cattle slaughtered. Chi-square (χ^2) test was applied to compare the infection status with regard to the hypothesized risk factors like age, sex, and cyst characteristics. A statistically significance association between variables and considered to exist if the completed P-value is less than 0.05.

RESULTS

Abattoir survey (postmortem examination)

Out of 600 cattle inspected in Nekemte municipality abattoir 93(15.5%), CI (12.6-18.4) were found infected with *Cysticercus bovis*. Male animals 76(12.66%) had higher cysts of *C. bovis* than female animals 17 (2.83%). Although more males than females were examined, the prevalence of infections showed significant difference (OR=36.85, P= 0.001). However, more light infections and apparently lower prevalence was observed in animals originated from Nekemte than those from Guto Gida and Sassiga areas (Table 1).

The infection of cattle with *C. bovis* was 34 (16.9%) in younger (<5 years) and 59 (14.8%) in older (>5 years) animals (OR=2.8, P=0.001). Out of 600 cattle carcasses examined, 598 (99.7%) were local breeds and infected with *C. bovis* while 2 (0.3%) cross breeds cattle carcasses failed to reveal infection.

Anatomical distributions of cyst

Seventy nine organs were found to harbor the cyst. The variation in the anatomical distribution of cysticerci were as follows shoulder, masseter, thigh, heart, tongue, liver, intercostals and diaphragm muscles were the major predilection sites with respective prevalence value of 29.11%, 21.5%, 16.5%, 12.66%, 11.4%, 5.06%, 2.5% and 1.3%, as presented in Table 2. The shoulder muscles were predominantly affected site in the study area.

Viability test

Out of 122 cysts encountered, 95 (77.87%) were viable while other 27 (22.13%) were non viable (degenerative) cysts. Viability test showed that shoulder had the highest relative frequency proportion of viable cysts 41(85.4%) followed by masseter 11(78.6%), thigh 17(77.3%), heart 14(73.68%), tongue 7(70%), liver 4(66.67%) and intercostal muscles 1(50%) (Table 3).

Among 122 total cysts of carcasses, 16 (13.1%) cysts were found in female animals with 10 (62.5%) cysts were alive while 106 (86.9%) cysts were found in male animals with 89 (83.9%) cysts were alive (Table 4).

Questionnaire survey on taeniasis

Survey was done at three distinct *Woredas*; namely, Nekemte, Guto Gida and Sassiga. Of the total 180 interviewed respondents who participated in this study, 48 (60%) out of 80 respondents in Nekemte, 34(68%) out of 50 respondents in Guto Gida and 23(46%) out of 50 respondents in Sassiga *woreda* had contracted *T. saginata* infection at least once in their life time and maximum infestation frequency was two times per year.

The majority of the respondents had an experience of raw meat consumption due to traditional and cultural practice. The multiple logistic regression analysis of the risk factors showed significance difference (p<0.05) in the prevalence of taeniasis with raw meat consumers, age, religion, sex, marital status, place and educational level of the respondents. Accordingly frequent raw meat consumers (OR=3.5, 95% CI [2.08-81.04], male individuals (OR=5.8, 95% CI [1.23-5.43], Christian (3.6) and old age (OR=3.65) had higher likelihood of acquiring taeniasis than Muslims, cooked meat eaters and female, respectively (Table 5).

DISCUSSION

Among 600 carcasses of cattle inspected in Nekemte municipal abattoir, 93 carcasses were found to harbor viable or non viable cysts of *Cysticercus bovis* with an overall prevalence of 15.5%. The infection prevalence of *T. saginata* cysticercosis was invariably high in those animals come from Guto Gida and Sassiga *woredas*. This suggests wide occurrences of the disease throughout the study areas regardless of agro-ecological and socio-cultural differences.

The present finding on the prevalence of *C. bovis* is in agreement with earlier reports of 13.3% at Addis Ababa abattoir (Nigatu *et al.*, 2009), 13.85% at Debre-Zeit abattoir (Getachew, 1990), 11.3% at Wolaita Soddo municipal abattoir (Alemayehu *et al.*, 2009), 18.49% at Bahir Dar municipal abattoir (Nigatu, 2008) and 19.4% (Alemu, 1997), 21.7% at Nekemte municipal abattoir (Ahmed, 1990), but it is far lower than the 30% prevalence report for the whole Ethiopia (Solomon, 2006) and greater than 9.7% in Gondar municipal abattoir (Amsalu, 1999), 2.2-3.2% in Addis Ababa abattoir (Teka, 1997), 3.11% Central Ethiopia (Tembo, 2001), 5.8% in Nekemte municipal abattoir (Hailu, 2010), 7.5% at Addis Ababa abattoir (Nigatu, 2004) and 4.9% at Gondar municipal abattoir (Shimeles, 2004)).

Prevalence of this study is comparable to some reports from African countries, such as 20% in Senegal, 27% in Tanzania and 38–62% in Kenya (Over *et al.*, 1992; Onyango-Abuje *et al.*, 1996), 6.1% in Zambia (Dorny *et al.*, 2002), 0.23% in Egypt (Hardy *et al.*, 1999), 6.2% in Namibia (Kumba *et al.*, 2001). Likewise Opara *et al.* (2006) have reported comparable prevalence of 26.2% from slaughter animals in Nigeria. Conversely, lower prevalence was reported from developed countries, such as 0.26% in Croatia (Zivkovic *et al.*, 1996), 0.48–1.08% in Germany (Abuseir *et al.*, 2006) and 0.9% in Cuba (Suarez and Santizo, 2005).

Thus, *T. saginata* cysticercosis has more public health and economic significance in developing countries like Ethiopia compared with developed countries. Problems associated with poor sanitary infrastructure, low awareness and improper disposal of sewage are major factors for higher prevalence of cysticercosis in developing countries. Improper removal and treatment of sewage, application of sewage sludge to fields and faecal contamination of feed and/or water by farm employees are possible sources of infection in the developed

countries (Fertig and Dorn, 2005).

The highest prevalence of *C. bovis* in young cattle in the present study is in line with the works of Gracey *et al.* (1999) who described that in countries where *T. saginata* is common in cattle frequently ingest tapeworm ova. An active immunity develops and the prevalence, which decreases progressively with age. Soulsby (2006) has also the opinion that, adult cattle have also indicated that in Africa are resistant to re-infection because they acquire cysticercosis at a young age. With subsequent development of active immunity since the animals slaughtered are old, the majority of cysticerci from initial calf hood infection may degenerate or disappear (Pal, 2007).

Most of these reports 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 this study. Similarly, analysis of 7 year's (1994–2000) routine meat inspection data from Addis Ababa abattoir showed as low as 0.11% cysticercosis prevalence which suggests inefficiency of routine inspection (Tembo, 2001).

In line with this, Wanzala *et al.* (2003) have reported that dissection was twice as efficient in the detection of bovine cysticercosis as routinely used meat inspection. Similarly, Minozzo and co-workers (2002) have demonstrated a wide distribution of *T. saginata* metacestode infection throughout bovine muscles showing inefficiency of routine meat inspection. Thus, higher prevalence in the present study might be attributed to the variation in the method and quality of meat inspection, human use of non latrine as well as personal and environmental contamination of the study areas. Furthermore, the study animals were from outside of the town and managed under extensive farming system, where contamination of grazing fields by human excreta is common, especially in Guto Gida *woreda*.

Generally, light infections among the inspected animals were observed in this study except for few animals which were regarded as heavy infections. More light infections were observed in animals that came from Nekemte areas, perhaps due to the absence of habitual raw meat consumption among the local community and less conducive environment for the parasite. Secondly, the practical limitations to the number of incisions allowed in skeletal muscles might have reduced the efficiency of cyst detection. Thirdly, human used toilet.

In an experimental study by Minozzo and co-investigators (2002), *T. saginata* metacestodes were found distributed in all bovine muscles inspected. Therefore, increasing the area and number of predilection sites observed during inspection and varying the procedure based on the nature of husbandry practice and the target human populations for consumption are essential to effectively improve meat inspection procedures (Wanzala *et al.*, 2003).

However, the balance between the minimally impacting carcasses' market value and adequately inspecting them is clearly a challenge for the public health authorities. The prevalence of *T. saginata* cysticercosis in sex, origin, local and crossbred of animals varied significantly ($P < 0.05$). One possible explanation for this significant difference between local and crossbred of cattle in the study area is might be due to the fact that; crossbred animals are kept indoor, they are fed only with feed guaranteed free from *cysticerci* eggs (this means that no feed from pastures or crops can be used, unless treated) and less exposed to human excreta than local breed. So that, fecal contamination of grazing fields, rather than some innate susceptibility, might be the explanation for their higher infection prevalence. Pawlowski and Murrell (2001) reported the existence of difference in geographical isolates of the parasite and in the breed of cattle as a possible factor affecting the distribution and prevalence of *T. saginata* cysticercosis.

Sex-related distribution of *C. bovis* infection of the slaughtered cattle in this study showed that incidence rate was significantly ($P = 0.001$, $OR = 36.85$) higher in males than in females. The variations in prevalence rate might be because higher number of males (86.83%) of total slaughtered than number that were females (13.16%). This finding is in agreement with the report of Ahmed (1990).

During the study period, the most frequently affected organs with the highest number of cysts of *C. bovis* was recorded in shoulder muscles followed by masseter muscles, thigh muscles, heart, tongue and liver. The variations in anatomical distribution depend on a number of factors, such as blood kinetics and animals' daily activities. Any geographical and environmental factors affecting blood kinetics in the animal affect the distribution of oncospheres as well and hence the predilection sites during meat inspection (Gracey *et al.*, 1999).

The finding of the current study is in agreement with the reports of Getachew (1990), Solomon (2006), Amsalu (1999), Shimeles (2004), Opara *et al.* (2006), Alemayehuet *et al.* (2009) and Hailu (2010) who indicated that examination of the shoulder muscles is the most effective means of detection of bovine cysticercosis, while the heart and liver are described as the most frequently infected organ by Mohammed (1986), Pawlowski and Schultz (1997) and Tembo (2001), respectively. Thus, there is no particular "predilection site" which could be acceptable for all cattle.

Viability test showed that shoulder muscles had the highest relative frequency proportion of viable cysts 41 (85.4%) followed by masseter 11 (78.6%), thigh 17 (77.3%), heart 14 (73.68%), tongue 7 (70%), liver 4 (66.67%) and intercostal muscles 1 (50%). This observation goes parallel with the findings of Amsalu (1999),

Dawit (2004) and Opara *et al.* (2006) who recovered higher proportion of cysts from shoulder muscles that had the highest proportion of viable cyst.

The explanation for this may lie in the fact that muscle activity receives more blood than a muscle at rest, and that the distribution of the cysts is controlled by the volume and intensity of the arterial blood (Gracey *et al.*, 1999). On the contrary, more proportion of the nonviable cysts was found in the diaphragms, intercostals muscles, liver and tongue.

Human taeniasis was a widespread health problem in the study area with prevalence of 68% (34/50), 60% (48/80) and 46% (23/50) in Guto Gida, Nekemte and Sassiga *woredas* respectively. The occurrence of the disease had significant association ($P=0.04214$, $OR=2.5$) with habit of raw meat consumption. Thus, infection of human being by *T. saginata* is mainly due to the habit of eating raw 'kurt' or semi-raw 'kitifo' meat dishes in Ethiopia (Pal, 2012) and in other countries like meat *tartar shashlik* in Union Soviet Socialist Republic (Abdullaev, 1994), *shish kebab* and *tikka* in India (Anataraman, 1989), *larb* in Thailand (Chularerk *et al.*, 1997) and raw meat consumption in Cuba (Suarez and Santizo, 2005).

In Ethiopia, even most of well conscious professionals (veterinarians and medical professionals) themselves often consume "Kurt or kitifo" due to deep-rooted tradition inherited from parents. Awareness creation is more effective when given at childhood levels particularly at primary schools. Taeniasis prevalence was higher among the Christian community than Muslims in the study area. Similar to the reports of Tembo (2001), Hailu (2005) and Deressa *et al.* (2012), taeniasis prevalence was higher among the Christian community than Muslims. Because raw meat consumption is not common in Muslims as in Christians, and Christians also celebrate several annual festivals with the tradition of raw meat consumption (Teka, 1997).

This presentation revealed that males 91 (68.25%) were highly affected than females 14 (26.9%) ($OR=5.8$, $P=0.001$). This observation is similar to the finding of Getachew (1990) who reported higher prevalence of taeniasis among males than females in Debre-Zeit abattoir. The difference in the rate of infection between males and females in the study area could be due to the fact that males enjoy eating raw beef with local drink "Tej and Catukela", as it is traditionally described "Arada Tej" at Nekemte town, "Kubaya sefar Tej" at Sassiga woreda and "Kub-lame or Catukela" at Guto Gida woreda. The second reason might be males have the access to eat raw tongue and rumen folds locally called "Milas-Sember" during "Kircha", this is common in the study area. The third reason might be males provide and control the finance and hence, they can eat raw beef in the butcher house.

Taenia saginata was observed among old aged people (> 30 years) as compared to young age people (< 30 years). This agrees with Tembo (2001), Shimeles (2004) and Alemayehu *et al.* (2009) observation that the older people greater chance of eating raw beef and hence contracting taeniasis. Therefore, the two age groups might be due to the fact that older people have the finance to eat raw beef in the butchers house and generally the tradition of consuming "Arada-Tej" and "Catukela" is common among older people and also might be it is the older males individuals who participates in "Kircha" and hence having the opportunity to eat raw beef particularly tongue and rumen fold "Milas-Sember" in the field.

Based on the place of respondents at the three woredas' survey showed that Guto Gida woreda was the highest infection rates (68%), followed by Nekemte (60%) and less infection rates was observed in Sassiga woredas' (46%). The difference of the infection rates in different areas was due to the fact that the difference of cultural, religion and use of latrine. The majority of the communities in Guto Gida woreda were Christian with feeding habit of raw meat and non use of sanitary latrine than in Nekemte and Sassiga woredas'.

Depending on the marital status, married peoples were more infected than unmarried ones. This might be due to the fact that married peoples have the finance to eat raw beef in the butchers house and generally the tradition of drinking "Arada-Tej" and "Catukela" than unmarried peoples. The results indicated that uneducated had higher prevalence than those of educated ones ($OR=1.3$, $P=0.023$). Most of the peoples in the study area were uneducated and with low level of awareness about this helminthic zoonotic disease.

The study showed that the existence of higher prevalence of cysticercosis throughout the edible organ together with deep-rooted tradition of raw meat consumption, which magnifies the public health hazards of taeniasis in the study area. Therefore, attention must be given to the revision of routine meat inspection, public awareness on improving personal and environmental hygiene.

CONFLICT OF INTEREST

The author confirms you there is no any conflict of interest related with the research project.

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LIST OF TABLES

Table 1. Analysis of potential risk factors associated with the occurrence of viable cysts in carasses inspected at the Nekemte municipalabattoir 2012-2013

Risk factors	No. of animals examined	Infected	Chi square	P-value
Sex				
➤ Male	521	82 (15.74%)	39.676	0.001
➤ Female	79	11 (13.9%)		
Age				
<5 Years	201	34 (16.9%)	3.199	0.00
>5 Years	399	59 (14.8%)		
Breed				
➤ Local	598	93 (15.5%)	41.134	0.000
➤ Cross	2	-		
Origin of animals				
➤ Nekemte	116	9 (7.76%)	12.35	0.0235
➤ Guto Gida	273	55 (20.14)		
➤ Sassiga	211	29 (13.74%)		

Table 2. Number of organs infected and distribution of *C.bovis* on different organs at Nekemte municipality abattoir2012-2013

Organs Examined	No. of organs infected	Prevalence (%)	Total No. of cysts examined in each organ	Percentage (%)
Tongue	9	11.4%	10	8.2%
Masseter muscles	13	16.5%	15	12.3%
Shoulder muscles	23	29.11%	48	39.34%
Thigh muscles	17	21.5%	22	18.0%
Heart	10	12.66%	18	15.6%
Liver	4	5.06%	6	4.9%
Diaphragm m/s	1	1.3%	1	0.8%
Intercostal m/s	2	2.5%	2	1.6%
Total	79	100.0%	122	100.0%

Table 3. Proportion of viable and non viable cysts in different organs

Organs affected	Condition of cysts				
	Total No. of cyst	Viable	Percent (%)	Non viable	Percent (%)
Tongue	10	7	70%	3	30%
Masseter muscles	14	11	78.57%	3	25%
Shoulder muscles	48	41	85.4%	7	14%
Thigh muscles	22	17	77.68%	5	22.7%
Heart	19	14	73.3%	5	26.3%
Liver	6	4	66.67%	2	33.3%
Diaphragm muscles	1	-	-	1	100%
Intercostal muscles	2	1	50%	1	50%
Total	122	95	62.35	27	37.75

Table 4. Distribution of *Cysticercus bovis* cyst between male and female animals

Predilection Site	Female			Male			Total
	No. cyst	Viable	Non viable	No. cyst	Viable	Non viable	
Tongue	2	1	1	5	3	2	7
Masseter m/s	2	1	1	13	11	2	15
Shoulder m/s	3	2	1	45	39	6	48
Thigh m/s	3	2	1	18	16	2	21
Heart	3	2	1	10	8	2	13
Liver	2	1	1	14	12	2	16
Diaphragm m/s	-	-	-	1	-	1	1
Intercostal m/s	1	1	-	-	-	-	1
Total	16	10	6	106	89	17	122

Table 5. Questionnaire survey for public health significance in three distinct woredas'

Risk factor	Interviewed No.	Infested No.	Prevalence (95% CI)	(%)	OR(95% CI)	P-value
Age						
➤ <30years	48	17	35.4 (28.4-42.4)			
➤ 30-49years	132	88	66.67(59.8-73.6)		3.65	0.022
➤ >30years						
Sex						
➤ Male	128	91	68.25 (61.4-75)		5.8	0.000
➤ Female	52	14	26.9 (20.4-33.4)			
Religion						
➤ Muslim	17	4	23.53(18.87-29.7)			
➤ Christian	163	101	61.96 (54.86-69)		5.3	0.001
Place of respondents						
➤ Nekemte	80	48	60 (52.8-67)		1.8	
➤ Guto Gida	50	34	68 (61.2-74.8)		2.5	0.04214
➤ Sassiga	50	23	46 (38.7-53.3)			
Habit of raw meat consumption						
➤ Not consume	75	36	48 (40.7-55.3)			
➤ Consume	105	80	76.2 (69.9-82.4)		3.5	0.0313
Marital status						
➤ Un married	80	42	52.5 (45.2-59.8)			
➤ Married	100	63	63 (55.9-70)		1.5	0.040
Education						
➤ Educated	83	45	54.2 (46.9-61.5)			
➤ Non educate	97	60	61.85 (54.7-68.9)		1.3	0.023

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