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Study on Prevalence of Bovine Cysticercosis and Retrospective Survey of Human Taeniasis in and Around Asella Town, South East, Ethiopia

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Abstract

Bovine *cysticercosis/Taenia saginata* is a food-borne parasitic zoonosis disease of great public health significance especially in developing countriescaused by the larval stage of the tapeworm. The present study were conducted by both retrospective and cross-sectional study, on four years data and 405 slaughtered head of cattle respectively, in Asella town, in thecentral part of the Oromia national regional state,south east Ethiopia from Novembers 2017 to April 2018 to determine the prevalence of the bovine cysticercosis. Out of 405 examined heads of cattle 11(2.7%) were found infected with bovine Cysticercus. There was no significant variation ($p > 0.05$) between different groups of age, sex, breed, body condition and origin of animals with the prevalence of bovine cysticercosis. The anatomical distribution of the cysticerci was being high in the tongue (45.5%) followed by masseter (18.2%), thigh muscel (18.2%), shoulder (9.1%) and heart (9.1%) There is significance difference in the distribution of the parasite in different organs ($p < 0.05$). The viability rate of cysts was higher in heart (100%), shoulder (100%) followed by masseter muscle (50%), thigh muscle (50%) and tongue (40%). proportion of counted cysts viability indicated that 6(54.5%) were viable while other and 5(45.5%) were nonviable. From the retrospective data between years of 2007-2010 reviewed, from the total of 5310 suspected patient, 258(4.9%) were found positive stool examination result for *T. saginata* egg. The prevalence was highest in 2007, 5.5 % (OR=1.09, 95%CI: 0.72-1.65, $P > 0.05$) and gradually decreased significantly to 3.8 % ($P < 0.05$, OR=0.62, 95%CI: 0.40-0.94) in 2008. Slightly raised without significant difference to 5.2% in 2009 and 5.3% in 2010. In terms of gender, significantly higher ($P < 0.05$ proportion of positive stool for *T. saginata* was observed in males patients with diagnostic prevalence of (7.2%) compared to female patients (3.6%).

Keywords: *Abattoir; Asella; Bovine*; *Cysticercosis*; *Ethiopia*; *Prevalence*; *Taenia.*

Introduction

Ethiopia has one of the largest inventories in Africa with livestock currently supporting and sustaining the livelihoods of an estimated 80 percent of the rural poor. An animal rearing is an integral part of the agricultural production and estimated livestock population is 56,706,389 cattle, 29,332,382.56 sheep, 29,112,963 goats, 1,164,106 camels and 56,866,719 poultry (CSA, 2015). In the country, cattle are important source of income for rural communities and are one of the nation's major sources of foreign currency from export. However, this great potential is not properly exploited. This is because of endemic disease burdens, traditional management system, inferior genetic makeup coupled with malnutrition and absence of well-developed market infrastructure (MoRD, 1997).

Parasitic diseases are highly prevalent in Sub–Saharan Africa and incur severe economic losses by reducing productivity. *Taenia saginata*/Bovine cysticercosis is a food-borne parasitic zoonosis caused by the larval stage of the tapeworm *Taenia saginata* commonly referred to as the beef tapeworm. Tapeworm infection has been recorded in 1500 years ago and it is the earliest human parasite (Abilo and meseret, 2006). Meat- borne diseases are common in developing countries including Ethiopia because of the prevailing poor food handling and sanitation practices, inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in safer equipments and lack of education for food-handlers (WHO, 2004).The adult tapeworm, *T. saginata* occurs in the small intestine of the definitive host, man and the metacestode (*Cysticercus bovis*) is found in cattle that serves as main intermediate host (Soulsby, 1982). Globally, there are 77 million human carriers of *T. saginata* out of which about 40% live in Africa (Megersa *et al*., 2010).

Bovine cysticercosis has a worldwide distribution but it is quite common in Africa reaching a level of 80% in Ethiopia, 30-36% in Kenya, 15% in Rwanda, 20% in Guinea, 18% in Sierra Leone, 20% in Cameroon, 2% in Senegal and 8% in Sudan (Urguhart *et al*., 2007). In Eastern African countries like Ethiopia up to 70% of the population reports to have been infected with a tape worm (Kebede *et al*., 2009). Both adult and larval forms of *T. saginata* are hazardously affected health of their respective hosts, either directly or indirectly with several secondary infections, particularly in human. The occurrence of metacestode larval stage of *C. bovis* in cattle musculature is causing bovine cysticercosis while the adult stage of worm in human small intestine is characterized by Taeniasis (Abilo*et al.,* 2006; Minozzo *et al*., 2002).

Cysts of *C. bovis* can be found anywhere in the carcass and viscera but its illustrated sites are predilection like masseter, tongue, heart, triceps, intercostals muscle and the diaphragm which organs are consumed at raw level and causes of public health hazardous except heart of animals. Also, the infection in cattle has economic significance due to the total or partial condemnation of carcasses or their reduced value due to refrigeration, extra handling and transport (Gyles *et al*., 2004)

In live animal or cattle having *C.bovis* show no symptoms and the presence of the cysts in carcasses is observed visually during the routine meat inspection by making different incisions into muscles and organs (Gracey *et al*., 2009). Human infection that occurs through consuming of infected raw or semi-cooked beef may results in epigastric pains, diarrhea, nausea, weakness or loss of appetite (Lees *et al.*, 2002).

Human taeniasis is common in Ethiopia, as the practice of eating raw or undercooked beef is not uncommon in many sections of human population (Gebreab, 1995). Habit of eating raw beef dishes, low level of toilet used by human population, backyard slaughter, low availability of taenicides, free access of cattle to surface water and proximity of waste water are important causes for transmission of bovine cysticercosis to a herd of cattle and taeniasi*s* in human population (Kumar and Tadesse, 2011).

Therefore the objectives of this thesis was

- To determine the prevalence and viability of bovine cysticercosis in cattle slaughtered at Asella municipal abattoir
- To evaluate the prevalence and possible trends of human *T. saginata*in and around AsellaTown based on hospital data over a period of four years.

Materials and Methods

Study Area

The study was conducted from November 2017 to April 2018 at Asella Municipal Abattoir and Asella Referral Teaching Hospital and College of Healthy Sciences. Asella town, the capital of Arsi zone in the central part of the Oromia National Regional State, is located at about 175 km Southeast of Addis Ababa at 6° 59' to 8° 49' N latitudes and 38° 41' to 40° 44' E longitudes with an altitude of the area ranges from 2500 to 3000 meter above sea level. Asella town is characterized by mild sub-tropical weather with the maximum and minimum temperature ranging from 18°C and 5°C, respectively around the year. Agricultural production system of the study area is of mixed crop and livestock production (KARC, 2008). Livestock's are the major agricultural resources in Asella and surrounding area and has livestock population of 86,122 cattle, 51,292 sheep, 16,292 goats and 35,489 poultry, (TDAO, 2006). According to national census reported a total human population of Asella 67,269 of whom 33,826 were men and 33,443 were women (PHCE, 2007).

Study Population

The study animals were indigenous zebu and exotic cross breed cattle brought at Assela municipal abattoir in Assela town for slaughtering, from different localities during the study period. Most of the slaughtered animals were male cattle originated from different localities mainly from market origins of Digalutijo, Lemubilbilo, Hetosa and Tiyo districts of Arisi zone, South east Ethiopia. During sampling of the study animals in the study time, sex, breed, origin, ages and body conditions of all the sampled animals from the study area was recorded for the assessment of risk factors.

Study Design

A cross sectional and retrospective study was conducted from November, 2017 to April, 2018 to determine the prevalence of C. *bovine* at Asella municipal abattoir and retrospective study was performed in patients data given stool sample for parasitological examination inAsella Referral Teaching hospital. Laboratory records were reviewed through patient's files, in hospital archives. The suspected patients were both male and female under different age category suffering from gastrointestinal disturbance, who attend medical treatment in the study hospital. Data considering age, gender and stool examination results was collected.

Sample Size Determination

The total number of sampled animals required for this study was determined according to the formula given by Thrusfield (2005), taking 50% prevalence of bovine cysticercosis in the study abattor, 95% level of confidence and 5% desired level of precision.

$N=1.96^2 P_{exp} (1-P_{exp})/D^2$

Where N= required sample size
P_{exp}= expected prevalence and
D= desired absolute precision (usually 0.05)

Accordingly, 384 cattle were the calculated sample size, however, total of 405 cattle were sampled by simple random sampling technique and examined using the routine meat inspection methods for *bovin cysticercosis*.

Study Methodology

Abattoir survey

Regular visits of the abattoir on three slaughtering days per week were performed to carry out both ante mortem and post mortem inspection of cattle

slaughtered at the study abattoir during the study period. For the ante-mortem, examination the cattle were randomly selected and examined clinically both at rest and in motion. They were tagged with an identification number, sex, age, body conditon, breed and the origin of the animals was recorded. During pre-slaughter inspection sampled cattle were examined clinically both at rest and in motion. The age of the animals was determined by dental eruption formula according to (De Lahunta and Habel, 1986) and the animals were categorized into three age groups less than 5 years, 5 – 10 and greater than 10 years. Body condition score was ranked as good, medium and poor as described by (Nicholson and Butterworth, 1986).

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

Retrospective hospital data survey

Retrospective survey of hospital data was carried out based on a review of daily laboratory record findings of stool examination report of suspected patients (patients with symptom of abdominal discomfort) in Assela referral hospital. Data was routinely collected from Asela Referral hospital in the study period from November 2017 to April 2018, in which the patients that was coming to hospital from different areas in and around the town. The relevant four years data were collected from the hospital, parasitology laboratory record book. Information collected included number of patients examined, sex, age and the stool result of each year.

Cyst viability

The cysticerci which was found during detail postmortem examination was trimmed off with the surrounding tissues and transported in ice box to Asella regional veterinary Parasitology laboratory for confirmation of cyst viability. The cysts were incubated at 37°C for 1–2 hrs using 30% ox bile solution diluted in normal saline. The cysts were regarded as viable if the scolexevaginate during the incubation period (Graceyet *al*., 2009).

Data Analysis

The abattoir survey and hospital data were recorded and entered in to Microsoft Excel 2013© and analyzed using SPSS version 20. Descriptive statistic (Chi-squared test) was employed. Anatomical distribution of *C. bovis*and cyst viability were tabulated. The retrospective hospital data were also summarized and analysed. Logistic regression was used to determine the level of significance of risk factors associated with the exposure of human taeniasis. A level of significance of $P < 0.05$ at 95% confidence was used.

Results

In the study period a total of 405 cattle were inspected in Asella municipal abattoir from November 2017 to April 2018. From a total of examined cattle, 11(2.7%) were found to be infected to Cysticercus bovis. Regarding to age group higher prevalence was in old 8(3.1%) and lower in 3(2.1%) adult, but there was no statistical variation (X^2=2.455, P=0.117) among age groups and the prevalence (p>0.05). *Cysticercus bovies* with respect to sex revealed that higher prevalence 1(11.1%) in female and lower prevalence 10(2.5%) in male, but there was no statistical variation (X^2=2.455, P=0.117) among sex groups and the prevalence (p>0.05). According to this result there was no significantly associated with body condition score of the animal (χ2=0.710. *P*= 0.399). The higher prevalence was observed in animals with medium

body condition (3.4%) than in animals with good body condition score (2.1%). In this result breed of cattle was not significantly associated with *c. bovis* prevalence ($\chi 2$ =0.902, P=0.342). Comparatively, higher prevalence was observed in local breeds (3.1%) compared within cross breed (1.2%) Table 1.

Table 1: Prevalence of *Cystcercus bovis* in relation with age, sex, body condition scores and breed of the animals

Variable	Number of examine	Number of positive	Prevalence %	X^2	p-value
Age					
<5	143	3	2.1		
≥5	262	8	3.1	2.455	0.117
Sex					
Male	396	10	2.5		
Female	9	1	11.1		
Body condition score					
Medium	207	7	3.4	0.710	0.399
Good	198	4	2.0		
Breed					
Local	322	10	3.1	0.902	0.342
Cross	83	1	1.2		
Total	405	11	2.7		

Prevalence in relation to localities/ origin of the animals According to the data showed the distribution of bovine cysticercosis was not significantly associated (X^2=1.981, *P*= 0.576) with the localities/ origin of the slaughtered cattle. Comparable prevalence was observed in cattle originated from Lemubilbilo (3.9%), followed by Digalutijo (3.1%), and (1.4%), Hexosa district. However *c.bovis*was not found in cattle from Tiyo district in Table 2.

Table 2: Prevalence of *Cystcercus bovis* in relation to localities/origin of the animal

Variables	Number of examined	Number of infected	Prevalence (%)	X^2	*P*-value
Origin					
Digalutijo	223	7	3.1		
Lemubilbilo	77	3	3.9		
Tiyo	36	-	-		
Hexosa	69	1	1.4		
Total	405	11	2,7	1.981	0.576

Anatomical distribution of *Cystcercus bovis* in deferent organs. Tongue was the most frequently infected organ with a prevalence of (45.5%) followed by masseter (18.2%), thigh muscle (18.2%), shoulder (9.1%) and heart (9.1%). There is significance difference in the distribution of the parasite in different organs (p<0.05) in table 4.

Table 3: Anatomical distribution of *Cystcercus bovis* in deferent organs

Organ affected	Number of positive	Prevalence%	X^2	*P*-value
Tounge	5	45.5		
Heart	1	9.1		
Shoulder muscle	1	9.1		
Thigh muscle	2	18.2		
Masseter muscle	2	18.2		
Total	11	100.1	405.0	0.000

Examination for the condition of cyst viability indicated that (54.5%) viable and (45.5%) nonviable was obtained. The viability rate of cysts was higher in heart(100%) followed by shoulder (100%), masseter(50%), thigh (50%) and tongue (40%) (Table 5).

Table 4: Total cyst count and their viability within infested organ

Organs affected	No. cysts Collected (%)	No. viable cyst (%)	No. non-viable cyst (%)	X^2	P-value
Tongue	5(45.5)	2(40)	3(60)		
Heart	1(9.1)	1(100)	-		
Shoulder muscle	1(9.1)	1(100)	-		
Thigh muscle	2(18.2)	1(50)	1(50)		
Masseter muscle	2(18.1)	1(50)	1(50)		
Total	11(100)	6(54.5)	5(45.5)	483.3	0.000

Prevalence of *T. saginata*

A total of 5310 patient records from 2007 to 2010 were collected and computed for the prevalence of *Taeniasaginata*based of their age, sex and years of examination. Of these patients, 258(4.9%) were found positive stool result for *T. saginata*egg. The stool examination result showed that the prevalence of the disease was highest in 2007 (5.5%) and decreased significantly to 3.8%, (P< 0.026, OR= 0.62, 95%CI: 0.40-0.94) in 2008. However, the prevalence rose insignificantly to 5.2%, (OR=1.04, 95%CI: 0.70-1.54) in 2009 and slightly increase to 5.3% in 2010 (Table 5).

Regarding age of patient infected, higher prevalence of infections was observed in patients more than 31-45 years of age (5.4 %) with low prevalence at the age of <18 years. In terms of gender, proportion of positive stool for *T. saginata*was observed in males patients with diagnostic prevalence of 7.2% compared to female patients. (Table 5)

Table 5: Proportion of human patients infected with eggs of *Taenia saginata* by age, sex and year

Variables	Number of Stool examined	Number of *T. saginata*positive (%)	OR	95%CI	P-value
Age					
<18years	876	36(4.1)	3.25	1.84-5.75	0.000
19-30	2223	108(4.9)	3.60	2.23-5.82	0.000
31-45	1401	76(5.4)	1.65	1.10-2.47	0.015
>45	810	38(4.7)	-	-	-
Sex					
Male	1900	136(7.2)	-	-	-
Female	3410	122(3.6)	0.23	0.16-0.33	0.000
Year					
2007	1235	68(5.5)	1.09	0.72-1.65	0.690
2008	1677	64(3.8)	0.62	0.40-0.94	0.026
2009	1698	89(5.2)	1.04	0.70-1.54	0.848
2010	700	37(5.3)	-	-	-
Total	5310	258(4.9)			

Discussion

The overall prevalence of bovine cysticercosis among 405 examined cattle in Asella Municipal abattoir during the study period was 2.7% (11/405). Comparable to this finding different researchers in country reported prevalence of 2.2% by Teka (1997) from Adisababa, 2.59% by Dawit*et al*. (2012) from Wolaitasoddo municipal abattoir and 3% by Bedu *et al*. (2011) from Zeway Municipal Abattoir. In contrast to the current result Adem*et al.* (2016) reported low prevalence of bovine cysticercosis (1.2%) in the same abattoir.

In contrast, higher prevalence of *C.bovis* compared to the current finding was reported in different abattoirs of the country, 12% by Abunna (2013) at Yirgalem, 17.5% by Hailu (2005) in East Shoa, 18.49% by Kebede (2008) in North West Ethiopia and 26.3% by Abunna (2008) at Hawassa. This finding is considered to be higher than the previous prevalence reported by different researchers from developed countries, such as 0.23% by Haridy (1999) 0.37% by Rodriguez-Hidalog (2003) 0.2% by Blessing *et al.* (2010) and 0.11% by Zdolec *et al.* (2012) were reported in Egypt, northern Ecuador, south Africa and Croatia respectively.

This could be due to strict application of meat inspection and public health extension rules and difference in hygiene measures in the study countries. It's known that sanitation facilities are better in the developed countries than in the developing countries in which low level of personal, poor environmental hygiene, habit of raw meat consumption, low number of incision made at inspection site in the abattoir, and management type of the animals practiced increase the prevalence of the diseases in the environment.

The main reason with low prevalence of bovine cysticercosis in the current study could be due to low number of organs inspected and low incision made at inspection site at the abattoir. In Asella municipal abattoir the commonly inspected organs for presence of *C. bovis*were internal organs (liver, heart, lung and tongue) and masseters, shoulder, thigh muscle and other predilection sites are rarely inspected due to multiple mutilation of carcass causes reduction in marketability of the meat and the owners not permit multiple incision of heavy muscles.

Another possible reason for variation in prevalence may be due to difference in sample size, origins of animals that were presented for slaughter, status of the people in the environment

especially related to experience and appropriate use of toilet, habit of the community feeding raw and undercooked meat consumption. The number of viable *T. saginata* eggs ingested by cattle was also some of the reasons for variation of *C. bovis* prevalence indifferent localities (Taresa *et al.,* 2011).

In this study, there is no significant association (P>0.05) between,age, sex, origin, breed, body condition and the prevalence of bovine cysticercosis. Those results agree with the previous reports of Tembo (2001), Hailu (2005) and Fufa (2006). One possible explanation for the insignificant variation of those variables might be due to the fact that the two age group of animals has close susceptibility to *Taenia saginata* egg and the animals slaughtered in this abattoir were adult and old and both sexes are equally exposed to the disease in the study area, which leads to equal exposure of animals to *T. saginata* eggs and have similar husbandry systems (the same type of livestock management, extensive) Abunna *et al*. (2008).

The present study showed thattongue was the most frequently infected organ with a prevalence of (45.5%) followed by masseter (18.2%), thigh muscel (18.2%), shoulder (9.1%) and heart (9.1%). Similar findings were reported by Mulugeta (2010), Hailu (2005) and Ahmed (1990).According to this result there was significance difference in the distribution of *C. bovis*in different organs of cattle (P<0.05). Examination for the condition of cyst viability indicated that (54.5%) viable and (45.5%) nonviable *C. bovis cysts* were observed. The viability rate of *C. bovis* was higher in cysts collected from heart (100%) followed by from shoulder (100%), masseter muscle (50%) thigh muscle (50%) and tongue (40%).

The variations in anatomical distribution depend on a number of factors, such as blood kinetics and animal's 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 and Collins, 1992).

In the current survey of human taeniasis, a four years retrospective data (from September 2007 to March 2010), which was taken from parasitology laboratory case book record in Asella referral teaching hospital and college of healthy sciences, was analyzed to estimate the prevalence of *T. saginata* among the population of in and around Asella town. According to this hospital based retrospective survey, out of 5310 patients taken stool examination (from 2007 to 2010), 258 of those patients were stool positive for *T. saginata* egg with prevalence rate of 4.9 (258/5310) for *T. saginata* infection. In agreement with this result comparative prevalence of 4.3% human taeniasis was reported in Nepal by Sah *et al.* (2012). However, in other previous studies of human *T. saginata* showed lower prevalence estimates of 1.2% in Mexico (Martinez-Maya *et al.,*2002) and 2.5% in Kenya (Asaava *et al.,* 2009).This difference in prevalence of human Taeniasis in different areas may be associated with the difference in occurrence of cysticercosis in cattle, the level of raw meat consumption and the meat inspection procedures practiced. On the other hand, the reason for this variation may be related to the level of environmental contamination and degree of awareness of different societies about Taeniosis transmission (Teklemariam and Debash, 2015).

Regarding age of patient infected, there was significant association (P< 0.01) between patient's age categories with infection rate of *T.saginata* with higher prevalence of infections in patients more than 31-45 years of age (5.4 %) compared with 4.1% in age group of<18 years (OR=3.25, 95%CI:1.84-5.75), 4.9% in 19-30 years of age (OR=3.60, 95%CI:2.23-5.82), and 4.7% in >45 years of age. This prevalence is in agreement with the previous study of (Abunna *et al*., 2008; Adugna *et al*., 2013; Lielt *et al.,* 2015). This could be explained by the fact that higher age group people frequently eat raw meat and are prone to c. bovis cysts. the older peoples also possibly have had more time to be exposed and infected by viable *c.bovis*cysts. However younger people do not have such an access.

In this study *T. saginata* prevalence was significant higher (P< 0.01) in male (7.2%) than female which is a similar report with findings of Hailu (2005); Abunna (2013) and Lielt*et al*. (2015) in other parts of Ethiopia. This may be due to economic reasons and cultural practice. In Ethiopia, men do not commonly prepared their dish rather they often visit restaurants and butcher.

Conclusion and Recommendations

In this result, although the prevalence was not higher compared to other studies, the current study showed that *Taenia saginata*/ *Cysticercus bovis* is an important zoonotic parasitic disease in the study areas. Its public health hazard and economic losses due to bovine cysticercosis are associated with total condemnation of carcasses with generalized infestation and downgrading carcasses which are subjected to refrigeration, in addition to the cost of the refrigeration and extra handling and transport. The four years hospital based stool egg diagnostic data analysis showed that prevalence of *Taenia saginata* human infection slightly decreased in the four years in Assela town. However, the stool examination result of suspected patients showed that the prevalence of *Taenia saginata* infection was not significantly decreased year after year in the population

Based on the above conclusion the following recommendations forwarded.

- There should be public awareness about the health and economic importance of the disease through social and public media.
- Avoid eating of raw meat that is not inspected by well experienced meat inspector.
- Back yard slaughtering of cattle should be avoided.
- Animal should be dewormed on regular basis of cattle is essential.
- Meat inspection activity should be conducted by qualified meat inspector.
- Use of latrines and improved standards of human hygiene.

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