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### RESEARCH PAPER

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## Study on the Prevalence of Bovine Cysticercosis in Gondar Elfora Abattoir, Gondar, Ethiopia

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### ABSTRACT

A cross-sectional study was conducted from October 2015 to April 2016 in cattle slaughtered at Gondar ELFORA abattoir with the objective of estimating the prevalence and cyst distribution of *Taenia saginata* cysticercosis. The abattoir survey was carried out by routine meat inspection of carcasses, and post mortem examination of 400 slaughtered cattle were examined from randomly selected animals of which 9 (2.25%) were infected with *T. saginata* metacestodes. Of the total 29 *Cysticercus bovis* cyst collected from infected carcasses, 11 (37.93%) were found live (viable) while 18 (62.03%) of them were degenerative cyst. The tongue, masseter muscles, heart, and triceps muscles are the main predilection sites of the cysts. Anatomical distribution of the cyst showed that highest proportions were observed in triceps muscle 11 (37.93%), followed by tongue 8 (27.58%), masseter muscle 6 (20.7%) and heart 4 (13.79%). In this study, the prevalence of bovine cysticercosis was not varied significantly for age groups, body condition and origin of the animals ( $p>0.05$ ). The current study suggests that there is considerable prevalence of *T. saginata* metacestodes in some of the edible organs, and therefore sufficient emphasis should be given to this problem so as to improve health, quality and quantity of beef that may satisfy the domestic requirements of the country.

**Key words:** Cattle, Cysticercosis, Gondar, Prevalence and *Taenia saginata*.

## INTRODUCTION

The nation's domestic meat consumption of about 45% comes from cattle, which generates export income mainly from the sale of live animals. In foreign trade, although the country is ideally placed to export live animals to the big markets of the Middle East and substantial markets of North and West Africa, export earning is relatively low. This is mainly due to the presence of a number of unimproved animal health problems, among which, *Taenia saginata* (*T. saginata*) or *Cysticercus bovis* (*C. bovis*) is one that remains a major public and animal health problem [Mekbib et al., 2013].

Animal diseases are one of the most important constraints to increase productivity of food animals in all parts of the world. Parasitism is one of the major problems that affect the productivity of livestock worldwide. Among many parasitic problems of domestic animals, tapeworms are an economically important intestinal parasites found all over the world, which have infected human beings for thousands of years [Radostits et al., 2007].

*Bovine cysticercosis* is a disease that affects the muscle of cattle and is caused by the metacestode stage of the human intestinal cestode, *T. saginata*. It is cosmopolitan in its distribution and it occurs in developing as well as in developed countries. The adult *Taenia* infection in man is referred to as *Taeniasis* and that due to the larval stage cysticercosis [Roberts and Janovy, 2009]. The distribution is associated with economic conditions, religious beliefs and close proximity of humans to cattle in utility function. *T. saginata* is wider in developing countries where hygienic conditions are poor and where the inhabitants traditionally eat raw or insufficiently cooked meat [Smyth, 1994]. The infection is also a problem in developed countries where undercooked beef steak is consumed. It is important to note that eggs have been demonstrated to survive almost all stages of sewage treatment. It is significant; to that even the high standard of meat inspection in abattoirs of highly developed countries that are expected to identify measly beef carcasses has not succeeded in eliminating this parasite [Minozzo et al., 2002].

*Taenia saginata/Cysticercus bovis* is important from the standpoint of the health of cattle because of consequences for the meat supply and, more importantly, from the direct effects on the well-being of humans who, almost universally, consume beef as a source of protein and other minerals [Wanzala et al., 2003].

Its life cycle is entirely dependent on the link between man and cattle; so that any break in this link can result in the total elimination of the parasite. Cysts of *Cysticercus bovis* can be found anywhere in the carcass and viscera, but there seems to be special affinity towards some parts which are described as sites of predilection (masseter, tongue, heart, triceps, intercostal muscles and the diaphragm). Most of these organs except the heart are consumed raw or under cooked and could be a potential public health hazard in contracting *taeniasis* [Wanzala et al., 2003] (FAO), 2011].

In Africa, inadequate health education and low availability of taenicidal are the major obstacles for the control of the disease. The variations in the epidemiological patterns of *Taeniasis/Cysticercosis* throughout Africa are a reflection of the numbers and distribution of human and cattle populations [Harrison et al., 2001]. In East African countries prevalence rates of 30 to 80% have been noted [Teka, 2006]. *Bovine cysticercosis* is very common in Africa and is endemic in areas of Central and East African countries like Ethiopia, Kenya and Zaire [Harrison et al., 2001]. The custom of eating raw or undercooked beef dishes such as kourt, lebleb, kitffo and the habit of defecating in open fields coupled with the tradition of allowing cattle to graze in such fields made *taeniasis* of human and *cysticercosis* of cattle are common in Ethiopia [Teka, 2006]. A high prevalence of human infection in different agro-

climatic zones of the country has been reported [Tembo, 2001]. Estimates made by different investigators on prevalence of *taeniasis* in Ethiopia vary widely from 2% - 16% to over 70% [Abusier et al., 2006].

The prevalence of *C. bovis* was reported by different individuals was 3.2% in different agro-climatic zones of the country [Tembo, 2001], 2.2-3.2% in Addis Ababa abattoir [Teka, 2006], 19.4% in Bahir dar [Alemu, 2005], 21.17% in Nekemte [Teka, 2006], 13.85% in Debre Zeit [Belayneh, 2004] and 2.99% in Gondar [Ambachew and Yitigel, 2015]. In Ethiopia, cattle are mainly raised under extensive husbandry practice by the rural communities. Existence of higher population density, raw meat consumption, poor hygiene and sanitary infrastructure may facilitate the transmission of the disease between animals and human beings in the rural area. *Taenia saginata*, is a major problem in developing countries like Ethiopia due to the culture of eating raw meat inform of kourt and kitfo as routine dish and during holidays prompted human taeniasis [Gebre Emanuel, 1997].

The 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 refrigeration and extra handling and transport [Kebede et al., 2006]. The parasite is could be controlled by routine meat inspection, restriction of raw or undercooked beef consumption, utilization of latrine, treating infected human and public awareness about the life cycle and control measures.

Therefore, the objectives of this study were:

- ✓ To estimate the prevalence of bovine cysticercosis in and around Gondar
- ✓ To assess the distribution of this parasite cysts in organs or tissues of infected animal

## MATERIALS AND METHODS

### Study Area

The study was conducted from October 2015 to April 2016 in Gondar ELFORA abattoir, North Gondar, Ethiopia. Gondar town, the capital town of North Gondar Administrative zone which is located in Amhara National Regional state 740 km away from Addis Ababa to North West direction. The town is found at latitude of 12.3-13.8°N, at a longitude of 35.3-35.7°E and at 2200 Meter above sea level. The annual mean minimum and maximum temperature of the area vary between 12.3-17.7°C and 22-30°C, respectively with an annual average temperature of 19.7°C. The region receives a bimodal rainfall, the average annual precipitation being 1000mm that comes from the long and short rainy seasons. The short rainy season occur during the months of March, April and May while the long ones extend from June to September [CSA, 2012]. The production system observed around the areas is cereal based agricultural activities and livestock farming activities. The livestock population of northwest Gondar is estimated to be 1936514 cattle, 524063 sheep, 682264 goats, 36828 horses, 12473 mules 223116 donkey and 3165068 poultry [(MOA), 2013].

### Study Animals

Study populations were cattle presented to the abattoir for slaughtering and routine meat inspection. From those animals that daily came to the ELFORA abattoir, the study animals were selected in systematic random sampling method, and the slaughtered cattle were routinely inspected for *T. saginata*, cysticercosis. Body condition for each cattle was estimated based on [Nicoloson and Butterworth, 1986] scores with the scale ranging from 1, 2 and 3 (poor), 4, 5 and 6 (medium) and 7, 8 and 9 (good). The age was classified as Adult (< or = 6) and Old (> 6) [Torell et al., 2003].

### Study Design

A cross-sectional type study was conducted from October 2015 to April 2016 to assess both the prevalence of bovine cysticercosis and its distribution of cysts.

### Sampling Method and Sample Size Determination

The total numbers of cattle required for the study was calculated based on the formula given by [Thrusfield, 2005] with 95% confidence interval and at 5% desired precision. The expected prevalence of bovine cysticercosis in Gondar was 2.99% [Ambachew, and Yitagel, 2015].

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

Where:

n= required sample size

P<sub>exp</sub>= expected prevalence

d= desired absolute precision

n= 45, but in order to increase the precision the sample size was increased to 400.

### Study Methodology

Active abattoir survey

The cross sectional study, which was based on the active abattoir survey, was conducted during routine meat inspection on randomly selected 400 cattle slaughtered at Gondar ELFORA abattoir. Before slaughtering and inspecting the animals, ante-mortem inspection was carried out and the tag number of each animal was recorded. Ante mortem examination on individual animals was done for the assessment of body condition, age, sex, breed and their place of origin.

Meat inspection during post mortem examination was made in accordance with the procedures of the Ethiopian Ministry of Agriculture Meat Inspection Regulation Number 428 of 1972 for *T. saginata* cysticercosis (bovine cysticercosis). Visual inspection, 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 are performed during inspection of carcass.

The collected positive samples were transported to the Parasitology laboratory in University of Gondar Faculty of Veterinary Medicine for viability test. The viability test was assessed by incubating the cysts in a normal saline solution containing 30 % ox bile at 37 °C for 2 h. A cyst is regarded as viable if the scolex evaginated during incubation.

### Data Analysis

Abattoir data were collected and recorded on specially designed forms on Microsoft Excel spread sheet. Statistical analysis was done using SPSS version 20 Chi-square ( $\chi^2$ ) test was used to determine the variation in infection, prevalence between origins, ages and body conditions. Statistical significance was set at  $P < 0.05$  to determine whether there are significant differences between the parameters measured between the groups.

## RESULTS

### Prevalence of bovine cysticercosis and potential risk factors

Of the total 400 inspected animals in Gondar ELFORA abattoir, 9 animals had harbored varying number of *C. bovis* with overall prevalence of 2.25% (9/400). Out of 74 animals from high land one (1) of them has been infected by *C. bovis*, where as among 326 animals from low land eight (8) animals have been infected (Table 1). But the analysis showed that there were no statistically significance among cattle come from high land and low land ( $p>0.05$ ).

Out of 118 adult animals, 3 animals were infected and out of 282 old animals 6 of them were infected with *C. bovis*. But the analysis revealed insignificance association between two ages categories ( $p>0.05$ ).

Out of 101 good, 230 medium, 69 poor body condition animals 2, 3, 4 animals were positive for *C. bovis*, respectively. But the analysis showed insignificance association between those body condition ( $p>0.05$ ).

**Table 1. Analysis potential risk factors with occurrence of *C. bovis*.**

Risk factors	No of animal examined	No of positive animals	X <sup>2</sup>	P-value
<b>Age</b>				
Adult	118	3	0.065	0.799
Old	282	6		
<b>Body condition</b>				
Good	101	2	4.916	0.086
Medium	230	3		
Poor	69	4		
<b>Origin</b>				
High land	74	1	0.333	0.564
Low land	326	8		

**Table 2. Distribution of *C. bovis* cysts and its relative proportion of viable cysts in the inspected organs.**

Organs or tissues inspected	No. inspected animals	No. positive animals	No. of cyst collected	Percent of cyst collected (%)	No. of viable cyst	Percent of viable cyst (%)
Tongue	400	2	8	27.58	3	27.27
Masseter	400	2	6	20.7	1	9.09
Triceps	400	4	11	37.93	5	45.45
Heart	400	1	4	13.79	2	18.18
Liver	400	0	0	0	0	0
Intercostal	400	0	0	0	0	0
Diaphragm	400	0	0	0	0	0
<b>Total</b>	400	9	29	100	11	37.93%

### Viability test and Anatomical distribution of cysts

From the total 29 *C. bovis* cyst collected from the abattoir during the study period, 11 (37.93%) were found viable (live) while the other 18 (62.07%) were degenerated (Table 2). As it is depicted in Table-2, of the organs or carcass examined, the highest proportion of the *C. bovis* cysts were observed in the triceps 11 (37.93%), followed by tongue 8 (27.58%), masseter 6 (20.7%) and heart 4 (13.79%). Active abattoir survey data showed that there was variation in the anatomical distribution of cysticercus in organs inspected. The viability test of the cysts also revealed that the triceps harbored the highest number of viable cysts (45.45%), followed by tongue (27.27%), heart (18.18%) and masseter (9.09%).

### DISCUSSION

The prevalence of *C. bovis* is low in developed countries, being less than 1% in carcasses inspected [Onyango et al., 1996] and it is very common in Africa reaching a level of 80% in Ethiopia, 30-36% in Serraleon, 29% in Cameroon, 20% in Senegal, 0.8% in Sudan [Gebre Emanuel, 1997]. There were different results reported on the prevalence of Bovine Cysticercosis in Ethiopia by different Authors and researchers in different years [Hailu, 2005] in East Shoa (17.5%), [Nigatu, 2004] in Addis Ababa (7.5%), [Ahmed, 1990] in Nekemte (21%) and [Dessie, 1992] at Assela (2.7%). In this study, the prevalence of cysticercosis was 2.25 %, which is nearly similar to the finding of [Dessie, 1992] from Assela (2.7%), [Tolosa et al., 2009] from Jimma (2.93%) but lower than that reported in other parts of the country, [Dawit, 2004] 4.6% at Gondar, [Nigatu, 2004] 7.5% in Addis Ababa, [Hailu, 2005] 17.5% in East Shoa, [Abunna et al., 2008] 26.5% in Hawassa. The reason for the lower prevalence of bovine cysticercosis in this study might be good management system and awareness of the population and environmental hygiene applied in this study area. Another reason for this difference might be due to status of the people in the environment (keeping personal and environmental hygiene decrease the prevalence of the parasite), husbandry system and hygiene difference eating habits are the most important. The higher prevalence of cysticercosis in developing countries is associated with poor sanitary infrastructure, low awareness and improper disposal of sewage, which also pertains to Ethiopia, where the widespread habit of eating raw meat is an additional important risk factor.

Prevalence of this study was very low when comparable with some reports from African countries, such as 20% in Senegal, 27% in Tanzania and 38-62% in Kenya [Over et al., 1992]). But it is higher than reports in some countries, such as 0.9% in Cuba [Suarez and Santizo, 2005] and 0.48-1.08% in Germany [Abusier et al., 2006]. Thus *T. saginata* cysticercosis has more public health importance in developing countries like Ethiopia compared with developed countries. Improper removal and treatment of sewage, application of sewage and sludge for pasture as a fertilizer and fecal contamination of feed and water by farm employees are possible sources of infection in the developed countries [Fralova, 1985].

The present prevalence was lower than the prevalence reports of [Ambachew and Yitagel, 2015] in the same study area which was 2.99%. The reason why the prevalence decreases in trend might be due to, frequent use of latrine by farmers, regular deworming of human and animals as a result of easily availability of taenicidal drugs and gradual decrement of the consumption of raw or under cooked meat as a result of improvement on health education. This may be due to seasonal variation and practical limitations during meat inspection. Variation of prevalence may be due to personal and environmental hygiene, variation in the method and quality of meat inspection, management of animals, difference in sample size

taken, experience and diligence of inspector and other factors may be contributed for the change of prevalence of *Cysticercus bovis*.

In current study there is no statistically significant difference ( $P>0.05$ ) between age group. It concurs with [Hailu, 2005] in East Shoa and [Tembo, 2001] in central Ethiopia and not in agreement with report of [Jemal and Haileleul, 2011] in Kombolcha. Body condition and origin of animals were the predictors which had showed statistically insignificance ( $p>0.05$ ). Possible explanation for this insignificance of variations might be due to the fact that all age groups, body condition and origin of animals are equally exposible to the infection and most animals are reared with similar husbandry system, similar age almost old which leads to equal exposure of the animal to *T. saginata* eggs. This insignificance may be due to small sample size.

The organs affected in order of proportion of the cysts were triceps 11(37.93%), tongue 8 (27.58%), masseter 6 (20.7%) and heart 4 (13.79%). This result is line with [Fufa, 2006], Hawassa, indicated that the triceps being most frequently affected muscle and disagree with report of [Ambachew and Yitagel, 2015] in Gondar. The variation in anatomical distribution of *T. saginata* metacestode in different predilection site depends on a number of factors, such as animal's daily activity and blood kinetics. Any geographical and environmental factors affecting blood kinetics in the animal affect the distribution of oncospheres as well and hence, affect predilection sites during meat inspection [Gracey et al., 1999]. The viability test of the cysts also revealed that the triceps harbored the highest number of viable cysts (45.45%), followed by tongue (18.18%), heart (18.18%) and masseter (9.09%). This result of this study is agree with [Tolosa et al., 2009] in Jimma and disagrees with the report of [Ambachew and Yitagel, 2015] in Gondar. In all organs the findings were less than from the findings of [Abunna et al., 2008].

## CONCLUSION AND RECOMMENDATIONS

*Taenia saginata* is a medically and economically important cestodes parasite, while infections of cattle with *Cysticercus bovis* (larval stage) cause economic losses in the meat industry. In this study, the prevalence of bovine Cysticercosis determined by the active abattoir survey was relatively lower than the reports by different researchers in different parts of the country. The prevalence of *Taenia saginata* cysticercosis is associated with undercooked beef consumption, poor waste disposal, poor sludge and sewage treatment system, low level of public awareness and presence of backyard (village) slaughtering practices, which also pertains to Ethiopia, where the widespread habit of eating raw meat. So the disease causes public health and financial problems that need serious attention in order to keep health of the public. Based on the finding of present study, the following points were recommended:

- Public education to avoid consumption of raw meat must be made compulsory at different education levels.
- There should be strong and close interaction between veterinary and medical professionals to reduce the impact of the disease in both animal and human population.
- Educate peoples for the use of latrine and the danger of defecation on the open environment.
- Strict routine meat inspection of slaughtered animals should be carried out so that, infected carcasses can be condemned accordingly human infestation with zoonotic cysticercosis will be reduced.

- The proper anti-parasitic medication need to be recommended for minimization of its exposure.

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