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Study on the Prevalence of *Cysticercus bovis* in Kombolcha Elfora, North-Eastern Ethiopia

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Abstract: A cross-sectional study was carried out from November 2009 to April 2010 on bovine cysticercosis at Kombolcha ELFORA meat factory with the objectives of determining the prevalence of bovine cysticercosis, cyst viability and cyst distribution through various body organs; and to assess some of the determinant factors associated with it. A total of 421 carcasses were examined during the study period, of which 27 (6.4%) were found infected with *Taenia (T) saginata* metacestode. Out of the total of 158 cysticerci detected, 108 (68.35%) were alive while 50(31.65%) were died cysts. The anatomical distribution of the cyst showed that highest proportions of *Cysticercus bovis* (*C. bovis*) cyst were observed in triceps muscle 65 (41.1%), followed by heart 33 (20.9%), tongue 27 (16.9%), masseter muscle 23 (14.4%), liver 6 (3.7%) and the lowest was in diaphragm 4 (2.5%). However, there was no significant difference ($p>0.05$) in the distribution rates of the cysticerci in the various organs of cattle slaughtered at the abattoir. Out of 297 male cattle examined, 18 (6.1%) had cysts of bovine cysticercosis while 9 (7.5%) of the 124 investigated female animals were infected. However, the difference between the two sexes was not statistically significant ($p>0.05$).The prevalence of *C. bovis* infection was significantly ($p<0.05$) higher in adults (11.9%) as compared to that of old aged animals (5%). Regarding to origin of animals, there was no statistical significance difference observed on *C. bovis* infection ($p>0.05$). The current finding clearly indicated that relatively high prevalence of *T. saginata* metacestodes were found distributed throughout the organs of slaughtered cattle. As a result, emphasis should be given to prevent and control the impacts of this disease in animals and in humans.

Key words: Prevalence · *Cysticercus bovis* · Bovine · Kombolcha · Ethiopia

INTRODUCTION

Cysticercus bovis 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 occurs in developing as well as in industrialized countries. 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 parasites [1]. *Cysticercus bovis* cysts can be found anywhere in the carcass, meat 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 [1, 2].

Tapeworm infection has been recorded in history from 1500 years ago and has been recognized as one of the earliest human parasite. *Taenia saginata* is a worldwide zoonotic cestode whose epidemiology is ethnically and culturally determined with estimation of 50-77 million cases of infestation worldwide with 50, 000 people dying from this problem annually. Both the adult and larvae forms hazardously affect the health of their respective hosts, either directly or indirectly, accompanied with several secondary infections, particularly in human hosts. The occurrence of larvae (*C. bovis*) in cattle musculature causes bovine cysticercosis while the adult worms in human small intestine cause taeniasis [4-6].

Distribution is associated with economic condition and religious beliefs, close proximity of humans to cattle kept with little or no distinction between companion or utility functions, slaughtering is often carried out in open air in absence of abattoir, allow the parasite to continue its

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life cycle till to date and in the coming future [1]. Transmission of the parasite occurs most commonly in the environment characterized by poor sanitation, primitive livestock husbandry practice and inadequate meat inspection, management and control policy [7].

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 [8].

The prevalence of *C. bovis* is low in developing countries, being less than 1% in carcasses inspected [9]. It is quite common in Africa reaching a level of 40% of the cases reported [10]. From this, 80% was in Ethiopia, 30-36% in Sierra Leon, 20% in Cameroon, 2% in Senegal and 0.8% was in Sudan [11].

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 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 unemployed animal health problems, among which, *T. saginata/ C. bovis* is one that remains a major public and animal health problem [12].

Cysticercosis affects both the health of the consumer and more significantly the country's economy, which approach 30% when allowance is made for the loss in the carcass weight and the cost of freezing the infected meat [13, 14]. Generally, the loss is determined by disease prevalence, grade of the animal infected, potential markets, price of cattle and treatment costs for detained carcass [15] and medical costs for infected human beings lowering productivity of infected workers who may be absent from work or reduce their working hours [16].

Previous studies on the prevalence of *C. bovis* in Ethiopia showed variable results with localities. Relatively lower prevalence was reported in Wolaita Soddo (2.59%) [17], Central Ethiopia (3.1%) [18], Gondar (4.9%) [19], Kombolcha (6.66%) [20] and Addis Ababa (7.5%) [21], while higher prevalence was recorded in East Shoa (17.5%) [22], Nekemte (21%) [23] and Hawassa (22.9%) [24] and (26.25%) [25]. Therefore; this study was undertaken with the objectives of determining the prevalence of *C. bovis* in Kombolcha ELFORA meat factory and to assess some of the risk factors associated with it.

MATERIALS AND METHODS

Study Area and Population: The study was conducted from November 2009 to April 2010 at Kombolcha ELFORA meat factory. Kombolcha is located in South Wollo at 37 kms North-East of Addis Ababa at an altitude of 1500-1840 meter above sea level. In general, the climate of Wollo is divided into semi-arid, arid and semi-desert climatic conditions. Kombolcha and its surroundings are characterized as 90% mid altitude ('Woinadega') and 10% high altitude ('Dega'). According to CSA [26], the animal population of the study area comprises of 90,664 cattle, 12,975 sheep, 31,043 goats, 489 horses, 7,758 donkeys, 866 camel and 43,010 poultry.

Study Design: A cross-sectional study was conducted on *C. bovis* from November 2009 to April 2010 at Kombolcha ELFORA meat factory. The sources of animals for the study were from Kombolcha, Dessie Zuria, Batti, Kemissie and Raya Woreda. The slaughtered animals in the abattoir were inclusive of the two sexes (males and females). The desired sample size was calculated using the formula recommended by Thrusfield [27] with 95% confidence level, 5% desired absolute precision and expected prevalence. Accordingly, a total of 298 cattle were supposed to be sampled. However, to increase the level of accuracy of prevalence determination, the sample size was increased to 421in the current study.

Meat Inspection: Ante-mortem examination of all cattle brought for slaughter during period of the study was performed. A record of age, breed, sex and the origin of the animal was taken. Age of cattle was estimated by dentition and grouped into adult (animals < 5 years) and old (animals' = 5 years). Post-mortem examination was done by systematic examination of different parts of the carcass and organs. The examination consisted of visual inspection, palpation and incisions. In positive cases, the site, density and nature of the cyst were recorded and transported to Parasitological department of Kombolcha Regional Veterinary Laboratory for viability tests.

Data Analysis: Data were collected and recorded on Excel spread sheet and preliminary descriptive analysis such as prevalence of *C. bovis* related to specific factors (origin, sex and age of animals) was calculated to assess the strength of association of different risk factors to the occurrence infection. Statistical analysis was done using SPSS version 17.0. The occurrence of *C. bovis* infection was calculated by dividing the number of animals

harboring a cyst by the total number of animals examined. The risk factor associated with parasitic infection were determined using percentages (%) to measure occurrence and Chi-square ($\chi 2$) to measure association were the statistical tools applied. In all the analysis, confidence level at 95% and $p<0.05$ was set for significance.

RESULTS

Prevalence of *Cysticercus Bovis*: Out of the total 421 slaughtered animals inspected, 27 (6.4%) animals were found positive for *C. bovis* at postmortem inspection. There was no statistical significant difference ($p>0.05$) between sex and origin of animals with the prevalence of *C. bovis* infection, but there was statistical significant difference ($p<0.05$) between age groups of animals (Table 1). Regarding to origin of animals, the highest prevalence was observed in cattle from Kemissie (7.6%) followed by Kombolcha (6.7%), Batti (6.5%), Dessie Zuria (6.4) and the least was from Raya (6%) (Table 1).

The abattoir survey analysis clearly indicated that there was a significant variation with regard to the anatomical distribution of *C. bovis* in the inspected organs of slaughtered animals. The highest intensity of infection was observed in triceps muscle followed by heart, tongue, masseter muscle, liver and the lowest in diaphragm (Table 2). A total of 158 cysts were recovered from 27 cysticercosis positive animals during the study period. Out of the total of 158 cysts detected, 108(68.35%) were found to be alive (viable), while 50 (31.65%) were died (degenerative) cysts (Table 2).

Table 1: Prevalence of *C. bovis* in relation to age, sex and origin of animals:

Variable	No. of Inspected	No. of Infested	Prevalence (%)	($\chi 2$)	P-Value
Age					
Adult	84	10	11.9	6.012	0.017
Old	337	17	5		
Sex					
Male	297	18	6.1	0.089	0.657
Female	124	9	7.5		
Origin					
Raya	168	10	6		
Dessie Zuria	80	5	6.4		
Batti	62	4	6.5	0.951	0.820
Kombolch	45	3	6.7		
Kemissie	66	5	7.6		
Total	421	27	6.4%		

Table 2: The anatomical distribution and viability of *C. bovis* among inspected organs:

Organ inspected	No. of live/ viable cysts(%)	No. of died cysts(%)	Total (%)
Triceps muscle	50 (31.6%)	15 (8.86%)	65(41.1%)
Heart	20 (12.5)	13 (7.6%)	33(20.9%)
Tongue	18(11.25%)	9 (5.6%)	27(16.9%)
Masseter	15(9.37%)	8 (5.0%)	23(14.4%)
Liver	3(1.87%)	3 (1.87%)	6(3.7%)
Diaphragm	2(1.25%)	2 (1.25%)	4(2.5%)
Total	108 (68.35%)	50 (31.65%)	158(99.5%)

DISCUSSION

In the present study, the prevalence of C. *bovis* was found to be 6.4%, which is comparable to the previous finding of Getachew [28] in Mekelle (6.01%), Nigatu [21] in Addis Ababa (7.5%), Jemal and Haileluel [20] in Kombolcha (6.66%), Dawit [19] in Gondar (4.9%) and Haylegebriel and Alembrhan [29] in Eastern Tigray (5.73%). The current finding was relatively higher than previous findings of Tembo [18] in central Ethiopia (3.11%), Nuraddis and Frew [30] in Addis Ababa Municipal Abattoir (3.6%), Dessie [14] in Assela (2.7%), Tolosa *et al.* [31] and Gomol *et al.* [32] in Jimma municipal abattoir with prevalence of 2.93 % and 3.6%, respectively, of Dawit *et al.* [17] in Wolaita Soddo (2.59%) and of Teka [33], in which the prevalence was 2.2%. On the other hand, the present finding was extremely lower than the previous findings of Ahmed [23] in Nekemte (21%), Abunna *et al.* [25] in Hawassa abattoir (26.25%), Kebede [34] in North West Ethiopia(18.49%), Hailu [22] in East Shoa (17.5%), Mesfin and Nuradddis [24] in Hawassa municipal abattoir (22.9%) and Hailemariam *et al.* [35] in Ethiopia (92.7%).

The above difference in prevalence of *C. bovis* might be associated with many reasons including time of occurrence (higher in dry season than rainy season) [20, 21], 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 [20].

Association of *C. bovis* with potential risk factors revealed significant relationship ($p< 0.05$) with age being higher in adults (13.3%) as compared to that of old aged animals (5%). This finding was in agreement with the reports of Gomol *et al.* [32], Jemal and Haileluel [20],

Dawit *et al* [17] and Mesfin and Nuradddis [24]. However, it contradicts with the findings of Hailu [22], Tembo [18] and Nuraddis and Frew [30]. 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 cysticerci. The re-stimulation of animal's immunity following continuous invasion of onchospheres, 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 [20, 36]. In addition, this might be due to that any age groups of animal have close susceptibility to *T. saginata* [30].

There was no statistical significance difference ($p>0.05$) with sex and origin of animals associated with *C. bovis* infection. This was in line with the report of Gomol *et al.* [32], Jemal and Haileluel [20], Dawit *et al* [17], Mesfin and Nuradddis [24] and Haylegebriel and Alembrhan [29]. Nevertheless; this finding was in contrary to that of Nuraddis and Frew [30] 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 were found on triceps (41.9%) followed by heart (20.6%), tongue (16.9%), masseter muscle (14.4%), liver (3.7%) and diaphragm (2.5%). This finding was in agreement with the report of Gracey [37], Getachew [38], Tolosa *et al.* [31], Gomol *et al.* [32], Jemal and Haileleul [20] and Nuraddis and Frew [30] indicated that the triceps being the most frequently affected muscle by *C. bovis*. However, this result was not in line with Ahmed [23], Hailu [22], Solomon [39], Amsalu [40], Abunna *et al.* [25] and Mesfin and Nuradddis [24] who reported that tongue was the most frequently affected organ; and Dawit *et al*. [17], Haylegebriel and Alembrhan [29] and Nzeyiman *et al.* [41] who reported that heart as being frequently affected by the cyst. Similarly, the current finding contradicts with the earlier finding of Minozzo *et al.* [6] who reported that higher populations of cysts were found in the masseter muscles. The variation between organs of slaughtered animals might be due to blood kinetics and animal's 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 [36]. Most of these organs, except the heart, are consumed raw or under cooked and could be a potential public health hazard in contracting taeniasis [3].

CONCLUSION

Bovine cysticercosisis is one of the major zoonotic diseases that remain a major health problem of animals and humans causing serious socio-economic impact. Although the prevalence found in the current study was relatively low (6.4%), its significance on the health of both animals and public should not be under estimated. 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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