

Cystercus Bovis: Prevalence, Associated Risk Factors and Cyst Character per Organ Load in Haramaya Municipal Abattoir East Hararghe Zone of Oromia Regional State, Ethiopia

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ABSTRACT

Background: Bovine cysticercosis is an infection of cattle caused by the larval stage of *Cysticercus bovis*, the human intestinal cestode.

Aims: A cross sectional study was conducted from November 2015 to March 2016 with the objectives of determining the prevalence of bovine cysticercosis, cyst distribution in different organs and cyst viability in cattle slaughtered at Haramaya municipal abattoir.

Materials and Methods: Random sampling technique was the sampling strategy used to collect all the necessary data from abattoir survey of the study animals. The sample size required for this study was determined based on the expected prevalence (50%) of *C. bovis* and the 5% desired absolute precision and 95% CI. Regarding the risk factors associated with the prevalence of *C. bovis*, the effect of sex, age and body condition score of the animals slaughtered were analyzed using logistic regression and it revealed that there was no statistical significance difference ($P > 0.05$) between sex. But statistical significance differences ($P < 0.05$) were observed among age categories and body condition scores. The proportion of viable cysts in the inspection sites was tongue (31.25%), shoulder (28.12%), masseter muscle (21.9%), liver (15.625%) and heart (3.125%).

Result: Overall prevalence was 14.39% with (95% CI of 0.11-0.18). A total of 80 *C. bovis* were collected during the inspection, out of which 32 (40%) were found to be alive while the rest 48 (60%) were degenerative cysts. Anatomical distribution of the cyst showed that 28 (35%), 22 (27.5%), 19 (23.75%), 7 (8.75%) and 4 (5%) of *C. bovis* were observed in shoulder muscle, tongue, masseter muscle, liver and heart respectively. Out of 337 male cattle examined, 48 (14.23%) had cysts of bovine cysticercosis while 11 (15.06%) of the 73 investigated female animals were infected.

Conclusion: In conclusion, the present study revealed that high prevalence of *C. bovis* was observed and therefore 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.

Keywords: *C. bovis*; Cattle; Haramaya; Abattoir; Prevalence; Cysts; Bovine

INTRODUCTION

In Sub-Saharan Africa, livestock diseases, negatively affect the public health and impede economic growth by incurring direct morbidity, mortality and indirect economic losses. However, its productivity remains marginal mainly due to the presence of a number of unimproved animal health problems, among them *C. bovis* remains a major animal health problem [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 predilection sites: masseter, tongue, heart, triceps, intercostal muscles and the diaphragm [2].

The adult stage can be found in the intestines of the human final host after consumption of raw or undercooked beef infected with viable larvae of *cysticercus* consist of a transparent capsule with an

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Received Date: August 10, 2020; Accepted date: September 28, 2020; Published date: October 05, 2020

Citation: Abdurehman A*, Hussen S, Jafer M, Aliye F, Jemal A., Abdusemed S (2020) *Cystercus bovis*: prevalence, associated risk factors and cyst character per organ load in Haramaya municipal abattoir east Hararghe zone of Oromia regional state, Ethiopia. J Microb Biochem Technol. 12:438. 5:162 doi: 10.35248/1948-5948.20.12.438

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invaginated scolex which survive from months to years when they die. Cysticerci undergo degeneration, followed by calcification [3].

It is found worldwide, but most often reported developing in countries, where unhygienic conditions are coupled with poor cattle management practices and lack or absence of meat inspection that is very common in Africa reaching a level of 30-36% in Kenya, 20% in Guinea, 18% in Sierra Leone and 20% in Cameroon [4].

Lack of awareness about raw meat consumption, existence of highest population density, poor hygiene and sanitary facilities are some of the factors that facilitate the transmission. The prevalence and intensity of bovine cysticercosis in cattle depends mainly on infection pressure and degree of protective immunity before reaching the age of grazing [5].

The prevalence reports of bovine cysticercosis in Ethiopia showed variable results with localities. Relatively higher prevalence were 17.5% while lower prevalence of 3.1% in Central Ethiopia and in East Shoa [6,7].

“kosso” is mainly related to the cherished and honored tradition of eating raw beef in most parts of the country [8]. The effect on human health is generally slight and symptoms may be vague or absent and has debilitating effect on people who already have live of protein deficiency diets suffer from iron deficiency and infested by hookworm [9].

The presence of viable cysts in the infected carcasses suggested a serious threat to the beef consumers who are at risk of contracting the disease and disperse egg through indiscriminate defecation and prevalence and intensity of bovine cysticercosis in cattle depends mainly on infected pasture and degree of protective immunity before reaching the age of grazing [10].

Therefore, the study was undertaken with the objectives of determining prevalence of *Cysticercus bovis* at Haramaya municipal abattoir, Investigate the potential risk factors associated with *C. bovis* and distribution of cysts in organs of infected animals and cyst viability.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted at Haramaya municipal abattoir, in Haramaya town, which is found in East Hararghe administrative zone of Oromia Regional in Eastern Ethiopia. The study area has a latitude and longitude of 9°24'N 42°01'E and the area is found at an altitude of 1600-2100 m.a.s.l. with 64.5 relative humidity, is 511 Km far from Addis Ababa. The district experience rain fall with a short rainy season occurs usually in February and long rainy season extends from July to September. The annual rain fall of the areas ranges from 118-866 mm similarly the average monthly minimum and maximum temperature of the area is 9.4 and 24 °C, respectively. Mixed crop-livestock farming is the predominant production system in the rural area. The main livestock types kept in the area includes cattle, sheep, goat, camel, donkey and poultry. The total cattle population of Haramaya town and surrounding is about, 98090, 120145 goat, 69950 sheep, 480 camel and 28250 Equine species [11].

Study population

The study population consists of indigenous cattle managed extensively brought to the abattoir for slaughtering purpose from 3 districts (Haramaya, Kersa and Dawe).

Study design and sampling technique

A cross sectional study was carried to determine the prevalence of *C. bovis*. Random sampling technique was the sampling strategy used to collect all the necessary data from abattoir survey of the study animals. The sample size required for this study was determined based on the expected prevalence (50%) of *C. bovis* and the 5% desired absolute precision and 95% CI according to the following formula by Thrusfield [12].

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

Where: n = sample size, p = expected prevalence and d = desired absolute precision at 95% Confidence level. Substituting the values in the formula the sample size was calculated to be 384 cattle. But to increase the precision the sample size was projected to 410 cattle.

Study Methodology

Abattoir survey: Ante-mortem and post-mortem examinations were conducted by visiting the abattoir. For the ante-mortem examination cattle were randomly selected and they were tagged with an identification number through grouping the study animals by sex, age, body condition and their origin. The age category was selected as <5 as young and >5 years as adult based on owner information and dentition in addition to the modified method described by [13].

Body condition was scored following the guidelines set by [14]. Accordingly, animal were classified into medium and good category of body condition. For the post-mortem examination the heart, liver, lung, tongue, masseter muscle, shoulder muscle, neck muscle, intercostal muscle and diaphragm were inspected for the presence of cysticerci by applying a two-stage meat inspection procedure stipulated by Ethiopian Ministry of Agriculture Meat Inspection Regulations [15]. During the first stage, visualization and palpation of organs, muscles and carcass were carried out; during the second stage, further incisions were done in each case where one or more cyst cerci were found [16].

Cyst distribution and characterization: Anatomical distribution of the cysts by organ or muscle affected and their status as active (fluid-filled) or calcified were determined, as described by [17]. All suspected active cysts found during post-mortem examination were removed with the surrounding tissue, enclosed in labeled bottles and taken to the Veterinary Parasitology Laboratory at Haramaya University. The viability of the cysts was tested in the laboratory by incubating them at 37 °C in 30% ox bile dissolved in normal saline for about one to two hours. A cyst was regarded as viable if the scolex evaginated during incubation. Metacystodes were identified by the cysticercus size, presence of a rostellum and absence of hooks on rostellum of evaginated cyst [17].

Data Management and Analysis

All the data obtained from the study were entered into Microsoft Excel data sheets, coded and analyzed using STATA 13. Descriptive statistics were used to summarize the data collected. The prevalence of bovine cysticercosis was calculated as the number of cattle found positive for at least one cyst (active or calcified) during meat inspection divided by 410 (n). Moreover, Odds Ratio (OR) was calculated using logistic regression to assess the association between different risk factors for the prevalence of *C. bovis*. A 95% confidence interval and P-value less than 0.05 (at 5% level of significance) were considered statistically significant in all analysis.

RESULTS

Over all prevalence of Bovine Cysticercosis

Analysis of the data revealed that, out of the total of 410 cattle slaughtered at Haramaya municipal abattoir, the overall prevalence was 59 (14.3%)(95% CI=11.1-18.16) (Table 1).

Prevalence of C.bovis based on sex and body condition of cattle

Rate of infection in different body condition groups (good and medium) and sex (male and female) and the prevalence between body condition groups a statistically analysis showed that there was a highly significant variation ($p < 0.05$). But no significance variation was seen between male and female ($P > 0.05$) (Table 2).

Prevalence of C.bovis based on Age and Origin of cattle

Statistical analysis to look at the effect of age and origin of

cattle for C. bovis infection in cattle slaughtered in Haramaya municipal abattoir revealed that there is statistical significance difference ($P = 0.035$) between age categories. However; there was no statistical significance difference ($P = 0.162$) among the origins (Table 3).

Anatomical Distribution of Cysts

Active abattoir survey data showed that there was variation in the anatomical distributions of Cysticercus in organs inspected. The highest proportions of C. bovis cysts were observed in shoulder, tongue, masseter muscle, liver and heart (Table 4).

Cyst distribution and characterization

From the total of 80 cysts that were collected from the abattoir during the study period, 32 (40%) were found viable, 25 (31.25%) non-viable and 23 (28.75%) calcified (Table 5).

Table 1: Distribution of C. bovis cyst in different organs (n=410).

Organ affected	No of cattle affected	% of affected cattle
Shoulder	14	23.72%
Tongue	11	18.64%
Masseter	9	15.25%
Liver	6	10.2%
Heart	2	3.4%
No >one organ affected	13	22.03%
No >two organ affected	4	6.8%
Total	59	14.39

Table 2: Prevalence of C.bovis based on sex and body condition of cattle using univariate logistic regression.

Variables	No. examined	No. affected	%	Odd Ratio	p-value	95% CI
Sex:						
Male	337	48	14.24%	0.952	0.898	0.45-1.99
Female	73	11	15.06%	Ref*	-	-
Body condition:						
Good	253	21	8.3%	0.297	0.03	0.96-0.609
Medium	157	32	20.38%	Ref*	-	-

Where; Ref* = is taken as reference

Table 3: Prevalence of C.bovis based on age and origin of cattle using univariate logistic regression.

Risk factor	No. examined	No. affected	%	Odd Ratio	P-value	95% CI
Origion:						
Haramaya	179	32	17.87%	Ref*	-	-
Dawe	127	15	11.81%	0.61	0.162	0.31-1.22
Kersa	104	12	11.54%	0.55		
Age:						
>5	277	45	16.24%	2.143	0.035	1.05-4.357
<5	133	14	10.53%	Ref*	-	-

Table 4: Distribution of C.bovis in different organs.

Organs affected	Number of cyst	%
Shoulder	28	28(35%)
Tongue	22	22(27.5%)
Masseter	19	19(23.75%)
Liver	7	7(8.75%)
Heart	4	4(5%)
Total	80	100

Table 5: Characterizations of cyst cerci from edible parts of infected cattle.

Organ	Viable	Non-viable	Calcified
Tongue	10(0.31)	7(0.28)	5(0.217)
Shoulder	9(0.2812)	9(0.36)	10(0.4347)
Masseter	7(0.22)	8(0.32)	4(0.1739)
Liver	5(0.1562)	0	2(0.09)
Heart	1(0.031)	1(0.04)	2(0.09)
Total	32(40%)	25(31.25%)	23(28.75%)

DISCUSSION

Meat inspection of cattle slaughtered in Haramaya municipal abattoir revealed that 14.39% overall prevalence of *C. bovis*. This is similar to that found by Getachew [17] in Debrezeit abattoir 13.8%, NigatuKebede [18] in Addis Ababa (13.3%) and (Regassa [19] WolitaSodo (11.3%) but the present finding is higher than studies conducted in Kombolcha, in Jimma south-western Ethiopia (2.9% and 4.4% in Ziway southern Ethiopia (3.0%) and (6.7%) [20]. By (Megersa, Tolosa, Bedu and Endris & Negussie [20-23]. However, the present result was lower compared to studies conducted in Harar eastern Ethiopia, (19.7%) Hawassa in southern Ethiopia and that found in north-western Ethiopia (18.5%) (26.3%) by Terefe, Abunna and Kebede [24-26].

Moreover; differences in the prevalence of the disease can also be found within a region. In two studies conducted in and around Addis Ababa in central Ethiopia, prevalence varied between 7.5% and 89.4% [26, 6]. (Kebede, Tilahun & Hailu and Tembo). Such differences in prevalence may be associated with the number of cattle examined, the sensitivity of the meat inspection procedures, which can be affected by the site and method of incision, abattoir facilities and management, the motivation and competency of the meat inspectors and the willingness of the owner to cooperate Abunna; Dorny & Praet and Wanzala [25,27,28].

The geographical differences in the habit of raw meat consumption, environmental and personal hygiene, animal husbandry practices, proximity to waste water and accessibility of taeniacides for treating animals might also contribute to differences in prevalence [27,29]. Cabaret, Dorny & Praet and Wanzala. As incising the meat at a large number of different sites to allow a more detailed examination reduces the market value of the carcass, these inspections will require the full support of butchers. To obtain the best estimate of the prevalence of bovine cysticercosis and increased confidence in the results of the study, the researchers should negotiate with butchers so that multiple incisions could be made during inspection; they also performs a detailed examination of all muscles and organs [24]. Post-mortem examination of different organ (liver, shoulder, tongue, heart and masseter muscle) requires careful inspection to identify the cyst. Shoulder and masseter muscles [25]. Shoulder, heart and tongue [21] and heart, masseter, tongue, triceps and thigh muscles [26]. Previously have been reported as major sites to be inspected.

Shoulder muscles, liver and heart, which together constituted 35%, 9.0% and 5% relative prevalence, total cyst count and relative viability of the cysts respectively, are also the main components of the locally prepared Ethiopian traditional dishes of raw or undercooked meat called kurt, kitfo, dullet and food prepared from raw or undercooked finely chopped offal (kidney, liver, heart,) mixed with spices and butter or oil. It is therefore essential to increase the area and number of edible sites examined during meat inspection [28,24].

In this study there was statistically significant difference between age groups ($p < 0.05$) and this result is in agreement with report of Gomol and Jemal, Haileleul [29,30] and not concurs with earlier observation of Hailu, Tembo and Nuraddis and Frew [7,6,31]. This statistical significant variation in prevalence of *C. bovis* might be due to small number of slaughtered animal and age dependent immunity (32).

In the present study there was no statistically significant variation observed between sex which is in accordance with report of Gomol, Kebede, Jemal and Haileleul and of Garedaghi [29,26,30,33] and in contrary with Nuraddis and Frew [31].

In the present study, origin of cattle has also shown no statistically significant difference ($p > 0.05$). But body condition of animals shows statistically significant difference ($p < 0.05$). This significant variation between body condition of cattle for prevalence of *C. bovis* might be due to the fact that it could be associated with the management and origin of these animals i.e. most of the animal slaughtered in the abattoir were brought from closed fattening system flourishing in which in turn reduce the exposure of grazing a contaminated field by egg of *C. bovis* from human feces as they feed of relatively clean pasture or closed feed at home and hygienic with eating habit deference.

According to the current study, the most frequently affected organ with the highest number of cysts was the shoulder muscle (27) followed by tongue (22), masseter (19), liver muscle (7) and heart (4) and this result is in agreement with reports of Getachew and Terefe [17,24]. But not in line with the findings of Belaynehin Debre Zeit, Tolosa and Gomelet in Jimma municipal abattoir and Jamal and Haileleul at Kombolcha Elfora meat factory, Abunna in Hawassa town and Nuraddis and Frew in Addis Ababa municipal abattoir [32,34,30,25,31]. This different results reported by different researchers may be due to the difference in geographical area, breed of cattle, management system and activity of muscle groups.

Of the total cysts collected, 80 (40%) were viable while the rest 80 (31%) non-viable and 80 (29) are dead. However, viability test of the cysts revealed that it was the tongue which harbored the highest number of viable cysts (32%), followed by shoulder (28%), masseter (22%), liver (16%) and heart (3.1) which is line with mesfin and Nuraddis but disagrees with the reports of (Terefe, Abunna, Jemal and Haileleul and Nuraddis and Frew [24,25,30,31].

CONCLUSION and RECOMMENDATIONS

The present study confirmed that the occurrence of bovine cysticercosis in Haramaya municipality abattoir is a high prevalence. Such large (14.39%) prevalence of the disease is associated with the presence of back yard (village) slaughtering practices, indiscriminate defecation, low level of public awareness and poor waste disposal and poor sewage treatment system. During the study period viable cysts were recorded in edible organ and red offal in which raw or

undercooked beef meat food and undercooked finely chopped red offal (kidney, liver, heart) mixed with spices and butter or oil were prepared. The presence of viable cysts in the infected carcasses examined suggested a serious threat to the beef consumers who are at risk of contracting the disease and disperse egg through indiscriminate defecation. Therefore; Intermediate hosts (cattle and sheep) generally should be prohibited from grazing on areas contaminated with feces.

In line with the findings of the present study, the following recommendations are forwarded in order to mitigate the effects of the disease: Strict routine meat inspection of slaughtered animals should be carried out, so that infected carcasses can be condemned accordingly. There should be prohibition of backyard slaughtering system of animals through establishing and reinforcing government intervention, construction of slaughter houses which fulfill the basic facilities of an abattoir, such as chilling and freezing room to reduce condemnation of lightly infected carcasses.

Farmers should be fully supported and informed of the life cycle of *T. saginata* and potential risk factors for cattle to become infected and untreated human feces should not be used as fertilizers.

ACKNOWLEDGEMENTS

We would like to acknowledge Haramaya University for facility provision, also like to extend my thanks to staff members of Haramaya municipality abattoir and Haramaya University College of Veterinary Medicine for their kind cooperation

CONFLICT OF INTEREST

None declared.

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