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Prevalence of Cysticercus Bovis in Hawassa Municipal Abattoir and its Public Health Implication

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Abstract: A cross sectional study on the prevalence of bovine cysticercosis in Hawassa municipal abattoir was conducted from October 2011 to March 2012 with the objectives of determining the prevalence of *Cysticercus bovis* cyst viability and cyst distribution in different organs/tissues and public health implication of *Taenia saginata* Cysticercosis. Questionnaire survey and inventory of pharmaceutical drug shops were also used to determine human taeniasis and associated financial losses. Ante and post mortem examination of 384 cattle at the abattoir showed prevalence of 22.9% (88) for cysticercosis. Of the total *cysticerci* collected, 55 (62.5%) were found to be viable while 33(37.5%) were non-viable. The percentage of *Cysticercus bovis* cysts in different organs was observed as 67.74% in tongue, 52% in shoulder, 60% in heart and 75% in masseter muscle, respectively. Result indicated that only age groups are highly significant effect ($p<0.003$). But sex, body condition, origin and breed of animals didn't have significant effect ($p>0.05$) on prevalence of cysticercosis. The prevalence of taeniasis among interviewed respondents of Hawassa town was44%. Result indicated that the sex, occupation, educational level, eating habit and martial status should be showed highly significant effect ($p<0.05$). But age groups and religion didn't have significant effect ($p>0.05$) on prevalence of the disease; however, statistically significant difference was observed in the disease prevalence between raw and cooked meat eaters. For the years 2008 and 2009, a total worth of 184,406 ETB was estimated from a sale of 92,203 adult taenicidal drugs. The result of this study revealed that taeniasis was a wide spread public health problem in the study area which needs due attention to safeguard the public.

Key words: Abattoir · Cattle · *Cysticercus bovis* · Prevalence · Public Health · Taeniasis

INTRODUCTION

Although the livestock sector in Ethiopia has a significant contribution to the national economy, productivity (meat and milk) per animal is very low [1]. The main technical limitations on livestock development and that determine the biological efficiency of production in Ethiopia are inadequate feeding, poor animal health, low potential of the genotypes used for yield traits and the traditional low input livestock management practices.

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 problem, among which, *T. saginata*/*C. bovis* one that remains a major public and animal health problem [2].

Bovine cysticercosis, parasitic zoonosis, is a muscular infestation of cattle caused by the metacestode of the human intestinal *T. saginata* [3].

Bovine Cysticercosis has little effect on animal health, but it is economically important disease as it causes carcass condemnation arising from heavy infestation with the cysticerci of *T. Saginata* as well as the cost of inspecting meat, the necessity to freeze or boil infected meat and losses may also occur from restriction of exports of live animal and animal products. The presence of cysticerci in muscles is not associated with clinical signs; however, the adult tape worm in man produced diarrhea, hunger pain, abdominal discomfort, constipation and nausea [4].

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The disease caused by *T. saginata* infection is locally known as "kosso" and is mainly related to the cherished and honored tradition of eating raw beef in most parts of the country [5].

The life cycle of the parasite, *T. saginata*, involves humans as final host and cattle as intermediate host. Although the cyst may occur anywhere in the striated muscle, the predilection sites at least for the view point of routine meat inspection are heart, tongue, masseter muscle and shoulder [4, 6]. The *cysticerci* may survive from months to years and when they die they frequently degenerate in to a caseous mass which may become calcified [6].

Lack of awareness about raw meat consumption, existence of highest population density, poor hygiene and sanitary facilities are some of the factors that facilitate to 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 [7]. The prevalence reports of bovine cysticercosis in Ethiopia showed variable results with localities. Relatively lower prevalence of 3.1% in Central Ethiopia [8], 4.9% at Gondar [9] and 7.5% in Addis Ababa [10] were reported, while higher prevalence are 17.5% in East Shoa [11], 21% at Nekemt[12] and 26.25 in Hawassa [13].

Therefore, the present study was undertaken with the objectives of determining prevalence of cysticercosis in Hawassa municipal abattoir and to determine the distribution of cysts in organ and tissues within infected animals and its public health implication in Hawassa town.

MATERIALS AND METHODS

Study Area Description: The study was carried out in Hawassa in southern Ethiopia situated 275 km south of Addis Ababa (the capital of Ethiopia) at a latitude of 7°04'N and a longitude 38°31'E on the escarpment of the Great Rift Valley. The altitude ranges from 1650 to 1700 m above sea level. The mean annual rainfall and temperature are 900-1100 mm and 27°C, respectively. The total livestock population of Sidama zone is estimated to constitute, 1,721,341 cattle, 228,941 goats, 457,465 sheep, 204,460 equines, 725,540 poultry and 44,492 beehives [14].

Study Animals: The study animals are cattle which come to Hawassa municipality abattoir for slaughtering and it include both sexes and all age group weather they are from intensive or extensive farming system. The animals examined were selected randomly. Majority of cattle were expected to come from Arsi, Tulu, Borana and Hawassa and its surrounding area.

Study Design: For this study, cross-sectional (systemic random sampling) and retrospective study was conducted in which active abattoir survey, questionnaire and drug shop inventory were used.

Sampling and Sample Size Determination: The sample size was determined by simple random sampling method using the expected prevalence of bovine cysticercosis in Hawassa was 26.25% [13], 95% confidence interval at a desired absolute precession of 5% according to the formula given by Thursfield [15]. Therefore, the required sample size was 297, but 384 cattle were sampled, with the intention to increase the level of accuracy of determining the prevalence.

Study Methodology

Retrospective Study: A retrospective study, which were based on data recorded at the abattoir were used to determine the prevalence of *C. bovis* and data on the number of affected cattle and respective condemned carcass and organs (liver, lung, tongue, heart etc) were recorded and analyzed.

Active Abattoir Survey: The cross sectional study, which was based on the active abattoir survey, was conducted during detail meat inspection on randomly selected 384 cattle slaughtered at Hawassa municipality abattoir. In this study animals were selected during antemortam inspection (AMI) and the related risk factors such as sex, age, origin, breed and body condition recorded before slaughtering. The tags of study animal were properly recoded during AMI.

Meat inspection during post mortem examination was made in accordance with the procedures of the Ethiopia 16 Ministry of Agriculture Meat Regulation (1972) for the detection of *T. saginata* cysticercosis (bovine cysticercosis). Visual inspection/assessment and palpation followed by multi incisions on each predilection sites (organs) of the recorded animal were also carefully inspected for the *C. bovis*.

All the encountered cysts taken to Hawassa university laboratory for confirmation of cysts viability. The metacestode were incubated at 37°C for 1-2hrs in a 40% ox bile solution diluted in normal saline. After this the scolex examined under microscope by pressing the

incubation period at the same time the scolex were checked whether it is *T. saginata* / cysticercosis bovis or other species of metacestode based on the size of *Cysticercus* and absence of hook on the rostellum of the eveginated cyst [17].

Questionnaire Survey: To each of the randomly selected households in the various kebele peasant associations of the study area in Hawassa, risk assessment questionnaires were administered. Accordingly, questionnaires were administrated to individual interviews of the household heads (male or female). The purpose of this interview were to estimate the risk factors (eating raw beef, age, religion and sex) associated with cysticercosis, Taeniasis and relative frequency of Taeniasis and to identify the risk factors associated with the transmission of infection. The questions to be asked were subsequently used in the establishment of relative Taeniasis cases among respondent households. In the questionnaire survey, the number of cattle owned general management of cattle with particular emphasis on feeding practices and husbandry. In addition to these, the aim of feeding cattle, presence and usage of sanitary facilities especially toilet, knowledge of *T. saginata* (life cycle). Regarding medical, history related to traditional and modern tanicidal drugs, impact of Taeniasis and possible options were included, to estimate the risk factor associated with Taeniasis and the occurrence of the disease human and public impact of the disease were assessed.

Inventory of Pharmaceutical Drug Shops: Different human drug store located at Hawassa town were invested for the amount of drugs and cost of drugs they sale for human to treat the adult stage of human *T. saginata* so the economic impact of the disease were assessed. An inventory of pharmaceutical drug shop, rural drug vendors and clinics in the study area were conducted by recording data yearly taenicidal drug sales and adult doses. Together with this, annual adult dose of taenicidal drug sold (based on patient complaints and prescription) in 2008 and 2009 were gathered and analyzed to estimate the socio-economic impact of Taeniasis in and around Hawassa town or in the study area.

Data Management and Analysis: Abattoir and questionnaire data were collected and were stored in to a computer on a Microsoft excel spreadsheet and analyzed using SPSS version 16 software program. The outcome variables for the abattoir study will be cases of *C. bovis* detected during routine postmortem inspection. The association between the risk factors and the outcome variables was assessed using chi-square (x^2) test. Pharmaceutical inventory were arranged and analyzed. In all the analyses, confidence level will be held at 95% and $P<0.05$ was set for significance.

RESULTS

Prevalence of Bovine Cysticercosis: Analysis of the data revealed that, out of the total of 384 cattle 88 (22.9%) was found infected with *C. bovis.*

Sex and Age Prevalence: Rate of infection in different age groups (=3, 4-5, >5) and sex (male and female) and the prevalence between these age groups a statistically analysis showed that there was a highly significant variation ($p<0.003$). But no significance variation was seen among the sex ($p>0.05$) (Table 1).

The prevalence rate was also assessed based on the body condition (good and medium), origin (Hawassa, Arsi, Borana and Tulu and breed (local and cross) of animal and no significance difference was observed in prevalence *C. bovis* when body condition, origin and breeds of animals were compared (Table 2).

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 tongues [31], shoulder [25], heart [20] and masseter muscle [12] (Table 3).

Viability Test: From the total of 88 cysts that were collected from the abattoir during the study period 55(62.5%) were found viable and 33(37.5%) were found non-viable in each organ (Table 4).

Questionnaire Survey Result: The survey result showed that all individuals surveyed were aware of *T. saginata* Taeniasis and disclosed finding proglottids in their faeces and under wear, which indicated the presence of *T. saginata.* The prevalence of Taeniasis among interviewed respondents of Hawassa town who participated in this study was 44%. Among interviewed respondents 29(44%) and 21(0%) had habit of raw and cooked meat consumption respectively (Table 5).

Table 1: Prevalence of risk factors based on sex and age associated with *C. bovis*

Risk factors	No of animals examined	No of infected animals	Prevalence (%)	X^2	p-value
Sex					
Male	368	85	23.1		
Female	16	3	18.75	0.164	0.685
Total	384	88	22.9		
Age					
= 3	9	2	22.2		
= 4-5	132	17	12.9	11.660	O.OO3
>5	243	69	28.4		
Total	384	88	22.9		

Table 2: The prevalence of bovine carcasses infected with *C. bovis* based on the body condition, origin and breed of the animal

Risk factors	No of animals examined	No of infected animals	Prevalence (%)	X^2	p-value
Body condition					
Good	209	46	22.0		
Medium	175	42	24.0	0.214	0.644
Total	384	88	22.9		
Origin					
Hawassa	175	42	24.0		
Arsi	58	17	29.3		
Borana	56	8	14.3	3.855	0.278
Tulu	95	21	22.1		
Total	384	88	22.9		
Breed					
Local	348	78	22.4		
Cross	36	10	27.8	0.531	0.466
Total	384	88	22.9		

Table 3: Prevalence, frequency and distribution of *C. bovis* in different organs and tissues of affected animals

Organ affected	Percentage (%)
Heart	20(22.7)
Shoulder	25(28.4)
Tongue	31(35.2)
Masseter muscle	12(13.63)
Lung	0
Liver	0
Total	88(22.9)

Table 4: Viability of cysts in different organ/tissues

Organ/tissues inspected	Total cyst	No of viable cyst (%)
Heart	20	12(60)
Shoulder	25	13(52)
Tongue	31	21(67.74)
Masseter muscle	12	9(75)
Total	88	55(62.5)

Table 5: Prevalence of *T. saginata* in human population of Hawassa Town

Variable	No of interviews	No of infected	Prevalence (%)	X^2	p-value
Sex					
Male	32	18	56.25		
Female	18	4	22.20	5.414	0.020
Total	50	22	44.00		
Age					
21-25	12	2	16.70		
26-30	17	8	47.00	5.175	0.075
>31	21	12	57.14		
Total	50	22	44.00		
Religion					
Protestant	17	6	35.30		
Orthodox	22	13	59.00	3.805	0.149
Muslim	11	3	27.30		
Total	50	22	44.00		
Occupation					
Farmer	25	17	68.00		
Civil servant	18	4	22.20	11.817	0.003
Student	7	1	14.30		
Total	50	22	44.00		
Educational level					
Fe	25	14	56.00		
Eel	13	7	53.80		
College	6	1	16.70	8.506	0.037
University	6	0	0.00		
Total	50	22	44.00		
Eating habit					
Raw meat consumption	29	22	75.90		
Cooked meat consumption	21	0	0.00	28.448	0.000
Total	50	22	44.00		
Marritial status					
Married	32	18	56.25		
Single	18	4	22.20	5.414	0.020
Total	50	22	44.00		

Table 6: Taenicidal drugs in inventory pharmacies in the year 2008 and 2009

Name of drug	Doses in year 2008	Doses in year 2009	Total Doses	Cost in ETB
Praziquantel	10582	19258	29840	59680 ETB
Vermox	16201	13570	29771	59542 ETB
Niclosamide	17561	15031	32592	65184 ETB
Total	44344	47859	92203	184406 ETB

Association of Risk Factors with Prevalence of Taeniasis: Among the respondents interviewed, majority of them had an experience of raw meat consumption as a result of traditional and cultural practices. A statistical analysis showed that there was a highly significant variation between raw meat and cooked meat eaters, sex, occupation, educational and maritial status ($p<0.05$). But no significance variation was seen among age and religion ($p>0.05$) (Table 5).

Inventory of Pharmaceutical Shop: Pharmaceutical drug shop inventory showed a total of 92,203 adult taenicidal drugs with a total worth of 184,406 ETB for the years 2008 and 2009 (Table 6).

DISCUSSION

In the current study, prevalence of bovine cysticercosis was 22.9%, which is comparable to findings of Natneal [18] in Debreziet Elfora export abattoir 22.75%, Hailu [11] in East Shoa 17.5%, Ahmed [12] in Nekemt municipal abattoir 21%, Getachew [19] in Debreziet abattoir 13.8%. But the present prevalence was greater than to the findings of Tembo [8] in the central Ethiopia (3.11%), Dawit [9] in Gondar (4.9%), Getachew [20] in Jimma (2.93%) and Nuraddis and Frew [21] in Addis Ababa municipal abattoir (3.6%) and also lower than Abunna *et al*. [13] in Hawassa municipal abattoir 26.25%, 38% in Kenya [22].

The present prevalence was lower than the prevalence reports of Abunna *et al.* [13] in the same study area which was 26.25%, this variation of prevalence may be due to personal and environmental hygiene, variation in the method and quality of meat inspection, management of animals, experience and diligence of inspector and other factors may have contributed for the change of prevalence of *T. saginata* cysticercosis.

In this study there was statistically significant difference between age group ($p<0.05$) and this result is in agreement with report of Gomol *et al.* [23] and Jemal and Haileleul [24] and not concurs with earlier observation of Hailu [11], [8] and Nuraddis and Frew [21]. This significant variation in prevalence of *C. bovis* might be due to age dependent immunity.

In present study there is no statistically significant variation observed between sex in accordance with report of Gomol *et al.* [23], Kebede *et al.* [25], Jemal and Haileleul [24] and of Garedaghi *et al.* [26] and in contrary with Nuraddis and Frew [21]. In this study breed, origin and body condition of animals also shown no statistically significant difference ($p>0.05$).

According to the current study, the most frequently affected organ with the highest number of cysts was the tongue muscle [31] followed by shoulder [25], heart [20] and masseter muscle [12] And not in line with the finding of Belayneh [27] in Debre Zeit, Tolosa *et al.* [28] and Gomel *et al.* [23] in Jimma municipal abattoir and Jamal and Haileleul [24] at Kombolcha Elfora meat factory, Abunna *et al.* [29] in Hawassa Town and Nuraddis and Frew [21] in Addis Ababa municipal abattoir.

Of the total cysts collected, 55(62.5%) were viable while the rest 33(37.5%) non-viable, however, viability test of the cysts revealed that it was the tongue which harbored the highest number of viable cysts (67.74%), followed by shoulder (52%), heart (60%) and masseter muscle (75%) which is not in agreement with the report of Abunna *et al.* [29], Jemal and Haileleul [24] and Nuraddis and Frew [21].

Human Taeniasis was a wide spread health problem in the area reaching the prevalence of 44% in Hawassa town in this study. The present result of Taeniasis was less than to the results of Abunna *et al.* [13] (64.2%), Hailu [11] (79.5%) and Dawit [9] (69.2%).

In Ethiopia there is a habit of consuming raw or undercooked tongue and rumen fold preparation known as 'Mila's senber' as well as raw liver, kidney or muscle consumption [13]. Infestation by *T. saginata* is mainly due to the habit of eating raw or undercooked infested (measly) beef due to low awareness creation about the diseases. Due to deep-rooted tradition, inherited from parents, even most of conscious professionals (medical professionals and veterinarians) themselves often consume 'Kurt' or "kitifo" in Ethiopia. The individuals surveyed in this study disclosed the finding of proglottids in their faeces, under wear and on their body, which is supported by 30WHO (1983) guide lines, that states *T. saginata* is known by more frequent expulsion through the anus than *T. solium*. This study showed that there was highly significant variation among raw meat and cooked meat eaters, sex, occupation, educational level and martial status ($p<0.05$). But no significant variation were observed between age and religion ($p>0.05$).

The reason for this significant variation was that raw meat eaters had been higher probability of getting viable *cysticerci* during meat consumption when compared to cooked meat eaters. Due to great attitude of people towards the consumption of raw or undercooked beef and Human infestation by *T. saginata* is not generally considered to be threatening health problem in the study area, these all conditions may magnify the public health hazards of *T. saginata* in the study area and the economic importance of cysticercosis.

Inventory of 8 pharmaceutical shops out of drug shops existing in Hawassa town for the years 2008 and 2009 indicated that, a total of 92203 adult taenicidal drugs doses with an estimated cost of 184406 ETB. And therefore the diseases deserve due attention to safe guard the public health and further promote beef industry in the country.

CONCLUSION

This study confirmed the occurrence of bovine cysticercosis and Taeniasis in Hawassa municipality

abattoir and people of Hawassa town indicated that there was a high prevalence, respectively. Taeniasis caused some financial losses increasing the demand of taenicidal drugs by infested personals. So the disease causes public health and financial problems that need serious attention in order to keep the health of the public.

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