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Prevalence and public health significance of bovine cysticercosis at Elfora Abattoir, Bishoftu, Ethiopia

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A cross sectional study was conducted from November 2013 to April 2014 to determine the prevalence of bovine cysticercosis, assess the associated risk factors and public health importance of Taeniasis at Elfora abattoir, Bishoftu town. Active abattoir survey from local zebu cattle presented to Elfora Abattoir and questionnaire survey data collected were analyzed using STATA version 11. From the total 430 carcasses examined, 24 (5.6%) were found to be infected with *Cysticercus bovis.* Cyst prevalence per organs were tongue, 14 (3.2%), triceps muscle 9 (2.1%), masseter muscle 7 (1.6%), heart 4 (0.9%) and diaphragm 1 (0.2%). From a total of 54 *C. bovis* cysts collected, 36 (66.6%) and 18 (33.3%) were live and degenerated cysts, respectively. 64% human *Taeniasis was recorded with* a statistically significant differences (P<0.05) among age groups, gender, raw meat consumption, education level and occupation of individuals interviewed. High raw meat consumers had higher odds of acquiring taeniasis (OR= 48.71) than low raw meat consumers. However, no statistically significant differences (P>0.05) in the prevalence of taeniasis among various religions of the interviewee. The study revealed the presence of bovine cysticercosis and its public health hazards in the area, which needs increasing awareness about the health impact of taeniasis to safeguard the public.

Key words: Abattoir, *Cysticercus bovis,* prevalence, public health, *Taenia saginata.*

INTRODUCTION

Ethiopia has the highest livestock population in Africa with estimated number of 44.3 million cattle, 25.6 million sheep, 23.4 goats, 3.3 million camels and 35.7 million poultry (Community-supported agriculture (CSA), 2004). Despite the huge population of livestock in the country, efficient utilization of the immense resources is constrained by a multitude of factors in which parasites play a major role. Losses from parasitic infections include

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losses through death, reducing working power, milk yield, hide and skin quality and condemnation carcasses or organs after slaughter (Albero, 1983). One of such parasitic diseases is bovine cysticercosis.

Bovine cysticercosis is parasitic zoonoses, which refers to the infection of cattle with metacestodes of the human tapeworm – *Taenia saginata* (Oladele et al., 2004). *T. saginata* in humans cause bovine cysticercosis, which occurs virtually worldwide, but particularly in Africa, Latin America, Caucasian and south/central Asia and eastern Mediterranean countries. It is found particularly in Mexico, Central and South America, sub-Saharan Africa, India and China (The World Organization for Animal Health (OIE), 2014). It is distributed worldwide, with variable degree of prevalence (Harrison and Sewell, 1991), but most often in developing countries, where unhygienic conditions are coupled with poor cattle management practices and lack or absence of meat inspection (Carlos et al., 2003). Cattle are infected when they swallow *T. saginata* eggs. Ova swallowed by cattle hatch in the duodenum to liberate onchospheres. These enter the lymphatics and blood vessels of the hepatic portal system and spread to muscles via the general circulation. They develop into oval infective cysticerci in 60 to 75 days (Eom et al., 1992).

After consumption by humans with raw or inadequately cooked beef, cysticerci attach to the intestinal mucosa and grow to sexually mature tape worms in about 3 months, gravid (ova containing), actively motile segments detach from the strobilus in the intestines and are passed in the faeces (Gracey et al., 1999). As man is the source of the parasites, human habits are responsible for the spread of bovine cysticercosis. An infected human may pass millions of eggs daily, either free in the faeces or as intact segments, each containing about 250,000 eggs (Urquhart et al., 1996). In areas with transhumant or nomadic systems, these habits are conditioned by the way of life, and animals are exposed to infected faeces. Animals may become coprophagous due to pica, which is linked with certain food deficiencies (CTA, 1989).

In Ethiopia, many parasitic zoonoses like cysticercosis and hydatidosis are commonly reported. Taeniasis due to *T. saginata* is a well known disease in the country. The disease has been reported by different travelers who come to Ethiopia in ancient time and is documented in medical history of Ethiopia (Pankrhast, 1990). Existence of higher population density, raw meat consumption, low awareness, poor hygiene and sanitary infrastructures may facilitate transmission of the disease between cattle and human beings. In some parts of Ethiopia, due to the habit of eating raw beef dishes such as ‘‘kurt’’ and ‘‘kitfo’’ that are served raw or undercooked, the disease has been thought to be acquired from these sources (Teka, 1997).

The prevalence of bovine cysticercosis is different in different agro-climatic zones of Ethiopia (Tembo, 2001) and the variation of the prevalence ranges from 10 to 70% (Mamo, 1988). Studies to establish the prevalence of bovine cysticercosis and taeniasis in humans have been done in different parts of Ethiopia with various results. For instance, Addis Ababa abattoir 2.2 to 3.2% (Teka, 1997) and 13.3% (Kebede et al., 2009), Bahir Dar 19.4% (Alemu, 1997), Gonder 9.67% (Demissie, 1989), Mekelle 7.23% (Getachew and Ashiwani, 2013), Wolaita Soddo 11.3% (Regassa et al., 2009), Nekemte 21.7% (Ibrahim, 1990) and Debre Zeit 13.85% (Getachew, 1990).

However, there is lack of recent information on bovine cysticercosis and taeniasis in East Shoa Zone of Oromia Regional State particularly in and around Bishoftu. This area is known for its commercial, domestic and export abattoirs growing in number currently. Reliable and up to date epidemiological information is needed on zoonotic parasites such as taeniasis/cysticercosis by veterinary service and public health authorities. Thus, determining prevalence of bovine cysticercosis, human taeniasis and identifying associated risk factors are mandatory. Therefore, the objectives of this study were to determine the prevalence, public health importance and associated risk factors of bovine cysticercosis in Bishoftu town, Ethiopia.

MATERIALS AND METHODS

Study animals

Animals which were presented to Elfora abattoir, Bishoftu, came from different regions in Ethiopia such as Wollo, Gondar and Borana. Local Zebu cattle brought to the abattoir for slaughter were considered a study population for the active abattoir survey. The animals included in the study consist of cattle of different age, sex and origin.

Sampling and sample size determination

Sampling was conducted using simple random sampling method. Accordingly, the sample size was determined using the formula recommended by Thrusfield (2005). A prevalence of 13.8% was recorded by Getachew (1990), nearly 24 years ago; hence in the present study expected prevalence of 50% was taken to increase our sample size.

$N= 1.96^2 \times Pexp\ (1-Pexp)\ /d^2$

Where N = required sample size; Pexp = expected prevalence and d^2 = desired absolute precision.

$N =1.\ 96^2 \times 0.5\ (1-0.5)\ /\ (0.05)^2 = 384$

Actually, a total of 430 animals were sampled for this study.

Research ethics

Initially, the research proposal has been subjected to ethical

Table 1. prevalence of *C. bovis* in different organs.

Organs inspected	Number positive	Prevalence (%)
Tongue	14	3.2
Triceps	9	2.1
Masseter muscle	7	1.6
Heart	4	0.9
Diaphragm	1	0.2

evaluation and approved by Mekelle University, College of Veterinary Medicine, Research and Community Services Council. Each participant has been informed about the purposes of the study and their volunteerism to participate was confirmed by taking consent from each respondents. Respondents were free to withdraw from the study and interviewees' data remained confidential throughout the study.

Active abattoir survey

A cross sectional study was conducted on randomly selected cattle slaughtered at Elfora abattoir. Individual identification was given for each cattle to be slaughtered. All cattle were subjected to ante-mortem examination followed by routine post mortem meat inspection procedures. A total of 430 local zebu cattle carcasses presented to Elfora abattoir 5 days/week were examined for the presence of *C. bovis* according to the guideline described by the Ministry Of Agriculture (MOA, 1972). The MOA guidelines followed was as follows; for masseter muscle the deep linear incisions were made parallel to the mandible; the tongue was examined from base to top, the heart were incised from base to apex to open the pericardium and incision was also made into cardiac muscle for detail examination. Deep, adjacent and parallel incisions were made above the point of elbow in the shoulder muscles.

Cyst viability test

The *C. bovis* which was found during meat inspection was trimmed of with the surrounding tissues and transported to Addis Ababa University, College of Veterinary Medicine and Agriculture, Veterinary Parasitology Laboratory for confirmation of cyst viability. The viability of the cysts was examined by using 30% ox bile solution diluted in normal saline and incubated at 37°C for 1 to 2 h. A cyst was regarded as viable if the scolex evaginated according to Gracey et al. (2009).

Questionnaire survey on human taeniasis

To determine the infection rate and associated risk factors of human taeniasis, 100 volunteer respondents from different sex, age, level of education, occupation and religion were selected using random sampling based on willingness to participate in the questionnaire survey.

Data management and analysis

The data collected was entered into Microsoft Office Excel 2007 program and analyzed using STATA software version 11.0 (Stata Corp, 2009). Descriptive statistic (Chi-squared test) was employed to measure associations among categorical variables. 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 $P \leq 0.05$ was used.

RESULTS AND DISCUSSION

Active abattoir survey

In this study, a total of 430 bovine carcasses were inspected, 24 were found with cyst of *C. bovis* with an overall prevalence of 5.6%. The results of the current study was in agreement with the findings reported in different agro-climatic climatic zones of Ethiopia by Alula (2010) 5.4% in Kombolcha; Dawit (2004) 4.9% in Gonder; Taresa et al. (2011) 3.65% in Jimma and Ibrahim and Zerihun (2012) 3.6% in Addis Ababa abattoir. However, our finding was lower than the prevalence reported by previous authors in different parts of Ethiopia such as Regassa et al. (2009); Kebede et al. (2009); Abunna et al. (2008) and Hailu (2005). The current prevalence recorded was also significantly lower than the report of Getachew (1990) in Bishoftu. Such lower prevalence could be attributed to the change in culture of raw meat consumption, awareness in using latrine and low contamination from where animals were bought.

Anatomical distribution of the cyst

During inspection, *C. bovis* was found in different organs with higher number of cysts encountered in the tongue (14; 3.2%), followed by triceps muscle (9; 2.1%), masseter muscle (7; 1.6%), heart (4; 0.9%) and diaphragm (1; 0.2%) (Table 1). Other studies carried out elsewhere showed that tongue; heart and masseter appear were the most frequent locations for cysticerci (Belino, 1975). Further, Abunna (2006) and Getachew (1990) reported triceps as being frequently affected by the cyst. However, the current study showed that the most frequently affected organ with the highest number of cysts was the tongue which is in agreement with the report of Bedu et al. (2011) and Belino (1975). It is evident from the result that other organs such as triceps, masseter muscle, heart and diaphragm were also frequently affected predilection sites for *C. bovis* which is similar to earlier reports in various endemic areas (Hailu, 2005; Dawit et al., 2012). In this study the diaphragm was ranked among the least affected sites which is in agreement with other reports (Dawit et al., 2012; Abunna et al., 2007).

Cyst viability test

The analysis for viability test showed that (36; 66.6%) of

Table 2. Proportion of viable cyst in different organs inspected.

Organ	*Cysticercus bovis*		
	No. of cysts examined	No. of viable cysts	Proportion of viable cyst in each organ (%)
Triceps muscle	15	12	80
Tongue	22	16	72.72
Masseter muscle	11	5	45.45
Heart	5	2	40
Diaphragm	1	1	100
Total	54	36	66.6

Table 3. Chi-square analysis of associated risk factors of human taeniasis.

Predictor variables	*Taenia* Infection (%)		P-value
	Not infected	Infected	
Age of respondent			
15-30 years	21 (67.74)	10 (32.26)	0.00
Above 30 years	15 (21.74)	54 (78.26)	
Gender of respondents			
Male	17 (26.56)	47 (73.44)	0.009
Female	19 (52)	17 (47.22)	
Occupation			
Student	20 (74.07)	7 (25.93)	
Merchant	2 (11.11)	16 (86.89)	
Government-employee	5 (35.71)	9 (64.29)	0.00
Privet employee	5 (45.45)	6 (54.55)	
Daily labor	4 (13.33)	26 (86.67)	
Religion			
Christian	34 (37.78)	56 (62.22)	0.267
Muslim	2 (20.00)	8 (80.00)	
Level of education			
Illiterate	1 (12.50)	7 (87.50)	
Elementary School	3 (12.00)	22 (88.00)	0.00
High school and above	32 (47.76)	35 (52.24)	
Raw meat consumption			
Only raw beef	0 (0.00)	6 (100.00)	
Raw and Partially cooked	14 (20.00)	56 (80.00)	0.00
Only partially cooked	2 (50.00)	2 (50.00)	
Only properly cooked	20 (100.00)	0 (0.00)	

the 54 cysts collected were alive (Table 2). Triceps muscle had the highest proportion of viable cysts (12; 80%) followed by tongue (16; 72.72%), masseter muscle (5; 45.45%) and heart (2; 40%). Only one cyst was detected in diaphragm, which was viable. The results of viability test showing highest proportion of viable cysts in triceps muscles was comparable to the works of Tembo (2001) and Shimeles (2004).

Table 4. logistic regression analysis of risk factors associated with human taeniasis.

Risk Factors	Exposure (%)	SE	Odds ratio (OR)	95% CI	P-value
Gender					
Female	17 (47.22)	-	-	-	-
Male	47 (73.44)	1.35	3.08	[1.31 -7.28]	0.01
Age					
15-30 years	10 (32.26)	-	-	-	-
>30 years	54 (78.26)	3.64	7.56	[2.93-19.4]	0.00
Raw meat consumption					
No	2 (8.3)	38.75	-	-	-
Yes	62 (81.6)	38.75	48.71	[10.24-231.6]	0.00
Level of education					
Illiterate	7 (87.5)	-	-	-	-
Elementary school	22 (88)	7.01	6.4	[0.74-54.91]	0.009
Above high school	35 (52.2)	-	6.70	[1.83-24.55]	0.004
Occupation					
Gov. Employee	9 (64.3)	3.65	5.14	[1.27-20.67]	0.021
Merchants	16 (88.9)	19.86	22.85	[4.16-125.54]	0.00
Private Company	6 (54.5)	2.56	3.42	[0.79-14.85]	0.100
Daily Laborers	26 (86.7)	12.88	18.57	[4.67-72.34]	0.00

Questionnaire survey on taeniasis

Information collected to determine the status of human taeniasis showed an overall infection rate of 64% (Table 3). The present prevalence recorded agreed with the finding of Dawit et al., (2012) and Abunna et al. (2007) who reported an overall infection prevalence of 62.5 and 64.2% in Wolaita Soddo and Hawassa town, respectively. But the infection prevalence in the current finding was relatively lower than the finding of Hailu (2005) and Dawit (2004) who reported 79.5% in East Shoa and 69.2% in Gondar, respectively. The chi-squared analysis of risk factors associated with the occurrence of human taeniasis revealed a significant difference ($P < 0.05$) for the age group, gender, occupation, level of education and raw meat consumption habit of respondents (Table 3). Regarding age of respondents infected, higher prevalence of infection was recorded in individuals who are older than 30 years compared to those who are younger than 30 years (15 to 30 years). This could be explained by the fact that older people frequently eat raw meat and are prone to infection with *C. bovis*. However, younger people do not have such an access.

Higher prevalence of taeniasis in males than females in the present study could be due to economic reasons and cultural practices. In Ethiopia, men do not commonly prepare their dish; rather they often visit restaurants and butcheries. This is in agreement with the observation made by Bedu et al. (2011), who reported male have higher odds (OR = 3.77, CI = 95%) than female individuals. The present study also revealed that raw meat consumers had contracted taeniasis infection more frequently than low (occasional) raw meat consumers; this is in agreement with the finding of Megerssa et al., (2010) who reported high raw meat consumers have higher odds of (OR =17.2; CI = 172.9) than less raw meat consumers. However, no statistically significant difference ($P > 0.05$) in prevalence was observed between Muslims and Christians which is in consent with the findings of Dawit et al., (2012), Abunna et al. (2007), Hailu (2005) and Tembo (2001). The multivariable logistic regression analysis of the risk factors revealed significant difference ($p < 0.05$) in the prevalence of taeniasis in association with raw meat consumers, sex, age, occupation and level of education (Table 4).

Accordingly, male individuals [OR = 3.08, 95% CI (1.31 to 7.28)], respondents above the age of 30 years [OR =7.56, 95% CI (2.93 to 19.4)], frequent raw meat consumers [OR = 48.71, 95% CI (10.24 to 231)], individuals studied above high school [OR = 6.7, 95% CI

(1.83 to 24.55)], merchants [OR = 22.85, 95% CI (4.16 to 125.5)], daily laborers [OR = 18, 95% CI (4.67 to 72.34)] had higher odds of acquiring taeniasis than female respondents, individuals aged 15 to 30 years, occasional raw meat consumers, individuals studied elementary school, government employee and private company workers, respectively.

In the present study, both abattoir and the questionnaire survey showed that *T. saginata* was an important parasitic cattle disease and in terms of its public health implications in the study area. Teaching and awareness creation to reduce and ultimately avoid the consumption of raw and undercooked meat consumption, improving animal management system and reducing environmental contamination could reduce infection rate in humans and animals.

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Conflict of interest statement

The authors would like to declare that there have no conflicts of interest regarding this research paper.

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