Short communication

Prevalence of *Taenia saginata* cysticerci in Addis Ababa Abattoir Enterprise, Ethiopia

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A B S T R A C T

An abattoir-based survey was conducted in Addis Ababa from December 2018 to April 2019 with the objectives of determining the prevalence of bovine cysticercosis and the viability of *Taenia saginata* cysticerci. Routine meat inspection was performed on the study animals. Palpation followed by incision of the heart, tongue, triceps muscle, masseter muscle and diaphragm were made to detect the presence of *T. saginata* cysts. From the detected cysts, 41 were randomly selected and subjected to viability test. From the total 500 study animals, 14(2.8%) had varying number of *T. saginata* cysts. The highest proportion of *T. saginata* cyst was observed in the triceps muscle 6(42.8%), followed by heart 3(21.4%), tongue 2(14.3%) and masseter muscle 2(14.3%). There was no cyst observed in the liver or diaphragm. Of the total randomly selected 41 cysticerci, 20(48.8%) were found to be viable while the rest 21(51.2%) cysticerci were found to be non-viable. Sex, breed, age, and body condition of the study animals were found to have no significant association with the occurrence of cysticerci ($P > 0.05$). Even though routine meat inspection has low sensitivity and usually under-estimates the prevalence of the disease, bovine cysticercosis was found to be prevalent in the study area. Therefore, an appropriate control program involving enforcement of meat inspection, promoting public awareness and improving personal and environmental hygiene should be designed and implemented.

1. Introduction

Bovine cysticercosis is a parasitic infection of cattle caused by the larval stage (cysticercus) of the cestode *Taenia saginata* (Laranjo-González et al., 2016). The parasite utilizes bovines as intermediate host and humans as final host (Dermauw et al., 2018). The presence of cysticerci in bovine carcasses and viscera leads to the condemnation of the beef originating from the infected animals and can cause major economic implications (Soare et al., 2011). In Africa, poor sanitation, ingestion of undercooked infected meat, inadequate/lack of health education and low availability of taenicides are the major obstacles in the control of the disease (Tembo, 2001). A high prevalence of human infection in different agro-climatic zones has been reported in Ethiopia (Jorga et al., 2020a). Estimates made by investigators on the prevalence of taeniasis in Ethiopia vary widely from 2 to 16% based on routine meat inspection

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(Tegegne et al., 2018). The high prevalence of bovine cysticercosis in Ethiopia is due to poor hygiene, poor livestock husbandry practices, ineffective/lack of meat inspection and control measures (Semie et al., 2018). Therefore, sufficient emphasis should be given to address these problems to improve health, and the quality and supply of beef for domestic requirements and export markets. In recent years limited research has been conducted to determine the status of *T. saginata* prevalence in cattle slaughtered in Addis Ababa Abattoir Enterprise. To safe guard public health and increase export revenue, there is a need for continuous research on the epidemiology, public health and economic significance of *T. saginata*. Therefore, this study was conducted to estimate the prevalence of *T. saginata* in cattle slaughtered at Addis Ababa Abattoir Enterprise.

2. Materials and method

2.1. Study area description

The study was conducted in Addis Ababa Abattoir Enterprise, Addis Ababa. Addis Ababa is located in the central highlands of Ethiopia at an altitude of 2500 m above sea level. The average annual temperature and rainfall of the city are 21 °C and 1800 mm, respectively. The relative humidity varies from 70 to 80% during the rainy season and from 40 to 50% during the dry season. An average 183,000 cattle, 42,200 sheep, 4700 goats and 830 pigs are slaughtered annually in the abattoir (*Central Statistical Agency Addis Ababa City Administration Agricultural Report,* 2016). In general, the cattle slaughtered in the abattoir come from the different regions and agro-ecological zones of the country.

2.2. Study design

Cattle of different sex and age groups that were approved for slaughter in Addis Ababa Abattoir Enterprise were included in the study. An abattoir-based survey was conducted from December 2018 to April 2019 in Addis Ababa. The abattoir survey was conducted three days per week and animals were selected for examination using systematic sampling by selecting at the 10th interval. The total number of animals included in the study was determined by using the expected prevalence of bovine cysticercosis in Addis Ababa which is 3.6% by Nuraddis and Frew (2012) at 95% confidence interval and desired absolute precision of 5% according to the formula given by Thrusfield, (2005).

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

Where: P_{exp} = expected prevalence (3.6%).
n = required sample size
d = desired absolute precision.
Hence, the required sample size as per the above formula is 354 cattle but to increase accuracy, 500 animals were included in the study.

2.3. Abattoir survey

Detailed antemortem and postmortem inspection was conducted on the study animals. Each study animal was marked with an identification number. Age, sex and body condition score of the animals were recorded. Body condition score of study animals was determined according to Neary and Yager (2002) and classified as poor (hide bound with obvious bony prominences and deep sunk tail base), medium (ribs and other bony prominences noticeable on visual inspection but have fair fleshy background on palpation) or good (bony structures notable only on palpation). Age of study animals was estimated by dentition according to De Lahunta and Habel (1986) and animals were categorized into young (<5 years) or adult (>5 years).

Conclusive data concerning the origin of the study animals could not be found because most animals slaughtered in Addis Ababa pass through a long chain of buying and selling before they end-up in Addis Ababa livestock markets. During post mortem inspection, palpation followed by incision of the heart, tongue, triceps muscle, masseter muscle and diaphragm was made to detect the presence of *T. saginata* cysts. The recovered cysticerci were incubated in ox bile at 37 °C for 1–2 h(s) using 40% ox bile solution diluted with normal saline. The scolex was examined under microscope for viability test. Cysticerci were regarded as viable if the scolex evaginates during the incubation period (Nigatu, 2004).

2.4. Data analysis

The data collected from the abattoir survey were recorded and coded. The data were then imported into Statistical package for Social Science (SPSS) version 20 for analysis. Descriptive statistics was used to estimate the prevalence of *T. saginata* while Pearson Chi-square Test was used to evaluate the associations of different variables with the prevalence of *T. saginata*. In all calculations, the confidence interval (CI) and the significance level were set at 95% and at 5% respectively.

Table 1

prevalence of *Taenia saginata* cysticerci in relation to sex, age, body condition and breed of study animals.

Risk factor	Total No of carcasses examined	No of positive carcasses (%)	Chi-square (X^2)	*P*-value
Sex				
Male	492	14 (2.8)	0.234	0.628
Female	8	0 (0)		
Age				
Young (<5 years)	198	5(2.5)	0.091	0.763
Adult (≥5 years)	302	9(2.9)		
Body condition				
Poor	52	2(0.4)		
Medium	338	8(1.6)	0.725	0.696
Good	110	4(0.8)		
Breed				
Local*	480	14 (2.9)	0.600	0.439
Cross**	20	0 (0)		

* Small East African Zebu, Large East African Zebu, Sanga, and Zenga.
** crossbreed of the different local and exotic cattle breeds.

Fig. 1. Map of Ethiopia showing origin of cattle slaughtered (stars) at Addis Ababa Enterprise (Kumsa, 2019).

Table 2

Anatomical distribution of cysts in the organs/muscles of affected animals.

Infected organ/muscle	Number of infected cattle	Proportion (%)
Triceps	6	42.8
Heart	3	21.4
Masseter	2	14.3
Tongue	2	14.3
Triceps + tongue	1	7.1
Total	14	100

3. Results

3.1. Prevalence of bovine cysticercosis

From a total of 500 animals examined, 14(2.8%) had varying number of cysticerci. Sex, breed, age, and body condition of the animals were found to have no significant relationship with the occurrence of cysticercosis ($P > 0.05$) (Table 1). (See Fig. 1.)

3.2. Anatomical distribution and viability of cysticerci

Analysis of active abattoir survey data showed that there was a variation with regard to the anatomical distribution of *T. saginata* cyst in the organs/muscles inspected carcasses (Table 2). The highest proportion of *T. saginata* cyst was observed in the triceps muscle 6 (42.8%), followed by heart 3(21.4%), tongue 2(14.3%) and masseter muscle 2(14.3%). There was no cyst observed in the liver or diaphragm. Of the randomly selected 41 cysticerci, 20(48.8%) were found to be viable by in vitro hatching and the remaining 21

Table 3

Viability test of the recovered cysts.

Organ	Viable cysticerci (%)	Non-viable cysticerci (%)
Triceps	17(85)	7(33.3)
Heart	1(5)	6(28.6)
Tongue	0	5(23.8)
Masseter	2(10)	3(14.3)
Total	20 (100)	21(100)

(51.2%) cysticerci were non-viable (Table 3).

4. Discussion

In this study, the prevalence of bovine cysticercosis among cattle slaughtered at the Addis Ababa Abattoir Enterprise was found to be 2.8%. This result is comparable with the finding of Tolosa et al. (2009) in Jimma municipal abattoir, South West Ethiopia, who reported a prevalence of 2.9%. However, the present finding is lower than that of Kebede et al. (2008) who reported a prevalence of 7.5% in Addis Ababa. Conversely, a lower prevalence relative to the present study was reported from various developed countries, such as 0.48–1.08% in Germany by Abuseir et al. (2006). Thus, bovine cysticercosis has more public health and economic significance in developing countries like Ethiopia. The problems associated with poor sanitary infrastructure, lack of awareness and consumption of raw meat are major risk factors for the high prevalence in developing countries. The majority of the findings in Ethiopia including this study are based on surveys carried out on carcasses subjected to routine meat inspection. The true distribution of the infection could be higher than reported because of the lower sensitivity of the meat inspection compared to other diagnostic procedures like serological tests. Generally, the method of meat inspection, the ability of meat inspectors to identify cases, differences in animal husbandry, sample size and sampling method, and other factors can influence the sensitivity of detection and contribute to reported variations of prevalence in bovine cysticercosis in different studies and in different parts of the country (Wabi and Girmay, 2019).

The present study showed that the most frequently affected organ was the triceps muscle. This is in agreement with the finding of Belayneh (1990) in Debre Zeit, Tolosa et al. (2009) and Gomol et al. (2011) in Jimma municipal abattoir.

5. Conclusion and recommendations

Although the sensitivity of meat inspection for the detection of cysticercosis is low, this study has shown that bovine cysticercosis is prevalent in cattle slaughtered in Addis Ababa Abattoir Enterprise. Therefore, an appropriate control program involving enforcement of meat inspection, promoting public awareness and improving personal and environmental hygiene should be designed and implemented.

Declaration of Competing Interest

The authors declare that there is no financial or political interest that influenced them in doing this research.

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