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Full Length Research Paper

Prevalence of bovine cysticercosis and age relationship at post-mortem in Nyagatare Slaughterhouse

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Bovine cysticercosis caused by the larval stage of the human tapeworm *Taenia saginata* is a zoonotic disease of great public health significance especially in developing countries. The present study was conducted on 291 slaughtered cattle at Nyagatare slaughterhouse in Eastern Rwanda between December 2013 and April 2014 to determine prevalence of bovine cysticercosis and its associated risk factors. Nine out of the 291 meat carcasses examined at postmortem were found to be infected with the parasite (3%). The infestation rate was higher in adult cattle than young cattle, where the highest prevalence (66.7%) was detected in older cattle 5 years and above followed by the carcasses of middle aged cattle of 3-5 years. The infestation was lowest in carcasses of cattle of young age (2-3 years). There was no significant difference (*p*>0.05) between breeds of slaughtered cattle, where out of 9 infected animals, 5 were from local breed and 4 were from crosses breed. On the other hand, the infestation rate was higher in female than male carcasses, but there is no significant variation was observed between sexes of cattle (*p*> 0.05). The infestation was mainly found in the heart muscles (35%, *n*=9), followed by masseter muscles (29.5%, *n*=9), tongue muscles (29.5%, *n*=9) and diaphragm muscles (6%, *n*=*9*). However, there was no significant difference (*p*>0.05) in the distribution rates of the cysticerci in the various organs of the cattle slaughtered at the abattoir.

Key words: Nyagatare abattoir, prevalence, slaughter, cattle, *Cysticercus bovis*, age, sex.

INTRODUCTION

Cysticercus bovis is a food-borne parasitic disease caused by the immature form of the human cestode *Taenia saginata* commonly referred to as the beef tapeworm (Karshima et al., 2013). *C. bovis* infestation is an important zoonotic disease commonly frequent in African countries than in other parts of the world and it remains enzootic in both humans and cattle higher in Africa (Flutch et al., 2008; Urquhart, 1961). The cysticercosis infestations were detected by many studies as a worldwide and its prevalence rates in both humans and cattle ranges between 1 and 10% (Onyango-Abuje, 1996).

The occurrence of *C. bovis* in cattle musculature resulted from bovine cysticercosis infestation, while in human the adult worms live in the small intestines causing taeniasis (Garedaghi et al., 2011; Rabi et al., 2010 and Nigatu, 2008). It was reported that humans acquire the disease by eating raw or poorly cooked beef meat (Cheruiyot and Onyango-Abuje, 1984). The clinical

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signs in humans are nausea, headache, increased appetite, weight loss, abdominal pain, intestinal obstruction, nervous syndromes and epilepsy (Ofukwu et al., 2009; Gracey et al., 1999).

Various risk factors associated with the prevalence of taeniasis were reported in different corners of the world. Regions, religion, occupation, raw or undercooked meat consumption, use of spices with raw meat, poor meat inspection services. Besides, outdoor defecation in or near cattle rearing facilities or pastures, lack of effective fly and bird control around cattle facilities, use of sewage effluent, sludge or untreated human faeces to irrigate or fertilize feed crops and pastures (WHO, 2005).

In Rwanda, the prevalence of *C. bovis* is recorded at 15% (Ashwani and Gebretsadik, 2008) whereas; the prevalence rate of bovine cysticercosis in Ethiopia was ranged from 2.2-3.2% after meat inspection (Edem, 2009). In Iran, the percentage of *C. bovis* was (0.6%) at post-mortem inspection (Oryan, 2012). The examination of various organs of cattle during meat inspection in Meshkinshahr Abattoir in Iran showed that 3% were infected with bovine cysticercosis (Garedaghi et al., 2011). In Africa, Urquhart (1961) reported a prevalence of 10%. However, the occurrence had found reduced to 4.8%. Karshima et al. (2013) in Nigeria recorded a prevalence rate of 4.8% while the highest prevalence of 64.2% was recorded in Ethiopia (Abuna, 2007).

It was reported that several factors, such as activity of the muscles, age, and the geographical location determine largely the predilection sites for *C. bovis* in slaughtered cattle (Opara et al., 2006). Workers in Nigeria showed that the prevalence of *C. bovis* in cattle was 2.67% and the infestation was highest in the tongue compared to other organs. The cysts were found in the tongue (13%), diaphragm (7.6%), heart (7.3%), masseter (4.1%) and liver (0.3%) (Karshima et al., 2013). Further findings which revealed that cysticerci are most frequently located in the tongue, heart and masseter appear to confirm earlier reports by Belino (1975). The tongue, masseter muscles, cardiac muscles, triceps muscles and thigh muscles were the main predilection sites of the cysts. The cysts of bovine cysticercosis were also identified on the spleen, intercostal muscles, diaphragm and liver (Garedaghi et al., 2011).

Studies have showed that female cattle and exotic breeds are reported to be more infected with *C. bovis* (Garedaghi et al., 2011; Falake and Ogundipe, 2003).

Bovine cysticercosis is well documented worldwide and remains a public health concern that reduces export earnings in many countries (Edem, 2009). It is therefore, important that due attention be given to this disease to improve the quality and quantity of beef so as to satisfy the domestic consumption and to increase the foreign export earnings. Unfortunately, empirical evidence shows that the farmers and butchers in Rwanda pay very little attention to this disease. Observations show that meat is lost through partial or total condemnations in Nyagatare due to *C. bovis*.

The objectives of this study were to determine the prevalence of *C. bovis* at post-mortem in Nyagatare abattoir, to know if a relationship exists between age, sex, breed of cattle and prevalence of organ infestation by *C. bovis.*

MATERIALS AND METHODS

Geographical study area

The study was conducted in Nyagatare, one of the seven districts of the Eastern Province of Rwanda. The district is located between1°18'0.00"S and 30°19'30.00"E. The average altitude is at 1400 m above the sea level and receives annual rainfall of 827 mm per year. The annual average temperature ranges between 25.3 and 27.7°C (Nyagatare District, 2007).

Experimental animals

A total number of 291 cattle slaughtered during the period of the study were all taken as the sample. All these animals originated from Nyagatare District.

Study design

A cross-sectional study was conducted at Nyagatare slaughterhouse in the Eastern Province, Rwanda between December 2013 and April 2014. During the period of the study, the slaughterhouse was visited four days a week.

Meat Inspection

Ante-mortem examination of all cattle brought for slaughter during period of the study was done. A record of age, breed, sex and the origin of the animal was taken. Age of cattle by dentition was carried out. Post-mortem examination was done by systematic examination of different parts of the carcass. The examination consisted of visual inspection, palpation and incisions.

Data analysis

Demographic and epidemiological characteristics were analysed using descriptive statistics. Categorical variables were described using percentages, whilst bivariate analysis was performed using χ^2 and Fischers exact tests. *P*-values ≤0.05 was considered significant. Collected data were entered and managed in MS Excel and SPSS version 16.

Table 1. Predilection sites of bovine cysticercosis at post-mortem.

Location of the parasite	Total number inspected	Positive cases	Percentage (%)
Heart	291	6	2
Masseter muscles	291	5	1.7
Tongue	291	5	1.7
Diaphragm	291	1	0.3

Occurrence of *C. bovis* according to sex and breed of cattle.

Table 2. Sex-based occurrence of bovine cysticercosis.

Sex	Total number of carcasses	Positive cases	Occurrence (%)
Males	257	2	0.6
Females	34	7	2.4
Total	291	9	3

Table 3. Age-based prevalence of bovine cysticercosis.

Age group	Total number of carcasses	Number of infected cattle
Above 5 years	3	2 (66.7%; *n*=3)
[3-5years]	20	5 (25%; *n*=20)
[2-3 years]	268	2 (0.7%; *n*=268)
Total	291	9 (0.3%; *n*=291)

Ethical considerations

Ethical approval for this study was obtained from the research committee of the School of Animals Sciences and Veterinary Medicine, College of Agriculture Animal Sciences and Veterinary Medicine, University of Rwanda. Meat inspection was performed by a qualified and registered veterinarian through routine ante-mortem and post-mortem inspection Procedures to ensure personal safety while conducting the study were undertaken. Slaughterhouse owners were informed about the study purpose and procedures and provided written consent prior to study procedures on their animals.

RESULTS

Overall occurrence of *C. bovis*

The study showed that from 291 carcasses inspected, 9 (3%) were positive for bovine cysticercosis. The parasite was more frequent in the heart than in other organs with 35% of the all positive cases.

Occurrence of *C. bovis* in different organs of the animal

The results of the present study show that there was no significant difference (p>0.5) in the distribution rates of the cysticerci in the organs of the cattle slaughtered at the abattoir. From the total positive cases, cysts were found in the heart with the highest rate of infestation (35%, *n*=*9*), masseter muscles (29.5%, *n*=9), tongue (29.5%, *n*=9) and the diaphragm (6%, *n*=*9*) which is least infected (Table 1). No cysts were found in the triceps muscles, liver, intercostal muscles, spleen, lungs, intestinal mucosa or kidney. Partial condemnation of 2 heads and 1 heart were observed.

Of the 291 carcasses examined 257 were from males and 34 from females. Although more males than females were examined, the occurrence of infection was more in female than male carcasses. The study showed that out of 9 infected cattle, 7 (2.4%; *n*=291) were females and males were only 2 (0.6%; *n*=291) (Table 2).

With regard to the occurrence of *C. bovis* in association with sex, 2.4% (7/291) of females inspected were found positive whilst the occurrence in males was 0.6% (2/291). Statistical analysis showed that the disease is associated with sex ($p<0.05$, *n*=291).

In Table 3, it was observed the highest occurrence of infection 66.7% (2/3) was in the animals of more than 5 years old. The next greater prevalence was observed in middle age animals with 25% (5/20) and the least prevalence was observed in younger animals with 0.7% (2/268). The result of the occurrence of *C. bovis* relative to age group is statistically significant ($p<0.05$, *n*=291).

A monthly trend analysis indicated that all the values

Table 4. Monthly-based prevalence of bovine cysticercosis.

Month	Number of inspected animals	Positive cases	Monthly prevalence (%)	Overall prevalence (%)
December	12	0	0.0	0.0
January	34	1	2.9	0.3
February	86	3	3.4	1.0
March	78	1	1.2	0.3
April	81	4	4.9	1.4
Total	291	9	-	3.0

recorded in January, February and April were significantly higher (p<0.05) than the rest of the period of our study (Table 4).

Contributing socio-economic and environmental factors to the prevalence of the disease

The socio-economic and environmental factors that contribute to high incidence of the disease in cattle is explained by absence of public latrines around the roads and markets and by the availability of grazing pasture that brings cattle together during grazing thereby exposing them to the infection. Rainfall washes large land areas that might have been contaminated with human waste to grazing land thus contaminating the grazing areas.

DISCUSSION

The study revealed the prevalence of 3% for *C. bovis* in cattle and this figure is slightly low compared to 3.6% found by Nuraddis (2012) in Ethiopia, 13.3% found by Quadeer (2008) in Nigeria, 4.8% found by Karshima (2013) in Nigeria. But the study results are similar to those of Garedaghi (2012) who conducted a similar study in Iran. Study prevalence is also higher than the 0.6% found by Oryan (2012) in Iran.

As it is in Iran (Garedaghi 2012), the reason for this low prevalence of 3% found in Nyagatare district of Rwanda versus 4.8% found in Nigeria could be a result of adequate sanitation in Nyagatare district. This minimizes the rate of infection. In addition, high temperatures in Nyagatare which kills proglottids from faeces of infected human might also be another reason. Other reasons for this low prevalence in Nyagatare might be associated with a small sample size and rainfall patterns in which may impact on the prevalence of the disease.

Observations in this study showed that heart muscles, the masseter muscles, tongue and diaphragm were the preferred organs (predilection sites) for the cysts of *C. bovis*. Our findings agree with the ones of Quadeer (2008); Garedaghi (2012); Nuraddis (2012); Opara et al. (2006); and Minozzo et al. (2002), *C. bovis* tends to concentrate in the tongue. The reasons could be that the predilection of the parasite is largely determined by different factors such as activity of the muscles, age, and the geographical area; this was also the case for our study.

Although, more male carcasses than female were inspected, the occurrence rate was more in the females than males. The reason of this difference could be that cows are stressed during oestrus cycle which causes hormonal imbalances and suckling of calves which weakens the immune system so leading to easy infection. The other likely reason is because cows are kept longer for breeding and milking while the bulls and steers are sold off at an early age. These results are different from what was found by Yohana et al. (2013) in Tanzania in his study conducted on pigs.

There is a relationship between prevalence with the ages of the animals. From 3 carcasses aged more than 5 years, 2 were infected with *C. bovis*. Five out of 20 carcasses from cattle aged between 4 and 5years were infected. In contrast, only 2 out of 248 carcasses from cattle aged between 2 and 3 years were infected. The reason for this relationship of prevalence with the ages of the animals could be explained by the life cycle of *C. bovis* which may take time to be found in young animals because they met with few or non-infected human excreta at their early age. Our results agree with the one of Karshima et al. (2013) in his research conducted in Nigeria.

There was, statistically, no significant difference (p>0.5) between breeds of the animals slaughtered because out of 9 infected cattle 5 were local and 4 were crosses. This is a small difference which may be associated with management system, whereby cross cattle breeds were from dairy farms having less exposure to contaminated pasture with infected human excreta while the local cattle breeds are for fattening or extensive management system.

The socio-economic and environmental factors that contribute to this prevalence of the disease in cattle is explained by absence of public latrines around the roads and markets and by the availability of grazing pasture that brings cattle together during grazing thereby exposing them to the infection. Rainfall washes large land areas that might have been contaminated with human

waste to grazing land thus contaminating the grazing areas. Public education on the use of latrines and improved standards of human hygiene are recommended.

Conclusion

Meat inspection protocols were able to detect the prevalence of bovine cysticercosis of 3%. The occurrence of *C. bovis* was higher in adult cattle than in young ones. Although more males than females were inspected more female carcasses were infected than male. There was no significant difference (p>0.5) in the distribution rates of the cysticerci in the organs of the cattle slaughtered in the slaughterhouse.

Poor hygienic principles reference to waste disposal, poor sludge and sewage treatment and food associated with undercooked beef consumption were the major risk factors for the occurrence of the disease.

Given that many families in Rwanda and particularly in Nyagatare keep some animals in their backyards (and the trend is increasing), the human/animal interface continues to expand. The true prevalence of *C. bovis* in cattle and *T. saginata* in humans is of utmost importance to both animal and human health authorities for surveillance and control measures to be applied accurately. The relationship between the two parasitic diseases at human/animal interface in Rwanda can only be established if the true prevalence of the two diseases is known. Finally, despite that the 3% prevalence which seems small; it is still not only a public health concern, but also cause of economic loss associated with meat condemnation at abattoirs.

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