



Prevalence and Economic Impact of Bovine Fasciolosis at Kampala City Abattoir, Central Uganda

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Authors' contributions

This work was carried out in collaboration between all authors. Author NJ designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed literature searches. Authors MJS, MB, JK, PO, JB, HI managed the analyses of the study and literature searches, author IJS participated in the planning of the study, drafting and critical review of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was carried out to determine the prevalence of bovine fasciolosis in indigenous cattle slaughtered in Kampala City abattoir and to compare the diagnostic efficiency of fecal and post mortem examination. The study also assessed the economic impact of bovine fasciolosis associated with liver condemnation in the abattoir and weight loss to the animal.

Methods: A cross sectional, experimental study of bovine fasciolosis was conducted using postmortem liver and fecal examination of slaughtered animals. A total of 511 slaughtered cattle were examined at post mortem and *Fasciola* species were recorded. The number of eggs per gram of feces was determined using the standard McMaster method (14). The formulae $a+b+ct$ determine the total annual loss was used according to Ogunrinade and Adegoke 1982.

Results: Of the 511 livers and fecal samples examined, 429(84%) and 358(70%) were positive for fasciolosis respectively. The most common *Fasciola* species affecting the cattle was *F. gigantica* (73.3%), followed by *F. hepatica* (5.68%). Mixed infections and unidentified or immature forms of *Fasciola* spp. were present in 0.59%, and 4.31% of cattle, respectively. The prevalence of fasciolosis recorded in this study was higher than that reported by other researchers in Uganda. The study also showed a strong relationship between fecal examination and postmortem findings of liver lesions though postmortem examination may be considered a better diagnostic tool for fasciolosis ($k=213$, $P<0.05$). The abattoir lost a total of 231,186,550,000 Uganda shillings (92,474,620 US Dollars) annually on totally condemned liver.

Conclusion: The prevalence of bovine fasciolosis amongst cattle slaughtered in Kampala City Trader's abattoir is high. Great economic losses as a result of condemnation of infected livers were incurred, and that *F. gigantica* is the main species of liver flukes affecting cattle in all districts of Uganda. Local climatic factors, cattle population and the presence of the snail intermediate hosts are probably the main drivers influencing the incidence of the disease in the various districts of the country. This disease therefore deserves serious attention by the various stakeholders in order to promote the beef industry in the study area in particular and in the country in general.

Keywords: Cattle; economic impact; *Fasciola gigantica*; fasciolosis; *Fasciola hepatica*; prevalence.

1. INTRODUCTION

Fasciolosis is an important parasitic disease in tropical and subtropical countries which limited the productivity of ruminants in particular cattle [1]. *Fasciola hepatica* and *Fasciola gigantica* were the two liver flukes commonly reported to cause fasciolosis in ruminants [1]. Once ingested, the parasites migrate through the liver parenchyma to the bile ducts leading to liver damage. Other subclinical and chronic cases of the disease usually results in decreased animal production, secondary bacterial infections, fertility problems, loss of weight, poor carcass quality and great expenses with antihelminthics [2]. Recently, worldwide losses in animal productivity due to this infection were conservatively estimated at over US\$3.2 billion per annum [3].

Incidence of human infection apparently increased worldwide over the past 20 years [4,5]. *F. hepatica* occurs mainly in sheep and cattle rearing areas of temperate climates, particularly in parts of Europe, China, Africa, Middle East, Central and South America [6]. Sporadic cases were reported in the United States [6]. An

estimated 2.4 to 17 million people were infected in more than 51 countries [7] and 91 million were at risk worldwide [8]. *F. hepatica* existed in zoonotic foci which were more restricted to cooler regions of Africa, including Kenya, Ethiopia and Tanzania [9-11]. Like elsewhere, in Uganda the lowland areas of Mount Elgon were known to be endemic zones for *F. gigantica* with reports showing the prevalence of *Fasciola* species in highland areas at 78% and low land areas at 65% [12]. Therefore this study aimed to determine the prevalence of bovine fasciolosis and its economic impact in Kampala City abattoir.

2. MATERIALS AND METHODS

2.1 Study Site

The study was carried out in the month of August 2014 in Kampala City abattoir. This area is characterized by a tropical rainforest climate in Koppen Geiger climate classification system. It features two annual wet seasons and a very short dry season.

2.2 Study Animals

The study animals comprised of 511 heads of indigenous ankole, short horn zebu and fresian cattle that were slaughtered at the abattoir. Most of the cattle slaughtered were trade animals brought to the abattoir from distant areas. Most of the cattle slaughtered in the abattoir came from 31 districts of Uganda which include Kiruhura, Kiboga, Lyantode, Ssembabule, Rakai, Nakaseke, Kyankwazi, Gomba, Isingiro, Mbarara, Hoima, Lwengo, Mubende, Kyegegwa, Ntungamo, Ibanda, kayunga, Luwero, Kamwenge, Palisa, Mityaana, Mukono, Kabale, Kyankwazi, Ntoroko, Kaberamaido, Kalungu, Masaka, Mpigi, Maddi, Iganga Districts.

2.3 Study Design and Sample Collection

A cross sectional study was carried out. All animals brought for slaughter were physically observed prior to slaughter. Inspection of animals was closely made mostly during motion of the animals to the slaughter areas after offloading from the vehicles that transported them from the kraal. Meanwhile, very weak and tired animals were inspected during rest. At ante-mortem examination detail records about the species, breeds, sex, origins and body conditions of the animals were performed; body condition scoring was based on outlook. To properly evaluate body condition for cattle, we observed the skeletal structures, muscle and fat positioning and ranked them on a scale of 1 to 9, with 1 being emaciated and 9 being obese [13]. Fecal samples for parasitological examination were collected directly from freshly defecated feces and placed into clean plastic bottles containing 5% formalin. Each sample was clearly labeled with animal's identification, date of collection and these were transported to the Veterinary Parasitological laboratory of College of Veterinary Medicine, Animal resources and Biosecurity-Makerere University for analysis. Samples were packed and kept in the refrigerator to avoid development of eggs and hatching. In the laboratory, parasitological examination was performed to detect the presence of *Fasciola* spp. using the standard McMaster method [14].

Post slaughter examination involved visual examination of carcasses and organs with keen attention being directed to the livers. All livers having *Fasciola* species condemned were registered and flukes were isolated in bottles containing 5% formalin for species identification.

2.4 Laboratory Methods

McMaster method (14) was used since we were interested in the number of eggs per gram of animal stool. We weighed 3 g of feces and added 42 mL of water in a beaker, this was homogenized and the suspension was poured through a 250- μ m aperture sieve, collecting the filtrate in another beaker. The filtrate was then agitated and transferred to a 15 mL test tube. The samples were then centrifuged at 2000 rpm for 2 minutes, after which the supernatant was then poured off. The sediment was then agitated and the tube was filled with saturated Zinc sulphate. We inverted the tube 6 times and quickly transferred fluid using a pipette into both chambers of a McMaster slide. Egg counts in excess of 1000 showed severe infestation of parasites.

2.5 Species Identification

After making systematic incisions to the liver parenchyma and bile ducts, flukes were collected into the universal bottles containing 5% formalin and examined to identify the involved species. The liver flukes collected were measured and classified into species based on the size and morphological features described by Reinecke and Soulsby et al. [15,16]. They were transferred to Petri dishes on a table under which was a clean white paper. A thin, transparent piece of glass was placed on top of them and their sizes were measured using a ruler. *F. gigantica* (20 – 75 mm x 3.12 mm) resembled *F. hepatica* (20 – 30 mm x 10 mm) but is readily recognized by its larger size, rough edges (spines), shoulders not prominent and the body was more transparent. It was grayish- brown in and color changed to grey when preserved.

2.6 Sample Size and Sampling Procedures

The sample size was calculated based on previous data showing that the existing prevalence is around 78% in lowland areas of Uganda [12]. The sample size was calculated using the formula by Cochran; $n = 1.96^2 P_{exp} (1 - P_{exp}) / d^2$ [17].

Where n = required sample size,
 P_{exp} = expected prevalence and
 d = desired absolute precision formula.

$$n = \frac{4 \times 0.78 (1 - 0.78)}{0.05^2}$$

$$n = 275$$

Thus, the minimum sample size required for this work was 275 cattle.

A Systematic random sampling method was employed to determine the magnitude of economic loss due to liver condemnation at Kampala city traders' abattoir. Estimation of monetary losses was assessed through participatory approaches including meetings and interviews with retailers and butchers. The prices were taken from the current retail price of 13,000 Uganda shillings per 1 Kg of liver. The formulae $a+b+c$ to determine the total annual loss was used given by Ogunrinade A. and Adegoke G.D [18] where *a* represented total annual liver condemnation, *b* represented annual partial liver condemnation and *c* represented carcass weight loss due to liver condemnation.

2.7 Procedure for Post Mortem Inspection of the Liver

Post mortem inspection was carried out according to the method described by Thornton's and Gracey [19]. Meat inspection was carried out by the team comprising of veterinarians and official meat inspectors. Liver examination was carried out concurrently with meat inspection of bovine carcasses and other organs.

2.8. Monetary Loss Due to Liver Condemnation and Carcass Weight Loss

The formula from Ogunrinade and Adegoke was used to calculate monetary loss due to carcass weight loss, partial and total liver condemnation [18].

3. RESULTS

3.1 Prevalence of Fasciolosis

The prevalence of the disease in cattle slaughtered at the abattoir was 429(84.0%) during postmortem (*F. gigantica*, 375(73.3%), *F. hepatica*, 5.68% and the immature/unidentified forms constituted 4.31%).

The prevalence of bovine fasciolosis by fecal analysis was 70% (n=358) as shown in Fig. 1 with *F. gigantica* being the most prevalent species in the studied samples (66%). Co-infection with *F. hepatica* and *F. gigantica* (0.59%: n=3) was identified using the two

methods. Fecal analysis also showed that 219(42.86%), 112(21.92%), 25(4.89%) of the cattle had 100-500, 600-900 and above 1000 eggs per gram of stool respectively. These results showed that *F. gigantica* was more common than *F. hepatica*.

3.2 Prevalence of Bovine Fasciolosis in Body Condition

The prevalence of Fasciolosis in both body condition groups (good and poor) was determined in coproscopy. Approximately, 45% of the animals were seen to be unhealthy and in poor body conditions while 54.6% looked healthy and in good body condition. However this could not be related to the prevalence of fasciolosis as some cattle that seemed to be healthy visually had also been infected with the disease. Out of the 279 cattle with good body condition, 191(64.4%) cattle were positive for fasciolosis and out of the 232 cattle with poor body condition, 228 (98%) cattle were positive for Fasciolosis. Statistical analysis showed no significant difference ($P > 0.05$) between the condition scores (Table 1). However, there was a significantly high parasite intensity ($P < 0.05$) among cattle with poor body condition by stool analysis (Table 2).

3.3 Prevalence of Bovine Fasciolosis by Breed

Out of 511 cattle examined at Kampala city traders abattoir, 319(62.4%) were Ankole, 107(20.9%) Zebu and 85(16.6%) Friesian. The prevalence of bovine fasciolosis was 262(82.1%), 90(84.1%), and 71(83.5%) in Ankole, Zebu and Friesian breeds of cattle respectively (Table 1). However there was no significant difference in prevalence among the breeds ($P > 0.05$).

3.4 Prevalence of Fasciolosis by Sex

Due to the high demand of fatty beef, 74.0% slaughtered cattle were females while only 26.0% were males. The prevalence of bovine fasciolosis was 84.1% (n=318) and 78.9% (n=105) in female and male cattle respectively. However there was no significant difference in prevalence of the disease between sexes ($P > 0.05$). Also, there was no significant difference in parasite intensity between the sexes ($P > 0.05$).

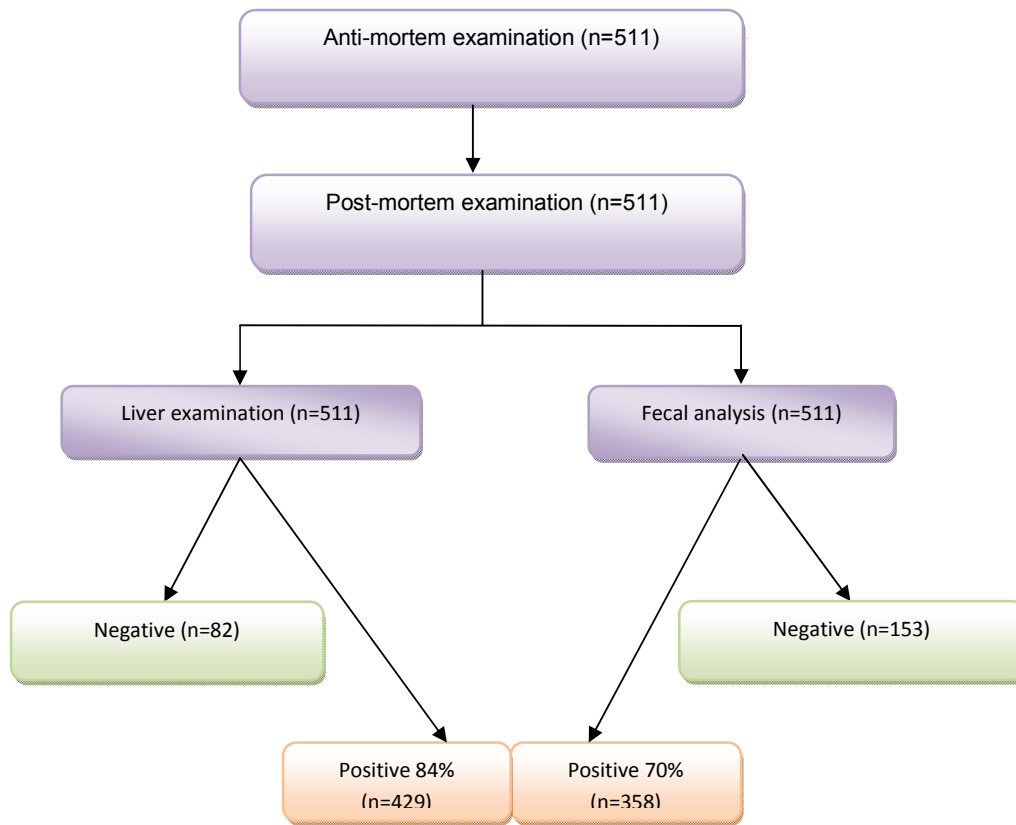


Fig. 1. Study profile

3.5 Prevalence of Fasciolosis by District of Origin

The cattle slaughtered in this abattoir originated from 18 districts of Uganda. The highest number of the cattle slaughtered in this abattoir during the time of the study originated from Kiruhura district (n=112) and the least number from Ntugamo and Luwero (n=3). The prevalence was high throughout all districts with an average of 80% prevalence (Fig. 2).

3.6 Parasite Intensity and Prevalence by Stool Analysis

Stool analysis was carried out to determine the prevalence and parasite intensity of *Fasciola* species (Table 2). The prevalence was highest among cattle with poor body condition and the parasite intensity in this particular group was significantly higher ($\chi^2 = 276, P < 0.05$). The difference in the prevalence and parasite intensity by sex or breed was not statistically significant.

3.7 Monetary Loss Due to Condemnation

The abattoir lost a total of 231,186,550,000 Uganda shillings (92,474,620 US Dollars/92 million US Dollars) annually. Loss due to total annual liver condemnation was 21,112,000,000/-, partial annual liver condemnation was 10,292,100,000/- and annual loss due to carcass weight loss was 199,782,450,000/-. With this amount (231,186,550,000/-) of money lost annually everyone is able to see the economic impact of such a tropical disease in Africa, more especially to a developing country like Uganda.

4. DISCUSSION

The prevalence of bovine fasciolosis was significantly high in the study area in both post mortem and fecal examination and this might be attributed to lack of control strategy applied to fasciolosis coupled with the wide distribution of swamps in most cattle rearing areas in Uganda which provide suitable habitats for snails. Also, these areas are characterized by humid and warm conditions that are conducive for the

survival of the aquatic snails that act as the intermediate hosts for *Fasciola* species. The practice of communal grazing was dominant in the study area and this feeding method predisposed the cattle to fasciolosis which also partly explain the high prevalence of the disease. This study revealed an overall prevalence of 84% *Fasciola* infection which is higher than the 36.5% and 31.7%, reported in Uganda in the year 2002 and Zimbabwe respectively [20,21]. In Ethiopia, Kenya, Tanzania and Nigeria reports showed prevalence of 39.6%, 8.6%, 16.3% and 31.7%, respectively [22-25]. Worldwide prevalence of fasciolosis has been reported to be ranging from 1.15% to 80% [26-35,21,9,25]. The upper limit (80%) is similar to the results obtained in our study. The results of this study were also similar to those by Amal et al. [36] who reported the prevalence of the disease in indigenous Nilotic cattle to range from 85.3% to 99.2% with an average of 96.8% in Sudan and in the highland areas of Mt. Elgon [12]. The difference in the

prevalence of fasciolosis in different areas may be explained by variation in climatic conditions that may influence the distribution of the snails which are the intermediate hosts.

Both sexes were found equally susceptible in present study. These results are in agreement with those of Maqbool et al. and Khan et al. [37,38]. Who also did not find statistical association between sex and incidence of disease. The results in the present study differ with the findings in Zambia, Tanzania and Zimbabwe [31,1,39] which suggested that difference in susceptibility between sexes may exist.

Breed specific distribution of the disease in cattle showed that there was no difference in the prevalence by breed. This may mean that all breeds in this study were equally susceptible to fasciolosis.

Table 1. Prevalence of Bovine fasciolosis in cattle examined at Kampala city abattoir by breed, sex and body condition

	No. of cattle examined (%)	No. of positive (%)
Breed		
Ankole	319(62.4)	262 (82.1)
Friesian	85(16.6)	71 (83.5)
Zebu	107(20.9)	90 (84.1)
Sex		
Male	133(26.0)	105 (78.9)
Female	378(74.0)	318 (84.1)
Body condition		
Good	279(54.6)	191(68.5)
Poor	232(45.4)	232 (100)

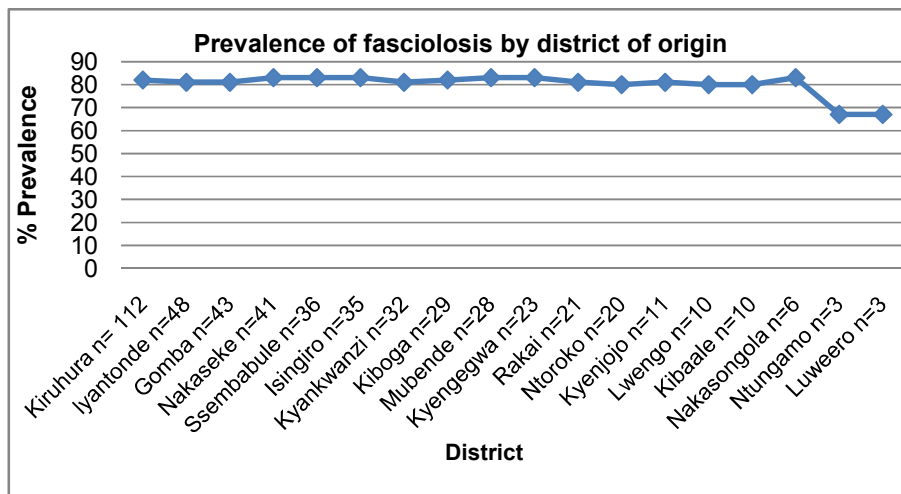


Fig. 2. Prevalence of fasciolosis by district of origin

Table 2. Parasite intensity and prevalence by stool analysis

	No. of cattle examined (%)	No. of positive (%)	Number of eggs counted (%) (100-500) (600-900) (>1000)
Breed			
Ankole	319(62.4)	216(68)	133(62)69(32)14(6)
Friesian	85(16.6)	59(69)	38(64)17(29)4(7)
Zebu	107(20.9)	81(76)	48(59)26(32)7(9)
Sex			
Male	133(26.0)	86(65)	53(62)25(29)8(9)
Female	378(74.0)	270(71)	166(62)87(32)17(6)
Body condition			
Good	279(54.6)	128(46)	127(99)0(0)1(1)
Poor	232(45.4)	228(98)	92(40)112(49)24(11)

While close to 50% of the animals (45.4%) were seen to be unhealthy and in poor body conditions, statistical analysis showed no significance ($P > 0.05$) between the condition scores.

The economic loss due to bovine fasciolosis in this study was estimated at US\$ 92.5 million per annum. Fasciolosis is a major problem in development of livestock industry causing huge economic losses through reduction in productivity of animal in terms of lowered growth rate, meat and milk production, fertility, feed efficiency and draught power [40]. Condemnation of infected livers and cost of control measures are other sources of economic loss. It has been estimated that economic losses due to fascioliasis reached up to US\$ 2 billion per year worldwide [41]. Economic losses due to bovine fascioliasis were recorded as 18000 USD, 2975USD and 4000 USD/ annum in Tanzania, Tehsil Sargodha and Southern Ethiopia respectively [42,43,9]. Economic losses measured in this study are considerably higher than reported in the studies above warranting urgent attention and adoption of suitable measures for the control of disease.

5. CONCLUSION

The prevalence of fasciolosis in Kampala city traders' abattoir is high. All breeds of cattle from various district showed a high prevalence. Bovine fasciolosis is therefore an important parasitic disease causing great loss of revenue due to condemnation of affected livers and weight loss of the animal at Kampala city trader's abattoir.

6. RECOMMENDATION

Establishment of an effective control programme with regular treatment with flukicides is known to

be effective against both mature and immature flukes. Control of snails which are the intermediate host for *Fasciola* species is important to reduce and eventually mitigate the intensity of infection in a herd over time and subsequent environmental contamination.

Greater vigilance of this parasite within indigenous cattle should therefore be encouraged to mitigate the problem. We also recommend another study to examine the effect of different grazing methods on the prevalence of bovine fasciolosis and to correlate weight and parasite intensity.

ETHICAL APPROVAL

Ethical clearance was received from the Faculty Ethical Review Committee of Kyambogo University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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