Prevalence and economic significance of bovine fasciolosis in slaughtered cattle at Arusha abattoir, Tanzania

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SUMMARY

The aim of this study was to establish the prevalence and economic significance of fasciolosis in cattle slaughtered at Arusha abattoir in Tanzania. A 3-year database (2005-2008) from the abattoir was retrieved and analysed. In addition, meat inspection was carried out for one month (July 2008) with focus on *Fasciola* infection and its associated economic loss due to liver condemnation. Results from the retrospective study revealed that 8302 (6.7%) livers out of 123790 examined livers were condemned due to fasciolosis. Analysis of primary data (meat inspection) showed that 150 of 469 cattle livers condemned were due to fasciolosis, a relative condemnation rate of 32.0% per month. Based on the current local price of liver, the economic loss per month due to liver condemnation was estimated at Tanzania shillings (TZS) 1,800,000/- (approximately US $1,500), which summed to TZS 21,600,000/- (US $18,000) per annum. The specific cause of liver fasciolosis was *Fasciola gigantica*. These results indicate that *F. gigantica* infection is an important condition that leads to high liver condemnation rates in cattle slaughtered, resulting into high financial loss. This merits for more extensive epidemiological investigations to better determine the prevalence, economic impact and public health importance of the disease.

Key words: Bovine fasciolosis, liver condemnation, economic significance, Tanzania.

INTRODUCTION

Fasciolosis is among important parasitic diseases in tropical and subtropical countries which limits productivity of ruminants in particular cattle. *Fasciola hepatica* and *F. gigantica* are the two liver flukes commonly reported to cause fasciolosis in ruminants (Keyyu *et al.*, 2005). The disease causes poor health, reduced growth rate, high mortalities, especially in small ruminants and calves and liver condemnations at slaughter houses (Ngategize *et al.*, 1993). For example, Kithuka *et al.* (2002) reported up to 0.26 million USD annual loss attributable to fasciolosis-associated liver condemnations in cattle slaughtered in Kenya. Apart from its veterinary and economic importance throughout the world, fasciolosis has recently been shown to be a re-emerging and widespread zoonosis affecting a number of human populations (Mas-Coma and Bargues, 1997; Esteban *et al.*, 2003).

The prevalence of fasciolosis in many parts of Africa has been determined in live animals and at slaughter houses. Previous

studies in live animals have suggested that the prevalence of fasciolosis infections in Tanzania ranges from 17.8% in small scale dairy farms to 94% in traditional cattle farms (Keyyu *et al.,* 2005; Swai *et al.,* 2006; Keyyu *et al.,* 2006). A study conducted by Keyyu *et al.* (2006) reported up to 100% liver condemnation rates in some slaughter slabs in Iringa region in Tanzania due to liver flukes in cattle. Poor farming systems and water resources are among the factors that contribute to increased rate of bovine fasciolosis in tropical and subtropical countries, including Tanzania (Mas-coma *et al.,* 2005). In addition, microclimate that favours the survival of vector snail makes the disease endemic in a given region (Makundi, 2001).

Estimation of economic losses due to fasciolosis at national or regional level is limited by lack of accurate estimation of the prevalence of disease. Until recently no systematic study has been undertaken to ascertain the economic importance of liver fluke infections in slaughtered cattle in Tanzania, albeit, there is an increasing number of liver condemnations due to fasciolosis reported by the meat inspection services. This study aimed at determining the prevalence and economic importance of liver fasciolosis in cattle slaughtered at Arusha abattoir in Tanzania.

MATERIALS AND METHODS

Study area and animals

The study was conducted at municipality abattoir in Arusha region which is located in northern highlands of Tanzania. The municipality is situated between 1.6^0 and 4.0^0 latitude south and 34.5^0 and 37.5^0 longitude east. The region has both unimodal and bimodal rainfall patterns, with short rains starting in September and ending in December and long rains starting in March and ending in May. The highlands usually receive bimodal rains ranging between 800 and 1,200 mm per annum whereas the lowlands receive unimodal rains between 500 and 700 mm per annum. The mean monthly temperature of Arusha region is 20ºC. However during the cooler period (June - August) the mean average temperature drops to 17ºC.

The study involved cattle slaughtered at Arusha municipal abattoir. It was difficult to precisely trace back the geographical origins of all animals slaughtered and relate the findings to a particular locality. Slaughtered cattle were bought from different cattle markets namely Meserani, Ngaramtoni, Themi and Oldonyosambu which are located within Arusha region. Nevertheless, animals slaughtered were adult local breeds of cattle from agro-pastoral farming systems within Arusha and nearby regions namely Manyara, Dodoma, Shinyanga, Singida, Mara and Mwanza regions.

Sampling method

A retrospective study design was adopted which focused on retrieval and analysis of secondary data on previous meat inspections carried out at Arusha municipal abattoir between June 2005 and May 2008 inclusive. Data analysis focused on the number of livers condemned due to *Fasciola* infection in cattle slaughtered during the period of reference. In addition to retrospective data that ended in May 2008, primary data were also collected by performing inspection of cattle slaughtered at the abattoir for 30 days in July 2008 to validate secondary data from the retrospective study. Liver inspection was carried out by visual examination, palpation and incision of the organ. *Fasciola* infection was judged based on liver enlargement with bumpy, raised and/or depressed areas, dark blue to black disclourations, hardness in consistence and during incision when liver

flukes were seen. For each condemned liver, an attempt was made to establish the source of the animal through available records.

For *Fasciola* species identification, one or more samples of the worms were collected from 125 livers which had active infection. The worm samples were preserved in universal bottles which contained 70% ethanol during field work. The samples were subsequently transported to the laboratory for further identification at the Faculty of Veterinary Medicine, Sokoine University of Agriculture in Morogoro.

Liver condemnation information was summarized from the total number of livers inspected. Other causes of liver condemnation such as abscesses were also recorded in the postmortem meat inspection reports. These, however, were not used in the economic loss estimations. Information on light liver infestation/infections which were passed as fit for human consumption after trimming the affected parts during the routine postmortem inspection was also omitted.

Laboratory sample processing and *Fasciola* species identification

For each of the 125 samples of *Fasciola* collected, a preliminary identification was done through observation of the morphology and measurements as described by Soulsby (1982). Thereafter, 60 randomly drawn samples, with an average of 15 per each source of the cattle were stained for detailed microscopic examination. Staining of *Fasciola* was carried out as described by Soulsby (1982). *Fasciola* worms were hydrated using the sequence of 70%, 50%, 30% ethanol (changed two times) for 5-10 minutes in each. Then the worms were stained in 1 ml aceto alum carmine solution diluted with 5 ml of distilled water for 10 minutes. Thereafter, the worms were washed in water before differentiation of specimens in 2% aqueous hydrochloric acid solution until their surface became pale pink and the outline of the internal organs were visible. The worms were washed in distilled water before being dehydrated in 30%, 50%, 70%, and 90% and absolute alcohol two times in each concentration for 5-10 minutes. Lastly, the worm samples were cleared in clove oil, mounted on the glass slide and observed under stereo microscope at 20 x magnification with a side lamp.

Fasciola eggs identification

For further *Fasciola* species identification, eggs which were laid in the 70% ethanol were recovered by sedimentation technique. A total of 50 samples had eggs which were examined using a compound microscope with a 10 times and 40 times magnification objective lens.

Estimation of economic losses due to liver condemnation

A number of parameters were used to estimate the losses attributable to liver condemnations in slaughtered cattle at Arusha municipal abattoir. Such parameters included the average number of cattle slaughtered per month, the prevalence of fasciolosis, the average weight (expressed as Kg) of liver in a mature cattle and the selling price of the cattle livers (expresed as TZS/Kg of liver). The average selling price of cattle liver was established through a survey which was conducted in various meat shops in Arusha municipality during July 2008 month. A total of 100 livers from mature cattle were weighed immediately after slaughter using weighing balance to get average weight. The exchange rate of 1USD to 1,200/= TZS based on information from the National Bank of Commerce, foreign exchange department was adopted to compute equivalent value in USD from TZS.

RESULTS

Retrospective results showed that a total of 123,790 cattle were slaughtered between June 2005 to May 2008. During that period, 16,465 (13.3%) livers were condemned due to various reasons. Fasciolosis was responsible for 50.4% of total liver condemnations (Table 1). The overall prevalence of fasciolosis was found to be 6.7%.

Table 1. Prevalence of bovine liver fasciolosis between June 2005 to May 2008

Period	Slaughtered cattle	Condemned livers		Fasciolosis prevalence
		Total	Due to Fasciolosis	%
2005/2006	35090	6036 (17.2)	3033 (50.2)	8.6
2006/2007	40095	7317 (18.2)	3374 (46.1)	8.4
2007/2008	48605	3112 (6.4)	1895 (60.9)	3.8
Total	123790	16465 (13.3)	8302 (50.4)	6.7

From primary data obtained in July 2008, out of 4329 livers inspected, 469 (10.8%) livers were condemned due to various causes. Of the condemned livers, 150 (31.9%) were due to fasciolosis (Table 2). The recorded fasciolosis prevalence was 3.4%. There were no multiple causes of liver condemnation in a single liver. Up to 83.3% of the livers condemned due to fasciolosis had active infection with visible live flukes. Laboratory species identification of liver flukes sampled revealed that all the 60 worm samples examined were *F. gigantica*.

Table 2. Prevalence of bovine liver fasciolosis based on source (cattle market) as recorded in July 2008

Table 1. Prevalence of bovine liver fasciolosis from different sources

Source	Slaughtered cattle	Condemned livers		Fasciolosis prevalence
		Total	Due to *Fasciola*	(%)
Meserani	1707	193 (11.3)	61 (31.6)	3.5
Ngaramtoni	1232	153 (12.4)	36 (23.5)	2.9
Themi	752	83 (6.0)	39 (46.9)	5.1
Oldonyosambu	640	16465 (13.3)	14 (35.0)	2.1
Total	4329	469 (10.8)	150 (31.9)	3.4

Financial losses caused by bovine liver fasciolosis between June-July 2008

From the measurements taken at the abattoir, a mature bovine's normal liver (without pathological lesions) weighed 3 kg in average. The price of a kilogram of liver was about TZS 4,000/-. The approximate total weight of the 150 livers condemned due to fasciolosis was therefore equal to 450 kg, which was equivalent to TZS 1,800,000/- loss in one month. The annual financial loss assuming constant rate of condemnation and price of the liver would amount TZS 21,600,000/- which is

equivalent to US $18,000 at an exchange rate of TZS 1,200/- a dollar.

DISCUSSION

The findings of this study showed that fasciolosis is prevalent in cattle slaughtered at Arusha abattoir and the disease causes high economic losses due to liver condemnations. This merits for more extensive epidemiological investigations to better determine the prevalence in live cattle in the regions where they come from and the public health importance of the disease. Although abattoir surveys have their own limitations, they are useful for quick and economical epidemio-surveillance investigations of livestock diseases particularly for chronic and ill-defined conditions which are not apparent to either the stock owner or his veterinary surgeon but have detectable gross lesions at post mortem inspection (Blamier *et al.,* 1980). This is the first scientific publication that reports financial implication of cattle liver condemnation in Arusha Tanzania. The study employed slaughter survey to establish the prevalence status of fasciolosis and its economic significance.

The liver fasciolosis prevalence observed in this study was 6.7% which is lower than what had been reported previously in Tanzania. Earlier studies on *Fasciola* infections in live animals, reported the prevalence of 56.5% in Arusha which is in northern Tanzania (Swai *et al.,* 2006). In other studies by Keyyu *et al.* (2005) and Keyyu *et al.,* (2006) reported the prevalence of bovine fasciolosis in Iringa region located in the southern highlands of Tanzania to range from 17.8% % in small scale dairy farms to 94% in traditional cattle farms. The cattle liver condemnations rates in Iringa due to liver fasciolosis were up to 100% in some slaughter slabs (Keyyu, Pers commun 2008). Our results are plausible, considering the relative drought conditions existing in most rural areas occupied by the pastoralists in Arusha and nearby regions, which is unfavourable for snail survival. In the contrary, the southern highlands of Tanzania, especially Iringa is known to be a liver fluke endemic area (Makundi, 2001; Keyyu *et al.,* 2006). The cool and sub-humid climate in the southern highlands of Tanzania provides optimal conditions for the survival of liver fluke and there are numerous habitats for the snails that are intermediate hosts for flukes.

The findings of this study showed that, apparently all of the cattle liver fasciolosis was caused by *F. gigantica,* which accounted 32% of causes of liver condemnation. The findings compares well with other studies by Keyyu, (2004) and Keyyu *et al*. (2005) who identified *F. gigantica* as the cause of liver facsiolosis in southern highlands of Tanzania. Other studies elsewhere in Africa also reported *F. gigantica* as the most common species which infects cattle. For example, Phiri *et al.* (2005) and Mungube *et al.* (2006) found that *F. gigantica*, was the leading cause of liver condemnation in Zambia and Kenya respectively. It is established that *F. gigantica* is the most common *Fasciola* spcies found in Africa and is widely distributed in tropical and subtropical areas (Wamae *et al.,* 1998; Mage *et al.,* 2002). However, Mekroud *et al.* (2004) reported *F. hepatica* as the major cause of liver condemnation in Algeria while Yilma and Malone (1998) reported both *F. gigantica* and *F. hepatica* to affect cattle in Ethiopia. This difference in species may depend on the common *Fasciola* species circulating in the local environment, differences in climatic conditions that are conducive to the intermidiate hosts and the type of intermediate host snail present in the locality.

In the present study, an annual loss of about US $ 18,000 was estimated at Arusha

municipal abattoir alone using the observed number of condemned livers in the one month which were valued to US $ 1,500 assuming constant prices and monthly liver condemnation rate. However, given the large size of the bovine liver, it is also possible that fasciolosis liver condemnation has been underestimated, because some livers with partial infection that were passed as fit for human consumption after trimming of the affected parts were not included in the financial loss estimation. There are other additional losses such poor carcass quality and quantity due to interruption of the liver metabolic functions of animals infested with *Fasciola* parasite (Mungube *et al.,* 2006). It has been reported by Spithill *et al*. (1999) that worldwide losses in animal productivity due to fasciolosis were conservatively estimated at over US $3.2 billion per annum. In Ethiopia, abattoir studies reported an average of 148.12 and 54,063.34 Ethiopian birr (US $5,429 and $5,631,598) per day and annum, respectively (Tadele and Worku, 2007). Furthermore, as a zoonotic disease, the World Health Organization (WHO) estimated that 2.4 million people were infected with *Fasciola* in 1995 and a further 180 million were at risk of infection (Anonymus, 1995).

It is therefore concluded that fasciolosis causes significant losses to farmers, butchers and consumers. The study has also confirmed that *F. gigantica* accounts for the largest proportion of the causes of cattle liver condemnation at Arusha abattoir. We therefore recommend that the disease should be further investigated on farms to determine the prevalence in animals of various ages, species and breeds and to develop economic strategies for disease control at farm level. The disease should also be investigated in humans to better determine its zoonotic importance.

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