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# Prevalence of amphistomiasis and its association with *Fasciola gigantica* infections in Zambian cattle from communal grazing areas

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**Abstract**

To estimate prevalence of amphistomiasis and its association with bovine *Fasciola gigantica* infections in Zambia, 709 faeces of cattle presented for slaughter from three major cattle rearing areas of Central, Southern and Western provinces were analysed. The prevalence rate of amphistomes was 51.6%. Egg counts per gram (EPG) of faeces ranged from 0 to 385 with a mean (± SEM) of 11.96 ± 1.07. The origin of the cattle had a significant influence ($P < 0.001$) on the prevalence rate. *Fasciola gigantica* infections accounted for 46.7% of the cattle examined. The mean EPG count (± SEM) was 6.3 ± 0.66 with a range of 0 to 223. A total of 34.6% were mixed infections while single *Fasciola* and amphistome infections represented 12.1% and 17.1%, respectively. Significantly more cattle (63.8%) were infected with either single or both trematode infections ($P < 0.0001$) than not. Mixed trematode infections were highest in the Southern province (80.0%) while the lowest were recorded in Central province (16.3%). A positive correlation ($r^2 = 0.0428$) was present in mixed infections. In order to minimize losses, epidemiology and cross-resistance of amphistomiasis and fascioliasis should be studied in different ecological regions of Zambia to formulate efficient control programmes.

## Introduction

Trematode infections are some of the most economically important helminth diseases hampering the productivity of domestic ruminants worldwide. Tropical fascioliasis caused by *Fasciola gigantica* has been researched widely with reported estimated prevalences in ruminants ranging up to 80–100% (Spithill *et al.*, 1999). Amphistomiasis, whose emergence is most recent has, on the other hand, not been widely investigated. It is a snail-borne trematode disease of ruminants that decreases production (Spence *et al.*, 1996), and causes disease and mortality (Agosti *et al.*, 1980).

The diagnosis of trematode infections in ruminants has relied on the detection of eggs in the faeces of infected animals. Although not highly accurate in individual adult animals, it has considerable value in the diagnosis and control in herds if its limitations are understood (Murrell *et al.*, 1989; Anderson *et al.*, 1999). Variation in egg counts has been reported and found to be influenced by feed composition, faecal consistency and the time of day of faecal collection (Coyle, 1958) with neither uniformity nor consistency in low, medium and high fluke burdens (Duwell & Reisenleiter, 1984). Egg production may be suppressed after acquisition of immunity resulting in low egg counts even in the presence of high numbers of adult worms in the host (Winks *et al.*, 1983). However, losses in re-infected animals may be significant because immune responses may not provide adequate protection. Therefore, the above limitations may make it difficult,

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practically, to have correct egg per gram (EPG) values which can be related to actual infection levels.

Heterologous cross-resistance between *F. gigantica* in cattle exposed to *Schistosoma bovis* and vice versa has been described (Yagi *et al.*, 1986; Haroun & Hillyer, 1986) implying that these parasites may be susceptible to the same or similar effector responses (Spithill *et al.*, 1999). However, evidence of cross-resistance between *F. gigantica* and amphistomes is scarce.

Some studies showing high prevalence rates of fascioliasis have been carried out in Western and Southern provinces of Zambia (Silangwa, 1973; Pandey & Ahmadu, 1998; Phiri, 2004). As no previous studies have been undertaken on the prevalence and distribution of amphistome species in cattle of the resource-poor livestock farmers, the objectives of the present study were to determine: (i) the prevalence and distribution of amphistomiasis in cattle in the three major cattle keeping areas of Zambia using coprological examination; and (ii) its association with *F. gigantica* infection as well as examining the associations of origin, sex and age on its occurrence. Despite technical difficulties in specific identification of adult amphistomes, *Paramphistomum microbothrium* in domestic ruminants and *Calicophoron calicophorum* in lechwe (*Kobus leche*) in Zambia have been reported (Wright *et al.*, 1979; Kock *et al.*, 2002).

## Materials and methods

### *Study areas*

This study was carried out from March 2002 to September 2003 in Central, Southern and Western provinces of Zambia. These provinces were selected because of the high prevalence of fascioliasis and their importance in cattle rearing. The cattle population in these areas makes up the bulk of the national herd. Unlike commercial farmers, traditional farmers in the communal areas rarely practice any form of worm control in their livestock. Important geographical features in these areas are the Kafue and Zambezi rivers with their associated wetlands and ox-bow lakes.

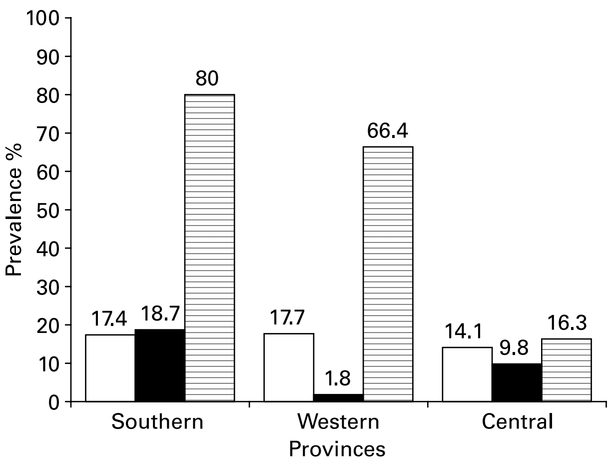


Fig. 1. Prevalence of amphistome (□), *Fasciola* (■) and mixed amphistome and *Fasciola* (▤) infections according to Southern ($n = 391$), Western ($n = 226$) and Central ($n = 92$) provinces of origin in Zambia.

### *Age estimation*

Age estimation of cattle was done by inspection of the incisor teeth according to a method by Yeates & Schmidt (1974) which is based on incisor temporary teeth replacement and the degree of wear of permanent teeth. Cattle estimated to be less than 4 years old were considered as young cattle while those 4 years and above as adults.

### *Coprological examination*

Faeces were collected randomly from the rectum of cattle brought for slaughter. A sieving and sedimentation technique with a glass beads layer for the detection and quantitation of *Fasciola* and amphistome eggs as described by Taira *et al.* (1983) was used to determine faecal egg counts. *Fasciola* eggs appeared oval, operculated and golden brown while those of amphistomes were large, clear, operculated and containing large granules in contrast to the blue colour of stained debris. The prevalence of infection was recorded using the ratio between the number of infected cattle and that of examined cattle and expressed as a percentage.

### *Statistical analysis*

The Pearson's chi-square, Fisher's exact test and continuity corrected chi-square test using SPSS® version 11.0 (SPSS Institute, Chicago, Illinois) was used to determine associations of origin, age and sex on the prevalence of fascioliasis. A $P$ value of less than 5% was considered statistically significant. Faecal egg counts were transformed into logarithmic values and analysis of correlation in mixed infections was done on $\log_{10}$ transformed egg counts.

## Results

The prevalence rate of amphistomes was 51.6% ($n = 709$). Eggs per gram of faeces varied throughout the study period but ranged from 0 to 385 with a mean (± SEM) of 11.96 ± 1.07. The site at Mongu, which lies along the Zambezi wetlands, had the highest prevalence (93.9%). Mazabuka, which lies along the Kafue wetlands, had a prevalence of 45.8% and Mumbwa, which lies away from major wetlands, had the lowest prevalence of 26.1%. Thus, the origin of the cattle had a significant association ($P < 0.001$) with prevalence rates. When the origins were grouped into provinces, the Western province had the highest prevalence of 84.1% followed by the Southern province (37.9%) while the lowest prevalence rate was in the Central province (26.1%).

The average age of cattle was 5.3 years with a range of 0.5 to 12 years. The prevalences of amphistomiasis in adult (53.3%) and young cattle (46.6%) were not significant ($\chi^2 = 2.11$, $P = 0.146$), neither were those in females (53.5%) and males (49.5%) ($\chi^2 = 1.40$, $P = 0.236$). Female cattle had higher prevalences when grouped into origin (26.1% for Central, 49.6% for Western and 22.0% for Southern) than their male counterparts (4.3%, 34.5% and 15.9%, respectively). These differences were also not significant.

*Fasciola gigantica* infections were detected in 46.7% of the faecal samples examined. The mean EPG count (± SEM) was 6.3 ± 0.66 with a range of 0 to 223. A total of 34.6% had mixed trematode infections while 12.1% and 17.1% were positive for *Fasciola* and amphistomes, respectively. Therefore, significantly more cattle (63.8%) had either single or both trematode infections ($\chi^2 = 124.69$; $P < 0.0001$).

The prevalence and distribution of infections according to origin are shown in fig. 1. Single amphistome infections were highest in the Western province (17.7%) while the Central province had the lowest (14.1%). Mixed infections were highest in the Southern province (80.0%) while the lowest was recorded in the Central province (16.3%). The origin of cattle was significantly ($P < 0.0001$) associated with the occurrence of mixed trematode infections. However, associations with age of cattle (42.1% young; 57.9% adult; $P = 0.110$) and sex (47.4% male; 52.6% female; $P = 0.942$) were not significant. Figure 2 shows a positive correlation between EPGs in mixed infections ($r^2 = 0.0428$).

## Discussion

*Fasciola gigantica* and amphistome species were common trematodes of cattle found in the present study occurring as either single or mixed infections. This study has revealed, for the first time, the presence and extent of amphistomiasis and its association with fascioliasis in cattle in Zambia. The true prevalences of these infections may be underestimates in the absence of serological tests. The prevalences and EPGs rank among the highest in Africa. Amphistome and *Fasciola* infections have been reported in other parts of Africa (Ajanusi *et al.*, 2001; Pfukenyi *et al.*, 2002; Keyyu *et al.*, 2003). The prevalence of amphistomes in Zambia was higher than that found by Pfukenyi *et al.* (2002) in Zimbabwe (33.0%) and Ajanusi *et al.* (2001) in Nigeria (4.9%), but lower than that by Keyyu *et al.* (2003) in Tanzania (81.9%). Elsewhere, prevalences of 5.5–20% have been reported (Agosti *et al.*, 1980; Tinar *et al.*, 1992; Szmidt-Adjide *et al.*, 2000; Rangel-Ruiz *et al.*, 2003).

In agreement with Szmidt-Adjide *et al.* (2000), sex and age differences were, overall, not significantly associated with the prevalence of amphistome infections. However, infections recorded in females were higher than in males as reported by Asanji (1989) and Kang & Kim (1988) suggesting that differences in susceptibility between sexes may exist. In addition, sex and age of cattle tendered for slaughter depend on the culling policy of an individual farmer where cows that experience problems with their health and production are usually culled while it is a standard production procedure for males to be eliminated. Pfukenyi *et al.* (2002) and Keyyu *et al.* (2003) reported a significant difference in the prevalence of amphistomes between adult and young cattle. Previous infections and host age afford some protection against reinfection and hence acute disease is usually seen in younger animals while older animals, capable of withstanding massive exposure, seed the pastures with eggs (Horak, 1971). Upon reinfection with amphistome metacercariae, cattle can mount resistance which may involve tissue eosinophils and mucosal mast cells as the major cellular effector systems (Mavenyengwa *et al.*, 2003).

Mixed infections (34.6%) in cattle were higher than single infections in all three provinces. The presence of wetlands and high livestock density in the grazing circuits of cattle in Western and Southern provinces may have increased the risk of acquiring infections. The difference between the infections might result from the density of metacercariae on the grazed grass or from specific development of metacercariae in the definitive host (Szmidt-Adjide *et al.*, 2000).

In conclusion, amphistomes and *Fasciola* were highly prevalent in the studied areas and both parasite species occurred as mixed infections in most cattle. Since it was common to record mixed infections that were positively correlated, anthelmintics used should be effective against both parasites. Further research on the epidemiology and cross-resistance of these two infections is needed.

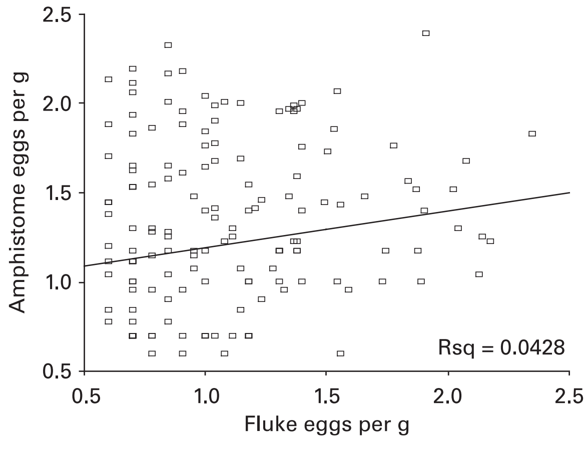


Fig. 2. Correlation between *Fasciola gigantica* and amphistome EPGs in cattle from Southern, Western and Central provinces of Zambia.


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