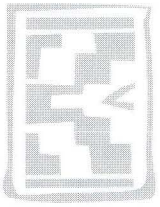

Occurrence of concurrent trypanosomosis, theileriosis, anaplasmosis and helminthosis in Friesian, Zebu and Sahiwal cattle in Uganda

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ABSTRACT

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An epidemiological investigation was conducted on farms in Tororo and Soroti districts of Uganda from January to February 2000 to determine the cause of reported persistent mortality of cattle. Blood and faecal material of 98 cattle comprising of 33 Friesians, 58 Zebu and 7 Sahiwal were examined. Results revealed that seven (7.1 %) cattle had trypanosome infection, mainly due to *Trypanosoma vivax* and *T. brucei*, 17 (17.3%) *Fasciola* infection, 28 (28.6%) gastrointestinal nematode infection, 33 (33.7%) *Theileria sp.* infection and 13 (13.3%) *Anaplasma marginale* infection. Mixed infections were detected in 30%, 20.6% and 43 % of the Friesian, Zebu and Sahiwal cattle respectively. Anaemia (PCV < 25) was detected in 24%, 19% and 14% of the Friesian, Zebu and Sahiwal cattle respectively. Persistent mortality of cattle on these farms could have been due to either single or mixed parasitic infections probably exacerbated by malnutrition.

Keywords: Anaplasmosis, cattle, concurrent infections, helminthosis, theileriosis, trypanosomosis

INTRODUCTION

Uganda has an estimated cattle population of 4.4 million (Anon. 1995). Cattle are the most economically important species of livestock. The majority of them are indigenous breeds consisting of Zebu and Sanga, while exotic high-yielding breeds constitute only 5 % of the entire cattle population. Zebu and Sanga cattle are mainly kept under traditional management systems, but a small number are maintained under improved management conditions together with cattle of exotic breeds on either private or government-owned farms. Many of the latter farms aim to increase milk production to satisfy the milk demand of the growing human population of Uganda, now estimated at 20 million. However, livestock production in general is hampered by disease, most important of which are trypanosomosis, tick borne diseases and helminthosis that are endemic in Uganda and often occur concurrently.

Existing reports in Uganda indicate that the prevalence of trypanosomosis in cattle is 11.9 % under the intensive dairy system and 25% under the communal grazing systems (Okuna, Katabazi, Omollo, Magona & Mayende 1996). Reported prevalence of fasciolosis in cattle range from 29 % to 36 % (Magona, Olaho-Mukani, Musisi & Walubengo 1999a) and of gastrointestinal nematode infections range from 22–61% (Magona & Musisi 1998), while those of theileriosis, anaplasmosis and babesiosis are 48 %, 36 % and 16 % respectively (Anon. 1996). However, there are no published reports on the prevalence of mixed parasitic infections in both indigenous and exotic breeds of cattle on farms in

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Uganda. This paper describes the prevalence of anaemia, and single and mixed parasitic infections which were the cause of persistent mortality in Friesian, Zebu and Sahiwal cattle on two farms in Uganda.

MATERIALS AND METHODS

Farms visited

Serere Agricultural and Animal Production Research Institute (SAARI) farm in Soroti and Morukatipe Government Prison (MGP) farm in Tororo, on which persistent cattle mortality had been reported, were visited.

SAARI farm is located 17 km southwest of Soroti town in Eastern Uganda. The vegetation in the area is savannah grassland. Soroti district receives 1 000–1 500 mm of rainfall annually. The rainfall is bimodal, with two wet seasons (March to May and September to November) and two dry seasons (December to February and June to August). Soroti district has a daily mean minimum temperature of 18 °C and mean maximum of 30 °C.

Crop farming is practiced and legumes, sunflower and cassava are grown on SAARI farm and pastures are present. At the time of the visit, the farm had eight Friesian, eight Sahiwal and over 500 Zebu cattle. Friesian and Sahiwal cattle herds were confined to separate paddocks and managed in a rotational grazing system in which both herds shared pastures sequentially. Zebu cattle were divided into different herds and were grazed during the day but kept in paddocks at night. Hired herdsmen were daily allocated one or more herds to control.

Water for animals in the paddocks was pumped from boreholes into watering troughs. In addition, a water reservoir was available on the farm from which the cattle were sometimes watered when the pump failed.

Disease management was mainly by routine vaccinations against epidemic diseases such as rinderpest and contagious bovine pleuropneumonia (CBPP) and irregular tick control, which depended on the availability of acaricides, was also practiced. Endemic diseases other than tick borne diseases were managed by treating cases whenever they occurred.

MGP farm is located about 10 km northeast of Tororo town close to the Uganda/Kenya border. The vegetation in the area is savannah grassland. The area receives 1 200–1 500 mm of rainfall annually. The rainfall is bimodal, with two wet seasons (March to May and September to November) and two dry seasons (December to February and June to August). Tororo district has a daily mean minimum temperature of 15 °C and mean maximum of 27 °C.

On this farm crops such as cotton and maize are grown. At the time of the visit, the farm had 25 Friesian cattle. Adult cattle were separated from calves. Calves were kept in paddocks during the day and housed at night, while adult cattle were herded on savannah pastures during the day and kept in the calf paddocks at night. Much of the area on which the animals grazed had broken fences and neighbouring village cattle-owners encroached on the farm pastures to graze their cattle. The main source of water for the animals on this farm was a stream.

Disease management on the farm was by irregular tick control by dipping, often hampered by the unavailability of sufficient funds for the maintenance of the dip tank. In addition, diseases were managed by the treatment of cases as they occurred. Vaccination against major epidemic diseases such as rinderpest and CBPP was carried out regularly.

Disease transmission potential

Soroto district, especially Serere County where the SAARI farm is located is infested by the tsetse fly, *Glossina fuscipes fuscipes* (Okuna, Okiria, Odiit, Mugenyi, Olaho-Mukani, Mayende & Khisa 1999) which transmits *Trypanosoma brucei*, *Trypanosoma congolense* and *Trypanosoma vivax,* the causative agents of bovine trypanosomosis. Tororo district, where MGP farm is located, is similarly infested with tsetse flies, mainly *G. fuscipes fuscipes* and, to a lesser extent, *Glossina pallidipes* (Magona, Katabazi, Olaho-Mukani, Mayende & Walubengo 1997).

The tick species of economic importance that are known to occur in the two areas include *Rhipicephalus appendiculatus, Rhipicephalus evertsi evertsi, Boophilus decoloratus* and *Amblyomma variegatum* (Okello-Onen, Tukahirwa, Perry, Rowlands, Nagda, Musisi, Bode, Heinonen, Mwayi & Opuda-Asibo 1999) which transmit *Theileria* sp., *Anaplasma marginale*, *Babesia bigemina* and *Cowdria ruminantium,* respectively.

Climatic conditions and the presence of swamps and marsh land in both Soroti and Tororo districts are suitable habitats for the snail *Lymnaea natalen-*

sis (Ogamba-Ongoma 1972), the intermediate host of *Fasciola gigantica* that is prevalent in cattle in these areas (Magona *et al.* 1999a). In addition, climatic conditions in the areas also favour continuous survival of other species of helminth larvae on pasture.

Cattle sampling and examination

The cattle sampled were of all ages and of both sexes. All the Friesians and Sahiwal cattle together with 10 % of the Zebu (58) on SAARI farm and all the Friesians on MGP farm were sampled. The disease history of the farm was obtained and a general examination was carried out at the time of sampling.

Blood examination

Cattle were bled from the jugular vein into vacuum tubes (Becton-Dickinson) containing heparin. Some blood was drawn into microhaematocrit tubes, and processed and examined as described by Woo (1969). Thick and thin blood smears were made to examine for haemoparasites and for morphological identification of trypanosomes. Following rapid air-drying, the thick film preparations were placed in distilled water for 5 min to lyse the erythrocytes while thin films were fixed for 3 min in methanol. Thick and thin films were then stained in 10% Giemsa for 30 min. In addition, the packed cell volume (PCV) was measured using a microhaematocrit reader (Hawksley, London, UK) after the blood samples had been centrifuged. Cattle with a PCV of less than 25% were considered to be anaemic.

Faecal examination

Faecal samples were obtained directly from the rectum of each animal and each sample was placed separately in a plastic bag, labelled and transported on ice to the laboratory where it was immediately examined. Faecal samples were examined for trematode eggs using the sedimentation technique and for nematode eggs using a modified McMaster method accurate to 50 eggs/g of faeces (Thienpoint, Rochette, & Vanparijs 1979), with nematode eggs being identified as "strongyle-type".

RESULTS

During the 2 months before the visit to SAARI farm, four (33 %) Friesian cattle had died while a large number of the Zebu cattle had been progressively wasting. On MGP farm, six (20 %) cattle had died within 2 months preceding the visit. Most deaths on the two farms occurred during a dry season.

All Friesian cattle on MGP farm were in good physical condition. On SAARI farm, all Sahiwal cattle were in a good condition, but 33 % of the Friesian cattle, 75% of the Zebu adult cattle and 33% of the calves were in poor condition. There was shortage of pasture on both farms since the visits to both farms were during a dry season.

The prevalence of the different parasitic infections, mixed infections and mean PCV of calves (up to 1 year of age) and adult cattle (above 1 year of age) of the different breeds are shown in Table 1. *Theileria* sp., gastrointestinal nematodes, *F. gigantica*, *A. marginale* and trypanosome infections (mainly *T. vivax* and *T. brucei*) were detected in cattle on both farms. In general, Friesian adult cattle had a higher prevalence of *F. gigantica, A. marginale* and trypanosome infections than the calves. All Friesian calves on SAARI farm had only *Theileria* sp. infection, while Friesian calves on MGP farm had gastrointestinal nematodes, *Fasciola* infection and a low prevalence of *Theileria* sp. infections of which 20% were mixed infections. Friesian adult cattle on SAARI farm had *A. marginale, Theileria* sp. and trypanosome infections of which 32 % were mixed infections. On MGP farm, Friesian adult cattle had *A. marginale*, *Theileria* sp., *Fasciola* sp., gastrointestinal nematodes and trypanosome infections.

Zebu calves had *Theileria* sp., gastrointestinal nematodes, *Fasciola* sp. and trypanosome infection and 30 % of the infections were mixed. Zebu adult cattle had single or mixed infection of gastrointestinal nematodes, *Theileria* sp., *Fasciola* sp. and trypanosome infection. One Sahiwal had mixed infection of *Fasciola* sp. and *Theileria* sp. Overall, 24.5% of all the cattle (43% of the Sahiwal, 30% of the Friesians and 20.6 % of the Zebu) had mixed infections.

Friesian cattle had the lowest mean PCV, followed by Zebu and Sahiwal. Anaemia was detected in 21 %, 24 %, 19 % and 14 % of Friesians, Zebu and Sahiwal, respectively. On MGP farm, Friesian cattle had a high mean PCV (27.8%) and a mortality rate of 20%. On SAARI farm, Sahiwal cattle had a high mean PCV (29.6 %), but Friesian cattle had a low mean PCV (22.6%) and an alarmingly high mortality rate (33%). Zebu cattle manifested chronic wasting, but had a high mean PCV (28.4%).

Table 2 shows the prevalence of different disease combinations that constituted mixed infections in

TABLE 1 Mean packed cell volume (PCV) and prevalence (%) of different diseases in Friesian, Zebu and Sahiwal on two farms in Uganda. January to February 2000

Breed	Farm	Age group (*n*)	Mean PCV ± 95 % CI	Prevalence (%)					
				Trypanosome infection	Gastrointestinal nematode infection	*Fasciola* sp. infection	*Theileria* sp. infection	*A. marginale* infection	Mixed infection
Friesian	SAARI	Calves (2)	21.5 ± 6.8	0	0	0	100	0	0
		Adults (6)	23.0 ± 4.4	16.6	0	0	50	50	33
		All (8)	22.6 ± 3.5	25	0	0	62.5	37.5	25
Friesian	MGP	Calves (5)	27.8 ± 2.3	0	40	20	20	0	20
		Adults (20)	27.6 ± 1.7	5	10	20	20	25	35
		All (25)	27.6 ± 1.4	4	16	20	20	20	32
Zebu	SAARI	Calves (27)	29.6 ± 1.7	7	37	11	52	0	30
		Adults (31)	27.4 ± 1.4	6	29	13	16	16	12.9
		All (58)	28.4 ± 1.1	7	33	12	33	9	20.6
Sahiwal	SAARI	Adults (7)	29.6 ± 3.0	14	0	43	71	0	43
All	All	Calves (34)	28.8 ± 1.5	5.8	35.3	11.8	50	2.9	26.5
		Adults (64)	27.3 ± 1.0	7.8	23.4	20.3	25	13.3	23.4
		All (98)	27.8 ± 0.8	7.1	27.6	17.3	33.6	13.3	24.5

Calves = < 1 year
Adults = > 1 year

TABLE 2 Nature and prevalence of mixed parasitic infections in Friesians, Zebu and Sahiwal breeds of cattle on the two farms in Uganda, January to February 2000

Breed	Nature of mixed parasitic infections	Prevalence (%)
Friesian (n = 33)	*Trypanosoma* sp./*A. marginale*/*Fasciola* sp.	3
	GIT nematodes/*Fasciola* sp./*Theileria* sp.	3
	Trypanosoma sp./*A. marginale*	3
	GIT nematodes/*Theileria* sp.	3
	Fasciola sp./*Theileria* sp.	9
	Fasciola sp./*A. marginale*	3
	A. marginale/GIT nematodes	6
Zebu (n = 58)	*Trypanosoma* sp./*Fasciola* sp./*Theileria* sp.	1.7
	Trypanosoma sp./GIT nematode/*Theileria* sp.	1.7
	GIT nematodes/*Fasciola* sp./*Theileria* sp.	3.4
	GIT nematodes/*Trypanosoma* sp.	1.7
	GIT nematodes/*Fasciola* sp.	3.4
	GIT nematodes/*Theileria* sp.	6.9
	T. parva/*A. marginale*	1.7
Sahiwal (n = 7)	*Trypanosoma* sp./*Fasciola* sp.	14
	Fasciola sp./*Theileria* sp.	29

the Friesians, Zebu and Sahiwal cattle the predominant form in the Friesian and Sahiwal cattle being *Fasciola* sp. and *Theileria* sp., while in the Zebu it cattle was gastrointestinal nematodes and *Theileria* sp. Sahiwal cattle suffered from mixed infections with two species of parasites, while those of the Friesians and Zebu consisted of two or three. The ratio of mixed infections with two species of parasites to those with three was 7:3 in Friesian and 2:1 in Zebu cattle.

DISCUSSION

This study was undertaken to determine the probable cause of persistent mortality and chronic wasting of cattle on farms in Uganda. Investigations revealed the occurrence of multiple parasitic infections which included trypanosomes, mainly *T. vivax* and *T. brucei*, *Fasciola* sp., gastrointestinal nematodes, *Theileria* sp. and A. *marginale* in the Friesian, Zebu and Sahiwal cattle.

The low mean PCV and associated high mortality of Friesian cattle on SAARI farm was probably due to the high prevalence of single or mixed infections with *Theileria* sp., *A. marginale* and trypanosomes. However, the relatively lower prevalence of single or mixed infections of *Theileria* sp., *A. marginale* and trypanosomes, together with gastrointestinal nematodes, seemed to have had less impact on the health conditions of the Friesian cattle on MGP farm in terms of reducing the mean PCV, but caused a substantially high mortality. All Friesian calves on SAARI farm had only *Theileria* sp. infection, which led to a low mean PCV (21.5). Friesian calves on MGP farm had a high prevalence of gastrointestinal nematodes and *Fasciola* sp. infections and a low prevalence of *Theileria* sp. infections (20%) with 20% of the infections being mixed, but these had less of an impact on the mean PCV (27.8). Parasitic gastro-enteritis caused by gastrointestinal nematodes results in ill-thrift, poor growth and diarrhoea in young cattle, but profound anaemia is associated with haemonchosis. Haemonchosis, fasciolosis, anaplasmosis, and trypanosomosis affect the haematocrit of affected animals (Urquhart, Armour, Duncan, Dunn, Jennings 1987). Generally, trypanosomosis and anaplasmosis cause substantial mortality in adult cattle (Kalu 1996), but *T. parva* infection is associated with high mortality of exotic breeds of cattle such as the Friesians (Gitau, McDermott, Katende, Callaghan, Brown & Perry 2000).

In this survey, *Theileria* sp., gastrointestinal nematodes, *Fasciola* sp. and trypanosomosis were the major infections in the Zebu calves. Theileriosis has been reported to cause a 13.5% cumulative annual mortality in Zebu calves in Uganda (Okello-Onen, Heuer, Perry, Tukahirwa, Ssenyonga, Heinonen, & Bode 1996). Sauvage, Brown, Parkinson, Rossiter & McGovern (1974) similarly found 19.8– 47.9% of indigenous calves up to 1 year of age excreting strongyle-type eggs in Ankole district in Uganda, but the animals were in good condition. Trypanosomosis due to *T. vivax* which was found in

the Zebu calves in this study also causes retarded growth. It is considered that the single or mixed infection of gastrointestinal nematodes, fasciolosis and trypanosomosis that were found in the Zebu adult cattle caused the chronic wasting which was observed on SAARI farm. Zebu adult cattle exposed to *Theileria* sp. infection generally develop endemic stability in endemic areas, but usually succumb to *A. marginale* infection, which is often peracute and fatal in older cattle (Jain 1993) in which it is characterised by pyrexia, progressive anaemia and icterus.

Anaemia of varying degrees of severity was detected in Friesian, Zebu and Sahiwal cattle on the farms. It was more severe in the Friesian cattle than in the Zebu and Sahiwal cattle. These differences in the severity of anaemia probably reflect existing variations in innate resistance to parasitic diseases among Friesian, Zebu and Sahiwal breeds of cattle.

A substantial proportion of Zebu cattle manifested anaemia but no parasitic infections were detected. Such cases of anaemia could have been probably due to other causes of anaemia, such as malnutrition bearing in mind that the investigation took place during one of the dry seasons, when a shortage of pasture usually occurs in this part of Africa. Malnutrition due to cobalt, copper and iron deficiency is known to cause anaemia by impairment of erythropoiesis (Jain 1993). However, these could have been also cases of undetected subclinical chronic trypanosomosis which is responsible for the condition known as the "Thin Cow Syndrome" (Dowler 1989), as many Zebu cattle were in poor physical condition.

The differences in the prevalence of *Theileria* sp. and *A. marginale* infections on the two farms seemed to concur with the level of tick control. The MGP farm with a more regular dipping programme had a lower prevalence of tick borne diseases than the SAARI farm that had an inefficient tick-control programme.

Zebu cattle had a lower prevalence of *Fasciola* sp. infection than Friesian and Sahiwal cattle. This finding concurred with observation made by Bitakaramire (1973) in Kenya that indigenous small Zebu cattle had a lower prevalence of fasciolosis than exotic European and large Zebu breeds such as the Sahiwal, a fact that was attributed to genetic resistance.

Older Friesian and Zebu cattle had higher prevalence of trypanosomosis, fasciolosis and anaplasmosis than the calves. Other studies conducted in Uganda have similarly found older cattle to have higher prevalence of fasciolosis (Magona *et al.* 1999a) and trypanosomosis (Magona, Greiner, Mehlitz 1999b) than calves.

The subclinical gastrointestinal nematode infections recorded in the Friesian and Zebu cattle probably did not increase their risk of mortality *per se.* However, such infections cause a detrimental effect on productivity through decreased weight as evidenced by the progressive wasting of Zebu cattle or decreased milk and fertility of older cattle (Eysker & Ploeger 2000).

Mild or subclinical *Fasciola* infection observed in the Friesians, Zebu and Sahiwal is usually associated with ill-thrift (Urquhart *et al.* 1987), but severe liver fluke infections in cattle manifest clinically as weight loss and ventral oedema due to hypoalbuminaemia and anaemia.

Persistent mortality of cattle occurred on the farms during one of the dry seasons and commenced at the end of the previous rainy season. The highest prevalence of vector borne diseases such as trypanosomosis and helminthosis usually occur during the dry seasons. This is also the period when the plane of nutrition is very low due to the reduced pasture. Poor nutrition, especially low protein intake is known to exacerbate both trypanosomosis and helminthosis in livestock (Holmes, Katunguka-Rwakishaya, Bennison, Wassink & Parkins 2000).

The occurrence of mixed parasite infections in the Friesian, Zebu and Sahiwal cattle probably exacerbated the poor health condition of the affected cattle, either through anaemia caused by trypanosomosis, fasciolosis, parasitic gastroenteritis and anaplasmosis or through synergistic effects due to interaction among various combinations of these diseases. *Trypanosoma vivax* and *T. brucei* were detected in the infected cattle but usually cause less severe anaemia than *T. congolense* which was not detected. In cases of mixed infections, the ability of *T. brucei* to cause immunosuppression in the host could lead to increased virulence of gastrointestinal nematode infections (Dwinger, Agyemang, Kaufmann, Grieve & Bah 1994). Stress resulting from chronic subclinical trypanosomosis due to *T. vivax* or *T. congolense* has been reported to cause patent parasitaemia and clinical anaplasmosis to emerge in premune carrier animals as well as other diseases (Fox, Mmbando, Fox & Wilson 1993).

Open grazing systems allow for more characteristic cycles of *T. parva* transmission to occur, both from

carrier and clinically affected cattle (Gitau *et al.* 2000). It is considered that mixing susceptible Friesian cattle with potentially infected carrier Sahiwal cattle in a sequential rotational grazing system was an important predisposing factor to *T. parva* infection (Gitau *et al.* 2000). Similarly, sharing of grazing land between susceptible Friesian cattle and *T. parva*-carrier village cattle was a predisposing factor to infection, because they were parasitized with infected ticks.

In conclusion, persistent mortality of Friesians, Zebu and Sahiwal cattle on the farms investigated in Uganda could have been probably due to multiple parasitic infections including trypanosomosis, theileriosis, anaplasmosis, fasciolosis and gastrointestinal nematode infections that occurred either as single or mixed infections, which might have been exacerbated by malnutrition.

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