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Sero-prevalences of Tick-borne infections among the Nkedi Zebu and Ankole cattle in Soroti district, Uganda

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ABSTRACT

This cross-sectional study was conducted to establish and compare the antibody titres and sero-prevalences of tick-borne infections among randomly selected Nkedi Zebu and Ankole cattle in the six villages of Akumoi, Aswii, Kamod, Osamito, Okokoma and Opungure in Soroti district, Uganda. The antibody titres were established using the indirect antibody detection ELISA tests.

The Nkedi Zebu had a significantly higher mean antibody titre against *T. parva* infection (1.8 ± 0.1) compared to the Ankole cattle (1.2 ± 0.1). While the mean antibodies titres of Ankole against *B. bigemina* and *A. marginale* infections (2.2 ± 0.04 , 0.05 ± 0.05) respectively were very similar to those of the Nkedi Zebu cattle (2.1 ± 0.05 , 0.06 ± 0.05) respectively. Sero-prevalences of East Coast Fever, babesiosis and anaplasmosis (100%, 100%, 58%) among the Ankole cattle were quite similar to those of Nkedi Zebu cattle (99%, 100%, 57%) respectively.

This study has demonstrated that the Nkedi Zebu are better primed to produce antibodies against *T. parva* as compared to the Ankole cattle, thus extra control strategies for tick-borne infections need to be instituted if the Ankole cattle are to be reared successfully in this agro-pastoral farming system.

Key words: Agro-pastoral, antibody titres, sero-prevalence, tick-borne infections

INTRODUCTION

Tick-borne diseases have a major global impact on cattle farming, affecting 80% of the world's cattle population (Minjauw and McLeod, 2003). In eastern, central, and southern Africa tick-borne diseases constitutes one of the major impediments to the development and improvement of the livestock industry by causing significant production losses and mortality (Mukhebi *et al.*, 1992) in the highly susceptible exotic and cross-bred cattle. The national cattle herd is at constant risk of tick-borne diseases and the overall loss of the calf crop due to these diseases is estimated to be 30% over the greater part of Uganda (Magona, 2004). Of the deaths attributable to tick borne diseases, East Coast Fever (ECF) is responsible for 79%, anaplasmosis 11%, and babesiosis 4.4% (Magona, 2004) in Uganda.

However breed related susceptibility to tick-borne disease does exist and has been observed in several tropical areas. Studies done by Jacobsen (1983) in Zimbabwe found higher ECF induced mortality rate of 14% in crossbred calves than in the zebu calves (4.2%) and had a lower recovery rate (57%) in crossbred calves than in zebu calves (90%) in the Zanzibar. In another study, the mortality following experimental infection with *T. parva* was found to be higher in the crossbreds (64%), than Ankole cattle (32%), due to the genetic ability of the Ankole cattle to limit the explosive multiplication of *T. parva* microschizont (Paling *et al.*, 1991). Meanwhile similar differences to bovine anaplasmosis have been observed, with exotic breeds being more susceptible than the indigenous cattle breeds (Ajayi *et al.*, 1982).

The impetus to carry out this study therefore came as a result of lack of adequate knowledge of the differences in responses to natural tick-borne infections among the common indigenous breeds of Uganda and yet tick-borne infections were ranked high in the disease diagnostic survey of National Agricultural Research Organisation (NARO)/ Livestock System Research Programme (LRSP) report, (1999). Also the current restocking programmes do not take into considerations the differences in diseases challenges of the different areas of the country (Magona *et al.*, 2004). The knowledge obtained from this study will be used to guide several stakeholders in the livestock industry in designing better restocking programmes and control strategies for tick-borne infections.

MATERIALS AND METHODS

Study sites and collection of blood samples

This study was conducted in six villages of Akumoi, Aswii, Kamod, Osamito, Okokoma and Opungure in Soroti district located in central eastern Uganda. The district lies over 2,500 feet above sea level with a vegetation of mainly savannah grassland and receives an annual rainfall of 1,200 - 1,500 mm. There are two rainfall seasons stretching from March to May and the second short rainfall season, September to November. There are two dry seasons; - December to February and June to August. The daily minimum and maximum mean temperatures are 15°C and 27°C respectively. The farmers practice an agro-pastoral farming system which is the main source of milk and meat consumed in Uganda (Ocaido *et al.*, 2005). Farmers mainly keep cattle, goats and sheep by tethering, open grazing or communal grazing (Ocaido *et al.*, 2005). *R. appendiculatus*, *R. evertsi evertsi*, *B. decoloratus* and *A. variegatum* are the major tick species of economic importance in the study area and are capable of transmitting *T. parva*, *A. marginale*, *B. bigemina* and *C. ruminantium*, respectively (Okello-Onen *et al.*, 1999).

The Nkedi Zebu cattle are dual purposes breeds used for draught power, meat and milk. They can be grey, grey pied, black, black pied or light red, and they have a mean adult weight and a height of 285 kg and 104 cm respectively. A fully grown cow at 101 cm and 285 kg is substantially smaller than the mature bull (104 cm and 360 kg) (Felius, 1985; Magona *et al.*, 2004). The pure Ankole cow or bull has a head of medium length with characteristically long horns with a big base, a short neck with a deep dewlap, a narrow chest with a small and cervico-thoracic hump which is barely visible on the animal, long legs (a cow stands at 130 cm and bull 145 cm), a skinny body (Felius, 1985; Magona *et al.*, 2004). Petersen and co-workers (2004) noted that an adult cow weighs between 292 - 341 kg and has an average lactation of 220 - 230 days.

In this study, Nkedi Zebu (n = 103) and Ankole (n = 81) cattle from the same herds were randomly selected and about 5 ml of blood was obtained from the jugular vein of well restrained cattle into a non heparinised vacutainer tube (Becton-Dickinson, vacutainer system, UK). The vacutainer tubes were labelled to indicate the sample number and the names of cattle owner, village and herd size. The sex, age and breed of the animal were recorded against the sample number. Sera was later separated and stored under cold conditions in the laboratory.

Bovine antibodies to tick-borne infections

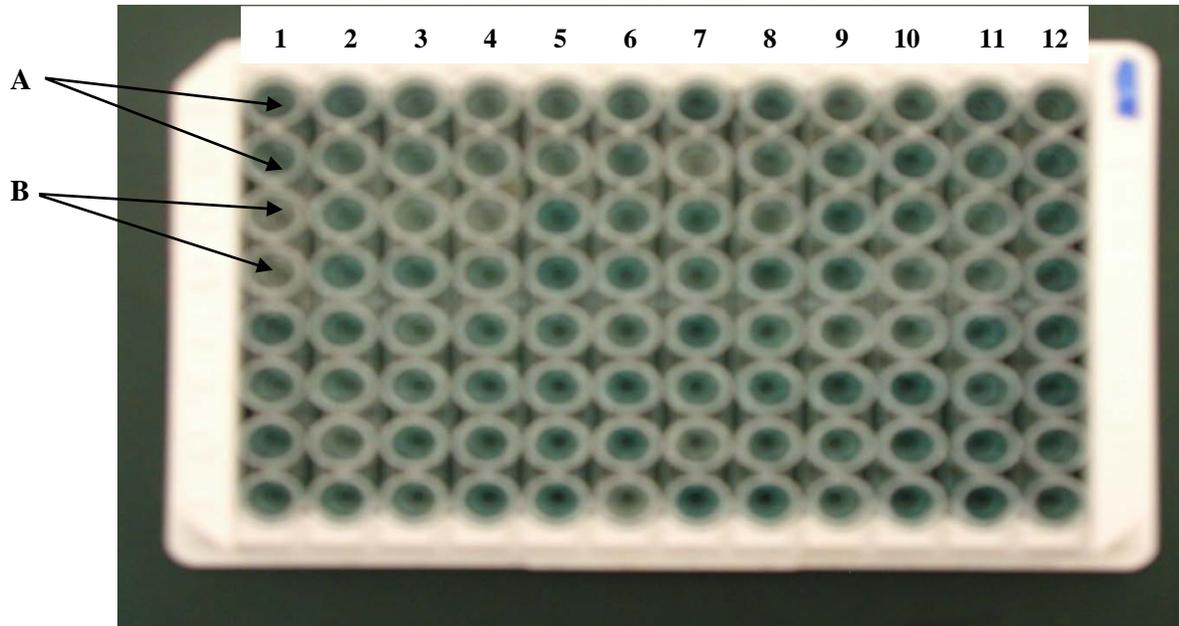


Figure 1. The ELISA plates 1 of *T. parva*, A and B are the positive and negative controls respectively

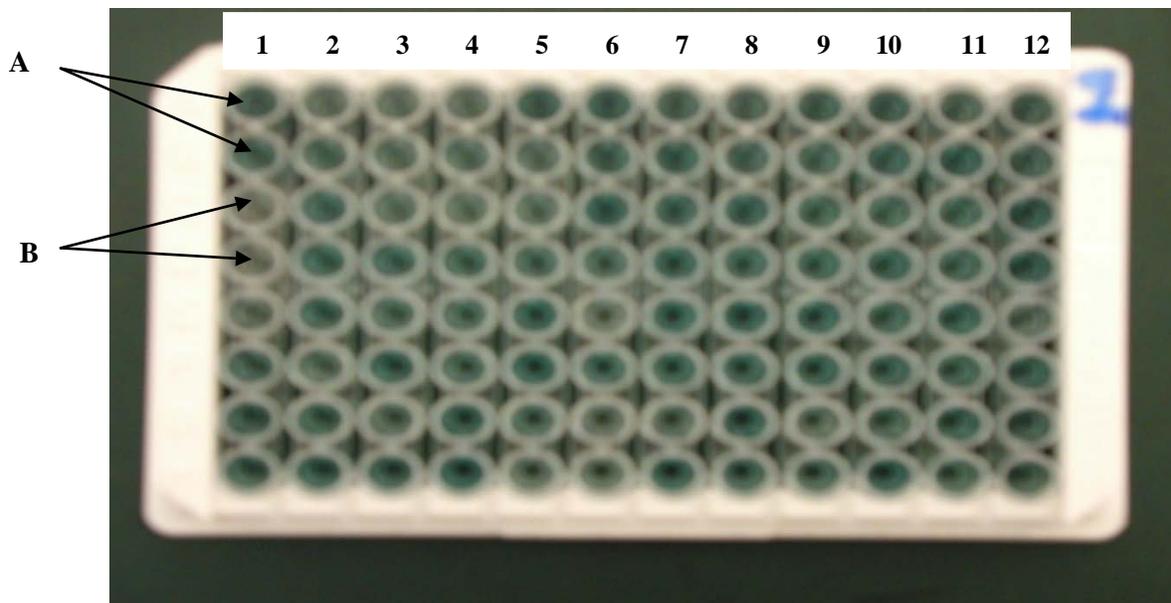


Figure 2. The ELISA plates 2 of *T. parva*, A and B are the positive and negative controls respectively

Serological analysis

Serological analysis was carried out using the indirect antibody detection ELISA kits (Svanova Biotech AB Uppsala, Sweden for *T. parva*, *A. marginale* and *B. bigemina* infections. The sera was screened for antibodies against *T. parva*, *A. marginale* and *B. bigemina* infections using ELISA kit utilizing *T. parva* schizont antigen (polymorphic immunodominant molecule), a 19 kD utilising *A. marginale* recombinant antigen and a 200 kD utilising *B. bigemina* antigen (Katende *et al.*, 1998; Morzaria *et al.*, 1999; Tebele *et al.*, 2000). All tests were performed according to the manufacturer instructions.

The student's t-test was performed at 95% confidence interval to establish whether there is any significant difference between the mean antibody titres of tick-borne infections among the Nkedi Zebu and Ankole cattle.

RESULTS

In Africa, ticks and tick borne diseases are major constraints to the improvement of livestock health and productivity (Gray, 1985). Breed related susceptibility (resistance) to tick borne disease does exist and has been observed in several tropical areas. Studies done by Jacobsen (1983) in Zimbabwe found higher ECF induced mortality rate of 14% in crossbred calves than in the zebu calves (4.2%) and had a lower recovery rate (57%) in crossbred calves than in zebu calves (90%) in the Zanzibar. In another study, the mortality following experimental infection with *T. parva* was found to be higher in the crossbreds (64%), than Ankole cattle (32%) (Paling *et al.*, 1991). This difference in mortality was attributed to the genetic ability of the Ankole cattle to limit the explosive multiplication of *T. parva* microschorizont (Paling *et al.*, 1991).

The mean antibody titres against tick borne infections (*T. parva*, *B. bigemina* and *A. marginale*) among the different age groups of the Nkedi Zebu (n = 103) and Ankole (n = 81) cattle were compared using the student's t-test at 95% confidence interval. The mean antibody titres produced by the Nkedi Zebu against *T. parva*, *B. bigemina* and *A. marginale* was 1.45 ± 0.056 , 2.21 ± 0.043 , 0.58 ± 0.048 compared to Ankole cattle that was 1.29 ± 0.058 , 2.1 ± 0.053 , 0.59 ± 0.049 for *T. parva*, *B. bigemina* and *A. marginale* respectively. The Nkedi Zebu produced a significantly higher antibody titre to *T. parva* infection ($p = 0.04$) compared to the Ankole cattle as shown in Table 1 and Fig.3. Otherwise the mean antibody titres produced by the Nkedi Zebu against *B. bigemina* and *A. marginale* were quite similar to that of the Ankole cattle.

The mean antibody titres against tick borne infections (*T. parva*, *B. bigemina* and *A. marginale*) among the Nkedi Zebu (n = 103) and Ankole (n = 81) cattle were compared among the different age groups using the student's t- test at 95% confidence interval and no significant difference was observed in the mean antibody titres as shown in Table 2, Fig. 4, 5 and 6. The sero-prevalence of *T. parva*, *B. bigemina* and *A. marginale* infections among the Nkedi Zebu was 99%, 100% and 57% respectively, which was very similar to that of the Ankole, thus *T. parva*, *B. bigemina* and *A. marginale* was 100%, 100%, 58% respectively.

Bovine antibodies to tick-borne infections

Table 1. Independent sample t - test for equality of the mean antibody titres against *T. parva*, *B. bigemina* and *A. marginale* among the Nkedi Zebu (n = 103) and Ankole (n = 81) cattle, Kasilo county, Soroti district, 2007.

Tick-bone Infection	Breed of cattle	p-value	Mean	Std. error mean	95% CI of the difference
<i>T. parva</i>	Nkedi Zebu	0.04	1.4563	0.05605	0.002 - 0.32
	Ankole		1.2943	0.05849	
<i>B. bigemina</i>	Nkedi Zebu	0.15	2.2001	0.04307	-0.04 - 0.23
	Ankole		2.1017	0.05355	
<i>A. marginale</i>	Nkedi Zebu	0.9	0.5846	0.04815	0.14 - 0.12
	Ankole		0.5929	0.04981	

p-value = level of significance, CI = confidence interval, Std. = standard

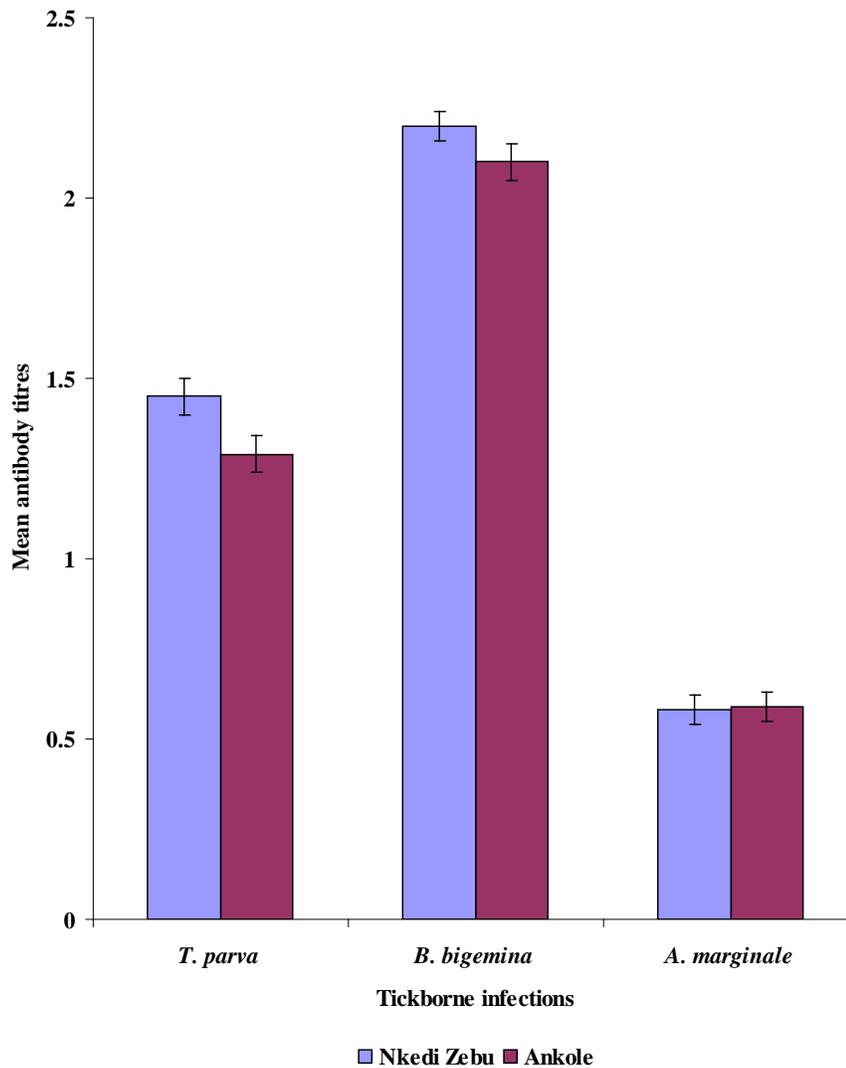


Figure 3. Mean antibody titres against *T. parva*, *B. bigemina* and *A. marginale* of the Nkedi Zebu and Ankole cattle in Kasilo county, Soroti district, 2007.

Bovine antibodies to tick-borne infections

Table 2. Independent samples t-test for equality of the mean antibody titres of *T. parva*, *B. bigemina* and *A. marginale* of the different age groups among the Nkedi Zebu (n = 103) and Ankole (n = 81) cattle, Kasilo county, Soroti district, 2007.

Age group (months)	Tick-borne Infection	df	p-value	Std. error difference	95% CI of the difference	
0 – 6	<i>T. parva</i>	5	0.44	0.585	-1.995	1.014
	<i>B. bigemina</i>	5	0.37	0.271	-0.960	0.434
	<i>A. marginale</i>	5	0.92	0.103	-0.256	0.276
7 – 12	<i>T. parva</i>	10	0.17	0.288	-0.221	1.061
	<i>B. bigemina</i>	10	0.77	0.255	-0.494	0.641
	<i>A. marginale</i>	10	0.67	0.406	-1.079	0.732
13 –24	<i>T. parva</i>	35	0.48	0.187	-0.246	0.514
	<i>B. bigemina</i>	35	0.61	0.128	-0.325	0.196
	<i>A. marginale</i>	35	0.34	0.161	-0.172	0.482
> 24	<i>T. parva</i>	126	0.05	0.097	-0.003	0.381
	<i>B. bigemina</i>	126	0.07	0.085	-0.015	0.321
	<i>A. marginale</i>	126	0.53	0.079	-0.204	0.107

df=degrees of freedom, p-value = level of significance, CI = confidence interval, Std = standard deviation

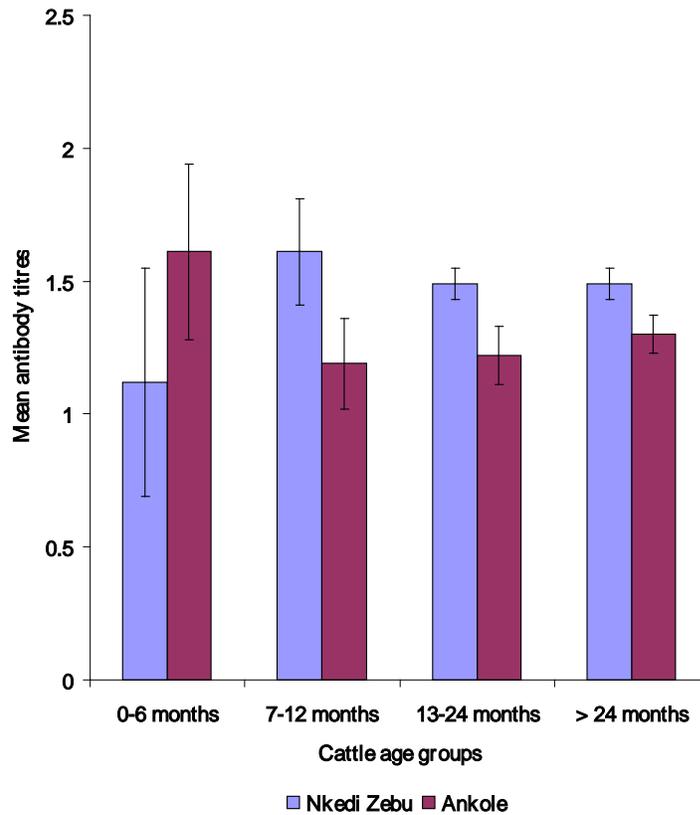


Figure 4. Mean anti-body titres against *T. parva* in the different age groups of Nkedi Zebu and Ankole cattle in Kasilo county, Soroti district, 2007.

Bovine antibodies to tick-borne infections

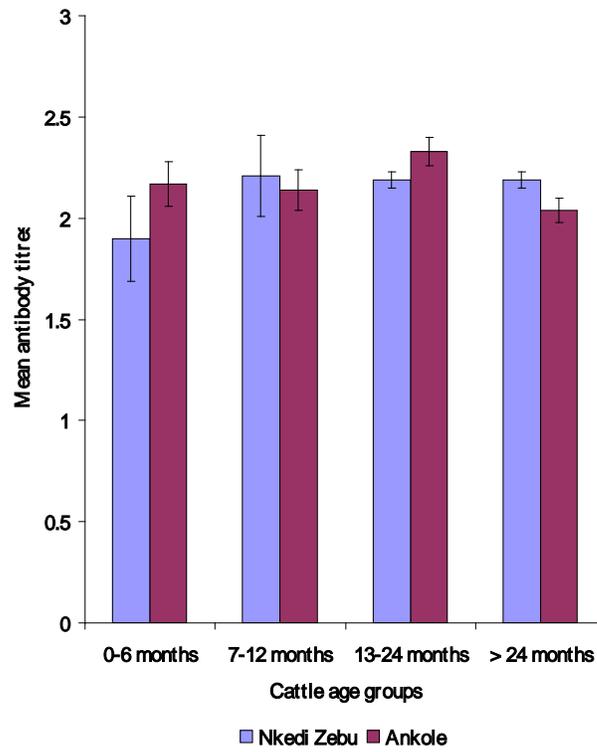


Figure 5. Mean antibody titres against *B. bigemina* in the different age groups of Nkedi Zebu and Ankole cattle in Kasilo county Soroti district, 2007

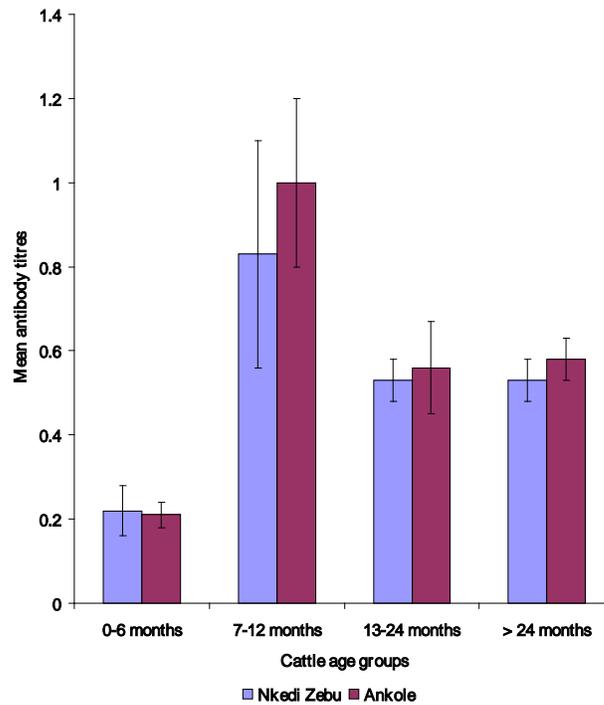


Figure 6. Mean antibody titres against *A. marginale* in the different age groups of Nkedi Zebu and Ankole cattle in Kasilo county Soroti district, 2007.

DISCUSSION

More than 95% of the cattle in Uganda are of the Zebu or Sanga breeds (Magona and Mayende, 2002). In the eastern Uganda, where the study was done, most of the cattle are of the Nkedi Zebu breed although the Ankole breed (Sanga) have been brought in as result of a restocking programme that is ongoing (Fèvre *et al.*, 2001). The Ankole cattle have the good attributes of faster growth, and higher birth weight, weight gain, higher milk production and carcass weight compared to the Nkedi Zebu (Petersen *et al.*, 2004). In this cross-sectional study we established the antibody responses of the Nkedi Zebu and Ankole cattle to natural tick-borne infections under the similar environmental conditions.

This study revealed that there was a significant difference ($p = 0.04$) in the mean antibody titre to *T. parva* infection whereby the Nkedi Zebu had a higher mean antibody titre than the Ankole cattle. This is in agreement with previous studies which have shown that indigenous cattle have a certain degree of genetic resistance to both ticks and tick borne diseases (Norval *et al.*, 1992; Lawrence *et al.*, 1996). Resistance to tick-borne micro-organisms varies among different breeds of cattle. Generally, zebu (*Bos indicus*) cattle possess a higher resistance to ticks and tick-borne micro-organisms than European (*Bos taurus*) cattle. Mattioli *et al.* (2000) observed that the host's immune system would appear to be the single most important factor that regulates this resistance. The main effector immune mechanisms governing resistance against ticks and TBMs have been studied. The cellular immune response appears more effective and stable than humoral immunity in modulating resistance to ticks and TBMs (Mattioli *et al.*, 2000). Matoyelo *et al.* (2002) also observed that Zebu cattle also had significantly higher serum complement levels than crossbred cattle.

The high sero-prevalence of tick-borne diseases among the Nkedi Zebu and Ankole cattle (sero-prevalence of *T. parva*, *B. bigemina* and *A. marginale* of the Nkedi Zebu was 99%, 100% and 57% respectively, in the Ankole cattle, the sero-prevalence of *T. parva*, *B. bigemina* and *A. marginale* was 100%, 100%, 58% respectively) in the study area, implies that the high challenge of tick-borne infections to the two breeds is similar and high in this area. Probably because restocking by central government and non government organisations is not being accompanied by appropriate tick and tick-borne disease control strategies (Magona *et al.*, 2004). Communal grazing under the pastoral farming system and the suitable climate favours the rapid multiplication of ticks, this leads to high tick burdens on cattle, and consequently the occurrence of the diseases they transmit (Rubaire-Akiiki *et al.*, 2004). The high sero-prevalence and high antibody titres for tick borne infections revealed by this study is in agreement with previous findings which reported that more than 90% of the national cattle herd in this country is at constant risk of tick borne diseases (Anon, 1997; Magona *et al.*, 2004).

CONCLUSIONS

This study has demonstrated that the Nkedi Zebu produced significantly higher mean antibody titres against *T. parva* infection than the Ankole cattle in the Soroti agro-pastoral farming system. This means that the Nkedi Zebu cattle are better primed to protect themselves against the *T. parva* infection by producing more antibodies compared than Ankole cattle.

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