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Tick-Borne Parasites of Domestic Ruminants in Gulu District, Uganda: Prevalence Varied with the Intensity of Management

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Abstract: The study assessed the prevalence of tick-borne parasites in domestic ruminants in relation to the control and/or management practices applied by farmers against ticks and TBDs in Gulu district, Uganda. Blood smears were made from 552 domestic ruminants (cattle, sheep and goats) under open grazing (agro-pastoral), tethering and zero-grazing systems to determine the prevalence of tick-borne parasites from January-March, 2008. The significance of the relationships between prevalence of tick-borne parasites and management system, ruminant type and sex of the animal were analyzed using one-way Analysis of Variance (ANOVA) and Fisher Least Significant Difference (FLSD).

Key words: Livestock, production systems, Theileria, Babesia, Anaplasma, tethering system

INTRODUCTION

Disease is an important constraint to increased production of animal food for human consumptions in most parts of the world. Diseases limit and in some instances, even preclude the development of viable animal industries wherever they occur. Tick-transmitted diseases such as babesiosis and theileriosis are economically important globally (Otim, 2000; Bell-Sakyil *et al*., 2004; Altay *et al*., 2007; Yin and Luo, 2007). Tick-borne diseases are a major constraint to the improvement of livestock production in the developing world particularly the sub-Saharan Africa (Norval *et al*., 1992; Bell-Sakyil *et al*., 2004).

In most parts of Africa, earlier investigations were not production system-specific and did not target biological, management and social economic parameters of the production system to establish the presence and magnitude of the problems due to tick-borne diseases (Pegram and Chizyuka, 1987). As a result in most cases control efforts have not been commensurate with the magnitude of the disease problem. In Uganda the influence of the different management systems and the disease control practices employed by farmers on the epizootiology of tick-borne diseases of domestic ruminants have been poorly studied.

A study conducted by Rubaire-Akiiki *et al*. (2004) concentrated only on dairy farms (cattle) and also left out small ruminants i.e., sheep and goats which could also act as reserviours of cattle infections since they share grazing land. In the Kenya highlands on the other hand, Deem *et al*. (1993); Gitau *et al*. (1994, 1997, 2000) demonstrated that the prevalence of *Theileria parva* infections and the reported East Coast Fever morbidity, mortality and case-fatality can vary significantly by zones and grazing system and that these differences have important implications for both the impact and control of theileriosis.

Miodrag and McIntyre noted that many host characteristics, specific agents and environmental factors act as determinants of disease in fluencing directly or indirectly the frequency of occurrence and the distribution of any given disease. These determinants together with some of their important interrelationships, such as modes of transmission of infectious agent will determine the patterns of disease in the animal populations. Measures for successful disease control must be based therefore, on an understanding of the relative importance of each disease determinant. Generally the occurrence and importance of tick-borne diseases is a reflection of complex interactions involving the causative organisms, the tick vectors, the vertebrate hosts and the environment (Norval *et al*., 1992). These interactions, however are driven and modified by a wide variety of factors ranging from climate, soil and vegetation to human activities including livestock production systems and measures taken to control ticks and tick-borne diseases. Norval *et al*. (1992) and Perry (1994) report that control of tick-borne diseases in East Africa has proved difficult largely because of lack of epizootiological information and partly because control strategies commonly applied is not production

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systems-specific. In Gulu district, there are three livestock production systems. These are zero-grazing, open grazing/agro-pastoral and tethering systems. This study therefore assessed the prevalence of tick-borne parasites in the three livestock production systems in Gulu district in relation to the control strategies employed by farmers in the management of ticks and TBDs.

MATERIALS AND METHODS

Study area: The study was carried out in Gulu district in selected farms representing three livestock production systems of agro-pastoralism (open grazing), semi-intensive (tethering) and zero-grazing systems.

Gulu district lies 332 km North of the capital Kampala with a surface area of 11734 km^2; latitude 2°45"N and longitude 32°0"E. It shares borders with seven other districts as well as Sudan. It has historically been seen as the most important and influential of the northern districts. The 2002 census put the population at 468,407 (UBOS, 2002). Over 90% of the population is considered to be agriculturalists and over 90% of the population had been displaced, mostly into camps clustered around towns and trading centers (http://en.wikipedia.org/wiki/gulu-district). With the return of peace in the region, a good number of the population have already returned to their respective homes or satellite camps in trading centers near their villages.

Gulu district is approximately 1000-1200 m above sea level. It has an average temperature of over 25°C per annum and rainfall ranges between 1000-1500 mm annually. This favours agriculture and also provides an ideal condition for ticks, the vectors for tick-borne parasites.

Study design: Farms in each livestock production system for sheep, goats and cattle were selected in the surrounding areas of Gulu Municipality using stratified random sampling with the strata being species of animals under study, livestock production system and sex of the animals. For tethering system, 4 farms were sampled due to the small size of these farms in the area per species and two for the other systems each. In large farms least systematic sampling method was used to determine the smallest sampling unit to select at least 10 animals per sex and age while in small farms all animals were examined. A total of 552 animals were sampled for the study.

Tools for data collection

Microscopic examination of blood smears: To identify tick-borne parasites of domestic ruminants in the three livestock production systems, thin and thick blood smears were made for each animal following the procedures described by Emberth (1986). About 2 mL of blood were collected from each animal in Ethyenediaminetetracetic Acid (EDTA) coated vacutainer tubes from the jugular vein from which thin and thick blood smears were made and stained with Giemsa to determine the infection with tick-borne parasites. Later dried smears were examined under a compound microscope using oil immersion objective at ×100 magnification. A single infected cell in a slide depicted positive.

Administration of questionnaires: To evaluate the control strategies employed by farmers against ticks and tick-borne diseases, surveys were conducted in the selected farms from the three livestock production systems to assess the status of existing tick control practices. A semi-structured questionnaire was administered to collect data on farmers knowledge of ticks and TBDs, types of tick control strategies used, method of application and frequency of application. Two farmers were selected per farm to take part in the survey as respondents.

Data analysis: The data was captured and analyzed using statistical SPSS 15.0 at 5% level of significance. One way ANOVA was used to assess the significant effects of the ruminant's type (cattle, goats and sheep) and the production system on the prevalence of tick-borne parasites (Anaplasma, Theileria and Babesia) in Gulu district. A further analysis using Fisher Least Significant Difference (FLSD) with the same level of significance was done to separate the means in order to find out which treatment levels were significantly different.

RESULTS AND DISCUSSION

Out of the 552 animals examined 28% were raised under zero grazing, 30.5% under tethering system and 41.5% in open grazing system.

Prevalence of tick-borne parasites in domestic ruminants: The following TBPs were found: Theileria, Babesia and Anaplasma. Details of the results are shown in Table 1 and 2.

Table 1 shows that Theileria has the highest prevalence rate in cattle (26.81%) compared to the rest of the ruminants under the same condition of rearing, this implies that cattle in Gulu are at a higher risk of contracting Theileria across all grazing systems compared to Anaplasma and Babesia. On the other hand, the prevalence of Anaplasma was found to be high in goats (19.0%) under open grazing followed by sheep (10.91%) and yet under tethering it was noted that the prevalence

Table 1: Percentage prevalence of each tick-borne parasite by grazing system and ruminant type

Ruminant type	Tick-borne parasites	Grazing system: Open grazing	Tethering	Zero-grazing
Cattle	Anaplasma	10.14	04.71	1.81
	Theileria	26.81	07.61	4.71
	Babesia	02.17	01.45	0.36
Goats	Anaplasma	19.00	13.57	5.40
	Theileria	09.50	07.69	1.81
	Babesia	01.36	00.90	0.00
Sheep	Anaplasma	10.91	07.27	0.00
	Theileria	14.55	09.10	0.00
	Babesia	03.64	01.82	0.00

Table 2: Summary of ANOVA for the difference in the effect of grazing system and ruminant type on the prevalence of tick-borne parasites of domestic ruminants in Gulu district

Parasite	Factor	Probability values	Significance status
Anaplasma	Ruminants	0.299	Insignificant
	Grazing system	0.050	Boundary significance
Theileria	Ruminants	0.620	Insignificant
	Grazing system	0.039	Significant
Babesia	Ruminants	0.602	Insignificant
	Grazing system	0.025	Significant

of Anaplasma in goats was about twice (13.57%) more than that of sheep (7.27%). Babesia was found to have higher prevalence in sheep under open grazing and tethering (3.64 and 1.82%), respectively compared to the rest of the ruminants.

The prevalence of tick-borne parasites in Gulu district was found to be at 25.4, 29.53 and 3.44% for Anaplasma, Theileria and Babesia, respectively. This prevalence was across all the ruminants namely cattle, sheep and goats, irrespective of the method used to rear them. Babesia was the least prevalent parasite among ruminants.

The prevalence of Anaplasma was weakly dependent on the grazing system ($p = 0.05$). However, the ruminant type was not significant in determining the prevalence of Anaplasma ($p = 0.299$, Table 2) implying that the average prevalence of Anaplasma across the three ruminants were not significantly different at the 5% level of significance. The prevalence of the tick-borne parasites (Anaplasma, Theileria and Babesia) is not explained by the ruminant type (Probability values of 0.562, 0.620 and 0.602, respectively).

This means that the average prevalence of Anaplasma, Theileria and Babesia are statistically the same across all the ruminants. However, the prevalence of Theileria and Babesia was found to be dependent on the grazing systems with probability value of 0.039 and 0.025, respectively as shown in Table 2. This implies that the grazing system was highly significant in determining the prevalence rates of Theileria and Babesia across all the ruminants. These two parasites had a higher prevalence in open grazing than in tethering and zero-grazing systems.

Table 3: Tick control strategies used by farmers in Gulu district, Uganda

Control strategy	No of farmers	Percentage use
Conventional acaricides	35	76.09
Botanicals	06	13.04
None	05	10.87

Table 4: Frequency of application of acaricides by farmers in Gulu district, Uganda

Frequency	No. of farmers	Percentage use (%)
Weekly	02	04.3
After every 2 weeks	08	17.4
Once a month	16	34.8
After every 3 months	08	17.4
Not sure	12	26.1

Tick control strategies and farm characteristics: Survey carried out in the farms revealed farm characteristics which may be of epidemiological importance in respect to TBPs prevalence in Gulu district. These characteristics include: agro-pastoral farmers kept large herds of livestock compared to farmers that practiced tethering and zero-grazing systems; many of which were the indigenous breeds. The literacy level of most farmers in the study area is low. Animals mixed for several reasons: at drinking points (for agro-pastoralism and tethering) in the grazing land (agro-pastoralism and to some extent tethering system) and lastly for all grazing systems animals met while seeking bulls for mating. All zero-grazers in the study area obtained pasture for their animals from open pasture land. Animals were watered in open water sources such as swamps and seasonal streams (for agro-pastoral and tethered) while zero-grazers carried water for their animals.

The intensity of management of ticks and TBDs varied with production system being more intensive in zero-grazed farms followed by tethered and agro-pastoral farms and number of animals kept. Zero-grazed farms with over 10 animals had a higher prevalence rate than those with fewer animals.

Management strategies employed by farmers includes bush burning during the dry season, treatment of infected animals and those shown in Table 3. Common methods of application of acaricides were: pour on, hand spraying and body washing. The frequency of application of acaricides by farmers in the study area is shown in Table 4.

The frequency of application depended greatly on the number of animals kept in a farm. Farmers in group farms (farms owned by >1 person) did not have definite interval of application. Irregularities in the frequency of application were registered mainly in agro-pastoral farms. Three farms visited under open grazing reported not to have practiced any form of management of ticks while over 75% use conventional acaricides.

Prevalence of tick-borne parasites in domestic ruminants by production system: Prevalence of infection with tick-borne parasites varied by livestock production and/or grazing systems being highest in open grazing system (39.1%) followed by tethering system (13.8%) and least in zero-grazing system (6.9%). This concurs with the findings of Rubaire-Akiiki *et al.* (2004) in Mbale district which showed that the prevalence of tick-borne parasites in dairy cattle vary with agro-ecological zones and management systems. Gitau *et al.* (1997, 2000) also reported a marked variation in the prevalence of *Theileria parva* infection by agro-ecological zones and management systems in the Kenyan highlands.

The high prevalence of tick-borne parasites in open grazing (agro-pastoral) system corresponds with low level of agro-pastoral farmers knowledge on tick-associated problems and diseases. Most of these farmers reported that they never practiced tick management however, the few who did so did not do it at regular intervals. In most of the group farms there was no mass treatment of the animals. Farmers basically handled those animals with heavy tick challenges only. Farms under open grazing system were mainly located in places far away from urban centers which hardly had access to veterinary services. One of the respondents in these farms confessed that the visit together with the American marines was his first time to see a veterinary officer. According to Magona and Mayende (2002) >95% of the cattle in Uganda are of the Zebu or Ankole (Sanga) breeds raised under open grazing system. While in Gulu where the study was done, most of the cattle are of the E. African short horned Zebu breed although, the Ankole breed have been introduced as a result of the restocking programme that is ongoing. These animals (zebu) are more resistant to TBDs compared to the Ankole breed (Kabi *et al.*, 2008) although, the Ankole cattle have the good attributes of faster growth and higher birth weight, weight gain and higher milk production compared to the Zebu (Petersen *et al.*, 2004). They (Zebu) therefore remain carriers of the parasites with low level of parasitamae in blood. This explains farmers laxity in management of ticks and tick-borne diseases. Besides, animals kept under open grazing system have higher chance of mixing with wild game with which they share pasture that could be important reservoirs of tick-borne infections. Communal grazing under the agro-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).

Farm survey showed that farmers under zero-grazing system had better knowledge of ticks and TBDs and also applied better control strategies against them. Animals kept here are mainly Friesians that are highly susceptible to infections and therefore easily develop disease symptoms (Mukhebi, 1992). This accounts for the farmers better practice of management. The intensity of the input of farmers in management of ticks and tick borne diseases however declined with increasing number of animals. A number of deaths were reported in farms with over 30 herds of cattle under zero-grazing (Veterinary Officer Gulu district, personal communication).

Management of ticks and TBDs was not done in sheep and goats farms except for goats farms under zero-grazing system but at low intensity compared to that of cattle farms. Generally the farm survey demonstrated that very little attention is usually given to the small domestic animals (goats and sheep) especially when it comes to the management of ticks. They are also known to be fairly resistant to the infections resulting in laxity on the side of farmers. Goats and sheep were also sampled from places far away from town where the level of income constraints on livestock productivity greatly.

Statistics also indicate that zero-grazing and tethering systems are the same in the determination of the prevalence of tick-borne parasites in the study area. This is contrary to previous findings (Rubaire-Akiiki *et al.*, 2004; Gitau *et al.*, 1997, 2000). This result can be explained by the fact that in both systems the number of animals kept by farmers in the study area was low compared to that of the farmers rearing animals under open grazing system hence easier to manage ticks and TBPs on them. Secondly, most zero-grazers obtained pasture for their animals from the same pasture land where the tethered animals graze. This practice results into the importation of ticks to animals under zero-grazing system.

The high prevalence of the infection with TBPs demonstrated by microscopy implies that the post war restocking programme of the government of Uganda does not take into consideration the control of ticks and tick borne infections in livestock in the study area. Kabi *et al.* (2008) and Magona *et al.* (2004) found similar results with serology in the Eastern (Uganda) part of the country which is also covered by the restocking programme.

Tick control strategies: The farm survey showed that the control of ticks basically relied on the use of conventional acaricides. This is similar to the findings of Rubaire-Akiiki *et al.* (2004) and Okello-Onen *et al.* (1997). In most farms where they are used however, the intensity of use varied greatly by the number of animals kept and the system of grazing being less intensive in open grazing and large farms. This could be as a result of the affordability of these acaricides to the individual farmers. Most farmers rearing animals under zero-grazing system were comparatively well off financially hence being able to buy the acaricides and use them at regular intervals.

CONCLUSION

In the study the three tick-borne parasites were found infecting domestic ruminants in zero-grazing, tethering and open grazing systems: Theileria, Anaplasma and Babesia. The most prevalent tick-borne parasites were Theileria and Anaplasma. The prevalence of the three tick-borne parasites also varied significantly by grazing systems and intensity of management especially in zero grazing system. The study also revealed that there was no significant difference between zero-grazing and tethering systems ($p = 0.05$).

Ruminants raised under open grazing were more likely to have increased risk of contracting the parasites compared to their counterparts under tethering and zero-grazing, respectively. Management of ticks and tick-borne parasites was more intensive in zero-grazed farms than in the other systems. It was therefore recommended that farmers in the study area use tethering system which is less costly compared to zero-grazing since it reduces the prevalence of Theileria, Babesia and Anaplasma.

RECOMMENDATION

Basing on the results of this study, it is recommended that farmers in Gulu district should be encouraged to use tethering system which reduces the prevalence rate and is less costly compared to zero-grazing. This is because it was observed from the socio-economic and/or control point of view that the prevalence of these parasites under tethering and zero-grazing were not significantly different in Gulu district.

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