RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES
ISSN 2221-1896
www.roavs.com

Disease and health conditions affecting camel production in pastoral and agro-pastoral communities of northern Tanzania

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Abstract

A cross-sectional field survey was conducted to determine the seroprevalence and to identify risk factors for brucellosis seropositivity and udder health in camel from 8 geographical localities of northern Tanzania during the period of June to August 2010. The study populations comprised 193 camels of all age and sexes, selected from 14 traditional managed herds. Individual animal and herd-level data were collected using a structured questionnaire. Mastitis was investigated based on microbiology and California mastitis test (CMT), while brucellosis was evaluated serologically for antibodies against *Brucella* infection using Rose Bengal Plate test (RBPT). The crude prevalence of antibodies to *Brucella* was 2.1% for individual camels and 21.4% for herds. Of the 128 udder quarters and 128 teats investigated, proportion found to have physical lesion or defects were 0.8% for teats and 4.7% for udder quarters, respectively. The common observed teats lesion was scar and for quarters was firmness upon touch. Of the 32 lactating camels examined, 12.5% had abnormalities in their udder as evidence of mastitis with 3.1% and 9.3% being clinical and sub-clinical mastitis respectively; at camel level. Of the 128 quarters examined 9(7.03%) were infected: 4(3.1%) clinically and 5(3.9%) sub-clinically. *E. coli* was the major isolate from camel milk samples. The mean (±SE) calving interval of the 17 camels that were reported to have calved more than once in their life time was estimated to be 789 ± 14 days. Results of univariable logistic regression models identified body condition score and geographical location to be the major risk factors for individual herd seroprevalence. Poor condition score (16.6%; P<0.036) was associated with increased risk of seropositivity compared to animals with fair to good condition. Results of the present study suggest that poor husbandry practices, production related diseases namely brucellosis and mastitis in camels exists within camel herds in Tanzania. These diseases deserve further research attention owing to its potential impact on meat, milk production affecting food security.

Key words: Camel, Diseases, Husbandry Practices, Risk Factors, Tanzania

Introduction

Available figures indicate that camels make up 79% of the world 19 million camels population found in the arid and semi-arid regions of northeast Africa, mainly Somalia, Sudan, Ethiopia and Kenya (FAO, 2005). Because of lack of regular census, there are no reliable or up to date information on the numbers of camels in Tanzania.

In the past few years, pastoralists in the semi arid part of northern Tanzania have witnessed frequent drought and competition for grazing resources leading to livestock/crop farmers conflicts and instability. Owing to the increasing human population and diminishing number of livestock per pastoralist due to diseases and other social factors, there is an urgent need to develop marginal resources, such as arid land, and optimise their utilisation through appropriate livestock production systems of which camel production is the most suitable without doubt. These complexities of factors have created a renewed sprit and efforts from Community based organisations (CBO's) with a view of introducing camel as a substitute animal for milk production and livelihood. Unlike other animal species camels suffer least and they have survived the crisis without the heavy losses (Farah, 1996). The camel is morphologically, behaviorally and physiologically adapted to heat, water shortage and poor quality fodder (Yagil, 1984). There is therefore, a great scope for increasing its productivity by improved husbandry methods and selective breeding. In addition to these, however, the health status of these animals has to be improved tremendously if we are to exploit their potentials to the maximum (Wilson, 1984; 1998). The envisaged increased production and productivity of camel is limited among others by the widespread

occurrence of vectors and diseases (Perry and Randolph, 1999; Abdurahman 2006; Hadush et al., 2008).

In Tanzania, there is no study conducted on camel diseases and hence prevalence of the diseases, its economic impact on livestock production sector of the country and its potential public health significance to the camel rearing community is unknown. In an attempt to determine the diseases and health conditions prevalent in the area, eight administrative localities, where camels have been introduced recently, located in Northern Tanzania were targeted for study. This paper reports the status of camel diseases and husbandry practices employed by camel keepers. Production related diseases such as brucellosis and udder health (mastitis) are the main focus of this paper.

Materials and Methods

This rapid exploratory cross-sectional survey was conducted in camel herds in 8 districts of the Tanga, Arusha, Manyara and Kilimanjaro regions, north Tanzania. These eight districts which covers an area of 52,944 km^2 lies between Latitude 2^o 11' and 6^o 14' South of Equator, and Longitude 35^o 11' and 38^o 26' East of Greenwich and receives an average annual rainfall of 1100 mm which is bimodal in distribution. The long rains fall between March- May and the short rains fall between October – December. The amount and duration of rainfall varies from year to year and from season to season. Temperatures vary between 13^oC to 31^oC through-out the year, the coldest month being July and warmest months being October and March, prior to the rains.

The study subjects were all ages, sexes, indigenous breeds of camel, (one hump camel) reared under extensive husbandry which allows free grazing, usually mixed with livestock from other villages. The breeding system used is natural mating, with bulls running freely with females all year round. No supplementary feeding is practiced. Lactating camels were milked twice a day, in the morning and in the late afternoon. Milking hygiene procedures were poorly practiced. Farmer acquisition of camels was through cash purchase from neighbours or through subsidized price or loan from Non-governmental Organisation, mainly Heifer Project International. The list of all camel owners in each district was obtained from District Livestock Office and further validated from the data we obtained from Heifer Project International country office, the main supplier of the camels in Tanzania.

Semi-structured questionnaire (SSQ) comprising farm, camel bio-data, udder and teat lesions/defects were developed during the period of April through May 2010. Administration of the SSQ on each selected herd and on herd inspection were used to collect herd management and mammary gland data of each lactating camel. Data collected were herd size, source of animals classified as homebred or brought –in, calving dates, sex, age retrieved from owner herd record. Body condition of camels was assessed visually and rated as poor, fair and good. Other information assessed includes health status at a time of visit classified as healthy or unhealthy, history of husbandry practices intervention such as vector and endo-parasite control, history of abortion and udder infection. Field survey was conducted during the period of June to August 2010.

Approximately 10ml of blood sample was collected from the jugular vein of each animal in all selected herds using plain vacutainer tube (Becton Dickson, UK). Each sample was labelled using codes describing the specific animal and herd. The tube was set tilted on a table over night at a room temperature to allow clotting. Next morning, the clotted blood in the tubes was centrifuged (at 3000 *g* for 20 min) to obtain clear serum. The obtained serum was stored at -20^oC until tested by Rose Bengal Plate test (RBPT).

All sera samples were screened using RBPT antigen (VLA Weybridge, UK). The test procedure recommended by Alton et al., (1988) was followed. Briefly, 30 µl of RBPT antigen and 30 µl of the test serum were placed alongside on the plate, and then mixed thoroughly. The plate was shaken for 4 min and the degree of agglutination reactions was recorded. The sample was classified positive if any agglutination was observed and negative if no agglutination. The RBPT, when compared to complement fixation test (CFT), has shown a sensitivity of 94.2% and a specificity of 87% on field sera and has been described by other researchers (Stemshorn et al., 1985; Rojas and Alonso, 2005). Confirmation of positives samples with tests of higher sensitivities and specificities such as a CFT or enzyme linked immunosorbent assay (ELISA) was not done due to the lack of resources (funds) to buy the required kits.

Clinical examination of the lactating camel consisted of detailed visual inspection and systemic palpation of udder and teats. Teat ends were observed for alterations such as wounds, scars, markers, vesicles, warts, patent orifice and ease of milking. Inspection of the udder included visual examination posteriorly to ascertain size and disproportional symmetry. Right and left quarters were expressed relative to the examiner position. All individual udder quarters were observed for abnormal consistency like firmness, fibrosis, oedema, warmth and other physical defects.

All sampled lactating camels (n=32) were clinically examined for evidence of clinical mastitis as manifested by visible changes in milk and the udder. The examination was complemented by testing milk from lactating quarters (n= 128) for sub clinical mastitis

using California Mastitis Test (Bovi vet CMT test, Denmark) as a side pen (or quick field) test. Briefly, milk samples were collected from each udder quarters after discarding the initial fore milk streams, following teat disinfections. Examination was carried out by mixing equal amount of milk and CMT reagent (Kruuse Denmark) into the four cups of the CMT paddle. The paddle was gently rotated to mix the contents. Results were read immediately as per manufacturer's recommendation and were scored as 0 (negative or trace), 1+ (weak positive), 2+ (distinct positive), 3+ (strong positive) depending on the amount and thickness of gel formed as described by Schalm et al., (1971) and Ikram (1997). Udder infection was concluded based on clinical examination, nature and appearance of milk with secretion and CMT (Radostits et al., 2000). Accordingly, milk with pus, flakes, clots, blood tinged watery secretion, yet no visible and palpable changes in udder quarters and acute mastitis with signs of systematic involvement was diagnosed as clinical mastitis. Sub-clinical mastitis was diagnosed based on CMT results (Radostits et al., 2000). An udder quarter was defined as CMT positive, if it had a score of >1+ and a camel was defined as CMT positive when it had at least one of the udder quarter with a CMT score of >1+.

Milk samples were collected from all CMT positive quarters during screening for sub clinical mastitis. The teat of affected quarter was carefully washed with clean water and soap, dried and teat ends were disinfected with cotton swabs soaked in 70% alcohols and allowed to dry. Approximately 10 ml of milk was collected aseptically after discarding the first stream of milk. Samples were placed immediately into an ice box and brought to the Veterinary Investigation Centre laboratory for processing and storage.

A 3 cm loopful of each sample of milk sediment was inoculated (streaked) on to MacConkey agar (Carter et al., 1991), and plate incubated aerobically at 37^{o}C for 24-72 hours. Plates were examined for bacterial growth on daily basis. Bacterial pathogen identification was undertaken using Gram stain according to Quinn et al., (1994). Cultures were considered to be positive when bacterial growth was observed on the culture plates after 24 and 48 hours of incubation at 37^{o}C and negative when no bacterial growth was observed on the culture plates. Bacterial isolates were identified on the basis of colony characteristics and gram stain.

Statistical analysis

Herds and individual camel derived data were stored in Microsoft Excel. Descriptive statistics for the camel and herd level explanatory variables examined in the study were developed using Epi-Info version 6.04d. Relationships between explanatory (independent) variables (herd and animal-level) and outcome (dependent) variables (CMT and *Brucella* sero-status: negative or positive) were univariably investigated for statistical association. Data were analysed using Epi-Info (Version 6.04b, CDC, Atlanta, USA) and statistical significance between variables was examined using P-value at critical probability of P<0.05. Calving interval (CI): was defined as the average interval between the two most-recent consecutive calvings for each female camel in each herd. On the other hand, long calving interval (LCI) was considered to occur if the CI was beyond the standard recommended of 750 days under arid tropical condition (Farah, 1996).

Results

All selected herds (n=14) were visited and owner or any other household member interviewed during the period of June-August 2010(a 100% response rate). The interviewed households had about 338 camel with an average (mean ± SD) herd size of 24.1± 21.9, range, 3-72. Significantly large groups were seen in Longido compared to other districts (P<0.05). The average age of all investigated camels were 6.8 years with range varying from 1 month to 22 years and the majorities (89%) of the animals were below 10 years of age. The mean age of lactating camels sampled was 9.8± 3.5 (range, 6 to 20). One humped camel was the predominant specie kept. Of the 193 camels examined, 144(74.6%) and 49(35.4%) were females and males, respectively. The proportions of camel in each category of each variable investigated are detailed in Table 1. Regular vector and endo-parasite (worm) control practices were reported to be the common intervention made to 74% and 56% of the study camels respectively. The mean (mean ± SE) estimated CI of the camels that had calved more than once was 789 ± 14 days.

Over all, 8.9 %(6/67) of the examined (second calvers and above) camels and 21 %(3/14) of the herds visited were reported to have had at least one case of abortion within a period of 1 to 2 years prior to the current study.

The prevalence of brucellosis of camels in each category of each variable investigated during the study is shown in Table 1. Univariable analysis of risk factors showed that the administrative location of camels was significantly associated with *Brucella* spp infection seroprevalence (*P< 0.05*). Out of 193 serum samples tested, 4(2.1%) were proved to be positive by RBPT. Moreover, in this study the overall herd level prevalence was 21.4 % (3/14), however, within herd prevalence varied from 0% - 13% based on RBPT. The questionnaire results showed that the management and hygienic measures practiced in the visited herds were poor. This was evidenced by the presence of high

number of poor to fair body condition (55%) and the obvious skin lesion observed during sampling. Seroprevalence was significantly affected by body condition score, with poor body condition score being associated with higher seroprevalence (*P = 0.036*). None of the other investigated factors were associated with seroprevalence.

Of the overall (128) udder quarters and (128) teats examined, 6(4.7%) and 1(0.8%) respectively, were affected by lesion. 122(95.3%) quarters and 127(99.2%) teats respectively, were found to have no lesion or deformities. Scar was the single teat lesions/defects identified, seen in left front teats (FL). Of all the udder quarters investigated, 'firmness' upon touch and abscess were singled out as the commonest sign observed. Fore left (FL) quarters were significantly more affected than other quarters (*P<0.05*).

Of the 32 lactating camels examined, 12.5% had abnormalities in their udder as evidence of mastitis with 3.1% and 9.3% being clinical and sub-clinical mastitis respectively; at camel level (Table 2). Of the 128 quarters examined 9(7.03%) were infected: 4(3.1%) clinically and 5(3.9%) sub-clinically. All investigated quarters were functional and none was blind.

A total of 9 milk samples collected from clinical and CMT positive quarters (7; 78%) yielded growth of bacteria. Bacteria growth colonies characteristics were described as medium, roundish and pink (lactose fermentors). *E. coli* were the predominant isolate in all samples.

Discussion

This study reported brucellosis and mastitis in camels of Tanzania for the first time and as a result there is no udder health and brucellosis result to compare our results with. The overall prevalence of camel mastitis observed at camel and quarter level in this study was somewhat low with results of previous studies in other parts of East and greater Horn of Africa (Obied et al., 1996; Abera et al., 2010). However, the difference in prevalence with those observed in other countries, mainly East and Horn of Africa could be due to difference in breed used, management system employed and Agro-ecological zone/region (Chafe et al., 2008). Occurrence of mastitis may be influenced by some heritable characteristics such as capacity of milk production, teat structure and udder conformation as well as genetic variation in disease resistance among breeds (Abdurahman, 1995). Earlier works (Abdurahman, 2006) showed that camels are much more susceptible to mastitis, mainly in areas where hygienic condition is poor and treatment of mastitis is not pursued. Bacteriological analysis of milk samples in this study revealed that *E. coli* was the predominant pathogen isolated in sub-clinical and clinical cases of mastitis. This finding was in agreement with other previous studies in Sudan, Ethiopia (Abdurahman, 1995; Abera et al., 2010). However, these results disagree with the findings of Tibary et al. (2006) and Bekele and Molla (2001) who reported *Staphylococcus* as predominant isolate from camels in Afar region, north-eastern Ethiopia.

The seroprevalence (2.1%) of camel brucellosis detected in this study was very low in comparison to 3.7-10% reported by other workers in Kenya, Somalia, Sudan and Ethiopia (Teshome et al., 2003; Ghanem et al., 2009; Obied et al., 1996; Omer et al., 2000). However, the present finding is in agreement with reports of few workers (Abbas and Agab, 2002). The low seroprevalence of brucellosis in the present study could be associated with the relatively young age and small herd size of the camel in the areas under study. The low seroprevalence of brucellosis in this survey probably could shadow the strength of associations between the herds or management related risk factors and brucellosis seroprevalence. However, the influences of management related risk factors and characteristics of the population for occurrence of infection in a herd are reported to have an important role (Baumann and Zessin, 1992).

Results from the questionnaire revealed that majorities of the surveyed farms reported high level and regular use of acaricide and wormicide to control both ecto- and endo-parasites in their animals. Despite such high intervention levels, majorities (68%) of the animals were observed to carry ticks of various spp (*Rhipicephalus appendiculatus, Ambylomma variegatum, Boophilus decolaratus*) and about (17.6%) camels had skin lesion at a time of examination. If the low tick count index is taken as an indicator of quality of husbandry practice, then it would appear husbandry practices on most surveyed herds was generally poor because of the high number of tick load observed during sampling. This observation is well supported by the higher number of poor to fair body score animals and skin lesion (abscesses, bruises, mange) recorded in this study; suggesting that the current tick control practices is inefficient and therefore the need to improve husbandry practices.

The estimated mean calving interval was in consistent with the figure recommended by other researchers (Farah, 1996) but slightly shorter than the interval of 822 days recorded for Somalian camels (Farah et al., 2004). Long calving interval implies that farmer's income suffers because camels spend a greater portion of their lactation at low production levels and also the calf crop is also reduced.

Table 1: The proportions of camels and prevalence of brucellosis in each category of each variable investigated during the study

Variables	Number examined	(%)	Number positive	Seroprevalence (%)
Administrative localities				
Arumeru	20	10.4	0	0
Longido	84	43.5	0	0
Monduli	7	3.7	0	0
Mwanga	8	4.1	0	0
Same	12	6.2	1	8.3
Hai	20	10.4	0	0
Simanjiro	27	14.0	1	3.7
Kilindi	15	7.5	2	13.3
Age category				
0.1- 1.0 yrs	24	12.4	1	4.6
>1-5 yrs	51	26.4	1	1.9
>5-10 yrs	98	50.7	2	2.04
>10-15yrs	10	5.18	0	0
>15 yrs	10	5.18	0	0
Sex				
Female	144	74.6	3	2.08
Male	49	25.4	1	2.04
Source				
Brought-in	83	43.0	3	3.6
Homebred	110	57.0	1	0.9
Body score				
Poor	6	3.1	1	16.6
Fair	102	52.8	2	1.9
Good	85	44.0	1	1.17
Healthy status				
Health	180	93.3	3	1.6
Un-healthy	13	6.7	1	7.6

Table 2: Prevalence of clinical and sub clinical mastitis

Forms of mastitis	Camel level prevalence	Quarter level prevalence
Clinical	1(3.1%)	4(3.1%)
Sub-clinical	3(9.3%)	5(3.9%)
Total	4(12.5%)	9(7.03%)

In conclusion the observed overall individual animal sero-prevalence of camel brucellosis in the area under study was not high. However, it deserves due attention because of the public health significance of the disease. At this time, it may be appropriate to practice a test and slaughter control strategy at least in the study area before the disease spreads and attains higher level of prevalence.

Moreover, the present study revealed that mastitis is prevalent among lactating camel. Lack of proper attention to health of the mammary gland, poor sanitation and improper milking technique were probably important predisposing factors of mastitis in the area. A practical mastitis control strategy in the herd and national approach is needed.

Our studies recorded a slight extended long calving interval on camel herds. Poor condition score and sub-optimal husbandry services were common and may interact as management causes of LCI. Larger prospective, longitudinal studies would be required for a comprehensive and specific investigation of potential causes of brucellosis, mastitis and sub-fertility in camel in the area under study.

Acknowledgements

We thank MoLD&F for funding this work. The cooperation and support by the camel owners during data collection and examination of animals are highly acknowledged. Thanks are extended to the Director of Veterinary Service for permission to publish this work.

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