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PREVALENCE OF BOVINE TUBERCULOSIS IN CAMELS IN NORTHERN NIGERIA

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ABSTRACT

This paper describes the prevalence of exposure of camels to tuberculosis in Northern Nigeria. A one-step antibody detection assay employing a cocktail of selected *M. tuberculosis* and *M. bovis* antigens with a blue latex-based signal detection system was used. Nearly 17% of the 1395 animals tested showed positive reactions in the rapid test with a variable prevalence according to age and sex. The age of the animal was more important factor than sex for antibody detection rates recorded in this study. Positive reactions increased significantly ($P<0.05$) with age (camels older than 10 years: 9.82%) and more ($P<0.05$) females (11.40%) than male camels showed positive test results. The rapid test for TB is simple, easy to perform, rapid and more affordable than other tests. Camels infected with *M. bovis* poses great risk of exposure to uninfected livestock and humans and should be removed from the population. The speed of the test is useful for making decision about the herd or area status in modelling a control programme. Although the findings did not indicate clinical disease, but showed that a large percentage were exposed and could be diseased, hence indicating that these positive camels could pose a great risk of infection to other livestock and humans.

Key words: Camel, serology, *Mycobacterium* species, Northern Nigeria, tuberculosis

Camels suffer from fewer diseases than other livestock (Mukasa-Mugerwa, 1981; Brown, 2004). However, camels are susceptible to bovine tuberculosis and sporadic cases have been reported especially following closed confinement with cattle (Mukasa-Mugerwa, 1981; Pavlik *et al,* 2005; Kinne *et al,* 2006; Wernery *et al,* 2007). Tuberculosis (TB) is highly endemic in livestock in the Northern Nigeria region (Alhaji, 1976; Antia and Alonge, 1982; Du-Said and Abdullahi, 1994; Ojo, 1996; Alaku *et al,* 2002; Cadmus *et al,* 2004; Okoli *et al,* 2006; Bikom and Oboegbulem, 2007) and is of concern to the medical and veterinary authorities. TB in domestic animals and wildlife is known to hinder control or eradication programmes in cattle (Morris *et al,* 1994; Morris and Pfeiffer 1995; Cousins and Florisson, 2005) and to be a risk to humans that live in these areas who may be exposed to infected animals.

Difficulties in the diagnosis of TB in live camels with the current available tests have been documented (Wernery and Kaaden, 2002; Kinne *et al,* 2006; Wernery *et al,* 2007). The intradermal tuberculin test, which is the classical diagnostic test, often gives non-specific reactions (Kinne *et al,* 2006). However, the serological assay has proved as a convenient, rapid and accurate for TB diagnosis in live camels and other animals under field conditions (Hasegawa *et al,* 2002; Lyashchenko *et al,* 2007; Wernery *et al,* 2007 and Lyashchenko *et al,* 2008).

In the light of widespread extensive cattle rearing coupled with the increasing socio-economic importance of camels in Northern Nigeria, particularly in Sokoto, Kano and Maiduguri areas, this study was undertaken to screen camels for bovine tuberculosis exposure and describe the implications of the detection rates of TB antibodies and limitations of rearing camel for bovine tuberculosis control in Nigeria.

Materials and Methods

The study period was June - September 2008 which corresponds to a time of massive livestock movements and when camel owners from these neighbouring countries enter Nigeria in the course of their seasonal migration for better pastures and water.

A total of 1395 camels, aged at least 5 years and of both sex, either for slaughter (855) or draft (540) were sampled. The age of each camel was obtained from the owner's record, otherwise it was estimated by observing the conformation of teeth (Schwartz and Dioli, 1992; FAO, 1994). For proper sampling, the team was distributed into the 3 study areas

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Table 1. Prevalence and 95% confidence intervals of draft camel reactors according to sex and age in Northern Nigeria.

Sex/Age	Positive reactors	Negative reactors	Total	Prevalence (% ± 95% CI)	
				In sample group	Total
Male	27	93	120	23 (15 - 31)	5 (1 - 9)
Female	73	347	420	21 (17 - 25)	14 (11 - 17)
<10 year	54	294	348	16 (12 - 20)	10 (7 - 13)
>10 year	46	146	192	24 (18 - 30)	9 (5 - 13)
Total	100	440	540		19 (16 - 22)

Table 2. Prevalence and 95% confidence intervals of slaughtered camel reactors according to sex and age in Northern Nigeria.

Sex/Age	Positive reactors	Negative reactors	Total	Prevalence (% ± 95% CI)	
				In sample group	Total
Male	51	322	373	14 (10 - 18)	6 (4 - 8)
Female	86	396	482	18 (15 - 21)	10 (7 - 13)
<10 year	46	292	388	14 (10 - 18)	5 (3 - 7)
>10 year	91	426	517	18 (15 - 21)	11 (8 - 14)
Total	137	718	855		16 (14 - 18)

and assisted by local field staff. The whole group assembled at the end of the period in the Ahmadu Bello University Zaria-Nigeria for data analysis and interpretation.

Blood was withdrawn from the jugular vein of draft camels in the markets and just before slaughter in the abattoirs, serum was separated and refrigerated at 4°C and tested within 24 hours of collection. Samples were collected from all slaughtered camels while for draft camels the inverse sampling method was used. All camel owners from the region visiting the camel markets were listed (together with information about their camels) from which the selection of participants was made by random-number generation and the camels of willing participants sampled inversely until a representative number of over 500 was achieved. Briefly, single blood collections were made on the draft camels which were identified by local names given by the owners.

Rapid test (RT)

Based on the lateral-flow technology, a simple one-step antibody detection assay (PrimaTB STAT-PAK®) developed by Chembio Ltd in the UK was used. The test (sensitivity and specificity of 89%) employed a cocktail of selected *M. tuberculosis* and *M. bovis* antigens and blue latex-based signal detection system. The principles and mechanism of the lateral-flow-based rapid test for TB using serum has been previously described (Lyashchenko *et al,* 2007; Wernery *et al,* 2007). Briefly, the ready-to-use disposable device consisted of a plastic cassette containing a strip of nitrocellulose membrane impregnated with test antigen and laminated with several pads made of glass fibre and cellulose. The test required that 30µl of serum was poured into the centre of sample well followed by 3 drops of sample buffer, added sequentially. Results were read after 20 min. Any visible band in the test area, in addition to the control line, was considered an antibody positive result, whereas no band in the test area in addition to the visible control line was considered a negative result.

Statistical Analysis

Camel Tb antibody detection assay data were analysed at the individual, draft and slaughtered level. Data were analysed using positive and negative as response outcomes (binomial variable) and variable (binary variable). The observed prevalence rates were corrected using the Rogan-and-Gladen formula to the true rates and the 95% confidence intervals calculated as previously described (Putt *et al,* 1988; Petrie and Watson, 1999; Greiner and Gardner, 2000). The McNemar's test approximating the Chi-squared distribution and normal distribution techniques were also applied to compare and determine the level of significant differences (α=0.05; two tailed) between the proportions (Putt *et al,* 1988; Petrie and Watson, 1999). As camels in this region were used maximally until about 10 years of age and thereafter sold off for slaughter, the data was distributed into 2 age groups, less or more than 10 years.

Result

A total of 100 out of 540 draft and 137 out of 855 slaughtered camels tested in this study were positive giving prevalence rates of the lateral-flow antibody detection assay (PrimaTB STAT-PAK®) as 19% (95% CI; 16 - 22) and 16% (95% CI; 14 - 18), respectively (Tables 1 and 2).

Overall among the draft camels, no significant difference was observed in the level of anti-TB antibody detection response between the 2 age groups, less or more than 10 years (X^2 = 0.5396; -2% - 5%) but there were significantly more female positive reactors compared to the male camels (X^2 = 21.844; 5% to 12% and P<0.05). This represented an estimated relative risk of 73/27 = 2.7 (i.e., the females showed more than two-and-half folds greater reaction Tb antibodies than the male counter parts).

For the slaughtered camels, female camel positive reactors (X^2 = 9.121; 1.5% to 6.7% and P<0.05) recorded were significantly high and the rate of detection of Tb antibody also increased with camel age group (X^2 = 15.219; 2.7% to 7.8% and P<0.05). Amongst the slaughtered camels, the females were observed test positively by 86/51 = 1.54 (or over one-and-half) times compared to the males while the older age group (more than 10 years) showed a relative risk of 91/46 = 1.98 (or about twice as positive than the younger age group). However, the male/female ratio noted for the animals used in this study varied from less than 3/4 to 3/7 within groups (slaughter and draft).

Based on the stated sensitivity and specificity of 89% for the test, accuracy rates were 64.96% for draft and 60.70% for slaughtered camels.

Discussion

The extensive pastoral management system is the common practice but few herders graze their animals in proximate areas. The expectation of the study was to find relatively high levels of anti-tuberculosis antibody in camels in the Northern Nigeria region because of the high prevalence previously reported in many livestock species and humans (Alhaji, 1976; Du-Said and Abdullahi, 1994a; Ojo, 1996; Garba *et al,* 2004; Amusa *et al,* 2005; Adesiji and Fagbami, 2006; Garba and Galadima, 2006a; Chafe *et al,* 2008). Some of this evidence was not published. Camel TB cases of bovine origin, have been reported in many other camel rearing regions (Bush *et al,* 1990; Kinne *et al,* 2006; Wernery *et al,* 2007). This study provides the first systematic record of the level of antibody response by camels in Northern Nigeria to a cocktail of *M. tuberculosis* and *M. bovis* antigens. The observed anti-Tb antibody prevalence of 19% (draft) and 16% (slaughtered) camels is higher than the prevalence rates of bovine TB of 3% to 9.6% as reported by some workers through single intradermal tests and from abattoirs studies (Zinsstag *et al,* 2006). A link between TB infection in herders and their cattle has also been observed (Abubakar *et al,* 2005); with over 20% of herders reacting positively where 9% of animals within their herds were reactors. We, therefore, conclude that the close association between man and his animals could be an important route of transmission. This is especially the case with camels, where herders are not only very closely associated with their animals but also rely on camel milk as a source of food for the family. This close contact could serve as route of infection not only to the herders and their families but also to their own offsprings and other domestic animals as well.

Slaughtered camels that may be infected and diseased could potentially be a source of infection to humans especially when the meat is not properly cooked. This is common, especially in restaurants as camel meat takes very long to cook. To complicate matters, most retailers do not disclose whether the meat they are selling is camel's meat or beef.

The age-related increase in prevalence recorded in this study is consistent with the endemic pattern of tuberculosis in cattle (Pollock and Neill, 2002; Cleaveland *et al,* 2007). Animals increasingly become exposed in endemic situations where the infection is continuously present and hence show increasing positivity with age (Cleaveland *et al,* 2007). Alternatively, under stress or old age, latent infections may be reactivated and lead to development of the disease (Pollock and Neill, 2002). The disease status of the camels used in this study was not determined, but based on the high level of anti-Tb antibody detection and the deep intensity of the test bands by the positive reactors amongst draft camels; we anticipate that Tb lesions would be visible if the reactors are slaughtered and post-examined.

In other prevalence studies of tuberculosis in livestock especially in cattle where high prevalences have been recorded, increase in livestock density and contact rates (potential for transmission) increase with increasing numbers of individuals (Cleaveland *et al,* 2007). The camels of Northern Nigeria were reared under typical nomadic or sedentary systems, grazing from the same natural pasture with common drinking spots as other livestock such as cattle and

confinement by herders or group of herders of their livestock species including camel within a limited enclosure for shelter or houses at night is common (FDLPCS, 1992). The possibility of long and close contact during grazing and drinking between camels and other livestock was high. Therefore, the system of management may play a major role in the Tb prevalence in camels. TB has been reported to be prevalent in many food animals including cattle, donkey, sheep and goats (Alhaji, 1976; Antia and Alonge, 1982; Du-Said and Abdullahi, 1994b; Ojo, 1996; Alaku *et al,* 2002; Cadmus *et al,* 2004; Abubakar *et al,* 2005; Okoli *et al,* 2006; Bikom and Oboegbulem, 2007) and its zoonotic form also widely documented (Garba *et al,* 2004; Abubakar *et al,* 2005; Amusa *et al,* 2005; Adesiji and Fagbami, 2006; Garba and Galadima, 2006b; Okoli *et al,* 2006; Zinsstag *et al,* 2006). The camels in this study must have been exposed to the continuous presence of TB infection in other livestock especially cattle (or their owners).

Strict control of bovine TB in livestock species relies on timely detection and removal or slaughter of infected animals and / or herds but this strategy is difficult to conduct in camels because of the lack of adequate tests for live animals (Wernery *et al,* 2007). TB detection and removal or slaughter of infected animals is not the routine practice in Nigeria due to many reasons amongst which is inadequate funding for surveillance and detection of infected or exposed animals.

The average herd size of camel in the study area is 11 (3 - 34) but larger sizes (50 - 200 heads) are not uncommon particularly during transhumance when camel owners from neighbouring countries enter the country in search for a better pasture (Chafe *et al,* 2008). The large herd size and movement suggest greater contact with other livestock which may be infected. In this study, sex and age were observed to be influencing or predisposing factors for camel TB. More female camels were seroreactors suggesting more susceptibility or increase exposure to the continuous presence of the infection. Age could be the more important factor here than sex. Age is thought to be important factor for the long incubation of TB. The potential use of the antibody based rapid test method to improve surveillance and ante-mortem diagnosis of TB in camels has been reported (Wernery *et al,* 2007). The lateral-flow-based rapid test detected all infected camels and produced no false positive results when used during a TB outbreak in a camel herd in Dubai and the magnitude of the humoral immune response were associated with the severity of disease or presence of gross lesions in the camel (Wernery *et al,* 2007) and also for other livestock species (Lyashchenko *et al,* 2008). With respect to the difficulties in the diagnosis of TB in camels, the shortcomings likely to be faced in using a single test in a control programme under various conditions should be considered (Wernery and Kaaden, 2002; Wernery *et al,* 2007).

The rapid test for TB is simple, easy to perform, rapid and more affordable than other tests. Its speed is useful in mass surveillance where a herd or area status decision may be needed in modelling a control programme. The test kit does not need refrigeration and its stability at room temperature makes it very suitable for use under tropical field and resource poor conditions, such as the study area. In fact, the specificity (to detect the major antibodies IgM, IgG and IgA), the immunoassay format (independent of antibody origin), multi-host diagnostic potential and suitability of the rapid test for TB to various conditions have been described earlier (Hasegawa *et al,* 2002; Lyashchenko *et al,* 2007; Wernery *et al,* 2007; Lyashchenko *et al,* 2008).

Camels infected with *M. bovis,* even without clinical manifestations, pose great risk of exposure to uninfected livestock and humans and should be removed from the population. This strategy will prevent the transmission flow of the infection in Northern Nigeria. The serology based rapid test for TB could provide a useful screening tool for controlling TB in populations of livestock species including camels with practical acceptability in the topics.

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News

First France Cup of dromedary races on 12 August 2012

The first Cup of dromedary races will take place on 12 August 2012 at La Chartre sur le Loir 's des Glerches horserace track. The Dromas Association is most honoured by the integration of the first France Cup of dromedaries into the great PMH event organised by the races society of La Chartre sur Loir for the celebration of the 125th birthday of their horserace track. The France Cup of dromedaries is an opportunity for offering the public at large a better knowledge of these animals and for boosting the French dromedary activities.