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Full Length Research Paper

Camel brucellosis and management practices in Jijiga and Babile districts, Eastern Ethiopia

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A cross-sectional study was carried out on sera of 822 randomly selected camels in order to estimate seroprevalence and risk factors of brucellosis and assess camel management practices. A questionnaire survey was administered to one-hundred willing respondents out of the total 185 camel owners whose camels were included in the sample unit. The sera were first screened by Rose Bengal plate test (RBPT) and then all positive reactors were further tested by the complement fixation test (CFT) for confirmation. The overall seroprevalence of brucella in camels was 2.43% (95% CI = 1.3 - 3.8). None of the potential risk factors studied (district, sex, age, herd size, camel rearing experience and parity) had significant effect on animal level seroprevalence (P > 0.05). The herd level seroprevalence was significantly associated with abortion (P = 0.012) and still birth (P = 0.016). Significant proportion (40%) of camel herders kept camels together with cattle, sheep and goats. Thirty-two percent of camel herders kept camel with cattle. The camel herd composition was dominated by pregnant (21.8%), lactating (21.1%) and mature non-lactating she camels (19.3%). The major diseases affecting camels were trypanosomiasis (93%), anthrax (80%), pneumonia (70%), "bent neck" (59%), abscess (59%), endoparasites (54%) and ectoparasites (51%). Camel management practices like herding, watering, milking, delivery and mating assistance were mainly the responsibilities of adults and young males. Although, seroprevalence of camel brucellosis was low, it could pose considerable threat to public health and market value of camels. The camel health and management practices are inadequate. Public education and detailed epidemiological studies of camel diseases were suggested.

Key words: Camel, brucellosis, seroprevalence, milking, watering, herding, risk factor.

INTRODUCTION

Camels play an important socio-economic role within the pastoral and agricultural system in dry and semi dry zones of Asia and Africa (Gwida et al., 2011). Camels are known to have peculiar physiological features by which they regulate body temperature to changes in ambient temperatures, enabling them to survive and produce under harsh environmental conditions. These characteristics features of camels have made it possible to use to use marginal and desertified ecosystems and over the centuries, the camel has been a symbol of stability for the pastoralists in the arid zones of the world (Yagil, 1985; Higgins et al., 1992; Abbas et al., 1992).

Like other livestock or even more, camels are susceptible to common diseases including brucellosis (Wilson 1984; Abbas and Tilley, 1990). Brucellosis is an infectious disease of animals and humans caused by a number of host-adapted species of genus *Brucella* (Radostits et al., 2006; Mantur et al., 2007). The disease in animals is characterized by abortions or reproductive failure (Abbas and Agab, 2002). Camels are highly susceptible to brucellosis caused by *Brucella melitensis* and *Brucella abortus* (Abbas and Agab, 2002; Gwida et al., 2011) especially when they are pastured together with

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infected sheep, goats and cattle. The large herd size, sharing of watering points with ruminants and inadequate hygienic practices under pastoral management system favors transmission of camel brucellosis, particularly at time of abortion or delivery, by an infected female (Abbas and Agab, 2002).

Brucellosis is transmitted to humans mainly by direct contact with infected livestock and the consumption of unpasteurized contaminated milk and dairy products (Musa et al., 2008). Cattle, goat, sheep, camels and other livestock may be infected and transmit the disease to human populations. Pastoralists in endemic areas are at high risk of infection by *Brucella* species (Skalsky et al., 2008).

In Ethiopia, camels are a subset of large livestock resource with a population of 2.3 million (CSAE, 2004). Among the pastoral and agropastoral communities of Ethiopia, camels are the most important livestock species uniquely adapted to live in hot and arid environments that are inhospitable to other domestic animals. Camels are traditionally raised by these communities primarily for milk production (Demeke and Kumsa, 1997). Despite the presence of large population of camel in the pastoral areas of Ethiopia, reports of camel brucellosis (Dominech, 1977; Richared, 1980; Teshome et al., 2003; Megersa et al., 2005) and studies of management practices are limited; in particular no published information is available for camel brucellosis in Babile district.

Seroprevalence of camel brucellosis in Jijiga district was earlier reported by Teshome et al. (2003). The aims of the present study were to estimate the seroprevalence of camel brucellosis, identify potential risk factors to acquire the disease and assess camel management practices in Jijiga and Babile districts of Jijiga zone, Eastern Ethiopia.

MATERIALS AND METHODS

Study area

A cross-sectional study was carried out from October, 2005 to March, 2006 in Jijiga and Baile districts of Jijiga Zone. Jijiga district is located 9° 35' N latitude and 42° 8' E longitude and has an elevation of 1,609 m above sea level (masl) (htpp//populationmongabay.com/). The climate is generally semiarid and arid with 402.9 mm annual average rainfall. The annual daily minimum and maximum temperature ranges from 12.8 to 28.3°C (NMAEJB, 2006). Babile district is located 8°40' 0" N latitude and 42° 25' 0" E longitude and has an altitude ranging from 950 to 2000 masl (htpp// population mongabay.com/). The districts are inhabited by different tribes of Somali communities of which the Yebere, Abskul, Gedebursi, Malingur, Bertire, Giri, Hawya and Jarso are known camel rearing tribes.

Study design, study animals and blood collection

A cross-sectional study was carried out on 822 selected camels of both sexes with no history of vaccination against brucellosis. Sample size was determined according to Thrusfield (2005) for random sampling and calculated using the expected prevalence of 4.16% (Teshome et al., 2003), 95% confidence interval and 2% absolute precision. The minimum sample size calculated was 382 however; it was inflated to 822 for better precision. Babile and Jijiga districts were purposively selected based on their accessibility and camel population. Then, 36 settlements (kebeles) were randomly selected from both districts. Camel populations found in these settlements were the study population where individual animals were sampled using systematic random sampling. Camels aged two and above years were included in the study. Herd consisting ≥ 35 and ≤ 34 camels were considered as large and small herds, respectively. Blood samples were collected from the jugular vein using plain vacutainer tubes. The samples were left at room temperature overnight to allow clotting for sera separation. The separated sera were stored at -20°C until serologically tested.

Rose Bengal plate test (RBPT)

All collected sera were initially screened for antibodies against *Brucella* by the Rose Bengal plate test (RBPT). The test was performed using commercially available antigen (Institute Pourquer, 3409 Montpellier Cedex 5, France) following the method described by Alton et al. (1975) and OIE (2004).

Complement fixation test (CFT)

All sera reacted positive to the RBPT were further tested using CFT for confirmation. The CFT was performed at the National Veterinary Institute in DebreZeit, Ethiopia, using the protocols recommended by OIE (2004). A standard *B. abortus* antigen for CFT (Veterinary Laboratories Agency, United Kingdom) was employed to detect the presence of antibodies against *Brucella* in the sera. The control sera and complement were both obtained from the Federal Institute for Health Protection of Consumers and Veterinary Medicine, Germany. Sera with a strong reaction that is more than 75% fixation of the complement (3+) at a dilution of 1:5 and with at least 50% fixation of the complement (2+) at dilutions of 1:10 and 1:20 were classified as positive (+).

Questionnaire survey

A questionnaire survey was administered to one-hundred willing respondents out of the total 185 camel owners whose camels were included in the sample unit. The information gathered relates to livestock structure, composition of camel herds, camel rearing experience, camel management (milking, herding, watering, delivery and mating assistance), milk consumption habits and purpose of camel rearing. Additionally, age, sex, herd size, parity and physiological status of sampled camels were recorded.

Data analysis

The data generated were stored in Microsoft Excel spreadsheet (Microsoft Corporation) and analyzed using STATA version 11.0 for windows (Stata Corp. College Station, USA). Variables with more than two categories were transformed into indicator (dummy) variables. Herds containing at least one seropositive camel were considered positive. Seroprevalence was calculated by dividing the number of camel tested positive (CFT) by the total number of camels tested. Similarly, herd-level seroprevalence was calculated as the number of herds with at least one positive camel divided by the total number of herds tested. Association between the occurrence of *Brucella* infection and the potential risk factors on

Table 1. Results of serological diagnosis of camel brucellosis by RBPT and CFT in Jijiga and Babile districts of Somali region.

Location	N	RBPT		CFT	
		No. positive	%	No. positive	%
Jijiga	594	23	3.18	17	2.86
Babile	228	5	2.19	3	1.32
Total	822	28	3.41	20	2.43

N = number of camels examined; No. = number.

Table 2. Univariate logistic regression analysis of potential risk factors associated with animal level camel brucellosis.

Risk factor	Category	Tested	No. positive	Prevalence (%)	Univariate	
					OR (95% CI)	P-value
District	Babile	228	3	1.32	1.0	
	Jijiga	594	17	2.86	2.21(0.64 - 7.61)	0.209
Sex	Female	641	15	2.34	1.0	
	Male	181	5	2.76	1.19(0.43 - 3.31)	0.745
Age	≤ 4 years	174	3	1.72	1.0	
	5 - 10 years	449	10	2.23	1.30(0.35 - 4.77)	0.694
	≥ 11 yrs	199	7	3.52	2.08(0.53 - 8.16)	0.295
Herd size	Small	573	13	2.27	1.0	
	Large	249	7	2.81	1.25(0.49 - 3.16)	0.643
Camel rearing experience	≤ 30 years	463	9	1.94	1.0	
	≥ 31 years	359	11	3.06	1.59(0.65 - 3.89)	0.305
Parity	Zero	188	2	1.06	1.0	
	First	158	5	3.16	3.04(0.58 - 15.88)	0.188
	Second	64	3	4.69	4.57(0.75 - 8.02)	0.100
	Third	231	5	2.16	2.06(0.39 - 10.73)	0.392
Abortion	No	584	13	2.23	1.0	
	Yes	57	2	3.51	1.60(0.35 - 7.26)	0.544

No. Pos. = number positive, exp = experience, OR = odds ratio, CI = confidence interval.

both herd and animal level were studied using logistic regression. Non-collinear variables that presented P-value of < 0.25 in univariable analysis were offered to the multivariable regression model. For statistical inference, the level of significance was set as 0.05.

RESULTS

Seroprevalence of camel brucellosis

The overall animal level seroprevalence of camel brucellosis was 2.43% (95% confidence interval (CI) = 1.38 to 3.49). The antibody titers ranged from 1:10 to 1:320. Among the 36 settlement areas included in the study, brucellosis was detected in 11 (30.6%) dispersedly located settlement areas. Higher seroprevalence was found in Jijiga district than in Babile (Table 1).

Results of univariate logistic regression analysis of potential risk factors at animal level revealed that all the variables investigated had no significant association with *Brucella* seropositivity (P > 0.05). High seroprevalence was observed in camels older than 11 years of age (3.52%) than in those under 4 years of age (1.72%). The seroprevalence was also higher in male (2.76%) animals than in females (2.34%) and the seroprevalence increased with parity number and herd size (Table 2). Similarly, none of the variable offered to the final model were significant predictors of camel brucellosis (Table 3).

Out of the 185 herds investigated, 28 (15.14%) and 19 (10.27 %) herds reacted positively for RBPT and CFT,

Table 3. Multivariable logistic regression model for predictors' of animal level camel brucellosis.

Risk factor	Category	Adjusted odds ratio (95% CI)	P-value
District	Babile	1.0	-
	Jijiga	2.12 (0.61 - 7.37)	0.238
Parity	None	1.0	-
	One	2.98 (0.57 - 15.61)	0.196
	Two	4.40 (0.72 - 27.04)	0.109
	Three	2.04 (0.39 - 10.65)	0.397

Table 4. Logistic regression analysis of potential risk factors associated with herd level camel brucellosis in Jijiga and Babile districts.

Risk factor		Herd tested	Positive	Prevalence (%)	Univariate		Multivariate	
					Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
District	Babile	52	3	5.77	1.0	-	1.0	-
	Jijiga	133	16	12.03	2.23(0.62, 8.01)	0.218	3.70(0.88, 15.60)	0.075
Herd size	Small	148	13	8.78	1.0	-	1.0	-
	Large	37	6	16.22	2.01(0.71, 5.70)	0.190	1.07(0.33, 3.48)	0.911
Abortion	No	128	8	6.25	1.0	-	1.0	-
	Yes	57	11	19.30	3.59(1.36, 9.48)	0.010	3.91(1.36, 11.25)	0.012
Still birth	No	159	13	8.18	1.0	-	1.0	-
	Yes	26	6	23.08	3.37(1.15, 9.86)	0.027	4.35(1.31, 14.42)	0.016

respectively. Within herd, seroprevalence varied from absence of reactor animals to presence of two reactors out of the herd (0 to 7.7%). As observed in the current study, abortion and still birth had a significant association with herd level seroprevalence both by univariate and multivariate logistic regression analysis ($P \leq 0.05$). Although statistically not significant, higher sero-prevalence was seen in large (16.22%) than in small herd size (8.78%) during herd level analysis (Table 4).

Questionnaire survey

The questionnaire survey revealed that extensive management system was exercised in the area; camels are kept alone as well as together with other species of animals mainly for milk production, and other functions including transport and social security. The highest proportion (40%) of the camel herds kept together with cattle, sheep and goats, while 32% of camel herds were kept only with cattle, 8% with sheep and goats, 4% with cattle and equine and 16% camel herds alone. The mean camel herd size was 21.7 with the maximum and minimum values being 100 and 4, respectively. The camel herd composition was dominated by pregnant camels (21.8%) followed by lactating (21%) and non-lactating camels (19.3%). Camel bulls constituted only 12.4% of the herd. Females in general make up about 74.6% of the total herd while immature camel made 25.4% of the herd. The camel rearing experience of pastoralists ranged from 4 to 50 years with a mean of 23.97 years. In the present study, it was observed that pastoralists mainly keep camels for milk production (84%). Other purposes of keeping camels include draught mitigation (10%) and herd accumulation (6%). Cattle were mainly kept for milk production while sheep and goats were used as the sources of meat for home consumption and immediate cash income following sale. Donkeys were kept for transportation of water and other goods for home usage.

According to the respondents, 75% of the total milk production was sold to the nearby urban dwellers (mainly in Jijiga town) to generate income. The remaining 25% milk was used for home consumption. All the herders

(100%) consumed fresh raw milk without any heat treatment. They also consume milk after mixing with boiled tea. Camel meat was consumed in the area cooked; however, 18% of respondents consume liver and hump of camel as raw. In the family, activities like herding and watering were done by young and adult males but milking of camels was done mainly by adult males (56%), followed by young males (31%) and females (13%).

Camel owners use traditional wells (59%) and ponds (41%) as the main water sources during dry season for their camels. Camels stay without drinking water for 5 to 20 days in the dry season and for more than 24 days during wet season, due to the fact that they also get water indirectly from the green feed available (mainly cactus). Camels were allowed to drink water from rivers in 20 to 24 days interval. Rivers found in Jerer, Fafen and Daketa valleys are used as a source of water for camels during rainy season. Camels move about 30 to 40 km/s in search of water and pasture during draught period. Prevalent camel diseases reported by respondents include trypanosomosis (93%), anthrax (80%), pneumonia (70%), “bent neck” (59%), abscess (59%), endoparasites (54%), ectoparasites (51%), abortion (30%), wound (23%) and paralysis (5%). Furthermore, trypanosomosis (54%), anthrax (20%), endoparasites (9%), toxic plants (8%), sunstroke (5%) and pneumonia (4%) were mentioned as causes of abortion in camels.

Delivery and mating assistance to camels were strictly the job of adult males (99%) and young males had very limited role in these aspects (1%). Most of the camel owners (65%) receive animal health service from public veterinary clinics. However, 30% of respondents administered drugs to their camels by themselves while 5% were dependent on traditional healers. It was reported that symptoms suggestive of brucellosis including abortion, stillbirth, and swollen joints occurred in 64, 35 and 27% of camel herds in a year, respectively. Usually, aborted camels are removed from the herd mainly by means of selling. Aborted fetus, placenta and discharges were left on the ground. Most of the herders used breeding bull from their own herd (90%) while (10%) used communal village bull. The majority of camel owners (61%) allow camels to graze separately while (34%) practiced grazing of camels with other species of animals. Ninty-eight percent of camel herds had separate night resting area and 2% of camel herds shared night enclosures with cattle and small ruminants.

DISCUSSION

The present study revealed 2.43% overall seroprevalence of camel brucellosis. This seroprevalence is in agreement with the previous reports of 2.8% by Teshome et al. (2003) and 1.8% Megersa et al. (2005) from Ethiopia, 3.1% Omer et al. (2000) from Eritrea, 0.3 to 1.9% Baumann and Zessin (1992) and 3.1% Gahanem et al. (2009) from Somalia. However, relatively higher seroprevalence of camel brucellosis has been recorded in Jordan 19.4% (Dawood, 2008), in Sudan 30.5% (Omer et al., 2007), in Darfur (Western Sudan) 23.8% (Musa et al., 2008) and in Egypt 7.3% (El-Boshy et al., 2009). The low seroprevalence observed in the present study might be due to the low density of camel population kept in a widely extended grazing land and the presence of many watering points in the river path of the valleys which reduce the concentration and close contact of camels. Moreover, the good practice of herders’ timely culling of aborted and non-conceiving females from the herds might have contributed to the situation.

Our result is in accordance with the findings of Abbas and Agab (2002) who reported low seroprevalence (less than 5%) in nomadic or extensively kept camels. The slightly higher seroprevalence in older animals (3.52%) was in line with previous reports of Radostits et al. (2006) which indicated that infection may occur in animals of all age groups but persists commonly in sexually mature animals. Age and sex had no significant effect ($P > 0.05$) on animal level seroprevalence suggesting existence of susceptibility to brucellosis among male and female camels of different age groups which is in agreement with the previous reports from Ethiopia (Teshome et al., 2003) and Saudi Arabia (Radwan et al., 1992).

The herd (10.27%) and within herd (0 to 7.7%) level seroprevalence reported in the current study is moderately high. The herd level seroprevalence was significantly associated with abortion ($P = 0.012$) and still birth ($P = 0.016$). In agreement with our findings Wilson (1998), Tibary et al. (2006), Musa et al. (2008) and Gwida et al. (2011) also reported brucellosis as an important cause of reproductive failure. However, as opposed to our finding, Megersa et al. (2011) reported absence of association between camel brucellosis and abortion at herd level.

The proportions of pregnant (21.8%) and lactating (21.1%) camels in the herd structure reported in current study were very close to the reports of Megersa (2004) and this can be related possibly to camel rearing practices and ecological similarities of the two areas. In this study, the respondents indicated that diseases like trypanosomosis (54%) and anthrax (20%) were causes of abortion in their camels. This was in accordance with Wilson (1998) who suggested trypanosomosis as cause abortion in extensively managed animals.

Conclusion

The present study showed that seroprevalence of camel brucellosis was low. Age, sex, parity, camel rearing experience and herd size had no significant association with *Brucella* seropositivity at animal level. However, at herd level, *Brucella* seropositivity was significantly associated with abortion and still birth. Although seroprevalence of

camel brucellosis is low, the seropositive animals may serve as future foci of infection, pose public health risk, leads to low productivity and market value of camels. Trypanosomosis was among the widespread camel diseases leading to abortion. Further epidemiological studies leading to improvement of health and management of camels and education of pastoralists are imperative to fully exploit the camel resources of the areas.

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