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Full Length Research Paper

Seroprevalence of small ruminant brucellosis and its public health awareness in selected sites of Dire Dawa region, Eastern Ethiopia

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Between November 2010 and April 2011, a serological study was conducted on small ruminants to determine the prevalence of brucellosis and factors affecting its frequency in these animals. Out of 384 sheep and goats sera tested using Rose Bengal plate test (RBPT) and complement fixation test (CFT), 36 (9.38%) reacted positively using RBPT. Of these reactant sera, 35 also tested positive using CFT, giving an overall prevalence of small ruminant brucellosis of 9.11% (95% CI: 6.43% to 12.45). Using a logistic regression model, no statistically significant differences were recorded in seroprevalence between sheep and goats (OR = 1.10, 95% CI: 0.54 to 2.23), male and female animals (OR = 1.02, 95%: 0.50 to 2.06), and among different age groups. A questionnaire was administered to 49 small ruminant owners to determine their awareness of brucellosis and identify their practices and feeding habits that would predispose them to this disease. Nearly half of the sheep and goat owners questioned did not know about small ruminant brucellosis; however, almost all of them confirmed the presence of abortion in their animals (in Afan Oromo called "Ilman Dhaha " or "Ilman Darba"). 87.76% of the respondents drank un-boiled milk and/or consumed raw meat of small ruminants and 95.92% of them handled fetal membranes and disposed of aborted fetuses using bare hands. Poor awareness of the zoonotic importance of brucellosis and the practices of consuming raw milk and meat and handling potentially infectious materials using bare hands pose a serious danger to small ruminant owners.

Key words: Brucellosis, Dire Dawa, public health, seroprevalence, small ruminants.

INTRODUCTION

The health and production of animals as well as the well being of humans have been seriously endangered by pathogenic infections. Pathogens that are transmitted between the environment, livestock and humans present great challenges for the protection of human and animal health (Biet et al., 2005). Among these pathogens, different species of brucella are involved in causing brucellosis, a major disease of domestic livestock and wild animals with serious zoonotic implications in man (Cadmus et al., 2006). The primary hosts of brucellosis are cattle, sheep, goats and pigs (Djuricic, 2010). In sheep and goats, brucellosis is mainly caused by *Brucella melitensis* (Blasco and Molina-Flores, 2011; Coelho et al., 2007; Godfroid et al., 2010) although sporadic cases due to *Brucella abortus* and *Brucella suis* have been observed (Garin-Bastuji, 2011; OIE, 2009b). Furthermore, *Brucella ovis* is responsible for epididymitis in rams and occasionally infects ewes (Garin-Bastuji, 2011; OIE, 2009a). A number of factors influencing the susceptibility of animals to brucellosis, includes natural resistance, age, level of immunity, and environmental stress (Tesfaye et al., 2011).

Almost all human cases of brucellosis are acquired from animals, in particular goats and sheep (Kaoud et al., 2010). In humans, infection with *B. melitensis* is an important clinically overt disease (Corbel, 1997) and

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remains one of the most common zoonotic diseases worldwide, with more than 500,000 human cases reported annually (Pappas et al., 2006; Seleem et al., 2010). Humans can become infected through direct or indirect contact with infected animals and their birthing products or by consumption of infected animals' products (WHO, 2006; Lopes et al., 2010).

The detection of specific antibodies in serum or milk remains the most practical means of diagnosis of brucellosis (WHO, 2006). Among many serological tests available, the complement fixation test (CFT) is the only test prescribed for confirmation and international trade. The Rose Bengal plate agglutination, complement fixation and indirect ELISA tests are recommended for screening flocks and individual animals (FAO, 2003).

Brucellosis is endemic among small ruminant flocks of Ethiopia. There are several previous reports of its serological prevalence in these animals in different parts of the country using various tests such as Rose Bengal plate test (RBPT), CFT, and iELISA. Teshale et al. (2006), reported a prevalence of 1.9% (38 of 2000) in sheep and goats in Afar and Somali pastoral areas; Yesuf et al. (2010) found a prevalence of 2.5% (20 of 800) in sheep in south Wollo Zone and Ashagrie et al. (2011) reported a prevalence of 5.2% (20 of 384) in goats in South Omo Zone.

In Dire Dawa, however, there is little information on small ruminant brucellosis. The following serological survey was therefore carried out to assess the current situation of small ruminant brucellosis and animal owner's awareness of the problem and its zoonotic impact in this area.

MATERIALS AND METHODS

Study area

The study area, Dire Dawa administrative council, is situated ~ 518 km east of the capital city, Addis Ababa, between 09°28'N to 09°49'N latitude and 41°38'E to 42°19'E longitude. It is situated at an altitude range of 950 to 2250 m.a.s.l., and encompasses an area of 1288.02 km^2. The rainfall pattern is bimodal with the highest rainfall in July and August with an average 700 to 900 mm. The monthly mean maximum temperature ranges from 28.1°C in December and January to 34.6°C in May. It is consid ered the most important area for sheep and goat production. The small ruminant population of the administrative council was estimated to be 227,481 heads (54,600 sheep and 172,881 Goats) (CSA, 2010).

Study animals and questionnaire

The study animals consisted of 384 traditionally managed small ruminants of which 171 (44.53%) were Black head Ogaden sheep while the remaining 213 (55.47%) were Somali goat types. The animals were obtained from Aseliso, Gedenser, Goladey and Hula Hulal peasant associations (PAs). There was no history of vaccination of brucellosis in the study area.

A questionnaire was administered to 49 sheep and goat owners residing in the aforementioned sites. Origin, species, sex and age of the animals were recorded, along with the brucellosis status of the study unit, classified as positive or negative.

Study design and sampling method

The design adopted for this study was a cross-sectional survey whereby blood samples were taken from randomly selected small ruminants belonging to four peasant associations. Simultaneously, a questionnaire was administered to small ruminant owning family members.

The sample size was determined using the method recommended by Thrusfield (2005) for simple random sampling. With an expected prevalence of 50% of small ruminant brucellosis in the selected sites, 0.05% desired absolute precision and 95% level of confidence, the target sample size was calculated to be 384 (171 sheep and 213 goats).

Ethical Issues

Small ruminant owners participating in the study were informed about the purpose of the study and their agreement was obtained.

Serum sample collection

Prior to blood sampling, data on species, sex and age of the animals were registered. Only sheep and goats older than one year were sampled. Blood samples were collected using plain vacutainer tubes and needles directly from the jugular vein and kept overnight to clot at a slanting position at room temperature. Then, the separated serum was carefully collected in a cryovial stored at - 20°C (Reviriego et al., 2000) at Dire Dawa Veterinary Diagnostic and Investigation Laboratory until further processing conducted.

Serological tests

All sera collected were first tested using RBPT) according to the procedure described by Nielsen and Dunkan (1990) to detect *Brucella* agglutinins. Sera found to be positive or inconclusive by the RBPT were re-tested using the CFT (Nielson and Dunkan, 1990).

Questionnaire survey

The questionnaire was administered only to small ruminant owners in all selected peasant associations by personal interview. The questions were related to their awareness of small ruminant abortions, their consumption of small ruminants' meat and milk and their practices of handling aborted foetuses and retained foetal membranes.

Data analysis

The data were analyzed using STATA (StataCorp, 2009). Descriptive statistics was employed in determining the prevalence of small ruminant brucellosis and the traditions and practices of small ruminant owners. The logistic regression model was used to identify whether the potential risk factors such as origin of animals, species, sex and age of the small ruminants influenced the seroprevalence of small ruminant brucellosis. A significant asso-ciation was said to exist if the Odds ratio (OR) is different from one and the 95% confidence interval of the OR does not include one

Table 1. Seroprevalence of brucellosis using RBT and CFT tests in small ruminants in Dire Dawa region.

Species	Total examined	RBPT		CFT	
		Positive	Prevalence (95% CI)	Positive	Prevalence (95% CI)
Sheep	171	15	8.77% (4.99-14.06)	15	8.77% (4.99-14.06)
Goat	213	21	9.86% (6.21-14.68)	20	9.39% (5.83-14.13)
Total	384	36	9.38 (6.65-12.74)	35	9.11 (6.43-12.45)

Table 2. Assessment of potential risk factors of small ruminant brucellosis using CFT as confirmatory test.

Variable	Total examined	CFT positive	Sero-prevalence (%)	Crude OR (95% CI)	Adjusted OR (95% CI)	*P*-Value
Origin						
Gedenser	117	8	6.84	1.00*	1.00*	
Goladay	73	7	9.59	1.44 (0.50-4.19)	1.46 (0.51-4.23)	0.483
Hula Hulal	86	8	9.30	1.40 (0.50-3.89)	1.50 (0.51-3.95)	0.503
Aseliso	108	12	11.11	1.70 (0.67-4.34)	1.68 (0.66-4.30)	0.278
Species						
Sheep	171	15	8.77	1.00*	1.00*	
Goat	213	20	9.39	1.08 (0.53-2.17)	1.10 (0.54-2.23)	0.792
Sex						
Male	178	16	8.99	1.00*	1.00*	
Female	206	19	9.22	1.03 (0.51-2.07)	1.02 (0.50-2.06)	0.959
Age (years)						
1-2	108	11	10.19	1.00*	1.00*	
3-4	220	20	9.09	0.88 (0.41-1.91)	0.87 (0.40-1.90)	0.718
>4	56	4	7.14	0.68 (0.21-2.24)	0.69 (0.21-2.31)	0.552

*, Reference group.

RESULTS

Out of the 384 sheep and goat sera screened with RBPT 36 (9.38% CI: 6.65 to 12.74), samples were found to be positive for *Brucella* antibodies. Of these RBPT positive sera, 35 were also shown to be positive by f CFT giving an overall confirmed brucellosis seroprevalence of 9.11% (95% CI: 6.43 to 12.45%) among small ruminants in the study area (Table 1).

Among the selected sites, seroprevalence of small ruminant brucellosis was highest in sheep and goats sampled from Aseliso (11.11%) and lowest in that of Gedenser (6.84%). A higher seroprevalence of brucellosis was found in goats (9.39%) than in sheep (8.77%), in female sheep and goats (9.22%) than in males and in those grouped into 1 to 2 years of age (10.19%) than in those categorized >4 years old. However, through the logistic regression model, these differences were not statistically significant (Table 2).

From a total of 49 sheep and goat owners interviewed, 25 (48.98%) had no awareness about brucellosis, although almost all of them recognized the existence of abortion (locally called in Afaan Oromo as “Ilman Darba”or “Ilman Dhaha”) among small ruminant flocks . Almost all (95.92%) of the respondents assisted in removing retained fetal membranes and disposal of the placentae and aborted foetuses with bare-hands (Table 3). Regarding their drinking and eating habits, 43 (87.76%) sheep and goat owners had the habit of drinking raw milk (24.49% drank only raw milk and 63.27% drank both raw and boiled milk) as well as eating raw meat (24.48% consumed only raw meat and 63.28% consumed both raw and cooked meat) (Table 3).

DISCUSSION

The overall prevalence of small ruminant brucellosis in this study, based on RBPT, was determined as 9.38% (95% CI: 6.65 to 12.74) whereas on the basis of CFT, the

Table 3. Owners' awareness about small ruminant brucellosis, habit of drinking milk and eating meat and handling of aborted materials of small ruminants.

Variable	Number of respondents	Percentage (%)
Awareness on brucellosis		
Yes	24	48.98
No	25	51.02
Removal and disposal of foetal membranes and aborted foetus		
With bare hand	47	95.92
Glove protected hand	2	4.08
Habit of drinking milk		
Raw	12	24.49*
Boiled	5	10.20
Both raw and boiled	31	63.27*
Do not drink milk	1	2.04
Habit of eating meat		
Raw meat	12	24.48**
Cooked meat	6	12.24
Both raw and cooked meat	31	63.28**

*, Had habit of drinking raw milk and add to 87.76%; **, had habit of eating raw meat and add to 87.76%.

prevalence was 9.11% (95% CI: 6.43 to 12.45). Species-wise, the prevalence was shown to be 8.77% in sheep and 9.39% in goats (Table 1). The present findings indicate the existence of small ruminant brucellosis at a moderate prevalence. This is in fair agreement with the reports of Ashagrie et al. (2011) who determined a prevalence of 4.2% (16 of 384) with CFT in small ruminants in South Omo Zone; Brisibe et al. (1996) who reported 4.8% (10 of 210) prevalence in sheep and 6.0% (12 of 201) in goats using RBPT in Borno and Yobe States, Nigeria; El-Gohary and Hattab (1992) who recorded 10.7% prevalence in sheep and goats using RBPT. This could be due to the similarities of animal husbandry in communal grazing range lands and watering areas and possibly similar climatic conditions (Teshale et al., 2006). However, the prevalence presently recorded is lower than that recorded by Al-Majali (2005) where 27.7% (305 of 1100) of goats were seropositive by both RBPT and CFT and Hamidullah et al. (2009) in which 34.88% (120 of 344) sheep and goats were found to be positive for brucellosis using the RBPT and 32.5% using serum agglutination test (SAT) in Kohat, Jordan. The reason for this discrepancy could be variation in management practices and frequent introduction of new animals without proper serological testing and detection and removal of animals with high incidence of abortions (Hamidullah et al., 2009). The prevalence in the present animals is higher than that reported by Ferede et al. (2011) who recorded seropositivity of 1.2% (6 of 500) using RBPT and 0.4% (2 of 500) using CFT in small ruminants in Bahir Dar; Teshale et al. (2006) who recorded an overall positive percentage of 1.9% (38 of 2000) in sheep and goats using RBPT in Afar and Jijiga; Bekele et al. (2011) who detected brucellosis in 1.2% (5 of 421 sheep) using both RBPT and CFT and 2.3% (7 of 309) in goats using RBPT and 1.9% (6 of 309 using CFT in Jijiga; Tekelye and Kasali (1990) who recorded 1.5% prevalence in sheep and 1.3% in goats in central highlands of Ethiopia. This could be ascribed to strong clan-based segregation of animals and range lands in the Jijiga (Teshale et al., 2006; Bekele et al., 2011) and to differences in geographical location and livestock management in Baher Dar characterized by mixed farming, in which fewer animals are raised separately (Ferede et al., 2011).

In the present study, a higher seroprevalence was found in goats (9.39%) than in sheep (8.77%). This finding is in conformity with Bekele et al. (2011) who reported a slightly higher prevalence in goats than sheep. Likov et al. (2010) also noted that in affected herds, the prevalence rate in goats was greater than in sheep. This might be due to herding of both sheep and goats together that could facilitate transmission of the disease between both flocks. In contrast to these findings, however, Reviriego et al. (2000) recorded that odds of brucellosis in the ovine flocks were considerably higher than those in goat herds.

In the present study, serological prevalence was lower in males (8.99%) as compared to females (9.22%). However, logistic regression analysis revealed no

statistically significant variation in seroprevalence among the factors considered (Table 2). On the other hand, Akbarmehr and Ghiyamirad (2011), Bekele et al. (2011) and Teshale et al. (2006) documented a higher prevalence in both female sheep and goats than males.

A slightly higher prevalence was presently noted in younger animals than older ones. Those at the age of 1 to 2 years (10.19%) were more seropositive than those above 4 years old (7.14%). However, the variation was statistically non-significant (Table 2) and this variation could be due to the low number of sampled animals in this age group. Our findings are in agreement with the finding of Ashagrie et al. (2011).

Brucellosis is transmissible from animals to humans through contaminated milk, raw milk products, meat or direct contact with infected animals. Almost all small ruminant owners residing in the study area were able to recognize the occurrence of abortion in their flocks but about 51.02% of them lacked knowledge about brucellosis. Furthermore, 87.76% of the respondents had the habit of drinking un-boiled milk and eating raw meat of small ruminants 95.92% of the respondents used to handle retained fetal membranes and dispose of aborted fetuses using bare hands. Similar findings were reported by Bekele et al. (2011).

CONCLUSION AND RECOMMENDATIONS

This study could make a useful contribution towards the prevention of small ruminant brucellosis in the area. An effort should be focused on educating farmers on testing and removing affected animals, and using anti-brucellosis vaccines to protect the animals and stressing the necessity of boiling of milk and cooking meat obtained from small ruminants. The animal herders and their families should also be tested to confirm its public health threat.

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