American-Eurasian J. Agric. & Environ. Sci., 6 (5): 508-512, 2009
ISSN 1818-6769

Seroprevalence Study of Bovine Brucellosis in Pastoral and Agro-Pastoral Areas of East Showa Zone, Oromia Regional State, Ethiopia

[1]Hunduma Dinka and [2]Regassa Chala

[1]Adama University, School of Agriculture, P.O. Box 1457, Adama, Ethiopia
[2] Adami Tulu Agricultural Research Center, Animal Health Research Division, P.O. Box 35, Zeway, Ethiopia

Abstract: A total of 1106 livestock sera from pastoral and agro-pastoral farming system were screened for antibodies for *Brucella* species using the Rose Bengal Plate Test. *Brucella* antibody was detected in all study districts and an overall herd seroprevalence of 11.2% were recorded from the study areas. Accordingly, in pastoral area the prevalence of brucellosis was 15.2% whereas in agro-pastoral 4.1%. The study revealed that pastoral animals were more than three times more likely of being exposed to *Brucella* infection compared to animals in the agro-pastoral farming systems. Cattle in pastoral farming system had significantly higher *Brucella* antibodies ($P<0.05$) compared to agro-pastoral farming systems. A prevalence rate of 12.2% was observed in female animals and 9.8% in male animals. On the other hand, the highest, 12.0%, brucellosis seroprevalences were observed within the older animals (>2 years) whereas this parameter relatively remained low, 10.2%, in younger animals (≤2 years). This study therefore, showed that *Brucella* antibodies was present in both pastoral and agro pastoral area of East Showa Zone of Oromia Regional State thus calling for formulation of strategic control measures in order to reduce associated reproductive wastage and the public health risks.

Key words: Pastoral · Agro-pastoral · *Brucella* antibody · Rose Bengal plate test · Public health risks · Oromia Regional State

INTRODUCTION

Livestock rearing is the principal economic activity supporting livelihoods in the desert, arid grasslands and savannahs, which cover about 14 million km^2, i.e. more than 50%, of the Sab-Saharan Africa (SSA) land surface. In these areas, the harsh environmental conditions are unsuitable for any other form of agriculture and for the people living in these environments; livestock is the principal currency for social and commercial transactions [1].

Within SSA, many of the known infectious diseases occur commonly and are poorly controlled, both in livestock and in human populations. Despite their social and economic importance, public funds raised for the control of infectious diseases, such as brucellosis for example, progressively decreased over the last 2 decades [2, 3]. Bovine brucellosis is a disease of cattle usually caused by *Brucella abortus*, less frequently by *Brucella melitensis* and rarely by *Brucella suis* [4]. The disease is characterized by abortion in the last trimester or birth of unthrifty newborn in the female animals, orchitis and epydidimitis with frequent sterility in male animals [4, 5]. Brucellosis is a zoonosis that exists worldwide and is more or less endemic within most Africa countries [3]. It has been stated that in sub-Saharan Africa, the epidemiology of brucellosis in humans and livestock are not well understood and available data are limited [2, 6].

In Ethiopia, there is no documented information on how and when brucellosis was introduced and established. Even though, several serological surveys have showed bovine brucellosis is an endemic and widespread disease in urban, peri-urban, highland and lowland, extensive and intensive farming, small holder farms and ranches of the country [7-14] there is no reports on the seroprevalence of the disease in pastoral and agro-pastoral areas. The aim of this paper, therefore, is to determine the seroprevalence of bovine brucellosis and to identify the associated risk factors under pastoral and agro-pastoral areas of East Showa Zone of Oromia Regional state, Ethiopia.

Corresponding Author: Hunduma Dinka, Adama University, School of Agriculture, P.O. Box 1457, Adama, Ethiopia

MATERIALS AND METHODS

Study Area and Animals: The study included twenty Peasant Associations (Pas), from four districts (Fantale, Arsi Negele, Adami Tulu and Lume) in East Showa Zone of Oromia Regional State. The main livelihood system for the four study districts is both pastoralist and agro-pastoralist farming systems. It has been defined that pastoralists are part of the society who mainly rear and derive most of their income from domestic animals, whereas agro-pastoralists are segment of pastoral society who promote opportunistic crop farming integrated to their livestock husbandry practices. They are found below 1,600 meters a.s.l. and receive erratic rain fall which ranges between 200 to 700 mm on average annually [15]. The study areas were selected purposively to include both agro-ecological zones based on their livestock population and ease of their access. Accordingly, from Fantale; Kobo, Banti and Toro PAs were selected for agro-pastoral agro-ecology while Tututi and Dire Seden are for pastoralist PAs. For Arsi Negele district; Lepis PA is the pastoral area whereas Abine Garmama for agro-pastoral PA. For Lume district; Tulu Ree PA is the pastoral area whereas Koka and Dibdeba for agro-pastoral PA. For Adami Tulu district; Jido and Hurufa Lole PA are the pastoral areas whereas Elka Chelemo and Anano for agro-pastoral PA. Cattle population of both sexes more than 6 months old were included for the study purpose where animals greater than 2 years represents adult animals (used for breeding purpose) while leas or equal to 2 years of age represents young animals.

Study Design and Blood Sample Collection: A cross-sectional epidemiological study was carried out on indigenous cattle using a serological test - Rose Bengal Plate Test (RBPT). For this study a total of 1106 blood samples were randomly collected from the four districts. 286 blood samples (170 from pastoral and 116 from agro-pastoral) were collected from Fantale district; 280 samples, 131 from pastoral and 149 from agro-pastoral, from Arsi Negele district; 136 samples, 94 from pastoral and 42 from agro-pastoral, from Lume district whereas a total of 404 samples were collected, 217 from pastoral and 187 from agro-pastoral, from Adami Tulu district. From all districts samples were collected randomly to encompass as much as possible both sexes, age categories and different parities and all these information were recorded during sampling. Cattle in Fantale area are Kereu cattle type whereas those in other three districts are Arsi cattle type.

Serological Tests: About 10 milliliters of blood was collected from the jugular vein of each selected animal using plain vacutainer tubes and allowed to clot overnight at room temperature. The serum samples were separated and transported in iceboxes to National Veterinary Institute (NVI), Debre Zeit, Ethiopia and stored at -20°C until testing. Serum samples were screened for antibodies for *Brucella* species using the Rose Bengal Plate test. In brief, 30 ìl of serum was mixed with an equal volume of antigen suspension on a glass plate and agitated. After four minutes of rocking, any visible agglutination was considered as positive [4]. Agglutinations were recorded as 0, +, ++ and +++, according to the degree of agglutination [16]. A score of 0 indicates the absence of agglutination; + indicates barely visible agglutination; ++ indicates fine agglutination and +++ indicates coarse clumping. Those samples with no agglutination (0) were recorded as negative while those with +, ++ and +++ were recorded as positive. RBPT *Brucella* antigen (Institute Pourquier, France), positive control and negative control sera (National Veterinary Institute, Debre Zeit, Ethiopia) were used for the RBPT.

Data Analysis: The data collected from the field were entered into a computer on a Microsoft Excel spreadsheet. Categorical variables (districts, sex, age, parity number, cattle type and agro-ecology) were expressed in percentages. The seroprevalence proportion was calculated as the number of animals testing positive by the RBPT, divided by the total number of animals tested. The degree of association between or among each risk factor was assessed using the Chi-square ($x2$) test [17]. For all analyses, a p-value of less than 0.05 was taken as significant.

RESULTS

The overall individual animal level seroprevalence, 11.2% (124/1106), of bovine brucellosis was recorded from the study area on the basis of RBPT. The highest prevalence, 18.6% (52/280), was recorded at Arsi Negele district whereas the least at Lume district (Table 1). In pastoral area the prevalence of brucellosis was 15.2% whereas in agro-pastoral 4.1%. There was statistically significant difference in the seropositivity to brucellosis among the herds tested in the four districts ($P<0.05$). Not only among districts, but also within districts the highest seroprevalence of bovine brucellosis in pastoral area was recorded than in agro-pastoral area farming system. The study revealed that pastoral animals were more than

Table 1: Over all (n = 1106) seroprevalence of bovine brucellosis in four districts, pastoral and agro-pastoral area, of East Showa Zone, Oromia Regional State

Districts	No. of animals examined	RBPT positive animals (No., %)
Fantale	286	25 (8.7)
Pastoral	170	21 (12.3)
Agro-pastoral	116	4 (3.4)
Arsi Negele	280	52 (18.6)
Pastoral	231	51 (22.1)
Agro-pastoral	49	1(2.0)
Lume	136	7 (5.1)
Pastoral	94	7 (7.4)
Agro-pastoral	42	0 (0.0)
Adami Tulu	404	40 (10.0)
Pastoral	217	29 (13.4)
Agro-pastoral	187	11 (5.9)
Total	1106	124 (11.2)

$x2 = 17.58$; P-value = 0.0005

Table 2: Association of risk factors with the seroprevalence of bovine brucellosis (n = 1106) detected by RBPT in four districts, pastoral and agro-pastoral area, of East Showa Zone, Oromia Regional State

Risk factors	No. of animals examined	RBPT positive animals $x2$ (P-value)	(No. and %)
Agro-ecology			
Pastoral	712	108 (15.2)	25.67 (4.0528e-7)
Agro-pastoral	394	16 (4.1)	
Sex			
Female	639	78 (12.2)	1.2 (0.2733)
Male	467	46 (9.8)	
Age			
Young (0.6, 2 years]	49	50 (10.2)	0.73 (0.3928)
Adul (>2 years)	615	74 (12.0)	
Cattle type			
Kereyu cattle	286	25(8.7)	1.91 (0.1669)
Arsi cattle	820	99 (12.1)	
Parity number			
No parity	143	16 (11.2)	0.26 (0.8780)
1st, 2nd & 3rd parities	311	39 (12.5)	
4th, 5th,6th & 7th parities	84	11(13.1)	

three times more likely of being exposed to *Brucella* infection compared to animals in the agro-pastoral farming systems. Statistically there is a significant difference (P<0.05) in *Brucella* antibodies for cattle in pastoral farming system when compared to those of in agro-pastoral farming systems.

A prevalence rate of 12.2% was observed in female animals and 9.8% in male animals. On the other hand the highest, 12.0%, brucellosis seroprevalences were observed within the older animals (>2 years) whereas this parameter relatively remained low, 10.2%, in younger animals (≤2 years) (Table 2). There was no statistically significant difference (P > 0.05) observed in the prevalence of bovine brucellosis between both the sex and age group of the study animals. The study also showed that there is risk of *Brucella* infection as parity number increases. However, significant difference in seropositivity was not observed among the three parity groups (P > 0.05). In terms of cattle type, seroprevalence of bovine brucellosis was highest (12.1%) in Arsi cattle type while relatively low (8.7%) in Kereyu cattle type even though there is no statistically significance difference between them.

DISCUSSION

This study demonstrated that the overall seroprevalence of bovine brucellosis in pastoral and agro-pastoral area of East Showa Zone, Oromia Regional State, was 11.2% by the RBPT. This report is within the range, 10 to 15%, that was estimated for any assumed brucellosis seroprevalence for East Africa [3]. In sub-Saharan Africa, the highest incidences of brucellosis are found in pastoral production systems [2, 3, 6]. This is in accord with the result of the present study in cattle where we found 15.2% in pastoral production system and 4.1% in agro-pastoral areas of the study districts. Not only among the study districts but also with in districts, seroprevalence of bovine brucellosis was detected to be high in pastoral area than in agro-pastoral area of the farming systems. Shirima *et al*. [18] depicted that pastoral animals were three more likely of being exposed to *Brucella* infection compared to animals in the agro-pastoral farming systems which is in agreement with the present study where we also observed that pastoral animals are more than three times more likely of being exposed to *Brucella* infection when compared to animals in the agro-pastoral farming systems. The highest prevalence observed in pastoral area, animals feed and water in large number together, is similar to observations made by several investigators [7-9, 11, 13, 19-21]. According to one finding, large herd size enhances the exposure potential, especially following abortions through increased contact and common feeding and watering points promoting transmission of *Brucella* organisms [20]. Moreover, it was explained that mobile herds have greater opportunity to come into contact with other potentially infected herds during their movement into the different areas [22].

On the other hand, the finding of low seroprevalence of bovine brucellosis in agro-pastoral farming system where crop farming is integrated to livestock husbandry practices is consistent with the previous reports of Hellmann *et al*. [20] and Maiga *et al.* [21] from Southern Sudan and Mali, respectively. Moreover, it was explained by Berhe *et al*. [11], from Ethiopia, that cattle herds in this system are small in size and sedentary with little possibility of contact with other infected herds, thus, there was less risk of acquiring the disease. In general, it was described that the incidence of brucellosis is relatively high in pastoral production systems and decreased as herd size and size of land holding decreased [2].

Similar to the result of the present study, a higher seroprevalence of bovine brucellosis in females than males was recorded by Asfaw *et al.* [7], Tolosa *et al.* [13], Kebede *et al.* [14] and Nicoletti [23]. The reason was explained by Kebede et al. [14] that males are kept for relatively shorter time duration in breeding herd than females and thus the chance of exposure is lower for males.

In this study, brucellosis seroprevalence increased with age and parity which is in agreement with the reports of Asfaw *et al.* [7], Bekele *et al.* [9], Berhe *et al.* [11], Kebede *et al.* [14] and Hellmann *et al.* [20]. It has been reported that susceptibility of cattle to *Brucella* infection is influenced by age of the individual animal. Thus, sexually matured and pregnant cattle are more susceptible to infection with *Brucella* organisms than sexually immature animals of either sex [24]. On the other hand, younger animals tend to be more resistant to infection and frequently clear infections, although latent infections could occur [5]. This may be due to the fact that sex hormones and erythritol, which stimulate the growth and multiplication of *Brucella* organisms, tend to increase in concentration with age and sexual maturity [24].

In conclusion, the seroprevalence described only using RBPT in this study shows that bovine brucellosis is a widespread and well-established infection in both pastoral and agro-pastoral farming systems of the study areas. Especially cattle herders in pastoral areas are in close contact with their animal, consumption of raw milk and handling of aborted materials is common. The authors recommend further detailed epidemiological studies to investigate the link between bovine and human brucellosis in the present study area for formulation of strategic control measures in order to reduce associated reproductive wastage and the public health risks.

ACKNOWLEDGEMENTS

The study was financially supported by Ethiopian Agricultural Research Institute. We also acknowledge the cooperation we received from the farmers and help from development agents under the Regional Agriculture and Rural Development Office. We are further grateful to Mr Eshetu, Shimellis and G/mikael in collecting the samples and especially Mr Shimellis' assistance during laboratory analysis work. We further appreciate the cooperation we received from the Adami Tulu Agricultural Research Center who facilitated the work.

REFERENCES

1. McDermott, J., F. Randolph and J. Staal, 1999. The economics of optimal health and productivity in smallholder livestock systems in developing countries. Rev. Sci. Tech. Off. int. Epiz., 18(2): 399-424.
2. McDermott, J. and S. Arimi, 2002. Brucellosis in sub-Saharan Africa: epidemiology, control and impact. Veterinary Microbiology, 90: 111-134.
3. Mangen, M., M. Otte, J. Pfeiffer and P. Chilonda, 2002. Bovine brucellosis in Sub-Saharan Africa: Estimation of seroprevalence and impact on meat and milk off take potential. Food and Agriculture Organization Livestock Information and Policy Branch, AGAL December.
4. OIE, 2008. Bovine Brucellosis. Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. Office international des Epizootics, Paris.
5. Rodostits, M., C. Gay, W. Hinchcliff and D. Constable, 2007. Veterinary Medicine, A text book of the diseases of cattle, horses, sheep, pigs and goats. 10th ed. Grafos, S.A. Arte sobre papel, Spain.
6. Schelling, E., C. Diguimbaye, J. Nicolet, P. Boerlin, M. Tanner and J. Zinsstag, 2003. Brucellosis and Q-fever seroprevalences of nomadic pastoralists and their livestock in Chad. Preventive Veterinary Medicine, 61: 279-293.
7. Asfaw, Y., B. Molla, K. Zessin and A. Tegegn, 1998. A crosssectional study on bovine brucellosis and test performance in intra and peri-urban dairy production system in and around Addis Ababa. Bulletin of Animal Health and Production in Africa, 46: 217-224.

8. Asmare, K., 2004. Epidemiology of brucellosis in cattle and its seroprevalence in animal health professionals in Sidama Zone, Southern Ethiopia. MSc Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
9. Bekele, A., B. Molla, Y. Asfaw and L. Yigezu, 2000. Bovine brucellosis in ranches and farms in southeastern Ethiopia. Bulletin of Animal Health and Production in Africa, 48: 13-17.
10. Hailemelekot, M., T. Kassa and Y. Asfaw, 2007. Seroprevalence study of bovine brucellosis in Bahir Dar milk shed, North Western Amhara Region. Ethiopian Veterinary Journal, 11(1): 49-65.
11. Berhe, G., K. Belihu and Y. Asfawu, 2007. Seroepidemiological Investigation of Bovine Brucellosis in the Extensive Cattle Production System of Tigray Region of Ethiopia. International Journal of Applied Research in Veterinary Medicine, 5(2): 65-71.
12. Eshetu, Y., J. Kassahun, P. Abebe, M. Beyene, B. Zewdie and A. Bekele, 2005. Seroprevalence Study Of Brucellosis On Dairy Cattle In Addis Ababa, Ethiopia. Bulletin of Animal Health and Production in Africa, 53(3): 211-214.
13. Tolosa, T., F. Regassa and K. Belihu, 2008. Seroprevalence Study Of Bovine Brucellosis In Extensive Management System In Selected Sites Of Jimma Zone, Western Ethiopia. Bulletin of Animal Health and Production in Africa, 56(1): 25-37.
14. Kebede, T., G. Ejeta and G. Ameni, 2008. Seroprevalence of bovine brucellosis in smallholder farms in central Ethiopia (Wuchale-Jida district). Revue de Médecine Vétérinaire, 159(1): 3-9.
15. Habtamu, T., 2004. Pastoralism and agro-pastoralism system. Proceedings of the 18th Annual Conference of the Ethiopian Veterinary Association (EVA), held in Addis Ababa, June 9-10, 2004, Ethiopia.
16. Mac Millan, A., 1990. Conventional serological tests. In: Nielson K., Duncan J.R., (eds.): Animal brucellosis, Boston, CRC Press.
17. http://www.fourmilab.ch/rpkp/experiments/analysis/chiCalc.html, Chi-Square Calculator.
18. Shirima, G., S. Cleaveland, R. Kazwala, D. Kambarage, F. Nigel, A. McMillan and Patrick, 2007. Sero-Prevalence Of Brucellosis In Smallholder Dairy, Agropastoral, Pastoral, Beef Ranch and Wildlife Animals in Tanzania. Bulletin of Animal Health and Production in Africa, 54(4): 13-22.
19. Kagumba, M. and E. Nandokha, 1978. A survey of the prevalence of bovine brucellosis in east Africa. Bulletin of Animal Health and Production in Africa, 26: 224-229.
20. Hellmann, E., C. Staak and M. Baumann, 1984. Bovine brucellosis among two different cattle populations in Bahr el Ghazal Province of Southern Sudan. Tropenmed Parasitol, 35: 123-126.
21. Maiga, S., M. Traore, M. Niang and I. Toure, 1996. Seroepidemiological investigation of bovine brucellosis in the dairying belt of Bamako, Mali. Proceedings of 18th International Conference held at Bamako, January, 1996.
22. Omer, K., G. Holstand, E. Skjerve, Z. Woldehiwet and G. MacMillian, 2000. Prevalence of antibodies to Brucella species in cattle, sheep, goats, horses and camels in the State of Eritrea, influence of husbandry system. Epidemiol. Infect., 125: 447-453.
23. Nicoletti, P., 1984. The control of brucellosis in tropical and subtropical region. Preventive Veterinary Medicine, 2: 193-196.
24. Walker, L., 1999. Brucella. In: Dwright C.H., Chunge Z.Y. (eds.) Veterinary Microbiology. Massachusetts, Black Wells Science.