Sci. Technol. Arts Res. J., Oct. - Dec. 2020, 9(4), 15-23
DOI: https://doi.org/10.20372/star.v9i4.02
ISSN: 2226-7522 (Print) and 2305-3372 (Online)
Science, Technology and Arts Research Journal
Sci. Technol. Arts Res. J., Oct. - Dec. 2020, 9(4), 15-23
Journal Homepage: https://journals.wgu.edu.et

Original Research

Prevalence of Brucellosis in Sheep and Goats in Dire District, Borana Zone, Oromia Regional State, Ethiopia

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Abstract

The cross-sectional study was conducted in Dirre district in the four pastoral areas of Borona name, Harallo, Dda-Mega, Madacho, and Mana soda. Seroprevalence and the potential risk factors associated with shoat brucellosis in the study area were determined by using serological tests. Sera samples were collected from 237 unvaccinated and apparently healthy sheep and goats. The samples were examined serologically by the Rose Bengal Plate Test (RBPT) for the first screening test and indirect ELISA for confirmation. All positive serum samples for RBPT were confirmed with indirect ELISA. Out of the total 237 samples examined serologically, 13% were screened to be positive for RBPT, and these positive samples on RBPT were retested with indirect ELISA and confirmed that 1.7% were positive as a brucellosis confirmation test. In conclusion, the current finding was slightly lower than the pooled seroprevalence estimate of brucellosis at the national level: 2.6% (95% CI: 2.2–3.0) in cattle, 4% (95% CI: 3.1–5.1) in goats, and 3% (95% CI: 2.3–3.9) in sheep. From the samples taken from four pastoral associations, the highest sero-prevalence confirmation result by indirect ELISA was recorded in Mana-Soda pastoral association 4 (6.7%), which had a statistically significant difference from other pastoral associations under the current investigation with p value = 0.017 and $\chi 2$ = 12.003; Based on sex, Sheep and goat brucellosis sero-prevalence has no statistically significant difference among male and female animals with (P =based; $\chi 2$ = 1.441). Among sheep and goat species, the indirect ELISA confirmed result was 0% (4.3%), respectively, but there was no statistically significant difference seen between these two species (P value = 0.230) and ($\chi 2$ =1.441); based on age the prevalence was higher in the adult age group (1.8%) than in the young age group (0%) with no statistically significant difference among age groups ($\chi 2$ =0.314; P value = 0.0575). The present study showed that brucellosis is more prevalent in goats than sheep and is also found in different pastoral associations, which is an indication of its endemic special distribution in the area, which needs a well-planned epidemiological study and routine testing in order to reduce its impact on reproduction and production of animals and to prevent its zoonotic transmission to humans dealing with their management and consuming their raw milk and meat.

Article Information

Article History:
Received : 10-10-2020
Revised : 16-11-2020
Accepted : 26-12-2020

Keywords:
Brucellosis, Dirre, ELISA, Goat, RBP, Sheep

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INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa, with a livestock population of 53.99 million cattle, 49.56 million small ruminants, 9.01 million equines, and 50.38 million chickens (CSA 2012). The livestock industry plays an important role in the economy of the country. In addition, human life is highly associated with the livestock populations in the different livestock production systems, particularly in pastoral communities. Megersa B. *et al.,* 2011. The threat of zoonotic diseases for humans is high; of this zoonotic disease, brucellosis is the one affecting both humans and livestock. In both pastoral and mixed (agro-pastoral) livestock production systems, people live closely with livestock, making contact with different animal discharges and consumption of raw animal products, which leads to a high incidence of brucellosis and, thus, a higher risk of acquiring the infection (Habtamu *et al.,* 2015; Terefe *et al.,* 2017)

Consumption of contaminated foods and occupational contact remain the main sources of Brucella infection in humans (Annapurna SA, 2012). The disease is considered one of the most widely spread zoonoses in the world (Corbel, 2006). 6 Different studies (Kassahun et al., 2006; Tolosa *et al.*, 2007; Animut et al., 2009; Tibeso *et al.,* 2012) have indicated that brucellosis is prevalent in Ethiopia. The spread of this disease can also occur through penetration of the intact skin and conjunctivitis, contamination of the udder during milking, grazing on infected pasture or consuming other feed with infected cows, and contact with aborted foetuses and infected newborn calves (Radostits *et al.,* 2000). In both pastoral and mixed (agro-pastoral) livestock production systems, people have contacts with livestock and livestock products and discharges and consume raw animal products. This could enhance the incidence of brucellosis infection (Habtamu *et al.,* 2015; Terefe *et al.,* 2017).

Infected animals are left unknown, become a source of diseases for humans, and continue to transmit diseases. The disease is widespread and established in small ruminants and humans in Dirre district (Shimelis, 2008). Because of traditional husbandry and poor management practices, the same grazing area for different species of animals, letting aborted material into the environment, and unrestricted movement of animals were thought to support the spread of the disease between animals as well as humans in the study area. The current status of the disease in sheep and goats is not known in Dirre District, hence this study is planned to be undertaken with objectives.

1. To assess the sero-prevalence of brucellosis in sheep and goats in the study area
2. To study the risk factors associated with sheep and goat brucellosis distribution in the study area
3. To study the zoonotic importance of brucellosis in the study area.

MATERIAL AND METHODS

Descriptions of study area

The study was conducted from October 2019 to December 2019 in the dire district of Borana zone, Oromia regional state, about 670 km from Addis Ababa. Dire districts are agro-ecologically

lowland and midland areas with an elevation ranging from 1100-1857 meters above sea level (masl). The average annual rainfall ranges from 300 300-700 mm mainly received in the long rainy season (Ganna) from April to June and in a short rainy season (Hagayyaa) from September to November. Relatively, the altitude of Dire district is high, with moderate grain production when sufficient rain is available. As a result, farming practices are common around Mega Town in Dire District. Other remaining Pastoral Associations are pastoralists with sedentary, transhumant, and movements of pastoralists for water and grazing.

Study population

Goats and sheep of all age groups and sexes in the study area are managed under the pastoral production system, which is our study population. They are multi-functional since the community has the habit of consuming goat and sheep milk. The animals were extensively managed, and with no extra feed supplement, they adapted to the harsh environment. The male population in the flock is small in number because the males are mostly sold, and only a few remain for breeding purposes.

Study design

The cross-sectional study and random sampling of the study animals' was conducted in Dirre district in the Borana zone. The district was selected purposefully with the aim of determining the prevalence of brucellosis in pastoral goats and sheep. Questionnaires and serological tests (surveys) were used as tools to determine the prevalence and assess the associated risk factors. The selection of the Pastoral Associations (Pas) was based on a random sampling of households. From each of the four PAs selected, households were again randomly selected. Then the study animals were selected randomly. Sex and age were considered potential risk factors for the occurrence of brucellosis in goats and sheep, which were randomly selected from the study population.

Sample size determination and sampling

To calculate the total sample size, the Thrust Field (2005) formula was used.

The sample size for this survey was calculated using the Thrusfield formula.

$$n = \frac{1.96^2 (P\text{exp}(1-P\text{exp})..}{d^2}$$

Where n is the required sample size, P_{exp} is the expected prevalence, and d is the desired absolute precision at 5%. From previous study in the other similar study areas 'p' the expected prevalence of brucellosis was supposed to be 8.8%. Accordingly, the sample size computed was 123 sheep and goats serum samples, but to increase the level of precision, the sample was increased to 246 samples were planned to be taken, but finally, we could sample only 237 samples from the district then three PA were randomly selected from the district and 60blood samples were collected randomly from first and second PAS selected while we could sample only 57 from the third PA selected for this study.

Sample Collection

From all the randomly selected sheep and goats in the study area, serum was collected from jugular veins using disposable needles and plain vacationer tubes aseptically. About 8 ml of blood was collected from each animal

and allowed to clot at room temperature. Finally, serum was separated from clotted blood by decanting it into plastic crumple vials. After 24 hours, serums were labelled, properly packed, put in an ice box for cold chain maintenance, transported to the laboratory, and submitted and stored at -20 ℃ for serological testing by RBPLT and indirect ELISA at Yabello Regional Veterinary Laboratory. The preserved samples were tested using RBPT for screening and ELISA for confirmation. Then, all the RBPT test-positive sera were serially tested for confirmation of the serm for brucellosis sero positivity, and the results are shown in Table 1 below.

Figure 1 *Staffs on field preparing for blood sampling in Dirre district*

Figure 2 *Blood Sampling from Jugular Vein of Goats*

RESULTS

RBPT

From all the 237 sheep and goats sampled for sera extraction (175 goats and 62 sheep) screened by RBT, 31 (13%) were found to be positive. From 175 sera taken from goats, 26 (14.9%) were found positive, and from 62 sera taken from ovine, 5 (8.1%) were found positive for RBPT. Overall, 201 (84.81%) animals were found negative for serum tests. Among the goats analysed, 149 (85.14%) were tested negative for brucellosis, whereas 57 (91.9%) of the sheep samples were tested negative for brucellosis by RBPT. Among the 209 females sampled, 30 were positive, but only one of the 27 male animals was positive, according to RBPT. When we compare the sex and age of the animals studied, a high prevalence was found in females at 179 (85.6%), while it was 26 (96.3%) for male animals. While comparing among age groups, a higher prevalence was found in adults than in young animals, with a prevalence of 190 (86.4%) and 16 (94.1%), respectively, as shown in Table 1&2 below.

Indirect ELISA Result

Out of 237 sera taken from sheep and goats, 175 (goats) and 62 (sheep) were screened by indirect ELISA, and 4 (1.7%) animals were found to be positive. From 175 sera taken from goats, 4 (2.3%) animals were found positive; the remaining 171 (97.7%) animals were confirmed to be negative, and from 62 sera taken from sheep (62) sampled, all of them animals were found negative for brucellosis by indirect ELISA. The case was more profoundly common in females: from 209 females, 3 (1.4%) females became positive, and from 27 males, only one animal became positive by indirect ELISA. And also, when we compare within age and sex, high prevalence was more common in adult females (4 (1.8%)) than in young females (3 (1.3%)), respectively, as shown in Table 1 below, and there was only one confirmation test for male animals in general by the ELISA Test.

Table 1

Sheep and goat Brucellosis prevalence in selected PA Dire districts of Borana

Factors		RBPT			ELISA		
		No tested	negative	positive	No tested	negative	positive
	D/Mega	60	50(24.3%)	10(16.7%)	60	60(100%)	0
PA	Harallo	58	53(91.4%)	5(8.6%)	58	58	0
	Madhacho	59	50(84.7%)	9(15.3%)	59	59	0
	Soda	60	53(88.3%)	7(11.7%)	60	56(93.3%)	4(6.7%)
Specious	Caprine	175	149(85.1%)	26(14.9%)	175	171(97.7%)	4(2.3%)
	Ovine	62	57(91.9%)	5(8.1%)	62	62(100%)	0
Age	Adult	220	190(86.4%)	30(13.6%)	220	216(98.2%)	4(1.8%)
	Young	17	16(94.1%)	1(5.9%)	17	17(100%)	0
Sex	Female	209	179(85.6%)	30(14.4%)	209	206(98.6%)	3(1.4%)
	Male	27	26(96.3%)	1(3.7%)	27	26(96.3%)	1(3.7%)

Table 2

Pearson Chi-Square and p value of Risk factors associated with Sheep and goat brucellosis at 95 CI, 5% precision of serological tests

Factors		Chi-Square	p value	significance
Peasant association	RBPT	8.256	0.083	Not significant
	ELISA	12.003	0.017	Significant
	RBPT	1.858	0.173	Not significant
Specious	ELISA	1.441	0.230	Not significant
Age	RBPT	0.835	0.361	Not significant
	ELISA	0.314	0.575	Not significant
Sex	RBPT	2.537	0.281	Not significant
	ELISA	0.759	0.684	Not significant

DISCUSSION

The overall seroprevalence of sheep and goat brucellosis in Dire district of Borana zone was confirmed to be 1.7% by using an ELISA confirmatory test. The current study conducted in four pastoral associations in the dire district, namely Harallo, Dida-Mega, Madacho, and Mana-Soda, confirmed that sheep and goat brucellosis is a prevalent disease in the area. The sero prevalence of sheep and goat brucellosis found in the current study (1.7%) is different from other sero prevalence studies reported by other researchers in the same study area. The current sero-prevalence was lower than the 8.8% (95% CI: 5.4–13.2) previously reported by Wushet (2020) and higher than the zero sero-prevalence reported by Asamenew et al. (2020).

CONCLUSIONS

This difference could be due to differences during sampling, sample preservation methods, the dynamic nature of the herd population in which infected animals might be culled or introduced to the area, or it might be due to study design problems that might not randomly include all the animals to be included under normal random population and disease distribution scenarios. Concerning the risk factors, the study area showed a significant difference (P is less than 0.005) and was believed to affect the occurrence of brucellosis among sheep and goats. From the current study, it seems that the incidence of brucellosis in sheep and goats in the study districts could cause efficient reproduction and production of sheep and goats in the area. It might also pose a public health threat as the disease is zoonotic, which might hamper raw milk and meat consumption and lead to decreased income for the farmers. Traditional husbandry and poor management practices, mixing with other animals, sharing breeding bulls, and the existing habit of raw milk consumption and close contact with animals can spread the disease from animals to humans in the study area. Therefore, based on the above conclusion, the following recommendations are forwarded:

Recommendations

- Routine testing and culling of sero-positive animals based on confirmatory test results should be practiced.
- Public health education on improved animal management and the risk of zoonotic transmission to humans should be provided to the herding community.
- Herd owners should manage their flocks separately as much as possible.
- Owners shouldn't buy animals with an abortion history and should request confirmatory testing during massive restocking if possible.
- They should avoid bare-handed handling of aborted materials of shoat and should safely dispose of them on a drugged ground where dogs and other carnivores couldn't reach them.
- They should avoid the habit of drinking raw shoat milk and eating raw shoat meat to control zoonotic transmissions.
- Further epidemiological studies should be performed in the entire Borana zone on sheep and goat brucellosis to depict its epidemiological trend and give rational recommendations to prevent and control the disease.

ACKNOWLEDGEMENTS

We acknowledge the Oromia Regional State Agricultural Development Bureau, the Oromia Finance and Economic Development Bureau, the Oromia Pastoral Area Development Commission, the Ethiopian Biodiversity Institute Veterinary Diagnostic Laboratory, and Wollega University for their overall support. Our special acknowledgement is for our colleagues, Huqa Liban and Mekonnen Belete from Yaballo Regional Veterinary Laboratory, whose technical support during the field survey and laboratory test was vital for this research work to be completed. We also thank the pastoralists in the Dirre district who collaborated with us in allowing the animals to be tested and consented to the questionnaire survey.

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