

Sero-Prevalence of Brucellosis in Goats Purchased for Slaughter in Selected Export Abattoirs, Ethiopia

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Abstract: A cross sectional study was conducted from November 2014 to April 2015 to determine the sero-prevalence of brucellosis in selected sheep and goat product export abattoirs and to assess the possible association of different epidemiological risk factors with the occurrence of the disease. A total of 450 sera were collected from goats in those selected export abattoirs, using systematic random sampling technique. Rose Bengal Plate Test was used as a screening test and detected 1.56% (N=7) of the samples as sero positive. Up on further testing by CFT for confirmation, only 1.11% (N=5) of the samples were positive. In this study there was no statistically significant relationship observed between the risk factors like age, origin and sex ($P>0.05$), although higher prevalence was observed in adults (1.97%), but statistically significant relationship was observed between sero-prevalence and body condition of animals, where higher prevalence was observed in poor body conditioned goats ($p<0.05$). Even though the overall prevalence observed in this study was relatively low, the finding still has the capability to indicate the presence of the disease and the importance of intervention in the areas from which the goats are supplied or produced as there is risk of spread of the disease which is economically important. Prevalence of the disease in those export abattoirs may lead to prohibition of export of slaughtered goats to Middle East and other countries to preclude risk of zoonosis. This in turn results in loss of income from the export sector. Therefore, awareness creation for animal owners and implementation of strategic control measure is necessary to prevent further spread of the disease in the study area.

Key words: Brucellosis • CFT • Abattoirs • Goats • RBPT • Cross Sectional

INTRODUCTION

Ethiopia is an agricultural based country and owns huge number of small ruminants, estimated to be 48.2 million head of sheep and goats [1]. Of the total number of goats (about 21.7 million head), 70% are found in low land pastoral areas. This is because they are well adapted to hot and dry conditions and provide golden opportunity to alternatively exploit the potential of pastoral areas. Goats are highly adapted to broad range of environmental conditions. Moreover, low cost of production, requirement of little land and higher prolificacy made them attractive assets for development. This makes investment in these animals avoid losses due to high inflation rates that are found in unstable

economies of many underdeveloped countries like Ethiopia. This is because sheep and goats provide rapid cash turnover [2].

The small ruminants and their meat/milk products represent an important export commodity, which significantly contribute to the national economy. Goats together with sheep contribute to a quarter of the domestic meat consumption; about half of the domestic wool requirements; about 40% of fresh skins and 92% of the value of semi- processed skin and hide export trade. It is estimated that 1,078,000 sheep and 1,128,000 goats are used in Ethiopia for domestic consumption annually. There is also a growing export market for sheep and goats meat in the Middle Eastern Gulf states and some African countries. At optimum off take rates, Ethiopia can export

700,000 sheep and 2 million goats annually and at the same time supply 1,078,000 sheep and 1,128,000 goats for the domestic market [3].

Even though this sector contributes much to the national economy, its development is hampered by different constraints. The most important constraints to small ruminant production are poor management system, low genetic endowment and wide spread endemic diseases. Among many factors that limit economic return from small ruminants, reproductive diseases including brucellosis are the major disease constraints [4].

Brucellosis is an infectious bacterial zoonotic disease caused by member of genus *Brucella*. The disease is primary reproductive disease clinically characterized by abortion in the last trimester and retained placenta in females whereas orchitis and epididymitis with frequent sterility in males [5]. The incidence of the disease in humans is thus closely tied to the prevalence of the infection in sheep, goats and cattle and practices that allow exposure of humans to potentially infected animals or their products [6].

Despite the presence of larger population of small ruminants in different regions of Ethiopia, very limited researches are done on brucellosis. The sero-prevalence of brucellosis in goat was variably reported in different parts of the country. Among this; Prevalence of 4.8% from Afar region [7], 9.7% from Afar and Somali region [8], 3.2% from Southern Ethiopia region [9], 2.12% in some export abattoirs were reported [2]. Occurrence of such disease might result in loss of income from prohibition of export of live animals and their products due to its public health significance. Therefore, it was found important to study brucellosis in goats purchased for slaughter in those selected export abattoirs with the objective of determining the sero-prevalence of brucellosis in goats in those selected export abattoirs and assessing some of the possible epidemiological risk factors that might contribute for the occurrence of brucellosis in goats.

MATERIALS AND METHODS

Study Area: The study was conducted in some selected export abattoirs found in Debre-Zeit and Modjo town. Debre-Zeit is located between latitude of 8°45' N and longitude of 38° 59' E and it is 47.9 km South East of Addis Ababa, the capital city of Ethiopia, While Modjo town is the center of Lume district in Eastern Shewa Administrative Zone of Oromia Regional State. It is located 70 kilometers south east of Addis Ababa 8°N and 39°E at an altitude of 1777 meter above sea level [10].

The animals were supplied from different parts of the country. For most of the areas the average annual rainfall range from 400 to 700 mm and with the mean daily temperature is 25-44°C, while for few others rain fall pattern can be characterized as erratic, unreliable and unpredictable with average rain fall of 200 mm. average daily temperature of 28-44°C [1].

Study Population: About 450 sera were collected from goats that were purchased for slaughter. All the study animals were male and unvaccinated against *Brucella*. The origins of the animals were different areas in the country, Ethiopia. The animals were purchased from farmers on weight basis and certain weight ranges were approved depending on the customers' preferences. The study animals were with different age category mainly within a range of 1-4 years. Their age was determined based on their dental eruption patterns. In general goats were classified as young and adult i.e., young if 1-3 years old and having up to four permanent teeth and adult if 4-5 years and greater than four permanent teeth [11].

Sampling Method and Sample Size: The sampling method employed was systematic random sampling by choosing the first case and the interval between cases with lottery method. The sample size was determined according to Thrusfield [12] as indicated below. Previous study conducted by Nigatu *et al.* [2] On the prevalence of brucellosis in goats in the same area showed 2.12%. Therefore, using 2.12% as expected prevalence and 5% absolute precision at 95% confidence level, the number of animals needed in the study was 32. However, to increase the level of precision of the prevalence, the sample size was increased to about 14 folds i.e. 450.

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

where:

n = sample size

Pexp = expected prevalence

d = desired absolute precision

Data Recording: While collecting the blood specimens from study animals, we recorded the data corresponding to each animal such as origin, body condition, species, sex and age in pre designed recording sheet

Blood Sample Collection: About 10ml of blood was collected from the jugular vein of each goat using sterile plain vacutainer tubes and needles. Each sample was

labeled using codes describing the specific animal. Blood was allowed to clot for 1-2 hours at room temperature, stored in slant position overnight at 4°C then serum was separated from clotted blood. Separated serum was collected in a screw capped sterilized plastic vial and was stored at -20°C until tested.

Laboratory techniques

Rose Bengal Plate Test (RBPT): Rose Bengal Plate Test (RBPT) was used as a screening test for presence of *Brucella* antibody in the serum samples collected, according to the procedure described by OIE, [13]. The test was carried out at the National Animal Health Diagnostic and Investigation Center (NAHDIC), Sebeta, Ethiopia which is certified for ISO/IEC 1705/25.

Complement Fixation Test (CFT): All the RBPT positive sera were re-tested using CFT (also carried out at NAHDIC) for further confirmation according to the protocol described in OIE manual [13]. Standard *B. abortus* antigen (0.2 CH 63) which was supplied from AHVLA was used for CFT to confirm the presence of anti-*Brucella* antibodies in the sera.

Data Management and Analysis: Data collected from abattoirs and obtained in laboratory were entered into a computer, on Microsoft Excel spread sheet. Statistical analysis (descriptive analysis) was performed using ‘Statistical Package for the Social Sciences’ (SPSS) version 16. The degree of association between each risk factor was assessed using the Chi-square (χ^2) test. For all analyses, a *p*-value of less than 0.05 was taken as significant.

RESULTS

A total of 450 sera were tested for the presence of serum antibodies against *Brucella* infection in goats in those selected export abattoirs. Seven sera were found positive to RBPT; up on re- testing of these samples for confirmation using CFT, only five sera were found to be positive.

Sero-prevalence of 2% (1 out of 50), 0% (0 out of 50), 1% (1 out of 100), 1.3% (2 out of 150) and 1% (1 out of 100) was recorded in Abattoir 1, 2, 3, 4 and 5 respectively. The difference was not statistically significant ($p > 0.05$) (Table-4).

Table 5: Sero -prevalence of brucellosis in goats in relation to Abattoirs in selected export abattoirs, Ethiopia

Abattoirs	Number of Samples tested	RBPT		CFT	
		Negative	Positive	Negative	Positive
Abt-1	50	49	1(2%)	49	1(2%)
Abt-2	50	50	0(0%)	50	0(0%)
Abt-3	100	98	2(2%)	99	1(1%)
Abt-4	150	147	3(2%)	148	2(1.3%)
Abt-5		100	99	1(1%)	99
Total	450	443(98.4%)	7(1.56%)	445(98.9%)	5(1.1%)

$\chi^2 (4) = 1.379$, $P = 0.848$ $\chi^2 (4) = 1.011$, $P = 0.908$

Remark: - “Abt 1-5”= code for abattoir 1 to 5

Table 6: Sero -prevalence of Brucellosis in goats in relation to Age in selected export abattoirs, Ethiopia

Age category	Number of animals	RBPT		CFT positive	
		Negative	Positive	Negative	Positive
Young	247	245	2(0.8%)	246	1(0.4%)
Adult	203	198	5(2.46%)	199	4(1.97%)
Total	450	443	7(1.56%)	445	5(1.11%)

$\chi^2 (1) = 1.989$, $P = 0.158$ $\chi^2 (1) = 2.486$, $P = 0.115$

OR (adult) = 3.093 OR (adult) = 4.945

Table 7: Sero-prevalence of brucellosis in goats in relation to body condition in selected Export abattoirs, Ethiopia

Body condition	Number of animals	RBPT		CFT	
		Negative	Positive	Negative	Positive
Poor	31	25	6(19.35%)	26	5(16.1%)
Medium	118	117	1(0.8%)	118	0 (0%)
Good	301	301	0(0%)	301	0 (0%)
Total	450	443	7(1.56%)	445	5(1.11%)

$\chi^2 (2) = 69.27$, $P = 0.00$ $\chi^2 (2) = 68.34$, $P = 0.00$

Table 8: Sero-prevalence of brucellosis in relation to origin of animal in selected export abattoirs, Ethiopia

Origin	Number of animals	RBPT		CFT	
		Negative	Positive	Negative	Positive
Boran	122	119	3(2.45%)	120	2(1.63%)
Arbaminch	104	101	3(2.88%)	101	3(2.88%)
Somali	111	110	1(0.90%)	111	0 (0%)
Harar	113	113	0(0%)	113	0 (0%)
Total	450	447	7(1.56%)	445	5(1.1%)

$\chi^2 (3) = 3.94, P = 0.267$ $\chi^2 (3) = 5.804, P = 0.122$

Sero-prevalence of 0.4% (1 out of 247) and 1.97% (4 out of 203) was observed in young and adult goats, respectively and the difference in prevalence was not statistically significant (Table-5).

Sero-prevalence of 16.1% (5 out of 31), 0% (0 of 118) and 0% (0 out of 301) were observed, in poor, medium and good body conditioned goats respectively. The difference in prevalence is statistically highly significant ($p < 0.05$) (Table 6).

Sero-prevalence of 1.63% (2 out of 122), 2.9% (3 out of 104), 0% (0 out of 111) and 0% (0 out of 113) were recorded in Boran, Arbaminch, Somali and Harar respectively. The difference in prevalence was not statistically significant ($p > 0.05$) (Table 7).

DISCUSSION

The present study indicated that, the overall sero-prevalence of brucellosis in goats in those selected export abattoirs to be 1.56% (N=7) with RBPT and 1.11% (N=5) with CFT. Two of the samples tested positive for brucella antibodies by RBPT, tested negative by CFT. This could be due to cross-reactions between *Brucella* and other bacteria which share similar epitopes, which might result in false positive result [14].

A 1.11% CFT confirmed finding of this study was in line with previous studies conducted by Bamaïyi *et al.* [15], who reported sero-prevalence of 0.91% in goats from Malaysia and Ferede *et al.* [16] who reported a sero-prevalence of 0.87% in goat from Bahir Dar.

The sero-prevalence of Brucellosis in goats in this study was lower than most of the sero-prevalence reported by different previous studies i.e. lower than studies by: Yibeltal, [17] who documented a prevalence of 16% in Afar region, Mengistu *et al.* [9] who reported 3.2% prevalence in goats in southern Ethiopia, Ashenafi *et al.* [6] who reported a sero-prevalence of 5.8% in goats of pastoral regions of Afar, Bekele [18] who reported 2% sero-prevalence in goats in Jijiga, Dabassa *et al.* [19] who documented 1.88% in goats in Yabello district and Nigatu

et al. [2] who reported 2.12% sero-prevalence and Tsehay *et al.* [20] who reported 3.09% sero-prevalence in goats of pastoral areas of Somali and Oromia region.

The difference in the sero-prevalence of brucellosis between the current and previous studies might be due to difference in geographical location of sampled animals since abattoirs purchased both from highlands and lowlands of various regions, sample size and/or the test protocols used in the study.

A 1.11% CFT confirmed prevalence of this study appeared generally to be low when compared with most previous studies involving both female and male animals. This might be because of infected male animals are usually observed to be non reactors to serological tests due to low antibody titer [21] and because serological tests under estimate brucellosis in males due to the colonization of the bacteria in the testes and reticulo-endothelial system [22].

Since all study animals were caprine, male (due to unslaughter of female animals in those export abattoirs) and local breeds, no statistics had been computed on species, sex and breed. However, comparison of sero-prevalence of caprine brucellosis was carried out for different epidemiological risk factors like origin, age and body condition of goats. Accordingly, there were no statistically significant variations observed between brucellosis sero-prevalence and origin of the animals ($P > 0.05$). This might be due to similarity of the geographical nature of the areas from which the animals were sourced and sampled.

However prevalence rate varied significantly ($p < 0.05$) with body conditions in which higher prevalence was observed in poor body conditioned goats than that of medium and good body conditioned ones. This variation may be due to the possible associations of higher prevalence of brucellosis occurrence in the presence of various infectious diseases that can lead to the reduction of body weight, such as tuberculosis [23]. The prevalence of goat brucellosis in young animals in this study was 0.40% (1 out of 247), while that of adults

was 1.97% (4 out of 203). In fact *B.melitensis* causes disease only in adult (sexually mature) females and males. Young animals may be infected but do not show any clinical sign and generally show only a weak and transient serological response [24].

Statistical analysis of the data showed that there was no significant difference in sero-prevalence of *Brucella* antibodies between age groups, though older age group showed relatively higher prevalence. This finding was in agreement with previous reports of Tsehay *et al.* [20] and Nigatu *et al.* [2] who did not observe statistically significant difference between the sero-prevalence of brucellosis and age. Ashenafi *et al.* [7] also reported a higher prevalence of brucellosis in adult goats in pastoral region of Afar, than younger ones which was in agreement with this study, however statistically significant relation was recorded between sero prevalence of brucellosis and age category ($p < 0.05$). This difference might be due to variations in sample size and sample collection areas.

CONCLUSION

Brucellosis is one of the “neglected diseases of poverty” which is endemic zoonotic disease that is found primarily in impoverished parts of the world. In the present study, relatively low number of sero-reactors was identified in those export abattoirs. Even though no statically significant difference were recorded in the prevalence rates between the categories of each risk factors tested, there was a statistically highly significant difference on the prevalence rate of brucellosis among different categories of body conditions, where the disease was highly prevalent in poor conditioned goats than medium and good conditioned ones.

Though the causative agent, *Brucella* is not resistant to mild unfavorable environmental conditions and may die at lower pH of meat, positive sero-reactors existence in those animals subjected for slaughter may lead to ban of export of meat and meat-products to avoid zoonotic risks. Therefore it is recommended to perform screening tests in goats that are supplied to abattoirs before slaughtering process, improve awareness of animal owners about the risk of brucellosis, to undertake further and detail epidemiological study in those areas that supply livestock for export abattoirs to know the level and the trend of the disease dynamics and to estimate the economic significance of the disease, further more for both human

and animal brucellosis, extension services should include emphasis on addressing the impacts of risk factors for the occurrence of brucellosis and interdisciplinary collaboration and joint ventures among health and related professionals is of paramount importance to control this disease that currently perpetuates poverty.

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