

*Full Length Research Paper*

# Prevalence of bovine tuberculosis in Arsi Zones of Oromia, Ethiopia

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**A study to determine the prevalence of bovine tuberculosis (TB) was conducted on 625 animals (140 local Arsi cattle breeds and 485 of their crosses with pure Holstein Friesians) randomly selected from four districts of Arsi Zone and West Arsi Zone, Oromia, Ethiopia, using comparative intradermal tuberculin (CIT) test. An overall individual animal prevalence of 12.16% was recorded under traditional animal husbandry system in the study area. The higher percentage of positive results in tested animals was recorded in Arsi Zone (15.8%) and the lower percentage of positive results was found in the West Arsi Zone (8.9%). There was statistically significant difference ( $X^2 = 5.44$ ; P-value = 0.0196) in individual prevalence between the two Zones. Other epidemiological risk factors including age, sex, breed, and reproductive status of the animals were assessed for their contribution to the prevalence of the disease. Accordingly, a statistically significant ( $X^2 = 4.49$ , P-value = 0.0340) difference was found only between the type of animal breeds and their reactivity to the tuberculin test but not for other epidemiological factors. This study therefore, showed that bovine TB was present in Arsi Zone and West Arsi Zone, Oromia. This calls for a further detail study on farmers' awareness regarding its transmission and zoonotic potential; and the formulation of strategic control measures by the relevant animal health agencies to reduce the associated economic and zoonotic effects.**

**Key words:** Bovine tuberculosis, Arsi zones – Oromia, comparative intradermal tuberculin (CIT) test, prevalence, risk factors.

## INTRODUCTION

Bovine Tuberculosis (TB) is a chronic bacterial disease of animals and humans caused by *Mycobacterium bovis*. In a large number of countries bovine TB is a major infectious disease among cattle, other domesticated animals, and certain wildlife populations (OIE, 2009). Bovine TB is considered by the World Organization for Animal Health (OIE) to be an important zoonotic disease of major socio-economic and public health importance, with an impact on international trade of live animals and animal products. Bovine TB remains one of the most

devastating diseases of cattle in developing countries throughout the world. The disease is important not only because of its detrimental effect on animal production, but also for public health reasons due to close proximity of people with cattle and usually very low standard of hygiene when handling animal products (Radostits et al., 2007).

Ethiopia has ~40 million cattle, the largest cattle population in Africa and the seventh in size in the world (Ethiopian Ministry of Agriculture and Rural Development; <http://www.moard.gov.et/statistical.htm>). In contrast to the huge livestock resource, the livestock productivity is however found to be very low. The major biological and socio-economical factors attributing to the low productivity includes: the low genetic potential and performance, poor nutrition (in quality and quantity terms), the prevailing of different kind of diseases, traditional way of husbandry systems and inadequate

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**Abbreviations:** TB, Tuberculosis; CIT, comparative intradermal tuberculin; PPD, purified protein derivative.

skilled manpower, among others. Ethiopia is one of the African countries where TB is wide spread in both humans and cattle and the endemic nature of TB in humans and cattle has long been documented (Shitaye et al., 2007).

In Ethiopia, detection of bovine TB is done most commonly on the basis of tuberculin skin testing, abattoir meat inspection and very rarely on bacteriological techniques. Studies conducted in different parts of the country indicated an average prevalence rate of 15% bovine TB, ranging from 3.4% in small holder production system up to 50% in intensive dairy productions (Ameni and Roger, 1998; Ameni et al., 2002; Assegid et al., 2000). Though several studies have been done to determine the prevalence of bovine TB in cattle in different areas or zones of Ethiopia (Ameni et al., 2001; Kiros, 1998; Assegid et al., 2000; Ameni et al., 2002; Ameni and Erkihun, 2007; Laval and Ameni, 2004; Ameni and Wudie, 2003), the extent of the disease under traditional animal husbandry system in Arsi zones (Arsi and West Arsi) of Oromia is not known. Most of the Arsi farmers are still keeping cattle using the traditional animal husbandry system. This segment of the population consumes animal products raw and often shares the same sheltering with animals. This study was formulated, therefore, to investigate the prevalence of bovine TB and identify the associated risk factors under traditional animal husbandry system in Arsi Zones of Oromia, Ethiopia.

## MATERIALS AND METHODS

### Study subjects and sampling

The study was conducted in Arsi Zones (Arsi and West Arsi) of Oromia, Ethiopia, located at distances of 175 – 255 km south-east and south of Addis Ababa at 7°57'N and 39°7'E with an altitude of 2430 m above sea level to 7°21' N and 38°42' E at an altitude of 2322 m above sea level, respectively. Agricultural production system of the study area is of mixed crop and livestock production. Dairy farming using improved breeds is a common practice in urban and peri-urban areas. In rural areas, mainly local breeds are found, grazing on communal land under traditional animal husbandry system (KARC, 2008). The study districts were selected purposively based on their livestock population (both local and crossbred types) and ease of their accessibility. A total of 625 cattle (327 animals from West Arsi Zone – Shashamane and Arsi Negele districts; and 298 animals from Arsi Zone – Bokoji and Tiyo districts) were randomly selected from all the study districts of which 140 were local Arsi breed whereas 485 were crossbred cattle from Holstein Friesian and local Arsi breeds. 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 less or equal to 2 years and greater or equal to 6 months of age represents young animals.

### Comparative intradermal tuberculin (CIT) test

The animal's skin was shaved at two sites (12 cm apart) on the right-hand side of the mid-neck area. The skin thickness was

measured with calipers before the tuberculin was injected. Aliquots of 0.1 ml of 2,500 international units (IU) per millilitre (ml) of bovine purified protein derivative (PPD) (Veterinary Laboratories Agency, Addlestone, United Kingdom), and 0.1 ml of 2,500 IU/ml of avian PPD (Veterinary Laboratories Agency, Addlestone) were injected into the dermis at these sites. After 72 h, the thickness of the skin at the injection sites was measured, using calipers. The results were interpreted in accordance with the recommendations of the OIE (OIE, 2009). Briefly, when the change in skin thickness was greater at the avian PPD injection site, the animal was considered positive for mycobacterial species other than the mammalian type (*M. tuberculosis* and *M. bovis*). However, when an increase in thickness was observed at both sites, the difference in thickness was considered. Thus, if the increase in thickness at the injection site for bovine PPD (B) was greater than that at the avian PPD site (A), and if B minus A was less than 2 mm, the animal was classified as negative for bovine TB. If B minus A was between 2 and 4 mm, or above 4 mm, the animal was classified as either suspect/doubtful, or positive, respectively.

### Data analysis

The individual animal prevalence level was defined as the number of positive reactors per 100 animals tested. Categorical variables (districts, zones, sex, age, physiological status and breed type) were expressed in percentages. The degree of association between or among each risk factor was assessed using the Chi-square ( $\chi^2$ ) test. For all analyses, a p-value of less than 0.05 was taken as statistically significant (<http://www.fourmilab.ch/rpkp/experiments/analysis/chiCalc.html>, Chi-Square Calculator).

## RESULTS

The tuberculin skin test conducted in the study areas indicated that from 625 animals tested 76 (12.16%) animals were found positive for bovine TB (Table 1). The higher percentage of positive results in tested animals was recorded in Arsi Zone (15.8%) where as the lower percentage of positive results was found in the West Arsi Zone (8.9%).

In this study, the effect of different kind of risk factors (like breed type, sex, age and others) for the occurrence of bovine TB was investigated. Accordingly, even though there was no significance difference between both sexes a higher prevalence of bovine TB in female animals were recorded at Bokoji, Tiyo, Shashemane and Arsi Negele districts with 17.50, 16.2, 10.8 and 9.2%, respectively (Tables 1, 2, 3 and 4). Out of 22.4% of the local Arsi breed animals tested 6.43% (9/140) were found to be positive for the disease whereas it was 13.8% (67/485) in crossbred cattle from Holstein Friesian and local Arsi breeds revealing a statistically significant association between the type of animal breeds and their reactivity to the tuberculin test ( $X^2 = 4.49$ , P-value = 0.0340).

The difference in reactivity to the CIDT test among females at different reproductive status was statistically significant ( $X^2 = 9.14$ , P-value = 0.0025) showing higher prevalence of bovine TB in pregnant animals when compared to the non pregnant ones: (25.5, 11.6)%, (23.2, 10.8)%, (16.4, 7.14)%, (12.8, 7.50)% at Bokoji, Tiyo,

**Table 1.** Results of the CIT test of bovine TB in four districts of Arsi Zones of Oromia, Ethiopia.

Zones	Number tested	Number of positive results (No. and %)	X <sup>2</sup> (P-value)
<b>West Arsi Zone</b>			
Shashamane district	155	15(9.68)	0.2(0.6547)
Arsi Negele district	172	14(8.14)	
<b>Arsi Zone</b>			
Bokoji district	155	25(16.13)	0.02(0.8875)
Tiyo district	143	22(15.38)	
Total	625	76(12.16)	

X<sup>2</sup> = 5.44; P-value = 0.0196.

**Table 2.** Distribution of CIT test positive animals in relation to various risk factors in Shashemane district of West Arsi Zone of Oromia, Ethiopia.

Categorical variable	Number tested	Number of positive results (No. and %)	X <sup>2</sup> (P-value)
<b>Age</b>			
Adult cow	95	11(11.58)	0.89(0.3454)
Young (bull and heifer)	60	4(6.67)	
<b>Sex</b>			
Male	16	0(0.00)	1.71(0.1909)
Female	139	15(10.79)	
<b>Breed</b>			
Local	22	1(4.54)	0.66(0.4165)
Crossbred	133	14(10.53)	
<b>Reproductive status</b>			
Pregnant	55	9(16.36)	2.32(0.1277)
Non-pregnant	84	6(7.14)	
Total	155	15(9.68)	

Shashemane and Arsi Negele districts, respectively. Tables 5

## DISCUSSION

This study demonstrated that the overall individual animal prevalence of bovine TB in Arsi Zones of Oromia, Ethiopia, was 12.16% by using CIT test. This is within the array reported by the previous studies conducted in other parts of the country that indicated an average prevalence rate of 15% bovine TB ranging from 3.4% in small holder production system up to 50% in intensive dairy productions (Ameni and Roger, 1998; Ameni et al., 2002; Ameni and Erkihun 2007; Ameni et al., 2001; Assegid et al., 2000).

One of the main individual risk factors identified by numerous studies in both developed and developing countries is the age of animals. The duration of exposure increases with age; older animals are more likely to have been exposed than younger ones, as shown by several cross-sectional studies carried out in Tanzania, Zambia and Chad (Cleaveland et al., 2007; Cook et al., 1996; Inangolet et al., 2008; Kazwala et al., 2001; Munyeme et al., 2009) which was in agreement with the present findings in all the study areas. This was reasoned out by Griffin et al. (1996) in that animals might get infected at a young age, but only expresses the disease clinically when they are adults. Moreover, Pollock and Neill (2002) further argued and explained the late occurrence of disease in that Mycobacteria can remain in a latent state for a long period in an infected animal before reactivation

**Table 3.** Distribution of CIT test positive animals in relation to various risk factors in Arsi Negele district of West Arsi Zone of Oromia, Ethiopia.

Categorical variable	Number tested	Number of positive results (No. and %)	$\chi^2$ (P-value)
<b>Age</b>			
Adult	75	11(14.67)	6.38(0.0115)
Young(bull and heifer)	97	3(3.09)	
<b>Sex</b>			
Male	53	3(5.66)	0.54(0.4624)
Female	119	11(9.24)	
<b>Breed</b>			
Local	66	4(6.06)	0.53(0.4666)
Crossbred	106	10(9.43)	
<b>Reproductive status</b>			
Pregnant	39	5(12.82)	0.72(0.3961)
Non-pregnant	80	6(7.50)	
Total	172	14(8.14)	

**Table 4.** Distribution of CIT test positive animals in relation to various risk factors in Tiyo district of Arsi Zone of Oromia, Ethiopia.

Categorical variable	Number tested	Number of positive results (No. and %)	$\chi^2$ (P-value)
<b>Age</b>			
Adult	92 94	17(18.08)	1.15(0.2835)
Young(bull and heifer)	49	5(10.20)	
<b>Sex</b>			
Male	13	1(7.69)	0.51(0.4751)
Female	130	21(16.15)	
<b>Breed</b>			
Local	13	0(0.00)	2.16(0.1416)
<b>Reproductive status</b>			
Pregnant	56	13(23.21)	2.56(0.1095)
Non-pregnant	74	8(10.81)	
Total	143	22(15.38)	

at an older age.

Zebu (*Bos indicus*) type cattle are thought to be much more resistant to bovine TB than European cattle (Radostits et al., 2007). The result of the present study concurs where we found the prevalence to be 6.43% in

local Arsi cattle breed whereas 13.81% in crossbred cattle from Holestin Fresian and local Arsi breeds. Sex has only been mentioned as a risk factor in studies carried out in Africa. Opinions diverge regarding its influence on the susceptibility to a *M. bovis* infection. A

**Table 5.** Distribution of CIT test positive animals in relation to various risk factors in Bokoji district of Arsi Zone of Oromia, Ethiopia.

Categorical variable	Number tested	Number of positive results (No. and %)	X <sup>2</sup> (P-value)
<b>Age</b>			
Adult	113	22(19.47)	2.61(0.1061)
Young(bull and heifer)	42	3(7.14)	
<b>Sex</b>			
Male	35	4(11.43)	0.55(0.4583)
Female	120	21(17.50)	
<b>Breed</b>			
Local	39	4(10.26)	0.98(0.3221)
Crossbred	116	21(18.10)	
<b>Reproductive status</b>			
Pregnant	51	13(25.49)	2.71(0.0997)
Non-pregnant	69	8(11.59)	
Total	155	25(16.13)	

cross-sectional study conducted from 2006 to 2007 on 1470 animals in Uganda revealed significantly more females positive to the skin test than males (Inangolet et al., 2008), which concurs with the findings of this study. On contrary to these findings, a cross-sectional study conducted in Tanzania from 1994 to 1997, which included 5692 indigenous and 244 exotic cattle, revealed that male cattle were significantly more affected by bovine TB than female animals (Kazwala et al., 2001). Justification given for this as explained by the same author was that male cattle are mostly used as draught oxen, which are kept longer in the herd than females. Due to this particular longevity, it is more probable that they get in contact with infected cattle from other affected herds and in turn get infected. This would imply that contact between herds is a major source for bovine TB transmission.

## Conclusion

The prevalence described only using CIT test in this study shows that bovine TB is present and is well-established in Arsi Zone and West Arsi Zone, Oromia, Ethiopia. Cattle owners in the study areas are usually in close contact with their animals and also consume raw milk regularly, both of which pose high infection risks to them. The authors recommend further detailed epidemiological studies to investigate the link between bovine and human TB in the present study area to allow formulation of appropriate strategic control measures in order to reduce associated public health risks.

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