Occurrence of Bovine Tuberculosis in Cattle Slaughtered at Yirgalem Municipal Abattoir, Southern Ethiopia

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Abstract

A cross sectional study was conducted at Yirgalem municipal abattoir from November 2011 to March 2012 to estimate the prevalence of Bovine Tuberculosis (BTB) and to assess the associated risk factors based on detail post mortem and histopathological examinations. Accordingly, the randomly selected 402 slaughtered cattle were subjected to postmortem examination out of which 24 (6.0%) were found positive for tuberculous lesion. Of the 24 tissue specimens collected from the gross tuberculous lesion, 12.5% were positive by histopathological examination. The higher proportion of the gross TB lesion was recorded in mesenteric lymph nodes (79.2%, 19/24) followed by medistinal (12.5%, 3/24) and bronchial lymph nodes (8.3%, 2/24). Similarly, with histopathological examination, two-third of the TB lesions (66.7%) were detected in digestive tract while only one-third (33.3%) was recorded in the respiratory system. This indicated the occurrence of larger proportion of TB lesions in the digestive system than in the respiratory pathway. The multivariable logistic regression analysis of the risk factors also revealed higher occurrence of BTB among the cross breed (OR = 5.9, 95%CI = 1.6, 22.1) and animals with poor body condition score (OR = 5.6, 95%CI = 1.6, 19.9) when compared with local and animals with good body condition score. In conclusion, this study revealed the status of BTB in the study area. Further study is required to trace back the disease to the origin of the animals so that the overall epidemiological picture and the route of the disease can be understood.

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INTRODUCTION

Tuberculosis is an infectious disease caused by strains of *Mycobacterium tuberculosis* complex and has been a major health risk to human and animal for centuries. It is widely distributed throughout the world affecting all age of human and animals causing significant economic loss (Cosivi et al., 1998). Bovine tuberculosis (BTB) is a chronic infectious disease of animal characterized by the formation of granulomas in tissues and organs more significantly in lung, lymph nodes and kidneys. It is caused by *Mycobacterium bovis* which is the most universal pathogen among Mycobacterium and affects many vertebrate animals although cattle, goats, pigs are found to be most susceptible while sheep and horses are showing a high natural resistance (Shitaye et al.,2007). BTB is zoonotic disease which can also be transmitted to human by aerogenous route and/or through consumption of infected milk and other animal products. Ethiopia is a country where the impact of BTB is particularly important and it is amongst the three African countries with the highest burden of human TB case (WHO, 2005). According to Bogale et al. (2004), Ameni et al. (2006) and Biffa et al. (2009), the prevalence of BTB in certain part of Ethiopia was found to be high ranging from 3.4% in small holder production system to 50% in pre-urban (intensive) dairy production system. Detection of BTB in Ethiopia is carried out most commonly on the bases of tuberculin test, abattoir meat inspection and rarely on bacteriological techniques (Shitaye et al., 2007).

In Ethiopia the routine abattoir inspection for any infection including BTB applies the method developed by meat inspection and quarantine decision of the Ministry of Agriculture. It involves visual examination, palpation and incision of organs like kidney, lung and pleural lymph nodes Condemnation of carcass on the bases of detected tuberculous lesion is a standard practice for the control of zoonotic infection at abattoir (Shitaye et al., 2007). Among the undertaken abattoir studies, prevalence of 5.2% (Ameni and Wudie, 2003), 4.5% (Teklu et al., 2004) and 3.5% (Shitaye et al., 2006) have been reported in the central Ethiopia and information on the status of the diseases at the abattoir level is lacking in most of the Southern parts of Ethiopia including the study area. Hence, this study is designed to estimate the prevalence of BTB and to assess the potential risk factors for the occurrence of the diseases in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted between November 2011 to March 2012 on cattle which were brought to Yirgalem municipal abattoir for slaughter from different areas. Yirgalem was the town of Dale district of Sidama Zone, SNNPRs. The town is located 322km south of Addis Ababa and 47km south east of Hawassa.

Study design

Study population and study type

The study animals were cattle which were brought to Yirgalem municipal abattoir for slaughtering purposes from different districts of Sidama, Arsi and Borona zones. A cross-sectional study was employed at which all cattle which were brought to abattoir for slaughter were subjected to both antemortem and detailed postmortem examinations.

Sample Size and sampling procedure

Sample size was calculated using the formula given by Thrusfield (2005) with 50% expected prevalence, 95% confidence interval and 5% desired absolute precision. Accordingly, the sample size was determined to be 384, and a total of 402 animals were sampled to increase precision. The sampling procedure was carried out using systematic random sampling in such a way that sampling units were selected at equal intervals with the first animal being selected randomly. The estimate of the total number of animals slaughtered during the preceding year (year 2010) was 10,800 cattle which were obtained from the record. The number of slaughtered animal during the 5 months of the year 2010 was calculated to be 4500 cattle, as the current study period was also 5 months. Subsequently, the sampling interval was computed as the total number of cattle slaughtered during the study period divided by the required sample size. Therefore, the sampling interval was 11 (5,400/402). Then the first animal was chosen randomly from the first 11, after which every 11 cattle were included in the sample during the slaughter operation until the required 402 cattle is obtained.

Study Methodology

All the study animals were subjected to antemortem inspection before slaughter to gather all the necessary data with regard to origin, sex, breed, body condition score and age of the animals. Then detail postmortem examination of these cattle was conducted by inspecting organs including lungs, kidneys, liver, spleen and intestine. The lymph nodes which are considered to a predilection site for TB microbes (bronchial, Medistinal, mesenteric, and hepatic) were also inspected for the presence of gross TB lesions. For confirmation, tissue specimens from the TB-suspected lesion were collected for histopathological examination with hematoxylin–eosin stain.

Data Management and Analysis

The collected data was recorded and coded on excel sheet and summarized using descriptive statistics. Logistic regression analysis was employed to analyze the association between TB occurrence and the potential risk factors (sex, age, body condition, breed and origin) using statistical software (STATA version 11). The association was summarized using both univariable and multivariable logistic regression analysis.

RESULTS

Prevalence

Abattoir Survey Result

Based on the detail post mortem examination conducted on 402 cattle, the prevalence of BTB was found to be 6.0% (24/402). The lesions were found in various forms with different sizes in the organs and lymph nodes. The organ level distribution of the lesion was summarized in table 1. Larger proportion of TB lesions was recorded in mesenteric lymph nodes 79.2% (19/24), followed by medistinal (12.5%, 3/24) and bronchial lymph nodes (8.3%, 2/24), respectively. Hence, the higher proportion (79.2%) of the lesions was recorded in the digestive system than respiratory pathway (20.8%). In current study, no TB lesion was observed in muscle, lung tissue, hepatic lymph nodes and heart.

Table 1: Organ level distribution of TB lesion in various organs of cattle slaughtered At Yirgalem municipal abattoir (n = 402)

Organ inspected	Number affected	Relative percentage (%)	Organ level prevalence (%)
Lungs	0	0	0
Bronchial lymph nodes	2	8.3	0.49
Mediastinal lymph nodes	3	12.5	0.75
Prescapular lymph nodes	0	0	0
Liver	0	0	0
Hepatic lymph nodes	0	0	0
Heart	0	0	0
Mesenteric lymph nodes	19	79.2	4.73
Muscle	0	0	0
Total	24	1.00	6.00

Table 2: Summary of organ level distribution of BTB based on histopathological examination (N=402).

Organ inspected	Tubercle lesion positive animal, No (%)	Hematoxylin –Eosin stain positive, No (%)
Bronchial lymph nodes	2 (0.5)	1 (0.3)
Mediastinal lymph nodes	3 (0.8)	0
Mesenteric lymph nodes	19 (4.7)	2 (0.5)
Total	24 (6.0%)	3 (0.75%)

Histopathological Examination Results

Out of the 24 tissue specimens collected from the grossly diagnosed TB lesions, three (12.5%) were found positive and the prevalence of BTB based on histopathological examination with hematoxylin–eosin stain was 0.75% (3/402). The organ level distribution of BTB showed that 66.7% (2/3) of the lesions were in the digestive tract (mesenteric lymph nodes) and 33.3% (1/3) in the respiratory tract (bronchial lymph nodes).

Analysis of risk factors

Logistic regression analysis: The distribution of tuberculous lesion in the slaughtered cattle in relation with the considered potential risk factors was summarized using univariate and multivariate logistic regression analysis as follows. *Univariate regression analysis* of risk factors (Table 3) shows the association between the BTB prevalence and different risk factors. Accordingly, the occurrence of BTB differed significantly among the breed (p=0.001), body condition score (p=0.006), sex (p = 0.030). Hence, this analysis showed the higher chance of occurrence of the disease in cross breed (OR = 5.7, 95%CI = 2.0, 15.8), poor body condition animals (OR = 4.84, 95%CI = 1.58, 14.8) and males (OR = 2.7, 95%CI = 1.1, 6.5) when compared local animals, animals with good body condition and the females, respectively. This analysis indicated that there is no association of tuberculosis occurrence with age and origin of the animals. Similarly, the *multivariable logistic regression analysis* revealed that the occurrence of the BTB significantly vary with breed (p = 0,009) and body condition score (p = 0.007), indicating the higher occurrence chance of BTB among the cross breed (OR = 5.9, 95%CI = 1.6, 22.1) and animals with poor body condition (OR = 5.6, 95%CI = 1.6, 19.9) when compared with local and animals with good body condition. This analysis also did not reveal any association of tuberculosis occurrence with age, sex and origin of the animals.

Table 3: Logistic regression analysis of the association of the potential risk factors with BTB occurrence in cattle

Risk factors		No inspected	No (%) positive	Univariate Analysis		Multivariable Analysis	
				Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Breed	Local	375	18 (4.8)	1		1	
	Cross	27	6 (22.2)	5.7 (2.0, 15.8)	0.001	5.9(1.6, 22.1)	0.009
Sex	Female	66	7 (5.1)	1		1	
	Male	336	17 (10.6)	2.7(1.1, 6.5)	0.030	1.3 (0.4, 4.2)	0.611
Age	≤ 5	125	5 (4.1)	1		1	
	> 5 -7	226	14 (6.2)	1.6(0.5, 4.4)	0.406	1.4 (0.5, 4.1)	0.527
	> 7	51	5 (9.8)	2.5 (0.7, 8.9)	0.170	1.6 (0.4, 6.3)	0.519
BCS	Poor	28	5 (17.9)	1		1	
	Medium	84	6 (6.1)	2.9 (0.8,1.1)	0.097	2.7 (0.7, 10.5)	0.143
	Good	290	13 (4.5)	4.8 (1.6, 14.8)	0.006	5.6 (1.6,19.9)	0.007
Origin	Arsi	50	4 (8)	1		1	
	Sidama	342	20 (5.8)	1.4 (0.5, 4.38)	0.55	1.1 (0.4, 3.7)	0.33
	Borana	10	0*				

*All the 10 cattle from Borana were found negative and comparison during the analysis was made only between the Arsi and Sidama cattle.

DISCUSSION

There are many different reports regarding the status of bovine tuberculosis in different parts of Ethiopia and other countries as it is one of the important infectious diseases affecting both human and animals of all age groups. Most of the works carried out on the investigation of this disease is based on either tuberculin skin test or detail postmortem examination at different abattoirs or both techniques employed together. The respective 6.0% and 0.75% abattoir and histopathology based prevalence report of this study is comparable with the previous records of Ameni and Wudie (2003), Teklu et al. (2004) and Shitaye et al. (2006) who reported a prevalence of 5.2% in Nazareth, 4.5% in Hosanna and 3.46% in Addis Ababa, respectively. Still there was relatively higher prevalence of 8.8% (Ameni et al., 2006), 10.1% (Biffa et al., 2009), 11.6% (Regassa, 2010) at different parts of the country. Exceptionally, a prevalence of 19.8% was reported from cattle slaughtered in rural Tanzania (Cleaveland and Kazawala, 2007). In areas where disease control program is absent, as high as 40% prevalence of BTB can occur in slaughter cattle in public abattoirs (Thoen et al., 2006).

Routine meat inspection carried out at various abattoirs of the country commonly report low levels of BTB prevalence. Bogale et al. (2004) reported prevalence of 1.3% in Hosanna abattoir, Southern Ethiopia. Similarly, a condemnation rate of tuberculous organ from slaughtered cattle at Dire-Dawa slaughterhouse ranged between 1% and 1.5% in 6940 animals slaughtered within 17 months (Shitaye et al., 2006). Collated data from abattoirs in different parts of the country on the number of cases with tuberculous lesions ranged from 0.02% to 1.8% (Shitaye et al., 2007). The earlier report by Gezahegne (1991) from eight export abattoirs showed a prevalence of 0.8% of 144,487 slaughtered animals, in which the whole carcass of 978 animals were condemned. Furthermore, results based on meat inspection data by Shitaye et al. (2007) indicated that BTB had a prevalence of 0.052% in 1,336,266 cattle slaughtered in Addis Ababa and Debre-Zeit abattoirs in the years 1996-2005. The infection proportion in cattle has been found to differ greatly from place to place which most probably be linked to the type of the production system (most notably in extensive/pastoral), which is unlikely to favor the spread of the disease in contrast to intensive dairy farms (Ameni et al., 2006; Shitaye et al., 2007). It could also be associated with the kinetic and the intensity of lesion development (pathology) in different livestock husbandry systems (Ameni et al., 2006). The variations in the prevalence of the BTB observed among these studies could also be partly explained by the low sensitivity of the postmortem based detection of tuberculosis, which is affected by the method employed, expertise of the examiner and the anatomical sites examined. In line with this, several studies have shown that the power of postmortem based detection of tuberculosis infection can be improved with enhanced meat inspection procedures, particularly with multiple slicing of organs and lymph nodes.

Based on the active abattoir survey carried out, the TB tubercles were found in different forms with different sizes in various organs. The organ level distribution of the lesion in the current study indicated that the larger proportion (79.2%) of TB lesions was recorded in the digestive pathways, followed by respiratory pathway (20.8%). The larger proportion of TB lesions recorded in the digestive pathway contradicts the reports of Regassa et al. (2010) who reported 50% of TB lesion in respiratory pathway, followed by 28.6% in digestive system, and 21.4% in prescapular lymph nodes. Additionally and on the contrary to the current report, O'Reilly and Dabron (1995) also mentioned that inhalation was the most important route of infection. However, this finding is in agreement with the report of Cleaveland and Kazawala (2007) in which the majority of visible lesions were recorded in the gastrointestinal tract rather than respiratory tract. This is an indication that ingestion is also one of the important routes of transmission implicating that considerable number of the cases probably may occur during the suckling time from infected dam or by liking, feeding or drinking contaminated materials (Regassa et al., 2010). Concerning the histopathological result, the prevalence (0.75%) is relatively higher than the 0.4% report of Regassa et al. (2010). On the other hand, the positive proportion of histopathology out of the 24 gross lesions was 12.5% which is relatively lower than the 28.6% report of Regassa et al. (2010).

The higher BTB prevalence among the crosses than local cattle recorded in this study is in line with previous report (O'Reilly and Dabron, 1995; Kiros, 1998; Ameni et al., 2006). This could be attributed to the fact that genetically improved cattle may suffer more severely from deficient housing and mal-nutrition and thus become prone to infection than zebu breeds (O'Reilly and Dabron, 1995). The higher BTB prevalence in animals with poor body condition could be due to the fact that they might be immuno-compromised probably due to malnourishment and higher workload. On the other hand, poor body condition score could also be due to the chronic BTB infection and in such case, body condition score is considered as a dependent not as a risk factor. However, in the current study we consider it as a risk factor for the

BTB infection. This finding is in agreement with reports from previous studies in Ethiopia (Bogale et al., 2004).

Detection of BTB in Ethiopia is most commonly carried out by abattoir meat inspection, tuberculin skin test and very rarely by Acid fast stain. BTB has serious public health implication in areas where there is a habit of raw animal product consumption. The present study indicated the importance and magnitude of BTB based detailed postmortem examination of visceral organs and carcasses of cattle. In this study it was observed that some risk factors such as sex, breed and body condition contributed for the occurrence of the disease. In conclusion, the study revealed the status of BTB in the study area. Further study is required to trace back the source and route of the disease and understand the overall epidemiological picture. Additional microbiological and molecular techniques should be employed so as to identify causative agents to the strain level.

REFERENCES

Ameni G. and Wudie A. 2003. Preliminary study on bovine tuberculosis in Nazareth municipal abattoir of central Ethiopia. *Bull. Anim. Health. Prod. Afr*. 51:125-132.

Ameni G., Aseffa A., Engers H., Yong D.B., Hewinson, G.R. and Vardermeir M. H. 2006. Cattle husbandry is predominant factor affecting the pathology of bovine tuberclosis and IFN-gamma responses to mycobacterial antigens. *Clin. Vacc. Immun*. 13: 1030-1036.

Biffa D., Inangolet F., Oloya J., Bogale A., Badaso M., Asfaw Y. and Skerve E. 2009. Prevalence of bovine tuberculosis in Ethiopian slaughter cattle based on pos mortem examination. *Trop. Anim. Health Prod*. 41:755-765.

Bogale A., Woldesenbet Z., Yimer E. and Lemma E. 2004. Evaluation of abattoir inspection for the diagnosis of *M. bovis* infection in cattle in Addis Ababa abattoir. *Trop. Anim. Health Prod*. 36(60): 537-596.

Cleaveland S. and Kazawala R. 2007. Quantifying the costs and risk of bovine tuberculosis in Tanzania. *DFLD Animal Health program*: R7357, 1-5.

Cosivi O., Grange J.M., Dabron C.J., Raviglione M.C., Fujikura T., Cousins D., Robinson R.A., Huchzermeyer H. F., Kantor D.I. and Meslin F. X. 1998. Zoonotic Tuberculosis due to *M. bovis* in developing countries. *Emerg. Infect. Dis.* 4(1):1-17.

Gezahegne, L. 1991. Economic aspect of condemned organs and parts due to cystycercosis, hydatidosis, fasciolosis and tuberculosis. Analysis report MoA, Addis Ababa, Ethiopia.

Kiros T. 1998. Epidemiology and zoonotic importance of bovine tuberculosis in selected sites of Eastern Shoa Ethiopia, Faculties of Veterinary Medicine, Addis Ababa University and Freie Universitaet Berlin, *MSc Thesis*.

O'Reilly L.M. and Dabron C.J. 1995: The epidemiology of *Mycobacterium bovis* infection in animals and man. *Tuber. Lung Dis*. 76: 1-46.

Regassa A., Tassew A., Amenu K., Megersa B., Abuna F., Mekibib B., Macrotty T. and Ameni G. 2010. A cross-sectional study on bovine tuberculosis in Hawassa town and it is surrounding Southern Ethiopia: *Trop. Anim. Health Prod*. 42:915–920

Shitaye J.E., Getahun B., Alemayehu T., Skoric M., Treml F., Fictum P., Vrbas V. and Pavlik I. 2006. A prevalence study of bovine tuberculosis by using abattoir meat inspection and tuberculin skin testing data, histopathological and IS6110PCR examination of tissue with tuberculous lesion in cattle in Ethiopia. *Veterinary medicina*, 51: 512-522.

Shitaye J.E. Tsegaye W. and Pavlik, I. 2007. Bovine tuberculosis infection in animal and human population in Ethiopia. *Veterinarni Medicina* 8: 317 - 332.

Teklu A., Asseged B., Yimer E. Gebeyehu M. and Woldesenbet Z. 2004. Tuberculous lesion not detected by routine abattoir inspection the expereince of Hossana municipal abattoir Southern Ethiopia: *Scientific and Technical Office of Ineternational Des Epizooties*, 23: 957-964.

Thoen C.O., Steele J.H. and Grelsdorf M.J. 2006. *Mycobacterium bovis infection in animal and human* (2nd edition) USA: Black well publishing pp. 34-36.

Thrusfield M. 2005. Sampling In: *Veterinary Epidemiology*, 2nd ed. London: Black Well Science Ltd., pp. 179-284.

WHO 2005. Report of the WHO working group on zoonotic tuberculosis (*M. bovis*) with the participation of FAO.

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