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A study on the prevalence of tuberculosis in cattle at selected abattoirs in Ethiopia

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Abstract
A cross-sectional study was conducted from November 2014 to August 2016 at Adama Municipal Abattoir and Bishoftu ELFORA Export Abattoir, Central Ethiopia, to estimate the prevalence and distribution of lesions of bovine tuberculosis on the basis of gross examination. On 1,896 cattle, a detailed postmortem investigation was used to conduct this study (1,266 from Adama and 630 from Bishoftu). A systematic random sample strategy was used to choose the study animals. An ante-mortem examination was used to investigate potential risk factors. Post mortem examination was done by examination of bronchial, mediastinal, retropharyngeal, mandibular, mesenteric and pre-scapular lymph nodes and palpation and then incision of organs such as the lungs, liver and kidneys. Descriptive statistics were used to summarize the prevalence of bovine tuberculosis and Chi-square (X^2) test was applied to compare the infection status with regard to the hypothesized risk factors and ($P<0.05$) was set for statistical significance. The overall prevalence of bovine tuberculosis was 4.22% (80/1896) on the basis of gross TB lesions. Larger proportion (52.5%) of TB lesion was recorded in the respiratory pathway followed by lymph nodes of the head (26.25%), mesenteric lymph nodes (7.5%), pre-scapular lymph nodes (7.5%) and liver and hepatic lymph nodes (6.25%). The prevalence of the disease was statistically significantly ($P<0.05$) varying with origin of animal, location of abattoir and body condition score. In conclusion, the disease is ubiquitous in slaughtered cattle and is a major cause of liver condemnation at the Adama municipal abattoir and Bishoftu ELFORA export abattoir; further extensive investigations on the disease's epidemiology and strategic strategies to reduce the disease should be undertaken.

Keywords: abattoir, Adama, Bishoftu, bovine tuberculosis, cattle, prevalence

1. Introduction
Bovine Tuberculosis is a bacterial illness that affects both animals and humans. It is caused by bacilli that grow slowly and are part of the *Mycobacterium tuberculosis complex*. M. bovis is the most widespread disease among mycobacteria, affecting a wide range of vertebrate animals of all ages, including humans, while cattle, goats, and pigs are the most susceptible. The condition is marked by the production of granulomas in tissues and organs, particularly in the lungs, lymph nodes, intestine, and kidney, among other places (Radostitis *et al.*, 2007; Hlokwe *et al*., 2013; Pal *et al*., 2014; Terefe, 2014) [20, 14, 24, 19].

Cattle are considered to be the main hosts for *M.bovis* (Radostitis *et al.*, 2007) [20]. BTB is transmitted to calves through ingestion, and lesions affect the mesenteric lymph nodes, with probable spread to other organs. In older cattle, infection is frequently spread through the respiratory tract, resulting in lung and lymph node lesions (Carter and Wise, 2004). It has been reported as one of the major cattle infection generating significant economic loss in 176 countries (Awah-Ndukum *et al.*, 2013) [5]. Tuberculosis (TB) is a disease that affects people of all ages all over the world. In humans, tuberculosis causes more deaths than any other bacterial disease (Bhatia and Ichpujanti, 1994) [7].

Animal TB is managed and eliminated in industrialized countries by milk testing and slaughter, which has resulted in a significant reduction in the incidence of *M. bovis* disease in both cattle and humans. Animal TB is widespread in developing countries, however, since control measures are either not implemented or are implemented ineffectively. In Ethiopia, Animals are kept in the same house as their owners, and cow dung is used to paint the walls and floors of buildings as well as provide energy for cooking. All of these actions increase the risk of TB spreading to humans (Asseged, 1999) [3]. Due to a lack of good testing facilities, the disease's widespread dissemination and economic loss have yet to be properly

assessed (Asseged, 2004) [4]. As a result, understanding the disease's distribution, prevalence, and risk factors is critical in developing an effective control strategy. The objectives of this study were to estimate the prevalence of bovine tuberculosis in the Adama municipal abattoir and the Bishoftu ELFORA export abattoir in central Ethiopia, as well as to evaluate the distribution of tuberculous lesions in slaughtered animals.

2. Material and Methods

2.1 Study Area Description

The study was conducted in Adama and Bishoftu towns, located in Eastern part of Oromia Regional State, Central Ethiopia.

2.1.1 Adama town: Adama town is located in the east Shoa Zone of Oromia Regional State. Adama is a town in the Oromia Regional State's east Shoa Zone. It is located 99 kilometers southeast of Addis Ababa. At a height of 1,712 meters above sea level, the town is located at latitude and longitude of 8.540N 39.270E. The town is located on the road linking Addis Ababa and Dire Dawa-Djibouti. In the town and surrounding Adama, there are various resorts, such as Sodore, and many live animal export farms. As a result, there are a lot of human and animal population shifts. The slaughtering capacity of the Adama abattoir is roughly 100 cattle and 500 sheep and goats (ATAO, 2016) [1].

2.1.2 Bishoftu town: Bishoftu is a major city in the Oromia regional state's east Shewa zone. This town is roughly 45 kilometers south east of Addis Ababa. It is 1,850 meters above sea level. The average annual temperature is 21°C, while the average annual rainfall is 1,800mm. There are three exporting and one municipal abattoir in the city. The abattoir in Bishoftu has a capacity of roughly 200 cattle, 1500 sheep, and 400 goats. It also includes a large number of privately owned intensive and extensive dairy, poultry, and swine farms. This densely populated town is the primary source of livestock, chicken, and swine meat, as well as related items such as milk, eggs, and other dairy products to Addis Ababa supermarkets (BTAO, 2016).

2.2 Study Animals

The study animals were crossbred and indigenous zebu cattle breeds of both sexes brought to the Adama municipal and Bishoftu export abattoir for slaughter. Animals slaughtered at Adama municipal abattoir come from different parts of the country, including northeast and southeast (Afar, Harar, Arsi, Bale and Borena) areas, while those slaughtered at Bishoftu export abattoir come from west, northeast, and southeast (Walaga, Shewarobit, Kemisie, Haiq, Dessie, Harar and Borena) areas.

2.3 Study Design

A cross-sectional study was conducted from November 2014 to August 2016, to estimate the prevalence and distribution of lesions of bovine tuberculosis on the basis of gross examination considering the origin and body condition of the animals.

2.4. Sample Size Determination

The sample size was calculated according to formula by Thrusfield, (2007) [25]. 50% expected prevalence is taken to determine samples size with 95% confidence interval (CI) and 5% desired absolute precision.

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

Where,
n = sample size of the study population
d = desired precision
p = 50% expected prevalence
Accordingly, based on the above formula a sample size of 384 was calculated, but to increase the level of precision sample size had been increased to 1896.

2.5 Sampling Method

Systematic random sampling technique was employed in the lairage to select the required number of study animals. Very few numbers of female cattle were slaughtered in the abattoir. These were cows who had been culled due to reproductive issues, poor performance, or because they had reached the end of their reproductive lives. Prior to sampling, each selected animal was given an identification number and data on each animal geographic origin and body condition was recorded. Meat was inspected for bovine tuberculosis in accordance with the procedures outlined in the Ethiopian Ministry of Agriculture Meat Inspection Regulation (1972).

2.6. Methods of Data Collection and Procedures

2.6.1. Ante-mortem Examination

During ante mortem inspection, each of the study animals was given an identification number with a paint mark on their body and animal geographic origin was recorded. The body condition of study animals was classified into three main categories as poor, medium and good based on observation of muscle mass and fat cover on ribs, hip, between hooks, pins, spine and transverse processes (Nicholson and Butterworth, 1986) [17].

2.6.2 Post-mortem Examination

Routine meat inspection procedures of carcass for the detection of visible abnormalities including tuberculous lesions were carried out. The procedure involves examination of bronchial, mediastinal, retropharyngeal, mandibular, mesenteric and pre-scapular lymph nodes and palpation and then incision of organs such as the lungs, liver and kidneys. The organs/tissues were cut into many slices using separate scalpel blades, and the cut surfaces and internal regions were visually checked for the presence of tuberculosis lesions under bright light sources.

2.7. Data Analysis

All collected data was entered into a computer using Microsoft Excel and transferred to STATA version 14.0 (Stata Corp. College Station, TX, USA) for analysis. Descriptive statistics were used to calculate the prevalence of bovine tuberculosis. Chi-square (X^2) test was applied to compare the infection status with regard to the hypothesized risk factors and ($P<0.05$) was set for statistical significance.

3. Results

3.1 Postmortem findings

The prevalence of BTB was 4.22% (80/1896) on the basis of gross TB lesion. There was statistically significant difference between origin ($p<0.001$) of animal, location ($p<0.001$) of abattoir and body condition score ($p<0.001$) of the animals (Table 1).

Table 1: Association of different risk factors with in abattoir slaughtered cattle carcasses BTB affected lesions

Variables	No of cattle inspected	No of carcasses positive (%)	χ^2	P-value
Origin of animal				
Arsi, Bale and Borena (southeast)	1018	16((1.6)	45.9	0.000
Afar, Harar, Dessie, Kemisie, Shewarobit and Haiq (east-north)	593	51(8.6)		
Walaga (west)	285	13(4.6)		
Abattoir				
Adama abattoir	1266	32(2.5)	26.9	0.000
Bishoftu export abattoir	630	48(7.6)		
Body Condition Score				
Lean	460	33(7.2)	19.4	0.000
Medium	440	23(5.2)		
Good	996	24(2.4)		
Total	1896	80		

3.2 Distribution of tubercle lesions

The distribution of TB lesions in different tissues of cattle was presented below (Tables 2 and 3). About 52.5% of the lesions were observed in the lung and associated lymph nodes. The lung region contributes a higher percentage of tubercle lesions than the head and the gastrointestinal area.

Table 2: Percent of distribution of tuberculosis lesion in organs and lymph nodes

Organs	Postmortem	
	Number	Percent
Lung tissue	14	0.74
Bronchial LN	17	0.89
Mediastinal LN	11	0.58
Retropharyngeal LN	17	0.89
Mandibular LN	4	0.21
Mesenteric LN	6	0. 31
Prescapular LN	6	0. 31
Liver tissue	5	0.26
Total	80	

Table 3: Pooled tuberculosis lesions distribution

Anatomic site	Lesions	Percent from all*	Organ proportion**
Lymph nodes around head	21	1.1	26.25
Lung and lymph nodes around it	42	2.21	52.5
Mesenteric lymph nodes	6	0. 32	7.5
Prescapular LN	6	0. 32	7.5
Liver and hepatic lymph nodes	5	0.26	6.25
Total	80		

*Percent from all=lesion divided by/number of animal examined (1896) multiplied by 100
**Organ proportion=lesion in the region divided by overall lesions (80) multiplied by 100

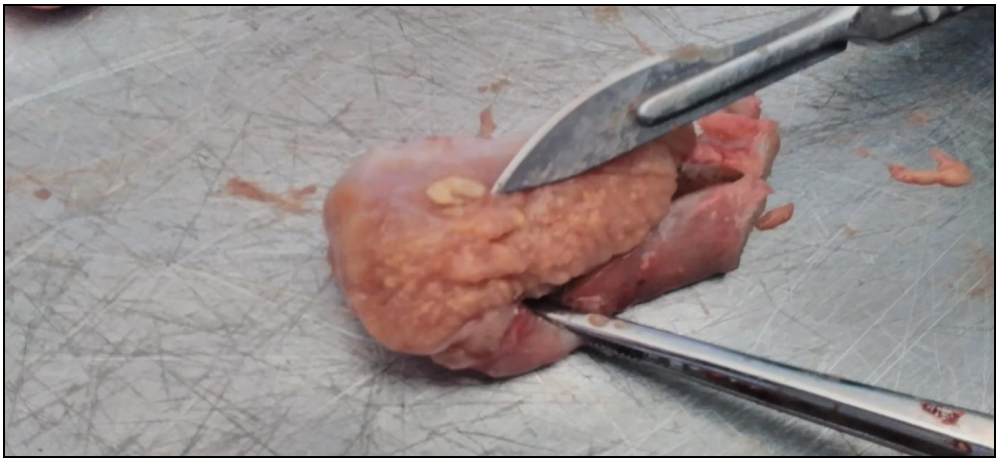

Fig 1: Tuberclous lesions in the mediastinal lymph node of cattle

4. Discussion

Based on postmortem examination in the present abattoir study, the prevalence of gross lesions of BTB was found to be 4.22%, which is comparable with the results reported by Demelash *et al*. (2009) [11] in Yabello municipal abattoir, Teklu *et al*. (2004) [23] in Hosanna and Berg *et al*. (2009) [6] in selected abattoirs in Ethiopia. However, the prevalence found in this study was lower than those reported by Ameni

et al. (2010) [2] in Kombolcha, Mekibeb *et al*. (2013) [15] in Addis Ababa and Romha *et al*. (2013) [22] in Humera abattoirs. While, it was higher than the finding recorded by Regassa *et al*. (2010) [21] in Hawassa, Nuru *et al*. (2017) [18] in Bahir Dar abattoir and Gumi *et al.* (2012) [12] in Negelle abattoirs. This difference in prevalence of tuberculous lesions could be due to the difference in origin or types of production system and breed of animals that were slaughtered in the abattoirs.

In the present study, larger proportion (52.5%) of TB lesion was recorded in the respiratory pathway of the lung and associated lymph nodes followed by lymph nodes around head (26.25%), mesenteric lymph nodes (7.5%), pre-scapular lymph nodes (7.5%) and liver and hepatic lymph nodes (6.25%). The observation of the largest proportion of TB lesions in the respiratory pathway was consistent with the reports of previous findings (Asseged *et al*., 2004; Regassa *et al*., 2010) [4]. This finding indicated that inhalation might be the principal route of TB infection in cattle. Therefore, during post-mortem examination focus should be given on lungs and associated lymph nodes.

The prevalence of the diseases was statistically significant difference ($P<0.05$) in the prevalence of the disease between body condition scores (BCS), the prevalence being higher in lean (7.2%) than medium (5.2%) and good (2.4%) body conditioned animals. The present result is consistent with previous reports of Haftom, (2008) [13] at Gonder Elfora abattoir and Negesse, (2007) [16] at Butajira municipal abattoir. Animals with good BCS have relatively strong immunological response to the infectious agent than animals with medium BCS, and the result could indicate the wasting nature of the disease (Radostits *et al*., 2007) [20].

5. Conclusion and Recommendations

The result of this study suggested the high prevalence of BTB in cattle slaughtered in Adama municipal abattoir and Bishoftu ELFORA export abattoir, in east Shewa, central Ethiopia. Larger proportion of BTB lesions recorded in the respiratory pathway of the lung and associated lymph nodes of this study suggested that inhalation might be the principal route of TB infection. In general, this study provides an insight into the prevalence and risk factors of Bovine tuberculosis in the study areas. Based on the above conclusion, the following recommendations were forwarded;

- Educating and informing the public about the zoonotic significance of disease.
- The abattoir inspection procedures should be improved and more attention should be given on the lungs and associated lymph nodes.
- Further work must address the factors influencing the occurrence of bovine tuberculosis in the study area.

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7. Contribution of Authors

All the authors contributed equally. They read the final version, and approved it for the publication.

8. Conflict of Interest

The authors declare that they do not have conflict of interest.

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