

Original Research Article

## Prevalence of Tuberculosis among Livestock Slaughtered for Human Consumption: A Jos Abattoir Based Study

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**Abstract:** Tuberculosis is a zoonotic and infectious granulomatous disease of virtually all vertebrates caused by the bacterial genus, *Mycobacterium*. Previous studies have shown that both humans and livestock like cattle, sheep and goat are susceptible to both *Mycobacterium tuberculosis* and *Mycobacterium bovis*. This retrospective study determined the prevalence of tuberculosis among these livestock slaughtered at Jos abattoir for human consumption between 2006 and 2012, which were potential sources of humans infections. It also determined the yearly and month-wise distribution of the prevalence of tuberculosis, and compared the prevalence among the study species. Seven-year abattoir entries were collated. All the prevalence were calculated using Microsoft Excel, and further subjected to Chi-square test for establishment of statistical significance using Graph-pad Prism. Lesions suggestive of tuberculosis were found in 5,726 (2.22%) animals (cattle: 5,504, sheep: 74, goat: 148) out of the 257,553 (cattle: 64,091, sheep: 72,004, goat: 121,458) slaughtered during the study period. Yearly prevalence was highest (4.21%) in 2011, and lowest (1.76%) in 2006. Month-wise prevalence for the study period was highest (3.24%) and lowest (1.37%) in November and April respectively. Prevalence in cattle, sheep and goat were 8.59%, 0.1% and 0.12% respectively. This study reported high prevalence of tuberculosis among livestock slaughtered for human consumption in the abattoir. We therefore recommend that the appropriate authorities should intensify efforts in public awareness on the dangers of consuming tuberculosis-infected meat, establish active surveillance network, and enforce active and thorough meat inspection.

**Keywords:** Cattle-Sheep-and-Goat, Jos Abattoir, Meat inspection, Nigeria, Prevalence, Tuberculosis.

### INTRODUCTION

Tuberculosis (TB) is a zoonotic and infectious granulomatous disease of virtually all vertebrates [1] and is caused by bacterial species belonging to the genus, *Mycobacterium* (*M.*). There is no strict host specificity, but the species *M. tuberculosis* affects mainly the primates, *M. bovis* affects mainly cattle, and *M. avium* affects mainly birds [2].

TB is a chronic wasting disease presenting with a wide range of clinical signs depending on the organs affected. Among the most common clinical signs in humans are chronic cough, which in severe cases, may be associated with bloody sputum, night sweats, fever, emaciation, chills, loss of appetite and fatigue [3,4]. Infected animals exhibit clinical signs comparable to those in humans, and in addition, a drop in both

quality and quantity of milk and meat [5] thereby resulting in serious economic loss.

In humans and animals, transmission can either be through pulmonary or extra-pulmonary routes, especially the oral route. Pulmonary transmission involves the inhalation of contaminated aerosol, leading to bacterial multiplication and development of primary lesions in the lungs and lymph nodes that drain the respiratory system [6]. Oral transmission is usually a consequence of ingestion of contaminated animal products like poorly cooked meat and unpasteurised milk, as seen among the pastoralists [6], or ingestion of contaminated feed, water or milk which usually happens among animals in a herd. Following infection via oral route, the bacteria multiply and produce

primary lesions in the lymph nodes associated with the alimentary canal .

Diagnosis of TB, both in humans and animals, can be achieved through a number of approaches. Some of these include microbiological, immunological/serological, radiological, and molecular techniques, and also post mortem examination especially in animals. The post mortem examination alone is not the best approach to TB diagnosis in terms of accuracy, however, it is the approach employed in many abattoirs especially in developing countries [7,8], Nigerian abattoirs inclusive. This is mainly because it is inexpensive compared to other approaches. It involves the detection of grayish- whitish gritty tubercles of varying sizes and numbers that may be localised in the lungs or disseminated throughout the body [9,10].

Epidemiologically, TB has a global distribution. The World Health Organisation (WHO), in 2010 [11], gave an estimate of one-third of the world human population as infected with TB. In 2015 alone, there was an estimate of 1.4 million deaths from tuberculosis, excluding HIV-TB co-infections [12]. However, with some drastic measures in both humans and animals, it has been brought under control in different parts of the world [13,14], leaving behind the countries of Africa, parts of Asia and Middle East with high burden of the disease [15].

In Nigeria, the record of tuberculosis had been consistently high. In fact, the WHO rated the country as the fourth globally and the first in Africa with the highest record of incidence of human tuberculosis in the year 2015 [12]. The incidence of the disease in Nigeria with those in India, Indonesia, China, Pakistan and South Africa accounted for about 60% of the total global incidence of the disease for the year. Also, Nigeria and India accounted for about 48% of global tuberculosis mortality among HIV-negative individuals [12]. Within Nigeria, Plateau State was shown in 2010

to be the sixth state with highest prevalence of tuberculosis [16]. Considering the high prevalence of the disease in humans in the state, it may not be unexpected to have a prevalence as high as 21.4% of *M. tuberculosis* complex in cattle [17].

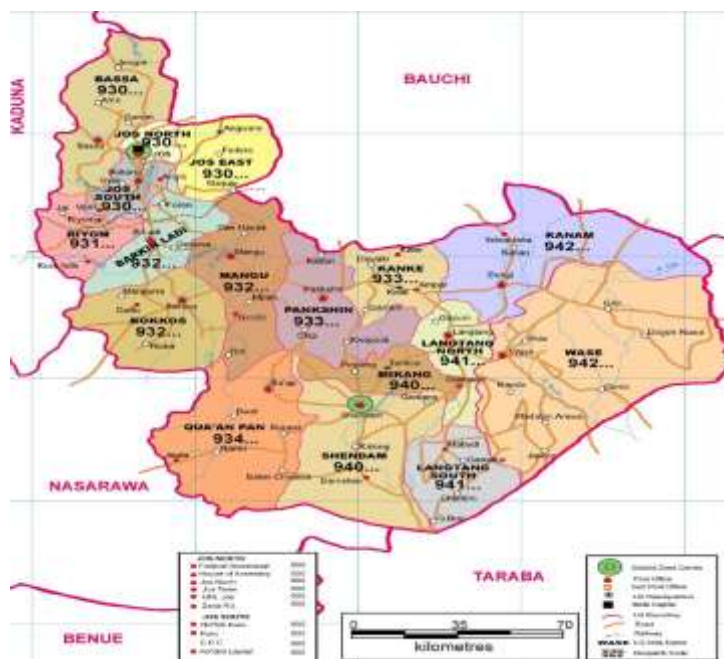
The animals slaughtered at the Jos abattoir include cattle, sheep, goat, pigs, and on rare occasions, camels. The mentioned animal species are susceptible to both *M. tuberculosis* and *M. bovis*, [18-22], which also cause tuberculosis in humans. It is therefore imperative that effective monitoring of the slaughtered animals be carried out in order to avoid the spread of the zoonotic tuberculosis from the slaughtered animals to human population. This study was therefore carried out to determine the prevalence of tuberculosis in cattle, sheep, and goat slaughtered at Jos abattoir for a period of seven years (2006-2012) which were potential sources of humans infections. It also determined the yearly and month-wise distribution of the prevalence of tuberculosis, and compared the prevalence among the study species.

## MATERIALS AND METHODS

### *Study Area*

Jos is the capital city of Plateau State, which is located in the North-Central geo-political zone of Nigeria. The state shares geographic boundaries with Bauchi, Kaduna, Nassarawa, and Taraba states at its North-Eastern, North-Western, South-Western and South-Eastern boundaries respectively. It is made up of seventeen Local Government areas (Fig. 1), covering an area of about 37Km<sup>2</sup>. It is endowed with near temperate climate, and the average temperature ranges between 18°C and 22°C, although it can get hotter during the hot season (March - April) and colder during the harmattan (December - February).

Plateau State is situated within the Guinea Savannah region of the country. The main occupation of the people is crop and animal farming.



**Fig-1: Map of Plateau State, showing the seventeen Local Government Areas, the neighbouring states, and some important places and features**

**Data Collection**

Seven-year (2006-2012) data were extracted from the Jos abattoir daily records and analysed in this study. The information of interest included the number of animals slaughtered, and the number that presented with post mortem lesions suggestive of tuberculosis. These information were collected for each of the study species: cattle, sheep, and goat.

**Data Analysis**

The combined overall and yearly prevalence of tuberculosis for all the study species during the study period were calculated. The month-wise and seasonal variations were also determined. Finally, the overall and yearly prevalence for each of the species were calculated and also compared between the species for the study period. The calculations were done using Microsoft excel and further subjected to Chi-Square for establishment of statistical significance using Graph pad.

**RESULTS**

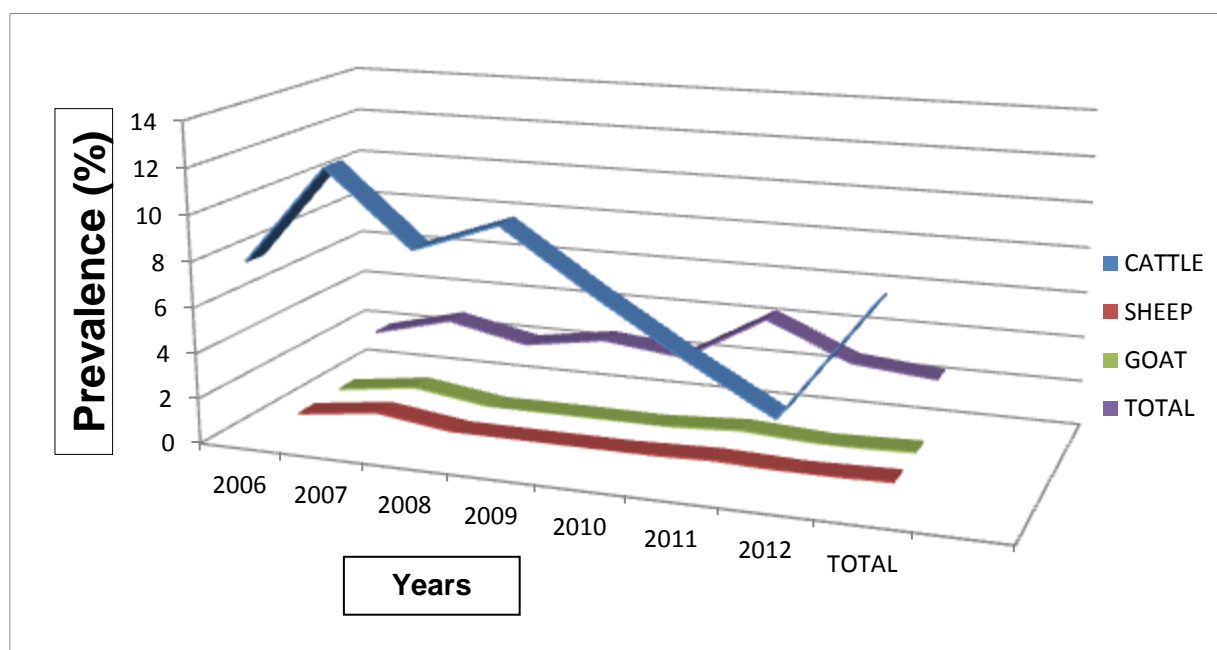
The total number of animals (cattle, sheep and goat) slaughtered during the study period was 257,553,

out of which 5,726 (2.22%) were positive for tuberculosis on post mortem examination. Yearly prevalence was highest (4.21%) in 2011, and lowest (1.76%) in 2006 (Table 1, Fig. 2). Based on month-wise distribution, the highest (3.24%), and lowest (1.37%) prevalence were recorded in November and April respectively (Fig. 3).

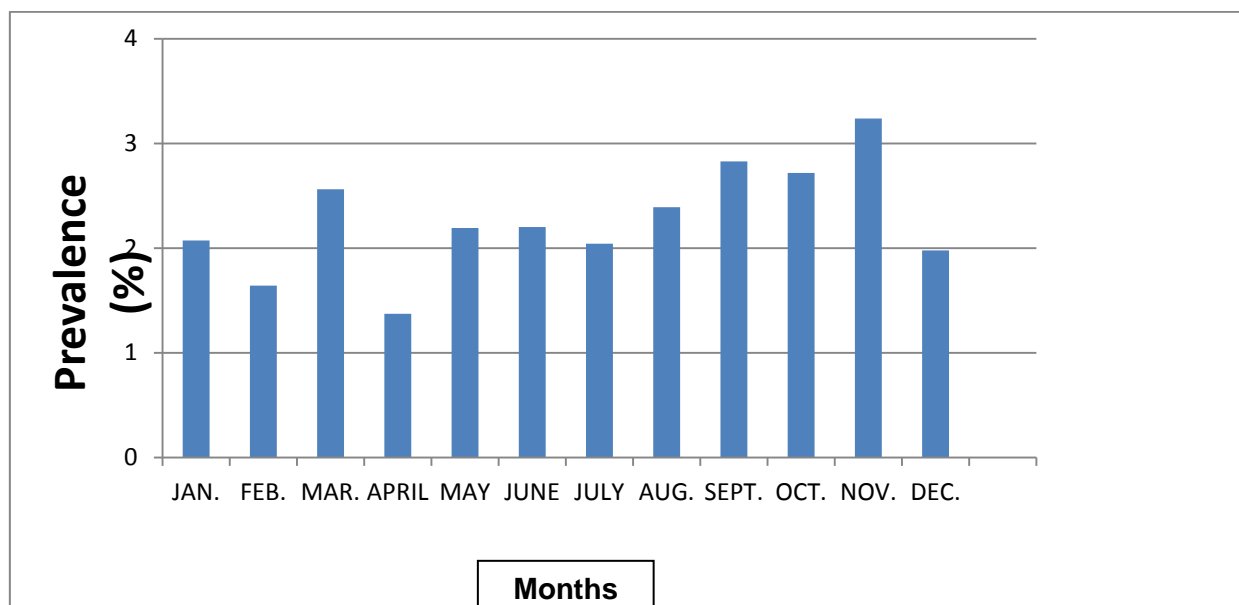
According to the records, a total of 64,091 cattle were slaughtered during the study period, out of which 5,504 (8.59%) animals presented with post mortem lesions attributable to tuberculosis. The peak yearly prevalence of 12.21% was recorded in 2007, while 3.53% prevalence in 2012 was observed to be the lowest. For the sheep, a total of 72,004 were slaughtered during the study period, out of which 74 (0.1%) were infected with tuberculosis. The yearly prevalence varied between 0.5% in 2007 and 0% in 2009, 2010, and 2012. For the goats, a total of 121,458 were slaughtered during the study period. Out of these, 148 (0.12%) presented with suggestive tuberculous lesions at post mortem examination. Yearly prevalence varied between 0.53% in 2007, and 0% in 2008, 2010 and 2012 (Table 1, Fig. 2).

**Table 1: Jos Abattoir records of suspected Tuberculous cases among animals slaughtered between 2006 and 2012**

YEAR		2006	2007	2008	2009	2010	2011	2012	TOTAL
CATTLE	No. of slaughtered animals	12,872	8,657	11,313	11,025	10,140	4,931	5,153	<b>64,091</b>
	No. of Tb cases	1,018	1,057	1,024	1,144	802	277	182	<b>5,504</b>
	Prevalence (%)	7.91	12.21	9.05	10.38	7.91	5.62	3.53	<b>8.59</b>
SHEEP	No. of slaughtered animals	20,029	13,282	13,208	12,553	11,225	812	895	<b>72,004</b>
	No. of Tb cases	5	67	1	0	0	1	0	<b>74</b>
	Prevalence (%)	0.02	0.5	0.01	0	0	0.12	0	<b>0.1</b>
GOAT	No. of slaughtered animals	25,793	24,702	28,999	22,572	17,483	905	1,004	<b>121,458</b>
	No. of Tb cases	11	131	0	4	0	2	0	<b>148</b>
	Prevalence (%)	0.04	0.53	0	0.02	0	0.22	0	<b>0.12</b>
TOTAL (CATTLE + SHEEP + GOAT)	No. of slaughtered animals	58,694	46,641	53,520	46,150	38,848	6,648	7,052	<b>257,553</b>
	No. of Tb cases	1,034	1,255	1,025	1,148	802	280	182	<b>5,726</b>
	Prevalence (%)	1.76	2.69	1.92	2.49	2.06	4.21	2.58	<b>2.22</b>



**Fig-2: Annual distribution of the prevalence of Tuberculosis among the study species (2006 and 2012)**



**Fig-3: Month-wise distribution of the overall prevalence of Tuberculosis in the study species slaughtered at Jos Abattoir between 2006 and 2012**

## DISCUSSION

Previous abattoir-based studies have shown tuberculosis to be the most often detected condition leading to meat condemnation [23,24]. Post mortem meat examination alone may lack the high degree of accuracy needed for confirmation of tuberculous infection. However, the use of abattoir post mortem records for the determination of the prevalence of tuberculosis plays important role in disease monitoring and surveillance [25], especially in the developing countries [8] like Nigeria.

The present study recorded a high overall prevalence (2.22%) of tuberculosis for the livestock (cattle, sheep and goat) slaughtered for human consumption. The highest annual prevalence (4.21%) was recorded in 2011, and the lowest (1.76%) in 2006. The figures remained averagely high all through the study period despite the reduced activities in the abattoir, which resulted from the alternative use of illegal slaughter slabs as the Jos ethno-religious crisis of 2008 to 2011 worsened. This high prevalence therefore suggests endemicity of tuberculosis among livestock in the state. Although the data for pigs were not included in the study, the Jos abattoir records showed they were also positive for tuberculosis on post mortem examination.

The month-wise prevalence for the study period was highest (3.24%), and lowest (1.37%) in November and April respectively. There were multiple peaks with no clear seasonal variation, which could be consequent to the fact that there were no entries for several days to months at irregular intervals due to workers' strike actions and the ethno-religious crisis in the state. It could also be as a result of the fact that the

entries for the different species were merged together, as [23] reported peak prevalence for different species at different seasons of the year.

The overall prevalence for cattle over the study period was 8.59%, with the highest (12.21%) and lowest (3.53%) annual records in 2007 and 2012 respectively. There was a significant difference between the annual prevalence for the years within the period of this study ( $P < 0.0001$ ). The overall prevalence is comparable to the findings of [26] from Yola abattoirs (8.78%). It is however, much higher than the findings of most of the other studies conducted in Nigeria, which include a range from 2.9% in Otukpo abattoir, Benue state to 0.55% in Ogbomoso, Oyo state [27-32]. On the other hand, it is much lower than the findings of [27] at Damboa abattoir, Maiduguri (20%).

The records of the prevalence of tuberculosis in the small ruminants, on the average, are lower than those in the cattle, which agrees with the finding of [23]. The overall prevalence for sheep over the study period was 0.1%, and the annual record varied between 0.5% in 2007 and 0% in 2009, 2010 and 2012. Like in the cattle, there was a statistically significant difference in the annual variation of the tuberculosis prevalence ( $P < 0.0001$ ). Meanwhile, there has been dearth of information on the prevalence of tuberculosis in sheep in the country. The findings of this study is much less than the 0.22% reported by [23] at Maiduguri abattoir.

In goats, the overall prevalence was found to be 0.12%. The annual prevalence varied between 0.53% in 2007 and 0% in 2008, 2010 and 2012. As with the other species, the variation in the annual prevalence of tuberculosis in goat was statistically significant

( $P < 0.0001$ ). Compared with the results of other studies in Nigeria, the finding of this study was much lower than those of [20] who reported a prevalence of 4.47% on post mortem examination, and 0.36% on bacterial culture at Ibadan, Oyo state. It is however higher than the 0.04% reported by [23] at Maiduguri abattoir, and the 0.03% reported by [33] at Bauchi central abattoir.

The findings of this study reveal a relatively high prevalence of the tuberculosis in the study species. This suggests endemicity of the disease in the state, considering the high prevalence reported also in humans [16]. There was also a wide variation in the daily, monthly and yearly record of tuberculosis in the abattoir. This could be as a result of poor record keeping, the several strike actions by the state civil servants, and the recurrent ethno-religious crises in the state during the study periods, during which there were no records for days, and sometimes, even weeks or months. The fluctuations could also be a result of lack of thoroughness of the understaffed team of animal health workers conducting the meat inspection. This aligns with the findings of [34] and [35], who reported that the success of post mortem surveillance for bovine tuberculosis depends, to a large extent, on the work load, time, and the expertise of the inspector conducting the examination.

#### CONCLUSION AND RECOMMENDATION

The findings of this study reveal a high prevalence of tuberculosis among cattle, sheep and goats slaughtered at Jos abattoir for human consumption. This therefore raises public health concern as the meat from the infected animals can serve as a means of transmission of the disease to humans. We therefore recommend that the appropriate authorities should intensify efforts in public awareness on the dangers of consumption of tuberculosis-infected meat, establishment of active surveillance network, and enforcement of active and thorough meat inspection both at the abattoir and the other slaughter slabs.

#### ACKNOWLEDGEMENT

We appreciate the management and staff of Jos Abattoir for granting us access to the records that were analysed in this study. We also thank Dr. Dzikwi-Emennaa Asabe and Dr. Karshima Solomon of the Department of Veterinary Public Health and Preventive Medicine for their selfless contributions to the success of this study.

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