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Retrospective study of bovine tuberculosis in Gombe Township Abattoir, Northeastern Nigeria

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ABSTRACT

Tuberculosis (TB) is a major global public health problem. The World Health Organization (WHO) estimates that there are 8 million new cases and 3 million deaths in humans due to the disease each year. A retrospective abattoir study of bovine tuberculosis in Gombe Township Abattoir in Northeastern Nigeria was carried out from 2008 to 2015 using the abattoir records. Out of 154,562 slaughtered heads of cattle examined at postmortem, 1202(0.78%) had typical tuberculous lesions and overall total prevalence rate of 0.78%. The annual prevalence was significantly higher in 2015(1.04%) with the lowest records in 2011(0.34%). The annual prevalence rate showed intermittent increase in levels above the expected prevalence and there was a statistically significant difference in the relative annual prevalence rate of the disease in the abattoir. The distribution and occurrence of the disease in rainy season were higher than that in the dry season. The disease also appeared to be more prevalent in the rainy season 792(65.90%) compared with the dry season 410(34.10%) and the difference was statistically significant ($\chi^2 = 15.45, p < 0.05$). It was concluded that bovine TB is prevalent in Northeastern Nigeria, with indications of epidemics status in Gombe state.

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1. Introduction

Bovine tuberculosis (bTB) is a chronic infectious and contagious zoonotic disease of domestic animals, wild animals and humans [1]. It also occurs in a wide range of mammalian species [2]. It is characterized by the formation of granulomas in tissues, especially in the lungs, lymph nodes, liver, intestines and kidney [3]. Tuberculosis is a major health problem with 8–9 million new cases and 3 million deaths annually worldwide [4]. The majority of these occur in the developing nations. In Nigeria, there have been limited studies to determine the prevalence or relationship between bovine and human TB, especially with the emerging culture of eating improperly cooked beef and mutton, along with the drinking of

unpasteurized fresh milk [5]. According to a previous study, an economic loss of ₦13, 871,014/annum due to bovine tuberculosis (7.95%) as a result of condemnations in some abattoirs in - Nigeria has been reported [6]. Another study reported an annual socioeconomic loss of ₦14–24 million/annum because of carcass condemnation in the abattoirs in Northeastern, Nigeria [7].

Bovine tuberculosis is caused by *Mycobacterium bovis* which is a member of *Mycobacterium tuberculosis* complex [8,9]. The organism may be transmitted by aerosol or droplets of exudates containing the bacilli. It can be transmitted by ingestion of feed and water contaminated with urine, faecal material or exudates that contain the tubercle bacilli from diseased animals [10].

In developing countries, especially Nigeria and particularly the northeastern region, there is paucity of information on the prevalence of bTB and though, it is a notifiable disease in many countries, the lack of effective disease surveillance and disease reporting system and the insidious nature of the disease has contributed to decreased recognition and reporting, leading to a lack of effective and sustainable measures for its control. This study was therefore conducted to determine the prevalence of bTB in Gombe, Northeastern Nigeria [11].

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The actual impact of animal bTB on human health is generally considered low in developing countries like Nigeria which may be based on the rare identification of *Mycobacterium bovis* isolates from human patients [12]. However, zoonotic bTB is present in most developing countries where surveillance and control activities are often inadequate or unavailable [13]. The human cases of tuberculosis associate with *M. bovis* infection, both pulmonary and extra pulmonary have been described in Nigeria [14–16]. From the limited survey conducted in Nigeria, on life tissues and lymph nodes of cattle from abattoirs and slaughterhouses have yielded *M. bovis* in majority of cases with few other *Mycobacteria* such as *M. tuberculosis* and *M. africanum* as occasional findings [16]. Nigeria is one of the African countries where bTB is widespread in both cattle and human [17]. This research will contribute in providing epidemiological data of bTB in Gombe Township Abattoir for epidemiological surveillance, baseline for academics and improving veterinary education, and human and animal health.

2. Materials and methods

2.1. Study area

This research was conducted in Gombe Township Abattoir. Gombe Township Abattoir was officially established to its full operation on July 4, 2007. The abattoir lies between the latitude 10.17°N and longitude 11.11°E whereas Gombe lies between latitude 10.08°N and 11.24°E and longitude 11.02°N and 11.18°E. Gombe is the capital city of Gombe state which is located in the centre of the northeastern part of the country. It borders Borno and Yobe to the east and north respectively, Adamawa and Taraba to the south, and Bauchi States to the west, with a total land mass area of 20, 265 km². The wet season is from April to October and the dry season is from November to March. Gombe has a population density of 2,353,879 [18]. Guinea Savannah grassland is the natural vegetation with some woodland. This makes Gombe a conducive grazing land and pasture for cattle rearing and predominantly an agrarian state with more than 80% of the population engaged in agricultural production [18].

2.2. Study design

A retrospective study on bTB cases recorded in Gombe Modern Township Abattoir was carried out from 2008 to 2015. Records were obtained from the Veterinary record book (NADIS/IBAR diseases' reporting network) at Gombe Area Veterinary Office and Gombe Township Abattoir. Slaughtered cattle examined at post-mortem and found with typical tuberculous lesions at the abattoir from 2008 to 2015 as described by Corner [19] and Grist [20] were considered as cases for the study.

2.3. Routine postmortem procedures

Standard daily Postmortem (PM) examination was employed in the abattoir as routine meat inspection procedures by the assigned meat inspectors (Veterinarians) at the abattoir. The sequelae are the suspected tuberculous bovine lesions recorded during this study period. Cattle brought in for slaughter were routinely subjected to procedures such as ante-mortem inspection and post-mortem examinations (by meat inspectors), before the carcasses were conveyed to the market, to minimize to a reasonable level the Public Health risk associated unwholesome meat. Post-mortem examinations of the carcasses were carried out by carefully inspecting the lymph nodes of the head, tonsils, thoracic cavity, and abdomen, including deep and superficial cervical, popliteal and sacral lymph nodes. The meat inspection procedures employed

visual examination and palpation of the lungs, liver, kidneys, lymph nodes of the carcass including the mesenteric lymph nodes and intestines. For this study, diagnosis of bovine tuberculosis was based on gross detection of typical tubercle, yellowish granulomatous caseated lesions or sometimes 'gritty' calcification in carcasses in the afore mentioned organs on incision and with the use of protective clothing. In addition, all nodular lungs were carefully inspected visually, palpated and incised [19–21].

2.4. Determination of prevalence

The monthly prevalence rate of the disease was calculated as the total number of cases of TB detected in a month divided by the total number of cattle slaughtered that month while the annual prevalence rate was calculated as the total number of bTB detected in a year divided by the total number of cattle slaughtered that year and expressed in percentage. The overall prevalence rate was calculated as the total number of cases detected over the total years under investigation divided by the total number of cattle slaughtered for all the years and presented in percentage. The seasonal prevalence rate was also determined by calculating the number of cases recorded during the rainy season (April-early-October) and the dry season period (November-March) and presented in percentage.

2.5. Data analysis

The data retrieved were statistically analyzed using the "Microsoft Excel 2010 (Version 1.0) and SPSS-Version 20.0". The data were also presented using descriptive statistics in the form of table. Chi-square test of association (χ^2) was used to determine possible association between season and disease occurrence in the abattoir, respectively. $P < 0.05$ was considered significant throughout the study.

3. Results

3.1. Prevalence of bovine TB (bTB) from the PM-records (2008–2015)

Out of 154,562 slaughtered heads of cattle examined at post-mortem from 2008 to 2015, 1202(0.78%) had tuberculous lesions. The total annual prevalence rate (0.78%) of bTB recorded in the study varied significantly ($\chi^2=99.624$, $p < 0.05$), with the highest in 2015(1.04%) and the lowest in 2011(0.34%) (Fig. 1). The overall annual prevalence rate showed intermittent increase in levels above the expected prevalence (Table 1).

3.2. Monthly distribution and occurrence of bTB

Of the total of one thousand two hundred and two (1202) of bTB lesions obtained at postmortem examination, 73(6.07%) typical tubercle granuloma cases suspected to be bTB were recorded in January, and 107(8.90%), 126(10.48%) and 112(9.32%) in June, July and August, respectively. This showed the higher distribution and occurrence of the disease at the peak of rainfall period. While, the occurrence of 126(10.48%), 98(8.15%) and 68(5.66%) in October, November and December respectively, showed the lesser occurrence in winter (Table 2). The Table also showed the monthly cumulative percentage rates of bTB over the eight (8) years period of the study as 9.53%.

3.3. Seasonal pattern of occurrence of bTB lesions

The distribution and occurrence of the disease in rainy season was higher 792(65.90%) at the abattoir than that in the dry season

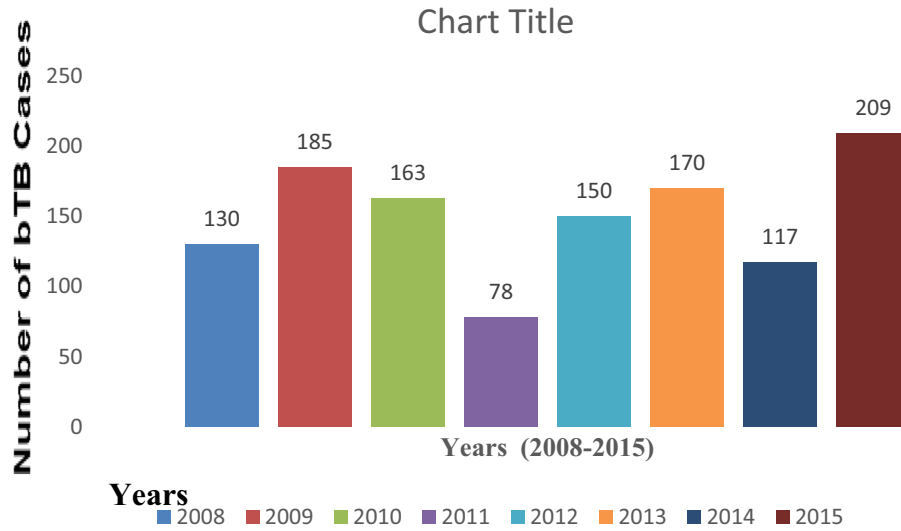


Fig. 1. Cumulative annual prevalence of bTB in Gombe abattoir from 2008 to 2015.

Table 1
Annual prevalence of a bovine tuberculosis in Gombe (2008–2015).

Year	Slaughtered cattle	bTB cases	Annual prevalence (%)	χ^2
2008	17090	130	0.76	99.624
2009	19161	185	0.97	
2010	17465	163	0.93	
2011	23139	78	0.34**	
2012	16306	150	0.92	
2013	22337	170	0.76	
2014	18951	117	0.62	
2015	20113	209	1.04**	
Total	154,562	1202	0.78	P = 0.0001

* $P < 0.05$ = Statistically significant ($\chi^2 = 99.624$, $P = 0.0001$).
 ** Significant extreme values.

Table 2
Monthly prevalence of bovine tuberculosis in Gombe Township Abattoir (2008–2015).

Months	bTB cases	Slaughtered cattle	Prevalence (%)	χ^2	P-value
January	73	11272	0.65	65.21	0.0001
February	70	9922	0.71		
March	101	9978	1.01		
April	89	10034	0.89		
May	86	11491	0.75		
June	107	12274	0.87		
July	126	15572	0.81		
August	112	12519	0.89		
September	146	13321	1.10		
October	126	18018	0.70		
November	98	13103	0.75		
December	68	17058	0.40		
Total	1202	154562	9.53		

Table 3
Seasonal prevalence of bTB in Gombe Township Abattoir (2008–2015).

Season	Slaughtered cattle	bTB cases (%)	Normal	χ^2	p-value
Wet season	94021	792 (65.90)	93229	15.447	0.0001
Dry season	61743	410 (34.10)	61333		
Total	155764	1202	154562		

* $P < 0.05$ = Statistically significant ($\chi^2 = 15.447$, $P = 0.0001$).

of 410(34.10%) and there was a statistically significant ($\chi^2 = 15.447$, $p < 0.05$) difference between the two seasons. The pattern of occurrence of the disease also appeared to be more prevalent in the rainy season than in the dry season in the state capital abattoir as previously reported and it was statistically ($p < 0.05$) significant (Table 3).

4. Discussion

The importance and impact of meat inspection as diagnostic and preventive tool in our local abattoirs cannot be overemphasized. Apart from the provision of epidemiological information on life threatening zoonotic diseases of meatborne origin, such as the bovine tuberculosis, brucellosis, and other toxico-infections. It also provides standards, ensures hygienic and wholesome meat free from infections and other toxicoses of inorganic sources (including heavy metals and chemicals used in Nigerian abattoirs/meat processing industries, like the use of vehicle tyres in burning carcasses). Thus, this study also aimed at determining the sensitivity and reliability of meat inspection as preventive tool and vital source of epidemiological data, surveillance and monitoring of meatborne zoonotic diseases like bTB, if proper records keeping would be ensured in our abattoirs.

The reason for the lower prevalence (0.34%) in 2011 found in this study may be attributed to high number of cattle slaughtered together with low number of bTB recorded during that particular year. This may also be attributed to the sources of the animals and limited access to the former source (Maiduguri axis) of animals for slaughter and majority of the animals were from the Adamawa and Cameroon border that might have less prevalence of the disease as reported before [22].

The results indicate the highest prevalence (1.04%) of bTB in 2015. This may be due to breach in public health measures and a

resultant escalating activity of insurgency – “Boko Haram” in the northeastern states (Borno, Yobe, and Chad). The political tension in the country had contributed to the movement of the herds-men/nomadic difficult which gave favorable condition for the spread of bTB among cattle due to increase in contacts, overcrowding and malnutrition as potential risk factors of the disease.

The overall (2008–2015) prevalence rates of 0.78% obtained in this study for bTB was lower than the previous studies conducted in the same Gombe Town by Adang et al. [23] who reported a prevalence of 26.60% using postmortem confirmed by histopathology; Madaki et al. [24] who reported a prevalence of 18.33% using lateral flow technique; and Salisu et al. [25] who reported a prevalence of 15.53% using lateral flow. These disparities could be due to lower sensitivity of the meat inspection procedure compared to detailed PM examinations, histopathology or culture of the tubercle lesions, different techniques and time frame used in the various studies. These are not unrelated with the fact that the prevalence rate recorded in this retrospective study may be an underestimation of the true prevalence prospectively.

However, a retrospective studies conducted by Aliyu et al. and Abubakar et al. [22,26] revealed a relatively higher prevalence of 12.27% in Gombe State as compared to the findings in this study. This could be due to an improved awareness and herd health management practices among the herds-men and other animal rearers in the vicinity [27].

The findings of 1202(0.78%) bTB suspected lesions and total prevalence rates, among the slaughtered cattle examined at the State abattoir had emphasized the importance of PM meat inspection as a vital tool for detecting and reducing some zoonotic diseases of public health importance like bTB. Bovine TB became an endemic problem in Gombe and Nigeria at large [22,27,28]. This agreed with the report of Cadmus et al. [29], as post-mortem examination still remains the immediate diagnostic tool to be used in endemic slaughter houses and abattoirs in the states of Nigeria. However, the records based on the abattoir meat inspection (recorded as bTB cases over time), may provide significantly underestimated figures of the true prevalence of the disease under study, taking into account the possibilities of missing data, paucity of information, and lack of sustainable surveillance and disease reporting network. Nevertheless, the obtainable data recorded in this work were from the NADIS/AU-IBAR report books from the State Area Veterinary Office with accuracy and could be used as a baseline epidemiological information of the disease in that region as well as being useful for academic purpose.

The disease also had seasonality trend as a risk factor that confounded the occurrence of the disease in the region. This is in line with the pathophysiology and immunology of the bTB as a chronic one with a delayed hypersensitivity that could be manifested in rainy season due to associated immunocompromization. According to previous reports, there is also a seasonal related increase in the prevalence of bTB in the Northern parts of the country [30,31]. It has also been speculated that, season has a significant influence of bTB in the northeastern region of Nigeria; they explained that, Fulani herds-men brought their cattle to the southern part of Nigeria to graze and move back up north once the rain begins, and that possibly, these cattle might have acquired the infection before coming to the south as latent bTB [32].

5. Conclusions

In conclusion, the study had determined the overall prevalence of bTB in Gombe Township Abattoir (2008–2015) at post-mortem as 0.78% and the sum of the monthly cumulative rates of bTB lesions over the period was 9.53%. Therefore, prevalence rates based on abattoir meat inspection recorded, has significantly

underestimated the true prevalence. We recommended that a proper post-mortem meat inspection should be practiced efficiently at the abattoir or slaughterhouses with a reliable compensation scheme for totally or partially condemned carcasses in Gombe state Nigeria. This is in order to encourage butchers to participate in the reduction of public exposure to bTB and to qualify the country to be able to participate in the export of meat and animals' products across the borders for sustainable Gross Domestic Product.

Competing interests

The authors have unanimously declared that, there is no any conflict of interest regarding the publication of this manuscript.

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