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Prevalence of bovine tuberculosis in cattle slaughtered at Gombe township abattoir, Gombe State, Nigeria

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A study to determine the prevalence of bovine tuberculosis in cattle slaughtered in the Gombe township abattoir was conducted from March to July, 2009. Three hundred and twenty (320) cattle comprising of four breeds, slaughtered at the abattoir were examined post mortemly for bovine tuberculosis. The four breeds and number of each examined were White Fulani (155), Red Bororo (92), Sokoto Gudali (53) and Muturu (20). Eighty five (26.6%) cattle were found to be infected with bovine tuberculosis. On the basis of animal characteristics, white Fulani breed 60 (38.7%), females (cows) 58 (62.4%) and adults 45 (14.1%) had the highest prevalence of bovine tuberculosis than other breeds, males (bulls), young adults and young, respectively. There was significant association between sex, age and breed of cattle with infection (P < 0.05). The study suggests that bovine tuberculosis is a disease common to cattle in Gombe, though with moderate prevalence and could be of economic and public health importance.

Key words: Bovine, tuberculosis, cattle, Gombe township abattoir, Nigeria.

INTRODUCTION

Bovine tuberculosis is a chronic contagious respiratory disease of cattle, usually caused by *Mycobacterium bovis* (Edward, 1998). Cattle are considered to be the main hosts of *Mycobacterium bovis*, although isolations have been made from many other livestock and wildlife species and transmission to humans poses a public health problem (OIE, 2010; Gupta et al., 2009; Hiko and Agga, 2011 and Mamo et al., 2011). Bovine tuberculosis along with other diseases is thus a serious problem in cattle rearing and seriously affects the productivity of the livestock industry in developing countries like Nigeria (Radostitis et al., 2007; Cosivi et al., 1998; Fikre et al. 2014; Berg et al., 2009; Demelash et al., 2010; Regassa et al., 2010 and Firdessa et al. 2012). In Ethiopia as well as other African countries like Nigeria, bovine tuberculosis is endemic in cattle and prevalence varies depending on the geographical location, breed and the husbandry practices. In such developing countries, the occurrence of bovine tuberculosis is widely distributed in areas where pasteurization of milk is rarely practiced and control measures are applied sporadically (Cosivi et al., 1998). In Gombe, milk pasteurization has not been largely practiced and no proper control measures have been put in place, thus people residing in the area

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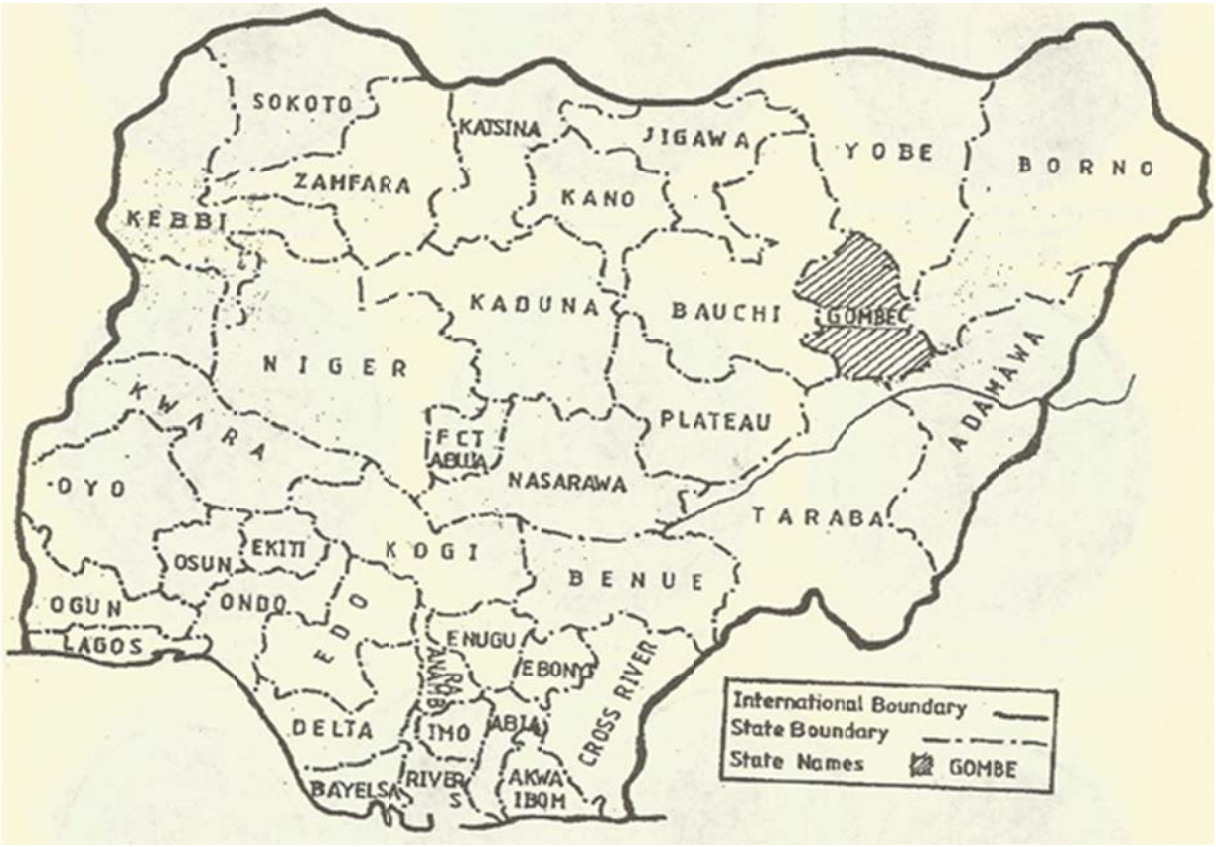

Figure 1. Map of Nigeria showing Gombe State, Nigeria.

consume a lot of raw milk predisposing them to human tuberculosis. Residents of the area could also be infected through drinking water that is contaminated with *M. bovis,* consumption of under cooked meat and drinking of milk directly from the udder of cows. Despite the existence of potential risk factors in the area, the occurrence of bovine tuberculosis has not been investigated, as previous studies estimating prevalence of bovine tuberculosis in the area are unavailable. There is therefore lack of adequate data on the epidemiology and public health implication of this disease in the area. The present study was thus, designed to determine the prevalence of bovine tuberculosis in Gombe using post mortem examination, in order to provide baseline information on the prevalence of the disease in the area (O'Reilly and Daborn, 1996). This type of information is of importance to public health officials.

MATERIALS AND METHODS

Study area

The study was conducted in Gombe township abattoir. Gombe town is the capital of Gombe State in North eastern Nigeria (Figure 1). Gombe town lies between latitude 10°08^{1}N and 11°24^{1}E and longitude 11°02^{1}N and 11°18^{1}E while Gombe State lies between Latitude 9°30^{1} and 12°30^{1}N and Longitude 8°45^{1}and11°45^{1}E. The State covers a land area of 20,265 sq. km, with a topography that is mainly mountainous, undulating and hilly, with flat open plains. The climate is warm, with temperatures not exceeding 30°C from March to May, in which March to May are the hottest months. Average daily temperatures are 34°C in April and 27°C in August. The area experiences two seasons; the rainy season, from April to October and dry season, from November to March. Annual average rainfall ranges between 850 to 1000 mm. The relative humidity ranges from 70 to 80% in August and decreases to about 15 to 20% in December. The natural vegetation is typically that of the Guinea Savanna grassland with some concentration of woodlands. This provides enough grazing land and pasture for cattle rearing. Gombe State is predominantly an agrarian state with more than 80% of the population engaged in agricultural production. Cereals such as groundnut, maize, guinea corn, millet and cowpea are predominantly grown in the area and provide enough fodder for the animals. The projected population is about 2,755,387, a majority of which are the Fulani people whose major occupation is cattle rearing (Diary 2012, Gombe State Government, Federal Republic of Nigeria). Cattle slaughtered in Gombe township abattoir from March to July 2009, were the study animals.

Sampling procedure

Three hundred and twenty (320) cattle were examined, which comprised of 155 White Fulani, 53 Sokoto Gudali, 92 Red Bororo and 20 Muturu breeds. Visits were made to the abattoir once a week for a period of three months (April to June). A total of 12 visits

were made during which a total of 320 cattle were sampled. Twenty five cattle were sampled in four visits, 26 in two visits, 27 in two visits, 28 in two visits and 29 in two visits. About 35 to 40 cattle were slaughtered each day in the abattoir, more than 50% of which were sampled during each visit. On each visit, the number of cattle slaughtered, the breed, sex and age were noted. The animals slaughtered in the abattoir were bought from the Tashan Dukku and Pantami cattle markets in Gombe. The animals were brought from other parts of the State and from neighbouring States like Borno, Yobe, Adamawa, Bauchi, Taraba and Kano States. The number of cattle slaughtered at the abattoir, the breed, sex and age, were confirmed by veterinary officers on duty at the abattoir. The current food security regulations in Nigeria, is that cattle suspected for tuberculosis should not be slaughtered for human consumption. Such cattle should be treated and certified tuberculosis free before being slaughtered for human consumption. Any cattle to be slaughtered for human consumption should be certified as being tuberculosis free. This regulation is to be enforced by veterinary officers at the abattoir.

Breed determination

White Fulani

The White Fulani breed has a commonly white coat colour on a black skin with black ears, eyes, muzzles, hooves, horn and tail tips. The breed is characterized by medium to long, high lyre shaped horns. That is, the horns are slender, medium to long size, measuring 81 to 107 cm and are lyre shaped, curved outwards and upwards, with an outward turn at the tip. It either has well developed thoracic humps or humps intermediate with the cervico-thoracic humps. The head is long, wide across the fore head and with a straight or concave appearance. The neck is strong, providing an upward carriage for the head. The average adult wither height is 130 cm. The udder is well developed, of a good shape and strong attachment. The teats are well positioned and are of medium to reasonably large size (Tawah and Rege, 1996 and Gates, 2007). The general shallowness of the body and lack of width, gives the breed a leggy appearance.

Red Bororo

The Red Bororo has red coat colour, with long and lyre shaped horns measuring 80 to 105 cm. This breed is adapted to long distance trekking in the pastoral management system. The Red Bororo is more tolerant to heat and trypanosomiasis than the Sokoto Gudali and more resistant to dermatophilosis and intestinal helminthes than the Muturu thus, has low mortality rate (Tawah and Rege, 1996 and Gates, 2007). It is the most numerous and wide spread breed in Nigeria, representing about 37.2% of the national cattle population. It has excellent potentials for milk and beef and its conformation and body size makes it suitable for draught. Its average lactation period is about 220 days. The average birth weight ranges from 18.2 to 24.2 kg. The mature weight of bulls and cows in the improved system of management is 350 to 665 and 250 to 380 kg, respectively. The slaughter and carcass weights are 325 and 166 kg.

Sokoto Gudali

The Sokoto Gudali has multiple coat colours and the most common one is the black and white coating with light underside, with very short horns. The Sokoto Gudali has deeper body than the White Fulani breed. The head is long and wide between the eyes and across the forehead, with a straight or slightly convex facial profile. The ears are long, large and convex, sometimes pendulous. The hump is thoracic in position. The average ranges from 130 to 138 cm for males and 116 to 132 cm for females. This breed is owned and managed by Fulani and Hausa pastoralists and transhumant herders (Gates, 2007) who feed them on communally owned grazing lands and browse especially in the dry season. This breed is known for its hardiness to the arid northerly environments and its beef quality and milk. The mature weight ranges from 495 to 660 kg for males and 240 to 355 kg for females.

Muturu breed

The Muturu breed has black and white patches of coat colour, with large udder for milk production (Getty et al., 1975 and Gates, 2007). It is the smallest cattle breed known. The height for withers is 95 cm for males and 88 cm for females. The weight is 147.2 kg for males and 110.0 kg for females. The management level where these cattle are kept is low. The breed maintains good body by grazing and browsing throughout the year. The breed is trypanotolerant and also tolerates ticks and tick-borne diseases. It has significant cultural values and is used for socio-cultural purposes, sacred and dedicated to shrines. It is sometimes used for work and is seldom milked.

Age determination

The age was determined using dentition according to (Getty et al., 1975). Cattle less than one year old (young) had temporary incisors that erupted at birth but could also have deciduous molars or premolars and never both. For cattle between one to three years of age, which were considered as young adults, those between 13 to 14 months had their full set of deciduous incisors but were temporary short, broad and bright. Those between 15 to 18 months of age had their deciduous incisors evident. The incisors were larger and narrower when compared with those of 13 to 14 months of age. The eruptions of the first central permanent incisors were indicative of cattle between 18 to 24 months of age. Cattle aged between 25 to 36 months had their middle incisors well erupted and developed permanently. The eruption of the second and third intermediate incisors indicated that the animal was 36 months old. Cattle above three years of age, which were considered as adults, had their incisors erupted and a few of them had their teeth worn down.

Post mortem examination of the lungs and abdominal cavity tuberculosis

The lungs and abdominal cavity of slaughtered cattle were examined for the presence of nodular tubercles. The lungs were serially sectioned for tuberculosis lesions and palpated to get infected lungs. Infected lungs identified to have tubercles, were incised in order to feel the gritty nature of the tubercles, abscesses were also incised to observe the pus formed inside them, as a result of the *M. bovis* infection. Method for identifying lesions was the same as the typical post mortem examination of cattle in the abattoir. This guaranteed the sensitivity and specificity of the method used for detecting tuberculosis. The lungs were also examined for inflammations. Examination of animals for bovine tuberculosis was carried out with the technical assistance of the veterinary officers at the abattoir, in order to guarantee the reliability and validity of the results. However, no physical examination or radiography was conducted. Only postmortem and laboratory examinations were carried out. After detailed postmortem examination, gross pathological tuberculous lesions were detected from the lungs and abdominal cavity. Both normal and infected

lungs were collected in specimen bottles containing 70% ethanol and taken to the histopathology laboratory of the Department of Veterinary Pathology and Microbiology, Ahmadu Bello University Zaria, Nigeria for laboratory analysis.

Laboratory analysis of infected and normal lungs

A specimen of an infected lung was analyzed histopathologically to identify the presence of granulomatous tubercles, which contained gram positive bacilli. A sample was considered positive for *M. bovis* if there were gram positive bacilli. Tissue sections of the lungs were taken and fixed in 10% buffered neutral formalin for 72 h. Sections were mounted on clean glass slides, dried at room temperature and stained with haematozylin and eosin. These were cover slipped and dried in an oven. The slides were examined under X10 and X40 objectives of the light microscope. This analysis gave the clear difference between the normal and infected lung. It also predicted the presence of *Mycobacterium bovis* that causes the disease.

Data analysis

The prevalence was expressed as a percentage by dividing the number of animals infected by the number of animals examined and multiplying by 100 (Margolis et al., 1982). The chi square test (X^2) was used to determine any possible association between prevalence of the disease and sex, age and breed of cattle. A statistically significant association between the result and the variable (sex, age and breed) was said to exist if the calculated $P < 0.05$. The null and alternative hypotheses were stated. The degree of freedom (df) was determined as (n - 1). The P - value (α) was set at 0.05 (95% CI). The decision was to reject Ho if $X^2_{cal} \geq X^2_{tab}$ and to accept Ho if $X^2_{cal} \leq X^2_{tab}$. Chi square was calculated using the formula;

$$X^2 = \frac{\sum (O - E)^2}{E}$$

RESULTS

Three hundred and twenty (320) cattle were examined, which comprised of 155 White Fulani, 53 Sokoto Gudali, 92 Red Bororo and 20 Muturu breeds. Postmortem examination showed that 85 (26.6%) of the 320 cattle examined were infected with tuberculosis. These comprised of 60 (38.8%) White Fulani, 9 (17.0%) Sokoto Gudali, 14 (15.3%) Red Bororo and 2 (10.1%) Muturu breeds. Prevalence of tuberculosis was higher in females 58 (62.4%) than in males 27 (11.9%) and Fourteen (29.8%) young, 26 (19.4%) young adults and 45 (32.4%) adults were infected. Chi square test showed association between sex, age, breed and infection ($P < 0.05$). (Table 1).

DISCUSSION

The prevalence of 26.6% obtained in this study is higher than that of Fikre et al. (2014) who reported prevalence of 11.3 and 20.% at animal and herd level respectively in and around Mekelle in Northern Ethiopia, Ameni and Erkihun (2007) who reported prevalence of 11 and 15% at animal and herd level respectively in Adama town in Ethiopia, Regassa et al. (2010) reported 11.6% at animal level in Hawassa town and its environs in Southern Ethiopia and Anon (2007) which was 2.1% in Maiduguri North eastern Nigeria but lower than 34.1 and 53.6% prevalence at herd and individual animal level respectively reported by Tsegaye et al. (2010), 46.0% prevalence reported in Ethiopia by Demelash (2008) and prevalence of 23.7 and 43.4% at animal and herd level respectively reported by Elias et al. (2008). The observed differences in prevalence could be due to the breeds and number of cattle examined and the production system. In the present study, four breeds of cattle totaling 320 animals were examined, with more males examined than females, more adults examined than young adults and young and the animals were reared under the extensive production system. It is likely that as the number of animals examined increases and the age and sex varies, the number of animals infected may also increase (O'Reilly and Daborn, 1996 and Asseged et al., 2000). Animal reared under the extensive production system are less prone to infection than animals reared under the intensive production system (Fikre et al., 2014). The intensive production system promotes close contact between animals, thereby favouring the spread of the disease. According to Griffin et al. (1993), Ameni et al. (2003) and Elias et al. (2008), poor managerial inputs increase the risk of bovine tuberculosis. Thus, the status of bovine tuberculosis could be improved by adopting sanitary measures that improve hygiene conditions of the animals. In the present study, female animals (cows) had a higher prevalence compared to males (bulls). This is in agreement with the findings of Inangolet et al. (2008) and Fikre et al. (2014). This could be as a result of the fact that cows are confined to a barn and kept long for production purpose which may facilitate infection and acquisition of the disease (Bikon and Oboegbulem, 2007). Dairy cows experience greater production stress and gathering of cattle during milking increases the risk of transmission as shown by bovine tuberculosis modeling in New Zealand (Barlow, 1997). Another explanation is that slaughtered females tend to be older than slaughtered males. The older the animal, the more the opportunity for exposure to tuberculosis, and the greater the likelihood that lesions will be larger and therefore easier to detect on postmortem examination. The higher rate of infection in adults and young adults compared to calves (young), suggests that, as the animal ages, the rate of infection increases and the longer the animal lives, the more the disease manifests itself. The finding of lower prevalence in Muturu breed compared to the other breeds could be that, genetically the Muturu breed is less prone to infection than the other breeds. The high prevalence of the disease in the White Fulani breed

Table 1. Prevalence of tuberculosis in cattle slaughtered at Gombe township abattoir, Gombe State, Nigeria.

Variable	Number of animals						
	Examined	Positive (%)	df	p-value (α)	X^2_{cal}	X^2_{tab}	Decision
Sex	320	85 (26.6)	1	0.05	86.20000	3.84146	Reject Ho
Male	227	27 (11.9)					
Female	93	58 (62.4)					
Age (years)	320	85 (26.6)	2	0.05	6.19000	5.99147	Reject Ho
< 1	47	14 (29.8)					
1 ≤ x ≤ 3	134	26 (19.4)					
> 3	139	45 (32.4)					
Breed	320	85 (26.6)	3	0.05	23.09000	7.81473	Reject Ho
White Fulani	155	60 (38.7)					
Sokoto Gudali	53	9 (17.0)					
Red Bororo	92	14 (15.2)					
Muturu	20	2 (10.0)					

df = degree of freedom, N = 320 (total number examined).

probably indicates its high susceptibility and low immunity to infection than the other breeds. Thus, susceptibility to infection may be breed-dependent and could be due to some intrinsic and extrinsic factors. It is also likely that certain breed of cattle may be more susceptible to tuberculosis due to housing, management and feeding differences. Human tuberculosis cases exist in the area, and this has necessitated the establishment of tuberculosis treatment centre within the state. The zoonotic risk of bovine tuberculosis is often associated with the consumption of unpasteurized milk infected with *M. bovis*. Consumer of milk in Gombe, generally prefer raw milk because of its taste, availability and lower price. The consumption of unpasteurized milk is a regular practice in Gombe, especially among the Fulani speaking race, where milk forms a major part of their daily meal. The cultural habit of most Fulani cattle rearing families drinking milk directly from the udders of their cattle, could be a predisposing or major risk factor of humans to *M. bovis* infection (Cosiviet al., 1998; Ayele et al., 2004). The culture of sharing human habitation with cattle is a common practice in Gombe, thus, aerosol transmission from cattle-to-man could also be considered. Humans may also be exposed to *M. bovis* infection through food and unhygienic practices. *M. bovis* according to Dankner et al. (1993) and Dela'rua (2006) is genetically similar to *M. tuberculosis* and could cause identical clinical signs in humans. The disease transmission could be cyclical from cow-to-man-to-cow (Cosivi et al., 1998), underlying the existence of higher risk of dissemination of mycobacteria among the cattle and human populations. Radostits et al. (2007) reported that infected cattle could be the main source of infection to other cattle and may act as maintenance and reservoir hosts. Bikon and Oboegbulem (2007), Cadmus et al. (1999; 2004), and Dusai and Abdullahi (1994) earlier reported bovine tuberculosis as a common disease of cattle in Nigeria. Bovine tuberculosis is thus an endemic problem in Gombe and Nigeria at large, with no well-defined national eradication control programme and could be of zoonotic and public health importance (Alhaji, 1976; Cosivi et al., 1998; Cadmus et al., 2004). Like in North America, carcasses with suspected lesions are condemned and often not allowed for human consumption. Thus, it is recommended that proper meat inspection at the abattoir should be intensified and properly conducted, to avoid the selling of infected lungs to the public. This entails detailed ante-mortem and postmortem inspection of animals brought for slaughter at the abattoir. Meat inspectors should be trained to check for miliary tubercles in the head, fore and hind limbs, lungs, heart, liver, spleen, kidneys and mammary glands and associated lymph nodes. Adequate palpation, with resultant production of gritty sound on incision of some of these organs and lymph nodes would form the basis of tentative diagnosis of tuberculosis. This form of diagnosis will help to a great extent in reducing the spread of zoonotic tuberculosis. When meat inspection procedures are properly carried out, cattle with visible lesions of tuberculosis could be identified. Only cattle that have been certified as disease free should be slaughtered at the abattoir for public human consumption.

CONCLUSION AND RECOMMENDATIONS

The public should be educated on the need to avoid the consumption of infected lungs and the impending dangers of their consumption. Infected lungs should be discarded, burnt or buried and not consumed by the public and owners of such should be adequately compensated. Proper surveillance/ambulatory services should be carried out within the state and its environs, for

diagnosis and treatment of infected animals with the appropriate drugs. The use of novel diagnostic techniques is recommended to monitor and control the spread of the disease in the area and in other areas at risk in Nigeria (Cui et al., 2013; Li et al., 2014).

Conflict of Interest

The authors have not declared any conflict of interest.

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