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PREVALENCE AND ECONOMIC LOSSES DUE TO BOVINE TUBERCULOSIS IN CATTLE SLAUGHTERED AT BODIJA MUNICIPAL ABATTOIR, IBADAN, NIGERIA

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ABSTRACT

Bovine tuberculosis (BTB) is a zoonotic disease responsible for considerable economic losses; with consequent negative impact on both public health and the livestock industry. However, the burden of this disease and associated economic losses remain un-investigated among slaughtered cattle in Ibadan, the hub of livestock activities in south-western Nigeria. A cross sectional study was conducted over a three-month period to determine the prevalence and economic losses due to BTB among slaughtered cattle at the Bodija Municipal Abattoir, Ibadan, in south-western Nigeria. Individual slaughtered cattle were purposively inspected for the presence of tuberculous lesions, and representative sample of affected organs and associated lymph nodes from the BTB suspected animals were taken. The suspected lesions were processed based on Becton Dickinson digestion and decontamination procedure and the losses due to BTB were estimated mathematically, using a formula. The BTB prevalence of 9.3 % (38/408) was obtained with a significant statistical association (P ≤ 0.05) of the disease with the breeds of cattle slaughtered. Out of the 46 visceral organs condemned: 29 (63 %) were lungs, 12 (26.1 %) livers, 4 (8.7 %) hearts and 1 (2.2 %) kidney. The total estimated annual economic loss (direct and indirect) due to BTB was estimated as Nigerian naria NGN 703,980,070 (EUR 1,725,441.4). This study revealed BTB as endemic and a major cause of concern considering its ill-health and economic effects on both humans and the livestock industry. Efforts are therefore required: to control this disease along the beef value chain in order to safeguard human and livestock health; as well as to limit the economic losses associated with its prevalence.

Key words: bovine tuberculosis; economic loss; prevalence; zoonoses

INTRODUCTION

Bovine tuberculosis (BTB) is a chronic infectious and contagious disease of both domestic and wild animals as well as humans [28]. It is caused by *Mycobacterium bo-*

vis, a slow growing, non-photochromogenic and acid-fast bacillus. The disease is characterized by the formation of granulomas in tissues and organs, more significantly in the lungs, lymph nodes, intestines, liver and kidneys [32]. The BTB disease is a cause of concern for humans and others animals judging from its negative economic and health implications [6, 10]. Indeed, the disease induces high animal morbidity and mortality that eventually reduces the financial capital and increases production costs [9]. Bovine TB affects cattle health, impacts negatively on profitability and trade and can decimate years of genetic improvement towards desirable production traits [3]. Bovine TB is an important zoonotic disease, known to exist in all parts of the world. It is recognized in 176 countries as an important bovine disease that causes great economic loss [18, 24, 31].

Cattle infected with *M. bovis* are the main source of infection for other cattle and humans. *M. bovis* could be excreted through aerosol, sputum, faeces (from both intestinal lesions and swallowed sputum from pulmonary lesions), milk, urine, vaginal and uterine discharges, and discharges from open peripheral lymph nodes [29]. Domestic animals are significant reservoir hosts for human TB, caused by *M. bovis* [17]. The majority of the cases of human TB, both pulmonary and extra pulmonary in Nigeria are due to *M. tuberculosis* [6]. However, due to the endemicity of BTB in the cattle population, people are at risk of exposure to *M. bovis* from consumption of unpasteurized milk and milk products as well as the dearth of meat inspection services to identify infected animals in the food chain [5]. Transmission through consumption of milk and unpasteurized dairy products from infected cattle occurs mostly among the general public, whereas exposure through airborne infection remains highest among farmers, veterinarians, and slaughterhouse workers [25].

The diagnosis of TB in cattle is mainly through tuberculin testing, culture, and molecular genotyping [4, 36]. Culture is regarded as the gold standard for confirmation of BTB but most laboratories in the country are ill-equipped. Hence, routine diagnosis of BTB at the abattoir is based on identification of characteristic tuberculous lesions [1, 20]. The disease is a major cause of economic losses due to organ condemnation at the abattoir and slaughter slabs in Nigeria. Available reports showed that BTB causes direct loss of up to 10 % to 18 % decrease in milk and 15 % meat production [37]. Thus, BTB is of paramount importance to cattle breeders and public health authorities because of its economic and zoonotic implications [19]. This study aims at providing information on the current prevalence and estimated financial loss due to BTB among slaughtered cattle in Ibadan, located in south-western Nigeria.

MATERIALS AND METHODS

Study area

This study was carried out at Bodija Municipal Abattoir, a major abattoir in the city of Ibadan, where 250 to 300 heads of cattle are slaughtered on a daily basis. The abattoir is a major recipient of animals from different parts of the country especially the north and it is located in the geographical grid of reference longitude 3 °E, latitude 7 °N [14].

Sample size

The sampling method was employed to generate data on cattle presented for slaughter at the abattoir. Because of an expected 50 % prevalence, 408 cattle were examined in this study.

Sampling procedure and laboratory diagnosis

A total of 408 cattle were thoroughly examined at *post mortem*. Organs such as lungs, liver, heart and kidneys were visually examined, palpated and incised to detect the presence of granulomas; associated lymph-nodes were also palpated and incised, especially the bronchial and hepatic lymph-nodes. Each sample obtained was appropriately kept in sample containers and labelled. Data on breed, sex and body score of each sampled animal were collected and documented. Samples obtained were transported to the Tuberculosis Laboratory of the Department of Veterinary Public Health and Preventive Medicine, University of Ibadan, Nigeria for analysis. Suspected lesions were processed based on Becton Dickinson digestion and decontamination procedure [2]. The suspension obtained after the sample processing was inoculated onto Lowenstein-Jensen slopes with pyruvate and glycerol and incubated at 37 °C for between eight and twelve weeks. Cultures were considered negative if no colony growth was detected after 8 weeks.

Assessment of economic losses

The loss due to BTB in Bodija Municipal Abattoir was estimated mathematically, using a formula set

by Ogunrinade and Ogunrinade [27] as modified by Guadu et al. [16]. The total annual financial loss incurred due to BTB was computed by summing up the direct and indirect losses.

A = direct economic losses (annual loss from organs condemnation)
B = indirect economic losses (annual loss from carcass weight reduction)

Direct economic losses

The direct economic loss (A) was calculated based on condemned edible visceral. There were no documented data on annual slaughter rates at the abattoir, therefore it was estimated based on observations made during the study period; 250 to 300 heads of cattle were slaughtered on a daily basis, six [6] times a week, an average of 275 heads of cattle was estimated, which resulted into a mean slaughter rate of 85,800 head of cattle per annum. The percentage of each condemned organ was taken into consideration and the average market price of healthy lung, liver, heart and kidneys, which are 2000, 3000, 1500 and 700 NGN (Nigerian naria), respectively.

The economic loss is calculated as follows:

$$A = (MAS \times PLu \times CLu) + (MAS \times PLi \times CLi) + + (MAS \times PHr \times CHr) + (MAS \times PKi \times CKi)$$

MAS = mean annual cattle slaughtered at study abattoir
PHr = percentage of heart condemned
PLu = percentage of lung condemned
CHr = mean cost of a heart
CLu = mean cost of a lung
PKi = percentage of kidney condemned
PLi = percentage of liver condemned
CKi = mean cost of a kidney
CLi = mean cost of a liver

Indirect economic losses

To calculate the indirect economic losses due to BTB, a 36.6 % weight loss due to BTB was used as reported by Kwaghe et al. [22] and an average carcass weight of Nigerian cattle is estimated as 292.35 kg according to the report of Umar et al. [35] in order to obtain percentage weight of carcass reduction due to BTB. Beef sellers were orally interviewed and an average of NGN 800 was obtained to be the cost a kilogram of beef.

$$B = MAS \times PCW \times MCB \times P$$
$$B = MAS \times (292.3\,KG \times 36.6\%) \times MCB \times P$$

MAS = mean annual cattle slaughtered at study abattoir
PCW = percentage of carcass weight reduction
MCB = mean cost of 1 kg beef in Ibadan city butcheries
P = prevalence rate of bovine tuberculosis at study abattoir

Table 1. Prevalence of bovine tuberculosis in relation to breed, sex and body score

Variables	No. examined	No. infected	Prevalence [%]	X^2	P-value
Breed					
Bunaji	158	22	13.9	6.712	0.035
Rahaji	157	9	5.7		
Sokoto Ruhali	93	7	7.5		
Total	**408**	**38**			
Sex					
Male	60	4	6.7	0.800	0.777
Female	348	34	9.8		
Body score					
Emaciated	186	17	9.1	0.632	0.427
Moderate	222	21	9.5		

P — value is significant at $P \leq 0.05$
*significant, X^2 — chi square

Data Analysis

The data obtained were coded in Microsoft excel and subjected to descriptive statistics and chi-square in order to assess the magnitude of the difference of comparable variables using SPSS version 16.0 software. Statistically significant association between variables is considered to exist if the p-value $P \leq 0.05$.

RESULTS

A total of 46 lesions suggestive of tuberculosis were obtained from 408 slaughtered cattle examined, out of which only 38 were culture positive for *Mycobacterium* spp., giving a prevalence of 9.3 % (38/408). The Bunaji breed (22/158; 13.9 %) of cattle had the highest prevalence, followed by Rahaji (9/157; 5.7 %) and Sokoto Gudali (7/93; 7.5 %). The prevalence for sex were: male (4/60; 6.7 %) and female (34/348; 9.8 %) while the body score was emaciated (17/186; 9.1 %) and moderate (21/222; 9.5 %). The chi square test statistic revealed that the prevalence was significantly different ($P \leq 0.05$) for breeds, but not for sex and the body score (Table 1). The localization of tubercles (Table 2) was highest in the lungs (29/46, 63 %), followed by liver (12/46; 26.1 %), heart (4/46; 8.7 %) and least in the kidneys (1/46; 2.2 %).

The total annual economic loss due to bovine tuberculosis in the study abattoir was estimated by summing up losses calculated from organ condemnation (direct losses) and carcass weight reduction (indirect losses). The direct economic losses were calculated to be NGN 21,059,610 (EUR 51,616.7) and the indirect economic losses was calculated to be NGN 682,920 460 (EUR 1,673,824.7). A total annual economic loss (A + B) of NGN 703,980, 070 (EUR 1,725,441.4) was obtained in this study.

**Conversion rate:* NGN 408 is equivalent to 1 EUR.

Table 2. Disseminated tubercles of bovine tuberculosis in various organs

Organs	Frequency	Percentage
Lungs	29	63.0
Liver	12	26.1
Heart	4	8.7
Kidneys	1	2.2
Total	**46**	**100.0**

DISCUSSION

From this study, a prevalence of 9.3 % BTB was obtained among slaughtered cattle in Ibadan, in south-western Nigeria. The fact that BTB due to *M. bovis* is endemic and despite the global recognition of the disease as an animal and a zoonotic disease, substantial evidence suggests that its impacts on human health has been underestimated [26]. However, consumption of unpasteurized infected milk, a major factor that predisposes humans contracting zoonotic TB is still popularly practiced in Nigeria, hence the importance of the prevalence obtained in this study. The prevalence of 9.3 % obtained in this study is in line with previous studies on BTB conducted in south-western Nigeria with an established prevalence of between 8.8 % [6] and 10.5 % [7]. It is also similar to the prevalence of 8.8 % obtained by E j e h [12] in Benue State, north-central Nigeria and higher than 6.41 % reported in Borno State, north-east Nigeria by K w a g h e et al. [22]. The difference in prevalence might be as a result of varying detection abilities of the meat inspectors. The effective detection of BTB tubercles at *post mortem* is dependent on the thoroughness of the examination, training and experience of the meat inspectors [15, 23]. Based on this study, the slaughter hall layout and the ratio of meat inspectors to butchers are influential factors, because butchers slaughter and dress carcasses irrespective of whether meat inspectors get to inspect it or not. A working system can therefore be developed to maintain and improve meat inspection carried out in the country [11, 13, 34].

The lungs recorded the highest prevalence for tubercle localization, which can be attributed to the infection route of entry. Other studies carried out in other parts of the country reveal that lungs are the most affected organs [12, 22]. Pathogenesis studies suggest strongly that the route of transmission of bovine TB is largely via the respiratory system, which requires transmission via infectious aerosols [8]. The lungs are also regarded as the most exposed organ to different aggressions because of its anatomical and histological peculiarities. This finding therefore sug-

gests increasing risk of exposure of livestock workers to BTB due to aerosolization of tubercle bacilli from infected cattle.

The estimated total annual economic loss due to BTB from both direct and indirect losses obtained in this study was estimated to be NGN 703,980,070 (EUR 1,725,441.4) which is huge for a developing country considering the fact that decreased milk production and reproductive rate were not considered. The total annual economic loss obtained in this study is higher compare to the NGN 349,580,199.89 (EUR 856,814.2) reported by Kwaghe et al. [22]. This difference could be due to variation in the prevalence of the disease, mean annual slaughtered cattle and the retail prices of organs in different locations. A retrospective study by Ejeh et al. [12] to determine the direct economic loss between the years 2008 and 2012, revealed values that ranged from NGN 356,000 (EUR 872.6) to NGN 2,000,000 (EUR 4901.9) which are lower compare to NGN 21,059,610 (EUR 51,616.7) obtained in this study, thereby confirming the endemicity of BTB as a source of leakage to the buoyancy of the nation's economy.

Bovine TB has posed a tremendous impact on livestock's economic growth of Africa, as it affects the continent's involvement in the international trade of animals and animal products. The disease causes severe economic losses in livestock due to poor production, death and partial condemnation of organs or total condemnation of carcasses [33]. Many countries, including Nigeria do not implement any control or eradication programs. The BTB is an important economic challenge worldwide, most especially in developing countries and it can cause significant economic losses [37]. The zoonotic nature of BTB, coupled with the fact that it constitutes a significant economic burden to the agricultural industries [21] indicates the need to properly strategize a means to totally eradicate it. Slaughter houses have been proven to provide the opportunity for detecting diseases of both economic and public health importance [30]. It therefore becomes imperative that meat inspection activities in slaughter houses in Nigeria be scaled up in order to safeguard the health of the public and invariably limit the spread of the disease in both human and other animals with eventual prevention of unwarranted economic losses due to the disease in animals.

CONCLUSIONS

Bovine tuberculosis is still endemic in the cattle population in Nigeria and causes huge economic losses to the country. The consequent gross shortage of dietary animal proteins, due to condemnation of infected visceral organs and edible meat, as well as indirect weight loss and a potential health hazard to humans as result of its zoonotic nature are over-whelming. There is therefore a need for urgent government intervention in ensuring optimal control measures against BTB from the farm to the slaughter houses. The meat inspection at slaughter houses should also be stepped up by veterinary meat inspectors as this will go a long way to minimize the spread of bovine tuberculosis in the country.

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