

## Prevalence and economic loss of bovine tuberculosis in a municipal abattoir, Abeokuta Southwestern Nigeria

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### Abstract

A 12 month cross-sectional study was carried out at Lafenwa Abattoir Abeokuta, Southwestern Nigeria from July, 2011 to June, 2012. This was to determine the prevalence and economic loss of bovine tuberculosis in this abattoir. A total of 928 cases of bovine tuberculosis out of 52,273 cattle slaughtered during this period were condemned, representing a total prevalence of 1.78% (95% CI: 1.31- 2.14%). Typical tuberculous lesions were found in the Lung, Liver and Spleen, higher rate of organ condemnation was observed in the lung followed by liver and spleen. There was statistically significant difference in rate of organ condemnation ( $P < 0.05$ ). The monthly prevalence and sequence plot revealed an epidemic tendency for bovine tuberculosis during this period and there was statistically significant difference between prevalence of bovine tuberculosis and seasonal occurrence. An estimated total loss of N1.2 million (US\$7,367) due to bovine tuberculosis was observed in this abattoir for the year. It was concluded that bovine tuberculosis is prevalent with epidemic tendency in cattle destined for human consumption, also with attending serious public health implications and huge loss to both the butchers and national economy.

**Keywords:** Bovine tuberculosis, Prevalence, Economic loss, Lafenwa abattoir

### Introduction

Meat inspection as part of the veterinary public health activities ensures the delivery of hygienically processed meat for public consumption while preventing the transmission of infectious and zoonotic diseases to humans (Alonge and Fasanmi, 1979). The activity also provides vital data and valuable information on the incidences and prevalence of animal diseases and conditions within any country (Phiri, 2006). The abattoir is a source of invaluable information on the incidence of animal diseases and conditions including those of zoonotic importance such as tuberculosis (Cadmus and Adesokan, 2009). Bovine Tuberculosis (BTB) is one of the seven most neglected endemic zoonoses in the world, particularly in developing

countries (WHO, 2006). In developing countries, animal tuberculosis is still prevalent and is responsible for significant economic loss in animal production. Indeed, the disease induces high animal morbidity and mortality that eventually reduces the financial capital and increases production costs and also account for human health problems and even deaths (Cosivi *et al.*, 1998). According to literature, approximately 85% of the cattle and 82% of the human population of Africa live in areas where animal tuberculosis is either partly controlled or uncontrolled (Ayele *et al.*, 2004). In contrast however, only a few African countries have applied disease control measures as part of "test and slaughter" strategy and consider the disease as notifiable (Cosivi *et al.*, 1998). Despite

this, in most developing countries pasteurization is not well practiced and therefore, 10% to 15% of human tuberculosis is considered to be caused by *M. bovis* (Thoen *et al.*, 2009).

In Nigeria, the endemic nature of bovine tuberculosis (BTB) has been reported judging from the prevalence from various abattoirs in the country (Igbokwe *et al.*, 2001; Cadmus *et al.*, 2008; Cadmus and Adesokan, 2009; Adamu *et al.*, 2011). However, to date, there is dearth of useful information on economic evaluation on condemned cases of bovine tuberculosis in Nigeria. Therefore, this study is with a view to evaluating the prevalence and possible economic implications associated with condemnations due to bovine tuberculosis at a municipal abattoir in Abeokuta, Southwestern Nigeria during routine meat inspection.

### **Materials and Methods**

**Study location:** The study was carried out in Lafenwa abattoir, which is the major abattoir in Abeokuta. The abattoir is located in Abeokuta North Local Government area, Abeokuta, Ogun State in South-west Nigeria, situated at 7°9'39" N, 3°20'54" W, in the rainforest vegetation zone of Nigeria (Google Earth, 2006).

**Study Design:** A 12 month cross-sectional study was carried out at Lafenwa Abattoir from July, 2011 to June, 2012 to determine an annual prevalence of tuberculosis in this abattoir. Post slaughter examination involved visual examination of carcasses and organs with keen attention being directed to viscera organs. Evidence of pathological cases of tuberculosis in the viscera during this period was based on post-mortem examination of characteristic lesions of tuberculosis at meat inspection as earlier described (Awah-Ndukum *et al.*, 2007).

**Seasonal Variation:** The months of the year were divided into two periods, i.e. the dry season (April to September) and the wet season (October to March), and the Chi-square ( $\chi^2$ ) test was applied to investigate associations between prevalence and season. The monthly oscillation was analyzed graphically, as plots of the monthly prevalence over the year evaluated.

**Economic loss evaluation:** The economic loss due to tuberculosis was assessed adopting the method by Ibronke and Fasina, 2010. This was carried out by considering the retail market prices of an average cattle liver, lung, and spleen and total weight loss for both total and partial condemnation of lung, liver and spleen due to tuberculosis. The retail market prices of an average size liver, lung and spleen was determined through interaction with the butchers in Lafenwa abattoir. For cases of partial condemnation, average value of the affected organs were used as reported by Ibronke and Fasina, 2010 that partial condemnation often reduces the market value of the remaining organ to about half of its original value as consumers see such tissues as being inferior and so offer less price for it. The average weights of the organs were determined using standard weighing scale. The information was subjected to mathematical computation using the formula set by Ibronke and Fasina, 2010.

**Statistical Analysis:** Data generated from postmortem meat inspection for cases of tuberculosis were recorded in Microsoft Excel 2003 program and analyzed using Statistical Packages for Social Sciences (SPSS 16). Descriptive statistics was used to determine the level of organs condemnation rates due to tuberculosis which was defined as proportion of condemned organs to the total number of

organs examined. Seasonal variation and comparison of rate of condemnation due to tuberculosis between organs were determined using Chi-square test.

### Result

A total of 52,273 cattle heads were slaughtered at Lafenwa abattoir during the one year period with an average slaughter of 4,356 cattle per month. A total of 928 cases of bovine tuberculosis were condemned representing a total prevalence of 1.78% (95% CI: 1.31- 2.14%). Average monthly prevalence of 1.72% was observed and varied from 0.79% in May, 2011 to 2.64% in December, 2011.

Organs specific prevalence was 1.56% (95% CI: 1.19-1.95%), 0.18% (95% CI: 0.12-0.23%) and 0.04% (95% CI: 0.02-0.06%) for Lung, Liver and Spleen respectively. Cases of pulmonary tuberculosis varied from 0.6% in May, 2011 to 2.43% in December, 2011 with an average prevalence of 1.57% per month. Hepatic tuberculosis varied from 0.04% in September, 2011 to 0.36% in November, 2011 with an average prevalence of 0.18% per month. While splenic tuberculosis varied from 0.00% in July, 2011 to 0.007% in February, 2012 with an average prevalence of 0.04% per month. The rate of organ condemnation as presented in Table 2, revealed a statistically significant difference in organ condemnation ( $X^2 = 133.66; P < 0.05$ ).

The monthly prevalence and sequence plot revealed an epidemic tendency for bovine tuberculosis particularly pulmonary tuberculosis and to lesser extent hepatic tuberculosis (Figure 2). The seasonal variation in prevalence revealed greater prevalence during the dry season (April - September) compare to wet season (Table 3) and there was statistical significance difference between the season and

prevalence of tuberculosis ( $X^2 = 16.19; P < 0.05$ ).

Table 4 shows the total weight loss of different organs and associated cost implications due to bovine tuberculosis. An estimated total loss of N1.2 million (US\$7,367) due to bovine tuberculosis was observed.

### Discussion

The World Organization for Animal Health (OIE) considers BTB to be an important zoonotic disease with a socioeconomic and public health impact that affects the international trade of livestock and animal products. The disease has a worldwide distribution including Africa, and in many countries, bovine tuberculosis remains a major chronically infectious disease among cattle and other domesticated animals (Ayele *et al.*, 2004). The prevalence of bovine tuberculosis has been reported in various areas in Nigeria. The prevalence rate (1.78%) of BTB observed in this study is higher than 0.55% prevalence reported by Ameen *et al.*, 2008, 1.1% reported by Bikom and Oboegbulem, 2007 and Nwanta *et al.*, 2011 but lower than 4.73% and 3.4% reported by Hena *et al.*, 2012 and Opara *et al.*, 2012 respectively.

The distribution of the lesions in various organs indicated that the lung was the most affected followed by liver and spleen, similar trend of distribution of affection in lung followed by liver have also been reported by Opara *et al.*, 2012. The occurrence of lesions in the different major organs suggests the possible route of transmission of the BTB, as observed in this study, is possible to suggest that, the principal mode of transmission of the aetiological agent of BTB is through inhalation route rather than ingestion as observed and reported by Radostitis *et al.*, 1994, Ameen *et al.*, 2008 and Opara *et al.*,

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**Table 1: Monthly and Organs Prevalence of Bovine Tuberculosis in a Municipal Abattoir, Southwestern, Nigeria.**

MONTH	LUNG				LIVER			SPLEEN			
	TS	TP n (%)	TC n(%)	PC n(%)	TOTAL n(%)	TC n(%)	PC n(%)	TOTAL n(%)	TC n(%)	PC n(%)	TOTAL n(%)
JULY	3832	61(1.59)	17(0.44)	38(0.99)	55(1.44)	1(0.03)	5(0.13)	6(0.16)	0(0.00)	0(0.00)	0(0.00)
AUGUST	4120	79(1.92)	25(0.61)	42(1.02)	67(1.63)	6(0.14)	3(0.07)	9(0.21)	0(0.00)	3(0.07)	3(0.07)
SEPT	4618	54(1.17)	20(0.43)	28(0.61)	48(1.04)	2(0.04)	2(0.04)	4(0.04)	2(0.04)	0(0.00)	2(0.04)
OCT	4467	114(2.55)	59(1.32)	47(1.05)	106(2.40)	4(0.09)	2(0.05)	6(0.14)	2(0.05)	0(0.00)	2(0.05)
NOV	4239	106(2.5)	28(0.66)	61(1.44)	89(2.10)	9(0.21)	6(0.14)	15(0.36)	0(0.00)	2(0.05)	2(0.05)
DEC	5072	134(2.64)	40(0.79)	83(1.64)	123(2.43)	1(0.02)	7(0.14)	8(0.16)	1(0.02)	2(0.04)	3(0.06)
JAN	3352	80(2.39)	22(0.66)	48(1.43)	70(2.09)	2(0.06)	8(0.24)	10(0.30)	0(0.00)	0(0.00)	0(0.00)
FEB	4366	87(1.2)	27(0.62)	49(1.12)	76(1.70)	2(0.05)	6(0.14)	8(0.19)	2(0.05)	1(0.02)	3(0.07)
MAR	4511	72(1.6)	28(0.62)	35(0.78)	63(1.40)	2(0.04)	6(0.13)	8(0.17)	0(0.00)	1(0.02)	1(0.02)
APR	3987	39(1.00)	16(0.40)	16(0.4)	32(0.80)	2(0.05)	3(0.08)	5(0.13)	0(0.00)	2(0.05)	2(0.05)
MAY	5182	41(0.79)	24(0.46)	8(0.15)	32(0.60)	2(0.04)	6(0.12)	8(0.16)	1(0.02)	0(0.00)	1(0.02)
JUNE	4527	61(1.34)	32(0.71)	22(0.49)	54(1.20)	3(0.07)	2(0.04)	5(0.11)	1(0.02)	1(0.02)	2(0.04)
TOTAL	52273	928(1.78)	338(0.65)	477(0.91)	815(1.56)	36(0.07)	56(0.11)	92(0.18)	9(0.02)	12(0.02)	21(0.04)
MEAN	4356.1	77.3(1.72)	28.2(0.64)	39.75(0.93)	67.92(1.57)	3(0.07)	4.67(0.11)	7.67(0.18)	0.75(0.02)	1(0.02)	1.75(0.04)

**TS- Total Slaughter, TP- Total Prevalence, TC-Total Condemnation, PC-Partial Condemnation, n-Number**

**Table 2: Organs Condemnation rate due Bovine Tuberculosis in a Municipal Abattoir, Southwestern, Nigeria**

Organ	Total Condemnation (TC)	Partial Condemnation (PC)	Total	Organ condemnation rate (%)
Lung	338(0.65)	477(0.91)	815(1.56)	87.64
Liver	36(0.07)	56(0.11)	92(0.18)	10.11
Spleen	9(0.02)	12(0.02)	21(0.04)	2.25
Total	383(0.74)	545(1.04)	928(1.78)	100.0

Organ condemnation:  $\chi^2 = 133.66$ ;  $P < 0.05$

**Table 3: Seasonal distribution in Prevalence of Bovine Tuberculosis in a Municipal Abattoir, Southwestern, Nigeria**

Season	Number of cattle Slaughtered	Number positive (%)
Dry (April- September)	26266	335 (7.81)
Wet (October - March)	26007	593 (12.91)

$$\chi^2 = 16.19; P < 0.05$$

**Table 4: Economic evaluation of Condemned organs due to Bovine Tuberculosis in a Municipal Abattoir, Southwestern, Nigeria**

Organs	TC	Weight (Kg)	Cost Implication (Naira)	PC	Weight (Kg) [50% of approximate weight lost totally]	Cost (Naira) [50% of average price]	Implication [Total cost of condemnation= Average price plus 50% of average price]	Total loss (Naira)	Total loss (US Dollars)
Lung	338	676	405,600	477	477	429,300		834,900	5,296.78
Liver	36	144	144,000	56	112	168,000		312,000	1,979.39
Spleen	9	10.8	7,203	12	7.2	7,200		14,403	91.38
<b>Total</b>	<b>383</b>	<b>830.8</b>	<b>556,803</b>	<b>545</b>	<b>596.2</b>	<b>604,500</b>		<b>1,161,303</b>	<b>7,367.55</b>

TC= Unit of organs totally condemned  
 PC= Unit of organs partially condemned  
 Average weight of lung is taken to be 2kg at N600/kg  
 Average weight of liver is taken to be 4kg at N1000/kg  
 Average weight of spleen is taken to be 1.2kg at N670/kg  
 Conversion rate of Nigerian naira 157.62= US\$1 at the time of study.

2012. Bovine tuberculosis as observed in this study appeared primarily in the pulmonary form, pulmonary TB lesions were empirically indicative of BTB prevalence among slaughtered cattle, a finding which have also been observed and reported by Edelsten, 1996 and Igbokwe *et al.*, 2001. The prevalence rate of 1.56% observed for pulmonary TB in this study is lower than 2.8% reported by Igbokwe *et al.*, 2001.

The monthly prevalence illustration revealed the variations in the occurrence and trend of BTB cases in different organs and during the period of study. The occurrence of BTB revealed an epidemic tendency and this suggest the need for control measures to reduce the number of

bovine TB cases and to prevent the spread of the disease to human populations. The highest prevalence of BTB recorded in December, 2011, may be due to seasonal influence and possibly increase in number of cattle slaughtered in the month of December compared to other months due to festive seasons of Christmas and New Year celebrations. Seasonal BTB prevalence rate revealed higher prevalence during the dry season compare to wet season and a strong association between the occurrence of tuberculosis lesions and seasonal distribution. This may probably suggest that season has effect on transmission rate of BTB. This finding have also been observed by Bikom and Oboegbulem (2007) in Cross river State abattoir, but

differs from Ameen *et al.*, (2008) and Nwanta *et al.*, (2011) who observed no association between occurrence of tuberculosis lesions and seasonal distribution.

Organ condemnation due to BTB as seen in this study account for close to N1.2 million (US\$7,367.55) huge economic losses to the butchers/traders especially in Nigeria where there is no compensation scheme available to the butchers/traders for condemned organs. This also impact negatively on the economic returns of Nigeria especially in this study where a single abattoir recorded close to N1.2 million (US\$7,367.55) losses for condemnation of organs due to a single disease as BTB. Estimating and extrapolating this loss for all abattoirs in the 36 States and Federal Capital Territory of the Nation will amount to huge economic loss and negative effect on gross domestic product of the country especially for a low-income food deficient country [LIFDC] like Nigeria (World Bank, 2006).

In conclusion, Bovine tuberculosis is prevalent in cattle destined for human consumption with serious public health implications; also BTB is endemic with epidemic and huge economic loss tendencies. Thus, information about zoonotic diseases and their potential impact on human health should be disseminated appropriately in Nigeria especially on the role of cattle in epidemiology of human tuberculosis. There is need for public awareness on possibilities of zoonotic spread to human with very devastating effect when considering the epidemic of *HIV/AIDS* in the country, there is also the need for Nigerian government to employ qualified, competent personnel to implement meat inspection measures, and also equip them with functional laboratories and facilities for effective

diagnoses during meat inspection exercises. On the other hand, farmers/butchers should be adequately compensated by appropriate authority for their condemned animal carcass(es) which will ultimately encourage co-operation between farmers and government agencies to prevent tuberculous products from entering the market for human consumption.

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