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MEAT INSPECTION AND CULTURAL ISOLATION OF MYCOBACTERIA AS PREDICTORS OF BOVINE TUBERCULOSIS IN IBADAN

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Abstract

In order to ascertain the effectiveness of meat inspection as against the conventional culture method in the confirmation of tuberculosis in cattle slaughtered at Bodija abattoir, Ibadan; a study to assess these two methods in their ability to diagnose bovine tuberculosis was carried out. In all, 290 cattle were inspected at the abattoir out of which 182 had miliary nodules and granulomatous tubercles in the different organs and their associated lymph nodes which are suggestive of tuberculosis. One hundred and fifty-nine (54.8%) animals were confirmed to have tuberculosis based on the mycobacterial culture. The sensitivity and specificity results of the postmortem examination vis-a vis the culture were 100% and 82.4% respectively; while the Positive Predictive Value (PPV) and the Negative Predictive Value (NPV) were 87.4% and 100% respectively. This study therefore confirms that with proper meat inspection, a large proportion of tuberculous cattle can be identified at postmortem. Hence, more emphasis should be directed at the improvement of meat inspection services in Nigeria since there are no available laboratory facilities for the diagnosis of bovine tuberculosis in the abattoirs.

Introduction

In a developing country like Nigeria where bovine tuberculosis is an endemic problem (Alhaji, 1976; Ayanwale, 1984; Wekhe and Berepubo, 1989; Du'sai and Abdullahi, 1994; Cadmus *et al*, 1999; Cadmus *et al*, 2004) with no well defined national eradication or animal tuberculosis control programme (Cosivi *et al*, 1998), it is imperative that simple and inexpensive measures be put in place to diagnose the disease in our local abattoirs and slaughter slabs. One of the most efficient and practical ways of doing this, is through proper meat inspection as carried out in the United Kingdom (De la Rua-Domenech, 2006) that faces similar problem of bovine tuberculosis as most countries of Africa. This entails both detailed antemortem and postmortem inspection of animals brought for slaughter (Gracey, 1986; FAO, 2000) by the veterinary meat inspectors. Signs like emaciation and cough are some of the cardinal symptoms looked out for during antemortem inspection (though, these are not confirmatory for bovine tuberculosis). Meat inspectors are trained to check for miliary and tubercles in the head, fore and hind limbs, lungs, heart, liver, spleen, kidney, and mammary glands and associated lymph nodes (Gracey, 1986; FAO, 2000; de la Rua-Domenech, 2006).

Adequate palpation, with resultant production of gritty sound on incision of some of these organs and lymph nodes form the basis of tentative diagnosis of tuberculosis. This form of diagnosis though; not confirmatory (since culture is the gold standard), helps to a great extent in reducing the spread of zoonotic tuberculosis found in most developing countries. It is to be noted that the presence of other higher bacteria like nocardia and corynebacteria could present similar nodular lesions. This becomes useful since most slaughter slabs and abattoirs do not have diagnostic facilities to confirm tuberculosis and similar diseases. When meat inspection procedures are properly carried out, 95% of cattle with visible lesions of tuberculosis can be identified (Corner, 1994).

The main aim of this study was to ascertain the predictive value of postmortem inspection of cattle vis a vis mycobacterial culture in the confirmation of bovine tuberculosis in a local abattoir in Ibadan.

Materials and Method

Meat inspection at the abattoir

The study was conducted at the Bodija Municipal Abattoir, Ibadan, within five months. During this period, visits were made to the abattoir during weekdays from 8.00 am to 12.30 pm which represents the peak slaughter time. A total of 290 cattle of various breeds, sexes and age groups were inspected. The different tissue samples, organs and lymph nodes were inspected through careful visual inspection, palpation and incision procedures for miliary nodules and granulomatous tubercles.

Detection of Mycobacteria

Tissue samples were collected from 182 and 108 animals with and without suspected lesions of tuberculosis, respectively. They were examined microscopically following Ziehl-Nielsen (ZN) staining for the detection of acid fast bacilli (AFB).

The samples were also cultured using the Lowenstein-Jensen (L-J) medium after decontamination and digestion of each tissue according to the Becton Dickinson (1999). Samples from all the 290 animals were cultured at 37°C for 8-12 weeks on paired L-J media enriched with pyruvate (L-J-P medium) and that enriched with glycerol (L-J-G medium) (Cadmus *et al*, 2004).

Statistical analysis

The statistical relationship between animal with/without lesions and culture result were calculated. For this, the Chi-square analysis in the form of a 2 by 2 table using the Nielsen *et al* (2004) method for the calculation of the sensitivity, specificity, positive predictive value and negative predictive value was used.

Results

General findings

Out of the 290 animals examined, 159 (54.8%) were confirmed to have bovine tuberculosis based on the culture result. However, of the 182 animals with suspected lesions of tuberculosis, 159 (87.4%) were culture positive. From the suspected male and female animals, 34 (79.1%) and 125 (89.9%) were confirmed positive by culture respectively (Table I). In the same vein, 134 (85.9%) adult animals (i.e. > 3 years), 22 (95.7%) young adults (i.e. 1-3 years) and 3 (100%) calves (less than one year) with suspected lesions were culture positive (Table II). The result of the breeds of cattle suspected but culture confirmed is shown in Table I.

Post-mortem examination

It was observed that generalized and localized lesions accounted for 11 (6.9%) and 148 (93.1%) respectively. Of these localized lesions, pulmonary involvement was 99 (62.3%), while the extra-pulmonary involvement was 60 (37.7%) (Table III). The lesions observed in the lungs were a combination of miliary nodules (1-2mm) and granulomatous lesions (20mm-1cm) in diameter. The liver, spleen, heart and lymph nodes of associated organs were also affected; with the kidney, fetlock joint, testis and mammary gland being the least affected in these animals (Table III).

Gross lesions revealed firm, enlarged lymph nodes, which on incision contained one or more areas of yellow-grey caseous necrosis, well encapsulated by fibrous connective tissue. In most cases, these foci contained calcified matter detectable by palpation and grittiness. In severely affected cases, multiple, well-encapsulated nodules from 3mm to 1cm in diameter were found throughout the lungs, liver, spleen, muscles of the diaphragm, heart and lymph nodes of associated organs.

Culture of samples

Out of the 182 cattle suspected to have bovine tuberculosis by gross postmortem examination, 159 (87.4%) were confirmed by culture. Therefore, using the Chi-Square, the following results were obtained: Sensitivity: 100%; Specificity: 82.4%; PPV: 87.4%; NPV: 100%.

Table I: Tuberculosis lesions in different breeds and sex of cattle examined

Breed	Number of cattle			Number of cows			Number of bulls		
	No.	Suspected	Confirmed by Culture	No.	Suspected	Confirmed by culture	No.	Suspected	Confirmed by culture
Bunaji	170	115 (67.7)	92 (80.0)	129	88 (68.2)	74 (84.1)	41	27 (65.9)	18 (66.7)
Rahaji	62	36 (58.1)	36 (100)	50	28 (56.0)	28 (100)	12	8 (66.7)	8 (100)
Sokoto gudali	2	1 (50)	1 (100)	2	1 (50)	1 (100)	0	0 (0)	0 (0)
Kuri	6	1 (16.7)	1 (100)	4	1 (25)	1 (100)	2	0 (0)	0(0)
Mixed breed	50	29 (58)	29 (100)	36	21 (58.3)	21 (100)	14	8 (57.1)	8 (100)
Total	290	182 (62.8)	159 (87.4)	221	139 (62.9)	125 (89.9)	69	43 (62.3)	34 (79.1)

Table II: Age range distribution of the different breeds of cattle examined

Breed	< 1 year (calf)			1 - 3 years (Young adult)			> 3 years (adult)			Total
	No.	Suspected	Confirmed by culture	No.	Suspected	Confirmed by culture	No.	Suspected	Confirmed by culture	
Bunaji	2	2 (100)	2 (100)	32	14 (43.8)	13 (92.9)	136	99 (72.8)	77 (77.8)	170
Rahaji	1	1 (100)	1 (100)	9	5 (55.6)	5 (100)	52	30 (57.7)	30 (100)	62
Sokoto gudali	0	0 (0)	0 (0)	1	0 (0)	0 (0)	1	1 (100)	1 (100)	2
Kuri	0	0 (0)	0 (0)	0	0 (0)	0 (0)	6	1 (16.7)	1(100)	6
Mixed breed	0	0 (0)	0 (0)	6	4 (66.7)	4 (100)	44	25 (56.8)	25 (100)	50
Total	3	3 (100)	3 (100)	48	23 (47.9)	22 (95.7)	239	156 (65.3)	134 (85.9)	290

Discussion

The results obtained showed that after detailed postmortem inspection was carried out, 87.4% of the infected animals identified were also confirmed by culture which is the gold standard for TB diagnosis in both animals and humans (Ayele *et al*, 2004; de la Rua-Domenech, 2006). The importance of this finding was further strengthened by the 100% and 82.4% sensitivity and specificity results obtained respectively. Our result is also in agreement with the findings of Pritchard (1988) who confirmed that meat inspection procedures allowed for the identification of 95% visible lesions of tuberculosis. Though we got a slightly lower value compared to Pritchard (1988), the possible reason for this could be due to the unfriendly nature of the butchers who during the course of the study sometimes resisted thorough postmortem examination of the carcasses. However, the 87.4% of the PPV value indicated a high level of positive prediction of tuberculosis in the suspected animals based on culture. In the same vein, the 100% result obtained for NPV confirms the authenticity of postmortem meat inspection as a very reliable diagnostic tool of tuberculosis diagnosis in the abattoir (Gracey, 1986; Pritchard, 1988; FAO, 2000; Ayele *et al*, 2004; de la Rua-Domenech, 2006). This is more relevant since bovine tuberculosis is endemic in Nigeria.

Table III: Predilection sites of organs confirmed with lesions of tuberculosis in cattle

Organs	No. affected	% affected
Lung	95	59.7
Liver	23	14.5
Heart	3	1.9
Spleen	4	2.5
Kidney	1	0.6
Mammary gland	2	1.3
Fetlock joint	1	0.6
Testis	2	1.3
Muscles	8	5
Mesenteric lymph node	3	1.9
Mediastinal lymph node	4	2.5
Hepatic and suprammary lymph node	13	8.1

The resources to be expended on laboratory confirmation which in the first place are limited and the risk of human infection will be highly reduced since a great number of the diseased meat and offals would have been identified by inspectors (Idrisu and Schnurrenberger, 1977; Idigbe *et al*, 1986; Cadmus *et al*, 1999; Cadmus *et al*, 2005). However, we cannot preclude the aspect of the laboratory diagnosis since there are other higher bacteria like nocardia, corynebacteria etc which present similar nodular lesions like tuberculosis and cannot be differentiated at postmortem.

Finally, in the industrialized countries, the main purpose of meat inspection in relation to bovine tuberculosis is to act as an ancillary surveillance system (Pritchard, 1988), however, in Nigeria and most other developing countries where routine tuberculin testing is not done, proper meat inspection will serve as a ready tool for identifying a large number of slaughtered cattle infected with tuberculosis.

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