Full Length Research Paper

Abattoir characteristics and seroprevalence of bovine brucellosis in cattle slaughtered at Bodija Municipal Abattoir, Ibadan, Nigeria

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Brucella abortus infection in humans in Nigeria has been recorded as a cause of febrile disease. In Nigeria, the transhumance (Fulani nomadic) husbandry system is the most common cattle farming system with about 95% of all the country's cattle population produced under this husbandry system. About 75% of all slaughtered cattle are processed in government-approved abattoirs. In view of the aforementioned, this abattoir can give a fair representation for a surveillance study of the Nigerian cattle population. 220 cattle were selected on arrival using systematic random sampling from a total slaughter population of 17,912 cattle, and were chosen over a 10-week period. Sixty-three percent (63.2%) of all slaughtered animals were cows, and only 4% were under 18 months (two-tooth). The indigenous breeds predominated and individual seroprevalence of *B. abortus* was estimated at 5.45% (n=12) using the Rose Bengal plate test. Currently, no safety measures is in place for abattoir workers and pre-slaughter monitoring for positive animals is lacking. Certain measures were suggested to reduce the zoonotic risk of human brucellosis from the slaughter process.

Key words: Abattoir, bovine, brucellosis, Nigeria, seroprevalence.

INTRODUCTION

Bovine brucellosis is recognized as an important potential zoonoses in developing countries (McDermott et al., 2013; Ducrotoy et al., 2014). Recently, the World Health Organization has declared brucellosis to be a significant re-emerging zoonoses (World Health Organization [WHO], 2004; Seleem et al., 2010).

Bovine brucellosis was initially reported in 1927 but first recorded in Nigeria around 1928 (Ducrotoy et al., 2014), while the first case in Southwest Nigeria was reported in 1965 (Ducrotoy et al., 2014). Prevalence of bovine brucellosis between 0.2 and 80% across the different regions of Nigeria as well as between herds have been

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reported by various authors and summarized by Ducrotoy et al. (2014), while institutional and abattoir prevalence between 3.7 and 48.8% have been reported in the Southern part of Nigeria (Cadmus et al., 2010, 2013). An earlier review of data on bovine brucellosis by the Food and Agriculture Organization of the United Nations (FAO) in Nigeria between 1974 and 1991 have also reported an individual seroprevalence at the abattoirs that ranged between 6.3 and 15.0% using the Rose Bengal plate test (RBPT) and 1.5 and 14.8% using the serum agglutination test (SAT) (Mangen et al., 2002).

Several cases of human brucellosis have been reported in Nigeria as summarized by Ducrotoy et al. (2014), but the first laboratory confirmed the case was recorded in 1941 (Ducrotoy et al., 2014). Although cases of human brucellosis are grossly underreported since it causes minimal mortality, it appears to be a cause of human febrile disease in Nigeria as in most African countries (Pappas et al., 2006). Several serological investigations for animal-originated human brucellosis in Nigeria have been carried out and prevalence of between 0 and 74% has been reported (Ducrotoy et al., 2014). However, most of the prevalence figures do not necessarily represent active disease, but only confirms exposure to *Brucella* as both RBPT and SAT tests which are routinely used to detect only agglutinating antibodies (Ducrotoy et al., 2014). Nevertheless, a number of researchers (Ofukwu et al., 2007; Diaz et al., 2011) that carried out seroprevalence studies for bovine brucellosis in human patients presenting with acute febrile illness or pyrexia of unknown origin (PUO) in Nigeria have suggested that brucellosis should always be considered when treating human patients with acute febrile reactions or symptoms.

Despite the evidences of brucellosis in human and animals (Diaz et al., 2011; Godfroid et al., 2011; Dean et al., 2012), particularly in Nigeria and the risks posed to abattoir workers, most of the studies done on brucellosis in the Bodija abattoir (Cadmus et al., 2010) did not assess the situations of the abattoir. In addition, Bodija abattoir is one of the largest abattoir in the Southwestern region with its attendant crowd and it receives cattle and other animals from different regions across the country for slaughter for human consumption. In view of the aforementioned, the abattoir is a potential source of infection to workers and visitors to the abattoir. The aim of this study therefore was to describe the abattoir activities and estimate the seroprevalence of bovine brucellosis in cattle presented for slaughter at the Bodija Municipal abattoir, in order to estimate the possible risks of zoonotic transfer to abattoir workers.

MATERIALS AND METHODS

Study area

Bodija is located in Ibadan North Local Government (Latitude 7° 24'40"N; Longitude 3° 35' 24"E), and it has a large, poorly organized market where goods and services are traded daily as well as an associated abattoir. After the Oko Oba Abattoir in Lagos, Bodija Abattoir in Ibadan is the second largest abattoir in South-West Nigeria. Cattle, both locally raised within Nigeria and trade cattle from across the countries north of Nigeria are moved and transported mainly from the northern parts of the country towards the south especially to Lagos and Ibadan where they are slaughtered daily in thousands for consumption. Ibadan (the largest city in West Africa) acts as a distribution network and a market for a large percentage of these cattle. Specifically, the Bodija Municipal Abattoir receives cattle from different parts of Nigeria and even beyond the Nigerian borders and will therefore be suitable to do representative seromonitoring of *Brucella abortus* in slaughtering cattle in Southwest Nigeria and assess the likelihood of zoonotic implications to abattoir workers.

Sampling frame

A total of 220 animals were sampled using systematic random sampling from a total slaughter population of 17,912 animals over a period of 10 weeks (Table 1). The calculation of sample size was done using Survey Toolbox Version 1.04 (Cameron, 1999). It was assumed that all animals irrespective of age and sex were equally exposed to the risk of *Brucella* species, the sample frequencies were normally distributed and that the test protocol gave a valid true specificity and sensitivity as previously calculated.

Blood collection

Blood samples were collected in sterile non EDTA coated vacutainer tubes/bottles directly from the jugular veins of cattle (n=220) prior to slaughter, over a period of ten weeks. The age, sex, breeds and body condition scores of sampled cattle were also recorded after they were sampled as described by Marston (2005). The activities of the butchers and other abattoir workers ranging from when the animals were brought in from either the lairage or market to the abattoir to the final movement of the finished product (meat) were observed. Workers were similarly observed for apparent states of health, pace of work, swelling and other behavioural signs/symptoms indicative of human brucellosis.

The blood samples were allowed to clot in a slanting position, centrifuged for 10 min at 1500 rpm and sera were decanted into sterile Bijou bottles. A total of 220 sera were decanted for serological evaluation. The standardized but simple RBPT was performed at room temperature (approximately 25°C) on all samples (OIE, 2012). Briefly described, a drop (approximately 30 µl) of each serum was placed on a clean white porcelain tile. 30 µl of *B. abortus* RBPT antigen (VLA, Weybridge) was placed beside each drop using a clean Pasteur pipette. These were mixed together using sterile applicator sticks and the mixtures were rocked for 4 min. The plates were observed for formation of distinct pink granules (agglutination) and results were recorded as positive or negative. All sera were tested using this procedure. The graded positive and negative controls were done using reference sera from VLA, Weybridge.

Statistical analyses were performed using data entered into Microsoft Excel® Spreadsheet and calculated using the Student T-Test.

RESULTS

Abattoir activities

Ante-mortem inspection of animals was rarely done thoroughly and most aspects of the bleeding, removal of internal organs and flaying

were done with the carcass on the abattoir floors contaminated with blood and intestinal contents. Numerous cases of manhandling and cruelty to animals were observed prior to slaughter and pre-slaughter stunning of cattle was never done. Most (>50%) of the animals were poorly bled leading to flushing and poor meat quality. No protective clothing was used by butchers and blood meal processors move about the abattoir freely to collect blood while animals are being slaughtered. Clean potable water was also in short supply in the abattoir and the entire slaughter process was carried out using a single bowl of water of less than 50 L per animal. The abattoir was almost always over-crowded due to the activity of touts, slaughter hands and blood meal producers.

Sampling result

In general, 17,912 cattle were slaughtered during the 10-weeks study period of which 6,596 (36.8%) and 11,316 (63.2%) were bulls and cows, respectively. Of the total 220 cattle sampled, 87 (39.54%), 92 (41.82%) and 41 (18.64%) were of good, fair and poor conditions, respectively (Table 1). Eighty eight (40%) of the cattle sampled were of the White Fulani breed, followed by Red Bororo with 68 (30.9%) and Adamawa Gudali having the least number of 5 (2.3%). In addition, 112 (50.9%) and 108 (49.1%) of the 220 cattle sampled were females and males, respectively, while 211 (95.9%) were above or greater than a year of age (Table 2). The gender distributions of slaughtered cattle sampled at the Bodija Municipal abattoir are as shown in Table 2. All the cattle presented for slaughter were indigenous breeds and they came primarily from transhumance and sedentary pasture-fed farming systems. No feedlot cattle was presented for slaughter and as such, majority (95.9%) of the slaughtered animals were adult, not steers under the age of two years, as practiced in developed countries. Serological investigation for bovine brucellosis in cattle slaughtered using the RBPT revealed a seroprevalence of 5.45% (n=12, P < 0.0001) (Table 3). These 12 animals include 5 (2.27%) mature bulls and 7 (3.18%) adult cows; 3 of which were in apparently good condition, 5 in fair condition and 4 cattle in poor condition.

DISCUSSION

Our study population was almost or wholly non-vaccinated cattle population from different areas of Nigeria since vaccination against brucellosis is not routinely practiced and the work has revealed some critical but important observations on the status of abattoir slaughter in Bodija Abattoir, Ibadan, Nigeria. We are aware that few cases of vaccination may have occurred but it is difficult to establish this in this study since this study population is from different parts of the country and the history cannot be verified. Cases of manhandling and cruelty were very prevalent amongst the abattoir workers, while slaughter procedures are inhumane and induced suffering to the cattle. This is similar to incidents previously described elsewhere in a slaughter slabs in Oyo State (Adeyemo et al., 2009). Many cases of poorly conducted ante-mortem inspections (AMI) were observed with implications for risk of transfers to humans of zoonotic and infectious diseases from cattle (FAO, 1994). Since the primary objectives of AMI is previously well described, a poorly conducted AMI as observed in the Bodija Municipal

Abattoir exposes the consuming public and the abattoir workers to tremendous health hazards. In addition, the quality of water used at the abattoir have been known to be heavily contaminated with faecal and other pathogenic microorganism from previous study (Adeyemo et al., 2009) and the quantity used per animal was grossly insufficient, thus the risk of human enteric infections and food-borne diseases associated with meat consumption from this abattoir is possible. Previous worker had recommended a volume of approximately 650 L of water per cow in the Nigerian abattoir (Alonge, 2001). The abattoir workers, including the touts, slaughter staff, blood meal producers, veterinary workers and other visitors are similarly at the risk of such infection described earlier as well as zoonotic diseases since they operate without any protective clothing. In view of the aforementioned, it becomes mandatory to enforce some level of protective material for such workers within the abattoir operations. Furthermore, it was found out that the abattoir floor was heavily contaminated with intestinal contents of the slaughtered cattle and subsequent carcasses were processed on the same floor, thus aiding cross contamination. Standard practice elsewhere and more hygienic methods of carcass processing suggests that abattoir slaughter should be carried out with the animals hoisted on rails and moved from one section to another without touching the ground (FAO, 1991).

A sero-prevalence of 5.45% was observed amongst the slaughtered cattle. This low sero-prevalence can be attributed to the likelihood that the sensitivity of the test falls below the threshold to determine the actual prevalence level of this disease in the surveyed population. This is because RBPT had previously been confirmed to have a low sensitivity (66.7%), although it is highly specific (98.9%) (Fosgate et al., 2002). Whether there is some degree of overestimation due to possible vaccination cannot be established in this study as information concerning vaccination status was not available. In addition, Gall and Nielsen (2004) had similarly confirmed that some serological test have higher performance indices than RBPT. It should be stated that the nature of the transhumant management of cattle in Nigeria is very conducive for the spread of an infectious agent like *B. abortus*. Livestock raised in the north part of Nigeria are moved down south for purposes of trade and feed resources, especially in the drier period of the year, and are returned up north following the end of the drought or dry period (Ducrotoy et al., 2014). Also young and susceptible animals are likely to become infected by carriers and sick animals at communal grazing and watering sites on the transhumance route and possibly returned up north with new infections. Such animals may only be presented at the second trade season to the south as adult, with full or partial manifestations of brucellosis. In addition, about 2.5 to 9% of heifers born from seropositive cows may be latently infected but serologically negative until when such heifers are

Table 1. Cattle slaughter figure and body conditions of sampled cattle over a 10-week study period.

Weeks of study	No. slaughtered	Bulls	Cows	Number sampled	Body conditions		
					Good	Fair	Poor
Week 1	1721	502	1219	22	8	9	6
Week 2	1609	693	916	18	8	6	4
Week 3	1622	487	1135	20	8	9	3
Week 4	1582	798	784	20	10	4	6
Week 5	1520	422	1098	20	6	13	1
Week 6	1542	539	1003	20	12	7	1
Week 7	1609	622	987	20	7	11	2
Week 8	1425	698	727	20	6	7	7
Week 9	1612	616	996	20	7	7	6
Week 10	1980	691	1289	20	6	12	2
Total	17912	6596	11316	220	87	92	41

Table 2. Breed, sex and age distributions of cattle sampled.

Breed	Sex of cattle		Age		Total (%)
	Male	Female	<1 year	> 1 year	
White Fulani	38	50	7	81	88 (40.0)
Red Bororo	31	37	2	66	68 (30.9)
Sokoto Gudali	17	13	0	30	30 (13.6)
Adamawa Gudali	3	2	0	5	5 (2.3)
Keteku	8	5	0	13	13 (5.9)
Kuri	5	3	0	8	8 (3.6)
Muturu	6	2	0	8	8 (3.6)
Total	108 (49.1%)	112 (50.9%)	9 (4.1%)	211 (95.9%)	220

Table 3. Distribution of RBPT positive samples with breed, gender, age and physical Conditions.

Breed	No. +Ve	% +Ve	Range at $CI_{95\%}$	% +Ve within breed	Sex		Age		Physical condition			Total No. of cattle tested
					+Ve Bull	+Ve Cow	+Ve Calve	+Ve Adult	+Ve Good	+Ve Fair	+Ve Poor	
White Fulani	6	2.73	1.26-5.82	6.81	1	5	0	6	1	2	3	88
Red Bororo	2	0.91	0.25-3.25	2.94	1	1	0	2	0	1	1	68
Sokoto Gudali	2	0.91	0.25-3.25	6.67	2	0	0	2	2	0	0	30
Adamawa Gudali	0	0.00	-	0.00	0	0	0	0	0	0	0	5
Keteku	1	0.45	0.08-2.53	12.50	0	1	0	1	0	1	0	13
Kuri	1	0.45	0.08-2.53	12.50	1	0	0	1	0	1	0	8
Muturu	0	0.00	-	0.00	0	0	0	0	0	0	0	8
Total	12	5.45	2.99-9.09	-	5	7	0	12	3	5	4	220

Scoring of animal body conditions were as described by Marston, 2005. Good: Moderate to fat; Fair: Borderline to moderate; Poor: Thin to borderline.

pregnant for the first time or later (Bishop et al., 1994), and this could be the principal reason why all the young stock in this study samples tested negative. Other workers have also confirmed that significant increase in brucellosis sero-positivity increases with the age of sampled animals (Ducrotoy et al., 2014).

The typical Nigerian stock for purposes of milk production is the White Fulani (Bunaji) breed, and 50% of all seropositive animals in this study were of this breed. Traditionally, wives of herdsmen prepare such milk (which may not be sufficiently pasteurized to kill the resident micro-organisms) and its products (soft cheeses) for sale to the consuming public (Cadmus et al., 2010). In addition, since close associations are known to exist

between the traditional stockmen and their stock, these stockmen are likely to be more predisposed to cases of brucellosis. Both of these situations predispose human to the risk of zoonotic transfer and the perpetuation of the infection in a herd that can easily be passed on prior to and during slaughter.

In conclusion, although calfhood vaccination, regular surveillance for early detection of brucella, and test and slaughter policies may be a standard in developed economies and conducted regularly, it is not routinely implemented in Nigeria, primarily for economic reasons, low prioritization of the disease against other animal and human diseases by government and lack of adequate veterinary infrastructure (McDermott et al., 2013). Since cattle are not routinely tested for brucellosis in Nigeria, precautionary measures against human infection particularly in the transhumant herds becomes vital. Consequently, slaughter processes at the abattoir pose severe zoonotic risk, especially to the abattoir workers where humans are often in close contact with blood and aerosols during the slaughter process. Health education on the importance and risk of zoonotic potentials of work-associated infection with brucellosis becomes necessary for the slaughter-men, butchers, butcher's assistants (slaughter hands), animal health workers, veterinarians and blood meal processors. The use of protective clothing and observance of high level of hygiene in the course of their work will reduce such risks. The early recognition of symptoms of human brucellosis (undulant fever, hygroma, weakness, muscle-aches and joint pains) will assist in mitigating infection and control of the disease. It should be appropriate for government to legislate and implement rapid penside test at the lairage for *B. abortus* to reduce the zoonotic risks associated with slaughtering of positive cattle.

Conflict of interests

The authors declare that they have no conflict of interest.

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