Sero-prevalence of *Bovine brucellosis* in the Gokwe Smallholder Dairy Project Herd of Zimbabwe

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Abstract

In a study to determine the sero-prevalence of *Bovine brucellosis* in the Gokwe Smallholder Dairy Project herd, a simple stratified completely randomised design was used to come up with project farmers with herds in the 10 Farmer Field Site Working Groups that participated in the research. Seventy-three animals were bled out of a total of 200 that constituted the project herd. An overall sero-prevalence of 4.11 % for *brucellosis* (SAT> 80) was noted for the project dairy herd. *Brucellosis* prevalence by epidemiological group (SAT > 80) was as follows: animal source - locally raised animals at 6 % versus bought-in animals at 0 %, CA vaccination status - vaccinated animals at 0 % versus the 4.84 % for the unvaccinated animals, breed - Friesian-Holstein at 5.71 % while the Jersey, Red Dane, exotic x exotic and the indigenous x exotic had 0 % and the nondescript indigenous at 33.33 %, animal parity - parity 0 1 had 0 % prevalence while those in parities 2 had a 6.98 % prevalence. Only 15.07 % of the bled animals were confirmed through records as vaccinated against *brucellosis* indicating marginal compliance with the dictates of the Dairy Act of Zimbabwe. Sixteen of the 73 animals that were bled had aborted at least once translating to 21.92 % of the herd experiencing abortions. The study revealed sero-prevalence of *brucellosis* in the project dairy herd thus indicating the risk to which dairy cattle handlers and consumers are exposed. There is need to train smallholder dairy farmers for total compliance with the dictates of the Zimbabwe Dairy and Animals Health Acts in order to guard against preventable animal losses and zoonotic disease transmission.

Introduction

Milk production in Zimbabwe is largely the preserve of large-scale dairy farmers who currently contribute 95 % of the milk produced in the country (Chivandi, 2001). The Government of Zimbabwe (GoZ) through the Agricultural and Rural Development Authority (ARDA) instituted the Dairy Development Programme (DDP) in 1982 with assistance from the Danish International Development Agency (DANIDA). The founding of the DDP was and remains premised on the development of smallholder dairy projects nationally. The objectives of the DDP include poverty alleviation, improvement of household nutrition and improving the financial status of the smallholder farmers by enabling them to engage in income generating farming activity all year-round (Chivandi, 2001). Additionally, the DDP aims at increasing the milk production base of the country as well as assisting smallholder farmers who normally rely on rain-fed cropping to diversify their agricultural production thereby spreading risk. To date there are twenty-two smallholder dairy projects throughout the country with 16 of them being fully functional. Each of these schemes operates on a Central Bulking Tank (CBT) basis.

Dairy production is associated with a number of zoonotic diseases such as *bovine tuberculosis* and *brucellosis*. The Food and Agricultural Organisation (FAO), World Health Organisation (WHO) and Organisation of International Export (OIE) consider *brucellosis* as the most widespread zoonosis worldwide (Mustafa and Nicoletti, 1995). The causative agent of *brucellosis* is a bacterium of the genus *Brucella*. A number of variants are known with *Brucella abortus* mainly prevalent in cattle while *Brucella melitensis* is mainly found in small ruminants and *Brucella suis* in pigs (Araj and Azzam, 1996). *Brucellosis* is a major public health problem in the Mediterranean countries and other developing countries (Araj and Azzam, 1996; Tohme et al., 2001). The importance of this highly contagious disease is due to both its economic impact on the livestock industry and health effects on humans. It causes adverse effects on total animal protein supplies. It presents a severe hazard to human health through either direct contact with infected animals, or more frequently, via the consumption of contaminated milk and dairy products (Mustafa and Nicoletti, 1995). In dairy production *brucellosis* causes heavy economic losses due to abortions, sterility, decreased milk production, veterinary attendance and the cost of replacement animals. The

disease also imposes an impediment to free animal movement and export (Mustafa and Nicoletti, 1995). Additionally, the disease presents a critical constraint to the importation of high producing breeds thus hindering the improvement of milk production through cross breeding. As a zoonotic infection, *brucellosis* has a variety of clinical pictures that may be confused with a number of illnesses in diagnosis (Atmaca et al., 2004). Karimi et al. (2003) point out that besides being an important public health problem in the developing world, *brucellosis* diagnosis is confounded largely due to the non-specific clinical picture. Diagnosis is made with certainty when *Brucella* species are recovered from blood, bone marrow, lymph nodes and milk (Young, 1998; Young, 2000). Most laboratories now employ high technology diagnostic tools such as rapid isolation techniques (BACTEC), Dupont Isolator and Polymarase Chain Reaction methods (Karimi et al., 2003). Such diagnostic methods are not available in developing countries due to resource limitation such that there is dependence on the Rose Bengal Test (RBT) as a screening test with the Serum Agglutination Test (SAT) as a confirmatory test.

Only a few limited surveys have been carried out on the prevalence of *B. brucellosis* in Ghana and most of the third world (Bonsu et al., 2000). This is largely true of the Zimbabwean Smallholder Dairy Sector. Since the GoZ initiated smallholder dairy projects, there has been no systematic study or survey of the sero-prevalence of *B. brucellosis* in such project areas. This is despite the high risk posed by to the management system currently in place that is largely exemplified by consumption of unpasteurised milk and failure to undertake the mandatory vaccination of all heifers meant to join the milking herds. This is also inspite of the Zimbabwe Dairy Act and the Animal Health Act (Oliver, 1987) that stipulate that all cows and heifers used for milk production should be certified *brucellosis* free. Not all milk brought to the CBTs is pasteurized, some is sold fresh, as naturally cultured milk and some as soft cheese. Such raw milk can be a source of brucellosis to both dairy cattle handlers and consumers. This study sought to generate baseline information on the sero-prevalence of *brucellosis* in the Gokwe Smallholder Dairy Project and hence the risk, if any, to which both dairy animal handlers and consumers are exposed with the ultimate aim of putting in place possible preventive and control measures at farm level.

Materials and Methods

Research Site

The research was carried out in the Gokwe Smallholder Dairy Project The project CBT is located at Gokwe Growth Point which is 200 km due North West from the city of Gweru, Zimbabwe. The area is in agro-ecological Zone III (NR III) which is characterized by unreliable rainfall averaging 600 mm per annum with mean minimum ambient temperatures of $18\,^{\circ}C$ in June with maximum ambient temperatures averaging $30\,^{\circ}C$ in October (Vincent and Thomas, 1960; Anderson et al., 1993). The area has a distinct rainy season (November to mid April) and a dry season that stretches from late April to end of October. The project farmers are located within a 25 km radius of the CBT. The farmers are divided into ten Farmer Field-Site Working Groups (FFSWG). Grouping is based on the relative distance between farmers who are members of the project. Farmers close-by form a FFSWG. In total the project farmers had 200 milking cows at the time of the study. The project dairy herd was made up of mixed exotic breeds (Friesian-Holstein, Jersey, Red Dane and Guernsey) and their crosses with nondescript indigenous breeds and a few nondescript indigenous breed animals.

Farmer Selection and Herd Sample Determination

A simple stratified completely randomised design (SCRD) was used to come up with farmers with dairy herds in the 10 FFSWG that participated in the research. The stratum was the FFSWG. Farmers in each of the FFSWG were made to pick cards with random numbers on them from a hat. All farmers in each group who picked odd numbers had their dairy herds admitted into the research and all such animals were later bled during data collection. The minimum number (out of a total of 200 herd for the entire project) of animals that had to be bled was determined using the equation used for calculating sample size in a binomial distribution as stated by Noordhuizen et al. (1997). The equation used is $n = Z^2 \times SD^2 / L^2$; where:

n = sample size (number of animals to be bled)
Z = Precision of estimate (Taken at 95 % = 1.96)
SD = Standard deviation (equal to pq for a binomial distribution as in this case)
L = Precision level or alpha error (Taken at 5 %)

The general prevalence of brucellosis in beef and dairy herds is 4 % (Oliver, 1987). A minimum of sixty (60) (from the equation) had to participate in the study. However 73 animals from the participating herds were finally bled.

Data Collection and Blood Collection

All animals from which blood was collected had the following information noted about them: FFSWG, owner, cow identity, breed, age, parity, source, abortion history, and contagious abortion (CA) vaccination status. The venipuncture site was first

cleaned with cotton wool soaked in methylated spirit prior to blood collection to minimize infection to animals. Blood was collected from nose-tong restrained animals by vein puncture of the jugular vein into silicone coated (5 ml) tubes for laboratory analysis. Sterile 16-gauge hypodermic needles and 10 ml disposable syringes were used to draw blood. The blood samples from animals were centrifuged at 3 000 rpm for 15 minutes to get serum. The collected serum was put in correspondingly labeled serum tubes and stored under refrigeration pending laboratory analysis.

Laboratory Assays

The sera samples were initially screened for *brucellosis* using the Rose Bengal Test (RBT). All sera samples that were found positive were subjected to the Serum Agglutination Test (SAT) that was used as a confirmatory test for the presence of *Brucella* in the blood of the animal. A minimum titre value of 80 was taken as indicative of *Brucella* presence. All sera samples that turned positive in the SAT had the corresponding animals re-bled and re-tested within 2 months of the initial blood collection.

Data Analysis

The overall prevalence of brucellosis in the Gokwe Smallholder Dairy Project Herd on the basis of breed, parity, source, abortion history, contagious abortion and vaccination status was determined using the General Statistics Package (Genstat Release 6.1, 2002).

Results and Discussion

Results on prevalence on the basis of animal source, vaccination status (at time of testing), abortion history, breed and parity as per the RBT and SAT>80 are shown in Table 1. Among the 73 animals bled, three were *brucellosis* positive (SAT 80) translating into an overall brucellosis sero-prevalence of 4.11 % (Table 1). Only eleven out of the 73 animals bled were vaccinated against *brucellosis* translating to 15.07 % compliance with dictates of the Zimbabwe Dairy Act (Oliver, 1987). Out of the 73 animals that were bled, 16 had aborted at least once translating into 21.92 % of the herd experiencing abortions (Table 1). Out of the 16 animals that aborted, 3 of them (18.75 %) were confirmed *brucellosis* positive (SAT > 80) indicating some degree of association between abortion and presence of *brucellosis*.

There is a relationship between animal source and the prevalence of *brucellosis*. Commercial dairying has been the preserve of the large-scale commercial dairy farmers for many years. These farmers have had many years of experience in commercial dairying and have acquired skills of dairying hence zero *brucellosis* prevalence in animals bought-in from large-scale commercial farmers (Table 1). The smallholder farming sector has been recently introduced to dairying through the GoZ initiated DDP (Chivandi, 2001). These smallholder dairy farmers have had very little experience in dairying and are largely still in the learning phase. It is therefore not surprising that a 100 % of all the *brucellosis* sero-positive (SAT > 80) animals are those that were "raised locally". Furthermore, all the *brucellosis* sero-positive (SAT > 80) animals were not vaccinated against contagious abortion (Table 1). Findings indicate that the smallholder dairy farmers due to their inexperience are negligent in critical dairy management practices such as prophylactic vaccination. This is largely true since only 15.07 % of the bled animals were confirmed vaccinated against *brucellosis* against the set 100 % vaccination against *brucellosis* of all heifers that join the milking herd as per the dictates of the Zimbabwe Dairy Act (Oliver, 1987).

Table 1: Frequency Of brucellosis positive animals by Rose Bengal Test (RBT) and Serum Agglutination Test (SAT) according to animal source, abortion history, vaccination status, breed and parity

Epidemiological Group	Total Number	RBT Positive		SAT >80 Positive	
		No.	%	No.	%
a) *Animal Source*					
(i) Locally raised	50	5	10.00	3	6.00
(ii) Bought-in	23	0	0.00	0	0.00
b) *Abortion History*					
(i) Aborted ≥ 1	16	5	31.25	3	18.75
(ii) Never aborted	57	0	0.00	0	0.00
c) *CA Vaccination Status*					
(i) Vaccinated	11	2	18.18	0	0.00
(ii) Not Vaccinated	62	3	4.84	3	4.84
d) *Breed*					
(i) Friesian-Holstein	35	3	8.57	2	5.71
(ii) Jersey	2	0	0.00	0	0.00
(iii) Red Dane	5	0	0.00	0	0.00
(iv) Exotic x Exotic	15	0	0.00	0	0.00
(v) *Indigenous x Exotic	13	0	0.00	0	0.00
(vi) *Indigenous	3	2	66.67	1	33.33
e) *Parity*					
(i) 0	20	0	0.00	0	0.00
(ii) 1	10	0	0.00	0	0.00
(Iii) ≥ 2	43	5	11.63	3	6.98

*Indigenous breeds: nondescript

It is the high level of failure to comply with the requirements of the Zimbabwe Dairy and Animal Health Acts (as reflected in this study) that poses a great risk to dairy animal handlers in Smallholder dairy projects (due to increased frequency of handling the animals) and to consumers of raw milk from central bulk storage tanks of such projects. Smallholder dairy farmers have to be made aware of the dangers to which they are exposing their families (some milk is used for family consumption), their milkers and consumers. All animals that are used in the smallholder dairy projects have to be frequently monitored against possible zoonosis in order to safeguard human life and prevent unnecessary animal losses. It is therefore critical that the GoZ carries out a massive campaign through the departments of Extension and Animal Health to ensure compliance with the legal requirements of the Dairy Act by all smallholder dairy farmers in order to protect people against zoonosis from dairying.

Conclusion

Brucellosis is a problem in the Gokwe Smallholder Dairy project herd. There is marginal compliance by the requirements of Dairy and Animal Health Acts of the GoZ by the Gokwe Smallholder Dairy farmers.

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