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An Assessment of The Risk Factors Associated with Subclinical Mastitis in Small Holder Dairy Cows and Large Mechanized Dairy Cows in Parts of Kaduna State, Nigeria

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Abstract

It appears that small holder dairy farmers as well as large mechanized dairy farmers in Kaduna State do not seem to be aware of the subclinical mastitis situation in their cows. A cross-sectional study was carried out with the objective of establishing the prevalence of subclinical mastitis and related risk indicators and to assess their contribution to the occurrence of subclinical mastitis. Three field procedures based on the principles of herd health and production management were followed: clinical inspection, farm management inspection and farm records inspection. The California mastitis test (CMT) was carried out on quarter milk samples to determine the prevalence of subclinical mastitis. A total of 150 lactating cows from 30 herds were investigated. Clinical mastitis was detected in about 5.0% of the lactating cows, subclinical mastitis was found in 24.5% (about 25%) of the cows screened. Farm inspection revealed that, water scarcity, poor housing, hand milking, single udder towel and dairy labourers as most substantial ($P < 0.05$) risk indicators. Overall, there was the epidemiological need to address such risk indicators.

Keywords: clinical mastitis; subclinical mastitis; small holder dairy cattle; large mechanized dairy cattle; risk indicators; kaduna

Introduction

Milk is designed by nature to give a complete food to very young animals and therefore has exceptionally high nutritional value containing carbohydrate, fat, protein vitamins and minerals, which is equally an excellent culture medium for many kinds of microorganisms (Rampone *et al*, 2003). It is an important food source for humans, either as fresh fluids or processed into a number of dairy products such as yoghurt, butter or cheese because it is nature's most nearly perfect food, deficient only in iron (Blood *et al.*, 2007). Microorganisms, particularly bacteria usually gain entry into milk through the udder of the cow by way of the teat canal, (Rendos *et al*, 2007). The organisms involved, most of which are saprophytic in the outside environment gain access by their ability to grow a short way up into the milk duct of the teat, causing mastitis of the udder (Rendos *et al*, 2007). Mastitis generally refers to the inflammation of one or more quarters of the udder, usually caused by bacterial infection (Erkine, 2001). It is a complex and multifactorial disease whose occurrence depends on variables related to the animal, environment and pathogen (Radostitis *et al.*, 2007). Mastitis is the greatest threat to dairying all over the world; it causes direct economic losses to farmers in several ways: Milk yields are reduced; there is damage to the mammary tissue, contaminated milk is discarded; it equally endangers public health from the infectious agents causing the disease condition and the resultant antibiotics used in treatment. Milk that is abnormal or contaminated with antibiotics is unsaleable; there are veterinary and antibiotic costs; a higher culling rate and occasional fatalities. The milk processing industry also incurs losses because of problems that result from antibiotics in milk and the reduced chemical and bacterial quality of mastitic milk which affects the suitability of milk for processing (Matta and Pung, 2007). The primary cause of mastitis in cattle, goats and sheep are well recognized group of microorganisms including Streptococcus sp. Staphylococcus sp, pasteurella sp and coliforms such as *E. coli*, Enterobacter sp and Klebsiella species.

Most mastitis persists for weeks or months in a mild form as subclinical infection which is not detected by

the stock men, only occasionally are there clinical signs with clots in the milk and inflamed quarters. With some pathogens however, the infection is frequently more acute and there is a general endotoxaemia with raised body temperature, loss of appetite and the cow may die unless supportive therapy is given (Sol *et al.*, 2000). Although several bacterial pathogens can cause mastitis, the genus staphylococcus is the primary and probably the most lethal agent because it causes chronic and deep infection in mammary glands that are extremely difficult to be cured (Kalorey *et al*, 2007). Staphylococcus has been found responsible for more than 80% of the subclinical bovine mastitis which may result in about 300 dollars per year of economic losses per animal (Fitzgerald *et al.*, 2000). When clinical mastitis occurs, the effective therapy is a course of antibiotic infusion into the udder through the teat duct. This always remedies the clinical disease and often eliminates the bacteria infection. Recovery from infections may be spontaneous but most persist, to be eliminated eventually by antibiotic therapy or lead to the cow being culled. (NMC, 2007). Dairy foods are frequently contaminated with Staphylococcus species and Staphylococcus enterotoxins are ranked as one of the most prevalent worldwide, causing gastroenteritis (Boerema *et al.*, 2006). The traditional dairy farms contribute substantially to the milk supply in the country and significantly to poverty alleviation and reduction of malnutrition; it provides a regular source of household income, food and self-employment particularly to the women folk. However, despite the important role of the industry, farmers continue to experience sub optimal performance of their animals due to disease problems especially mastitis. Yet despite the intensive research on the control of bovine mastitis, it still remains the costliest disease of the dairy animals (Bisaga *et al*; 2008) However, it is important to recognize that because most mastitis is subclinical and unseen, control depends primarily on adopting sound management routine for the whole herd (Landsborough & Ann 2004).

Materials And Methods

Field survey/ Questionnaire administration

Field survey

This was carried out according to the standard of field observational protocol following 2 procedures: Clinical inspection and farm management inspection. In clinical inspection, cow characteristics associated with clinical mastitis such as udder lesions, blind or swollen teat, udder fibrosis or lump etc were inspected and recorded. Also, farm management practices such as manure disposal, housing, milking practices etc that may predispose cows to mastitis were inspected and recorded.

Questionnaire Administration

A questionnaire designed with the objective of bringing out the multifaceted background of subclinical mastitis was administered in an interactive manner with the herdsmen and ranch attendants at every farm visited. This is in addition to the personal observation and inspection made. The information was then entered in to the questionnaire form.

Collection of milk samples

Herds of cattle were visited very early in the morning during the milking time, and then 10ml of fresh quarter milk sample (from each quarter) was collected directly from milking cows, mid-stream, in to sterile universal bottles.

California Mastitis Test

In order to study the quality of milk, the California mastitis test was carried out on milk samples of composite milk using the CMT kit. Five ml of each composite and bulk milk samples were collected, each sample was mixed with the reagent and the test carried out according to the manufacturer's instruction. The criteria used for scoring were:
0 (negative), +1 (weak positive) +2 (distinct positive) and +3 (strong positive) (Assefa *et al*; 2006). In this study, CMT score of 0 was regarded or grouped as having originated from cows free of subclinical mastitis and better-quality milk, while CMT result of ≥ + 1 was taken as evidence of subclinical mastitis and low-quality milk.

Results

Clinical Inspection

The result of the clinical inspection of 150 cows studied is shown in Table 1. Twenty-seven (27) cows representing 18.0% had various forms of udder lesions while 8 (5.0%) had blind teats, 11 (7.0%) showed udder lumps and 105 (70.0%) of the cows had soiled thighs whereas only 10 (6.6%) were infested by ticks. The 8 blind teats did not produce any milk and therefore could not be tested for California mastitis test.

Farm Inspection

The result of the farm management inspection is shown in table 2. From the result, the herd size in the farms were all above 11 cows, the number of labourers in all the farms were more than 2 except in one of the small holder farms managed by a man and his son (only 2). None of the dairy workers had less than 5 years' experience. The grazing of the cows was outdoor in all the farms. Hygiene was good in some of the large mechanized farms but poor in most of the small holder farms. None of the farms keeps record of their activities.

Housing condition for the herds

Table 3 shows the housing condition in the farms/herds. The cows were all housed on earthen floor, none has concrete floor. Also, they all used the same area for feeding and sleeping. The cows were not tethered in the house except in 3(25%) of small holder farms. The sanitary practices were fair in some of the large mechanized dairy farms but poor in some others, most especially in the small holder dairy farms. None of the farms disinfected the floor of the houses.

Other farm management and milking practices

This is as show in table 4. The large mechanized dairy farms have the borehole while the small holder dairy farms have the pond or rivers as their water sources and therefore while water scarcity is rare in the large mechanized farms, it is very frequent with the small holder farms. Most of the large mechanized farms restrained their cows before milking but the small holder farms seldom did so. Only 1 (8.0%) of the farms (a large mechanized farm) practice hand washing before milking, the rest does not. Seventy-five (75%) of the dairy farms carried out screening for mastitis while 5.0% does not. All the farms (100%) practiced stripping type of milking. Five dairy farms representing 42.0% washed only the teat of their cows before milking, only 1 (8.0%) washes the whole udder while 50% of the farms do not even wash at all. A single towel was being used for cleaning cow teat in only 2 (17.0%) of the farms. All of them feed the cows after milking and they all do not leave the milking of mastitis cows last except in one farm (8.0%).

California Mastitis Test (CMT)

Out of the 592 quarter milk samples screened for mastitis (8 samples were omitted due to blind teats) 145 were CMT positive, giving a prevalence of 24.5%. Between farms, the prevalence of subclinical mastitis ranged from 15.0 - 61.0%. (Table). Out of the 30 bulk milk samples obtained from 30 herds sampled, 19 (63.0%) were negative to CMT, five (16.7 %) were weakly positive and distinctly positive respectively, while only one (3.3%) was strongly positive to California mastitis test (Table).

Table 1: Clinical inspection/cow characteristics

Variables	Number of cows examined	Large mechanized farms (n=70)	Small holder farms (n =80)	Total (%)
Udder lesions	150	6	21	27(18.0)
Blind teat	150	2	6	8(5.0)
Udder lump	150	4	7	11 (7.0)
Soiled thighs	150	25	80	105 (70.0)
Tick-infestation	150	2	8	10 (6.6)

Table 2: Farm management inspection

Variables	No. of Farms	Farm management system		
		Large mechanized dairy farm (n=4)	Small holder dairy farm (n=8)	%
General management				
Herd size	12			
$1 \leq n \leq 5$		0	0	0
$6 \leq n \leq 10$		0	0	0
$n \geq 11$		4	8	100
Number of labourers	12			
$n \leq 2$		0	1	8
$n \geq 2$		4	7	92
Experience in dairying	12			
0 – 5		0	0	0
6 – 10		1	0	8

11 – 15		1	3	34
≥16		2	5	58
Grazing	12			
Indoor		0	0	0
Outdoor		4	8	100
Manure disposal	12			
Good		2	2	33
Poor		2	6	67
Record keeping	12			
Yes		0	0	0
No		4	8	100

Table 3: Housing condition of the dairy farms

Variables	No. of Farms	Farm management system		
		Large mechanized dairy farm (n=4)	Small holder dairy farm (n=8)	%
Housing floor type concrete	12	0	0	0
Earth		4	8	100
Sleeping area for cow	12			
Same as feeding		4	8	100
Separate area		0	0	0
Animal tethered while in house	12			
Yes		0	3	25
No		4	5	75
Cleaning procedures				
Sanitary practices	12			
Good		2	1	25
Poor		2	7	75
Presence of many flies	12			
Yes		2	6	67
No		2	2	33
Floor disinfected eriodically	12			
Yes		0	0	100
No		4	8	100

Table 4: Other farm management and milking practices

Variables	No. of Farms	Farm management system		
		Large mechanized dairy farm (n=4)	Small holder dairy farm (n=8)	%
Feeding				
Water source	12			
Tap		0	0	0
Borehole		4	0	33
Pond		0	8	67
Occurrence of water scarcity	12			
Frequent		0	6	50
Rare		4	2	50
Milking procedure				
Cows restrained for milking	12			
Yes		3	2	42
No		1	6	58
Hand washing	12			
Yes		1	0	8
No		3	8	92

Screening for mastitis	12			
Yes		4	5	75
No		0	3	25
Milking techniques	12			
Five finger squeezing		0	0	0
Stripping		4	8	100
Udder preparation	12			
Wash only teats		3	2	42
Wash the whole udder		1	0	8
Udder cloth	12			
Single towel		2	0	17
Separate		0	0	0
Feed after milking	12			
Yes		4	8	100
No		0	0	0
Mastitic cow milked last	12			
Yes		1	0	8
No		3	8	92

Table 5: California mastitis test of quarter milk samples

CMT Reactions								
Farm magt system/location	Farms	No of samples	-	+	++	+++	∑(CMT≥+)	Prevalence (%)
LMDF	X1	98	80	8	6	4	18	18.0
Kaduna	X2	60	49	6	3	2	11	18.3
SHDF	X3	39	26	13	0	0	13	33.3
Kaduna	X4	40	28	8	4	0	12	30.0
	X5	18	7	5	5	1	11	61.0
	X6	60	51	4	4	1	9	15.0
SHDF	Y1	40	28	6	2	4	12	30.0
Zaria	Y2	40	33	5	2	0	7	18.0
	Y3	37	17	14	3	3	20	54.0
	Y4	40	31	3	3	3	9	23.0
LMDF	Y5	80	68	4	7	1	12	15.0
Zaria	Y6	40	29	3	5	3	11	28.0
Total	-	592	447	79	44	22	145	24.5
%	-	-	75.5	13.4	7.4	3.7	24.5	

Key: – = Negative, + = Weak positive, ++ = Distinct positive, +++ = Strong positive, LMDF = Large mechanized dairy farm, SHDF = Small holder dairy farm

Table 6: California Mastitis test of bulk milk samples

	Farm	Herd No		CMT Scores		
			-	+	++	+++
LMDF Kaduna	x_1	5	3	1	1	0
	x_2	3	2	0	1	0
SHDF Kaduna	x_3	2	1	1	0	0
	x_4	2	1	0	1	0
	x_5	1	0	0	1	0
	x_6	3	3	0	0	0
SHDF Zaria	y_1	2	1	0	0	1
	y_2	2	2	0	0	0
	y_3	2	1	1	0	0
	y_4	2	1	1	0	0
LMDF Zaria	y_5	4	4	0	0	0
LMDF Zaria	y_6	2	0	1	1	0

	Total	30	19(63)	5(16.7)	5(16.7)	1(3.3)

Key: LMDF = Large Mechanized Dairy Farm, SHDF = Small Holder Dairy Farm. No in brackets represent percentage

Discussion

Examination of the cows and inspection of the farm premises revealed the cow characteristics/features and herd management practices that are risk indicators associated with mastitis e.g Tick infestation, reported in about 7.0% of the cattle can cause direct inflammatory reaction to the mammary gland and aggravate mastitic condition (FAO, 1990). The dirty and soiled thighs in 70.0% of the cows coupled with udder lessons resulting from various causes could lead to increased inflammatory infections with subsequent increase in mastitis cases. From the farm inspection, the poor housing condition for the herds coupled with poor waste disposal system creates an ideal condition for the spread of mastitis causing microorganisms as reported by similar works on hygienic practices in farms (Hamadou *et al.*, 2004). Also associated with increased risk of mastitis is the use of contaminated water for dairying. In this study, only the large mechanized farms had borehole system as their water source, the small holder farms depended on wells, rivers and ponds which were unsafe water sources that could carry contamination. The use of contaminated water for dairying activities contributes to an increased risk of subclinical mastitis (schukken, *et al.*, 1991).

The milking method employed in all the farms (100%) is the hand milking by tripping of the teat. This technique has the potential of causing microscopic trauma of the teat epithelium, leading to greater risk of mastitis. Not only this, the method of milking practice allows cross contamination (Umoh *et al.*, 2007). Overall, over 75% of the farms in this study operate under poor sanitary practices and poor hygiene as found by lack of hand washing before milking in over 90% of the farms, lack of udder washing before milking, the use of only a single towel for wiping of udder or lack of use at all and lack of periodic disinfection of the cow house floor in all (100%) of the farms. All these may result in increased exposure to and transmission of mastitic pathogens. The overall prevalence of mastitis from CMT test in this study was 24.5%. This prevalence is appreciable and may be attributed to the general low level of hygiene observed in the clinical and farm inspection. However, this prevalence is lower compared to 30.5% reported by Umoh *et al.*, 2007 for traditional dairy herds in Plateau State and 37.0% by Umoh *et al.*, 1990 in a study carried out in Kaduna and Zaria which is the same study area with this study. The difference could be due to the fact that while the other studies collected milk from nomadic Fulani herds only, the present study collected milk from both the traditional small holder farms and the large mechanized dairy farms, whose hygiene measures were higher. Also, the sample collection for this study was carried out during the dry season (January to April). This is the period known to record low prevalence of organisms and also the period during which the pH of milk tends to be low, which inhibits the growth of most organisms (Umoh *et al.*, 1990b).

However, the result is consistent with the 25.4% reported by Zouharova (2009) in Aydin, Turkey. The prevalence observed in individual farms showed the large mechanized dairy farms to have lower figures than their corresponding small holder dairy farms within the same sampling area. For instance, it was 18.0% and 18.3% in Kaduna large mechanized dairy farms but a prevalence of 30.0-61.0% was recorded for the small holder farms around Kaduna. This may be attributable to the fact that the large mechanized dairy farms adopted better farm management practices compared to the small holder dairy farms as evidenced in the outcome of farm inspection.

The prevalence of subclinical mastitis observed in the bulk milk samples, 16.7% and 3.3% were in conformity with the reported 15.9% of Strastkova *et al*; (2009) in Czech Republic in bulk tank milk and the 3.2% reported among nomadic herds by Umoh *et al*; (1990 a). The lower detection rate of mastitis in the bulk milk samples compared to the quarter milk was probably due to substantial dilution of contaminated milk and this helped to substantially reduce the likelihood of detection as reported by Strastkova *et al*; (2009).

Conclusion

The clinical inspection of cows and the farm management inspection exposed a number of demographic information and farm/herd management practices that are a critical risk factors for causing mastitis disease in cattle, such as udder lesions, soiled thighs and ticks' infestation in cattle as well as poor sanitary practices on the farm like dirty housing conditions, contaminated water sources, hand milking among others. The CMT value was

about 25%, which is quite appreciable and this equally poses a threat of consumption of mastic milk from consumers and its attendant consequences.

Recommendations

1. Dairy farmers should be educated by Government Agricultural Agencies and other stakeholders like Veterinary and Microbiology experts on the need to improve their level of hygiene in milk production and handling, through workshops, seminars and so on.
2. Dairy farmers should also be educated on the need to pay greater attention to mastitis control, by employing veterinary services in their animal healthcare from time to time, in order to achieve improved milk yield and quality.

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