

Quality Assessment of Fresh Milk from Traditionally Managed Nigerian Bunaji and Bokolooji Breeds of Cattle.

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ABSTRACT

The quality of fresh cow milk from traditionally managed Bunaji and Bokolooji Nigerian breeds of cattle in the Odeda Local Government Area, Ogun State, Nigeria were assessed. Raw milk samples were collected from twelve (12) lactating cows made up of 6 animals from each breed and analyzed for their chemical composition, bacteria count and isolates. The crude protein, potassium, and calcium content of Bokolooji breed were higher than Bunaji. While the fat, moisture, total solid, lactose, ash and sodium content ranked the same across breeds. The mean values of 5.71×10^6 cfu/ml and 5.77×10^6 cfu/ml was obtained for the total bacterial count for Bunaji and Bokolooji breeds, respectively.

Five bacteria species were isolated and identified from the milk samples across the breeds namely, *Bacillus spp.*, *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermimis*, *Micrococcus luteus* with *Bacillus spp.* and *Staphylococcus aureus* being the predominant bacteria isolates in the study. The results obtained from the study indicated that though the milk composition of both breeds is within the standard required for milk consumption, the bacteria count shows that the milk is not good for human consumption as the current situation is critical and needs real hygiene improvement from production to the point of processing.

(Keywords: bacteria count, cattle, milk, dairy products, chemical composition)

INTRODUCTION

Milk production from Nigeria local breeds of cattle represents an important component of the agribusiness sector of the smallholder economy with great economic, nutritional, and social implications. Cattle dairy products provide

important amino acid required for body building as well as for tissue repairs and the protein from these products equally supplies its own level of energy required for daily activities. In Nigeria, cattle is the primary source of milk, providing more than 90% of the total animal domestic milk output (Walshe *et al.*, 1991) with the white Fulani or 'Bunaji' breed recognized as the principal producer (Adeneye, 1989). Indigenous cattle breeds despite their low potential for milk product continue to dominate the traditional dairy subsector (Rim, 1992). This has led to importance of milk and milk product to meet the huge demand of milk as a source of protein in the country. However, poor nutrition (Adegbola, 2002) and low reproductive performance (Olaloku, 1999) have been highlighted as some of the major factors affecting milk production from these indigenous breeds of cattle.

Milk as a food of outstanding interest is designed by nature to be a complete food for every young mammal (Allan, 1991), but the quantity and quality of milk produced by most tropical breeds as continually been a source of concern to research and government institutions (Voh and Odere, 1989).

With milk production in Nigeria being almost entirely from indigenous breeds of cattle especially from the Fulani pastoralists, who are accustomed to extensive system of production, the need to investigate into the quality of fresh cow milk cannot be over-emphasized. This study therefore assessed the chemical composition and bacteria count of fresh milk from traditionally managed Nigerian Bunaji and Bokolooji breeds of cattle raised among Fulani rearers in the Odeda Local Government Area of Ogun State, south west Nigeria.

MATERIALS AND METHODS

Experimental Site, Animals and Management

The study was conducted on-farm among the agropastoralists settled in Alabata village, Odeda local Government area of Ogun State, Southwestern Nigeria. Climatically, the local government area enjoyed tropical climate and enjoys double maxima of rainfall from April - July and September – October. Average temperature is about 32°C but humidity can be as high as 95%. It has an area of 1,560 km² and a population of 109,449 at the 2006 census.

The animals were reared semi intensively in a temporary settlement in the study area and are herded to the fields in the morning after milking to graze natural forages and crop residues. They are returned in the evening and kept during the night in the open field, near the homestead. Raw milk from twelve (12) lactating cows made up of 6 Bunaji and 6 Bokooloji Nigerian breeds of cow were selected from the cattle herd and used for study.

Collection of Milk Samples

Conventional hand-milking was done by the Fulani herdsmen on the farm between 06.00hrs and 07.30hrs on a daily basis. Milk samples for constituent analysis were collected in hygienic conditions from each animal from both in bottles containing a pinch of potassium dichromate powder to maintain homogeneity and prevent clotting. The samples were kept chilled later and analyzed for milk components.

Chemical and Data Analysis

The percentage fat was determined by acid hydrolysis method, crude protein by Kjeldhal procedure. Determination of total solids in milk by the gravimetric method, while the mineral content by atomic absorption spectroscopy. Bacteria count in milk samples was estimated according to modified method as described by Baker and Breech (1986).

Statistical Analysis

Data obtained were subjected to Analysis of variance in completely randomized design using T-test (SPSS, 1999).

RESULTS AND DISCUSSION

Table 1 shows the chemical composition and bacterial count of milk from Bunaji and Bokooloji breeds of cattle. The crude protein content was significantly ($P > 0.05$) affected by breed, but higher in Bokooloji (4.10%) and lower in Bunaji (3.43%). The difference could be attributed to breed differences as well as the metabolic activities of bacteria present in the milk. However, these values were within the range 3.25 to 4.05% earlier reported (Muhammad *et al.*, 2005; Tayo *et al.*, 2005) but higher than 3.16 and 3.18% obtained by Alemmede and Sadiq, (2008) and Olafadehan and Adewumi (2010) for extensively managed Bunaji breed cattle.

The fat content obtained was slightly lower compared to 4.77 to 5.25% obtained in White Fulani cattle (Ibeawuchi and Daylop, 1995). The 4.6 to 4.7 % of fat observed was however within the range 3.78 – 5.71% of butterfat in the milk of grazing White Fulani cows fed poultry waste-cassava peel based diet (Ndubueze *et al.*, (2006). The variation could be attributed to the environment and stage of lactation as the fat content of milk has been found to vary considerably with the stage of lactation (O'Mahony, 1988). Moreover, values for the fat content in this study were higher than that of the protein content which corroborates earlier reports (Williamson and Payne, 1978; Olorunisomo *et al.*, 2014).

The 12.4% and 12.5% total solids obtained for the two breeds were within the range earlier reported (Adeneye *et al.*, 1970). The values were slightly lower than the ranges of 13.5 and 13.7% total solids for the milk of grazing Bunaji cows (Olafadehan and Adewumi, 2010). Ojedapo *et al.*, (2014) however, reported lower levels of 10.48% total solids while higher values of 15% was reported by Olorunsomo *et al.*, (2014) in Bunaji cows. Differences in nutrition and management could influence the variation of percent total solids in milk across study (Matthewman, 1993).

Table 1: Chemical and Bacterial Count of Milk from Bunaji and Bokooloji Breeds of Cattle.

Parameters	Treatments	
	Bunaji	Bokooloji
Crude protein (%)	3.43±0.20 ^b	4.10±0.17 ^a
Fat (%)	4.70±0.06	4.60±0.06
Moisture (%)	88.5±0.12	86.4±1.68
Total solids (%)	12.5±0.06	12.4±0.67
Lactose (%)	4.83±0.67	4.53±0.12
Ash (%)	0.81±0.08	0.79±0.17
Bacteria count (x 10 ⁶ cfu/ml)	5.97 ± 0.33	5.71±0.29

^{a,b}. Means with same superscript within the rows are not significantly different ($P < 0.05$)

The lactose contents of milk in this study were not affected ($p > 0.05$) by breed. This supports earlier observations by Ahamefule *et al.*, (2007). However, the lactose content obtained for Bokooloji and white Fulani in the present study were higher than that reported by Lingathurai *et al.*, (2009). The disparity in values may be due to system of management, environment and period of study.

Breed was observed to affect the ash contents of milk in this study. The variation obtained for Bokooloji and Bunaji cows in the present study could be influenced by breed differences, location as well as the type of feed fed. They were however, within the range 0.5 -0.8% reported for white Fulani cattle (Olaoku, 1972; Adebowale, 1976). Lower ash values were reported by Lingathurai *et al.* (2009) and higher range of 0.82 to 0.9 % and 1.2% ash content were obtained by Ndubueze *et al.*, (2006) and Olorunisomo *et al.*, (2014), respectively for white Fulani cattle. The differences may be as a result of the experimental location.

The mean values of 5.71×10^6 cfu/ml and 5.77×10^6 cfu/ml for total bacterial count (TBC) obtained for Bunaji and Bokooloji breeds were five times higher than the required bacterial count of 1.0×10^6 cfu/ml recommended for hygienic milk used as a basic standard by milk centers in the price incentive program. (Hayes *et al.*, 2001; Jayarao *et al.*, 2004). The high TBC may be due to lapses in milk sanitation as well as conducive ambient temperature and relative humidity for the growth of bacteria accompanied by the lack of milk refrigeration in the situation of long distance milk transportation (Aumaitre, 1999, Srairi *et al.*, 2006).

Higher air temperatures has been found to favor the increase of bacteria number, especially on the surfaces of not properly cleaned milking

equipment which could be a potential source of infection (Dahal *et al.*, 2010).

The presence of high coliform bacteria in the milk samples studied indicates a gross contamination indicating significant low level hygiene maintained during the processing of the milk products which shows that the current situation is critical and needs real improvement. Although, in the case of this study, a large percentage of the Fulanis' who are the handlers of these animals are illiterate and are not mindful of the possibility of contamination of milk from the kind of water and utensil used during milk processing. Moreover, the high TBC values found in this study are quite similar to earlier reports in the milk of Nigerian breeds of cattle (Olorunisomo *et al.*, 2014).

Table 2 shows the mineral composition of milk from Bunaji and Bokooloji cows. The potassium and calcium content of Bokooloji breed were higher ($P > 0.05$) than that of Bunaji, while sodium content was higher ($P > 0.05$) for Bunaji breed.

The variation in the mineral composition of milk can be attributed to factors such as forage, feeding systems, milking frequency, milking method, seasonal changes and lactation period. Minerals contribute to the buffering capacity of milk, the maintenance of milk pH, the ionic strength of milk, and milk's osmotic pressure.

However, the mineral composition of raw cow milk as observed in this study indicates that it is a rich source of nutrients and thus offers excellent opportunities for the development of local dairy industry thereby meeting the public need for nutrition.

Table 2: Mineral Composition of Milk from Bunaji and Bokoloji Breeds of Cow.

Parameters	Treatments	
	Bunaji	Bokoloji
Magnesium	2.05±0.27	2.05±0.04
Calcium	1.25±0.15	1.30±0.79
Sodium	4.27±0.37	4.26±0.35
Potassium	1.99±0.45	1.99±0.37

Table 3: Biochemical Characterization and Identification of Bacteria Isolated from the Milk of Bunaji and Bokoloji Breeds of Cattle.

Carbohydrate Utilization															
Sample	Shape	Grams reaction	Catalase	Oxidase	Coagulate test	Indole test	Urea	Motility test	Glucose	Lactose	Maltose	Sucrose	H2O	Organism	Pathogenic
T1	R	-	+	-	NA	+	-	+	+	+	+	-	-	<i>Escherichia coli</i>	**
T2	C	+	+	NA	+	NA	NA	-	+	+	-	-	-	<i>Staphylococcus aureus</i>	
T3	C	+	+	NA	-	NA	NA	-	+	+	-	+	-	<i>Staphyloco. epidermimis</i>	**
T4	C	+	+	+	-	NA	NA	-	+	+	-	-	-	<i>Micrococcus spp</i>	
T5	R	+	+	-	NA	NA	NA	-	+	+	-	-	-	<i>Bacillus spp</i>	**

R = Rod shape C = Cocci shape + = Positive result - = Negative result NA = Not Applicable

The biochemical characterization and identification of bacteria isolated from Bunaji and Bokoloji cow's milk are depicted in Table 3.

Five bacteria species were isolated and identified as *Bacillus spp.*, *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermimis*, and *Micrococcus luteus* across breeds. The identification of isolates on the basis of microscopic analysis and phenotypic characteristics (especially biochemical properties and sugar fermentation abilities) has been reported to be very useful and remains the most widely recognized approach (Kacem, et al., 2003).

The detection and presence of these bacteria indicates possible contamination as a result of poor hygiene practice among handlers. The identified bacteria species from the cow milk samples have been found in foods, environments and other places and earlier reports show that they may have entered the milk via cow, air, feedstuff, milk handling and through milking equipment (Clarence, et al., 2009).

In addition, Figure 1 shows the prevalence of identified bacteria isolates namely *Bacillus spp.*, *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermimis* and *Micrococcus luteus* in Bunaji and Bokoloji cow's milk.

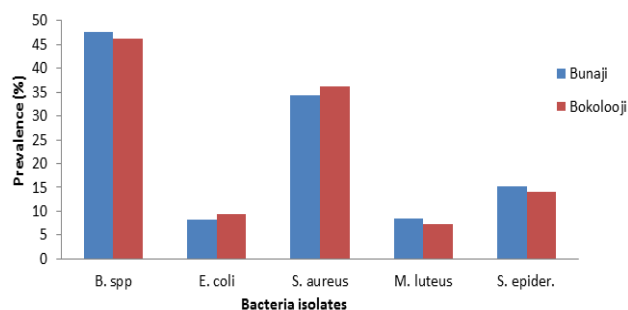


Figure 1: Prevalence of Bacteria Isolates in Milk of Bunaji and Bokoloji Breed of Cows.

The predominant bacteria isolates across breeds in this study were *Bacillus spp.* and *Staphylococcus aureus*. The high presence of these bacteria in the milk samples corroborates the findings of Almede and Sadiq, (2008); Adesina *et al.*, (2011) indicating a favorable environment that is capable of promoting their growth within the milk, which may pose a health concern to its consumers. Their presence, however, in the milk samples could be due to their ability to form spore which are capable of withstanding harsh environmental conditions and contaminate available materials.

Bacillus spp. are quite common in the agricultural environment and may contaminate milk from various sources both during the production, storage and processing. Raw milk is most frequently contaminated under conditions of inadequate udder hygiene, from soil, feed, dust and feces (Christiansson *et al.*, 1999). *Staphylococcus aureus* on the other hand, may have entered the milk from the nose where it is commonly found; hand, skin and clothing of handlers during milking processes (Hobbs and Golbert, 1982). Also, indiscriminate coughing, talking and sneezing may produce droplet which may have contact with milk during milking.

CONCLUSION

It was therefore concluded from the results obtained from the study that though the milk composition of both breeds is within the standard required for milk consumption. The presence of different bacteria with high content of *Staphylococcus aureus* and *Bacillus spp.* in the milk samples signifies poor hygiene level of milk production which can constitute a lot of health hazard to consumers in this study area. This study therefore confirms the broad variety in the hygienic quality of cows' raw milk collected from traditionally milk handlers in Nigeria and also emphasizes the poor hygienic quality of milk. An enlightenment program by the government agencies on sanitary milk handling within the community will enhance the production of hygienic milk among the agro-pastoralists.

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