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Comparative analysis of nutrient composition of milk from different breeds of cows

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ABSTRACT

Exogenous nutrients supply in the human diet is required because of their biological significance for general life maintenance. Milk is said to be the most unique and ideal class of food, because it meets the nutritional needs of the body better than any single food. This study investigated the major constituents of milk obtained from four different breeds of cows viz; Holstein Friesian (HF), White Fulani (WF), Red bororo (RB) and a crossbreed (HF+WF) found in Sokoto metropolis. Proximate parameters - moisture, ash, crude protein, lipid and lactose were determined using the AOAC methods while EDTA titration and spectrophotometric methods were used to determine calcium and phosphorus respectively. The results of the proximate composition showed no significant difference (P>0.05) with the exception of the ash content which differed significantly (p<0.05) between the samples, with the crossbreed having the highest concentration of minerals (0.97%) and RB with the least value (0.73%), but has the highest concentration of calcium even though not significantly different from the others. The values of the moisture content ranged from 81.33%-83%, from 5.7% (HF) to 6.4% (HF+WF) for crude protein, and 5.96% (HF) to 6.8% (HF+WF) for the lipid content. Overall, the local breeds (WF and RB) have shown more desirable nutritional qualities than the exotic breed (HF), however, crossbreeding showed a potential improvement in nutrients especially the protein content. A crossbreed between RB and HF holds a possibility of better nutrient yield, as this local breed (RB) appears to be a better dairy cattle than WF.

Keywords: Milk, Nutrient, Breeds of Cow, Calcium and Phosphorus.

INTRODUCTION

Milk is a complex mixture of proteins, carbohydrates, vitamins, minerals and other constituents dispersed in water [1]. It is one of the oldest foods known to man [2]. On the basis of the protein content of milk, it is generally regarded as “nature’s most nearly perfect food” owing to its rich protein profile containing more essential amino acids than any other natural food [3]. In addition, milk is an important source of mineral substances, especially calcium, phosphorus, sodium, potassium, chloride, iodine, magnesium, and small amounts of iron. Of these mineral constituents, calcium and phosphorus constitute a larger fraction in milk which is needed for bone growth and the proper development of newborns [4].

In humans, breast milk provides all the energy and nearly all nutrients required for infant growth and development during the first 4 to 6 months of life, as well as various immunological factors and bioactive components [5]. However, in the absence of breast-feeding, cow milk is commonly used as a weaning substitute for infants [6] often processed into various dairy formulas. Due to its high nutritive value, cow milk is widely consumed by infants and adults alike to meet their basic nutritional needs.

Cow milk is the most universal raw material for processing dairy products resulting in the broadest spectrum of manufactured dairy products. At present, the number of animals bred for dairy purposes abound which include

Cattle, Goat, Sheep, Horse, Donkey and Camel [7]. In Nigeria, cattle (cow) provide more than 90% of the total animal milk output while goats and sheep provides less than 10% and are kept for production of meat, hides and skin [8]. The white Fulani popularly called 'Bunaji' is the most numerous and wide spread of all the Nigerian cattle breeds accounting for about 37% of the national cattle population [9]. Subsequently, the Friesian breed was introduced in Nigeria and has been used to produce a stabilized crossbred Friesian + white Fulani cows whose dairy performance has been adjudged to be higher than the pure White Fulani [10].

One of the primary goals of the dairy industry has always been to improve the technological properties of milk, including its chemical composition. Milk processing suitability is significantly affected by the proportions of milk components. It has been shown that the quality of milk intended for consumption and processing varies subject to cattle breed [7,11]. Hence there is need to exploit the local and exotic breeds of dairy cattle in Nigeria in order to ascertain the best nutritionally enriched milk producer.

MATERIALS AND METHODS

Sample collection

Four (4) different breeds of cows with an average age of 4.5 years were used for this research. The breed names are Friesian, White Fulani, Red bororo and a cross breed between Friesian and White Fulani. The cows were found at Sidi Mamman Tsalha Asarkawa (S.M.T.A) - a semi intensive farm at Sokoto metropolis, Nigeria. Early morning fresh milk samples were collected from the cows with separate containers using standard milking procedures. To avoid contamination, containers used for sample collection were sterilized by soaking in 10% HNO_3 for 24hours; then in distilled water for another 24hours after which they were rinsed with more distilled water and finally dried ready for sample collection. The collected samples were immediately packaged and transported for analysis.

Proximate Analysis

Proximate parameters determined using the AOAC method. Moisture, ash, crude protein, crude lipid and lactose contents were determined by oven drying, furnace, micro Kjeldah, soxlet extraction and titrimetric methods respectively [12].

Elemental Analysis

Calcium concentration of the samples was determined using EDTA titration while that of phosphorus was determined using spectrophotometric method with Sp 2900 spectrophotometer manufactured by Pye Unicam Ltd, UK.

Statistical Analysis

The data was analyzed using one way analysis of variance (ANOVA) with SPSS 16.0 to examine the statistical significance of differences in the mean concentration of the proximate and mineral compositions of the different milk samples studied.

RESULTS AND DISCUSSION

The mean values (%) of the proximate analysis of milk samples obtained from the four different breeds of cow are presented in Table1. The analysis of variance showed that moisture, crude protein, lactose and lipid content were not significantly ($p>0.05$) different between the samples. However, from table1, the Ash content differed significantly ($p<0.05$) between the samples with the cross-breed having the highest concentration of minerals (0.97%) and the Red bororo with the least value (0.73%).

Comparison of the mineral composition showed that the differences between the samples were not statistically significant ($p>0.05$) as shown in Figure 1.

Table1: Proximate composition of milk from different breeds of cow

Parameter %	Red Bororo (RB)	Holstein Friesian(HF)	White Fulani (WF)	Cross breed (WFxHF)
Moisture	83.00 ±0.10	82.33±1.58	81.67±1.58	81.33±1.53
Ash	0.73±0.01[a]	0.81±0.02[b]	0.90±0.10[c]	0.97±0.30[d]
Lactose	4.20±0.26	5.20±0.30	5.40±0.10	4.50±0.88
Crude Protein	5.90±0.40	5.70±0.45	5.8±0.36	6.4±0.27
Lipid	6.17±0.91	5.96±0.21	6.23±0.16	6.8±0.62
Protein/lipid	0.96	0.96	0.93	0.94

Values represent mean ± SEM of triplicates. Different alphabets on the same row indicate significant difference at $p<0.05$, absence of alphabets on the same row indicates no significant difference ($p>0.05$).

An analysis of the proximate composition of the milk samples showed that the difference in the moisture content was not significant ($p>0.05$) with values of 81.33%-83% a little lower than 84.80%-85.2% reported by Salau and Bolakale [13], and 87.42% reported by Mirzadeh *et al.*,[14]. High moisture content is directly proportional to high water activity which in turn supports microbial growth consequently decreasing the shelf life of the milk sample. Conversely, low moisture content, implies low water activity, which causes the reduction of microbial growth and consequently increasing the shelf life of milk and milk products [15].

Generally milk protein percentage is positively correlated with the milk fat percentage. If one is high, the other is usually high [16]. This is true for all the crude protein/lipid content of the four milk samples ranging from 5.7% (HF) to 6.4% (HF+WF) for crude protein, and 5.96% (HF) to 6.8% (HF+WF) for the lipid content. Except for the findings of Salau and Bolakale [13], who recorded the same crude protein for WF, other studies have reported lower crude protein values in cow milk; 3.3 ±0.22% [14] and 3.73±0.68% [17]. Similarly, the lipid content exceeded reports of several studies [18,19], except for studies by Adeneye *et al.*,[20] who reported lipid content of 6.10% for white Fulani breed. This difference in crude protein and lipid values could be a consequence of feeding regimen [2] or difference in herd management by pastoralists [21]. Protein is required for body building and repair, while fat is widely known as a source of energy, excess content of fat in food could constitute health risk [22]. In the present study, the local breeds (WF, RB) and the crossbreed gave a higher crude protein and lipid content than the HF breed, although these differences were not significant ($p>0.05$). However, crossbreeding of the exotic breed (HF) with the local breed (WF) points to a promising protein content improvement of milk which could be exploited in the future.

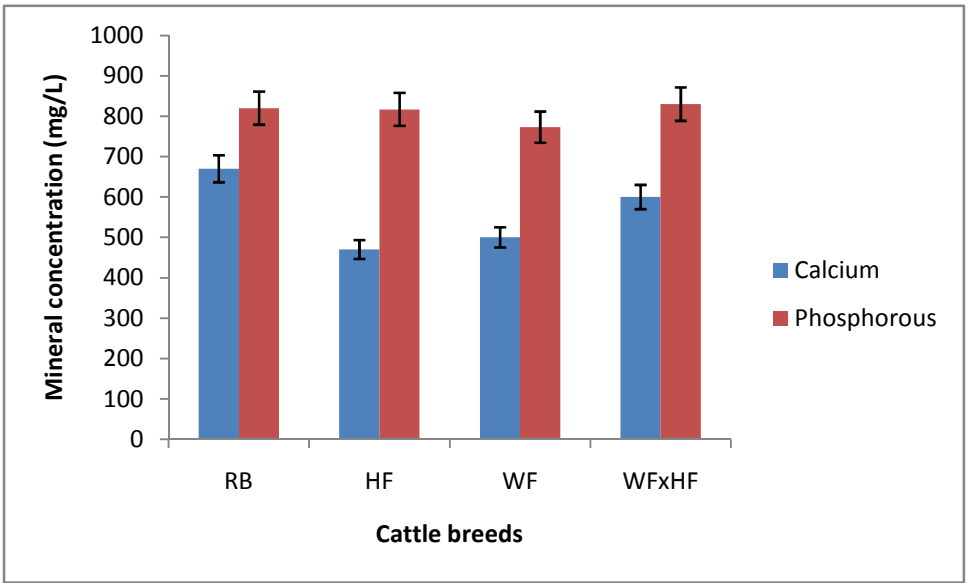

Fig.1: Mineral composition (calcium and phosphorus) of different breeds of cow.
**RB(Red Bororo); HF(Holstein Freisian); WF(White Fulani); HF+WF(Crossbreed)*

Ash content varied significantly ($p<0.05$) amongst the different breeds, contrary to previous reports by Adesina [19]. Ash content is a measure of the mineral composition of biological materials, hence the determination of its mineral composition. Milk and its products constitute a rich source of the mineral components that satisfy, to a great extent, men's demand for calcium, phosphorus, potassium, magnesium and sodium [23]. The phosphorus and calcium levels were reduced in comparison with previous studies [13,19,24]. This decreased Calcium levels might be due to nutritional stress posed by maintaining plasma Calcium constant during early weeks of lactation in which most cows remain under a negative Calcium balance. Thus, to maintain normal blood plasma Calcium level, resorption of bone Calcium stores and absorption of Calcium from intestine must meet the negative Calcium balance [25].

CONCLUSION

Comparison of the proximate analysis of milk samples from four different breeds of cattle has shown that the Exotic breed (Holstein Friesian) had less desirable traits nutritionally, which could be attributed to its adaptation to the herd management practices in Nigeria. However, the desirable nutritional potentials of Holstein Friesian breed was unmasked by crossbreeding it with a local breed (White Fulani). A crossbreed of Red Bororo and Holstein Friesian

holds a possibility of a better yield, as this local breed appears to be a better dairy cattle than the white Fulani breed from this present study. Hence, crossbreeding dairy breeds holds a great potential for the dairy industry.

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