



**PROXIMATE COMPOSITION, MINERAL AND VITAMIN CONTENTS OF
RAW MILK FROM WADARA AND BUNAJI BREEDS OF CATTLE IN
BAUCHI STATE, NIGERIA**

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ABSTRACT

The study was carried out to evaluate and compare the proximate, mineral and vitamin compositions of raw milk from Wadara and Bunaji cattle breeds. A total of 20 milk samples were collected, from 10 each breed of cow. The sampling was conducted in the morning, immediately after feeding to minimize milk degradation in each breed. A composite sample was prepared by pooling the milk and stored in sterilized containers to prevent contamination and transported to laboratory for analysis of proximate composition, mineral and vitamin contents. The result revealed no significant difference in ash content (0.75 ± 0.04 vs $0.76 \pm 0.06\%$), fat (4.04 ± 0.25 vs $4.17 \pm 0.28\%$), protein (3.14 ± 0.94 vs $3.48 \pm 0.18\%$) and carbohydrate (3.83 ± 0.47 vs $4.15 \pm 0.81\%$) as well as moisture (87.53 ± 0.99 vs $87.90 \pm 0.39\%$) content. Mineral content indicated a significant ($P < 0.05$) difference in copper (0.85 ± 0.05 vs $0.92 \pm 0.05 \text{mg/l}$) and sodium (118.07 ± 5.50 vs $124.51 \pm 7.99 \text{mg/l}$) levels among milk samples with Wadara's milk significantly ($P < 0.05$) higher in copper and sodium content than Bunaji milk, which is beneficial for individuals in need of more minerals. However, Bunaji's milk was significantly ($P < 0.001$) higher in vitamin E content (0.25 ± 0.00 vs $0.55 \pm 0.00 \text{iu}$) which offers better antioxidant properties, while both breeds have similar contents of vitamin A (1242.40 ± 2.11 vs $1245.60 \pm 0.00 \text{iu}$), B (8.97 ± 0.95 vs $9.27 \pm 0.00 \text{iu}$), C (8.20 ± 0.80 vs $8.50 \pm 0.00 \text{iu}$), D (40.78 ± 1.05 vs $41.50 \pm 0.00 \text{iu}$), and K (44.30 ± 0.00 vs $44.70 \pm 1.05 \text{iu}$). It can be concluded that Wadara and Bunaji breeds of cattle can be used for milk production. However, wadara milk is recommended for commercial production due to better mineral and vitamin E content.

Keywords: Proximate, Composition, Mineral, Vitamin, Milk, Breed

INTRODUCTION

Milk is a complex, heterogeneous mixture comprising fat emulsified as globules, major proteins like casein, and mineral matter in the colloidal state, alongside lactose and soluble whey proteins in a true solution (Dave and Mehta, 2021). As a vital source of nutrition, milk provides essential components such as proteins, fats, carbohydrates, vitamins, and minerals. It plays a critical role in human diets globally, contributing significantly to growth, development, and overall health. Beyond its nutritional importance, milk is also the primary raw material for various dairy products, including cheese, butter, yogurt, and milk powders, which are central to the global food industry (Abbaya *et al.*, 2022). Consequently, the quality and composition of milk have direct implications for both human health and the economic viability of dairy processing industries, which underscores the significance of research in this area (Polmi *et al.*, 2024). For example, a study conducted in Nasarawa State, Nigeria, assessed the proximate composition of fresh and fermented milk, revealing that bulk milk samples generally had the highest nutritional content. Significant differences were noted between the dry matter, oil, and ash contents of bulk milk samples and nono, a fermented milk product. The study suggested that these variations in milk composition could be attributed to genetic differences within breeds, as all cows from which samples were collected were of the same breed as white Fulani (Aliyu *et al.*, 2019).

Abbaya *et al.* (2020) reported that in terms of breed-specific variations, a study evaluating the milk composition of Nigerian indigenous cattle breeds revealed that the Bunaji breed had the highest milk yield, while the Bokoloji breed excelled in protein and fat contents, and the Rahaji breed was richest in minerals. The proximate and chemical compositions of milk are fundamental in determining



its nutritional value, technological suitability, and market potential. Proximate analysis evaluates key components such as moisture, protein, fat, lactose, and ash, all of which together define the basic nutritional profile of milk. The chemical composition, which includes specific bioactive compounds, minerals, vitamins, and enzymes, offers deeper insights into milk's health benefits and its suitability for various dairy processing applications (Lin *et al.*, 2021).

Understanding these components is essential for optimizing milk usage in functional foods and therapeutic formulations, thereby enhancing both consumer health and the dairy sector's offerings. In addition, identifying breeds with superior milk quality traits can inform breeding programs, improve the sustainability of dairy production systems, and contribute to the development of more effective dairy farming practices (Musa *et al.*, 2022). The study of milk composition in indigenous breeds is especially important for preserving genetic diversity and ensuring their inclusion in modern dairy initiatives (Damtew and Gebre, 2020; Shitu *et al.*, 2023). For instance, the protein content in milk varies between breeds, with values ranging from 3.29% to 3.95%, and the White Fulani breed consistently exhibiting the highest protein levels (Adamu *et al.*, 2020). Fat content ranges from 3.32% to 3.99%, with Red Bororo cattle showing consistently higher fat levels (Adamu *et al.*, 2020). Furthermore, the moisture content of milk is generally high across breeds, ranging from 82.28% to 84.00%, reflecting the significant water content in milk (Adamu *et al.*, 2020). The proximate, mineral, and vitamin composition of milk from indigenous Nigerian cattle breeds, specifically the Wadara and Bunaji, remains inadequately documented.

Understanding the nutritional profiles of these breeds is essential for optimizing dairy production and ensuring the health benefits of milk. There is paucity of information on the proximate composition, mineral content, and vitamin levels in milk from Wadara and Bunaji cattle which hinders the development of breed-specific management practices and nutritional strategies in Nigeria. This knowledge gap also impedes the ability to assess the suitability of milk from these breeds for various dairy products and consumer health needs (Aliyu *et al.*, 2019).

Therefore, there is a pressing need for targeted research to evaluate the proximate, mineral, and vitamin composition of raw milk from Bunaji and Wadara cattle. This study is aimed at evaluating and comparing the proximate, mineral, and vitamin compositions of raw milk from Bunaji and Wadara cattle breeds.

MATERIALS AND METHODS

Study Area

The study was conducted at Abubakar Tafawa Balewa University Dairy Research and Development Centre, Bauchi. The centre was established in 2015 and operational since 2020, is dedicated to advancing dairy science through comprehensive research and development initiatives. The centre is situated on approximately latitude 10.3297704°N and longitude 9.8453553°E at the Gubi campus in Bauchi State.

Experimental Animal

A total of twenty (20) cattle from two (2) indigenous breeds were selected from the Abubakar Tafawa Balewa University Dairy Research Centre. The breeds are Wadara and Bunaji. These cattle were selected based on good health, not subjected to recent nutritional deficiencies or treatments that could interfere with milk composition, similar age range and milked under standard farm management practices.

Sample Size Determination and Collection

The sample size for this study was determined using Cochran's formula. However, based on practical constraints and feasibility, a total of 20 milk samples were collected, 10 from each breed. Sampling was conducted in the morning, immediately after feeding, to minimize milk degradation. For each breed, a composite sample was prepared by pooling milk from 10 individual animals. Samples were stored in sterilized containers to prevent contamination and transported to the Abubakar Tatari Ali Polytechnic Laboratory for analysis.



Proximate, Mineral and Vitamin Composition Analysis

Proximate, mineral and vitamin composition analysis were determined according to the method of the Association of Official's Analytical Chemists, AOAC (2006), Atomic Absorption Spectrophotometry (AAS) and High-Performance Liquid Chromatography (HPLC) respectively.

Data Collection and Statistical Analysis

All measurements were conducted in triplicate to ensure accuracy and reproducibility. Data collected were subjected to Analysis of Variance (ANOVA) using SPSS software (Version 25). Mean and Standard Deviation (SD) were calculated for each component, Student's t-test was used to compare the compositions between the two breeds and statistical significance was set at $P < 0.05$.

RESULTS AND DISCUSSION

Proximate Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle

Proximate Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle is presented in Table 1. The result of the proximate composition revealed no significant difference in moisture (87.53 ± 0.99 vs $87.90 \pm 0.39\%$), ash (0.75 ± 0.04 vs $0.76 \pm 0.06\%$), fat (4.04 ± 0.25 vs $4.17 \pm 0.28\%$), protein (3.14 ± 0.94 vs $3.48 \pm 0.18\%$) and carbohydrate (3.83 ± 0.47 vs $4.15 \pm 0.81\%$). The proximate composition of cow's milk values observed in these two breeds were comparable to the values reported by Ajai *et al.* (2012) in cow's milk collected from three different locations. The composition of cattle milk can be influenced by environmental, nutritional, genetic and physiological factors (Abduljalil *et al.*, 2023).

Table 1: Proximate Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle

Nutrient (%)	Wadara Mean \pm SD	Bunaji Mean \pm SD	LOS
Moisture	87.90 ± 0.39	87.53 ± 0.99	0.283 ^{NS}
Ash	0.75 ± 0.04	0.76 ± 0.06	0.527 ^{NS}
Fat	4.04 ± 0.25	4.17 ± 0.28	0.281 ^{NS}
Protein	3.48 ± 0.18	3.14 ± 0.94	0.269 ^{NS}
Carbohydrate	3.83 ± 0.47	4.15 ± 0.81	0.293 ^{NS}

SD: Standard Deviation; LOS: Level of Significance; NS: Not Significant.

Mineral Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle

Mineral Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle is presented in Table 2. The result of the mineral composition of raw milk from Wadara and Bunaji breeds of cattle are copper (0.85 ± 0.05 vs $0.92 \pm 0.05\text{mg/l}$), sodium (118.07 ± 5.50 vs $124.51 \pm 7.99\text{mg/l}$), potassium (154.25 ± 5.37 vs $290.86 \pm 426.64\text{mg/l}$), magnesium (30.84 ± 0.97 vs $31.61 \pm 2.63\text{mg/l}$), calcium (87.16 ± 2.46 vs $88.28 \pm 2.57\text{mg/l}$), iron (2.91 ± 0.26 vs $3.20 \pm 0.37\text{mg/l}$) and zinc (0.86 ± 0.27 vs $0.91 \pm 0.04\text{mg/l}$). The result showed that, copper and sodium were slightly higher in Wadara's raw milk than the value observed in Bunaji. The mineral composition showed that copper and sodium levels were significantly ($P < 0.05$) different between Wadara and Bunaji cattle milks. This observation was similar to the report of Abduljalil *et al.* (2023), who obtained a significant variation in mineral content of Holstein Friesian, Red Bogoro, Sokoto Gudali and White Fulani breeds of cattle. The minerals studied were selenium, iron, copper, zinc, phosphorus, lead, chromium, manganese and cadmium with highest level of selenium obtained in the milk of the exotic breed (Holstein Friesian). However, K, Mg, Ca, Fe and Zn levels did not differ between the two breeds (Wadara and Bunaji). This observation is in agreement with the report of Ajai *et al.* (2012) in cow's milk. Fe, Cu, Zn and Mn are critical in protecting cellular components from oxidative damage.

Table 2: Mineral Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle

Nutrient (mg/l)	Wadara Mean \pm SD	Bunaji Mean \pm SD	LOS
Cu	0.92 \pm 0.05 ^a	0.85 \pm 0.05 ^b	0.002*
Na	124.51 \pm 7.99 ^a	118.07 \pm 5.50 ^b	0.050*
K	290.86 \pm 426.64	154.25 \pm 5.37	0.325 ^{NS}
Mg	31.61 \pm 2.63	30.84 \pm 0.97	0.395 ^{NS}
Ca	88.28 \pm 2.57	87.16 \pm 2.46	0.331 ^{NS}
Fe	3.20 \pm 0.37	2.91 \pm 0.26	0.058 ^{NS}
Zn	0.86 \pm 0.27	0.91 \pm 0.04	0.601 ^{NS}

^{a,b}: Means on the same row with different superscripts are significantly ($P < 0.05$) different; LOS: Level of Significance; NS: Not Significant. SD: Standard Deviation; Cu: Copper; Na: Sodium; K: Potassium; Mg: Magnesium; Ca: Calcium; Fe: Iron; Zn: Zinc.

Vitamin Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle

Result of the vitamin composition of raw milk from Wadara and Bunaji breeds of cattle is presented in Table 3. The result indicated the content of vitamin A (1242.40 \pm 2.11 vs 1245.60 \pm 0.00iu), vitamin B (8.97 \pm 0.95 vs 9.27 \pm 0.00iu), vitamin C (8.20 \pm 0.80 vs 8.50 \pm 0.00iu), vitamin D (40.78 \pm 1.05 vs 41.50 \pm 0.00iu), vitamin E (0.25 \pm 0.00 vs 0.55 \pm 0.00iu) and vitamin K as (44.30 \pm 0.00 vs 44.70 \pm 1.05iu). The result showed a significant difference in Vitamin composition with vitamin E slightly higher in Bunaji's raw milk than the value observed in Wadara. The concentration of antioxidant vitamins A, C and E obtained in this study were comparable to the values reported by Abduljalil *et al.* (2023) in different breeds of cattle. The vitamin A content in cow's milk can alleviate the deficiency symptoms of vitamin A and also contribute to the daily vitamin A requirement by the animal body. Vitamins C and E are most important as antioxidant that protect biomembrane (Cosmas *et al.*, 2010).

Table 3: Vitamin Composition of Raw Milk from Wadara and Bunaji Breeds of Cattle

Nutrient (iu)	Wadara Mean \pm SD	Bunaji Mean \pm SD	LOS
Vitamin A	1245.60 \pm 0.00	1242.40 \pm 2.11	1.000 ^{NS}
Vitamin B	9.27 \pm 0.00	8.97 \pm 0.95	1.000 ^{NS}
Vitamin C	8.50 \pm 0.00	8.20 \pm 0.80	1.000 ^{NS}
Vitamin D	41.50 \pm 0.00	40.78 \pm 1.05	1.000 ^{NS}
Vitamin E	0.25 \pm 0.00 ^b	0.55 \pm 0.00 ^a	0.000***
Vitamin K	44.30 \pm 0.00	44.70 \pm 1.05	0.246 ^{NS}

^{a,b}: Means on the same row with different superscripts are significantly ($P < 0.001$) different; LOS: Level of Significance; NS: Not Significant; SD: Standard Deviation.

CONCLUSION AND RECOMMENDATIONS

The results indicated no significant differences between the two breeds in terms of moisture, ash, fat, protein, and carbohydrate content, suggesting similar overall nutrient composition. There was significant difference ($P < 0.05$) in the mineral composition, with Wadara milk containing higher levels of copper (0.92 \pm 0.05mg/l) and sodium (124.51 \pm 7.99mg/l) than Bunaji milk. Other minerals, including potassium, magnesium, calcium, iron, and zinc, showed no significant difference between the two breeds. Vitamin composition, (A, B, C, D, and K) exhibited no significant differences between the two breeds, except vitamin E (0.25 \pm 0.00 vs 0.55 \pm 0.00IU). Wadara and Bunaji breeds can be used for milk production. However, Wadara's high protein content (3.48%) makes it better suited for protein-enriched dairy products and therefore, recommended for commercial production.

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