

## CHEMICAL COMPOSITION AND SENSORY PROPERTIES OF MILK BLENDS PRODUCED FROM TIGERNUTS (*CYPERUS ESCULENTUS L.*) AND SOYBEANS (*GLYCINE MAX*) SUPPLEMENTED WITH DATE PALM (*PHOENIX DACTYLIFERA L.*)

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### ABSTRACT

*This study evaluated the chemical composition and sensory properties of milk blends produced from fresh tiger nuts (TM), soybeans (SM), and date palm purchased from Ubani market, Umuahia Nigeria. Seven samples in the ratio of 50:50 (SM: TM), 70:30 (SM: TM), 30:70 (SM: TM), 60:40 (SM: TM), 40:60 (SM: TM), 100:0 (SM: TM), and 0:100 (SM: TM,) were supplemented with date palm syrup and analyzed using standard procedure. IBM Statistical Product for Service Solution (version 21.0) was used to analyze the data generated. Analysis of variance and Duncan Multiple Range Test were used to compare and separate the means respectively, significance was accepted at  $p < 0.05$ . Results shows the proximate ranged between 65.05 to 86.28% moisture, 4.73 to 6.96% crude protein, 4.58 to 24.41% fat, 0.43 to 0.68% ash, 0.20 to 0.33% crude fiber, 2.67 to 3.86% carbohydrates, 13.72 to 36.00g dry matter, 74.64 to 259.21Kcal energy. The micronutrients obtained were calcium (6.78 to 32.63mg), magnesium (32.92 to 60.78mg), potassium (2.88 to 77.21mg), iron (0.28 to 2.08mg), zinc (0.32 to 2.05mg), sodium (15.71 to 37.40mg), vitamin A (0.58 to 41.05ug), vitamin C (18.51 to 30.87mg), vitamin E (4.87 to 5.22mg), B1 (0.13 to 32.01mg), B2 (0.05 to 20.43mg), and B3 (0.03 to 0.81mg). The anti-nutrients and phytochemical ranges were 0.01 to 0.46mg phytates, 0.03 to 2.72mg oxalate, 0.05 to 0.51mg saponin, 0.22 to 0.63mg tannin, and 0.13 to 1.79mg alkaloids. The milk blends were acceptable to the panelists and could be used to improve nutrient intakes and varied meals.*

**KEYWORDS:** Milk blends, Tiger nuts, soybeans, date palm, nutrients intake.

### INTRODUCTION

Cow's milk is a good source of numerous nutrients such as proteins, fats, minerals, vitamins, sugar as well as water. These nutrients are from animal sources, and therefore readily bioavailable to the body. Adequate consumption of milk in the diet will result in good nutritional status. The current cost of animal milk is very high and not within the reach of most consumers in low and middle-income countries. This is given the economic downturn bedeviling the global community. Recently, most agricultural activities in various communities are currently being interrupted by militancy, banditry, and kidnapping. The breed of cattle good for milk production are few and scarce and with the upsurge in cattle rustling in developing countries especially in Nigeria, the number of cattle available for milk production is reducing daily, resulting in a reduced quantity of milk produced and high demand of the available ones. Generally, the multiplier effect is the high cost of food, inadequate milk intake, reduced variety of meals as most families will be limited to affordable foods, and subsequent poor nutritional status especially protein malnutrition. This decrease in milk consumption initiated the quest

for a non-dairy substitute. Plant milk has been consumed in different areas and regions in Africa. Belewu and Belewu [1] noted that milk from plant sources could have good nutritional values as well as economic potential. Many plant foods have the potential for milk production, the composition of which will depend on the foods used. Tiger nuts (*Cyperus esculentus L.*) is a cosmopolitan perennial crop widely known by different names as Zulu nut, yellow nut-grass, ground almond, chufa, edible rush, rush nut, Aya (Hausa), imumu (Yorumu Aki Hausa (Igbo) and Ofio (Southern Nigeria) in different cultures. This peanut-sized tuber grows freely and wildly in most African countries as well as in Europe and the Arabian, peninsula [2]. Devries and Feuke [3] underscored it as an under-utilized tuber. Its nutrient composition has significant health benefits including reduction of cholesterol, prevention of arteriosclerosis, and thrombosis, activation of blood circulation [4, 5], prevention, and treatment of urinary tract and bacterial infections, and reduction of vulnerability to colon cancer [6]. Soybeans (*Glycine max L.*) belong to the family leguminosae, an important oil seed grown as a food crop [7]. In

addition to its use in traditional soy foods, soybeans enjoy wide applicability in the food industries, ranging from its use as livestock feeds, for extraction of oil, protein ingredients, dairy and meat alternatives, tofu, soy sauce, soy sprouts, green vegetables [8]. Date palm (*Phoenix dactylifera* L.) is the oldest subsistence crop originally cultivated in all of Northern Africa, and the middle east, and currently cultivated in other parts of the world [9]. Date palm fruits contain high amounts of sugar, minerals, and vitamins [9,10], antioxidants - carotenoids and phenolics [11] as well as medicinal value [12 - 15]. The blending of these plant foods could produce a good substitute for dairy milk for a great majority of consumers in low and middle-income countries.

## MATERIALS AND METHODS

**Study Design:** The study employed an experimental design

**Collection and identification of raw materials:** Fresh tiger nuts, soybeans, and date palm were purchased from Ubani main market in Umuahia Abia state Nigeria. The materials were identified by E.N (an agronomist) in the Department of Crop Science, Michael Okpara University of Agriculture Umudike Nigeria.

**Preparation of Samples:** The tiger nuts, soybeans, and date palm were individually sorted to remove extraneous materials, washed with tap water, and drained in a colander. One thousand grams (1000g) of soybeans were blanched for 45minutes, washed, de-hulled, and grounded into a smooth paste. The paste was mixed with 2 litres of tap water and stirred thoroughly with a wooden spoon to obtain an even consistency. The slurry was strained through a muslin cloth (pore size 2mm) to separate the residue from the filtrate. The latter was boiled for 30 minutes, skimming off the scum at interval, allowed to cool until use. The Tiger nuts (1000g) were soaked in six changes of tap water for 48hrs, washed twice in two changes of water, drained in a colander, and milled into paste with 1litre of tap water in an electric Kenwood Food blender (Model BL335) made in China. The paste was slurred in 1 litre of water, filtered with a damp muslin cloth (2mm sieve size), poured into plastic containers ready for use. The Date fruits (500g) were soaked in tap water for 12hrs, drained in a colander, deseeded, and milled with 500ml of tap water with an electric Kenwood food blender (BL335). The solution was filtered through a muslin cloth (2mm pore size) with hand-pressed to remove the residue and obtain the syrup for use.

**Formulation of milk blends:** The Soybeans milk (SM) and Tiger nuts milk (TM) were formulated into blends of 100% SM: 0% TM, 100% TM: 0%SM, 50%SM: 50%TM, 70% SM: 30%TM, 30% SM: 70%TM, 60% SM: 40%TM, 40% SM: 60%TM, and coded as 501, 502, 503, 504, 505, 506, 507. Date palm syrup (400mls) solution in water was used to sweeten the milk blends. Commercial factory-made Vita milk (100%) coded as 500 served as control.

**Chemical analyses of the samples:** The milk blends' proximate, mineral, and vitamin contents were carried out in duplicates using standard methods. The moisture, protein, fat, ash, and crude fiber contents of the milk blends were determined by the method of AOAC [16]. Carbohydrate was determined by differences. Beta carotene was determined as described [17]. Vitamin C, magnesium, sodium, calcium, potassium, and phosphorus as well as phytates, oxalates, saponins, tannins, and alkaloids were also determined by AOAC [16] method. Sensory evaluation of the juices and blends was by twenty panelists using a 9-point hedonic scale, where 9 was assigned the highest score of – liked extremely and 1 the lowest score – extremely disliked as described in Iwe [18]. The mean scores for sensory attributes were recorded.

### Statistical analysis

Data obtained were analyzed with IBM Statistical Package for Service Solution (SPSS) version 21.0 software. Results were presented as means and standard deviations. Analysis of variance (ANOVA) was used to compare the means, differences between means were determined with Duncan's Multiple Range Test and significance was accepted at  $p < 0.05$

## RESULTS

Table 1 shows the proximate and energy composition of milk blends produced from soybeans, and tiger nuts supplemented with date palm fruit syrup. Sample 502 (0%SM: 100%TM) had the highest dry matter (36.00g/100g), fat (24.41 g/100g) and energy (259.21Kcal) value but lowest ash (0.43g/100g) content. The moisture content of the samples varied and ranges from 65.05 to 86.28 g/100g. Sample 503(50%SM: 50%TM) had the highest protein content (6.96 g/100g) and was significantly ( $P < 0.05$ ) different from the other samples. Sample 504 (70%SM: 30%TM) had the highest ash (0.68 g/100g) value, while the control sample 500 (100% Vita Milk) and 501 (100%SM: 0%TM) had the highest crude fiber (0.33 g/100g) and carbohydrates (3.86 g/100g) respectively,

**Table 1 Proximate (g/100g) and energy (Kcal) composition of milk blends produced from soybeans, and tiger nuts supplemented with date palm fruit syrup.**

Samples	Dry matter	Moisture	Protein	Fat	Ash	Crude fibre	CHO	Energy
500	13.72 <sup>f</sup> ±0.01	86.28 <sup>a</sup> ±0.01	4.73 <sup>h</sup> ±0.01	4.58 <sup>g</sup> ±0.02	0.45 <sup>d</sup> ±0.01	0.33 <sup>a</sup> ±0.01	3.64 <sup>b</sup> ±0.02	74.64 <sup>h</sup> ±0.16
501	14.58 <sup>f</sup> ±0.01	85.42 <sup>b</sup> ±0.01	5.51 <sup>g</sup> ±0.01	4.37 <sup>h</sup> ±0.01	0.63 <sup>b</sup> ±0.01	0.21 <sup>c</sup> ±0.01	3.86 <sup>a</sup> ±0.08	77.07 <sup>g</sup> ±0.24
502	36.00 <sup>a</sup> ±1.43	65.05 <sup>h</sup> ±0.01	6.77 <sup>b</sup> ±0.01	24.41 <sup>a</sup> ±0.01	0.43 <sup>d</sup> ±0.01	0.23 <sup>c</sup> ±0.01	3.11 <sup>d</sup> ±0.01	259.21 <sup>a</sup> ±0.13
503	25.44 <sup>d</sup> ±0.00	74.56 <sup>e</sup> ±0.00	6.96 <sup>a</sup> ±0.01	14.23 <sup>d</sup> ±0.01	0.55 <sup>c</sup> ±0.01	0.23 <sup>c</sup> ±0.01	3.47 <sup>c</sup> ±0.00	169.79 <sup>d</sup> ±0.18
504	19.48 <sup>e</sup> ±0.11	80.17 <sup>d</sup> ±0.11	6.02 <sup>f</sup> ±0.01	9.47 <sup>e</sup> ±0.01	0.68 <sup>a</sup> ±0.01	0.22 <sup>c</sup> ±0.03	3.45 <sup>c</sup> ±0.15	123.09 <sup>e</sup> ±0.66
505	29.18 <sup>b</sup> ±0.01	70.83 <sup>g</sup> ±0.02	6.06 <sup>c</sup> ±0.01	19.38 <sup>b</sup> ±0.01	0.63 <sup>b</sup> ±0.01	0.27 <sup>b</sup> ±0.01	2.84 <sup>e</sup> ±0.05	210.00 <sup>b</sup> ±0.01
506	19.47 <sup>e</sup> ±0.01	80.53 <sup>c</sup> ±0.01	6.62 <sup>c</sup> ±0.01	9.31 <sup>f</sup> ±0.01	0.67 <sup>a</sup> ±0.01	0.20 <sup>c</sup> ±0.00	2.67 <sup>f</sup> ±0.03	120.95 <sup>f</sup> ±0.04
507	27.57 <sup>c</sup> ±0.00	72.45 <sup>f</sup> ±0.02	6.21 <sup>d</sup> ±0.01	17.74 <sup>c</sup> ±0.01	0.61 <sup>b</sup> ±0.01	0.21 <sup>c</sup> ±0.01	2.79 <sup>ef</sup> ±0.02	195.64 <sup>c</sup> ±0.16

Values are mean, ±SD of duplicate determinations; Means with similar superscript (a to f) in the same column are not significantly (P < 0.05) different; CHO = Carbohydrates, 501 = 100% SM: 0% TM, 502 = 0% SM: 100%TM, 503 = 50%SM: 50%TM, 504 = 70% SM: 30%TM, 505 = 30% SM: 70%TM, 506 = 60% SM: 40%TM, 507 = 40% SM: 60%TM, 500 = 100% Vita milk (control)

Table 2 presents the mineral content of the milk blends made from soybeans and tiger nuts supplemented with date palm fruit syrup. Calcium (32.63mg/100g), magnesium (60.78mg/100g), potassium (77.21mg/100g) and sodium (37.40 mg/100g) were significantly (P < 0.05) higher in sample 500 (100% Vita milk), while sample 502 (0%SM: 100% TM) had the highest value for Iron (2.08mg/100g) and zinc (2.05mg/100g) respectively.

**Table 2 Mineral composition of milk blends produced from soybeans and tiger nuts supplemented with date palm fruit syrup (mg/100g)**

Samples	Calcium	Magnesium	Potassium	Iron	Zinc	Sodium
500	32.63 <sup>a</sup> ±0.01	60.78 <sup>a</sup> ±0.01	77.21 <sup>a</sup> ±0.01	0.28 <sup>h</sup> ±0.01	0.37 <sup>g</sup> ±0.01	37.40 <sup>a</sup> ±0.01
501	6.86 <sup>g</sup> ±0.01	36.52 <sup>e</sup> ±0.03	49.26 <sup>b</sup> ±0.03	0.57 <sup>g</sup> ±0.01	0.32 <sup>h</sup> ±0.01	24.76 <sup>b</sup> ±0.01
502	8.33 <sup>b</sup> ±0.01	52.23 <sup>b</sup> ±0.01	2.88 <sup>h</sup> ±0.16	2.08 <sup>a</sup> ±0.01	2.05 <sup>a</sup> ±0.01	18.61 <sup>f</sup> ±0.01
503	7.52 <sup>c</sup> ±0.01	45.34 <sup>c</sup> ±0.01	26.02 <sup>e</sup> ±0.01	1.35 <sup>c</sup> ±0.01	1.17 <sup>c</sup> ±0.01	20.31 <sup>e</sup> ±0.01
504	7.12 <sup>e</sup> ±0.01	33.25 <sup>f</sup> ±0.01	36.35 <sup>c</sup> ±0.01	0.86 <sup>e</sup> ±0.01	0.71 <sup>e</sup> ±0.01	24.11 <sup>c</sup> ±0.01
505	7.43 <sup>d</sup> ±0.01	45.37 <sup>c</sup> ±0.00	15.81 <sup>f</sup> ±0.01	1.67 <sup>b</sup> ±0.01	1.21 <sup>b</sup> ±0.01	16.21 <sup>g</sup> ±0.01
506	6.91 <sup>f</sup> ±0.01	32.92 <sup>g</sup> ±0.01	35.77 <sup>d</sup> ±0.01	0.78 <sup>f</sup> ±0.01	0.66 <sup>f</sup> ±0.01	23.67 <sup>d</sup> ±0.01
507	6.78 <sup>b</sup> ±0.02	44.22 <sup>d</sup> ±0.01	15.02 <sup>g</sup> ±0.01	1.25 <sup>d</sup> ±0.01	1.01 <sup>d</sup> ±0.01	15.71 <sup>h</sup> ±0.01

Values are mean, ±SD of duplicate determinations; Means with similar superscript (a to f) in the same column are not significantly (P < 0.05) different; 501 = 100% SM: 0% TM, 502 = 100% TM: 0%SM, 503 = 50%SM: 50%TM, 504 = 70% SM: 30%TM, 505 = 30% SM: 70%TM, 506 = 60% SM: 40%TM, 507 = 40% SM: 60% TM, 500 = 100% Vita milk (control)

Table 3 shows the vitamin content of the milk blends. Sample 501(100%SM: 0%TM) and 500 (100% Vita milk) had the highest vitamin A (41.05µg) and vitamin C (30.87mg/100g) values respectively. Sample 502 (0%SM: 100%TM) had the highest vitamin E (5.22mg/100g) and B2 (20.43) values, while 504 (70%SM: 30%TM) had the highest vitamin B3 value (81mg/100g).

**Table 3 Vitamins composition of milk blends produced from soybeans and tiger nuts supplemented with date palm fruit syrup (mg/100g)**

Samples	Vitamin A (µg)	Vitamin C (mg/100g)	Vitamin E (mg/100g)	Vitamin B1 (mg/100g)	Vitamin B2 (mg/100g)	Vitamin B3 (mg/100g)
500	40.52 <sup>b</sup> ±0.01	30.87 <sup>a</sup> ±0.01	4.97 <sup>e</sup> ±0.01	0.13 <sup>b</sup> ±0.01	0.05 <sup>g</sup> ±0.01	0.17 <sup>f</sup> ±0.01
501	41.05 <sup>a</sup> ±0.02	26.17 <sup>d</sup> ±0.01	5.17 <sup>bc</sup> ±0.01	0.17 <sup>g</sup> ±0.01	0.05 <sup>g</sup> ±0.01	0.15 <sup>f</sup> ±0.01
502	0.58 <sup>h</sup> ±0.01	28.52 <sup>b</sup> ±0.03	5.22 <sup>a</sup> ±0.01	30.05 <sup>b</sup> ±0.01	20.43 <sup>a</sup> ±0.01	0.03 <sup>g</sup> ±0.01
503	21.32 <sup>e</sup> ±0.01	27.48 <sup>c</sup> ±0.01	5.20 <sup>ab</sup> ±0.01	32.02 <sup>a</sup> ±0.01	10.27 <sup>d</sup> ±0.01	0.72 <sup>b</sup> ±0.01
504	30.27 <sup>c</sup> ±0.01	21.26 <sup>g</sup> ±0.01	5.02 <sup>d</sup> ±0.01	5.08 <sup>e</sup> ±0.01	4.27 <sup>e</sup> ±0.01	0.81 <sup>a</sup> ±0.01
505	10.05 <sup>f</sup> ±0.01	24.12 <sup>e</sup> ±0.01	5.15 <sup>c</sup> ±0.01	18.01 <sup>c</sup> ±0.01	13.21 <sup>b</sup> ±0.01	0.23 <sup>d</sup> ±0.01
506	26.42 <sup>d</sup> ±0.01	18.51 <sup>h</sup> ±0.01	4.87 <sup>f</sup> ±0.01	4.86 <sup>f</sup> ±0.01	3.93 <sup>f</sup> ±0.01	0.67 <sup>c</sup> ±0.01
507	8.83 <sup>g</sup> ±0.01	23.78 <sup>f</sup> ±0.01	4.88 <sup>f</sup> ±0.01	16.58 <sup>d</sup> ±0.01	11.94 <sup>c</sup> ±0.01	0.19 <sup>e</sup> ±0.01

Values are mean, ±SD of duplicate determinations; Means with similar superscript (a to f) in the same column are not significantly ( $P < 0.05$ ) different; 501 = 100% SM: 0% TM, 502 = 100% TM: 0%SM, 503 = 50%SM: 50%TM, 504 = 70% SM: 30%TM, 505 = 30% SM: 70%TM, 506 = 60% SM: 40%TM, 507 = 40% SM: 60%TM, 500 = 100% Vita milk (control)

Table 4 presents the phytochemicals and anti-nutrient content of the milk blends. Phytates (0.46mg/100g), tannin (0.63mg/100g), and alkaloids (1.79mg/100g) were significantly higher in sample 501 (100% Soy

milk), while samples 502 (0%SM: 100%TM) had the highest oxalates (2.72mg/100g), and saponins (0.51mg/100g) values.

**Table 4 Phytochemicals and anti-nutrients and composition of milk blends produced from soy beans and tiger nuts supplemented with date palm fruit syrup (mg/100g)**

Samples	Phytates	Oxalate	Saponin	Tannin	Alkaloids
500	0.01 <sup>f</sup> ±0.00	0.03 <sup>g</sup> ±0.01	0.05 <sup>g</sup> ±0.01	0.22 <sup>d</sup> ±0.01	0.13 <sup>g</sup> ±0.01
501	0.46 <sup>a</sup> ±0.01	0.03 <sup>g</sup> ±0.01	0.13 <sup>f</sup> ±0.01	0.63 <sup>a</sup> ±0.01	1.79 <sup>a</sup> ±0.01
502	0.03 <sup>f</sup> ±0.01	2.72 <sup>a</sup> ±0.01	0.51 <sup>a</sup> ±0.01	0.53 <sup>c</sup> ±0.01	1.49 <sup>f</sup> ±0.01
503	0.26 <sup>c</sup> ±0.01	1.39 <sup>d</sup> ±0.01	0.32 <sup>c</sup> ±0.01	0.58 <sup>b</sup> ±0.02	1.64 <sup>d</sup> ±0.01
504	0.34 <sup>b</sup> ±0.01	0.82 <sup>f</sup> ±0.01	0.24 <sup>e</sup> ±0.01	0.59 <sup>b</sup> ±0.01	1.71 <sup>b</sup> ±0.01
505	0.17 <sup>e</sup> ±0.01	1.92 <sup>b</sup> ±0.01	0.39 <sup>b</sup> ±0.01	0.58 <sup>b</sup> ±0.01	1.59 <sup>e</sup> ±0.01
506	0.29 <sup>c</sup> ±0.01	1.11 <sup>e</sup> ±0.01	0.28 <sup>d</sup> ±0.01	0.59 <sup>b</sup> ±0.01	1.67 <sup>c</sup> ±0.01
507	0.21 <sup>d</sup> ±0.01	1.64 <sup>c</sup> ±0.01	0.37 <sup>b</sup> ±0.02	0.56 <sup>bc</sup> ±0.01	1.61 <sup>e</sup> ±0.01

Values are mean, ±SD of duplicate determinations; Means with similar superscript (a to f) in the same column are not significantly ( $P < 0.05$ ) different; 501 = 100% SM: 0% TM, 502 = 100% TM: 0%SM, 503 = 50%SM: 50%TM, 504 = 70% SM: 30%TM, 505 = 30% SM: 70%TM, 506 = 60% SM: 40%TM, 507 = 40% SM: 60%TM, 500 = 100% Vita milk (control)

The sensory attributes of milk blends produced with soybeans and tiger nuts supplemented with date palm fruit syrup are shown in Table 5. Color scores (7.10 and 7.100) of milk blends produced from 504 (70%SM: 30%TM) and 505 (30%SM: 70%TM) were

comparable to 8.70 obtained for the control (100% vita milk). Values obtained for flavor (7.00), taste (6.95), mouth feel (6.65), and general acceptability (6.93) of sample 505 (30%SM: 70%TM) were also comparable to the control (100% Vita milk).

**Table 5 Sensory properties of milk blends produced from soybeans and tiger nuts supplemented with date palm fruit syrup**

Samples	Color	Flavor	Taste	Mouth feel	General acceptability
500	8.70 <sup>a</sup> ±0.66	8.15 <sup>a</sup> ±0.93	8.20 <sup>a</sup> ±1.28	7.95 <sup>a</sup> ±1.28	8.25 <sup>a</sup> ±0.94
501	6.90 <sup>b</sup> ±1.74	5.45 <sup>c</sup> ±1.79	5.00 <sup>c</sup> ±1.69	4.65 <sup>c</sup> ±1.39	5.50 <sup>c</sup> ±1.25
502	6.55 <sup>b</sup> ±1.64	6.80 <sup>b</sup> ±1.47	6.80 <sup>b</sup> ±1.47	6.60 <sup>b</sup> ±1.39	6.69 <sup>b</sup> ±1.32
503	6.35 <sup>b</sup> ±1.23	6.35 <sup>bc</sup> ±1.14	6.50 <sup>b</sup> ±1.43	6.00 <sup>b</sup> ±1.45	6.30 <sup>b</sup> ±1.07
504	7.00 <sup>b</sup> ±1.08	6.50 <sup>b</sup> ±1.05	6.20 <sup>b</sup> ±1.40	6.25 <sup>b</sup> ±1.12	6.49 <sup>b</sup> ±0.95
505	7.10 <sup>b</sup> ±1.41	7.00 <sup>b</sup> ±1.30	6.95 <sup>b</sup> ±1.43	6.65 <sup>b</sup> ±1.79	6.93 <sup>b</sup> ±1.33
506	6.65 <sup>b</sup> ±1.23	6.25 <sup>bc</sup> ±1.41	6.45 <sup>b</sup> ±1.50	6.45 <sup>b</sup> ±1.47	6.45 <sup>b</sup> ±1.19
507	6.75 <sup>b</sup> ±1.68	6.75 <sup>b</sup> ±1.71	6.95 <sup>b</sup> ±1.82	6.85 <sup>b</sup> ±1.66	6.83 <sup>b</sup> ±1.39

Values are mean, ±SD of duplicate determinations; Means with similar superscript (a to f) in the same column are not significantly ( $P < 0.05$ ) different; 501 = 100% SM: 0% TM, 502 = 100% TM: 0%SM, 503 = 50%SM: 50%TM, 504 = 70% SM: 30%TM, 505 = 30% SM: 70%TM, 506 = 60% SM: 40%TM, 507 = 40% SM: 60%TM, 500 = 100% Vita milk (control)

## DISCUSSION

Dry matter, moisture, and energy were quantitatively the major components of the milk beverages. The variability in the proximate composition of the milk blends could be attributed to their different formulations. The high protein content observed in sample 503 (50%SM: 50%TM) could be attributed to the equal proportion of the base materials (soybeans and tiger nuts) which are good sources of protein. Soybeans and tiger nuts are good sources of plant proteins [1, 19]. In this study protein value (4.73 to 6.96%) was lower compared to 7.95% and 8.07 to 8.90% protein reported for tiger-soy and tiger nut-coconut milk beverages respectively [20, 1]. This may be due to differences in recipe and processing methods employed in the different studies. Daily consumption of these milk blends could contribute to a reduction in protein malnutrition. This study had a moisture range above 6.69% reported for cow milk [21], below 89.19 to 93.29% for soy milk [22], and comparable to 73.57% for fresh coconut milk [23]. The difference in these studies could be attributed to differences in the food materials used and methods of processing employed. The moisture contents of the milk beverages could be used to quench thirst, but since they were above 14%, they are highly perishable and as such requires proper preservation to maintain food safety. The fat content (4.37 to 24.40%) of the beverages will ensure the absorption of fat-soluble vitamins, although they were lower than 27.22%, and comparable to 0.79 to 24.00% reported for tiger nut-soy milk [20], and tiger nut-coconut milk [24] respectively. High-fat content is an indication that a product will be vulnerable to rancidity. Ikujenlola et al. [25] discoursed that the reduced shelf life of milk is due to the rancidity of fat. This study had higher carbohydrate values than 1.31 to 2.48% reported for tiger nut-soy milk [26], 1.99 to 2.69% fat in soy milk stored at different temperatures [22], but below 4.80% fat in tiger nuts milk [20]. These disparities could be attributed to the differences in the methods of preparation or the varieties of raw materials used. Milk and blends have relatively low fibre contents. The study milk samples had similar crude fibre content except for samples 500 (100% Vita milk) and 505 (30%SM: 70%TM) which were significantly different from each other at  $P < 0.05$ . The low crude fibre contents of the study samples are due to the extensive removal of the fibre during sieving and could be compared to 0.24% reported for tiger nut-soy milk [20], but lower than 0.39 to 0.53% obtained for tiger nut-soy milk [26], and 0.70% obtained for coconut milk [24]. These variations could be due to the nature of the food materials used, the level of sieving/milling, and the processing methods employed. Ash content of food is an indication of its mineral value. This study ash content range (0.43 to 0.68%) was greater than 0.23 to 0.50% and 0.22 to 0.41% reported for tiger nut-soymilk, and soy milk stored at different temperatures [26, 22] respectively.

Low dry matter is characteristic of water-based products. This study's dry matter content differed from 7.73 and 8.37% obtained in tiger nut-soy milk [1]. The milk blends had a higher energy value than the control, but comparable to 100.542 and 388.30Kcal reported for soymilk, and tiger nut milk [1], and 295Kcal for tiger nut-soy milk [20]. These differences have already been attributed to different processing methods, blending formulation, and the nature of the food materials used.

There were significant variations in the mineral contents of the milk samples. Magnesium was the most predominant mineral in the milk samples, followed by potassium and sodium. Magnesium is very essential in growth, fat metabolism, and the central nervous system [27]. The milk samples had significantly higher iron and zinc content than the control (factory-made 100% soy milk) which had higher calcium, magnesium, potassium, and sodium content. The potassium and sodium ratio of sample 502 (100%TM:0%SM) is noteworthy as it is  $< 1$ . Weaver [28] reported that the potassium and sodium ratio  $< 1$  is implicated in salt-sensitive individuals. Although comparable to that reported in [29], this study's calcium value was above 6.5mg/100g in rice milk and below 16.0mg in coconut milk [24]. These ranges were lower than the International Dairy Federation [30] recommended dietary intake (RDI) for whole milk but could contribute to daily intake. The study samples' sodium range was lower than 20.22mg in coconut milk [31], and above 0.18 to 0.29mg in tiger nut milk [26]. The observed differences had already been attributed to variations in materials and processing methods used. Zinc and iron are very important for protein, growth, and collagen formation, and with hemoglobin, and myoglobin contributes to oxygen metabolism [32].

The study samples had significantly high vitamin content. In this study, the vitamin value of soymilk was greater than that of tiger nuts, and not in conformity with Awonorin and Udeozor [26] which had higher vitamin A values than soy milk. This could be attributed to differences in composition and blending formula. The vitamin C content of the blends was significantly high and can contribute 24.7 to 41.6% of RDI for adolescents 75mg [33]. Vitamin B1 and B2 values in the study's soy milk were different from 0.58 to 0.074mg and 0.062 to 0.085mg in soy milk reported [34].

The anti-nutrients composition of the milk samples was significantly varied and low. Anti-nutrients at levels less than 5.00mg/100g are within safe limits [35] and regarded as phytochemical. The phytochemical variations in the milk samples have been attributed to differences in quantities found in grains, nuts, and seeds used, depending on growing conditions, harvesting techniques, processing, and testing methods as well as maturity stage [36]. The phytate contents of the milk samples were at variance with 2.40mg and 2.35mg in tiger nut milk reported

[37, 38] respectively. This could be due to the nature of the raw materials used and the variations inherent in the chemical properties. Phytates are chelating agents that reduce the bioavailability of cations like calcium [39]. The study recorded higher oxalate values than 0.60mg in tiger nut milk as reported [38], but below the lethal level (3 to 4mg) in men [40]. Saponins are known to inhibit the activities of enzymes responsible for protein digestibility [41]; the study's lower values of saponins implied that the protein contents in the milk samples would be readily available. Nwaiquikpe et al. [38], had higher saponins (0.76mg) value in tiger nut milk than the present study. The saponin content could contribute to antimalarial activity and cytotoxic effect as reported [42 - 44]. Tannin in the milk blends was lower than 9.62mg reported for tiger nut milk [37]. Safe range of tannin is 0.15 to 0.20mg [35]. Alkaloids over 20mg/100g have been shown to possess toxicological effects [45]. The milk blends contained alkaloids that constitute heterocyclic nitrogen with medicinal properties [46 -50].

The flavor of products determines the likeness level [51]. The color, flavor, taste, and mouth feel of the factory made vita milk (control) were more acceptable to the panelists probably due to familiarity with the product. The acceptability of the blends on a nine-point hedonic scale was appreciable considering they are new products.

## CONCLUSION

The study underscored information on the chemical composition of the milk samples produced from soy milk and tiger nut blends supplemented with date palm. These chemical components would be essential for maintaining good health. The appreciable content of crude protein, energy, iron, zinc, calcium, ash with subsequent high mineral values, vitamin B1, B2, and E as well as some phytochemicals will improve nutrient intakes on daily consumption. The lower sodium level of the milk samples suggests a good choice for hypertensive patients.

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