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Vitamins & Minerals Determination on Therapeutic Yoghurt Produced from Tigernut and Coconut Milk Flavored with Pineapplejuice

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ABSTRACT: Tigernut (*Cyperusesculentus*) and Coconut (*Cocosnucifera*) milk were used to produce Therapeutic yoghurts in the following percentage blend ratios; 75% Tigernut milk: 25% coconut milk (75% TM: 25%CM), 25% Tigernut milk: 75% coconut milk (25% TM: 75%CM), 50% Tigernut milk: 50% coconut milk (50% TM: 50%CM), 100% Tigernut milk (100% TM), 100% Coconut milk (100%CM), and 100% Cow milk (100% CMY) used as control. The following were carried out on the samples; Vitamins and Minerals content analyses. The Mineral content,100% TMY had high amount of calcium (60.69mg/100g), iron (1.91mg/100g), zinc (1.95mg/100g).. The Vitamin content of 100% CMW (Control sample) was highest compared to the other sample ratios.

KEYWORDS: Therapeutic, Yoghurt, Tigernut milk, Coconut milk, Fermentation, Mineral content, Vitamin content.

I. RELATED WORK

Milk is a good source of nutrients except iron and ascorbic acid and it has been reported by [1] to be an essential food for infants, teens and adolescents. The expensiveness of milk in developing countries has led to the discovery of alternative sources of milk from plant crops [2]. Alternatives from plant sources have been consumed for thousands of years .They resemble animal milk, contain food nutrients for infants and adult's growth and development [3].The increasing love for plant based milk alternatives is driven by different factors and consumer demand as well as health related challenges such as Lactose intolerance and animal milk allergies,[4],Consumer's concern about cow milk hormones and cholesterol,[5],ethical disputes regarding the use of animal products,[6],environmental challenges,[7] and changes in life's choices and styles towards healthier foods[8].

II. INTRODUCTION

Tigernut as reported by [9] has medicinal properties such as prevention of colon cancer, coronary heart disease, ulcer and infertility as it contains phytonutrients such as quercetin which may boost libido in men,[10]. It was also recorded by,[11] to be rich in protein content and low fibre. [12]reported it have starch 86.4 % and moisture content 5.8 %.According to [13] Tigernut contains considerable amounts of essential amino acids. It is rich in mono saturated fatty acids (MUFA) and this makes it an excellent anti- diabetic agent as MUFA diets boosts glycemic tolerance, [14].

In addition, Coconut milk which is a liquid obtained by wet milling and sieving matured coconut kernels using a milk bag. The sieviate which is creamy and white in colour contains high fat content, moderate carbohydrate and protein, [15].It helps to prevent cancer and reduce the risk of heart diseases,[16]. These plant alternatives can be used for the production of Yoghurt a fermented healthy food which has gained a worldwide acceptance due to its high digestibility and health conferring properties[17]. Yoghurt is sour and can be taken as dessert, snack or probiotic food or drink to aid digestion and also balance the micro flora within the body intestine, [18], [19]. Yoghurts are probiotic carriers and are recorded by, [20] topossess high nutritional contents of protein, calcium, fat soluble vitamins and major minerals depending on the source of their parent material. This research was aimed at showcasing the proximate, mineral and vitamin contents of the therapeutic yoghurt made from tiger nut and coconut milk at their different blends.

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III. MATERIALS AND METHODS

Tigernut (*Cyperusesculentus*) tubers, coconut (*Cocosnucifera*) and pineapple (*Ananascomosus*) were purchased in large quantity from Eke market in Afikpo in Ebonyi State.

A. **SAMPLE PREPARATION.** Samples were prepared at the Processing laboratory of the Department of Food Technology, Akanu Ibiam Federal Polytechnic Unwana, Afikpo in Ebonyi State and the analytical grade chemicals used in the bench work for the analysis of this research were from the Science Laboratory of University of Jos, Mubi and the National Root Crops Research Institute (NRCRI) Umudike in Umuahia, Abia state.

B. **RAW MATERIAL PREPARATION**. The wet samples of tiger nut tubers were sorted to remove spoilt ones, soaked in clean water for 24hours to increase their tenderness. The coconuts were removed from their husks, the kernels separated from the shell. They were washed, diced into cubes to reduce the sizes and aid their milling in the blender. The milled sample was sieved using a Muslim cloth to extract the Tigernut and coconut milk. The pineapple were washed and peeled, washed again and reduced into smaller sizes for easier blending.

C. **FERMENTATION OF TIGER NUT MILK, COCONUT MILK AND THEIR DIFFERENT BLEND RATIOS.**1 litre each of the tiger nut milk(100TM%),coconut milk (100CM%) and their different blend ratios of 25TM:75CM%**,** 75TM:25CM%, 50TM:50CM% and cow milk(100CWM%) as control were pasteurized at 65^{o}C for 30 seconds. They were cooled in a water bath to 45^{O}C and 10% sugar was added and the sample was stirred to dissolve the sugar. The temperature of the samples dropped to 43^{O}C after the sugar was introduced. 5g starter culture containing *Lactobaccilus bulgaricus*, *Lactobaccilus thermophilus* and *Lactobaccilus acidophilus* was inoculated into the different samples. The samples were covered airtight to avoid the interference with wild yeast and kept in a warm cupboard for 12-48 hours all the samples except the cow milk sample which was kept for 12 hours. At the end of the fermentation, 30ml pineapple juice was added to each of the samples of yoghurt to enhance the taste, flavor and the nutritional properties.

IV. QUALITATIVE ANALYSES DONE ON THE SAMPLES

A. VITAMIN DETERMINATION

The yoghurt samples was measured into a 250ml volumetric flask and made up with distilled water and refluxed. The mixture was centrifuged and decanted. The filtrate was filtered using HPLC filter paper. Analysis was performed by injecting 20µl of the mixture into a Buck Scientific (USA) BLC10/11- model HPLC equipped with UV 254nm detector for fat and water soluble vitamins respectively. A C18, 4.6 X 150mm, 5µm column and a mobile phase of 95.5 (methanol: water) was used at a flow rate of 1.00ml/min at ambient temperature (36^{o}c). A 0.1mg mixed standard was analysed in a similar manner for identification. Peak identification was conducted by comparing the retention times of authentic standards and those obtained from the samples concentrations which were calculated using a four point- calibration curve.

B. MINERAL DETERMINATION

The mineral analysis was carried out using the method described by [21]. 5g of the sample was weighed into a porcelain crucible and the crucible with the sample was placed in a muffle furnace. The temperature was gradually increased until it reached 550^{o}c. The sample was asheduntil a white or grey ash was observed in the crucible. The ash was dissolved by adding 2ml of conc. HNO_3 to the crucible. The dissolved ash was transferred into 100ml volumetric flask and diluted to 100ml with distilled water, agitated and filtered. The standard and unknown samples were run into an atomic absorption spectrophotometer (AAS, 650 Model) with specific lamps (for all mineral elements and heavy metals) and flame photometer for Na and K and Ca after wet digestion method. The quantity of unknown concentration was determined from the calibration curve of standards.

C. STATISTICAL ANALYSIS

The experimental design used was CRD. The nutritional data was subjected to ANOVA to determine the significant differences that existed between samples ratio blends using SPSS version 20,[24],

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V. RESULTS AND DISCUSSIONS

TABLE 2: RESULT OF THE VITAMIN COMPOSITIONS OF TIGERNUT- COCONUT YOGHURT AND THEIR BLENDS

Samples	Vitamin A (µg/100g)	Vitamin B_1 (mg/100g)	Vitamin B_2 (mg/100g)	Vitamin B_3 (mg/100g)	Vitamin C (mg/100g)
100% TM	$4.42^{a} \pm 0.01$	$0.12^{e} \pm 0.01$	$0.08^{bc} \pm 0.00$	$0.08^{b} \pm 0.01$	$0.41^{f} \pm 0.03$
100% CM	$1.18^{d} \pm 0.01$	$0.32^{b} \pm 0.02$	$0.06^{bc} \pm 0.01$	$0.12^{a} \pm 0.03$	$4.53^{b} \pm 0.01$
75TM: 25CM%	$1.11^{d} \pm 0.01$	$0.40^{a} \pm 0.00$	$0.10_{b} \pm 0.01$	$0.27^{a} \pm 0.01$	$2.72^{e} \pm 0.01$
25TM: 75CM%	$3.27^{b} \pm 0.01$	$0.19^{d} \pm 0.01$	$0.08^{bc} \pm 0.01$	$0.23^{a} \pm 0.01$	$3.65^{c} \pm 0.01$
50TM: 50CM%	$2.84^{b} \pm 0.69$	$0.27^{c} \pm 0.03$	$0.05^{c} \pm 0.01$	$0.13^{b} \pm 0.03$	$2.92^{d} \pm 0.03$
100% CMY	$2.05^{c} \pm 0.03$	$0.43^{a} \pm 0.01$	$0.53^{a} \pm 0.03$	$0.22^{a} \pm 0.03$	$8.11^{a} \pm 0.01$

Values are mean ± standard deviation of replicate determination (n=2). Means in the same column followed by different superscripts are significantly ($p<0.05$) different

Keys; 100% TM (100% Tigernut milk yoghurt)
100% CM (100% Coconut milk yoghurt)
75 TM: 2502CM% (75% Tigernut milk + 25% Coconut milk yoghurt)
25 TM: 75CM% (25% Tigernut milk + 75% Coconut milk yoghurt)
50 TM: 50CM% (50% Tigernut milk + 50% Coconut milk yoghurt)
100% CMY (100% Cow milk yoghurt)

The Vitamin A value of 100%TM 4.43 was significantly ($p<0.05$) different from the other samples. 25TM:75CM% followed closely 3.27 and 50TM:50CM% 2.84. The least vitamin A value was seen in 100% CM 1.18 and 75TM: 25CM% 1.11. These values in µg/100g were higher compared to what,[23] reported in 1µ/ml of Tigernut-coconut- cow milk yoghurts and their blends. They reported 100% tigernut milk yoghurt (TNY) 63.47, Coconut milk yoghurt (CCY) 59.68 and Cow milk yoghurt (CTY) 65.76. Vitamin A which is also known as Retinol a fat soluble vitamin is called the growth vitamin. It helps in the activation of the epithelial tissues, aids in night visions and relates to a group of antioxidants; Lack of vitamin A leads to growth impairment of the bones and skeleton as well as causes night blindness.
The vitamin B_1 value of 100% CMY 0.43 and 75TM:25CM% 0.40 were significantly ($p<0.05$) different from the other samples. 100%CM was seen next 0.31 while 100%TM 0.12 had the least vitamin B_1 value. The samples vitamin B_2 values ranges from 0.05- 0.10 except for 100% CMY 0.53 which was significantly ($p<0.05$) different from all the other samples.
Among the other samples in term of vitamin B_3, 75TM: 25CM% 0.27 and 25TM: 75CM% 0.23 and 100% CMY 0.22 were significantly ($p<0.05$) different from others. They are followed closely by 100% CM 0.12 and 100% TM 0.08.
Vitamin B_1, B_2 and B_3 are some of B- complex vitamins which are water soluble and co-enzymes. They aids the enzymes in energy production, carbohydrate metabolism and other nervous as well as cardiovascular activities,[24]
The vitamin C value of 100% CMY 8.11 was very much significantly ($p<0.05$) different from the other samples. 100% CM 4.53 was also significantly ($p<0.05$) different from the other samples except 100%CMY. The least vitamin C value was shown by 100% TM 0.41. The vitamin C content of the samples 2.72- 4.53 were in close range to what,[23] reported on the vitamin C values (4.83-5.83) of Tigernut milk-coconut milk-cow milk yoghurt and their blends. Vitamin C also known as Ascorbic acid is a water soluble vitamin which stimulates the oxidation process, production of collagen and aids in adrenal function. It also helps the body to absorb iron and calcium,[25]

TABLE 3: MINERAL COMPOSITION RESULTS OF TIGERNUT-COCONUT MILK YOGHURT AND THEIR BLENDS.

Samples	Calcium (mg/100g)	Iron (mg/100g)	Potassium (mg/100g)	Zinc (mg/100g)	Phosphorus (mg/100g)
100% TM	$60.69^{b} \pm 0.01$	$1.91^{a} \pm 0.01$	$131.62^{b} \pm 0.01$	$1.95^{a} \pm 0.01$	$10.15^{f} \pm 0.03$
100% CM	$17.16^{f} \pm 0.03$	$0.78^{bc} \pm 0.74$	$33.78^{e} \pm 0.01$	$0.13^{f} \pm 0.01$	$55.67^{a} \pm 0.03$
75TM:25CM%	$60.92^{a} \pm 0.03$	$0.83^{bc} \pm 0.01$	$77.84^{d} \pm 0.01$	$0.83^{d} \pm 0.01$	$35.43^{c} \pm 0.01$
25TM:75CM%	$51.19^{c} \pm 0.02$	$1.13^{b} \pm 0.03$	$132.47^{a} \pm 0.01$	$1.10^{b} \pm 0.01$	$23.59^{d} \pm 0.01$

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50TM:50CM%	$38.92^{d} \pm 0.01$	$1.08^{bc} \pm 0.01$	$83.75^{c} \pm 0.02$	$1.04^{c} \pm 0.01$	$32.92^{c} \pm 0.03$
100% CMY	$17.94^{e} \pm 0.02$	$0.32^{c} \pm 0.03$	$26.12^{f} \pm 0.01$	$0.25^{e} \pm 0.03$	$14.37^{e} \pm 0.03$

Values are mean ± standard deviation of replicate determination (n=2). Means in the same column followed by different superscripts are significantly ($p<0.05$) different

Keys; 100% TM (100% Tigernut milk yoghurt)
100% CM (100% Coconut milk yoghurt)
75 TM: 25CM% (75% Tigernut milk + 25% Coconut milk yoghurt)
25 TM: 75CM% (25% Tigernut milk + 75% Coconut milk yoghurt)
50 TM: 50CM% (50% Tigernut milk + 50% Coconut milk yoghurt)
100% CMY (100% Cow milk yoghurt)

The calcium value of 75TM: 25CM% sample 60.92 was significantly ($p<0.05$) different from other samples. This was followed by 100%TM 60.69 and 25TM:75CM% 51.19 was closely following. The least value of calcium was seen in 100%CM 17.16. All the samples showed significant iron content with 100%TM 1.91 being significantly ($p<0.05$) different from all the other samples. The presence of minerals such as iron in food is highly important due to its requirement in blood formation and clotting; almost two third of iron in the body is found in the haemoglobin which helps to carry oxygen to the body tissues,[26] (National Institute of Health, 2013). The World Health Organization considers iron deficiency as the number one disorder in the world,[27].

The potassium value of 25TM:75CM% sample 132.47 was significantly ($p<0.05$) different from the other samples. 100%TM followed closely 131.62. The least potassium value was seen in 100% CMY. The presence of potassium and calcium in Tigernut are adequate for bone and teeth development in infants,

The zinc value of 100%TM sample 1.95 was significantly ($p<0.05$) different from all the other samples. 25TM:75CM% 1.10 was also significantly ($p<0.05$) different from 75TM:25CM% 0.83 and 50TM:50CM% 1.04. The lowest zinc value was seen in 100%CM 0.13.

However the least iron 0.32 and zinc 0.25 were close to what,[28] reported iron 0.65- 0.80 and zinc value 0.01 of two varieties of Tigernut flours. Zinc is a mineral element which helps the body's immune system to properly work by liberating stored vitamin A in the liver. It also serves as a co-enzyme in the breakdown of carbohydrate, protein and fat to produce energy and also plays a role in cell division, growth and wound healing by producing heme from hemoglobin [29]

The phosphorus content of 100%CM 55.67 was significantly ($p<0.05$) different from all the other samples while 100%TM 10.15 had the least value compared to the other samples. Phosphorus is part of the DNA (Deoxyribonucleic acid) and RNA (Ribonucleic acid) of every cell and thus is essential for growth and renewal of tissues. It is a critical buffer which helps to maintain the acid-base balance of cellular fluid and it assists many enzymes and vitamins in extracting the energy from nutrients, [29]

VI. CONCLUSION

At the end of this research, it was found out through careful production and analyses that 100% Tigernut milk (100%TM) had better sensory characteristics than the other sample ratios while the physico-chemical properties of 75% Tigernut: 25% coconut milk (75TM:25CM %) blend ratio and 100% cow milk were the best among the sample ratios.

Conclusively, this research had exposed the therapeutic potentials of Tigernut and coconut milk in yoghurt production as well as the different percentage blend ratios best for sensory, essential amino acid and physico-chemical characteristics determinations. It is recommended that more research be done on other percentage blend ratios of Tigernut and coconut milk for therapeutic yoghurt production.

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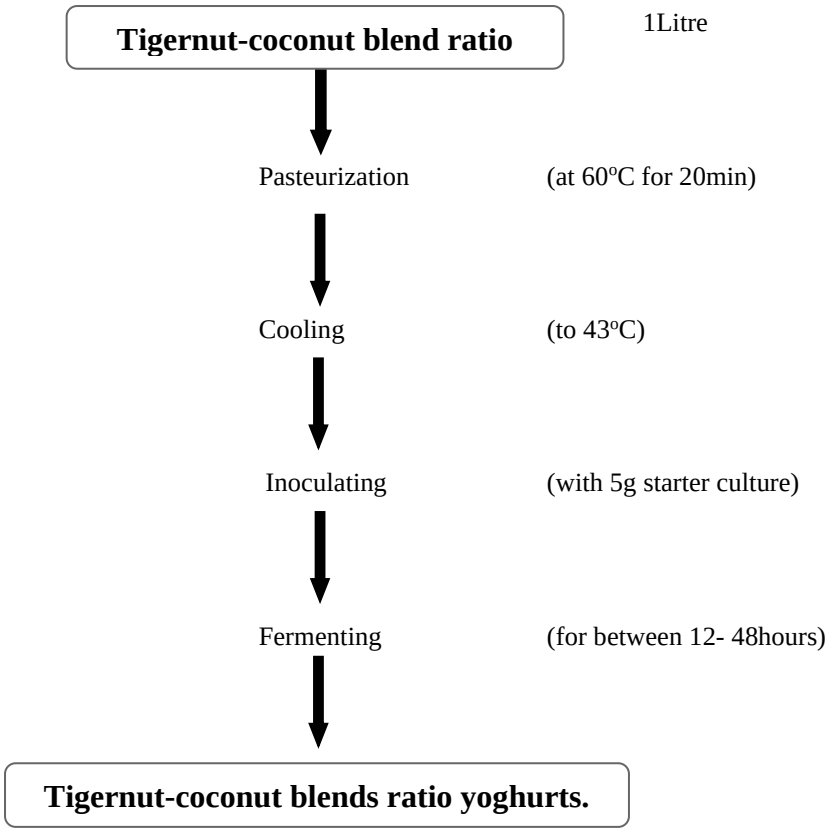

Fig. 1: Flowchart for the production of Tigernut-coconut yoghurt blend

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