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Physicochemical Properties and Sensory Evaluation of a Plant-Based Yoghurt Produced from Blends of Tiger Nut, Coconut and Dates

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Abstract: Plant based yoghurt was produced from blends of tiger nut, Coconut, and Date milk and fermented with Lactobacillus bulgaricus and Streptococcus thermophilis. Fourteen (14) experimental runs were carried out using Response Surface methodology (Face Centered Central Composite Design). An optimized milk blend with the ratio 0.167 Coconut, 0.667 Tiger nut, 0.167 Dates was used to achieve the desired product. The produced yoghurts were evaluated for proximate content, physiochemical such as PH, titratable acidity, sugar brix, and sensory characteristics. Results of the proximate content revealed that the plant -based milk blends gave high values for moisture (78.4 – 81.8%) as expected from liquid products. Ash content of the 14 extracts ranged from 0.29 to 0.40%. Protein content was generally low, ranging from 2.28 to 4.00% in all samples. Fat was appreciable in some samples about 5.6% and as low as 2.73% in sample 9 (1.0 A). Carbohydrate content ranged from 9.02% to 13.77%. pH analysis of all milk blends revealed various levels ranging from 5.77 to 7.01. Brix values obtained in this study showed that highest Brix values were seen in Blends 2 (0.167A, 0.167B & 0.667C), 1 (1.0 C), 13 (1.0 B) and 5 (0.667A, 0.167B & 0.167C) with Brix value 38.9, 37.5, 34.42, 31.3 respectively. There were significant ($P<0.05$) differences in taste and sweetness across the 14 samples for sensory evaluation.

Keywords: Yoghurt, Tiger Nut, Coconut, Dates

1. Introduction

Yoghurt is a fermented milk product with bacterial cultures - *Lactobacillus bulgaricus* and *Streptococcus thermophiles* resulting in the reduction of pH and development of pleasant organoleptic properties [1]. Plant-based yogurts represent an important segment among the dairy-free alternatives, meeting the needs of many consumers, such as those with dairy allergies and ethical concerns. Plant-based yogurts are generally made by fermenting aqueous extracts obtained from different raw materials such as legumes, oil seeds, cereals or pseudo-cereals [2]. These extracts have appearance and consistency similar to cow's milk resulting from the breakdown and homogenization of the parent materials [3]. Manufacturers can improve plant milk's sensory properties and consumer acceptability by combining two or more plant materials to leverage their different physicochemical and sensory properties [4]. In order to satisfy consumers and the market need and competition, yoghurt has been continuously modified to meet up with better sensory, keeping quality, and nutritional potentials of the final product. The most considered sensory attributes of yoghurt quality that ultimately decide the consumer acceptance are mouthfeel, flavor, and texture.

The findings of a study revealed that the sensory characteristics of some plant-based yoghurts were similarly rated as their dairy-based products counterparts; and allowed the identification of critical quality attributes of plant-based products and highlighted relationships between such features and formulation which would be used in future product development [5].

'Kunnu aya' is a typical refreshing beverage in Nigeria made from a mixture of tiger nuts, coconuts, and dates. The low keeping quality of 'kunnu aya' aroused the interest in yoghurt production since fermentation provides an acidic environment that can prevent spoilage. The combination of tiger nuts, coconuts, and date fruits should increase the yoghurt's aesthetic and sensory value produced from the blend [6].

Soybean has over the decade become the popular plant-based source used for yogurt production, soybean because of its protein quantity and functional properties. However, while soy has been the most widely used substrate in the production of plant-based yogurts, currently other substrates are in development, one of such is derived from coconut. Coconut and tiger nut was studied singly and in combination with cow milk, and pH ranged from 3.9 – 4.3; protein content from 2.66% - 3.78%; Titratable acidity from 0.5 – 0.75, but there was no difference organoleptically between the blends with plant material and the cow milk yoghurt; feasibility of the product and potential economic input was also revealed [7].

The physical properties are a critical aspect of yoghurt's quality and overall sensory consumer acceptability. They include the lack of perceived whey separation, and the stabilizers can be employed in yoghurt production to improve the body and texture of yoghurt. Yoghurt firmness is greatly enhanced by the use of stabilizers, preventing separation of the whey and help keep the fruit uniformly mixed in together, in the case of fruit yoghurt. In some cases, to improve the product's aesthetics and provide variety to the consumer, certain other ingredients are used, such as sweeteners, flavors, and fruits [8]. Some conditions like high temperature and humidity shorten plant milk shelf life mainly due to starch gelatinization [9], making it a serious concern to pasteurize the tiger nut milk blend and prolong its shelf-life. Most times, no heat treatment is given to tiger nut milk after production, bringing about significant microbial contamination of tiger nut milk [10, 9]. Hence, while a Combinations of gelling agents (e.g., natural gums, proteins, starches, pectin and agar) are often used in the food industry may provide gel-type food products (e.g., yogurts and puddings) with acceptable texture.

There is a need to consider the sensory and related quality attributes of these types of food products. The aim of this study was to determine the physicochemical and Sensory Evaluation of the plant based Yoghurt Milk Blend made from Tiger nut, Coconut and Dates.

2. Materials and Methods

2.1. Culture Preparation

Bacterial strains (*Lactobacillus bulgaricus* and *Streptococcus thermophiles*) were isolated and further confirmed using biochemical methods at the Sheda Science and Technology complex, Abuja. The bacterial strains were streaked severally after which a distinct colony was sub-cultured into a sterile MRS agar slant, incubated at 40°C anaerobically for 18 hours. They were stored under sterile glycerol in the 4°C in the refrigerator for further use.

2.2. Experimental Design

The experiment was a Response Surface Methodology (Face Centered Central Composite Design). The design was generated using Design Expert (Version 8.7.1.0). The design key shows the actual values as in Table 1 shows the 14 runs and the actual values of each of the three process variables (inoculums concentration, incubation time and incubation temperature represented as A, B and C respectively.

2.3. Statistical Analysis of the Data

Statistical analysis of results generated from analyses was carried out for proximate composition and sensory evaluation data. The results were also analyzed using statistical software (Design Expert version 8.0.3, State – Ease, Inc. Minneapolis, 2010). Model significance ($p< 0.05$), lack of fit ($p>0.05$) and adjusted regression coefficient (Adj.R^2) which indicate the model fitness were considered before fitting response into models.

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_{12} x_1 x_2 + \beta_{13} x_1 x_3 + \beta_{23} x_2 x_3 + \beta_{123} x_1 x_2 x_3 + \beta_{11} x_1^2 + \beta_{22} x_2^2 + \beta_{33} x_3^2$$

Where Y is the predicted response, β_0 is the constant, β is the parameter estimate (coefficient) for each linear and cross product terms for the prediction model. x_1, x_2, x_3 are the linear terms for coconut, tiger nut, date, and their respective cross product terms.

Table 1. *Experimental design showing the plant milk samples and their mixture components.*

Samples	Coconut milk	Tigernut milk	Date extract
1	0.000	0.000	1.000
2	0.167	0.167	0.667
3	0.167	0.667	0.167
4	0.500	0.500	0.000
5	0.667	0.167	0.167
6	0.000	1.000	0.000
7	0.333	0.333	0.333
8	0.000	0.000	1.000
9	1.000	0.000	0.000
10	0.500	0.000	0.500
11	0.500	0.500	0.000
12	0.000	0.500	0.500
13	0.000	0.100	0.000
14	1.000	0.000	0.000

2.4. Production of the Probiotic Yoghurt from the Optimized Milk Blend

The production of the yoghurt as shown in Figure 1. was carried out according to the procedure of Tamime and Robinson [11]. The optimized milk blend with the ratio 0.167 (Coconut), 0.667 (Tiger nut), 0.167 (Date) was used in yoghurt production. The milk was freshly prepared and pasteurized at 70°C for 30 min, it was thereafter transferred into the biosafety cabinet and allowed to cool to 45°C before inoculating it with the isolated strains (*Lactobacillus bulgaricus* and *Streptococcus thermophiles*) confirmed during the preliminary investigation of this study at the chosen concentration of 0.05, 1.02, and 2.0, then transferred into the fermentation jar and incubated anaerobically at the corresponding temperature of 37, 41, and 45°C and time of 14, 16, and 18hr (Table 1). The yoghurt produced was stored in a refrigerator at 4°C for sensory evaluation and further analyses.

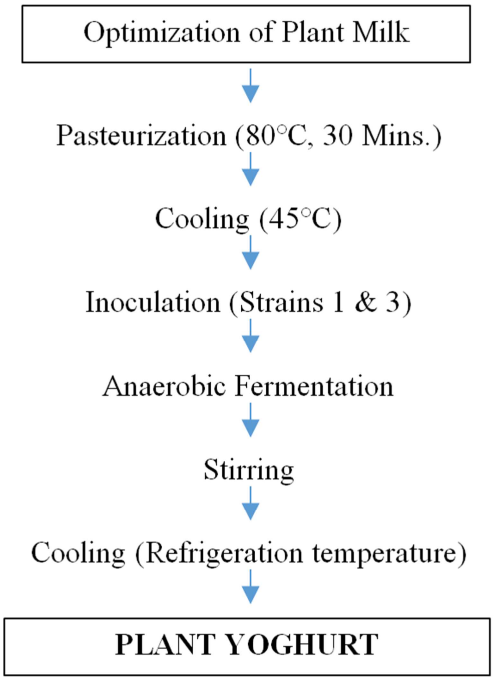

Figure 1. *Flowchart for production of Yoghurt.*

3. Proximate Content Determination

3.1. Determination of Moisture Content

Moisture content was determined in accordance with AOAC methods [12]. An aliquot of about two milliliters (2 ml) of the sample was weighed into a moisture can and kept in an air current oven at a temperature of 105°C for 3h. The can was then removed from the oven, cooled in a desiccator and weighed. This was repeated until a constant weight was obtained. The difference in weight was used to calculate the moisture content.

$$\%\ \text{Moisture content} = \frac{Wt\ of\ water\ loss}{wt\ of\ sample} \times \frac{100}{1}$$

3.2. Determination of Ash Content

The ash content of the processed samples was determined according to the method described by AOAC [12]. Three milliliters [3 ml] of each of the milk/yoghurt samples were weighed into crucibles of known weights respectively. The samples were ignited at 550°C for 3h in a muffle furnace (SXL). The crucibles were then transferred to desiccators to cool for 30min before weighing. The percentage ash in the sample was calculated as follows:

$$\%\text{Ash} = \frac{Wt\ of\ crucible\ ash - wt\ of\ crucible\ water\ loss}{sample\ weight} \times \frac{100}{1}$$

3.3. Determination of Fat Content

The crude fat was determined using the Rose-Gotlieb method according to AOAC [12]. A sample volume of 0.5 ml was weighed, wrapped in a Whatman number 1 filter paper and extracted in the extraction unit for 3h using petroleum ether as solvent. At the end of the extraction process, the ether was evaporated and the weight of the extraction flask taken. The weight of the flask was checked before extraction and after, the difference was recorded as ether extract, this was used to calculate the fat content.

$$\text{Crude fat} = \frac{Wt\ of\ ether\ extract}{sample\ weight} \times \frac{100}{1}$$

3.4. Determination of Protein Content

Determination of crude protein content of the various blends followed the method of Association of Official Analytical Chemist [12]. A sample volume (0.5 ml) was weighed into a 100ml kjedahl flask. One and a half tablet of kjedahl catalyst and 10 ml of Nitrogen free concentrated sulphuric acid were then added.. The mixture was heated slowly for digestion in a fume cupboard with the flask placed at an angle of 40° for 30min., heating was then increased and continued until frothing ceased. The sample was allowed to cool and then transferred into a 100 ml volumetric flask and made up to volume with distilled water. A 10 ml of the digest was introduced into 100 ml Kjedahl distillation flask and 10ml of 45% NaOH was added. The ammonia liberated was steam distilled into a 5ml boric acid indicator in a conical flask until 50ml of the distillate was obtained. This was back titrated against 0.05N H_2SO_4 to give the nitrogen content of the sample. A blank determination will also be carried out and subtracted from the sample reading and the %N calculated thus

$$\text{N}(\%) = \frac{Titre - Blank\ x\ Normality\ of\ Acid\ x\ 1.4}{weight\ of\ sample} \times \frac{100}{1}$$

3.5. Determination of Carbohydrate Content

This was determined by subtracting the sum of the % crude protein, moisture, ash and fat content and subtracted from 100%.

% CHO = 100 - % crude protein + % moisture, % ash + % fat content

3.6. Determination of the pH of Yoghurt Samples

Direct measurement using a pH meter was employed to determine the pH of yoghurt samples according to AOAC [12] method. The yoghurt samples (250 mg) was placed in beakers and stirred with a magnetic stirrer, pH was measured in triplicates by pH electrode connected to an ion analyzer. Electrode calibration was done at the commencement of each assay by buffer solutions with pH 4.0, 7.0 and 9.0 as standards. Results were recorded as they appeared digitally.

3.7. Determination of Sugar Brix

Ten (10) ml aliquot of the sample was diluted with 200 ml water. A few drops of the diluted sample were dropped on the prism surface of the refractometer and the brix read. The value obtained was multiplied by the dilution factor because of the dilution made. The value obtained was expressed as percentage.

3.8. Determination of Total Solids

Total solids include water soluble and water insoluble matter. A 50 ml of milk sample was measured into an evaporating dish. The sample was evaporated at 105°C in a water bath for about 40 min. The dish and contents were dried in an oven at 105°C. The dish (and residue) was cooled in a dessicator and weighed until the difference between the two successive weightings did not exceed 1 mg. The dish and the content were also weighed [13].

$$\text{Total solids} = \frac{\text{Weight of Residue}}{\text{ml of Sample Taken}} \text{ x } \frac{100}{1}$$

3.9. Sensory Analysis of the Probiotic Yoghurt from the Optimized Milk Blend

Twenty-five trained-assessors drawn from SHESCO laboratory, Abuja, Nigeria analyzed the sensory quality of the yoghurt samples. The 7- point category scale test was used for the sensory evaluation. Their sensory scores were measured on the 7-point category scale designated: 1- dislike extremely to 7- like extremely. 7-Point Hedonic Scale: 7=Like Extremely, 6=Like Very much, 5= Like moderately, 4= neither Like nor Dislike, 3=Dislike Moderately, 2=Dislike Very Much, 1=Dislike Extremely [14]. Sample were served cold from 010, 020, up to 0140 to avoid bias. Adequate lighting was provided and water for rinsing mouth in between samples too.

The sensory qualities assessed were color, sweetness, taste, aroma, appearance and overall acceptability. All the measurements were carried out in triplicates and the means calculated. The average of the scores sensory attributes were taken and subjected to regression analysis. Furthermore, optimization of the sensory attributes was carried out to ascertain the most acceptable blend which was reproduced for probiotic yoghurt production. [15].

4. Results and Discussion

Table 2. *Proximate for the composition of milk blends from tigernut, coconut and date.*

Sample	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	CHO (%)
1	79.80^{bcde}±0.20	0.33^{b}±0.00	3.75^{c}±0.01	4.4^{c}±0.02	11.71^{f}±0.00
2	79.47^{abc}±0.47	0.39^{a}±0.01	3.13^{c}±0.03	5.62^{ef}±0.43	11.17^{e}±0.10
3	81.00^{fg}±0.40	0.31^{b}±0.12	4.00^{b}±0.10	5.63^{ef}±0.13	9.05^{a}±0.00
4	78.43^{a}±0.38	0.38^{a}±0.02	3.12^{e}±0.02	2.77^{a}±0.02	15.00^{h}±0.02
5	81.80^{g}±1.10	0.40^{a}±0.00	2.38^{f}±0.00	5.79^{f}±0.15	9.42^{bc}±0.28
6	81.00^{fg}±0.15	0.32^{b}±0.01	3.80^{bc}±0.06	5.12^{d}±0.03	10.25^{d}±0.14
7	80.00^{cde}±1.00	0.31^{b}±0.02	3.00^{e}±0.00	5.26^{d}±0.03	10.40^{d}±0.35
8	79.30^{abd}±0.58	0.33^{b}±0.02	3.50^{d}±0.16	5.52^{e}±0.18	13.60^{d}±0.45
9	79.60^{abcd}±0.30	0.29^{c}±0.02	3.13^{e}±0.03	2.73^{a}±0.03	11.25^{g}±0.20
10	81.30^{fg}+1.20	0.38^{a}±0.01	2.28^{f}±0.01	5.07^{d}±0.06	11.25^{e}±0.20
11	80.30^{cdef}±0.25	0.35^{ab}±0.02	5.00^{a}±0.00	5.63^{ef}±0.03	9.02^{a}±0.02
12	81.00^{fg}±0.76	0.40^{a}±0.01	3.32^{de}±0.07	5.54^{ef}±0.01	9.16^{ab}±0.05
13	78.70^{ab}±0.95	0.38^{a}±0.01	3.10^{de}±0.06	4.06^{b}±0.04	13.77^{g}±0.15
14	80.50^{cde}±0.45	0.33^{b}±0.01	3.13^{de}±0.12	5.60^{ef}±0.15	10.37^{d}±0.10

Values are mean scores of triplicate determinations± SD. Value with different superscript in the same column differed significantly ($P \leq 0.05$)
Key: See Table 1 for Sample 1-14 Experimental Design Blends.

The fat content of the milk samples varied distinctively among the 14 samples and ranged from 2.73% to 5.79%. Most of the samples met the required limit for fat (3%) in milk according to codex alimentarius. The composition of dairy milk to be around 87% water, 3% protein, 0.8% minerals, 4% to 5% lactose, 3% to 4% fat, and 0.1% vitamins. The fat content of the blend is similar to the report on dairy milk and can be attributed mainly to the coconut extract which is rich in fat [16]. According to a previous report, fat content is essential in yogurt for texture, appearance, flavor and taste improvement. Yoghurts are classified according to their fat content into Yoghurt (3.25% and above, Low fat Yoghurt (0.5 – 2.0% fat) and Non-fat Yoghurt (below 0.5%) according to the United States Department of Agriculture [17], Thus, the product can be classified as yoghurt. Also, this is in agreement with the Codex standard for fermented milks-adopted in 2003, which stated that 'yoghurt should have less than 15% of fat content' and the maximum fat content is 15% [1]. The composition of some of the raw materials (like coconut) used in the blend could be responsible for the high-fat content.

Carbohydrate content of the milk blend from tiger nut, coconut and date, ranged from 9.02% to 13.6%, and varied significantly. The values obtained are higher than values reported for soymilk (4.78%) and almond milk (4.50%) [18]. This higher value could be associated with the carbohydrate content of tiger nut which is mainly starch [19].

4.1. Physiochemical Properties of the Yoghurt

Table 3. *Physico-chemical properties of milk blends from tiger nut, coconut and date.*

Sample	pH	Brix	Total solids
1	6.28^{bc}±0.31	13.00^{a}±0.10	19.74^{a}±0.03
2	6.39^{bc}±0.11	12.80^{a}±0.10	19.63^{ab}±1.20
3	6.98^{a}±0.04	10.60^{b}±0.4	15.53^{d}±0.03
4	5.77^{d}±0.10	8.68^{c}±0.20	19.25^{bc}±1.00
5	6.40^{cd}±0.10	9.79^{c}±1.30	18.57^{bc}±0.14
6	6.90^{b}±0.00	8.70^{c}±0.30	18.34^{bc}±0.04
7	6.63^{bc}±0.55	9.50^{bc}±0.15	17.58^{c}±0.15
8	7.01^{a}±0.01	12.50^{a}±0.20	18.21^{bc}±0.02
9	5.78^{d}±0.01	7.60^{d}±0.10	19.59^{ab}±0.09
10	6.51^{c}±0.10	11.90^{b}±0.95	19.21^{ab}±0.01
11	6.96^{a}±0.06	8.40^{c}±0.10	18.52^{bc}±0.01
12	6.80^{def}±0.50	11.31^{b}±0.22	19.92^{c}±0.52
13	6.00^{ab}±0.20	8.42^{c}±0.40	16.94^{abcd}±5.18
14	6.90^{ef}±0.06	7.70^{c}±0.03	19.34^{bc}±0.00

Values are mean scores of triplicate determinations± SD. Value with same superscript in the same column differed significantly (P≤ 0.05)
Key: See Table 1 for Sample 1-14 Experimental Design Blends.

Following codex standards for fermented milk and yoghurt, which requires that such products exhibit a total titratable acidity value of ≤0.6% lactic acid, the values obtained for all mixed concentrations of the starter cultures fall within the acceptable limits [1]. Mixed cultures have been employed as a measure to curb high percentage acidity ≥0.6% lactic acid in yoghurt to pH reductions during yoghurt production with *Lactobacillus bulgaris* as the sole culture [20].

Brix measurement, which indicates the total soluble sugars revealed that Brix value was highest in samples with 100% date, with an initial Brix value of 13.0° Brix as shown in Table 3. The Brix value (7.72) was lowest in coconut milk. Tiger nuts had lower sugar content than those of other tubers and nuts, making them suitable for dietetics and diabetics [21]. Brix value ranged from 7.6% (sample 9) to 13.0% (sample 1) and varied significantly (P<0.05) across the blends.

4.2. Total Solids

Total solids content shows the level of suspended and dissolved solids in the plant milk, and the results showed a range of 15.53% (sample 3) to 19.92% (sample 12). The report of Mosquera, *et al.,* [22], gave a total solid value of 13.9 – 14.8%, which falls within the range reported in this study. The total solids concentration level of 24% and above would severely inhibit the growth of Lactobacillus bulgaricus [23]. However, low percentage of total solids in yoghurt could lead to a malfunction of starter culture [24]. The total solids content of milk can be increased by concentration processes, such as, evaporation under vacuum, and membrane processing (i.e., reverse osmosis and ultrafiltration) or addition of milk powder.

4.3. Sensory Evaluation of the Plant Yoghurt Color

The model should bear only the linear terms and their corresponding coefficients. The mathematical model for color is presented in equation below:

$$Color = 5.99A + 6.19B + 6.32C$$

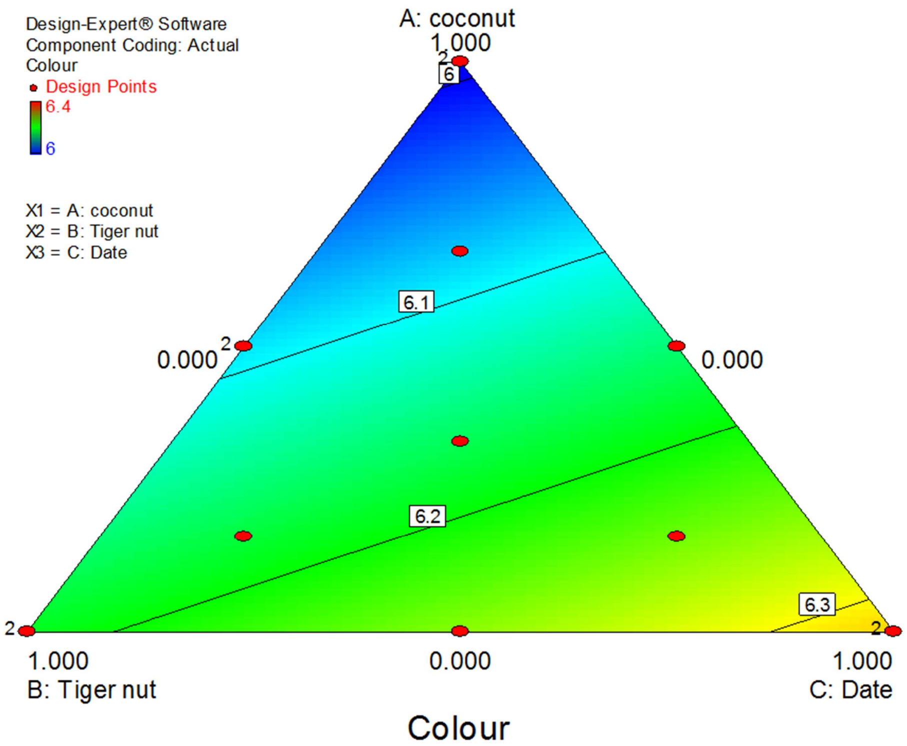

Figure 2. *Contour plot for Color.*

The contour plot of color, is shown in Figure 2 and the value of color (6.3) represents the blend of components B, Tiger nut and C, Date (0.125 and 0.90), respectively, when component A (Coconut) is set at its central value (constant). Increasing the Date from 0.625 to 0.895 and decreasing the Tiger nut from 0.875 to 0.105, while coconut was kept at a constant, marginally increased the sensory value of color from 6.2 to 6.3. The lack of fit of the model for color was insignificant and this shows that the model is correct and can be adequately used to predict the outcome of color when various ratios of the components (tiger nut, coconut and date) are blended.

Color is a very important indicator for accessing the quality of non-dairy milk products, especially from plant materials [25]. It is generally conceived that white and/or cream colored products represent the universal standard of color for dairy milk and non-dairy milk; an attribute that is determined by a cascade of enzyme reactions which, if not controlled through stringent process conditions, would lead to the development of colored pigments, usually in the form of brown, grey and black, which would be unacceptable to many consumers. Data obtained showed that a blend of tiger-nut, coconut milk and date extract (milk blend 2 and 7) depicted that a mixed ratio of each starting material produced a colored product that was acceptable.

4.4. Taste

The model should bear only the linear terms and their corresponding coefficients. The mathematical model for taste is presented in equation below.

$$Taste = 6.89A + 6.31B + 6.68C - 1.85AC - 1.54BC$$

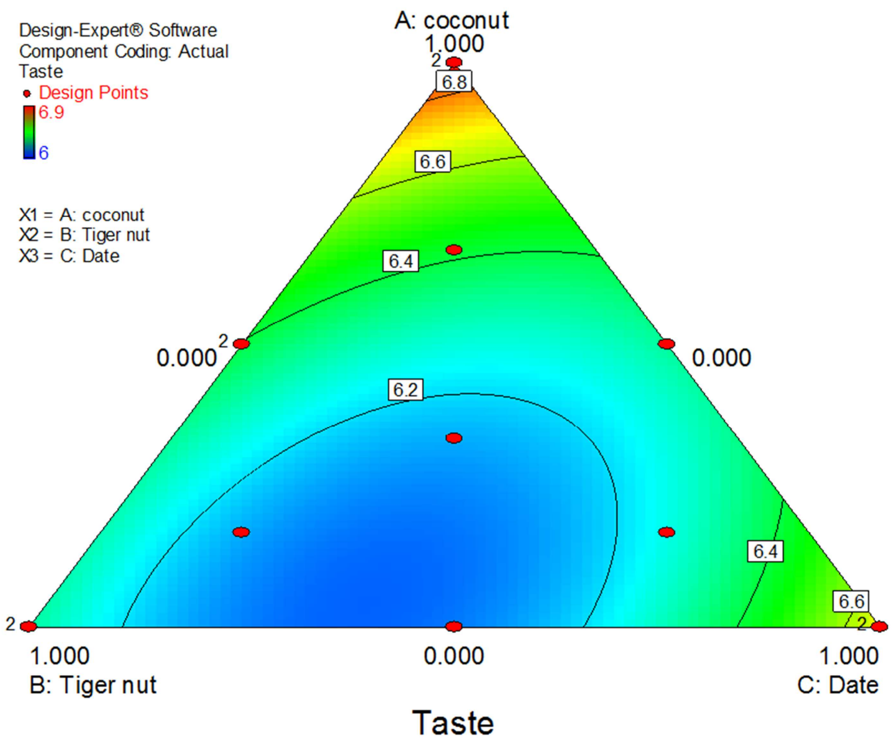

Figure 3. *Contour plot for Taste.*

Figure 3 showed the Contour plot for taste of the plant milk blend. Increasing the date from 0.875 to 0.925 and decreasing the tiger nut from 0.250 to 0.125, increased the taste from 6.4 to 6.6. The lack of fit of the model for taste was insignificant and the correlation coefficient was very high (83%).

This shows the model can be adequately used to predict the optimum ratio for blending the components (tiger nut, coconut and date) and also predict the results that can be achieved from such blending.

4.5. Sweetness

The model and the linear mixture presented significant p-value ($p<0.05$). Lack of fit was not significant ($p=0.0834$). Therefore, the model should bear only the linear terms and their corresponding coefficients as shown in Equation below.

$$Sweetness = 6.66A + 6.31B + 6.71C$$

The value of date increased from 0.48 to 0.750, and the tiger nut decreased from 0.750 to 0.250, the sweetness of the milk increased marginally from 6.4 to 6.6. The lack of fit of the model for sweetness was insignificant and this shows that the model is correct and can be adequately used to predict the outcome of sweetness when various ratios of the components (tiger nut, coconut and date) are blended.

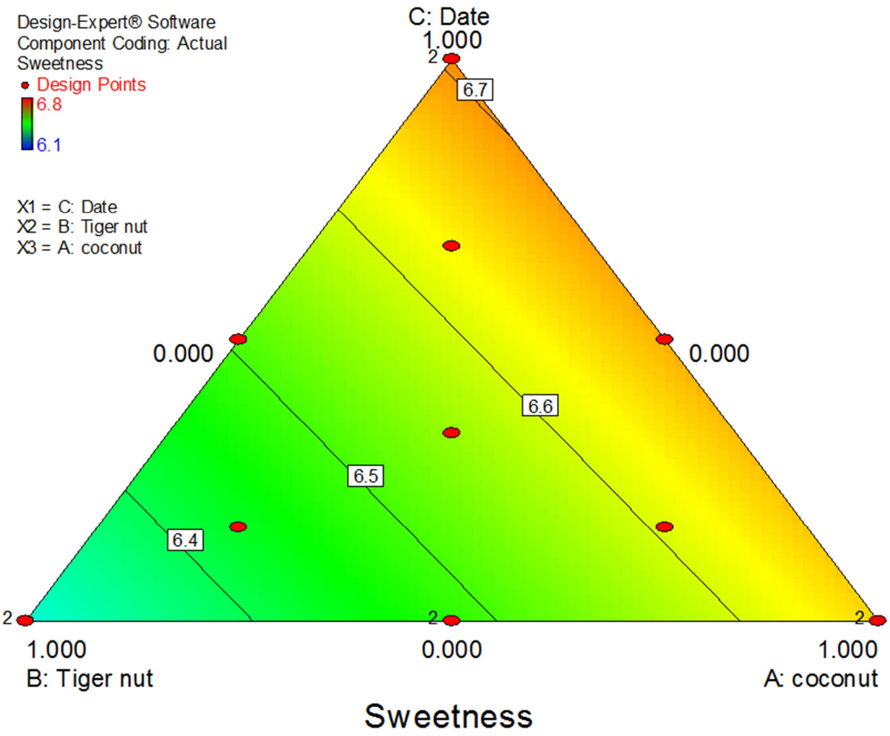

Figure 4. *Contour plot for Sweetness.*

4.6. Acceptability

In the model for acceptability, the linear mixture, BC (interaction of tiger nut and date), presented significant p-value ($p<0.05$). adjR^2 = 0.8031 (80.31%) Therefore, the mathematical model should bear those terms and their corresponding coefficients.

General acceptability = 6.36A +6.01B + 6.26C – 1.38BC

Figure 5 shows the contour plot for overall acceptability of the milk blend. From the plot, as the date fraction decreases from 0.125 to 0.375 and the coconut from 0.750 to 0.875.

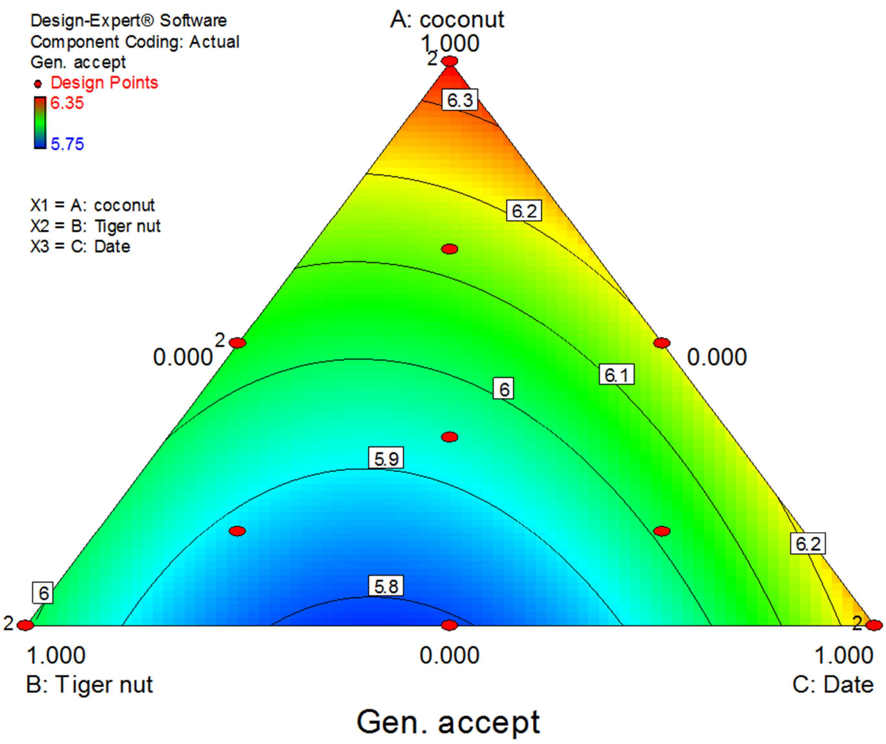

Figure 5. *Contour plot for acceptability.*

While the tiger nut is kept at its constant value, the overall acceptability increased from 6.2 to 6.3. The lack of fit of the model for overall acceptability was insignificant and this shows that the model is correct and can be adequately used to predict the outcome of overall acceptability when various ratios of the components (tiger nut, coconut and date) are blended.

The combination of tiger nuts, coconuts and date fruits can be said to have increased the aesthetic and sensory value of the yoghurt produced from the blend and this is in agreement with previous report [6]. The colors of samples 3, 6 and 8 were liked very much by the panelists while all other samples were liked moderately.

In this study, Taste and Overall acceptability were significantly different (P<0.05) in their sensory scores. This is in agreement with findings from other studies, which revealed that incubation duration, incubation temperature, and starter culture concentration are factors to consider in plant-based yoghurt production [26, 27].

5. Conclusion

The low brix values of the formulated plant based yoghurt (7.72^0) reveal the suitability of the product to be used as potential food for diabetics. The combination of tigernut, coconut and dates increased the sensory acceptability of yoghurt samples. The results obtained showed that the model can be used to predict optimum ratios for blending components and also predict results that can be obtained from such blending.

Conflict of Interest

All the authors do not have any possible conflict of interest.

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