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Original Paper

Proximate and Sensory Evaluation of Different Zobo-Moringa Blends Packaged in Tea Bags

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Abstract

Different blends of Roselle calyx and Moringa leaves (90:10%. 80:20%, 70:30%, and 50:50% respectively) were used in processing the novel instant "Zobo-moringa mix" by drying, grinding and mixing of Zobo calyx, moringa leaves, ginger, cloves and orange flavour. Various recipes were formulated using linear programming, after which sensory evaluation was carried out to obtain an acceptable formula. Dried Moringa leaves were added at different proportion by varying the amount of Zobo calyx used. All samples were packaged in teabags. Proximate analysis was carried out on the samples. The results of the proximate analysis showed that the proximate composition of the samples was significantly higher ($P < 0.05$) in protein and it increases as the proportion of Moringa increases from 2.325% to 28.05%. For the crude fiber, there was a decrease in its composition from 14.00% to 5.70% as the proportion of Moringa increases. It is significantly low in carbohydrate from 59.98% to 29.62% as the proportion of Moringa increases. The results of the sensory evaluation of the samples showed that the samples into which Moringa were incorporated were generally more accepted than the conventional Zobo sample (control).

Keywords

Zobo, Moringa, Mix, Sample, Blend

1. Introduction

The major Nigerian local beverages are burukutu (sorghum beer), kunnuzaki (millet food drink), pito (fermented alcoholic beverage from sorghum or maize), palmwine, adoyo (ripe pineapple juice and supernatant derived from ogi), ogogoro (distilled palm wine or local gin), nunu (fermented skim milk),

fura da nunu (fermented skim milk with millet dough), Zobo (extracts of calyx of *Hibiscus sabdariffa),* wara (cheese whey), etc. Zobo drink isa traditional non-alcoholic beverage which is consumed in most part of Nigeria, mostly in northern part of Nigeria (Osuntogun, 2004). The zobo drink is a red liquid drink and taste like fruit punch, served as a fair source of vitamin A, riboflavin, niacin, calcium and iron (Qi et al., 2005), and is low in sugar content. It is extracted from the dried reddish purple calyces of the plant *Hibiscus sabdriffa* (Scott, 2003). *Hibiscus sabdariffa* (Roselle) is an annual herb that is grown in the tropics and it is widely cultivated in Nigeria mainly in the Northeastern and Middle-belt regions (Bolade et al., 2009; Nwafor & Ikenebomeh, 2009; Yadong et al., 2005; and Omemu et al., 2006). Moringa Leaf powder is an excellent nutritional supplement and can be added to any dish (Fuglie, 2001).The shelf life of any drink is dependent on the packaging material used; the use of teabags proves to be a means of preventing loss of quality of products, inhibitmicrobial contamination, preventing discolouration of the drink, and above all permitting large-scale production and preservation of the beverage for a longer period with maximum retention of nutritive value (Vermeiren et al., 1999).

The production process of *Hibiscus sabdariffa* (zobo) drink has not been mechanized nor standardized and the shelf life of the drink is less than two days due to microbial attack, making it loose its physico-chemical and organoleptic quality (Nwafor & Ikenebomeh, 2009; and Olawale, 2011). This work is therefore aimed at producing instant "zobo-moringa mix" which can keep longer and can be prepared easily by extraction using hot water.

2. Materials

2.1 Sample Collection

The dried zobo calyx, moringa leaves, sweetener, flavours and other ingredient used in this work were bought from the main market (Eke-onuwa) in Owerri and transported to FUTO where the production and analysis of the product was carried out. The materials were procured in its wholesome condition and reasonable quantities.

3. Methods

3.1 Preparation of Raw Materials for the Developed Instant Zobo-Moringa Beverage

3.1.1 Processing of *Hibiscus Sabdariffa* Calyxes

The *Hibiscus sabdariffa* calyces were obtained and the dirt was sorted out by winnowing. It was mixed and dried in the oven to further reduce the moisture content. The dried calyces were then crushed to a mesh size of 200 micron and sieved. These tea size particles were then stored in an air tight vessel.

3.1.2 Processing of *Moringaoliefera* Leaves Powder

Leaves were dried at room temperature inside a room protected from light (to prevent the loss of vitamins) and protected from dust and pests (to prevent contamination). Dried leaves were made into powder using a burr mills (motor driven). The powder is sifted to remove any remaining stems. It was stored in airtight containers protected from heat, humidity and light.

3.1.3 Processing of Ginger and Cloves

The ginger bulbs were dried under sunlight and it was grounded into powder using an attrition mill. The cloves were also grounded into powder using the attrition mill. The entire grounded ingredients were stored in an air tight container, in other to prevent them from losing their volatile components.

Figure 1. Image Showing Processed Ingredients

3.2 Recipe Formulation

Linear programming is a mathematical technique used in computer simulations to find the best possible solution in allocating limited resources or ingredient to achieve maximum profit and cost. It can be applied to a wide variety of fields of study and has proved useful in planning, routing, scheduling, assignment and designing, such as transportation or manufacturing industries. This model was used to calculate the formulation needed to obtain the desired product. Five recipes were obtained and these were the result:

Table 1. Formula for Instant "Zobomix" in Teabag Derived Using Linear Programming

	Formulations in %				
INGRIDIENT	1	2	3	4	5
Roselle calyx	58.80	56.70	54.20	52.50	50.70
Ginger bulb	23.80	25.70	26.55	27.75	28.55
Cloves	12.85	13.05	14.70	15.20	16.20
Orange flavor	4.55	4.55	4.55	4.55	4.55

Table 2. Samples and Their Different Proportions

	SAMPLES				
INGREDIENTS	ZM90	ZM80	ZM70	ZM50	ZCON
Zobo	90%	80%	70%	50%	100%
Moringa	10%	20%	30%	50%	
Ginger	26.12%	26.12%	26.12%	26.12%	26.12%
Cloves	13.38%	13.38%	13.38%	13.38%	13.38%
Orange flavor	4.6%	4.6%	4.6%	4.6%	4.6%

Key; ZCON= Zobo Control, ZM90= Zobo:Moringa 90:10, ZM80= Zobo:Moringa 80:20, ZM70= Zobo:Moringa 70:30, ZM50= Zobo:Moringa 50:50

4. Proximate Analysis

The proximate analysis was carried out on the Roselle-Moringa blend. They were analyzed chemically according to the official methods of analysis described by Association of Official Analytical Chemists (A.O.A.C, 1990).

4.1 Determination of Moisture Content

The moisture content was determined by weighing out 2 g of each of the sample into a dry petri dish of a known mass, charged into the oven at temperature of 105^{o}C and heated for 3 hours. The dried samples were then withdrawn from the oven and placed in a desiccator to cool. They were weighed using the analyticalbalance (electronic) and the whole process was repeated until a constant mass was obtained. The difference in mass as percentage (% moisture) was calculated thus:

$$\%Moisture = \frac{M_2 - M_3}{M_2 - M_1} x\ 100$$

Where;

M_1 = mass of dish

M_2 = mass of dish + sample before drying

M_3 = mass of dish + sample after drying.

4.2 Determination of Crude Fat

A soxhlet extraction unit was setup with a reflux condenser. A small round bottom flask was weighed after washing and drying, and half filled with light petroleum ether (Boiling point 40-60^{o}C) and fixed into the unit. Two (2) grams of each of the samples were wrapped with a Whitman filter paper and gradually lowered into the thimble which was fitted into the cleaned, dried and weighed round bottom flask containing 120 ml of petroleum ether. Samples were slowly heated with heating mantle for 5 hours. Refluxed petroleum ether was recovered and the flask containing the fat and oil was cooled in the desiccator and reweighed after drying. By difference, the mass of oil extracted was determined and thus expressed as percentage;

$$\% \ CrudeFat = \frac{\text{mass of fat}}{\text{mass of sample}} \text{ x } \frac{100}{1}$$

4.3 Determination of Crude Protein

The Keldjhal method as described by AOAC (1990) was used. The total nitrogen was determined and 6.25 were used to multiply to obtain the protein. Two (2) grams of each of the samples was boiled in 10ml of concentrated H_2SO_4 in the presence of selenium catalyst. Boiling was done under a fume cupboard until a clear solution was formed. The digest was transferred into a volumetric flask containing a 100 ml of distilled water and 10ml of it was mixed with equal volumes of 45% NaOH solution and was poured into a Keldjhal distillate apparatus. On distillation of the mixture; the distillate was collected in a 100ml of 4% Boric acid solution containing 3 drops of a mixed indicator (methyl red and bromocresolgreen). A total of 50ml distillate was collected and titrated against 0.02N H_2SO_4 solution. Titration was done from green to a deep red end point. A reagent blank was determined as discussed above but without the sample. The protein content was calculated.

4.4 Determination of Crude Fiber

Two (2) grams of each sample were defatted and boiled in 200 ml of 1.25 H_2SO_4 for 30 minutes. The boiled samples were washed with hot water using a twofold muslin cloth to retain particles. The retained particles were returned to the flask and boiled again in 200 ml of 1.25 NaOH solution and was again washed with hot plate and allowed to dry before been transferred to the oven to dry at 105^{o}C to a constant weigh and was subsequently placed in muffle furnace at 550^{o}C for 4hours and finally cooled in a desiccator and reweigh. By difference in mass, the mass of the fiber was determined and was given by;

$$\% \ CrudeFibre = \frac{W_1 - W_2}{W_3} \ x \ 100$$

Where;

W_1 = Weight of sample before incineration

W_2 = Weight of sample after incineration

W_3 = Weight of original sample

4.5 Determination of Ash Content

Five (5) grams of the sample was put in a crucible, ignited and tarred. The crucible was placed in a drying oven at 100 ℃ for 4 hours and then transferred to a cool muffle furnace as the temperature was increased to 550 ℃ ± 5 ℃. The temperature was maintained for 8 hours until white ash was obtained. The crucible was placed in a desiccator with the aid of thongs, to cool and then weight was determined. The percentage (%) ash was calculated as thus;

$$\% \, Ash = \frac{\text{Ash}}{\text{mass of original sample}} \text{ x } 100$$

4.6 Determination of Carbohydrate

The carbohydrate content was determined by the difference method.

100% - *a* + *b* + *c* + *d* + *e* = % *Carbohydrate*

Where;

a = % moisture

b = % ash

c = % crude fibre

d = % fat

e = % crude protein

4.6 Sensory Evaluation

Sensory evaluation was carried out using an 18-man panelist to assess the organoleptic attributes of the Roselle-Moringa blend samples. The organoleptic attributes assessed were; colour, taste, aroma, mouth-feel and general acceptability. The panelists were selected randomly from the staff and students of Federal University of Technology, Owerri. The sensory evaluation was conducted using a 9-point hedonic scale as described by Ihekoronye and Ngoddy (1985), where scoring scale ranges from 9 = liked extremely to 1 = disliked extremely.

4.7 Statistical Analysis

The results of the proximate analyses and the sensory evaluation were computed and a one-way Analysis of Variance (ANOVA) and Fishers Least Significant Difference (LSD) was used to establish the significance differences among the value at 0.05 level of confidence. The statistical analysis was computed using the program, Minitab 16.2.1 (2010).

5. Results and Discussion

5.1 Recipe Formulation of Instant Zobo Drink

Five formulas of instant "zobo mix" (Table 4) were selected using linear programming. The result from the sensory evaluation using the ranking-for-preference test showed that Formula 3 was the most generally accepted of the lot; with a mean score of 7.994±0.938, the panelists liked the product very much. Formula 3 was however similar to Formula 2 and Formula 4. Formula 5 was accepted at a similar level to Formula 4. Formula 1 was the least accepted of the lot, its mean score of 5.278±1.274

meant the panelists were indifferent to the product. The acceptance level of Formula 1 was significantly different from other formulations produced. The sensory analysis showed Formula 3 to be the best in terms of taste, aroma, mouth- feel and general acceptance. It lagged behind Formula 2, Formula 4 and Formulae 5 in terms of colour but was still deemed similar to them. Formula 1 was the least appreciated of the lot in all criteria with a similarity only in colour and in aroma to any of the products. The tabular representation of the results of the sensory evaluation of the various recipes done by the 18-man panelists is shown in Table 3, while the optimum formula obtained from linear programming is given in Table 4.

Table 3. Sensory Evaluation Carried out on the Recipes Formulations

Formulations	Taste	Colour	Aroma	Mouth-feel	General
1	6.000^{b}	7.278^{a}	6.944^{b}	6.444^{a}	6.389^{b}
2	7.000^{ab}	7.556^{a}	7.000^{ab}	6.722^{a}	7.500^{a}
3	7.611^{a}	6.944^{a}	7.889^{a}	7.222^{a}	7.944^{a}
4	7.000^{ab}	7.556^{a}	7.000^{ab}	6.722^{a}	7.500^{a}
5	4.611^{c}	6.389^{b}	6.278^{b}	5.167^{b}	5.278^{c}
LSD	1.091	0.836	0.937	0.983	0.904

Table 4. Ingredients Used for the Instant "Zobo Mix"

Ingredient	Quantity used (%)
Roselle calyx	55.40
Ginger bulbs	26.12
Cloves	13.88
Orange flavor	4.60

5.2 Proximate Result of the Zobo-Moringa Mix

The tabular representation of the results of the proximate analysis carried out on the zobo-moringa mix for the different samples is shown in table 3.2. From the result of the proximate analysis (See Table 5 for codes)

For the Fat analysis, it was observed that ZCON (6.30 ± 0.02) (control) is significantly different ($P < 0.05$) from the samples that were mixed (i.e., ZM90, ZM80, ZM70, and ZM50). Also there was no significant difference ($P > 0.05$) between ZM90 (8.50 ± 0.02) and ZM80 (11.40 ± 0.01), while ZM70 (14.50 ± 0.01) and ZM50 (17.10 ± 0.01) was significantly different ($P < 0.05$). For Protein the ZCON (control) (2.325 ± 0.03) ranked lowest while ZM50 (28.050 ± 0.21) ranked highest and this is attributed to the high protein content of the dried Moringa leaves. Also samples with Moringa (i.e., ZM90, ZM80, ZM70, and ZM50) were significantly different ($P < 0.05$) from the control (ZCON), and this difference increases as the composition of Moringa increases. There was no significant difference ($P > 0.05$) in the

Moisture content in all samples and this is as a result that the ingredient used was uniformly dried and the samples were prepared from the stock. For the Ash, there was significant difference ($P < 0.05$) amongst the samples. ZCON (6.4 ± 0.09) has the least mean score, while ZM50 (7.75 ± 0.18) ranks the highest. It was observed that the higher the proportion of the blend the greater the Ash content of the sample. For Carbohydrate: ZCON (59.98±0.61) has the highest mean value than other samples (i.e., ZM90, ZM80, ZM70, and ZM50), and these values are significantly different ($P < 0.05$). For Fibre the samples (i.e., ZM90, ZM80, ZM70, and ZM50) are all significantly different ($P < 0.05$) and their mean values are lower than ZCON (control).

Table 5. Mean Value of Proximate Analysis Carried out on the Samples

Sample	Moisture	Protein	Fiber	CHO	Fat	Ash
ZCON	11.00^{a} ±0.05	2.32^{a} ±0.03	14.00^{a} ±0.04	59.98^{a} ±0.61	6.30^{e} ±0.02	6.40^{d} ±0.1
ZM90	12.28^{a} ±1.25	19.48^{b} ±0.48	8.50^{b} ±0.02	44.45^{b} ±1.7	8.50^{d} ±0.02	6.80^{c} ±0.8
ZM80	10.75^{a} ±0.25	23.44^{c} ±0.04	7.00^{b} ±0.03	40.37^{c} ±0.33	11.40^{c} ±0.01	10^{bc} ±0.1
ZM70	11.00^{a} ±0	25.43^{d} ±0.04	6.30^{bc} ±0.11	35.37^{d} ±0.04	14.50^{b} ±0.01	7.40^{b} ±0.1
ZM50	11.75^{a} ±0.25	28.05^{e} ±0.15	5.70^{c} ±0.1	29.62^{e} ±0.46	17.10^{a} ±0.01	7.75^{a} ±0.05
LSD	**2.263**	**0.816**	**0.248**	**3.017**	**0.042**	**0.335**

Key; ZCON= Zobo Control, ZM90=Zobo:Moringa 90:10, ZM80= Zobo:Moringa 80:20, ZM70= Zobo:Moringa 70:30 ZM50= Zobo:Moringa 50:50.

5.3 Sensory Evaluation on the Samples (Zobo-Moringa Blend)

The results of the sensory evaluation are shown in Table 5. There was no significant difference ($P < 0.05$), in colour among the samples, but there was a significant difference between the four samples and control. The highest value of7.90 was obtained from sample ZCON, while the lowest value was obtained from the ZM50. Generally, the value of the ZCON were greater than other samples, this may be as a result green pigmentation of the chlorophyll present in the Moringa leaves which makes the colour brighter and sharper. For the Aroma, there was a significant difference ($P < 0.05$), between ZM50 and ZCON, ZM90 and ZM50, but there was no significant difference ($P < 0.05$), between ZM70 and ZM80, ZM70 and ZM50, ZM70 and ZM90, ZM80 and ZM90, ZM80 and ZCON. For Taste, there was no significant difference ($P < 0.05$) among the samples, but there was a significant difference between the samples and the control. For the mouth feel, there was no significant difference between sample ZM90, ZM80 and ZM50 but there was a significant difference ($P < 0.05$), between samples ZM50, ZM70, ZM80, ZM90 and ZCON; there was also a significant difference between ZM80 and ZCON. for the general acceptance there was no significant difference among the samples, also there was no significant difference ($P < 0.05$) between the samples and the control, this may be attributed to the same recipe (ginger, close and flavour) used for the samples, also the packaging in teabags makes the products more acceptable to the panelists.

Table 6. Mean Values Sensory Evaluation of the Various Samples

Sample	Colour	Aroma	Taste	Mouthfeel	General
ZM90	7.80a ±0.87	6.70 b ±0.90	8.6 a ±0.49	8.0 a ±0.78	8.70a ± 0.46
ZM80	7.70a ±1.01	6.80ab ±0.60	8.70[a] ±0.46	7.9 a ±0.54	8.30 [a] ±0.46
ZM70	7.70a ±0.46	7.00ab ±0.89	8.70 [a] ±046	7.3 b ±0.64	8.60a ± 0.49
ZM50	7.00b ± 0.63	7.30 a ±0.90	8.70[a] ±0.46	7.4 a ±0.49	8.70 a ±0.46
ZCON	7.90a ±1.04	6.30bc ±0.46	7.90b ±0.54	6.50[c] ± 0.81	7.60 a ±0.49
LSD	0.449	0.574	0.366	0.640	-

Key; ZCON= Zobo Control 100%, ZM90= Zobo:Moringa 90:10, ZM80= Zobo:Moringa 80:20, ZM70= Zobo:Moringa 70:30, ZM50= Zobo:Moringa 50:50

6. Conclusion

The findings from this work have shown that an acceptable instant "zobo-moringa" mix could be formulated. Interestingly, a formular for that was developed using linear programming. This is very important in industrial production of instant "zobo-moringa" mix.

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