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Physicochemical Properties and Sensory Evaluation of Kunu-Zaki Beverage Produced by Substitution of Sweet Potatoes with Date Fruits

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Abstract: *Different blends of millet and dry date fruits; 100:20, 100:30 100:40 and 100:50 % of millet/date fruits were soaked overnight and were wet milled with ginger and cloves using equal volume of water. Each of the wet milled blends was divided into three equal parts. Each of the two parts was prepared into a porridge using hot water and was mixed with the respective remaining part, left overnight, sieved with muslin cloth to produce the 'kunu-zaki' samples: K20, K30, K40 and K50. Sample KC was produced the same way using 100:40% millet/sweet potatoes. The physicochemical and sensory properties of the 'kunu-zaki' samples: millets/date fruits and millet/sweet potatoes blends were compared. The results showed that the pH, viscosity, ºBrix value, TTA and sedimentation rate of the millet/date fruits blends and millet/sweet potatoes blend all fell within the range values of 4.04 – 4.66, 0.008 – 0.0130 Pas, 6.0 – 6.8 ºBx, 0.387 – 0.459 %lactic acid and 2.267 – 3.267 ml/min respectively. The sensory results showed that the millet/date fruits blends scored higher than millet/sweet potatoes blend in all the sensory parameters studied. Sample K50 was the most preferred while sample K20 was the least preferred among the millet/date fruit blends.*

Keywords: *Acceptability. Date fruits, Fermented beverages, Kunu-zaki, Sweet potatoes*

I. Introduction

Kunu-zaki is a traditional cereal based non-alcoholic, fermented beverage, widely consumed in the Northern parts of Nigeria [1,2]. It is of low viscosity, has a sweet-sour taste and milky cream in appearance. Kunu-zaki is relatively cheap because it is produced almost entirely from locally sourced raw materials. The major cereal used as a basic raw material for the production of kunu-zaki is millet (Pennisetum typhoidum), but it can also be produced from guinea corn (Sorghum bicolor), rice (Oryza sativa) or Maize (Zea mays) wholly or as composites [3].

Although kunu-zaki is known to originate in the Northern part of Nigeria, it has received widespread acceptance among the people of other parts of the country and consumption cuts across all social classes and ages. Kunu-zaki enjoys such a wide patronage because of its thirst quenching and energy giving ability [4]. It is sometimes used as a weaning drink for infants [5].

In the traditional processing of kunu-zaki, sweet potatoes (Ipomoea batates), ginger (Zingiber officinale), cloves (Eugenia aromatic) and black pepper (Piper guinese) are often used as additional ingredients to the basic ingredient; millet. Sweet potatoes are used to add sweetness and body to the drink, while ginger, cloves and black pepper are added in desired combination for flavouring [3,5,6]. Availability of fresh sweet potatoes throughout the year for the production of this beverage is posed with the problem of storage as they rot easily [7] and the dry sweet potato chips are not left without the problem of mould growth, weevil and rodent attack. The sweetening power of sweet potatoes in kunu is not usually sufficient for many consumers hence sugar is added to taste [8].

Date is a fruit of the date palm (Pheonix dactylifera L.), belonging to the family of Arecaccae, which is believed to have originated around Iraq and have possibly been cultivated as early as 4000 BC, from where it spread to the rest of the world [9]. According to literature [10, 11], the date fruit contains high percentage of carbohydrates with total sugars of about 44-88% and is known to be packed with an impressive list of essential nutrients, vitamins and minerals that are required for normal growth, development and overall well-being. In addition to being eaten out-of-hand, dates have been employed as natural sweeteners and used in sweetening a variety of drinks. The work of Philip et al., [12] showed that dates ranked the best among 12 most popular natural sweeteners because of their antioxidant content. However, the nutritive values of sweet potatoes and date fruits have been compared by United States Department of Agriculture (USDA) [11, 13]. Their results showed that date fruits have higher nutritive value than sweet potatoes in almost all the nutrients studied. Also date fruits have very low sodium content (1mg) and much higher potassium content (696mg) per 100g of date fruit than sweet potatoes whose sodium and potassium contents were 55mg and 337mg respectively per 100g of sweet potatoes.

Thus, the use of date fruits as natural sweeteners for kunu-zaki beverage will not only pose a more acceptable sweetening power to the beverage but will also go a long way to improve the nutritive value of this beverage as well as make it more suitable for persons suffering of hypertension because of its low sodium content [14].

II. Materials And Methods

2.1 Materials

Millet, date fruits, sweet potatoes, ginger and cloves used in this work were procured from main market; Eke Ukwu Owerri, Imo State, Nigeria. The materials were sorted and only those in good condition were used.

2.2 Production of Kunu-Zaki

Four different samples of kunu-zaki were produced from different blends of millet and date fruits as shown in Table 1. Sample KC was produced from a blend of millet and sweet potatoes (Table 1). The different sample blends were washed, soaked overnight and wet milled with equal volume of water. Ginger and cloves were added to each of the blends prior to milling as indicated in Table 1. Each of the wet milled samples were divided into three equal parts. Two parts were prepared into a thick porridge using boiled water. The remaining one part of the wet milled samples were added back to their respective thick porridges and stirred. They were allowed to stand overnight for about 15 hours to allow for fermentation and flavour development. The fermented samples were sieved using muslin cloth to give the different kunu-zaki samples which were used for subsequent analysis.

2.3 Chemical Analysis

The pH values of the kunu-zaki samples were determined using a pH meter (Jenway3510). The ºBrix values of the samples were determined using a refractometer (Mil Waukee, MA 871) and the titratable acidity (TTA %lactic acid) was determined by titration of 10ml of kunu-zaki against 0.1N NaOH to phenolphthalein end point [15]. The viscosities of the samples were obtained using a viscometer (Brookefield MA02346).

2.4 Sensory Evaluation

Sensory evaluation was carried out using an 18-man panel to assess the organoleptic attributes of the kunu-zaki samples under a 9 point hedonic scale ranging from 9 (liked extremely) to 1 (disliked extremely). The organoleptic attributes assessed were taste, colour, aroma, mouth-feel and general acceptability. The panelists were selected randomly from staff and students of the Federal University of Technology, Owerri, Nigeria.

2.5 Statistical Analysis

The results obtained from the analyses of the samples were computed using one-way analysis of variance (ANOVA) and Fisher's least significant difference (LSD) to establish the significant differences among the samples at 0.05 level of confidence.

Table 1. Compositions of the kunu-zaki Samples

Samples	Ingredients Proportion (w/w of Millet)				
	Millet	Dates	Sweet Potatoes	Ginger	Cloves
KC	100%	0%	40%	6%	2%
K20	100%	20%	0%	6%	2%
K30	100%	30%	0%	6%	2%
K40	100%	40%	0%	6%	2%
K50	100%	50%	0%	6%	2%

III. Results And Discussions

3.1 Physicochemical Results

The results of the physicochemical parameters of the various kunu-zaki samples are shown in Table 2. All the samples were slightly acidic with pH range of 4.04 to 4.66. This could be attributed to lactic acid fermentation of the beverage which led to the production of lactic acids which caused slight acidity of the samples [16]. However, the samples made with date fruits showed significant increase ($P < 0.05$) in pH with increase in date fruit incorporation. The sample K20 had the lowest pH value of 4.01 while that of K50 had the highest value of 4.66. The sample KC made with sweet potatoes (40% incorporation) had pH value of 4.32 which was significantly higher ($P < 0.05$) than that of K40 (4.29) made with 40% incorporation of date fruits which is an indication that date fruits may be more fermentable than the sweet potatoes.

The viscosities of all the samples ranged from 0.008 to 0.013Pas. The viscosity of samples made with date fruits increased significantly ($P<0.05$) with increase in date fruit incorporation. Highest viscosity value was

observed in sample KC made with sweet potatoes (0.0130Pas) and was significantly higher ($P < 0.05$) than the value of sample K50 which had 50% incorporation of date fruit.

The ºBrix values of the samples made with date fruits increased significantly ($P < 0.05$) from K20 to K50. However, the sample KC which was made with 40% sweet potatoes had the highest ºBrix value of 6.8. The highest value of ºBrix obtained for this sample is in agreement with the findings in literature which showed that the sugar content of sweet potatoes is majorly sucrose while that contained in date fruit are majorly glucose and fructose. This could explain the highest ºBrix value of sample (KC) made with sweet potatoes, as ºBrix value measures exclusively the amount of sucrose dissolved in a sample rather than the total sugar content [17 – 19]. The values of titratable acidity (TTA) of the samples KC, K20, K30 and K40 were statistically similar ($P >0.05$) and were significantly higher ($P < 0.05$) than that of K50 (0.387). The low value of TTA for sample K50 indicates poor fermentation which could have caused poor production of lactic acid. This invariably led to higher pH value of this sample when compared with the other samples.

Table 2. Physicochemical Parameters of the Kunu-Zaki Samples Produced

Samples	pH	Viscosity (Pas)	ºBrix	TTA	Sedimentation Rate (ml/min)
KC	4.32^{b}	0.0130^{a}	6.8^{a}	0.4589^{a}	3.2667^{a}
K20	4.04^{e}	0.0080^{c}	5.8^{e}	0.4608^{a}	2.2667^{d}
K30	4.18^{d}	0.0095^{b}	6.0^{d}	0.4600^{a}	3.0670^{c}
K40	4.29^{c}	0.0100^{b}	6.2^{c}	0.4590^{a}	3.2333^{b}
K50	4.66^{a}	0.0116^{a}	6.4^{b}	0.3870^{b}	3.2667^{a}
LSD	**0.018**	**0.0010**	**0.182**	**0.0020**	**0.0020**

Mean values with different superscripts within a column are significantly different at $P \leq 0.05$

The values of the sedimentation rate (Table 2) also showed significant increase ($P < 0.05$) in the sedimentation rate of the samples with increase in date fruit incorporation. Among the samples made with date fruit, K50 had the highest sedimentation value (3.2667ml/min) while the lowest value was that of K20 (2.2667ml/min). However, there was no significant difference ($P > 0.05$) between the sedimentation rate of the sample made with sweet potatoes and that made with 50% incorporation of date fruits (K50).

Table 3. Results of the Sensory Evaluation of the Kunu-Zaki Samples

Samples	Taste	Colour	Aroma	Mouth-Feel	General Acceptance
KC	4.611^{c}	6.389^{b}	6.278^{b}	5.167^{b}	5.278^{c}
K20	6.000^{b}	7.278^{a}	6.944^{b}	6.444^{a}	6.389^{b}
K30	7.000^{ab}	7.556^{a}	7.000^{ab}	6.722^{a}	7.500^{a}
K40	6.722^{ab}	7.278^{a}	7.111^{ab}	6.722^{a}	7.222^{ab}
K50	7.611^{a}	6.944^{ab}	7.889^{a}	7.222^{a}	7.944^{a}
LSD	**1.091**	**0.836**	**0.937**	**0.983**	**0.904**

Mean values with different superscripts within a column are significantly different at $P \leq 0.05$

3.2 Sensory Results of the Kunu-Zaki Samples

The results of the sensory evaluation of the various samples are shown in Table 3. Sample KC made with 40% sweet potatoes scored lowest in all the parameters (taste, colour, aroma, mouth feel, general acceptability) studied. The sample K50 scored highest in taste, aroma, mouth feel and general acceptability but was the least preferred in colour among the kunu samples made with date fruits. This could possibly be attributed to the darker colour imparted to the beverage by this fruit at higher concentrations. However, the kunu-Zaki sample K50 was the most preferred followed by K30 and the least was KC made with sweet potatoes.

IV. Conclusion

The results obtained from the different analyses of the Kunu-Zaki beverages produced by substitution of sweet potatoes with date fruits showed that the substitution did not alter the physicochemical and sensory properties of the beverage rather it helped to improve these properties thereby making them more acceptable.

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