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Research Article

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Production and quality evaluation of Kunun-zaki (A Nigerian fermented cereal beverage) from Millet and *Vigna-racemosa* blends

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ABSTRACT

Kunun-zaki, a beverage popular among the Northern Nigerians lacks varieties in terms of taste and flavor, because it is made from cerealsonly. This has accounted for the low demand and intake of the beverage in other parts of the country. There is therefore the need to add variety to the convectional kunun-zaki and also increase its nutritional value. In this study, proximate composition, mineral content and sensory quality of non-convectional kunun-zaki produced from blends of millet and Vigna-racemosa was determined. The Millet-Vignaracemosakunun blends were prepared by substituting kunun-zaki with Vigna-racemosakunun at varying proportions (100:0; 95:5; 90:10; 85:15; 80:20; 75:25). The results of the proximate composition, mineral content and sensory properties showed that addition of Vigna-racemosakunun to millet based kunun-zaki increases the protein content of the conventional kunun by 233-330%, ash content by 5 to 27% and fat content by 35 to 63%. However, moisture, crude fibre and carbohydrate content of the kunun decreased slightly, depending on level of substitution. The mineral contents (calcium, copper, zinc, iron and manganese) of the non-conventional kunun were also higher than that of the conventional kunun-zaki. Results of the sensory analysis showed that the Millet-Vigna-racemosakunun blends had the best sensory attributes. Generally, kunun from millet and Vigna-racemosa blends were highly acceptable and more nutritious compared to the conventional millet based kunun-zaki.

Keywords: Kunnu-zaki, *Vigna-racemosa*, Millet, Proximate composition, Sensory qualities.

INTRODUCTION

Kunun-Zaki is a traditional fermented non-alcoholic beverage commonly consumed in the Northern part of Nigeria. It is usually produced from millet, sorghum and maize. It is of low viscosity and has a sweet-sour taste and a milky cream appearance [1]. Kunun-zaki is greatly consumed by large number of people as a thirst quencher and as refreshment in some communities. It is also widely accepted as food drink in some urban centre, and sometimes used as a weaning food for infants [2].

Kunun-zaki being a cereal based beverage is low in nutritional value. Ayo and Okaka [3] reported that kunun-zaki contains low protein (0.1%), fat (0.6%) and carbohydrate (9-12%) but high in moisture content (85-87%).Since the nutrient content of kunun-zaki is very low. It is important to fortify the beverage with legumes which have been reported to be rich in protein. According to Vijayakumari*et al*. [4] and Perumal*et al*. [5], legume seeds contain an average of twice as much protein as cereals and nutritive value of high dietary protein sources. *Vigna-racemosa,* an underutilized legume could therefore be a good supplement for cereals based beverage such as Kunun-zaki.

Vigna spp. is genus of flowering plants in the family Fabaceae, formerly leguminosae. It is an underutilized food

crop which exhibit many excellent nutritional attributes. *Vigna spp.* contains high protein content (29.3%) and sulphur amino acids (2.05-3.63 g per 16 g N) [6].*Vigna-racemosa*a type of*Vignaspp,*is an underutilized legume that is locally known as "ewe". *Vigna-racemosa* is not only used as sources of food for humans and livestock but also for soil conservation and fertility maintenance [7]. *Vigna-racemosa* is also called "the poor-man's meat" owing to its uses as a primary protein source which can furnish protein supply to bridge up the protein deficiency gap at low cost than any other crop [8].

Nutritional quality of food is a key element in maintaining human overall physical well-being because nutritional well-being is a sustainable force for health and development and maximization of human potential [9]. Enhancing the nutritional value of Kunun-zaki (a beverage largely consumed by low income Nigerian) could help in solving the problem of protein-calorie malnutrition in developing country. Hence, this study aimed at investigating the quality attributes of kunun-zaki produced from millet and *Vigna-racemosa* blends.

EXPERIMENTAL SECTION

Millet, sugar and spices such as ginger, alligator pepper, red pepper (Capsicum species), black pepper (*Piper guineense*) and "kakandoru" and *Vigna-racemosa* ("ewe") were purchased in a local market in the Southwestern part of Nigeria. All the reagents used in the analysis were of analytical grade. The experiments were carried out in Food processing and Food Chemistry laboratory, Department of Food Science and Engineering, LadokeAkintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Production of Kunnu-zaki

Traditional method of Kunun-zaki production protocol described by Adebayo et al. [10] was modified. Millet (1 kg) and the spices (20 g of each spice) were soaked separately for 72 hr., wet milled using hammer mill and wet sieved with muslin cloth. The slurry was fermented for 48 hr. at ambient temperature, during which it was allowed to sediment. The supernatant was decanted and the slurry residue was mixed with water (1 L) and divided into two equal parts. One part of the slurry was boiled and the uncooked slurry (second part) was mixed with the boiled one. Water (500 ml) and sugar (200 g) were added to obtain the desired thickness and taste. Figure 1 shows the flow chart for the production of kunnu-zaki.

Production of Vigna-racemosaKunun

Vigna-racemosa(1 kg)was sorted, roasted and dry milled using hammer mill. The spices (20 g of each spice) were all dry milled and mixed with the *Vigna-racemosa* powder, and water (5 L) was added to the mixture to obtain mash slurry. The slurry was allowed to ferment for 48 hr., during which it was allowed to sediment. The supernatant was decanted and the slurry residue was mixed with water (1 L) and divided into two equal parts. One portion of the slurry was boiled and the second part was mixed with the uncooked portion. Sugar (200 g) was added to obtain the desired taste.

Preparation of Millet-VignaracemosaKunun blends

Five blends containing varying proportions of *Vigna-racemosa*kunun (0 to 25%) together with kunun-zaki were prepared by mixing required amount of respective kunun.

Proximate composition

The samples obtained from the different blends of Millet and *Vigna-racemosa*kunun were analyzed for moisture, protein (N*6.25), ash, crude fibre and crude fat [11]. Carbohydrate was determined by difference [11]. The calcium, copper, zinc, iron and manganese content of the kunun samples were determined by atomic absorption spectrophotometer [11].

Sensory evaluation

The kunun samples obtained from the various blends of *Vigna-racemosa* and millet kunun were evaluated by 20-member taste panelists, comprising of trained staff and students (of the department of food science and engineering, LadokeAkintola University of Technology) who are familiar with kunun. The kunun samples were rated based on the following quality attributes; color, taste, flavor, sweetness, smoothness and overall acceptability using 7-point hedonic scale [12]. The scores obtained were subjected to analysis of variance (ANOVA) at 5% level of significant and means were separated using Duncan multiple range test.

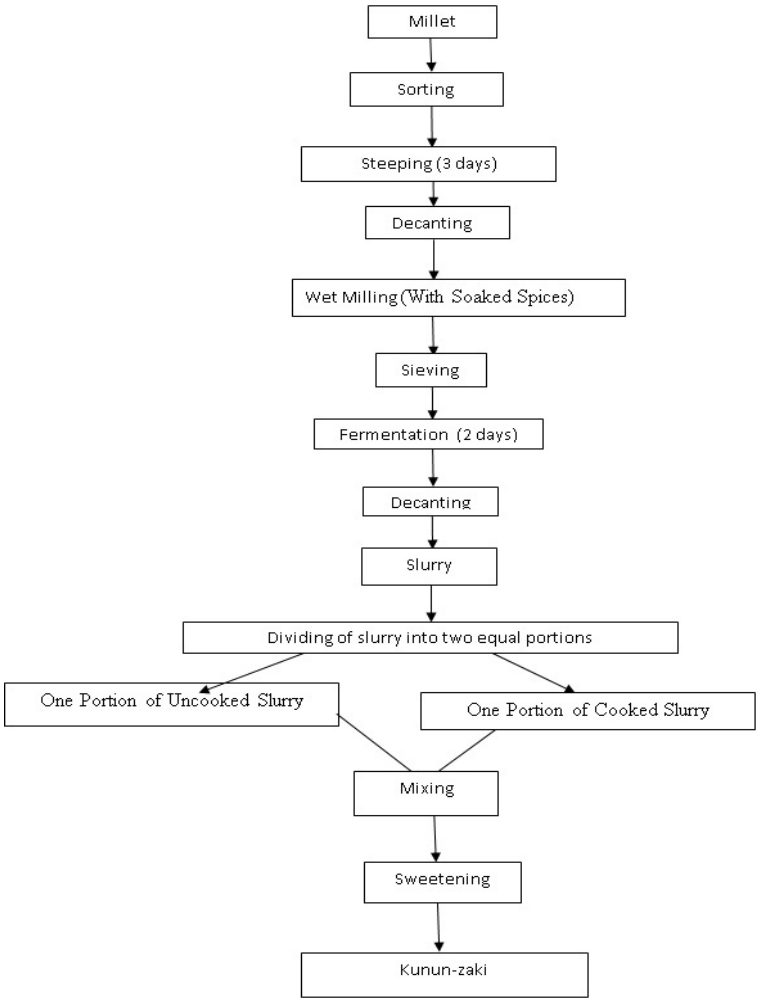

Figure 1:Flow chart for the production of Kunun-zaki

RESULTS AND DISCUSSION

Proximate composition of Millet-Vignaracemosakunun blends

The proximate composition of Millet-*Vignaracemosa*kunun blends showed significant difference (P<0.05) in all the proximate parameters (Table 1). The moisture content ranged from 73.87- 76.77% for control (Kunun-zaki) and millet-*Vignaracemosa*kunun blends. The variation in the moisture content of the kunun could be due to variation in the quantity of *Vigna-racemosa* in the blends. The moisture content of the non-convetionalkunun reported in this study is close to the moisture content (78.81-90.71%) of commercially-available kunun-zaki sold within Bidametropolis [13] but lower than the moisture content (86.05%) of kunun-zaki produced from sorghum [14]. The lower moisture content of the kunun indicates that its solid content is high, which means that the kunun can last for few hours in the stomach before digestion. Thus, it can be used as weaning food.

The protein content of the non-conventional kunun increases as the level of substitution with *Vigna-racemosa*kunun increased in the blend. The protein content of the 25% *Vigna-racemosa*kunun blend was more than four times higher than the protein content (1.13%) of conventional Millet kunun-zaki. The protein content of Millet-*Vignaracemosa*kunun (3.76 to 4.86%) reported in this study is higher than the protein content (1.14%) of kunun-zaki produced from Millet and malted rice [15], Millet and ground malted rice (1.01%) [16] and commercially available kunun-zaki (0.29 to 0.98%) [13]. The high protein content of the non-conventional kunun may be attributed to the composition of legume [4,5]. The relatively high protein content of the Millet-*Vignaracemosa*kunun indicates that the kunun will not only quench consumers thirst but also add to their protein intake.

The fat content of the Millet-*Vigna-racemosa*kunun blends ranged from 0.96 to 1.16%. These results showed that the fat content of the non-conventional kunun is slightly higher than that of the conventional Millet kunun-zaki (0.71%). The fat content of *Vigna-racemosa*seed could be responsible for the slightly higher fat content of the kunun blends. The fat content of the kunun reported in this study is lower that the fat contents (2.6 to 3.8%) of kunun

produced from rice and acha blends [17] but higher that the fat content of kunun-zaki (0.39 to 0.82%) reported by [14]. Gaffa and Ayo [18] also reported fat content of 0.32% and 0.34% for improved and traditional kunun-zaki respectively. The relatively high fat content of the Millet-*Vigna-racemosa*kunun indicates that the non-conventional kunun can develop off flavor and colour if stored at room temperature for few days. However, Kunun-zaki is usually produced for daily consumption. Since the fat content of the non-conventional kunun is not on the high side, the kunun can be consumed by both children and adults without any health implication.

The ash content of the non-conventional kunun increased as the proportion of *Vigna-racemosa* in the kunun blends increases. The blend containing 25% *Vigna-racemosa* had the highest (0.93%) ash content while the convectional Millet kunun-zaki had the lowest (0.70%) ash content. Ash contents of food are indication of the amount of minerals present in the food. Thus, the higher the ash contents of a food material, the higher its mineral content. The ash content of the Millet-*Vignaracemosa*kunnu reported in this study is higher than the ash content (0.5%) of tigernutkunun reported by [19],butsimilar to the ash content (0.98%) of kunun-zaki produced from Millet only [14]. The ash content of kunun-zaki produced using an improved traditional method was reported to be 1.3% [18]. This value is higher than the ash content of Millet-*Vignaracemosa*kunnu reported in this study. The ash content of the kunun produced from improved traditional method was slightly higher than the ash content of the non-conventional kunun reported in this study probably because of differences in the ingredients and processing methods used to produce the kunun.

The crude fibre content of the kunun blend samples decreased as the substitution level of *Vignaracemosa* increases in the kunun blends (Table 1). Thus, the fibre contents (0.93 to 1.00%) of the Millet-*Vignaracemosa*kunun reported in this study was higher than the crude fibre content (0.20%) of Tigernut-kunnu reported by [19] and Tigernut-soy milk drink (0.24%) reported by [20]. Although, kunun-zaki are generally not expected to be high in fibre due to low fibre content of Millet, which is the main ingredient. The relatively high fibre content of the non-conventional kunun shows that consumption of the kunun can improve people's healthy living through normal bowel movement and easy food digestibility.

The total carbohydrate content varied slightly among the samples. The carbohydrate content of the blends ranged from 25.20 to 27.53% while that of the control (conventional Millet kunun-zaki) was 28.63%. The reduction in the carbohydrate content of the non-conventional kunun could be due to the low carbohydrate content of the legume (*Vignaracemosa*) present in the kunun blends. The carbohydrate contents of kunun-zaki produced from maize, millet and sorghum were reported to be 7.45%, 8.18% and 11.38% respectively [14]. These values are lower than the carbohydrate content of Millet-*Vignaracemosa*kunun reported in this study. In another study, the carbohydrate contents of kunun-zaki produced from the combination of millet-wheat, millet-wheat-malted rice and millet-malted rice were 88.38%, 90.02% and 88.61% respectively [15]. The low carbohydrate contents of the non-conventional kunun indicate that the kunun can be tolerated by people suffering from diabetics and those on diet.

Mineral contents of Millet-Vignaracemosakunun blends

The mineral content of kunun produced from millet and *Vigna-racemosa* blend are presented in Table 2. The calcium, copper, zinc, iron and manganese content of the non-conventional kunun produced in this study ranged from 2.31 to 3.33ppm, 0.37 to 0.47ppm, 0.50 to 0.64ppm, 2.12 to 2.47ppm and 0.20 to 0.39ppm respectively. The calcium content of the kunun blends were significantly ($p>0.05$) higher than the calcium content of the control. The copper content of all the kunun blend samples did not differ significantly from the control, while the zinc, iron and manganese content of the non-conventional kunun were only slightly higher than that of the control (conventional millet based kunun).

Table 1: Proximate Composition of Millet-*Vigna-racemosa*Kunun blends

Sample	Moisture Content (%)	Crude Protein (%)	Fat (%)	Ash (%)	Crude Fibre (%)	Carbohydrate (%)
A	76.77^{f}	1.13^{a}	0.71^{a}	0.70^{a}	1.07^{b}	28.63^{c}
B	75.23^{c}	3.76^{b}	0.96^{b}	0.76^{a}	1.00^{ab}	27.53^{c}
C	73.87^{a}	4.13^{c}	1.00^{b}	0.81^{b}	1.00^{ab}	26.63^{b}
D	76.13^{e}	4.40^{d}	1.06^{b}	0.86^{b}	0.96^{a}	25.80^{a}
E	74.53^{b}	4.56^{d}	1.16^{c}	0.90^{c}	0.93^{a}	25.67^{a}
F	75.67^{d}	4.86^{e}	1.16^{c}	0.93^{c}	0.93^{a}	25.20^{a}

Values are mean ± Standard deviation of triplicate determinations. Means with the same superscripts within the same column are not significantly different (P>0.05). Means with different superscripts are significantly different (P<0.05).

Sample A= 100% Kunun-zaki; B= 95% Kunun-zaki +5% Vigna-racemosakunun; C= 90% Kunun-zaki +10% Vigna-racemosa; D=85% Kunun-zaki +15% Vigna-racemosakunun; E=80% Kunun-zaki +20% Vigna-racemosakunun;F= 75% Kunun-zaki +25% Vigna-racemosakunun.

Table 2: Mineral Composition of Millet-*Vigna-racemosa*Kunun blends

Samples	Calcium (ppm)	Copper (ppm)	Zinc (ppm)	Iron (ppm)	Manganese (ppm)
A	2.31[a]	0.37[a]	0.50[a]	2.12[a]	0.20[a]
B	2.50[a]	0.43[a]	0.53[a]	2.27[b]	0.21[a]
C	2.83[b]	0.43[a]	0.53[a]	2.40[c]	0.24[a]
D	3.00[c]	0.43[a]	0.57[b]	2.40[c]	0.33[b]
E	3.67[c]	0.44[a]	0.63[c]	2.43[c]	0.38[c]
F	3.33[c]	0.47[a]	0.64[c]	2.47[c]	0.39[c]

Values are mean ± Standard deviation of triplicate determinations. Means with the same superscripts within the same column are not significantly different (P>0.05). Means with different superscripts are significantly different (P<0.05).
Sample A= 100% Kunun-zaki; B= 95% Kunun-zaki +5% Vigna-racemosakunun; C= 90% Kunun-zaki +10% Vigna-racemosa; D=85% Kunun-zaki +15% Vigna-racemosakunun; E=80% Kunun-zaki +20% Vigna-racemosakunun; F= 75% Kunun-zaki +25% Vigna-racemosakunun.

The calcium content (2.31 to 3.33ppm) of the millet-*Vignaracemosa*kunun blend produced in this study is close to the calcium content (5.5ppm) of kunnu-zaki reported by Adebayo *et al*. [10]. Belewu and Abodunrin [19] also reported calcium content of 4.0ppm for Tigernutkunun. The calcium content of the kunun blends reported in this study is higher than the calcium content (0.27 to 0.32ppm) of commercially-available kunun-zaki sold in Bida metropolis [13]. The presence of high amount of calcium in Millet-*Vignaracemosa*kunun blends indicates that the kunun will enrich both children and adults diet with calcium, which is an important element in the formation and development of strong bone and teeth.

Sensory quality of millet-Vignaracemosakunun blend

The sensory quality attributes of the non-conventional kunun was slightly different from that of the conventional kunun produced from Millet only (Table 3). The colour of the kunun produced from Millet-*Vignaracemosa*kunun blends did not differ significantly (p>0.05) from the colour of the kunun produced from millet only. Although differences occur in terms of taste, flavor, sweetness, and smoothness and overall acceptability, such differences were minimal. However, statistical analysis showed that there was significant difference (p>0.05) in the parameters (taste, flavor, sweetness, smoothness and overall acceptability). Majority of the judges preferred the non-conventional kunun than the conventional millet based kunun-zaki.

Table 3: Sensory Attributes of Millet-*Vigna-racemosa*Kunun blends

Samples	Color	Taste	Flavour	Sweetness	Smoothness	Overall acceptability
A	2.67[a]	2.66[b]	2.33[a]	2.87[b]	1.73[a]	2.60[ab]
B	2.40[a]	2.33[b]	3.00[ab]	2.33[b]	2.66[b]	2.65[ab]
C	3.00[a]	1.67[a]	2.26[a]	1.60[a]	2.86[b]	1.80[a]
D	2.80[a]	3.27[c]	2.40[a]	3.26[c]	3.13[b]	2.87[b]
E	2.40[a]	2.80[b]	3.13[ab]	2.86[b]	2.93[b]	2.93[b]
F	2.47[a]	2.06[b]	2.60[b]	2.60[b]	2.80[b]	2.62[ab]

Values are mean ± Standard deviation of triplicate determinations. Means with the same superscripts within the same column are not significantly different (P>0.05). Means with different superscripts are significantly different (P<0.05).
Sample A= 100% Kunun-zaki; B= 95% Kunun-zaki +5% Vigna-racemosakunun; C= 90% Kunun-zaki +10% Vigna-racemosa; D=85% Kunun-zaki +15% Vigna-racemosakunun; E=80% Kunun-zaki +20% Vigna-racemosakunun; F= 75% Kunun-zaki +25% Vigna-racemosakunun.

CONCLUSION

Data from this study revealed that nutritious and acceptable kunun can be produced from blend of Millet and *Vigna-racemosa*kunun. Millet-*Vignaracemosa*kunun will add variety to the commonly consumed cereal based kunun-zaki. The dietary intake of the populace willalsobe enhanced through the consumption of the non-conventional Millet-*Vignaracemosa*kunun.

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