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INFLUENCE OF SPROUTED AFRICA BREADFRUIT MILK EXTRACT ON NUTRITIONAL, SENSORY AND MICROBIOLOGICAL QUALITY OF KUNUN-ZAKI

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Abstract
Kunun -zaki is a popular traditional non alcoholic drink value for its high refreshing quality, sweet -sour taste and high viscosity value. The major unit operations in processing include washing, steeping, wet milling, sieving, mixing, cooking, cooling and fermentation. This study evaluated the nutritional, sensory and microbiological quality of kunu-zaki using Sorghum bicolor (sorghum) substituted with milk extract of sprouted Africa bread fruit (ABF) seed at 0-25% levels. The results obtained from substitution at 25% level increased the protein and ash content while carbohydrate and moisture content were reduced significantly (p< 0.05%). pH, titratable acidity and total solid ranged were 4.12-4.37; 2.18-2.26 (g/ml) and 14.98-17.98 (%) respectively in all the substituted ABF kunun-zaki. Total viable counts of microbial load were in the range of (1.65-2.41, 1.68-2.66 and 33.4-42.5) x10^3 cfu/ml for kunun- zaki stored for 1, 10 and 15 days at 7 ^{o}C respectively. Control sample had lowest viable count throughout the storage periods than the ABF substituted samples. There was a significant difference (p < 0.05) in the sensory attributes with regards to taste and flavor of control at 25% substitution level. General acceptability of the scores of the products increased from 6.87 to 7.40 with the increased in the level of ABF substituted in kunun-zaki production.

Keywords: sprouted, milk extract, breadfruit milk, quality, kunun-zaki

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1. INTRODUCTION

The prominent cereals that play significant role in the diet of people all over the world particularly in the developing nations are maize, sorghum and millet (Akinoso *et al*., 2013). Although maize is widely grown among the three crops but sorghum and millet are highly values for non alcoholic cereal- based beverage in Western Africa (Gaffa and Ayo 2002). Sorghum has better nutritional value and widely cultivated than millet and thus more preferably utilized for beverages production. Among the traditional non alcoholic beverages from sorghum, Kunun -zaki has been reported to possess high refreshing quality, sweet -sour taste and higher viscosity value as this has resulted in the acceptability of the beverages among various classes of people all over the country for his thirst quenching ability (Obadina et al., 2008; Bede *et al.,* 2015). The drink has its origin in the northern parts of Nigeria but now popular in almost all the states with women playing a leading role in the preparation, processing and marketing using simple household equipments (Sowonola *et al*., 2005). Its application as breakfast drink, appetizer and weaning food has also been reported (Akoma *et al*., 2006). However, the nutritional quality of the drink is inferior to yoghurt due to lower protein content and deficiency in certain essential amino acids; this may have a negative effect on the nutritional status of the people who consume it, especially on the infant's growth who are given kunun-zaki as a weaning drink (Akintunde, 2005). Research work carried out on the improvement of the nutritional value of kunun-zaki, shows that fortification with protein-rich foods improves its nutritious values (Peter and Uchenna, 2011; Solakunmi *et al.,* 2013). In order to meet the protein demands in developing countries, where animal protein is inadequate and relatively expensive, research effort is shifted towards alternative sources of protein from legume seeds (Afaneh *et al.,* 2011; Makinde and Oyeleke, 2012).
The World Food Program also encourages the incorporation of highly nutritious but neglected foods in the diets as a means of combating

malnutrition (Grosskinsky and Gillick, 2000).To this end, research into Africabreadfruits seed (*Treculia africana*) as dietary component has recently gained attention. Treculia Africana is a leguminous crop with fruit heads known as *afon*, *ediang* or *ekwa* in Nigeria. It is a rich source of vegetable oil (10%), protein (17%) and carbohydrates (40%), as well as several minerals and vitamins (Enibe *et al.*, 2002). There are no reports in the literature on the production of sorghum-breadfruit seed composite Kunun-zaki. This research work was designed to produce and evaluate enriched kunun-zaki from sorghum-breadfruit seed for enhanced protein and sensory qualities.

2. MATERIALS AND METHODS

Sample collection and preparation

Sorghum (Sorghum bicolour) and Africa breadfruits seed (*Treculia africana*), cloves, red pepper, ginger and sugar were purchased from local market in Ibadan, Oyo State, Nigeria. The seeds were washed thoroughly to remove inherent dirt and stored prior to utilization.

Africa Breadfruit milk preparation

Healthy Africa bread fruit seeds (200g) were rinsed in distilled water and drained. Steeping was carried out in two stages (Peter and Uchenna, 2011). The weighed grains in perforated black nylon were steeped in 4 L of tap water for 4 h, air-rested for 2 h and re-steeped in clean tap water for 4 h. The out-of-steep grains were stored for 72 h under dark conditions at 28±2°C, during which the sprouted grains were, turned once every 24 h and moistened on alternate days by dipping each bag in 2 L of water for 30s. The sprouted grains were cleaned by de-rooting and dried at 50°C for 24h before milled into flour. The breadfruit flour obtained was processed into milk. The ratio of water to flour was 10:1 (w/w). The resulting slurry was brought to boil for 15 minutes, filtered through a muslin cloth to remove the filter cake and stored at 7 ^{o} C until it is utilized.

Kunun-zaki preparation

Figure 1 depicts the flow chart of kunun-zaki production according to modify method of Makinde and Oyenike (2005) and Obadina *et al.* (2008). Five hundred grams of Sorghum grains were washed, cleaned and steeped in water for 24 hr. Thereafter the steeped grain was washed; spices (w/w) added (0.65% ginger, 0.25% red pepper, 0.05% cloves, 0.15% black pepper) and ground into slurry. The resulting slurry was filtered (muslin cloth). The filtrate was allowed to settle, the supernatant decanted and the sediment was divided into three parts. Two-third of the residue was gelatinized by addition 500ml hot water for 5 minutes, cooled to 35 °C while 300 ml cold water was added to the one-third portion. The two slurries were thoroughly mixed, fermented (left for 12h), followed by the addition of sugar (10%) and Africa breadfruit seed milk (Table 1), and stored at 7 ^{o} C until it is needed for analysis.

Proximate analysis

Moisture, fat, protein, ash, crude fiber was determined using procedure of AOAC (1990).

Total solids

Total solid was determined by evaporating 25ml of kunun-zaki to dryness on boiling water bath which was followed by drying to constant weight in an oven at 130°C for 2-3 hr. It was estimated from equation 1.

pH determination

The pH was measure using digital pH meter (Cosort C380, Belgium). This was calibrated by the use of prepared buffer solutions of accurately known pH (pH 4 and pH 9). 30 ml of the sample was measured into a curvette and the glass electrode of the pH metre was dipped into the sample.

$$Total\ solid = \frac{Dry\ weight}{Weight\ of\ the\ sample} x\ 100 \qquad (1)$$

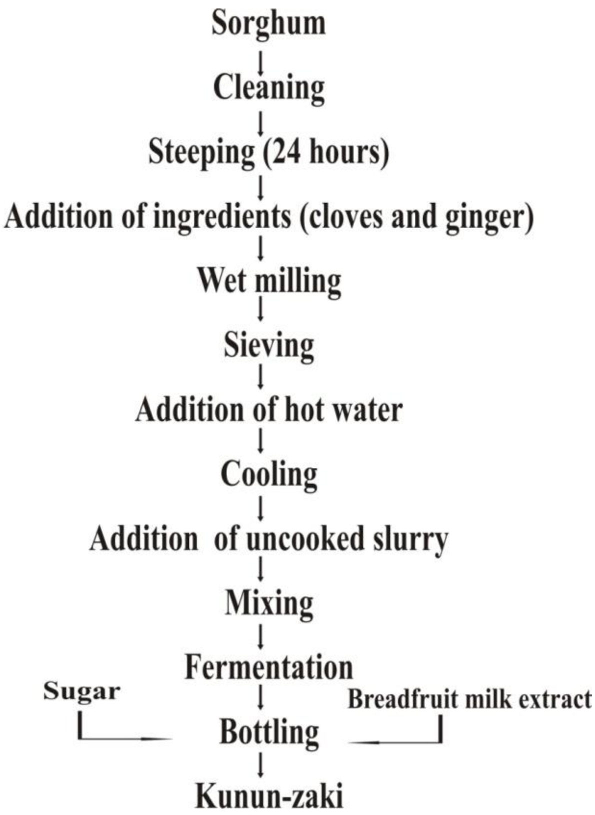

Fig 1: Flow chart of Kunun-zaki enriched with ABF milk extract

Titratable acidity
A portion (10ml) of kunun- zaki was measured into a 250ml conical flask and four drops of phenolphthalein indicator was added. This was titrated with the standard 0.1N NaOH to distinct faint pink point. The total titratable was expressed in g/100ml as described by (Agarry et al., 2010).

Sensory evaluation
Samples were subjected to sensory evaluation using twenty panelists randomly selected from the student and staff of Polytechnic community. The samples were coded and presented to the panelists in clean transparent plastic bottles at room temperature (27 ± 2 ^{0}C) in individual booths with adequate florescent lights. Sample presented to the panelists was at random and one at a time. Water was provided for mouth wash in between evaluations. Panelists rated the products for overall acceptability and sensory attributes of colour, aroma, taste and mouthfeel. A 9-point hedonic scale (Ihekoronye and Ngoddy, 1985) was used for rating.

Total viable count
Nutrient Agar (NA) (Biotech Lab. Ipswich, UK) was inoculated with a 0.1ml of appropriately diluted kunu-zaki by spread-plating technique and incubated at 37 ^{o}C for 24 h. Colonies were counted and multiplied by the dilution factor (Ogbonna *et al*., 2011).

Statistical analysis
All the procedures were replicated and mean data recorded. Data were subjected to ANOVA and Duncan multiple range test to determine significant differences between the mean values at p<0.05 using SPSS version 16 as described by Akinoso *et al.* (2014).

Table 1. Composition of kunu - zaki samples

Samples (%)	Sorghum (%)	SABF extract (%)
A	95	5
B	90	10
C	85	15
D	80	20
E	75	25
Control	100	0

SABF = Sprouted Africa breadfruit seed

3. RESULT AND DISCUSSIONS

Physicochemical properties of kunun- zaki

The results of the physic-chemical properties of the various kunun- zaki samples are shown in Table 2. All the samples were slightly acidic with pH range of 4.12- 4.37. The pH of the control is 4.80. This could be the effect of lactic acid production by fermentative lactic acid bacteria during the fermentation process, resulting in the pH lowering as the fermentation progressed (Nkama et al., 2010). The pH obtained in sample A, B, C and D were significantly different ($p < 0.05$) from each other but lower than the value obtained from the control sample. However the lower pH value of kunun- zaki beverages produced from sprouted Africa breadfruit seed (SABF) could be due to biochemical reactions associated with substrate germination. Nelson and Cox (2008) reported that germination of seed resulted in liberation of organic acid in the form of triacylglycerol, tricarboxylic acid and related organic acids are also produced from catabolism of fatty acids during respiration. Germination of seeds was also associated with rapid rate of biosynthesis of gibberellic acid (Ibegbulem and Chikezie, 2013). The titratable acidity (TTA) found in kunu-zaki beverage ranges between 2.16-2.26g/ml. The values of titratable acid in all the SABF substituted samples were statistically similar ($p > 0.05$) but slightly lower than 3.30-3.40g/ml reported by Makinde and Oyeleke (2012). The total solid content of kunun- zaki ranges between 14.20-17.98%. Result showed that total solids increased with increasing level of SABF substitution. Samples A, B, C, were significantly different from E ($p < 0.05$) in total solid. The result obtained at 25% SABF level was higher than 15.33% reported by Akoma et al. (2010) for malted rice and lower than 32.2% reported by Makinde and Oyeleke (2012) at 30% sesame seed substitution level. This may be attributed to processing conditions and variation in crop physiology.

Proximate composition of kunun- zaki

The proximate composition of kunun- zaki is presented in Table 3. The protein content of samples A- E ranges between 2.27-4.34%. Kunun - zaki produced from 100% sorghum had the lowest protein (2.15%) while the highest value (4.34%) was recorded for sample E. The increment in protein level was due to the substituted SABF in kunun- zaki samples. The protein value 3.07-4.34% obtained at 10-25% substitution of SABF in this study was higher than 2.97% reported by Afaneh *et al*.(2011) in the production of vegetable yoghurt from 100% un-sprouted sesame seed; a protein and oil rich seed. A similar finding was also reported by Ibegbulem, and Chikezie (2013) that sprouted seed contain digestive enzymes, phyto-chemicals, bio-available vitamins, minerals, amino acids and improved proteins quality than un-sprouted seed. The Carbohydrate content of the samples ranged from 7.42-10.51 in the SABF kunun- zaki samples. The highest Carbohydrate content (10.51%) was found in the control sample. Addition of SABF may have contributed to lower value obtained in the samples A-E. The same trend was also observed by Adelekan *et al.* (2013) for substituting soymilk in kunun-zaki beverage. The fat content also increased slightly from 1.23% in control sample to 1.40% in sample E. The insignificant differences ($p > 0.05$) in fat content of all the samples may be due to degradation of fat content as substrate during malting and fermentation of seed into kunun- zaki (Solakunmi *et al.*, 2013). The ash content also increased with the level of SABF seed added. High amount of ash content is an indication of considerable amount of mineral element in the food substances and the value obtained in this study was lower than 3.92% reported by Agarry et al. (2010) in kunun- zaki from millet; this may be due to high proportion of mineral content in millet than sorghum. The moisture content of the samples varied from 80.15-85.40%. The moisture content of kunun-zaki produced from control (85.40%) was significantly higher than the samples B (83.60%), C (82.38%), D (81.87%) and E (80.15%). The higher moisture content may be an indication of short shelf life as high moisture content favors the growth of spoilage organisms (Ogbonna et al., 2011; Munasinghe et al., 2013).

Table 2. Effect of sprouted Africa breadfruit milk extract on physicochemical properties of kunun - zaki

Sample	pH	Titrable acidity (g/ml)	Total solid (%)
A	4.12^{c}± 0.01	2.18^{a}± 0.01	14.98^{a}± 0.02
B	4.20^{a} ±0.01	2.20^{a} ±0.01	15.24^{a} ±0.02
C	4.30^{bc} ±0.01	2.23a ±0.02	16.64^{b} ±0.01
D	4.30.^{bc}±0.01	2.24.^{a}±0.01	16.69^{bc}±0.01
E	4.37^{b} ±0.01	2.26^{a} ±0.02	17.98^{c} ±0.01
Control	4.80^{a} ±0.01	2.16^{a} ±0.01	14.20^{a} ±0.01

Table 3. Effect of Africa bread fruit milk extract on proximate composition of Kunun - zaki

Sample	Protein (%)	Carbohydrate (%)	Fat (%)	Fibre (%)	Moisture (%)	Ash (%)
A	2.27^{a}± 0.02	10.11^{a}± 0.01	1.25^{a}± 0.01	0.16^{a}± 0.01	84.21^{ab}± 0.15	0.46^{a}± 0.00
B	3.07^{b} ±0.01	9.43^{ab} ±0.02	1.36^{a} ±0.02	0.17^{a} ±0.01	83.60^{b} ±0.02	0.47^{a} ±0.01
C	3.54^{bc} ±0.02	9.13^{b} ±0.02	1.37^{a} ±0.01	0.18^{a} ±0.01	82.38^{bc} ±0.02	0.47^{a} ±0.01
D	4.03.^{cd}±0.03	8.13^{c} ±0.01	1.39.^{a}±0.01	0.18^{a}±0.01	81.87^{c} ±0.01	0.49.^{a}±0.00
E	4.34^{d} ±0.02	7.42^{d} ±0.01	1.40^{a} ±0.01	0.19^{a} ±0.01	80.15^{c} ±0.01	0.64^{c} ±0.01
Control	2.15^{a} ±0.01	10.51^{a} ±0.01	1.23^{a} ±0.01	0.15^{a} ±0.01	85.40^{a} ±0.02	0.45^{a} ±0.00

Table 4. Effect of breadfruit milk extract on sensory evaluation of Kunun - zaki

Sample	Flavour	Taste	Appearance	General Acceptability
A	6.27^{c}± 1.51	6.20^{c}± 1.90	7.03^{b}± 1.3	6.87^{c} ±1.61
B	7.13^{a} ±1.36	6.70^{b} ±1.39	7.37^{a}±1.25	7.20^{bc}± 1.10
C	6.93^{b} ±1.41	6.90b ±1.16	7.43^{a}± 1.38	7.43^{b} ±1.38
D	6.93.^{b}±1.40	6.80.^{b}±1.71	6.97^{b}± 1.16	7.10^{bc} ±1.27
E	7.10^{b} ±1.58	6.80^{b} ±1.35	7.20^{a} ±1.65	7.40^{b} ±1.38
Control	7.60^{a} ±1.31	7.53^{a} ±1.33	7.27^{a} ±1.64	8.07^{a} ±1.26

Table 5. Microbial load of Kunun- zaki

Sample	Bacteria		
	Day 1	Day 8	Day 15
A	$2.0x10^3$	$2.56x10^3$	$3.44x10^4$
B	$2.14x10^3$	$2.66x10^3$	$3.55x10^4$
C	$1.72x10^3$	$2.56x10^3$	$3.66x10^4$
D	$2x10^3$	$2.48x10^3$	$3.44x10^4$
E	$2.41x10^3$	$2.60x10^3$	$4.25x10^4$
Control	$1.65x10^3$	$1.68x10^3$	$3.34x10^4$

Sensory properties

The sensory scores of kunun-zaki are presented in Table 4. The average mean scores of flavor and taste in sample B, C, D and E were not significantly different from each other ($p>0.05$) but significantly lower than control sample and higher than sample A with the lowest level of SABF substitution. The score obtained for appearance showed that sample B, C and E were not significantly different from the control sample but were rated higher than sample A and D. General acceptability of the scores of the products increased from 6.87 to 7.40 with an increased in SABF level substituted in kunun-zaki beverages.

Mean bacteria count

The result of mean total viable count (TVC) was presented in figure 5. The result showed bacterial load in the range of (1.65-2.41, 1.68-2.66 and 33.4-42.5) $x10^3$ cfu/ml for storage of kunun- zaki at 1, 10 and 15 days respectively. Control sample had the lowest viable count throughout the storage periods than the SABF substituted samples. The result obtained at fifteenth day of storage was lower than 7.33 $x10^6$ - 81.67x 10^8 cfu/ml obtained by Amusa and Asaye (2009) but higher than 6.036 $x10^3$ cfu/ml reported by Ogbonna *et al*. (2011) in hawked kunun-zaki from local markets in Nigeria. The variation in value may be due to poor hygienic preparation and handling among the indigenous producer.

4. CONCLUSIONS

Acceptable kunun-zaki was produced from sorghum and SABF in this study. The substitution of SABF in kunun-zaki increased the protein, ash content and total solid of the beverage with slight reduction in the moisture content. All the samples have bacterial count within acceptable level for human consumption. Addition of 25% SABF resulted in kunu-zaki with better nutritional value than the control sample.

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