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Chemical Composition and Sensory Qualities of *Kunu-Zaki* Fortified with Beniseed (*Sesamum indicum*)

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Abstract

This study determined the chemical composition and sensory qualities of *Kunu-zaki* fortified with beniseed at various inclusion levels. The *Kunu-zaki* was processed from sorghum (*Sorghum bicolor*). Seven (7) samples were prepared with 5%, 10%, 15%, 20%, 25% and 30% beniseeds inclusion levels. Proximate composition as well as sensory qualities of the various samples of the *Kunu-zaki* was examined. Specifically, crude protein, crude fat, crude fibre, moisture, ash, dry matter and carbohydrate contents of the composition were analysed using the AOAC (1990) procedure. Analysis of Variance (ANOVA) was used to determine significant difference in the samples on variables of interest. Results revealed that *Kunu-zaki* fortified with beniseed at 20% inclusion level resulted in the highest crude protein (CP) level (2.21). In contrast, the fortified *Kunu-zaki* at 10% inclusion level contained the lowest CP but the highest carbohydrate level. The substitution effect of beniseeds was highest most in carbohydrate and crude protein properties of the samples. It is concluded that crude protein, crude fat, crude fibre and carbohydrate content of the samples are not cumulatively proportional to rate of beniseed inclusion and that Kunu-zaki with no beniseed inclusion was the most accepted by the consumers. It is recommended that effort to promote Kunu-zaki fortified with beniseeds should focus on nutritional composition as a unique selling point rather than the sensory qualities.

Keywords: Beniseed, *Kunu-zaki* Fortified, Sensory, Chemical Composition

Introduction

The most important staple foods for many people in the developed and developing countries are produced from cereals (Adegbehingbe, 2014). In the developed countries, 70% of the cereal produced is used as animal feed while in the developing countries 68-98% of the cereal production is used for human consumption (FAO, 2009). These foods are often fermented. Fermented food describes food substance that has gone through lactofermentation as a way of preserving it. Lactofertation helps in preserving essential and beneficial food properties like b-vitamins, omega-3 fatty acid as well as various strains of probiotics. Fermented food, particularly the traditional ones, play prominent role in the food basket of millions of Africans (Adimpong, Nielsen, Sørensen, Derkx, & Jespersen, 2012). African indigenous fermented foods are reputed for their improved flavor, texture, shelf-life, rich in micronutrients and absence of antinutrients and toxic compounds (Dakwa, Sakyi-Dawson, Diako, Annan and Amoa-Awua, 2005; Obilie, Tano-Debrah, and Amoa-Awua, 2004).

Cereal based foods and beverages, including those made from beniseeds, sorghum and mullet enjoy widespread consumption worldwide and in Nigeria. These cereals are predominantly used for food in African countries including Nigeria. Sorghum (*Sorghum bicolor*) is an ancient crop grown almost everywhere in the world. Sorghum is one of the five top cereal crops and ranks after maize (Ayo, Onuoha, Ikuomola, Esan, & Oigiangbe, 2010). It belongs to the grass family, native to Australia but has expanded to many places including Africa, Asia and the Mesoamerica climes. Millets, on the other hand, refer to a group of diverse small-seeded cereal-bearing grasses grown throughout the world particularly for food. Apart from *Kunu-zaki*, other fermented foods produced from sorghum include 'buchera', 'koko' and 'ogi-baba' (Adelekan, Alamu, Arisa, Adebayo and Dosa, 2013; Muyanja, Narvhus, Treimo, and Langsrud, 2002). *Kunu-zaki* is produced from any of sorghum, millet and beniseeds.

Kunu-zaki is a sweetened cereal based non-alcoholic beverage that is widely consumed in Nigeria especially in Northern part of the country (Amusa and Odunbaku, 2009; Gaffa, Jideani and Nkama, 2002). According to Gaffa , Jideani and Nkama (2002), *Kunu-zaki* is essentially produced from sorghum but sometimes, it can also be produced from maize. It is a highly nutritious non-alcoholic drink that is produced from various cereal grains such as millet. Although *Kunu-zaki* is traditionally a Northern Nigeria beverage, it has found great appeal in other parts of the country. It is consumed among different classes of personality either as a food supplement or thirst quencher. The availability of *Kunu-zaki* as an alternative for carbonated drinks products which have little to nutritional benefits that is cheaply available for every class of individual. *Kunu-zaki* is one of the complex mixtures which contain macro-molecules such as protein, carbohydrates and lipids (Gaffa, Jideani & Nkama, 2002). During the preparation of *Kunu-zaki* , the ingredients needed are ginger (zingiber officimals), alligator pepper (afromonium melegueta), red pepper (capsicum species), black pepper (piper guineense) and kakandoru or eru. All these ingredients perform one function or the other in the course of the preparation. The most abundant constituents of *Kunu-zaki* is water and it acts as the medium in which all other constituents are dissolved and contain only traces amount of in-organic substances(Otaru, Ameh, Okafor, Odigure, & Abdulkareem, 2013)

Ordinarily, *Kunu-zaki* is reported to have low protein content with implications on its general acceptability (Ayo *et al.*, 2013). To fortify *Kunu-zaki*, spices are often added to improve the taste. During the preparation of *Kunu-zaki* , the ingredients often added include ginger (*zingiber officinales*), Aligator pepper (*Afromonium melegueta*), red pepper (*Capsicum* species), black pepper (*Piper guinense*) and kakandoru or Eru (Otaru et al., 2013). The most abundant constituent of *Kunu-zaki* is water and it acts as the medium in which all other constituents are dissolved and contain only traces amount of inorganic substances. The nutritive value of *Kunu-zaki* is highly due to the presence of protein, carbohydrates and some vitamin especially the vitamin B (Adebayo & Ojo, 2012).

Although, *Kunu-zaki* *is* predominantly consumed in the North, the product is gaining increasing acceptance in other parts of the country. It is, however, thought that the present traditional production process is outdated, inefficient, time consuming and with product quality varying between batches (Ayo *et al.*, 2010). In this present study, attempts have been made to improve on sensory quality of the *Kunu-zaki* , by adding beniseeds. It is hoped that maintaining nutrients and improving sensory quality of the final product will lead to improvement in nutritive quality and acceptability of the product (Ayo *et al.*, 2010).

Purpose of the Study

The purpose of the study was to determine the nutritional composition and sensory evaluation of *Kunu-zaki* fortified with beniseed. Specifically, the study

1) produced of *Kunu-zaki* made from combination of millet and sorghum.
2) fortified the prepared *Kunu-zaki* with beniseed.
3) determined chemical composition of *Kunu-zaki* not fortified with beniseed
4) determined the chemical composition of *Kunu-zaki* fortified with beniseed.

5) evaluated the sensory quality and consumer acceptability of the *Kunu-zaki* fortified with beniseed.

Materials and Methods

Collection of raw materials**:** Sorghum grains (*sorghum vulgare*), maize (*Zea mays*), malted grain of millet were obtained from Ayetoro market in Ogun State, Nigeria. Ginger (*Zingiber officinate*). Cloves (*Eugenia coryphée*), Red pepper (*Capsicum annum*) were used. The chemical preservatives such as sodium benzoate, and sodium metabisulphite (BDH) were used.

Table 1: Ingredients for ordinary and fortified *Kunu-zaki*

	Ordinary *Kunu-zaki*
Ingredient	**Quantity**
Sorghum	700g
Ginger	5g
Cloves	3g
Alligator pepper	2g
Black pepper	2g
Kakandora/eru	3g
Water	500ml

Methods

Kunu-zaki without beniseed

Production of *Kunu-zaki* : *Kunu-zaki* was produced as described by Akoma *et al.* (2002) using sorghum.

Procedures in preparing *Kunu-zaki*

i. Dirt was removed from the ingredients and washed in clean water
ii. 700g of sorghum was steeped in 1000ml tap water (1:2.w/v) for 24hours at ambient temperature (30-32^{0}C).
iii. The water was then decanted off and the sorghum washed with more tap water before wet-milling with the spices
iv. The sorghum (grain) was steeped and spices added (mixture of cloves, ginger and black pepper).
v. The paste was divided into seven portions with each having 100g.
vi. One of the portions was reserved without addition of beniseeds while the other 6 portions had beniseeds at 5%, 10%, 15%, 20%, 25% and 30% inclusion levels. The quantity of the pure *Kunu-zaki* was also reduced at the same rate.
vii. 75% of the samples were cooked using two volume of boiling water and allowed to cool to 45^{0}C. Ground malted millet or sorghum mixed separately with the remaining uncooked 25% paste (1:4. w/w) before being added to the cooked paste (i.e. gelatinized starch at 45^{0}C).
viii. This mixture was then be stirred vigorously for about 5 minutes and then allowed to ferment for 8-10hours to produce the *Kunu-zaki* The fermented *Kunu-zaki* was sieved (mesh size approx 350m) and served without the addition of sweetening agent.
ix. The prepared *Kunu-zaki* was divided into 7 equal portions

Preparation of Beniseeds

i. Dirt was removed from the beniseeds and washed in clean water

ii. 200g of beniseed was steeped in 100ml tap water for 24hours at ambient temperature (30-32^{0}C).
iii. The water was decanted off and the beniseed washed with more tap water before it was wet-milled
iv. The wet-milled beniseeds were sieved and put aside

Preparation of Samples of the *Kunu-zaki*

Seven samples of *Kunu-zaki* were produced. Sample 1 contains 100% of *Kunu-zaki* while the other samples contained *Kunu-zaki* fortified with beniseeds at various inclusion level in percentages as follows:

Sample	Description
1	100% *Kunu-zaki*
2	95% *Kunu-zaki* + 5% Beniseed
3	90% *Kunu-zaki* +10% Beniseed
4	85% *Kunu-zaki* + 15% Beniseed
5	80% *Kunu-zaki* + 20% Beniseed
6	75% *Kunu-zaki* + 25% Beniseed
7	70% *Kunu-zaki* + 30% Beniseed

In preparing the samples, the prepared beniseeds were added to the seven portions of the prepared *Kunu-zaki* at 0%, 5%, 10%, 15%, 20%, 25% and 30% levels. The beniseeds was substituted for the *Kunu-zaki* at ratio 1:3.5.

Chemical Analysis

Chemical tested

1. Crude protein
2. Crude fat
3. Crude fibre
4. Ash
5. Moisture
6. Dry matter

The pH of the various samples was measured with pH meter (Model 7020 Electronic Ltd. England) after standardization with pH 4 and 7 buffers (BDH. England). Titratable acidity (TA%. Lactic acid) determined by titration of 10ml *Kunu-zaki* against 0.1 NaOH to phenolphthalein end point. Crude protein and crude fat of samples (10ml) determined with standard micro-kjeldahl and soxhlet procedures, respectively (AOAC, 1990): (Pearson, 1970).

Total ash was obtained by igniting 10ml sample at 600^{0}C using muffle furnace (Pearson, 1976). Mineral content of the samples was determined with an automated atomic absorption spectrophotometer (Perkin-Elmer, Model 2380). The samples and standard solutions were prepared according to the procedures of the AOAC (1990).

Sensory Analysis

The chemical preserved *Kunu-zaki* samples fortified with beniseed and the one without beniseed were evaluated for taste, colour, flavor, general consistency and acceptability/preference on a 5-point scale (5,4,3,2,1), 5 as Excellent and 1 as Poor by panel of 11 judges made of lectures technologists, and non-academicians who were randomly selected from College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria.

Statistical Analysis

Mean differences in sensory quality were computed using analysis of variance (ANOVA) and the difference of mean determined using Duncan's Multiple Range test (Duncan, 1955).

Results

Proximate Composition**:** Table 1 and Table 2 present the chemical composition and changes that occurred in them, respectively, at different beniseed inclusion level. It is evident in Table 1 that the substitution effect of beniseed inclusion resulted in general increase in the crude protein, fat, fibre and ash content of the fortified *Kunu-zaki* indicating that the substitution effects of beniseed inclusion in the fortified *Kunu-zaki* were positive in terms of CP, fat, fibre and ash contents.

Proximate Composition of *Kunu-zaki* fortified with Beniseed.

The proximate composition of the *Kunu-zaki* fortified with beniseed at various inclusion levels is presented in Table 1.

Table1: Proximate Composition of *Kunu-zaki* Fortified with Beniseed

SAMPLE	% CP	% FAT	% FIBRE	% Ash	% MC	% DM	%CHO
100% *Kunu-zaki*	3.48	1.30	1.01	1.39	68.79	31.21	24.90
95% *Kunu-zaki* + 5% Beniseed	5.62	1.48	0.96	1.45	66.81	33.19	24.64
90% *Kunu-zaki* + 10% Beniseed	6.24	1.54	1.13	1.53	62.67	37.33	28.02
85% *Kunu-zaki* + 15% Beniseed	8.13	1.69	1.18	1.67	60.38	39.62	28.13
80% *Kunu-zaki* + 20% Beniseed	10.34	1.76	1.23	1.75	58.97	41.03	27.18
75% *Kunu-zaki* + 25% Beniseed	11.56	1.88	1.29	1.84	56.76	43.24	27.96
70% *Kunu-zaki* + 30% Beniseed	13.15	1.97	1. 34	1.96	53.28	46.72	29.64

CP= Crude protein: MC= Moisture Content: DM= Dry Matter; and CHO= Carbohydrate

Table 2 shows that CP was highest at 20% inclusion level. At this level the carbohydrate content was at the lowest level (-0.95).

Percentage Change in Chemical Composition of the Samples

Table 2 presents the percentage change in chemical composition of the five samples of *Kunu-zaki* fortified at various inclusion levels.

Table 2: Percentage change in chemical composition of the fortified *Kunu-zaki* at various beniseed inclusion level

S/N	Sample	%CP	%FAT	%FIBRE	%Ash	%MC	%DM	%CHO
1	100% *Kunu-zaki*	-	-	-	-	-	-	-
2	95% *Kunu-zaki* + 5% Beniseed	2.14	0.16	-0.05	0.06	-1.98	1.98	-0.26
3	90% *Kunu-zaki* +10% Beniseed	0.62	0.06	0.17	0.08	-4.14	4.14	3.38
4	85% *Kunu-zaki* + 15% Beniseed	1.89	0.15	0.05	0.14	-2.29	2.29	0.11
5	80% *Kunu-zaki* + 20% Beniseed	2.21	0.07	0.05	0.08	-1.41	1.41	-0.95
6	75% *Kunu-zaki* + 25% Beniseed	1.22	0.12	0.06	0.09	-2.21	2.21	0.78
7	70% *Kunu-zaki* + 30% Beniseed	1.59	0.09	0.05	0.12	-3.48	3.48	1.68

CP= Crude protein: Mc= Moisture Content: DM= Dry Matter; and CHO= Carbohydrate

Sensory Quality

Table 3 presents the sensory qualities of *Kunu-zaki* fortified with beniseeds at various inclusions levels.

Table 3: Sensory Qualities of *Kunu-zaki* samples

Samples	Colour	Taste	Aroma	Overall acceptability
100% *Kunu-zaki*	4.8	4.8b	4.3a	4.8b
90% *Kunu-zaki* + 10% Beniseed	3.2	3.1b	3.3b	3.2n
80% *Kunu-zaki* + 20% Beniseed	2.9	2.3c	2.3c	2.7c
70% *Kunu-zaki* + 30% Beniseed	3.2	2.9c	2.6c	2.9c
S.E	10.04	+0.01	+0.02	+0.03

Means with different superscripts across the columns are significantly different (p<0.05)

Table 3 shows sensory qualities of *Kunu-zaki* without the inclusion of beniseed recorded the highest acceptability in terms of colour (4.8), taste (4.8), aroma (4.3) and overall acceptability (4.8). The least acceptability level occurred at 20% fortification level. These findings are in contrast with the proximate composition where *Kunu-zaki* at 20% inclusion level recorded highest gain in CP. It is also evident in Table 3 that significant (p<0.05) difference exist between 0% inclusion level and 20% inclusion level. This implies that difference in acceptability as enumerated above is not due to chance.

Discussion of Results

A crude protein (CP) content 3.48 was obtained in 100% *Kunu-zaki*, while higher value was obtained in 70% *Kunu-zaki* + 30% Beniseed (13.15%), followed by 75% *Kunu-zaki* + 25% Beniseed, (11.56%) and 80% *Kunu-zaki* + 20% Beniseed, (10.34%). However, 5.62%, 6.24%, and 8.13% crude protein content were obtained from 95% *Kunu-zaki* + 5% Beniseed, 90% *Kunu-zaki* + 10% Beniseed, and 85% *Kunu-zaki* + 15% Beniseed respectively.

Grain legumes are important as sources of protein, energy and other nutrients. They contain as high as 20 to 50% protein, which in general runs well above twice the level in cereal grains and significantly more than the levels in conventional root crops (Ustimenko, 1983). The protein is relatively high in lysine content, a factor of much nutritional importance. Legumes have lower level of this amino acid. The levels of the sulphur-containing amino acids (methionine and cystine) in cereals are adequate to compensate for the low values in legumes to produce a protein mixture of enhanced biological values. Grain legumes, with the exception of the oil seeds have very low oil content (less than 3%). They also contain more than 50% carbohydrate fraction which is essential in the form of fibre.

Lower and similar values of fat ranging between 1.37% to 1.88% were obtained across the raw *Kunu-zaki* and those fortified at different percentage content. The highest percentage was however recorded for *Kunu-zaki* fortified at 70% *Kunu-zaki* + beniseed (1.97%). The increase in the fat content in the *Kunu-zaki* samples can be attributed to the fact that beniseed are oil seeds which is one major advantage over animal-based fats. Apata (1990) reported that beniseed contain high levels of oleic and linoleic acids. The implication of this is the possibility of preventing disease associated with intake of saturated fatty acid and cholesterol in humans.

Generally, plant oils are of more nutritionally benefited than fat oil from animal source like egg, meat and milk. This is because food containing more of unsaturated fatty acid and less of saturated fatty acids and cholesterol, helps to prevent deposition of fatty materials in the walls of the coronary artery. This helps to prevent incidence of cardiovascular disease like arterosclerosis (Potter and Hotchkiss, 1996) which involves the deposition of fat on the walls of the artheries in the human blood circulatory system that invariably reduce the flow of blood to the heart.

Lower and similar values of ash content ranging between 1.39% to 1.84% were obtained across the raw *Kunu-zaki* and those fortified at different percentages content. The highest percentage were however recorded for *Kunu-zaki* fortified at 70% *Kunu-zaki* + 30% beniseed (1.96%). Ash content has being reported to be a measure of mineral constituents (Apata, 1990). Beniseeds are excellent source of calcium, magnesium, phosphorus and iron.

The moisture content obtained across the raw and fortified *Kunu-zaki* ranged from 53.28% to 68.79%. The highest moisture content was obtained in 70% *Kunu-zaki* + 30% beniseed (53.28%). Shelf life has being reported to decrease with higher amount of moisture content (Norman and Joseph, 1995). Likewise, food microbes multiplies when moisture is high in food samples.

From the table above, lower percentage in dry matter were obtained from raw *Kunu-zaki* (31.21%) and higher percentage in dry matter were obtained from *Kunu-zaki* fortified at 70% *Kunu-zaki* + 30% beniseed (46.72%).

Similar carbohydrate content was obtained from raw *Kunu-zaki* (24.97%) and 95% *Kunu-zaki* + 5% beniseed (24.64%). This same is true for carbohydrates obtained from 90% *Kunu-zaki* + 10% beniseed (28.02%) and 85% *Kunu-zaki* + 15% Beniseed (28.13%). Higher percentages of carbohydrates is however, obtained from *Kunu-zaki* fortified at 70% *Kunu-zaki* + 30% Beniseed (46.72%).

The study findings reveal that *Kunu-zaki* fortified with beniseed at 20% inclusion level resulted in the highest crude protein level (2.21). In other words, a 5% increase in beniseed inclusion from 15% level resulted in the highest increase in protein level. In contrast, however, the fortified *Kunu-zaki* at 10% inclusion level contained the lowest CP but the highest carbohydrate level. Besides, the lowest changes in CP level occurred at 10% beniseed inclusion level implying that crude protein gain is not cumulatively proportional to rate of beniseed inclusion.

It is also evident in the table 2 that 20% beniseed inclusion recorded lowest cumulative level of carbohydrate content (10.95%). The dry matter (1.41) also followed the same trend. From the foregoing, it appears that the most significant substitution rate occurred between protein and carbohydrate content.

In terms of the sensory qualities of the samples, the highest score for colour was obtained in *Kunu-zaki* sample containing 100% sorghum/millet (4.81). Followed closely to this were *Kunu-zaki* samples containing 10% beniseed (3.2) and 30% beniseed (3.2) respectively. The *Kunu-zaki* samples having the lowest values in colour was the one containing a mixture of 90% *Kunu-zaki* + 10% Beniseed (3.1). These values were however not significantly ($p>0.05$) different.

The highest significant ($p<0.05$) score of taste was obtained in 100% *Kunu-zaki* (4.8) followed by the *Kunu-zaki* samples containing 90% *Kunu-zaki* + 10% Beniseed (3.1), 70% *Kunu-zaki* + 30% Beniseed (2.9) and 80% *Kunu-zaki* + 20% Beniseed (2.3) respectively.

The highest significant ($p<0.05$) score of aroma was obtained in *Kunu-zaki* samples containing 100% sorghum/millet (4.3), while the lowest score of aroma was obtained in *Kunu-zaki* containing blends of 80% *Kunu-zaki* + 20% Beniseed (2.3).

Kunu-zaki sample containing 100% sorghum/millet was highly accepted ($p<0.05$) among other samples (4.8), next to this was *Kunu-zaki* sample containing 90% *Kunu-zaki* + 10 beniseed (3.2). at 30% inclusion level of beniseed, the acceptability scores reduced to 2.7. The fact that the *Kunu-zaki* with no beniseed inclusion had the highest acceptance level suggests that *Kunu-zaki* fortified with beniseeds might be less acceptable to the consumers. This might not be unconnected to familiarity factor. That is, the taste and other sensory parameters of *Kunu-zaki* fortified with beniseeds might still be strange to the consumers. To promote Kunu-zaki fortified with beniseeds, the nutritional properties may therefore be the unique selling point (USP) rather than sensory qualities.

Conclusions

In this study, results obtained showed that protein content of *Kunu-zaki* can be increased by fortification with beniseed which are leguminous seed. Legumes are important sources of protein; they contain 20 to 50% of protein, which in general runs well above twice the level found in cereal grains. Also, the nutritional advantage from the present of protein in the incorporated beniseed believed to go a long way for the treatment of malnutrition related diseases e.g. kwashiorkor, e.t.c. Another conclusion from the study is that rate of substitution of beniseed for *Kunu-zaki* was most pronounced on protein and carbohydrate rate.

Recommendations

Based on the study findings and conclusions, it is recommended that:

- *Kunu-zaki* should be prepared without beniseeds until people are convinced about the nutritional benefits (e.g. improved protein content) because the study revealed that *Kunu-zaki* without beniseed inclusion resulted in higher degree of likeness by the consumers
- Level of inclusion of beniseed in *Kunu-zaki* to fortify it should be at 20% level if protein maximization is the goal but 10% inclusion level should be maintained if optimum carbohydrate content is the goal all thing being equal.
- For health benefit rather than sensory experience, *Kunu-* should be fortified with beniseeds.

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