

The Nutritional and Sensory Quality Characteristics of *Kunun-zaki* Produced with the Addition of Hydrolytic Enzymes from Malted Rice (*Oryza sativa*)

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Abstract

Kunun-zaki was produced from millet (*Pennisetum typhodeum*), sorghum (*Sorghum bicolor*) or maize (*Zea mays*) with or without the addition of hydrolytic enzymes obtained from ground-malted rice (*Oryza sativa* FARO 37) and analyzed for its chemical and organoleptic quality attributes. The results obtained show that there were 33, 44, 66% increases in crude protein 52, 117 and 91% increases in sucrose contents in those products (ie *kunun-zaki* produced from millet, sorghum and maize respectively) in which the extracts from ground-malted rice were incorporated. A similar increase was observed in acidity, iron, calcium and phosphorus contents. Furthermore, the sensory attributes of *kunun-zaki* produced using extracts from ground-malted rice did not differ ($p>0.05$) from the other products in appearance, taste, texture and sensory overall acceptability but differed ($p<0.05$) in aroma, which could be attributed to the production of more organic acids in these products by the fermenting microorganisms. The result obtained in this study therefore suggests that it could be economical and nutritious to use malted cereal grains in the production of *kunun-zaki*.

Introduction

Kunun-zaki is a popular locally fermented non-alcoholic cereal beverage produced from sorghum, millet or maize, spiced (ginger, black pepper, clove) and sweetened with sugar (Adeyemi and Umar, 1994). Studies by some workers show that *kunun-zaki* is rich in carbohydrate, B vitamin and minerals but low in protein (Ayo and Okaka, 1998).

In the production of *kunun-zaki*, two methods are employed. In one of the methods, the cereal is steeped in water for 24hrs, wet milled and sieved. The sediment obtained is divided into two unequal portions; one portion is cooked and then mixed with the uncooked portion (being the source of inoculum) and allowed to ferment for 8-10hrs (Efiuwewere and Akoma, 1995). In the second method, a portion of the cereal is malted, dried, ground and then mixed with the uncooked portion. This mixture is then added to the cooked portion and stirred vigorously and allowed to ferment. The hydrolytic enzyme (amylase) in the malted cereal aids in digesting the thick slurry thereby converting the complex carbohydrate to simple sugars. The final product is usually sweet. Ayo and Okaka (1998) exploited the hydrolytic properties of the crude extracts of *Cadaba farinosa* in obtaining

a similar sweet product.

A study on the glycemic effect of *kunun-zaki* on the blood glucose in non-diabetic persons by Awogbenga *et al* (1999) shows that *kunun-zaki* has similar response but lower glycemic index as compared with those of high energy drinks (glucose) suggesting that *kunun-zaki* would be beneficial to diabetic patients. The aim of the present work is to evaluate the nutritional and sensory quality attributes of *kunun-zaki* produced using the hydrolytic enzymes from malted rice grain.

Materials and Methods

Millet (*Pennisetum typhodeum*), sorghum (*Sorghum bicolor*), maize (*Zea mays*) and spices such as ginger (*Zingiber officinale*), black pepper (*Pipper sp*) and clove (*Enginia sp*) were purchased from Post Office Market Bida. Paddy rice (*Oryza sativa* FARO 37) was purchased from the National Cereal Research Institute Badeggi Niger State. These grains were sorted, cleaned and stored in cellophane bags.

Malting

A 500g of the paddy rice was washed with tap water and soaked in 1000ml

of tap water (1:2w/v) for 12hrs and then drained. The drained grains were couched by covering them with moist cloth for 3-4days at ambient temperature (25-30°C) to germinate. The dried malted rice were ground and packed in cellophane bags.

Production of *kunun-zaki*

Kunun-zaki was produced from millet, maize and sorghum respectively. The cleaned grains were steeped in tap water (1:2w/v) for 24hrs, mixed with spices and washed in fresh tap water before wet milling. The resulting slurry (i.e. paste) was then sieved (mesh size: 350mm) in excess tap water. Following sedimentation, both the uncooked and cooked pastes (at 45°C) were mixed in an unequal ratio (1:3v/v) as described by Efiuwewere and Akoma (1995), followed by further dilution with 3vol water. This mixture was allowed to ferment for 8-10hrs (ambient temperature) to *kunun-zaki*, which was sweetened with sugar to taste.

The same procedure was adopted in the production of *kunun-zaki* using ground-malted rice grain. However, in the later, the ground-malted rice was mixed with the uncooked paste (1:4w/w) before being added to the cooked paste (i.e.

gelatinized starch at 45°C) and stirred vigorously for about 5min. This mixture was allowed to ferment for 8-10hrs following which it was sieved (aseptically). Artificial sweetening agent was not added to this product.

Chemical analysis

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) was determined by titration of 10ml *kunun-zaki* against 0.1N NaOH to phenolphthalein end point. Total soluble solids were determined in duplicates using Abbe 60 Refractometer and the result expressed as degree brix (°Brix).

Acidity (volatile) and specific gravity of the samples were determined as described by Pearson (1976) while ash, sugar (% sucrose) and protein content were determined according to AOAC (1980) methods.

Calcium and iron contents of the samples were 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 (1980). Total phosphorus in the samples was determined with a Technician Auto-analyser (AA 11) after incubation with molybdo-vanadate solution (AOAC, 1980).

Sensory evaluation

The sensory attributes (appearance, taste, texture, aroma and overall acceptability) of *kunun-zaki* produced from various cereals were evaluated by a 10-member panel, comprising of students and lecturers in the Department of Science Laboratory Technology using a 7 point hedonic scale; where 1= like extremely, 4= neither like nor dislike and 7= dislike extremely (Larmond, 1977) to assess the level of acceptability of the products.

Statistical analysis

Mean differences in sensory quality were

Table 1. Chemical composition of *kunun-zaki* produced with or without the addition of ground-malted rice

Analysis	Product ^{1,2}					
	Mil	Mil + GMR	Sor	Sor + GMR	Mai	Mai + GMR
pH	3.6	3.5	3.7	3.6	3.7	3.6
TA (%lactic acid)	0.747	0.789	0.732	1.512	0.597	1.610
Acidity (%acetic acid)	0.68	1.4	0.51	1.2	0.59	1.22
Sugar (%sucrose)	6.74	10.24	3.74	8.10	4.32	8.24
Specific gravity	1.0454	1.0511	1.0346	1.0468	1.0397	1.0481
Total solid °Brix	13.2	14.1	13.4	14.5	13.2	14.3
Ash (%)	0.174	0.30	0.18	0.33	0.18	0.32
Iron (%)	0.0022	0.0027	0.0017	0.0020	0.0016	0.0019
Calcium (%)	0.012	0.015	0.010	0.014	0.011	0.014
Protein (% factor 6.25)	0.76	1.01	0.63	0.91	0.54	0.88
Phosphorus (%)	0.04	0.11	0.04	0.10	0.04	0.10

¹Each value is the mean of two determinations.

²Mil = millet, Sor = sorghum, Mai = maize, GMR = ground malted rice.

Table 2. Sensory Quality attributes of *kunun-zaki* following production

Product	Sensory scores ^{1,2,3}				
	Appearance	Texture	Taste	Aroma	SOA
Millet	2.5±1.5	2.5±1.2	3.0±0.94	3.1±1.4b	2.3±1.2
Millet+ GMR	2.4±0.7	2.5±1.2	3.8±1.3	4.1±1.5a	3.2±1.1
Sorghum	2.8±1.6	3.6±1.7	5.0±1.6	2.8±1.4b	3.4±1.5
Sorghum + GMR	2.5±1.2	3.0±1.3	4.1±1.8	4.7±2.0a	3.9±1.5
Maize	2.9±1.9	2.9±1.4	3.7±1.7	3.1±1.5b	3.4±1.7
Maize + GMR	2.6±1.5	2.7±0.5	3.8±1.4	4.3±1.2a	3.1±1.1

¹Each value is the mean ±SD of 10-member panelist

²Values with different letters within each column are significantly different (p<0.05)

³SOA =sensory overall acceptability; GMR + ground malted rice

computed using analysis of variance (ANOVA).

Results and Discussion

The *kunun-zaki* produced with the addition of ground-malted rice to either millet, sorghum or maize as shown in **Table 1** resulted in 33, 44, 63% increases in crude protein as well as 52, 117 and 91% increases in sucrose contents respectively. A similar trend was observed in the phosphorus, calcium, iron and ash contents (**Table 1**). The implication of this study is that, malting of rice increased the quantity of hydrolytic enzymes (amylase, protease etc) present in them resulting in products that are more nutritious than those *kunun-zaki* produced without the addition of malted rice. Also, the higher sucrose contents of these products could possibly account for the higher acidity of these products as against those obtained from other treatments (**Table 1**). Similarly, the pH of the *kunun-zaki* during the production stage showed a

marked decrease with concomitant increase in titratable acidity in all the treatments, however, these changes were more prominent in those substrates treated with extracts from ground-malted rice (**Figures 1 and 2**). Lactic acid bacteria fermentation has been shown by several workers to improve the nutritional quality of foods: there is increase in bio-availability of iron and other minerals (Anderson, 1988), phosphorus is released from phytate (Lopez *et al*, 1983) while thiamine and riboflavin are increased (Steinkraus, 1983). Therefore, the results obtained in this present study agree with the findings of these workers.

The organoleptic quality of *kunun-zaki* produced using the combinations of cereal and ground-malted rice did not differ significantly (p>0.05) from other products in sensory attributes except in aroma (**Table 2**). It is likely that the higher acidity of these products (**Table 1**) possibly enhanced their aroma thereby making them preferable (**Table 2**). Ayo

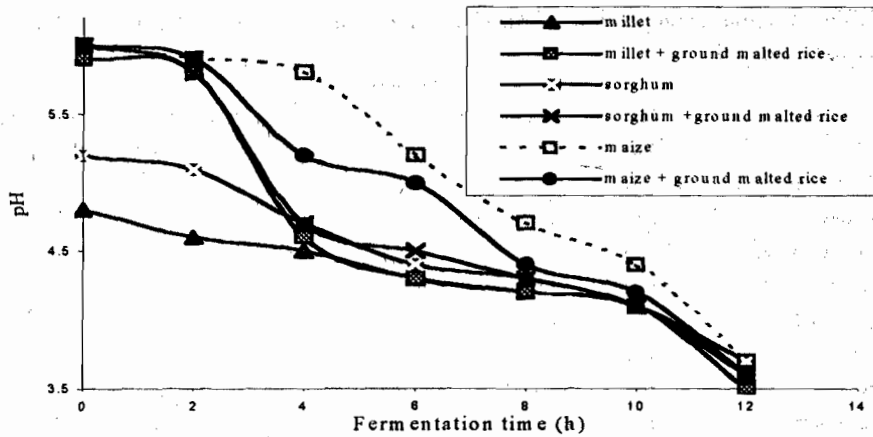


Figure 1: Changes in pH of kunun-zaki during production.

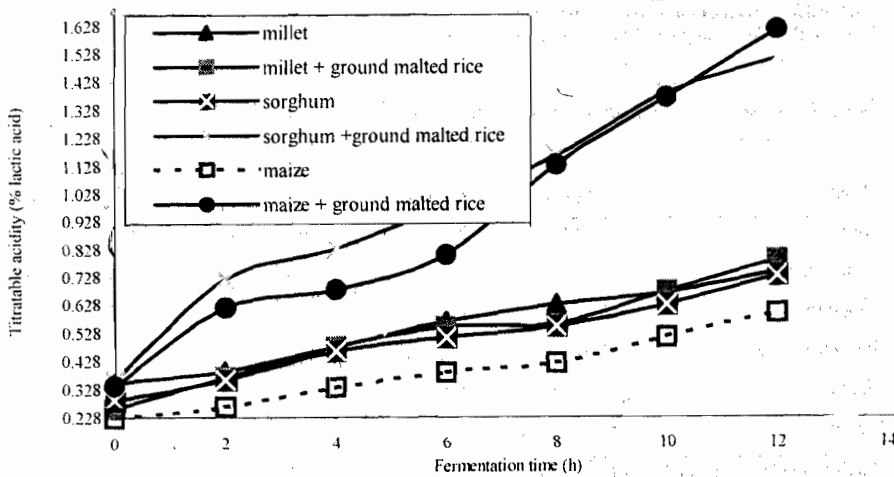


Figure 2: Changes in TA of kunun-zaki during production.

and Okaka (1998) reported producing sweetened *kunun-zaki* by using crude extracts of *Cadaba farinosa* (a hydrolytic enzyme), which according to these workers digested the thick gelatinous starch of the cereal substrate used in the production to smaller units (maltose, glucose and dextrin).

Intense souring activity (evident by gas bubbles) was observed as fermentation progressed particularly at the 6th hour in those substrates previously treated with

hydrolytic enzymes from ground-malted rice. A rapid breakdown (liquefaction) of the gelatinized starch was noticed when; the mixture of ground-malted rice plus uncooked and cooked paste was vigorously stirred together resulting in the production of sweet substrates. Other workers have advocated the use of an alternative-sweetening agent for use in the production of *kunun-zaki* so as to reduce the rising cost of the product and as well as for health purposes (Ayo and Okaka, 1998;

Awogbenga *et al.*, 1999). This suggestion is confirmed by the results obtained in this study. We therefore conclude that it could be economical and nutritious to use malted cereal grains in the production of *kunun-zaki*.

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