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Research Article

Effect of Fermentation Variables on Nutritional and Organoleptic Scores of Kunu-Zaki Produced From Rice and Acha Blends

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Abstract: Kunu-zaki was produced from different blends of rice and acha. The samples were subjected to sensory evaluation by panellists and scoring was done on a seven point hedonic scale where 1-7 represents like extremely to dislike extremely. Three samples (Rice: Acha 3:0, 3:1 and 3:2) were significantly ($p<0.05$) preferred. These were further produced by fermentation with or without aeration. The results show that fermentation with or without aeration did not significantly affect both nutrient levels and organoleptic acceptability. The results also show that kunu-zaki produced from rice and acha blends in a ratio of 3:1 is more preferred organoleptically than that produced from either rice or acha only.

Keywords: Acha, fermentation, kunu-zaki, nutrient levels, rice, sensory evaluation

INTRODUCTION

Cereals constitute a major part of the diet in Africa and they are used to prepare a variety of food and beverages one of which is kunu-zaki (Adebayo *et al*., 2010). Kunu-zaki is the name given to all kinds of sweetened and non-alcoholic cereal based beverages among the Hausas in the northern part of Nigeria. It has low viscosity, a sweet-sour taste depending on the level of fermentation and is milky cream in appearance Adeyemi and Umar (1994). Specifications are normally attached to denote source from which it was made hence kunu-zaki is referred to as "sweet kunu'', kunu-gyada is "groundnut kunu'' or kunu made from groundnut.

Kunu-zaki, known for its moderately high carbohydrate content, sweet taste and low viscosity, is produced mainly from millet (Pennisetum spp), although sorghum (Sorghum bicolor), maize (Zea mays), rice (Oryza sativa) and other cereals could be used. It is normally flavoured with a combination of spices commonly called "Kayan yaji'' which includes ginger (Zingiber officinale), cloves (Eugenia aromatica), black pepper (Piper guinese) and cinnamon (Xylopia acthiopica) (Jay, 1987; Adebayo *et al*., 2010). The nutritional and medical value of kunu-zaki has been reported in literature (Ayo *et al*., 2004). The production of kunu-zaki involves steeping the grains in water over a period of 8-48 hours during which period fermentation occurs (Adeyemi and Umar, 1994). The grains are then wet milled and sieved. The sediment obtained is divided into two unequal portions; one portion is cooked and then mixed with the uncooked portion and allowed to ferment for 8-10 h after which it is sieved using a muslin cloth (Efiuvwevwere 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 then sieving is done. The filtrate-kunu zaki is consumed as a beverage with or without addition of sugar as a sweetener (Gaffa and Ayo, 2002).

Although a lot of research study has been done on the production, microbial analysis, nutritional value, organoleptic evaluation and storage of kunu-zaki, there is no documented literature on its production from rice and acha, singularly or in combination. Hence this research was done to evaluate the effect of fermentation variables on the nutritional properties of kunu-zaki produced from rice and acha blends and also test its organoleptic acceptability.

MATERIALS AND METHODS

Materials: Rice (Oryza sativa) was obtained from Vunchi village, Niger state. Acha(Digitaria exilis) was obtained from National Cereal Research Institute (NCRI) Badeggi, ginger (Zingiber officinale), cloves(Eugenia carypyllata), black pepper(Piper guinese) and cinnamon (Xylopia acthiopica) were all purchased from Minna Central market, Niger state, Nigeria.

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Malting: One thousand grains (1000 g) of both rice and acha were weighed into separate plastic buckets. The grains were washed separately and steeped in tap water (1:2w/v) for 24 h and dried. The grains were spread on a clean flat surface and covered with a clean sac. It was kept at ambient temperature (25-29°C) in the dark for three days and allowed to germinate. This is to facilitate the development of amylases and proteases. After malting, the germinated grains were packed in sterile polythene bags and frozen until they were used.

Production of kunu-zaki: The grains (rice and acha) were cleaned and steeped in tap water (1:2w/v) for 24 h. The grains were washed and then mixed with the spices (ginger, cloves, black pepper and cinnamon) and wet milled. The paste was divided into two portions. To each half, the required milled malted grains were added. One portion was cooked and allowed to cool to 45°C and then the uncooked portion was added and mixed as described by Efiuvwevwere and Akoma (1995). The mixture was allowed to ferment for 12 h after which it was sieved. Nine samples of kunu-zaki were produced from a combination of rice and acha in varying percentages as follows:

Sample A- rice only	1:3 (malted:unmalted)
Sample B- acha only	1:3 (malted:unmalted)
Sample C- rice and acha	1:1
Sample D- rice and acha	1:2
Sample E- rice and acha	2:1
Sample F- rice and acha	3:1
Sample G- rice and acha	3:2
Sample H- rice and acha	2:3
Sample I- rice and acha	1:3

Sensory evaluation: Sensory evaluation was done on each of the nine kunu-zaki samples produced by a panel of 13 judges comprising of some trained students and experienced lecturers as described by Larmond (1977). The quality characteristics including appearance, aroma, taste and overall acceptability of the samples were evaluated based on a seven point hedonic scale (where 1 = like extremely, 2 = like very much, 3 = like slightly, 4 = neither like nor dislike, 5 = dislike slightly, 6 = dislike very much, 7 = dislike extremely).

From the sensory evaluation scores, the most acceptable products were further produced by varying the fermentation conditions which include aeration, non-aeration and pH.

Proximate analysis: Moisture content, crude protein, crude fat and ash were determined as described by AOAC (1990).

Table 1: Sensory scores of Kunu-zaki produced from rice and acha blends

Samples	Appearance and colour	Taste	Aroma	Overall acceptability	Total score
A	2.0±0.9	2.0±0.7	2.1±1.0	1.8±0.8	7.9±0.9^{a}
B	2.9±1.1	4.0±1.5	3.6±1.4	4.0±1.7	14.5±1.5^{c}
C	2.4±0.7	1.9±0.8	2.4±1.0	2.6±0.6	9.3±0.8^{ab}
D	2.6±0.9	2.5±1.2	2.4±1.2	2.8±0.8	10.3±1.0^{abc}
E	2.5±0.5	1.9±0.9	2.1±1.0	2.3 ±0.9	8.8±0.8^{ab}
F	1.9±1.0	2.1±0.9	1.9±0.8	1.9±0.7	7.8±0.9^{a}
G	1.9±0.8	2.0±1.0	2.4±1.2	2.1±1.0	8.4±1.0^{ab}
H	2.0±1.1	2.6±1.5	2.5±1.5	2.4±1.2	9.5±1.3^{ab}
I	3.2±1.8	3.7±1.5	3.5±1.8	3.7±1.7	14.1±1.7^{bc}

Values are expressed as mean ±SD for 13 assessments from panel members, different letters within the same column are significantly different ($p<0.05$)

Table 2: Sensory scores of Kunu-zaki produced from rice and acha blends with and without aeration

Samples	Appearance and colour	Taste	Aroma	Overall acceptability	Total score
A^1	1.8±0.6	2.0±0.9	2.0±0.7	2.2±1.0	80±0.8^{a}
A^2	2.0±0.8	2.8±1.2	2.5±1.1	2.5±1.0	9.8±1.0^{a}
F^1	1.8±0.9	2.1±1.1	1.6±0.5	2.0±1.0	7.5±0.9^{a}
F^2	1.8±0.7	2.5±1.1	1.8±0.4	2.2±0.9	8.3±0.8^{a}
G^1	1.8±1.0	2.4±1.1	2.1±1.9	2.0±0.7	8.3±1.2^{a}
G^2	2.2±1.1	3.6±1.7	3.0±1.8	2.8±1.1	11.6±1.4^{a}

^{1} and ^{2} represent fermentation with and without aeration respectively

Table 3: Proximate analysis for preferred Kunu-zaki samples (Rice and Acha, 3:0, 3:1 and 3:2)

Samples	% Carbohydrate	% Protein	% Fat	% Fibre	% Moisture	% Ash	NFE*	Energy (Kjg^{-1})
A^1	7.7	2.5	2.8	0.0	85.2	1.8	92.9	1708.6
A^2	8.0	2.4	2.6	0.0	85.2	1.8	93.2	1704.4
F^1	8.7	4.0	3.5	0.0	82.2	1.6	90.9	1726.6
F^2	7.7	3.9	3.6	0.0	83.2	1.6	91.0	1730.4
G^1	8.2	4.5	3.6	0.0	82.2	1.5	90.4	1730.4
G^2	8.1	4.5	3.8	0.0	82.2	1.4	90.3	1736.3

^{1} and ^{2} represent fermentation with and without aeration respectively; *: Nitrogen free extract

Statistical analysis: The mean of three replicates was taken and statistical analysis (ANOVA and Dunnet's posthoc test) was done using graph pad prism version 5.0 software.

RESULTS

The sensory scores of kunu-zaki produced from rice and acha blends, are shown in Table 1:

As shown in table one above, kunu-zaki produced from rice and acha blends was generally preferred with higher amounts of rice and lower amounts of acha used (Samples F and G) and did not differ significantly from samples produced from rice only. The production of kunu-zaki from rice and acha blends with increased amounts of acha (Samples D and I) resulted in a reduction in the acceptability which was significant ($p<0.05$) when acha only (Sample B) was used. Samples A, G and F (rice: acha; 3:0, 3:2 and 3:1, respectively) were selected for further fermentation with or without aeration, to determine the effect on its acceptability and nutrient level. The results are shown in Table 2 and 3:

As seen in Table 2 and 3 above, fermentation with or without aeration in the production process of kunu-zaki from rice and acha blends, does not significantly affect the sensory scores or the nutrient and energy value of the beverage.

DISCUSSION

In most developing countries, there is a high cost of fortified foods which normally is beyond the reach of the rural people who constitute a major part of the population in these countries. This has resulted in a dependence on traditional foods consisting mainly of un-supplemented cereals such as maize, millet and sorghum. In view of this therefore, there is a need for blending of locally available food commodities. A number of foods have been researched into and blended to give rise to more nutritive foods (Nnam, 2002). This study shows that the popular local beverage kunu-zaki usually produced from cereals like millet, maize, rice, groundnut, rice and sorghum, can be produced from a blend of other cereals like acha which is highly nutritive, to improve the nutritional quality of the drink. From the results, kunu-zaki produced from a blend of rice and acha, has a higher protein value (Table 3) than that from millet, guinea corn and maize as reported by Adebayo *et al*. (2010). Kunu-zaki produced from rice and acha (rice: acha 3:2) was most preferred while that from acha only was least preferred (Table 1). With increasing amounts of acha, there is a decrease in acceptability. This could be as a result of the fact that rice has a sweeter more preferred taste than acha. As can be seen from Table 3, there is an increase in protein and energy value of the drink with increase in amount of acha used consistent with data given by Solomon (2005) on the nutrient composition of rice and acha where acha was shown to have higher protein content than rice. There was no significant difference in organoleptic acceptability and nutrient quality of samples fermented with or without aeration (Table 3) showing that the fermentation required in the kunu-zaki production process is not significantly affected by aeration.

CONCLUSION

Data from this study reveal that a commercially acceptable kunu-zaki can also be produced from a blend of rice and acha which is highly nutritious adding to the various forms in which rice and acha could be used as a food source especially for children, nursing mothers and invalids who require a high calorie liquid diet.

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