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RESEARCH ARTICLE

Effect of carrot flour on functional properties and mineral composition of instant Kunu-Zaki blends made from sorghum

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ABSTRACT

Instant Kunu-zaki, samples were produced using fermented sorghum and carrot processed into flour. It was prepared by blending different ratios of fermented sorghum flour and carrot flour (90:10, 75:25, 70:30, and 65:35). The functional and mineral properties of these flour blends were evaluated. Loose density values ranged from 0.50 to 0.54g/ml, bulk density ranged from 0.73 to 0.81g/ml, swelling index ranged from 0.96 to 2.57% g/ml, wettability ranged from 23.00 to 71.07%, viscosity ranged from 33.60 to 30.63 CPS, water absorption capacity ranged from 180.90 to 350.08% and dispersibility ranged from 60.33 to 67.57%. Increase in proportion of carrot flour significantly ($P < 0.05$) increased the swelling Index, wettability, water absorption and dispersibility. The result of the mineral evaluation shows that increase in addition of carrot flour increased potassium content from 7.83 to 14.09mg/100g, calcium from 4.56 to 10.11mg/100g and iron from 4.83 to 9.86mg/100g. This shows that addition of carrot flour into sorghum improved the mineral content of instant Kunu-zaki as well as improved the functional properties. It is recommended that further research should be carried out on consumers' acceptability and storage life of the instant Kunu-Zaki produced from composite flour.

Keywords: Carrot Flour, Functional Properties, Kunu-zaki, Mineral Properties, Sorghum Flour

1. INTRODUCTION

Kunu is a cereal based on non-alcoholic fermented beverage mostly consumed in the northern part of Nigeria. It can be produced either from millet (*Pennisetun glaucum*), sorghum (*Sorghum bicolor*) or maize (*Zea mays*) and other raw materials like sweet potatoes and spices. Among other several types of Kunu, Kunu-zaki (from sorghum) is the most preferred [1]. It is consumed anytime of the day by both adult and children as a breakfast food drink or as, it is a refreshing drink, and can also serve as an appetizer [2]. It is also sometimes used as a weaning drink for infant [3]. Kunu-Zaki processed from sorghum grain contains protein, fat, ash and carbohydrate.

Sorghum is widely grown for food use in Africa. It is eaten as flat bread prepared from fermented dove (Kisra), fermented porridge (ting, Uji, Togwa) and alcoholic and non-alcoholic beverages (e.g. Kunu-Zaki, brukutu, Pito, Dolo and Buskra) respectively. Sorghum consists essentially of starch, protein and fat. It is a source of the B group vitamins especially thiamine, riboflavin and Niacin. It contains a detectable amount of vitamin D, E and K. Sorghum also contains mineral such as Fe, Zn, P, K, and Cu.

Daucus carota popularly known as carrot is the most important crop of Apiacea family. It is one of the most important vegetable grown throughout the world and it is one of the most single sources of carotenoid. Carrot has many medicinal properties, they are said to cleanse the intestine and to be diuretic, revitalizing and nice in alkaline element which purify the blood.

Carrots are one of the highest contributors of vitamin pro A-the power house vitamin for so much of our body and it also provides ample amount of vitamin C, D, E, K, as well as many mineral such as magnesium, potassium and calcium. They are also highly nutritious due to their high fibre content.

Kunu- zaki has a short shelf life due to its high moisture content making it highly susceptible to microbial proliferation hence, the need to produce instant Kunu-zaki flours. Many researchers have tried to find a way to improve the shelf life of Kunu-zaki, by addition of preservatives, other by processing to powdered forms. All these methods could affect its nutritional composition therefore the need to improve its nutritional values.

Sorghum though containing a good amount of essential nutrients and mineral which is good for human health is limited in pro-vitamin A. this nutritional deficiency could however, be improved by the addition of carrots. This study was therefore, designed to evaluate the effect of adding carrot flour to the mineral composition of this instant Kunu-Zaki.

2. METHODS AND MATERIALS

2.1. Sample Collection

The raw materials used for the preparation are sorghum grain, carrot, black pepper, clove, tamarine, sugar and ginger which were collected from local market of the area.

2.2. Sample Preparation

2.2.1. Preparation of Carrot Flour

About 25kg of moderately carrot (*Daucus-carota*) were sorted, washed, peeled and the carrot were manually sliced (approximately 1.50-2.50mm thick). The slices of carrot were spread on jute bag to avoid non-enzymatic browning as a result of direct contact of the slices with metal tray and oven dried at 50°C for 12 hours , it was then milled after cooling using a locally fabricated miller and sieved through a 212µm sieve to obtain carrot flour.

2.2.2. Preparation of fermented Sorghum Flour

Two kilogram of sorghum grains were washed in tap water and then soaked for 48 hours for it to ferment. The soaking water was changed every 12 hours. Thereafter the grains were dehulled using a mortar and pestle and washed again to remove the bran. The dehulled grains were oven dried at 600°C for 12 hours and thereafter milled and sieved through a 212um sieve to obtain fermented sorghum flour.

2.3. Formulation of composite flour for instant kunu-zaki production

The formulation was carried out using the method of Sengev IA, *et al.*, (2010) [4]. Fermented sorghum flour and carrot flour were blended at varying proportion (90:10, 75:25, 70:30, 65:35) respectively to obtain 4 different composite flour samples. Spices such as ginger (0.6%), cloves (0.4% and pepper (0.1%) were added to each blends. The blended flour was packed into air tight containers ready for analysis.

2.4. Functional Properties Analysis

Loose and packed bulk densities, the Swelling Index, Dispersibility, Viscosity and Water Absorption Capacity of the samples were all determined using the method described by Onwuka [5].

2.5. Statistical Analysis

Data obtained from functional properties and mineral composition were subjected to analysis of variance (ANOVA) using statistical packaged for social science (SPSS) version 21.0. Duncan's multiple range test (DMRT) was used to compare the means statistical significance was accepted at P < 0.05.

3. RESULTS AND DISCUSSION

The result of functional properties is presented in table 1. The addition of carrot flour significantly (P < 0.05) affects the bulk density of the flour blends. However Thaoge *et al.,* (2002) [6] reported similar values of both loose and bulk densities for instant Kunu-mix. The bulk and loose densities ranged from 0.050 to 0.54glml respectively. Bulk density gives an indication of the relative volume of packaging material required. Generally, higher bulk density is desirable for the greater ease of dispersibility and reduction of paste thickness which is an important factor in convalescence in child feeding [7].

The swelling index of the sample ranged from 0.96 to 2.57%. Significantly (P<0.05) difference were observed among the sample. Increase in addition of carrot significantly (P<0.05) increased the swelling of the sample. Addition of carrot flour significantly (P<0.05) affected the wettability of the flour blends. Thaoge *et al.,* (2002) [6] reported higher values of the wettability for instant Kunu-zaki, ranging from 23 to 71 g/ml. The addition of carrot flour had no significant (P > 0.05) difference on the dispersibility of the blend; however, the dispersibility values of the flour blends were high, ranging from 60.30 to 67.51%. The viscosity of the flour blends decreased as the carrot flour increased. The decrease in viscosity may be ascribed to the reduction of sorghum flour which consequently reduced the starch content of the blends.

The lower viscosity indicated that the flour could be used as weaning food and more flour concentration would be required to form gel and improved on the nutrient density of the food [8]. The effect of carrot flour on the mineral composition of instant Kunu-zaki is presented in table 2.

Table 1. Effect of carrot flour on functional composition of instant Kunu-zaki

Sample	UMC_1	UMC_2	UMC_3	UMC_4
Loose Density	$0.50^{b}\pm0.00$	$0.53^{a}\pm0.00$	$0.54^{a}\pm0.00$	$0.54^{a}\pm0.01$
Bulk Density	$0.73^{c}\pm0.01$	$0.77^{b}\pm0.00$	$0.80^{a}\pm0.00$	$0.81^{a}\pm0.02$
Swelling Index	$0.96^{d}\pm.02$	$1.81^{c}\pm.001$	$2.01^{c}\pm0.11$	$2.57^{a}\pm0.01$
Wettability	$23.00^{d}\pm1.00$	$44.88^{c}\pm0.01$	$60.00^{b}\pm0.07$	$71.07^{a}\pm0.06$
Viscosity	$33.60^{d}\pm0.10$	$35.10^{c}\pm0.10$	$30.30^{a}\pm0.6$	$30.63^{b}\pm0.06$
WAC	$180.90^{d}\pm0.5$	$274.00^{c}\pm5.60$	$291.66^{b}\pm1.5$	$60.33^{a}\pm0.58$
Dispensability	$67.57^{a}\pm0.01$	$65.32^{b}\pm0.02$	$64.10^{c}\pm0.17$	$350.08^{a}\pm0.13$

*Mean values on the same row having different superscripts are significantly different ($p < 0.05$)

Table 2. Effect of Carrot Flour on the Mineral Composition of Instant Kunu-zaki

Sample	Potassium (mg/100g)	Calcium (mg/100g)	Iron (mg/100g)
UMC_1	$7.83^{d}\pm0.17$	$4.56^{d}\pm0.07$	$4.83^{d}\pm0.02$
UMC_2	$8.67^{b}\pm0.04$	$4.81^{b}\pm0.02$	$8.24^{b}\pm0.51$
UMC_3	$8.90^{a}\pm0.05$	$6.62^{a}\pm0.02$	$9.00^{a}\pm0.05$
UMC_4	$14.09^{c}\pm0.09$	$10.11^{c}\pm0.07$	$9.86^{c}\pm0.51$

*Mean values on the same row having different superscripts are significantly different ($p < 0.05$)

UMC1-Kunu-zaki prepared with 90% sorghum:10% carrot flour,
UMC2-Kunu-zaki prepared with 75% sorghum:25%carrot flour,
UMC3-Kunu-zaki prepared with 70% sorghum:30% carrot flour,
UMC4-Kunu-zaki prepared with 65% sorghum:35% carrot flour

These were significant (P<0.05) differences in the mineral content of the samples. Addition of carrot flour significantly (P<0.05) increased the potassium from 7.83 to 14.09mg/100g. Potassium helps in regular heart rhythm and regulation of nerve impulse conduction.

The calcium content of instant Kunu-zaki ranged from 4.81 top 10.11. Calcium helps in clotting of the blood, Normal development and maintenance of bones and teeth.

There was significant (P<0.05) difference among the samples in their iron content of the sample. Addition of carrot flour significantly (P<0.05) increased the iron content of the flour blends. Iron content of the flour blends increased from 4.83 to 9.86 mg/100g. Iron is essential for formulation of haemoglobin of the red blood cells.

4. CONCLUSION

Instant Kunu-Zaki was produced from blends of fermented sorghum flour and carrot flour. Increase in proportion of carrot flour in instant Kunu-zaki significantly increased the functional properties like bulk density, wettability, water absorption capacity and dispensability.

Substitution of fermented sorghum flour with carrot flour significantly improved the calcium, potassium and iron content of Kunu-zaki. This study shows that addition of carrot flour to instant Kunu-zaki can significantly improve its functional and mineral composition. It is therefore recommended that further research be carried out on consumer's acceptability and storage life of the instant Kunu-zaki produced from composite flour.

5. ACKNOWLEDGEMENT

NA

6. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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