

MINERAL COMPOSITION, SHELF-LIFE AND SENSORY ATTRIBUTES OF FORTIFIED 'KUNUZAKI' BEVERAGE

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Abstract. 'Kunuzaki' is one of the nourishing and non-alcoholic beverages consumed in Nigeria. The processing involved washing of the grain (millet or maize or sorghum), par-boiling, grinding, sieving, cooking, cooling and storage after production. In this work, the sample was fortified with vitamin C, calcium, iron, flavour and preservations. The control and fortified samples were subjected to mineral determination and organoleptic tests using standard methods. The shelf-life span of the samples was examined. From the results, the samples fortified with calcium and iron produced the highest calcium ($64.8-73.5 \text{ mg}\cdot\text{kg}^{-1}$) and Fe ($8.1-9.2 \text{ mg}\cdot\text{kg}^{-1}$) values. The sample fortified with citric acid had the longest span (14 days) when stored at an ambient temperature. The best overall result was obtained in sample that contained all the additives.

Key words: 'kunuzaki' beverage, fortification, additives, minerals, organoleptic attributes, non-alcoholic

INTRODUCTION

'Kunuzaki' is a non-alcoholic beverage made from millet or sorghum grains. It is generally accepted and widely consumed in many parts of Nigeria. 'Kunuzaki' is stored in plastic containers and could be stored in refrigerators. It is a considerably cheap beverage drink because the ingredients used for the preparation are cheap and available anywhere in the market and stores.

The local process of preparation involves wet milling of the grains. Water, spices like ginger, nutmeg and *Piper guinense* are added to give good flavours and aromatic taste. Wide variation exists in the methods of preparation depending on taste, cultural norms and habits. For example, some people in some regions prefer it with much pepper and sugar while some with little or no pepper and sugar [Adeyemi and Umar 1994].

Food fortification has become prominent in recent years due to changes that have occurred in people's life-style, several diseases have nearly disappeared in developed

counties compared to underdeveloped. Additives used in fortifications are used to compensate for losses during processing, addition at levels higher than those found in the original food and includes adding nutrients that are not present in the original and addition to levels specified in the standards of identity [Nieman et al. 1992]. In Nigeria, there is a public awareness on public health measures to prevent diseases through fortification or enrichment.

Studies have been reported on 'kunuzaki'. Adeyemi and Umar [1994] reported the effect of methods of manufacturing on the quality. Bankole et al. [1999] reported on the anti-microbial effect of spices on 'kunuzaki'. Onuorah et al. [1987] reported on the occurrence of staphylococci and coliforms and utensils used in the preparation in Samaru, while Tahir and Oyewole [1993] also gave a report on the bacteriological studies. No report on fortification is available.

As the basic ingredients of 'kunuzaki' may have contents of some nutrients, it is considered that additions incorporation could be used to improve its nutritional quality. To this end, sugar, ferrous, sulphate, vitamin C, strawberry flavour, calcium carbonate and preservative (citric acid) were added to 'kunuzaki' beverage to improve its nutritional value and to help in preparation and storage. This work therefore investigated the mineral composition and sensory attributes of fortified and unfortified 'kunuzaki' drink.

MATERIALS AND METHODS

Collection of materials

The materials (soyabean, millet, vitamin C, calcium carbonate, ferrous sulphate, citric acid, strawberry flavour, red pepper, *Piper guinensis*, cloves, ginger, sugar and *Xylo-pia villosa* chip) used in the production of 'kunuzaki' were purchased from Oja-Oba market, Akure, Ondo state, Nigeria in May 2005.

Sample preparation

Figure 1 depicts the flow chart of 'kunuzaki' production. One kilogram of millet grains was washed, cleaned and steeped in twice its volume of two liters of water for 24 h, thereafter the steeped grains were washed, spices (w/w) added (0.65% ginger, 0.25% red pepper, 0.05% cloves 0.15% *Piper guinensis*) and ground into slurry. The slurry was divided into two equal halves with one half poured inside the pot, boiled and stirred for 2 min to the temperature of 35°C and subsequently added to the remaining half of the slurry, boiled for 5 min and allowed to cool. The 'kunuzaki' drink was measured (100 cm³) into four different containers. Into three of these containers, additives were added and no additive was applied into the last which served as the control (Table 1). Samples were assigned code numbers (K-K3).

Mineral determination

The sample (25 cm³) was placed in a conical flask, 25 cm³ of concentrated HCl and HNO₃ (1:1) was added and placed on a hot plate and heated until the solution became clear. This solution was made up to 50 cm³ with 10% HCl. The minerals were determined using SP 9 Pye Unicam Spectrophotometer. Appropriate filter and cathode lamps were selected for each mineral. The instrument was then set up according to the instruction in the manufactures manual.

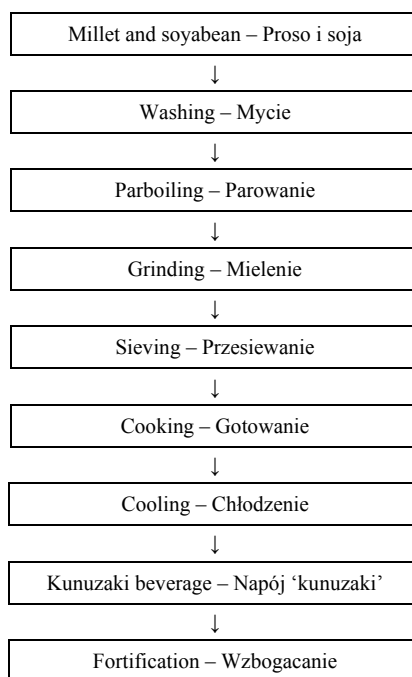


Fig. 1. Flow chart of 'kunuzaki' beverage production

Rys. 1. Schemat przygotowania próbek napoju 'kunuzaki'

Table 1. Recipe formulation of 'kunuzaki'
Tabela 1. Skład próbek napoju 'kunuzaki'

Sample code Próbka	Volume of drink Objętość napoju cm ³	Sugar Cukier g	Sitric acid Kwas cytrynowy g	Folic acid Kwas foliowy g	Flavour Zapach cm ³	Ferrous Sole żelaza g	Vitamin C Witamina C g
K (control)	100	–	–	–	–	–	–
K1	100	30	2.5	2.5	3	2.5	2.5
K2	100	30	–	–	3	2.5	2.5
K3	100	30	–	–	–	–	–

Sensory evaluation

To evaluate its acceptability, colour, taste, flavour and appearance were evaluated on a 9-point scale by trained panel of ten judges in Chemistry Laboratory of Federal College of Agriculture, Akure, Nigeria. The quality parameters were quantified and the mean scores of the ten evaluations were calculated.

RESULTS AND DISCUSSION

The mineral results are depicted in Table 2. The results ranged thus: Na (52.6-65.5), K (58.1-70.4), Fe (5.6-9.2), Ca (51.8-73.5), Zn (2.9-4.1), Mg (51.9-65.4) and Pb (not detected). From these results it was observed that the results of fortified 'kunuzaki' had higher values compared to the unfortified sample. This is attributed to the use of additives. In all the samples Pb was not detected meaning that the samples were devoid of this heavy metal which could lead to malfunctions of the body. The values of Na, Mg and Ca were in close agreement with those values reported for apricot purees [Voi et al. 1995] and fortified 'sobo' drinks [Abulude and Adebusey 2005], but higher than values earlier found by Ewaidah [1993] for grapes and Elkins et al. [1996] for apple juice.

Table 2. Mineral content of 'kunuzaki', mg·kg⁻¹
Tabela 2. Zawartość soli mineralnych w napoju 'kunuzaki', mg·kg⁻¹

Sample code* Próbka	Na	K	Fe	Ca	Zn	Mg	Pb
K (control)	54.6	64.2	7.5	51.8	3.4	65.4	ND
K1	65.5	70.4	9.2	64.8	2.9	56.6	ND
K2	48.9	62.9	8.1	73.5	4.1	62.7	ND
K3	52.6	58.1	5.6	54.4	3.7	51.9	ND

*See Table 1, ND – not detected.

*Tak jak w tabeli 1, ND – nie stwierdzono.

The result of organoleptic test is shown in Table 3 sample K1 had the highest value of 7.2 for colour. The panelists rated samples K, K2 and K3 the same (7.0), sample K2 had the highest value for flavour. As expected, this was due to the addition of the strawberry flavour. The acceptability of taste of K, K2 and K3 was due to the addition of sweetener (sugar). Overall acceptability is the product of colour, taste and flavour. Overall acceptability of fortified samples was higher than the control (K). There was least preference for control in terms of taste and overall acceptability. It could be concluded that fortification of 'kunuzaki' samples with additives to a certain level resulted in organoleptically more acceptable samples than the control.

Table 3. Organoleptic attributes of 'kunuzaki'
Tabela 3. Organoleptyczna ocena napoju 'kunuzaki'

Sample code Próbka	Colour Kolor	Flavour Zapach	Taste Smak	Overall acceptability Akceptowalność ogólna
K (control)	7.0	6.8	6.0	6.5
K1	7.2	7.5	7.1	7.2
K2	7.0	7.2	7.0	7.0
K3	7.0	6.5	7.0	6.9

*See Table 1.

*Tak jak w tabeli 1.

Table 4 shows the changes in pH and taste during storage at ambient temperature for 14 days period. There was rapid fermentation and spoilage in K, K2 and K3 due to sugar added. There was rapid drop in pH and sour taste developed after the second day of storage. This trend continued until samples were completely spoiled. In contrast the fortified 'kunuzaki' with preservatives remained fresh and maintained its attractive aroma and taste until the second week.

Table 4. Shelf-life of 'kunuzaki' stored at ambient temperature

Tabela 4. Trwałość napoju „kunuzaki” przechowywanego w temperaturze pokojowej

Storage days Czas przechowywania dni	pH				Taste – Smak			
	K	K1	K2	K3	K	K1	K2	K3*
1	4.21	4.20	4.22	4.21	fresh świeży	fresh świeży	fresh świeży	fresh świeży
2	4.21	4.20	4.22	4.21	fresh świeży	fresh świeży	fresh świeży	fresh świeży
3	3.67	4.20	3.57	3.66	spoilage sfermentowany	fresh świeży	complete spoilage całkowicie sfermentowany	complete spoilage całkowicie sfermentowany
4	3.54	4.20	3.57	3.66	complete spoilage całkowicie sfermentowany	fresh świeży	complete spoilage całkowicie sfermentowany	complete spoilage całkowicie sfermentowany
7	3.54	4.20	3.57	3.66	complete spoilage całkowicie sfermentowany	fresh świeży	complete spoilage całkowicie sfermentowany	complete spoilage całkowicie sfermentowany
14	3.54	4.20	3.57	3.66	complete spoilage całkowicie sfermentowany	fresh świeży	complete spoilage całkowicie sfermentowany	complete spoilage całkowicie sfermentowany

*Sample codes (see Table 1).

*Próbki kontrolne (patrz tabela 1).

Extraneous substances added to foods by the manufactures are known as additives though some are beneficial while others may be harmful. Food on the market shelves usually contains some vital substances added to make it more palatable or to increase its nutrients contents and shelf-life. At times, manufactures do add these substances to make the process involved easier while some other substances may accidentally found their ways into foods and beverages.

Preservations are normally added to protect food against spoilage and to increase their long shelf life. Refrigeration as one of the preservative method could be admitted since fungus and bacteria cannot withstand very low temperature. Natural and artificial

occurring agent/materials can impact flavour and odour to foods and beverages. These agents/materials include basically, extracts from spices and herbs, as well as synthetic agents e.g. peppermint, most synthetic flavours not only taste great like natural flavour but also have the advantage of stability [Wardlaw 1999].

Vitamin C performs variety of important cell functions. It does these primarily by acting as a non-specific reducing agent in the body at times vitamin C act as anti-biotic. It is often lost in the process of grinding and cooking and it is very unstable when in contact with heat, copper or oxygen. The RDA is $60 \text{ mg}\cdot\text{day}^{-1}$. The RDA is based on the threshold for urine excretion and for prevention of deficiency with a margin of safety. The major deficiency is known as scurvy which presents normal synthesis of collagen, thus causing wide spread and significant changes in the connective tissues throughout the body. The first sign and symptoms of scurvy include fatigue and pinpoint hemorrhages around their follicles on the back of the arms and legs. The signs are seen at about 20-40 days of vitamin C deficiency of the body. Treatment can be affected with adequate intake of foods and beverages fortified with vitamin C; also vitamin C tablets could be taken for the same purpose.

Folic acid is meant to produce red blood cells in the body; this is comprised of vitamin B. Deficiency in the body is abnormal. Low level of one of the B vitamins results in anemia. Anemia occurs in both the male and female, but it is very prominent in female. Folic acid deficiency has been indicated as a cause of natural tube defects in the developing fetus. Fatigue is often the first sign of folic acid deficiency anemia. Other symptoms include: anorexia, nervous, pale skin, rapid heartbeat, weakness and weight loss. Treatment is basically through supplements and good foods, self-care includes avoiding alcohol, nonherbal tea, antacids and phosphate contained in beer, ice cream and soft drinks, which restricts iron absorption [Wardlaw 1999].

Calcium is needed in the body. It works in conjunction with Mg and P for building and maintains strong bone, teeth and metabolism of vitamin D. Calcium also aids in enzyme secretion, fat metabolism, egg shell formation, blood clotting, muscle growth and contraction. It also maintains a healthy heart and it facilitates the passage of nutrients in and out of the cell wall [Wardlaw 1999]. The major symptoms of deficiency are skeletal abnormalities, osteopenia, osteomalacia, osteoporosis and rickets. Osteomalacia is a failure to mineralize the bone matrix, resulting in a reduction of the mineral content of the bone. In children, osteomalacia is known, as "rickets". Osteopenia is the presence of less than normal amount of bone. Osteopenia if not treated may result in osteoporosis. Other symptoms include insomnia, tenancy, premenstrual cramps and hypertension.

Sugar contains pure carbohydrate, provides calories, it does not contain any of the other important nutrients such as vitamins, fiber and minerals. Sugar consumption is linked to two important health problems, dental caries or tooth decay and reactive hypoglycemia (over production of insulin). The result is below normal drop in blood glucose [Slavin 1987]. All people should eat less sugar. Although sugar does not cause diabetes and there has been considerable debate on the effect of various sources of sugar on blood glucose. Over consumption of sugar certainly makes it more difficult to attain a reasonable weight [Nieman et al. 1992].

CONCLUSION

This work evaluated preparation of 'kunuzaki' with the addition of additives in response to mineral, shelf life and sensory properties. It showed that the desired attributes were not adversely affected with the fortification. The preservative had anti-microbial effect on the production, thereby increasing the shelf-life. In contrast the unfortified samples were adversely affected. It is recommended that local beverages should be adequately fortified so that the nutrients loss during processing would be replaced

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SKŁAD MINERALNY, TRWAŁOŚĆ I WALORY SENSORYCZNE WZBOGACANEGO NAPOJU 'KUNUZAKI'

Streszczenie. 'Kunuzaki' jest odżywczym i bezalkoholowym napojem konsumowanym w Nigerii. Proces produkcyjny polega na myciu ziarna (proso, kukurydza lub sorgo), potem jego parowaniu, mieleniu, przesiewaniu, gotowaniu, chłodzeniu i przechowywaniu gotowego napoju. W ramach badań do próbek napoju dodawano: witaminę C, sole wapnia i żelaza oraz preparaty smakowo-zapachowe i utrwalające. Zarówno próbka wzorcowa,

jak i wzbogacone były poddane analizom chemicznym i organoleptycznym. Najbardziej trwałe stwierdzono dla próbek z dodatkiem kwasu cytrynowego (14 dni). Najlepszą jakością charakteryzowały się próbki zawierające wszystkie badane dodatki.

Słowa kluczowe: napój 'kunuzaki', wzbogacenie, dodatki, jakość, organoleptyka, bezalkoholowy

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