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Full Length Research Papers

Quality Characteristics of Kunun Zaki (A Nigerian Fermented Cereal Beverage) Sold Within Bida Metropolis

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The quality characteristics of kunun zaki obtained from four sales point within Bida metropolis as well as the laboratory produced one were evaluated in this study for its microbiological, chemical, physical and sensory characteristics. The results obtained show that the pH of the laboratory prepared kunun zaki (4.20) was significantly different ($p<0.05$) from the commercially prepared ones (3.13-3.36) however, there were no significant differences ($p>0.05$) among the means in titratable acidity of the five product in also, the TSS of the laboratory produced kunun-zaki (9.07) differed ($p<0.05$) from the rest products. Also, the total viable count (log_{10}cfu/ml) of the five types of kunun zaki evaluated in this study (2.01-2.90) showed that the laboratory prepared product had the least count (2.01 log_{10} cfu/ml) and this differed ($p<0.05$) from the counts obtained from the other products. Furthermore, the crude protein (%) of laboratory prepared kunun zaki was higher (1.43) and significantly different ($p<0.05$) from the other products. The magnesium content of kunun zaki purchased from the sales point at MQ lodge near Federal Polytechnic, Bida was higher (0.56) and differed ($p<0.05$) from the other products. Generally, the sensory quality characteristic (appearance and overall acceptability) of the kunun zaki produced in the laboratory was better and significantly different ($p<0.05$) from the other products. This study showed that if proper quality control programme is put in place in the production of indigenous food quality foods would be produced.

Keyword: kunun-zaki, quality characteristics, sales point.

INTRODUCTION

Kunun zaki is a traditional fermented non-alcoholic cereal beverage widely consumed in Northern Nigeria. It can be produced either from millet (*Pennisetum glaucum*), Sorghum (*Sorghum bicolor*) or Maize (*Zea mays*). It is believed to be of immense social, economic, nutrition and medicinal importance to its numerous consumers (Efiuvwewere and Akoma, 1995) and, generally regarded as an after-meal refreshing drink during the dry season in both rural and urban centres. Kunun zaki is widely consumed for its thirst quenching properties and is consumed throughout the year especially during the dry season. It can be sweetened with honey or sugar together with small quantities of sweet potatoes and spices-ginger, black pepper or clove (Elmahmood and Doughari, 2007). However, in spite of its popularity, kunun zaki is known to have short shelf life. This therefore, limits its production on a large scale and hence reduces the economic value of the product (Efiuwevwere and Akoma, 1997).

Several reports are available in the literature on kunun zaki with respect to its production, microbiological, sensory and nutritional quality characteristics during production and storage (Efiuvwevwere and Akoma, 1997; Akoma *et al.*,

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2002). Akoma *et al*. (2006) reported the medicinal quality attributes of kunun zaki, these workers reported a higher lymphocyte count in the blood serum of albino rats fed with kunun zaki over a certain period of time thereby, suggesting its medicinal attributes. At present, there is no information available on the quality characteristics of kunun zaki produced and sold within Bida metropolis and this therefore forms the basis of this study.

MATERIALS AND METHODS

Source of materials

Millet (*Pennisetum glaucum*), ginger (*Zingiber offinale*) black pepper (*Pipper spp*), clove (*Eugina caryophyllata*) and sweet potato (*Ipomea batatas*) were all purchased from Bida modern market. These grains were sorted, cleaned and stored in plastic containers before being used. Kunun zaki was purchased from various locations. Model market (BIDA 3), small gate (BIDA 1), MQ lodge (BIDA 2) and inside Federal Polytechnic Bida compound (BIDA 4) and as well as laboratory produced kunun zaki (Lab product).

Production of Kunun Zaki

Five hundred (500g) of millet was steeped in 1000ml of tap water (1:2w/v) in a plastic bucket for 8h after which the grain was washed and mixed with 60g of spices (ginger 40g, clove 10g, black pepper 10g) and 100g of dry sweet potato; these were washed and then ground to paste. The slurry was divided into two unequal portions (1:3w/w). One portion (larger portion) was cooked by adding boiling water and allowed to cool to about 50^{o}C following which uncooked portion (smaller portion) was added to the cooled gelatinized starch and then mixed thoroughly. The uncooked portion serves as source of inoculum and also enhances colour formation as well as the texture of the final product. The mixture was allowed to ferment for 8h after which it was sieved and packaged.

Total Viable Counts (TVC)

The total viable count of each sample was determined using pour plate technique (Harrigan and McCance, 1976) following serial dilution (10^{-1} to 10^{-6}) using sterile 0.1% peptone water on nutrient agar (LAB M) in triplicates. Plates were incubated aerobically at 35^{o}C and the colonies that developed 25 to 250 (Speck, 1984) were counted, calculated and recorded as colony forming units (cfu/ml) after 24-48h incubation period.

Coliform and fungal counts

Coliform counts of samples were determined on MacConkey Agar (LAB M) using pour-plate technique following appropriate dilution. The plate were incubated for 24h at 35^{o}C, colonies of typical characteristics (pink colour) were counted and recorded as coliforms (Harrigan and McCance, 1976). Fungal counts were determined on triplicate Potato Dextrose Agar (LAB M) plates incubated aerobically at ambient temperatures (30-35^{o}C) for 5-7 days (Harrigan and McCance, 1976). Colonies that developed were counted and recorded as cfu/ml.

Lactic acid bacteria (LAB) count

Lactic acid bacteria counts were determined on triplicate MRS Agar plates supplemented with 0.02% Sodium azide (Lindquist, 1998) and incubated at 35^{o}C for 5 days (Speck, 1984). Typical whitish, greyish/opaque pinpoint colonies were counted and recorded as cfu/ml (Harrigan and McCance, 1976).

Chemical Analysis

pH and titratable acidity (% lactic acid)

The pH of the five kunun zaki samples was determined in triplicates using pH meter (TECPEL pH meter, model 705) after standardization with pH 4 and 7 buffers (BDH, England). Titratable acidity of five kunun zaki sample was determined in triplicates by titrating 10ml of the sample with 0.1N NaOH to the phenolphthalein end point (pink).

Physical Analysis

Total soluble solid (^{o}Brix)

Total soluble solid of the five kunun zaki samples were determined in triplicate using Refractometer (CHASE brand Refractrometer) and the results expressed as degree brix (^{o}Brix).

Proximate Analysis

The moisture content, crude protein, ash content and total solid of the various kunun zaki were determined in triplicate as described in AOAC (1990).

Mineral Analysis

The mineral contents (magnesium, potassium, sodium and

Table 1. Chemical and physical characteristics of kunun zaki

	Product[1,2,3]				
Analyses	Lab product	BIDA1	BIDA2	BIDA3	BIDA4
pH	4.20±.06[a]	3.36±.01[c]	3.6±0.01[b]	3.13±0.03[e]	3.25±0.03[d]
Titratable acidity (% lactic acid)	0.620±0.265[a]	0.720±0.001[a]	0.831±0.001[a]	0.910±0.006[a]	0.780±0.001[a]
Total soluble solids (^{o}Brix)	9.07±0.03[a]	4.81±0.001[d]	4.90±0.01[c]	4.70±0.01[e]	5.50±0.01[b]

[1]Each data is the mean of triplicate determinations

[2]Different letters within the same row are significantly different ($p<0.05$)

[3]BIDA 1: vended at small gate Fed Poly; Bida 2: vended at MQ lodge near Fed. Poly Bida; BIDA 3: vended at modern market Bida; BIDA 4: vended inside Fed Poly Bida near SAAS complex

calcium) of the kunun zaki samples were determined in triplicate using Atomic Absorption-Spectrophotometer (Bulk Scientific, USA: Accusy 211) as described by AOAC (2006).

Organoleptic Analysis

The sensory evaluation of the five kunun zaki used in this study was done using a 7 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 (Larmond, 1977) to measure the sensory qualities (appearance, taste, aroma and overall acceptability) of the product by using 20-member panellist (comprising of lecturers, laboratory staff and students of the Department of Science Laboratory Technology, Federal Polytechnic, Bida). The panellists were instructed to rinse their mouth with clean water between the times of tasting.

Statistical Analysis

Analysis of variance (ANOVA) was carried out for the sensory scores, total soluble solids, proximate analysis, mineral analysis, pH and titratable acidity of the five kunun zaki used in this study. The mean scores were determined (Duncan, p=0.05) using 2006 Statistical Packages for Social Sciences (SPSS) for windows version 15.0 (SPSS, 2006).

RESULTS

pH and titratable acidity

The pH and titratable acidity of the five kunun-zaki (laboratory and commercially prepared kunun-zaki) evaluated in this study are shown in Table 1; the pH ranged from 3.13-4.20. The pH of laboratory prepared kunun zaki (4.20) was significantly different ($p<0.05$) from the commercially prepared ones. Similarly, the titratable acidity (% lactic acid) of the five products ranged from 0.620 – 0.910; there were no significant differences ($p>0.05$) among the means of the five kunun-zaki samples in their titratable acidity (Table 1).

Total soluble solid

The total soluble solids (TSS, ^{o}Brix) of the five kunun zaki of this study, ranged from 4.81-9.07; the TSS of the laboratory produced kunun-zaki (9.07) differed ($p<0.05$) from the rest products (Table 1).

Microbiological quality of kunun zaki

The total viable count (log_{10}cfu/ml) of the five types of kunun zaki evaluated in this study as shown in (Table 2) ranged from (2.01-2.90). The total viable count of the laboratory prepared product was the least count (2.01 log_{10} cfu/ml) and differed ($p<0.05$) from the other products (Table 2). The coliform count (log_{10}cfu/ml) as shown in (Table 2) ranged from (<1-1.31). The coliform count of laboratory prepared kunun zaki was insignificantly low (<1log_{10} cfu/ml, i.e. zero count).

The fungal count as shown in (Table 2) ranged from 2.00 - 3.50. The fungal count of kunun zaki obtained from the sales point at the Modern market (Bida 3) was higher (3.50 log_{10} cfu/ml) than the other products and differed significantly ($p<0.05$). The LAB counts of the five products are shown in (Table 2) and these ranged from 4.77-6.63 log_{10}cfu/ml. The LAB count of laboratory prepared kunun zaki was higher and significantly different ($p<0.05$) from the other products (Table 2).

Table 2. Microbiological quality of kunun zaki

Analyses	Products/Counts (log_{10} cfu/ml)[1,2,3]				
	Lab product	BIDA1	BIDA2	BIDA3	BIDA4
Total viable count	2.01±0.01^{d}	2.80±0.01^{c}	2.80±0.01^{c}	3.80±0.01^{a}	2.90±0.01^{b}
Coliform count	<1^{e}	1.41±0.01^{a}	1.21±0.01^{d}	1.24±0.01^{c}	1.31±0.01^{b}
Fungal count	2.10±0.01^{c}	2.10±0.01^{c}	2.00±0.02^{d}	3.50±0.01^{a}	2.40±0.01^{b}
LAB count	6.63±0.19^{a}	5.43±0.22^{b}	5.20±0.12^{bc}	4.77±0.09^{c}	5.47±0.24^{b}

[1]Each data is the mean of triplicate determinations

[2]Different letters within the same row are significantly different ($p<0.05$)

[3]BIDA 1: sales point at small gate Fed Poly; Bida 2: Sales point at MQ lodge near Fed. Poly Bida; BIDA 3: Sales point at modern market Bida; BIDA 4: Sales point inside Fed Poly Bida near SAAS complex

Table 3. Proximate and mineral composition of kunun zaki

Analyses	Products[1,2,3]				
	Lab product	BIDA1	BIDA2	BIDA3	BIDA4
Proximate (%)					
Crude protein	1.43±0.01^{a}	0.42±0.01^{d}	0.29±0.02^{e}	0.98±0.01^{b}	0.94±0.01^{c}
Ash content	0.03±0.01^{c}	0.01±0.01^{d}	0.09±0.02^{b}	0.13±0.01^{a}	0.03±0.02^{c}
Moisture content	78.81±0.01^{e}	89.910.02^{b}	85.83±0.02^{c}	90.71±0.01^{a}	82.20±0.02^{d}
Total solids	14.17±0.01^{a}	9.17±0.01^{e}	12.14±0.02^{c}	12.19±0.3^{b}	9.25±0.01^{d}
Mineral (ppm)					
Magnesium	0.42±0.01^{c}	0.40±0.01^{d}	0.56±0.02^{a}	0.43±0.03^{c}	0.55±0.01^{b}
Potassium	0.12±0.01^{b}	0.11±0.01^{b}	0.01±0.01^{c}	0.17±0.01^{a}	0.10±0.01^{b}
Sodium	0.02±0.03^{c}	0.15±0.01^{b}	0.80±0.01^{a}	0.01±0.02^{c}	0.02±0.01^{c}
Calcium	0.27±0.01^{a}	0.30±001^{a}	0.30±0.02^{a}	0.32±0.01^{a}	0.32±0.01^{a}

[1]Each data is the mean of triplicate determinations

[2]Different letters within the same row are significantly different ($p<0.05$)

[3]BIDA 1: sales point at small gate Fed Poly; Bida 2: Sales point at MQ lodge near Fed. Poly Bida; BIDA3: Sales point at modern market Bida; BIDA 4: Sales point inside Fed Poly Bida near SAAS complex

The proximate and mineral composition of kunun zaki

The crude protein (%), ash and moisture content (%) of the kunun zaki as shown in (Table 3) ranged from (0.29 – 1.43), (0.01-0.13), and (78.8-90.7) respectively. The crude protein (%) of laboratory prepared kunun zaki was higher (1.43) and significantly different ($p<0.05$) from the other products. The moisture content (%) of the laboratory prepared kunun zaki was the least (78.8) and this differed ($p<0.05$) from the moisture content of the other products (Table 3). The total solid of five types of kunun zaki evaluated in this study ranged from 9.17-14.17 the total solid content of the laboratory prepared kunun zaki was higher (14.17) and significantly different ($p<0.05$) from the other products.

The magnesium, potassium, sodium and calcium (ppm) of the five types of kunun zaki evaluated in this study (Table 3) ranged from (0.40-0.56), (0.10-0.17), (0.10-0.80) and (0.27-0.32) respectively. The magnesium content of kunun zaki purchased from the sales point at MQ lodge near Federal Polytechnic, Bida (Bida 2) was higher (0.56) and differed ($p<0.05$) from the other products and also, the potassium content of the kunun-zaki from BIDA 2 was lower (0.01) and differed significantly ($p<0.05$) from the rest products.. The sodium content of kunun zaki obtained from BIDA 2 was higher (0.80) and significantly different ($p<0.05$) from the other kunun-zaki (Table 3); but however, the calcium contents of the five kunun-zaki samples were not significantly different (Table 3).

Table 4. Sensory quality attributes of laboratory produced kunun zaki and those collected from four locations in Bida

	Products[1,2,3]				
Quality attributes	LAB1	BIDA (1)	BIDA (2)	BIDA (3)	BIDA (4)
Appearance	1.50 ± 0.11[b]	2.50 ± 0.21[a]	2.62 ± 0.31[a]	2.20 ± 0.23[a]	2.11 ± 0.10[a]
Taste	1.81 ± 0.2[c]	2.33 ± 0.30[bc]	2.71 ± 0.33[ab]	3.10 ± 0.33[a]	2.20 ± 0.80[bc]
Aroma	2.01 ± 0.24[c]	2.31 ± 0.22[bc]	2.80 ± 0.31[ab]	3.01 ± 0.32[a]	2.10 ± 0.21[c]
Overall acceptability	1.50 ± 0.13[b]	2.13 ± 0.22[a]	2.65 ± 0.23[a]	2.30 ± 0.22[a]	2.12 ± 0.21[a]

[1]Each data is the mean± standard error of 20 member taste panelist (7-point hedonic scale: 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)

[2]Different letters within the same row are significantly different ($p<0.05$)

[3] BIDA 1: sales point at small gate Fed Poly; Bida 2: Sales point at MQ lodge near Fed. Poly Bida; BIDA3: Sales point at modern market Bida; BIDA 4: Sales point inside Fed Poly Bida near SAAS complex.

Sensory quality of kunun zaki

The sensory quality characteristics of five types of kunun zaki evaluated in this study are shown in (Table 4) and this ranged from 1.50-2.62 (appearance), 1.81-3.11 (taste), 2.01–3.01 (aroma) and overall acceptability (1.50-2.65). Generally, the quality characteristic (appearance and overall acceptability) of the kunun zaki produced in the laboratory was better than the other four products and this differed significantly ($p<0.05$).

DISCUSSION

The result obtained in this study (Table 1) shows that the pH of the five products ranged from 3.25-4.20. The pH of kunun-zaki was reported by several workers to be in the range of 3.5-3.71 (Efiuvwevwere and Akoma, 1995); 3.4-4.3 (Elmahmood and Doughari, 2007). Therefore, the result obtained in this study is in agreement with those reported by these workers. The high acidity of the kunun-zaki as obtained in this study could be responsible for its enhanced sensory quality characteristics. The total soluble solid (^{o}Brix) of the kunun zaki prepared in the laboratory as observed in this study was higher (9.0, Table 1) than the commercially prepared one (4.8 – 5.5). This probably could be as a result of over dilution of the product with water during production by these producers in order to increase their profit margin. Such dilution of the product with water lowers the quality and increases the risk of contamination with pathogenic organism especially if the water source is of poor quality.

The total viable and fungal count was lower in the kunun zaki produced in the laboratory (Table 2) as compared with the commercially produced ones. This could be as a result of the strict sanitary measure that was put in place during production; hand gloves were worn, clean water was used and also the production area and utensils were properly cleaned and sanitized. The coliform count of the kunun zaki produced in the laboratory was insignificantly lower ($<1\log_{10}$ cfu/ml) than the commercial produced ones. This differences could be as a result of poor sanitary practices usually observed by the uneducated commercially producers; however, the presence of coliforms in the commercially produced kunun-zaki is worrisome. There is therefore, the need by the governmental agencies (NAFDAC: National Agency for Food, Drug Administration and Control) to always try to ascertain their suitability to produce foods for sales to the public. The crude protein (%), moisture content (%) and total solid (%) of the kunun zaki produced in the laboratory were generally higher (1.43, 78.81 and 14.17 respectively) than the other products obtained commercially (Table 3). The result of this study has shown that laboratory produced kunun zaki had a better quality characteristics (organoleptically, microbiological, chemical and physical) as compared with the ones produced commercially. This is also obvious since strict sanitary measures were put in place during its production which contributed to its excellent quality. Therefore, there is need for proper health education by NAFDAC and other governmental agencies as well as non-governmental agencies (NGO) to enlighten the local producers of this popular indigenous beverage on the need to observe strict good quality control measures during production.

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