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EFFECT OF SODIUM BENZOATE ON THE QUALITY AND SENSORY PROPERTIES OF *KUNUN-ZAKI* SUPPLEMENTED WITH GROUNDNUT

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ABSTRACT

The quality parameters of kunu-*zaki* supplemented with groundnut was investigated in this study. Millet, groundnut, ginger, dry red pepper and sugar were used for the production. After production, some samples were pasteurized at 70^{0}C for 30 minutes and stored at refrigerated (^{o}C) and ambient conditions (^{o}C). A fresh control sample was also prepared at interval for comparison. Analyses were carried out to determine the chemical composition, microbiological and sensory qualities of product during storage over a period of twenty seven (27) days. Results showed that addition of groundnut improved chemical composition of the fresh samples. It could be attributed to the crude protein and the fat content in the added groundnut. The results were: moisture, 75.7%; crude protein, 13.06%; fat, 7.35%; ash, 0.39% and carbohydrate, 3.5%. The pH values for the fresh samples were: 3.31 (pasteurized refrigerated); 3.31 (pasteurized unrefrigerated); 3.57 (unpasteurized refrigerated); 3.64 (unpasteurized unrefrigerated) and 3.93 for the Fresh sample. The results of the mineral element (mg/100g) were: Ca, 152; Na, 0.19; Mg, 4.76; K, 2.74 and P, 123.22. There was no detection of the presence of the indicator organism – *E coli*. Results of the sensory evaluation of the product carried out using a five-man panel showed that there were no differences in the appearance, taste and flavor for the first day. However, the pasteurized refrigerated sample with the addition of sodium benzoate was better on the overall acceptability.

Keywords: Kunun-zaki, Groundnut, Sodium Benzoate, Pasteurization, Shelf Life

INTRODUCTION

Cereal food products constitute the bulk of foods of the daily main dishes of the average individual in North-Eastern Nigeria and Africa as a whole. Different preparation methods of cereals give rise to different products. The methods may be based on tradition, culture and individual's taste or need with or without the addition of other ingredients to make up a food product. Various cereal based foods include: *Tuwo, Masa, Fura, Ndaleyi, Burabusko, Tawiska and Gunsa* (**Nkama *et al.*, 1995**). Local alcoholic and non-alcoholic beverages of cereal origin include: *Burukutu, Pito, Busa, Iber, Mahewu, Kafir and Kunun* among others (**Okafor, 1990**). *Kunun-zaki* is one of the most highly consumed cereal-based non-alcoholic, non-carbonated beverages in Northern Nigeria (**Sopade, 1992**). All cereal-based non-alcoholic beverages are generally known as *kunun* (Hausa) and are common in almost all the Northern States of Nigeria. According to **Nkama *et al.* (1995)**, *kunun*, is widely consumed by 79% of Northern Nigerians on a daily basis and the remaining 21% of the population take it occasionally. Different types of *kunun* are available and obtain their names based on type of raw material employed in production, sensory attribute, locality or any other ingredient that is introduced. These include k*unun* gyada, *kunun tsamiya, kunun bururu*, and *kunun-zaki* having groundnut seed paste, tamarind fruit pulp, fermented cow milk, and sugar respectively added to them without any preservative used. Generally, consumption cuts across all age groups and social status with the peak of consumption been the hot season of the year when it is served chilled particularly *kunun-zaki*. The nutrient composition of *kunun gyada* has been analyzed. For the purpose of acquiring full knowledge of the nutritive value of some of our local *kunun* types, their chemical analysis is necessary. This will enhance their wider acceptability and consumption as well as the needed exploitation. K*unun-zaki* has been reported to be 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 24 hours, 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 8-10 hours (**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, 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.
According to **Egwaikhide and Faremi (2010)**, the preparation and consumption of *kunun* drinks is in almost every household in Nigeria as replacement for alcoholic beverages. **Sowonola *et al.*, (2005)**, stated that since the drink is produced from cereals, its protein composition is incomplete and needs to be supplemented. To make up for amino balance, millet protein should be supplemented with legume protein more so that it is often being used as a weaning drink for infants. *Kunun*, therefore, though rapidly gaining ground as a thirst-quenching beverage still has a short shelf life and low protein content. Attempt is, therefore, made in this study to supplement *kunun* with groundnut, examine the extension of its shelf life with a chemical preservative (sodium benzoate) and study the changes in its quality attributes during storage. The objectives of this study were to:

1. produce *kunun-zaki* from millet supplemented with groundnut,
2. determine the effect of chemical preservative (sodium benzoate) on the shelf life of the product and,
3. determine the quality parameters (percentage brix, proximate, mineral element, total viable count of mesophilic bacteria and total fungi count, the the physico-chemical properties (pH, titratable acidity, specific gravity, viscosity) and sensory qualities during storage.

MATERIAL AND METHODS

Materials used for the Production of *Kunun-Zaki*

The materials used for the production of *kunun-zaki* include: millet, groundnut, ginger, dry red pepper and sugar. These materials were purchased at Oba's market (*Oja-Oba*) in Akure, Ondo State. The following chemicals were used: sodium metabisulphite and sodium benzoate purchased at Pascal Laboratory store, Akure, Ondo State, Nigeria.

Method of Preparation of *Kunun-Zaki*

The method used to produce this *kunun-zaki* was similar to the improved method described by **Gaffa and Ayo (2002)** with little modifications (Fig 1). There was also no period of saccharification after the mixing of the boiled and cold portions as discussed by **Gaffa and Ayo (2002).** Sugar and preservative (Sodium Benzoate) were added, filtered and bottled before pasteurizing at 70^0C for thirty minutes and refrigerated at 8-10^0C. The samples were kept and evaluated for physicochemical and microbiological changes. The various samples are: Pasteurized Refrigerated (PR), Pasteurized Unrefrigerated (PUR), Unpasteurized Refrigerated (UPR) and Upasteurized Unrefrigerated. The control sample, referred to as fresh sample, was prepared on every day of analysis with the same procedure and ingredients but without preservative

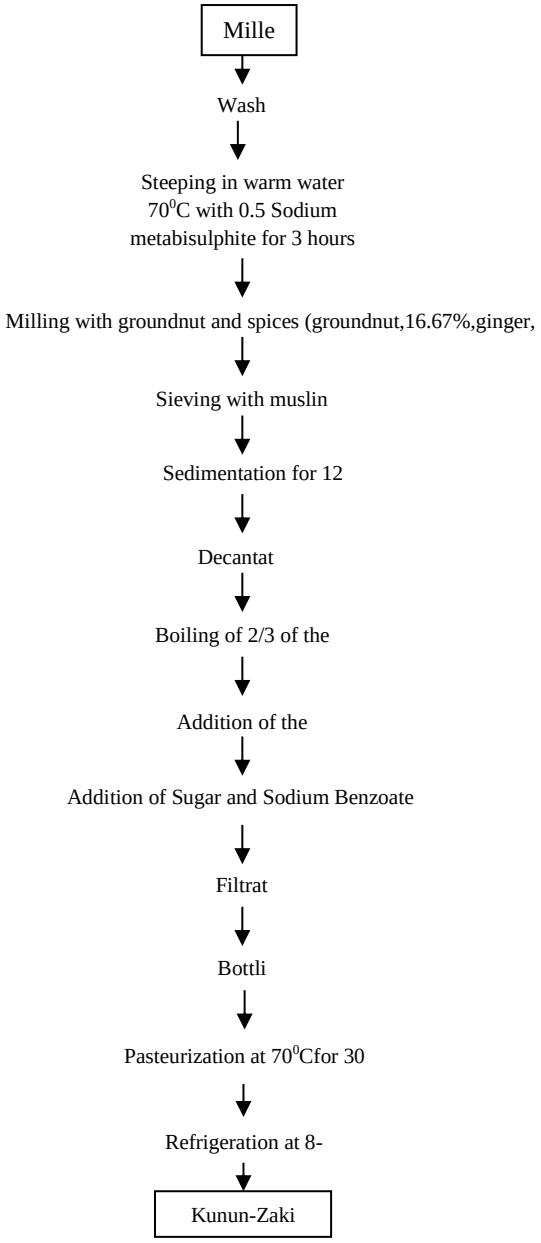

Figure 1 Modified Method for the Production of *kunun-zaki* supplemented with Groundnut. Source: **Gaffa and Ayo (2002)**

Analyses

The proximate analysis of the product was carried out which include: Ash, Fat, Moisture Content, Protein and Carbohydrate. Other analyses carried out were Mineral content, percentage brix, pH, titratable acidity, specific gravity and microbiological test (total viable count of mesophilic bacteria and total fungi count). The analyses were carried out according to the standard methods of Association of Official Analytical Chemist (**AOAC, 1990**).

Sensory Evaluation

A five-man (trained) panel was set up to evaluate the organoleptic properties (i.e., appearance, aroma and taste) of the stored samples. Questionnaires were distributed to each of the panel. The nine points Hedonic Scale method was used to collect the responses from the panelists while SPSS model 15 was used to analyze the data by ANOVA method. The means were separated with the Duncan's New Multiple Range (DNMR) test.

RESULTS AND DISCUSSION

Nutrient composition of freshly produced *kunun-zaki* supplemented with groundnut

Table 1 shows the nutrient composition of *kunun-zaki* supplemented with groundnut. There was considerable disparity in the protein and fat content of the product compared to the values obtained from literature.

Table 1 Nutrient composition of fresh *kunun-zaki* supplemented with groundnut

Constituents	Quantity (%) wet weight
Crude Protein	13.06 ± 1.21
Carbohydrate	3.5 ± 0.26
Fat	7.35 ± 0.64
Ash	0.39 ± 0.03
Moisture	75.7 ± 3.37
Total Solid	13.0 ± 1.20
Total Soluble Solid	2.0 ± 0.11

These increases might have been due to the addition of groundnut. According to **Ajay *et al.* (2008),** groundnut has always been valued for its high protein content. This is especially important for children and vegetarians. Also, in respect to the fatty acid composition it has been reported that 'the most important features of fatty acid profile in groundnut is the contribution of oleic and linoleic acid and their ratio".

Mineral composition of freshly produced *kunun-zaki* supplemented with groundnut

The mineral content is shown in Table 2. It could be observed from the table that *kunun-zaki* supplemented with groundnut contained high level of calcium and phosphorus.

Table 2 Mineral content of *kunun*-zaki supplemented with groundnut

Minerals	Content (mg/100g sample)
Sodium	0.19 ± 0.02
Potassium	2.74 ± 0.18
Calcium	152 ± 4.12
Phosphorus	123.22 ± 3.84
Magnesium	4.76 ± 0.38

Effect of storage on specific gravity and viscosity of *kunun-zaki* supplemented with groundnut

The Specific gravity, however, remained constant throughout the first seven days of storage as shown in Table 3. The value is also comparable to that obtained in the literature: 1.034 (**Sowonola *et al.*, 2005**) and 1.0426 (**Osuntogun and Aboaba, 2004**). Small differences were however observed in the viscosity of the samples (Table 4).

Table 3 Specific gravity of of *kunun-zaki* supplemented with groundnut

Days of Storage	Pasteurized Refrigerated (with sodium benzoate)	Pasteurized Unrefrigerated (with sodium benzoate)	Unpasteirised Refrigerated (with sodium benzoate)	Unpasteurized Unrefrigerated (with sodium benzoate)	Fresh Sample
0	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}
1	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.05 ± 0.01^{a}
2	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}
3	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}
7	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.04 ± 0.01^{a}	1.03 ± 0.01^{a}

Values on the same role with the same superscript are not significantly different at $p<0.05$

Table 4 Viscosity of *kunun-zaki* supplemented with groundnut (Pascal)

Days of Storage	Pasteurized Refrigerated (with sodium benzoate)	Pasteurized Unrefrigerated (with sodium benzoate)	Unpasteirised Refrigerated (with sodium benzoate)	Unpasteurized Unrefrigerated (with sodium benzoate)	Fresh sample
0	4.2 ± 0.33^{a}	4.0 ± 0.31^{a}	4.2 ± 0.3^{a}	5.0 ± 0.41^{a}	3.7 ± 0.28^{a}
1	4.0 ± 0.31^{a}	4.0 ± 0.31^{a}	4.0 ± 0.31^{a}	4.0 ± 0.31^{b}	4.0 ± 0.31^{a}
2	4.0 ± 0.31^{a}	3.5 ± 0.26^{a}	3.0 ± 0.21^{b}	3.0 ± 0.21^{c}	4.0 ± 0.31^{a}
3	3.8 ± 0.29^{a}	3.5 ± 0.26^{a}	3.0 ± 0.21^{b}	2.5 ± 0.16^{c}	3.8 ± 0.29^{a}
7	3.7 ± 0.28^{a}	3.5 ± 0.26^{a}	3.0 ± 0.21^{b}	3.0 ± 0.21^{c}	3.6 ± 0.27^{a}

Values on the same role with the same superscript are not significantly different at $p<0.05$

Effect of storage on pH and titratable acidity of *kunun-zaki* supplemented with groundnut

The pH values (Table 5) shows that *kunun* is an acidic food. The pH values for all the samples ranged between 2.93 – 4.6.

Table 5 pH of *kunun-zaki* supplemented with groundnut

Days of Storage	Pasteurized Refrigerated (with sodium benzoate)	Pasteurized Unrefrigerated (with sodium benzoate)	Unpasteurized Refrigerated (with sodium benzoate)	Unpasteurized Unrefrigerated (with sodium benzoate)	Fresh sample
0	3.31 ± 0.24^{c}	3.31 ± 0.24^{ab}	3.57 ± 0.27^{ab}	3.64 ± 0.27^{a}	3.93 ± 0.30^{ab}
1	3.80 ± 0.29^{bc}	3.72 ± 0.28^{a}	3.77 ± 0.29^{a}	3.92 ± 0.30^{a}	3.97 ± 0.31^{ab}
3	3.68 ± 0.28^{bc}	3.62 ± 0.27^{a}	3.60 ± 0.27^{ab}	3.63 ± 0.27^{a}	4.00 ± 0.31^{ab}
6	3.71 ± 0.28^{bc}	3.07 ± 0.22^{b}	3.73 ± 0.28^{a}	3.04 ± 0.21^{ab}	3.96 ± 0.31^{ab}
8	3.99 ± 0.30^{b}	3.67 ± 0.28^{a}	3.85 ± 0.29^{a}	2.93 ± 0.20^{ab}	4.20 ± 0.31^{a}
13	4.60 ± 0.32^{a}	3.57 ± 0.27^{a}	3.19 ± 0.23^{b}	N/A	4.21 ± 0.33^{a}
15	3.62 ± 0.27^{bc}	3.82 ± 0.29^{a}	4.02 ± 0.31^{a}	N/A	3.50 ± 0.26^{b}
20	3.79 ± 0.29^{bc}	3.66 ± 0.28^{a}	3.77 ± 0.29^{a}	N/A	4.28 ± 0.34^{a}
22	4.06 ± 0.32^{b}	3.76 ± 0.29^{a}	3.88 ± 0.30^{a}	N/A	3.97 ± 0.31^{ab}
27	3.62 ± 0.27^{bc}	3.58 ± 0.27^{a}	3.58 ± 0.27^{ab}	N/A	3.72 ± 0.28^{ab}

Values on the same row with the same superscript are not significantly different at $p<0.05$
N/A = the sample has spoilt by this time

The low pH (2.93) observed on the eighth day in the unpasteurized unrefrigerated sample was actually due to fermentation which had set in in the sample by this time. The effect of the added preservative could also be seen in the lower values of all the samples than the fresh sample. Table 6 shows the result for the titratable acidity of the samples throughout the storage period (27 days). It was observed that the readings, initially increased for all samples until it got to the peak, different for each sample, and began to decrease. The increase in the titratable acidity could be attributed to the effect of slight fermentation which may have set in at this time

These values and trends are similar to other works in literature. **Amusa and Ashaye (2009)** reported a similar value for *kunu-zaki* processed with different processing methods. For traditionally processed *kunun-zaki*, 0.22; 0.28 for *kunun-zaki* produced from sieved *kunun* flour and 0.21 for *kunun-zaki* produced from unsieved *kunun* flour.

Table 6 Titratable acidity of *kunun-zaki* supplemented with groundnut (g lactic acid/100g sample)

Days of Storage	Pasteurized Refrigerated (with sodium benzoate)	Pasteurized Unrefrigerated (with sodium benzoate))	Unpasteurized Refrigerated (with sodium benzoate)	Unpasteurized Unrefrigerated (with sodium benzoate)	Fresh sample
0	0.22 ± 0.02^{a}	0.18 ± 0.05^{a}	0.19 ± 0.06^{a}	0.18 ± 0.02^{b}	0.13 ± 0.03^{b}
1	0.24 ± 0.05^{a}	0.26 ± 0.02^{a}	0.22 ± 0.21^{a}	0.61 ± 0.15^{a}	0.14 ± 0.05^{b}
3	0.27 ± 0.05^{a}	0.28 ± 0.08^{a}	0.26 ± 0.03^{a}	0.95 ± 0.69^{a}	0.15 ± 0.05^{b}
6	0.28 ± 0.03^{a}	0.35 ± 0.08^{a}	0.28 ± 0.06^{a}	1.01 ± 0.03^{a}	0.27 ± 0.06^{a}
8	0.25 ± 0.02^{a}	0.19 ± 0.02^{a}	0.32 ± 0.03^{a}	N/A	0.10 ± 0.06^{b}
13	0.22 ± 0.09^{a}	0.20 ± 0.13^{a}	0.32 ± 0.10^{a}	N/A	0.10 ± 0.03^{b}
15	0.26 ± 0.05^{a}	0.22 ± 0.05^{a}	0.21 ± 0.03^{a}	N/A	0.10 ± 0.01^{b}
20	0.22 ± 0.03^{a}	0.23 ± 0.03^{a}	0.23 ± 0.06^{a}	N/A	0.12 ± 0.02^{b}
22	0.22 ± 0.02^{a}	0.30 ± 0.26^{a}	0.26 ± 0.21^{a}	N/A	0.19 ± 0.08^{ab}

Values on the same row with the same superscript are not significantly different at $p<0.05$
N/A = the sample has spoilt by this time

The titratable acid values obtained by **Adejuyitan *et al.* (2008)** are: 0.4 for *kunun* produced by dry milling and 0.55 for *kunun* produced by wet milling. Progressive increase in the value was also observed by **Agarry *et al.* (2010)** for the different types of *kunun* evaluated though wider ranges of values (0.05 – 0.6) were obtained.

Effect of storage on brix level of *kunun-zaki* supplemented with groundnut

The changes in the sugar level of the products were also observed during the first seven days (Table 7). It was observed that the sugar level of the products became stable after a day for the pasteurized refrigerated and after two days of production for the rest of the sample.

Table 7 Percentage brix of *kunun-zaki* supplemented with groundnut (%)

Days of Storage	Pasteurized Refrigerated (with sodium benzoate)	Pasteurized Unrefrigerated (with sodium benzoate)	Unpasteurized Refrigerated (with sodium benzoate)	Unpasteurized Unrefrigerated (with sodium benzoate)	Fresh sample
0	10 ± 0.90^a	9.0 ± 0.81^a	10 ± 0.90^a	9 ± 0.81^a	8.5 ± 0.76^a
1	8.0 ± 0.70^b	8.0 ± 0.70^a	8.0 ± 0.70^b	8.0 ± 0.70^a	9.0 ± 0.81^a
2	8.0 ± 0.70^b	7.5 ± 0.65^b	7.5 ± 0.65^b	7.5 ± 0.65^b	7.5 ± 0.65^b
3	8.0 ± 0.70^b	7.5 ± 0.65^b	7.5 ± 0.65^b	7.5 ± 0.6^b	7.5 ± 0.65^b
7	8.0 ± 0.70^b	7.5 ± 0.65^b	7.5 ± 0.65^b	7.5 ± 0.65^b	7.5 ± 0.65^b

Values on the same role with the same superscript are not significantly different at $p<0.05$

Effect of storage on microbiological status of *kunun-zaki* supplemented with groundnut

Tables 8 and 9 show the total viable count of mesophilic bacteria and the total fungi count respectively. The recorded values are however lower than those obtained in the literature for the locally produced samples. In their work, **Amusa and Odunbaku (2009)** reported the following mean values for total viable count (tvc) and yeast count (yc) for four different states in the south western part of Nigeria: Oyo State: tvc 6.8, yc 22.21; Ogun State: tvc 7.8, yc 23.23, Osun State: tvc 8.8, yc 21.86 and Lagos State: tvc 6.3, yc 54.2.

Table 8 Total viable count of mesophilic bacteria in *kunun-zaki* supplemented with groundnut (10^3 cfu/ml)

Days of Storage	Pasteurized		Unpasteurized		Fresh Sample
	Refrigerated (with sodium benzoate)	Unrefrigerated (with sodium benzoate)	Refrigerated (with sodium benzoate)	Unrefrigerated (with sodium benzoate)	
0	3	4	8	5	10
1	4	2	0	25	52
3	6	16	2	2	50
6	14	3	18	60	65
8	8	1	14	N/A	25
13	5	3	1	N/A	15
15	3	6	1	N/A	15
20	10	17	25	N/A	45
22	15	4	30	N/A	7

N/A = the sample had spoilt by this time

Table 9 Total fungi count in kunun-*zaki* supplemented with groundnut (10^3 cfu/ml)

Days of Storage	Pasteurized		Unpasteurized		Fresh Sample
	Refrigerated (with sodium benzoate)	Unrefrigerated (with sodium benzoate)	Refrigerated (with sodium benzoate)	Unrefrigerated (with sodium benzoate)	
0	1	1	2	2	3
1	3	2	2	8	1
3	1	1	3	5	2
6	2	3	4	2	4
8	1	3	3	N/A	5
13	1	1	1	N/A	3
15	1	2	3	N/A	1
20	1	3	3	N/A	5
22	1	15	55	N/A	25

N/A = the sample has spoilt by this time

These values are also lower than the values obtained by **Elmahmood and Doughari (2007)** for *kunun-zaki* obtained from different vendors (1.08 minimum). There were some irregularities (inconsistencies in microbial counts) observed in the values recorded in this study both for the total viable count and the total fungi count during the experiment. These could be due to the microbial succession taking place during the storage.

The test carried out on the sample for the presence of pathogenic organisms showed that the product was prepared under hygienic condition as there was no count recorded for all the pathogenic organisms enumerated for. The pathogenic organisms tested for include: *Salmonella* and *Shigella*, *Staphylococci* and *Enterococci*, *Coliform* and *Escherichia coli*.

Sensory quality of *kunun-zaki* supplemented with groundnut during storage

The mean scores of the sensory evaluation conducted at intervals during the storage period are as shown in Table 10. No statistical significant difference was observed in all the samples' attributes – appearance, aroma and taste evaluated on the first day until the third day. While the appearance of the unpasteurized unrefrigerated sample was ranked the best, it ranked lowest in taste but no difference was observed in the aroma. In case of the taste, there were more disparity in the preferences of the panelists with the taste of the pasteurized unrefrigerated sample ranking higher than the rest, followed by the fresh sample; the tastes of pasteurized refrigerated and unpasteurized refrigerated samples were the same. This is however contrary to what was observed by **Osuntogun and Aboaba (2004)** who studied the microbiological and physico-chemical properties of some non-alcoholic beverages, and reported that pasteurization did not alter the organoleptic qualities – taste, smell and physical appearance of their samples. On the sixth day, there were no statistical differences in the aroma but differences were observed in the taste and the appearance. The appearance of the unpasteurized unrefrigerated sample was preferred to the others. The appearances of the pasteurized refrigerated, pasteurized unrefrigerated and unpasteurized refrigerated samples were all the same. For the taste, likewise all these three samples – pasteurized refrigerated, pasteurized unrefrigerated and unpasteurized refrigerated exhibit no differences in their tastes. From the third day, it could be seen that the appearance of the unpasteurized unrefrigerated sample was preferred over and above the rest which again disagreed with the earlier observation by **Osuntogun and Aboaba (2004)**.

The effect of fermentation could be noticed in the unpasteurized unrefrigerated sample at this stage and this, probably, was responsible for its lowest preference by the panelists. On the eighth day, while there were no significant differences in the appearance and the aroma, the taste differed significantly. The differences in taste for the samples could be ranked in order of preference as pasteurized refrigerated, unpasteurized refrigerated, fresh sample and pasteurized unrefrigerated.

Table 10 Sensory qualities of *kunun-zaki* supplemented with groundnut

Days of Storage	Quality Attributes	Pasteurized		Unpasteurized		Fresh Sample
		Refrigerated (with sodium benzoate)	Unrefrigerated (with sodium benzoate)	Refrigerated (with sodium benzoate)	Unrefrigerated (with sodium benzoate)	
1st Day	Appearance	7.4[a]	7.4[a]	7.4[a]	7.8[a]	7.8[a]
	Aroma	6.8[a]	6.8[a]	7.2[a]	7.4[a]	7.4[a]
	Taste	6.8[a]	7.4[a]	7.6[a]	7.8[a]	8.0[a]
3rd Day	Appearance	6.5[b]	7.0[b]	7.0[b]	9.0[a]	7.0[b]
	Aroma	6.5[a]	6.5[a]	6.5[a]	7.0[a]	8.0[a]
	Taste	6.0[b]	7.5[a]	6.0[b]	4.5[c]	6.5[ab]
6th Day	Appearance	6.25[ab]	6.0[ab]	5.75[ab]	8.25[a]	5.25[b]
	Aroma	5.75[a]	6.0[a]	6.25[a]	6.0[a]	6.75[a]
	Taste	7.25[a]	7.0[a]	7.25[a]	4.25[b]	6.5[ab]
8th Day	Appearance	7.0[a]	7.33[a]	6.66[a]	NA	6.0[a]
	Aroma	7.0[a]	6.0[a]	6.67[a]	NA	7.0[a]
	Taste	7.66[a]	4.0[c]	6.0[b]	NA	6.66[ab]
13th Day	Appearance	6.33[a]	6.66[a]	7.66[a]	NA	6.33[a]
	Aroma	7.0[a]	7.0[a]	4.66[b]	NA	6.0[ab]
	Taste	7.33[a]	7.0[a]	4.66[b]	NA	4.0[b]
15th day	Appearance	7.0[a]	6.66[a]	6.33[a]	NA	6.33[a]
	Aroma	7.0[a]	7.0[a]	7.0[a]	NA	7.33[a]
	Taste	8.0[a]	7.66[a]	7.66[a]	NA	6.66[b]
20th Day	Appearance	7.66[a]	6.66[a]	7.0[a]	NA	6.66[a]
	Aroma	7.0[a]	6.67[ab]	6.33[ab]	NA	5.33[b]
	Taste	6.66[a]	6.66[a]	6.33[a]	NA	5.0[b]

Values on the same role with the same superscript are not significantly different at $p<0.05$
N/A = the sample has spoilt by this time

By the eighth day of storage, the unpasteurized unrefrigerated sample had spoilt and was disposed. On the thirteenth day, there was no statistical difference in the appearance while there were differences in aroma and the taste. While the aroma of the pasteurized refrigerated and the pasteurized unrefrigerated samples ranked the same, the unpasteurized refrigerated and the fresh samples ranked third and fourth respectively. On the fifteenth day, differences were only observed in the taste. The difference was observed in the fresh sample which ranked lowest. The appearance and aroma showed no statistical differences. The final evaluation carried out on the sample showed differences in the aroma and the taste, there were no statistical differences observed in the appearance. Generally however, it was observed that from the eighth day the appearances of all the samples were the same. The same trend was also observed for the aroma though there were differences on the thirteenth and twentieth day. **Gaffa *et al.* (2002)** also reported no difference in color and appearance of *kunun-zaki* produced from different saccharifying agents.

The general physical changes observed during storage were more pronounced in the pasteurized unrefrigerated sample compared to the other samples. From the second day of storage, water separation, coagulation and color changes were observed in the samples. These changes became more pronounced as the storage period progressed most especially in the pasteurized unrefrigerated sample. However, the effect of color change was not so much pronounced in the unpasteurized unrefrigerated sample. This could be due to the fact that it was not subjected to the pasteurization temperature which was responsible for the changes observed in the other samples. The pasteurization temperature imparted a cooked appearance on the other samples when compared to the unpasteurized sample. According to **Nkama *et al.* (2010)** who worked on the sensory and nutritional quality characteristics of powdered *kunun*, there was no difference in the sensory attributes of freshly prepared *kunun* and the reconstituted sample at $p< 0.05$. **Sowonola *et al.* (2005)** had evaluated the sensory attributes of *kunun* fortified with soymilk at different blend ratios and reported that there were significant differences in the samples.

CONCLUSION

Kunun-zaki supplemented with groundnut was produced, preserved with the aid of sodium benzoate for twenty seven days and evaluated for physical, chemical, microbiological and sensory qualities. Addition of groundnut increased the protein and fat content of the product thereby increasing its total food value. The addition of the preservative (sodium benzoate) also helped in extending the shelf life of the product from the usual 4-7 days storage period to almost a month. The result of the sensory evaluation for the product shows that there was difference in appearance and taste while there was no difference in the aroma. The differences were more pronounced in the taste throughout the storage period than other attributes of the product evaluated especially from the third day of storage. However, the pasteurized refrigerated sample was better on the overall acceptability while the unpasteurized unrefrigerated did not keep long as it was not pasteurized or refrigerated.

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