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PHYSICAL, ANTIOXIDANT AND SENSORY CHARACTERISTICS OF KUNUN-ZAKI ENRICHED WITH PUMPKIN SEEDS

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ABSTRACT

Assessment of nutrient content of kunun-zaki quality using pumpkin seeds as enrichment was made. Kunun-zaki and pumpkin seed flour mixed in three proportions of 85:15, 80:20 and 70:30 (v/v) of samples, coded as PZK15, PZK20 and PZK30 respectively, while the control sample was PZK CTRL. Proximate analysis of the kunun-zaki samples were determined, the physical test such as pH, titrable acidity and total solids, antioxidant properties and ascorbic acid were evaluated. The kunun- zaki samples was subjected to Sensory evaluation and data obtained was subjected to statistical analysis. Moisture content for enriched kunun-zaki samples was 74.76 –80.06%. Protein content of the enriched kunun-zaki samples ranged from 3.78 – 4.41 with sample PZK30 having the highest value. Enriched kunun-zaki sample had higher ash content (0.39 –0.53%) and fibre content (0.28 –0.63%) than the control sample of 0.35 and 0.24% respectively. There was an increase in the fat content of the enriched kunun-zaki samples (1.53 –2.60%) due to the addition of pumpkin seeds. The carbohydrate content was highest in PZK30 samples (17.06%) while the control sample was 14.09%. All the enriched kunun-zaki samples increased in antioxidant properties while in the physical properties; TTA, pH increases and TS decreased in content. Sensory evaluation of all the samples shows that PZK20 sample was rated highest in overall acceptability.

Keywords: Kunun-zaki. Enrichment, pumpkin seed flour and slurry,

INTRODUCTION

Kunun-zaki is an energy- dense beverage normally prepared from either one or more of fermented millet (Pennisetum typhoideum), sorghum (Sorghum bicolor), and maize (Zea mays) and is very popular in Nigeria, especially in the Northern part but the beverage is becoming widely acceptable throughout Nigeria (Adelekan et. al., 2013, Adejuyitan et al., 2008). Kunun-zaki is usually consumed during the dry season due to its thirst quenching properties though consumption has been observed throughout the year (Adebayo et. al., 2010).Kunun-zaki is usually produced majorly from cereals, which are deficient in nutritional quality, especially protein, vitamins, and minerals, and hence supplementation with richer sources of nutrients is required (Adelekan et. al., 2013). Pumpkin (Cucurbita pepo) pulp is a good supplement of protein, carbohydrate and fat with low anti-nutrient content (Kuku et. al. 2014). The popularity of the pumpkin plant stems from the high nutritional value of its leaf and seed which are eaten as food (Akwaowo et. al., 2000). The seeds are eaten roasted or boiled and are also sometimes used as soup thickeners (Kuku et. al., 2014). The objective of this study is to incorporate pumpkin seed flour extract into the Kunun-zaki beverage as an enrichment for possible nutritional improvement, to determine the physical, proximate and antioxidant properties of the enriched kunun-zaki and to determine the sensory evaluation of the enriched kunun-zaki.for possible acceptability of this product in order to meet the daily dietary requirements of the consumers.

MATERIALS AND METHODS

The millet grains, sugar, pumpkin seed, spices (ginger and pepper), were all purchased in Ikole central market, Ikole, Ekiti State, Nigeria.

Production of kunun-zaki

The modified method of Ayo et. al. (2013) was adopted in the production of kunun-zaki. One kilogram of cleaned millet grains were washed and steeped in clean water for 48 h. to soften the grains. The grains were washed to remove stones and wet milled into slurry. Two- third of the slurry was mixed with 2500 mL of boiling water and stirred to form a gel which was allowed to cool for 3 h. The remaining one- third of the slurry was added along with spices (ginger 65g, cloves and black pepper 10g) to the gel, mixed with cold boiled water (1000 mL) and left to ferment for 12 hr. It was then sieved and the filtrate kunun-zaki was sweetened with sucrose (250 g).

Production of pumpkin seed flour and slurry

The pumpkin seeds (1kg) were dried in an air forced oven at 60°C for 4hrs and milled using a blender (JTC OmniBlend V, United Kingdom) until a fine meal was obtained. One- third of the flour was mixed with 100 mL water (ratio 1:4) and boiled for 2-3 minutes to form slurry which was cooled and stored in refrigerator. Half of the slurry was then dried in an air forced oven at 65°C for 3hrs and cooled in desiccator (Julie, 2010).

Formulation of enriched kunun-zaki

Kunun-zaki and pumpkin seed flour and slurry were mixed in three different proportions (v/v) as shown in Table 1, coded as PZK15, PZK20, and PZK30 while the sample of kunun-zaki with no addition of pumpkin seed slurry served as control PZK CTR.

Table 1: Formulation of Enriched *kunun-zaki*

Samples	*Kunun-zaki* (%)	Pumpkin seed flour (%)
PZKCTRL	100	0
PZK15	85	15
PZK20	80	20
PZK30	70	30

Legends.

PZK CTRL represents *Kunun-zaki* drink without pumpkin seed
PZK15 represent *Kunun-zaki* drink enriched with 15% uncooked pumpkin seeds flour
PZK20 represent *Kunun-zaki* drink enriched with 20% cooked, dried pumpkin seed slurry
PZK30 represent *kunun-zaki* enriched with 30% cooked pumpkin seed slurry

Proximate analysis

The proximate analysis of the enriched *kunun-zaki* samples was determined using standard AOAC (2012) method while the percentage carbohydrate content was calculated by difference.

Physical properties Determination

The pH of 20 mL each of the **enriched** *kunun-zaki* samples was determined using a standardised pH meter (Jenway3510) (Onwuka, 2005). The Total Titrable Acidity was determined using the method of AOAC (2012). The determination of total soluble solids was carried out using a hand refractometer (CR300 Chroma-metter, Minolta, Japan) according to the method of AOAC (2012).The readings was taken and the soluble sugar was expressed in ° Brix.

Antioxidant Property using 2, 2-diphenyl-2-picrylhydrazyl hydrate (DPPH)

The radical scavenging ability of the samples was determined using the stable radical DPPH (2, 2-diphenyl-2-picrylhydrazyl hydrate) as described by Pownall *et al.*, (2010) and the percentage of inhibition was then calculated.

Determination of Total Phenol content

The Total Phenolic content was determined according to the methods of Gulcin *et al.* (2003) using the Folin-ciocalteu's phenol reagent. Standard Gallic acid at 0.1mg/ml was used to determine Gallic acid Equivalent (GAE) of samples, after preparing a calibration curve.

Ascorbic acid content Determination

Ascorbic acid content in the samples was estimated by volumetric method as described by Onwuka (2005).

Sensory evaluation/ Statistical analysis

The *Kunun-zaki* enriched samples sensory attributes were evaluated using a 7-point hedonic scale and a panel of untrained judges comprising fifteen participants randomly selected from the students of the Faculty of Agriculture, Federal University Oye-Ekiti was chosen to participate in the study. Colour, taste, flavor, texture and general acceptability of the beverage was determined (Adebayo *et. al.,* 2010).

The data generated was subjected to statistical analysis using one-way analysis of variance (one-way ANOVA) tests using IBM SPSS 20 at 5% significance difference and the difference in means was separated using the Duncan's Multiple Range test (IBM SPSS, 2011).

RESULTS AND DISCUSSION

Proximate compositions of the Enriched Kunun-zaki samples

The proximate compositions of kunun-zaki enriched with pumpkin seed slurry is shown in Table 2. The control sample PZK CTRL had the highest moisture content which differs significantly from the enriched kunun-zaki beverages. This may be as a result of no added pumpkin seed slurry to the control sample. The obtained moisture content values of all the kunun-zaki enriched samples were however found to be lower than 90.70% reported by Ofudje et al. (2016). Makinde and Oyeleke (2012a) reported moisture value for sorghum

based kunun-zaki sample as 80.60% which was similar to that of control kunun-zaki beverage obtained in this work.

Crude protein contents of the enriched kunun-zaki samples ranged between 3.78% - 4.41% (Table 2), which was significantly different ($p < 0.05$) from that of control kunun-zaki.. The increase in protein of the enriched kunun-zaki may be due to high protein content reported in pumpkin seeds (Kuku et. al. 2014 and Akwaowo et. al. 2000). The result for PZK15 was similar to protein value reported by Ofudje et. al. (2016). The crude protein content of all the kunun-zaki samples was however higher than the value of 0.83% that was reported for sorghum based kunun-zaki beverage (Emurotu et. al. 2017).

Crude fat content for enriched kunun-zaki beverage drink ranged from 2.60±0.07% to 1.53±0.01% (Table 2). Kunun-zaki sample PZK30 had the highest crude fat content of 2.6%,. The increase in crude fat content observed was as a result of the pumpkin seed slurry added. Pumpkin seed has been reported to be rich in fat content. The result for the enriched kunun-zaki samples and the kunun-zaki sample control in this work were higher compared to fat content value of 0.11% for kunun-zaki from sorghum (Emurotu et al. 2017). Makinde and Oyeleke (2012b) however reported an increase in fat content from 10.47% to 14.60% with the addition of sesame seeds to sorghum based *kunun-zaki.*

TABLE 2: Proximate Compositions of Enriched *Kunun-zaki* Beverages

SAMPLE	MOI	PRO	ASH	FIBRE	FAT	CHO
PZK15	80.06±0.07^{b}	3.78±0.02^{c}	0.39±0.01^{bc}	0.28±0.01^{a}	1.53±0.01^{c}	13.87±0.04^{c}
PZK20	78.64±0.83^{c}	4.11±0.00 ^{b}	0.47±0.01^{ab}	0.48±0.02^{b}	1.96±0.08^{b}	15.38±0.84^{b}
PZK30	74.76±0.36 ^{d}	4.41±0.06^{a}	0.53±0.01^{a}	0.63±0.00^{a}	2.60±0.07^{a}	17.06±0.34^{a}
PZKCTRL	82.87±0.21^{a}	1.52±0.00 ^{d}	0.35±0.01^{c}	0.24±0.00^{d}	0.94±0.01^{d}	14.09±0.20^{bc}

Values reported are means ± standard deviation of triplicate determinations. Mean values with different superscript within the columns are significantly ($P < 0.05$) different.

The ash content for the pumpkin seed enriched kunun-zaki beverage drink ranged from 0.39±0.01% to 0.53±0.01% (Table 2). Ash content in PZK30 was the highest which was significantly different from the other samples. Lower value of 0.02% ash content was reported for sorghum based kunun-zaki beverage samples (Emurotu et. al, 2017). The crude fiber content for the enriched and control kunun-zaki beverage drink was found to be 0.24 –0.63% (Table 2). There was an increase in the observed crude fiber contents. The results of the crude fiber content observed was however, higher than 0.01% of crude fiber reported by Emurotu et. al. (2017). The carbohydrate values obtained for all the kunun-zaki samples ranged from 13.87±0.04% to 17.06±0.34% (Table 2). PZK30 had the highest carbohydrate content (17.06±0.34%) when compared with PZK20 and PZK15. These values were comparable to the carbohydrate value of 13.9% observed by Emurotu et al. (2017) for soghum based kunun-zaki beverage.

Physical Properties for the Enriched Kunun-zaki Beverages

The physical properties of the enriched kunun-zaki beverages are shown in Table 3. The pH values for the kunun-zaki beverages was found to be 3.53±0.04, 3.61±0.01 and 3.61±00 for PZK15, PZK20 and PZK30 respectively which was significantly different ($P<0.05$) from the control sample PZK CTRL (3.30±0.00). The result of the pH value obtained for the control kunun-zaki beverage drink was low when compared to the pH value reported for kunun-zaki processed from millet, maize and guinea corn of 4.30, 4.20 and 5.00 respectively as reported by Ofudje et al. (2016). Makinde and Oyeleke, (2012a, 2012b) also reported a higher pH value for sorghum based kunun-zaki which was similar to the pH values obtained in this work for enriched kunun-zaki samples. The Total Titrable Acidity (TTA) for the enriched kunun-zaki samples is shown in Table 3. The control sample PZK CTRL had the highest TTA which was significantly different ($P<0.05$) from the enriched samples. The TTA result obtained for control sample PZK CTRL was low when compared to the value of TTA of 3.30% and 3.40% reported by Makinde and Oyeleke, (2012a) and Makinde and Oyeleke (2012b). The results for the Total Solids (TS) content of the kunun-zaki samples are shown in Table 3. The results shows that the total solids content of the samples increased with the addition of pumpkin seed slurry. The observed result for total solid in all the kunun-zaki samples in this work were found to be high when compared to the values of 4.30%, 5.80% and 8.40% reported by Ofudje et al. (2016) for kunun-zaki beverage drink produced from millet, maize and guinea corn respectively.

Table 3: Physical properties of Enriched *Kunun-zaki* beverages

Samples	pH	TTA(%)	TS
PZK15	3.53±0.04[a]	0.68±0.01[b]	19.94±0.07[c]
PZK20	3.61±0.01[a]	0.67±0.0[bc]	21.37±0.83[b]
PZK30	3.60±0.00[a]	0.64±0.01[c]	25.23±0.36[a]
PZKCTRL	3.30±0.00[a]	0.74±0.01[a]	17.13±0.21[d]

Values reported are means ± standard deviation of triplicate determinations. Mean values with different superscript within the columns are significantly different (P <0.05).

Legend
TTA: Total Titrable Acidity
TS: Total Soluble Solids (Brix)

Antioxidant Properties of Enriched Kunun-zaki Beverages

Antioxidant properties of enriched kunun-zaki are shown in Table 4. Ascorbic acid result for enriched kunun-zaki beverage drink samples ranged from 37.6±0.72 to 45.11±0.16 mg/100g with sample PZK30 having the highest while the Ascorbic acid value of control kunun-zaki beverage drink was lowest, which was significantly different ($p < 0.05$) from each other. \\

Total Phenolic content (TPC) for all the enriched kunun-zaki samples are shown in Table 4. Enriched kunun-zaki PZK30 had the highest TPC value which was significantly different ($p<0.05$) from all other samples. Sample PZK CTRL had the least TPC value of 41.73±0.37mgGAE/g. The result shows that the enriched kunun-zaki are rich in phenolics. The antioxidant activity of foods can be attributed to the phenolic contents, which are useful in preventing oxidation that can lead to rancidity.

The DPPH results of enriched kunun-zaki ranged from 42.57±0.77% to 52.58±0.13% (Table 4), with samples PZK20 and PZK30 having a similar highest values which were significantly different ($p<0.05$) from other samples. Pumpkin seeds has been reported to be rich in polyphenols (Kuku et. al, 2014), which can play a major role in the antioxidant activity of the kunun-zaki samples.

Table 4: Antioxidant Properties of Enriched *Kunun-zaki* Beverages

Samples	Ascorbic acid	DPPH	TPC
PZK15	37.6±0.72[c]	42.57±0.77[c]	77.66±0.62[c]
PZK20	41.56±0.67[b]	52.58±0.76[b]	82.54±0.78[b]
PZK30	45.11±0.16[a]	52.58±0.13[b]	101.55±0.77[a]
PZKCTRL	34.55±0.72[d]	36.85±0.26[d]	41.73±0.37[d]

Values reported are means ± standard deviation of triplicate determinations.
Mean values with different superscript within the columns are significantly different (P < 0.05).

Legend.
DPPH: 2,2-Diphenyl-1-picrylhydrazyl
TPC: Total Phenolic content

Sensory Evaluation of the Enriched Kunun-zaki Beverages

Table 5 shows the results for the sensory evaluation of the enriched kunun-zaki beverages. Enriched kunun-zaki (PZK20) was rated highest in colour, taste, flavour and overall acceptability by the panelists. The preference could be as a result of the improved characteristics from what they are used to in the control kunun-zaki samples. Though the texture of the control sample was still preferred, this is because the addition of pumpkin seed flours resulted in a gritty texture of the enriched samples.

The sensory evaluation results shows that increasing the concentration of pumpkin seed flour to about 20% w/v of kunun-zaki drink improves the quality and overall acceptability of the enriched kunun-zaki.

Table 5: Sensory attributes of Enriched *kunun-zaki* beverages

Samples	Colour	Taste	Flavour	Texture	Overall acceptability
PZK15	6.8±0.80[a]	6.0±0.69[b]	5.9±0.90[b]	6.7±0.85[b]	6.7±0.63[b]
PZK20	7.2±0.52[a]	6.9±0.85[a]	7.8±0.75[a]	5.9±0.90[c]	7.4±0.40[a]
PZK30	6.9±0.83[a]	6.1±05[b]	6.8±0.81[ab]	5.7±0.03[c]	6.7±0.63[b]
PZKCTRL	6.9±0.83[a]	5.1±0.65[c]	4.6±0.11[c]	7.1±0.85[a]	6.1±0.55[c]

Values reported are means ± standard deviation of triplicate determinations
Mean values with different superscript within the columns are significantly different ($P < 0.05$).

CONCLUSION

The results obtained in this study shows that enrichment of millet grains with pumpkin seed flour and slurry at different proportions of about 15 –30%, increases the nutrient value of the kunun-zaki obtained and this subsequently improves the kunun-zaki nutrient quality. Nutrients losses associated with traditional processing of kunun-zaki production can be eliminated with the addition of pumpkin seed flour to kunun-zaki. The sensory panel rated the enriched kunun-zaki produced from 20% enrichment with pumpkin seed slurry higher than 30% pumpkin seed slurry addition due to the impacted undesirable grainy and mushy texture of 30% addition to the kunun-zaki. Addition of up to 20% pumpkin seed slurry to enrich kunun-zaki is desirable and the beverage can be included as a refreshing drink for all ages to add to their daily nutrient intake.

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