

## CHEMICAL AND SENSORY EVALUATION OF KUNUN-ZAKI SWEETENED WITH SERENDIPITY BERRY (*DIOSCOREOPHYLLUM CUMMINSII*) AND ENRICHED WITH DEFATTED MORINGA SEED FLOUR

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### Abstract

The chemical composition and sensory quality of moringa seed enriched kunun-zaki with natural sweetener serendipity berry (*Dioscoreophyllum cumminsii*) and sucrose were evaluated in this study. A constant defatted moringa seed flour value (0.6%) was added to each sample while serendipity berry and sucrose were added at varying proportions (0, 0.4, 0.8, 1.2, 1.6 and 2.0 %) to a constant volume of 250 ml kunun-zaki. The results of the proximate composition, mineral element content and sensory quality revealed that addition of serendipity berry to the millet based kunun-zaki increased the protein content of kunun-zaki by 5.90-9.08% and reduced fat 0.94-0.91%. However, moisture, ash, crude fiber and carbohydrate contents of the two sweeteners decreased slightly. The mineral contents potassium, calcium and copper of kunun-zaki with serendipity berry were higher than the kunun-zaki with sucrose. Magnesium, manganese and zinc of kunun-zaki with sucrose were higher than kunun-zaki with serendipity berry. There were no significant differences ( $P < 0.05$ ) in all the samples in colour and aroma. There were significant differences in taste and overall acceptability between the two samples. However, kunun-zaki with serendipity berry compared favourably with kunun-zaki with sucrose. The addition of defatted moringa seed improved the protein content of the two samples of kunun-zaki. Kunun-zaki with serendipity berry had higher values of protein since the natural sweetener is protein based. This study has shown that kunun-zaki with serendipity berry was highly acceptable and more nutritious than kunun-zaki with sucrose.

**Keywords:** Kunun-zaki, serendipity berry, moringa, sucrose

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### 1. INTRODUCTION

Natural sweeteners are sweeteners obtained from agricultural products which could serve as substitute for sugar in our diets. Inglett and May (1969); Van Der Wel and Loeve (1972); Takahashi *et al.* (1990); Liu *et al.* (1993); Ming and Hellekank (1994) and Faus (2000) reported seven natural sweeteners that are available which include Brazzein, Thaumatin, Monelin, Curculin, Mabinlin, Miraculin and Pentadin. Natural sweeteners are have been regarded a low calorific food with little or no side effects such as obesity, diabetes etc. However, in the food industries, artificial sweeteners such as saccharin, aspartame, cyclamate and acesulfame K are used in beverage and food products. The use of artificial sweeteners have been reported to cause psychological problems,

mental disorders, bladder cancer, heart failure and brain tumors (Hagiwara *et al.*, 1984; Nabors, 1988; Kanarek, 1994; Cohen, 2001 and Weihrauch *et al.*, 2002). Monellin is a sweet protein from the fruit of "serendipity berry" (*Dioscoreophyllum cumminsii*), a tropical plant native to West Africa (Wlodawer and Hodgson, 1975). According to Inglett and May (1969); Faruya *et al.* (1983) and Penarrubia *et al.* (1992), protein from serendipity berry occurs naturally and is sweeter than sucrose. Serendipity berry (*Dioscoreophyllum cumminsii*) is a tropical rainforest vine. *Dioscoreophyllum* belongs to genus Tinosporeae comprising *D. cumminsii* and *D. volkensii* (Oselebe and Nwankiti, 2005). *Dioscoreophyllum cumminsii* is a tropical dioecious rainforest vine and grows in humid and heavily shaded under storey vegetation of

closed forest, from May to October. Addition of natural sweetener to kunun zaki beverage had been reported by Ojo et al. (2017). Adeyemi and Balogh (1994) and Frazier and Westhoff (1998) describe kunun zaki as a cheap, non-alcoholic beverage commonly consumed in the Northern Nigeria during the dry season. Kunun zaki is an appetizer and generally acceptable to children and adult in Nigeria (Amusa and Odunbaku 2009; Onuorah et al., 1987; Akpapunam et al., 2004). Kununzaki is prepared from cereals therefore, it is mainly carbohydrate food and deficient in some vital nutrients. Adelekan et al. (2013) suggested supplementation of kunun with rich sources of nutrients which may improve the nutritional quality of the product. However, addition of natural sweetener and moringa seed flour could be a source of nutrient in the beverage. Information on addition of serendipity berry and moringa seed flour is limited therefore, this study was undertaken to incorporate defatted moringa flour and a natural sweetener (*Dioscoreophyllum cumminsii*) into the beverage for possible nutritional improvement.

## 2. MATERIALS AND METHODS

### Materials

Cereal grains millet (*Pennisetum typhoideum*) and Moringa *oleifera* seeds were obtained from Institute of Agricultural Research and Training (IAR&T) Moor Plantation, Ibadan, Oyo State. Sweetener serendipity berry (*Dioscoreophyllum cumminsii*) was obtained from a farm at Esa-odo, Osun state. Moringa seeds flour used were defatted using hexane for 24 hrs, dried and packaged for further use. The serendipity berry seeds were separated from the fleshy part, dried and milled into flour.

Modified method of Ayo et al. (2013) was adopted for production of kunun-zaki. The millet grains were washed and steeped in clean water for 48 h. The grains were thoroughly washed and wet milled into the slurry. Two-third of the slurry was mixed with boiling water to form gel and cooled. The remaining

slurry was added to the gel and allowed to ferment for 12 h. The slurry was filtered and (0.4, 0.8, 1.2, 1.6 and 2.0 %) of sucrose and serendipity berry flour was added.

### Analyses

The proximate (moisture, ash, fat, and protein contents) and mineral analyses of kunun zaki samples were carried out using the methods of Association of Official Analytical Chemists (AOAC, 2006). Carbohydrate was determined by difference. Sensory evaluation was conducted on the kunu zaki with 20 semi-trained panelist using 9-point hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely). The sensory attributes determined were appearance, aroma, taste and acceptability.

### Statistical analysis

Data obtained were subjected to Analyses of Variance and differences between means were evaluated by Duncan's multiple range test using SPSS statistic program, version 10.01 (SPSS 1999).

## 3. RESULTS AND DISCUSSION

The proximate composition of defatted moringa seed flour kunun-zaki sweetened with serendipity berry and sucrose are shown in Table 1. Moisture contents of kunun-zaki with serendipity berry and sucrose ranged from (80.61-83.60%) and (82.93-83.92%) respectively. The variation in the moisture content of kunun-zaki could be due to variation in the quantities and types of sweeteners added. The results were similar to the reports of (Obanewo and Zidon, 2003; Adejuyitan et al., 2008). The moisture contents of kunun-zaki with serendipity berry were lower than kunun-zaki with sucrose. The lower moisture contents of kunun-zaki with serendipity berry indicated that the solid content is high, which means that the product can last for few hours in the stomach before digestion (Islamiyat et al., 2015). The ash contents of kunun-zaki with serendipity berry and sucrose ranged between (1.23-1.30%) and (1.23-1.30%). Significant differences were noted between the samples. The two set of samples had high ash contents.

**Table 1:** Proximate composition of defatted moringa seed kunun-zaki sweetened with serendipity berry and sucrose

	MC (%)	Ash (%)	Fat (%)	Protein (%)	Fiber (%)	Carbohydrate (%)
KT <sub>0</sub>	83.60±4.75 <sup>cd</sup>	1.30±0.02 <sup>a</sup>	0.92±0.01 <sup>a</sup>	5.60±0.33 <sup>c</sup>	1.05±0.01 <sup>b</sup>	7.81±0.45 <sup>c</sup>
KT <sub>1</sub>	82.60±4.33 <sup>ab</sup>	1.27±0.04 <sup>ac</sup>	0.94±0.03 <sup>c</sup>	5.94±0.35 <sup>cb</sup>	1.02±0.01 <sup>b</sup>	6.21±0.17 <sup>b</sup>
KT <sub>2</sub>	81.60±2.23 <sup>ab</sup>	1.28±0.08 <sup>ac</sup>	0.93±0.04 <sup>a</sup>	7.95±0.51 <sup>ab</sup>	1.05±0.02 <sup>c</sup>	6.20±0.56 <sup>c</sup>
KT <sub>3</sub>	81.63±2.88 <sup>c</sup>	1.25±0.01 <sup>bc</sup>	0.91±0.04 <sup>a</sup>	8.05±0.38 <sup>bd</sup>	1.03±0.02 <sup>c</sup>	6.18±0.30 <sup>b</sup>
KT <sub>4</sub>	81.65±2.80 <sup>c</sup>	1.23±0.01 <sup>ab</sup>	0.91±0.02 <sup>b</sup>	8.10±0.53 <sup>c</sup>	1.04±0.03 <sup>b</sup>	6.20±0.42 <sup>b</sup>
KT <sub>5</sub>	80.61±3.00 <sup>c</sup>	1.25±0.03 <sup>ab</sup>	0.94±0.02 <sup>b</sup>	9.08±0.84 <sup>c</sup>	1.02±0.02 <sup>a</sup>	6.18±0.16 <sup>c</sup>
KS <sub>1</sub>	83.91±3.56 <sup>c</sup>	1.25±0.03 <sup>b</sup>	1.03±0.03 <sup>a</sup>	5.25±0.37 <sup>c</sup>	1.12±0.04 <sup>b</sup>	7.46±0.70 <sup>b</sup>
KS <sub>2</sub>	83.92±4.28 <sup>ab</sup>	1.25±0.02 <sup>a</sup>	1.04±0.02 <sup>a</sup>	5.22±0.32 <sup>d</sup>	1.11±0.04 <sup>b</sup>	7.26±0.95 <sup>b</sup>
KS <sub>3</sub>	82.91±5.59 <sup>a</sup>	1.25±0.03 <sup>b</sup>	1.06±0.04 <sup>a</sup>	6.21±0.83 <sup>c</sup>	1.10±0.06 <sup>b</sup>	7.41±0.29 <sup>b</sup>
KS <sub>4</sub>	83.91±5.58 <sup>a</sup>	1.30±0.02 <sup>c</sup>	1.04±0.03 <sup>a</sup>	5.18±0.35 <sup>c</sup>	1.01±0.03 <sup>b</sup>	7.50±0.26 <sup>b</sup>
KS <sub>5</sub>	82.93±6.20 <sup>a</sup>	1.27±0.03 <sup>c</sup>	1.05±0.03 <sup>a</sup>	6.22±0.91 <sup>c</sup>	1.10±0.04 <sup>b</sup>	7.48±0.55 <sup>b</sup>

Means with the same superscripts within the same column are not significantly different ( $P>0.05$ ). Means with different superscripts are significantly different ( $P<0.05$ ). (KT<sub>0</sub>-KT<sub>5</sub>):Kunun-zaki with serendipity berry ranged from 0-2% and (KS<sub>1</sub>-KS<sub>5</sub>):kunun-zaki with sucrose ranged from 0.4-2%

Ash contents of food are indication of the amount of minerals present in the food. Thus, the higher the ash contents of a food material, the higher its mineral content. The results of this study is close to those reported by Amusa and Ashaye (2009) with values ( 1.16-1.75%) for freshly prepared kunun-zaki and are slightly lower than values (1.31-1.75%) reported by Sengev *et al.* (2012) for instant kunun-zaki flour blends of sorghum and mango mesocarp flours and higher than the values (0.20-0.62%) and (0.70-0.93%) reported by Adebayo *et al.* (2009) for fresh kunun-zaki samples and (Islamiyat *et al.*, 2015) for kunun-zaki from millet and vignarancemosa blends.

The fat content obtained from kunun-zaki with serendipity berry and sucrose ranged between (0.91-0.94%) and (1.03-1.06%) respectively. The fat content in kunun-zaki with serendipity berry was lower than that of sucrose. However, this could be as a result of the inclusion of serendipity berry into kunun-zaki. The results of both kunun-zaki with serendipity berry and sucrose were in the decrease side compared to the report of (Ndulaka *et al.*, 2014) 5.2-8.17% for fresh kunun-zaki and reconstituted kunun-zaki. The addition of serendipity berry and defatted moringa seed flour increased the protein content significantly ( $P<0.05$ ). The protein content had the values ranged from (5.90-9.08%) for serendipity berry and (5.22-6.22%) for sucrose. The protein content of kunun-zaki sweetened with serendipity berry (5.90-9.08%) reported in this study was higher than the protein content (8.6%) of substituted

kunun-zaki with soya bean (Adeniji and Kesinro, 2015). The improved protein contents of the kunun-zaki containing serendipity berry recorded in this study is an indication of higher nutrient content, since refreshing drinks are not nutrient dense. Therefore, the significant increase in the protein content showed that serendipity berry possesses better nourishing property. Serendipity berry was reported to be highly nutritious (Oselebe and Nwankiti, 2005). Crude fiber helps to improve people's healthy living through normal bowel movement and easy food digestibility (Okaka and Okaka2011). The crude fiber content ranged from (1.02-1.05%) for serendipity berry and ranged from (1.10-1.12%) for sucrose with no significant difference for the samples. The crude fiber contents for kunun-zaki with sucrose were higher than kunun-zaki with serendipity berry samples. This result is lower than values (3.56-5.00%) reported by Ogbonna *et al.* (2011) for freshly prepared and reconstituted kunun-zaki sample but higher than value (0.25%) reported by Adejuyitan *et al.*, (2008). The values for the carbohydrate of the kunun-zaki with sucrose which ranged from (6.72-7.50%) were not significantly different ( $P < 0.05$ ) from each other and they were high compared to kunun-zaki with serendipity berry (6.20-7.81%). This could be connected to the fact that serendipity berry is protein base (Inglett and May, 1969).

Table 2 shows the results of mineral element composition of kunun-zaki sweetened with serendipity berry and sucrose.

**Table 2:** Mineral elements composition of defatted moringa seed kunun-zaki sweetened with serendipity berry and sucrose

Sample (g)	K mg/100g	Na mg/100g	Ca mg/100g	Cu mg/100g	Mg mg/100g	Mn mg/100g	Fe mg/100g	Zn mg/100g
KT <sub>0</sub>	0.51±0.11 <sup>c</sup>	0.70±0.06 <sup>a</sup>	0.69±0.06 <sup>a</sup>	0.27±0.07 <sup>e</sup>	0.03±0.01 <sup>e</sup>	0.01±0.00 <sup>e</sup>	0.01±0.00 <sup>f</sup>	0.01±0.00 <sup>g</sup>
KT <sub>1</sub>	0.33±0.02 <sup>d</sup>	0.25±0.02 <sup>c</sup>	0.37±0.08 <sup>b</sup>	0.21±0.05 <sup>e</sup>	0.01±0.00 <sup>ab</sup>	0.01±0.00 <sup>d</sup>	0.04±0.02 <sup>d</sup>	0.02±0.00 <sup>b</sup>
KT <sub>2</sub>	0.35±0.02 <sup>d</sup>	0.40±0.19 <sup>b</sup>	0.42±0.07 <sup>b</sup>	0.30±0.02 <sup>c</sup>	0.01±0.00 <sup>cd</sup>	0.01±0.01 <sup>d</sup>	0.04±0.01 <sup>d</sup>	0.03±0.00 <sup>e</sup>
KT <sub>3</sub>	0.60±0.06 <sup>b</sup>	0.65±0.13 <sup>a</sup>	0.78±0.08 <sup>a</sup>	0.30±0.08 <sup>c</sup>	0.04±0.01 <sup>g</sup>	0.03±0.02 <sup>f</sup>	0.02±0.01 <sup>f</sup>	0.05±0.01 <sup>f</sup>
KT <sub>4</sub>	0.60±0.03 <sup>b</sup>	0.61±0.05 <sup>a</sup>	0.65±0.05 <sup>a</sup>	0.26±0.02 <sup>c</sup>	0.08±0.02 <sup>e</sup>	0.09±0.01 <sup>e</sup>	0.08±0.02 <sup>a</sup>	0.06±0.00 <sup>g</sup>
KT <sub>5</sub>	0.70±0.13 <sup>a</sup>	0.75±0.28 <sup>a</sup>	0.68±0.14 <sup>a</sup>	0.30±0.04 <sup>e</sup>	0.05±0.00 <sup>cd</sup>	0.56±0.00 <sup>d</sup>	0.02±0.02 <sup>c</sup>	0.07±0.01 <sup>a</sup>
SK <sub>1</sub>	0.18±0.10 <sup>e</sup>	0.17±0.02 <sup>cd</sup>	0.07±0.01 <sup>d</sup>	0.10±0.01 <sup>d</sup>	0.53±0.10 <sup>f</sup>	0.15±0.02 <sup>a</sup>	0.03±0.01 <sup>f</sup>	0.02±0.01 <sup>a</sup>
SK <sub>2</sub>	0.12±0.02 <sup>e</sup>	0.11±0.02 <sup>d</sup>	0.11±0.02 <sup>c</sup>	0.05±0.02 <sup>c</sup>	0.54±0.18 <sup>e</sup>	0.03±0.01 <sup>a</sup>	0.03±0.01 <sup>d</sup>	0.02±0.01 <sup>a</sup>
SK <sub>3</sub>	0.15±0.04 <sup>e</sup>	0.13±0.03 <sup>cd</sup>	0.04±0.02 <sup>c</sup>	0.05±0.02 <sup>c</sup>	0.49±0.14 <sup>a</sup>	0.24±0.04 <sup>a</sup>	0.01±0.00 <sup>a</sup>	0.09±0.02 <sup>d</sup>
SK <sub>4</sub>	0.16±0.04 <sup>e</sup>	0.15±0.02 <sup>cd</sup>	0.09±0.00 <sup>e</sup>	0.01±0.00 <sup>c</sup>	0.52±0.02 <sup>a</sup>	0.03±0.01 <sup>a</sup>	0.02±0.00 <sup>c</sup>	0.07±0.03 <sup>e</sup>
SK <sub>5</sub>	0.17±0.06 <sup>e</sup>	0.16±0.03 <sup>d</sup>	0.08±0.03 <sup>e</sup>	0.05±0.02 <sup>e</sup>	0.51±0.11 <sup>c</sup>	0.02±0.00 <sup>a</sup>	0.03±0.01 <sup>e</sup>	0.05±0.02 <sup>d</sup>

Means with the same superscripts within the same column are not significantly different ( $P>0.05$ ). Means with different superscripts are significantly different ( $P<0.05$ ). (KT<sub>0</sub>- KT<sub>5</sub>): Kunun-zaki with serendipity berry ranged from 0-2% and (KS<sub>1</sub> - KS<sub>5</sub>): kunun-zaki with sucrose ranged from 0.4-2%

There were significant differences ( $P<0.05$ ) in the mineral contents between kunun-zaki with serendipity berry and sucrose. Potassium, sodium and calcium contents of kunun-zaki with serendipity berry were higher than the values in kunun-zaki with sucrose. The values recorded for potassium, sodium and calcium in both the sweeteners were lower than potassium, sodium and calcium contents 21.5-23.5mg/100g, 140.2-148.9mg/100g and 5.6-88mg/100g of kunun-zaki fortified with tiger nut milk extract reported by Olusegun *et al.*, (2015). This could be due to the method of the production. The copper, iron and zinc contents for the samples were significantly lower in study to the values 0.37-0.47mg/100g, 2.12-2.40mg/100g and 0.50-0.64mg/100g reported in millet-vigna-racemosa kunun-zaki blends (Islamiyat *et al.*, 2015). Kunun-zaki with serendipity berry had highest values 0.10-0.56mg/100g of manganese content while kunun-zaki with sucrose had the lowest values 0.03-0.24mg/100g. The magnesium content 0.49-0.54mg/100g of kunun-zaki with sucrose

was the highest and kunun-zaki with serendipity berry was the lower 0.01-0.08mg/100g. Minerals are of great importance in diet as they play important roles in body metabolism (Cataldo *et al.*, 1999).

The results of the sensory scores are shown in Table 3. The analysis of variance revealed no significant difference ( $P<0.05$ ) in all samples in colour and aroma. There were significant difference ( $P<0.05$ ) in taste and overall acceptability between kunun-zaki with serendipity berry and sucrose. The difference might be due to the addition of the defatted moringa seed flour and natural sweetener serendipity berry. The sweetness of the serendipity berry might have affected the taste and overall acceptability. The fruit, serendipity berry contain protein sweetener called monellin that could replace sugar in foods for diabetics and dieters (Oselebe and Nwankiti 2005). However, kunun-zaki with serendipity berry and sucrose samples were both accepted.

**Table 3:** Sensory quality attributes of defatted moringa seed kunun-zaki sweetened with serendipity berry and sucrose

Sample	Appearance	Taste	Aroma	Overall acceptability
KT <sub>0</sub>	6.02±0.95 <sup>a</sup>	4.53±0.13 <sup>a</sup>	5.44±0.12 <sup>a</sup>	4.44±0.12 <sup>c</sup>
KT <sub>1</sub>	3.89±0.15 <sup>a</sup>	6.33±0.17 <sup>a</sup>	5.00±0.45 <sup>a</sup>	5.33±0.64 <sup>b</sup>
KT <sub>2</sub>	4.33±0.58 <sup>a</sup>	5.67±0.12 <sup>ab</sup>	5.00±0.65 <sup>a</sup>	6.00±0.39 <sup>b</sup>
KT <sub>3</sub>	4.22±0.04 <sup>a</sup>	6.22±0.48 <sup>b</sup>	5.00±0.15 <sup>a</sup>	5.00±0.06 <sup>a</sup>
KT <sub>4</sub>	4.00±0.86 <sup>a</sup>	5.68±0.41 <sup>b</sup>	5.00±0.25 <sup>a</sup>	5.55±0.18 <sup>a</sup>
KT <sub>5</sub>	4.78±0.44 <sup>a</sup>	6.56±0.79 <sup>b</sup>	5.00±0.35 <sup>a</sup>	3.77±0.92 <sup>a</sup>
KM <sub>1</sub>	4.67±0.11 <sup>a</sup>	5.11±0.33 <sup>a</sup>	4.00±0.31 <sup>a</sup>	3.78±0.64 <sup>a</sup>
KM <sub>2</sub>	4.80±0.42 <sup>a</sup>	5.16±0.67 <sup>b</sup>	4.00±0.01 <sup>a</sup>	5.00±0.06 <sup>a</sup>
KM <sub>3</sub>	4.43±0.35 <sup>a</sup>	5.01±0.45 <sup>b</sup>	4.00±0.25 <sup>a</sup>	5.11±0.83 <sup>a</sup>
KM <sub>4</sub>	4.55±0.05 <sup>a</sup>	5.07±0.91 <sup>a</sup>	4.00±0.00 <sup>a</sup>	5.77±0.48 <sup>b</sup>
KM <sub>5</sub>	4.05±0.00 <sup>a</sup>	5.07±0.35	4.02±0.04 <sup>a</sup>	6.11±0.31 <sup>a</sup>

Means with the same superscripts within the same column are not significantly different ( $P > 0.05$ ). Means with different superscripts are significantly different ( $P < 0.05$ ). (KT<sub>0</sub>- KT<sub>5</sub>): Kunun-zaki with serendipity berry ranged from 0-2% and (KS<sub>1</sub> - KS<sub>5</sub>): kunun-zaki with sucrose ranged from 0.4-2%

#### 4. CONCLUSION

From the results of this study, the introduction of a natural sweetener (serendipity berry) and defatted moringa seed flour into kunun-zaki increased the quantity of protein and reduced the values of fat. The use of this sweetener could be economical and nutritious to the beverage industries, since the sweetener is among the unpopular and under-utilized fruits found in the tropical forest.

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