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A COMPARATIVE STUDY OF THE NUTRITIONAL VALUES OF PALMWINE AND KUNU-ZAKI

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Abstract
The nutritional values of two Nigerian traditional beverages, palmwine (from Raphia hookeri) and kunu-zaki, a cereal-based non-alcoholic beverage processed from guinea corn (Sorghum bicolor) and millet (Pennisetum typhoduim) were investigated and compared. Results showed that kunu-zaki is comparatively richer in carbohydrate, crude protein, lipid, crude fibre, ash and caloric value than palmwine with significant (p□0.05) percentage differences of 220%; 334.48%; 33.33%; 244%; 565.84% and 551.41% respectively. However, moisture content and vitamins (A and C) were found to be 7.32%; 142.24% and 3.63%, respectively, significantly (p□0.05) higher in palmwine than in kunu-zaki. Similarly, higher significant (p□0.05) percentage differences of mineral elements such as Fe^{2+} *(319.9%) and* Cu^{2+} *(88%) were observed in palmwine than kunu-zaki, while,* Mg^{2+}*,* Ca^{2+} *and* Zn^{2+} *were 20.3%, 28.05% and 25.42%, respectively, significantly (p□0.05) more in kunu-zaki than in palmwine. Hence, the use of kunu-zaki as a rich body building and energy beverage is advocated.*

Keywords: beverage, kunu-zaki, mineral, nutrient, palmwine, sap.

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1. INTRODUCTION

Beverages are liquid foods that serve as sources of both fluid and nutrients that refresh and nourish the body (Ihekoronye and Ngoddy, 1985). They also provide energy for daily manual work. In Nigeria there are several types of traditional, alcoholic and non-alcoholic beverages produced locally. Palmwine and kunu-zaki are examples of these local beverages. It is often a subject of debate and argument which of these traditional beverages is more nutritious than the other.

Palmwine is a sweet, effervescent and alcoholic beverage obtained by the natural fermentation of the sap from various palm trees (Uzogara *et al.,* 1990; Uzochukwu *et al.,* 1991; Agu *et al.,* 1999; Ukhun et al., 2005; Obiahiagbon and Osagie, 2007; Adebayo and Ajiboye, 2011) such as palmyra or borassus palm (*Borassus flabellifer*), nipa palm (*Nypa fruticans*), wild date palm (*Phoenix sylvestris*), raphia palm (*Raphia hookeri*), oil palm (*Elaeis guineensis*), etc. Unfortunately, palmwine is not stable (Bohoua, 2008). When fresh it is sweet but this sweetness is lost over time due to spontaneous fermentation of its sugars to alcohol and subsequently acetic acid by a natural microflora (Odunfa, 1985; Obire, 2005) inherent in the wine. Palmwine is characterised by a tingling property which is a function of gas effervescence resulting from the fermentation of its sugar content (Bassir, 1962). However, several studies on the microbiology of palmwine have implicated several bacteria and yeast flora to be involved in the fermentation process (Faparusi and Bassir, 1972a; Okafor, 1972a and b; Okafor, 1975b; Eze and Ogan, 1987; Amanchukwu *et al.,* 1989; Ejiofor *et al.,* 1994; Orimaiye, 1997; Nester *et al.,* 2004). Palmwine has several nutritional, medical, religious and socio-economic uses (Odeyemi, 1977; Uzogara *et al.*, 1990) which have increasingly enhanced the popularity and demand for this natural product (FAO, 1998; Ogbulie *et al.,* 2007). The wine is rich in such nutrients as sugars, proteins, amino acids, vitamins and minerals (Ezeagu and Fafunso, 2003). Its residue (dregs) is rich in a dense population of yeasts (Bassir and Maduagwu, 1978; Bohoua, 2008) which are claimed medically to improve eye sight. The probiotic content of palmwine also bears on its nutritional value (Heller, 2001; Lourens-Hattingh and Wiljoen, 2001; Ezereonye, 2004). Palmwine contains about 10-12% sugar,

mainly sucrose (Bassir, 1962; Okafor, 1975a); about 0.36% protein (Okafor, 1978); 10-19mg/100ml of vitamin C as well as about 160µg/ml of vitamin B_{12} (Okechukwu *et al.,* 1984).
On the other hand, kunu-zaki is a traditional, non-alcoholic, fermented beverage in Nigeria (Adeyemi and Umar, 1994; Gaffa and Ayo, 2002) processed mainly from millet, sorghum and maize (Gaffa *et al.,* 2002a). The traditional processing of kunu-zaki basically involves the steeping of sorted cereal grains for about 24 hours or more; wet-milling; partial gelatinization and digestion of 75% of the slurry with hot water and malted rice; mixing the 25% ungelatinized slurry spiced with ground dry ginger, alligator pepper, and dry potato with the partially gelatinized 75% slurry; left over-night at room temperature for spontaneous fermentation; wet-sieving the next morning and consumption as a beverage with or without being sweetened with sugar (Onuorah et al., 1987a; Gaffa and Ayo, 2002; Adebayo *et al.,* 2010; Essien *et al.,* 2011). The nutritional and microbiological quality of kunu-zaki have been investigated (Gaffa *et al.,* 2002 b and c; Onuorah *et al.,* 1987b). It is a widely accepted food drink (Ihekoronye and Ngoddy, 1985) owing to its refreshing and nutritional qualities. The nutritional value of kunu-zaki is high due to the presence of proteins, carbohydrates, lipids and some vitamins especially vitamin B (Chapman, 1982) while its highest constituent is water (Adebayo *et al.,* 2010). Kunu-zaki processed from sorghum grains contains about 11.6% protein; 3.3% fat; 1.9% ash; and 76.8% carbohydrates as well as an array of amino-acids (Leichtenwalner *et al.,* 1979). However, this non-alcoholic and highly nutritious beverage is susceptible to easy spoilage if not refrigerated at very low temperatures for hours as a result of undesirable fermentation processes triggered by a mixed microflora of lactic acid bacteria, coliforms, molds and yeasts (Odunfa, 1988; Ojokoh et al., 2002; Amusa *et al.,* 2005).
This research, therefore, is designed to investigate comparatively, the nutritional values of palmwine from *Raphia hookeri* and kunu-zaki from guinea corn (*Sorghum bicolor*) and millet (*Pennisetum typhoduim*) with a view to ascertaining their nutritional superiority.

2. MATERIALS AND METHODS

A. Sources and preparation of samples

A fresh and undiluted raphia palmwine (PW) was collected aseptically from Ikot Mbonde Itam, Uyo, Nigeria, while samples of commercially prepared kunu-zaki (KZ) were purchased from a dealer at Uyo metropolis. Both samples were refrigerated at about 4°C prior to analyses.

B. Determination of nutritional factors

The nutritional factors in the samples of both the PW and KZ beverages were determined as follows:

a. Proximate analyses

The crude protein, moisture content, ash, crude fibre and lipid in both beverages were determined by the AOAC (2000) methods of analyses. Carbohydrates were measured using the estimation by difference method of Pearson (1976) and calorific values by the Atwater factor method of Hunt *et al.,* (1987).

b. Determination of vitamins

Vitamins A and C in both samples (PW and KZ) were determined using the AOAC (2000) and Roe and Kurethor (1943) methods.

c. Determination of mineral elements

The mineral elements (Mg^{2+}, Ca^{2+}, Fe^{2+}, Zn^{2+} and Cu^{2+}) in both PW and KZ were analysed using the atomic absorption spectrophotometer (AAS) method outlined in AOAC (2000)

C. Experimental design

The two beverage samples were each split into three blocks and each block subjected to fourteen treatments (seven proximate, two vitamins and five mineral composition analyses) with each treatment replicated three times to give two hundred and fifty two experimental units in a randomized complete block design (RCDB).

D. Statistical Analysis

A statistical measure of dispersion, the standard deviation (S.D), was used to evaluate the reliability of the means of data obtained. Data generated was subjected to Analysis of variance (ANOVA). Significance was accepted at p□0.05.

3. RESULTS AND DISCUSSION

A. Nutritional factors

a. Proximate composition

Table 1 shows the proximate composition of PW and KZ beverages with significant (p□0.05) percentage differences of 220% (carbohydrates), 334.48% (crude protein), 33.33% (lipids), 224% (crude fibre), 565.84% (ash), 7.32% (moisture content) while Figure 1 shows a significant (p□0.05) percentage difference of 551.41% caloric value between the two beverages. The results are indicative of the fact that, unlike PW which food nutrients undergo conversion during a spontaneous alcoholic fermentation process (especially the high-energy-bearing sugars to low-energy-bearing alcohol), the case is different in KZ where its processing technique traditionally generates high-energy-bearing nutrients such as short-chain oligosaccharides and dextrins which do not undergo any form of appreciable conversion during any spontaneous fermentation.

b. Vitamin composition

The vitamin composition of PW and KZ beverages which were significantly (p□0.05) different is displayed on Table 2. The high vitamin A content of PW corroborates the claim, traditionally and medically, that it improves eyesight. This may probably be a result of a dense concentration of yeasts in its dregs (Bassir and Maduagwu, 1978). Consequently, in Africa where vitamin deficiencies are a common occurrence, *fresh* palmwine is considered an important vitamin supplement to diets (Bassir, 1968).

c. Mineral composition

Table 3 shows the mineral composition of PW and KZ beverages. More Ca^{2+} and Mg^{2+} occurred in KZ than PW with a significant (p□0.05) percentage difference of 28.05% and 20.3%, respectively while more Fe^{2+} and Cu^{2+} were present in PW than in KZ with a significant (p□0.05) percentage difference of 319.9% and 88%, respectively.

Table 1: Proximate composition of palmwine and kunu-zaki*

Nutrient (%)	Samples	
	PW	KZ
Carbohydrates	1.130±0.12[a]	7.524±0.19[b]
Crude protein	0.058±0.02[e]	0.252±0.04[f]
Lipids	0.005±0.01[c]	0.016±0.05[d]
Crude fibre	0.027±0.08[i]	0.036±0.05[j]
Ash	0.05±0.03[m]	0.172±0.01[n]
Moisture content	98.73±0.06[ab]	92.00±0.03[k]

*Values are means of triplicate determinations ± SD.
[abc]Means on the same row with different superscripts are significantly different at p□0.05.

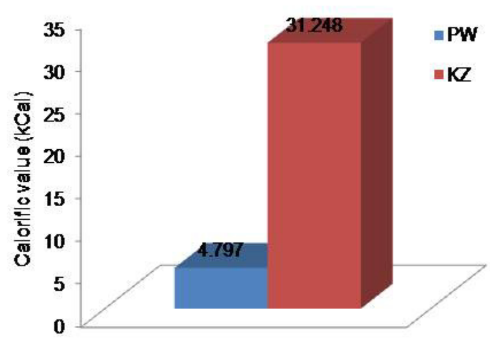

Fig. 1: Calorific value of palmwine and kunu-zaki beverages

Legend description: PW = palmwine. KZ = kunu-zaki.

Table 2: Vitamin composition of palmwine and kunu-zaki*

Vitamin (%)	Samples	
	PW	KZ
Vitamin A	20.76±0.01[ab]	8.57±0.03[a]
Vitamin C	7.43±0.12[c]	7.17±0.02[ef]

*Values are means of triplicate determinations ± SD.
[abc]Means on the same row with different superscripts are significantly different at p□0.05.

However, Zn^{2+} was 25.42% significantly (p□0.05) more in KZ than PW. Mineral elements are biochemically essential in diet for such functions as bone formation, strong teeth development and digestion aids (Adebayo *et al.,* 2010), enzyme stabilizers as well as transport cofactors in metabolic pathways.

Table 3: Mineral composition of palmwine and kunu-zaki*

Minerals (mg/l)	Samples	
	PW	KZ
Ca^{2+}	3.85±0.02[a]	4.93±0.06[f]
Mg^{2+}	31.33±0.02[b]	37.69±0.04[g]
Fe^{2+}	3.20±0.04[c]	0.001±0.00[h]
Zn^{2+}	0.12±0.01[d]	3.17±0.05[i]
Cu^{2+}	0.47±0.03[e]	0.25±0.01[j]

*Values are means of triplicate determinations ± SD.
[abc]Means on the same row with different superscripts are significantly different at p[illegible]0.05.

4. CONCLUSIONS

The results of this study revealed that kunu-zaki (KZ) contains more food nutrients and caloric value than palmwine (PW). However, palmwine (PW) has a higher moisture content, vitamins A and C as well as trace mineral elements than kunu-zaki (KZ). Based on these results, the use of kunu-zaki (KZ) as a rich, nutritious, body-building and energy beverage is therefore advocated.

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