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Sensory, Shelf-Life and Nutritional Evaluation of Kunu (Nigeria Non-Alcoholic Beverage) Produced from Different Grains

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Abstract: *The evaluation of the sensory properties, nutritional and consumer acceptability via titratable acidity was investigated on different cereal grains mostly used in the production of Kunu (Maize, sorghum, and millet). The grains were bought from Ibadan Market, sorted carefully after which equal mass (250g) of the sorted grains where soaked for seventy two (72) hours, drained and was milled with the inclusion of other ingredients as spice. The mixture was sieved and the liquid portion was further processed into Kunu-zaki for sensory property and nutritional evaluation with titratable acidity evaluation. The result obtained from the sensory evaluation showed that Sorghum has a better overall acceptability of 7.55 (approx 76%) above the other grains with maize and millet acceptability of 74% and 68%. Additionally, Sorghum has a lowered titratable acidity value (the lower the titratable value the longer the shelf-life) when evaluated on daily bases for three days which validate its better shelf life when compared with other grains. Nutritionally, Sorghum had a higher percentage of protein, lipid and ash content with Fe and cu the predominant minerals measured in mg/100g. It can be concluded that Sorghum is a better grain in the production of Kunu than Maize and millet due to its shelf life, nutritional and sensory properties.*

Keywords: *Kunu Zaki, Sensory properties, Shelf life, Nutritional evaluation, Titratable Acidity*

1. INTRODUCTION

Kunu zaki popularly known as Kunu is one of the drinks produced from cereal grains in Nigeria, particularly the northern part of the country. It is produced from grains such as maize, millet and sorghum [1][2]. The relative abundance of any of these in any locality determines to a large extent the type of grain for making the beverage [3]. Over the years, people of different ages have enjoyed its refreshing taste [4]. This taste is admired not only by the resource poor populace but also the well to do. It is cheap since it is produced from local sourced materials which are readily available [5]. Consequently, the drink serves as alternative to carbonated drinks in social gatherings and during religious festivities [6]. In fact, Adejuyitan *et al.* [7] revealed that Kunu is more nutritious when compared to carbonated drinks. It is also taken as remedy by alcoholic addict [4]. As explained by Abulude *et al.* [8], the method of production is basically the same but with some variance from place to place based on cultural norms, taste and habit. Adeyemi and Umar[9] described the processes involved which includes: thorough washing of the grains, addition of spices like *Piper guinense* and ginger, milling, division of milled products into three portions, gelatinising two of the portions (adding boiled water), cooling, mixing with the last portion, leaving overnight (to ferment), then sieving and sweetening to taste. However, the major challenge with this drink is that it has a short shelf life and therefore highly perishable [10]. According to Ayo *et al.* [11], this could be traced to its high moisture content and poor hygienic practice during preparation. Due to different fat content in grains, their shelf lives vary; hence there is a need to ascertain the grain which would give the best quality when Kunu is produced. Therefore, the aim of this study is to compare the shelf lives, acceptability and nutritional value of Kunu drinks prepared from different grains i.e. maize, millet and sorghum.

2. METHODOLOGY

2.1. Traditional Production of Kunu

The grains were bought from Ibadan Market, sorted carefully after which equal mass (250g) of the sorted grains where soaked for seventy two (72) hours (a process of fermentation), drained and was milled with the inclusion of other ingredients as spice. The mixture was sieved and was further processed into Kunu-zaki

2.2. Titratable Acidity

10ml sample of freshly prepared Kunu to be analyzed was collected, filtered with coffee filters. 30ml of distilled water in a 50ml beaker (for optimal accuracy, water should have been previously boiled for 15 min to reduce CO2 levels which can elevate apparent TA) was added. This is followed by the addition of 3 drops of phenolphthalein indicator. Approximately 2-3ml of filtered sample was added to the same 50ml beaker with an addition of magnetic stir bar placing the beaker on magnetic stirrer. The pH electrode was Submerge into contents of beaker maintaining clearance above the stir bar. The contents of beaker quickly titrated to establish pH=8.2 endpoint. 5ml of sample can be volumetrically added to the beaker to also record current level of NaOH in the burette. Titrate test sample of Kunu back to the pH=8.2 endpoint and record required ml NaOH.

Calculate total NaOH used and compute TA as follows:

TA (g/L) = (ml NaOH) (M NaOH)(150 g/mol)(0.5 mol/eq.) / (ml Kunu sample) = (ml NaOH) * 1.5

2.3. Proximate Composition

Estimations were made of nitrogen (as an index of crude protein), water, fat, ash, and crude fiber. When the total was subtracted from 100%, the difference was termed carbohydrate by difference. Determination of the moisture content, ash, and crude fat followed the method of AOAC (1990). Crude fiber determination followed the method of Pearson (1981). Estimation of nitrogen content was by the Kjeldahl method multiplied by 6.25, the nitrogen-protein factor to convert to crude protein.

2.4. Crude Fiber

Two grams of the sample was transferred into a 1 L conical flask. One hundred milliliters of sulfuric acid (0.255 mol/L) was heated to boiling and then introduced into the conical flask containing the sample. The contents were then boiled for 30 min, ensuring that the level of the acid was maintained by the addition of distilled water. After 30 min, the contents were then filtered through a muslin cloth held in a funnel. The residue was rinsed thoroughly until its washing was no longer acidic to litmus. The residue was then transferred into a conical flask. One hundred milliliters of sodium hydroxide (0.313 mol/L) was then brought to boil and then introduced into the conical flask containing the sample. The contents were then boiled for 30 min, ensuring that the level of the acid was maintained by the addition of distilled water. After 30 min, the contents were then filtered through a muslin cloth held in a funnel. The residue was rinsed thoroughly until its washing was no longer alkali. The residue was then introduced into an already dried crucible and ashed at 600°C ± 200°C.

2.5. Sensory Evaluation

The 9-point hedonic scale assessment and the paired comparison tests were used as described by Larmond (1977). A total number of 30 staff of the Nigerian stored products research institute and industrial training student of the university of Ibadan were selected based on their familiarity with Kunu zaki, The panelists scored coded drinks in terms of degree of liking to taste, color, and aroma. The 9-point hedonic scale used by the panelists for the evaluation ranged from 1 to 9 representing "extremely dislike" to "extremely like". The coded samples were served in clean, transparent cups at room temperature 25°C. Water was given to each panelist for oral rinsing in between tasting of the samples.

3. RESULTS

The result findings on the sensory properties of Kunu-zaki produced from three grains showed that Sorghum has a better appealing aroma and appearance when compared to maize and millet. Also, there was no observable significant difference between the colour of Sorghum and millet. The overall acceptability favored Kunu produced from Sorghum with 7.55 (75.5%) acceptance from respondent which is followed by maize then millet.

Table1. *Sensory evaluation of Kunu-zaki produced from three different grains (Sorghum, maize and millet)*

Sensory properties	Sorghum	Maize	Millet
Appearance	7.08±0.11[a]	6.92±0.06[a]	6.25±0.12[a]
Colour	6.67±0.21[a]	7.25±0.24[b]	6.83±0.26[a]
Aroma	7.62±0.13[abc]	7.33±0.22[a]	5.92±0.10[abc]
Taste	7.08±0.04[a]	7.33±0.13[a]	6.50±0.22[a]
Overall Acceptability	7.55±0.02[a]	7.42±0.12[a]	6.83±0.21[a]

Means with same superscript indicate no significant different at 5% for the attribute

Titratable acidity value of Kunu-zaki produced from three different grains was investigated on daily bases for three days with Sorghum having the least titratable acidity value after the third day, which signifies a longer shelf life when compared to the other grains. The higher the titratable acid value, the lower the shelf life and vice versa. The result also validate that the titratable acidity value increases with increase in storage time at room temperature.

Table2. *Titratable acidity value of Kunu-zaki produced from three different grains (Sorghum, maize and millet)*

	Kunu sample	Average titer value	Titratable acidity value
Fresh	Maize	0.30cm^3	1.30
	Millet	0.33cm^3	1.32
	Sorghum	0.47cm^3	1.88
After 24 hours	Maize	0.53cm^3	2.12
	Millet	0.50cm^3	2.00
	Sorghum	0.40cm^3	1.60
After 48 hours	Maize	0.67cm^3	3.68
	Millet	1.00cm^3	4.00
	Sorghum	0.83cm^3	3.32

Analysis of each sample where carried out in triplicate to give average titer value

3.1. Proximate Analysis

The result of the proximate analysis obtained in table 3 showed a significant increase in the protein and lipid content of Sorghum when compared with maize and millet. Also, there was no observable significant difference in ash content. Sorghum also had lower moisture content when compared to other grain.

Table3. *Proximate analysis of Kunu-zaki produced from three different grains (Sorghum, maize and millet)*

Proximate parameters	Maize	Sorghum	Millet
Moisture (%)	39.17±0.09[a]	38.33±0.08[b]	38.9±0.09[a]
Protein (%)	15.27±0.089[a]	17.53±0.089[b]	14.17±0.089[c]
Lipid (%)	1.27±0.08[a]	1.87±0.09[b]	1.67±0.08[b]
Ash (%)	2.77±0.08[a]	3.77±0.08[a]	1.87±0.08[a]
Crude fibre (%)	8.13±0.08[b]	7.67±0.08[a]	8.43±0.08[b]
Carbohydrate (by different)	33.39±0.08[a]	30.83±0.08[b]	34.96±0.12[a]

Means with same superscript indicate no significant different at 5% for the attribute

3.2. Mineral Analysis

Mineral composition of Kunu-zaki produced from three different grains were carried out to validate which of the grains has more affluent minerals. The result of the minerals analysed as shown below in the table 4, Kunu produced from Sorghum has an iron estimation of (13.17±0.08) which when compared to Kunu produced from Maize (6.33±0.08) and millet (8.17±0.08) is higher, Similar higher estimation was observed in the amount of zinc and magnesium of Sorghum (0.53±0.03) (0.02±0.005) when compared to that of maize (0.37±0.03) (0.0133±0.003) as well as that of millet (0.43±0.03) (0.0167±0.003). A relatively lower amount of calcium was estimated in sorghum (80.0±2.89) when compared to other grains.

Table4. *Mineral compostion of Kunu zaki produced from three different grains (Sorghum, maize and millet)*

Minerals	Maize	Sorghum	Millet
Iron (mg/100g)	6.33±0.08[a]	13.17±0.08[b]	8.17±0.09[c]
Zinc (mg/100g)	0.17±0.03[a]	0.50±0.05[b]	0.37±0.003[b]
Calcium (mg/100g)	90.0±2.89[a]	80.0±2.89[b]	111.67±4.41[c]
Magnesium (mg/100g)	2.77±0.08[a]	3.77±0.08[a]	1.87±0.08[a]
Selenium (mg/100g)	8.13±0.08[b]	7.67±0.08[a]	8.43±0.08[b]

Means with same superscript indicate no significant different at 5% for the attribute

4. DISCUSSION

The preference of grains used in the production of Kunu (a non-alcoholic beverage majorly taken by the northern part of Nigeria) has always be on the sensory properties with less attention placed on the nutritional quality and shelf life of these grains. Thus, efforts have been taken to compare and evaluate the sensory, shelf life and nutritional qualities of Kunu prepared from the three commonly used grains (Maize, Sorghum, and millet). The result of this study showed that Kunu made from sorghum have the highest overall acceptability (7.55±0.02) with a better aroma, taste and appearance (7.62±0.13, 7.08±0.04, 7.08±0.11) when compared with Kunu produced from maize (7.33±0.22, 7.33±0.13, 6.92±0.06) and Kunu made from millet (5.92±0.10, 6.50±0.22, 6.25±0.12). This could be attributed to the higher amount of minerals and vitamins richer in sorghum, which plays a role as a stimulant (due to its good flavor), improved palatability and taste. A cursory look at the proximate analysis of the three cereals being investigated provides some insight. Significant difference was observed in lipid contents of the three Kunu drinks with Kunu made from sorghum showing the highest composition while Kunu made from maize has lowest lipid (1.27±0.08) when compared to that of Kunu made from millet (1.67±0.08). There is a strong correlation between lipid contents of food substances and their taste. This is because of lipids hedonic properties which enhances good texture, flavor and aroma [12][13]. This claim is also supported by the report of Antia *et al.* [14], who stated that dietary fats function to increase food palatability by absorbing and retaining flavors. In the light of this, consumer preference may be based on associating sensory attributes with the physiologic consequences of ingestion, such as satiety and well-being [15]. Moreover, lipid plays a unique role in the human diet and serves as a concentrated source of dietary energy. Similarly, the percentage of Protein in Kunu made from sorghum (17.53±0.089) was observed to be relatively higher than Kunu produced from maize (15.27±0.089) and millet (14.17±0.089). Kunu made from sorghum has more protein (17.53±0.089) when compared with Kunu made from millet (14.17±0.089) and maize (15.27±0.089). Protein is an essential macro nutrients needed for growth and maintenance of human body [16]. However, in term of carbohydrate and crude fiber content, this study reveals Kunu from millet (34.96±0.12 and 8.43±0.08 respectively) to have the highest proportion. This is followed by Kunu from maize (33.39±0.08 and 8.13±0.08 respectively) and then Kunu made from sorghum (30.83±0.08 and 7.67±0.08 respectively). Carbohydrate is a good source of energy while dietary fiber is very important in human nutrition as it lowers the body cholesterol level; consequently decrease the risk of cardiovascular diseases. They are capable of absorbing more water many times their own weight when steeped in water, creating a soft bulk to the stool that can pass the waste products out of the body. Insoluble fibers promote regular bowel movement and decrease risk of colon cancer. In term of energy supply, the outcome of this work suggests that Kunu made from sorghum would be a preferred option over the other two. This is because of its Palatability which invariably is a determinant of energy intake [17]. This finding is in line with the discovery of Rolls *et al.*[18] whose work reveals that food commodities with relatively higher amount of protein and good starch content produces greater satiety than just high sucrose foods.

Titratable acidity value was observed to be on the increase in the three variety of Kunu as storage time progressed. This may be due to carbohydrate utilization by microorganisms leading to the generation of more hydrogen ions; indicating more acid production in the investigated drinks[19][20]. After 48 hours, Millet with the highest carbohydrate (34.96±0.12) content was observed to have the highest titratable acid value (4.00), followed by Maize (33.39±0.08) (3.68) and Sorghum (30.83±0.08) (3.32). This consistency suggests that there is direct correlation between the carbohydrate content of the drinks and their titratable acidity. Since titratable acidity value signifies spoilage [21], it is evident that Kunu made from sorghum has the best shelf life when compared with the other two.

In term of mineral constituents our analysis show the three different Kunu drinks to be similar but with some variations. For instance, the Magnesium content of the three drinks is not significantly different. There is also no significant difference in Zinc content of Kunu-sorghum (0.50±0.05) and millet (0.37±0.003). Similarly, no significant difference exists in the selenium content of Maize (8.13±0.08) and Millet (8.43±0.08). This explains why there is no significant difference in the ash content of the drinks as shown by the proximate analysis carried out in this study. In line with the assertion of Antia *et al.* [14], this suggests that there is no significant difference in the mineral composition of the drinks. These minerals are constituent of bones, teeth, blood, muscles, hair and nerve cells and according to Rumeza *et al.* [22] they are very important and essential ingredients of diet required for normal metabolic activities of body tissues. From the foregoing, it may not be wrong to suggest Kunu-sorghum to be a preferred option when compared with Kunu-maize and Kunu-millet at normal room temperature. To authenticate this claim, further work could be carried out using different temperature conditions.

5. CONCLUSION

It can be concluded that among the three majorly used grains in the production of Kunu (Nigeria non-alcoholic beverage), Sorghum showed a better Nutritional, sensory evaluated properties and posed a longer shelf life when compared to the millet and maize.

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