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Proximate, Mineral Composition and Sensory Evaluation of Zobo Processed with Wonderful Kola Extract (Buchholzia coriacea)

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ABTRACT

Composite Zobo, a well know non-alcoholic beverage was processed from dried purple calyces of Hibiscus sabdariffa, ginger, cloves, pineapple peel and enriched with wonderful kola extract in varying proportions. The proximate, mineral and sensory qualities of this drink were analyzed using standard methods. The results obtained for each sample (control to ZOWK 5) showed that the proximate composition had mean values ranging from (90.00 to 92.43%) for moisture, (0.96 to 1.05%) for ash, (0.20 to 0.60%) for fat, (3.82 to 6.74%) for protein and (1.06 to 3.02%) for carbohydrate. The results showed that there was significant difference ($p<0.05$) between the samples. Also, the mineral composition of the samples ranged from (13 - 33mg) for Iron, (13 - 27mg) for zinc, (6.7 -15.9mg) for potassium, (11.00 - 23.66mg) for magnesium and (4.2 - 18.69mg) for phosphorus with sample ZOWK 5 which contained the highest amount of wonderful kola extract having the highest mean score for iron, zinc, potassium, magnesium and a moderate concentration of phosphorus. There was a significant difference ($p<0.05$) in sensory qualities for all the samples. This result showed that Zobo with a little amount of wonderful kola is better than the one without wonderful kola due to the minerals added to the drink by wonderful kola.

Keywords: Mineral, non-alcoholic, Sensory, wonderful kola, Zobo

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INTRODUCTION

Zobo leaves, also known as Roselle (*Hibiscus sabdariffa* L.), are a well-liked plant that are members of the Hibiscus genus, family, and order Malvales (Nadelene, 2019). It is a bushy, annual herbaceous plant with a maximum height of two meters (Refaei et al., 2010). According to Akaninwor (2017), it has a crimson, smooth, cylindrical stem and alternates greenish leaves with red veins. According to Eckenam (2018), zobo leaves can range in length from 3 to 5 inches (13 cm) and have either short or long petioles.

The most popular usage of the zobo plant, despite its multiple uses, is as a refreshing beverage (Schippers, 2019) .Nigeria is well-known in its northern region and in a few neighboring West African nations for the non-alcoholic "zobo" drink that is made from dried calyx.
Hibiscus sabdariffa flower sepals are brewed or infused with different food spices, sweeteners, or flavors to create the zobo drink, which is typically consumed hot or cold (Ezekiel and Onyeoziri, 2016). Spices such as cinnamon, star anise, ginger, cloves, garlic, pepper, and natural or artificial flavoring can be added to prepare zobo drink. Occasionally, fruits are mixed and added, including sugar cane, oranges, lemons, pineapples, cucumbers, and any other desired fruit (Gbadamosi, 2017).

According to Ezeigbo et al. (2015), zobo drinks are high in carotenes, vitamin C, thiamine, calcium, fat, iron, fiber, phosphorus, riboflavin, and niacin. The nutrient carotene, found in zobo leaves, aids in the body's conversion of this resource into vitamin A, maintaining eye health. It aids in promoting healthy, clear vision and guards against eye conditions including night blindness. Additionally, essential organic acids found in zobo drink, such as maleic acid, acetic acid, tartaric acid, and citric acid (Adelekan et al., 2013), support healthy kidney function.
Wonderful kola (*Buchholzia Coriacea*), as it is known botanically, is a perennial plant that is a member of the Capparaceae family (Ibrahim and Fagbonun, 2017). According to Mbata et al. (2009), this plant is often found in Nigeria, Cameroon, Gabon, Central African Republic, Congo, Angola, and Ghana. It is an evergreen that can grow up to 20 meters in height.

In Nigeria, wonderful kola seeds go by various local names. In Yoruba, it is referred to as "Uworo," in Edo as "Owi," and in Igbo as "Uke." (Sofowora, 2018). The seeds' renowned name, "Wonderful Kola," came from their remarkable ability to treat a wide range of illnesses. Because of its capacity to improve memory, it is also known as memory nut (Ibrahim and Fagbonun, 2013).

Wonderful kola (*Buchholzia Coriacea*) seeds have long been used to cure a variety of conditions, including cough, catarrh, diabetes, rheumatism, and hypertension (Adisa et al., 2011). Furthermore, these seeds have been shown to alleviate a number of diseases, including dysentery, malaria, premature ejaculation, and chest discomfort, wrist pain, irregular menstruation, and others (Ezeifeka et al., 2019; Jaiyesimi et al., 2011; Ibrahim and Fagbonun, 2013). Wonderful kola has blood-cleansing and nervous system-improving properties. In Africa, it has long been used specifically to treat migraines (Jaiyesimi et al., 2019). Although, wonderful kola is used for a variety of purposes, not much is known about its nutritional value, phytochemicals, antibacterial qualities, or therapeutic uses. Wonderful kola extract-infused zobo drinks would compete well with most imported non-alcoholic beverages offered for sale in Nigeria. This study, however, is specifically designed to determine the amount of amazing kola extract that will boost the nutritious content of the beverage after it is prepared.

MATERIALS AND METHODS

Sources of raw materials

The dried zobo calyxes, wonderful kola seeds, ginger roots, cloves and pineapple peels were purchased at Ose market in Onitsha North LGA, Anambra state, Nigeria

Experimental design

Mixture design was used in this research work (Table 1) and principal factor was zobo samples with different proportions of wonderful kola extract, ginger, cloves and pineapple peel (ZOWK 1, ZOWK 2, ZOWK 3, ZOWK 4, ZOWK 5 and CONTROL). The samples were analyzed for proximate composition, mineral analysis and sensory attributes. The effects of the principal factor on these parameters were determined.

Preparation of additives

The ginger roots, pineapple peels and cloves were washed properly, under running water, the ginger roots were dehulled and then reduced in size together with the clove by using an electric blender (model: 220V/50Hz/200W).

Preparation of wonderful kola extract

The wonderful kola seeds were processed into extract according to Adelere et al., (2017). They were washed, dehulled, reduced to smaller sizes and then dried using a dehydrator and milled into fine flour using the electric blender. Distilled water was then added to the wonderful kola flour and boiled in a hot water bath at 60^{o}C for 1 hour. The extract was then filtered using Whatman filter paper and stored at 4º C for further studies.

Table 1: Experimental design for zobo calyxes and wonderful kola extract.

Samples	Zobo Calyxes (g)	Wonderful kola extract (g)	Pineapple peel (g)	Clove (g)	Ginger(g)
ZOWK 1	65.00	5.00	20.00	3.12	6.88
ZOWK 2	63.56	6.29	20.88	3.49	5.78
ZOWK 3	60.00	6.07	23.27	3.00	7.66
ZOWK 4	62.04	5.00	24.96	3.50	4.50
ZOWK 5	61.64	7.87	20.91	4.00	5.58
CONTROL	65.00	0.00	24.80	3.20	7.00

Zobo processing procedures

The zobo drink was processed according to Adeniji, (2017). The dried zobo calyxes were inspected and sorted to remove stick, stones and other foreign material. The dried zobo calyxes were then rinsed under running water.

Using the experimental design, the weight of the zobo calyxes was measured and added to 1 liter of boiling water along with the weight of the ginger, cloves and pineapple peel as stated in the experimental design and was cooked for about 20 minutes to obtain each of the various samples. The filtrate was obtained by filtration with a clean muslin cloth while the residue was discarded. The wonderful kola extract was then added to each of the sample as stated in the experimental design and the samples were then hot filled and packaged in sterilized bottles. The sample was cooled at room temperature and refrigerated at 28^{o}C.

Proximate analysis

Crude protein was determined using Formol titration, 0.5ml of 1% phenolphthalein indicator to 10ml of sample. It was titrated to pink color with 0.1M NaOH. The reading was noted. Exactly 2ml of formalin was added to the mixture and mixed for 3-5 minutes. The mixture was allowed to stand for 5-10 minutes. It was titrated again to the same pink color with 0.1M NaOH (a). A blank was done with 10ml of distilled water and 2ml of formalin (b).
Moisture content was done by the gravimetric method described by the AOAC (2015). A measured weight of the sample (10 ml) was added into a previously weighed moisture can. The sample in the can was dried in the oven at 105°C for 3 hours. It was cooled in a desiccator and weighed. It was then returned to the oven for further drying. Drying, cooling and weighing were done repeatedly at hourly interval until there were no further diminutions in the weight (that is, constant weight was obtained). The weight of moisture lost was calculated and expressed as a percentage of the weight of sample analyzed.

Ash content was done by the furnaces incineration gravimetric method described by James (1995) and AOAC (2012). 10ml of the sample was measured into a previously weighed porcelain crucible. The sample was burnt to ashes in a muffle furnace at 550°C. When it has become completely ashed, it was cooled in desiccator and weighed.

Crude fat was determined by the use of separation funnel method. 10 grammes of the sample was weighed into a beaker. 10ml of distilled water was added to it, then 10ml of Conc. HCl to it. It was shaken, warmed and cooled rapidly. 25ml of diethyl ether was added to the mixture and shaken. Then 25ml of petroleum ether was added to the mixture. The mixture was then transferred to a separating funnel and allowed to stand for 10-20 minutes. The tap was opened to drain the non-essential leaving the oil. The analyte was drained into an already washed, dried, cooled and weighed beaker. The content was placed in a heating mantle to dry it off. The boiling was done with boiling point of the solvent with the least boiling point which was 35ºC for diethyl ether and later increased to the solvent with the higher boiling point which was 50ºC for petroleum ether. The carbohydrate content was calculated by difference using the formula: %Carbohydrate content = 100 - (%Moisture + %Ash + %Protein + %Fat + %Crude + %Fiber).

Mineral analysis

Metal analysis was conducted using Varian AA240 Atomic Absorption Spectrophotometer according to the method of APHA 1995 (American Public Health Association) to determine the concentration of Iron (Fe), Magnesium (Mg), Zinc (Zn), Potassium (K) and Phosphorus (P).

Wet digestion technique

The method of Sun, 2000 was adopted. Samples weighing approximately 1g were transferred into a 100ml digestion flask, and then 10ml of 70% HNO_3 was added followed by heating until any vigorous reaction subsided (30-45 minutes). After cooling, 8ml of 70% perchloric acid ($HClO_4$) was added to each flask and the contents were gently heated on a hot plate until the solutions became colorless or nearly so, and white fumes of $HClO_4$ were evolved making sure contents didn't dry. After cooling, approximately 30ml of distilled water was added to each

flask and boiled for another 10 minutes, cooled and then filtered at room temperature. The digests were then subjected to atomic absorption spectrophotometric analysis.

Preparation of reference solutions

A series of standard metal solutions in the optimum concentration range were prepared, the reference solutions were prepared daily by diluting the single stock element solutions with water containing 1.5 mL concentrated nitric acid/liter. A calibration blank was prepared using all the reagents except for the metal stock solutions. Calibration curve for each metal was prepared by plotting the absorbance of standards versus their concentrations.

Statistical analysis

The data generated was subjected to analysis of variance (ANOVA) using version 21 of the software (SPSS) and the means was separated using Duncan Multiple range test at 95% confidence test.

RESULTS AND DISCUSSION

The proximate composition of zobo drink

The proximate composition of zobo processed with wonderful kola extract is shown in (Table 2). Moisture content of the samples ranged between 90.00 – 92.43% with sample 4 containing zobo calyces 62.04%, wonderful kola 5%, pineapple peel 24.96%, cloves 3.5%, ginger 4.5% having the highest value at 92.43% and sample 1 containing zobo calyces 65%, wonderful kola 5%, pineapple peel 20%, cloves 3.12%, ginger 6.88% having the lowest value of 90.00%. According to the results, there were significant differences ($p < 0.05$) between the moisture content of the samples. This study agrees with the findings of Adeniji, (2017) moisture ranges from 92.5 – 95.1% as they are closely related. The high moisture content of this beverage signifies that it is easily susceptible to microbial spoilage and deterioration hence Zobo has a short shelf life.

Ash content ranged from 0.96 – 1.05% with ZOWK 5 (zobo calyces 61.64%, wonderful kola 7.87%, ginger 20.91%, cloves 4%, pineapple peel 5.58%) having the lowest score and ZOWK 3 (zobo calyces 60%, wonderful kola 6.07%, ginger 23.27%, cloves 3%, pineapple peel 7.66%) having the highest score. These results were in close agreement with Ekanem, (2018) whose ash content range from 0.93% to 1.8%. Ash content of a food is reported to give an idea of the mineral elements present, and it indicates the composition of inorganic constituents after organic materials such as fats, proteins, and carbohydrates, as well as moisture, have been removed by incineration (Iwe et al., 2016). The fat content of the samples ranged from 0.20 – 0.60% with ZOWK 1 and 2 (zobo calyces 65%, 63.56%, wonderful kola 5%, 6.29%, ginger 20%, 20.88%, cloves 3.12%, 3.49%, pineapple peel 6.88%, 5.78% respectively) having the lowest value and Control and ZOWK 4 having the highest value. According to Muto Salamatu, (2023), the fat content in his research work ranges from 0.40 to 0.55%. This result was in closed range to the results gotten from this study. Also, kehinde *et al.,* (2022) gave the range for fat as 0.22 to 2.06. Food's flavor and consistency are influenced by its fat content (Ire et al., 2020). Prentice, (2005) states that lipids and carbs provide the majority of the energy that humans need from their diet. The beverage in this study had a relatively low crude fat content, which suggests that most of the product's energy came from carbohydrate.

Mineral composition of zobo drink

Table 3 shows the concentration of iron which ranged from 13-33% with Control (zobo calyces 65%, wonderful kola 0%, ginger 24.80%, cloves 3.20%, pineapple peel 7%) having the least score and ZOWK 5 (zobo calyces 61.64%, wonderful kola 7.87%, ginger 20.91%, cloves 4%, pineapple peel 5.58%) having the highest score. According to Babalola et al., (2015), zobo drink made from aqueous extract of Roselle calyces contains 6.25mg – 7.85mg iron per 100g. It was observed that the iron content of this study is higher than that reported by Babalola. This is because of the fact that the ingredient which has a high iron concentration was added to the sample in varying proportion.

The concentration of Zinc ranged from 13 – 27%. ZOWK 5 (zobo calyces 61.64%, wonderful kola 7.87%, ginger 20.91%, cloves 4%, and pineapple peel 5.58%) had the highest score while the Control (zobo calyces 65%, wonderful kola 0%, ginger 24.80%, cloves 3.20%, and pineapple peel 7%) had the lowest. According to Yakubu et al., (2022), zobo drink from sun-dried Roselle calyces contains 0.68mg – 1.05mg zinc per 100 ml serving which was lesser when compared to the result of this study. In another related research, Ayoola and Adeyeye, (2010) reported that one study analyzing canned zobo drink found higher zinc content of 1.92mg – 2.35mg per 100g in it . This shows that the mineral concentration found in this study is quite higher than those found in these literatures.

Potassium concentration from the (Table 3) ranged from 6.7 – 15.90%. ZOWK 5 zobo calyces 61.64%, wonderful kola 7.87%, ginger 20.91%, cloves 4%, pineapple peel 5.58%) had the highest valve (15.90%) while Control had the least (6.7%). It was seen that there was significant difference ($p < 0.05$) between the samples with ZOWK 2 and 5 being significantly different from the set of samples though not significantly different between

Table 2: Proximate composition of zobo processed with wonderful kola extract.

Samples	Moisture %	Protein %	Ash %	Fat %	Carbohydrate %
CONTROL	92.00^{ab} ±0.50	3.82^{e} ±0.01	1.00 ^{ab} ±0.00	0.60^{a} ±0.00	1.06 ^{d} ±0.07
ZOWK 1	90.00^{d}±0.00	5.18^{c} ±0.01	1.02 ^{ab} ±0.01	0.20 ^{c} ±0.00	1.17^{cd} ±0.06
ZOWK 2	90.20^{cd} ±0.01	6.17^{b} ±0.00	1.01 ^{ab} ±0.00	0.20 ^{c} ±0.00	2.34 ^{ab} ±0.5
ZOWK 3	91.93^{b}±0.30	5.41^{c}±1.07	1.05 ^{a} ±0.01	0.41^{b} ±0.01	2.34 ^{ab} ±0.5
ZOWK 4	92.43^{a}±0.05	4.40^{d} ±0.00	1.03 ^{a} ±0.04	0.60 ^{a} ±0.00	1.87^{bc} ±0.77
ZOWK 5	90.56^{c}±0.05	6.74 ^{a} ±0.01	0.96 ^{b} ±0.05	0.21 ^{c} ±0.01	3.02 ^{a}±0.31

Each mean is a mean of three replicates ± standard deviation of the mean. Mean followed by the same letter in the same column are not significantly different by New Duncan's Multiple Range (p<0.05)
Keywords: CONTROL (zobo calyxes 65%, wonderful kola extract 0%, pineapple peel 24%, cloves 3.2%, ginger 7%); ZOWK 1 (zobo calyxes 65%, wonderful kola extract 5%, pineapple peel 20%, cloves 3.12%, ginger 6.88%); ZOWK 2 (zobo calyxes 63.56%, wonderful kola extract 6.29%, pineapple peel 20.88%, cloves 3.49%, ginger 5.78%); ZOWK 3 (zobo calyxes 60%, wonderful kola extract 6.07%, pineapple peel 23.27%, cloves 3%, ginger 7.66%); ZOWK 4 (zobo calyxes 62.04%, wonderful kola extract 5%, pineapple peel 24.96%, cloves 3.5%, ginger 4.5%); ZOWK 5(zobo calyxes 61.64%, wonderful kola extract 7.87%, pineapple peel 20.91%, cloves 4.0%, ginger 5.58%).

Table 3: Mineral composition of zobo processed with wonderful kola (mg/100g).

Sample	Fe	Zn	K	Mg	P
Control	13.00^{f}±1.00	13.00^{c}±1.00	6.70 ^{d} ± 1.00	11.00 ^{e} 1.00	4.20 ^{e} ± 1.00
ZOWK 1	22.00^{c}±1.00	22.60 ^{b} ± 1.00	11.00 ^{c} ± 1.00	14.00 ^{d} ± 1.00	9.50 ^{d} ± 1.00
ZOWK 2	25.00^{d}±1.00	25.70 ^{a} ± 1.00	15.70 ^{a} ± 1.00	19.00 ^{b} ± 1.00	14.10 ^{b} ± 1.00
ZOWK 3	29.00^{b}±1.00	26.90 ^{a} ± 1.00	13.40 ^{b} ± 1.00	16.00 ^{c} ± 1.00	18.60 ^{a} ± 1.00
ZOWK 4	20.00^{e}±1.00	22.13 ^{b} ± 1.00	11.90^{bc} ± 1.00	15.00^{cd} ± 1.00	12.00 ^{c} ± 1.00
ZOWK 5	33.00^{a}±1.001	27.00 ^{a} ± 1.00	15.90 ^{a} ± 1.00	23.66 ^{a} ± 1.00	13.20 ^{bc} ± 1.00

Each mean is a mean of three replicates ± standard deviation of the mean. Mean followed by the same letter in the same column are not significantly different by New Duncan's Multiple Range (p<0.05)
Keywords: CONTROL (zobo calyxes 65%, wonderful kola extract 0%, pineapple peel 24%, cloves 3.2%, ginger 7%); ZOWK 1 (zobo calyxes 65%, wonderful kola extract 5%, pineapple peel 20%, cloves 3.12%, ginger 6.88%); ZOWK 2 (zobo calyxes 63.56%, wonderful kola extract 6.29%, pineapple peel 20.88%, cloves 3.49%, ginger 5.78%); ZOWK 3 (zobo calyxes 60%, wonderful kola extract 6.07%, pineapple peel 23.27%, cloves 3%, ginger 7.66%); ZOWK 4 (zobo calyxes 62.04%, wonderful kola extract 5%, pineapple peel 24.96%, cloves 3.5%, ginger 4.5%); ZOWK 5(zobo calyxes 61.64%, wonderful kola extract 7.87%, pineapple peel 20.91%, cloves 4.0%, ginger 5.58%.

themselves. Potassium helps nerves, muscles heart to function well, and also helps move nutrients and waste around your body's cells, Ai, (2015). Adeniji, (2017) reported that the range for potassium concentration where 2.0mg to 2.6mg per 100 g. Which were lower than that gotten in the result of this study? Again, this proves that the addition of wonderful kola and other ingredients increase the mineral concentration.

The concentration of magnesium was found to have a range between 11 – 23.66%.There was significant difference between the entire samples. Hassan et al., (2022) reported that 17.50 – 26.40 milligrams of magnesium was contained per 100 grams of aqueous zobo drink. Also, Ayoola and Adeyeye, (2010) showed that 32.50 – 48.15 milligrams of magnesium were contained per 100 grams of canned zobo drink sample in syrup.

Phosphorus ranged from 4.2 – 18.60%. ZOWK 3 (zobo calyces 60%, wonderful kola 6.07%, ginger 23.27%, cloves 3%, and pineapple peel 7.66%) had the highest value of phosphorus while the control had the least value. There is significant difference between the samples. Adeniji, (2017) reported that the phosphorus content of zobo drink range for 1.7mg to 2.0mg per 100 g which is actually lesser than the result gotten in this study.

Sensory Evaluation of Zobo Drink

The sensory evaluation of zobo is shown in (Table 4). Sensory evaluation parameters (color, taste, mouth feel, aroma and overall acceptability) were significantly different of the samples ranged from 4.96 – 7.84 and significantly varied from each other (P<0.05). The color of ZOWK 1 was most preferred by the sensory panelists while ZOWK 5 was the least preferred. Statistical analysis revealed there was significant difference in color between all the samples. ZOWK 1, 3 and 5 was significantly different from the rest. ZOWK 2 and 4 had no significant difference between them. The Taste scores ranged from 3.80 – 5.12 with ZOWK 1 having the most preferred taste and ZOWK 5 having the least desired taste. According to statistical analysis, the samples showed significant difference (P<0.05), with ZOWK 5, which showed a significant difference with others. ZOWK 1, 2 and 4 shows no significant difference between each other, likewise Control and ZOWK 3. The study shows that ZOWK 1 has the highest value for aroma while ZOWK 5 has the least value. The scores for mouth feel

Table 4: Sensory evaluation of zobo processed with wonderful kola.

Sample	Colour	Taste	Aroma	Mouth feel	Overall acceptability
CONTROL	7.36[b]±1.96	5.04 [b] ±1.69	5.80 [bc] ±1.77	5.00 [ab] ±1.93	5.40 [b] ±1.60
ZOWK 1	7.84[a]±0.93	5.12[a] ±2.06	6.36 [a] ±1.69	5.60 [a] ±2.50	6.96 [a] ±1.74
ZOWK 2	7.56[ab]±1.29	5.08 [a] ±1.84	6.24 [b] ±1.38	5.40 [ab] ±2.23	5.72 [ab] ±1.59
ZOWK 3	6.88[c]±1.06	4.92 [b] ±1.89	5.52[c] ±1.89	4.96 [c] ±1.88	5.48 [c] ±1.82
ZOWK 4	7.72 [ab] ±1.28	5.08 [a] ±1.75	6.28 [a] ±2.06	5.44 [ab] ±1.88	6.52 [a] ±1.80
ZOWK 5	4.96[d] ±1.83	3.80 [d] ±1.47	4.60 [d] ±1.80	4.20 [c] ±1.84	4.12 [d] ±1.76

Each mean is a mean of three replicates ± standard deviation of the mean. Mean followed by the same letter in the same column are not significantly different by New Duncan's Multiple Range (p<0.05.

Keywords: CONTROL (zobo calyxes 65%, wonderful kola extract 0%, pineapple peel 24%, cloves 3.2%, ginger 7%); ZOWK 1 (zobo calyxes 65%, wonderful kola extract 5%, pineapple peel 20%, cloves 3.12%, ginger 6.88%); ZOWK 2 (zobo calyxes 63.56%, wonderful kola extract 6.29%, pineapple peel 20.88%, cloves 3.49%, ginger 5.78%); ZOWK 3 (zobo calyxes 60%, wonderful kola extract 6.07%, pineapple peel 23.27%, cloves 3%, ginger 7.66%); ZOWK 4 (zobo calyxes 62.04%, wonderful kola extract 5%, pineapple peel 24.96%, cloves 3.5%, ginger 4.5%); ZOWK 5(zobo calyxes 61.64%, wonderful kola extract 7.87%, pineapple peel 20.91%, cloves 4.0%, ginger 5.58%.

ranged between 4.20 to 5.60. ZOWK 1 had the highest score for mouth feel while ZOWK 5 was the least preferred. The flavor of the samples varied significantly from each other (P<0.05). ZOWK 1 is seen to be significantly different from all the samples while ZOWK 2, 4 and Control had no significant difference between them. Also, ZOWK 3 and 5 are not significantly different from each other. The sensory score for general acceptability ranged between 4.12 to 6.96. ZOWK 1 stood out with a score of 6.96 while ZOWK 5 was the least preferred with a score of 4.12. The result of the statistical analysis shows that there exists a significant difference between the samples. ZOWK 1 and 4 however showed no significant difference between them while ZOWK 3, 5 and Control were all significantly different.

Overall, ZOWK 1 was the most preferred by the sensory panelists and this may be attributed to the balance in the recipe of production (zobo calyces 65%, wonderful kola 5%, ginger 20%, cloves 3.12%, pineapple peel 6.88%) with little wonderful kola as to much of this gives a bitter after taste.

Conclusion

This study has shown the proximate composition as well as its mineral composition and sensory attributes of zobo drinks with wonderful kola extract as a functional ingredient which are rich in essential micronutrients when compared to the regular zobo drink sold in Nigerian market. Results showed that there was significant difference (P<0.05) in the proximate composition of the samples. The differences in the proximate compositions were due to the compositional difference in the variable used for the beverage formulation. There were also significant variations (P<0.05) among the samples in almost all the parameters analyzed in the consumer acceptability analysis. The mineral content showed significant variation (P<0.05) among the sample analyzed. The sample with the highest wonderful kola extract of 7.87% was seen to have the highest concentration of iron, zinc, potassium, magnesium and a moderate concentration of phosphorus. Sensory qualities observed were slightly higher in acceptability in samples containing 0% and 5% of wonderful kola extract than the rest of the sample. This was as a result of the reduction of the bitter after taste of these samples to an extent due to their low concentration when compared to others with higher concentration. Also, the inclusion of wonderful kola extract in little proportions brought about a unique and different taste from the regular taste we know about.

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