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*Research Paper*

# Nutritional and chemical evaluation of carbonated and naturally flavoured zobo (*hibiscus sabdariffa*) drinks

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"Zobo"is a natural fruit drink used in Nigeria which is produced from Roselle leaf. The objectives of this study are to use local spices like ginger, date fruits to produce "zobo" juice. Also, to carbonate the zobo juice in order to protect the taste, and texture by maintaining proper temperature control which also acts as a preservative in the zobo drink.This was extracted using 50 g of Roselle leaf per 1 litre of water. Four temperature/time regimes (100°C for 1h, 100°C for 30 min, 80°C for 1h, and 80°C for 30 min) were used for the extraction. The "Zobo" extracts were flavoured with natural ingredients namely date (10 g) and ginger (10 g) and then carbonated using $CO_2$ tablets. The uncarbonated extract served as control. The samples were tested for pH, titratable acidity, total soluble solids, vitamins C, K and D, iron, zinc, protein and fat. Also, consumer acceptability of the samples was investigated using a 9-point hedionic scale and twenty untrained judges. The means of the values were separated using a one way analysis of variance(ANOVA).The "zobo" drink was found to have a pH range of 2.57-3.87 and a highest TTA value 0.82. Hence, they could serve as a natural acidulants. They were found to be good sources of ascorbic acid(19.37 mg-332.06 mg) and vitamin D (7.04 mg-362.60 mg). The consumer acceptability was the same for the four carbonated samples. Carbonated samples were preferred to uncarbonated ones. This research has been able to produce an acceptable nutritious zobo drink.

**Keywords:** *Hibiscus sabdariffa*, ginger, carbonated, Roselle, zobo drink.

## INTRODUCTION

"Zobo" drink is a non-alcoholic local beverage produced from the dried petals of *hibiscus sabdariffa* (Roselle) by boiling and filtration. *Hibiscus sabdariffa* is a vegetable plant of West African origin. The crop is native to India but was introduced to other part of the world such as Australia, central Africa, West Indies, Africa and many tropical countries (Omemu et al., 2006). The plant is widely cultivated for its strong fibers and it is well known for its edibility and medicinal properties, though the calyx is the most frequently used portion of the plant, the leaves and seeds are often made into salads, curries and potherbs (UNICEF, 2006).

Roselle (*Hibiscus sabdariffa*) is a species of Hibiscus probably native to West Africa, used for the production of bast fibre and as an infusion, in which it may be known as carcade. It is an annual or perennial herb or woody-based subshrub, growing to 2–2.5 m (7–8 ft) tall. The leaves are deeply three- to five-lobed, 8–15 cm (3–6 in) long, arranged alternately on the stems. It is best grown in tropical and subtropical regions.

It has the most widespread acceptance in the roselle producing areas of the Nigerian savannah regions where it is grown as a vegetable crop (Omemu et al., 2006). Roselle is used in Nigeria to make a refreshing drink known as Zobo.The name "zobo" is derived from the local Hausa (northern Nigeria) name for the roselle plant known as "zoborodo". The calyces contains about 6.9% protein, 8.3% moisture, 4% citric acid, 1.5% pigment

(mainly anthocyanin) and about 9% soluble solids with pH of about 2.7 (Omemu et al., 2006).

Many parts of the roselle are of value. The young leaves are eaten as cooked vegetable especially with soup. The seeds are pounded into meal which is used as oily soup or sauce after roasting. Oil extracted from the seed is a substitute for castor oil while the residue is used in a fermented form as soup or cake (Aliyu, 2000).

"Zobo" is an indigenous non-alcoholic drink made from a hot water extract of roselle calyces. Zobo drink is usually sweetened with sugar and may be flavoured with other materials such as pineapple, ginger and strawberry. It is quite popular in Northern part of Nigeria. It has gotten its popularity across the entire country because of its medicinal value as well as the increasing cost of other available soft drinks whose concentrate are mostly imported constituting a drain on the economy. It was to be fair sources of vitamin A (Holden et al*.,* 1999). It is also rich in riboflavin, niacin, calcium and iron (Qi et al*.,* 2005).

The phytochemicals was studied and it was characterized as a highly acidic food with low sugar content, rich in riboflavin, calcium, iron, vitamin A and niacin. The phytochemicals shows that the flowers are rich in anthocyanins, as well as protocatechuic acid. The dried calyces contain the flavonoids gossypetin, hibiscetine and sabdaretine.

The Hibiscus leaves are a good source of polyphenolic compounds. The major identified compounds include neochlorogenic acid, chlorogenic acid, cryptochlorogenic acid, caffeoylshikimic acid and flavonoid compounds such as quercetin, kaempferol and their derivatives (Zhen et al.,2016). Zobo beverage has been shown to be good source of natural carbohydrate, protein and vitamin C. These components tend to increase with increase in storage period, leading to the activities of the associated micro-organism such as *Staphylococcus, streptococcus, Alternaria Bacillus, Fusarium, Leuconostoc, Lactobacillus*, *Aspergillus, Penicillum,* and *Bacillus* species which have been reported to be associated with zobo beverage during storage (Babalola et al.,2000).The proliferation of the association micro-organisms potentiates spoilage and the short shelf life of this beverage to 24-48 h. The use of local spices to control the activities of micro-organisms in food has been reported. Apart from the antimicrobial properties spices are believed to have medicinal value also have desirable determinative influences on the overall organoleptic quality of food when used.

Moreover, the use of low temperature storage to retard and stabilize microbial growth in food is well documented. Hence, the application of extracts of spices alone or in combination with low temperature storage will possibly control microbial activities associated with zobo drink while retaining the native and economic quality (Mohamed et al*.,* 2007). Hence, the current research is aimed at chemical and nutritional evaluation of carbonated and naturally flavoured zobo (*Hibiscus sabdariffa*) drink.

## MATERIALS AND METHODS

### Sample collection and identification

The 'zobo' leaves, date fruit and ginger were obtained from Afororu Ahiazu Mbaise. The calcium tablets for carbonation were gotten from Ahiara Junction. The samples of Hibiscus sabdariffa leaves were identified and authenticated at the Herbarium Unit, Botany Department, Abia State University Uturu, Nigeria.

### Sample preparation

The "zobo" leaves were thoroughly sorted out to remove the unwanted substances. 50 g of the 'zobo' leaves were immersed in a container with 1 litre of water. Four temperature/time regimes was used; one portion termed sample A was extracted at 100°C for 1 h and another portion termed sample B was extracted at 100°C for 30 min, the third portion termed C was extracted at 80°C for 1 h and D portion was extracted at 80°C for 30 min. About 10 g of grinded date fruits and 10 g of ginger were immersed in the extracted 'zobo' in order to extract the dates and ginger respectively. The four samples (A, B, C, D) were carbonated. The control was prepared by 100°C extraction for 1 h, 10 g of ginger and date each but was not carbonated (Table 1).

**Table1.** Nutritional value per 100 g of Hibiscus sabdariffa

| Composition | Values |
|---|---|
| Energy | 205 KJ (49Kcal) |
| Carbohydrates | 11.31 g |
| Fat | 0.64 g |
| Protein | 0.96 g |
| Vitamin A | 14 µg (2%) |
| Thiamine (B1) | 0.11 mg (1%) |
| Riboflavin (B2) | 0.028 mg (2%) |
| Niacin (B3) | 0,31mg (2%) |
| Vitamin C | 12 mg (14%) |
| Calcium | 215 mg (22%) |
| Iron | 1.48 mg (11%) |
| Magnesium | 51 mg (14%) |
| Phosphorus | 37 mg (5%) |
| Potassium | 208 mg (4%) |
| Sodium | 6 mg (0%) |

Source: Holden et al.,(1999).

### Estimation of the pH range

The pH meter was calibrated with a pH buffer. The pH buffer 4/10 and distilled deionized water. 50 millilitres of

the sample was poured into a beaker. The probe was inserted into the sample 10 min after the meter was switched on and the pH reading was read and as the reading becomes stable.

**The estimation of total soluble solid**

This was determined by photometric method using HACH DR/2010 spectrophotometer at a wavelength of 810 nm and programme number 630. Few drops of the sample were placed on the light shield and viewed, with the value displayed in mg/l.

**Estimation of total titratable acidity**

This was determined with sodium hydroxide using phenolphthalein indicator solution. 10 millilitres of the sample was added into a beaker with 5 drops of phenolphthalein. Then 0.1N of sodium hydroxide (NaOH) was added till the solution starts changes to pinkish colouration.

**Estimation of zinc**

This was determined by the zincon method by the adaptation of the standard methods for the examination of water and wastewater at a wavelength of 575 nm.

**Estimation of protein content**

This estimation of protein content was determined using the micro kjeldahl method.

**Estimation of vitamin C**

This was determined using titrimetric method. Here, a weighed sample was homogenized in 6% EDTA/TCA solution. It was then filtered and used for analysis. Then, 20 ml of 30% KI solution was added to the homogenate followed by addition of 100 ml of distilled water. 1ml of 1% starch solution was added to it and it was titrated against 0.1 M $CuSO_4$ solution. There will be black colouration as the end point.

**Estimation of fat**

This was determined by the AOAC, (2000) method.

**Estimation of vitamin D and K**

This was determined by the Zakaria et al (1997) method.

**Sensory evaluation**

This was done using a 9 points hedionic scale. Eight trained panellists were employed to give judgement in the various parameters including Aroma, colour, taste, mouth feel and General acceptance.

## RESULTS AND DISCUSSION

There was no significant difference ($p<0.05$) among the samples in pH, but there was a significant between the samples and control (Table 2). There was also a significant difference ($p<0.05$) among the samples and the control in TTA. The control had the lowest pH value of 2.57 while sample B had the highest pH of 3.87. For the TTA, the control had the highest value of 0.82 while sample D had the least, 0.39 as seen in (Table 2). This result shows that Roselle drink is a natural acidulant since its pH is low (2.57-3.87). Therefore it will have an extended shelf-life since the low pH will not support a lot of microbial proliferation. Again, the result of this experiment showed that carbonation increased both the titratable and total acidity of the "zobo" drink, this is somehow expected since carbonation introduces $H^+$ (acidity) and carbonic acid into the system, (Smith and Hui, 2004). The result of the TSS of Roselle sample is shown in (Table 2). The highest TSS value of 11.0 was obtained from samples B and D while the lowest value of 7.05 was obtained from the control. Generally, the control sample had lower TSS than the carbonated ones. This implies that carbonation increases TSS of the nectar and this increase were due to change of protopectin to water soluble pectin fraction, Bhatti, (1995).

There was a significant difference ($p<0.05$) among the samples and the control for vitamin C, vitamin D3 and vitamin K as shown in (Table 3) value of vitamin C which is 332.06 was obtained from sample A while the lowest value of 19.37 was obtained from the control. Generally, the samples has a higher vitamin C content than the control, this implies that carbonation helped to maintain the acidity of the drink thereby increasing the vitamin C content of the "zobo" drink due to the H+ (acidity) and carbonic acid introduced by the carbonation, (Smith and Hui, 2004). For vitamin D3, the highest value being 362.60 was obtained from the control while the lowest value of 7.04 was obtained from sample A. Generally, the samples had lower values than the control. This may imply that carbonation reduced the vitamin D3 content. For vitamin K, the highest value of 364.39 was obtained from the control while the lowest value of 13.17 was obtained from the sample B. The stability of vitamin K was better in the control than in the carbonated samples. The results of the iron content of the Roselle samples are shown in (Table 3). There was a significant difference ($p<0.05$) among the samples and the control. The highest value of 7.41 was obtained from sample C, while the lowest value of 0.83 was obtained from sample D. Generally, samples A and C were higher than B and D; this may be due to the fact that samples A and C had

**Table 2.** Mean value of some physiochemical properties of carbonated zobo.

| Sample | TTA% | TSS% | $P^H$ |
|---|---|---|---|
| A | 0.57c ± 0.01 | 8.0 b ± 0.00 | 3.47 a ± 0.06 |
| B | 0.61b ± 0.01 | 11. c ± 0.00 | 3.87 a ± 0.06 |
| C | 0.55d ± 0.01 | 8.0b ± 0.00 | 3.50 a ± 0.10 |
| D | 0.39e ± 0.01 | 10.0a ± 0.00 | 3.57 a ± 0.12 |
| Control | 0.82a ± 0.00 | 7.05c ± 0.00 | 2.57 b ± 0.15 |
| LSD | 0.014 | 0.182 | 0.595 |

Each attribute means with different letters along the column are significantly ($p \leq 0.05$) different.
Sample A=100°C for 1 h.
Sample B= 100°C for 30 min.
Sample C= 80°C for 1 h.
Sample D= 80°C for 30 min.
Control= 100°C for 1 h (uncarbonated)

**Table 3.** Mean values of nutritional content of carbonated zobo drink sample.

| Sample | Vitamin C (mg) | Vitamin D3 (mg) | Vitamin K (mg) | Iron (mg/l) | Protein (%) | Fat (%) |
|---|---|---|---|---|---|---|
| A | 332.06a±0.03 | 7.04 e ±0.01 | 21.59c ± 0.18 | 4.74b ± 0.03 | 2.35a ± 0.02 | 4.83a ± 0.21 |
| B | 286.03 ± 0.03 | 7.85 d ±0.01 | 13.17e ± 0.04 | 2.34c ± 0.02 | 2.17b± 0.03b | 1.60b ± 0.2 |
| C | 196.25c±0.01 | 8.62 c ±0.01 | 24.49b ± 0.03 | 7.41a ± 0.02 | 2.04c ± 0.12 | 1.70b ± 0.17 |
| D | 155.77d±0.01 | 32.12 b ±0.02 | 16.53d ± 0.03 | 0.83e ± 0.00 | 1.25d ± 0.03 | 1.25c ± 0.13 |
| Control | 19.37e ± 0.01 | 362.60a ± 0.00 | 364.39a± 0.09 | 1.58 ± 0.01 | 1.18c± 0.0 | 1.03c ± 0.03 |
| LSD | 0.182 | 0.058 | 0.182 | 0.0315 | 0.061 | 0.295 |

Each attribute means with different letters along the column are significantly ($P \leq 0.05$) different.
Sample A = 100°C for 1h.
Sample B = 100°C for 30min.
Sample C = 80°C for 1h.
Sample D = 80°C for 30min
Control = 100°C for 1h (uncarbonated)

**Table 4.** Mean sensory scores of carbonated zobo drink.

| Sample | Colour | Aroma | Taste | Mouth feel | General acceptability |
|---|---|---|---|---|---|
| A | 7.70a ±0.46 | 7.00ab ±0.89 | 8.6a ±0.49 | 7.4a±0.49 | 8.70a± 0.46 |
| B | 7.90a±1.04 | 6.70b ±0.90 | 8.70a ±0.46 | 7.9a ±0.54 | 8.30a ±0.46 |
| C | 7.80a ±0.87 | 7.30a ±0.90 | 8.70a ±046 | 7.3 b ±0.64 | 8.60a±0.49 |
| D | 7.70a ±1.01 | 6.80ab ±0.60 | 8.70a ±0.46 | 8.0a ±0.78 | 8.70a ±0.46 |
| Control | 7.00b± 0.63 | 6.30bc ±0.46 | 7.9b ±0.54 | 6.5c 0.81 | 7.60a ±0.49 |
| LSD | 0.449 | 0.574 | S0.366 | 0.640 | - |

Each attribute means with different letters along the column are significantly ($P \leq 0.05$) different. Sample
A –100°C, 1h
Sample B –100°C, 30 min
Sample C–80°C, 1h
Sample D–80°C, 30 min
Control –100°C, 1h (uncarbonated)
LSD – least Significant Different

longer contact time of 1 h, while B and D had shorter contact time of 30 min. For zinc, the single value of 0.15 was obtained from sample D. The results of the protein and fat contents were shown in (Table 3). There was a significant difference among the samples and the control. The highest value of 2.35 was obtained from sample A while the lowest value of 1.18 was obtained from the control. Generally, the samples had higher values than the control; this implies that carbonation increased the protein contents. For fat, the highest value of 4.73 were obtained from sample A, while the lowest value of 1.02 was obtained from the control. Generally, the samples had higher values than the control due to the fact that carbonation reduces fat loss by binding to the fat cells, Hill and Kolb, (2001).

The result of the sensory evaluation is shown in (Table 4). There was no significant difference ($P < 0.05$), in colour among the samples, but there was a significant

difference between the four samples and control. The highest value of 7.90 was obtained from sample B, while the lowest value was obtained from the control. Generally, the value of the samples were greater than the value for the control, this may be as a result of the carbonation which makes the colour brighter and sharper. For the Aroma, there was a significant difference ($P < 0.05$), between sample C and the control, sample B and sample C, but there was no significant difference ($P < 0.05$), between sample A and B, A and C, A and D, B and D, D and control. For Taste, there was no significant difference ($P < 0.05$) among the samples, but there was a significant difference between the samples and the control. For the mouth feel, there was no significant difference between sample A, B and D but there was a significant difference ($P <0.05$), between samples A, B, D and sample C and Control; there was also a significant difference between C and control. For the general acceptance there was no significant difference among the samples, also there was no significant difference ($P <0.05$) between the samples and the control, this may be attributed to the same recipe (ginger and date) used for the samples, also the perception of the carbonation makes the products more acceptable to the panellists.

## Conclusion

Locally prepared 'zobo' drink has been one of the favourite delicacies for many persons over the years which are associated with short shelf life, hence, the need for longer shelf life has been achieved through this work by careful extraction and carbonation. As a natural acidulant they can incorporate into other food products such as sauces etc. Also, subsequent improvement of the general acceptability has been achieved by the use of ingredients such as date fruits and ginger for natural sweetness and good aroma respectively, owing to this, the product can compare favourably with other related products if commercialized. Their antioxidant and medicinal activities is also a contribution of this work. This research has been able to produce a packaged 'zobo drink' of good quality.

## Recommendation

Zobo drink is an acidic food and should be packaged with appropriate packaging material to avoid reaction and should be served chilled for maximum enjoyment and refreshment.

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