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EVALUATION OF THE SUGAR CONTENT OF SELECTED COKE DRINKS

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ABSTRACT
This research work is aimed at the Evaluation of sugar contents of Selected Coke Drinks. The study was motivated by the increasing global concern of reported cases of sugar-related ill health. Three different Coke drinks namely; RC, Pepsi and Coca-cola were tested to determine the amount of sugar present in the drinks. The selection of these three products was justified by the fact that they are the most commonly consumed coke drinks (amongst others), as reviewed. The soft drink bottles were purchased from "Everyday" supermarket in Owerri, Imo State; analysis was conducted on the samples at the New Concept Laboratory, Obinze Owerri. The parameters tested include pH, Total soluble sugar, Reducing sugar, Total reducing sugar, Sucrose, Glucose and Fructose. The results of the analysis showed that the pH of the three samples were 2.19, 2.21 and 2.27 for RC, Pepsi and Coca-Cola respectively. The Total Soluble Sugar was 8.50%, 10.20% and 7.20% for RC, Pepsi and Coca-cola products respectively. Also in that order, the Reducing sugar was gotten as 8.22%, 11.75%, and 10.18% respectively, while the Total reducing sugar was found to be 18.27%, 17.97% and 15.16% respectively. The sucrose content was 154.56% for RC, 148.53% for Pepsi and 125.06% for Coca-Cola. The glucose and fructose were 1.13%, 0.82%, 1.03% and 7.09%, 10.93% and 9.15% both for RC, Pepsi and Coca-Cola products respectively. Generally, RC was found to have the highest percentage of sugar content amongst the three samples examined. It is, thus, recommended that there should be prudent check in the rate of soft drink consumption, especially those that contain high sugar and phosphoric acids value (as are obtainable in our locality); also drinking plenty of water, instead of sugary drinks like soft drink, is better due to its high sugar and acidic contents.
Keywords: *Coke, Drinks, Evaluation, Sugar Content.*

1. INTRODUCTION

Sugar is a white crystalline carbohydrate used as a sweetener and preservative. Sugars are used extensively in food industries and at home as sweeteners, as well as sources of energy especially in non-alcoholic beverages (Achard, 2009). Sugars are the most abundant and widely distributed food component in the form of carbohydrate. Carbohydrates provide most of the energy in almost all human diets, especially for average income earners. Green plants can synthesize carbohydrates from water and carbon dioxide under the influence of sunlight (through photosynthesis), which gives Glucose-D ($C_6H_{12}O_6$) as a major product (Bosma, 2013).

Chemically, sugar belongs to the class of food "carbohydrates", and it is an energy source in the human diet. Sucrose or table sugar contains the chemical formula: $C_{12}H_{22}O_{11}$, and it is a disaccharide of fructose and glucose (Blanding, 2010). Sugars have a white crystalline appearance, and are found or obtained from various sources. Today, however, sugar is available commercially in mainly two plants; sugar cane (56%) and beet sugar (44%) (Bosma, 2013).

On the other hand, soft drinks are complex mixtures containing different substances such as colour combinations, flavouring agents, acidifiers, sweeteners, preservatives and caffeine. Eschner (2015) and Richard (2012) reported that soft drinks are usually mixed with water plus 1-3% liquid carbon dioxide, 3-5% liquid sugar, acidified to a pH of about 2.4 - 4.0, emulsifiers, colours, flavours and/or spices, herbs and extracts of roots, leaves, seed and flower or bark. According to the reports, soft drinks belong to the category of non-alcoholic beverages, which is usually (but not very necessarily) carbonated, containing natural or synthetic sweetening agents, edible acids, natural or artificial flavours, and sugars (or sugary substances) form major requirements for soft drinks production.

In spite of their numerous benefits (such as providing pleasant flavor and minerals, easy absorption, antioxidant roles and fibres, which are important vehicles for hydration), natural acids and sugars have all the acidogenic and cariogenic potentials that can lead to dental caries and enamel erosion (Eschner, 2015). The public health profile is strongly influenced by its dietary status and health style. Nigeria is one of the developing countries of the world where the aforementioned problem is common. Healthcare providers have raised concerns about the importance of soft drinks since they were included in human diets abinitio, and in western and developing countries, there is high tendency of consumption of soft drinks after meals or snacks/confectionaries. There are three main areas for the nutritional significance for soft drinks (Edwards, 2015). The first is energy provision; the second area is the roll of isotonic drinks to body fluids, and finally, its low calorie content (for those who wish to minimize their caloric intake).

There are different types of soft drinks within Nigeria from various manufacturers, which many believe some of them have high sugar content, and can increase the blood sugar level. It is therefore important to determine the sugar content of soft drinks found in our locality. It is important to ensure that sugar content does not exceed recommended dietary consumption. If the assertion of people concerning some of these drinks believed to contain lesser quantity of sugar is true, to establish the fact that the sugar content of some of these drinks have exceeded the stipulated dietary allowance, and if the sugar content in these selected soft drinks is higher than recommended dietary allowance, people may need to reconsider the amount of commercial soft drinks they consume on daily basis. In addition, excessive sugar consumption is an ongoing global concern, and it is therefore vital to assess the quantity of sugar added to soft drinks in Nigeria, to ensure appropriate food security. The choice of the samples is traceable to the high rate of consumption of the products globally, especially in Nigeria (Eze, 2017).

2. MATERIALS AND METHODS

The methods used for the analysis of the products were as developed by AOAC (1997). Plastic containers of the three soft drink brands and flavours (Coca-Cola, RC and Pepsi) were purchased from Everyday Supermarket in Owerri, Imo State of Nigeria during the month of January 2021. Sugar analysis was carried out with the samples at the New Concept Laboratory, Obinze Owerri within the same month, alongside with the determination of parameters like pH, total soluble sugar, reducing sugar, sucrose and fructose.

2.1 Determination of Fehling's Factor

Principle:

Invert sugar reduces the copper in Fehling-A solution to a brick-red insoluble cuprous oxide.

Use of the Reagents:

Fehling A: 69.3 g copper sulphate ($CuSO_4.5H_2O$) was dissolved in distilled water, and diluted to 1000 ml. It was filtered and stored in amber-coloured bottle.

Fehling B: 34.6 g Rochelle salt (potassium sodium tartrate) and 100 g of sodium hydroxide were dissolved in distilled water. The solution was diluted to 1000ml mark. It was filtered and store in amber coloured bottle. The Fehling factor is given by equation 1:

$$Fehling\ Factor = \frac{\text{Titre X Weight of Sucrose (in g)}}{5000} \qquad (1)$$

Neutral Lead Acetate: 20% neutral lead acetate solution was prepared. This reagent was used to clarify sugar solutions.

Potassium Oxalate Solution: 10% Potassium oxalate ($K_2C_2O_4.H_2O$) solution was prepared. This reagent was used to remove the excess lead used during clarification.

2.2 Determination of Reducing Sugars:

25 g of sample was weighed into 250 ml volumetric flask. 10 ml of neutral lead acetate solution was added and diluted to volume with water and filter. An aliquot of 25 ml of the clarified filtrate was transferred to 500 ml volumetric flask, containing 100 ml water. Potassium oxalate was added in small amounts until there is no further precipitation. It was made up to volume. The solution was mixed well and filtered using 'whatman' filter paper (No. 1). The filtrate was then transferred to a 50 ml burette, and the percentage volume evaluated using the following relationship in equation 2:

$$Reducing\ Sugar\ \%\ (as\ invert\ Sugar) = \frac{\text{Diltions X factor of Fehling (in g)}}{\text{Weight of Sample X Titre}}\ \text{X}\ 100 \qquad (2)$$

2.3 Determination of Total Reducing Sugars:

An aliquot of 50 ml of the clarified leaded filtrate was pipetted into a 100 ml volumetric flask, containing 25 g of sample. 5 ml of concentrated HCl was added, and allowed to stand at room temperature for 24 hours. It

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was then neutralized with concentrated sodium hydroxide solution, followed by 0.1N of the sodium hydroxide. It was made up to 100 ml volume, and transferred to a burette having an offset tip. The sodium was titrated against Fehling's solution using starch indicator, and reducing sugars was determined using the relationship in equation (3):

$$Total\ Reducing\ Sugar\ \%\ (as\ invert\ Sugar = \frac{\text{Diltions X factor of Fehling (in g)}}{\text{Weight of Sample X Titre}}\ X\ 100 \qquad (3)$$

2.4 Determination of Sucrose, Glucose and Fructose: Glucose ratio Principle:

Glucose % is determined eudiometrically using a weak alkaline medium and the value is subtracted from reducing sugars percentage, to arrive at fructose percentage; and fructose equals glucose ratio.

Reagents:

0.1N Iodine: 13g iodine and 20 g potassium iodide were weighed together and dissolved in water, to make up to 1litre. It was stored in amber coloured bottle.

0.2N Sodium bi-carbonate: 3.5 g sodium bicarbonate was dissolved in 200 ml of distilled water.

0.2N Sodium Carbonate: 4.25 g sodium carbonate was dissolved in 200 ml of distilled water.

0.1N Sodium Thiosulphate: 25 g sodium thiosulphate was dissolved in boiling distilled water. It was cooled and made up to 1litre. It was filtered, stored in amber-coloured bottle and standardized against potassium dichromate.

Procedure:

2 g of sample was weighed to 250 ml volumetric flask, and made up to volume with distilled water. It was mixed well, and an aliquot of 25 ml was transferred to a 250 ml of iodine flask. 50 ml of the 0.1N iodine was pipetted into the flask, and 50 ml of the 0.2N sodium carbonate was added, as well as 50 ml of the 0.2N sodium bicarbonate solution. It was allowed to stand in dark for 2hours, after which it was acidified with 12 ml of 25%H_2SO_4, and titrated with the standardized sodium thiosulphate, using starch as indicator. The Sucrose, Glucose and Fructose percentage were evaluated, using the provisions of equations 4, 5 and 6 respectively.

$$\text{Sucrose \%} = (\text{Total Reducing Sugar \% of Invert Sugar \%})\ X\ 0.95 \qquad (4)$$

$$\text{Glucose \%} = \frac{\text{Normality of Thiosuphate X Dilution X (B} - \text{S) X 0.009005}}{\text{0.1N X Weight of Sample}}\ X\ 100 \qquad (5)$$

Where B = Standard of the Blank (21.0), S = Titre value

$$\text{Fructose \%} = \text{Reducing Sugar \%} - \text{Glucose \%} \qquad (6)$$

2.5 Determination of Potential Hydrogen (pH) Value

25 g of the sample was poured into a clean dry 25 ml beaker, and 13 ml of hot distilled water was added to it and stirred slowly. It was then cooled in a cold water bath to 25^oC. Then the pH electrode was standardized with buffer solution, and the electrode immersed into the sample; the pH value was read and recorded accordingly.

3. RESULTS AND DISCUSSION

The results of analysis of the three coke samples are presented in table 1.

Table 1: Results of Analysis of Study Samples

Parameters Tested	Result obtained		
	RC	PEPSI	COCA-COLA
pH	2.19	2.21	2.27
Total Soluble Sugar	8.50	10.20	7.20
Reducing Sugar	8.22%	11.75%	10.18%
Total reducing sugar	18.27%	17.97%	15.16%
Sucrose	154.56%	148.53%	125.06%
Glucose	1.13%	0.82%	1.03%
Fructose	7.09%	10.93%	9.15%

From the result of analysis of the study samples, the three samples showed high acid levels, with 2.19 for RC, 2.21 for Pepsi and 2.27 for Coca-Cola. The high acid level of the products could be traceable to the level of phosphoric acid added to the drinks (mostly to give them tangy/sharper flavours, and prevent the growth of moulds/bacteria); this has the tendency of increasing the ulceric nature of the stomach. (Joshi and Agte, 2001). Dorota (2015) reviewed that high level of phosphoric acid can lead to organ damage, most notably the kidneys. And poor kidney functions can raise levels of phosphorous in the blood, which in turn lowers the calcium levels, increasing the risk of brittle-bone disease (Martin and Gonzalez, 2011; Calvo and Tucker, 2013; Calvo and Uribarri, 2013). However, the acid level of Coca-Cola was found to be higher than that of Pepsi and then RC.

Also the reducing sugars, as well as total soluble sugars were higher in Pepsi products than its other counterparts. Reducing sugar reduces the body calories, and thus increases the body fats (Bosma, 2013). So, high consumption of Pepsi would be a great disadvantage to weighty individuals (Edwards, 2015). Again, soluble sugar would regularly lead to increase in the blood sugar level, which exposes the body to diabetes *mellitus* (Blanding, 2010). Non-reducing sugars are commonly found in fungi, bacteria, yeast, insects and plants; their significant levels act as protectors of the body against various abiotic stresses, including heat drought, high salinity and ultra-violet rays (Blanding, 2010).

On the other hand, reducing sugars react easily with the free amino groups in amino acids, to form unique compounds for desirable flavors and aroma; they cause food browning in baked foods (Edwards, 2015). The levels of glucose fall between 0.82% and 1.13%, and that of fructose (mainly of natural sources) fall between 7.09% and 10.93%, and they both are simple sugars that are easily controlled by body metabolism (Achard, 2009).

4. CONCLUSION

The study samples were, generally, found to have high acid and sugar contents, with RC coke topping the chart for both parameters amongst other samples. This raises a great deal of global concern. The national health authorities and regulatory agencies, especially in developing countries (such as Nigeria) must, as a matter of urgency, sit up to their functions in this regard. The European partners of Coca-cola, for instance, use very small amount of phosphoric acid the products (like coca-cola classic, diet cokes and coca-cola zero sugar), and this has been found to give better tartness; our local companies in this business should imbibe the same culture. A nnumber of alternative flavouring and microbial growth-controlling drink additives such as *Acefulfame* (E950) and *Aspartame* (E951), whose health and safety status have been certified by the World Health Organization (WHO), as well as by the Scientific Committee on Food (SCF) and the European Union for food and beverages, are recommended, in replacement of phosphoric acids for the production of these drinks by our local manufacturers.

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