

Elucidation of Sugar in Edible Fruit – Pineapple (Ananas Comosus)

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Abstract

Sugar present in the juice of pineapple (*Ananas Cosmosus*) which is edible crystalline carbohydrate mainly sucrose, lactose and fructose was elucidated. Pineapple juice was extracted from the pineapple sample bought from Ekeonunwa market Owerri, Imo State. Qualitative and quantitative analysis were carried out. The qualitative analysis was carried out by using Benedict reagent, Seliwanoff's reagent, phenylhydrazine and thin layer chromatography. The quantitative evaluation was carried out by Dichromate method using glucose and fructose as standards.

The results obtained for qualitative analysis showed that the juice contain glucose and fructose. The amount of glucose found was $3.9 \times 10^{-2} \text{g/cm}^3$ and $1.41 \times 10^{-2} \text{g/cm}^3$ for fructose in the quantitative analysis.

Keywords: Sugar, pineapple, sucrose and fructose.

Introduction

Sugar is a term for a class of edible crystalline carbohydrate, mainly sucrose, lactose and fructose¹ characterized by a sweet flavor. Sugar is mostly extracted commercially from sugarcane and sugar beet. Glucose, fructose or fruit sugar, high fructose corn syrup are other sugar used in industrial food preparation, but are usually known by more specific names.

Nowadays, Brazil has the highest per capital production of sugar². Chemically sugar is one of the carbohydrates and is the source of energy in human diet. Sugar is important as a food and is valued for its sweetness. Sugar was once assumed to raise blood glucose level more quickly than starch because of its simpler chemical structure (with out scientific research) but results from more than twenty studies demonstrated that sugar and starch cause blood glucose to rise at similar rates. This result showed that controlling all carbohydrate is necessary for controlling blood glucose levels in diabetic, the idea behind carbohydrate counting³. Many experts believe that eating too much sugar does not cause diabetes,^{4,5} though excessive calories from sugar can lead to obesity which may increase the risk of diabetes. However, a 2010 meta-analysis of eleven studies involving 310,819 participants and 15,043 cases of type 2 diabetes⁶ found that "SSBs (Sugar-sweetened beverages) may increase the risk of metabolic syndrome and type 2 diabetes not only through obesity but also by increasing dietary glycemic load" leading to insulin resistance, β -cell dysfunction and inflammation.

Sugar has been produced in Indian subcontinent since ancient time. It was not plentiful or cheap in early times-honey was more often used for sweetening in most parts of the world. Originally people chewed sugarcane raw to extract its sweetness. Sugarcane was a native of tropical south Asia and Southeast Asia⁷.

The term sugar usually refers to sucrose, which is called "table sugar" or "saccharose". Sucrose is a white crystalline disaccharide. Sucrose is the most popular of the various sugar for flavoring, as well as properties (such as mouth feel, preservation; and texture) of beverage and food. Sugar include monosaccharide (e.g glucose, fructose, galactose), disaccharides (e.g sucrose, lactose maltose), trisaccharides and oligosaccharide⁸ in contrast to complex carbohydrate such as polysaccharide. Corn syrups, dextrose, crystalline fructose, and maltose for example are used in manufacturing and preparing food. The international commission form method of sugar Analysis sets standard for the measurement of the purity of refined sugar known as ICUMSA numbers, lower numbers' indicate a higher level of purity in the refined sugar⁹.

Pineapple (*Ananas comosus*) is the common name for tropical plant and its edible fruit which are coalesced berries¹⁰. The popularity of the pineapple is due to its sweet-sour taste containing 15% sugar, malic and citric fruits acids. It is also high in vitamin C and the essential mineral, manganese¹¹. Its protein-digesting enzyme Bromelain may help digestion after a high protein meal¹².

The word pineapple in English was first recorded in 1398, when conifer trees (now termed pinecones) the term pine cone for the reproductive organ of conifer trees was first recorded in 1694. When European explorers discovered this tropical fruit they called them pineapple (term first recorded in that sense in 1664 because of their resemblance to what is now known as the pine cone). In the scientific binomial *Ananas Comosus*, ananas, the original name of the fruit comes from the Tupi (Rio de Janeiro, Brazil) word Ananas, meaning "excellent fruit"¹² as recorded by Andre Thevet in 1555, and comosus, "tufted", refers to the stem of the fruit. Other members of the Ananas genus are often called pine as well by layman.

Pineapple is a herbaceous short-lived perennial plant, grows to 1.0 to 1.5 meters (3.3 to 4.9 ft) tall. Pineapple is one of locally available fruit that can be eaten fresh or canned or juice, it is also popularly used in desserts, salads, as a compliment to meat dishes and in fruit cocktail.

The nutritional values of pineapple raw per. 100g are Energy 202kj (48kcal), carbohydrate 12.63g, sugars 9.26g, Dietary fiber 14g, fats 0.12g; protein 0.54g. Thiamine, (vitamin B₁) ,0.079g (6%) Riboflavin (vitamin B₂), 0.031mg (2%) Niacin (vitamin B₃),0.489mg (3%), pantholthenic acid (B₅), 0.205mg (4%), (vitamin B₆) 0.110mg (8%) folate (vitamin B₉) 15μ (4%), vitamin C 36.2mg (60%). Calcium 13mg (1%), iron 0.28mg (2%) magnesium 12mg (3%), manganese 0.9mg (45%) phosphorus 8mg (1%) potassium 115mg (2%) and zinc 0.10mg (1%)¹³. Percentage are relative to US recommendation for adult.

In view of it is important to investigate in other to find out the type of sugar and its quantity contained in the juice of pineapple fruit.

Material and Methods

Sample Collection: Pineapple fruits were bought from Ekeonuwa market in Owerri, Imo State, Nigeria.

Sample Preparation: the bark of the pineapple fruits was peeled off; juice was extracted from the pineapple. The juice extracted from the pineapple was used for qualitative and quantitative analysis.

The qualitative characterization of sugar in pineapple was conducted using Benedict's reagent, Seliwanoff's reagent and phenyl hydrazine. Qualitative examination of the juice from the pineapple was also carried out using thin layer chromatography.

The quantitative Estimation of sugar in pineapple juice by Dichromate method was also carried out as follows, using 10cm³ of prepared pineapple juice.

The dichromate was standardized by using 25cm³ of dichromate, 100cm³ of 1 molar H₂SO₄, 5cm³ of 85% ortho phosphoric acid. These were poured into a flask and were titrated with Fe (NH₃). SO₄ from the burette to the purple – bluish green colour.

1g of sugar was poured into 1000cm³ of water to make sugar solution. 10cm³ of the sugar solution was taken and 25cm³ of the standard dichromate solution were added, allowed to stand with occasional shaking for 25 minutes and then 100cm³ of 1/molar H₂SO₄, 5cm³ of 85% Ortho phosphoric acid and 3 drops of diphenylamine indicator were added and mixed. These were titrated with Fe (NH₃). SO₄ to purple bluish colour.

A serial dilution of the glucose were prepared and repeated as in b above with each for the maximum length of time of oxidation. Then a graph of sugar concentrations (from zero sugar concentration). Against difference in volume Fe (NH₃). SO₄ were plotted.

A 10cm³ of the prepared pineapple juice were taken, 25cm³ of dichromate was added and shaken for the maximum length of time of oxidation. A 100cm³ of 1 molar H₂SO₄ and 5cm³ of 85% ortho phosphoric acid was also added and titrated against the Fe (NH₃). SO₄. Then it was extrapolated to find the sugar concentration.

Results and Discussions

The three reagents that are useful for the characterization of sugar are Benedicts reagent, Selliwanoff's reagent and phenylhydrazine. The following results were obtained when the tests were applied to the above mentioned samples of sugar.

Table-1
The results of the test with the reagents and the observation made

Reagent and test	Observations/ Inference
Benedicts Reagent	Glucose and pineapple showed a positive result of red cuprous oxide precipitate.
Selliwanoff's Reagent	Fructose and pineapple juice gave a positive result of red colour.
Phenyhydrazine	A yellow crystal precipitate was formed and maltose and laclose easily dissolved in hot water. The osazone of glucose and fructose were the same. The pineapple also forms the osazone, while sucrose did not form the osazone.

Table-2
Thin layer chromatographic characteristic of the sugars and the pineapple

Samples	Development system	Visualization reaction	No of spot	R _f value
Glucose	butane -1-ol, acetone and water (4:5:1)	iodine	1	0.34
Fructose	butane -1-ol, acetone and water (4:5:1)	Iodine	2	0.393 0.171
Maltose	butane -1-ol, acetone and water (4:5:1)	Iodine	1	0.21
Lactose	butane -1-ol, acetone and water (4:5:1)	Iodine	1	0.1
Pineapple Juice	butane -1-ol, acetone and water (4:5:1)	Iodine	3	0.19
Pineapple Juice	butane -1-ol, acetone and water (4:5:1)	Iodine		0.30

Table – 3
Show the titration value of Fe (NH₃).SO₄ against K₂Cr₂O₇ and sugar (glucose)

Glucose (g) ³	0.08	1.0 x10 ⁻²	2.0x1 ⁻²	3.0x10 ⁻²	4.0x10 ⁻²	5.0x10 ⁻² g/cm ³
Fe- (NH ₃). SO ₄	32.00	30.60	30.0	29.00	28.00	26.00
Difference	0	1.10	2.0	3.0	4.0	5.1

Glucose Calibration Curve

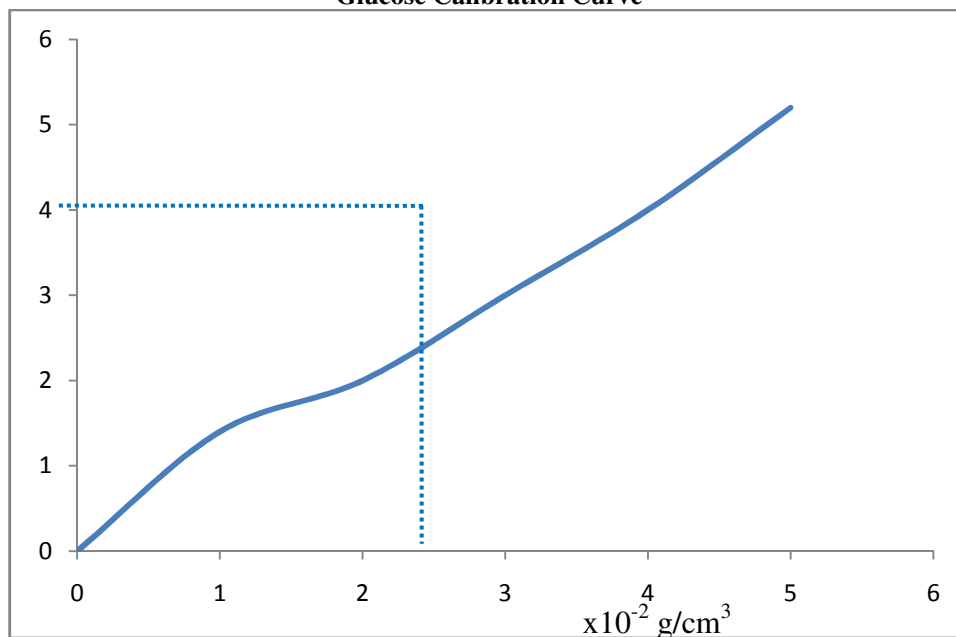


Figure-1
Total Sugar Content (g/cm³)

Table-4
The titration value of Fe (NH₃). SO₄ against K₂Cr₂O₇ and sugar (fructose)

Fructose g/cm ³	0	0.5 x10 ⁻²	1.0x10 ⁻²	1.5x10 ⁻²	2.x10 ⁻²
Fe- (NH ₃). SO ₄	32	30.60	29.50	28.30	27.26
Difference	0	1.20	2.43	3.63	4.80

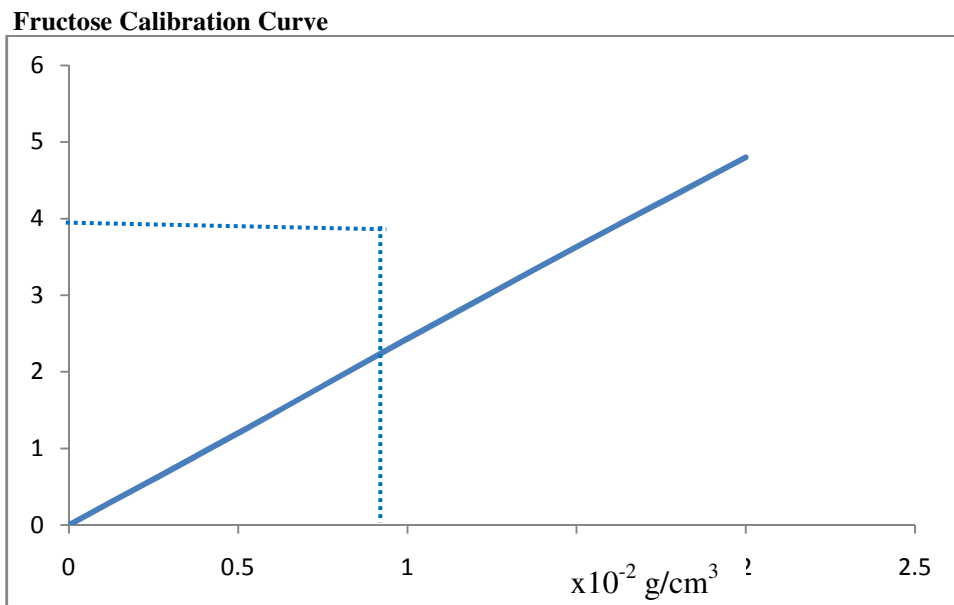


Figure-2
 Total sugar content g/cm^3

Tables – 5
 Show the titration values of $\text{Fe}(\text{NH}_3)\text{SO}_4$ against pineapple juice pineapple

Burette reading	1 st titration (cm^3)	2 nd titration (cm^3)	3 rd titration (cm^3)
Final Bur. Reading	28.00	28.00	28.00
Initial bur. Reading	0.00	0.00	0.00
	28.0	28.00	28.00

The difference of the pineapple is $32.00 - 28.00 = 4.00$.

The graphs for glucose and fructose are plotted in the figure-1 and figure-2. The sugar content in pineapple was determined and extrapolated in the calibration curves of glucose and fructose respectively.

The work elucidated the type and amount of the sugar in edible fruit-pineapple. The test carried out using the three reagents, Benedict's, Seliwanoff's and phenyl hydrazine showed that pineapple contain glucose and fructose.

The thin layer chromatography result showed the R_f value of 0.34 and 0.39, 0.17 for glucose and fructose respectively in btane-1-ol, acetone and water which is close to R_F value 0.36 and 0.17 of pineapple juice.

From literature pineapple contains "sucrose"¹⁴ but in the research, TLC and the reagents tests showed that pineapple contains glucose and fructose. This may be probably because of reactions due to ripening and storage. The pineapple juice was strained instead of boiling as given¹⁵.

The amount of the sugar content in pineapple was determined and extrapolated in the calibration curves for

glucose and fructose, the values were $4.00 \times 10^{-2} \text{g/cm}^3$ and $1.50 \times 10^{-2} \text{g/cm}^3$. Pineapple being one of the locally available fruits that can be consumed fresh and popularly used in many occasions has been examined and it was found out that it contains glucose with $4.00 \times 10^{-2} \text{g/cm}^3$ of fructose and $1.50 \times 10^{-2} \text{g/cm}^3$ of glucose. This implies that it contain sugar which is source of energy, but high consumption of sugar raises the blood glucose which may lead to diabetes, excess consumption of the fruit should be avoided and control in other to maintain good health.

Conclusion

The results obtained in this study showed that pineapple contains sugar (glucose and fructose) which is one of the carbohydrates and source of energy in human diet. Sugar is important as food and it is valued for its sweetness. From the quantitative analysis, it was discovered that the amount of the glucose and fructose present were $4.0 \times 10^{-2} \text{g/cm}^3$ and $1.450 \times 10^{-2} \text{g/cm}^3$ respectively. Therefore excess consumption of pineapple should be avoided since it contains sugar that may cause diabetes, obesity and may increase risk of metabolic syndrome.

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