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Determination of the saccharin content in some ice creams consumed in Port Harcourt

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Abstract
The scope of this study covered six different ice creams purchased outside the gates of some primary and secondary schools in Port Harcourt. Each category of ice cream was assayed for saccharin (n=3). Standard deviation was calculated to ascertain the level of deviation from the mean. A total of 18 samples (6x3) were analyzed. The Saccharin concentration was determined quantitatively at a wave length of 425nm using ultra violet spectrophotometric method. Some conventional ice creams and locally prepared ice creams were compared in this study. The calibration data obtained were satisfactory with a correlation coefficient of 0.996. The concentration of saccharin in these samples ranged between 25.0mg/Kg – 69.0mg/Kg. Both conventional and locally prepared ice creams showed similar trend in saccharin concentration. Two samples (a conventional ice cream and a locally prepared ice cream) gave highest concentration of 69.0mg/Kg saccharin respectively, while the lowest concentration (25.0mg/Kg) was assayed in one of the locally prepared ice creams. Both locally prepared and conventional ice creams showed very high levels of saccharin when compared with the World Health Organization (WHO) permissible level of 5mg/Kg/day. From the findings of this work, continuous consumption of these ice creams may result in adverse health conditions.

Keywords: Saccharin, ice cream, sweeteners, UV spectrophotometer

1. Introduction

Saccharin with an IUPAC name 1,1–dioxo–1, 2–benzoisothiazol-3-one is a sweet tasting synthetic compound. It is a non-caloric sweetening agent which has been used to sweeten foods and beverages. Etymologically, its name is derived from a Latin word "Saccharium" meaning sugar. Saccharin was discovered accidentally in 1879 by Constantine Feldberg, a graduate student at John Hopkins University[1].The use of saccharin became wide spread during the sugar shortages of World War 1.Its popularity further increased during the 1960s and 1970s among dieters as a result of its calorie-free status. The excellent stability of saccharin under food processing makes it ideally suited in many different products. It is used in a wide range of cases where heat processing is required (e.g. jams, canned products).However, at low pH (pH 2.5), it can be slowly hydrolyzed to 2-sulfobenzoic acid and 2-sulfoamylobenzoic acid [2].

In the past, saccharin was used in a variety of applications. It was first used as an antiseptic and preservative to retard fermentation in food. Later on, saccharin was used in the plastic industry as an antistatic agent and as a brightener in nickel plated automobile bumpers[3]. Today, saccharin is used in a wide variety of food products including baked goods, beverages, soft drinks, sugar preserves and confectionery, alcoholic drinks, vinegar, pickles and sauces other food products. It is also used in cosmetic industries and in manufacturing of toothpaste.

Ice-Cream: is a smooth, sweet, cold food prepared from a frozen mixture of milk products and flavourings, containing a minimum of 10 percent milk fat and eaten as a snack or desert. Ice cream is derived from earlier "iced cream" or "cream ice" that was similar to "iced tea". The name was later abbreviated to "ice cream" the name we know today. It is a refreshing food that is liked by both children and adults. Ice cream is rich in calcium and phosphorus and also contains many vitamins (natural and fortified), including vitamin A, C, D and E as well as thiamin, riboflavin, niacin, folate, vitamins B-6 and B-12.

Arising from some controversies surrounding the toxic effects of saccharin to the body physiology, several studies have been conducted using different analytical procedures to establish this fact. The effect of lose of sodium saccharin on the induction of rat urinary bladder proliferation was investigated using autoradiography and scanning electron Microscopy [4].

A study was conducted on the Rapid Spectrophotometric Determination of saccharin in soft drinks and pharmaceuticals using Azure B. as reagent [5]. The Rapid Determination of Saccharin sodium in ice cream by High performance liquid chromatography (HPLC) was also investigated [6]. A radial compression (18 column, 100mm x 8mm i.d; and ultraviolet detector at 421nm were applied in the determination without extraction.

Another researcher studied the estimation of saccharin in soda beverages syrups, kulfies and candies. Saccharin contents of these different food products were measured quantitatively by gravimetric method, using acetic acid and lead acetate as solvents [7]. Some others workers, investigated saccharin analysis in pharmaceutical and cosmetics preparations as follows: by derivative ultraviolet spectrophotometry [8]; the determination of saccharin in low calorie products using flow through spectrophotometric sensor[9]; the use of a simplified spectrophotometric method for routine analysis of saccharin in commercial non-caloric sweetners [10]; the spectrophotometric method for the determination of saccharin in food and pharmaceutical products [11] and the determination of saccharin in preserved fruits by High Performance liquid chromatography [12].

Ice cream comes in different brands. We have "conventional ice creams" with well-known brand names. There are also several "locally prepared ice creams" with unbranded names in the market. This study was aimed at determining the level of saccharin content in some commonly consumed ice creams in Port Harcourt metropolis. The assay covered both the conventional and locally manufactured ice creams.

2. Materials Method

The materials and method used in this study were all of analytical standard and principles. Ice cream samples were purchased at the gates of some Primary and Post Primary schools within Port Harcourt metropolis. Method of analysis of saccharin was by UV Spectrophotometer (UV–2500) at 425nm [13].

2.1 Sample Preparation/Extraction

25grams of each sample were weighed and transferred to 100ml volumetric flask with small amount of water. Enough boiling water was added to make up 75ml; the mixture was allowed to stand for one hour shaking occasionally. Then 3ml ethanoic acid was added and mixed thoroughly; followed by excess (5ml) of 20% neutral lead (II) acetate solution. Cold water was added to mark, stirred to complete homogenization and the mixture was allowed to stand for 20mins and filtered using Whatman 25mm filter paper. 25ml of filtrate was transferred into a separator, followed by 3ml HCl. Saccharin in the filtrate was extracted using 1:1 (v/v) of Ethoxyethane and Petroleum Ether. The extract was concentrated and the absorbance measured in the UV Spectrophotometer at 425nm using Nessler's reagent for colour development. Saccharin forms blue colour complex with Nessler's reagent in a slightly acidic medium of Lead (II) Acetate - Ethanoic Acid buffer. Prior to sample analysis, a calibration curve was developed from absorbance readings of serial dilutions of a standard solution of saccharin.

2.2 Formula for Calculation of Concentration of Serial Dilutions of Stock Standard Solution:

Conc. of Std. Soln. x Req. Vol. (Std) =Req. Conc. x Desired Soln. Vol.

$$\text{Req. Vol (Std)} = \frac{\text{Req. Conc. x Desired Vol.}}{\text{Conc. of Std. Soln.}}$$

Table 1: Volume of 1000ppm standard Stock solution required to prepare series of dilute standard solutions.

Volume of 1000ppm Stock solution (ml)	Total volume of solution n (ml)	Concentration of standard solution ppm
2.5	100ml	25
5.0	100ml	50
7.5	100ml	75
10.0	100ml	100
12.5	100ml	125

Table 2: Absorbance Readings of Different Concentrations of Standard Solution.

Concentration of Standard Solution (ppm)	Absorbance
25	0.011
50	0.026
75	0.040
100	0.058
125	0.070

3. Results and Discussion

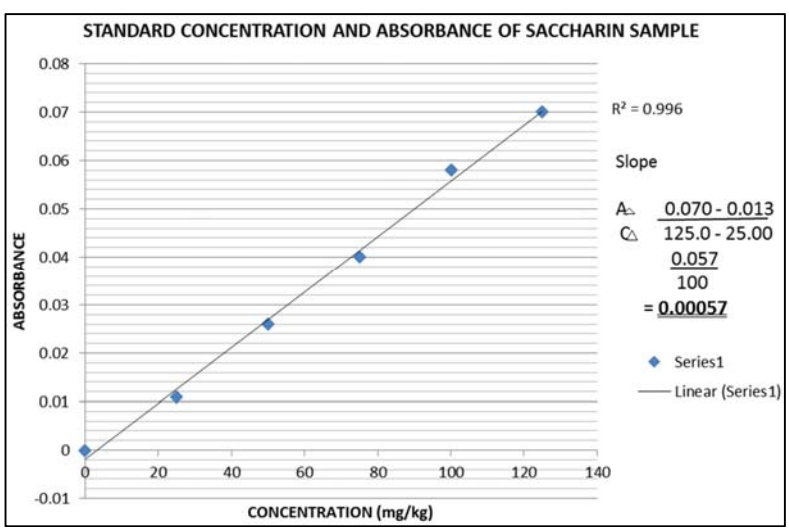

Fig 1: Calibration Curve for Saccharin

The standardized linear concentration ranges between 25mg/kg – 125mg/kg with absorbance range of 0.011 – 0.070.This was found to obey the Beer-Lambert's law which relates absorption to light path length, and also absorption to the concentration of absorbing species in the material. The general Beer-Lambert's law is usually expressed as "A = abc" [14].

Table 2: The Absorbance and Concentration of Saccharin in Different Ice Cream Samples

Samples	1st Absorbance	2nd Absorbance	3rd Absorbance	Mean Absorbance	S.D	Conc. (Mg/Kg)
C1	0.039	0.036	0.035	0.037	0.002	69.0
C2	0.025	0.025	0.024	0.024	0.001	48.0
C3	0.014	0.016	0.015	0.015	0.001	32.0
UB1	0.015	0.016	0.016	0.016	0.007	34.0
UB2	0.013	0.011	0.011	0.011	0.001	25.0
UB3	0.037	0.033	0.037	0.037	0.001	69.0

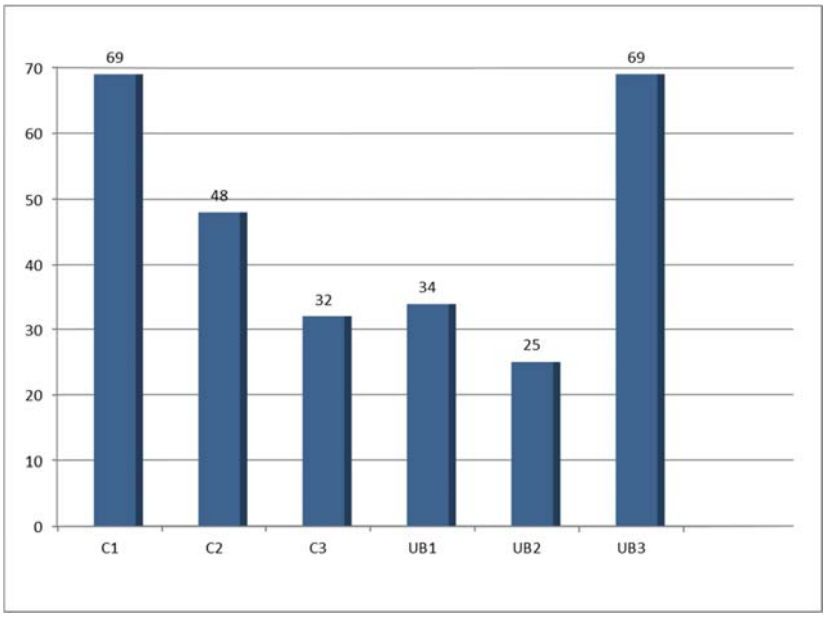

Fig 2: A bar chart representation of saccharine content in the ice cream samples C1, C2 and C3 represent Conventional ice cream while UB1, UB2 and UB3 represent Unbranded ice cream.

Using the calibration curve, the concentrations of saccharin in the various ice cream samples were determined. C-1, C-2 and C-3 represent three brands of conventional ice creams respectively while UB-1, UB-2 and UB-3 are three different unbranded ice creams. The amounts of saccharin contents determined from the six samples of ice cream indicate different levels of saccharin, except for C1 and UB3 which had the same saccharin content (69.0mg/Kg).The saccharin content in these ice creams ranged between 25.0mg/kg – 69.0mg/kg. Interestingly, a locally prepared ice cream, UB2 recorded the lowest concentration of saccharin (25.0mg/Kg).

When the saccharin concentrations in the studied ice creams were compared to the World Health Organization[15] permissible dose of 5mg/kg/day, they all exceeded it. The implication of this finding is that, both local ice creams and conventional ice creams are prepared without considering safe level of saccharin consumption. Children are most likely the largest consumers of ice cream especially the unbranded and affordable ones. This may increase the susceptibility of life hazards, as reported in a study of bladder cancer patients, where a possible link between the disease and use of saccharin has been established [16].

4. Conclusion and Recommendation

The UV spectrophotometric analytic procedure for the quantification of saccharin is a good method. The concentration of saccharin in all the ice cream samples is alarmingly high including the branded ones. While the association between saccharin consumption and bladder cancer risk is still controversial, many health groups still believe that it's used should be limited in infants, children and pregnant women. This is due to the possibility of allergic reactions. Saccharin belongs to a class of compounds known as sulfonamides, which can cause allergic reactions in some individuals. These reactions may include: headaches, breathing difficulties, diarrhoea and skin problems.

It is therefore recommended that, if saccharin must be used as an artificial sweetening agent in foods, recommended dietary standards should be complied with. Different regulatory bodies in the country should work in synergy to enforce and ensure compliance with existing national and international standards.

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