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SPECTROPHOTOMETRIC DETERMINATION OF TARTRAZINE IN SOME SELECTED BEVERAGES: A CASE STUDY OF KATSINA TOWN, NIGERIA

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ABSTRACT
The use of Tartrazine and other forms of azo dyes as colorants in food and beverages is on the increase rate despite their problems upon consumption by humans. This could be due to availability and effectiveness in imparting color to the different substrates. Therefore, there is need to constantly monitor the concentrations of these dyes in our foods and beverages. Hence, this research work was conducted to determine the concentration level of tartrazine used as colorants in five different brands of beverages using spectrophotometric method of analysis. A cross sectional primary data was obtained through experimental processes from the 5 different samples of beverages obtained from Katsina Central Market and Tsohuwar Kasuwa Market in the city of Katsina, Katsina State – Nigeria. The research work however used UV-Visible Spectrophotrometric concept to investigate the level of the dye in the samples and compare it with the existing maximum permissible limits provided by the Authorities concern. The research found that the concentrations for the two samples; A-210.368 mg/kg and D- 198.335 mg/kg containing tartrazine were found to be above the permissible limit while for the remaining three samples; B- 67.364 mg/kg, E-84.118 mg/kg and K- 74.304 mg/kg were within the permissible limit of 100mg/kg concentration as in accordance to Regulation (EC) No.1333/2008 of the European Parliament on Food Additives, Codex Alimentarius International Food Standard Commission (FAO/WHO), National Food and Drugs Administration and Control (NAFDAC). Therefore, samples B, E and K are safe for consumption when compared with samples A and D.

Keywords: Tartrazine, consumption, UV-Visible, concentrations, National food

INTRODUCTION

Azo dyes are organic compounds with the functional group R−N=N−R′, in which R and R′ are usually aryl. They are a commercially important family of azo compounds, i.e. compounds containing the linkage C-N=N-C (Sykes, *et al.*1974). More than half of the commercial dyes belong to this class. These dyes are highly colored and are prepared by diazotizing aromatic amine and coupling with suitable aromatic compound (Wilson *et al.*1966). Food additives (such as azo dyes) can be obtained from natural materials such as plant leaves, roots, bark, insect secretions, animals, or minerals, or they can be synthetic (Chanlon *et al.*2005). Azo dyes are added to food or beverages to perform certain technological purposes which consumers often take for granted as antioxidants, preservatives, sweeteners and colors (Fernandez *et al.*2010). For example, Tartrazine (also known as Acid Yellow 23, or Food Yellow 4, or C.I. 19140, or E102) is a synthetic lemon yellow azo dye primarily used as a food coloring (Dinc *et al.*2006). It is commonly used as color in beverages; soft drinks (such as Mountain Dew), energy and sports drinks, powdered drink, fruit cordials, and flavored/mixed alcoholic beverages. Others are candies, condiments and breakfast cereals etc

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Plate 1: Sample of beverages and soft drinks

Unfortunately, the dye was reported to cause hyperactivity in children when combined with some preservatives (such as sodium benzoate), allergic reactions in those with asthma or aspirin intolerance (Lockey et al.1977) and was also reported to cause cancer due to formation of aromatic amines upon their degradation behavior in an oxygenated condition (CHEMIK,

2016). It is on these developments, many researchers reported different methods that can used to monitor the concentration of this dye in different foodstuffs. Among those reported include; Ion Pairing High Performance Liquid Chromatography (HPLC) with di- or tetraalkylammonium salts was used to investigate azo dye in drinks as reported by Bruins *et al*. 1987; Riu *et al*. 1997; Pe`rez-Urquiza, Prat *et al*. 2000; Holcapek *et al*. 2001; Fuh and Chia 2002; Vanerkova *et al.* 2007. Electrophoresis and UV-Vis spectrophotometric techniques are also reported (Riu *et al*. 1998; Pe`rez-Urquiza, Ferrer *et al*. 2000; Poiger *et al*. 2000; Cunha Alpendurada, 2002; Go`mez *et al*. 2007; Minioti *et al*. 2007; Al-Degs *et al*. 2008; Ferna`ndez *et al*. 2009). Multi-syringe chromatography (MSC) coupled with a monolithic column has recently been used for the determination of three sulphonated azo dyes (Ferna`ndez *et al.* 2010). However, for this research UV-Visible Spectrophotometer at absorption wavelength of 419.5 nm was used to determine the concentration of Tartrazine in some selected beverages and soft drink.

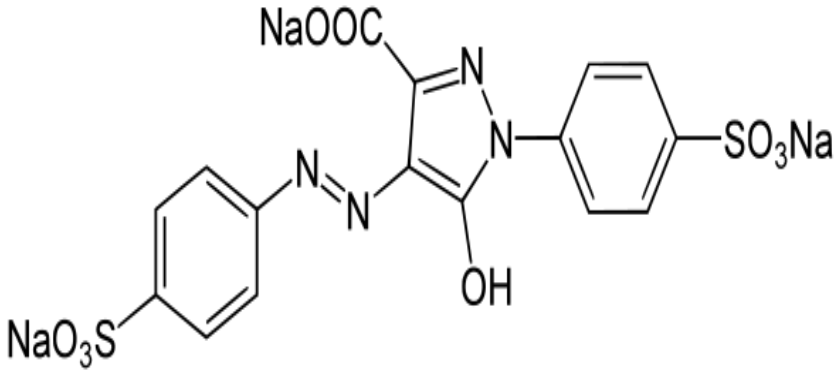

Fig. 1: Structural formula of Tartrazine

MATERIAL AND METHOD

Instruments/Apparatus

The instruments used in the research work include; UV-Visible Spectrophotometer (T60), Centrifuge Machine, Electrical Weighing Balance, Electric Shaker. While some of the apparatus used include; Volumetric Flasks, Measuring Cylinder, Beakers, Test Tubes, Pipettes, Syringes and some plastic containers. Water and detergents were used to wash all glassware and plastic containers and then allowed to dry.

Reagents

The reagents used in the conduct of this work were standard dye color (Tartrazine) of analytical grade made by Tianjin Kemiou Chemical Reagent Co. Ltd, China and Distilled water as solvent.

Sampling and Treatments

Five different samples of beverages (powdered) and soft drinks were purchased from Central market located at Katsina (Katsina State – Nigeria). About 1.0g of the powdered sample was accurately weighted using an electrical weighing balance and then dissolved in to a 25ml distilled water in volumetric flask and then centrifuged during 15 mins at 5000 rpm to obtained a clear solution for UV-Visible analysis. However, for liquid phase samples, were first degassed in an ultrasonic bath or electric shaker for 15 mins without any centrifuging or dilution before subjecting for UV-Visible analysis.

Similarly, the stock standard solution was prepared by dissolving 0.1g tartrazine of analytical grade (purchased from Denonso Chemical Store, Katsina, Nigeria) in to 100ml Volumetric Flask of Distilled Water. The solution was then stirred well for homogeneity. The working solution of the colorant was prepared by appropriate serial dilution of stock solutions with distilled water to give concentrations between 5 mg/kg, 10 mg/kg, 15 mg/kg, 20 mg/kg, 25 mg/kg, and 30 mg/kg.

Fig. 2: Map of study area

PROCEDURE (METHOD)

For the standard working solutions, a small portion of the solutions were measured and transferred in to 1.0cm path cell of T60 UV-Visible Spectrophotometer at 419.5nm to obtained their absorbance values. This was repeated three times to all the working standard solutions, average absorbance values were calculated and used to plot the calibration curve, which can be used to determine the concentration of the analyte in the samples.

However, in the same 1.0 cm path cell, a small portion of a clear and centrifuged sample solution were separately measured and placed in to T60 UV – Visible Spectrophotometer at 419.5nm absorption wavelengths of Tartrazine to determine the absorbance of Tartrazine in each sample solution. This was repeated three times to all the five different sample solutions, an average absorbance values were calculated and used on to the linear equation of the calibration curve of standard tartrazine to evaluate the concentration of the analyte in the samples.

RESULT

Based on the analysis conducted using Ultraviolet – Visible Spectrophotometer the concentrations of tartrizine obtained from each sample of beverages is shown below in Table 1. The concentrations values were obtained from the linear equation of the Standard Tartrizine Calibration Curve.

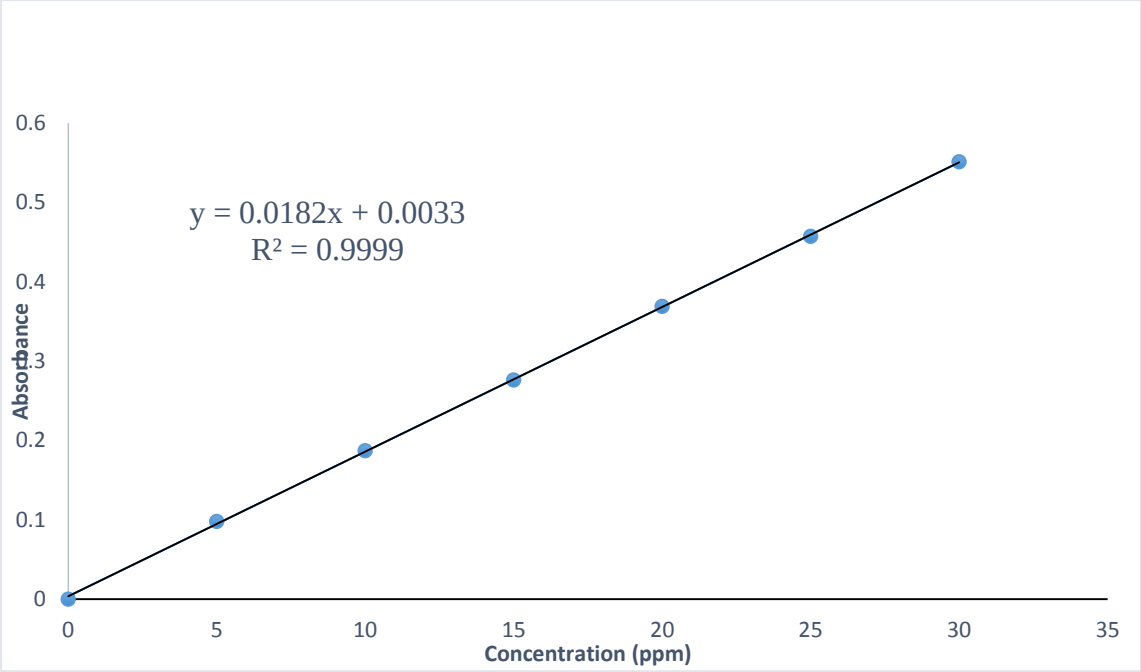

Fig. 3 Calibration Curve of Tartrazine

Table 1: Showing the Concentration values of Tartrazine present in the Samples used

SAMPLE CODE	SAMPLE ABSORBANCE	CONC. OBTAINED (mg/kg)
Sample K	1.295	70.973
Sample D	3.552	194.984
Sample A	3.832	210.368
Sample B	1.229	67.346
Sample E	1.534	84.104

Key: Sample K- fresh quick (bananamuz), Sample D- jolly cola, Sample A- jolly jus(orange), Sample B- tiara(mango), Sample E- foster clarks (pap/ccnut), ABS. – Absorption, CONC.- Concentration

DISCUSSION

Based on the analysis conducted, the concentrations of the analyte were found and contained in Table 1, which highlighted that the concentration values for Sample K, B and E are; 74.304ppm, 67.364ppm and 84.118ppm respectively and were within the permissible limit of 100mg/kg in non-alcoholic beverages as published by Codex Alimentarius International Food Standard Commission 2008, adopted by National Agency of Food and Drugs Administration and Control (NAFDAC) and Uk Food Standard Agency (2008). But the concentration values for sample D (194.984 mg/kg) and A (210.368 mg/kg) were found to be above the Maximum Permissible Limit of 100 mg/kg. This could be due to an effort by Food and Beverages Industries to have significant Market share through over coloring of their finished products to attracts more customers in their markets, this is in conformity with previously reported literature (Fernandez *et. al.,* 2010).

CONCLUSION

The use of spectrophotometric method for the determination of tartrazine in beverages or soft drinks was successful. Fortunately, the method consumes only distilled water, hence it is classified as most simple, accurate, easy and directly applicable in quantitative analysis. Therefore, the research justifies the safe consumption of sample K, B and E due to the level of analyte concentration found below the permissible limit, while sample D and A are not safe due to the level of analyte concentration found above the permissible limit of 100 mg/kg in non-alcoholic beverages as published by Codex Alimentarius International Food Standard Commission 2008, adopted by National Agency of Food and Drugs Administration and Control (NAFDAC) and Uk Food Standard Agency (2008).

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