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Caffeine Content in Cola and Energy Drinks Commonly Consumed In Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

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ABSTRACT
Caffeine is a most common ingredient in energy and cola drinks. Due to its stimulating effect and possibly health risk, it is important to ascertain how much of it is in these drinks. This study was carried out to determine the amount of caffeine in four brands of energy(Ed) and cola drinks (Cd), commonly consumed in Rufus Giwa Polytechnic. Quantitative analysis of caffeine was performed by a simple and fast spectrophotometric method using carbon tetrachloride as the extracting solvent. The result showed that brand 1Cd(27.70±0.04mg/L) has the lowest level of caffeine content while brand 2Ed (60.36±0.06) has the highest caffeine content. The caffeine content of all the drink samples analysedin the study were well below the maximum allowable limit set by FDA.

Keywords: caffeine, cola drink, energy drink, determination, High performance liquid chromatography, spectrophotometric method.

I. INTRODUCTION

All over the world energy and cola drinks are consumed for various reasons:Some persons take these drinks to keep them alert, some because of the taste and others on dietary /health grounds. Energy and cola drinks are generally composed of sugar, and/or artificial sweeteners, caffeine and additional ingredients, many of them in quantities novel for beverages, such as guarana and taurine. Today, millions of people consume energy drinks, thinking they will have more energy, be more alert or concentrated, build up their stamina, but are not aware of the amount of caffeine that they are ingesting. Consequently, a random overdose may occur (Avci et al., 2013).

The America Academy of Peadiatrics stated that energy drinks have no place in the diet of children and adolescents, due to their stimulant content but energy drink manufacturers continue to advertise directly to adolescents in media also viewed by children.

The mixing of energy drinks with alcohol is an obvious public health concern but adolescents' consumption of energy drinks alone also poses considerable health risks.

Caffeine is a most common ingredient in cola and energy drinks. Andrews et al., (2007), stated that caffeine is deliberately added as a flavouring agent and to make the drinks additive. Caffeine is contained in tea, cocoa, and many soft drinks and several drug preparations including over the counter stimulants and headache mixture (Newton et al., 1981). Caffeine content allowed in soft drinks may be in the range between 30 and 72mg/355mL (12 OZ) or 8.45- 20.28mg/100mL (NSDA 1999). Energy drinks are reported to contain as much as 80 – 300mg of caffeine and 35g 0f processed sugar per 8 – OZ serving (Clauson et al ., 2008). In human caffeine acts as a central nervous system stimulant, hence it is used both recreationally and medically to reduce physical fatigue and restore mental alertness when unusual weakness or drowsiness occurs (Nehlig et al., 1992;Maidon et al., 2012).

Caffeine has also been used as a drug to increase wakefulness and as a dietary aid and it is probably the most widely ingested natural alkaloid (Newton et al., 1981).

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Coffee, cocoa beans, cola nuts and tea leaves are common sources of caffeine (Ringe and Friedlieb,2014). Tea is the major dietary source of caffeine in the United Kingdom and in Asia (Berger, 1988).

II. LITERATURE

A wide variety of methods have been employed including High Performance Liquid Chromatography (HPLC) being the method of choice by many researchers in determining the caffeine contents of beverages (Camargo & Toledo, 1999; Bispo et al., 2002; Mumin et al., 2006; Nour et al., 2008; Violeta et al., 2010; Wanyika et al., 2010), however HPLC is an expensive method.

In the same vein, Khalid et al (2016), reported that Alpdogan et al (2002) used derivative spectrophotometric method using Philip 8740 UV/VIS spectrophotometer to determine the caffeine concentration in coffee and tea, Alghamdi et al (2005) used UV spectrophotometric method to determine caffeine and other food addictive in beverages, Wanyika et al (2010) used high performance liquid chromatography and UV/VIS spectrophotometer at 274nm to determine the level of caffeine in certain coffee (Nescafe, Africafe, Dorman's) and tea (chai, maramoja, kericho gold, sasini, final's premium) brands in Kenyan market. Also Kalra et al (2011), Mohammed et al (2012), Amos et al (2014),Hossain et al (2015) and Khalid et al (2016) all employed spectrophotometric methods in the determination of caffeine.

In this work the method reported by Amos et al (2014) is employed in the determination of the caffeine content in common energy and cola drinks sold in Rufus Giwa Polytechnic Owo, Ondo State, Nigeria.

III. MATERIALS AND METHOD

MATERIALS

The major materials used for this work are different brands of energy and cola drinks. Other material employed are: separating funnel, beakers, conical flasks, volumetric flasks, pipette, distilled water, carbon tetrachloride, caffeine and spectrophotometer.

METHODS

All the glassware were soaked overnight with chromic acid solution and washed thoroughly with water and detergent, then rinsed with distilled water, dried in the oven and transferred to a desiccator before use. The chemicals and reagents used in this study were of analytical grade and no further purification was carried out and was obtained from Enes Chemical Akure, Ondo State. Brands of commonly consumed cola and energy drinks were purchased from a shop in Rufus Giwa Polytechnic, Owo, Ondo State.

PREPARATION OF CAFFEINE STANDARD SOLUTIONS

A 100 ppm stock standard of caffeine was prepared by dissolving 25 mg of caffeine in 250 mL purified carbon tetrachloride (CCl_4) in a volumetric flask (250 mL). Working standards were prepared by pipetting 10, 20, 30, 40 and 50 mL aliquots of the stock standard solution into separate volumetric flasks (100 mL) and diluting to volume with purified carbon tetrachloride to produce concentrations of 10, 20, 30, 40 and 50 mg/L, respectively standard solution. The absorbance of each solution was measured at absorption maximum of 270 nm using 10 mm quartz cuvette. The absorbance values were then plotted against concentrations to generate a standard calibration curve.

CAFFEINE EXTRACTION PROCEDURE

An aliquot (5 mL) of the drink sample was drawn with a 10 mL pipette and placed into a 125 mL separating funnel followed by the addition of distilled water (10 mL), then 20% aqueous Na_2CO_3 solution (1 mL) and analytical grade CCl_4 (20 mL). The caffeine was extracted by inverting the funnel at least three times, venting the funnel after each inversion. The non-aqueous CCl_4 layer was removed to a clean 50 mL volumetric flask. Another 20 mL portion of CCl_4 was added to the aqueous solution in the separating funnel and the extraction procedure was repeated twice more and

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the CCl_4 solvent layers combined. This volume was made up to 50 mL with the solvent. This procedure was repeated for all the drink samples. The absorbance of the resulting solutions was then measured on UV/Vis spectrophotometer at 270 nm using 10 mm quartz cuvette.

QUANTITATIVE CAFFEINE DETERMINATION:

Quantitative analysis of caffeine was performed by a UV/VIS Spectrophotometer. The wavelength λ max was determined by scanning the standard solution from 200-600 nm and the obtained results gave an absorption spectrum, which was characterized by a single intensive absorption band located in the UV range at λ max = 270 nm. The quantitative amount of caffeine in samples (ppm) was then determined using the standard curve.

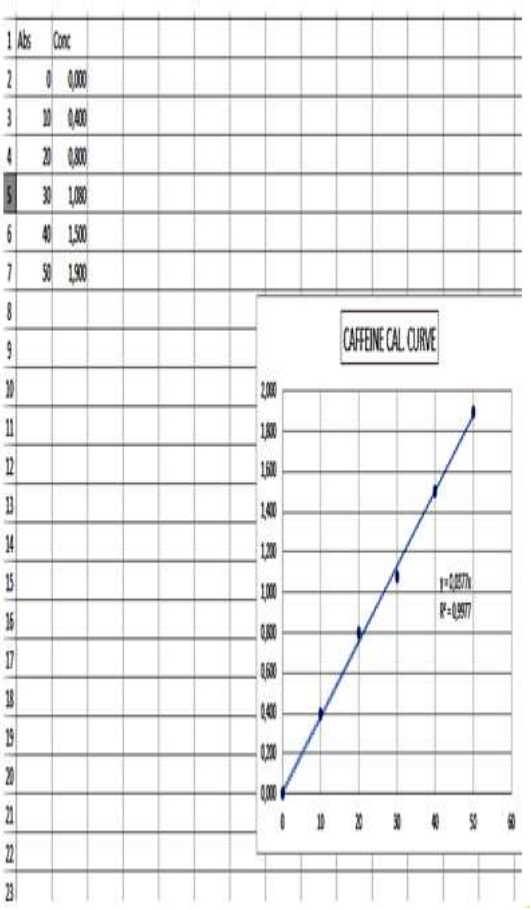
Results and Discussion

Table1 Concentration and Absorbance of caffeine standard.

Concentration mg/L	Absorbance
0	0.000
10	0.400
20	0.800
30	1.080
40	1.500
50	1.900

Table2 Caffeine content of the samples

Sample	Caffeine content mg/L
Brand1Cd	27.70±0.04
Brand2Cd	48.68±0.08
Brand1Ed	45.34±0.04
Brand2Ed	60.36±0.06



IV. DISCUSSION

The standard linear calibration curve obtained from the standard solutions analysis is presented in Fig. 1. It shows a good linear relationship between the absorbance and concentrations of the standard solutions.

From the result shown in table 2, the minimum caffeine level was observed in Brand1Cd (27.70±0.04mg/L), while the energy drink, Brand2Ed has the highest caffeine content (60.36±0.06).

It is generally agreed that there is little risk of harm when a person consumes less than 300mg of caffeine a day (Rogers and Dernoncourt, 1998; Smith, 2005). This amount typically corresponds to 4 cans of energy drink. Caffeine content in beverage drinks varies by brand from 10 to 60 mg of caffeine per serving (Violeta et al., 2010); however the US Food and Drug Administration (FDA, 2006) limits the maximum amount in carbonated beverages to 6 mg/oz (200 ppm).It also recommends consumption of less than 200mg /day in times of anxiety, stress or during pregnancy. Therefore caffeine content allowed in cola drinks may be in the range between 30 and 72 mg/355 mL

(12 oz) or 8.45-20.28 mg/100 mL (NSDA, 1999). Obviously, the levels of caffeine in the drink samples analysed in this study are well below the maximum allowable limits set by the above mentioned food regulatory bodies.

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