

Estimation of Caffeine in different brands of Energy drinks by Ultra-Violet Spectroscopy

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Abstract- Some drink manufacturers do not report how much Caffeine is present in their products. This work was done for the estimation of caffeine in ten different brands of energy drinks available in the market with the help of Ultra-Violet spectroscopy. These result showed that the concentration of Caffeine is much higher than in the different brands of soft drinks. The highest concentration of Caffeine was found in Power Horse (0.754955 mg/mL), so it is strongest CNS (central nervous system) stimulant among all other analyzed energy drinks. The lowest concentration of Caffeine among investigated energy drinks was Big Apple (0.100901 mg/mL). So it is the weakest stimulant among all samples.

Index Terms- Caffeine, Ultra-Violet spectroscopy, energy drinks, central nervous system, drug.

I. INTRODUCTION

Caffeine is a drug and shares a number of traits with more notorious drugs such as Cocaine and Heroin. It uses the same bio-chemical mechanisms as those other drugs to stimulate brain functions [1]. Its molecular formula is $C_8H_{10}N_4O_2$ and called trimethylxanthine [2]. According to the Huckel rule it is aromatic in nature [3]. Caffeine occurs naturally in many plants such as Coffee beans, Tea leaves and Cocoa beans [4]. It is moderately soluble in water at room temperature and its solubility increases with temperature [5]. It is weakly basic ($pK_a \approx 0.6$) [6]. It has a number of effects: improves performance during sleep deprivation, in shift workers it leads to fewer mistakes caused by tiredness, moderate doses in athletics can improve sprit, endurance or tolerance and team sports performance [7-11]. A high dose of caffeine has adverse effect on health [12-14]. The amount of Caffeine needed to produce effects varies from person to person, depending on body size and degree of tolerance. However the regular users develop a strong tolerance to these effects [15]. Energy drinks have large concentrations of Caffeine with sugar and other stimulants. These are the new trend in caffeinated beverages [16]. However some drink manufacturers do not report how much Caffeine is present in their products [17].

II. MATERIAL AND METHOD

The different brands of energy drinks were got from local market. The Caffeine content of the different energy drinks was calculated by UV spectrophotometer 3000.

A. Preparation of standard and sample solution:

a. Standard stock solution preparation

The standard stock solution of Caffeine was prepared by weighing 0.02 gram of Caffeine and was dissolved in 1000 mL of distilled water. After preparing the stock solution the dilutions were prepared as:

5 mL, 10 mL, 15 mL, 20 mL, 25 mL, 30 mL, 35 mL, 40 mL, 45 mL, 50 mL, 55 mL, 60 mL and 65 mL of stock solution were taken in 100 mL measuring flask separately and were diluted with distilled water up to the mark. In this way thirteen dilutions were made having concentrations of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2 and 1.3 mg per mL of the solutions respectively.

Sample solution preparation

First of all each energy drink solution was warmed to decarbonated them. Then 1 mL of each energy drink sample was diluted up to 100 mL with distilled water and took the absorbance at 272 nm. The absorbencies of these different solutions were shown in Table 2.

B. Determination of Wavelength [λ_{max}]

The λ_{max} was determined by scanning the standard solution from 190-400 nm range. We got the maximum absorbance [λ_{max}] at 272 nm. This value was used for calculating the absorbencies of different dilutions. The absorbencies of different dilutions are given in Table 1. Using the data obtained from UV spectrophotometer for the different dilutions of standard stock solution, a calibration curve got by plotting absorbance versus concentration of dilutions. The calibration curve is shown in Fig.1.

III. RESULT AND DISCUSSION

The absorbance of different brands of energy drinks was measured at 272 nm and by applying the formula we determined the concentration of Caffeine in them. Their results were shown in Table 2 and in figure 2. The concentration of Caffeine in Big Apple, Panda, Vimto, Red Bull Extra, Power Full, Red Bull, Mad Croc, Baar, Booster and Power Horse were found to be 0.100901, 0.136937, 0.272072, 0.400000, 0.454054, 0.455856, 0.475676, 0.554955, 0.61982 and 0.754955 mg/mL. It was concluded from the above data that the highest concentration of Caffeine was found in Power Horse, so it is a strongest CNS stimulant. The lowest concentration among the analyzed energy drinks was found in Big Apple.

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Figures and Tables

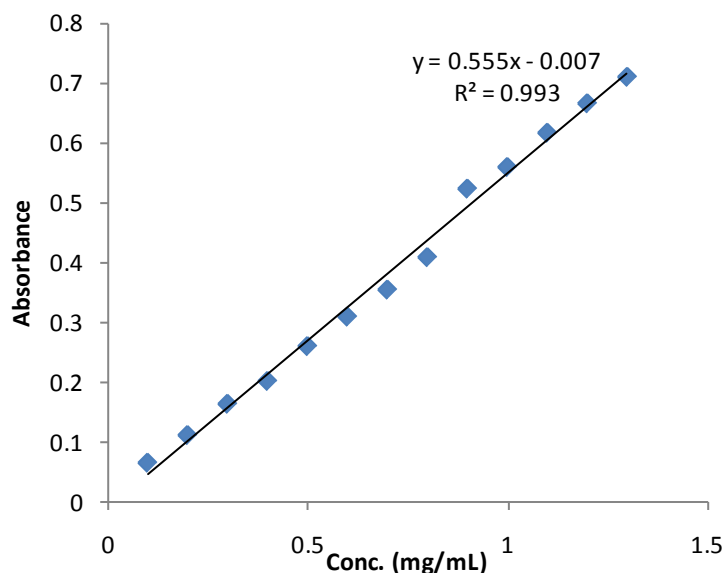


Figure1: Absorbance versus concentration of caffeine standards. ■ - Absorbance, -- trend line

Table 1. Absorbencies of dilutions

Sr. No.	Dilutions (mg/mL)	Absorbance
1	0.1	0.067
2	0.2	0.113

3	0.3	0.165
4	0.4	0.203
5	0.5	0.261
6	0.6	0.310
7	0.7	0.355
8	0.8	0.409
9	0.9	0.523
10	1.0	0.559
11	1.1	0.616
12	1.2	0.665
13	1.3	0.709

Table 2. Caffeine in drinks

different brands of energy

Sr.No.	Energy drink	Absorbance	Concentrations (mg/mL)
1	Big Apple	0.049	0.100901
2	Panda	0.069	0.136937
3	Vimto	0.144	0.272072
4	Red Bull Extra	0.215	0.400000
5	Power Full	0.245	0.454054
6	Red Bull	0.246	0.455856
7	Mad Croc	0.257	0.475676
8	Baar	0.301	0.554955
9	Booster	0.337	0.61982
10	Power Horse	0.412	0.754955

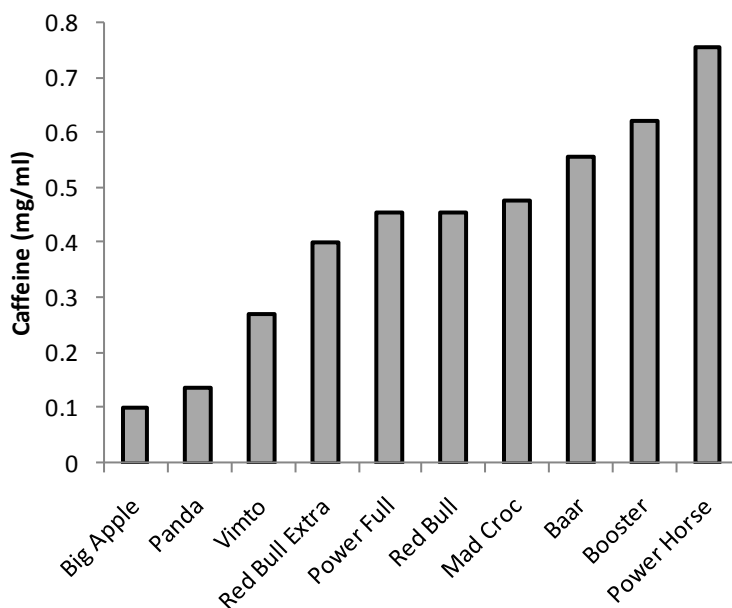


Figure 2: Caffeine in different energy drinks.