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

Muhammad Mufakkar*, Kalsoom Fatima*, Huma Faheem*, Shakeel Ahmad** and Muhammad Hammad Khan***

*Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.
**Department of Chemistry, Government M.A.O. College, Lower Mall Lahore, Pakistan.
***Centre for Environment protection studies, PCSIR laboratories, Ferozepur Road Lahore, Pakistan.

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 results 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 biochemical mechanisms as those other drugs to stimulate brain functions [1]. Its molecular formula is C₈H₁₀N₄O₂ and called trimethylxanthine [2]. According to the Hückel 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 (pKa= ~ 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 improve sprit, endurance or tolerance and teamwork [7-11]. A high dose of caffeine has adverse 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.

b. 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.

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, Vinto, 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 strongest CNS stimulant. The lowest concentration among the analyzed energy drinks was found in Big Apple.
REFERENCES


AUTHORS

First Author – Muhammad Mufakkar, Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.

Second Author – Kalsoom Fatima, Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.

Third Author – Huma Faheem, Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.

Fourth Author – Shakeel Ahmad, Department of Chemistry, Government M.A.O. College, Lower Mall Lahore, Pakistan.

Fifth Author – Muhammad Hammad Khan, Centre for Environment protection studies, PCSIR laboratories, Ferozepur Road Lahore, Pakistan.

Figures and Tables

![Graph showing absorbance versus concentration of caffeine standards with equation y = 0.555x - 0.007 and R² = 0.993.]

**Figure 1:** Absorbance versus concentration of caffeine standards. □ - Absorbance, -- trend line

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Dilutions (mg/mL)</th>
<th>Absorbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1</td>
<td>0.067</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>0.113</td>
</tr>
</tbody>
</table>

Table 1. Absorbencies of dilutions

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<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Energy drink</th>
<th>Absorbance</th>
<th>Concentrations (mg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Big Apple</td>
<td>0.049</td>
<td>0.10901</td>
</tr>
<tr>
<td>2</td>
<td>Panda</td>
<td>0.069</td>
<td>0.136937</td>
</tr>
<tr>
<td>3</td>
<td>Vimto</td>
<td>0.144</td>
<td>0.272072</td>
</tr>
<tr>
<td>4</td>
<td>Red Bull Extra</td>
<td>0.215</td>
<td>0.400000</td>
</tr>
<tr>
<td>5</td>
<td>Power Full</td>
<td>0.245</td>
<td>0.454054</td>
</tr>
<tr>
<td>6</td>
<td>Red Bull</td>
<td>0.246</td>
<td>0.455856</td>
</tr>
<tr>
<td>7</td>
<td>Mad Croc</td>
<td>0.257</td>
<td>0.475676</td>
</tr>
<tr>
<td>8</td>
<td>Baar</td>
<td>0.301</td>
<td>0.554955</td>
</tr>
<tr>
<td>9</td>
<td>Booster</td>
<td>0.337</td>
<td>0.61982</td>
</tr>
<tr>
<td>10</td>
<td>Power Horse</td>
<td>0.412</td>
<td>0.754955</td>
</tr>
</tbody>
</table>

Table 2. Caffeine in different brands of energy drinks.

Figure 2: Caffeine in different energy drinks.