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RESEARCH ARTICLE

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THE QUANTITATIVE DETERMINATION OF CAFFEINE IN ENERGY DRINKS AVAILABLE IN BANGLADESH

ABSTRACT

The aim of this study is to know the concentration of caffeine in energy drinks available in Bangladesh to ensure whether the caffeine concentration in energy drinks follow the FDA recommendation or not. Five (5) items (35 in quantity) of energy drinks available in Bangladesh were studied in this experiment. Caffeine content was analyzed and quantified of those common beverages by UV Spectroscopy. The study showed that there were no significant difference of caffeine contents in the four samples namely Tiger, Speed, Thunder, Power energy drink based on separate divisions. But there was noticeable difference in Black Horse energy drink. Among the seven divisions, the highest content of caffeine was found in Khulna and the lowest in Dhaka division.

Key Words Caffeine; Energy drinks; Overdose; Toxicity

1. INTRODUCTION

The term "Energy drinks" refers to beverages that claim to provide a burst of energy by using a combination of caffeine, other plant-based stimulants (e.g., guarana, yerba mate), simple sugars (e.g., glucose, fructose), glucuronolactone (a naturally occurring glucose metabolite), amino acids (e.g., taurine, carnitine, creatine), herbs (e.g., ginkgo biloba, ginseng), and vitamins.[1] Most often these drinks contain high amounts of caffeine and sugar.

Caffeine is a common organic molecule found in many beverages such as coffee, tea, energy drinks and cola. It is a stimulant to the central nervous system. It is generally agreed that there is little risk of harm when a person consumes less than 300 mg of caffeine a day. [2,3] However at times of anxiety or stress, or during pregnancy, the FDA recommends consumption of less than 200 mg a day.[4] While there are no regulatory requirements to control or label food products with their caffeine content, numerous studies have been carried out to determine the typical caffeine content of commonly consumed beverages.

Caffeine provides the main energizing "boost". [5] It first appeared in Europe and Asia in the 1960s in response to consumer demand for a dietary supplement that would result in increased energy. [6] Recently there has been an increase in the popularity of caffeine- containing "energy drinks" or "functional beverages". Functional beverages are also known as nutraceutical foods, which are substances considered to be a food or part of a food that may provide some health benefits. However, there are important health concerns that cannot be ignored with regards to the amount of caffeine contained in these drinks. [7] Regulation of energy drinks, including proper formulation, content labeling and health warnings has differed across Bangladesh. The absence of proper regulation has resulted in aggressive marketing of energy drinks, targeted primarily towards young males, for psychoactive, performance-enhancing and stimulant drug effects. There are increasing reports of caffeine intoxication from energy drinks, and it seems likely that problem with caffeine dependence. [6]

2. MATERIALS AND METHODS

2.1 Materials

Caffeine samples were kindly gifted by Incepta Pharmaceuticals Ltd., Bangladesh. Activated Charcoal (Merch Limited, Mumbai), energy drinks were collected from local market. UV-visible spectrophotometer (HACH Spectrophotometer, Model –DR/4000µ), Electronic

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Balance (Denver Instrument, USA) were used for the experiment process.

2.3 Method

2.3.1 Collection of Samples

Samples of energy drinks of five (05) brands were collected from all the seven divisions of Bangladesh namely Dhaka, Rajshahi, Chittagong, Khulna, Sylhet, Barisal and Rangpur.

2.3.2 Standard Preparation

A 100 ml stock standard of caffeine was prepared by dissolving 10 mg of caffeine in 100 ml of purified water. Working standards were prepared by pipetting 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 ml of aliquots of the stock standard solution into separate volumetric flask and 100 times diluting by purified water. Aliquots of the prepared standards were placed into quartz curettes and analyzed using UV spectrophotometer at 272 nm wavelength (Table 1 and Figure 1).

Concentration (micro gram)	Absorbance (nm)
0	0
1	0.06
2	0.109
3	0.148
4	0.199
5	0.242
6	0.309
7	0.343
8	0.392
9	0.457
10	0.497

Table 1: Absorbance of standard preparation of active caffeine

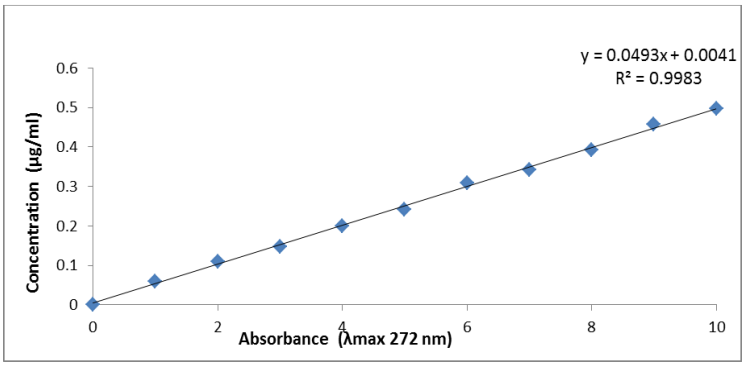

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Figure 1: Standard Curve of Caffeine

From the calibration curve the caffeine contents of all samples were calculated using the following equation:

y = 0.049x + 0.004 x = y – 0.004/ 0.049	Here, x = concentration y = absorbance

2.3.3 Sample Preparation

First step in the preparation sample was De-carbonation. Each bottle of samples was opened for 72 hours for de-carbonation. Then de-colorization of the energy drink was conducted by addition of 0.150 gm activated charcoal to 15 ml sample and kept for 5 minutes. After 5 minutes, sample was filtered by filter paper. Aliquots of the filtered samples were placed into quartz cuvettes and analyzed using UV spectrophotometer at 272 nm wavelength.

2.3.4 Standard Curve Preparation

The caffeine contents of the samples were calculated using the peak areas reported by the integrator and the standard curve. An example of the caffeine standard curve is shown in Figure 1.

3. RESULT & DISCUSSION

Brand Basis

There were difference of caffeine contents in each sample based on separate divisions such as Tiger ranged from 29.480 to 38.957 mg per 270 ml (Avg. value 33.502 mg per 270 ml) , Speed ranged from 21.429 to 38.061 mg per 250 ml (Avg. value 28.987 mg per 250 ml) , Black Horse ranged from 50.033 to 79.347 mg per 270 ml (Avg. value 69.248 mg per 270 ml) , Thunder ranged from 36.435 to 43.708 mg per 330 ml (Avg. value 39.504 mg per 330 ml) , Power ranged from 35.714 to 47.092 mg per 250 ml (Avg. value 40.641 mg per 250 ml), but there was noticeable difference in Black Horse energy drink.

The Food and Drug Administration (FDA) defines caffeine as a generally recognized as safe (GRAS) substance. However, FDA specifies that the maximum amount in carbonated beverages is limited to 0.02% or no greater than 200 parts per million. There, the highest legal amount of caffeine allowed in a 355 ml (12 oz) bottle of soft drinks is about 71 mg. So, Tiger and Black Horse Energy Drinks can contain maximum 54 mg/ 270 ml, Speed and Power no greater than 50 mg/ 250 ml, and Thunder 66 mg/ 330 ml. Here Tiger, Speed, Thunder, Power Energy Drinks remained under FDA limit and Only Black Horse energy drink crossed the limit given by FDA.

Region/ Division Basis

The regional caffeine contents were Dhaka from 21.429 to 54.496 mg per bottle (Avg. value 37.272 mg per bottle), Rajshahi from 24.898 to 79.347 mg per bottle (Avg. value 45.166 mg per bottle), Chittagong from 29.480 to 50.033 mg per bottle (Avg. value 38.332 mg per bottle), Khulna from 33.776 to 73.837 mg per bottle (Avg. value 45.396 mg per bottle), Sylhet from 28.316 to 71.633 mg per bottle (Avg.

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value 41.082 mg per bottle), Barisal from 26.122 to 77.143 mg per bottle (Avg. value 43.753 mg per bottle), Rangpur from 30.306 to 78.245 mg per bottle (Avg. value 44.632 mg per bottle). So the highest content of caffeine was found in Khulna and the lowest in Dhaka. Caffeine content of different energy drink brands are shown below (Table 2 and Figure 2).

Division	Caffeine content (mg per bottle)				
	Tiger	Speed	Black Horse	Thunder	Power
Dhaka	33.943	21.429	54.496	38.994	37.500
Rajshahi	36.092	24.898	79.347	43.708	41.786
Chittagong	29.480	38.061	50.033	36.435	37.653
Khulna	38.957	33.776	73.837	38.320	47.092
Sylhet	31.022	28.316	71.633	38.724	35.714
Barisal	29.535	26.122	77.143	42.496	43.469
Rangpur	35.486	30.306	78.245	37.849	41.276

Table 2: Division-wise caffeine content of energy drink brands

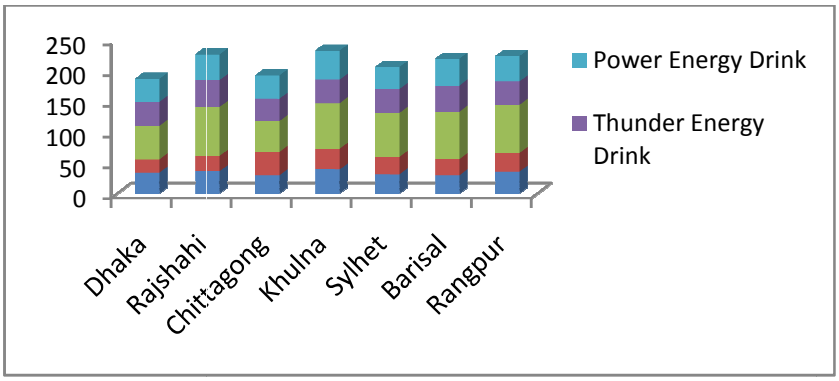

Figure 2: Graphical representation of division-wise caffeine content of energy drink brands

4. CONCLUSION

The consumption of high caffeine content energy drinks has increased markedly in recent years. Most of the beverage companies in Bangladesh are not following regulation of energy drinks, including content labeling and health warnings. Among the five items of tested energy drinks, the highest amount of caffeine was found in Black Horse Energy Drink which crossed the FDA limit and found variation in caffeine concentration in each sample of five items based on separate divisions. On the basis of division, the highest concentration was found in Khulna and the lowest in Dhaka division.

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[1.] Saugata Dutta, [2.] Mir Muhammad Nasir Uddin, [3.] Md. Abdul Motaleb Bhuiya [4.] Marzina Ajrin,

[1]Department of Pharmaceutical, Chemical & Environmental Sciences,
School of Science, University of Greenwich, UK.
[2]Department of Pharmacy, University of Chittagong,
[3] Assistant Professor, [4] Lecturer,
Department of Pharmacy, University of Science and Technology, Chittagong, Bangladesh.