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Estimation of caffeine in different beverages by Ultraviolet Spectroscopy

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Abstract

This study was undertaken with the objective of estimating the concentration of Caffeine of seven brands of soft drinks with the use of an analytical method, which will tell us the best brand amongst different brands containing caffeine. The highest concentration of caffeine was found in Power-ex (46 µg/ml), so it is a strongest CNS stimulant among all samples and it is harmful for health. And the lowest concentration of caffeine was found in XXX (19.5 µg/ml), so it is a weakest CNS stimulant among all samples.

Key-Words: Caffeine, UV-visible spectrometer, Beverages

Introduction

Caffeine is a bitter, white crystalline xanthine alkaloid that is a psychoactive stimulant. Caffeine was isolated from coffee in 1820 by a German chemist, Friedlieb Ferdinand Runge, and in 1821 by French chemists working independently; namely, by Robiquet and by Pelletierand Caventou. It was Pelletier, noting that the drug had been isolated from coffee, who coined the word "cafeine", which became the English word "caffeine". Caffeine is found in varying quantities in the beans, leaves, and fruit of some plants, where it acts as a natural pesticide that paralyzes and kills certain insects feeding on the plants. It is most commonly consumed by humans in infusions extracted from the bean of the coffee plant and the leaves of the tea bush, as well as from various foods and drinks containing products derived from the kola nut. Other sources include yerba maté, guarana berries, and the yaupon holly. In humans, caffeine acts as a central nervous system (CNS) stimulant, temporarily warding off drowsiness and restoring alertness.

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Caffeine is the world's most widely consumed psychoactive substance, but, unlike many other psychoactive substances, is legal and unregulated in nearly all jurisdictions. Beverages containing caffeine, such as coffee, tea, soft drinks, and energy drinks, enjoy great popularity; in North America, 90% of adults consume caffeine daily. The U.S. Food and Drug Administration (FDA) lists caffeine as a "multiple purpose generally recognized as safe food substance" Caffeine has diuretic properties when administered in sufficient doses to subjects who do not have a tolerance for it. Regular users, however, develop a strong tolerance to this effect and studies have generally failed to support the common notion that ordinary consumption of caffeinated beverages contributes significantly to dehydration.

Material and methods

The different brands of Berverages were procured from different Beverage companies like Red Bull, Pepsi, Coca-Cola, Mountain dew, XXX, Powerex,Thumpsup. The Caffeine content of the different beverages was calculated by U.V Spectrophotometer Shimanzu 1800 Compact.

Preparation of standard and samples solution

Standard Stock solution preparation

The Standard Solution of Caffeine was prepared by weighing 0.2µg of caffeine and was dissolved in 100 ml of water to get 200µg/ml.

Aliquots Preparation

After preparing the stock solution the aliquots are prepared. 1ml of stock solution was taken and

dissolved in 40ml of water in first volumetric flask and **5** µg/ml was prepared .1ml of stock solution was taken and dissolved in 20ml of water in second volumetric flask and make 10 µg/ml. 1ml of stock solution was taken and dissolved in 13.33ml of water in third volumetric flask and make 15 µg/ml.1ml of stock solution was taken and dissolved in 10ml of water in fourth volumetric flask and make 20 µg/ml. . 1ml of stock solution was taken and dissolved in 8ml of water in fifth volumetric flask and make 25 µg/ml. 1ml of stock solution was taken and dissolved in 6.66ml of water in sixth volumetric flask and make 30 µg/ml.

Determination of λmax

The λ max was determined by scan the standard solution from 190 – 400 nm, we got the maximum absorbance in the wavelength (λmax) 271.2nm.

Plot of Calibration Curve

Using the data obtained for the standard solution, prepare a calibration curve by graphing absorbance verses concentration of aliquots.

Sample Preparation

All the Beverages was first filter with 0.2 µm syringe filters and took a 1 ml of filtrate and make the 100 ml volume with water and took the absorbance at 271.2 nm.

Table 1: Absorbance of the different brands

S/No.	Soft drinks	Absorbance	Conc. (µg/ml)
1.	Pepsi	1.388	20.5
2.	Coco-cola	1.39	21
3.	Thumps-up	1.48	23.5
4.	Mountain-Dew	1.45	22.5
5.	XXX	1.35	19.5
6.	Power-ex	2.60	46
7.	Red-Bull	2.32	44

Results and Conclusion

The absorbance of Pepsi was found to be 0.1388 at 271.2 nm and by applying formula we get the concentration of caffeine 20.5 µg/ml which was present in the Pepsi. Similarly, the concentration of caffeine in coca-cola was found to be 21 µg/ml. and the concentration of caffeine in Thumps-up was found to be 23.5 µg/ml, the concentration of caffeine in Mountain Dew was found to be 22.5 µg/ml.The concentration of caffeine in XXX was found to be 19.5 µg/ml. The concentration of of caffeine in Power-ex was found to be 46 µg/ml. The concentration of caffeine in Red-Bull was found to be 44 µg/ml. In different brand of softdrink the highest concentration of caffeine was found in Power-ex (46 µg/ml) and the lowest concentration of caffeine was found in XXX(19.5 µg/ml). The brand of soft drink which are mostly use in daily use the highest concentration of caffeine was found in Thumps-up(23.5 µg/ml) and lowest concentration of caffiene was found in coca-cola(21 µg/ml).

The highest concentration of caffeine was found in Power-ex (46 µg/ml), so it is a strongest CNS stimulant among all samples and it is harmful for health, so it can be discontinued in the market. And the lowest concentration of caffeine was found in XXX (19.5 µg/ml), so it is a weakest CNS stimulant among all samples so it can be sold in the market.

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