Determination of the amount of Caffeine and Benzoic acid in selected soft drinks.

Doreen Amponsah.

Abstract— Caffeine is one of the main substances inculpated in the production of soft drinks. A variety of compounds are also used to preserve soft drinks; benzoic acid happens to be one of the preservatives. Caffeine and benzoic acid were isolated from four selected soft drinks – Coca Cola, Pepsi Cola, Mirinda and Fanta cocktail – using methylene chloride. For caffeine, the average absorbance obtained was 0.030, 0.029, 0.053 and 0.056 for Coca Cola, Pepsi Cola, Mirinda and Fanta cocktail respectively. And the average absorbance's obtained for benzoic acid was 0.014, 0.022, 0.028 and 0.027 for Coca Cola, Pepsi Cola, Mirinda, and Fanta cocktail respectively. Comparing the respective caffeine and benzoic acid average absorbance of the four selected soft drinks to the calibration curve of their standards, only Coca Cola and Pepsi Cola happened to contain Caffeine whilst all four selected soft drinks contained benzoic acid.

Key Terms— Caffeine, Benzoic Acid, Absorbance, Preservative, Compounds, Concentrations, Beverage.

1.0 INTRODUCTION

Soft drinks are manufactured from carbonated water, sugar cane syrup, caffeine and extract of kola nut and coca leaves. Kola also cola, is a common name for a genius of about 125 species of evergreen trees (trees that retain foliage throughout the year) and native to tropical West Africa and introduced into the West Indies and other tropical areas of the world. Kola trees are best known for their seeds or nuts, which are rich in caffeine.[1] Caffeine, is an alkaloid ($C_8H_{10}O_2N_4.H_2O$) found in coffee, tea, cacao, and some other plants. It is also present in most cola beverages. Caffeine is a non-polar organic compound, which goes by many names including caffeine, guaranine, mateina etc. The molecular weight of caffeine is 196.19g/mol, with a melting point of 238oC and a sublimation point at 178oC. The chemical name for caffeine is 1, 3, 7-trimethylxanthine or 1, 3, 7-trimethyl-2, 6-dioxopurine.2

Caffeine was discovered in coffee in 1820. In 1838 it was established that thiene, discovered in tea in 1827, is identical to caffeine. The drug increases the blood pressure, stimulates the central nervous system, promotes urine formation and stimulated the action of the heart and lungs. Caffeine is used in treating migraine because it constricts the dilated blood vessels and thereby reduces the pain. It also increases the potency of analgesics such as aspirin, and it can somewhat relieve asthma attacks by widening the bronchial airways.[1]

Coffee has been suggested as a possible cause of cancer or of birth defects.

No studies, however have yet confirmed any of these charge. Persons who stop drinking coffee do sometimes experience withdrawal headaches.

The principal physiological effects of coffee are due to caffeine, which acts as a mild stimulant. Tea is an aromatic stimulant, containing various polyphenols essential oils, and caffeine. The concentration of caffeine in tea ranges from 2.5 to 4.5 % as contrasted to an average concentration of about 1.5% in coffee.

Stimulants, any of a group of drugs that excite the central nervous system, increase alertness and alleviate fatigue. Caffeine is perhaps the most socially acceptable and commonly used stimulant. Other stimulants include cocaine and amphetamines, which creates intense feelings of euphoria. Amphetamines, commonly known as pep pills or diet pills also decrease appetite[1]

Caffeine produces increased mental alertness and reduces fatigue and increases the heart rate slightly. Caffeine is relatively nontoxic, but clearly has addictive potentials. Other withdrawal symptoms in heavy users include fatigue and difficulty in concentration. Over use can lead to insomnia, gastrointestinal disturbances and hypertension.

Caffeine is also useful in pain medication. Butalbital, sedative

barbiturate drug, is typically combined with other ingredients such as aspirin, acetaminophen, caffeine or codeine, to create a medication used to relieve headache or muscle pain in the neck and shoulders. It works by decreasing the activity of the central nervous system. Propoxyphene is also a drug containing caffeine and other ingredients such as aspirin and acetaminophen. This drug is used to treat mild to moderate pain.

It is a narcotic that works by depressing the activity of the central nervous system to create an anesthetic or pain killing effect.[1]

Benzoic acid (C_6H_5COOH) is the simplest of carboxylic acids of the aromatic series. It is used as a food preservative. Food preservation is the prevention of chemicals decomposition and the development of harmful bacterial in foods. Generally affected by the sterilization of the food (that is by the destruction of bacterial in it) is by heating in sealed vessels or making the conditions unfavorable for the development of bacterial. Yeast, a unicellular micro-organism producing zymase, converts sugars (hexose) into alcohol and carbon dioxide. This is because benzoic acid inhibits the growth of yeast and moulds.[3]

Benzoic acid is also a white crystal sparingly soluble in cold water, moderately soluble in hot water, having melting point of 122.4˚c and sublimes if rapidly heated.

1.1 Objectives

The purpose of this investigation is to determine caffeine and Benzoic acid in soft drinks.

- *Doreen Amponssah is a lecturer of Department of Cosmetology, Wa Polytechnic, Wa and PhD student of Kwame Nkrumah University of Science of Technology, Ghana.*
  Email: doreenopokuamponsah@gmail.com

2.0 MATERIALS AND METHODS

2.1 Sampling

The following soft drinks were obtained from a supermarket in Accra: Coke, Fanta cocktail, Pepsi cola, Miranda

2.2 Reagents used

Potassium chlorate, 2M ammonia solution, Methylene chloride (1,1 – dichloromethane), Conc. Hydrochloric acid, Dil. Hydrochloric acid, Anhydrous magnesium sulphate, Sodium carbonate, Benzoic acid standard, Caffeine standard.

2.3 Procedure

Scanning of caffeine and Benzoic standards using the Jenway 6100 spectrometer.

2.4 Preparation of a stock solution of 1000ppm (1mg/ml)

0.01g of benzoic acid standard and caffeine standard were weighed separately and dissolved into a two different 100ml volumetric flasks and topped with distilled water to the 100ml mark. 5ppm, 10ppm, 15ppm, 20ppm, and 25ppm were prepared from the stock solution.0.5ml of stock solution was pipette into 50ml volumetric flask and diluted with distilled water to the 50ml mark. 0.75ml of stock solution was pipette into 50ml volumetric flask and diluted with water to the 50ml mark. 1ml stock solution was pipette into 50ml volumetric flask and diluted with distilled water to the 50ml mark. 1.25ml of stock solution was pipette into 50ml volumetric flask and was topped with distilled water to the 50ml mark.

2.5 Extraction of caffeine

A brand of soft drink was recorded and 150ml was carefully measured into a conical flask. To this, 2.0g of sodium carbonate was added to it. The mixture was then tested with a red litmus paper and the litmus registered a blue color.

50ml of methylene chloride was added to the mixture in the conical flask and the flask swirled gently for at least 5 minutes

and poured into a separating funnel and allowed to settle for about 5 – 10 minutes. The organic layer was drained into a clean 250ml conical flask. A fresh 50ml sample of methylene chloride was added to the mixture in the separating funnel and the flask stoppered. The funnel was gently inverted a few times to allow the remaining caffeine to be extracted into the methylene chloride layer.

The lower layer was then separated and combined with the first extract. The total was treated with 5g anhydrous magnesium sulphate to remove water. The methylene chloride was filtered through a cotton pad into a 250ml Erlenmeyer flask. The extract in the Erlenmeyer flask was placed on a water bath to evaporate methylene chloride. A small amount of the precipitate was placed on a watch glass and mixed with 2 – 3 drops of concentrated hydrochloric acid. Few crystals of potassium chlorate were mixed well with a glass rod and mixture evaporated to dryness on a water bath. The watch glass was cooled and moistens with a drop of 2M ammonia solution. Residue turned purple which was an indication of the presence of caffeine. The rest of the precipitate was diluted with methylene chloride and taken to the UV for the absorbance to be taken.

2.6 Isolation of Benzoic Acid.

150ml of soft drink (coca cola) was poured into a conical flask and acidified with 2 drops of dilute hydrochloric acid. 50ml of methylene chloride was added and the flask swirled gently for at least 5 minutes. The mixture was transferred into 250ml separating funnel and allowed to settle for about 5 – 10 minutes. The organic layer was drained into a beaker and allowed to evaporate on a water bath, leaving a residue of benzoic acid. The residue was diluted with methylene chloride and sent to the UV for the absorbance to be taken.

3.0 RESULTS AND DISSCUSION

Standard Con'(ppm)	UV Absorbance
25	0.014
20	0.038
15	0.018
10	0.009

Table of Standard concentration (ppm) and UV absorbance of Benzoic Acid in Coca cola, Pepsi, Mirinda and Fanta Cocktail respectively.

Standard Con'(ppm)	UV Absorbance
25	0.030
20	0.027
15	0.011
10	0.006

Table of Standard concentration (ppm) and UV absorbance of Caffeine in Coca cola, Pepsi, Mirinda and Fanta Cocktail respectively.

Name of Soft Drink	Average Absorbance (benzoic Acid)	Average Absorbance (Caffeine)
Coca Cola	0.014	0.030
Pepsi Cola	0.022	0.029
Mirinda	0.028	0.053
Fanta Cocktail	0.027	0.056

Table of results obtained in the UV analysis of the soft drinks.

The average caffeine absorbance was 0.030, 0.029, 0.053 and 0.056 for Coca Cola, Pepsi Cola, Mirinda and Fanta cocktail respectively. These values give the evidence that only Coca Cola and Pepsi Cola contain caffeine because their caffeine absorbance was within the calibration curve for the caffeine standard.

The average benzoic acid absorbance was 0.014, 0.022, 0.028

and 0.027 for Coca Cola, Pepsi Cola, Mirinda and Fanta cocktail respectively. The benzoic acid absorbance for all the soft drinks listed above was within the calibration curve for the benzoic acid standard which indicates that they all contain benzoic acid.

4.0 CONCLUSION

In the investigation, Coca cola and Pepsi Cola were found to contain caffeine but the same cannot be said for Mirinda and Fanta cocktail. This was first shown by the confirmatory test for caffeine and secondly by comparing the average caffeine absorbance with the standard caffeine absorbance. All the soft drinks were found to contain benzoic acid.

RECOMMENDATION

From my investigation, some of the soft drinks contained caffeine and most contained benzoic acid. I recommend that further quantitative investigations and purity of compounds should be undertaken to ascertain the amounts of caffeine and benzoic acid available in soft drinks, so that further recommendation can be made on the tolerable amount which should be taken by humans.

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REFERENCES

[1] "Kola" Microsoft "R" Encarta R 2006 [CD]. Redmond,WA: Microsoft Corporation

[2] B .A, Weinderg, B .K Beaker "the world of caffeine" New York and London, Rowledge, P 201

[3] John Lambert and J.H Muir "Practical Chemistry" P236-237

[4] http: //en.wikipedia.org/wiki/