Caffeine Level from Coffee, Tea Leaves, Carbonated Drinks and Energy Drinks

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Abstract **Caffeine is natural substance found in more than 60 plants, the most common plants are coffee beans, tea leaves, there are also synthetic source of caffein like carbonated drink, energy drinks, and cacao pods caffeine can also be synthetic caffeine is added to foods, drinks, medicines. In this research, the concentration of caffeine in tea leaves, coffee beans, carbonated drink and energy drinks were assayed and also to see the benefit and the bad effect of caffeine on health. Five tea brands, five coffee types, carbonated drink and energy drinks were collected from the market, then each sample were tested for caffein level concentration of caffeine. Results show that the energy drinks have highest concentration of caffein among other sample in general, sequent with Beta tea brand and the Black frying seed coffee for tea brands Beta brand has highest concentration of caffeine among other tea brand and Black frying seed coffee has highest concentration of caffeine among other coffee types.**

Keywords: Caffeine, Energy Drinks, Caffeinism, Carbonated Drinks

I. INTRODUCTION

Caffeine (1,3,7-trimethylxanthine) is a naturally occurring alkaloid that can be found in coffee beans, tea leaves, cocoa beans, cola nuts, and other plants. It can be found in common beverages such as coffee, tea, and soft drinks products that contains cocoa or chocolate, and pharmaceuticals, such as pain relievers and over-the-counter stimulants [1]. Caffeine belongs to the purine family of chemicals, which means it contains a solid organic base with two rings, C5H4N4. Caffeine is swiftly and fully absorbed into the blood when consumed orally through the gastrointestinal tract. Individual variances in the time it takes to reach peak plasma levels in the blood stream can range from 15 to 120 minutes, with the majority of people attaining peak plasma levels in under an hour [2].

Structure and Physical and Chemical Properties Molar mass: 194.19 g/mol IUPAC ID: 1,3,7 Trimethylpurine-2,6-dione Melting point: 238 °C Boiling point: 178 °C Density: 1.23 g/cm³ Formula: C8H10N4O2

Caffein also make it extremely difficult to sleep and cause headaches, abnormal heart rhythms, and other problems. You could get withdrawal symptoms if you stop using caffeine. Caffeine has a higher sensitivity from one people than others [3]. Caffeine must be used in moderate. Women who are pregnant or nursing should abstention or reduce the amount of caffein that they consume. Caffeine may interact with some medications and supplements [4]. The aim of the study is to evaluate the amount of caffein in different products. Several studies have found that caffeine levels in coffee brews range from 2.4 to 4.5 mg/mL for Espresso (25 mL), 0.4 to 1.4 mg/mL for American or filtered (200 mL), 0.2 to 0.5 mg/mL for French or Plunger (100 mL), 0.7 to 5.4 mg/mL for Moka (30 mL), 1.6 mg/mL for Neapolitan (30 mL), and 1.94 mg/m [5]. Caffeine stimulates the brain, the heart, the muscles, and the blood pressure control centers [6]. Caffeine doses about 2-3 cups of coffee cause a slight increase in urine output in those who have not consumed caffeine in the previous days [7]. Caffeine has indeed been shown to improve lung function to the point where it must be adjusted for in diagnostic testing [8]. Caffeine use of 1000-1500 mg per day has been linked to a disorder called caffeinism [9].

II. MATERIALS AND METHODS

Different materials were collected randomly in this study for performing the extraction of caffeine from (Coffee, Tea, Energy Drink and Carbonated Drink).

Table 1: Demonstration of materials by its weight/volume.

Material	Weight/Volume
Tea bags	20 g
Coffee Powder	20 g
Sodium Carbonate	2 g
Carbonated Drink	250 ml
Energy Drink	250 ml
methylene chloride (or Chloroform)	25 mL

A. Methodology

This work was conducted in Chemistry Lab in Cihan University, the samples of tea and coffee (20 gm for each) were boiled in water bath for 15-20 minutes and were stirred continuously in the beaker, then the beaker that contained the samples were removed and cooled for 15 minutes in an ice bath. then 2 grams of sodium carbonate ($NaCO_3$) was added to the samples. Some of the chemicals in the extract solution will react with this, making them exceedingly water-soluble. The contents of the bowl were swirled until all of the sodium carbonate has dissolved. Then the samples were filtrated by using regular filter paper to remove any solid particles. The obtained solution was then transferred and was separated by using separation funnel. The methylene chloride was then settled to the bottom. The methylene chloride layer later on was carefully drained into a flask or beaker. The methylene chloride /caffeine solution was then filtered by using filter paper. This allowed the chloroform to filter through but will trap any water and residue. Anhydrous Sodium Sulfate was added in order to remove the last traces of water.

B. *Crystallization of Caffeine*

In order to crystalize water bath was used to boil the samples of methylene chloride over the water bath. The sample were evaporated down to about 20 mL and then removed from the heat. Dry watch glass was used and recorded the weight of the watch glass dry. The watch glass was placed over the boiling water bath and filled it with portion of the concentrated caffein solution and evaporate it. This process was repeated until all the concentrated solution was gone. The caffein was removed from the bottom of the watch glass and the pure caffein is white powder that precipitated on the bottom of the bottom of the watch glass

III. *RESULT AND DISCUSSION*

Table 2: concentration of caffeine in tea brands

Types of tea	Amount of tea (gr)	Amount of caffeine (gr)	Percentage of caffeine (%)
Sample 1	20	1.31	6.55
Sample 2	20	0.63	3.15
Sample 3	20	2.8	14
Sample 4	20	5.89	29.45
Sample 5	20	0.71	3.55

It was found that the caffeine concentration was in 5 tea brands, that Sample 4 highest concentration caffeine 5.89 g of 20 g tea sample but the lowest of one it is **sample 5** that has 0.63 g of 20 g tea sample.

Table 3: concentration of caffeine in coffee brands

Types of coffee	Amount of coffee (gr)	Amount of caffeine (gr)	Percentage of caffeine (%)
Coffee 1	20	3.69	18.45
Coffee 2	20	2.21	11.05
Frying black Seed	20	4.38	21.9
Not-frying Green seed	20	0.5	2.5
Coffee 3	20	2.53	12.65

According to the method that was been used, it was found that the caffeine concentration was in 5 coffee brands, that the Frying-Black seed coffee highest concentration caffeine has 4.38gr of 20gr tea sample but the Lowest of it is Not-Frying Green seed that has 0.5gr of 20gr tea sample.

Table 4: concentration of caffeine in Red bull and Coca-Cola

Types of Product	Amount of Product (ml)	Amount of caffeine (mg)	Percentage of caffeine (%)
Carbonated Drink	250	23	9.2
Energy Drink	250	80	32

The caffeine concentration was the highest for Energy Drink and Carbonated Drink, the Energy Drink had 80ml concentration of caffeine from 250ml but in the Carbonated Drink had 23ml of caffeine from 250ml of it.

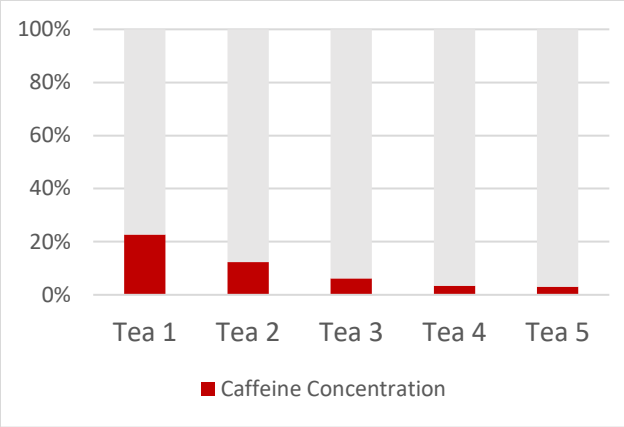

Figure 1: Concentration of Caffeine in Tea Brands

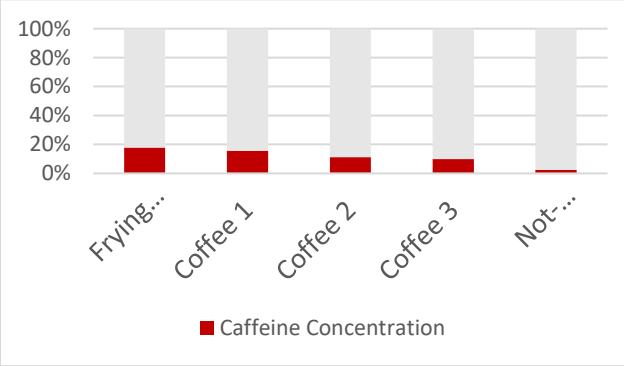

Figure 2: Concentration of Caffeine in different Coffee brands

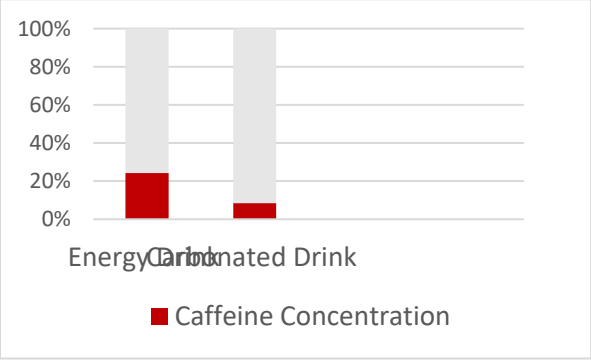

Figure 3: Concentration of Caffeine in Energy Drink and Carbonated Drink

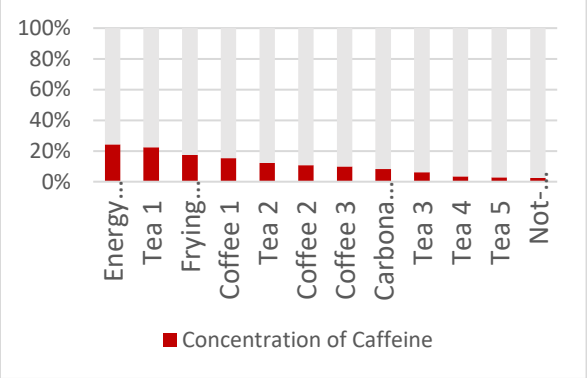

Figure 4: Concentration of Caffeine in Tea, Coffee, Energy Drink and Carbonated Drink

According to the results the highest level of caffeine was found in energy drinks, while
The lowest was found in tea. Where's Coffee brands showed intermediate amount of caffeine levels.

Estimated daily caffeine consumption ranged from 10 to 32 mg/kg, based on a rough estimate of 85 mg per cup of coffee [10]. The 99th percentile of adults in the United States consume this amount of caffeine [11].

If we consider the US Food and Drug Administration's classification of caffeine consumption, these amounts might be deemed minimal and safe. Caffeine intake of 130-300 mg/day is considered low/moderate, 400 mg/day is considered high, and 6,000 mg/day is considered heavy [11].

So according to the results that conducted, consuming 3 tea bags of T5 brand which has the lowest amount of caffeine it means consuming 150mg of caffeine, so according to the FDA [12] while T1 brand has the highest amount of caffeine among the other tea brands means 3 tea bags of it consuming 470mg of caffeine.

So according to the results that had obtained, consuming 3 cups coffee of Not-Frying Green Seed which has the lowest amount of caffeine it means consuming 300mg of caffeine, so according to the FDA while Frying Black Seed brand has the highest amount of caffeine among the samples of coffee.

As for Carbonated Drinks and Energy drinks it showed the highest among of caffeine which can lead to caffeinism because of the high amount of caffeine in it [13].

~~III.~~IV. DISCUSSION

High levels of caffeine consumption can lead to nervousness, and jitteriness. Caffeine increases the amount of acid that is released in the stomach that could lead to an upset stomach or heartburn. Caffeine consumption is categorized by the US Food and Drug Administration. Caffeine intake of 130-300 mg/day is considered low/moderate, 400 mg/day is considered high, and 6,000 mg/day is considered excessive. Consumption abundance of energy drinks that contain high levels of Caffeine can lead to many health problems such as, vomiting, palpitation, high blood pressure and in severe cases it could lead to death [12].

A study done by Ashraf et al., 2018 found that smokers were significantly more likely to drink caffeinated coffee, and that there was a dose-response relationship between coffee caffeine and smoking intake [14]. In a case-control study in France, tea consumption was found to be a critical factor for Parkinson's disease (PD) [11].

In contrast, cohort research in Dutse: Jigawa State found an inverse relationship between black tea consumption and the incidence of Parkinson's disease, but this link was independent of caffeine consumption; other components of black tea were responsible for this protective effect. Green tea, on the other hand, had no effect [15]. The majority of human studies conducted in last decade have shown moderate (400 mg/d) caffeine consumption has no substantial health effects for the majority of consumers [16].

Caffeine intake from tea is lower than that from coffee brew (198.2 to 435.8 mg) and guarana powder (198.2 to 435.8 mg) (551 mg) According to [17] tea can be a significant source of caffeine for strong tea drinkers, accounting for up to 48 percent of daily intake without causing harmful effects (400 mg day-1).

CONCLUSION

The aim of this study to evaluate the amount of caffein in the most purchased caffein drinks in the conventional markets, energy drinks have the highest amount of caffein and according to classification of caffeine consumption by the US Food and Drug Administration. Caffeine intake of 130-300 mg/day is considered low/moderate, 400 mg/day is considered high, and 6,000 mg/day is considered heavy. If consumed in large amounts, caffeinism can develop, resulting in health problems. So consuming high amount of energy drink can lead to caffeinism since it contains high amount of caffein. Consumption high amount of energy drinks can lead to caffeinism.

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