



## Extraction, Estimation and Study of Caffeine from different Tea Samples

**Ankita Priya\*, Puja Kumari\*, Madhu Rani Sinha\*\***

\*B.Sc. (2008-2011), Department of Chemistry, Patna Women's College, Patna University

\*\*Head, Department of Chemistry, Patna Women's College, Patna University

*The active ingredient that makes tea and coffee valuable to humans is Caffeine which is an alkaloid. Caffeine is found in sixty plant species. It belongs to family of naturally occurring compounds known as xanthenes. In humans, caffeine acts to stimulate the heart, nervous system and the respiratory system. Blood pressure is increased by its use, since heart rate is increased. It is diuretic and has the effect of delaying fatigue. It has bitter taste but no smell. High caffeine consumption in pregnant women leads to the malformation of their children. The various tea samples used for the experiment were gathered from different areas of Patna. The aim behind the experiment was to carry out extraction of an aqueous solution of tea with an organic solvent, and to isolate caffeine from different tea samples. This was a simple-seeming experiment, which in fact made use of a number of rather advanced chemical processes. To isolate it from tea samples caffeine was chemically separated from the rest of the tea solution, by the process is known as extraction. It is a chemical method of separating a specific component of a solution from rest of the solution. This was done by using dichloromethane in which caffeine is very soluble, while the rest of the tea solutions were not as soluble. The Procedure included weighing of six different varieties of tea samples for approximately 30 g which was further transferred into six different 500ml beakers. 250ml of distilled water was added with the help of a measuring cylinder and then 5g of sodium carbonate was added to each flask. The mixture was then stirred with a glass rod. The contents of the beaker were boiled on a hot water bath for approximately 10 minutes and then cooled to room temperature using ice water-bath. The cooled solutions were filtered using glass wool. The filtrates so formed were transferred into separating funnel and were extracted for four times using (4\*10ml) dichloromethane. After each extraction, the lower organic layers were then transferred into 250 ml beakers. The filtrates were then evaporated to dryness on water bath. The residue obtained was caffeine which was slight green in colour. For the calculation of percentage of caffeine in each tea sample the weight of caffeine with the watch glass was noted and then after transferring caffeine to another beaker, the weight of empty dry watch glasses were also noted. From the above process we were able to calculate the weight of caffeine in each tea samples and further we calculated the percentage of caffeine in the respective tea samples. It was found that Tata Tea Gold contains the maximum while the loose gol dana sample contains the minimum percentage of caffeine.*

**Key words :-** Caffeine and tea.

**Introduction :**As long ago as 2737 B.C. ,Chinese Emperor Shen Nung was boiling drinking water when the leaves of a nearby bush fell into the pot, creating a wonderful smelling drink and the first pot of tea. The relief from fatigue that tea provides is a big reason for its popularity. This is due to caffeine and caffeine has been a matter of controversy. It is a stimulant that has been shown to speed reaction time, increase alertness and improve concentration. The physical effect include

stimulation of digestive juice, the kidneys, and the metabolism in ways that possibly help eliminate toxin. An increase of mental alertness, shortening of reaction time, and improving efficiency of muscle action is brought about by caffeine stimulation of heart, and respiratory system, bringing more oxygen to the brain. Caffeine tolerance varies greatly among individuals, and an excess of it is toxic. Some research has shown a possibility that caffeine can interfere with foetal

development, including lowering birth weight and contributing to skeleton and other abnormalities. Until they reach the age of seven or eight months, babies cannot get rid of caffeine metabolites, and traces of caffeine can appear in breast milk too. Due to these concerns, pregnant and nursing mothers should limit or avoid any beverage with caffeine including tea. For most people, moderate doses of caffeine 200 to 300 milligrams (mg), or about two to four cups of brewed coffee a day is not harmful. But some circumstances may warrant limiting or even ending our caffeine routine. Though moderate caffeine intake isn't likely to cause harm, too much can noticeably affect our health. Heavy daily caffeine use more than 500 to 600 mg a day, or about four to seven cups of coffee can cause:

- Insomnia
- Nervousness
- Restlessness
- Irritability
- Nausea or other gastrointestinal problems
- Fast or irregular heartbeat
- Muscle tremors
- Headaches
- Anxiety

**Objective :**

The objective of the experiment was to carry out an extraction of an aqueous solution of tea with an organic solvent and to estimate the percentage of caffeine in each tea sample.

**Theory :**

The isolation of caffeine from tea is a simple – seeming experiment, which makes use of a number of advanced chemical processes. To isolate caffeine in a tea sample it is necessary to chemically separate it, using an organic solvent. The technique used to separate an organic compound from a mixture of compounds is called extraction. Here the organic solvent used is dichloromethane as caffeine is soluble in it. Six principle varieties were used for the experiment as – Tata Tea Gold, Red Label, Lipton, Green Label, loose tea leaf, and loose gol dana samples.

**Procedure :**

30 g of each tea sample was weighted and transferred into a 500 ml beaker. 250 ml of distilled

water was added using measuring cylinder, further 5 g of sodium carbonate was weighted and added to the beaker. The contents of the beaker were stirred with a glass rods. The content of the beakers were boiled on a water bath for approximately 10 minutes and then the tea solutions were cooled to room temperature using ice –water baths. The cooled solutions were filtered using glass wool, then the filtrates were extracted for four times using (4\*10 ml) dichloromethane in the separating funnel. After each extraction the organic layers were removed in the 250 ml beakers. Anhydrous sodium sulphate was added to the combined extracts and then filtered to remove solid sodium sulphate and then the dry solutions were transferred into six different pre-weighted, marked watch glasses. Then they were evaporated to dryness on water baths. The residue obtained was crude caffeine which was slight green in colour.

**Calculation :**

Estimation of weight of caffeine in different samples involves the formula –

$$\frac{\text{wt. of watch glass with caffeine} - \text{wt. of dry watch glass}}{\text{wt. of dry watch glass}} \times 100$$

Percentage calculation involves the formula –

$$\frac{\text{wt. of caffeine}}{\text{wt. of sample}} \times 100$$

Calculation of weight and percentage for tata tea gold sample is as follows:-

$$\begin{aligned} \text{Quantity of caffeine present} &= 56.005 - 54.980 \\ &= 1.025 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{Percentage of caffeine found} &= \frac{1.025}{30} \times 100 \\ &= 3.41\% \end{aligned}$$

**Observation :**

Through the formula illustrated the quantity and percentage of caffeine in the rest samples were calculated and it was found that -

|                |   |               |
|----------------|---|---------------|
| Lipton         | = | 0.125g, 0.41% |
| Red label      | = | 0.276g, 0.92% |
| Green label    | = | 0.070g, 0.23% |
| Loose tea leaf | = | 0.020g, 0.06% |
| Loose gol dana | = | 0.005g, 0.01% |

## Conclusion :

In consideration of the numerous sources of error, this experiment has been a success. Pure, or mostly pure, caffeine crystals have been isolated from a cup of tea and weighted. This value was similar to the accepted caffeine contents of tea, thus the results supported the original hypothesis. The comparative result obtained is as follows :-

| S. No. | Tea Type       | Wt. of Tea | Wt. of Caffeine | % of Caffeine |
|--------|----------------|------------|-----------------|---------------|
| 1      | TATA TEA GOLD  | 30 g       | 1.025 g         | 3.41%         |
| 2      | LIPTON         | 30 g       | 0.125 g         | 0.41%         |
| 3      | RED LABEL      | 30 g       | 0.276 g         | 0.92%         |
| 4      | GREEN LABEL    | 30 g       | 0.070 g         | 0.23%         |
| 5      | LOOSE TEA LEAF | 30 g       | 0.020 g         | 0.06%         |
| 6      | LOOSE GOL DANA | 30 g       | 0.005 g         | 0.01%         |

From the above given table we came to a conclusion that Tata tea gold contains the maximum percentage of caffeine, while the loose gol dana sample consists of the minimum percentage of caffeine. So people must prefer to use the loose gol dana sample for preparation of drinks as we already know that consumption of caffeine in moderate quantities does not effect the human health but when taken in large quantity may adversely affect .

## Discussion :

Some people are more sensitive to caffeine than are others. If you're susceptible to the effects of caffeine, just small amounts even one cup of coffee or tea may

prompt unwanted effects, such as anxiety, restlessness, irritability and sleep problems. How you react to caffeine may be determined in part by how much caffeine you're used to drinking. So, people who don't regularly consume caffeine tend to be more sensitive to its negative effects. Other factors may include body mass, age, smoking habits, drug or hormone use, stress and health conditions such as anxiety disorders. Sex may even play a role: Research suggests that men are more susceptible to caffeine than are women. Caffeine is probably the most frequently ingested pharmacologically active substance in the world.

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