Comparative Study On Extraction Of Caffeine From Three Different Roasted Tea And Green Tea And Determination Of Optimum Consumption Of Tea Per Day For An Adult.

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Abstract - **Caffeine is a bitter, white crystalline xanthine alkaloid and a stimulant drug. It is found in varying quantities in the seeds, leaves, and fruit of some plants. Generally tea is made from the leaves of an Asian evergreen known as Camellia sinensis. Caffeine is a prime constituent of tea. The presence of caffeine in plants helps to prevent them from insects and other herbivores with the compound's bitter taste and stimulating qualities. The growing buds and young leaves of tea plants manufacture the highest amounts of caffeine.Caffeine is the only legalized central nervous system stimulant to be used among humans. This experiment was conducted to estimate the total amount of caffeine in used tea leaves of roasted tea and green tea. 5g of roasted tea from three different sources Darjeeling, Assam and Nilgiri obtained caffeine 0.1g, 0.058g and 0.060g respectively. 5g of green tea from three different sources Darjeeling, Assam and Nilgiri obtained caffeine 0.040g, 0.037g and 0.021g respectively. The objective of this experiment was to extract caffeine from roasted tea and green tea and to check the quantity of different variety of roasted and green tea safe for human consumption.**

Keywords: caffeine, roasted tea, green tea, human consumption.

I. INTRODUCTION

Caffeine is a naturally occurring chemical stimulant found in the leaves, seeds and fruits of a numerous plant species of a group of compounds called trimethylxanthine. Chemical formula of caffeine is $C_8H_{10}N_4O_2$. In its pure form, caffeine is a white crystalline powder that tastes very bitter. It is medically useful to stimulate the heart and also serves as increasing the rate of urine excretion. Caffeine is one of the most studied ingredients in the food supply. The most common sources of caffeine are coffee, tea, cocoa beans and guarana. The amount of caffeine in food and beverage products varies depending on the serving size, the type of product and preparation method. Tea is an aromatic beverage commonly prepared by pouring hot or boiling water over cured leaves of the Camellia sinensis, an evergreen shrub native to Asia.After water, it is the most widely consumed drink in the world. There are many different types of tea; some teas, like Darjeeling and Chinese greens, have a cooling, slightly bitter, and astringent flavour,while others have vastly different profiles that include sweet, nutty, floral or grassy notes. Different types of tea (black tea, green tea, white tea, red tea) come from this plant contain caffeine. The caffeine content of tea leaves depends on the variety and the place where they were grown; most tea has 3-5% by weight. Caffeine and other purine alkaloids, including theobromine and theophylline, have played a major role in the long-standing popularity of non-alcoholic beverages and foods such as coffee, tea, cocoa, mate, chocolate and a wide range of soft drinks (Asahihara 2008). The growing buds and young leaves of tea plants manufacture the highest amounts of caffeine. Caffeine can be isolated from teas with liquid-liquid extraction. The quantity of caffeine is increased with temperature raised. (Shane-Rong Sheu *et al*., 2009). Caffeine toxicity in adults can present a spectrum of clinical symptoms, ranging from nervousness, irritability and insomnia to sensory disturbances, diuresis, arrhythmia, tachycardia, elevated respiration and gastrointestinal disturbances. Caffeine toxicity in children is manifested by severe emesis, tachycardia, central nervous system agitation and diuresis. Chronic exposure to caffeine has been implicated in a range of dysfunctions involving the gastrointestinal system, liver, renal system and musculature (Stavric 1988, James 1991b). During the past 20 years, a great deal of evidence has accumulated concerning the effects of caffeine consumption on reproduction and pre-and postnatal development.

The present study was carried out to study the extract and estimate the amount of caffeine present in roasted and green tea of Assam, Nilgiri and Darjeeling variety collected from local market of Kolkata, West Bengal using dichloromethane as solvent and to check the amount of tea safe for human consumption.

II. MATERIALS AND METHODS

Tea samples namely, roasted tea and green tea of Assam, Nilgiri and Darjeeling variety were obtained from different local markets of Kolkata. Tea was prepared using the standard procedure namely; addition of tea leaves after the water comes to boiling and leaving it to stand for 5 minutes before filtering.

II.A. Extraction of Caffeine:

5g of tea is taken and boiled in 100 ml of distilled water for 5 minutes. The resultant liquid is decanted and named Filtrate 1. The remaining residue is boiled in 100 ml distilled water for another 5 minutes. The liquid is decanted into Filtrate 1. To the Filtrate 1, 2g of sodium carbonateis added.After 10 minutes, it is placed in an ice bath to cool. The filtrate is then poured into a separating funnel and 20ml dichloromethaneis added to it. The two layers are separated using the separating funnel. The lower layer is collected into a conical flask. The previous three steps are repeated twice. About 1 teaspoon of Calcium Chloride is added to the conical flask. The contents are mixed well and left for 10 minutes. The dichloromethaneis decanted into a beaker. The dichloromethane was evaporated by placing the beaker on a water bath leaving behind a yellowish-white caffeine powder. On subtracting the weight of empty beaker from the weight of beaker containing caffeine, the amount of caffeine extracted was found. The weight of caffeine powder was considered as the final weight. The entire procedure was repeated for all the different samples used in the experiment.

III. RESULT

The total amount of caffeine present in the three samples of roasted tea is shown in Table 1. The caffeine content is maximum in roasted Darjeeling tea that is 0.1 g caffeine present in 5 g tea whereas the quantity of caffeine is minimum in roasted Assam tea that is 0.058g caffeine present per 5g tea. The total amount of caffeine present in the three samples of green tea is shown in Table 2. Darjeeling green tea contains maximum caffeine that is 0.040g caffeine in 5g tea whereas the caffeine content of Nilgiri green tea is minimum that is 0.021g per 5g tea.

Table 1. Caffeine Obtained From Different Roasted Tea Samples.

Serial No.	Name of Tea (Roasted)	Weight of Empty Beaker (g)	Weight of Beaker containing Caffeine (g)	Obtained Caffeine Content (g)
1.	*Darjeeling*	*98.340*	*98.440*	*0.100*
2.	*Assam*	*101.700*	*101.758*	*0.058*
3.	*Nilgiri*	*104.26*	*104.32*	*0.060*

Table 2. Caffeine Obtained From Different Green Tea Samples.

Serial No.	Name of Tea (Green)	Weight of Empty Beaker (g)	Weight of Beaker containing Caffeine (g)	Obtained Caffeine Content (g)
1.	*Darjeeling*	*94.940*	*94.480*	*0.040*
2.	*Assam*	*96.280*	*96.317*	*0.037*
3.	*Nilgiri*	*99.580*	*99.601*	*0.021*

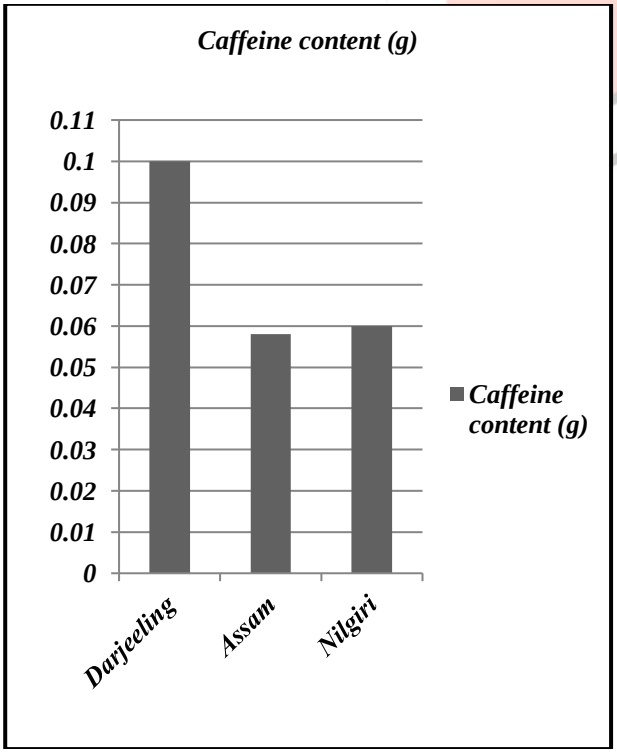

Figure 1. Graphical Representation Of Caffeine Content In Different Roasted Tea Samples

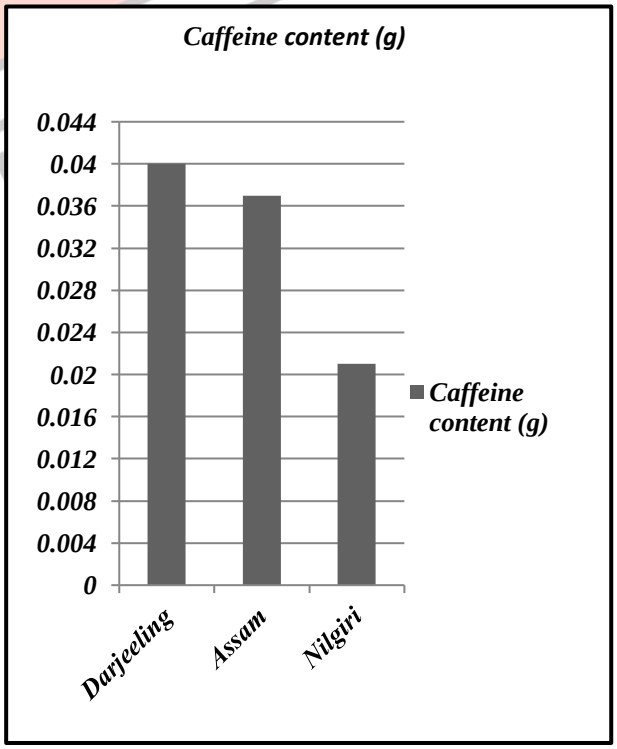

Figure 2. Graphical Representation Of Caffeine Content In Green Tea Samples

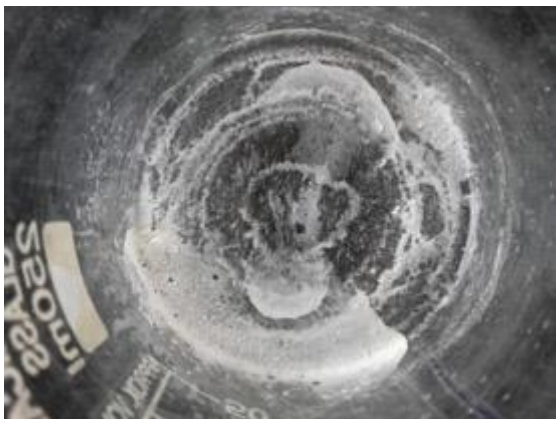

Figure 3.Caffeine Extracted From Roasted Assam Tea.

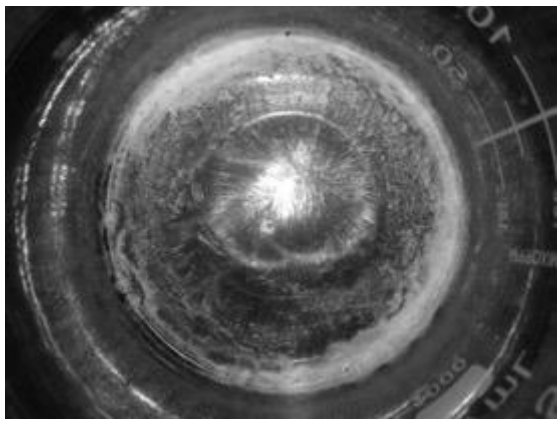

Figure 4.Caffeine Extracted From Roasted Nilgiri Tea.

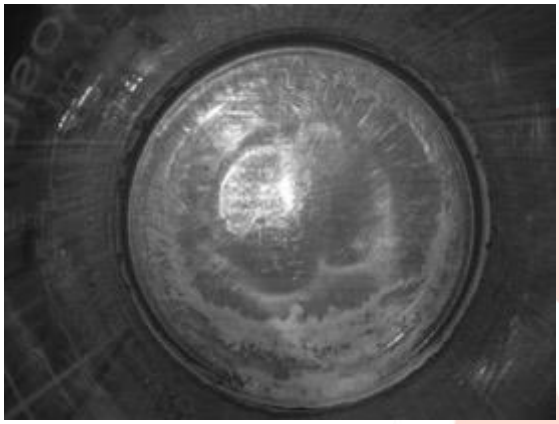

Figure 5.Caffeine Extracted From Roasted Darjeeling Tea.

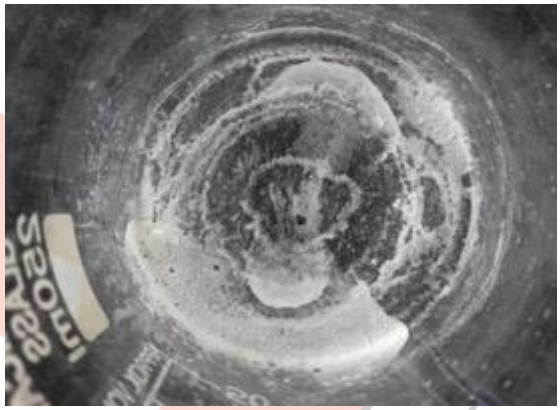

Figure 6.Caffeine Extracted From Green Assam Tea.

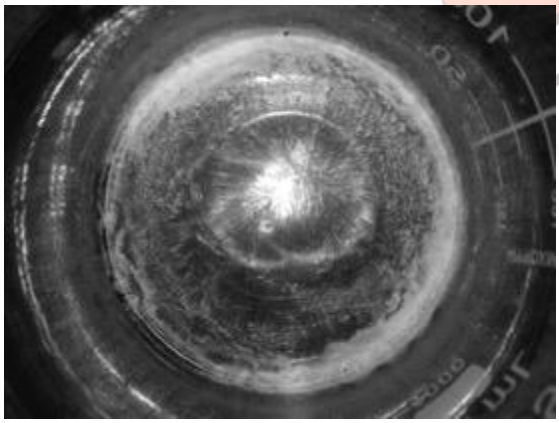

Figure 7. Caffeine Extracted From Green Nilgiri Tea.

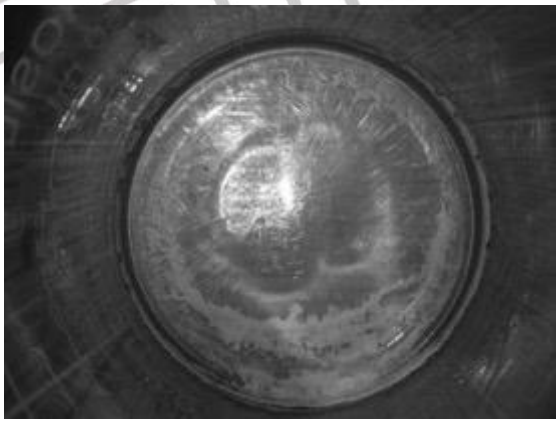

Figure 8. Caffeine Extracted From Green Darjeeling Tea.

IV. DISCUSSION

Caffeine is widely consumed at different levels by most segments of the population. Both the public and the scientific community have expressed concern about the potential for caffeine to produce adverse effects on human health. The possibility that caffeine ingestion adversely affects human health was investigated based on reviews of published (primarily) human studies obtained through a comprehensive literature search. Caffeine is rapidly and essentially completely absorbed from the gastrointestinal tract into the bloodstream. Maximum caffeine concentrations in blood are reached within 1–1.5 h following ingestion. Absorbed caffeine is readily distributed throughout the entire body. It passes across the blood–brain barrier, through the placenta into amniotic fluid and the foetus, and into breast milk. Caffeine toxicity in children is manifested

by severe emesis, tachycardia, central nervous system agitation and diuresis. The amount of caffeinealso varies depending on the variety of tea, brand of tea and is also directly attributed to the processing and leafmaturity (Komes *et al*., 2009**)**. It has been suggested that the change of caffeine content in tea leaves during the pile-fermentation depended not only on the growth and reproduction of microorganisms, but also on the tea composition (Wang *et al*., 2005, Wang *et.al*., 2008). Green tea contained less caffeine content when compared to black tea and hence is good for health **(**Kranthi Kumar and Kiran Kumar, 2014).

The following potential adverse effects of caffeine on human health were investigated: general toxicity, cardiovascular effects, effects on calcium balance and bone status, behavioural effects in adults and children, carcinogenic potential, genotoxic potential, and reproductive effects, including pre-and postnatal development. Chronic exposure to caffeine has been implicated in a range of dysfunctions involving the gastrointestinal system, liver, renal system and musculature (Stavric 1988, James 1991b). Caffeine toxicity in children is manifested by severe emesis, tachycardia, central nervous system agitation and diuresis. For women with preexisting bladder symptoms, even moderate caffeine intake (200–400 mg day1) may result in an increased risk for detrusor instability (Arya et al. 2000). Excessive caffeine intake (>400 mg day1) may increase the risk of detrusor instability (unstable bladder) development in women. Some negative associations between caffeine intake and bone density have been observed; these associations disappeared when confounders such as calcium intake were adjusted for in some studies (Cooper et al. 1992, Johansson et al. 1992). However, a single caffeine dose of 100 mg was shown to affect short-term memory adversely in one study (Terry and Phifer 1986). Larger amounts of caffeine (200, 400 or 600 mg as a single dose) have been associated not only with slight increases on an anger/hostility scale, but also with reduced ratings for drowsiness and incoordination (Roache and Griffiths 1987). Caffeine consumption has been associated with alteration of hormone levels (e.g. oestradiol), with tubal disease or endometriosis, with altered tubal transport time, and with reduced viability of the fertilized ovum (Alderete et al. 1995). Data from in vitro studies suggest that caffeine has variable, dose-related effects on human sperm motility, number and structure (Dlugosz and Bracken 1992). The majority of papers that showed an increased risk of spontaneous abortion with caffeine consumption showed associations at levels of 5300mg caffeine day/1. As smoking is closely associated with caffeine consumption, it is important to stress that caffeine and smoking impose similar adverse physiological effects on foetal development (Fortier et al. 1993). Olsen et al. (1991), in a study of 11 858 pregnant women in Denmark, found that maternal coffee consumption of four or more cups per day (400mg caffeine day/1) was associated with a moderate decrease in birth weight.

V. CONCLUSION

In the recent investigation with different tea leaves, highest amount of caffeine obtained from Darjeeling roasted tea (in 5g tea leaves caffeine found 0.1g) and lowest amount of caffeine obtained from Nilgiri green tea (in 5g tea leaves caffeine found 0.021g). Up to 400 milligrams (mg) of caffeine a day appears to be safe for most healthy adults. For preparing one cup of roasted Darjeeling tea (200ml) normally 2.5g tea leaves is needed whereas for preparing one cup roasted Assam or Nilgiri tea (200ml) 3g tea leaves is needed. For preparing one cup Darjeeling or Nilgiri green tea (200ml) requires 2.5g tea leaves and for preparing one cup Assam green tea (200ml) 5g tea leaves is needed. From the obtained data, and from experiments conducted, therefore, it could be suggested that adults should restrict themselves to a maximum of 8 cups of roasted Darjeeling tea or 10 cups of roasted Assam or Nilgiri tea per day. Whereas, maximum consumption of Darjeeling as well as Assam green tea should restrict to 20 cups per day and for Nilgiri green tea it should be 35 cups per day.

So, from the above mentioned result it can be easily concluded that a common tea lover who consumes maximum 6 to 8 cups of roasted tea per day is in a safe zone. Now a day, health conscious people who consume 8 to 10 cups of green tea per day, they are also in safe zone.

VI. REFERENCES

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