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Estimation of REEs in Some Selected Green /Organic/ Herbal Tea Available in Indian Market

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Abstract: Tea is one of the most consuming and cheap beverages after water all over the world. Tea is a potent stimulant of gastric acid excessive intake cause more acidity in stomach. Most of the population of India is switching from black tea to other herbal products that are marketed in India with name of Green /Organic/ Herbal tea. Studies in the past have shown that Oxides, Nitride and Chloride forms of Rare Earth Elements have adverse effect on human health. Aim of our study is to determine qualitatively as well as quantitatively REEs that present in the Green /Organic/ Herbal tea. To provide an overview of exposure to REEs people are getting by consuming such type of tea. For present work eleven Green /Organic/ Herbal tea samples were procured from local store brew was made and analysis was done on Perkin Elmer NexIon-300x Inductively Coupled Plasma Mass Spectrometer (ICP-MS). Ce was the most abundant element its concentration varied from highest 964.764 µg/L to lowest 73 ng/L. second most abundant elements were Nd, La and Y for some samples. Concentrations of Gd and Dy were found almost similar same was true for Tm and Lu. Lu was found to be least abundant highest 9.336 µg/L and lowest 1 ng/L. Results were observed different from the Black tea in which Ce was found most abundant and La was second most abundant.

Keywords: Rare Earth Elements; ICPMS; Herbal tea; Green tea; Organic tea.

I. INTRODUCTION

Tea is one of the most consuming and cheap beverages after water all over the world [1, 2]. It has huge demand and keeps on increasing as the world population is increasing. It is widely accepted that it has several health benefits [1]. Since, tea contains caffeine so the person who drinks tea hot or iced observes refreshing and relaxing effect immediately. That may be the reason that makes it most consuming non-alcoholic beverage. Traditionally, in India tea is served as welcome drink on the arrival of the guests and also it is an essential part of the diet of Indian population. Recent studies have shown that excessive intake of tea due to its high flavonoid contents may cause inhibition of some enzymes involved in hormone metabolism [3]. High and regular caffeine intake makes person addicted of it causes craving for tea this induces restlessness and anxiety, withdrawal is also find difficult. Tea is a potent stimulant of gastric acid excessive intake cause more acidity in stomach [4]. Probably due to these main reasons most of the population of India is switching from black tea to other herbal products that are marketed in India with name of Green /Organic/ Herbal tea. They can be prepared in the same manner the black tea/ Chai (Boiling half tea spoon of leaves in one cup of water two or three times rigorously adding refined sugar according to taste) is prepared. Companies are marketing their products with the name and ingredient of popular ayurvedic herbs that are traditionally known as beneficial to health they are doing so to make profit and to increase their sales. Numerous studies in the past have shown that Oxides, Nitride and Chloride forms of Rare Earth Elements have adverse effect on human health [5-7]. Inflammation endpoints, oxidative stress, and damage to lungs liver and kidney have been reported [8-9]. Aim of our study is to determine qualitatively as well as quantitatively REEs the present in the Green /Organic/ Herbal tea. To provide an overview of exposure to REEs people are getting by consuming such type of tea. For present work eleven tea samples were procured from local store brew was made and analysis was done on Perkin Elmer NexIon-300x Inductively Coupled Plasma Mass Spectrometer (ICP-MS).

II. EXPERIMENTAL

A. Materials

Total eleven types of Green /Organic/ Herbal tea of different companies and different brands were procured from a local market store. Out of total eleven types of tea seven teas were certified green tea; one was containing green tea along with lemon and ginger; second was containing green tea along with honey and lime; third was containing green tea and jasmine; fourth was containing green tea along with tulsi (holi Basil) and ginger. Procured teas were in different packages of different weight ranging 100 gm. and 250 gm.

All glassware and plasticware were soaked in 2% HNO_3 solution for 24 h and boiled for 1 h and washed with 2% HNO_3 solution prior to experiment.

B. Sample Preparation

Samples were prepared by traditional Indian method of tea making that is boiling rigorously 2, 3 times the half tea spoon of tea leaves in one cup of water so that the prepared brew remain same as the real brew that Indian population consumes this will give a chance to assess the actual amount of REEs reach in body of consumer. Tea packets were opened just before making the tea brew. Tea brew were prepared by boiling rigorously 500 mg of tea leaves from each packet in 50 ml of 5% HNO_3 solution, taken in platinum coated stain less steel vessel for five minutes on induction cooking plate operating at 1000W power, the solution reduced to 15 ml (approx). HNO_3 used was of LOBACHEMIE, Mumbai, India, Nitric Acid AR and water was distilled deionized Millipore water (18.2 M Ω). The reduced solution is then allowed to cool at room temperature and directly filtered into 15 ml centrifuge tubes made up of high density polyethylene (HDPE) with the help of funnels of same HDPE material and filter paper (Watman No. 42). Solution is then diluted in 2% HNO_3 in the ratio of 10:1 and analyzed in Perkin Elmer NexIon-300x Inductively Coupled Plasma Mass Spectrometer (ICP-MS).

II. INSTRUMENT AND METHOD

Instrument used was Perkin Elmer NexIon-300x Inductively Coupled Plasma Mass Spectrometer (ICP-MS). The Instrument operating conditions were as follows:

RF Power/ W	1500 W
Plasma gas flow	18 L/min
Auxiliary gas flow	1.2 L/min
Integral Time	15 s
Sweeps	20
Reading	1
Replicates	3
Scanning Mode	Peak hopping
Method	TotalQuant
Calibration Type	External
Measurement Time per sample	15 min (approx.)

All the tea samples were diluted in 2 % HNO_3 solution made by ultrapure Millipore water. 1 ml of each sample is mixed in 10 ml of 2% HNO_3 . Instrument was calibrated using certified external standard PerkinElmer Pure 200 $\mu\text{g/L}$ mix of 13 elements in 2% HNO_3 . Three replicates of measurement were done for each sample and average of readings is presented in results.

Semiquantitative method (TotalQuant) of analysis is chosen because it is easy, rapid and accurate. Its accuracy has been reported as it has relative percentage error within 10% and reproducibility (relative standard deviation lower than 5%) at concentrations equal to or greater than 10 times the detection limit (DL) [10].

III. RESULTS AND DISCUSSION

Results of measurement are represented in Table 1. Sample names are coded to avoid the conflicts Measurements have shown that; the samples S1 and S2 were most soluble during sample preparation color of the obtained brew was the darker; all the samples have shown the presence of all measured RREs except sample S1 and S2 the Tb was not detected in them ; Ce was the most abundant element its concentration varied from highest 964.764 $\mu\text{g/L}$ in sample S1 to lowest 73 ng/L in sample S7; second most abundant element was Nd in samples S1,S2,S4,S5,S8 and S10 with concentration 543.396 $\mu\text{g/L}$, 148.411 $\mu\text{g/L}$, 155 ng/L, 167 ng/L, 166 ng/L and 138 ng/L respectively; second most abundant element was La in samples S6,S9 and S11 with concentration 139 ng/L, 220 ng/L and 347 ng/L respectively; second most abundant element was Y in only two samples S3 and S7 with concentration 71 ng/L and 54 ng/L respectively; for all samples the concentrations of Gd and Dy were found almost similar; similarly for Tm and Lu concentration were found almost similar; Lu was found to be least abundant highest 9.336 $\mu\text{g/L}$ in sample S1 and lowest 1 ng/L in sample S7 .Results were observed different from the Black tea in which Ce was found most abundant and La was second most

abundant [11]. But for Lu results were found true. Four samples S5, S6, S9 and S11 were of same company but different brand names and ingredients showed similarities in abundant elements.

There can be many sources of accumulation of REEs in samples such as soil in which they cultivated, processing technology employed, packaging and handling of products and environment pollution [12-14].

The difference in the solubility of samples arises due to the compounds they contain and their degree of binding force. Previous studies have shown that the analyte elements may be highly extractable, moderately extractable and poorly extractable element [15].

IV. CONCLUSION

From our study it has been found that the all the Green /Organic/ Herbal tea samples were containing various REEs in trace amount. Fortunately their concentration found with current brewing method is very low. Green tea is a rich source of different beneficial organic constituents as well as inorganic elements, REEs are one of them. REEs found have their different role in biological system role of each element needs to be evaluated so that the maximum allowable and safe daily intake of each of the element can be determined.

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Element	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
				168	127	98	54	122	134	97	201
Y	189 ng/L	49 ng/L	71 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
				134	164	139	48	142	22	119	347
La	307 ng/L	74 ng/L	58 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
	964.764	151.278	101	277	303	232	73	285	407	243	628
Ce	μg/L	μg/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
	147.321			40		32	12	40	52	35	83
Pr	μg/L	59.72 μg/L	14 ng/L	ng/L	42 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
	543.396	148.411		155	167	122	44	166	211	138	323
Nd	μg/L	μg/L	54 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
	92.314			32		25	7	31	54	32	70
Sm	μg/L	27.683 μg/L	10 ng/L	ng/L	40 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Eu	34.735	7.756 μg/L	6 ng/L	11	11 ng/L	9 ng/L	5	12	13	12	20

	μg/L			ng/L			ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
	121.464			49	34	13	46	55	39	91		
Gd	μg/L	27.902 μg/L	14 ng/L	ng/L	50 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
						2				15		
Tb	N.D.	N.D.	3 ng/L	9 ng/L	9 ng/L	6 ng/L	ng/L	8 ng/L	8 ng/L	6 ng/L	ng/L	ng/L
	122.419			58	34	14	47	52	37			
Dy	μg/L	29.677 μg/L	18 ng/L	ng/L	49 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	9 ng/L	ng/L
				12		3		10		17		
Ho	26.7 μg/L	6.605 μg/L	4 ng/L	ng/L	10 ng/L	6 ng/L	ng/L	9 ng/L	ng/L	8 ng/L	ng/L	ng/L
				34		8	25	25	19	41		
Er	69.87 μg/L	13.331 μg/L	11 ng/L	ng/L	24 ng/L	8 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
	10.062					1						
Tm	μg/L	3.757 μg/L	2 ng/L	5 ng/L	4 ng/L	2 ng/L	ng/L	3 ng/L	4 ng/L	3 ng/L	5 ng/L	5 ng/L
	62.335			27		13	7	19	23	16	34	
Yb	μg/L	26.437 μg/L	10 ng/L	ng/L	21 ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
						1						
Lu	9.336 μg/L	1.852 μg/L	2 ng/L	5 ng/L	3 ng/L	2 ng/L	ng/L	3 ng/L	3 ng/L	3 ng/L	5 ng/L	5 ng/L

Table 1: Concentration of elements in samples.



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45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



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