RISING - A Journal of Researchers
Vol.1 Issue 2 (July 2017)
RISING A journal of researchers
ISSN No: 2456-7752

ESTIMATION OF ARSENIC AND NICKEL IN TEA SAMPLES FROM GUJARAT BY ATOMIC ABSORPTION SPECTROSCOPY

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ABSTRACT

In the whole world, Tea is the second most consumed beverage. It is an estimate that people consume 18-20 billion cups daily and an estimated average consumption of 1 Liter/person/day in the UK. Tea plays a very important role in improving beneficial intestinal digestion, as well as providing immunity against intestinal disorders and in protecting cell membranes from oxidative damage. It is considered to be as a best antioxidant source. The food which contains heavy metals is harmful to human health and various countries have imposed food laws to restrict the presence of heavy metals in food and beverages.

The main sources of heavy metals in different plants are their growth media, nutrients, agro inputs and soil. Other sources may include pesticides and fertilizers that are added for the benefit of the plant, but they behave as a contaminant source. More and more research is needed to describe the biological activities of green and black tea and to determine the optimal amount of tea consumption for possible health beneficial effects. The metals analyzed were Arsenic and Nickel. The data generated from five different brands (T1, T2, T3, T4, and T5) of tea samples and compared with Prevention of Food Adulteration (PFA) limit. The aim of this study was to determine the quantitative profile in terms of potentially toxic metals in the tea and hence the further work carried out analysis of heavy metals in the five different popular tea samples widely used in the area.

Keywords: *Heavy metals, toxic effects, antioxidant, pesticides and fertilizers*

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INTRODUCTION

Tea is the main product of the Camellia sinensis plant, prepared and cured by various methods. It is obtained from the leaves and leaf buds. Stagg and Million have elaborated the therapeutic action of tea. Tea, also known as the aromatic beverage prepared from the cured leaves after combining with hot or boiling water. Tea is second most popular beverages in the world and its health benefits have been known from ancient times. The intake of food contaminated by heavy metals is harmful to human health and several countries have food laws to restrict the presence of heavy metal amount in food and beverages. Tea leaves are very important source of mineral elements such as zinc, manganese, iron, copper, arsenic, magnesium, titanium, aluminum, strontium, bromine, sodium, potassium, phosphorous, iodine and fluorine. Tea leaves contain very little vitamins, carbohydrates and protein though may be a source of essential metals and the metal binding polyphenols.

Tea also has germicidal activities against various bacterias and microorganisms. The effect of tea is well established in prevention of coronary heart diseases, normalizing blood pressure, fat burning activity, diabetes by reducing the blood glucose activity. When a person eats and drink about 1 milligram (1/1,000 of a gram) of nickel every day. Generally, the amount of copper in human body remains constant. Nickel is required for good health. Although, exposure to higher doses of this metals can be harmful.

In various countries high intake of Arsenic is noted to cause liver and kidney failure and even death. Generally Food contains nickel and is the major source of nickel exposure for the local population. A person eat about 175 micrograms (µg; 1 µg=1 millionth of a gram) of nickel in a food every day. After nickel gets into human body, it can be distributed to all organs, but it mainly goes to the kidneys and damages it at a very high extent. The main target system for heavy metal toxicity is the nervous system, in adults, children as well as old age people. Arsenic exposure may also cause weakness in controlling joints, fingers and ankles. Metallic exposure with other effects like kidney failure and nervous system damage also causes increases in blood pressure, particularly in old-aged people.

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EXPERIMENTAL

Total Five different samples of tea denominated as T1,T2,T3,T4,T5 were obtained from Ahmedabad ,Vadodara,Rajkot,Bhavnagar and Junagadh as shown in figure 1.The Concentrated Nitric acid(HNO_3),Perchloric acid ($HClO_4$) were obtained from Merck India Pvt Ltd. Atomic Absorption Spectroscopy (AAS) standards solutions Arsenic and Nickel were obtained from Thomas Baker Chemicals, Pvt. Ltd., Mumbai.

Figure 1: Gujarat Map

(Source: http://www.google.com/gujarat map images)

All other Chemicals used during the Experiment were Analytical Grade. Trace metal analysis was performed on a Thermal Elemental AA Series Spectrometer of Perkin Elmer. All the atomic absorption measurements were carried out with a deuterium lamp.

Arsenic and Nickel were determined by the AAS in Flame. Each glass-ware was washed with chromic acid before analysis to improve purity. Standard calibration curves were constructed with known concentration solutions. The unmeasured samples were analyzed against the standard curve for measuring the concentration of the desired metal. The concentrations were expressed in µg/gram of the samples.

METHODS

1 g of pure sample in powder form is taken and transferred into a beaker. Add 5-10 milliliter of the mixture of nitric acid (HNO_3) and perchloric acid ($HClO_4$) (4:1) into that and allow it to stand overnight. The sample was heated until boils**,** if brownish black in color, and add again a quantity of above mixture.

Continuously heat till the solution becomes clear and transparent. Again raise the temperature and heat continuously to thick, till white smoke disappears, the remaining solution becomes clear and transparent. Allow it to Cool and transfer it into 100 ml volumetric flask, now wash the container with 2.5% nitric acid solution, now add this solution to the same volumetric flask and dilute with the same solvent to the volume. Similarly blank readings were taken using the same solutions to minimize the error in the analysis.

Table 1: Experimental Conditions

	HEAVY METALS	
	Arsenic	**Nickel**
Wavelength	198.7 nm	236.0 nm
Band pass	0.9 nm	0.4 nm
Flame type	H2-N2	H2-N2
Fuel flow	0.7 L/min	0.8 L/min
Lamp current	80 %	89 %

RESULTS AND DISCUSSION

The results obtained after analysis of tea samples by the Atomic absorption spectroscopy method are given in Table 2.

Table 2: Amount of metals in µg/gram

Samples	**Amount of heavy metals in µg/gm**	
	Arsenic	**Nickel**
T1	1.2825±0.92	25.5650±0.82
T2	1.3836±1.79	8.9026±0.48
T3	2.0079±0.72	7.8872±1.79
T4	4.6325±1.99	18.2210±0.55
T5	0.8934±0.76	15.689±1.94

Here in the samples, concentration of arsenic was found from 0.8934±0.76 to 4.6325±1.99 µg/g. The lowest concentration of arsenic was found in sample T5 and highest concentration was

found in sample T4. Nickel in tea samples was in the range from 7.8872±1.79 to 25.5650±0.82 µg/ g. The lowest value of Nickel was found in sample T3 and the highest in sample T1.

CONCLUSION

As Tea is the most consumed beverage in the world, it is necessary to maintain the contents consumed by the people. FDA have already set permissible limits for the contents present in the tea infusions. Here in this estimation, it is clearly observed that there was wide difference in the heavy metal content of tea samples collected from the different areas. Results indicate that the contents of Arsenic and Nickel in tea were different for the different climatic regions.A data generated for heavy metals in tea samples from five different brands (T1, T2, T3, T4, and T5) showed that the levels of Arsenic were below the PFA limit. The permissible limit for nickel as per PFA Act is 5 µg/g but the obtained result showed a higher amount of nickel in all the tea samples.

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