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Determination of Heavy Metal Concentration and Harmful Effects of Some Edible Vegetables around the Area of Paricchа Thermal Power Station in Jhansi (Uttar Pradesh India)

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Abstract: *The present research work deals with the quantification of heavy metals (Cu, Cd, Cr, Zn and Pb) in Fenu Greek, Cabbage, Cauliflower, Lady's Finger and Brinjal. The aim of this study is to determine environmental pollution in the area of Paricchа Thermal Power Station located in Jhansi. On the basis of Cu, Cd, Cr, Zn and Pb concentration in widely used vegetables by the local inhabitants. The heavy metal ion concentration was determined in polluted leaves of edible plants collected from a wide range of sites with different degree of metal pollution. Five heavy metals were analyzed using Atomic Absorption Spectrometer (AAS). All the heavy metals except Cadmium that measured were found to be at high levels in samples and beyond the safe limit.*

Keywords: *Atomic Absorption Spectra, concentration, digestion, metal toxicity, pollution.*

1. INTRODUCTION

In India about 75% of the electricity is generated by coal based thermal power plants which produce nearly 65 million tones per year of fly ash as a bye product[1]. UPRVUNL is owned state thermal power utility with generating capacity of 4683 MW operating 5 thermal power plant stations including Paricchа Thermal Power Plant. The plant is located in district Jhansi on Kalpi-Jhansi road in U.P. All the 6 units of this station are coal fired thermal power plants having a total generating capacity of 1140 MW. It has 6 units of 110,110, 210,210,250 and 250 MW, respectively. It has a total generation capacity of 1140 MW. The machinery is from Bharat Heavy Electricals limited.

Table1. *Generating Units of Paricchа Thermal Power Station*

Stage	No. of units	Installed capacity	Derated capacity	Date of synchronization	Date of commercial operation
	01	110	110	31-03-84	01-10-85
01	02	110	110	31-03-84	Dec-1984
	03	210	210	May 2006	24-11-06
02	04	210	210	28-12-06	01-12-07
	05	250	250	15-05-12	17-07-12
03	06	250	250	17-09-12	18-04-13

In the current era electric power is the most required need of human beings. Increased use of coal used electric power generation in Paricchа Thermal Power Station results in the generation of large quantity of fly-ash and other residues, health risk due to toxic trace metals present in soil have been widely reported and one of the most serious environmental concerns in present time. Dumping of the fly ash on open ground creates terrestrial pollution. Due to increased power generation the power plant produces a large quantity of fly-ash which degrades the quality of soil and also has an adverse effect over human health[2]. Crops and vegetables grown in the soil contaminated with heavy metals and intake of these vegetables is an important path of heavy metal toxicity in human beings, which may lead to various chronic diseases (Nolan, 2003).

2. MATERIALS AND METHODS

The present study was conducted about 3 kms away from Pariccha Thermal Power Station. It is situated in Jhansi district of Uttar Pradesh, India, at a height of about 240 meters above mean sea level. The power station is owned by Central Government and is a coal fired station located on National Highway No. 25 on the northern bank of Betwa River in Jhansi. Normal slope of the region is observed from South-West to North-West to North-East direction. Jhansi is situated 24^0 11' N to 25^0 57'N Latitude and 78^0 10' E to 79^0 23' E Longitude in the semi arid region of the country.

Sample Collection: The fresh green leaves of Fenu Greek, Cabbage, Cauliflower, Lady's Finger and Brinjal were collected two times in june 2013.The collected samples were analyzed for the determination of Cu, Cd, Cr, Zn and Pb .

Sample Preparation: The collected green leaves were washed thoroughly and then dried in oven at 80 degree Celcius. The dried samples were then ground into fine powder and sieved through 2 mm mesh sieve and were ready for further use. The concentrations of heavy metals were analyzed by Allen's Modified method[3].

1gm dried powder sample
+ 15 ml of digestion mixture (HNO_3, H_2SO_4, $HClO_4$ in 5:1:1)
↓
Heat at 80^0 C until transparent solution
↓
Filter through Whitman No. 42
↓
Filtrate
↓
Dilute upto 50 ml with distilled water
↓

The concentration of the respective metals is determined from the prepared sample on Atomic Absorption Spectrophotometer, Model Chemito AA 203D.

3. RESULT AND DISCUSSION

Research findings show that the concentrations of Cu, Cd, Cr, Zn and Pb have crossed the safe limits for consumption of plants and vegetables for inhabitants. Heavy metals are kept under environmental pollutants due to their toxic effects in plants, humans and foods. The accumulation characteristics of metals in plant tissues can reflect the agricultural application of fly ash cause environmental pollution or effect human health[4]. The fly ash composition is enriched in Cu and Zn which resulted an increased availability of these heavy metals particularly Cu and Zn[5]. Marshal and Sharma (2006) studied that crops and vegetables grown in the soils contaminated with heavy metals have greater accumulation of heavy metals than those grown in uncontaminated soil[6.] Muchuweti et al (2006) has suggested that intake of heavy metals through the food chain by human population has been widely reported throughout the world[7].

Effect of Zn: Zn is the essential element of human diet. The results clearly show that the average value of concentration of Zn around the ParicchaThermal Power Station is beyond the range of safe limit (India and European Standards). The maximum and minimum concentration of Zn was found in Lady's Finger and Cabbage as 89.57 and 47.49 µg/ g respectively.

Effect of Lead: Ikeda et al (2000) suggested that Cd and Pb are non essential metals causing adverse effect even at very low concentrations[8]. Zhuang et al (2009) have also found higher than the maximum permissible levels of Cd and Pb concentrations in collected vegetables[9] .The another toxic heavy metal is Pb which is also a composition of fly ash. The maximum concentration of Pb was found in Fenu Greek as 9.926 49 µg/ g which exceeds the permissible limits in India.

Effect of Copper, Cadmiun and Chromium: In all above of these heavy metals, Cu is a trace metal or borderline metal or micronutrient which is necessary for the production of thyroxine, energy production, collagen and elastins in human beings. The total amount of copper in the body is only 75- 100 milli grams. The maximum concentration of Cu found in Brinjal is 22.412 µg/ g.

Maximum concentration of Cr was found in Cauliflower as 7.881 µg/ g and the value of Cd was found to be < 0.05 µg/ g in all samples. Radwan and Sharma (2006) have also found highest concentration of Zn and lowest concentration of Cd in vegetables collected from Egyptian market[10].

4. CONCLUSION

From the findings of research work we conclude that the concentrations of Cu, Cd, Cr, Zn and Pb can cause arteriosclerosis, brain disease itia-itia, thalassemia, hypertension etc. Increased demand for coal based energy will bound to produce more fly ash. The major concerns associated with coal burnt fly ash are enhanced rate of production, its unutilization and fly ash around management for storage. Due to wind and rainfall actions, the environment of soil and terrestrial are changed rapidly, thereby influencing the crop yield and flora of the area. An advanced technology to reduce generation of fly ash and an alternative recycle action for fly ash will be the best solution to reduce heavy metal toxicity in human beings.

Table2. *Heavy metal concentration present in Fenu Greek, Cabbage, Cauliflower, Lady's Finger and Brinjal*

Name of heavy metal	Name of the plant samples				
	Fenu Greek	**Cabbage**	**Cauliflower**	**Lady's Finger**	**Brinjal**
Copper	11.143	2.773	6.420	15.588	22.412
Chromium	6.537	< 0.25	7.881	<0.25	<0.25
Cadmium	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Zinc	89.50	47.49	54.58	89.57	51.37
Lead	9.926	2.369	5.164	7.784	4.328

"All the metals analyzed on Atomic Absorption Spectrophotometer [GBC AVANTA].

"Values expressed in mg / Kg or µg / g dry weight of the sample.

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