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Heavy Metal Contamination of Some Common Tubers Sold in Local Markets of Ernakulam District, Kerala, India

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Abstract

A study was conducted in three different markets of Ernakulam district to check the concentration of heavy metal in tuber foods. The accumulation of heavy metals was studied in tubers such as colocasia, elephant yam, potato, sweet potato, tapioca and yam, were collected from three different markets of Ernakulam district (Cochin, Thripunithura, Ernakulam). All the collected samples were washed, dried, digested and the concentration of heavy metals was found out using atomic absorption spectrophotometer (AAS). It has been observed that the peeled samples were having less concentration of metals than the unpeeled samples collected from three markets. The samples were collected from Thripunithura market showed more contamination than other two samples. The Zinc content of few samples exceeded the Food Adulteration Act (PFA) limit. The copper content was not that much high compared to PFA limit in all the observed samples. The cadmium content of most samples exceeded the PFA Limit. The lead contend of all samples were above the PFA limit.

Keywords: Heavy metals, atomic absorption spectrophotometer, copper, zinc, lead, cadmium.

Introduction

Analysis of heavy metals is an important part of environmental pollution studies[1,2]. Tubers are the most efficient carbohydrates producers[3]. Tuber crops have been lesser attended to by the researchers the world over, being considered inferior food stuffs. The consequence of trace metals in foods such as vegetable and tubers have been a considerable interest because of their toxicity effects which are important in human beings[4]. The heavy metals occur in solution as cations and are adsorbed by negatively charged soil particles[5]. Adsorption increases with pH so that desorption and solution concentration are greatest in acid soil[6]. Desorption also depends on the activity of microorganisms, which change the pH at micro sites and from soluble organic complexes. Some plants are tolerant to high metal concentrations, whereas non-tolerant plants will not grow. In many plant species there is restricted translocation of metals, including copper, cadmium, lead and zinc from roots to shoots. Concentration of metals is low in shoots of tolerant plants. The metals are retained in cell wall in roots[6].

The heavy metals such as cadmium and lead are released mainly from the manufacture of batteries and zinc from zinc plating industries[7]. Zinc and copper were predominate in sewage sludge and is released in to the soil[8]. The threshold value of acid soils is less because of greater solubility of metals. Atmospheric metals are deposited on plant surfaces by rain and dust[1]. Several authors have shown a relationship between atmospheric element deposition and elevated element concentrations in plants and top soils, especially in cities and in the vicinity of emitting factories[2,9,10]. The present study was aimed to find out the trace metal concentration in tubers available in local markets of Ernakulam district.

Material and Methods

Study Area: The area chosen for the study is Ernakulam a district of Kerala state which extends $10^0$00' North latitude and 76^0 15 E East longitudes. The samples of various tubers such as potato, sweet potato, tapioca, elephant yam, yam and colocasia were collected from three different markets of Ernakulam district (Cochin, Tripunithura, and Ernakulam).

Sampling: The samples were collected and a portion of it was peeled and another portion was unpeeled. Then it was washed and dried in hot air even at 80^0C. After drying it was ground to make fine powder and 0.5 gm of each sample was digested in a Microwave digester[11]. Then it was tested for metals in the atomic absorption spectrophotometer (AAS).

Results and Discussion

The heavy metal concentration values were found higher in unpeeled samples than in peeled samples as given in table-1.

The values attained by the unpeeled samples showed higher value than the peeled samples. This shows that the contamination was higher on the surface than inside the sample. The outer skin tissues had more metal contamination than the inner part of the tubers[12]. By peeling the vegetable skin the amount of heavy metal entry into human body can be reduced. Most of the tubers used for cooking are peeled and hence a great

amount of contamination can be avoided using this peeling procedure. Roots adsorb heavy metals easily and less transported to the other edible parts such as leaves and shoots of many plants[6]. As tubers are grown under the soil they are more contaminated that the other vegetables. They can absorb heavy metals more readily than the other plants. Thus they show more metal contamination on the surface than in the inner tissues. Though the concentration of heavy metals in many plants can be reduced up to 20-50% by proper washing, tubers do not show much reduction. Washing practices should be done as it may reduce a small amount of heavy metals. In certain cases this contamination may be the cause of any toxic effect. Thus there is a need of proper washing of tubers.

Analyses of these samples for zinc showed the values are obtained were within the limits of prevention of food adulteration act (PFA). The high values were shown by certain samples such as elephant yam collected from Cochin market (52.42-peeled), colocasia collected from Tripunithura market (54 -Peeled), (75.28-unpeeled), tapioca collected from Ernakulam market (53.86-Peeled), (81.68-unpeeled) (figure-1). The daily intake of zinc metal in recommended dosage in various countries is 3.2 - 29.0 mg/day. The application of phosphate fertilizers are the main reason for this increased value of the zinc for certain samples.

Copper values obtained for peeled samples were lower than that of unpeeled samples (figure-2). The values obtained by analysis were not much higher compared to PFA limit. The unpeeled yam sample collected from Tripunithura market was having the highest value compared to others. The recommended daily intake copper ranges from 2.0 to 3.0 mg in humans. These samples are comparatively less contaminated.

Cadmium values were higher for most of the samples, compared to PFA limit (1.5 mg/Kg). When compared to the samples of the other two places the samples of Ernakulam market showed the high contamination (Figure-3). The cadmium uptake in human beings can be up to 10-20 µg but it can be up to 0.9 -2.8 mg/day in smokers[13]. When compared with the standards the values obtained are very high.

The Lead values were also high in the samples (figure-4). The value ranges from 2.4-26.4 mg/Kg. The lowest value was for elephant yam collected from Ernakulam market and the highest value was for yam collected from Tripunithura market. The samples collected from Tripunithura market were having higher levels of lead than the samples of other two places. For a city dweller the lead intake can be up to 200-300 µg/day. The World Health Organization (WHO) has reported that 15-18 millions are affected by lead in blood.

Table-1
Heavy metal concentration values of Peeled and unpeeled samples

Sl.No	Samples	Places	Zinc		Copper		Cadmium		Lead	
			Peeled	Un peeled	Peeled	Un peeled	Peeled	Un Peeled	Peeled	Un Peeled
	Blank		0.0208		0.006		0.016		0.048	
1.	Elephant Yam	Cochin	32.54	52.42	5.4	6.6	1.44	13.26	8.4	12.4
2.	Elephant Yam	Tripunithura	27.26	43.43	6.8	9.2	1.4	1.6	14.4	20.4
3.	Elephant Yam	Ernakulam	26.48	27.32	7.8	8.2	0.4	1.8	2.4	12.4
4.	Colocasia	Cochin	14.56	17.76	6.4	10.6	0.6	2.8	6.4	6.4
5.	Colocasia	Tripunithura	54.00	75.28	2.6	3.8	1.8	2.2	14.4	16.4
6.	Colocasia	Ernakulam	13.44	26.84	3	7	0.2	1.8	12.4	20.4
7.	Yam	Cochin	16.98	22.7	7.2	7.6	1	1.8	14.4	16.4
8.	Yam	Tripunithura	24.12	36.3	12.8	17	1.8	2.2	20.4	26.4
9.	Yam	Ernakulam	12.38	12.48	6.6	8.4	1.2	1.8	16.4	20.4
10.	Tapioca	Cochin	6.40	11.34	1.2	4.6	1.4	1.8	12.4	14.4
11.	Tapioca	Tripunithura	21.34	26.36	1	4.2	1.2	2.2	10.4	14.4
12.	Tapioca	Ernakulam	53.86	81.68	1.4	4.8	12.8	22.8	6.4	10.4
13.	Sweet Potato	Cochin	6.6	10.42	1.4	9.6	0.2	1.2	4.4	14.4
14.	Sweet Potato	Tripunithura	8.24	13.06	1.8	7.2	1.4	2.8	12.4	16.4
15.	Sweet Potato	Ernakulam	8.32	10.42	1	2.6	12.8	20.8	8.4	10.4
16.	Potato	Cochin	18.3	26.03	6.6	7.8	14.8	18.8	8.4	12.4
17.	Potato	Cochin	23.66	26.42	5.8	7.6	1	1.8	12.4	16.4
18.	Potato	Tripunithura	13.32	16.14	8.8	12.2	18.8	20.8	12.4	14.4

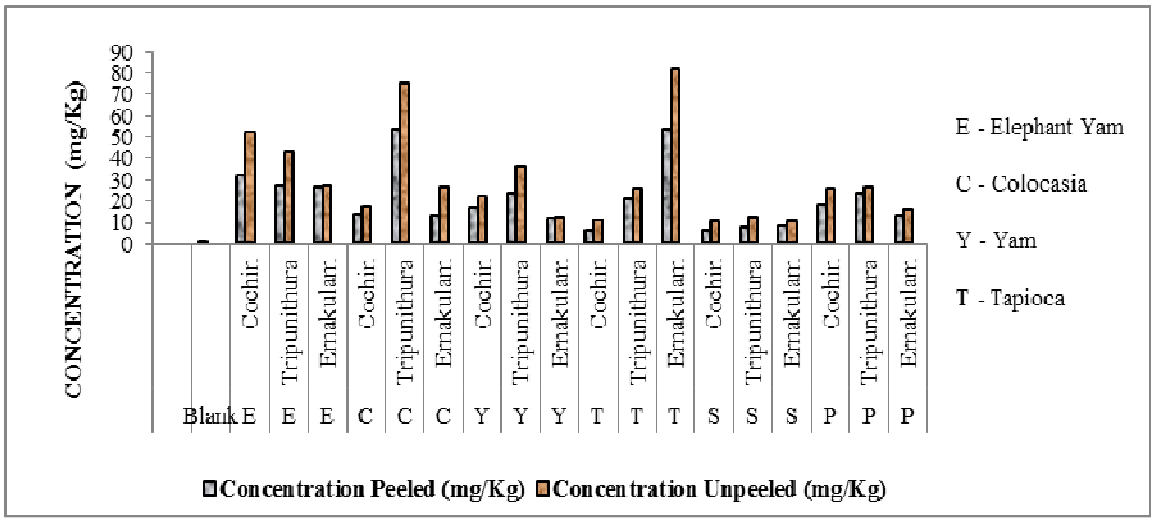

Figure-1
Concentration of Zinc

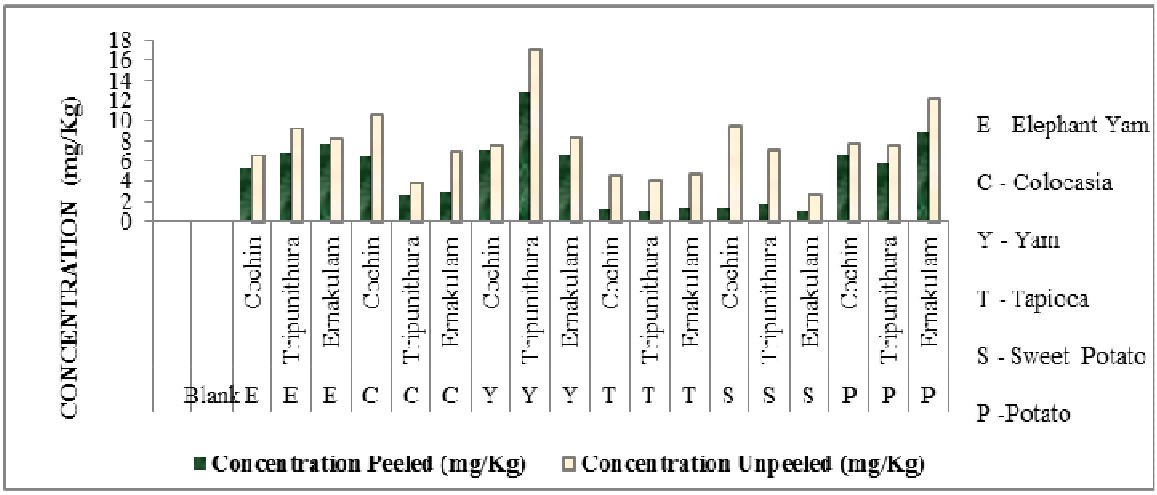

Figure-2
Concentration of Copper

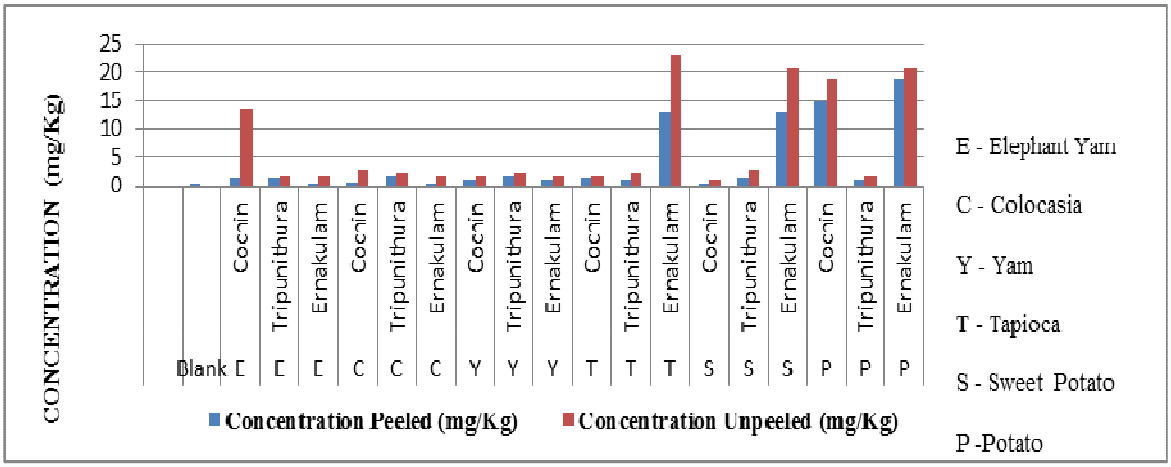

Figure-3
Concentration of Cadmium

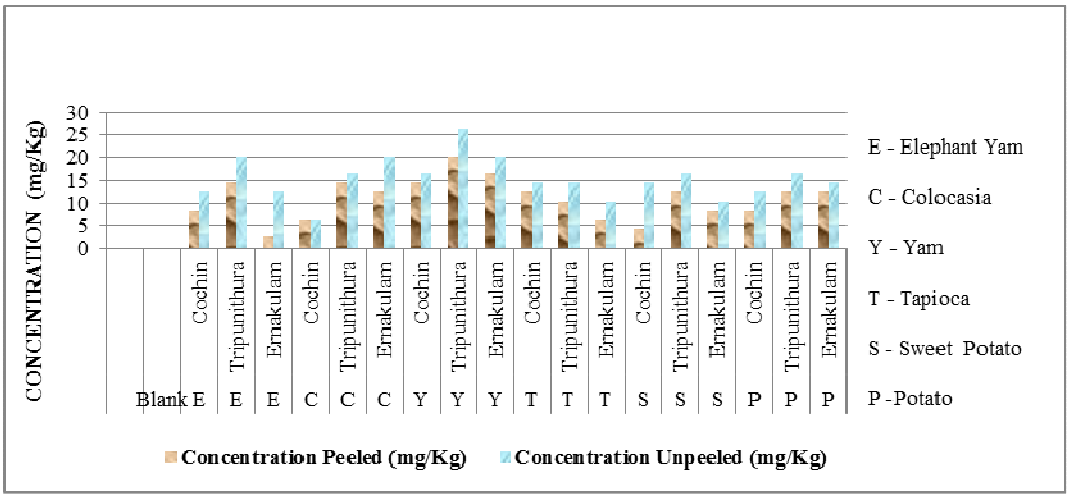

Figure- 4
Concentration of Lead

Conclusion

The accumulation of heavy metals in tubers may be due to the atmospheric deposition or transfer from soil. Our findings conclude that the unpeeled samples showed more concentration of heavy metals than the peeled samples. The samples collected from Tripunithura market had more concentration of heavy metals than those collected from other two markets. Secondly samples collected from Ernakulam market showed high heavy metal concentration than sample collected from Cochin. Thus it was determined that samples collected from Tripunithura market showed more contamination. This may be due to application of polluted water into the agricultural field and the application of fertilizers. The high concentration may also be due to atmospheric deposition and also due to soil characteristics which need further study.

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