

Analysis of Heavy Metals Content in the Vegetables of Panhera, Parbhani, Maharashtra (India).

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ABSTRACT

Panhera is a village in Parbhani Taluka, Parbhani district of Marathwada region of Maharashtra state. Most of the village farmers from this village are engaged in vegetable cultivation and the village serves as one of the main supplier of vegetables required in the Parbhani market. All the fields and farms of this region are irrigated by the Godavari River water which is highly polluted by urban waste and heavy metals. The purpose of this study was to study the Heavy metal content i.e. Pb, Cd, As and Cu in vegetables irrigated by Godavari River and to evaluate the level of heavy metals by the different vegetables, for this study four farms were selected in the Panhera region. Each farm was situated near the bank of Godavari River. The vegetable samples from four different sites were collected and digested by using tri-acid digestion method. The concentration of heavy metals (Pb, Cd, As and Cu) were analyzed using Atomic Absorption Spectrophotometer (AAS). Present results were compared with World Health Organization standard or Indian Prevention of Food Adulteration (WHO/IPFA). The results showed that, the heavy metals were below to the level of human consumption standard.

Keywords: Heavy metals, Panhera, Godavari River, Vegetables, AAS.

INTRODUCTION

Heavy metals are very toxic in elemental and soluble salt forms. Their presence in the atmosphere, soil and water even in traces can cause serious problems to organism¹. Heavy metals are harmful because of their non-biodegradable nature, long biological half life and their capacity to accumulate in different parts of plants. Even at low concentrations, they show damaging effects to human and animals because there is no mechanism for their elimination from the body^{2,3}. Food and water are not the main sources of essential metals, but are also the media through which we are exposed to various toxic metals. Heavy metals are easily accumulated in the edible parts of leafy vegetables⁴.

A lot of research on heavy metal content in different types of organic wastes and transfer to the soil and crops⁵⁻⁹. Panhera is a village in Parbhani Taluka, Parbhani district of Maharashtra state of India. Godavari River is the main river which flows through the easiest and cheapest source of water for irrigation to the villagers on the bank of this river.

Study Area

The study area for the research work is Panhera, Parbhani Taluka, Marathwada region of Maharashtra. This is one of the fast growing rural area are having large farming community. Location of village is between 18.33 degree and 20.53 degree North latitude and soil conditions in some parts East Longitude. Godavari is popularly known as Ganga of South India. In recent years, increase in temperature and decrease in rainfall is observed due to urbanizations and global warming. Vegetables like Coriander, Spinach, Onion, Cauliflower, Brinjal, Cabbage, Tomato, Cucumber, Potato and Carrot are very important crops of the Panhera village.

For the present study four different sites were selected from Panhera, Parbhani district of Marathwada region.

Site-1 Pedgaon, Site-2 Bhogaon, Site-3 Mohapuri, Site-4 Aland

The purpose of this study was to study the bioaccumulation of heavy metals i.e. Pb, Cd, As and Cu in soil. Soil and vegetables irrigated by

Godavari River water and to evaluate the level of different vegetables. These are the most toxic heavy metals in water, soil and vegetables.

MATERIAL AND METHODOLOGY

Analytical reagent (AR) grade chemicals and distilled water were used throughout the study. The sampling was carried out according to grab method as given in APHA for the sampling of water¹⁰ soils and vegetables. Four farms were selected around the Panhera region for study purpose. Each farm was situated near the bank of Godavari River.

Sample preparation and treatment

Vegetable samples were brought to the laboratory and washed under clean tap water followed by double distilled water to eliminate soil and air-borne pollutants. The moisture and water droplets were removed with the help of blotting papers. 100 gram of edible portion of all ten samples easy homogenized, and immediately oven dried at 100°C until the constant weight was achieved. Fully dry samples were then ground to fine powder in manual grinder and kept in clean, dry, stopper glass containers at room temperature. A working solution of H₂SO₄ (65%), HClO₄ (70%) and HNO₃ (70%) with ratio 1:1:5 was prepared and used for digestion of the samples. For heavy metal analysis, one gram of dry powder of each sample was digested in 100 ml Pyrex glass beaker by adding 15 ml of afore mentioned three-acid mixture with whatman filter paper. Finally volume of the extent was made up to 50 ml using double distilled water¹⁰⁻¹². Analysis of heavy metals was carried out by using Atomic Absorption Spectrophotometer, Model SL-242, ELICO.

RESULTS AND DISCUSSION

Concentration of lead, cadmium, arsenic and copper from randomly collected samples of coriander (*Coriandrum sativum*), spinach (*Spinacia oleracea*), onion (*Allium cepa*), cauliflower (*Brassica oleracea*), brinjal (*Solanum melongena*), cabbage (*Brassica oleracea*), tomato (*Solanum lycopersium*), cucumber (*Cucumis sativus*), potato (*Solanum tuberosum*) and carrot (*Daucus carota*) from four different sites in Panhera area were analyzed. The study showed that, the concentration of metals greatly varied in sample collected from different sites.

Lead

Table 1. Shows the lead (Pb) concentration in vegetable samples collected from different sites Panhera area. Lead concentration in 35% vegetable sample collected from this area recorded higher than the permissible limits of Indian Prevention of Food Adulteration Act (IPFA) 1954. Lead concentration ranges from 1.40 to 9.40 ppm for Pedgaon area and 1.40 to 6.90 ppm of Bhogaon area. High concentration of lead in vegetables was due to high content of metals in the soil, and may be due to irrigation by metal contaminated water released from nearby industries. Maximum vegetables sample (80%) collected from Mohapuri and the entire samples collected from Aland have lead concentration within permissible limit. Fig. 1. shows comparison of lead (Pb) level in different vegetables collected from different sites. From Table-1 it is clear that, site-1 is most polluted while site-4 is least polluted. Highest level of lead was found in spinach and cauliflower while lowest level of lead was found in cucumber.

Cadmium

Table 2 shows the cadmium (Cd) concentration in vegetable samples collected from above mentioned four sites. Cadmium concentration in the entire sample collected from Aland within the permissible limits of Indian Prevention of Food Adulteration Act (IPFA), 1954. Cadmium concentration in two out of ten samples collected from Mohapuri has recorded higher than the permissible limits of 1.5 µg/g. 30% vegetable sample collected from Pedgaon and Bhogaon area recorded cadmium concentration higher than the permissible limit. Concentration ranges from 0.40 to 3.10 ppm from Pedgaon area and 0.50 to 1.90 ppm for Bhogaon area is shown in fig. 2. Three out of four of coriander and onion shows high level of cadmium than permissible limits.

Arsenic

Arsenic concentration in 5 out of 40 samples collected from industrial area has higher than the permissible limits of Indian Prevention of Food Adulteration Act (IPFA), 1954. Arsenic concentration in all sample collected from Aland and 90% sample collected from Mohapuri were within limit (Table-3).

Copper

Table 4 shows concentration of copper (Cu) in vegetable samples collected from different sites in ppm while fig 4 shows its comparative

representation. Copper concentration of most of vegetable sample was within permissible limit. Only two out of 40 samples shows copper concentration above permissible limit.

Concentration ranges from 4.30 to 25.20 ppm from Pedgaon area, 6.10 to 12.30 ppm for Bhogaon area, 1.20 to 14.60 ppm for Mohapuri area and 2.10 to 6.50 ppm for Aland.

Table 1: Concentration of Lead in vegetable samples collected from different sites ($\mu\text{g/g}$ dry wt.)

Sr.No.	Vegetables	Site-1	Site-2	Site-3	Site-4
01	Coriander(<i>Coriandrum sativum</i>)	6.10	4.90	2.10	1.10
02	Spinach (<i>Spinacia oleracea</i>)	9.20	4.70	4.10	1.20
03	Onion (<i>Allium cepa</i>)	2.20	2.30	1.30	1.30
04	Cauliflower (<i>Brassica oleracea</i>)	8.10	6.90	1.90	N.D.
05	Brinjal (<i>Solanum melongena</i>)	2.20	2.30	2.10	1.10
06	Cabbage (<i>Brassica boleracea</i>)	2.00	1.80	4.80	N.D.
07	Tomato (<i>Solanum lycopersium</i>)	2.10	2.10	1.10	1.40
08	Cucumber (<i>Cucumis sativus</i>)	1.40	1.45	2.00	1.20
09	Potato (<i>Solanum tuberosum</i>)	2.30	2.20	N.D.	N.D.
10	Carrot (<i>Daucus carota</i>)	9.40	2.00	1.80	N.D.

N.D.-Not Detected

Table 2: Concentration of Cadmium in vegetable samples collected from different sites ($\mu\text{g/g}$ dry wt.)

Sr.No.	Vegetables	Site-1	Site-2	Site-3	Site-4
01	Coriander(<i>Coriandrum sativum</i>)	2.60	1.90	1.40	1.20
02	Spinach (<i>Spinacia oleracea</i>)	1.10	1.20	1.00	N.D.
03	Onion (<i>Allium cepa</i>)	3.10	1.60	1.60	1.90
04	Cauliflower (<i>Brassica boleracea</i>)	1.00	1.50	N.D.	1.40
05	Brinjal (<i>Solanum melongena</i>)	1.65	1.80	1.10	1.60
06	Cabbage (<i>Brassica oleracea</i>)	1.80	1.10	1.20	1.00
07	Tomato (<i>Solanum lycopersium</i>)	1.80	1.70	N.D.	N.D.
08	Cucumber (<i>Cucumis sativus</i>)	1.10	1.20	1.80	1.10
09	Potato (<i>Solanum tuberosum</i>)	1.50	1.10	1.20	N.D.
10	Carrot (<i>Daucus carota</i>)	1.20	1.80	N.D.	N.D.

Table 3: Concentration of Arsenic in vegetable samples collected from different sites ($\mu\text{g/g}$ dry wt.)

Sr.No.	Vegetables	Site-1	Site-2	Site-3	Site-4
01	Coriander(<i>Coriandrum sativum</i>)	1.10	1.10	0.90	0.50
02	Spinach (<i>Spinacia oleracea</i>)	0.80	1.20	0.70	N.D.
03	Onion (<i>Allium cepa</i>)	1.20	0.50	N.D.	N.D.
04	Cauliflower (<i>Brassica boleracea</i>)	1.80	0.70	0.80	0.50
05	Brinjal (<i>Solanum melongena</i>)	1.30	0.80	1.80	0.40
06	Cabbage (<i>Brassica oleracea</i>)	1.60	N.D.	1.00	0.50
07	Tomato (<i>Solanum lycopersium</i>)	1.50	0.90	0.80	N.D.
08	Cucumber (<i>Cucumis sativus</i>)	0.80	0.80	N.D.	0.60
09	Potato (<i>Solanum tuberosum</i>)	1.70	N.D.	1.40	N.D.
10	Carrot (<i>Daucus carota</i>)	2.10	1.10	0.50	N.D.

Table 4: Concentration of Copper in vegetable samples collected from different sites ($\mu\text{g/g}$ dry wt.)

Sr.No.	Vegetables	Site-1	Site-2	Site-3	Site-4
01	Coriander(<i>Coriandrum sativum</i>)	10.20	10.30	4.10	1.90
02	Spinach (<i>Spinacia oleracea</i>)	7.80	8.20	14.60	3.10
03	Onion (<i>Allium cepa</i>)	7.60	6.20	3.50	2.10
04	Cauliflower (<i>Brassica boleracea</i>)	25.20	12.30	9.20	6.10
05	Brinjal (<i>Solanum melongena</i>)	4.30	10.20	1.20	2.90
06	Cabbage (<i>Brassica oleracea</i>)	6.10	8020	4.60	6.50
07	Tomato (<i>Solanum lycopersium</i>)	6.40	8.10	3.00	4.10
08	Cucumber (<i>Cucumis sativus</i>)	25.10	7.10	6.10	2.50
09	Potato (<i>Solanum tuberosum</i>)	9.50	14.10	7.80	5.10
10	Carrot (<i>Daucus carota</i>)	9.40	6.10	5.20	2.90

N.D.-Not Detected

CONCLUSION AND RECOMMENDATION

The main source of heavy metal pollution is urbanization. The Heavy metal concentration in the different vegetable sample was found higher the permissible limits according to Indian Prevention of Food Adulteration Act (PFA), 1954. Nearly 35% samples collected from Pedgaon area showed higher levels of cadmium than the permissible limit of 1.5 mg/kg. Nearly 75% of onion and coriander samples showed higher levels of cadmium within the safe limits. The high concentration of arsenic and copper was recorded in carrot and cauliflower respectively. Result of the study showed that vegetables grown in the vicinity of an urbanization area were most contaminated. This is due to content of metals in the soil and may be due to use of contaminated water released from industries for irrigation. Vegetables grown away from the industrial area and city (Parbhani) were least contaminated and safe.

By controlling industrial and vehicular pollution of water, soil and air can prevent cadmium and lead contamination. Limiting the use of wastewater for irrigation and minimizing the use of sewage sludge, municipal compost and certain pesticides can help in controlling heavy metal pollution. Farmers need to be made aware if side effects associated with certain pesticides, fertilizers and irrigation water sources during cultivation. Washing of vegetables at farm should be done with clean water. Care should be taken during the transport and sale of vegetables. The results of the present study showed that consumers are at greater risk of purchasing fresh of vegetables with high level of heavy metal beyond permissible limits as defined by the Indian Prevention of Food Adulteration Act (IPFA), 1954.

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