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Analysis of Heavy metals in vegetables collected from selected area around Dhulia, North Maharashtra, Maharashtra, India.

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Abstract: This study was conducted to determine the concentration of heavy metals Lead (Pb), Cadmium (Cd), Arsenic (As) and Copper (Cu) in ten vegetables. The purpose of this study was to study the Heavy metal content i.e. Pb, Cd, As and Cu in vegetables irrigated by Panjara River and to analyze the level of heavy metals by the different vegetables, for this study four areas were selected around the Dhulia urban region. Each area was situated near the bank of Panjara 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 (WHO).The results showed that, the heavy metals were below to the level of human consumption standard.
Key Words : Heavy metals, Dhulia, Panjara River, Vegetables, AAS.

Introduction

Dhulia city is situated at the bank of Panjara River in Maharashtra state. Around Dhulia city there are numbers of villages having large farming communities. Vegetables and fruits are very important part of the human diet as they contain proteins, carbohydrates, vitamins, minerals and trace elements. They contain both essential and toxic elements in various concentrations. Many researchers have shown that some common vegetables have ability of accumulating high level of metals from the soil. Distribution of heavy metals in plant body depends upon their concentration in soil and water as well as plant spices and its populations.[1,2,3] Heavy metals plays very important role in the metabolism and growth of plants and animals. These metals can alter the metabolism and functions of some essential trace elements like iron, copper, zinc, calcium, selenium and manganese by competing for the ligands in biological system.[4] Food and water are not only the main source 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 vegetables.[5]

Some aromatic and medicinal plants are also capable of accumulating heavy metals from contaminated soil.[6] All heavy metals, both essential (iron, zinc, manganese, chromium, copper, nickel and non essential cadmium, lead) can cause toxic effects to plants and humans if found in high concentration[7]. Several studies have indicated that vegetables, grown in heavy metal contaminated soils accumulated high amount of the metals.[8,9,10] Vegetables absorb and adsorb these metals from the ground as well as the parts of vegetables exposed to air from polluted environments.[11]

A lot of research on heavy metal content in different types of organic wastes such as industrial sludge[12] compost[13,14] and transfer to the soil and crops[15-16] have been undertaken. Dhulia, a city of oil and cattle feed industry in North Maharashtra, Maharashtra, India, has a high degree of air, low water and soil pollution.

Study Area

The study area for the research work is Dhulia, North Maharashtra region of Maharashtra. This is one of the fast growing urban area are having large farming community. Panjara River is popularly of North Maharashtra, Maharashtra, 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 around the Dhulia area.

For the present study four different sites were selected around Dhulia, of North Maharashtra region.

Site-1 Market Yard, Site-2 Fagane, Site-3 Balapur, Site-4 Mukati

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 Panjara River water and to evaluate the level 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 water soils and vegetables. Four farms were selected around the Dhulia region for study purpose. Each farm was situated near the bank of Panjara 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-born pollutants. The moisture and water droplets were removed with the help of blotting papers.100 gram of edible portion of all four samples easy homogenized, and immediately oven dried at100^o 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 H_2SO_4 (65%), $HClO_4$ (70%) and HNO_3 (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 water. 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 (*Brassicaoleracea*), brinjal(*Solanummelongena*),cabbage(*Brassicaoleracea*),tomato(*Solanum lycopersium*),cucumber (*Cucumis sativus*), potato (*Solanum tuberosum*)and carrot (*Daucus carota*) form four different sites in Dhulia area were analyzed. The study showed that, the concentration of metals greatly varied in sample collected from different sites.

Lead

Table -1 Concentration of Lead in vegetable samples collected from different sites (µg/g dry wt.)

Sr.No.	Vegetables	Site-1	Site-2	Site-3	Site-4
01	Coriander*(Coriandrum sativum)*	4.50	3.60	2.05	0.90
02	Spinach (*Spinacia oleracea*)	8.20	4.20	3.90	1.20
03	Onion (*Allium cepa*)	2.10	2.10	1.10	1.10
04	Cauliflower (*Brassicaoleracea*	6.10	5.90	1.80	N.D.
05	Brinjal (*Solanum melongena*	2.10	2.10	1.90	1.10
06	Cabbage (*Brassica boleracea*	1.90	1.60	3.50	N.D.
07	Tomato (*Solanum lycopersium*)	1.95	1.90	1.10	1.10

08	Cucumber (*Cucumis sativus*)	1.30	1.30	1.50	1.10
09	Potato (*Solanum tuberosum*	2.10	2.00	N.D.	N.D.
10	Carrot (*Daucus carota*)	7.80	1.60	1.60	N.D.

N.D.-Not Detected

Table 1 shows the lead (Pb) concentration in vegetable samples collected from different sites of 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 1.30 to 7.80 ppm for market yard area and 1.30 to 5.90 ppm of Fagne 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 Balapur area and the entire samples collected from Mukti area lead concentration within permissible limit. 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 Concentration of Cadmium in vegetable samples collected from different sites (µg/g dry wt.)

Sr.No.	**Vegetables**	**Site-1**	**Site-2**	**Site-3**	**Site-4**
01	Coriander*(Coriandrum sativum)*	2.40	1.70	1.30	1.20
02	Spinach (*Spinacia oleracea*)	1.10	1.20	1.00	N.D.
03	Onion (*Allium cepa*)	2.80	1.50	1.50	1.60
04	Cauliflower (*Brassica boleracea*	1.00	1.40	N.D.	1.40
05	Brinjal (*Solanum melongena*	1.45	1.80	1.10	1.30
06	Cabbage (*Brassica boleracea*	1.50	1.10	1.20	1.00
07	Tomato (*Solanum lycopersium*)	1.60	1.60	N.D.	N.D.
08	Cucumber (*Cucumis sativus*)	1.10	1.20	1.40	1.10
09	Potato (*Solanum tuberosum*	1.40	1.10	1.20	N.D.
10	Carrot (*Daucus carota*)	1.10	1.40	N.D.	N.D.

N.D.-Not Detected

Table 2 shows the cadmium (Cd) concentration in vegetable samples collected from above mentioned four sites. Cadmium concentration in the entire sample collected from Mukti within the permissible limits of Indian Prevention of Food Adulteration Act (IPFA), 1954. Cadmium concentration in two out of ten samples collected from Balapur area has recorded higher than the permissible limits of 1.5 µg/g.30% vegetable sample collected from Market yard and Balapur area recorded cadmium concentration higher than the permissible limit. Concentration ranges from 1.00 to 2.80 ppm from Market yard area and 1.00 to 1.50 ppm for Balapur area is shown in Table-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 various area has higher than the permissible limits of Indian Prevention of Food Adulteration Act (IPFA), 1954.Arsenic concentration in all sample collected from Balapur and Mukti area were within limit (Table-3).

Table -3 Concentration of Arsenic in vegetable samples collected from different sites (µg/g dry wt.)

Sr.No.	**Vegetables**	**Site-1**	**Site-2**	**Site-3**	**Site-4**
01	Coriander*(Coriandrum sativum)*	1.10	1.10	0.80	0.30
02	Spinach (*Spinacia oleracea*)	0.80	1.20	0.60	N.D.
03	Onion (*Allium cepa*)	1.20	0.40	N.D.	N.D.
04	Cauliflower (*Brassica boleracea*	1.60	0.50	0.80	0.40
05	Brinjal (*Solanummelongena*	1.30	0.80	1.40	0.40
06	Cabbage (*Brassica boleracea*	1.40	N.D.	1.00	0.20
07	Tomato (*Solanum lycopersium*)	1.10	0.80	0.60	N.D.
08	Cucumber (*Cucumis sativus*)	0.80	0.70	N.D.	0.20

09	Potato (*Solanum tuberosum*	1.70	N.D.	1.40	N.D.
10	Carrot (*Daucus carota*)	2.00	1.10	0.40	N.D.

N.D.-Not Detected

Copper

Table -4 Concentration of Copper in vegetable samples collected from different sites (μg/g dry wt.)

Sr.No.	**Vegetables**	**Site-1**	**Site-2**	**Site-3**	**Site-4**
01	Coriander*(Coriandrum sativum)*	9.80	10.30	4.10	1.90
02	Spinach (*Spinacia oleracea*),	6.60	8.20	10.20	2.10
03	Onion (*Allium cepa*)	6.70	6.20	3.10	1.10
04	Cauliflower (*Brassica boleracea*	12.50	8.20	7.50	5.10
05	Brinjal (*Solanummelongena*	4.30	10.20	1.20	2.60
06	Cabbage (*Brassica boleracea*	6.10	8.20	4.60	6.10
07	Tomato (*Solanum lycopersium*)	6.40	8.10	3.00	3.30
08	Cucumber (*Cucumis sativus*)	18.20	7.10	6.10	2.10
09	Potato (*Solanum tuberosum*	5.40	14.10	7.80	5.10
10	Carrot (*Daucus carota*)	7.30	5.20	4.20	1.20

N.D.-Not Detected

Table 4 shows concentration of copper (Cu) in vegetable samples collected from different sites in ppm. 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 5.40 to 18.20 ppm from Market yard area, 5.20 to 14.10 ppm for Fagne area, 1.20 to 10.20 ppm for Balapur area and 1.10 to 6.10 ppm for Mukti area.

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 of1.5 mg/kg. Nearby 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 Dhulia city 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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References

1. Pickering K.T. and Owen L.A.in “An Introduction to Global Environment Issyes”,2nd ed.,London,New York,1997,P.187.
2. Chen. Z.Wang C. and Wang Z., Environmental International, 2005, 31,778.
3. Singh K.P., Mohan D., Singha S. and Dalwani R., Chemosphere, 2004, 55,227.
4. Mapanda E.N.,Nyamangaraand K.E.Giller.AgricEcosyst.Environ., 2005,107,151.
5. Najat K.Mohammed, Fatma O.Khamis., Natural Science, 2012, Vol.4, No.8, 588-594.
6. Gundermann D. and Hutchinson T., Sci. Total Environ. 2003, 13, 302.
7. Varatakshmi L.R. and Ganeshmurthy A.N., World Congress of Soil Science, Soil Solutions for a Changing World, Aug.2010, Australia.
8. Sharma R.K., Agrawal M. and.Marshall, Bull .Environ Contam. Taxicol. 2006,77,311.
9. Mahakalkar A.S. Gupta and. Nandeshwar S.N., Current World Environment. 2013, Vol. 8(3), 463-468.
10. Sharma R.K.,Agrawal M. and Marshall F.M.,Bull.EnvironContam.,Taxicol.,2007,66,258.
11. Vousta D., Grimanis A. and Samara C., Environmental Pollution, 1996, 94,325.
12. Kandpal G. Ram B. Srivastava P.C.and Singh S.K., J.HazardMater. 2004, 106B, 133.
13. Farrell M. and Jones D.L., Bioresour. Technol., 2009, 100, 4423.
14. Nikita Sharma.Balaji More, Deepika Bhandari and Swati D.Wavha., Global Journal For Research Analysis, 2005, 3(5), 2014, 56-57.
15. Doherty V.F., Sogbanmu T.O., Kanife U.C. and Wright O., Global Advanced Research Journal of Environmental Science and Toxicology. 2012, 1(6), 137-142.
16. Mohammad Naser, Sultana S. Gomes R. and Noor S., Bangladesh J. Agril. Res., 2012, 37(1), 9-17.

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