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Research Article

Chemistry

A STUDY ON HEAVY METALS CONTAMINATION IN BRINJAL OF KARUR, TIRUCHIRAPPALLI AND THANJAVUR DISTRICT, TAMILNADU, INDIA

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ABSTRACT

In the present study, the level of heavy metals (Fe, Cu, Zn, Cr, Ar, Pb, Hg and Cd) were determined and estimated in Brinjal from Tiruchirappalli (Kundur Station & Mathur station), Karur (Pugalur station and Velayuthapalayam station), and Thanjavur (Patteswaram station) Districts, Tamil Nadu state, India, during April 2015 and used to evaluate the level of these metals in the vegetable. As a result, Brinjal grown in Mathur and Kundur contain higher concentrations of these elements due to industrial effluents and urban pollution as compared to those grown in Pugalur, Velayuthapalayam and Patteswaram. The higher concentrations of metals indicates that industrial activities such as textile, dyes, leather factory, mills and chemical industries contaminate or introduce heavy metals into the soil.

Keywords: Heavy metals, Vegetables, Brinjal, Pugalur, Velayuthapalayam, Kundur, Mathur and Patteswaram

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INTRODUCTION

Vegetables are important edible crops and are an essential part of the human diet. They are rich in nutrients required for human health, and are an important source of carbohydrates, vitamins, minerals, and fibers (Hu *et al.*, 2013). Heavy metals can be readily taken up by vegetable roots, and can be accumulated at high levels in the edible parts of vegetables, even heavy metal in soil at low levels (Yang *et al.*, 2009). In many countries and regions, vegetables are exposed to heavy metals. Therefore, vegetable consumption is considered to be one of the major sources of heavy metal intake for humans and elevated levels of heavy metal in edible parts of vegetables can affect human health. Food safety is a major public health concern. Because of the increasing risk of contamination of food by pesticides, heavy metals, and/or toxins, the food safety issues have attracted the attention of research recently. A heavy metal is a general term applying to the group of metals and metalloids with the atomic density greater than 5g/cm3. The food chain contamination is the major pathway of heavy metal exposure for humans (Khan *et al.*, 2008).

Some trace elements are essential in plant nutrition, but plants growing in the nearby zone of industrial areas display increased concentration of heavy metals serving in many cases as biomonitors of pollution loads (Mingorance *et al*., 2007). Vegetables cultivated in soils polluted with toxic metals due to industrial activities take up heavy metals and accumulate them in their edible and no edible parts in quantities high enough to cause clinical problems both to animals and human beings consuming these metal-rich plants because there is no good mechanism for their elimination from the human body (Arora*et al*., 2008; Alam *et al*., 2003).. In the present study to analysis the heavy metal content of Brinjal in Pugalur, Velayuthapalayam, Kundur, Mathur and Patteswaram.

METHADOLOGY

Sample collection and preparation

Approximately 0.5kg of each Brinjal was collected from Kundur, Mathur,Pugalur, Velayuthapalayam, and Patteswaram. The collected vegetable carries in polythene bags and transported to the laboratory for preparation and analysis. The samples were washed with distilled water to eliminate air-borne pollutants. Dust was removed according to the common household practices. Excess moisture was removed by drying samples on the sheet of paper. The samples were then sliced, weighed and oven dried at 60°C to a constant weight.

Analysis of vegetable samples

The procedures used in the analysis of vegetable samples were adopted from analytical chemistry (Brodie, 1985). A portion of the unwashed Brinjal was dried in oven while the other portion washed before oven drying at 80°C for 48 hours. They were grounded to a fine powder and sieved through plastic sieve of 60μm aperture. One gram of the fine sieved powder of each sample was accurately weighed into a conical flask. The powder was digested using a tri-acid mixture of 5ml of concentrated H_2SO_4, 2ml of concentrated HNO_3 and of 5ml of 30% H_2O_2. The mixture was heated on a hot plate at 100°C for two hours in a fume cupboard. The resulting solution was left to cool over night and filtered into 100ml conical flask and the filtrate was made to the mark using de-ionized distilled water.

The heavy metals viz. iron, copper, zinc, chromium, arsenic, lead, mercury and cadmium were measured using Atomic Absorption Spectrophotometer (Perkin Elmer Analyst 200). Arsenic was quantified by AAS. Assuming As(V) may be present in the water samples along with As (III),reduction of As (V) to As (III) was performed with potassium iodide solution and ascorbic acid in moderately concentrated (5 mol/l) HCl solution. Time for reduction was 30 minutes. 10 ml of reduced water samples were analyzed using Atomic Absorption Spectrophotometer withMHS-15 (Mercury Hydride Generation System). The selected data were subjected to statistical analysis to test the standard deviations.

RESULTS AND DISCUSSION

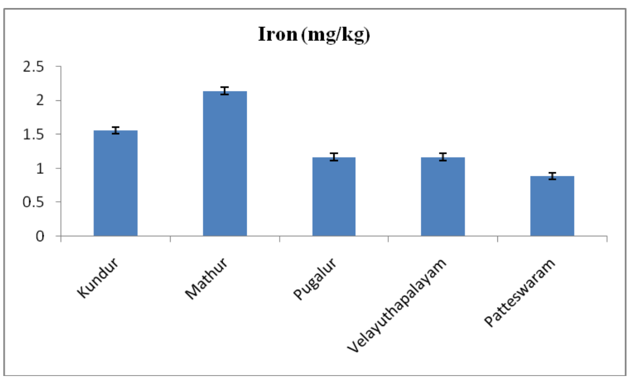
The mean concentrations of Fe, Cu, Zn, Cr, Ar, Pb, Hg and Cd in Brinjal studied are given in Table-1. A statistically significant differences in the average concentrations (ppm/g of dry wt) of metals Fe, Cu, Zn, Cr, Ar, Pb, Hg, and Cd in Brinjalat different locations (Kundur, Mathur, Pugalur, Velayuthapalayam, and Patteswaram). The experiment values of Fecontent han been regarded in the order –Mathur > Kundur> Pugalur> Velayuthapalayam> Patteswaram. The concentrations of Hg content can be regarded in the order-Mathur> Pugalur> Kundur> Patteswaram> Velayuthapalayam. The heavy metal concentrations of Ar can be regarded in the order-Mathur > Kundur > Pugalur > Velayuthapalayam > Patteswaram. The content of Cumetal concentrations can be arranged in the order –Mathur >Kundur> Patteswaram> Velayuthapalayam> Pugalur. The heavy metal of Cd content has been given in the order -Mathur> Kundur> Patteswaram> Pugalur> Velayuthapalayam. Yang *et al*., (2009) found that Chinese leek, pakchoi, and carrot had higher Cd concentrations in their edible parts than radish, cucumber, and tomato.Cd accumulation in vegetable species decreased in the order of leafy vegetables > solanaceous vegetables > root vegetables > allimus vegetables > melon vegetables > legumes vegetables (Yang *et al*., 2010).

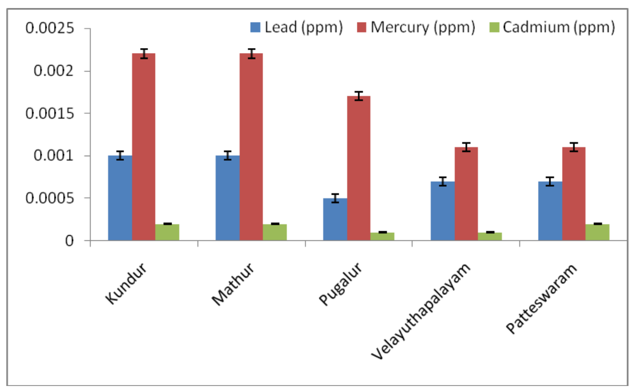
Alexander *et al*. (2006) reported that Pb significantly accumulated in lettuce and onion, while Cd accumulated to the greatest extents in spinach and lettuce. The metal concentrations of Pb can be regarded in the order -Mathur> Kundur> Pugalur> Velayuthapalayam > Patteswaram. The content of Cr concentrations can be regarded in the order of Mathur> Kundur> Pugalur> Patteswaram> Velayuthapalayam. The concentrations of Zn content can be arranged in the order of Mathur> Kundur> Pugalur> Velayuthapalayam > Patteswaram. Several studies have indicated that vegetables grown in heavy metals contaminated soils have higher concentrations of heavy metals than those grown in uncontaminated soils (Guttormsen *et al*., 1995; Dowdy and Larson, 1995).

Food safety is a major public health relative activity. During the last decades, the increasing demand for food safety has stimulated research regarding the risk associated with consumption of food stuffs contaminated by pesticides, heavy metals and/or toxins. With the increasing contamination of the environment by toxic substances, food has become a possible source of exposure of pollutants to humans. The public health sector has found out the transfer of contaminants through the food chain to human. The study provides baseline information by assessing the levels of heavy metals in Brinjal which are largely consumed by human (D'mello, 2003).

Table - 1 Heavy metal contents of Brinjal in Kundur,Mathur, Pugalur, Velayuthapalayam, and Patteswaram

S.No	Name of heavy metals(ppm)	Kundur	Mathur	Pugalur	Velayutha-palayam	Patteswaram
1	Iron	1.56±0.109	2.14±0.149	1.17±0.081	1.17±0.081	0.89±0.062
2	Copper	0.20±0.014	0.21±0.014	0.11±0.007	0.11±0.007	0.14±0.009
3	Zinc	0.44±0.030	0.55±0.038	0.47±0.020	0.35±0.024	0.29±0.032
4	Chromium	0.38±0.026	0.38±0.026	0.33±0.023	0.28±0.023	0.28±0.032
5	Arsenic	0.654±0.045	0.899±0.062	0.412±0.028	0.457±0.031	0.384±0.026
6	Lead	0.0010±0.0001	0.0010±0.0001	0.0005±0.0001	0.0007±0.0001	0.0007±0.0001
7	Mercury	0.0022±0.0004	0.0022±0.0004	0.0017±0.0003	0.0011±0.0001	0.0011±0.0001
8	Cadmium	0.0002±0.00001	0.0002±0.00001	0.0001±0.00001	0.0001±0.00001	0.0002±0.00001





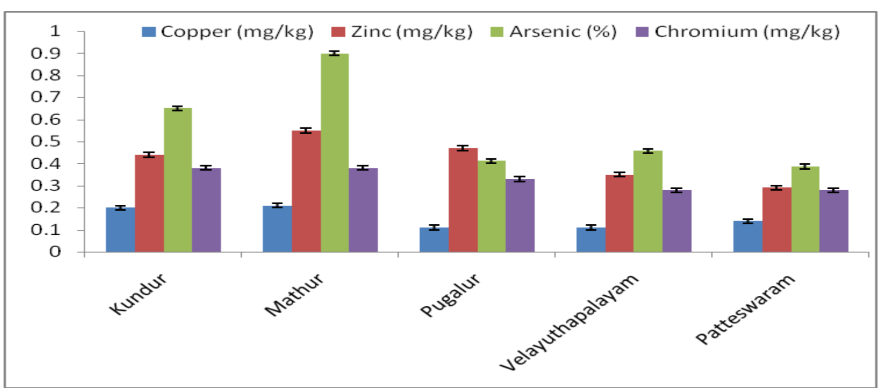


Figure - 1 Heavy metal contents of Brinjal in Kundur,Mathur, Pugalur, Velayuthapalayam, and Patteswaram

Food safety is a major public health relative activity. During the last decades, the increasing demand for food safety has stimulated research regarding the risk associated with consumption of food stuffs contaminated by pesticides, heavy metals and/or toxins. With the increasing contamination of the environment by toxic substances, food has become a possible source of exposure of pollutants to humans. The public health sector has found out the transfer of contaminants through the food chain to human. The study provides baseline information by assessing the levels of heavy metals in Brinjal which are largely consumed by human (D'mello, 2003: Ambika Asati *et al.*, 2016).

Vegetable species differ widely in their ability to take up and accumulate heavy metals, even among cultivars and varieties within the same species (Zhu *et al*., 2007; Samuel *al*., 2012; Ramteke *et al*., 2016). Metal concentration of Arsenic in Mathur shows the highest value and lowest value occurs in Patteswaram station. The variation is due to the effluents come out from industries which situated large in number at Tiruchirappalli district. Hence the two area (Kundur and Mathur) productions are having a large quantities of heavy metals . In future, the level of heavy metal concentrations may be reduced. Säumel *et al*. (2012) reported that Zn concentrations in green beans, tomato, potato, kahlrabi, and carrots were significantly lower than the concentrations in leafy vegetables.

High concentration of these metals in polluted area's vegetable (Brinjal) might be due to high contents of metals in the soil as caused by irrigation with metal contaminated water released from different kinds of industries. Mathur and Kundur are highly polluted by industrial effluents, sewage sludge, municipal waste water and urban pollution. Comparatively low concentration of metal ions in the vegetable (Brinjal) from indirectly polluted area might be due to the pattern of contamination, where pond and canals' contaminated water submersed the adjacent cultivable land during rainy season after that the farmers grew their vegetable in winter. The higher concentrations of metals indicate that industrial activities, such as textile, leather factory, milling and chemical industries contaminate or introduce heavy metals into the soil.

CONCLUSION

The present study concluded that the concentrations of heavy metals in the Brinjal decreased in the order of Mathur> Kundur> Pugalur> Velayuthapalayam>Patteswaram. The ability for heavy metal uptake and accumulation of vegetable was the highest in Mathur and that of Patteswaram vegetable was the lowest. These results indicated that the higher concentrations of metals may be due to industrial activities, such as textile, leather factory, milling and chemical industries contaminate or introduce heavy metals into the soil.

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