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ORIGINAL ARTICLE

Heavy metals and their effect on Indian kitchen vegetable

Waghmare SB[1] and Anasane PY[2]

[1]Department of Chemistry, [2]Department of Botany, G.S. Gawande College, Umarkhed 445206 (M.S.) India.
*Corresponding author email: waghmare@gsgcollege.edu.in, | anasane@gsgcollege.edu.in

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ABSTRACT

The concentration of heavy metals such as Cd, Pd, Cu and Zn on vegetable such as Spinach (leaf) and Tomato. Trace element as Pd and Cd showed high concentration. Although some heavy metals such as Cu, Zn, Mn and Fe are essential in plant nutrition, many of them do not play any significant role in the plant physiology. The vegetables cultivated and the exposure to heavy metals continuous and is even increasing. Consequently, elevated levels of heavy metals affect food quality and human health all over the world. The concentration of Cd for the vegetable sample as Spinach was 0.3 mg/kg^{-1} and Tomato were found to be 0.2mg/kg^{-1} more than the permissible limit. The concentration of the remaining heavy metals as Cu for Spinach is 0.03 mg/kg^{-1}, tomato is 0.045 mg/kg^{-1} respectively and Zn for Spinach is 2.0 mg/kg^{-1}and for tomato is 3.8 mg/kg^{-1}respectively were within the permissible limit as compared with the FAO (mg/kg^{-1} 1985 and WHO) Pd and Cd are the most severe contaminants. The high level of Cadmium (Cd) in vegetables especially Spinach and Tomato, are suspected for human carcinogens and many more health risks. Samples selected for the study are highly contaminated with Pd and Cd and possess a major health concern from the research.

Keywords: Spinach leaves, Tomato, Pd and Cd, health effect.

INTRODUCTION

The vegetable samples (Spinach leaves, Tomato) selected for the study had a water supply from the near Umarkhed and allied area showed the higher level of heavy metals. The vegetable samples selected for the study were Spinach and Tomato. Vegetables are used as food include those used in making soups or served as integral parts of the main sources of a meal. Leafy vegetables occupy a very important place in the human diet, but unfortunately constitute a group of foods which contributes maximally to nitrate and other anions as well as heavy metals consumption.

The excessive application of nitrogen and other inorganic fertilizers and organic manures to these vegetables can accumulate high levels of nitrate and other anions as well as heavy metals. Vegetables act as neutralizing agents for acidic substances formed during digestion. As human activities increases, especially with the application of modern technologies, pollution. Vegetables has been proved to be an important part of the human diet because they are the derivatives of a balanced diet (Carbohydrates, proteins, vitamins, minerals and trace elements.

On the other hand, release and subsequent deposition of heavy metals in food products like fruits, vegetables etc cannot be emphasized [1]. Heavy metals are mobile and easily taken up by the plants in the environment [2].

Metals accumulation in vegetables may pose a direct threat to human health [3]. Different substances occur naturally in our environment as a consequence of natural events. Many diseases are caused by the inability of environment to to support the mineral needs of human, plants and animals or man. Untreated sewage and industrial water are commonly used for the cultivation of vegetables around farm land [4]. Such kind of untreated and wastage, industrial water has been made applicable to the vegetable. The concentration of heavy metal like Pd for Spinach is found to be 5.5 mg/kg^{-1} and for tomato is 5.5 $mg\backslash kg^{-1}$more than the maximum permissible limit.

2. EXPERIMENTAL DETAILS

Vegetable samples were divided into leaf, stem and root. Vegetable samples include spinach, lettuce, cabbage and onion. Vegetable samples were collected from different agricultural locations; vegetable samples were collected from three different locations to provide replicate samples of each plant. Vegetable samples were divided into leaf, stem and root. Vegetable samples include spinach, lettuce, cabbage and onion.

Analysis of heavy metal content:

Standard protocols were followed for the preparation of material and analysis of heavy metal content. The samples were immediately oven dried at $80^{o}C$ until fully dry and were then ground to a fine powder.

The samples were then digested using a tri-acid digestion process to extract the heavy metals, and the resulting solutions analyzed for concentrations of Lead, Copper, Zinc and Cadmium with the highly sensitive ICP-MS. A number of other techniques are also being tested using analysis equipment that is more readily available in Indian laboratories.

Digestion of Vegetable Samples for Heavy Metal: Determination The vegetable samples were weighed to determine the fresh weight and dried in an oven at 80 o C for 72 hours to determine their dry weight. The dry samples were crushed in a mortar and the resulting powder digested by weighing 0.5g of oven-dried ground and sieve (<1mm) into an acid washed porclain crucible

Vegetable samples were washed with distilled water and then dried for two days with tissue paper and were weighed. The collected vegetable samples were dried in an oven at 70oC for three days. The dried samples were taken for weighing and crushing in a mortal, chopped material were then analyzed for the heavy metals as copper, cadmium, zinc, lead. The samples were then followed by wet digestion with HNO3 and some amount of conc. H2SO4 in a 25 ml conical flask. The resulting samples (that were grinded in a mortar the resulting powder) were then followed by Atomic absorption spectrometry (AAS) for determination of heavy metals as Pd, Cd, Cu, Zn.

3. RESULTS AND DISCUSSION

The vegetable samples selected for the study were Spinach and Tomato. The vegetable samples were analyzed for heavy metals such as Pd, Cd, Zn and Cu. The heavy metal like Pd and Cd showed the higher level of concentration more than the maximum permissible limit as compared with the WHO, FAO like International organizations. The vegetable samples (Spinach leaves, Tomato) selected for the study had a water supply from the Umarkhed and allied area showed the higher level of heavy metals. The concentration of Cd for vegetable samples like spinach and tomato was found to be 0.3 mg/kg-1and 0.2 mg/kg-1 respectively.

The results also indicate that all the vegetable samples analyzed in this study had high levels of heavy metals and anions. The levels of all the metals studied were higher than those recommended by Food and

Agricultural Organization (FAO) and the WHO/EU joint limits of 0.1-0.2 µg/g Cr, 0.3 µg/g Fe; 0.1 µg/g Pb; 0.1 µg/g Cu; 0.1 µg/g Zn; 0.1 µg/g Ni; 0.02 µg/g Cd and 0.3 µg/g Mn. The high levels of these heavy metals place the consumers these vegetable crops grown within the study area at health risk with time unless an urgent step is taken by relevant agencies in address this issue.

Elemental Analysis of Samples: Determination of Pb, Fe, Cu, Zn, Cd, Ni, Mn and Cr were made directly on each final solution using Perkin- Elmer Analyst 300 Atomic Absorption Spectroscopy (AAS).

Table 1: Some trace elements and their concentration (Mg/kg-1) near Umarkhed area.

Sr. No	Name of vegetable samples	Heavy elements mgkg $^{-1}$			
		Cd	Pb	Cu	Zn
1	Spinach	0.2	3.5	0.02	2.0
2	Tomato	0.2	4.5	0.040	3.8

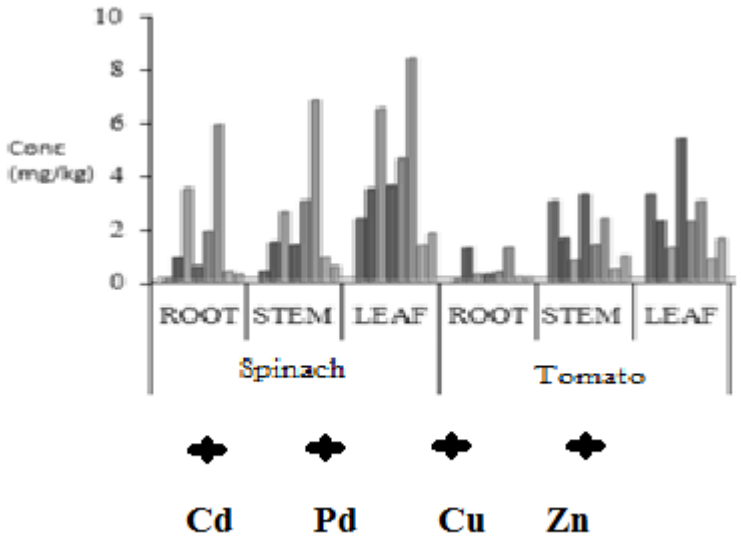

Fig. 1 : Conc. of Heavy metals in different parts of vegetable samples.

4. DISCUSSION AND CONCLUSION

According to the International organization like WHO and FAO, the Safe limit for the heavy metal like Cd is 0.30 mg/kg-1 (WHO and FAO mg/kg-1 Codex Alimentarius Commission) [5-9], 0.06mg/l (WHO-mg/l from table no 2), 0.01mgl- 1(recommended maximum concentration of trace elements for crop production.

The concentrations of heavy metals in all the vegetable samples in the four locations were higher than the guideline values of 0.1-0.2 mg/kg Cr, 0.2 mg/kg Fe; 0.1 mg/kg Pb; 0.1 mg/kg Cu; 0.1 mg/kg Zn; 0.1 mg/kg Ni; 0.02 mg/kg Cd and 0.3 mg/kg Mn. The result of this study agreed with the data reported. This might as a results high accumulation of these metals by plant.

In the whole plants studied from the four agricultural locations leaf contained higher concentrations of heavy metals than roots and stems.

The concentration of Cd for the vegetable sample as Spinach was 0.3 mg/kg-1 and Tomato were found to be 0.2mg/kg^{-1} more than the permissible limit. The concentration of the remaining heavy metals as Cu for Spinach is 0.03 mg/kg^{-1}, tomato is 0.045 mg/kg-1 respectively and Zn for Spinach is 2.0 mg/kg-1and for tomato is 3.8 mg/kg- 1respectively were within the

permissible limit as compared with the FAO (mg/kg-1 1985 and WHO). Pd and Cd are the most severe contaminants. The high level of Cadmium (Cd) in vegetables especially Spinach and Tomato, are suspected for human carcinogens and many more health risks. Samples selected for the study are highly contaminated with Pd and Cd and possess a major health concern from the research [5-9].

Urban poverty is reflected in the nutritional status of the urban, whose intake of important nutrients frequently lies below the minimum recommended daily allowance. Over the past few decades there has been a change in the focus of nutritional health concerns in India. Chemical contamination from sources such as industries, vehicles and pesticides can affect the safety of food. Heavy metals are one of a range of important types of contaminants that can be found on the surface and in the tissue of fresh vegetables [10-11].

The problems like malnutrition, to widespread chronic shortages of micronutrients, particularly iron and vitamin A, these deficiencies are not directly life-threatening; they cause serious functional disorders prolonged human consumption of unsafe concentrations of heavy metals in foodstuffs may lead to the disruption of numerous biological and biochemical processes in the human body. Heavy metal accumulation gives rise to toxic concentrations in the body, while some elements (e.g. *arsenic, cadmium, chromium*) act as carcinogens and others (e.g. *mercury* and *lead*) are associated with developmental abnormalities in children.

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