Original Article

Concentrations Of Heavy Metals In Leafy Vegetables Taken From A Local Market In Kundra, Koraput, Odisha, India

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Abstract

Plants are the major source of energy for humans. Leafy vegetables are rich sources of nutrients, fibers, minerals and trace elements which help in treatment of diseases and maintaining good health. However heavy metal contamination due to environmental pollution results in poisonous and hazardous effects. This study is based on the concentration of heavy metals in leafy vegetables in a village named Kundra located in district Koraput, 42 kilometers from Koraput of Odisha, India, which has a population of about 5326.About 130 samples were examined and studied from the local market of Kundra. These leafy vegetables commonly called Lal bhaji sago (Red Spinach), Muniga Sago (Drumstick Leaves) and Methi sago (Fenugeek leaves) were used for this study. The samples were cut air dried for four days. Next it was washed in 20% v/v solution of nitric acid, dried sample was then grounded into powder, it was sieved through nylon sieve of size 2mm. The digestion of the sample involves 20 ml of concentrated nitric acid, perchloric acid, and hydrochloric acid in the ratio of 10:1:3, followed by drying at 105 degree Celsius on a hot plate. The obtained solution was than filtered, the residue was than analyzed using digital spectrophotometer by continuous dilution method. The concentration of Iron, copper and zinc was determined, which constituted below permissible limit according to World Health Organization. Monitoring heavy metals in vegetables is essential; as these are considered to be a major indicator of environmental pollution.

Keywords: Heavy metal, Contamination, digestion, trace elements, poisonous

1.INTRODUCTION

Plants are the basic and first part of the food chain on the planet. Vegetables are plants that are consumed by human or other animals as food. [1] Vegetables contain important nutrient and trace elements, so they act as protective food, also for maintenance of health, preventing and treatment of diseases. Vegetables are rich source of vitamins, fibers, minerals, also possess antioxidants.[2]

The problem of heavy metal contamination of food products is a critical one in food quality assurance. Plants and vegetables captivate elements by absorbing from contaminated or polluted soil and untreated waste water, which is used for irrigation. Even due to air pollution deposits of different minerals, dust is accumulated in different consumable parts of the plant.[3]

2. AREA OF STUDY

A large variety of leafy vegetables from Kundra, Koraput, Odisha, India was selected as a test subject for this determination. From Subdistrict Jeypore it is 22 kilometers distant and 42 km away from district headquarters Koraput. About 1274 houses are located in Kundra village, and its total population is 5326.[4]

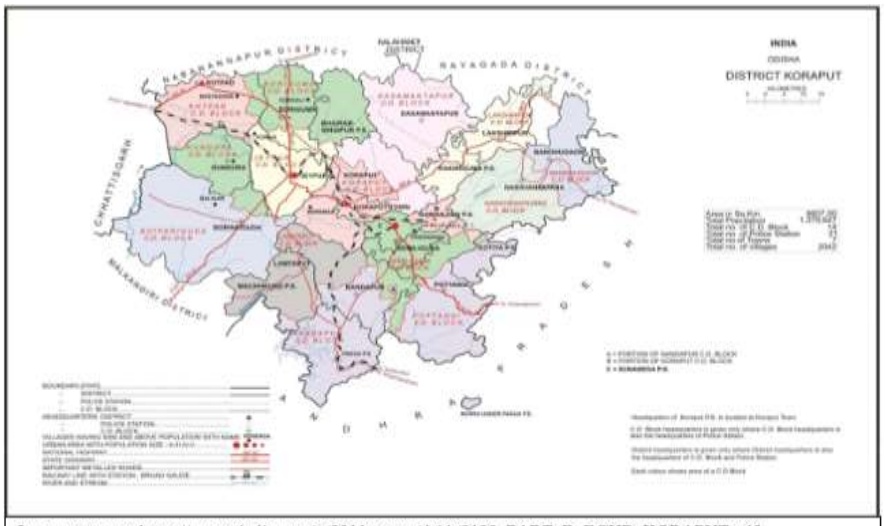


Image courtesy: https://censusindia.gov.in/2011census/dchb/2129_PART_B_DCHB_KORAPUT.pdf

3. MATERIAL AND METHODS

In this experiment, all glassware and plastic containers are washed with detergent solution, after which they are cleaned with Nitric acid (20% v/v) and then rinsed with tap water. After the metal salts were rinsed with tap water and washed with distilled deionized water, a standard solution of metal salts and other ingredients was prepared.[5]

4. SAMPLE AND SAMPLING

We studied approximately 130 samples from which three leafy vegetables were chosen - Lal Bhaji, Drumstick Leaf, and Methi Leaf. The samples were purchased in the local market, which is known as Kundra market.

Table 1 Leafy vegetable, common name, botanical name and family

Sl no.	Common name	Vernacular name	Botanical name	Family	Habitat	Important plant part
1	Lal Bhaji	Red spinach	*Amaranthus tricolour l.*	Amaranthaceae	Cultivated	Leaves
2	Moringa leaves	Drumstick leaves	*Moringa oleifera*	Moringaceae	Cultivated	Leaves ,fruits
3	Methi leaves	Fenugreek leaves	*Trigonella foenumgraecum l.*	Fabaceae	Cultivated	Leaves, seeds

6. SAMPLE DIGESTION:-

It involves the following process.

1. We take one gram of sample in conical flask.
2. Then we add 20 ml of concentrated HNO_3, 2 ml of $HClO_4$ and HCl at a ratio of 10:1:3,the chemicals are mixed properly and left for 10 minutes.
3. In addition, the sample was heated for about one hour on a hot plate at a moderate temperature between 70 °C and 80 °C.
4. The mixture was allowed to evaporate, then after dryness occurred until 105 °C was reached and to reduce the volume from 1.0 ml to 0.1 ml.
5. Once this is added, boil the residue for 10 minutes, then let it cool and filter it through Whatman filter paper into a 100 ml volumetric flask.
6. After filtration, the distilled deionized water was added up to the mark.

7. SAMPLE ANALYSIS

With the aid of digital spectrophotometer and by preparing standard graphical representation, the metal concentrations found in each sample digest were determined by continuously dilution.

8. DAILY INTAKE OF HEAVY METALS FROM VEGETABLE [6]:-

By using this formula, one can determine how much heavy metals are present in certain leafy vegetables when consumed on a daily basis based on the number of heavy metals in them

DIM = DVC ×VMC A.K.M.

DIM = Daily Intake of Metals

DVC= Daily Vegetable Consumption

VMC = Vegetable Metal Concentration

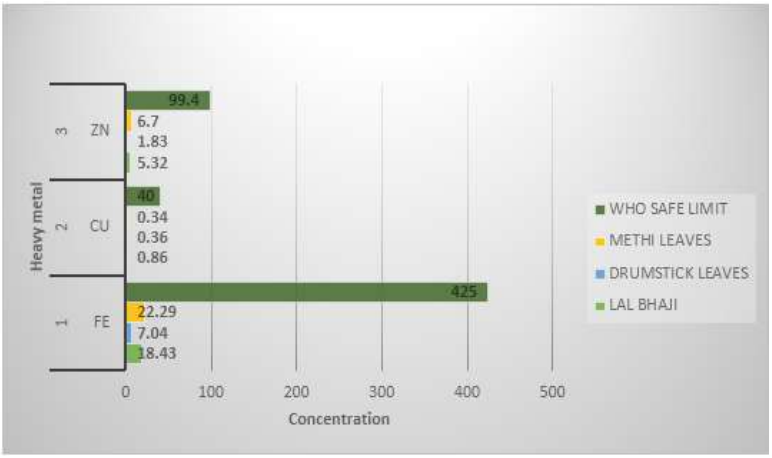
The daily vegetable consumption from an assessment by the World Health Organization in 1999 amounted to 98 grams per person per day. According to WHO, heavy metal intake was based on body weight of an adult. [7]

9. RESULT AND DISCUSSION

In Table 2 we find the metal concentration to be more concentrated in Lal Bhaji, copper is more concentrated than iron.

Table 2 Concentration of metal in different leafy vegetables (mg/kg)

Sl no.	Sample/metal	Lal bhaji	Drumstick leaves	Methi leaves	WHO safe limit
1	Fe	18.43	7.04	22.29	425
2	Cu	0.86	0.36	0.34	40
3	Zn	5.32	1.83	6.70	99.4

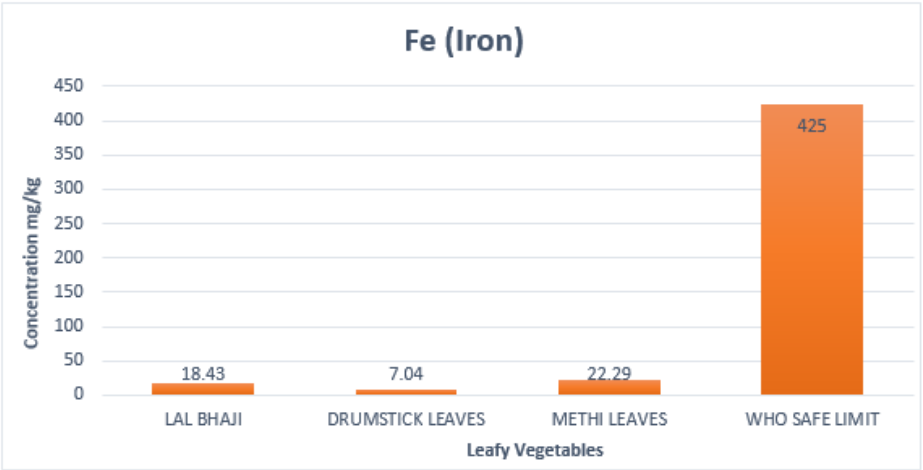


According to Table 3 we find the daily intake of heavy metals through consumption of vegetables.

Table 3 Daily intake of heavy metals from different leafy vegetables (mg/kg)

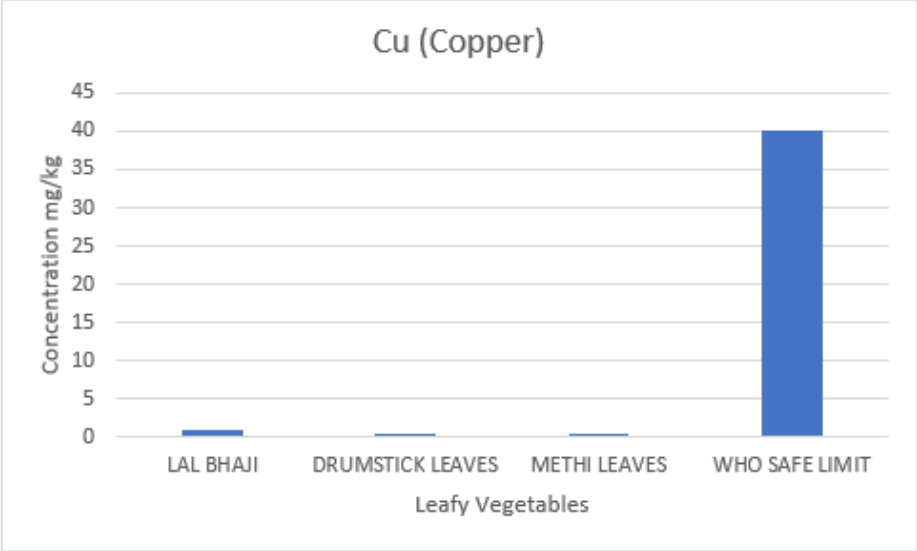
Sl no	Heavy metal	Mean metal concentration	Daily intake	WHO limit(mg)
1	Fe	15.92	1560.16	48
2	Cu	0.52	50.96	3
3	Zn	4.61	451.78	60

Minerals such as iron have many functions in the body, including growth and development, making hemoglobin that carries oxygen from the lungs to various parts of our bodies, and enhancing our energy production. It also helps to develop the immune system of body. In plants, iron is essential for the synthesis of chlorophyll with activates several respirator enzymes. Iron is also essential for maintaining healthy cell division and different enzymes functions in our body.[8-10] Methi leaves have the highest amount of iron and drumstick leaves have the lowest amount. They are ranked according to their iron contents Methi leaves>Lal Bhaji>Drumstick leaves. The leafy vegetables plants contain less than the value set forth by the World Health Organization, which makes them a safe food supplement. They are also a good source of iron.



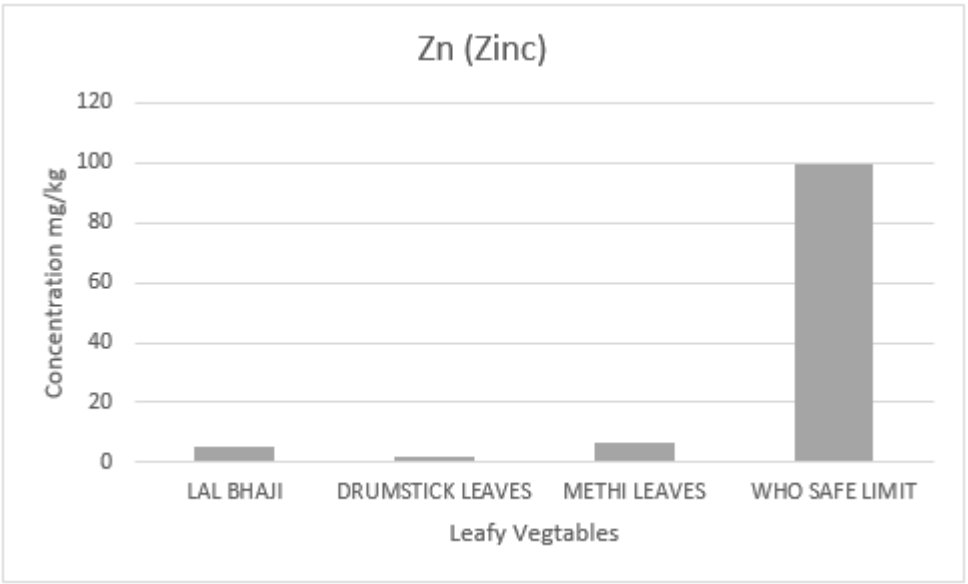
The trace element copper is one of the trace supplements used by the human body. Copper has several functions in the human body, such as assisting in energy production, supporting the brain, nervous system and aiding in the transportation of iron. Plants contain copper, which contributes to the production of melanin from the skin of our bodies. Copper is necessary for the activation of a variety of enzymes.

Copper is found in the highest concentration in Lal bhaji leaves, and the lowest concentration in Methi leaves. These three leaves are listed in order according to their copper content: Lal bhaji > drumstick leaves > Methi leaves. The copper content of the leafy vegetable in this study was lower than the level of W.H.O.[11-14]



Humans require zinc as an essential nutrient in their diet and for more information, see the Zinc Fact Sheet. Zinc is required to develop even functions and express genes in our bodies in addition to helping in the synthesis of different proteins and healing of wounds.[15-17] Our study suggests the zinc concentration in Methi leaves is the highest while it is the lowest in Drumstick leaves, so the leaves are listed in the following order: Methi leaves > Lal Bhaji > Drumstick leaves. The zinc is present in this kind of leaves is extremely low.

The daily consumption of leafy vegetables, which contains iron, copper and zinc is based on the body weight. According to WHO, the maximum weekly intake of heavy metals per person for an adult is 60 kg of body weight the average diet per person per day is 98 grams of vegetables, if the mean level of iron is 15. 92 mg/kg, copper is 0.52mg/kg and zinc is 4.61 mg/kg found to be consumed daily.[18-21]



10. CONCLUSION

These three leafy vegetables contain heavy metals like iron, zinc, and copper, which are essential nutrients for humans, and which have different functions and mechanisms in humans and other animals. A typical daily requirement for iron in

foods for human body is 17 milligrams, copper is 2-3 milligrams, and zinc is 3-4 milligrams in standard weight. The levels of heavy metal found in leafy vegetables are safe within WHO recommended limits.

Vegetables are the primary source of food and nutrition for humans and animals, and they are also considered to be bioindicators of environmental pollution. Monitoring heavy metals in vegetables is essential; as these are considered to be a major indicator of environmental pollution.

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