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A Review on the Concentration of the Heavy Metals in Vegetable Samples like Spinach and Tomato Grown Near the Area of Amba Nalla of Amravati City

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ABSTRACT: The concentration of heavy metals such as Pd, Cd, Cu and Zn were studied using AAS on vegetable samples as Spinach (leaf) and Tomato . Trace element as Pd and Cd showed high concentration . 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\kg^{-1}more than the maximum permissible limit according to the International organization like FAO and WHO indicating that the Vegetables grown near Amba nalla region in Amravati city have 5.5mg/kg^{-1} high heavy metal value for Pd .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 posses a major health concern from the research**.**

KEYWORDS: **:** Heavy metals, Vegetables ,health risks , WHO limits, Spinach, Contamination,. Permissible limits.

I. INTRODUCTION

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 (Dospatliev etal.,2012).On the other hand ,release and subsequent deposition of heavy metals in food products like fruits,vegetables etc cannot be emphasized (Bvenura etal .,2012). Heavy metals are mobile and easily taken up by the plants in the emvironment (Khairiah etal., 2004). Metals accumulation in vegetables may pose a direct threat to human health (Mohajeretal.,2012). 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 (Ddepoju-Bello etal.,2013).Untreated sewage and industrial water is commonly used for the cultivation of vegetables around farm lands .(Razaal.,2005).Such kind of untreated and wastage ,industrial water have been made applicable to the vegetable samples as especially spinach and tomato are taken for analysis .Regulatory frameworks and guidelines for heavy metals in the environment and food stuffs have been developed in many countries around the world as Australia and countries around the world such as Australia and New Zealand (Yu-Jing et al .,2004).Disposal of sewage water is a great problem(Kalaskar etal., 2012).Water used for irrigation is normally obtained from urban streams ,wells and rivers which have often been reported to be polluted by heavy metals that can as well be the source of heavy metals accumulations in agriculture products(Kihampa etal ,2011).The chemical combined form as well as the elemental form of metals are toxic (Elmier-Rico etal.,2007). Heavy metals are given significant interest throughout the globe due to their toxic , mutagenic and teratogenic effects even at very low concentrations (Oluwole etal.,2013). During the agrochemical conditions of Urban Vegetable soils resulting from their input intensity-,year-round vegetative cover, soil and hydrological characteristics and their spatial Variability have raised considerable research interests (Abdu etal.,2011). The health risks will depend on the chemical composition of the waste material its physical characteristics,

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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 (Etem Osma etal., 2012). Diet has been long considered as the major source of human exposure to trace elements and consequently the levels in basic foodstuff , but mechanical uptakes are of greater interest from the toxicological and nutritional points of view (Subramanian etal.,2012).The best method for the determination of concentration of Trace elements (accumulation either in vegetables or in water) applied is Atomic Absorption Spectrophotometry AAS (Mosleh etal.,2013) . Various methods used for the enrichment & separation of heavy metal ions including Solvent extraction,copreceipitation ,Cloud point extraction & membrane Filtration have been carried in various research work (Chalapathi etal.,2010).

II. MATERIAL AND METHODS

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 70^{o}C for three days . The dried samples were taken for weighing and crushing in a mortal ,chopped material were then analysed for the heavy metals as copper , cadmium, zinc , lead.The samples were then followed by wet digestion with HNO_3 and some amount of conc. H_2SO_4 in a 25 ml conical flask .The resulting samples (that were grinded in a mortar ie the resulting powder)were then followed by Atomic absorption spectrometry(AAS) for determination of heavy metals as Pd, Cd, ,Cu,Zn. The concentration (noted) of each samples were then (studied) compared with the help of FAO/WHO .The concentration of the (collected) vegetable samples concentration were studied compared with the WHO maximum permissible limit

III. RESULT AND DISCUSSIONS

The vegetable samples(Spinach Leaves ,Tomato) selected for the study had a water supply from the Amba nalla area showed the higher level of heavy metals. The vegetable samples (amba nalla) selected for the study were Spinach and Tomato. The vegetable samples were analysed for heavy metals such as Pd, Cd ,Zn and Cu. Among them , 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 concentration of Cd for vegetable samples like spinach and tomato was found to be 0.3 mg/kg^{-1}and 0.2 mg/kg^{-1} respectively(from table no 1). According to the International organization like WHO and FAO ,the Safe limit for the heavy metal like Cd is 0.30mg/kg^{-1}(WHOand FAOmg/kg^{-1} Codex Alimentarius Commission 1984 from table no 4), 0.06mg/l (WHO-mg/l from table no 2),0.01mgl^{-1}(recommended maximum concentration of trace elements for crop production 1985 FAOmg/l^{-1}from table no 2), Cd - 0.1mg /kg^{-}1(WHO mg/kg^{-1}from table no 3). Cadmium more than the permissible limit(WHO,FAO) results for several health risks such as Cd in its higher concentration results Carcinogenic, painful Osteomalacia (bone disease), destruction of red blood cell and kidney damage ,also affects several important enzymes problems. Cd is chemically similar to Zinc (Zn) found in the +2 oxidation state .Much of the physiological action of Cadmium arises from its chemically similar to Zinc. Specifically ,Cd may replace Zn in some enzymes thereby altering the stereochemistry of the enzyme and impairing its catalytic activity. Disease symptoms ultimately results (Okoronkwo etal., 2005). But in our research work , as the Zn concentration was found to be 2.5mg/$^{kg-}$1spinach and 3.8 mg/kg^{-1}for tomato respectively. According to the recommendation of international organizations like FAO mg/l (1985) the permissible value for Zn is 2.0 mg/l, and the permissible value for Zn is 5.00mg/l and that of the excessive limit is 15.00mg/l according to the Bis Indian Standards (IS10500 : 199) (mg/l^{-1}). Though the resulted values for Zn ie 2.0 found more than the maximum permissible limit , FAO (1985 mg/l) ie 2.00mg/l, but the other organizations shows the values to be within the permissible limit. Similarly, the international organization like EPA(mgL^{-1}) recommends maximum value for Zn is 5.00,WHO(mg/L^{-1}) Max allowable concentration is 5.00. On account of comparison of limits with the International organizations ,Zn results to be within the limit, as Zn & Cd exists in similar oxidation state of +2. If Zn is found more than the permissible limit , there is a possibility of interacting with Cd. Cd shows value more than the permissible level . So there was not found the possibility of replacing Cd to Zn. Cd is chemically very similar to zinc found in the +2oxidation state (Okoronkwo et al.,2005). Similarly, Pb was also found to be more than the maximum permissible limit (WHO,FAO 1984 from table no 4). The observed value of lead (Pd) was found to be 5.5 mg/kg^{-1}for spinach and 5.5mg/kg^{-1} for tomato. The maximum permitted value for Pd in vegetables is 0.1 mg/L (WHO) .The safe value for Pd according to FAO/WHO(mg/kg^{-1}) Codex Alimentarius Commission 1984 is 5.00. FAO(mgL^{-1}) from table no(4)

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recommended maximum concentration of trace elements for Crop production (1985) for Pd is 5.00(from table no2) . According to WHO ,the safe limit for lead is 0.3 mg/kg^{-1}(from table no3) ,Lead according to WHOmg/l is 0.1 (Table no 2) . Also, according to the BIS Indian Drinking water Standard (1998) the maximum permissible value for Pd is0.05mg/l and the excessive limit is 0.05mg/l (Table no6) . The values found were 5.5mg/kg^{-1} for spinach and 5.5 mg/kg^{-1} , that results to be more on comparing with the Bis Indian Water Standard values. The Bis Indian Water Standards for heavy metals concentration can be matched for other than the water ,as so the resulting values of the vegetables in our research are compared (Spinach ,Tomato).Pd(lead) is very toxic and has very chronic health implications even at low concentrations (Okoronkwo et al., 2005). Ingestion of lead could cause mental retardation in children , colic anaemia and renal diseases . The accumulation of Pd in plants through foliage is more pronounced at locations close to the emission source of Pd vapour and fine particles(Abou-Arab etal.,2000). Exposure to its high levels can damage the brain ,kidneys and ultimately cause death and long term exposure result in decreased performance in some tests that measure the functions of the nervous system; weakness in fingres, wrists or ankles ; small increase in blood pressure and anaemia. Others are abdominal pain ,arthritis, attention deficit, back problems, blindness, cancer, constipation, convulsions, depression, diabetes, migraine headache ,thyroid imbalances and tooth decay (Lokeshappa etal.,2012). In our research work, the Pd concentration was found more than the safe limit FAO - 1984,85,WHO from table no 2, 3,4,5respct) and as a result of it the above problems ,symptoms and diseases were found in some of the candidates from the total population. On the other hand, the research shows the concentration of copper (Cu) (WHO,FAO mg/kg^{-1} from table no 1) is 0.03.mg/kg^{-1} for spinach and 0.045 mg/kg^{-1} for tomato . The maximum permissible value for Cu is 0.1 mg/l(WHO), 0.20(FAO mg/l) . On the other hand, the permissible value for Cu is 0.05mg/l and excessive limit is1.5mg/(BIS 1998). The Effluent Standards (CPCB,1998) for Cu is 3.00.As a result of it , on comparing the obtained values from the work , the concentration of Cu is found within the limit . Total number of heavy metal, as (four trace elements) Pd, Cd, Zn and Cu were determined . Out of them, two metals like Pd and Cd resulted more than their safe limit (FAO-WHO) whereas the remaining two Cu and Zn were found within their limit . According to the research work ,There exists contamination of vegetables with heavy metals especially Pd and Cd due to which people are resulted being suffering through various diseases. The responsible authorities should give an impetus to the concentration of heavy metals in vegetable cultivation (spinach and tomato) and should also take care that the consumption of the vegetables do not results causing any harm to the health of the consumer after consuming it ..

Table No. I Concentration of some trace elements (mg/ Kg^{-1}) found in some vegetables grown near the Amba nalla under waste water irrigation.

Sr.No.	Name of vegetable samples	Heavy elements (mg Kg^{-1})			
		Cd*	Pb*	Cu	Zn
1	Spinach	0.3	5.5	0.03	2.5
2	Tomato	0 .2	5.5	0.045	3.8

(*) indicates the high level of heavy metal concentration more than the permissible level according to the International Organisations like WHO and FAO , BIS ,EPA .

Table No. II Concentration of heavy metals according to the International organization like WHO (mg/L) and FAO (mg/L) 1985 maximum concentration (levels) of heavy trace elements for crop production.

Sr.No.	Heavy Metals	Maximum permissible limit of heavy metals according to WHO (mg/L)	
		WHO (mg/L)	FAO (mg/L)1985
1	Cadmium (Cd)	0.06	0.01
2	Lead(Pb)	0.1	5.0
3	Copper (Cu)	0.1	0.20
4	Zinc (Zn)	15.0	2.0

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Table No.III WHO maximum permissible level of heavy metals in vegetables found in mg/Kg^{-1}

Sr.No.	Heavy metals	Maximum permissible level of heavy metals according to WHO (mg Kg^{-1})
1	Lead(Pb)	0.3
2	Zinc (Zn)	100
3	Cadmium (Cd)	0.1

Table No.(IV) Safe limits/Permissible limits

FAO/ WHO (mg Kg^{-1}) Codex alimentarius Commision 1984					
Cu	Pb	Zn	Cd	Fe	Ni
40.00	5.00	0.60	0.30	-	-

Table No.(V) FAO (mg/L^{-1}) recommended Maximum concentration of trace elements for crop production (1985)

Cu	Pb	Zn	Cd	Fe	Ni
0.20	5.00	2.0	0.01	5.0	0.20

Table no(VI) Permissible and Excessive limits of BIS Indian Drinking Water Quality Standard Values :10500(1998), Effluent Standards (CPCB 1998) water Quality Standards .

Sr. No.	Parameters (Heavy metals)	BIS(1998)		Effluent standard (CPCB,1998)	Drinking Water standards (BIS:10500)
		Permissible limit (mg/liter)	Excessive limit (mg/liter)		
1	Zn	5	15	5.0	NA
2	Cu	0.05	1.5	3.0	0.01
3	Cd	0.01	0.01	2.0	NA
4	Pb	0.05	0.05	0.10	0.30

*** NA**: Not Applicable . ** CPCB- Central Pollution Control Board (1998) .

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