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International Journal of Current Research
Vol. 8, Issue, 01, pp.24906-24912, January, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ACCUMULATION OF XENOBIOTICS IN VEGETABLES AND ITS IMPACT ON HEALTH

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ARTICLE INFO

Article History:
Received 12th October, 2015
Received in revised form
19th November, 2015
Accepted 02nd December, 2015
Published online 31st January, 2016

Key words:
Xenobiotics,
Sewage,
Food chain,
Toxicity,
Health,
Accumulation.

ABSTRACT

The present study was focused to assess the levels of different heavy metals (xenobiotics) like Pb, Cd, Mn, Ni, Cu, Zn and Fe in vegetables irrigated with waste water (sewage). The results indicated a sustainable build up of heavy metals in vegetables irrigated with sewage. The maximum accumulation of inc in sewage irrigated vegetable noticed is Radish root (81.4 ± 2.08 µg/g). Similarly copper in radish root (29.9 ± 1.28 µg/g), Manganese in radish root (181.1± 1.84 µg/g), Nickel in radish root (15.8 ± 1.57 µg/g), Lead in radish root (46.40 ± 0.77 µg/g), Cadmium in radish root (11.41 ± 1.41 µg/g) and Iron in coriander root (661.0 ± 2.03 µg/g). The accumulation of heavy metals in sewage irrigated soil and vegetables has caused increasing concern. The use of sewage is a common practice in majority of urbans and periurbans An investigation made on the impact of sewage for irrigation on the soil and potentiality of vegetables for the accumulation of heavy metals from the soil. The vegetables have a potentiality for the accumulation of heavy metals from the soil and thus, cleans up the environment, however, the consumption of contaminated heavy metals present in the vegetables has positive impact on the health of man. Regular monitoring of levels of these metals from the sewage, in vegetables and in other food materials is essential to present excessive buildup of these xenobiotics in the food chain.

Citation: **Rolli, N. M., Gadi, S. B., Giraddi, T. P., Paramanna, D. and Giddannavar, H. S. 2016.** "Accumulation of Xenobiotics in vegetables and its impact on health", *International Journal of Current Research,* 8, (01), 24906-24912.

INTRODUCTION

Industrial or municipal waste water is mostly used for the irrigation of crops, mainly in urban and periurban area, due to its easy availability and scarcity of fresh water. Heavy metals are harmful because of their non-biodegradable nature, long biological half lives and their potential to accumulate in different body parts. Even at low concentrations the heavy metals have damaging effects to man and animals because there is no good mechanism for their elimination from the body. Nowadays heavy metals ubiquitous because of their excessive use in industrial applications. Waste water contains substantial amount of toxic metals which create problems (Chen *et al*., 2005). Excessive accumulation of heavy metals in agricultural soils through waste water irrigation, may not only results in soil contamination, but also affect food quality and safety (Muchelweti *et al*., 2006). Most of the studies show that the use of sewage contaminated with heavy metals for irrigation over long period of time increases the heavy metal contents of the soils above the permissible limit.

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Ultimately, increasing the heavy metal content in soil also increases the uptake of heavy metals by plants depending upon soil type (Nazir *et al*., 2015). Heavy metal toxicity has sever effect on our health, particularly important systems are damaged such as nervous system, kidneys, lungs and other organ functions (Pophali *et al*., 1990 and Choudhary, 2012). The vegetables containing heavy metals has significant health implications for both consumers and farmers. It had been established that bacteria, viruses, protozoa, nematodes are able to causing diseases can be found in foods contaminated with sewage. Therefore, before the irrigation waste water should be treated with aquatic plants to remove harmful substance by using phytoremediation technique. The indiscriminate use of sewage causes clogging of soil pores resulting in decreased permeability. Lack of aeration in sewage produces toxic gases which were found to create unhygienic conditions (Hunashyal *et al*., 2003).

Perishable vegetables around urban areas, which are more prone to heavy metals contamination due to urban and industrial activities including vehicular pollution. Continuous use of waste water for irrigation leads to accumulation of heavy metals in vegetables (Gupta *et al*., 2009 and Singh & Agarwal, 2010). A number of serious health problems can develop as a result of excessive uptake of dietary heavy metals. Furthermore the consumption of heavy metal contaminated food can seriously deplete some essential nutrients in the body causing decrease in immunological defenses, intrauterine growth retardation, impaired psycho-social behavior, disabilities associated with malnutrition and a high prevalence of upper gastrointestinal cancer (Chaolan, *et al*., 2013). The present study was plan to assess, the status of different xenobiotics in different parts of vegetables grown using the fresh water and sewage for agriculture. The sewage has health implications for both consumers and farmers, proper health education is indispensible.

MATERIALS AND METHODS

All the experiments were conducted at environmental science laboratory of Botany Department, Karnatak University, Dharwad and Environmental Science laboratory, BLDEA's vDegree College Jamkhandi. Samples of of some commonly grown vegetables i.e lady's finger (*Abelmoschus esculentus*), Tomato (*Lycopersicum esculantum*), Mint (*Mentha arvensis)*, Radish (*Raphanus sativa*), Coriander (*Coriandrum sativum*) and Spinach (*Spinacia oleracea)* were collected from the Madihal (periurban area nearer to Dharwad) randomly from the field which is irrigated with sewage, however, for control (fresh water) the field selected is Ammanagatti village near Dharwad. The vegetables collected from three different sites (results in triplicates) of the experiment. Sewage sample is collected in a large prosterilized containers and transported to the laboratory for physicochemical analysis as per standard methods (APHA-1998) and 'Na' is analyzed by using Atomic Absorption Spectrophotometer. Sewage and fresh water samples for the estimation of heavy metals present using mixed acid digestion method has been employed (Allen *et al*., 1974). Soil samples were collected both for sewage and fresh water with an average depth of 5-20 cm randomly where vegetables were growing.

The soil is air dried, sieved to desired particle size for analysis. Similarly for the estimation of heavy metals in vegetables were dried at 80^0C in an oven for 24 hours to get constant weight. The dried part (Root, Stem, Leaf and Fruit) of the plant individually is homogenized with a blender to a powdery form. One gram of each sample was separately digested by using analytical grade (AR) chemicals such as nitric acid (HNO_3), Sulphuric acid (H_2SO_4), hydrogen peroxide (H_2O_2) and perchloric acid (60%) in Gerhardt digestion unit. The solution was filtered using whattman filter paper number, 44 in a volumetric flask, by adding double distilled water and final volume is made to 100 ml and analyzed for heavy metals such as zinc (Zn wavelength 213.9 nm), copper (Cu wavelength 324.7 nm), Manganese (Mn wavelength 279.5 nm), Nickel (Ni wavelength 232.0 nm), Iron (Fe wavelength 248.3 nm), Lead (Pb wavelength 217.0 nm) and Cadmium (Cd wavelength 228.8 nm) with GBC-932 plus Atomic Absorption Spectrophotometer (Austrelia) with an air / acetylene) flame and their respective wavelength metal hollow cathode lamps. Standard solutions for heavy metals were purchased from Siscochemical laboratory Bombay (1000 mg /lt). The working standards were prepared by serial dilutions of standard stock solutions and were used for the calibration of the instrument. The experimental results were in triplicate.

RESULTS AND DISCUSSION

The physic-chemical characteristics of sewage fresh water sampled from Madihal (Periurban) (Dharwad) are from presented in the Table 1. The physical parameters includes temperature and colour of the water while chemical parameters include pH, dissolved oxygen, contents, alkalinity, hardness, COD, Chloride, Calcium, Magnesium, Na and SO_4 were measured (Table 1). The sewage was dark brown in colour with an unpleasant odour. All the physic-chemical parameters within WHO (1993) range except chloride, COD and alkalinity. The alkalinity of sewage is due to detergents and soap (WHO, 1993).

Table 1. Comparison of sewage with WHO standards

Parameters	P^H	Odour	EC	TDS	Hardness	Alkalinity	COD	Chloride	Ca	Mg	Na	K	SO4
Sewage	7.6	Foul smell	1.283	780	341.0	552.5	273	451	95	80	141	-	59
WHO (1993)	6.5 to 8.8	Acceptable	1400 µohms	1000	500	120	5	250	100	150	200		250

Note: All parameters are in mg/lt except pH and EC

Table 2. WHO standards

Heavy metals	Plants	Water
Zinc	50	5.0
Copper	10	2.0
Manganese	-	-
Nickel	10	0.2
Lead	2	0.05
Cadmium	10	2.0
Iron	20	1.0

Plant- µg/g ; Water - µg/ml

Table 3. Kabata -Pendias (2005)

Heavy metal	Sufficient or normal	Excessive or toxic	Tolerable in agricultural crops
Zinc	27 - 150	100 - 400	300
Copper	5 - 30	20 - 100	50
Manganese	30 - 300	400 - 1000	300
Nickel	0.1 - 5	10 - 100	50
Lead	5-15	30 - 300	10
Cadmium	0.05 - 0.2	5 - 30	3
Iron	375 - 400	600 - 700	500

Table 4. Accumulation profile of heavy metals in vegetables

Vegetables		Zn		Cu		Mn		Ni	
		control	sewage	control	sewage	control	sewage	control	sewage
Lady's Finger	Root	49.28±1.25	68.21±1.87	5.71±0.30	6.1±0.61	21.4±1.40	164.1±1.52	2.13±0.51	16.42±1.50
	Stem	40.14±1.38	49.22±2.20	5.45±0.85	6.5±0.35	25.81±0.80	160.1±2.08	2.12±0.91	15.44±0.60
	Leaf	41.05±0.98	46.35±2.08	9.10±1.18	11.6±1.49	24.09±0.80	151.8±0.30	1.05±1.40	11.49±1.05
	Fruit	38.96±0.87	49.36±1.55	12.10±1.26	20.2±1.75	21.80±0.75	126.4±1.72	1.01±0.80	14.10±0.77
Tomato	Root	20.31±1.68	61.54±1.42	16.85±1.59	24.1±1.55	26.11±1.14	138.1±1.25	1.08±1.49	14.09±1.14
	Stem	17.56±1.13	50.23±1.26	13.42±2.08	20.8±1.22	28.41±1.30	54.80±1.30	4.91±1.45	13.80±.064
	Leaf	23.63±1.02	48.93±1.85	10.95±1.75	15.1±2.03	26.80±1.55	51.82±1.85	4.10±1.55	11.91±0.72
	Fruit	27.50±0.56	51.8±0.72	11.61±1.45	20.4±1.45	44.12±0.72	58.74±1.30	3.5±0.87	9.21±1.30
Pudina (Mint)	Root	25.10±0.98	51.60±1.45	4.11±0.86	15.11±1.69	30.18±0.77	118.4±1.24	2.50±1.40	8.91±1.15
	Stem	24.09±1.12	52.18±1.69	5.91±2.06	16.39±1.65	30.01±1.01	121.9±3.01	2.01±0.35	7.48±2.12
	Leaf	24.81±1.51	50.11±1.45	5.08±1.57	16.42±0.95	29.08±1.20	125.1±1.54	1.09±0.64	7.91±1.30
Radish	Root	27.10±1.20	81.4±2.08	17.90±1.65	29.9±1.28	28.41±1.26	181.1±1.84	4.06±1.60	15.8±1.57
	Stem	26.18±1.96	74.1±2.14	16.42±0.84	25.8±1.45	24.01±1.40	171.4±0.72	2.91±1.57	14.10±1.21
	Leaf	25.12±0.68	72.9±1.58	14.01±1.49	25.1±1.58	21.90±2.05	159.4±2.18	2.18±0.50	14.18±1.25
Coriander	Root	26.10±1.49	55.16±1.75	4.89±0.70	20.11±1.14	30.01±1.89	114.4±1.55	2.01±1.13	8.93±2.84
	Stem	25.91±1.04	52.09±1.45	4.80±1.26	25.14±0.86	29.41±2.21	121.8±1.15	1.98±0.45	7.45±2.02
	Leaf	25.80±1.68	54.12±2.14	4.74±1.75	23.5±0.65	28.04±2.35	124.9±1.26	1.15±0.94	7.84±1.52
Spinach	Root	24.91±1.98	75.01±2.08	4.18±1.68	24.1±1.15	30.40±0.94	174.1±0.87	2.11±1.26	8.71±1.36
	Stem	21.04±1.85	69.08±1.26	5.15±2.10	21.15±0.77	30.19±1.13	169.4±0.96	1.98±1.17	7.80±0.85
	Leaf	21.42±0.75	64.08±1.75	4.91±0.95	21.09±1.13	28.41±1.84	168.4±1.01	1.41±1.57	7.81±1.25
Soil		30.24±1.16	47.76±1.42	14.41±1.15	32.12±1.05	27.85±1.65	247.66±1.15	2.01±0.51	38.86±1.13
Water		4.18±1.17	4.03±2.08	31.33±1.29	210.02±0.84	275.26±2.31	410.32±1.58	108.5±1.70	112.97±1.57

Vegetables & soil: µg/g
Sewage / fresh water: µg/lt

Table 5. Accumulation profile of heavy metals in vegetables

Vegetables		Pb		Cd		Fe	
		control	sewage	control	sewage	control	sewage
Lady's Finger	Root	16.81±1.45	41.06±0.77	1.08±0.02	11.01±1.52	421.11±2.51	621.02±2.25
	Stem	10.1±0.87	40.01±0.76	0.98±0.08	10.01±0.94	400.01±3.22	600.58±2.61
	Leaf	9.4±1.25	38.81±1.13	0.94±0.51	9.48±0.83	281.42±2.65	584.21±2.41
	Fruit	8.01±1.14	35.10±1.18	0.80±0.24	9.21±1.45	374.35±1.98	581.12±1.54
Tomato	Root	7.81±2.05	29.95±0.96	1.41±1.02	9.40±1.74	418.54±3.01	648.34±1.58
	Stem	6.48±1.38	30.40±1.25	1.91±0.68	10.01±1.08	390.14±2.05	638.48±1.26
	Leaf	9.40±0.68	35.40±1.26	0.94±1.08	9.41±0.81	354.23±1.65	649.25±1.20
	Fruit	10.21±0.77	41.81±0.92	0.91±0.93	8.98±0.50	348.58±1.58	639.47±2.18
Pudina (Mint)	Root	9.4±0.58	35.10±0.65	1.04±0.81	10.14±1.52	351.28±2.18	634.15±1.13
	Stem	8.9±1.24	32.91±1.15	0.98±0.07	9.48±1.54	345.25±1.95	618.24±1.55
	Leaf	8.1±1.13	30.08±0.72	0.94±0.03	8.51±2.01	315.47±1.20	601.14±1.25
Radish	Root	10.98±0.78	46.40±0.77	1.08±1.12	11.41±1.41	424.68±2.14	625.52±1.73
	Stem	9.08±0.76	41.34±1.15	0.98±1.13	10.16±0.82	418.74±2.18	611.31±2.08
	Leaf	8.12±1.13	35.18±1.52	1.08±0.76	10.01±0.65	391.47±1.84	604.23±1.58
Coriander	Root	9.01±1.18	34.11±1.26	1.01±0.93	10.16±0.83	354.29±1.64	661.24±2.03
	Stem	8.91±0.28	33.09±1.58	0.98±0.07	9.78±1.30	349.21±1.15	619.48±1.58
	Leaf	8.01±0.84	30.14±1.12	1.01±1.12	8.91±0.94	318.24±1.30	612.24±1.26
Spinach	Root	9.12±1.57	35.14±0.83	1.08±1.16	10.16±1.20	348.14±1.60	625.41±1.05
	Stem	8.43±1.68	33.01±0.94	1.11±1.52	9.58±0.92	331.25±1.12	612.14±0.98
	Leaf	8.12±1.54	32.911.40	1.04±0.93	9.01±0.66	312.48±2.06	603.45±1.56
Soil		10.12±1.45	54.01±0.94	2.01±0.41	12.41±0.84	548.21±1.81	824.11±1.41
Water		21.41±1.04	64.91±1.15	2.91±0.51	18.91±0.41	621.4±1.41	989.15±2.18

Vegetables & soil: µg/g
Sewage / fresh water: µg/lt

The sewage also contains excess content of heavy metals. These heavy metals to the extent exceeding the sufficient and normal status but are tolerable level in agricultural crops (Kabata Pendias, 2005). The concentration of heavy metals in different vegetables at different parts are presented in the Table (4 & 5). The analysis of data showed that the metal translocation and accumulation potentiality vary from one plant itself.

Among the vegetables the underground edible parts and the fruit bearing plants shows significant accumulation of metals. The heavy metal concentrations in edible part of vegetables in Dharwad (India), are shown Table 4 & 5 and Fig 1 & 2. It was clearly observed that the concentration of all the heavy metals is higher in waste water (sewage) irrigated vegetables than fresh water (control) irrigated plants. The above table 4 & 5 shows a very high concentration of heavy metals in vegetables irrigated with waste water.

Zinc

The tolerable limit of agricultural crops for zinc is 300µg/g and normal is 27-150 µg/g. In the vegetable irrigated with fresh water recorded maximum in lady's finger (49.28±1.25 µg/g) minimum was recorded in tomato stem (17.56±1.16 µg/g).

However, radish root found to accumulate heavy metal maximum concentration of Zn (81.41±2.04 µg/g) and minimum was recorded in lady's finger leaf (46.35±2.98 µg/g). The concentration of Zn in most of the vegetables brought from the field were higher than those of vegetables irrigated with fresh water. This meant that the source of irrigation (waste water) was probably because of scarcity of fresh water. Zinc is considered to be relatively nontoxic, especially if taken orally. However, excess amount can cause system dysfunctions that result in impairment of growth and reproduction. The clinical signs of zinc toxicosis have been reported as vomiting, diarrhea, bloody urine, icterus (yellow mucus membrane), liver failure, kidney failure and anemia (Duruibe *et al*., 2007). Zinc is nutritionally essential metal. Excess Zn in the body bound in various transcription regions such as polymerase enzymes (Wang *et al*., 1997).

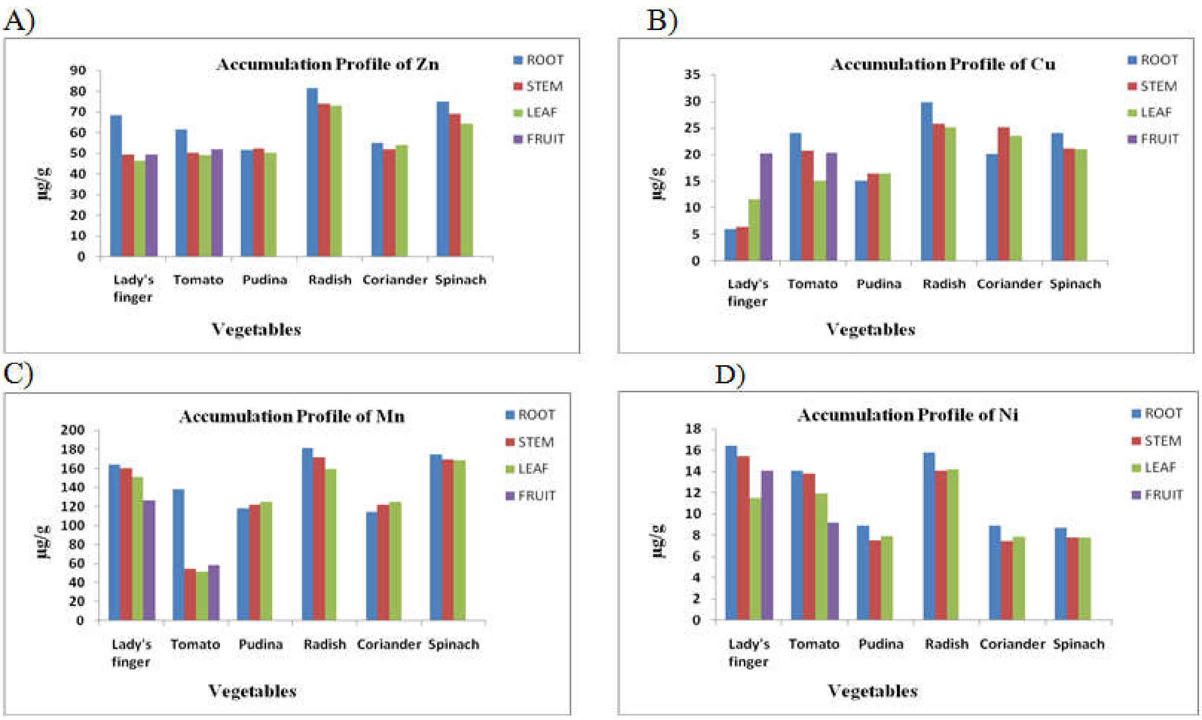

Fig 1.Metal accumulation profile in vegetables

A) Zinc B) Copper C) Manganese D) Nickel

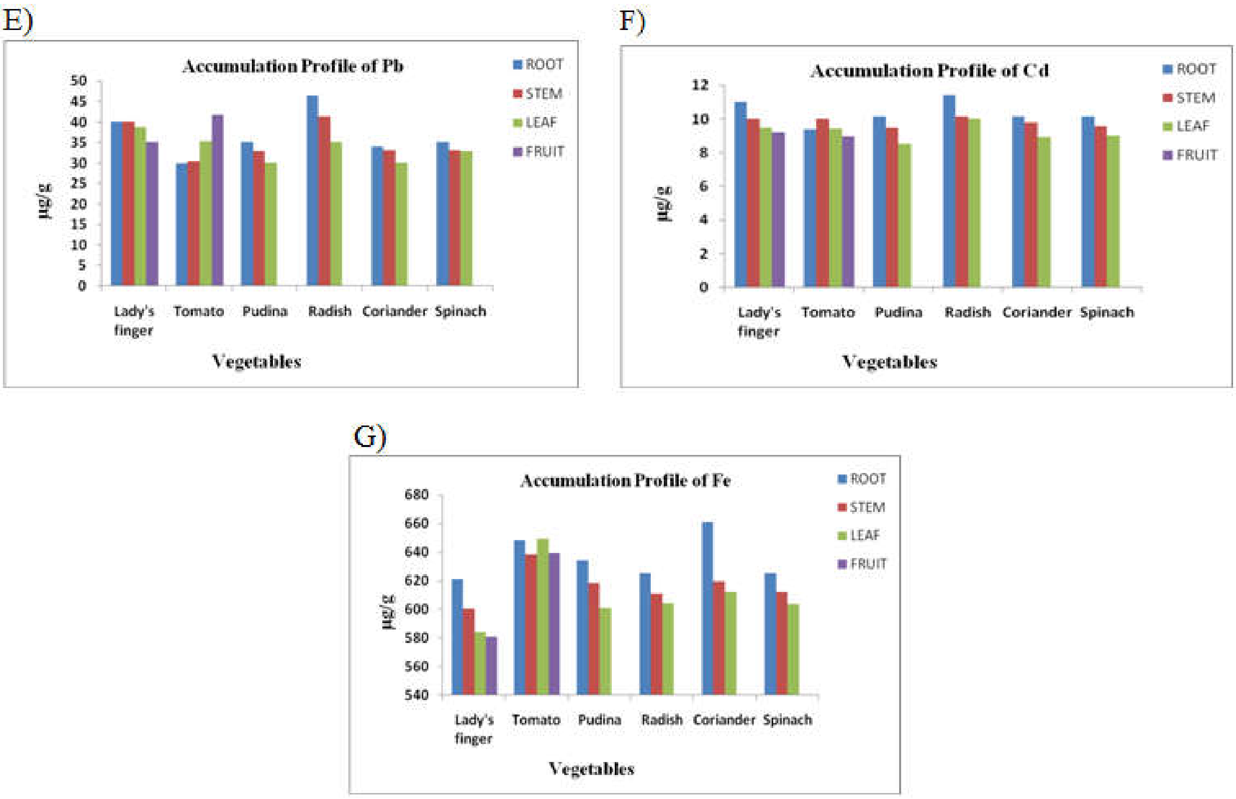

Fig. 2. Metal accumulation profile in vegetables

E)Lead F)Cadmium G)Iron

Fig 3. Map showing Dharwad district (Karnataka, India)

Copper

Tolerable limit in agricultural crops for Cu is 50 µg/g and normal limit is about 5-30 µg/g. The vegetables irrigated with fresh water contains 17.90±1.65 µg/g of Cu in root part of radish and minimum was recorded 4.11±0.86 µg/g in mint root. However, maximum accumulation of Cu was recorded in root part of radish to about 29.9±1.28 µg/g and minimum content was recorded in 6.1±0.61 µg/g in root part of lady's finger. Copper is essential element, but higher concentration intake leads to serve mucosal irritation, widespread capillary damage, renal and hepatic damage. Similar trend was observed for the other metals i.e maximum accumulation in waste water irrigated vegetables and minimum in fresh water irrigated vegetables. The differences of the metal contents in these vegetables depends on the physical chemical nature of the soil and absorption capacity of each metal by the plant, which is altered by various factors like environmental and human interference and nature of the plant (Salmeron & Pozo, 1989).

In a general population food and drinking water potential sources of excess exposure. Excessive accumulation of copper in liver, brain, kidneys, menifests into 'Wilson's disease' (This disorder is also called hepatolenticular degeneration).

Manganese

For manganese the tolerable limit in agricultural crops is 300 µg/g and normal value is 30-300 µg/g (Kabata Pendias, 2005). In our observation maximum content of manganese was recorded in tomato fruit (44.12±0.72 µg/g) and minimum content in lady's finger, root to the extent of 21.4±1.40 µg/g irrigated with fresh water. However, the waste water irrigated vegetable shows maximum accumulation recorded in radish, root (181.1 µg/g) and minimum was recorded in tomato leaf to the extent of 51.82±0.72 µg/g. Manganese is micronutrient essential for physiological functions. In higher concentrations it is toxic causing neuropsychiatic disorder characterized by irritability, difficulty in walking and speech disturbances (Singh & Kalamdhad, 2011).

Nickel

Nickel has been considered to be an essential trace element for human and animal health (Zighan *et al*., 2012). The permissible tolerable limit in agricultural crops according to Kabata Pendias (2005) is 50µg/g and normal is about 0.1-5.0 µg/g. Due to the bioaccumulation nickel shows skin irritation, damage to the lungs, nervous system and mucosa membranes.

When present easily distributed to kidneys, pituitary, lungs, skin, adrinals, ovaries and testis but however, risks were highest for lungs and nasal cancers (Singh & Kalamdhad, 2011). Tomato stem found to accumulate the maximum concentration of nickel to about 4.91±1.45 µg/g and minimum accumulation was recorded in lady's finger fruit (1.01±0.80 µg/g) when the vegetables were treated with fresh water. However, sewage irrigated vegetables shows nickel accumulation to the extent of 15.8±1.57 µg/g in radish root and minimum accumulation was recorded in coriander stem to the extent of 7.45±2.02 µg/g. Nickel is ubiquitous in nature. It occurs mainly in the form of sulphide and silicate minerals. Nickel when administrated to animals is rapidly distributed to the kidneys, pituitary, lungs, skin, adrenals, ovaries and testis (Sunderman, 1989). Nickel is carcinogenic to human and risks are highest for lung and nasal cancers. Nickel also damages DNA directly through reactive oxygen species (McCoy and Kenney, 1992).

Lead

The permissible tolerable limit in agricultural crops is 10.0 µg/g and normal is varying from 5.0 -15.0 µg/g (Kabata Pendias, 2005). Lead is a poisonous metal, in human it is directly absorbed into the blood stream and is stored in soft tissues, bones and teeth. Chronic damage to the central nervous system (CNS) and peripheral nervous system (PNS). Lead can also causes difficulties in pregnancy (Seokjoo *et al*., 2008). In our results maximum accumulation in radish root (10.98±0.78 µg/g) and minimum was recorded in tomato stem (6.48±1.38 µg/g) in fresh water irrigated soils. However, waste water irrigated radish root showed significantly higher accumulation of lead (46.40±0.77 µg/g) and minimum accumulation was recorded in tomato root (29.95±0.96 µg/g). Lead is essential element, but higher concentration intake leads to serve mucosal irritation, widespread capillary damage, renal and hepatic damage and possible necrotic changes in liver and kidney. Lead is ubiquitous metal and predominantly poisoning in children. Children absorbs greater proportion of lead than adults. Toxicity includes damage to the membranes and disturbances in energy metabolism. On protein binding sites Pb can substitute calcium and zinc. This substitution alter the normal functioning of proteins and induce aberrant gene transcription (Boutan *et al*., 2001).

Cadmium

The permissible tolerable limit in agricultural crops for cadmium is 3.0 µg/g and normal is varying about 0.05 – 0.2 µg/g (Kabata-Pendias, 2005). In control i.e fresh water irrigated vegetables maximum accumulation is 1.91±0.68 µg/g in tomato stem and minimum recorded is 0.80±0.24 µg/g in lady's finger fruit. Surprisingly it is observed that the concentration of cadmium in waste water irrigated vegetables is higher and alarming. Maximum accumulation is recorded in radish root (11.41±1.41 µg/g) and minimum record in mint leaves (8.51±2.01 µg/g). Cadmium accumulate in the human kidney for relatively long time and higher dose is risk to the kidney, respiratory system, cardiac failure and is associated with bone diseases (Singh & Kalamdhad, 2011). It is well known that cadmium affects the transcription of number of genes. Cadmium induces those human genes that perform protective functions and those coding for metallothionines (Schmidt, 1985). Wang and Crowley (2005) reported that disruption in the transcription of genes in coding ribosomal proteins explains molecular mechanism od cadmium toxicity.

Iron

A similar trend was observed for the iron also. The permissible tolerable limit in agricultural crops is 375.0 µg/g. Maximum accumulation in radish root to the extent of 424.68±2.14 µg/g and minimum in spinach leaves and is recorded to about 312.48±2.06 µg/g in fresh water irrigated vegetables. However, in waste water irrigated vegetables maximum accumulation was noticed in coriander root (661.24±2.03 µg/g) and minimum in lady's finger fruit (581.12±1.54 µg/g). Entry of heavy metals to the food chain has been reported through vegetable consumption (Dube *et.al* .,2004, Liu, *et al*., 2006). The use of sewage, contaminated vegetables with heavy metals has significant health implications for both farmers and consumer (Birley *et al.,* 2002, Alam *et al.,* 2003). Patra *et al.,* 2001 studied xenobiotic effect of vegetables extracts (Cauliflower, spinach, radish) containing combination of various heavy metals after in vivo acute exposure in mice and found significant increase in chromosome aberrations when compared to control mice. The toxicity of metals commonly involves the brain and kidney, particularly Pb accumulates in the vital organs of man and animals. Its cumulative poisoning effects are serious hematological damage, anemia, kidney malfunctioning, brain damage etc. Cd is also one of the most serious environmental pollutants. Cd enters the organism primarily via the alimentary and or respiratory tract. Cd damages a specific structure of the functional unit of kidney (Lal, 2005, Tuzen *et.al.,* 2005) and skeletal deformities commonly known as itai-itai disease (Anonymous, 1997). Thus, increased circulation of heavy metals in vegetables results in inevitable buildup of toxins in the human food chain and their accumulation leads to various ailments. Our results shows agreement with previous studies showing elevated levels of heavy metals in the edible part of food crops with continuous waste water irrigation (Liu *et al*., 2005; Khan *et al*., 2007). The results of the present study showed that the vegetables grown by using the sewage constitute risk due to accumulation of metals. In almost all collected samples it was recorded that the heavy metal concentrations are above the permissible limit set by WHO but are in the range except nickel, cadmium and iron accumulation (Kabata Pendias, 1995). Further, the vegetables are very effective in absorbing the toxic pollutants of the soil. The use of vegetables which have potentiality to remove the metal from the sewage irrigated soil, thereby cleaning up of environment. The sewage has significant health implications for both consumers and farmers and hence, proper health education is quite essential for women and men who were in contact with sewage during farming (Hunsyal *et al.,* 2003).

Acknowledgements

The authors are thankful to the Principal, BLDEA's Com. BHS Arts & TGP Science College, Jamkhandi (Karnataka), Principal, JSS College Dharwad and to the Chairman, PG Department Botany, Karnatak University, Dharwad (Karnataka) for providing necessary facilities to carry out research work.

REFERENCES

Alam, M.G.M., Snow, E.T., Tanaka, A. 2003. Arsenic and heavy metal contamination of vegetables grown in Santa village, Bangladesh. *Science of the Total Environment,* 308, 83-96.

Allen S.E., Grimshaw H.M., Parkinson J.A., Quarm by C. 1974. Chemical analysis of ecological materials, Blackwell Scientific Publications, Oxford.

Anonymous. 1997. Report on Cadmium in fresh water fish. Water quality criteria for European fresh water fish. European Inland Fisheries Advisory Commission. F.A.O.U.N. Technical paper No. 30.

APHA, AWWA, WEF. 1998. Standard methods for the examination of water and waste water (20Th edn.) Washington, DC: American Public Health Association.

Birley, M.H., Lock K. 2002. Health and peri-urban natural resource production *Environment and Urbanization*. Vol(10) N0 1: 89-106.

Bouton, C.M. and Pevsner, J. 2000. Effects of lead on gene expression. *Neurotoxicology,* 21, 1045-1055.

Chaolan, Z., Zhongyi, Li, Weiwei, Y., Lipping, P., Minghua G., Dokyoung, L. 2013. Assessment of metals pollution on agricultural soil surrounding a lead-zinc mining area in the Karst region of Guangxi, Chaina, *Bull Environ Contam Toxicol.,* 90: 736-741.

Chen, Y., Wang, C., Wang, Z. 2005. Residues and source indentification of persistent organic pollutants in farmland soils irrigated by effluents from biological treatment plants. *Environment International,* 31*:* 778-783.

Choudhary, R. 2012. Heavy metal analysis of water of Kaliasote dam of Bhopal, MP, India, *Research Journal of Recent Sciences*, 1: 352-353.

Dube, B.K., Sinha, P., Chatarjee C. 2004. Crop plants as biological tools for assessing and monitoring agricultural lands inundated with sewage and sludge, *Bull. Environ. Contam. Toxicol*, 72: 429-436.

Gupta, S., Satpati, S., Nayek, S., Garai, D. 2009. Effect of waste water irrigation on vegetables in relation to bioaccumulation of heavy metals and biochemical changes, *Environ. Monit. Assess.,* Doi 10.1007/s 10661-009-0936-3.

Hunshyal, C.S., Brook, R., Bradford, A. 2003. Waste water irrigation in Hubli-Dharwad, India, Implications for health and livelihoods, *Environment and Urbanization,* 15(2):157-170.

Kabata-Pendias, A. 2005. Heavy metals (problems and solutions). Edited by: W. Salomonas, U. Forstner and P. Mader), Springer Verlag, Berlin, Heidelberg, New York. London, Tokyo, 3-18.

Khan, S., Cao, Q., Zheng, Y.M., Huang, Y.Z. and Zhu, Y.G. 2007. Health risks of heavy metals in contaminated soils and food crops irrigated with waste water in Veijing, China. *Environment Pollution,* 1-7.

Lal, R.B. 2005. Effect of heavy metal toxicity and exposure on human health. Indian *J. Environ. And Ecoplan*. 10(2): 533-536.

Liu, J., Xie, Y., Ward, J Diwan, B.A. and Waalkies, M.P. 2006. Toxicogenomic analysis of aberrant gene xpression in liver tumors and non-tumors livers of adult mice exposed in vitro to inorganic arsenic. *Toxicol. Sci*. 77: 249-257.

Liu, W.H., Zhao, J.Z., Ouyang, Y. Z., Soderlund, L and Liu, G.H. 2005. Impacts of sewage irrigation on heavy metals distribution and contamination. *Environment International,* 31: 805-812.

McCoy, H. and Kenney, M.A. 1992. A review of bioindications on Ni and Mg. II Immune system and oncology. Magnes. Res. 5:223-232.

Muchuweti, M., Birkett, J., Chinyanga, E.N., Zvauya, R., Scrimshaw, M.D., Lster, J.N. 2006. Heavy metal content of vegetables irrigated with mixture of waste water and sewage sludge in Zimbabwe: implications for human health. *Agriculture, Ecosystem and Environment,* 112: 41-48.

Nazir, R., Muhammad, M., Hameed, R., Naveed, R., Nausheen, N., Mohib, U. & Zeenat S. 2015. Accumulation of heavy metals (Ni, Cu, Cd, Cr, Pb, Zn, Fe) in the soil, water and plants and analysis of physico-chemical parameters of soil and water collected from Tanda dam kohat. *Journal of Pharmaceutical Sciences and Research*. 7(3): 89-97.

Patra, U., Gupta, S., Talapatra, S.N., Giri A.K. 2001. Genotoxic effects after invivo exposure of vegetables extracts containing heavy metals from Dhapa area of Calcutta, India. I effects of cauliflower, Spinach and radish, *Food and Chem. Toxicol*, 39: 67-72.

Pophali, S., Siddiqui, S., Khan, L.H. 1990. Sources and distribution of heavy metals in the abiotic components of a polluted urban stream.

Salmeron, J. and Pozo, R. 1989. Heavy metal uptake from greenhouse border soils for edible vegetables. *Journal of the Science of food and Agriculture,* 49: 307-314.

Schmidt, C.J., Jubier, M.F. and Hamer, D.H. 1985. Structure and expression of two human metallothionein-I isoform genes and a related pseudogene. *J. Biol. Chem.,* 260: 7731-7737.

Seokjoo, Y., Sang, S.H. and Rana, S.V.S. 2008. Molecular markers of heavy metal toxicity- A new paradigm for health risk assessment. *Journal of Environmental Biology,* 29(1): 1-14.

Singh, A. and Agrwal. 2010. Effects of municipal waste water irrigation on availability of heavy metals and morphological characters of *Beta vulgaris* L*, journal of Environmental Biology,* 31(5): 727-736.

Singh, J. & Kalamdhad, A.S. 2011. Effcets of heavy metals on soil, plants human health and aquatic life. *International Journal of esearch in Chemistry and Environment,* vol. 1 issue 2, 15-21.

Sunderman, F.W. 1989. Jr.: Mechanism of nickel carcinogenesis. *Scand. J. Work. Environ. Hlth.,* 15: 1-12.

Tuzen, M., Parlor, K., Soylak, M. 2005. Enrichment / Seperation of Cadmium (II) and lead (II) in environmental samples by solid phase extraction. *J. Hazard Mat IN press*.

Wang, A. and Crowley, D.E. 2005. Global gene expression responses to cadmium toxicity in *Escherichia coli. J. Bacterol.,* 187: 3259-3266.

World Health Organization. 1993. Guidelines for drinking water quality-I, Recommendations, 2nd Edi. Geneva WHO.

Zigan, Hasan, Zubair Anwar, Khalid Usman Khattak, Mazhar Islam, Rizwan Ullah Khan, Jabar Zaman Khan Khattak. 2012. "Civic Pollution and its effect on water quality of river toi at district kohat, NWFP", *Research Journal of Environmental and Earth Sciences*, vol 4:5.

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