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Heavy Metal Contamination in Vegetables, Fruits, Soil and Water – A Critical Review

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Abstract

India has diverse agro-climate and produces a wide range of fruits and vegetables. It is the 2nd largest producer of fruits and vegetables in the world. It produces 74 million tones of fruits and 146 million tonnes of vegetables. Fruits and vegetables not only provide us nutritional and healthy foods, but also generate a considerable cash income for growers. Quality assurance is a prerequisite for high value fresh fruits and vegetables. The quality of fresh fruits and vegetables has a decisive effect on their value. This is a particularly true when consumers have a high income and the market provides a wide choice of produce. Fruit and vegetables are rich sources of vitamins, minerals, and fibers and also have beneficial antioxidative effects. However, the intake of heavy metal-contaminated fruit and vegetables may pose a risk to human health; hence the heavy metal contamination of food is one of the most important aspects of food quality assurance.

Highlights

- Heavy metal contamination is a serious problem worldwide due to the adverse effects on food quality.
- The main threats to human health from heavy metals are associated with exposure to lead, cadmium, mercury and arsenic.

Keywords: Heavy metal, Fruits, Vegetables, Pollution.

Food safety is a major concern worldwide. The heavy metals pollution is one of the problems that arise due to the increased uses of fertilisers and other chemicals to meet the higher demands of food production for human consumption. Heavy metals are the major contaminants of food supply and may be considered the most important problem to our environment (Zaidi *et al.,*2005). A heavy metal is any one of a number of elements that exhibit metallic properties, which includes transition metals lanthanides actinides as well as the metalloids arsenic and antimony. Typically the term refers to elements of atomic number 21 or higher (e.g. Scandium or above) The term heavy metal chiefly arose with discussions of pollutants discharged to the environment in the form of air, water or soil contaminants, while many heavy metals have considerable toxicity, others are considered not deemed to possess significant toxic properties, and, in fact, several of these elements including zinc, iron, copper, chromium and cobalt are necessary for metabolic function for a large class of organisms (Hogan 2011). Heavy metals such as Cd, Cu, Pb, Cr and Hg are important environmental pollutants, particularly in areas with high anthropogenic pressure. Their presence in the atmosphere, soil, water, even in traces, can cause serious problems to all organisms (Islam *et al.,*2007) .It is well known that an excess or deficiency of trace metals present in the human body can cause harmful effects. For example an excess of Cu in the body cause Willson's disease while a deficiency of Zn is responsible for retarded body growth (Olivares and Uauy 1996). Increasing knowledge about the potentially deleterious effects of heavy metals on environmental and human health has prompted closer examination of the presence and behaviour of such elements in agriculture ecosystems. Heavy metals occur in fertilizers and in some pesticides, purposefully included as micronutitional or bicidal components, present as naturally occurring contaminants or introduced when waste materials are used to formulate fertilizer products. Heavy metals may be of particular concern in tree fruit production because of the importance of foliar spray, which deposits fertilizers and pesticide residue directly on to fruits. Current issues concerning heavy metal and nutrient management include natural cadmium enrichment in phosphorous fertilizer, anthropogenic heavy metal contamination of zinc fertilizer and copper contamination of soil resulting from historical pesticide application (ISHS 2001). Health risk assessment for heavy metals of the population is a very good technique because such assessment would be useful to give information about any threat regarding heavy metals contamination in vegetables (Khan *et al.,*2009). Ingestion of heavy metals through food can cause accumulation in organisms, producing serious health hazards such as injury to the kidney, symptoms of chronic toxicity, renal failure and liver damage (Sathawara *et al.,*2004). Human beings are encouraged to consume more vegetables and fruits, which are a good source of vitamins, minerals, fibres and also beneficial to their health. However, these plants contain both essential and toxic metals over a wide range of concentrations. It is well known that plants take up metals by absorbing them from contaminated soils as well as from deposits on parts of the plants exposed to the air from polluted environments (Chojnacha *et al.,*2005; Khairiah *et al.,*2004). Heavy metal accumulation in soils is of concern in agricultural production due to the adverse effects on food safety and marketability, crop growth due to phytotoxicity and environmental health of soil organisms. The influence of plants and their metabolic activities affects the geological and biological redistribution of heavy metals through pollution of the air, water and soil (Nagajyoti *et al.,*2010). Heavy metals, in general, are not biodegradable, have long biological half lives and have the potential for accumulation in the different body organs leading to unwanted side effects (Jarup 2003; Sathawara *et al.,*2004). Human health may be directly affected by ingestion fruits and vegetables, if enhanced amount of macronutrients are present in such edible (Disipio and Trulli 1999).

Tests that aim to assess metal "bioavailability" are now gaining widespread acceptance by regulators as a means to characterise hazards from contaminants in soil. While a significant advance on the use of total metal concentrations, the concept raises difficulties in providing an adequate assessment of potential risk, due to changes in environmental conditions which affect bioavailability, e.g. soil pH, soil organic matter content (McLaughlin *et al.,*2000). Heavy metal is present in diminutive quantities in the water and is further added due to soil erosion and leaching of minerals. However, in the recent past, freshwater pollution due to heavy metals has become a hazard due to discharge of industrial effluents. Heavy metals like Mn, Fe, Ni, Cu, Zn and Cr are essential for the growth of organisms while Pb, Cd, Hg and Ag are not biologically essential but definitely toxic. Even the essential heavy metals may be beyond optimum threshold levels, hazardous and toxic. After entering the water, metals may precipitate, gets absorbed on solid surface, remain suspended in water or taken up by fauna. A very important biological property of metal is its tendency to accumulate (Puttaiah and Kiran 2008). For most people, the main route of exposure to toxic elements is through dietary intake (Calderon *et al.,*2003; Roychowdhury *et al.,*2003). The major contribution for the daily intake is the ingestion route, eventual uptake in the body stream is contributed through inhalation for Pb (41%) and Cd (16%) and ingestion for Cu (98.8%) and Zn (99.6%). The total intake of these elements through the duplicate diet study is 9500 µg/day for Zn, 1770 µg/day for Cu, 27 µg/day for Pb and 2.5 µg/day for Cd, respectively. The daily intake of these metals by the population of Bombay is well below the recommended dietary values (Tripathi *et al.,*1997). Leaf surfaces can act as points of uptake for heavy metals, both by stomatal and cuticle pathways. Stomates allow passage of gaseous heavy metals, e.g. mercury, whereas cuticle intake is applicable to ionic forms of heavy metals. High relative humidity promotes cuticle intake, since those conditions create a swollen cuticle, subject to easiest penetration. There is a pronounced difference on cuticular uptake rate for different heavy metals. For example, copper, zinc and cadmium are found to be taken up at high rates by cuticles of many plants, whereas lead is transmitted in very low quantities (Hogan 2011).

Heavy Metals In Fruits & Vegetables

All heavy-metal levels were below permissible limits except 'lead' (Pb) on vegetables which was 1.8-3.5 times higher. The highest hazard index (42%) found in waste water irrigated cabbage (Lente *et al.,* 2013). Leafy vegetables like *Amaranthus* have more scavenging capacity for Cd and Pb, while *Spinacia Oleracea* has more scavenging capacity for chromium (Kumar *et al.,*2013). Vegetable production of *Solanum melongena* was negatively affected by the presence of heavy metals in Kolkatta, India. The concentration of Cd, Cr, Pb, Ni and Hg were found to be higher than the WHO, FAO permissible limit in *Solanum melongena* (Nandi *et al.,*2012). The heavy metals not only affect the nutritive values of vegetables but also affect the health of human beings and therefore the safe limits of these heavy metals are lowered regularly in these vegetables. This regulation is the responsibility of National and International regulatory authority (Mohammad and Ahmed 2006). Four sites in Ranchi city, Bihar were analyzed for metal contamination. The concentration ranges (ppm) were 13.733-20.667 for Pb in peas, 0.3333-4.333 for Ni, 1.167-2.933 for Ni and 0.100-0.800 for Cd in cucumber, 0.267-0.867 for Cd in coriander (Ghosh *et al.,* 2011). Ladyfinger was found to be the best accumulator of all detected metals. The highest mean content (mg/kg) of Zn ranged from 62.667-12.833, 2.667-26.00 for Cu, 0.0-1.833 for Pb and 0.0-0.667 for Ni (Tewari and Pande, 2013). Zinc permissible limit for edible parts of crops is 50 mg/kg (Awasthi, 2000). Vegetable samples collected from farms and urban markets in Zanzibars showed higher concentrations of Zn, Fe, Cr and Mn in amaranth while in cabbage, Cd, Ni and Pb were on higher side. Although the mean concentrations of the essential elements were in the range reported in the literature, Pb and Cd were in concentrations above FAO/WHO tolerable limits (Mohammed and Khamis 2012). The average concentrations in some selected fruits and vegetables were found to be 0.02-1.824,0.75-6.21,0.042-11.4,0.141-1.168,0.19-5.143 and 0.01-0.362 mg/kg for Pb, Cu, Zn, Co, Ni and Cd respectively (Elbagermi *et al.,* 2012). According to market basket survey of some Egyptian fruits and vegetables, the average concentrations (mg/kg) for Pb, Cd, Cu and Zn were found to be 0.01-0.87,0.01-0.15,0.83-18.3 and 1.36-20.9, respectively (Radwan and Salama, 2006). According to Joint FAO and WHO Expert Committee on Food Additives 1999, the daily intakes of Pb, Cd, Cu and Zn were below the recommended tolerable levels proposed by and may not constitute a health hazards for consumers. The order of toxic heavy metal contamination in vegetables followed the order : spinach>radish>brinjal>beans. Accumulation of heavy metals in these vegetables might be due to the use of sewage fed lake water for their cultivation (Lokeshwari and Chandrappa 2006). The impact of human activity on the food chain, monitoring of trace metals in a variety of fruits being sold in Karachi's metropolis was studied (Zahir *et al.,* 2009). The edible portion of *B. Vulgaris* showed higher concentration of Cd which was higher than the Indian standard during summer whereas Pb and Ni concentrations were higher in both summer and winter seasons (Sharma *et al.,* 2007). High levels of Cu, Zn, Pb, Cd, Ni and Fe was reported in leaf vegetables grown in domestic gardens in close proximity to the copper smelter in Wollongong, New South Wales, Australia. Mean levels (dry matter weight) of Pb, Cd and Ni in lettuce were 23, 4.5 and 2.7 ppm, respectively (Beavington 1975). In two districts of West Bengal, India, the mean concentration of Cu was within the safe value recommended by FAO/WHO but of Pb in all the samples and of Cd & Cr in some of the samples exceed the allowable limit. The study highlighted how there is an increased risk of taking fresh fruits and vegetables (Banerjee *et al.,* 2010). Heavy metals accumulation in vegetables tested was higher at market sites than those at the crop production sites. The contributions of these vegetables to dietary intake of Cu, Zn, Cd and Pb were 13%,1%,47% and 9% of provisional tolerable daily intake, respectively (Sharma *et al.,*2009). Emissions of heavy metals from the industries and vehicles may be deposited on the vegetable surfaces during their production, transport and marketing. Elevated levels of heavy metals were reported in vegetables sold in the markets at Riyadh city in Saudi Arabia due to atmospheric deposition (Jassir *et al.,* 2005). The leaves of spinach, cabbage, cauliflower, radish and coriander contained higher concentrations of Cu (0.923 mg kg-1), Cd (0.073 mg kg-1), Cr (0.546 mg kg-1), Zn (1.893 mg kg-1) and Pb (2.652 mg kg-1) as compared to other parts of each vegetable (Farooq *et al.,* 2008). At one site the vegetable samples recorded very high levels of Cd and Pb and >95% of the samples had Cd and Pb exceeding the maximum level set by Australian and New Zealand Food Authority. At second site 17% and 44% of vegetable samples exceeded the maximum limit of Cd and Pb, respectively (Kachenko and Singh 2006). The mathematical model result showed that the primary inputs of Cr, Co and Ni were due to pedogenic factors, while the inputs of Pb and Cd were due to anthropogenic sources (Bordean *et al.,*2011). Washing of vegetables with clean water was a very effective and easy way of decontaminating the metal pollution as it reduced the contamination by 75-100% (Singh and Kumar 2006). Edible part of the vegetables (under ground) such as, garlic (19.27 microg g(-1) dw), potato (11.81 microg g(-1) dw) and turmeric (20.86 microg g(-1) dw) has accumulated lowest level of toxic metal, Cr than leafy and fruit bearing vegetables (Sinha *et al.,*2006). Highest concentration of Pb and Cu are in pulses (green gram), Cd in leafy vegetables (amaranth) and Zn in meat. Root vegetables and fruits contained a lower concentration of these metals (Tripathi *et al.,*1997). Consumption of vegetables and fish contaminated with the heavy metals Cu, Zn, Pb, Cd, Hg, and Cr is the most likely route for human exposure in Tianjin, China. Health risks associated with these heavy metals were assessed based on the target hazard quotients (THQs), which can be derived from concentrations of heavy metals in vegetables and fish consumed in four districts (Dong Li, Xi Qing, Jin Nan, and Bei Chen) and the urban area of Tianjin, China (Wang *et al.* 2005). Six essential elements, cadmium and lead were determined in some horticultural species cultivated in greenhouse borders by atomic absorption spectrophotometry to evaluate the contribution of these vegetables to the daily intake of cadmium and lead in Spain. If the mean levels of cadmium and lead (0.029 mg kg^{-1} and 0.221 mg kg^{-1} respectively) are taken into account, the daily intake contribution of these metals will be 1.4 μg day^{-1} for cadmium and 11 μg day^{-1} for lead (Zurera *et al.,*1989). In Kalipur, Bangladesh, studies were conducted on the uptake of Cu, Pb, Ni and Cd by Brassica oleracea from fields irrigated with industrial effluent indicated widespread contamination from heavy metals despite showing a healthy and gigantic external morphology (Kisku *et al.,*2000). 48 and 75% of the vegetable samples had concentrations of Cd and Pb which exceeded the FAO-WHO limits, respectively (Mohajer *et al.,*2012). The levels (mg/100g dry weight) ranged from 0.885 to 1.39 for Cu and 0.05 to 0.315 for Pb in two popular leafy vegetables viz. Chinese cabbage and pumpkin grown around Morogoro Municipality, Tanzania. Three sites (Mazimbu, Kihonda and Towelo) were studied. Vegetables from Mazimbu showed higher whereas Towelo showed lower concentrations of Cu and Pb (Chove *et al.,*2006). HQ was found to be high for Zn followed by Cr and Pb with special reference to leafy vegetables particularly spinach and amaranthus (Chary *et al.,*2008). Effects of excess zinc on plant growth of Chinese cabbage, celery and pakchopi was studied and results revealed that excess Zn in growth media caused toxicity to all three vegetable crops (Long *et al.,* 2003).The levels of Cadmium and Zinc for the leafy vegetables ranged from 0.028±0.003 to 0.091±0.103 and from 0.348±0.317 to 0.77±0.38mg/kg dry weight respectively. Lead was not detected in all the samples (Kudirat and Funmilayo 2011). Chinese cabbage picks up Lead more readily compared to other heavy metals such as Cadmium, Copper, Nickel and Zinc. In contrast, no Lead was detected in vegetable samples as at the time of this study and hence within safe limit, regular monitoring is required over a long period as the vegetables are transported from different sources (Wong *et al.,*1996). The site of growth noticeably influences the heavy metal uptake by vegetables. Generally, lead contaminations occur in vegetables grown on contaminated soils. Lead poisoning is a global reality, and fortunately is not a very common clinical diagnosis yet in Nigeria except for few occupational exposures (Anetor *et al.,*1999). The contents of investigated trace elements (μg/g) in canned foods were found to be in the range of 2.85–7.77 for copper, 8.46–21.9 for zinc, 6.46–18.6 for manganese, 27.5–79.6

for iron, 0.05–0.35 for selenium, 0.93–3.17 for aluminium, 0.19–0.52 for chromium, 0.18–0.75 for nickel, and 0.20–1.10 for cobalt (Tuzin and Soylak 2007).

Heavy Metals In Soil

Heavy metals occur naturally in soil environment from the pedogenetic processes of weathering of parent materials at levels that are regarded as trace (<1000 mg/kg) and rarely toxic (Pendias and Pendias 2001; Pierzynski *et al.,*2000). The uptake of metals from the soil depends on different factors such as their soluble content in it, soil pH, plant growth stages, types of species, fertilizers and soil (Ismail *et al.,*2005; Sharma *et al.,* 2006). The worldwide Pb concentration for surface soils averages 32 mg/kg and ranges from 10 to 67 mg/kg (Pendias and Pendias 2001). Tiruchirappalli, an open dumpsite in Tamilnadu receives 400-470 tonnes of municipal soild waste. The heavy metal concentration in soil samples collected from the solid waste found in the order of Mn> Pb>Cu>Cd in the ranges of 0.1605-1.7962,0.7655-5.1485,0.546-2.6886 and 0.1641-1.0372 mg/l, respectively. The presence of heavy metals in soil samples indicates that there is appreciable contamination of soil by leachate migration from this dumping site (Kanmani and Gandhimathi 2013). The concentrations of heavy metals from different sites ranged from a minimum of 42.400 to a maximum of 137.858, 25.500-108.325, 4.800- 32.283 and 2.283-13.725 for Zn, Cu, Pb and Ni, respectively (Tewari and Pande 2013). Heavy metal contamination of soil may pose risks and hazards to humans and the ecosystem through direct ingestion or contact with contaminated soil, the food chain, drinking of contaminated ground water, reduction in food quality via phytotoxicity, reduction in land usability for agricultural production causing food insecurity and land tenure problems (McLaughlin *et al.,*2000; McLaughlin *et al.,*2000; Ling *et al.,*2007). Distribution and forms of Cu, Zn, Cd, Fe and Mn in soils were studies near a copper smelter in Washington which revealed that the mobility of Cu, Zn, and Cd in the soils was limited, as evidenced by a sharp reduction in concentrations of the three elements with depth. Comparing subsoil concentrations of these elements with those from areas relatively unpolluted by smelter fallout revealed that Cd was more leachable than Cu or Zn (Kuo *et al.,*1983). Metal bearing solids at contaminated sites can originate from various anthropogenic sources like metal mine tailings, disposal of high metal wastes, lead based paints, compost, pesticides, petrochemicals and atmospheric deposition (Basta *et al.,*2005). There was significant correlation between distance from the main chimney of the smelter and the levels of a number of metals in soil (Beavington 1975). Accumulation of Heavy Metals in Soil and their Transfer to Leafy Vegetables was studied in the Region of Dhaka Aricha Highway, Savar, Bangladesh (Aktaruzzaman *et al.,*2013). Higher concentrations of Cu (137.7 μg/g) and Zn (139 μg/g) were reported in the soils collected from industrial areas of Surat, Western India (Krishna and Govil 2007). Cr, Ni and Pb concentrations in the soils of Jagiroad paper mill area, Assam , India, mainly originated from paper mill effluent and soil Cd was associated with natural concentration (Reza *et al.,*2013). Most accumulation of heavy metals was observed in the surface layer of the soil. However through shrink-swell cracks heavy metals can penetrate into the subsoil layers and consequently contaminate the surface groundwater. Long term irrigation with effluent and sludge increased heavy metal contents in soil and plants and made this practice unsafe to be applied by man (Behbahaninia *et al.,*2009). Soil metal concentrations decreased with depth, suggesting anthropogenic sources of contamination (Kachenko and Singh 2006). The concept of pollution index (PI) of soils gives important information on the extent and degree of multi-element contamination and can be applied to the evaluation of soils prior to their agricultural use and remediations (Chon *et al.,*2011). The analysis of plant available metal content in the soil showed the highest level of Fe, which ranged from 529.02 to 2615 microg g(-1) dw and lowest level of Ni (3.12 to 10.51 microg g(-1) dw) (Sinha *et al.,*2006). Cd uptake in sludge-amended and Cd salt treated soils maintained at high and low soil pH was studied. Cd uptake by plants grown in sludge amended soils was significantly lower than Cd uptake by plants grown in the Cd-salt treated soils at low and high pH (Brown *et al.,*1998). Zinc phytotoxicity in most leafy vegetables occurs when Zn accumulates to an average tissue concentration of 500 mg/kg dry weight than twice the concentration of Zn found in the vegetables at the Pension site (Berry and Wallace 1989). The total of Cd concentration in most of the soil samples exceeded the suggested Swiss thresholds (0.8 mg/kg). Most of the plants grown on the soils of Isfahan province, Iran, were contaminated with heavy metals and pose a major health concern (Mohajer *et al.,*2012). Vegetables, especially those of leafy vegetables grown in heavy metal contaminated soils, accumulate higher amounts of metals than those grown in uncontaminated soils because of the fact that they absorb these metals through their leaves (Jassir *et al.,*2005).

Heavy Metals In Irrigation/Drinking Water

Disposal of sewage water and industrial wastes is a great problem. Often it is drained to the agricultural lands where it is used for growing crops including vegetables. These sewage effluents are considered not only a rich source of organic matter and other nutrients but also they elevate the level of heavy metals like Fe, Mn, Cu, Zn, Pb, Cr, Ni, Cd and Co in receiving soils (Singh *et al.,*2004). Concentration of Pb, Cr and Fe was found to be higher than the standard limit indicating imperilled state of canal water of Chittagong city, Bangladesh (Islam *et al.,*2013). All water samples from farming sites in Accra (Ghana) contained detectable concentrations of each of the seven heavy metals except for irrigation water which had no detectable chromium, cadmium and cobalt (Lente *et al.,*2013). Most of our water sources are gradually becoming polluted due to the addition of foreign materials from the surroundings. The lakes have a complex and fragile ecosystem, as they do not have self cleaning ability and therefore readily accumulate pollutants. Bellandur lake in Bangalore is 130 years old and sewage from residential areas near Bangalore International airport is directly allowed into this lake. The water samples were analysed which showed that the average concentrations (µg/l) for Fe (1087), Zn (132),Cu (12), Ni (3), Cr (6), Pb (9) and Cd (0.7) were 2,9,4,6,6,9 and 23-fold higher than the natural element levels 500 (Fe), 15 (Zn), 3 (Cu), 0.5 (Ni), 1 (Cr), 1 (Pb) and 0.03 (Cd) in freshwater respectively (Lokeshwari and Chandrappa, 2006). Increasing pollution has given rise to concern on the intake of harmful metals in humans. These metals enter the human body through inhalation and ingestion. The intake through ingestion depends on food habit. Dareta Village is a mining community with so many mining mills in operation within the village. The trace metal levels of water from hand dug wells around Dareta Village were determined. Water samples were collected from 12 wells scattered around the village. The metals studied include Cd, Pb, Cu, and Zn. The mean trace metal concentrations and their ranges were Pb 0.279(0.25-0.869)ppm; Cd 0.0177(0.0112- 0.0256) ppm; Zn 0.512 (0.248-1.842) ppm; Cu 0.182 (0.110-0.729)ppm (Ogabiela *et al.,* 2011). Jannapura lake, a perennial fresh water body located in Bhadravathi town of Karnataka state, India is used for irrigation purpose. This lake receives untreated domestic wastewater from residential areas. Water samples collected during October 2004 to June 2005 were analyzed using Atomic Absorption Spectrophotometer for Cu, Zn, Pb, Cd and Ni. The concentration of all the heavy metals of concern in the water exceeded the permissible limits as per WHO Standards. The study indicated that the water of the lake was not suitable for drinking purpose. The concentration of Zn for irrigation and livestock watering are 1.0 and 0-20 mg/l respectively. High concentration of Zn in water is unsuitable for the sustenance of the aquatic life. But could be used for irrigation and live stock watering (Puttaiah and Kiran, 2008). Although Zn has been found to have low toxicity to human, prolonged consumption of large doses can result in some health complications such as fatigue, dizziness and neutropenia (Hess and Schmid, 2002). Nigeria'a industrial cities are resulting in an increased quantity of discharge and an wide range of pollutants reaching water bodies. Urbanization and industrialization have contributed to the large scale of pollution currently observed in most Nigerian cities notably those swarming with industries viz. Lagos, Kano and Kaduna states. There are no incentives for implementing pollution reduction measures. Wastes are disposed indiscriminately especially from small and medium scale industries. The lack of information on pollution is a serious hindrance to pollution directly or remotely. Thus, in addition to treatment of wastewater before disposal, appraisal of water resources would offer proficient information to indicate areas of main concern. This would prove useful in detection of threats to human and environmental health (Ekiye *et al.,*2010). Wastewater from urban area is being used profitably to irrigate crops in the vicinity of cities from the time unknown. Wastewater is till considered rich in plant nutrients and organic matter.

However, the situation is changed now because, in many cities and towns the wastewater is sold for secondary use and it is a good source of income to municipalities (Saif *et al.,* 2005). Drinking water samples of industrial area of Sheikhupura, Pakistan that is swarming with small and large industries were analyzed. Samples were collected from the twelve different sites of the mentioned area for six months at frequency of once per fifteen days and were analyzed under strict quality control conditions and ASTM (American Standard Testing Methods) methods were employed for strictly precise and accurate results. Four sites showed bacterial contamination, five sites indicated high level of TDS (Total Dissolved Solids) and conductivity. Only one site indicated elevated chromium leve(0.6 mg/L)l, two depicted increased level of arsenic but five sites gave idea about the high level of manganese(highest average value 1.2 mg/L) in the study area (Gilani *et al.,*2013). The use of treated and untreated wastewater for irrigation has increased the contamination of Cd, Pb and Ni in edible portion of vegetables causing potential health risk in the long term from this practice (Sharma *et al.,*2007). Consumption of heavy metal and minerals by adult women through food in sewage and tube-well irrigated area was studied around Ludhiana city in Punjab, India (Kawatra and Bakhetia, 2008). Wastewater irrigation is known to contribute significantly to the heavy metal contents of soils (Mapanda *et al.,* 2005). The city of Ludhiana (Punjab, India) has large number of industries like cycle, cycle parts, sewing machine, textiles, dyeing etc. and effluents from these units is thrown into sewage system without much treatment. Municipal sewage is partly used for irrigation purposes in fields of nearby villages. The crops grown in such areas are vegetables and among these leafy vegetables and root crops accumulate large amounts of Zn, Cu, Pb and Cd than those from tubewell irrigated soils (Abdulla *et al.,*1995; Setia *et al.,*1998). There was significant increase in the nickel content of soil irrigated with paper mill effluent whereas in the soil irrigated with sewage, chromium, iron and cadmium contents were increased appreciably. Among various metallic concentrations, maximum concewntration of Fe was observed in leaves (400.12±11.47 mg/kg) and root (301.41±13.14 mg/kg) of *Spinacia oleracea* after irrigation with effluent of paper mill whereas it was (400.49±5.97 mg/kg) in leaves and (363.94±11.37 mg/kg) in root after irrigation with sewage after 60 days (Pathak *et al.,*2013). Heavy metal accumulation in vegetables irrigated with water from different sources was studied (Arora *et al.,*2008).

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