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# Accumulation of heavy Metals in Vegetables Grown Along National High Ways-A Case Study of Tehran-Iran

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***ABSTRACT :*** *Vegetables constitute an important part of the human diet since they contain carbohydrates, proteins, as well as vitamins, minerals and trace elements. 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.The levels of heavy metal contents in all six vegetable samples which are polluted around Tehran. Samples were collected and analysed for heavy metals. The result showed that the higher concentration of Cadmium in vegetable of Parsley (Petroslinum sativum Hoffim) at station five 0.005 mg/g. Maximum Lead and Chromium is observed in Spinach (Spinacia oleracea L.) at station three 0.64 mg/g and 2.67 mg/g respectively.Maximum Zinc was observed in Sweet basil ( Ocimum basilicum L. ) 1.193 μg/g at station four opposite site. Maximum Copper and Nickel observed in Spinach(Spinacia oleracea L.) 0.899 μg/g and 0.228 mg/g at station three.*

***KEY WORDS:*** *Polluted vegetables, Heavy metals, Tehran-Iran.*

## I. INTRODUCTION

Generally heavy metals like cadmium, lead and zing are toxic at high concentrations.Contamination of vegetables with heavy metals are reported due to irrigation of contaminated water, addition of chemical fertilizers, industrial emissions and transportation, etc. These food plants contain both essential and toxic metals over a wide range of concentration. It is well known that plants take up metals by absorbing them from contaminated soil as well as deposits on aerial plant parts exposed to the air from polluted environments. In India heavy metal contamination study of soil and vegetables of Varansi has made by Sharma (16). Another interesting survey along two national Highways near Lucknow were carried out. The pattern of lead deposition has reflected by soil pb burdens, showed that decrease in concentration with increasing distance from the road margins. At both the sites lead concentration was above back ground concentration at the soil depth of 15 cm. Some plants contained high concentration of Pb over their respective controls, with more accumulation in the underground portions of the plants. The cattle grazed near the roadside pastures, naturally milk samples contained lead at an elevated concentration (17).The plantation along the roads in Jalgaon city are mainly includes Neem (*Azadirachta indica*), Peepal (*Ficus religiosa*), Banyan (*Ficus benghalensis*), Almond (*Terminalia catapa*). Investigation was carried out by bio-monitoring, leaf area, total chlorophyll, plant protein were analyzed to study the impact of air pollutants. It was observed that vegetation at roadside with heavy traffic was much affected by vehicular emission. Significant decrease in total chlorophyll and protein content was observed with reduced leaf area.(18).

Another study carried out at Aurangabad city to count the total number of vehicle passes in unit time and different sites were selected. Commonly occurring six plants were marked for study. The effect of vehicular emissions on selected plants with different characteristics of plants viz. dust deposition, chlorophyll content and moisture content were studied. The results obtained during the present investigation reveals that, the total number of vehicles passed in unit time is higher at Kranti Chowk, Nagar Naka and Railway station area as compare to University campus. The chlorophyll content in Ashoka and Bogunvelia plant are found low at Kranti Chowk and Nagar Naka as compare to Eucalyptus, Neem and Babul. Where as, similar results were recorded in case of moisture content (2). It indicates that vehicular pollution in cities is in increasing rate and it directly impact on air, soil, plants and water too. Heavy metals are easily accumulated in human vital organs and threaten human health. In recent years, the food structure of the whole world, greatly changed with increasing consumption of vegetables. However, vegetables can take up a lot of essential nutrients and certain trace elements in a short period. Therefore, the safety of vegetables is very important (12, 23). Although soil heavy metal pollution is often mentioned recently, little information is available on heavy metal transfer from soil to vegetable (3, 19). Some studies reported that the bioavailability of soil metal to vegetable was controlled by soil properties, soil metal speciation and plant species (4, 10).

In addition, foliar uptake of atmospheric heavy metal emissions has also been identified as an important pathway of heavy metal contamination in vegetable crops (1, 15). Delbari et al (8) carried out research on agricultural soil samples were collected from six polluted sites from Tehran and India and analysed heavy metals. Seasonal variations of heavy metal deposition in agricultural crop due to pollution was recorded from Tehran-Iran (5). Delbari and Kulkarni (7) reported heavy metal pollution in agricultural soils from Tehan-Iran. Delbari et al.(9) conducted research on heavy metals contamination in soils along highways near Pune. During the survey six sites selected for heavy metal concentration like Cr, Cu, Ni, Pb and Zn in agriculture soils. The results indicate that levels of heavy metals concentration were below normal range mentioned in standard values. Delbari and Kulkarni (6) determine heavy metal pollution in vegetables in Tehran-Iran. Four seasons like summer, fall, spring and winter were considered for concentration of heavy metals in vegetables. Present research work includes the concentrations of Ni, Cr, Cd, Cu, Zn, and Pb in crops samples collected from Tehran-Iran were reported.

**AREA UNDER STUDY:** Tehran's air quality is impacted by the stationary and mobile sources as well as its location and topography. It is estimated that about 30% of Iran's industrial establishments are located around Tehran (20). Of these establishments, metal and chemical factories are located mostly up wind to the west of the city, a refinery to the south and small factories throughout the city. Stationary sources (industries and residential/commercial services) accounted for approximately 29% of the air pollution while approximately 71% of Tehran's air pollution was related to mobile sources (11).Tehran had about 1.3 million motor vehicles. The most recent data indicates that approximately 2.5 million of Iran's 7.5 million vehicles are located in Tehran (33%) while the city has about 10% of Iran's total population of 69.51 million (21).Iran's auto industry has boomed in recent years to become one of the biggest sectors outside of oil. Iran boasts the largest car industry in the Middle East and Central Asia. Since 2000, Iran's auto manufacturers have increased their annual production from approximately 300,000 to about 1 million vehicles. Every day 1200 vehicles and 600 motorcycles join the existing fleet in Tehran, clogging the streets with traffic and choking everyone with fumes. The cost of traffic congestion in the capital is put at 2 billion hours of time wasted each year'. It is estimated that about 1.5 million old vehicles (20 years and older) are operating across the country. The high number of old and polluting vehicles is a major cause of the air pollution in Tehran. The local winds are often not strong enough to circulate the air. In addition, the major winds blow from the west, south and southeast, where most of the industries are located. Rather than cleaning the air, they can pollute the air further (13). Each year, Tehran faces the problem of temperature inversion for about 250 days. The temperature inversions push dense clouds of stagnant smog down onto the city. Air pollution mitigation master plan and strategies in the past 10 years.

Six stations were selected for crop sample collection for analysis point of view in table-1.

Table-1: The areas around Tehran were selected for data collection.

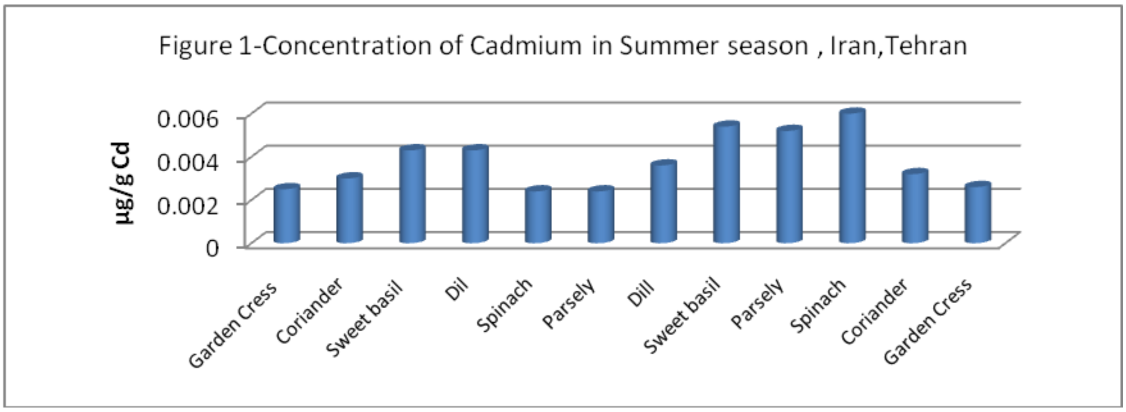
| No. St | Name of station around Tehran-Iran | Name of crops | Name of crops (opposite site) |
|---|---|---|---|
| 1 | Saidi high way (shahidbeheshty complex) | *Lepidium sativum* L. | *Coriandrum sativum* L. |
| 2 | Saidi high way (shah Tareeh) | *Ocimum basilicum* L. | *Aniethum graveolens* L. |
| 3 | Tehran-Qom high way (Turouzabad) | *Spinacia oleracea* L | *Petroselinum sativum* Hoffm |
| 4 | Tehran-Qom high way (Jalil Abad) | *Aniethum graveolens* L. | *Ocimum basilicum* L. |
| 5 | Tehran-Varamin high way(near Amin Abad road) | *Petroselinum sativum* Hoffm | *Spinacia oleracea* L |
| 6 | Tehran-Varamin high way (Firooz Abad) | *Coriandrums ativum* L. | *Lepidium sativum* L. |

## II. METHODOLOGY FOR DATA COLLECTION AND ANALYSIS

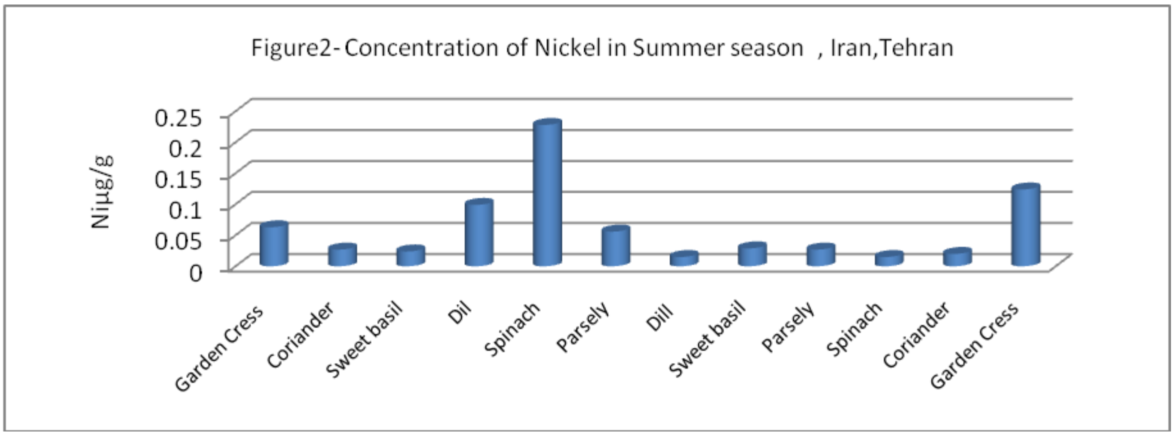
36 Soil samples (6 stations and every station 3 samples 5m, 10m, 15m and opposite site) were collected. The areas selected for collection from various locations to cover industrial, commercial and residential zones. The collected soil samples were air-dried and sieved into coarse and fine fractions. Well-mixed samples of 2 gram each were taken in 250 mL glass beakers and digested with 8 mL of aquaregia on a sand bath for 2 hours. After evaporation to near dryness, the samples were dissolved with 10 mL of 2 % nitric acid, filtered and then diluted to 50 mL with distilled water. Heavy metal concentrations of each fraction were analyzed by Atomic Absorption Spectrophotometer. Quality assurance was guaranteed through double determinations and use of blanks for correction of background and other sources of error.

## III. RESULTS AND DISCUSSION

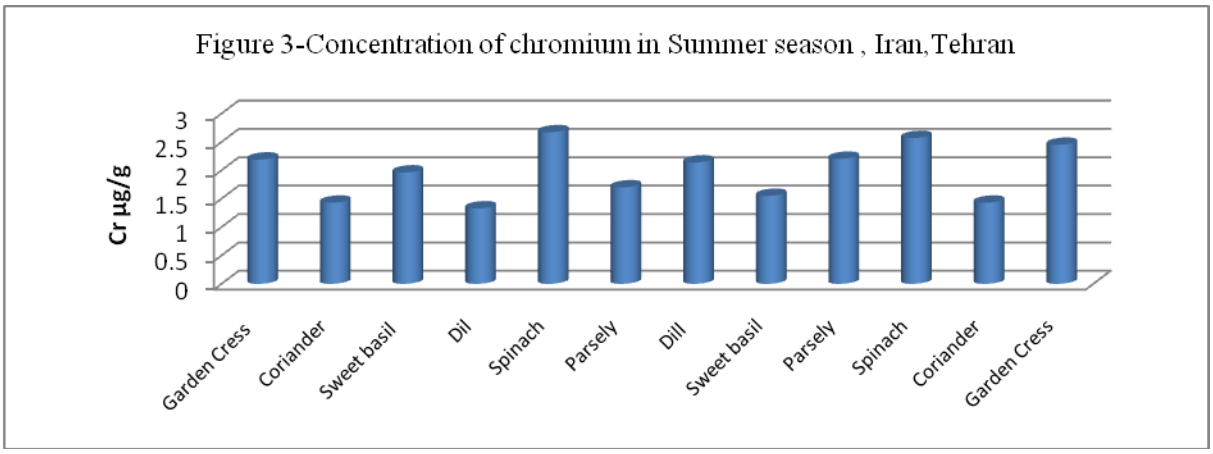
**Cadmium**: The concentration of cadmium in the agricultural crop ranged from 0.002 to 0.006 µg/g figure 1. Maximum Cd was observed at station five, 0.005 µg/g Tehran-Varamin high way (near Amin Abad road) in Parsley (*Petroslinum sativum* Hoffm) crop and minimum was 0.0025 µg/g in station one in Garden Cress (*Lepidium sativum* L.). (Fig.-1)



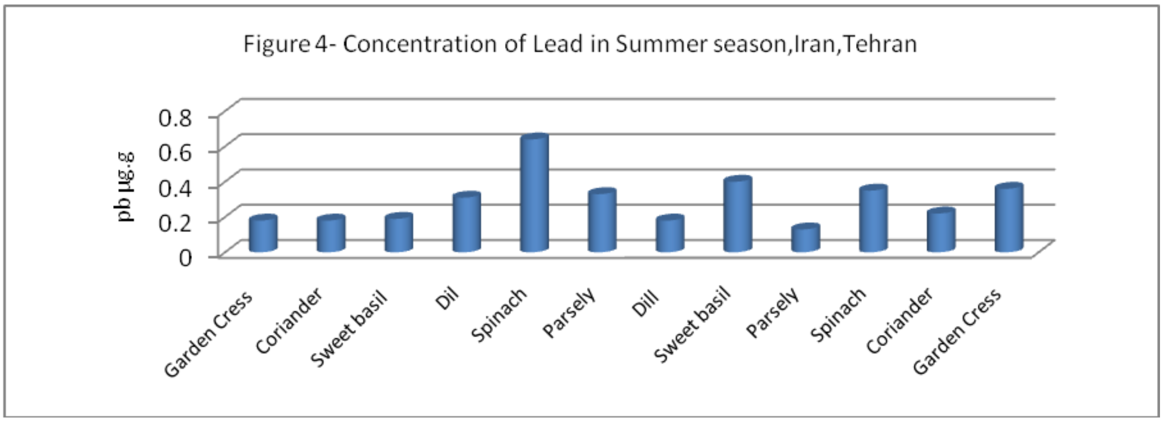

**Nickel:** The concentration of nickel in crops ranged from 0.015 to 0.228 µg/g. Maximum nickel observed in Spinach (*Spinacia oleracea* L.) 0.228 µg/g at station three Tehran-Qom high way (Turouz Abad), and minimum concentration was observed in Dill (*Anethum graveolens* L.) 0.015 µg/g at station four ,Tehran-Qom high way (Jalil Abad).( Fig.-2).



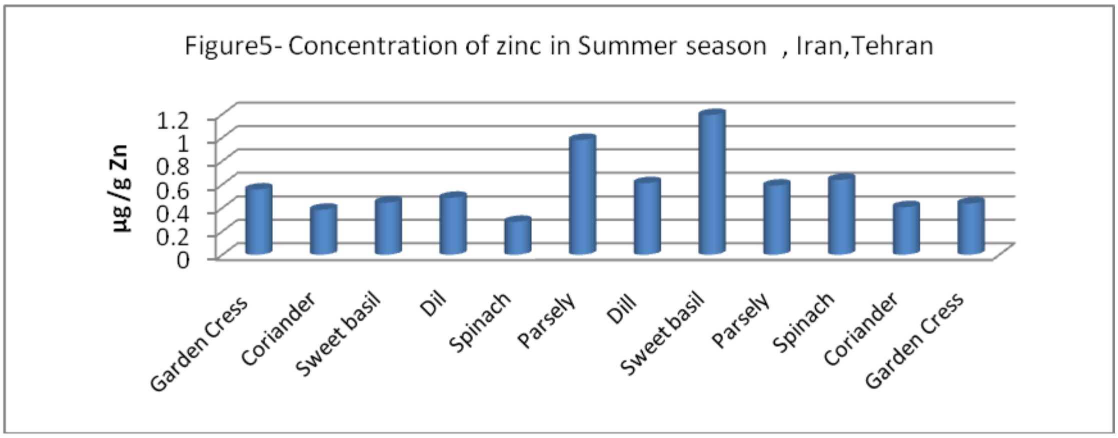

**Chromium**: The concentration of Chromium in crops ranged from 1.33 to 2.67 µg/g. Maximum Chromium observed in Spinach (*Spinacia oleracea* L.) 2.67 µg/g at station three Tehran-Qom high way (Turouz Abad), and minimum concentration was observed in Dill (*Anethum graveolens* L.) 1.33µg/g at station two opposite site Saidi high way (shah Tareeh).(Fig.-3).



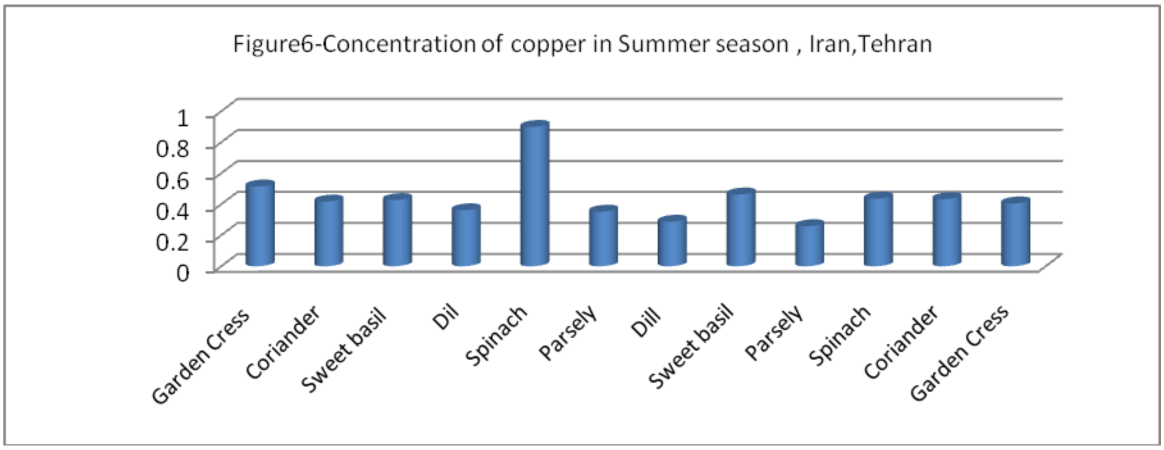

**Lead:** The concentration of Lead in agricultural crop ranged from 0.13 to 0.64 µg/g. Maximum lead was observed in Spinach (*Spinacia oleracea* L.) , 0.64 µg/g at station three Tehran-Qom high way (Turouz Abad), and minimum concentration was observed in Parsley (*Petroselinum sativum* Hoffm.) 0.13 µg/g at station five Tehran-Varamin high way(near Amin Abad road).(Fig.- 4).




**Zinc:** The concentration of Zinc in crops ranged from 0.445 to 1.193 µg/g. Maximum zinc was observed in Sweet basil ( *Ocimum basilicum* L. ) 1.193 µg/g at station four ,opposite site Tehran-Qom high way (Jalil Abad), and minimum concentration was observed in Garden cress (*Lepidium sativum* L.), 0.445 µg/g at station two Saidi high way(shah Tareeh).(Fig.-5).




**Copper**: The concentration of Copper in crops ranged from 0.258 to 0.899 µg/g. Maximum copper was observed in Spinach(*Spinacia oleracea* L.) 0.899 µg/g at station three Tehran-Qom high way(Turouz Abad),and minimum concentration was observed in Parsley (*Petroselinum sativum* Hoffm.), 0. 258 µg/g at station five Tehran-Varamin high way (near Amin Abad road).(Fig.-6).




## IV. DISCUSS AND CONCLUSION

Heavy metals, such as cadmium, copper, lead and chromium are important environmental pollutants, particularly in areas under irrigation with waste water. Water analysis revealed that Firoozabad river from Iran is contaminated with Ni, Cd, Cu and Pb. Data showed that the major industries effluents enter into above river. The daily domestic and industrial waste water discharge from the industries like Sajrerey Tannery, Painting factory, Soap factory, Melting industry, etc. and other wastes from garages, gas station, hospitals, are discharge in the same river. Farms which are irrigated with this contaminated water the same elements are detected in the leafy vegetables. Additionally no treatment is applied to the industrial discharge to detoxify the waste water draining into rivers. Unfortunately, metals emitted in such manner are easily transferred to all of the food chain, thereby affecting human and animal health. Some vegetables under waste water irrigation showed that concentration of Cd, Pb, Zn and Fe are grater than the maximum permitted level that extended by WHO (14).

In present investigation six stations were studied for heavy metals concentration. These crops are grown along the highways in Tehran-Iran. Maximum levels of Copper, Lead, Chromium and Nickel was observed in Spinach (*Spinacia oleracea* L.).

Maximum concentration of Zinc was observed in Sweet basil (*Ocimum basilicum* L.) and maximum level of Cadmium in Parsley (*Petroslinum sativum* Hoffin). Iran and other countries located in the arid belt of the world, face sever water scarcity and to partially meet the demand for water by their large urban population and they are compelled to re-use a significant volume of urban and industrial waste water contaminated by heavy metals. Yargholi et al. (22) carried out experimental studies on cadmium absorption and accumulation in different parts of vegetables grown in Iran. Investigation was carried out in seven types of vegetables commonly consumed in the country, such as onion, leek, parsley, coriander, lettuce, cress and mint. The results showed that cadmium concentration levels is highest in lettuce in its root while leek had the least. Adverse effect of cadmium after entrance into human body, it accumulated in soft tissues, primarily the liver and kidneys. Human studies have shown that chronic exposure to cadmium can dead to serious health effects including lung caner, emphysema and other lung diseases and kidney damage. This indicates that heavy metal accumulation in soils and crops are adversely effects on food quality, crop growth and health problems. Metals such as lead, mercury, cadmium and copper are cumulative poisons. The values of these metals were need to be below the recommended maximum tolerable levels proposed by the FAO/WHO Expert Committee on Food Additives. The application of waste water generally led to changes in the physicochemical characteristics of soil and consequently heavy metal uptake by vegetables.The heavy metal concentration in soil can generally be predicted starting from the elements abundance in the parent material because parent material weathering is one of the main natural sources of heavy metals to the soil system.

## V. ACKNOWLEDGEMENT

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## REFERENCES

[1] N. L. Bassuk, Reducing lead uptake in lettuce. J. Hortic. Sci. 21,1986, 993–995.
[2] S.P. Chavan, A.M. Late, B.J. Bhosale, P.M. Nalawade and M.B. Mule, Effect of vehicular pollution on plants: a case study from Aurangabad City, (MS),India. Chemical, Biological and Environmental Enginering (ICBEE) 2nd International Conference, 2010, 216-219.

[3] H. M.Chen,C. R.Zheng, C.Tu and Y. G. Zhu, Heavy metal pollution in soils in China: Status and countermeasures. Ambio. 28, 1999, 130–134.

[4] B. E. Davies, Inter-relationships between soil properties and the uptake of cadmium, copper, lead and zinc from contaminated soils by radish (Raphanus sativus L.). Water Air Soil Poll. 63,1992, 331–342

[5] Azam Sadat Delbari and D. K. Kulkarni, Seasonal Variation in heavy concentration in agriculture soils in Teheran- Iran. Bioscience Discovery 2(3),2011,333-340.

[6] A. S. Delbari and D. K. Kulkarni, Determination of Heavy Metal Pollution in Vegetables grown along the roadside in Tehran–Iran.Annals of Biological Research 4(2),2013, 224-233.

[7] A. S. Delbari, D.K. Kulkarni, Aboli Lale and P.G. Saptarshi, Heavy metals pollution in Agricultural soils around Teheran- Case study of national highway. Asian Journal of Development Matters special 5(1), 2011, 302-310.

[8] A.S. Delbari, D.KKulkarni and P.G. Saptarshi, A comparative study of heavy metals pollution along highways in agricultural soils from Tehran-Iran and Pune-India. Asian J.Environ Sci. 6(2),2011, 112-118.

[9] A. S. Delbari, D.K. Kulkarni and P.G. Saptarshi, Heavy metal contamination in soils along highways near Pune-India. International Journal of Pollution Abatement Technology, 1(1), 2012, 35-39.

[10] S. Ehlken and G.Kirchner, Environmental processes affecting plant root uptake of radioactive trace elements and variability of transfer factor data: A review. J. Environ. Radioactiv. 58, 2002, 97–112.

[11] P.Hastaie, Air quality management in Tehran. Accessedon the internet. http://www.worldbank.org/transport/utsr/budapest/mar1am/hastaie.pdf.2000.

[12] H. Y. Liu, A. Probst and B. H. Liao, Metal contamination of soils and crops affected by the Chenzhou lead/zinc mine spill (Hunan, China). Sci. Total Environ. 339,2005, 153–166.

[13] A. Madanipour, Tehran: The Making of a Metropolis. Wiley, New York,1998.

[14] B.Mohsen and S.Mohsen, Investigation of metal accumulation in some vegetables irrigated with waste water in Shahre Rey –Iran and Toxicological implications. Am-Euras. J. Agric.& Environ. Sci. 4(1), 2008, 86-92.

[15] R. Salim, M. Al-Subu, M. A. Douleh, L. Chenavier and J. Hagemeyer, Effects of root and foliar treatments of carrot plants with lead and cadmium on the growth, uptake and the distribution of metals in treated plants. J.Environ. Sci. Heal. A. 27, 1992, 1 739–1 758.

[16] R.K. Sharmaand, M.Agarwal and F. Marshall, Heavy metal contamination of soil and vegetables in suburban areas of Varansi, India. Ecotoxicol. Environ Saf 66, 2007, 258-266.

[17] N. Singh, V. Pandey, J. Misra, M. Yunus and K.J. Ahmad, Atmospheric lead pollution from vehicular emissions- measurements in plants, soil and milk samples. Environmental Monitoring and Assessment 45(1), 1997, 9-19.

[18] N.D. Wagh, P.V. Shukla, S.B. Tamble and S.T. Ingle, Biological monitoring of roadside plants exposed to vehicular pollution in Jalgaon city. J. Environ. Biol.2, 2006, 419-421.

[19] S. C.Wong, X. D. Li, G.Zhang, S. H. Qi and Y. S. Min, Heavy metals in agricultural soil of the Pearl RiverDelta, South China. Environ. Pollut. 119, 2002, 33–34.

[20] www.BBC Persian.com, January 2, 2000.

[21] www.Hamshahri.com, July 31, 2005

[22] B. Yargholi, A.A. Azimi, A. Baghvand, A.M. Liaghat and G.A. Fardi, Investigation of Cadmium absorption and accumulation in different parts of some vegetables. Am-Euras. J. Agric. & Environ. Sci. 3(3), 2008,357-364.

[23] D. M.Zhou, X. Z. Hao, Y. J. Wang, Y. H. Dong and L. Cang, Copper and Zn uptake by radish and pakchoi as affected by application of livestock and poultry manures. Chemosphere.59, 2005, 167–175.