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Study and Measurement of Pb, Cd, Cr and Zn in Green Leaf of Tea Cultivated in Gillan Province of Iran

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Abstract: One of the effects of industrialization of communities is great consumption of different chemical substances that resulted severe consequences such as, chronic poisoning that most of them will be dangerous and life threatening. The metals are part of major substances with mutational and carcinogenic effects. With respect to the collective characteristics of these metals on human and environmental health, we decided to evaluate their adverse effects. Present study was done in Gillan province (North of Iran) on green leaf of Tea cultivated in Lahijan and Fuman cities. The samples were selected from ten regions and five samples from selected areas were studied. evaluation of metals in green leaves (Pb, Cd, Cr and Zn) was carried out by atomic absorption spectrometry .The results showed a significant relation between the amount of lead and regions ($P < 0.05$) and also comparison between these mean numbers showed that in Eastern station, lead had the highest amount with average of 5.300 ppm in Fuman and 4.300 ppm in Lahijan samples. Amounts of other metals (Cd, Cr and Cu) were below standard that proposed by WHO. With respect to obtained results, there is a great potential for hazardous substance in the studied regions and it is necessary to make a serious analysis about this substances in other regions of Gillan Province.

Key words: Tea, Pb, Cd, Cr, Zn, Iran

Introduction

Areas in the Iran are known to have elevated soil metal concentrations, particularly some urban areas. With the gradual urbanization of the country and the need to build on land that has been used previously for industrial sites, householders and professionals are becoming more aware of low-level contamination of soils (Callow, 1995; Chang, 1974).

These metals can derive naturally, but are often augmented by, for example, atmospheric deposition, previous site use, use of contaminated soil to level a site, metal garden containers and furniture, bonfires, paint, composts, pesticides and fertilizers. The burning of fossil fuels, smelting and other processing techniques release these chemicals into the atmosphere, which are later deposited on soil and vegetation. Widely used soil additives, superphosphate and lime, contain small quantities of cadmium, chromium, copper and zinc as well as other metals. Cadmium is also used in plating metals and in the manufacture of batteries. Lead comes largely from automobile exhaust fumes deposited mainly within 10 m of major roadways and near urban centres (Chang, 1974; Dudka *et al.*, 1999; Haro and Pujadas, 2000).

The concentration of heavy metals/metalloids in the soil is an important issue with regards to human health. Ingestion of vegetables grown in contaminated soil may pose health issues. The accumulation of metals varies greatly both between species and cultivars. Soil applied heavy metals are not readily absorbed by plants.

Generally plants translocate larger quantities of metals to their leaves than to their fruits or seeds (Callow, 1995; Chang, 1974; Dudka *et al.*, 1999; Ellen *et al.*, 1990).

There is evidence to suggest that vegetable cultivars vary in the uptake of pollutants. Thus investigating which vegetables and cultivars accumulate higher and lower concentrations, under controlled conditions, could present useful information, in order to be able to make recommendations as to the suitability of the use of various cultivars on slightly contaminated land.

The pollution of air, soil and water by industrial substances such as heavy metals spreads to agricultural farm, resulting in great economical Damage. The most common heavy metals implicated in acute and/or chronic conditions include lead, arsenic, and mercury. Lead is the most significant toxin of the heavy metals. Industrial decisions, such as the addition of lead to paints, dyes, and gasoline, have created an epidemic of lead poisonings. Lead is a naturally occurring substance and can be found in organic and inorganic forms. Inorganic forms of lead typically affect the CNS, peripheral nervous system (PNS), hematopoietic, renal, GI, cardiovascular, and reproductive systems. Organic lead toxicities tend to predominately affect the CNS (Chang, 1974; Harms, 1975; Haro and Pujadas, 2000). Hence, we designed a study to determine the amount of metals in Tea (*Thea sinensis* L.) cultivated in Gillan (Lahijan and Fuman) Province of Iran that are highly cultivated in this province.

Table 1: The average mean amounts were assessed in green leaf samples of Lahijan cultivated Tea Region

Region	Station	Lead (ppm)	SEM (±)	Cadmium (ppm)	SEM (±)	Chromium (ppm)	SEM (±)	Zinc (ppm)	SEM (±)
North	I	4.420	1.898	0.205	0.073	0.000	0.000	1.840	0.922
	II	4.200	0.158	0.182	0.020	0.018	0.002	3.747	0.089
East	I	4.300	0.419	0.161	0.047	0.000	0.000	2.563	1.286
	II	1..303	0.283	0.199	0.021	0.102	0.050	3.704	0.169
West	I	1.400	0.416	0.203	0.029	0.000	0.000	2.712	1.362
	II	0.656	0.032	0.113	0.021	0.000	0.000	2.391	1.195
South	I	1.021	0.429	0.129	0.062	0.240	0.014	1.800	0.180
	II	0.647	0.118	0.127	0.076	0.000	0.000	1.557	0.155
	III	0.937	0.457	0.179	0.054	0.142	0.087	2.547	1.487
	IV	1.648	0.368	0.361	0.039	0.000	0.000	5.100	0.077

Table 2: The average mean lead, cadmium, chromium and zinc were assessed in green leaf samples of Fuman cultivated Tea (ppm)

Region	Station	Lead (ppm)	SEM (±)	Cadmium (ppm)	SEM (±)	Chromium (ppm)	SEM (±)	Zinc (ppm)	SEM (±)
North	I	2.708	1.968	0.106	0.033	0.000	0.000	1.271	0.367
	II	4.057	0.909	0.110	0.014	0.000	0.000	1.310	0.047
East	I	5.300	0.847	0.103	0.010	0.000	0.000	1.205	0.168
	II	2.937	1.699	0.142	0.001	0.000	0.000	1.749	0.064
West	I	0.860	0.057	0.084	0.017	0.052	0.032	1.694	0.061
	II	0.587	0.157	0.072	0.029	0.000	0.000	0.852	0.473
	I	1.100	0.221	0.089	0.009	0.000	0.000	1.553	0.007
South	II	0.531	0.234	0.038	0.014	0.000	0.000	0.037	0.037
	III	1.302	0.499	0.107	0.220	0.000	0.000	3.250	0.899
	IV	1.635	0.017	0.272	0.004	0.000	0.000	1.865	0.119

Materials and Methods

Chemicals: All materials were provided from the Merck Company.

Selection of Samples: This study investigated the amount of Lead, Cadmium, Chromium and Zinc in Tea samples (Thea sinensis L.) in Lahijan and Fuman cities of Gillan Province. 2 stations in the north, 2 in the east, 2 in the west and 4 stations in the south of Gillan (Agricultural regions) were selected. From each research station 3 samples of Tea (Lahijan and Fuman) were gathered that weighted 200 grams. Totally, 60 samples from the 10 stations were gathered (Helrich, 1990; Klassen *et al.*, 1998; Mark, 1983).

Determination of Metals: At First, green leaf samples were washed and then 100 grams of each sample were selected. Then, the selected samples changed to ash, cooled and added about 2ml nitric acid to remove the organic matter, and then put them on hot plate to evaporate acid. The samples were placed in furnace at 450 - 500°C for about 1 hour. If there is any organic matter, add 2ml HNO_3 and evaporate on hot plate and repeat this process so that all of the samples lose their color and change to white, then add 10ml HCl 1N and heat on hot plate to dissolve ash and transfer the final solution to 25 ml volumetric flask and adjust to volume with HCl 1N. The samples are ready for injection to 70 furnace device (Flameless Atomic Absorption Spectrophotometery). Flameless Atomic Absorption Spectrophotometery is a very ideal, sensitive and easy method performed the measurement of the mentioned metals. We aspirated each sample and recorded the concentration at 217nm for Cd , 262nm for Cr, 283.3 nm for Pb and 185nm for Zn (Helrich, 1990; Klassen *et al.*, 1998; Mark, 1983; Mercedes, 2002).

Statistical analysis: Data were analyzed using the one-tailed variance test.

Results

With respect to Table 1 and 2, the maximum amounts of lead in Lahijan and Fuman were found in the first station of the north (4.420 ppm) and eastern regions (5.30 ppm) respectively. The maximum amount of Cadmium was found in the 4th station of the southern part for Lahijan (0.361 ppm) and Fuman (0.272 ppm). Chromium had its largest amount in the first station of the southern region for Lahijan (0.24 ppm) and in the western region for Fuman (0.052 ppm).The maximum amount of Zinc was in the fourth station of the southern part for Lahijan (5.100 ppm) and in the third station part for Fuman (3.250 ppm). Variance analysis of different regions showed the following results:

The similarity in the amount of Lead between geographic parts was failed ($P < 0.05$) and significant difference was found between the four regional parts ($P < 0.05$). No significant difference was found between the amounts of Cadmium, Chromium and Zinc between 4 geographic parts ($P<0.05$).

Discussion

The results of this study, when compared with the standard measures (2 ppm for Lead and Cadmium. 0.25 ppm for Chromium and 10 PPM for Zinc) show that there is no need to be concerned about the amount of Cadmium, Chromium and Zinc in Tea samples, but the amount of Lead should be considered because its mean amount was found greater than the standard one. Therefore, the amount of Lead in the soil is important due to the direct transmission of Lead, and also due to forming water-soluble forms of Lead by streams of water or rain (Munoz and Devesa, 2000; Nolet *et al.*, 1971; Northy and James, 1988; Shallari *et al.*, 1998). Furthermore, the effect of Lead in the water or air is directly transmitted.

When the amount of Lead was evaluated , it shows maximum amounts in northern and eastern parts and can be resulted that the gradient of the lead is geographically toward these areas and to the Caspian sea, so that the surface water streams toward the mentioned parts and gives water to the vegetables grown there and this could be one of the reasons for this pollution. Another reason is the consumption of surplus water, which is a major source of Lead pollution and flows toward the rivers and then being consumed to give water to the farms (Shendeh, 1992; Simon, 1999; W.H.O, 1996).

Conclusion: This result is highly cohsistant to Ellen *et al.,* 1990 who showed the contribution to the recommended amounts of the essential elements Cu, Mn and Zn to be no more than 1%-3%. From the vegetables an average portion of spinach contains 19% and 2.6% of the tolerable daily amounts of Cd and Pb, respectively. For the other species of vegetables these figures are less than 5% for Cd (except for endive, 6.8%) and for lead less than 1%. Spinach contributes considerably to the need for Cu, Mn and Zn, in general more than 10% of the recommended daily amounts. The other species of vegetables contribute only from less than 1% to less than few percents (Shendeh, 1992; Wojciechowska-Mazurek *et al.*, 1995).

Wojciechowska *et al.* (1995) concluded that in strawberries, raspberries and currants (about 0.1 mg/kg on average), cadmium in raspberries and strawberries (mean 0.02 mg/kg). Mercury, zinc and copper levels were low. The levels of all these metals were lowest in apples and pears (Pb-mean 0.010-0.089 mg/kg), Cd mean 0.001-0.006 mg/kg). The content of metals in fruit, but ever more in soil, from highly industrialized areas was significantly higher (Nolet *et al.*, 1971; Shendeh, 1992; Wojciechowska-Mazurek *et al.*, 1995).

Additionally, the eastern part is transit way of the country so that the fuel being used as benzene or gas oil fueled cars can result in air pollution and ultimately pollution of the plants, growing in these areas .

References

Callow, P., 1995. Handbook of ecotoxicoicgy, second ed, Black well science inc. Maiden, PP: 526-533.

Chang, K.Y., 1974. Trace metals in wastewaters effluents. Water Polution. J. Control fed, 46: 2663-2675.

Dudka, S., M. Piotrowska and A. Chlopecka, 1999. Effect of elevated concentrations of Cd and Zn in soil on spring Tea yield, Black Well Sci., inc, pp: 398- 403.

Ellen, G., J.W. Van and K. Tolsma, 1990. Heavy metals in vegetables grown in The Netherlands and in domestic and imported fruits. Z Lebensm Unters Forsch, 190: 34-9.

Harms, U., 1975. The levels of heavy metals (Mn, Fe, Co, Ni, Cu, Zn, Cd, Pb, Hg) in fish and vegetables. Lebensm Unters Forsch, 11; 157: 125-32.

Haro, A. and A. Pujadas, 2000. Phytoremediation of the polluted soils after the toxic spill of the Aznalcollar mine by using wild species collected in situ. Fresenius Environ., Bull., 9: 275-580.

Helrich, K., 1990. Official methods of analysis of the Association of official Analytical chemists (AOAC), 15 th ed., Virginia. Association of Official Analytical Chemist's inc., PP: 237-273.

Klassen, C.D., M. Amdur and J. Doul, 1998. Cassarett and Doulls toxicology, third ed. pp: 124-156.

Mark, H.F., 1983. Encyclopedia of chemical technology, vol 6, third ed, USA, John Willey and Sons Press, pp: 148-234.

Mercedes Rio, 2002. Heavy metals and arsenic uptake by wild vegetation in the Guadiamar river area after the toxic spill of the Aznalcollar mine, J. Biotech., 98: 125-137.

Munoz, O. and A. Devesa, 2000. Total heavy metals and inorganic arsenic in vegetables, J. Agri. Food Chem., 48: 4369-4376.

Nolet, B.A., U. Dijkstra and F.G. Heidecke, 1971. Cadmium in the environment, Cleveland, CRC press, PP: 44-48.

Northy, S.R. and W.M. James, 1988. Heavy Metal in natural waters, 3rd ed , California, PP: 106-124.

Shallari, S., C. Schwartz and S.R. Northy, 1998. Heavy metals in soils and plants of serpentine and industrial sites of Albania. Sci. Total Environ., 209: 133-142.

Shendeh, H., 1992. Phytoremediation of heavy metal in plant systems globalization, a challenge for change, ASA 8th Annual meeting Indiana Polis, Indiana, 3: 177-179.

Simon, M., 1999. Pollution of soils by the toxic sill of a pyrite mine (Aznalcollar, Spain). Sci. Total Environ., 242: 105-115.

W.H.O., 1996. Trace elements in human nutrition and health, Geneva, WHO, 1996, PP: 72-100.

Wojciechowska-Mazurek, M., T. Zawadzka, K. Karlowski, K. Starska, K. Cwiek-Ludwicka and E. Brulinska-Ostrowska, 1995. Content of lead, cadmium, mercury, zinc and copper in fruit from various regions of Poland Rocz Panstw Zakl Hig, 46: 223-38.