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RESEARCH ARTICLE

IMPACT OF MUNICIPAL WASTE WATER OF SARGODHA CITY ON PHYSIO-CHEMICAL ATTRIBUTES AND MINERAL STATUS OF TWO SELECTED VEGETABLES (*YELLOW MUSTARD AND RADISH)*

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ABSTRACT

The present study was carried out in order to investigate the impact of municipal waste water of Sargodha city on physio-chemical attributes and mineral status of two selected vegetables Yellow Mustard & Radish. Field surveys were carried out. Three experimental sites i.e. Silanwali road, Chak 85 and Faisalabad road were selected in Sargodha during this survey. Water, soil and vegetable samples were collected from these sites. The collected samples were processed following standard procedures and were analyzed for Copper, Chromium, Lead, Cadmium, Nickel, Zinc, Cobalt, Arsenic, Manganese, Iron, Magnesium and Molybdenum. The survey data showed significant variations in heavy metals concentrations of different water, soil and vegetable samples.

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INTRODUCTION

Pakistan is facing chronic shortage of water which is being overcome by the use of sewage water for raising vegetables. The farmers get good vegetable yields with sewage water as it contains large amount of organic matter and plant nutrients. However, sewage also contains some metals which could be potentially toxic for these vegetables and consumers. The metals which have been identified in sewage include Chromium, Cadmium, Copper, Lead, Nickel, Zinc, Cobalt, Magnesium, Iron, Arsenic, Manganese, Iron and Molybdenum. In local and urban areas, there is a large production of wastewater from homes and industries which is used for irrigation. This waste water contains heavy metals which can be taken up by the plants and cause serious effect on human health when eaten especially at raw stage. Farmers use this untreated wastewater for irrigation because it is of low cost than other sources of irrigation water. The use of untreated waste water is one of the most significant sources of water pollution that may directly affect the human health through crops and soil (Butt *et al*., 2005). Waste water irrigation has significant contribution to the heavy metal content of the soils.

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This loading of heavy metals results in the contamination of food chain mainly through the vegetables grown on such soils (Rattan *et al*., 2002). In those areas of the world where untreated waste water is used to irrigate vegetables and other crops which are eaten uncooked, transmission and spread of infections is likely to occur through the consumption of such crops (Shuval *et al*., 1985). Untreated or partially treated wastewater can introduce a huge amount of inorganic and organic contaminates into agricultural soils (Wang and Tao1998). Continual use of wastewater over long periods of time exerts adverse impacts on quality of soil and also on the plants grown on such soils (Sinha *et al.,* 2006). Vegetables accumulate heavy metals in their edible and non edible parts. Although some of the heavy metals such as Zn, Mn, Ni and Cu act as micro-nutrients at lower concentrations but they become toxic at higher concentrations. Health risks due to heavy metal contamination of soil and vegetables have been widely reported (Satarug *et al*., 2000).

Those crops and vegetables which are grown in soils contaminated with heavy metals have greater accumulation of heavy metals than those grown in uncontaminated soil (Marshall *et al*., 2007). The widespread heavy metal contamination has raised public and scientific interest hence special attention is given to them throughout the world due to their effects even at very low concentrations (Islam *et al*., 2007). Due to their presence in excess, heavy metals enter the body and cause various diseases. These may disturb the normal functions of central nervous system, lungs, liver, heart, kidney and brain, produce hypertension, abdominal pain, skin eruptions, intestinal ulcer and different types of cancer (Huheey *et al*., 2000). Present research work was therefore carried out to study the effects of municipal waste water of Sargodha city on physio-chemical attributes and mineral status of two selected vegetables Yellow Mustard & Radish.

MATERIALS AND METHODS

Collection of samples

The samples of vegetables (*Brassica campestris* and *Raphanus sativus*) were randomly collected from the fields irrigated with municipal wastewater of Sargodha city at seedling, vegetative and maturity stages. Leafy vegetables were preferred for sampling because previous researches indicate that they accumulate heavy metals at a greater capacity than other vegetables.

Study area

Three sites were selected to study the sewage water effects on vegetables

- Silanwali road
- Chak 85 iii. Faisalabad road

Washing of samples

The collected vegetable samples were washed with distilled water to remove dust particles. The samples were then cut to separate the roots/ stems and leaves using a knife.

Weighing

Fresh weight of samples was taken using Electric balance.

Drying of samples

Leaves of vegetables were air-dried and then placed in an oven at 100 °C and then dry weight was taken using Electric balance.

Grinding of samples

Dried samples of leaves of vegetables were ground into a fine powder and stored, until used for acid digestion.

Preparation of samples / Wet digestion

Samples (0.2g) of leaves of each vegetable were weighed on electric balance and treated with 10 ml of concentrated HNO_3. A sample was prepared applying 10 ml of HNO_3 into empty digestion flask. The flasks were kept for a night at room temperature. After that the samples were digested against 2ml H_2O_2 on Hot plate. H_2O_2 was further added to the sample (2ml of each was added occasionally) and digestion continued until a colorless solution was obtained. After cooling, the solution was filtered with What man No. 42 filter paper and it was then transferred quantitatively to a 50 ml volumetric flask by adding distilled water up to 50ml volume. Soil digestion was also carried out in the same way as above. Water was filtered and then subjected to analysis.

Preparation of standards and analysis of samples

Working standard solutions of Lead (Pb), Copper (Cu), Chromium (Cr), Zinc (Zn), Cadmium (Cd), Iron(Fe), Arsenic (As), Cobalt (Co), Aluminum (Al), Mercury (Hg),Manganese (Mn), Nickel (Ni), Magnesium (Mg) and Molybdenum (Mo) were prepared from the stock standard solutions containing 1000 ppm of element and measurement of elements were done on atomic absorption spectrophotometer. The calibration curves were prepared for each element individually applying linear correlation by least square method. A blank reading was also taken and necessary correction was made during the calculation of concentration of various elements.

Statistical analysis

Three samples of leaves of each vegetable were analyzed individually. Data were reported as significant and non significant. One way SPSS analysis of variance (ANOVA) was used to determine significant difference between groups.

RESULTS

The survey data showed variation in heavy metals concentrations of different water sources. All water samples in sewage water irrigated vegetables were within the safe limits. The field experimental data showed that due to sewage application, Zn content was much higher in leaves of *Brassica campestris*. Cadmium accumulation in the vegetables irrigated with sewage water was also much higher. Like all the heavy metals, Nickel also showed the similar trend for its accumulation in the vegetables. In water there was higher concentration of heavy metals as compared to vegetables but lower than that of soil samples.

Table 1. Analysis of Variance of Heavy Metals about *Brassica campestris* in Soil, Leaves and Sewage water

Parameters	Soil	Leaves	Sewage water
Mn	0.005**	0.000***	0.003**
Fe	0.000***	0.000***	0.000***
Cd	0.000***	0.004**	0.064
Co	0.000***	0.006**	0.001**
Zn	0.000***	0.000***	0.001**
Ni	0.000***	0.000***	0.001**
Mg	0.000***	0.002**	0.002**
Cu	0.000***	0.010*	0.000***
Cr	0.006**	0.007**	0.000***
Pb	0.004**	0.000***	0.006**
As	0.000***	0.001**	0.003**
Hg	0.004**	0.002**	0.004**
Mo	0.003**	0.000***	0.051
Al	0.000***	0.000***	0.000***

The table shows p-values, results are significant at ($p<0.05-P<0.001$), where *=0.05, **=0.01 and ***=0.001

Rests of the elements are not toxic to human unless they are present in high concentrations. The present study provides baseline data on trace metal concentrations of Lead (Pb), Copper (Cu), Chromium (Cr), Zinc (Zn), Cadmium (Cd), Iron(Fe), Arsenic (As), Cobalt (Co), Aluminum (Al), Mercury (Hg),Manganese (Mn), Nickel (Ni), Magnesium (Mg), and

Molybdenum (Mo), in *Brassica campestris* and *Raphanus sativus*, their proximate analysis and nutritional composition.

Table 2. Analysis of Variance of Heavy Metals about *Raphanus sativus* in Soil, Root and Sewage water

Parameters	Soil	Root	Sewage water
Mn	0.007**	0.000***	0.000***
Fe	0.002**	0.001**	0.000***
Cd	0.000***	0.000***	0.000***
Co	0.001**	0.000***	0.000***
Zn	0.000***	0.000***	0.002**
Ni	0.000***	0.000***	0.004**
Mg	0.001**	0.000***	0.000***
Cu	0.000***	0.001**	0.000***
Cr	0.000***	0.000***	0.000***
Pb	0.013*	0.001**	0.003**
As	0.000***	0.000***	0.000***
Hg	0.000***	0.000***	0.000***
Mo	0.000***	0.001**	0.001**
Al	0.000***	0.000***	0.000***

The table shows p-values, results are significant at ($p<0.05$-$P<0.001$), where *=0.05, **=0.01 and ***=0.001

DISCUSSION

Manganese is one of the major minerals, which is related to the carbohydrate and fat metabolism. In this study concentration of manganese was in the range of 0.003 to 0.007 mg Kg^{-1}. The concentration of Iron was 0.001 to 0.002 mg Kg^{-1}. Cobalt concentration was in the range of 0.001 to 0.006 mg Kg^{-1}.
Zinc has been well known to be an important trace element. Its minimum concentration was recorded as 0.001 mg Kg^{-1}in *Brassica campestris and Raphanus sativus.* Maximum concentrations of zinc were found to be 0.002mg Kg^{-1}. Cadmium is toxic to human even at low concentrations. It is reported to cause osteomalacia (Schumacher *et al.*, 1991).Concentration of cadmium in samples was recorded to be in the range of 0.004 to 0.064 mg Kg^{-1}. The concentration of Magnesium ranges 0.001 to 0.002 mg Kg^{-1}. Copper concentration was in the range of 0.001 to 0.010 mg Kg^{-1}. Maximum concentration of cadmium was higher in soil samples as compared to water and vegetables. However leave samples have higher concentration as compared to water samples.

Nickel regulates the mineral metabolism, enzyme activity and several other metabolic processes in plants. It is used as a fungicide but it is well toxic to the germination of some seeds. It causes mitotic disturbances in root tips of some plants. High concentrations of nickel cause severe chlorosis and necrosis in plants and a host of other growth abnormalities and anatomical changes (Mishra and Kar, 1974). Nickel ranges between 0.001 and 0.004mg Kg^{-1}in selected vegetables. Major sources of Nickel that bring it into the atmosphere involve Iron, steel and cement production and Fuel combustion to produce heat and electricity. Thus nickel levels are far below than the recommended daily dietary intake of nickel which is about 0.025 mg per day. Chromium is one of the known toxic pollutants in the world. All selected vegetables samples bear the concentration level of chromium that fall into the range of 0.006-0.007mg $Kg^{-1.}$

The minimum concentration of Lead was recorded as 0.001 mg Kg^{-1}in *Brassica campestris and Raphanus sativus.* Maximum concentrations of zinc were found to be 0.013mg Kg^{-1}. Concentration of Arsenic in samples was recorded to be in the range of 0.001 to 0.003 mg Kg^{-1}. Concentration of Mercury in samples was recorded to be in the range of 0.002 to 0.004 mg Kg^{-1}. The minimum concentration of Molybdenum was recorded as 0.001 mg Kg^{-1}in *Brassica campestris and Raphanus sativus* and maximum concentrations was found to be 0.013mg Kg^{-1}. Continuous irrigation with wastewater could lead to the accumulation of heavy metals in soils beyond crop tolerance levels (Rusan *et al.*, 2007). Uptake of trace metals from soil differs from plant to plant and from site to site. Thus, there is need of careful studies in order to fully analyze and understand the long term environmental impacts of the use of sewage water for crop irrigation (Nabulo *et al*., 2008).

REFERENCES

Butt, M. S., Sharif, K., Bajwa, B. E., and Aziz, A. 2005. Hazardous effects of sewage water on the environment: Focus on heavy metals and chemical composition of soil and vegetables. *Management of Environmental Quality*, 16, 338–346.

Huheey, J. E., E. A. Keiter and R. L. Keiter, 2000. Inorganic Chemistry, 4th ed., Pearson Education Inc., USA, p. 889.

Islam, E., Y. Xiao-E., H. Zhen-li and M. Qaisar, 2007. Assessing potential dietary toxicity of heavy metals in selected vegetables and food crops. *Journal of Zhejiang University Science,* 8: 1-13.

Nabulo, G., Origa, H. O., Nasinyama, G. W., Cole D., 2008. Assessment of Zn, Cu, Pb, and Ni contamination in wetland soils and plants in the lake basin. *International Journal of Environmental Science and Technology,* 5 (1), 65-74.

Rattan, R. K., Dutta, S. P., Chandra, S., Saharaan, N. 2002. Heavy metals in environments-Indian scenario. *Fertil News,* 47:21–40.

Rusan, M. J. M., Hinnawi, S., Rousan, L., 2007. Long term effect of wastewater irrigation of forage crops on soil and plant quality parameters. *Desalination*, 215 (1-3), 143-152.

Satarug, S., M. R. Haswell-Elkins and M.R. Moore, 2000. Safe levels of cadmium intake to prevent renal toxicity of human subjects. *British Journal of Nutrition,* 84: 791-802.

Shuval, H. I., Yekutiel, P. and Fattal, B. 1985. Epidemiological evidence for helminth and cholera transmission by vegetables irrigated with wastewater. Jerusalem case study. *Water Science and Technology,* 17(4/5):433-442.

Sinha, S., Gupta, A. K., Bhatt, K., Pandey, K., Rai, U. N., and Singh, K. P. 2006. Distribution of metals in the edible plants grown at Jajmau, Kanpur (India) receiving treated tannery wastewater: Relation with physico-chemical properties of the soil. *Environmental Monitoring and Assessment,* 115, 1–22.

Wang, X. J., and Tao, S. 1998. Spatial structures and relations of heavy metal content in wastewater irrigated agricultural soil of Beijing's Eastern farming regions. *Bulletin of Environmental Contamination and Toxicology,* 61, 261–268.

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