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(RESEARCH ARTICLE)

# Assessment of heavy metal concentrations in waste water irrigated vegetables

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## Abstract

Shortage of good quality irrigation water in present changing scenario of climate forces farmers to use waste water for growing vegetables in urban and peri-urban areas which resulted in buildup of heavy metal in the food chain. Three commonly grown vegetables of city Multan; Onion, Brinjal and Tomato irrigated with waste water were selected to examine the heavy metal contents. The vegetables samples were collected from Haji Block Industrial Estate areas irrigated by waste water due to shortage of canal water. Total thirty samples of three vegetable were collected and analyzed. The results showed that the vegetable samples were contaminated with Pb, Cd and Ni. This study suggests that in future, waste water should be used after treatment to save the health of the masses. The re-use of waste water will help in proper management of soil health and will also save the soil water resources under present climatic conditions.

**Keywords:** Heavy metals; Brinjal; onion; Tomato; Waste water

## 1. Introduction

Industrial or municipal waste water is commonly used for irrigation of crops, due to its easy accessibility, disposal problems and shortage of good quality water. Wastewater application caused buildup of heavy metals in soil which act as source for heavy metals accumulation in vegetables (Atif *et al.,* 2015; Chen *et al*., 2005). Demands of risk free vegetables are increasing day by day. Publics are more aware about their health and in eating of nontoxic food. To solve this problem, scientists are conducting different experimental studies to provide risk free and nutritious food to the world. Heavy metal contamination of soil and in vegetables causes major human health problems. Toxic metals cause serious health problems due to their capability to get accumulation in different parts of body (Randhawa *et al.*, 2014; Wei and Yang, 2010; Kibassa *et al*., 2013). This problem is becoming serious day by day especially in underdeveloped countries like Pakistan, Bangladesh and India (Khan *et al*., 2013; Singh *et al*., 2010). The higher concentration of heavy metals in fruits and vegetables is the cause of occurrence of bone cancer, upper intestinal cancer, renal failure and hypertension (Atif *et al*., 2015; Turkdogan *et al*., 2003). The basic objectives of the present study were to determine the concentration of heavy metals (lead, cadmium and nickel) in commonly cultivated vegetables irrigated with waste water.

## 2. Material and methods

A number of farmers' fields were selected in the vicinity of Haji Block Industrial Estate of Multan. In these areas farmers are using industrial and city waste water for growing of vegetables. The most commonly produced vegetables in the

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study sites are tomato, onion and brinjal. These vegetable are mainly cultivated for domestic consumption and to be sold in the local market of Multan and other parts of Southern Punjab. From the fields the samples of vegetables (onion, tomato and brinjal) were collected randomly. In laboratory, vegetables were washed with distilled water to remove soil particles, dried, crushed and ground for heavy metals analysis. Heavy metals contents in vegetable samples were estimated by digesting with tri-acid mixture. Then the digested samples were cooled and filtered through whatman No.42 filter paper and volumes were made up to 50 ml using distilled water (Atif *et al*., 2015). Heavy metals (Pb, Ni and Cd) concentrations in vegetable samples were estimated on Atomic Absorption Spectrophotometer (Shimadzu-7000, Japan) by using respective hallow cathode lamp.

## 3. Results and discussion

The application of waste water generally led to changes in the physicochemical characteristics of soil and consequently heavy metal uptake by vegetables. The main sources of heavy metals to vegetable crops are their growth media especially waste water if used for irrigation. The concentrations of heavy metals, lead (Pb) cadmium (Cd) and nickel (Ni) in edible parts of onion are shown in the Figure -1. The concentration of lead in different onion samples ranged from 3.56-6.13 µg $kg^{-1}$ with an average value of 4.64 µg $kg^{-1}$. While the contents of cadmium in onion samples ranged from 1.43-2.80 µg $kg^{-1}$ and nickel concentration ranged from 10.54-21.43 µg $kg^{-1}$ (Figure-1). Continuous irrigation of cultivated land with sewage and industrial/city waste water may cause heavy metal accumulation in the soil and vegetables (Atif *et al*., 2015; Sharma *et al*., 2007). The results (Figure-2) depicted that lead contents in different brinjal samples ranged from 3.41-6.23 µg $kg^{-1}$ and the contents of cadmium in brinjal samples ranged from 0.84-2.93 µg $kg^{-1}$ , and the nickel in brinjal samples ranged from 7.3-22.15 µg $kg^{-1}$ (Figure-2). Different samples of vegetables grown on land irrigated with waste water revealed the same results (Randhawa *et al*., 2014; Ahmed *et al*., 2012). The heavy metals analysis of tomato samples showed (Figure-3) that lead concentration ranged from 3.71-6.92 µg $kg^{-1}$, cadmium contents ranged 1.12-3.27 µg $kg^{-1}$ and nickel contents ranged 9.20-24.0 µg $kg^{-1}$.

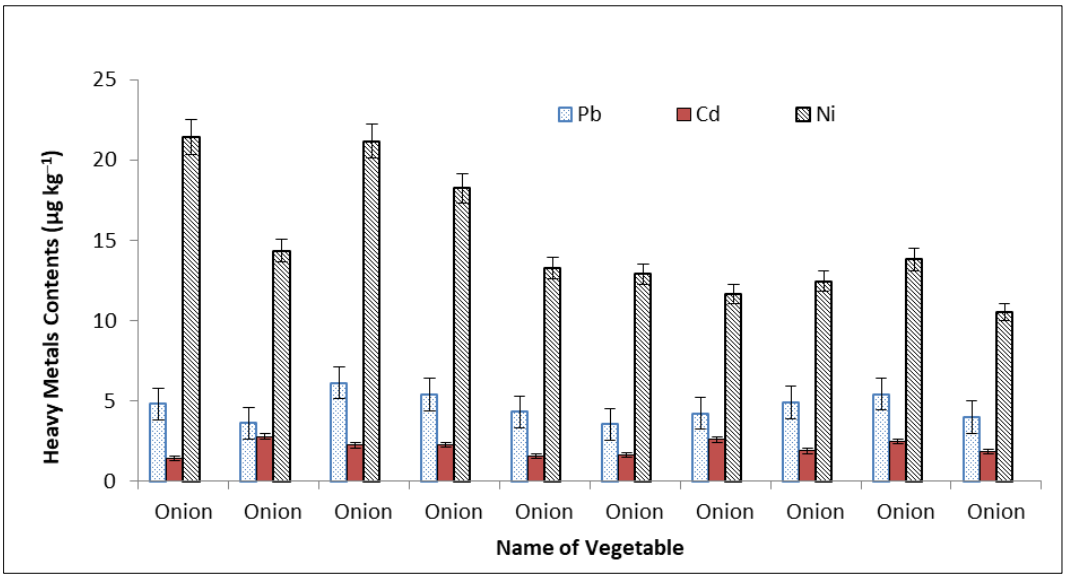


**Figure 1** Heavy metals (Pb, Cd and Ni) contents (µg $kg^{-1}$) in onion irrigated with waste water

Heavy metals contents depicted variations among different vegetables. The difference in heavy metals contents in different types of vegetables may be attributed to the differences in their morphology and physiology for heavy metals uptake, exclusion and retention (Atif *et al*., 2015 and Kumar *et al*., 2009). Amassing of heavy metals in vegetables is due to presence of higher concentration in soil and irrigation water. Different vegetables have different amount of heavy metals which show differences in their uptake capacity (Randhawa *et al*., 2014). Similarly Latif *et al*., (2008) found higher level of metals in different waste water irrigated vegetables.

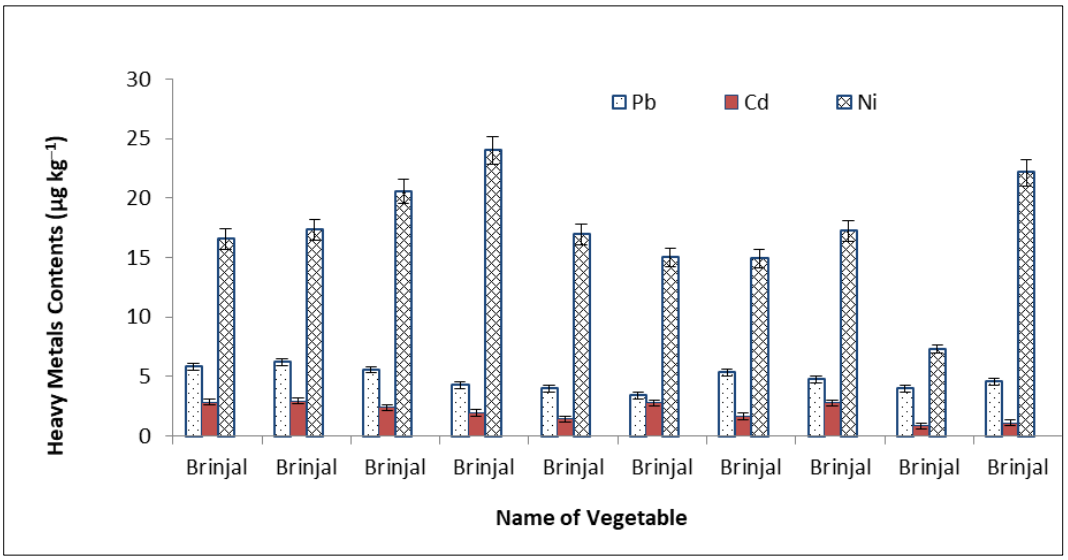


**Figure 2** Heavy metals (Pb, Cd and Ni) contents (µg kg$^{-1}$) in brinjal irrigated with waste water

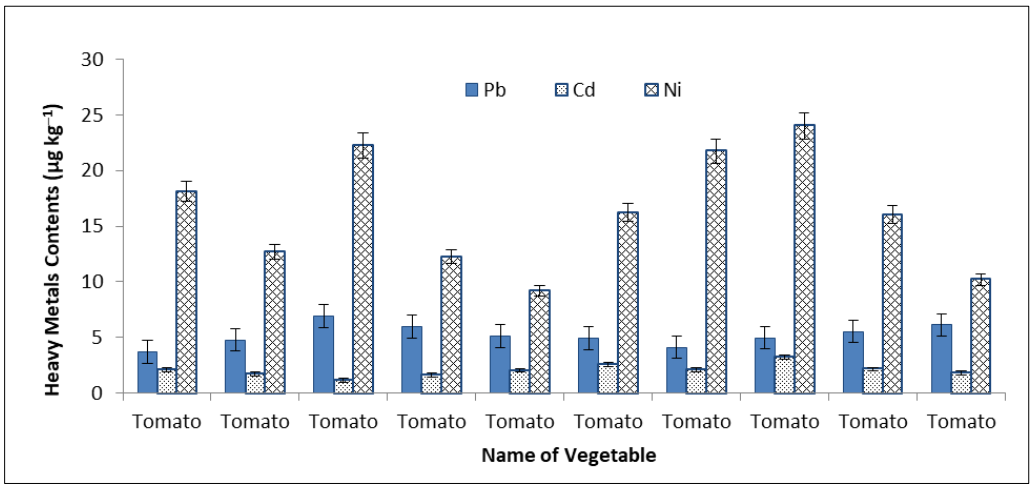


**Figure 3** Heavy metals (Pb, Cd and Ni) contents (µg kg$^{-1}$) in tomato irrigated with waste water

## 4. Conclusion

It can be concluded on the basis of results that irrigation with sewage/waste water is the main factor that add in accumulation and make vegetables unhealthy for human consumptions. By avoiding irrigations with waste water the heavy metals contents can be reduced in vegetables. This investigation will also be supportive for the country to formulate the database for policy making to control heavy metals contents in the food chain.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest.

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