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Research Article

# Comparative Study on Heavy Metal Contents in *Taraxacum Officinale*

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**ABSTRACT**

Determination of heavy metals including Pb, Cd, Cr, Mn, Fe, Co, Ni and Cu in *Taraxacum Officinale* from polluted and unpolluted areas of Peshawar was performed by atomic absorption spectrometry. High concentration of iron was found in flowers of plants from polluted area (67.30 mg $kg^{-1}$), leaves (31.91 mg $kg^{-1}$), roots (20.06 mg $kg^{-1}$) and stem (11.75 mg $kg^{-1}$) followed by lead in flowers (8.05 mg $kg^{-1}$), leaves (4.96 mg $kg^{-1}$), roots (4.71 mg $kg^{-1}$) and stem (2.86 mg $kg^{-1}$). The concentration of other metals was also high in some parts of the plant. The results showed that the plant exposed to pollution contained greater amount of heavy metals than plant growing in unpolluted area. The implication of the investigation was to make awareness among the public about the use of *T. officinale* containing high level of heavy metals and their adverse toxic effects.

**KEYWORDS**: *Taraxicum officinale*, atomic absorption spectroscopy.

## INTRODUCTION

*Taraxacum officinale* is commonly known as Dandelion (Bathur) belongs to the family compositae is widely distributed in the world as hawkweed. It is cultivated in the former USSR as a source of rubber latex, also used in Europe as substitute for coffee. Its root is an important drug of herbal medicine, have long been used on the continent as a remedy for liver complaints. Dandelion leaves are adjunct to treatments where enhanced urinary output is desirable. The plant is diuretic, stimulant, anti-biotic, anti-rheumatic, anti-spasmodic, tonic, hepatic, laxative and nutritive [1,2]. Keeping in view the importance of this medicinal plant and its possible impact by heavy metals, a study was carried out to determine the concentration level of heavy metals in *T. officinale* collected from polluted and unpolluted areas of Peshawar.

The environmental variation have direct or indirect impact on the medicinal plants and they may be regarded as an index of trace metal concentration in the environment i.e., soil, water and atmosphere.

Heavy metals contamination has great significance due to their tendency to accumulate in human organs over a prolonged period of time. The presence of heavy metals beyond the allowed upper and lower limits can cause metabolic disturbance. Thus both the deficiency as well as an excess of essential micronutrients (e.g. Fe, Zn, Cu) may produce undesirable effects [3, 4]. Effects of toxic metals (e.g., Cd, Cr, Pb, Ni etc) on human health and their interaction with essential trace elements may produce serious consequences [5]. For example cadmium causes oesteomalica and pyelonephristis. Similarly lead may cause renal tumors and other carcinomas [6]. However copper, iron and zinc are less toxic than former ones but these metals can also be dangerous beyond the permissible limits [7].

Environmental impact of heavy metals, as well as their health effects has been the source of major concern. WHO recommends that medicinal plants which form the raw materials for the finished products may be checked for the presence of heavy metals, pesticides, bacterial or fungal contamination [8, 9].

There are few reports about the potential influence of metals on the pharmacological effects of natural drugs obtained from medicinal plants [10]. Such influence is possible directly e.g., by metal binding to pharmacologically active substances or indirectly by influencing bioavailability, pharmacokinetics or side effects of drugs.

The main objective of this investigation was to ascertain the concentration of heavy metals in different parts of plant collected from area contaminated with air, soil and water pollutants.

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## MATERIALS AND METHODS

Collection and Post Harvest Treatment of Plant Material *Taraxacum officinale* was collected from polluted and non-polluted area of Peshawar Valley. Which are at a distance of about 5km from the main polluted area. Plant parts, especially roots were washed in fresh running water to eliminate dust, dirt and possible parasites and then with de-ionized water and dried in shade at 25-30 $^{o}C$. During all these steps of sample processing necessary measures were taken in order to avoid any loss or contamination with heavy metals.

*Acid Digestion of Plant Samples* Weighed quantities of crushed and powdered portion from each part of plant, root, stem, leaf and flower were taken in a china dish and

Table-1 Heavy Metals Concentration (mg $kg^{-1}$) in *Taraxacum officinale* Growing in Polluted and Un-polluted Area.

| Heavy Metals | Plant Parts (Polluted) | | | | Plant Parts (Unpolluted) | | | |
|---|---|---|---|---|---|---|---|---|
| | Root | Stem | Leaves | Flowers | Root | Stem | Leaves | Flowers |
| Pb | 4.71±0.102 | 2.86±0.002 | 4.96±0.006 | 8.05±0.09 | 2.33±0.01 | 2.52±0.02 | 1.95±0.007 | 1.96±0.13 |
| Fe | 20.06±0.009 | 11.75±0.05 | 31.91±0.006 | 67.30±0.084 | 11.01±0.07 | 4.59±0.13 | 27.90±0.004 | 21.95±0.036 |
| Cd | nd | nd | nd | nd | Nd | nd | nd | nd |
| Cu | 1.35±0.02 | 1.15±0.007 | 1.42±0.004 | 2.19±0.01 | 0.87±0.03 | 1.14±0.15 | 1.11±0.07 | 1.34±0.53 |
| Cr | 0.08±0.005 | 0.08±0.04 | 0.20±0.02 | 0.21±0.008 | 0.08±0.07 | 0.05±0.01 | 0.10±0.02 | 0.09±0.05 |
| Ni | 0.21±0.004 | 0.20±0.053 | 0.28±0.029 | 0.35±0.008 | 0.04±0.003 | 0.07±0.008 | 0.24±0.017 | 0.26±0.105 |
| Co | 0.16±0.200 | 0.14±0.132 | 0.21±0.107 | 0.20±0.002 | 0.10±0.04 | 0.13±0.06 | 0.17±0.09 | 0.08±0.11 |
| Mn | 1.79±0.03 | 1.38±0.141 | 2.68±0.000 | 3.68±0.000 | 0.71±0.03 | 0.55±0.06 | 2.80±0.00 | 2.03±0.004 |

± Standard Deviation., nd: not detected, WHO permissible limits for Pb: 10 mg/kg; Cd: 0.3 mg/kg (WHO 1998). FDA permissible limits for Cr, 120 µg (RDI); Ni: 0.1 mg/I (FDA 1993, 1999).

heated in an oven at 110 °C to evolve moisture. Then the dried sample after charing, was heated in a furnace for 4h at 550 °C. The contents of china dish was cooled in desiccator and 2.5 mL 6M $HNO_3$ was added to the dish to dissolve its contents. The solution was filtered and transferred to a 20 mL flask and diluted to the mark [18].

For estimation of heavy metals, flame atomic absorption. Spectrophotometer (Polarized Zeeman Hitachi 2000) was used.

*Calibration of Equipment* For the studied elements we established the following sensitivity and detection limits respectively of the used FAA apparatus.

- Pb 0.2 and 1.0 mg $kg^{-1}$
- Cr 0.5 and 3.0 mg $kg^{-1}$
- Cd 0.2 and 1.0 mg $kg^{-1}$
- Fe 0.5 and 5.0 mg $kg^{-1}$
- Cu 0.5 and 3.0 mg $kg^{-1}$
- Mn 0.5 and 2.50 mg $kg^{-1}$
- Zn 0.05 and 5.0 mg $kg^{-1}$
- Co 1.0 and 5.0 mg $kg^{-1}$
- Ni 0.5 and 4.0 mg $kg^{-1}$

## RESULTS AND DISCUSSIONS

In the present study heavy metals like Pb, Cr, Cd, Fe, Cu, Co, Zn and Ni were determined in the roots, stem, leaves and flowers of *T. officinale*. Selection of the plant parts used for this study was based on their extensive use in traditional system of medicine. The plants have been collected from a contaminated and uncontaminated area of Peshawar. The concentration of the studied metals is given in Table-1.

*Lead:* Lead is regarded as very hazardous for plants and humans. The sources of lead pollution of agricultural soils and plants are lead mines, fuel combustion, sewage sludge applications and farmyard manure. The maximum acceptable concentration for foodstuffs is around 1mg/kg. Long-term exposure to lead can result in a build-up of lead in the body and more severe symptoms [11].

The concentration of lead in plants from polluted area are flowers (8.05 mg/kg), leaves (4.96 mg/kg) followed by roots (4.71 mg/kg) and stem (2.86 mg/kg) as compared to unpolluted plants which are stem (2.52 mg/kg), roots (2.33 mg/kg) followed by flowers (1.96 mg/kg) and leaves (1.95 mg/kg). Obviously, the high lead concentration in aerial parts of plants from polluted area is due to the lead coming from the emission of vehicles as well as its presence in the soils polluted with wastes from different operations [12].

*Iron:* Iron is very essential for plants and animals. Its deficiency in plants produces chlorosis disease, [13] however, its high concentration also affects plant growth. The plant samples collected from polluted area (Table 1) for example high amount of iron was found in flowers 67.06 mg/kg followed by leaves 31.91 mg/kg then roots 20.06 mg/kg and stem 11.75 mg/kg. In case of plant samples collected from unpolluted area, high concentration was found in leaves 27.90 mg/kg, followed by flowers 21.95 mg/kg then roots 11.01 mg/kg and stem 4.59 mg/kg. Thus in general concentration of iron in polluted area is higher. So the plants collected from polluted area is more affected by pollution, thus emitting more iron into the environment and to the soil.

*Cadmium:* Cadmium is toxic metal having functions neither in human body nor in animals or plants. Once accumulated in the kidney then it stays there resulting in high blood pressure and kidney diseases and difficult to remove by excretion. Cadmium directly damages nerve cells. It inhibits the release of acetylcholine and activates cholinesterase enzyme, resulting in a tendency for hyperactivity of the nervous system [6].

Critical level of cadmium in soil is 3-5 mg/kg [14]. At this level in most cases it cannot cause toxic or excessive accumulation. Concentration in plants or the lowest level of cadmium, which can cause yield reduction, is between 5-10 mg/kg. Surprisingly no cadmium was detected in plant samples. This may be due to a very low level (below detection limit) of cadmium present in the available soil for plant growth.

*Copper:* Although copper is an essential enzymatic element for normal plant growth and development but can be toxic at excessive levels. Phytotoxicity can occur if its concentration in plants is higher than 20 mg/kg DW (dry weight). Critical concentration for copper in plants is 20-100 mg/kg [15]. As with other heavy metals, some species can tolerate very high amount of copper [16].

As can be seen from the data in Table-1, the concentration of copper was found high in the followers collected from polluted area 2.19 mg/kg, followed by leaves 1.42 mg/kg, roots 1,35 mg/kg and stem 1.15 mg/kg. In case of the unpolluted area, copper was found high in flowers 1.34 mg/kg followed by the stem 1.14 mg/kg, leaves 1.11 mg/kg and roots 0.87 mg/kg. Although the concentration of copper in the polluted area is more than the unpolluted area, however it is well beyond the critical level of copper in plants [14].

*Chromium:* Chromium is one of known environmental toxic pollutants in the world. The main sources of chromium contamination are tanneries, steel industries, sewage sludge application and fly ash [17]. Concentration between 5-30 mg/kg is considered critical for plants and could cause yields reduction [18].

Deficiency of chromium decreases the efficiency of insulin and increases sugar and cholesterol in the blood [19]. High chromium was found in the flowers and leaves of plant from polluted area, 0.21 and 0.20 mg/kg as compared to unpolluted area, 0.09 and 0.10 mg/kg respectively (Table-1). Least amount of chromium was found in the root and stem, 0.08 and 0.05 mg/kg respectively.

From the above data it can be seen that excess of chromium was found in the flowers and leaves. With the exception of fall out of atmospheric pollutants through rain and accumulation of the pollution in the flowers and leaves, it is probable that these metals were translocated through air dust blowing from nearby.

*Nickel:* Nickel is an abundant element, it is required in minute quantity for body as it is mostly present in the pancreas and hence plays an important role in the production of insulin. Its deficiency results in a disorder of the liver [20].

More nickel was found in the plant from polluted area, the concentration of nickel found in plants from polluted area (Table-1) was high in flowers, 0.35 mg/kg, followed by leaves 0.28 mg/kg, roots 0.21 mg/kg and stem 0.20 mg/kg. In case of the unpolluted area, nickel was found high in flowers 0.26 followed by leaves 0.24 mg/kg, stem 0.07 mg/kg and roots 0.04 mg/kg. The higher concentration of nickel in plants from polluted area can be explained on the basis of anthropogenic activities.

*Cobalt:* Cobalt is necessary for normal growth of plants and animals. More cobalt is found in the plant from polluted area where its concentration is 0.20, 0.21, 0.14 and 0.16 mg/kg in flowers, leaves, stem and roots respectively, as compared to unpolluted area (Table-1) found as: 0.08, 0.17, 0.13 and 0.10 mg/kg in flowers, leaves, stem and roots respectively. Although cobalt is toxic at elevated concentration however, the body needs only in trace amount. Cobalt in the form of vitamin B12 is in its physiologically active form. It is very essential to provide 3.0 µg (microgram) per day in the form of vitamin B12 for a diabetic individual [19].

*Manganese:* Manganese is also an essential element for plant and animal growth. Its uptake is controlled metabolically. Soils derive manganese from the parent material and its contents in the rocks are higher than the concentration of other micronutrients apart from iron [21].

The main sources of manganese in the soil are fertilizers, sewage sludge and ferrous smelters. Critical manganese concentration in soils is rather high 1500-3000 mg/kg, while critical concentration in plants i.e., in the range of 300-500 mg $kg^{-1}$ [17].

As can be seen from the data in Table-1, the concentration of manganese was found high in the flowers 3.68 mg/kg collected from polluted area, followed by the leaves 2.86 mg/kg, roots 1.79 mg/kg and stem 1.38 mg/kg. In case of the unpolluted area, manganese was found high in the leaves 2.80 mg/kg, followed by the flowers 2.03 mg/kg, roots 0.71 mg/kg and the stem, 0.55 mg/kg. Thus the concentration level of manganese is well below the critical level and hence acceptable, because it neither affects the plant growth nor will cause pollution.

**CONCLUSIONS**

The study showed that plants grown on polluted area has high concentration of heavy metals than unpolluted area. The population generally uses herbal medicine for prolonged period of time to achieve desirable effects. Prolong consumption of such herbal medicine might reduce chronic or subtle health hazards. Thus our finding indicate that the medicinal plant or plant parts used for different types of diseases must be checked for heavy metals contamination in order to make it safe for human consumption. In other words for local or pharmaceutical purposes, it should be collected from area not contaminated with heavy metals.

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