

SURVEY OF HEAVY METALS (Pb, Cd, Ni, Cu, AND Zn) IN SUNFLOWER PLANTS AT SIBBI IN THE REGION OF BALOCHISTAN

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ABSTRACT: The objective of this study is to determine the level of heavy metals (Pb, Cd, Ni, Cu, and Zn) in sunflower collected from Sibbi in the region of Balochistan. The plant samples were taken from the same area and analyzed to assess their heavy metal contamination. It was noted that plant samples of sunflowers were contaminated as irrigated by waste water. The conventional analytical techniques (Atomic Absorption Spectroscopy) were employed to evaluate the quantity of heavy metals samples, compared with the permissible limits for human consumption.

Keywords: Heavy Metals, Vegetables & Atomic Absorption Spectroscopy

1. INTRODUCTION

The pollution of the environment is because of some natural sources as well as human generated. Nowadays, the rapid growth in innovation in technologies, substantial amount of waste chemicals is emitted to the environment in cities as well as in villages. The concentration of toxic chemicals released to the environments by these means is hazardous for the living organism. The accumulation of these wastes in oceans, soils, and ultimately to foods for animals. The consumption of vegetation by the living being, grown on contaminated soil and polluted water, gravely damage the living organism [1].

The various growing methods are used by the growers to increase the yield of the crop and one such method is the fertilizers and animal's dung to the soil. The irrigation with wastewater is another method or practice and chances of over applications like animal dung, wastewater, and fertilizers. The different toxic in the soil/water affect the quality of the crop and its yield as well, alarming the

shortage of the food supply. Furthermore, the plant acts as vehicles to transfer these elements in the chain of food [2].

Sunflower (*Helianthus annuus* L.) is one of the four most important oil crops in the world. Because of its moderate cultivation requirements and high oil quality, its acreage has increased in both developed and developing countries. It fits well in existing cropping systems and can be grown without replacing any major crop. Sunflower oil contains a high percentage of polyunsaturated fatty acids that reduce cholesterol in the blood and prevents heart diseases. Sunflower oil is quite palatable and contains soluble vitamins A, D, E and K. In Pakistan, sunflower has the potential to bridge up the gap between demand and supply of edible oil and it is well adapted to existing agroecological conditions. The general image of the plant of sunflower (*Helianthus annuus*) is given below in Figure-1:



Figure-1. The general image of the plant of sunflower (*Helianthus annuus*) .

The metals which have higher specific gravity than 5 grams/cm³ are called the heavy metals and most of the metals are not degradable and exist in the ecosystem. The living organisms need some quantity of elements like iron, lead, cobalt, and chromium while in the greater amount it is very dangerous for human health. The contamination of plants and vegetables are most common which resulted in the usage of untreated water for irrigation, released by industries, vehicles, and different types of machinery to the soil [3]. The discharge of sewerage and waste of animals is the potential sources of heavy metals that contaminate the soil and plant. The amount of metal contents found in surface water by wastes and garbage. Furthermore, the metal finds its ways by leaching in the soil where the plant can contaminate the food chain. This conclusion for some plants represents a seriously harmful when used as food [4]. The plants do not absorb greater amount of heavy metals, and the quantity which they absorb depends upon the specie and the nature of plants, the chemical compositions of soils, the number of heavy metals, and the temperature of the soil. It is very necessary to take heavy metals in it which is very breakthrough for human beings. The intake of heavy metals in greater quantity through contaminated vegetables produces harmful diseases [5].

The heavy metals like copper, cobalt, zinc, iron, and manganese at lower concentrations are very significant metals for enzyme activity and biological processes. Different other metals like cadmium and mercury have no importance in the bodies of living organisms and are very dangerous at a lower concentration. Significant metals have to harmful effects at higher concentrations [6]. The food chain contaminated with heavy metals becomes the latest problem due to potential accumulations in biosystems via contamination of water, soil, and air. Continuously crops eaten by human beings that have a higher level of heavy metals cause health issues like Cd which present in plants can cause the lives of animals and peoples. The high level of contamination with cadmium effects the renal and pulmonary system. The greater amount of Pb causes the failure of kidney, reproduction, joints, and cardiac issues [7].

The determination of the quantity of heavy metals is very significant while consideration of the necessity of vegetables to the health of human beings because peoples like to eat vegetables for making their life healthy. A vegetable plays an important role in human health because of vegetable shave proteins, carbohydrates, vitamins, and some amount of minerals. The levels of the heavy metals were also determined in the soil where the vegetables are cultivated [8].

The heavy metals are found in soil by natural and as well as out of human activity. The heavy metals are potentially dangerous for human life because they cause cancer, illness, and blindness. The heavy metals pollution of aqueous stream, soil, and sediments are the main environmental issue. Most of the developing countries have identified the heavy metals contaminated wastewater being used for irrigation purposes. The all of heavy metals at higher concentrations have harmful effects and regard as environmental pollutants. The vegetables like cabbage

grown by using wastewater which takes a higher amount of heavy metals to cause health issues to the users [9].

Therefore, the present study was undertaken to investigate the concentration levels of heavy metals (Pb, Cd, Ni, Cu, and Zn) at Sunflowers to quantify the concentrations of heavy metal content by sunflowers specie.

2. EXPERIMENTAL

Samples and sampling

The sunflower samples were obtained in Oct. 2015 from crop fields in Sibi Dader. In this area, sunflower grew with the usage of fertilizers, animal dung, and irrigated by the waste water. Specimens were obtained by using the methods given by Radojevic and Bashkin [10]. Samples were collected and transported to the laboratories in polythene bags for analysis.

Digestion and analysis of samples

The specimens were dried on 105°C for a day in the oven until the samples were broken down [11]. Just one part with two grams of dried sample disaggregated and sieved and the specimens placed in 100 cm³ and digested with 15 cm³ concentrates with nitric acid at a 550°C for three hours and filtered in 10 cm³ volume of flask [52 & 18]. The level of iron, cobalt, lead, and chromium in the specimens was investigated by sp 1900 Atomic Absorption Spectrometer with air acetylene burner. The amount of heavy metal concentration calculated in the specimen is as:

$$\text{Concentrations} = \frac{\text{Concentrations (milligram/Liter)} \times V}{M}$$

where:

V = final volume 100 cm³ of solutions after digestions

M = initial weights (2 grams) of specimen calculated

Transfer factors for heavy metals from soil to sunflower

Ionic cases of the soils sample were compared with sunflower specimens then transfer factors are the ratios of the concentrations of heavy metal in the plants to the concentrations of heavy metal in the soil. The heavy metal transfer factor for every metal describes by Harrison and Chirgawi by this equation:

$$\text{Transfer Factor} = \text{Ps/St (milligrams per kg dry weight)} \quad (2)$$

where:

Ps = plant metal contents

St = total heavy metals content

Data analyses

Data were obtained by three parts and data were subject to the static test of significances by analysis of variances and the student's tests at p is less than 0.05 to assesses a couple of results in the soils and vegetables and these results were significantly considered less than 0.05, and total data were analyzed statistically by software.

3. RESULTS AND DISCUSSION

The heavy metals have great importance in eco-chemistry and eco-toxicology due to their toxic at less level and tendencies to accumulate in people's organisms. The data observed is given by Table-1 and Figure-2. It was observed that the more concentration of copper was found in sunflower than zinc, lead, and nickel, respectively. The lower concentration of cadmium was recorded in sunflower in Sibi Dadar.

Tble-1. Heavy metals level (mg/kg) in Sunflower.

S.No.	Name of Plant	Pb	Cd	Ni	Cu	Zn
1	Sunflower	4.4	1.6	2.9	15.05	8.4

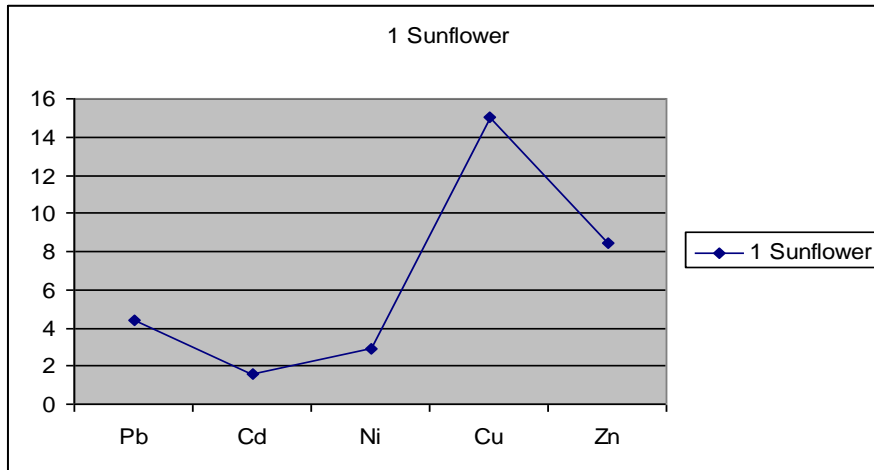


Figure-2. Heavy metals level (mg/kg) in Sunflower.

Table 2: Heavy metals concentrations by WHO standards in ppm.

S.NO.	Pb	Zn	Cu	Co	Cd	Ni	Cr	Mo	Mn
1.000	0.100	2.000	0.050	1.000	0.010	0.030	0.050	0.001	0.050

The consumption of vegetables contained heavy metals results in health issues. This work resulted that the continuous consumption of sunflowers is very harmful and hazardous results. Environmental monitoring can be done for heavy metals regularly to evaluate the HMs toxicity in vegetables from the areas Table 2 represents the permissible limit of these toxic elements evaluated by WHO.

The HMs accumulates and translocation varies from plant to plant and metals to metals not follow the exact patterns. The genotype effects, environmental effects, and the effects of their interactions greatly affect the heavy metal uptakes in crop genotype [12]. Furthermore, the heavy metal in soil occurs in complex form due to inter-linkage with the number of physicochemical forms that in turn influences their availabilities [13]. The plants taking up the heavy metals from the soils with various reactions like adsorptions, ion exchange, and precipitations with others [14]. The relative fewer concentrations of cadmium accumulated in brassica oleracea l. var capitata and lactuca sativa which describes the presence of zinc in the vegetables. Many professionals and researchers identify that the occurrences of zinc inhibit cadmium adsorptions and thereby causes fewer cadmium accumulations in plant [15]. These results indicate that the vegetable accumulates some quantity of zinc. Cadmium and Zinc that may be considered chemically the same compounds due to having the same ion structures and electronegativity which influence each other in plants uptake and accumulate while they play another role in the plant's metabolisms. The Zn is the micronutrients while cadmium is harmful and doesn't play roles in plants [16]. Furthermore, these both have the different ion radii ($Zn^{2+} = 0.074 \text{ nm}$ and $Cd^{2+} = 0.0979 \text{ nm}$); this variation plays important role in the plants selection for Zn [17]. The result reveals that the average concentrations absorb in the parts of the vegetables. The chromium and

zinc are the compounds having the same geochemical and environmental parameters; and the chemical similarity leads to interact in two metals among the uptake of plants, transportation, and accumulation in the different parts of the plant [18]. Furthermore, in general, the acceptable value of zinc in the soils and plants plays significant roles in the cadmium accumulate in crop plants. The iron concentrations reduce the uptakes of cadmium [19]. Order of zinc accumulates in spinach and spinach, which are given in tables 1, 2, and 3. The average concentrations of zinc in vegetables irrigate with tap water than the treated water in cabbage. The zinc is the micronutrients important for plant metabolisms while vegetable absorbs when physiological function shows the indication that the speedy growth rates are taken into the controlled than those which grow in the soils from mine areas irrigate with wastewater. Hence it may be the result that the greatly lower accumulations of cadmium. The higher concentrations of nickel found in cabbage can attribute to the microbiological consortiums in the plant's root which excretes organic acid that facilitates the absorptions and accumulations of nickel cabbage. It is in the context of this statement that the many microorganisms excrete with compounds that increase bioavailability and enhances the roots absorptions of important metals like nickel [20]. Cu is the most important micronutrient which plays a significant role in plant development. In the study Cu accumulated in various parts of the crops and the orders of accumulations of Cu in cabbage is greater than the spinach. The average concentrations of Cu in vegetables were very low than the recommendations of FAO in vegetables 73.3 milligrams per kg and the lower concentrations of chromium were founds and the orders of chromium absorptions is found greater in cabbage than spinach and total concentration are shown in table 2 according to FAO standards. Pb absorbed greatly just a plant that is used in the experiments. The

average concentrations of lead accumulate greater than the limit which is 0.005 milligrams per kg. The higher mobilization and uptaking of lead were found in the more acidic soils. Many of professionals and researchers stated that with lower pH than the higher potentials to be uptaken and Translocate by the plant [21]. The presence of lead in the soils has the greater potential for absorptions while lead is not capable to translocate the plant from growing soils. From this statement that the lead is greatly adsorbed by sediment particles and too difficult to be Trans locate [22]. Limited steps for lead accumulations are the great distances translocations from root to shoot [23].

4. CONCLUSION

It is concluded that sunflowers germinated poorly in lagoon soil due to the contamination of heavy metals content significantly. High contamination of heavy metals by soil causes poor growth of sunflower plants. Further sunflowers have a huge tendency for the accumulation of heavy metals. The content varies with time of harvesting and stage of maturity of crops. The majority of heavy metals level was above the permissible limits as per the WHO standard that may be due to polluted water. Consumption of such sunflowers seeds oil may constitute possible health hazards at the time of the study.

5. RECOMMENDATIONS

- Sunflower seed oils are not recommended for breast cancer women patients.
- Awareness is very necessary about the contamination of heavy metals by Sunflowers seeds oil.
- Further research is needed to obtain more specific information about the effect of age of the Sunflowers plants on accumulation and distribution of the heavy metal in the different plant parts, variations in uptake between different plant species, cropping history, and fertilization.

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