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INVESTIGATION OF THE SUBSEQUENT USE OF LANDS ALONG THE ARAZ RIVER CONTAMINATED WITH HEAVY METALS

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Abstract Heavy metals from human activities contaminate the soil by polluting it and thus affecting plant growth.

In this article, the amount of nickel in the leaves of plants along the Araz River was compared with the plants used in the experiment, and more nickel was found in the leaves of plants used in the experiment, as well as in the roots and stems of plants growing in heavy metal soils. Ethylenediaminetetraacetic acid (EDATA) has been shown to cause an increase in nickel levels, as in other metals. When we compare the amount of nickel in lettuce leaves with other plants, nickel is found more in lettuce than in other heavy metals.

Keywords: Heavy metals, soil, plant, waste, nickel, plant root, plant leaf, physicochemical method, ion exchange, phytoextraction, Ethylenediaminetetraacetic acid

1. Introduction

Soil is one of the main ecological elements that make up the ecosystem and is an important material basis for human survival and development.

In modern times, due to the development of industry and the extraction of natural resources, the discharge of waste into the environment, mainly soil and water, has increased significantly, which has led to the accumulation of heavy metals. As a result, soil, groundwater, sediments, surface water and air are polluted with dangerous heavy metals and toxic chemicals. These substances are considered one of the main threats to the world due to their inability to break down into non-toxic compounds and their long-term effects. [1-3] Contamination of soil with heavy metals is one of the major environmental problems in the world.

Heavy metals have a specific gravity of more than 4.5 g / cm³ and contain more than 40 chemical elements. Heavy metals occur naturally in the Earth's crust. It is also dumped into the soil as a result of human activity, which leads to high concentrations of heavy metals in the soil. The most common heavy metals in contaminated soils are Pb, Cr, As, Zn, Mn, Cd, Cu, and Hg.

The most common heavy metals in soils are nickel (Ni), lead (Pb), cadmium (Cd), arsenic (As), chromium (Cr), copper (Cu), cobalt (Co), zinc (Zn), manganese (Mn), aluminum (Al) and mercury (Hg). Among these heavy metals, As, Pb, Cd, and Hg are among the 20 most dangerous substances. [4]

Excessive dumping of heavy metals on agricultural lands results in the accumulation of large amounts of food plants and vegetables, which can lead to serious health risks for humans. Heavy metals are said to cause many diseases in humans, such as cardiovascular disease, cancer, psychological disorders, chronic anemia, kidney, nervous system, brain, skin, and bone damage. [5-15]

Heavy metals occur naturally in the Earth's crust. At the same time, it falls into the soil as a result of various production activities, which results in the presence of high levels of toxic metal compounds in the soil. Natural processes also cause soil contamination with heavy metals.

Methods for removing heavy metals from the soil are based on physical, chemical, and biological processes and can be classified as follows:

• physical methods that allow a high cleaning effect and a large amount of soil to be cleaned;

• very effective chemical methods;

• simple and easy-to-use physical and chemical processes;

• environmentally friendly and cost-effective bioremediation processes. [16-17]

Chemical methods use chemical events such as ion exchange and chemical reactions to stabilize heavy metals and metalloids and reduce them to less toxic forms. Chemical reagents are required for these processes.[18-24]

Over the past few years, nanotechnology has been widely used in many areas, including soil remediation. The use of nanoparticles (D <100 nm) in the extraction of heavy metals is considered appropriate for soil cleaning

2. Materials and Methods

Table 1 determined the concentration of heavy metals present in the soil by analyzing the soil samples taken for analysis, and the allowable concentration limits for compliance with the requirements of the standard.

Table 1

.Amount of heavy metals for soil and permissible concentration limits of substances

Article	BBQH based on soil background, mg / kg		Mg/kg		Mg/kg		Consemg / kg, mg / kg of heavy metals in agricultural lands	
	according to the standard	the example we took	according to the standard	the example we took	according to the standard	the example we took	according to the standard	the example we took
Copper element (Cu)	30	35	21.60–60.20	23.50–66.60	10-264.9	11-268,1	28.64	29,01
Nickel (Ni)	20-60	25-71	21.23–34.15	26.03–38.19	18.53-66.67	19,3-67/9	253.7	258,32
Cobalt (Co)	5	7	-		7.88-14.58	8,90-15,9	25.05	25,81

Chrome (Cr)	6	8	43.22–0.15	49.72–0.60	20.66-264.43	21,54-745,32	138.4	141,11
Lead (Pb)	32-130	34-132	39.01–66.31	44.81–71.81	5.63-132.08	6,89-133,8	13.96	14.89
Zinc (Zn)	23	24	121.52–178.91	129,33 - 181,08	32.48-271.68	33,76-276,8	45.26	47,1
Manganese (Mn)	500	509	456.45–789.68	466,9-881,8-1	347.77	351,9	665	701
Cadmium (Cd)	0.2	0,23	0.56–1.43	0,58-2,1	0,18-0,96	0,188-0,99	0.26	0,28
Arsen (As)	2	3	3.4–7.43	3,8-8,1	7.46	8,43	5.89	5,99
Mercury (Hg)	0.06	0,07	0.016–0.356	0,019-0,387	-		0.159	0,164

. Concentration criteria for hyperaccumulative plants (% in leaf dry matter) Cd ≥ 0.01, Pb ≥ 0.1, Co ≥ 0.1, Sb ≥ 0.1, Cu ≥ 0.1, Ni ≥ 0.1, Mn ≥ 0 , 1 and Z ≥ 1.0 were adopted.

However, in the samples we took for analysis, the number of heavy metals exceeded the standards, which is due to the human factor and the ongoing civil war in these areas.

As phytoextraction is a safe, least destructive, environmentally efficient, and economical treatment technique that allows large-scale soil cleaning, it is advisable to remove heavy metals from the soil by this method.

Table .2

The most modern methods of soil cleaning

Article	Advantages	Restrictions	Applicability
Land change	Effective for high levels of pollution	Large workload, production of expensive, hazardous waste, and adverse effects on the soil	Long-lasting
Vitrification	Easy to apply, applied to various metals	Expensive due to energy demand	Long-lasting
Thermal desorption	Safe, less re-contamination, and less energy consumption	Suitable for mercury only For other metals such as lead, arsenic, cadmium, and chromium, initial cleaning is required	Long-lasting

Soil washing	Effective, completely cleans metals	Extractors create an environmental problem, the efficiency of which varies depending on the soil, metal, and the type of extractor	Long-lasting
Solidification / stabilization	Chemical agents are less harmful because they remain only in the treated area	Contaminants are not removed	Contaminants are not removed
Nanotechnologies	Apply to large areas, high efficiency	potential toxicity of nanomaterials, the interaction of soil and nanoparticles, formed particles	Large-scale, long-term
Electrochemical cleaning	Very effective for saturated clay soils	Environmentally unacceptable, the nature of the spread of metals	Long-lasting
Microbial bioremediation	İqtisadi əlverişli, remediasiya üçün az vaxt tələb olunur	Mikroorqanizm, torpaq, bitki və metal növündən asılıdır	Large-scale and long-lasting
Fitovolatizasiya	Economically viable and less destructive	Volatile metals are formed, causing environmental problems, which are not controlled after the release of the metal into the atmosphere	mall and medium scale, long-term
mall and medium scale, long-term	destructive	Temporary solution, efficiency varies depending on soil, plant, and metal type	Small and medium scale and short term
Phytoextraction	Highly economical, environmentally friendly, less destructive	Efficiency depends on the tolerance of the plant, the bioavailability of metals in the soil.	Large-scale and long-lasting

3.Results and Discussion

3.1 Study of plant development in soils used in scientific research and with the addition of heavy metals

The soil to be used in our study was brought from fertile soils near the Araz River. The imported soil was sieved in August 2021 to obtain a more homogeneous structure. For each plant species, 11 plants will be planted, 3 of which will be in the raw soil for control purposes, 11 in the heavy metal-mixed soil, and a total of 14 pots have been prepared, 3 of which are in the soil. 1 should be controlled as raw soil and 2 as heavy metal soil. After labeling the prepared containers, 6 kg of soil is poured from the filtered soil into each container.

Prior to the addition of heavy metals, samples were taken from the soil used for each plant and the amounts of Pb, Ni, Cu, Zn, and Cd were analyzed separately. The following is the average of the 5 samples examined. (Table 3)

Table 3

The average amount of heavy metal in the first soil not contaminated with heavy metals from which plants will be grown

Heavy Metal	Analysis Result (mg / Kg)
(Pb)	10,24 ± 0,53
l (Ni)	63,59 ± 0,52
(Cu)	27,48 ± 1,38
(Zn)	47,01 ± 2,00
(Cd)	0,2 ± 0,10

Cadmium (Cd), nickel (Ni), copper (Cu), zinc (Zn), and lead (Pb) were used as heavy metals. The chemical salts used are given in Table 4.

Table 4

Chemical salts used

Ağır Metal	%	Tzu	The amount added to each dish
Kadmiyum (Cd)	%98'lik	$Cd(CH_3COO)_2 \cdot 2 H_2O$	0,4522 gram Cd
Nikel (Ni)	%98'lik	$Ni(NO_3)_2 \cdot 6 H_2O$	0,6750 gram Ni
Bakır (Cu)	%98'lik	$CuSO_4 \cdot 5 H_2O$	0,4756 gram Cu
Çinko (Zn)	%98'lik	$ZnSO_4 \cdot 7 H_2O$	0,3627 gram Zn
Kurşun (Pb)	%98'lik	$Pb(CH_3COO)_2 \cdot 3 H_2O$	1,4976 gram Pb

Heavy metals were added to the soil samples in two batches with an interval of two days. After the chemicals to be added were weighed accurately, they were dissolved in 500 mL of distilled water and 8.20 mL of solution was added to each pot. The pots are watered abundantly. In order to avoid toxic effects on the seeds, 500 g of soil was added after each coarse metal was added.

The plants in our study were selected from plants that can be grown in the region.

Lettuce (L.actuva Sativa Var. Longifolia), beans (Phaseolus vulgaris), summer pumpkin

(Cucurbita Pepo), corn (Zea mays) and radish (Raphanus sativus var. Radicula) were selected from a total of 5 plants. Plant seeds were purchased from the Chamber of Agriculture. Taking into account the risk of each seed falling into the pots, 6 corn, beans, and pumpkins were planted at a depth of 2-3 cm on each axis, a pinch of radishes and lettuce were planted in the soil and 500 mL. water was added to the containers. Plant specimens were released to grow in natural weather conditions. The remaining plants and 3 non-seeded pots for each plant were irrigated according to ty

3.2 Preparation of soil sample for analysis

After the raw soil is sieved and placed in pots, equal amounts of soil samples are taken from the containers allocated to each plant and mixed. Samples were taken from the soil taken separately for each plant and placed in sample containers, first in an oven at 105 ° C for 2 hours and then in a desiccator for 2 hours. Samples were drawn and placed in the oven at 105 ° C for 2 h and then stored in a desiccator for 2 h. The amount of moisture is calculated after taking samples from the desiccator.

Samples taken to examine the heavy metal content in the soil were stored in an oven at 105 ° C for 2 hours and then in a desiccator for 2 hours. Samples of 05-1 g were taken for heavy metal analysis and placed in the Teflon cells of the microwave oven. 2.5 mL of HNO_3 and 7.5 mL of HCl were added. After waiting for 10 minutes, it was lit in the microwave (BERGHOF VMS-3 Speed Wave) in the program shown in the table below

Ethylenediaminetetraacetic acid was added to 4 of the 8 containers containing heavy metal contaminated soil 10 days prior to harvest.

(EDTA) was added. 30 mmol EDTA was added to each coarse.

(EDTA: $C_{10}H_{14}N_2Na_2O_8$ $2H_2O$) [12]. The results are shown in Table 5. The microwave program is given in Table 6

Table 5.

Growth cycles of plants

PLANT	Growth rate
SWEET CORN	38 day
beans	58 day
PUMPKIN (storm	59 day

radish	68 day

Table 6.

The microwave program is given in microwave software

addım	1	2	3
T °C	140	160	175
Ta (min)	5	3	3
Time (min)	5	5	20

The sample from the microwave was filtered and diluted to 50 ml. later

Heavy metals were determined at the ICP-OES (Inductive Connected Plasma Optical Emission Spectrometer) (Perkinelmer Optima 2100 DV).

Result

Sufficiently large plants are cut close to the ground. Then the stem and leaves separated. The leaves and stems separated from each other were pulled one by one without wasting time. After the stems and leaves of all plants have been cut and the pulling process completed, the root part has been removed from the soil. The soil removed from the pot was taken to a large bowl to completely remove the root part from the soil. The soil softened by pouring a certain amount of water. The root is removed from the softened soil and washed in plenty of clean drinking water to clean the remaining soil inside the root. After removing water from the washed root, the roots were weighed accurately. The irrigated soil is placed in plastic bags, then placed in containers and allowed to dry to keep the amount of metal in it. The stems and leaves of the drawn and marked corn plant were cut into smaller pieces and placed in aluminum foil containers and kept in the oven at 105 ° C for 1 day to dry.

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