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Removal method of Cu, Cd, Pb and Zn from contaminated soil by using Plant-Based surfactants, *Sapindus mukorossi* L: A review

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Abstract
In today's time, as technology has developed, the spread of pollution in the environment is also increasing. Some heavy metals like Zn, Pb, Cd, Ni, Cu, and Cd are entered into the soil through chemical factories and mining and these types of heavy metals are responsible for decreasing the fertility rate of the soil.
When humans eat the crops grown on such land, these heavy metals enter the human body and after a long period, they produce disease. Currently, there are many ways to extract such heavy metals but they are expensive.
However, some researchers have tried to remove such heavy metals from soil by using plant extracts and have achieved success. This review article shows how heavy metals can be removed from soil using Aretha extract.

Key words: Pollution, Heavy metals, Plant extract, Aritha (*Sapindus mucoraceae* L.)

Introduction
Nowadays, as the number of industries and chemical factories are increasing day by day, the harmful chemicals released from them are polluting the water and soil and causing great harm to human life.
Heavy metals like lead, nickel, arsenic, chromium, cadmium, zinc and copper enter the soil and water through mining, auto mobile production, battery production, chemical fertilizers and pollute the soil and water. Drinking such water and using crops grown in such land as food causes disease in organisms including humans as well as aquatic organisms and other terrestrial animals [1].
Heavy metals exist in cationic and anionic forms, including lead, zinc, and copper as cationic forms, and arsenic and chromium as anionic forms [2]. In contaminated soils, these heavy metals coexist in their different oxidation states and may interact with other minerals or organic compounds, which undergo oxidation or reduction under the influence of soil moisture and atmosphere, thereby reducing the soil's moisture holding capacity and the land is gradually becoming infertile.
There are many chemical reagents and biological extracts that can be used to remove heavy metals from soil. In this review paper we have described methods of removing copper, cadmium and zinc from soil by using saponins which is extracted from Aritha (Fruit).

Methods
Following steps are required for removal of heavy metal by using plant extract

1. Soil Samples and Characterization
- First, collect soil samples from 2 to 3 locations then place these soil samples in a well-ventilated area to remove moisture from the soil. Then grind it using 2 mm sieve. Now these soil samples can be collected in a plastic bag.
- Now examine the following parameters of these samples including Ph, electrical conductivity, bulk density, porosity, particle size distribution, cation exchange capacity and organic matter and record the results [3].

2. Soil Contamination Procedure
Z. Gusaitin and E. kalimiuk adopted the following method in which cadmium nitrate, copper sulphate, zinc nitrate were dissolved in 3 liters of water after which 4 kg of soil sample was added. The filtrate was then filtered properly and the filtrate was then analyzed using a flame atomic absorption spectrophotometer [4].

3. Saponin preparation
A 20% stock solution of saponin was prepared using 40 g of certified pure dried organic soap powder (*Sapindus mucoraceae L.*), and adding 200 ml of distilled water. The solution was stirred gently at room temperature for 3 h and then centrifuged at 7000 rpm for 15 min before filtering [5]. Prepare solutions such as 1%, 3% and 5% (w/v) by appropriately diluting the stock solution with distilled water. All solutions should be freshly prepared on the day of use. Is the supernatant (liters) and MS is the dry mass (kg) of the soil. To record the pH values of the solution before washing and the values of the supernatant after washing, to ensure precision, we performed all experiments in triplicate and presented the results as averages [6].

Formula for Calculation
Percentage copper removal (%) $=C_1V_1/C_sM_S$ X 100
- Where C_1 (mg/l) and C_S (mg/kg), are the concentrations of metal in supernatant and soil respectively; V_1 is the volume of supernatant (liters) and M_S is the dry mass of the soil (kg).
- Cu and Cd had the higher removal than Zn and Pb. Similar trend was observed by other researchers [7].
- Same formula use for Zn, Pb, Cd.

Significance of this method
- There are many other ways to remove heavy metals from soil, the advantage of this method is that it saves both cost and time to remove heavy metals compared to other methods.

Limitation

Aritha was commonly found in India in earlier times but in today's polluted environment it is getting less and less day by day, now Aritha is placed as an endangered plant.

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