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***Research article***

# DETERMINATION OF AVAILABLE FRACTION OF HEAVY METALS IN SOILBY USING DIFFERENT PROCEDURES FROM KURDISTAN REGION IRAQ.

Khsraw A.Rashid[1]and Zhino.K.Mohammed[1]

[1]Soil and water science Department, Faculty of Agriculture Science, University of Sulaimani, Sulaimani, Kurdistan Region –Iraq,
khasraw.rashid@univsul.edu.iq and zhino.mohammed@univsul.edu.iq

**ABSTRACT:** The extractability of Mn, Ni, Cr and Co, was evaluated using $H_2O$ $CaCl_2$ $BaCl_2$ and $HNO_3$extractants in this research. The surface soils were used to assess plant available metals with different extraction methods. The amounts of metal extracted by extraction solution were differences except the $CaCl_2$ and $BaCl_2$ were similar in metals extractability, all procedure were extracted highest concentration of Mn. While the strong extraction solution for metal extraction is $HNO_3$ was extracted potentially available heavy metals in soil. The obtained results indicated a high variability of metal extraction depending on extraction procedure, and nature of the soil. The order of metal extraction by $H_2O$ is Mn>Ni>Cr>Co and the values are (5.52, 1.85, 1.79, 1.09 mg $kg^{-1}$ soil) respectively, $CaCl_2$ and $BaCl_2$ extraction metals orderMn>Cr>Ni>Co, the values are (5.51, 2.69, 2.16 and 1.59 mg $kg^{-1}$ soil) and (5.59, 2.52, 2.22 and 1.70 mg $kg^{-1}$ soil) respectively, nevertheless the $HNO_3$ metal extraction in order Mn>Ni>Co>Cr and values arre (213.02, 32.63, 14.80 and 13.92 mg $kg^{-1}$ soil) respectively, While all procedure have highest affected on Mn extraction than the other metals and all different procedures extracted the available form of metals in soil.
**Key Words:** Extraction procedure, Heavy metals, Bioavailable fraction, Pollution

## INTRODUCTION

Heavy metals in soils may exist in different chemical forms or ways of binding. In unpolluted soils heavy metals are mainly bound to silicates and primary minerals forming relatively immobile species, whereas in polluted ones heavy metals are generally more mobile and bound to other soil phases. In environmental studies the determination of the different ways of binding gives more information on heavy metal mobility, as well as on their availability or toxicity, in comparison with the total element content. However, the determination of the different ways of binding is difficult and often impossible. Different approaches are used for soilanalysis, many of them focused on pollutant desorption from the solid phase; others are focused on the pollutant adsorption from a solution by the solid phase. Extraction procedures by means of a single extracting are widely used in soil science. These procedures are designed to dissolve a phase whose element content is correlated with the availability of the element to the plants. This approach is well established for major elements and nutrients and it is commonly applied in studies of fertility and quality of crops, for predicting the uptake of essential elements, for diagnosis of deficiency or excess of one element in a soil, in studies of the physical-chemical behavior of elements in soils.
The application of extraction procedures to polluted or naturally contaminated soils is mainly focused to ascertain the potential availability and mobility of pollutants which is related to soil-plant transfer of pollutants and to study its migration in a soil profile which is usually connected with groundwater problems [1].
The present study was conducted with an aim to determination of bioavailable fraction of heavy metals by different extraction procedure. And comparisons between different procedures to extraction of heavy metal in serpentine soil were naturally contaminated by heavy metals.

## MATERIAL AND METHODS

### Study area and Soil samples.

Soil samples (0-30 cm depth) were collected randomly from Penjween area, which content of high concentration heavy metals naturally. Soil samples were taken in 23 July, 2013 from penjween area (Mlakawa location) then the latitude and longitude of study area between 3536´22.7″ N to 4554´7.17″E and 3535´8.66″N to 4554´8.20″E in Elevation (m) 1398 to 1299. Composite soil samples were air dried and passed through a 2.0 mm sieve. Soil samples were stored in plastic bags prior to analyses.

**Metal Extraction**

**$CaCl_2$ metals extractable.**

A five gram (5.00 g) air-dried soil (ground to <0.25mm)was extracted with 50 ml of 0.01 M $CaCl_2$ with shaken for 5 h. The concentration of metals was analyzed in the supernatant usingAAS [2]**.**

**$BaCl_2$ metals extractable.**

A five gram (5.00 g) air-dried soil (ground to <0.25mm)was extracted with 50 ml of 0.01 M $BaCl_2$ with shaken for 5 h. The concentration of metals was analyzed in the supernatant usingAAS [2].

**C. $HNO_3$ metals extractable.**

From air-dried soil samples, 4.00 g (ground to <0.25mm) was extracted with 40 ml of 0.43 M $HNO_3$ with shaking for 4 h. The supernatant was separated by filtration and the concentration of metals was analyzed by using AAS [2]

**D. $H_2O$ metals extractable**

A five gram (5.00 g) air-dried (ground to <0.25mm) was extracted with 50 ml of distilled water with shacked for 2h. The amount of metals was determined in the supernatant using AAS according [2-3].

## RESULTS AND DISCUSSION

**$H_2O$ extractable metals.**

The results in the table-1 show that the extractability of heavy metals by $H_2O$ was in order Mn>Ni>Cr>Co, and the value is (5.52, 1.85, 1.79, 1.09 mg $kg^{-1}$ soil) respectively, the distilled water was extracted Mn more than the other metals (Ni, Cr and Co) this differences of extractability by water refer to the solubility of heavy metals in water and depending on solubility constant of heavy metals in water[4] ,while the total concentration of Mn in the soil was higher than the other metals because the Mn was an essential metal to plant growth[5].Form of metals (Mn, Ni, Cr and Co) were extracted bay $H_2O$ were available form in soil was used by plant.

**$CaCl_2$ extractable metals.**

The results in table (1) show that $CaCl_2$ solution was extracted heavy metals in order Mn>Cr>Ni>Co and the value is (5.51, 2.69, 2.16 and 1.59 mg $kg^{-1}$soil) respectively, differences between $H_2O$ and $CaCl_2$ solution were in Cr metals the $CaCl_2$ solution extracted more Cr in comparison to Ni and Co, this differences may be due to the oxidation states of Cr in soil [6] and Cr solubility in $CaCl_2$ solution.

**Table-1: Heavy metals concentrations in soil were extracted by $H_2O$, $CaCl_2$, $BaCl_2$ and $HNO_3$.**

| Extractable solution | Concentration of metals $mgkg^{-1}$ in soil | | | |
|---|---|---|---|---|
| | Mn | Ni | Cr | Co |
| $H_2O$ | 5.52 | 1.85 | 1.79 | 1.09 |
| $CaCl_2$ | 5.51 | 2.16 | 2.69 | 1.59 |
| $BaCl_2$ | 5.59 | 2.22 | 2.52 | 1.70 |
| $HNO_3$ | 213.02 | 32.63 | 13.92 | 14.80 |

**$BaCl_2$ extractable metals.**

Table-1 show that similarity between $BaCl_2$ and $CaCl_2$ metals extractability, however, $BaCl_2$ extracted heavy metals in order Mn>Cr>Ni>Co, while the value is (5.59, 2.52, 2.22 and 1.70 mg $kg^{-1}$ soil) respectively, the similarity between both solutions $BaCl_2$ and $CaCl_2$ depending on form of salts both of them were chloride salt and affected on reaction with heavy metals in soil were the similar [5]. Then the BaCl2 and $CaCl_2$ solution extract the available form of heavy metals were used by plant. This solution salts show the extractable or exchangeable form of metals can exchange by the alternative metals in valence on surface soil particles.

**$HNO_3$ extractable metals.**

The $HNO_3$ was extracted high concentration of heavy metals in soil for the reason that the $HNO_3$ was strong acid and most of heavy metals were available in acid medium [7].Then $HNO_3$which dissolves the finer soil particle and there for, heavy metals that exist in mineral structural in soil was dissolved by $HNO_3$ solution [8] The present research shows that in Fig (1) the highest metal extractability by $HNO_3$ solution in comparison with $H_2O$, $CaCL_2$ and $BaCL_2$. While the order of metals extraction by $HNO_3$ are Mn>Ni>Co>Cr and value is (213.02, 32.63, 14.80 and 13.92 mg $kg^{-1}$ soil) respectively, showed in table (1). This result was in agreement with [9].$HNO_3$solution in this procedure was extracted the potentially available metals in soil. The different procedure for metal extractable each single procedure has suitability for single metals. While all procedure have highest affected on Mn extraction than the other metals and all different procedures extracted the available form of metals in soil.

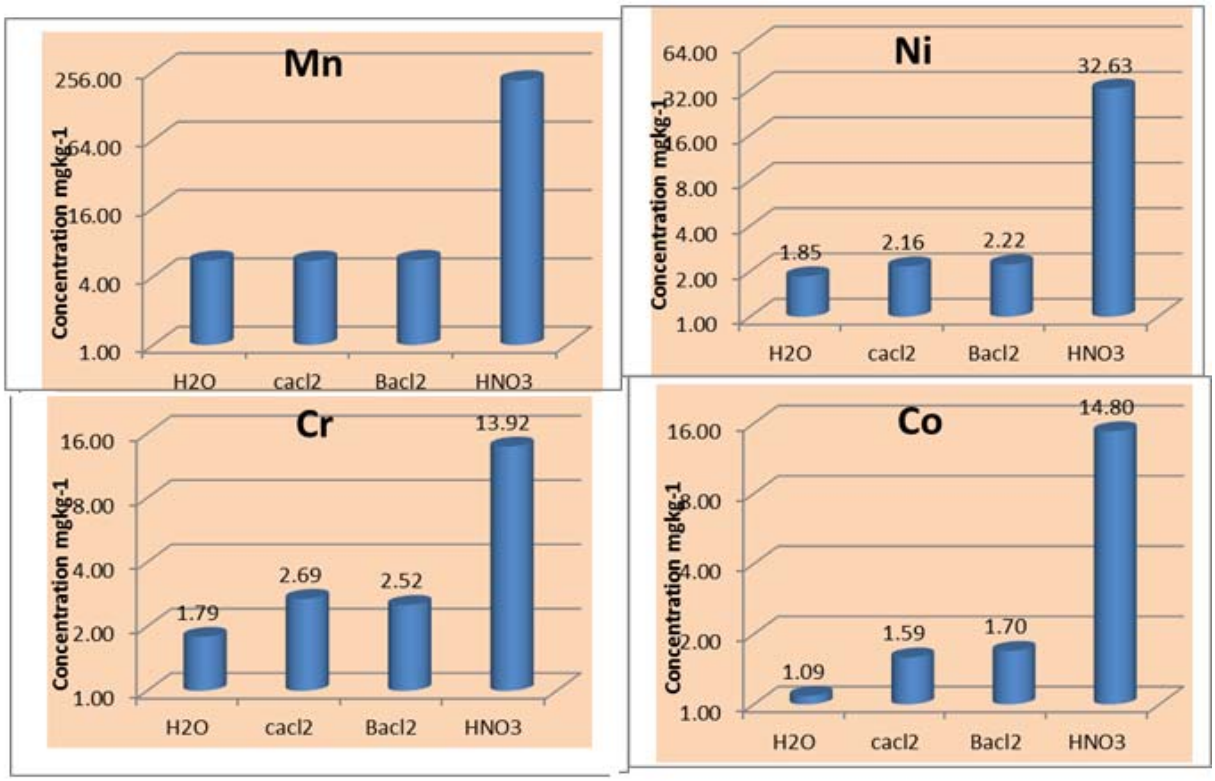


**Figure-1: Concentration of Heavy metals in soil by different extraction solution.**

## CONCLUSION

In the present research study show that the different extraction solution extracted mostMn concentration in comparison with Ni, Cr and Co. The $CaCl_2$ and $BaCl_2$ have similarity in extracted metals in soil.However,the $HNO_3$ was stronger solution for metal extraction and extracted the potentially available metals in soil but other solution $H_2O$, $CaCl_2$ and $BaCl_2$ extracted the available form of heavy metals in soil were used by plant. Present study suggested that the heavy metals study in the environmental field needed the information on the available form were release to food chain, at that point the most substantial extraction solution was extract near the total metals concentration in soil is $HNO_3$ solution.

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