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Efficacy of some Sudanese Medicinal Plants Extracts to Remove Heavy Metals from Water

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ABSTRACT

Some heavy metals have bio-importance as trace elements but, the biotoxic effects of many of them in human are of great concern.Although several adverse health effects of heavy metals have been known for a long time, exposure to heavy metals continues, and is even increasing in some parts of the world, particularly in less developed countries. The main threats to human health from heavy metals are associated with exposure to lead, cadmium, mercury and arsenic. The use of certain whole plants and plant extracts is reported to possess an ability to serve in water purification.The main objectives of this study are to test certain sudanese plants ethanolic extracts namely; *Moringaoleifera*, *Typhalatifolia* and *Cymbopogonproxmus* for their ability to purify water from cadmium, zinc, chromium and lead. Analysis of the heavy metals cadmium, chromium, lead and zinc were performed before and after treatment of water with the extracts. The findings showed that ethanolic extracts of *M. oleifera*, *T.latifolia* and *C.proxmus* were capable of absorbing the chromium, cadmium and zinc. Lead metal absorbed by *T.latifolia*and *C.proxmus*ethanolic extracts and the extract of *M. oleifera* didn't absorb this metal. It can reasonably conclude that, all tested ethanolic plants extracts had capability to remove such metals also this finding confirm the traditional use of these plants in water purification.Therefore, a wide investigation of these plants for their removal potent of heavy metals and the identification of the phytochemicals of these plants would be an interesting line of inquiry.

INTRODUCTION

Recently, water pollution as results of industrial and economical progression is becoming a significant environmental problem. Metals are widely distributed throughout nature and occur freely in soil and water (Nema *et al*., 2016). Heavy metals are defined as metallic elements that have relatively high density compared to water (Tchounwou *et al*., 2012). Heavy metal pollution is identified as one of the consequences brought about by development and economic progress (De Guzman *et al*.,2016). Heavy metals can cause brain damage and many diseases in human beings. They cannot be degraded easily and their cleanup usually requires their removal. Therefore, the direct release of reused waste water for the irrigation of agriculture and horticultural is viewed as posing potential risk to human health (Yapoga *et al*., 2013). There are 59 elements classified as heavy metals and out of these five are considered to be highly toxic and hazardous. These are cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb) and zinc (Zn), which are released into the environment by human activities or through natural constituents of the earth's crust (Shaban *et al*., 2016). Traditional systems of

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medicine continue to be widely practiced on many accounts. Centellaasiatica and Orthosiphonstamineus as phytoremediation agents, both species were grown in contaminated soil obtained from industrial land. Plant growth response and their ability to accumulate and translocate zinc, copper and lead were assessed (AbdManan *et al*., 2015). *Eichhornicrassipes* can be used to serve as a phytoremediation plant in the cleaning up of Zn, Cd, Cu and Cr from industrial wastewater (Yapoga *et al*., 2013). Chelation of heavy metals is considered very important and very useful, especially for plants, which are economics (Sellal *et al*., 2016). Different plants have been used to achieve maximum heavy metals removal from metaliferous waste water, in recent years (Manios *et al*., 2003).

Cymbopogon proxmus belong to family Poaceae, locally known as Half bar , is an aromatic densely- tufted grass growing wildly and widely in Upper Egypt. The herb is highly reputed in folkloric medicine (Sabry *et al*., 2014). *Cymbopogon* essential oils are characterized by monoterpene constituents Citral is one of the important components of the oil present in several species of *C. proxmus* with wide industrial uses such as raw material for perfumery, confectionery and vitamin A (Lal and Awasthi, 2015). In Sudan *Cymbopogonproxmus used* to purify drinking water. (Abed elmonem *et al*., 2012)

Typhalatifolia family (Typhaceae)*Typha* species have a very high growth rate and a prodigious ability to produce biomass that could be used as a feed source for biofuel. *Typhalatifoli* is reported as assisting with water purification and in some countries has been planted in wetlands created for this purpose (Jhonson, 2011).

Moringaoleifera(moringaceae) is a highly valued plant that is mostly cultivated in the tropics and subtropics. It is used for food, medication and industrial purposes (Moyo *et al*., 2011; Marrufo *et al*., 2013**).** Moreover, it is widely cultivated in different countries, an extensive variety of nutritional and medicinal uses have been attributed to its roots, bark, leaves, flowers, fruits and seeds (Mbikay, 2012). *M. oleifera* (seeds) used to improve the quality of drinking water in the rural areas. (Nand *et al*., 2012) Therefore, in this regard, ethanolic extracts of *M. oleifera, T. latifolia* and *C. proxmus* were tested for their potent to improve the quality of water. Analysis of the heavy metals cadmium, chromium, lead and zinc was performed before and after treatment of water with the extract.

MATERIALS AND METHODS

Collection and Identification of Plants:

The seeds of *M. oleifera* were collected in December 2015 from southern (Salha) countryside of Omdurman. The leaves of *T. latifolia* were collected in February 2016 from Soba station for sewage treatment of Khartoum State. The samples after collection were shade dried at room temperature. *C. proxmus*(Mahareib) was collected in December 2015 from Omdurman market. The studied plants were authenticated at Medicinal and aromatic plants institute, Khartoum, Sudan.

Preparation of Extracts:

About 250g of *M. oleifera* seeds were coarsely powdered using mortar and pestle. Sample was successively defatted with petroleum ether and then extracted with 80% ethanol using solvent semi-continuous extractor (Soxhlet). Extraction carried out for about six hours for petroleum ether and eight hours for ethanol till the color of solvent at the last siphoning time returned colorless. While,300g of each sample of *C. proxmus*and *T. latifolia*were extracted by soaking in 80% ethanol for about seven days. Solvents were evaporated under reduced pressure using rotary evaporator apparatus and further dried under open air in petri dishes till complete dryness and the yield percentages were calculated . Extraction was carried out according to method described by Handa *et al*. (2008) with slight modifications.

Preparation of heavy metals solution:

The concentrations of metals (zinc, lead, cadmium and chromium) were prepared in the linear range according to(Nand *et al*.,2012) with some modification. The concentration was prepared as 5ppm and 10ppm. For specific metal analysis, standard solutions of known concentrations were used and the effect of the addition samples of extracts metal adsorptions was tested. The samples of extracts were prepared by taking approximately 0.1g of the samples and mixing it with about 5 mL of prepared solution. All experiments were conducted at room temperature and after being allowed to stand for two hours, the samples were analyzed using Atomic Absorption Spectrophotometer (AAS) (Model 210 VGP).. The concentrations of the metals, cadmium, chromium, zinc, and lead adsorbed by samples extract were determined after and before adding the extracts.

RESULTS AND DISCUSSION

Figure 1 shows the adsorption of cadmium by using the three plants extracts.Results of this study revealed that Cadmium (Cd) was highly adsorbed by *M. oleifera* extract than *T. latifolia* (bous) and *C. proxmus*(mahreib) extracts. *T. latifolia* (bous) as shown in Figure 2, has higher capability to absorb chromium than *C.*

proxmus(mahreib) and *M. oleifera* extracts. *T. latifolia* (bous) extracts highly absorbed lead (Pb) than *C. proxmus*(mahreib) extract, on the other hand *M. oleifera* is not absorbed any amount of lead (Figure 3). Figure 4 shows absorption of Zn using plants extracts.Zinc metal is highly absorbed by *M. oleifera*extract than of *T. latifolia*(bous) and *C. proxmus*(mahreib) extract.

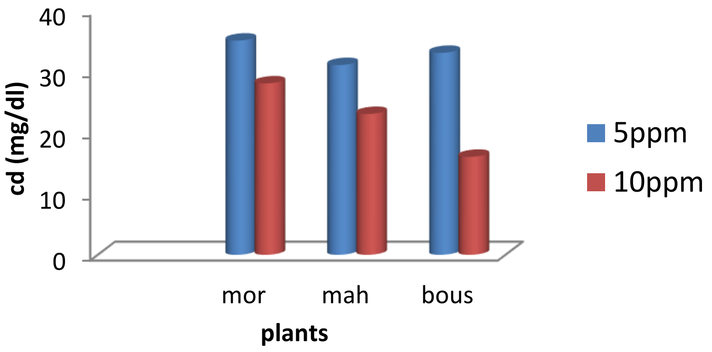

Fig. 1: Adsorption of cadmium using plants extracts

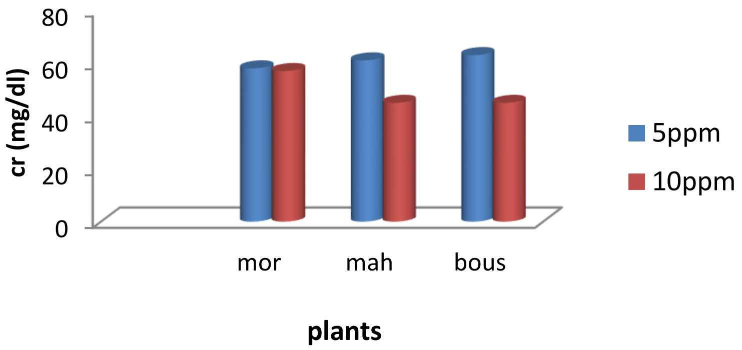

Fig. 2: Adsorption of chromium by plants

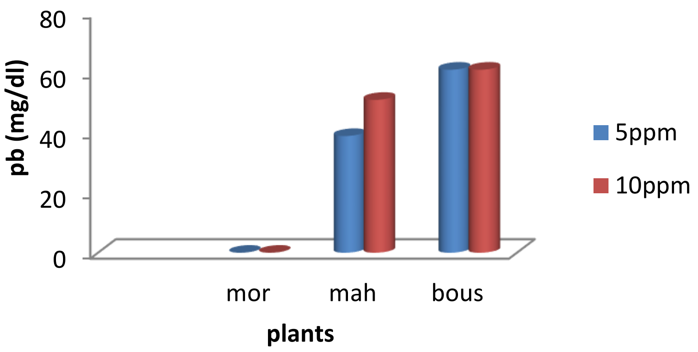

Fig. 3: adsorption of Pb using plants extracts

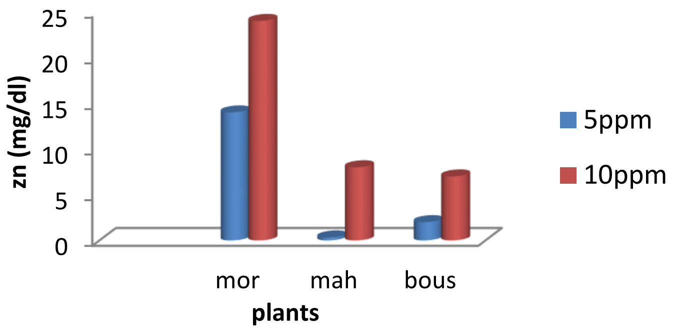

Fig. 4: Adsorption of Zn using plants extracts

The adsorbing power of *M. oleifera* to cadmium , zinc and chromium in the present study is in agreement with study carried by Ravikumarand Sheeja, 2013 but it contrast with it in adsorbing of lead and this may be due to nature of sample that in previous study powdered seeds used but in current study ethanolic extract of seed used after defatted of seed with petroleum ether so essential oil may have role in adsorbing of this metal . Previous phytochemical investigations have identified some phenolic compounds and flavonoids in *M.oleifrai* (Mbikay,2012; Verma *et al*.,2009). *C. proxmus* contained flavonoids,tannins,alkaloids and saponins(Ibrahim and El-Khateeb2013) reported that *T .latifolia* used as the sources of flavonoid, steroids,tannin .The presence of terpenoids in *T .latifolia* reported by Rao *et al*., 2016. Previous finding showed that all tested plants contained flavonoids. Due to the specific chemical structure, flavonoids can chelate metal ions and form complexes (Symonowicz and Kolanek, 2012). The efficacy of these plants for removal of heavy metal may be to the presence of these compounds.

Conclusion:

Heavy metals can cause many dangerous diseases in human beings so that we must remove it using chemicals and other methods. However, these methods were not very effective and highly cost, but plants and biological methods is best choice in this field. We use the plant according to their folkloric use in water purification. The results of this study showed that all tested plants have capability to remove such metals and the study had confirmed the traditional use of these plants in water purification. Therefore, a wide investigation of these plants for their removal potent of heavy metals and the identification of the flavonoids of these plants would be an interesting line of inquiry.

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