Short Communication

Phytoremediation of Chromium and Cobalt using *Pistia stratiotes*: A sustainable approach

Santosh Kumar Prajapati, Neelima Meravi, Shivangee Singh
Department of Botany, School of Life Sciences, Guru Ghasidas Vishwavidyalaya, C.G. 495009, India
E-mail: snshprjpt@rediffmail.com

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Abstract
This experimental study showed that aquatic macrophytes, *Pistia stratiotes*, may be used for phytoremediation of water bodies polluted with heavy metals, Cr and Co in a sustainable way.

Keywords phytoremediation; Chromium; Cobalt; *Pistia stratiotes*.

1 Introduction
Pollution of the biosphere with toxic metals has accelerated dramatically since the beginning of the Industrial Revolution (Nriagu, 1979; Sayyed and Sayadi, 2011). The heavy metal load from domestic wastewater and sewage alone (Nriagu and Pacyna, 1988) ensures that this will be a continuing problem for science and humankind. The release of toxic heavy metals such as Chromium (Cr) and Cobalt (Co) into the environment is a serious pollution problem affecting water quality, therefore presenting a direct hazard to human health. Ions of chromium and cadmium which are frequently present in the wastewaters can cause renal dysfunction as well as chronic alterations in nervous system and gastrointestinal tract. These metals are released from a variety of sources such as mining, urban sewage, smelters, tanneries, textile industry and chemical industry. Technologies used for their removal from aquatic bodies include reverse-osmosis, ion-exchange, electrodialysis, adsorption, etc. Most of these technologies are quite costly, energy intensive and metal specific. Contrary to this, phytoremediation offers a promising technology for heavy metal removal from waste water (Singh et al., 1996; Miretzky et al., 2004).

Phytoremediation involves phytoextraction (Kumar et al., 1995), rhizofiltration (Dushenkov et al., 1995), phytostabilization (Salt et al., 1995) and phytotransformation/phytodegradation (Susarla et al., 2002). Aquatic macrophytes *Pistia stratiotes* L. has been extensively used for phytoremediation (Quian et al., 1999; Skinner et al., 2007). *Pistia stratiotes* was used in laboratory experiments for the removal of several heavy metals (Fe, Cu, Zn, Mn, Cr, and Pb) resulting from anthropogenic activity (Miretzky et al., 2004).

2 Material and Methods
Aquatic macrophytes *Pistia stratiotes* L. (water lettuce) was selected to assess its heavy metal removal capacities for Cr and Co from water under laboratory conditions. *Pistia stratiotes* L. is a perennial freshwater weed spread across the world and carries its entire life cycle as free-floating plant, only the root system is completely submerged. This species takes up metals from water, produces an internal concentration several folds greater than their surroundings and shows much higher metal-accumulating capacity than non-hyper
accumulating terrestrial plants. Therefore this species was selected for present phytoremediation experiment. The metal concentration was measured with the help of atomic absorption spectrophotometer (AAS) model: AA 7000, SHIMADZU and the standard was prepared using standard metal solution of Inorganic Ventures.

3 Results and Discussion
Cr and Co from the water were very efficiently removed by *Pistia stratiotes* (Fig. 1). It is clear from the figure that Cr was almost completely removed in 48 hours and non detectible level was present after 72 hours. Similar results were observed with the removal of Co from water. The present finding is in consonant with other findings and is supported by literature.

![Fig. 1 Concurrent removal of Cr and Co by *Pistia stratiotes*](image1)

When the removal of heavy metals Cr and Co from water was done separately by *Pistia stratiotes* then different results were observed (Fig. 2). It can be seen clearly that almost all Cr is removed by *Pistia stratiotes* in 48 hours and there was negligible amount of Cr in water after 48 hours which cannot be detected. However, Co was not completely removed in 4 days. The main reason for this may be the toxicity of Co to *Pistia stratiotes*.

![Fig. 2 Removal of Cr and Co by *Pistia stratiotes*](image2)
Table 1 Percent age removal of heavy metals by *Pistia stratiotes*

<table>
<thead>
<tr>
<th>Days</th>
<th>Cr % removal</th>
<th>Co % removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>86</td>
</tr>
</tbody>
</table>

It can be observed from the Table 1 that percentage removal efficiency of *Pistia stratiotes* for the two toxic heavy metals differs. The capacity of *Pistia stratiotes* for Cr removal is high as compared to Co from water. Other researches also have similar findings and the reasons are also similar i.e. high toxicity of Co as compared to Cr for *Pistia stratiotes*.

It can be concluded from the present study that aquatic macrophytes *Pistia stratiotes* can be used for phytoremediation of water bodies polluted with toxic metals Cr and Co in a sustainable way.

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**References**


