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# Study of bio-adsorption ability of heavy metals by peels of banana varieties in different forms

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**Abstract :** *The bio-adsorption capacity of fruit peels of three banana species namely Musa acuminata, M. paradisiaca and M. polymorpha, which are the most common banana species in Bihar, was analyzed. Fresh and dry forms of banana peels of all the three species were exposed to Cu(II) and Pb(II) salt solution for bio-adsorption and values were compared.*

*Among the three species, M. paradisiaca was found to be more effective for bio-adsorption. The bio-adsorption was directly proportional to amounts of protein, phenols and organic acid present in peels.*

**Keywords**: *Bio-adsorption, Heavy metal, Banana peels.*

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## Introduction:

Heavy metal species may be considered a "contaminant" if it occurs where it is unwanted and cause a detrimental effect to the humans or to the environment. There are many ways by which these toxins can be introduced into the body such as consumption of foods, beverages, skin exposure and the inhaled air. Plants experience oxidative stress upon exposure to heavy metals that leads to cellular damage and disturbance of cellular ionic homeostasis. (Halim *et. al*., 2003). These heavy metals in toxic amount in waste water are non-biodegradable. The toxicity of heavy metals is

enhanced in living tissue by biomagnification through food chain which can cause various diseases and disorders (Saikaew and Kaewsarn, 2009). Heavy metals cannot be destroyed biologically but are only transformed from one state to another. Among the heavy metals, Cu and Pb are the major available heavy metals in the aquatic environment and cause severe damage to living organisms.

Bio-adsorption is one of the physico-chemical treatment processes found to be effective in removing heavy metals from aqueous solutions. According to Singhal et. al. (2014) and Hossain *et. al.* (2012), an adsorbent can be considered economic if it is abundant in nature, requires little processing and is a byproduct of waste material from waste industry. Bio-adsorption by plant wastes are inexpensive as they have no or very low economic value.

Several other techniques were applied to remove heavy metal ions from industrial waste water such as activated carbon adsorption, chemical precipitation, reverse osmosis, electro-dialysis and ion exchange are expensive.

Castro *et. al.*(2011) found that banana peels contain nitrogen, sulfur and carboxylic acids. These acids are capable to bind with positively charged metals that leach into rivers from industrial operations.

The present study deals with the bio-adsorption ability of heavy metals by banana peels of three species.

**Materials and Methods :**

Peels of three different varieties of banana namely *M. acuminata, M. paradisiaca and M. polymorpha* were collected from the shops of Patna, Bihar. For fresh bio-adsorbent, fresh banana peels were cut into small pieces(<5mm) and washed with distilled water to remove external dirt and sundried for 10 days. Separate solutions of 1% copper(II)sulphate and lead(II)nitrate were prepared in distilled water respectively. 1g of fresh and dried peels of all the three species were soaked into Cu and Pb solution for one hour at room temperature, then the peels were filtered out and the solutions left were used for estimating Cu and Pb content. Estimation of Cu in copper sulphate was done by acid-alkali titration method. Estimation of Pb in lead nitrate was done by permanganate titration method. (Singh *et. al.* 2010)

Estimation of protein was done by Lowery *et. al*. (1951) method, phenol by Folin-ciocalteau reagent and organic acid by acid base titration.

**Table 1. Adsorption of Pb and Cu on banana peals**

| Bio-adsorbents | Pb adsorbed (mg/100ml) | Cu adsorbed (mg/100ml) |
|---|---|---|
| CONTROL | – | – |
| Fresh *M. acuminata* | 541.3 | 148.1 |
| Fresh *M. polymorpha* | 537.3 | 89.0 |
| Fresh *M. paradisiaca* | 790.3 | 116.2 |
| Dry *M. acuminata* | 1156.5 | 188.4 |
| Dry *M. polymorpha* | 1093.5 | 176.5 |
| Dry *M. paradisiaca* | 1252.6 | 208.9 |

**Table 2. Estimation of protein, phenol, organic acid in banana peels**

| Banana peel extract | Protein (mg/ml) | Phenol (mg/ml) | organic acid (mg/ml) |
|---|---|---|---|
| *M. polymorpha* | 189.1 | 32.33 | 0.11 |
| *M. acuminata* | 453.42 | 39.5 | 0.18 |
| *M. paradisiaca* | 913.2 | 5.01 | 0.08 |

**Results and Discussion :**

It was observed that all the three species of banana peels adsorbed copper and lead from solutions (Table 1). The range of adsorbtion was between 30% to 80%. The amount of Cu adsorbed by *M. acuminata* in fresh and dry peels was 37.16% and 56.07% respectively. The amount of Cu adsorbed by *M. paradisiaca* in fresh and dry peels was 44.42% and 79.11% respectively. The amount of Cu adsorbed by *M. polymorpha* in fresh and dry peels was 34.92% and 66.83% respectively.

Likewise, the amount of Pb adsorbed by *M. acuminata* in fresh and dry peels was 32.35% and 69.11% respectively. The amount of Pb adsorbed by *M. paradisiaca* in fresh and dry peels was 47.23% and 74.85% respectively. The amount of Pb adsorbed by *M. polymorpha* in fresh and dry peels was 30.67% and 64.75% respectively.

It was observed that the amount of adsorption of heavy metal Cu and Pb was significantly more in dry bio-adsorbents than in fresh bio-adsorbents. It also observed that among the banana species amount of adsorption in *M. paradisiaca* was maximum and in *M. polymorpha* it was minimum.

The estimation of protein, phenolic content and organic acid showed that the amount of protein in *M. acuminata* was 453.42(mg/ml), *M. paradisiaca* was 913.2(mg/ml) and *M. polymorpha* was 189.1(mg/ml) and the amount of protein in *M. acuminata* was 32.33(mg/ml), *M. paradisiaca* was 39.5(mg/ml) and *M. polymorpha* was 5.01 (mg/ml). The organic acid content was very low, in *M. acuminata* it was 0.11mg/1ml, in *M. paradisiaca* 0.18mg/1ml and in *M. polymorpha* it was 0.08mg/1ml (Table 2).

All the three substances were found maximum in *M. paradisiaca* and minimum in *M. polymorpha.*

It was observed that banana peels are good source of bio-adsorbent. Dry peels showed significantly better adsorbance than fresh peels. The bio-adsorbance of Cu and Pb was found to be maximum in *M. paradisica* which contains maximum amount of protein, phenols an organic acid among the three species used. It seems that these compounds may have sites which provide surface for adsorption of Cu and Pb.

To conclude, instead of chemicals, low cost and nonhazardous agro-waste materials like banana peels can be used as heavy metal removers from wastewater and industrial effluents to overcome water pollution.

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