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Bioaccumulation of Heavy Metals in Different Parts of Impatiens Balsamina

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Abstract: An attempt has been made to estimate the presence of heavy metals – chromium and copper in the tannery effluent. Bioaccumulation of chromium and copper were carried out using different parts of an ornamental plant, Impatiens balsamina. The results of the study revealed that chromium and copper were accumulated in different parts of Impatiens balsamina which were analysed using FTIR technique.

Keywords: Tannery Effluent, Heavy Metals, Bioaccumulation, Impatiens Balsamina, FTIR.

I. INTRODUCTION

Pollution is a major environmental issue in the world due to its adverse effect on living organism (Karthikeyan et al., 2009). In the past few decades, uncontrolled urbanization has caused a serious pollution problem due to the disposal of sewage and industrial effluents to water bodies (Tamil Selvi et al., 2012). Tannery is one of the important industry causing water pollution. Heavy metals in the tannery effluent is one of the most hazardous environmental pollutants, toxic heavy metals like Cr, Cu, Zn, Pb and Cd are mostly absorbed and get accumulated in various plant parts as free metals which may adversely affect the plant growth and metabolism. Human beings and cattles are affected when these metals are incorporated into the food chain (Indu shekar Thakur and Shaili Srivastava. 2011). Major diseases of cattle and human beings produced by chromium and nickel are bronchitis and cancer. It affects the resources health and livelihood of thousands of people and causes decline of trees. (Thambavani et al., 2009). Hence tannery effluent with high pollutional load should be treated before its disposal. Based upon all the above said investigation carried out by many researchers pertaining to toxicity of heavy metals of various industrial effluents, an attempt has been carried out to study the impact of heavy metals present in the tannery effluent on the plant parts of an ornamental plant , Impatiens balsamina.

II. MATERIALS AND METHODS

Untreated tannery effluent was used as the material in this study. The untreated sample was collected from the point where in all the effluent are discharged together from tannery company situated in Chennai, Tamil Nadu, India, in polythene containers (5 litres capacity). They were brought to the laboratory with due care and stored at 25°C for further analysis. Heavy metals such as Chromium and Copper present in the untreated tannery sample was estimated by using Atomic Absorption Spectrophotometer (AAS, Perkin Elmer Analyst, 300) by following the procedure of APHA (1995).

A. Bioaccumulation Of Heavy Metals – Chromium And Copper In Different Parts (Root, Shoot And Leaves) Of Impatiens Balsamina

The saplings of ornamental plant, Impatiens balsamina were procured from a local nursery located in Chennai to study the effect of heavy metals present in the tannery effluent. They were grown for a period of 30 days using diluted tannery effluent (10%) by following the procedure of Nirmla (2013). At the end of the experiment (after 30 days), the different parts of ornamental plant , Impatiens balsamina such as root, shoot and leaves were removed, washed thoroughly and dried at 103° C – 105°C in a hot air oven. The dried parts of the plants were ground to coarse powder using a porcelain mortar and pestle. These samples was used to determine the amount of Chromium and Copper absorbed by the different parts of the plants using FTIR technique (Nirmala, 2013).

III. RESIULTS AND DISCUSSIONS

The results of analysis of heavy metals – chromium and copper present in the tannery effluent are depicted in table – 1. The results of the study showed that the Chromium evels of untreated effluent ranges between 0.009 mg/l (August 2011) and 5.230 mg / l (September 2011) and the value are higher than the permissible level (3 mg / l) of CPCB, (1995). Copper levels of untreated tannery effluent ranges between 0.00012 mg/l (August 2011) and 0.00160 mg / l (September, 2011) and the values are within the permissible level (1.5 mg/l) of CPCB (1995).

A. Bioaccumulation of Heavy Metals – Chromium and Copper by Different Parts (Root, Shoot, Leaves) of Impatiens Balsamina

The results of the bioaccumulation of heavy metals – copper and chromuim in different parts (root, shoot and leaves) of Impatiens balsamina are represented in figure 1-6. The results of the study shows the FTIR analysis of control (root, Fig - 1), which is represented by three peaks between (1800-1000cm-1). This shows the intensity of heavy metals such as copper (1043.49/cm-1) and chromium (1639.49/cm-1); intensity 71.181, 72.483 respectively. The relative area which represent the total intensity covered by that particular heavy metal during FTIR spectrum. Thus relative area of copper is 37.272 and chromium is 5.185. The FTIR analysis of control (shoot – Fig - 2), which is indicated by three peaks between (1800-1000cm-1). This shows intensity of heavy metals such as copper (1049.28/cm-1) and Chromium (1639.49/cm-1); intensity 43.106 and 37.103 respectively. The FTIR analysis of control (leaf – Fig -3), which is represented by three peaks between 1800-1000cm-1. This shows the intensity of heavy metals such as copper (1058.92/cm-1) and chromium (1639.49/cm-1); intensity 42.188 and 29.921 respectively. The relative area represent the total intensity covered by that particular heavy metals during FTIR spectrum. Thus, relative area of copper is 712.633 and Chromium is 103.433. The FTIR analysis of untreated (root- Fig - 4) shows peak area range from (1800-1000cm-1). Then, its intensity of copper (52.608) and chromium (56.565) respectively. The relative area of untreated root is 49.908 and 14.196. When the relative area is compared to control root, shows increasing pattern of intensity and relative area. Thus, the presence of heavy metals in untreated effluent shows higher range.

TABLE I. Heavy metals of untreated tannery effluent collected for a period of 5 months from August 2014 - December 2014

S. No.	Parameters	CPCB (1995)	Untreated				
			August 2011	September 2011	October 2011	November 2011	December 2011
1.	Chromium (mg / l)	3	0.009	0.0095	0.0724	5.230	5.140
2.	Copper (mg / l)	1.5	0.00012	0.00012	0.00121	0.00130	0.00160

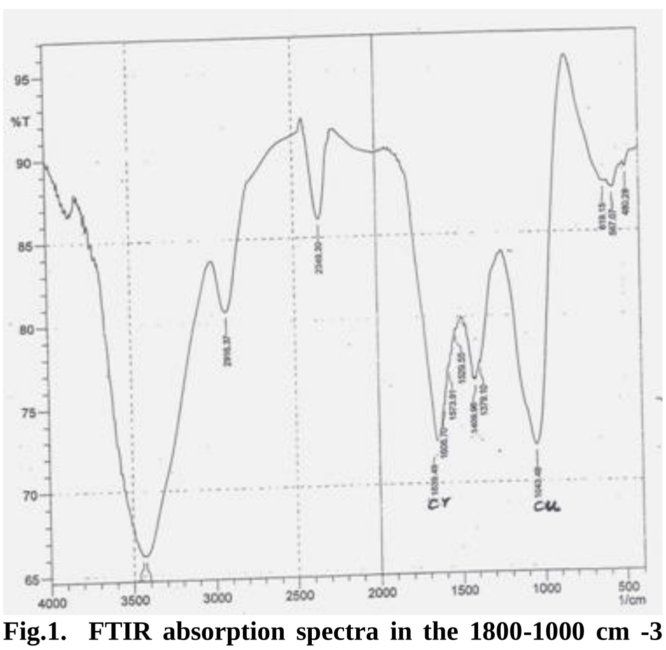

Fig.1. FTIR absorption spectra in the 1800-1000 cm -3 region of Chromium and Copper of root of L. balsamima exposed to control (tap water).

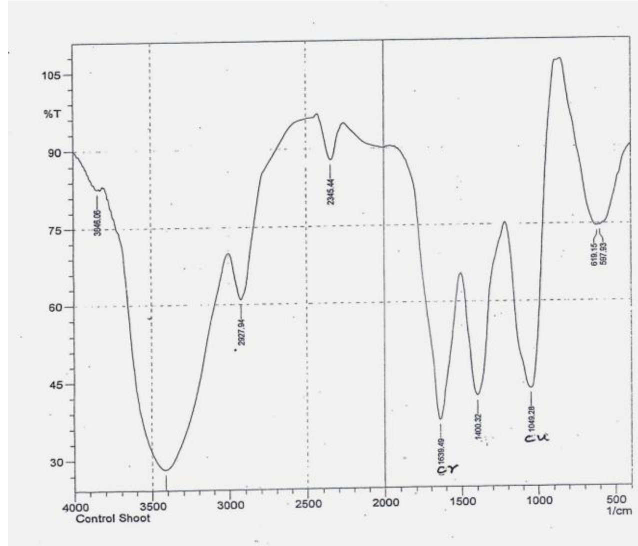

Fig.2. FTIR absorption spectra in the 1800-1000 cm -3 region of Chromium and Copper of shoot of L. balsamima exposed to control (tap water).

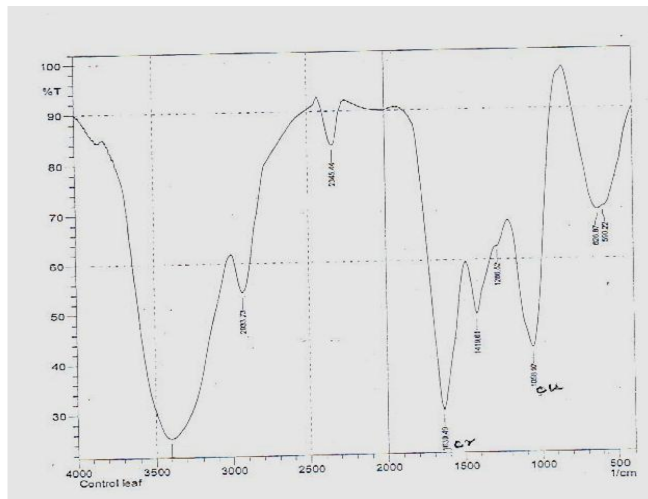

Fig.3. FTIR absorption spectra in the 1800-1000 cm -3 region of Chromium and Copper of leaves of L. balsamima exposed to control (tap water).

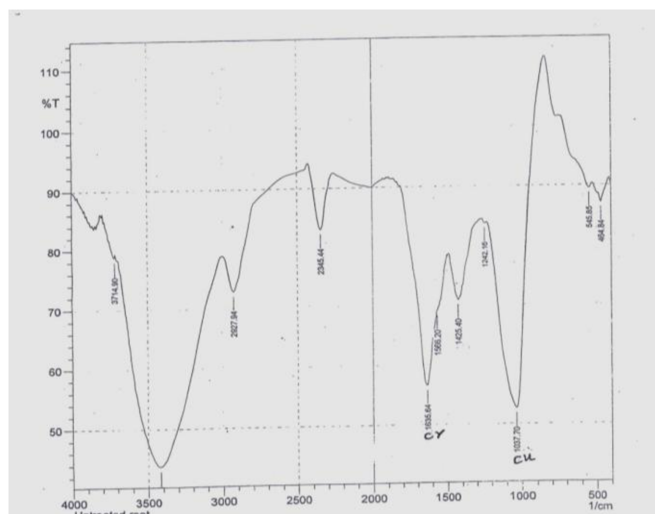

Fig.4. FTIR absorption spectra in the 1800-1000 cm -3 region of Chromium and Copper of root of L. balsamima exposed to Untreated sample.

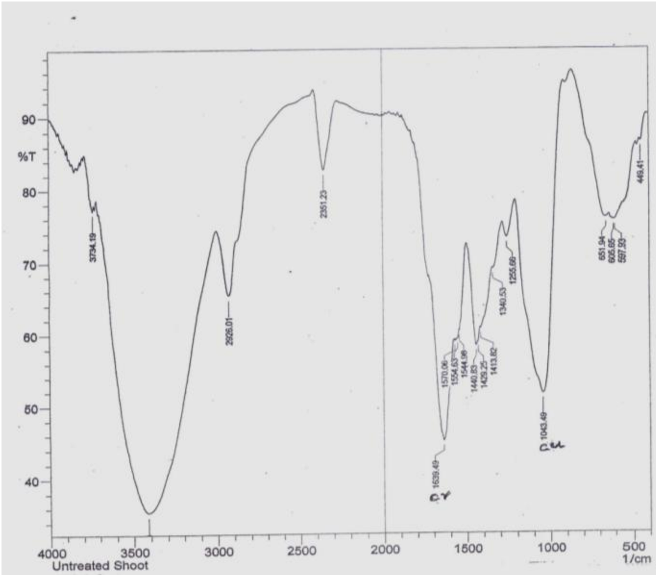

Fig.5. FTIR absorption spectra in the 1800-1000 cm -3 region of Chromium and Copper of shoot of L. balsamima exposed to Untreated sample.

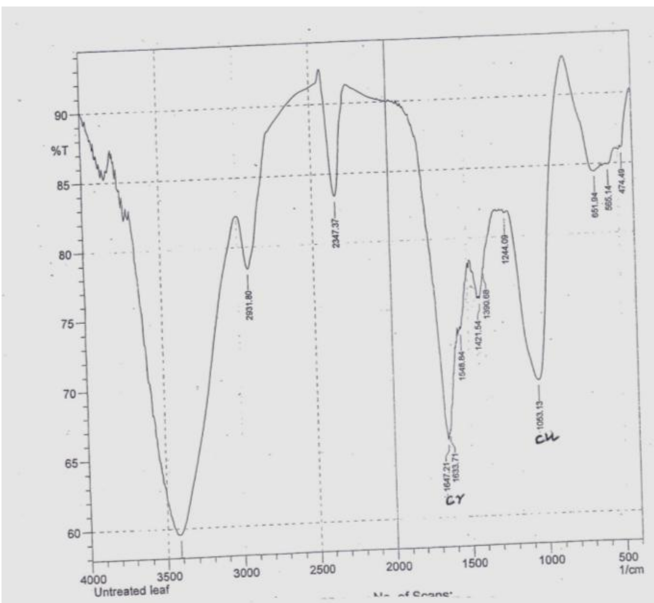

Fig.6. FTIR absorption spectra in the 1800-1000 cm -3 region of Chromium and Copper of leaves of L. balsamima exposed to Untreated sample .

The FTIR analysis of untreated (shoot - Fig - 5), reveals peak area range from 1800-1000cm-1. Then, its intensity of copper is 51.581 and chromium is 45.097 respectively. The relative area of untreated shoot is 54.148 and 39.818. When the relative area is compared to control shoot, shows increasing pattern of intensity and relative area. Thus the presence of heavy metals in untreated effluent shows higher range. The FTIR analysis of untreated (leaf – Fig -6) shows peak area ranges from (1800-1000cm-1). Then its intensity is copper (69.606) and chromium (65.531). The relative area of untreated leaf is 39.633 and 11.949. When the relative area is compared to control leaf, shows increasing pattern of intensity and relative area. Thus, the presence of heavy metals in untreated effluent shows higher range. The overall results indicates the maximum level of chromium and copper accumulation in the leaves and roots of Impatiens balsamina were recorded when exposed to untreated effluent as confirmed by FTIR analysis . This may be due to high toxicity of sample which is supported by the work of Kanwar et al., (1990) when compared to control. The presence of heavy metals in the tannery effluent produce several adverse effects on living organisms as reported by Chukwu (2006). Hence tannery effluent should be treated before its disposal into the environment (Sukumaran et al., 2008).

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