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Assessment of the biosorptive properties of Padina commersonii (Seaweed)

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***Abstract*— Water used in industries creates waste water that has a potential hazard for our environment because of introducing various contaminants in the terms of heavy metals into soil and water resources. Of the pollutants emitted by vehicle and some industrial processes in urban areas, antimony (Sb) is observed at alarming scale. While this metal is known to be potentially toxic, it can transfer from the soil or atmosphere to plants, and accumulate in their edible parts. In this present study the impact of antimony (III) chloride was analysed. Seedlings of *Pennisettum typhoides* (Burn.f.) Stap &C.E.Hubb. were treated with various concentration of antimony (III) chloride such as 5mM, 10mM, 15mM, 20mM and 25mM. After 10 days of treatment various biochemical and enzyme characteristics were analysed. Apart from the biochemical such as glucose, protein, aminoacid, the activity of nitrate reductase was gradually decreased with increasing concentration of antimony (III) chloride. But the content of proline, leaf nitrate, catalase and peroxidise activity was in reverse. When optimal concentration 15mM of antimony (III) chloride was treated with various amounts of sea weed (*Padina commersonii*) *viz.*, 2gm, 4gm and 6gm, and the filtrate was applied on the same plant. The reduced biochemical and enzyme characteristics due to metal toxicity were found improved considerably. From this study, it was inferred that the biosorbent**

***Keywords*— Antimony(III)chloride, enzyme activity, biochemical characteristics, Padina**

I. INTRODUCTION

Land and water are precious natural resources on which rely the sustainability of agriculture and the civilization of mankind. Pollution is an environmental problem of worldwide concern. Consuming of water by agricultural, industrial and domestic sectors resulted in the generation of large amounts of waste water containing a number of pollutants [1]. Accumulation of toxic heavy metals in the environment and their impact on both public health and natural environment were studied in detail [2]. The accumulation of heavy metals in soil is becoming a serious problem as a result of industrial and agricultural practices. Of the various methods used to remove the heavy metal from environment, bioadsorbtion is a low cost method removing the metal ions from the aqueous solution.

Algae have been found to be potential and suitable biosorbent because of their fast and easy growth as well as their wide availability. There were various researches on the usage of micro and macro algae as sorbent materials [3-7] The sorption capability of algae has been attributed to their cell walls which are often porous and allow the passage of molecules and ions in aqueous solutions [8&9] Essentially, the extracellular biopolymers of Phaeophyta are predominately alginic acid or alginate with a smaller amount of fucoidan which seems easily permeable to small ions [10]. Whereas the Rhodophyta contain a number of sulfated galactans like agar, carregeenan and porphyran [11]. Thus, the adsorption capacity along with the dye sorption process onto the surface is due to the different long chain extracellular biopolymers. Furthermore, these functional groups found on the algal cell surface such as hydroxyl, carboxyl, amino and phosphate and other charged groups are considered to be responsible for dye binding and separation of contaminants from water [12-15]

II. MATERIAL AND METHODS

The seeds were procured from Tamil Nadu Agricultural University, Coimbatore. Algal biomass *Padina commersonni* used as a biadsorbent, was collected from sea shore area of Rameswaram. The various concentration of antimony(III)chloride (5mM, 10mM, 15mM, 20mM and 25mM) were prepared. Both control and experimental plants were allowed to grow in soil mixture (red:black:gardensoil) in the ratio of 1:1:1. After 10 days, the seedlings of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb. were treated with heavy metal solution aforesaid. Various biochemical and enzymatic characteristics were analysed on the treated plants. The optimal concentration antimony (15mM) was mixed with various amounts of algal biomass (2g/L, 4g/L and 6g/L w/v)

and kept in shaker for 24 hours. The filtrate was used to treat plants. After 10 days of treatment, the same biochemical and enzymatic characteristics were analysed as follows : protein [16], glucose [17], aminoacid content [17], proline [18], *in vivo* nitrate reductase [19], peroxidise and catalase activity [20].

III. RESULTS

Table. 1. The effect of various concentration of antimony(III)chloride on the biochemical characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

S.No	Parameters	Control	5mM	10mM	15mM	20mM	25mM
1.	Protein content (mg/gLFW)	7.24±0.013 (100)	5.23±0.003 (72)	4.12±0.052 (57)	3.01±0.003 (42)	2.87±0.510 (40)	2.56±0.043 (35)
2.	Total soluble sugar (mg/gLFW)	16. 82± 0.004 (100)	12.56±0.043 (75)	10.43±0.021 (62)	8.42±0.006 (50)	7.65±0.082 (45)	7.012±0.004 (42)
3.	Aminoacid content (mg/gLFW)	19.56±0.450 (100)	21.56±0.001 (110)	25.71±0.037 (131)	29.01±0.001 (148)	34.72±0.053 (178)	36.21±0.002 (185)
4.	Proline content (mg/gLFW)	1.054±0.016 (100)	1.23±0.047 (117)	1.57±0.007 (149)	1.93±0.054 (183)	2.31±0.410 (219)	2.57±0.002 (244)

Table .2. The effect of various concentration of antimony(III)chloride on the enzyme characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

S.No	Parameters	Control	5mM	10mM	15mM	20mM	25mM
1.	NR activity (µmole/gLFW)	5.001± 0.012 (100)	3.81±0.002 (76)	2.71±0.004 (54)	1.95±0.059 (39)	1.83±0.001 (37)	1.64±0.004 (33)
2.	Catalase activity (µmole/gLFW)	1.872± 0.046 (100)	2.32±0.004 (124)	2.901±0.001 (155)	3.451±0.581 (184)	3.872±0.005 (207)	4.03±0.005 (215)
3.	Peroxidase activity (µmole/gLFW)	0.175± 0.041 (100)	0.218±0.007 (125)	0.294±0.032 (168)	0.345±0.735 (197)	0.402±0.002 (229)	0.461±0.001 (263)

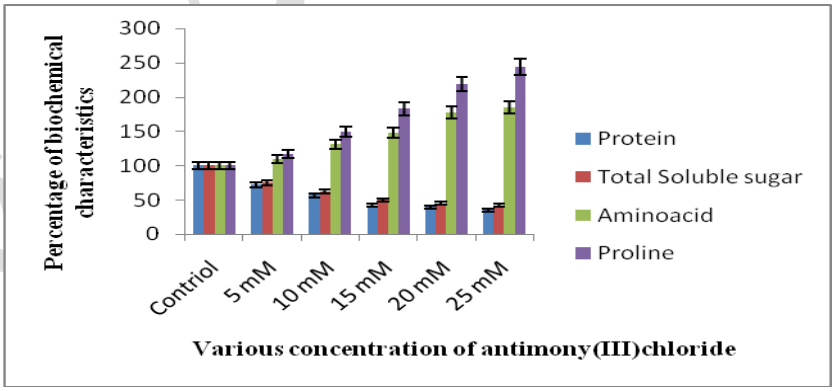

Fig. 1. The effect of various concentration of antimony(III)chloride on the biochemical characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

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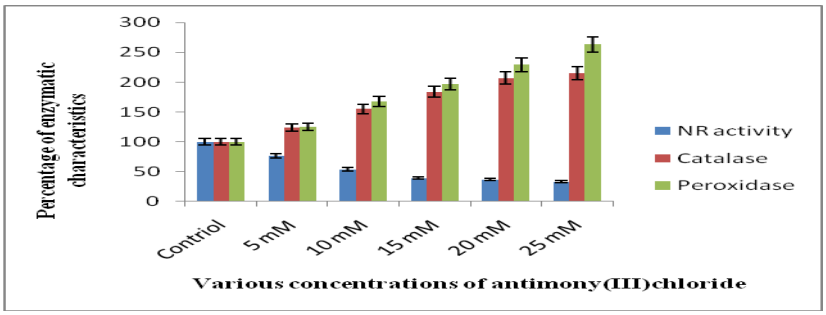


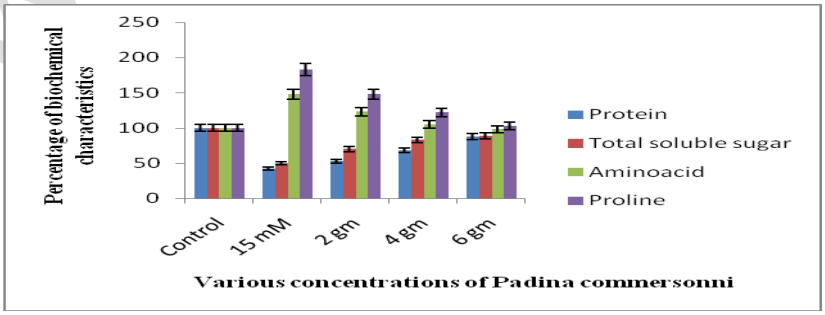
Fig. 2. The effect of various concentration of antimony(III)chloride on the enzyme characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

Table . 3. Effect of *Padina commerssioni* treated antimony(III)chloride on the biochemical characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

S.No	Parameters	Control	15mM	2gm/L	4gm/L	6gm/L
1.	Protein content (mg/gLFW)	7.24±0.013 (100)	3.01±0.003 (42)	3.87±0.004 (53)	4.93±0.034 (68)	6.43±0.005 (88)
2.	Total soluble sugar (mg/gLFW)	16. 82± 0.004 (100)	8.42±0.006 (50)	11.78±0.035 (70)	13.90±0.164 (83)	14.97±0.056 (89)
3.	Aminoacid (mg/gLFW)	19.56±0.450 (100)	29.01±0.001 (148)	24.10±0.572 (123)	20.47±0.145 (105)	19.23±0.001 (98)
4.	Proline (mg/gLFW)	1.054±0.016 (100)	1.93±0.054 (183)	1.56±0.008 (148)	1.281±0.052 (122)	1.081±0.047 (103)

Table . 4. Effect of *Padina commerssioni* treated antimony(III)chloride on the enzyme characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

S.No	Parameters	Control	15mM	2gm/L	4gm/L	6gm/L
1.	NR activity	5.001± 0.012 (100)	1.95±0.059 (39)	2.86±0.001 (57)	3.95±0.039 (79)	5.25±0.003 (105)
2.	Catalase	1.872± 0.046 (100)	3.451±0.581 (184)	2.871±0.004 (153)	2.371±0.001 (127)	1.732±0.012 (93)
3.	Peroxidase	0.175± 0.041 (100)	0.294±0.032 (168)	0.234±0.032 (134)	0.191±0.007 (109)	0.167±0.001 (95)



Fig, 3. Effect of *Padina commerssioni* treated antimony(III)chloride on the biochemical characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

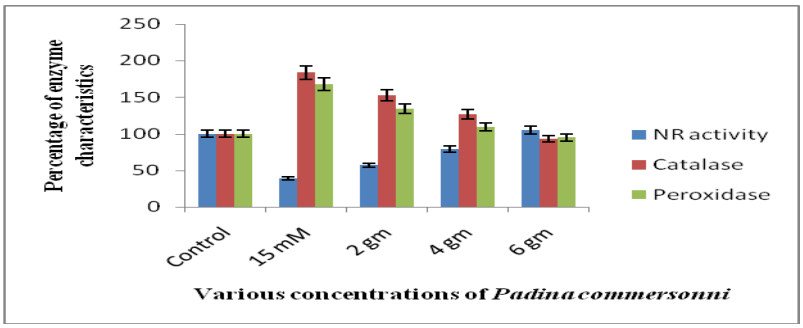


Fig. 4. Effect of *Padina commerssioni* treated antimony(III)chloride on the enzyme characteristics of *Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubb.

IV. Discussion

There was a decrease in protein content and total soluble sugar with increasing concentration of antimony(III)chloride (Table 1). This results coincides with [21] reduction in the protein contents in the roots, leaves and petioles of water hyacinth and lettuce plants after chromium treatment. The metal ion seems to interfere with protein synthesis. Leaf protein level accounts for the major portion of RUBP carboxylase enzyme, which is essential for primary carboxylation activity in photosynthesis [22]. A decrease in leaf protein indicates the reduction in RUBP carboxlase activity. The present investigation showed that the free aminoacid and proline content increased with increasing the concentration of antimony(III)chloride. Destruction of protein or the increase in the biosynthesis of aminoacids from the nitrate source, which were not utilised in the protein synthesis might have could aminacid accumulation [23]. Proline accumulation in the leaves of plants happens when subjected to stress [24]. In the present study, the nitrate reductase activity is decreased in *Pennisetum typhoides* with increasing the concentration of antimony(III)chloride (Table. 2). In water stressed plants, lowering of nitrate reductase activity may either be a decreased rate of enzyme synthesis or an increased rate of enzyme degradation [25]. The activity of catalase and peroxidase were increased with increase the concentration of antimony(III)chloride (Table. 2).

Plants applied with bioadsorbent treated metal solution showed increase in protein content, total soluble sugar and activity of nitrate reductase (Table 3&4). In contrary aminoacid content, activity of catalase and peroxidise was decreased (Table 3&4).

V. Conclusion

From the present investigation, it is confirmed that the algal biomass *Padina commersonni* is nullifying the toxicity of heavy metal. Scince it restores the suppressed biochemicals and enzyme activity due to metal toxicity.

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