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# Physiological and biomolecular interventions in the bio-decolorization of Methylene blue dye by *Salvinia molesta* D. Mitch

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**ABSTRACT**

Methylene blue, a cationic dye as a pollutant is discharged from industrial effluent into aquatic bodies. The dye is biomagnified through the food chain and is detrimental to the sustainability of aquatic flora. Despite of number of physico-chemical techniques of dye removal, the use of aquatic flora for bio-adsorption is encouraged. Thus, we used *Salvinia molesta* D. Mitch in bio-reduction of methylene blue on concentrations of 0, 10, 20, and 30 mg $L^{-1}$ through 5 days with biosorption kinetics. The dye removal was concentration-dependent, maximized at 2 days with 30 mg $L^{-1}$ which altered the relative growth rate (44%) of plants. Biosorption recorded 71% capacity at optimum pH (8.0), 24 h reducing major bond energies of amide, hydroxyl groups, etc. Bioaccumulation of dye changed potassium content (446%) under maximum dye concentration modifying tissues for dye sequestration. Reactive oxygen species were altered on dye reduction by oxidase (33%) with redox homeostasis by enzymes. Plants altered the metabolism with over accumulation of polyamines (51%), abscisic acids (448%), and phosphoenolpyruvate carboxylase (83%) on dye reduction. Thus, this study is rationalized with a sustainable approach where aquatic ecosystems can be decontaminated from dye toxicity with the exercise of bioresources like *Salvinia molesta* D. Mitch as herein.

**NOVELTY STATEMENT**

Azo dyes as industrial effluents are more hazardous with their high solubility in water causing inhibition of life processes in aquatic ecosystem. Methylene blue as a dye, in the aquatic environment deteriorates the ecosystem by increasing a chemical oxygen demand, impairing light harnessing mechanism, inhibiting growth of microflora, recalcitrance, bioaccumulation, mutagenicity of the whole environment. Aquatic weed like *Salvinia molesta* D. Mitch is evident as an effective bio-adsorbent, bio-decolorization, finally dye removing material to reduce water pollution as an alternative strategy for environmental remediation.

**KEYWORDS**

Antioxidizing enzymes; aquatic weeds; azo dyes; biosorption; glutathione; redox homeostasis

## Introduction

Industrial pollution has become an environmental hazard due to the release of various toxic substances. These may include effluents comprised of metals, metalloids, organic dyes, heterocyclic residues those are discharged onto surface water. Organic dyes are one of those toxic substances mostly discharged and remains immiscible in water for vulnerability of aquatic ecosystem. Methylene blue (MB), an azo dye with their higher solubility is significantly absorbed by soil microflora that often ensures bio-magnifications within an aquatic ecosystem (Mosoarca *et al.* 2020). Various agricultural wastes such as peat moss, leaf dust, decayed woods, and cotton stalks serve as key absorbers of the MB dye in those contaminated soil and aquatic bodies (Fritsch *et al.* 2017). Biological materials are offered in adsorption of dyes from polluted water bodies either simply or in modified residues (Crini 2005). The turnover or any modification or organic dye happens to be by autocatalytic degradation or by organisms with reduction process. Many chemical residues both in bulk and nano forms are useful in synthetic dye reduction process, however, not eco-friendly as well as economic. Synthetic nanomaterials like 4-nitrophenol coated with silver nanoparticles and various plasmons, such as graphene oxide, chitosan encapsulation shown higher efficiency in reducing MB (Liu *et al.* 2020).

Thus, chemically synthesized materials are though potential in dye degradation but seriously environmental hazardous in nature. On the other hand, various plant species due to their specific cell wall residues have been identified as effective bio-absorbents for these dyes (Omran *et al.* 2016). Aquatic species reported better in the adsorption process by which separation of dyes from sewages are materialized.

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