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Pollutant Removal Efficiency and Phytotoxicity Assessment of Textile Industry Wastewater using *Spirulina* sp.

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Abstract

Textile industry wastewater (TWW) is a significant environmental pollutant due to its high concentrations of toxic chemicals, synthetic dyes, recalcitrant organic compounds, and excess nutrients, necessitating effective treatment prior to discharge. This study investigates the potential of *Spirulina* sp., a locally isolated strain from a freshwater reservoir, for the bioremediation of TWW as a sustainable and eco-friendly alternative to conventional treatment methods. TWW samples were collected from a leading textile company in the Biyagama Export Processing Zone, Sri Lanka. A 10% (v/v) homogeneous inoculum of *Spirulina* sp. was introduced into 20 L transparent glass tanks under greenhouse conditions, maintained with continuous aeration and a 12:12 h light: dark photoperiod. Over four weeks, the growth of *Spirulina* sp. and TWW decolorization were monitored spectrophotometrically. The results revealed a growth efficiency of 83.57 ± 0.69% and TWW decolorization efficiency of 79.03 ± 0.11%, as evidenced by absorbance measurements using an ultraviolet-visible spectrophotometer. The study recorded a significant chemical oxygen demand (COD) removal of 93.11 ± 1.14%, indicating the bioremediation potential of *Spirulina* sp. Ammoniacal nitrogen, nitrate, and phosphate removal efficiencies were recorded as 96.86 ± 0.79%, 73 ± 0.97%, and 33.33 ± 1.13%, respectively. The lower phosphate removal efficiency suggests that phosphorus in TWW may be in a less bioavailable form for *Spirulina* sp. To evaluate the phytotoxicity of the treated TWW, a seed germination assay using green gram (*Vigna radiata)* was conducted. After five days, a 75% seed germination rate was observed in *Spirulina*-treated TWW compared to the untreated TWW, with shoot and root development of 5.13 ± 0.08 cm and 4.42 ± 1.47 cm, respectively. Overall, this study highlights the efficacy of *Spirulina* sp. in pollutant removal and the potential reuse of treated wastewater for irrigation, promoting plant growth and contributing to sustainable wastewater management practices.

Keywords: *Bioremediation, Phytotoxicity, Pollutant removal, Spirulina sp., Textile wastewater*