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Biodegradation of synthetic textile dyes using a cyanobacterial co-culture

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Textile wastewater contains recalcitrant synthetic dyes which should be properly treated before releasing to the environment. This study investigated the degradation potential of a combined culture of CB3-CB5 against Rhodamine-B and reactive blue dye. CB3 and CB5 are filamentous cyanobacterial strains isolated from freshwater bodies in Sri Lanka. A total of 3 mL of each strain was inoculated into 150 mL of 10 ppm dye solutions prepared using sterilized tap water within 250 mL erlenmeyer flasks. The cultures were maintained under continuous illumination (2000-3000 lux) and ambient laboratory conditions for 28 days, with daily manual shaking of two times. Cyanobacterial growth and dye decolorization were monitored twice a week using a UV-spectrophotometer at 680 nm for growth and at λmax values of 563 nm Rhodamine-B and 616 nm blue dye for decolorization. After 28 days, biomass was harvested by centrifugation at 3000 rpm for 10 mins and oven-dried to obtain the final dry cell weight. The CB3-CB5 co-culture exhibited significantly higher decolorization efficiency for blue dye (74.8%) compared to Rhodamine-B (3.7%). Biomass productivity was observed as 0.67 mg/day and 0.33 mg/day in the blue dye and rhodamine-B, respectively. A toxicity assay using mung bean seeds (*Vigna radiata*) confirmed reduced dye toxicity after treatment. In the co-culture treated Rhodamine-B sample, the average root and shoot lengths were recorded as 5.87 ± 1.4 cm and 5.47 ± 1.9 cm, respectively, whereas for the blue dye, they were recorded as 4.28 ± 2.8 cm and 3.87 ± 1.7 cm, respectively, compared to their control. These results indicate the effective detoxification of the selected dyes by the cyanobacterial co-culture. The lower decolorization of Rhodamine B was attributed to its recalcitrant xanthene ring structure. Overall, CB3-CB5 co-culture exhibited its potential for biodegradation of synthetic textile dyes, particularly those with simpler molecular structures.

Keywords: *Decolorization, eco-remediation, filamentous strains, phytotoxicity, rhodamine*