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Prosopis juliflora peroxidases for phenol remediation from industrial wastewater — An innovative practice for environmental sustainability

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ABSTRACT

Prosopis juliflora or Mesquite, one of the world's worst invaders, yields low-purity peroxidases (MPx), which remove phenols from the wastewater of textile and leather industries. Within 30 min, MPx removes phenols from wastewater of the textile industry (94.95 ± 0.82%) and leather industry (91.49 ± 1.54%). After treatment with MPx, the residual phenol in the wastewater remained much below the environmentally safe limit outlined by the USEPA. For maximum phenols removal, MPx requires 4–6 mM H_2O_2, whereas Horseradish peroxidase (HRP), a commercially available and the most widely used peroxidase, uses 8 mM H_2O_2. MPx perform better than (HRP), in parameters such as phenol removal efficiency, need of chemical additive, stability, and time of preparation. MPx, therefore, offer an economically viable method for wastewater treatment and also obviate several challenges of using purified enzymes. Extraction from the non-edible invasive plant is an added benefit as it does not require specific cultivation conditions and address the concern of competing with food resource. Further, using an invasive plant as a bioresource will help in the management of aggressive invaders like *P. juliflora*. We report a procedure to prepare MPx with a lesser number of chemicals and use it with a low concentration of H_2O_2 for remediation of phenol from industrial wastewater. MPx, with high phenol removal capacity, shows the potential to act as an economic but effective alternative to purified peroxidases for environmental remediation withstanding the principles of the circular economy.

1. Introduction

Phenols, though essential for industrial growth, remain an environmental challenge affecting the quality of water, and soil and health of living organisms (Singh et al., 2017, 2020). Several industries, such as textile, leather, binders, plastics, adhesives, agriculture, food preservatives, pharmaceutical, and aluminium manufacturing release wastewater containing phenols and chlorophenols in the environment (ATSDR, 1999, 2008). Textile and leather industries, the biggest water-polluting industries, use phenols as raw material and contribute to 17.25% of water pollution globally (Ghaly et al., 2013; Rawat et al., 2016; Sany et al., 2019). Though permissible limit of phenol in water is 3.5 mg L^{-1} (US EPA, 1980), the

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