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Photocatalytic degradation of microcystin-LR using nanostructured rutile and coir fibre

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Microcystins (MCs) are secondary metabolites of cyanobacteria, which tend to persist in the aquatic environment. Among 70 recorded analogues of MCs, Microcystin-LR (MC-LR) is the dominant and the most toxic cogener. Photocatalytic technology has been constantly recognized as a promising green approach in treating pollutants. The present study records the effective utilization of nanostructured rutile and coir fibre to treat MC-LR. Approximately 2 g of nanostructured rutile and coir fibre (100 nm) were coated in two separate glass slides and dipped in 100 µg/mL of filter sterilized lake water containing 50, 75 and 100 µg/mL of MC-LR. For both nanoparticles (rutile and coir fibre) at 50, 75 and 100 µg/mL of MC-LR concentrations, two experimental set ups (A-Exposed to sunlight, B-Exposed to 12 W UV light) and two control set ups (A1-Control exposed to sunlight, B1-Control exposed to 12 W UV light) were maintained. Sample aliquots of 1 mL was removed at every 30 minutes interval for a period of 3 hours. Subsequently, samples were subjected to freeze drying followed by reconstitution in 50% HPLC grade methanol and analyzed under PDA-HPLC to quantify the remaining MC-LR concentrations. Under the influence of UV light, nanostructured rutile showed, 100 % removal of MC-LR at 50 and 75 µg/mL within 1.5 hours and 2 hours respectively, whereas 87.4 ± 2.31% removal for 100 µg/mL of MC-LR was recorded at the end of 3 hours. When the same experiment was repeated by exposing to sunlight, MC-LR removal percentages were 77.29 ± 1.9 at 50 µg/mL, 36.4 ± 3.8 at 75 µg/mL and 19 ± 3.78 at 100 µg/mL. Moreover, when nanostructured coir fibre was used under 12W UV light, 100% removal of 50 µg/mL MC-LR, was evident at 2 hours, whereas 85.68 ± 9.4% for 75 µg/mL and 56.2 ± 4.37% for 100 µg/mL was observed at the end of 3 hours. At the exposure to sunlight, nanostructured coir particles showed 72.4 ± 2.3 at 50 µg/mL, 56.2 ± 8.2 at 75 µg/mL and 46.8 ± 6.98 at 100 µg/mL at the end of 3 hours. Two-way ANOVA confirmed that there is a significant difference in the MC-LR photocatalytic degradation ability of nanostructured rutile and coir fibre (P=0.02). Therefore, it could be concluded that nanostructured rutile is effective than coir fibre based nanoparticles in treating MC-LR contaminated water. Furthermore, UV exposure of both types of nanostructures can enhance photocatalytic degradation of MC-LR.

Keywords: Coir fibre, Microcystin-LR, nanoparticles, photocatalytic oxidation, rutile