

Efficiency Assessment of Bamboo Leaves (*Bambusa vulgaris*), Indian Almond Leaves (*Terminalia catappa*), and Charcoal as Natural Filters for Aquarium Wastewater

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Untreated aquarium wastewater causes pollution and ecological risks. Advanced filtration used in large scale aquaculture is costly for small scale keepers. Thus low-cost, sustainable alternatives like plant-based materials are needed for pollutant removal. This study is evaluating natural materials such as Indian almond leaves, bamboo leaves, and charcoal in filtration to improve aquarium wastewater quality. Aquarium effluent water was collected and treated with leaf and charcoal combinations. T1 – Indian almond leaves, T2 and T3 – bamboo and Indian almond leaves at different ratios, and T4 – bamboo leaves, each with 1 g charcoal (2 g total). A control without plant materials was included to assess natural changes. Leaves were washed, sun-dried, crushed, briefly boiled, soaked for 24 h, and re-dried. Charcoal was washed, oven-dried, crushed, and sieved. Each material combination was placed in muslin filter pouches and submerged in wastewater for 28 days. Water quality parameters such as pH, electrical conductivity, turbidity, dissolved oxygen, biochemical oxygen demand, nitrate, nitrite, and phosphate were assessed on 0, 7, 14, 21 and 28 days. Statistical analysis showed significant differences among treatments ($P < 0.05$). All combinations significantly reduced turbidity and nutrient concentrations compared to the control. Treatments stabilized electrical conductivity and pH within the range of 7.7–7.9. Dissolved oxygen improved, while biochemical oxygen demand decreased to 2.0 mg/L, indicating effective organic load reduction. The charcoal and bamboo leaf combination showed highest nitrate removal, whereas Indian almond leaves effectively reduced nitrite concentrations to < 0.1 mg/L. Phosphate concentrations were significantly reduced to 0.108–0.175 mg/L across treatments. This study shows that bamboo leaves, Indian almond leaves, and charcoal, used individually or in combination, can significantly improve wastewater quality. All water quality standards adhered to Sri Lankan Central Environmental Authority acceptable standards. These findings confirm that natural leaf-charcoal filtration systems are sustainable, biodegradable, and cost-effective filters for small-scale and household aquaculture.

Keywords: Aquarium wastewater, Bamboo leaves, Charcoal, Indian almond leaves, Plant-based filtration.