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Tannins as an Alternative to Metallic Coagulants in Water Treatment from Tropical Semi-Arid Reservoirs

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Highlights:

- Coagulation is vital for water treatment, but aluminum coagulants pose health and disposal challenges, prompting exploration of organic alternatives.
- Tannins offer sustainability benefits in water treatment. Study evaluated their efficacy in treating eutrophicated waters, showing turbidity reduction.
- Tannin-based coagulants effectively reduced algal biomass but struggled with color removal. Further research needed for optimization and broader applicability.
- Enhanced understanding and optimization of tannin-based coagulants are necessary for improving water treatment effectiveness and addressing color removal challenges.

Keywords: natural coagulant; sustainability; coagulation.

INTRODUCTION

Coagulation is a vital step in water treatment processes. It involves the destabilization of colloidal particles and suspended matter, including microorganisms, to facilitate their removal in subsequent separation units such as filtration. This is typically achieved through the addition of coagulants. However, the prevalent use of aluminum salts as coagulants in water treatment poses challenges due to residual aluminum content in the treated water, which can adversely affect human health. Furthermore, the precipitation of aluminum during the coagulation process presents difficulties in proper disposal.

These issues have spurred efforts to explore sustainable alternatives with lower environmental impact. This has led to research on replacing inorganic coagulants with organic ones, such as tannins, which are secondary polyphenolic metabolites derived from plants. Tannins offer sustainability and reduced pollution, making them a promising option for water treatment.

Nonetheless, the use of natural coagulants presents challenges, including the need for further research on their efficacy across various water types and optimization of the coagulation process.

METHODOLOGY

The study aimed to evaluate the effectiveness of plant-based coagulants for the treatment of eutrophicated waters from reservoirs in the Brazilian semiarid region. Three natural coagulants were tested: cashew tree (*Anacardium occidentale*) bark, black mimosa (*Mimosa tenuiflora*) bark, and Tanfloc SG from black wattle (*Acacia mearnsii*) bark. Jar-test experiments were conducted in two reservoirs located in the tropical semiarid region, with four different doses of each coagulant (10, 25, 50, and 100 mg.L-1) applied. The reduction in turbidity and chlorophyll-a was measured for all coagulants, and higher doses showed increased removal of algal biomass and turbidity. Additional parameters measured after coagulant application included zeta potential, apparent color, pH, and humic substances (UV 254).

RESULTS AND CONCLUSIONS

The study investigated the effectiveness of various coagulants in treating water samples from the studied reservoirs. The results demonstrated that all tested coagulants were able to reduce turbidity and chlorophyll-a levels, with higher doses leading to greater removal of algal biomass and turbidity. The proximity of the zeta potential to the isoelectric point (0 mV) facilitated the ability of tannins to neutralize the surface charges of suspended particles. Importantly, the use of tannin-based coagulants did not significantly alter the water pH.

Despite the effective reduction in algal biomass and turbidity, the tannin-based coagulants were unable to satisfactorily remove the color from the water, rendering them less suitable for water treatment purposes in the studied reservoirs. While organic coagulants derived from tannins show promise in improving certain water quality parameters, their limited effectiveness in color removal remains a challenge that requires further investigation.

Additional research is necessary to optimize the performance of tannin-based coagulants across different water compositions and to address their limitations in color removal, in order to enhance their suitability for water treatment applications.

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