Bioremoval of Malachite Green by Immobilized *Trametes pubescens*

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ABSTRACT

Keywords: Coconut coir, Dye removal, Malachite green, *Trametes pubscens*.

INTRODUCTION

Dyes are colored substance that chemically binds to the substrate to which it is being applied used for creating attractive shades and different colors on fabrics. Each year millions, litres of dyes are released into environments from the effluents created by man textile industries, dye producing industries and printing industries(Kant). These dyes are able to persist in environments longer due to their inherent properties of being chemically stable, resistant to fading, unaffected by light and microbial degradation. Most of the effluents produced by the following industries are carcinogenic, toxic and mutagenic. Dyeing and textile industries use various synthetic dyes which can pose threat to environmental and public safety. Textile effluent contains 5-10% of dye usually discharged into natural water which leads to concern due to their toxic and carcinogenic nature(Rai et al.). Basic malachite green dye has been widely used for the dyeing of leather, wool, jute and silk, as in distilleries, as a fungicide and antiseptic in aquaculture industry to control fish parasites and disease. Malachite green has properties that make it difficult to remove from aqueous solutions and also toxic to major microorganisms (Shedbalkar and Jadhav). Though, the use of this dye has been banned in several countries and not approved by US Food and Drug Administration, it is still being used in many parts of the world due to its low cost, easy availability and efficacy and to lack of a proper alternative. Currently, ozonation, coagulation/flocculation, oxidation, and ultrafiltration are used for the dye removal. All these methods have intense energy requirements, hence, are costly and reléase hazardous by-products. Conventional biological system for bioremediation and decolorization of dye are not efficient enough. Therefore, the development of an eco-friendly, efficient, and low-cost technique is needed for dye removal. Fungi especially white rot fungi produces lignolytic enzymes such as laccase, lignin peroxide and manganese peroxide can be used to bioremediate various dyes present in water waste (Prasongsuk et al.). Laccase may be utilized as alternative biological system to decolorize and detoxify textile effluents in water originated from textile manufacturing industries (Laraib et al.). The search for inexpensive and efficient matrix for immobilization is mandatory. Bioreactors operated with immobilized fungal cells have shown enhanced productivity, and permit expanded process strength and resistance to shock loadings in comparison to free fungal cells for decolorization of dyes (Laraib et al.). Nowadays, the world is moving toward the utilization of plant biomass, therefore natural matrix such as coconut coir can be utilized for immobilization. Coir, or coconut fibre, is a natural fibre extracted from the outer husk of coconut and used in products such as floor mats, door mats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. The individual fibre cells are narrow and hollow, with thick walls made of cellulose. They are pale when immature, but later become hardened and yellowed as a layer of lignin is deposited on their walls. Fungi can be immobilized onto natural substrate such as coconut coir and immobilized fungi can be used for bioremoval of malachite green.

OBJECTIVES

1. Immobilization of *Trametes pubscens* on coconut fibres.
2. Mycoremediation of malachite green by immobilized fungi.

METHODOLOGY

1. *Trametes pubscens* was revived on sabouraud dextrose and incubated at 30 ℃ for 7 days.
2. *Trametes pubscens* was added to sabouraud dextrose broth which contained 0.5% coconut coir and incubated at 30 ℃ for 7 days.
3. Immobilized coir was transferred to sabouraud dextrose broth which contained 0.001% malachite green and incubated at 30 ℃ for 72 h.
4. After incubation, the sample was centrifuged for 15 mins at 7500 rpm and the absorbance was recorded at 616 nm.
5. % decolorization of malachite green was calculated by using the following formula:
   % Decolorization= (initial OD-final OD/ initial OD)*100
6. Factors (temperature, initial dye concentration, reaction time) affecting bioremoval of malachite green were optimized by central composite design. The range of the factors were temperature 24, 28, 29, 30 and 34 ℃, reaction time 24, 43.2, 48, 52.8 and 72 h, dye concentration 0.003, 0.0058, 0.0065, 0.0072, 0.01%.

CONCLUSION/RESULTS

In this study for the treatment of malachite green, mycelia of *Trametes pubscens* was used to degrade malachite green dye with the production of laccase enzyme. *Trametes pubscens* was immobilized on coconut coir (Figure 1). Immobilized fungi removed 86.71% malachite green from the solution. Parameter optimizations for a process involving multiple components have been proved appropriate by adopting statistical methods as compared to traditional one-factor-at-a-time strategies; therefore, a central composite design in response surface methodology (RSM) was adopted to optimize the conditions affecting dye removal process. Immobilized fungi removed 100% malachite green in optimized conditions. The optimized conditions are temperature 30℃, reaction time 59.27 h and dye concentration 0.006% (Figure 2). Thus, bioremediation has proved to be an effective method to get rid of dyes from the textile effluent.

Figure 1. Immobilized *Trametes pubscens* on coconut coir.

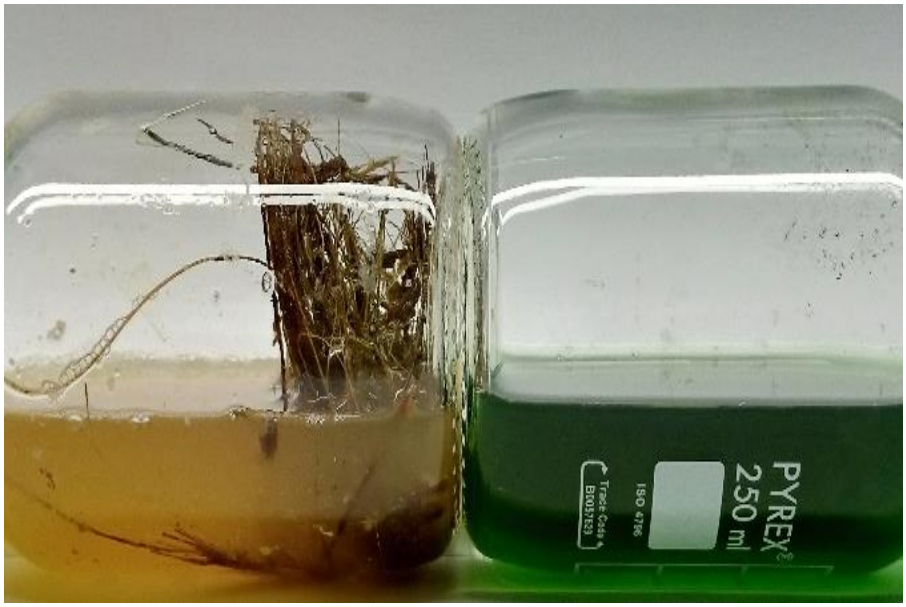

Figure 2. Malachite green removal by immobilized *Trametes pubscens*

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