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Decolorization of the dye congored by Pleurotus sajor caju silver nanoparticle

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Abstract. Microorganisms play an important role in toxic remediation of metals through reduction of metal ions. In this paper we have reported the decolorization of the dye congo red by silver nanoparticle synthesized by using *Pleurotus sajor caju* a white rot fungi and its comparison with its plain culture(*Pleurotus sajor caju*).The characterization of silver nanoparticle was done by using UV-visible spectroscopy, FTIR and scanning electron microscopy. The nanoparticles were synthesized in the size range of 40nm. These particles were then checked for their efficiency to decolorize the dye congored. The *Pleurotus sajor caju* silver nanoparticle effectively decolorized the dye within 24hours of incubation when compared with its plain culture (*Pleurotus sajor caju)* which takes more than 48 hours for the same process. This is for the first time reporting that Pleurotus sajor caju silver nanoparticle was used for the decolorization of the dye Congo red.

Keywords: Pleurotus sajor caju, silver nanoparticle,UV- visible, FTIR, SEM, decolorization, congo red.

1. Introduction

Pleurotus spp. are edible white rot fungi and have been used for the degradation of several pollutants including dyes (Palmieri et al., 2005; Nilsson et al., 2006). *Pleurotus* is used in biotechnological processes of bioconversion and bioremediation, such as the fungal degradation of chlorinated monoaromatics and BTEX compounds(Buswell, 2001), in the purification of air, water and soil, in the cleanup of contaminated soils and in the treatment of industrial effluents (Reid et al., 2002). The biodegradation of dyes by white rot fungi offers an advantage over other processes because of their ability to completely mineralize various dyes .Nanotechnology enables the development of nanoscale particles of metals with novel and distinctive physic-chemical properties, and a broad range of scientific and technological applications (Moore 2006).To date, nanoparticles have been used in a variety of electronic applications and commercial products, including imaging and medical apparatus(Mornet et al., 2004) ,fabrics, cosmetics and water remediation technologies(Tratnyek et al.,2006). Another potential use of silver nanoparticles in water filters in wastewater treatment plants. At nanoscale silver exhibits remarkably unusual physical, chemical and biological properties (Evan off and Chumanov 2005; Chen and Schluesener 2007). Recently it was shown that silver ions may be reduced extracellularly using fungus *Phanerochaete chrysoporium* (Vigneshwaran etal.2007) and *Pleurotus sajor caju* (Nithya and Ragunathan 2009).

In this paper we have made an attempt to decolorize the dye congored by silver nanoparticle synthesized by using *Pleurotus sajor* caju and its comparison with the plain culture.

2. Materials and Methods:

2.1. Organism:

The organism used in this study was *Pleurotus sajor caju* and it was maintained on 2%malt agar plates.

2.2. Synthesis of silver nanoparticle

The organism was allowed to grow in the biomass production broth containing 5g/l malt extract powder and 10g/l glucose and after 7 days the biomass was separated and allowed to grow in deionised water for 3days.To the filtered biomass 1mM final concentration $AgNo_3$ was added and incubated in dark conditions at 30℃ under shaking conditions and the formation of nanoparticle was examined under UV-visible spectrophotometer at 24hr time interval.

2.3. Characterization of the nanoparticle

The particle was characterized by UV-visible studies , FTIR and the particles were subjected to SEM studies for their size determination.

2.4. Decolorization studies

For decolorization study, 250 mL Erlenmeyer flasks containing 125 mL solutions of congo red was prepared in the media containing 30 g sucrose, 3 g NaNO3, 0.5 g KCl, 0.5 g MgSO4.7H2O, 0.01g FeSO4.7H2O, 1 g K2HPO4 and 15 g agar per liter was used. Final pH of the medium is 7.3 ± 0.2 at 25°C. (Hazrat Aliet al.,2009) The *Pleurotus sajor caju* silver nanoparticle was added to the above media which is indicated as test . Similarly plain culture (*Pleurotus sajor caju)* was also added to this media separately which serves as control for the above. Congo red of 50µM concentration was used in this study. The flasks were incubated at 30°C under shaking conditions. After 24hr interval samples were withdrawn, filtered and centrifuged at 4400rpm for 5mins and the supernatants was analyzed spectrophotometrically using UV-Visible spectrophotometer at 498nm. The decolorization efficiency was expressed as per the following equation; Decolorization (%) = [(Initial Absorbance – Final Absorbance) / Initial Absorbance] × 100.

3. Results

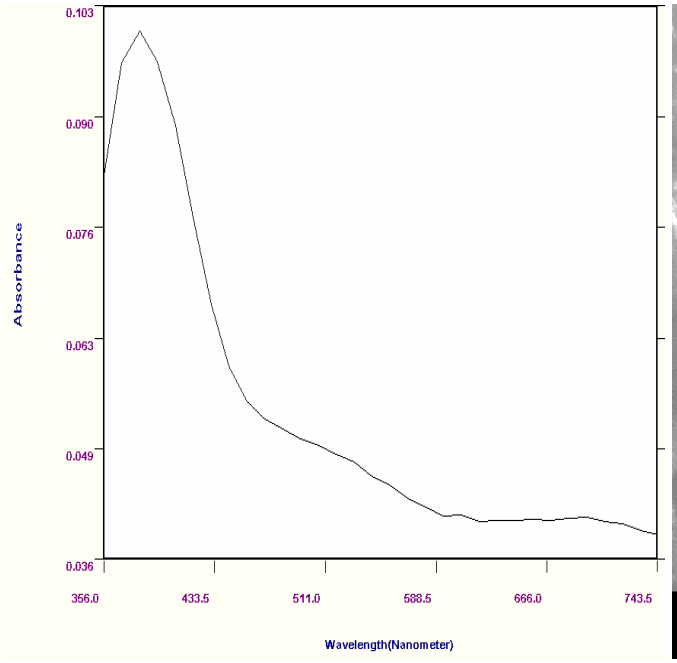
The *Pleurotus sajor caju* silver nanoparticle was formed after 48hours of the incubation with 1mM silver nitrate.

3.1. Characterization studies

The UV-Visible studies indicated the surface Plasmon resonance at 381nm which depicts the formation of silver nanoparticle. (Fig.1)The FTIR studies showed the presence of functional groups involved in the reduction of silver nitrate to silver ions.

3.2. SEM studies

The SEM micrographs of nanoparticle obtained in the filtrate showed that silver nanoparticles are spherical shaped, well distributed without aggregation and an average size of about 40 nm.(Fig.2)



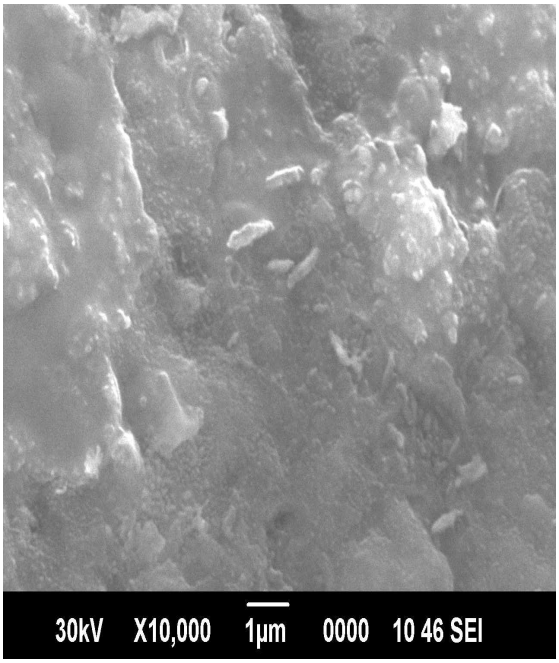


Fig.1 UV-Visible graph of the synthesized NP Fig.2 SEM image of the Pleurotus sajor caju AgNP

3.3. Decolorization studies

A significant decolorization rate was observed for the dye congo red. The *Pleurotus sajor caju* silver nanoparticle effectively decolorized 78% of the dye in 24 hour incubation and the dye was fully decolorized after 35 hour incubation. Whereas the plain culture (*Pleurotus sajor caju)* was able to degrade only 67% of the dye under same incubation conditions and complete decolorization was observed after 48 hour incubation.Graph.1

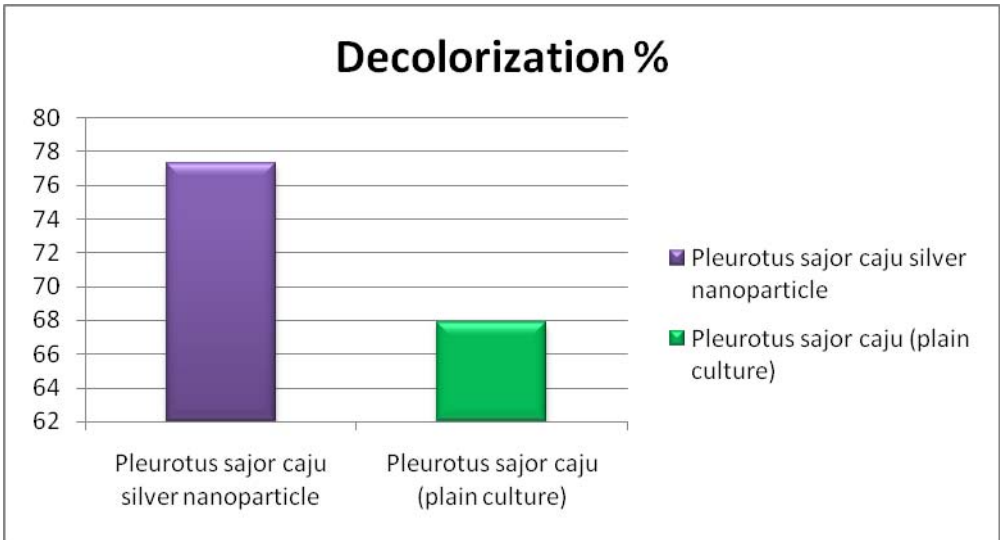


Fig.1. % of decolorizationof the dye congo red after 24 hour incubation

4. Discussion

Youssef et al. (2008) have studied the decolorization of malachite green by *Acremonium kiliense*. According to them 95.4% MG was decolorized within 72 h. Similarly among the azo dyes, the percentage of decolourisation for congo red was not as high as the other two azo dyes, but a 60% decolourisation after 12 h was achieved for this dye. (Aveenesh et al.,2010) In this study when compared with nanoparticle the plain culture could degrade only 67% of the dye this might me due to the complex nature of the dye. A slower rate of decolorization was attributed to higher molecular weight, structural complexicity of the dyes (Hu and Wu, 2001). An UV-Vis spectrum is one of the important and easy techniques to verify the formation of metal nanoparticles provided surface Plasmon resonance exists for the metal (Sadowski et al .,2008 and Kalishwaralal et al .,2008) reported the nanoparticles synthesized in the size range of 100nm and 50nm and in this paper we obtain particles in the size range of 40nm.

5. Conclusion

The present study revealed the ability of the *Pleurotus sajor caju* silver nanoparticle to decolorize congored. From the results we conclude that the nanoparticle decolorize better than the plain culture. These preliminary results suggest that silver nanoparticles can be used for treatment of textile effluents. The development of such particles may be considered a breakthrough in the field for the efficient clean up of the dyes on large scale process since they are easy to synthesize on large scale and cost effective. Further research on the role of pH, temperature and other parameters will be carried out.

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7. References

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