Decolorization of dye congo red by *Aspergillus niger* silver nanoparticles

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**ABSTRACT**

Bioremediation using a variety of microbes for the degradation of xenobiotics seems a green solution to the problem of environmental pollution. Microbes have been gifted by nature with the ability of degrading a wide spectrum of environmental pollutants. Different fungi have the potentials to degrade complex and recalcitrant organic compounds into simpler fragments; sometimes achieving complete mineralization. Nanomaterials reveal good result than other techniques used in waste water treatment because of its high surface area. It is suggested that these may be used in future at large scale water purification. In the present study we have reported the decolorization of the dye congo red by using *Aspergillus niger* silver nanoparticle and its comparison with plain culture. In the present study the silver nanoparticle was synthesized at 1mM concentration. Detailed characterization of nanoparticle using UV-Visible studies and Scanning electron microscopic studies confirmed the presence of 80nm sized particles. These particles were then checked for their efficiency to decolorize the dye congo red. The nanoparticle efficiently decolorized the dye within 48 hour of incubation where as the plain culture (Control) partial decolorization continued upto 78 hours. In our experiment we found that *Aspergillus niger* silver nanoparticle as an efficient decolorizer against the dye congo red.

**Key words:** Silver nanoparticle, decolorization, azo dye, waste water.

**INTRODUCTION**

Environmental pollution from human activities is a major challenge of civilization today [1-3]. Textile dyes constitute a major source of pollution. Textile industries consume a major share of dyes in India [4]. Textile dyes are classified as azo, diazo, cationic, basic, anthraquinone base and metal complex dyes based on the nature of their chemical structure. Synthetic dyes such as azo dyes, xanthenes dyes and anthraquinone dyes are very toxic to living organisms. Azo dyes constitute a major class of environmental pollutants. Some of the azo dyes or their breakdown products are known to be highly toxic and mutagenic on living organisms [5]. Characteristics of the waste water from textile industries vary depending on the process employed [6]. Accordingly wastewater generated from of the operations in wet processing such as desiring, scouring, bleaching, mercerizing, dyeing, printing and finishing differ considerably [7, 8].Removal of dyes from textile waste effluents has been carried out by physical, chemical and biological methods, such as flocculation, membrane filtration, electrochemical techniques, ozonation, coagulation, adsorption and fungal discoloration [9]. Fungal bioremediation is becoming an attractive option for removal of dyes from industrial effluents as microorganisms is nature’s tools for cleaning the environment. Dyes may significantly affect photosynthetic activity in aquatic life because of reduced light penetration and may also be toxic to some aquatic life due to the presence of aromatics, metals, chlorides, etc. [10]. 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 [11]. Another potential use of silver nanoparticles in water filters in wastewater treatment plants. At nanoscale silver exhibits remarkably unusual physical, chemical and biological properties [12-13]. Recently it was shown that silver ions may be reduced extracellularly using fungus *Phanerochaete chrysoporium* [14] and *Pleurotus sajor-caju* [15]. In this paper we have made an attempt to...
decolorize the dye congored by silver nano particle synthesized by using *Aspergillus niger* and its comparison with its plain culture.

**MATERIALS AND METHODS**

**Organism:**
The organism used in this study was *Aspergillus niger* and it was maintained on potato dextrose agar plates.

**Isolation of fungal culture**
The fungal test organism used in this study was *Aspergillus niger*. The fungal culture was isolated and identified in the laboratory of department of biotechnology using relevant manuals, were subcultured on potato dextrose agar medium and maintained on PDA agar slants.

**Microscopic observation and colony characterization**
The fungi were microscopically characterized and fungal isolates were observed using hand lens and colony morphology was recorded with respect to color, shape, size and nature of colony.

**Synthesis of silver nanoparticle**
The organism was allowed to grow in the biomass production broth containing Glucose 10g/l, Potassium dihydrogen orthophosphate 1g/l, potassium chloride 0.5g/l, Magnesium sulphate 5g/l, Ferrous sulphate 0.1g/l, Sodium nitrate 2g/l, yeast extract 1g/l at a pH of 6.0 and after 7 days the biomass was separated and allowed to grow in de ionised water for 3 days. To the filtered biomass 1mM final concentration AgNO₃ was added and incubated in dark conditions at 30°C under shaking conditions and the formation of nanoparticle was examined under UV-visible spectrophotometer at 24hr time interval.

**Characterization of the nanoparticle**
The particle was characterized by UV-visible studies and the particles were subjected to SEM studies for their size determination.

**Decolorization studies**
For decolorization study, 250 mL Erlenmeyer flasks containing 125 mL solutions of congo red was prepared in the media containing sucrose, NaNO₃, KCl, MgSO₄.7H₂O, FeSO₄.7H₂O, K₂HPO₄ and agar per ml was used. Final pH of the medium is 7.3 ± 0.2. The *Aspergillus niger* silver nanoparticle was added to the above media which is indicated as test. Similarly plain culture (*Aspergillus niger*) 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 room temperature. 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.

**RESULTS AND DISCUSSION**

**Characterization studies**

**Ultraviolet-Visible (UV-VIS) spectroscopic analysis**
It is generally recognized that UV-visible spectroscopy could be used to examine size and shape controlled nanoparticles in aqueous suspensions[16]. SNP’s have free electrons, which give rise to an SPR absorption band[17], due to the combined vibration of electrons of metal nanoparticles in resonance with the light wave[18,19]. Silver nanoparticles are known to exhibit a UV-visible absorption maximum in the range of 338-376 nm. In the present study absorption peak was observed at 358 nm which is a characteristic of silver nanoparticle(Fig 1).
Scanning Electron Microscopic studies

The SEM image has been employed to characterize the size, shape and morphology of synthesized silver nanoparticles. From the SEM image of synthesized silver nanoparticles, it is evident that the morphology of the synthesized silver nanoparticles are spherical shaped with the diameter range of 50-80 nm. The SEM image showed that the high density silver nanoparticles synthesized by the *Aspergillus niger* development of silver nanoparticles[20]. The diameter size in our study confirms the presence of nanoparticle have been synthesized.

Decolorization studies

A significant decolorization rate was observed for the dye Congo red. The *Aspergillus niger* silver nanoparticle effectively decolorized 80.2% of dye within 42 hour incubation and the dye was fully decolorized within 78 hour of incubation. Whereas the plain culture (*Aspergillus niger*) was able to degrade only 40% of dye at the same incubation conditions and partial decolorization was observed after 78 hour incubation (Fig.3)
The present study revealed the ability of the *Aspergillus niger* silver nanoparticle to decolourize Congo red, nanoparticles decolourise better than the plain culture of the same strain. The development of such particles may be considered a break through in the field for the efficient clean up of the dyes. They are easy to synthesise and cost effective.

**REFERENCES**