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Silver nanoparticles synthesized from *cynodon dactylon (l.)* Leaf aqueous extract

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ABSTRACT
The present study reports a green chemistry approach for the phytosynthesis of silver nanoparticles (AgNPs) by using the leaf extract of cynodon dactylon (L.) Pers and dye degradation property of its AgNPs. Initially, synthesis of AgNPs was confirmed by colour change from pale yellowish reaction mixture to dark brown after 20 minutes of boiling. In order to confirm the formation of silver nanoparticles, UV-Vis, XRD and SEM charaterizations were made. The nanoparticles showed an absorption peak at 350 nm in UV-Visible spectrum corresponding to the Plasmon Resonance Band of the synthesized AgNPs. XRD analysis showed that size of the silver nanoparticles was around 13 nm. Various concentration of nanoparticles (2.0-10.0 mg)were mixed separately with water containing methylene blue dye (10 mgl1000 ml). A control was maintained without the addition of the AgNPs. At specific day intervals, aliquots of 2-3 ml suspension were filtered and used to take absorbance at 660 nm. Using the absorbance values, percentage of dye degradation was calculated. The percentage of dye degradation was increased with increasing the day. Of various concentration of AgNPs used, dye solution containing 10 mg AgNPs showed 75% dye degradation after 5 days of incubation at room temperature.
Keywords: *Cynodon dactylon, silver nanoparticles, dye degradation, methylene blue*

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INTRODUCTION
Nanotechnology is the science of producing and utilizing nanosized particles [1]. Silver nanoparticles (AgNPs) is useful in various fields such as catalysis, optics, biomedical, pharmaceutical and sensor technology [2]. Although many methods are available to synthesize AgNPs, most of them utilized toxic chemicals and also include the use of enormous energy. This scenario is not economic and cause serious pollution to environment. Synthesis of nanomaterials using biological entities is gaining attention because biological methods are less expensive, nontoxic and involving environmentally acceptable procedures [3]. The use of plant and plant extract in nanoparticles synthesis is advantageous compared to microbial based system because it eliminates the intricate process of maintaining cell cultures [4]. Dyes are a major class of synthetic organic compounds used in many industries especially textiles [5] which consume about 60% of total dye production for coloration of different fabrics. Moreover, after the completion of their use nearly 15% of dyes are washed out. These dye compounds dissolve in water bodies with a concentration in between 10 and 200 milligram per liter results in major water pollution worldwide [6,7]. Therefore, treatment of dye effluents from textile industries is a compulsory part of waste water treatment. The release of dye effluents in aquatic systems is chief environmental concern because coloration not only decreases sunlight penetration and dissolved oxygen in water bodies, but also releases toxic compounds during chemical or biological reaction pathway that affects aquatic flora and fauna [8]. Nowadays biosynthesised nanocatalysts are widely used for the efficient removal of dye contaminants. Plant contains a complex network of metabolites and enzyme that can be used to synthesize naoparticles. The presence of different chemical compounds in plant such as polyphenols, flavonoids, sterols, triterpenes, reducing sugar like glucose and fructose, and protein could help produce metallic nanoparticles [9]. Since nanotechnology field has provided a new platform for waste water treatment [10], researchers have explored this technique for degradation of dye [8].
The focus of the present investigation is to apply the accurate principles of green chemistry for the synthesis of AgNPs using leaf extract of Cyanodon dactylon (L.) Pers. (Bermuda grass) as reducing and

capping agent. Bermuda grass belongs to the family, Poaceae. it is native to East Asia, Africa, Southern Europe and Australia. Cyanodon is generally considered as a weed and has been found to possess various potential medicinal properties [12]. Many researches showed that Bermuda grass as a wide spread creeping grass could be useful for stabilizing spill affected soil [13,14]. Various studies show that Pb, Ni [15], Mn, Cu, Zn, Pb, Co [16], Cr, Zn, Cd [17] and Cr, U [18] bioaccumulation potential of this plant. Recently, biosorption of thymol blue from industrial wastewater using activated biocarbon from this plant leaves was shown [19]. Methylene blue is a model cationic dye employed by industries such textile industry for a variety of purposes. It is a heterocyclic aromatic chemical compound with a molecular formula C16H18CIN3S. It causes eye burn which may be responsible for permanent injury to the eyes of human as well as aquatic animals. It can also cause irritation to the gastrointestinal tract with symptoms of nausea, vomiting and diarrhea. Methylene blue also causes irritation to the skin when in contact with it [20]. So far, there is no report on exploration of phytosynthesized silver nanoparticles of C. dactylon for degradation of textile dye methylene blue. Therefore, the study was undertaken with the objectives: to synthesis and characterization of silver nanoparticles using leaf extract of *C. dactylon* and to assess the exploitation feasibility of these nanoparticles for phytoremediation purpose.

MATERIAL AND METHODS

PREPARATION OF PLANT EXTRACT

C. dactylon leaves were collected from Bharathiar university campus, Coimbatore, Tamil Nadu, India. Washed leaves were cut into bits and 10 mg of tissue ground well with adding adequate distilled water. The filtrate was made up to 100 ml with distilled water and it was boiled for 20 minutes. After cooling, it was centrifuged at 8000 rpm for 10 minutes. Then the supernatant was taken for the synthesis of silver nanoparticles

SYNTHESIS OF SILVER NANOPARTICLES

10 ml of supernatant was taken in a conical flask and 90 ml of different concentrations of silver nitrate solution was added to it separately. Then the solution was boiled in a waterbath for 20 minutes. The formation of silver nanoparticle was indicated by the appearance of dark brown colour in the reaction mixture after boiling.

UV-VISIBLE SPECTRA ANALYSIS

UV-visible spectral analysis was performed for samples containing different concentrations of AgNO3 and the absorption maxima were recorded at a wavelength of 200-800 nm using spectrophotometer.

XRD ANALYSIS OF SILVER NANOPARTICLES

After confirmation of phytosynthesis of AgNPs by UV-Vis, the solution was centrifuged at 8000 rpm for 10 minutes. The pellet was washed with water two to three times and allowed to dry to get pure AgNPs. It was then subjected to X-ray diffraction (XRD) to examine the crystalline nature of AgNPs in the given sample.

RESULTS AND DISCUSSION

Among various concentrations containing AgNO3 tried, 3 mM showed efficient production of AgNPs during 20 minutes boiling. Reduction of Ag into AgNPs is usually marked by colour change. The synthesized NPs exhibited dark brown colour transition from their original pale yellow colour (Figure 1)

Fig.1 Colour change pale yellow to dark brown

UV-VIS SPECTROSCOPE

when monitored by UV-Vis spectroscope in a range of 200-800 nm. The colour change was due to the excitation of Surface Plasmon Resonance of the synthesized AgNPs [21]. A strong SPR band was appeared at 350 nm (Figure 2). In order to confirm the stability of synthesized AgNPs, OD was taken using small volume of sample for three days before using AgNPs for degradation of dye study and found that appearance of SPR band only at 350 nm. Generally green synthesized AgNPs were found to be stable for six months without relocating the SPR band [22, 23]. This stability may be due to the presence of phytochemicals present in the leaf extract of C.dactylon which act as stabilizing agents.

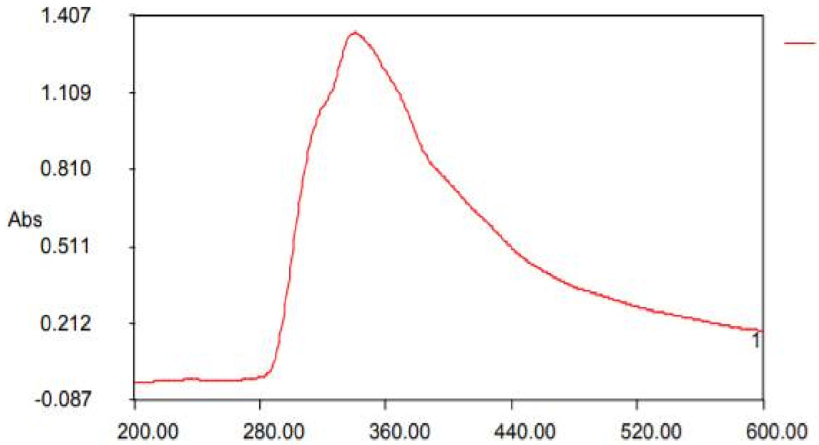

Fig 2. UV-VIS Spectrum of phytosynthesized AgNPs

XRD

XRD pattern of synthesized AgNPs was recorded using XRD Shimadzu 6000. The diffractogram obtained was compared with JCPDS library to confirm the crystalline structure of synthesized AgNP (Figure 3). The average size of the AgNPs was calculated using values of XRD (Table 1). Diffractogram shows three distinct diffraction peaks of 32.2, 27.7, 46.2° at 2θ values which can be indexed to the plane of (1 0 1), (3 1 0) and (1 5 1), correspondingly. The inter planar spacing (dA) values were found to be 2.775, 3.208 and 1.963 attributing to the above said planes, respectively. The average size of the AgNPs synthesized is approximately to be ~13 nm which is obtained by applying Debyr Scherrer's formula. Generally, strong peaks are associated with the face centered cubic lattice [24]. The remaining inconspicuous peaks obtained at 2θ values can be ascribed to some of the phytocompounds moieties present on the surface of synthesized AgNPs [25, 26].

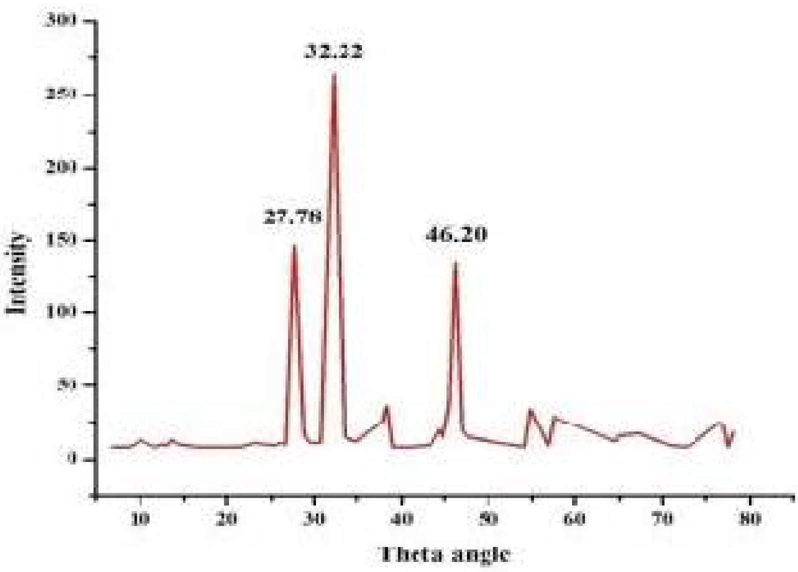

Fig. 3 FTIR Spectrum of phytosynthesized AgNP

SEM analysis indicates the presence of AgNPs in a denser condition with spherical and uniform nature (Figure 4). Mostly, they were found as mono dispersed form. In common, nanoparticles are not mingled with each other even though they are in aggregated form. This is due to the presence of capping agents or phytocompounds which usually stabilize the NPs [27]. analysis indicates the presence of AgNPs in a denser condition with spherical and uniform nature (Figure 4). Mostly, they were found as mono dispersed form. In common, nanoparticles are not mingled with each other even though they are in aggregated form. This is due to the presence of capping agents or phytocompounds which usually stabilize the NPs [27].

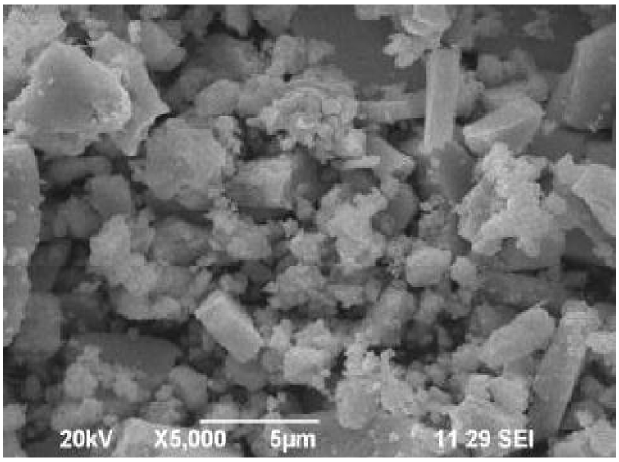

Fig.4 FTIR Spectrum of phytosynthesized AgNPs

CONCLUSION

Green nanotechnology is gaining importance due to its wide application and elimination of harmful reagent and provides effective synthesis of silver nanoparticles in one step. Here, the silver nanoparticles were synthesised using aqueous leaf extract of C. dactylon. The synthesised nanoparticles proved its efficiency for the degradation of one of the important textile dyes, i.e methylene blue in an eco-friendly manner. In future, an attempt will be made to enhance its efficiency for complete degradation of dye within short exposure by applying various parameters such as sunlight and controlled light exposure. Thus, this study exhibits the dye degradation property of the Bermuda grass especially their eco-friendly synthesised AgNPs.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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