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Research Article

Biosynthesis of silver nanoparticles using Rice grass (*Oryza sativa*) aqueous leaf extract.

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ABSTRACT
The wide-scale application of silver nanoparticles (AgNPs) in areas such as nanomedicine, and environmental cleaning has led to their increased demand. Chemical methods of AgNPs synthesis involve the use of toxic reagents and solvents. The present study reports a green method where silver nanoparticles are synthesized using aqueous extract of rice grass (*Oryza sativa*) from aqueous silver nitrate solution. To identify the compounds present in the plant extract which is responsible for reduction of silver ions, the functional groups present in plant extract were investigated by FTIR. The techniques used to characterize synthesized nanoparticles are XRD analysis, FTIR and UV–visible spectrophotometer. UV–Visible spectrophotometer showed absorbance peak in range of 359nm-457nm.

KEYWORDS
Nanoparticles, Rice grass, FTIR, XRD.

1. INTRODUCTION

Among the metal nanoparticles, silver nanoparticles are found to have profound applications in the fields of medicine, agriculture, environmental biotechnology etc. It can be used in wound dressings as antimicrobial agents (Singh& Singh, 2014; Habiboallah, 2014; Nambiar & Bhathena, 2010), in topical creams (Tian *et al*., 2007), acts as anticancer agents (Kaur & Tikoo, 2013) etc. Silver nanoparticles can be synthesized using physical, chemical and biological methods. The physical and chemical techniques are more expensive, energy requiring and may involve the use of many hazardous toxic chemicals (Okafor, 2013). A very effective alternative is the biosynthesis, where either microorganisms or plant extracts are employed for the production of nanoparticles. The bioactive compounds present in extracts of plants are nowadays widely used for the biosynthesis of nanoparticles (Ghaffari-Moghaddam *et al*., 2014; Faramarzi & Sadighi, 2013; *Azizi* et *al*. 2013, Prasad *et al*., 2013, Das *et al*., 2010; Gilaki, 2010; Vaidyanathan, 2009). Specific compounds with active functional groups can bring about the reduction of metal ions to metal nanoparticles. Moreover, this technique is easy, eco-friendly, low-cost and a fast and sustainable method (Ibrahim, 2015).

In this paper, we present the use of rice grass leaf extract for the synthesis of silver nanoparticles. The synthesized nanoparticles were analyzed by UV–Vis spectroscopy, X–ray diffraction (XRD), and Fourier transform infrared (FT–IR) spectroscopy.

2. MATERIALS AND METHODS

The rice grass mediated silver nanoparticle production was carried out at room temperature and involved the preparation of aqueous plant extract and aqueous solution of Silver Nitrate. Fresh rice grass was harvested from six week old germinated paddy grains. The leaves were first washed with tap water and later with distilled water and then dried at room temperature. 10 gm of finely chopped leaves were weighed out and added to 100 mL of boiling distilled water and continued boiling till 20 minutes. When cooled, this aqueous leaf extract was filtered through Whatman filter paper No. 1. 10 mL of filtered leaf extract (Fig.1) was added drop-wise to 90mL of 1mMole AgNO3 solution (Fig. 2) while continuous stirring (Fig. 3). To avoid photo activation of silver nitrate, this setup was carried out in dark chamber. Colour change of the solution to dark brown (Fig. 4) was observed, which indicated the reduction of Ag+ to Ag0. UV-Vis spectral analysis was done of this solution to confirm it. The solution was later centrifuged, sediment collected in a crucible and dried in Hot air oven at 800C (Fig. 5). The dried powder was collected in eppendorf tubes and used for XRD and FTIR analysis.

Fig. 1

Fig. 2

Fig. 3

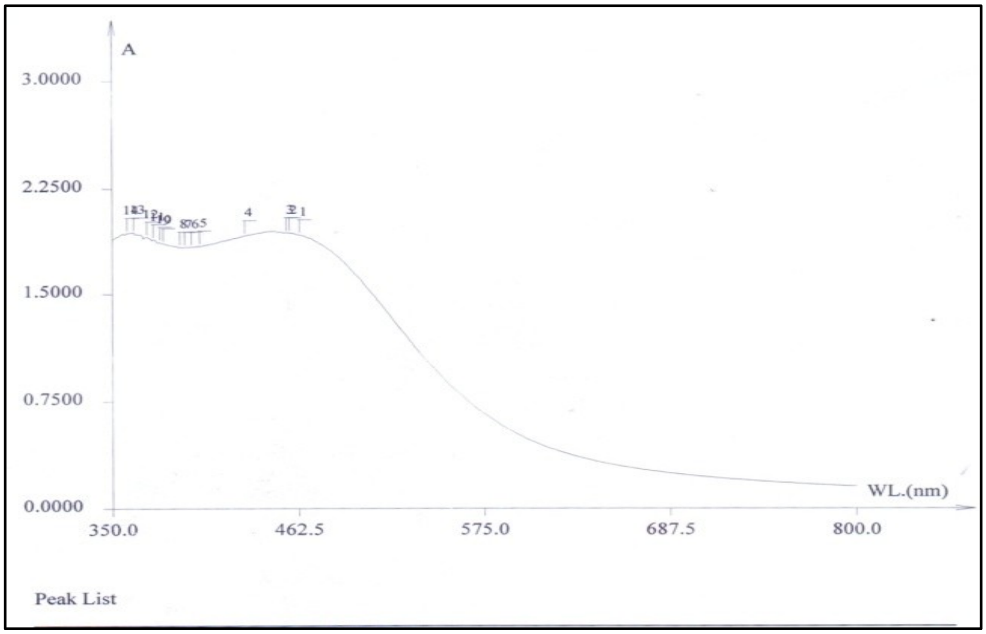
Fig. 4

Fig. 5

3. RESULTS AND DISCUSSION

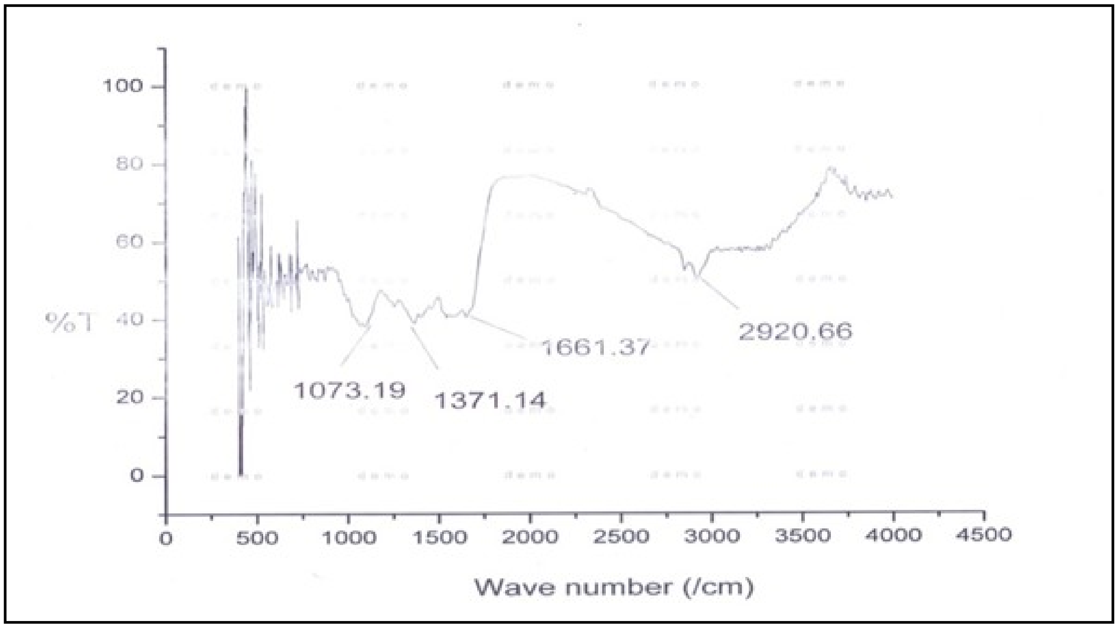
3.1. UV–vis spectroscopy

Silver nanoparticle formation in the solution is mainly represented by a reaction solution colour change to dark brown (Ajayi and Afolayan, 2017). Addition of plant extract to 1mMole $AgNO_3$ solution resulted in colour change from initial colourless to yellowish to light brown to dark brown. (Fig.4). This colour change indicated the formation of silver nanoparticles (AgNPs). The production of AgNPs was monitored using UV-Visible spectrometer. The reaction kinetics showing the AgNPs production is presented in Figure 6. The UV-Vis Spectrum showed maximum absorption peak ranging between 359nm – 457nm which corresponds to AgNPs production.



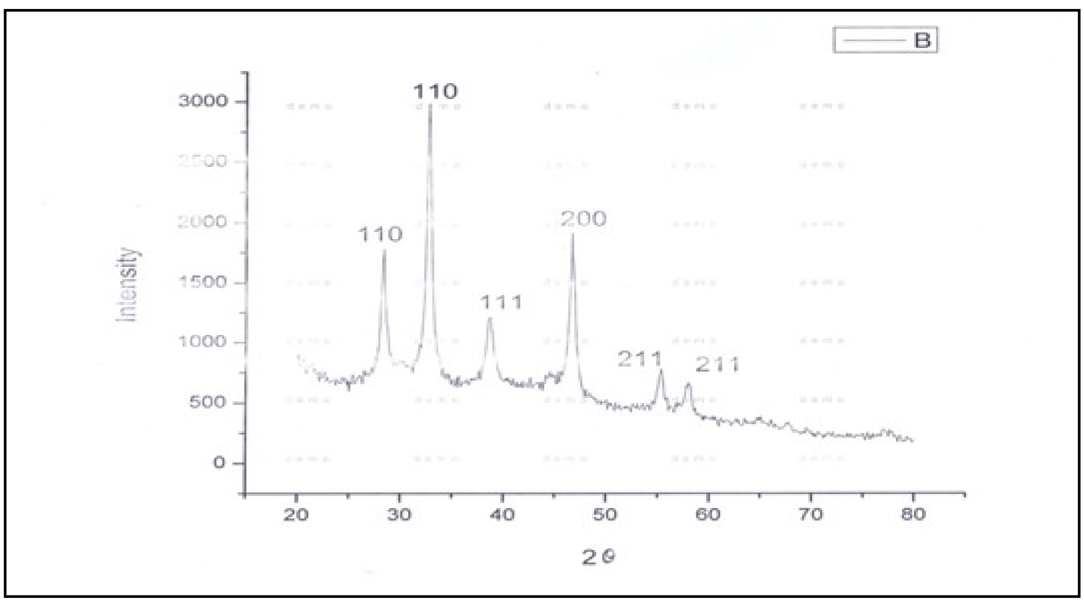
3.2. FTIR Analysis

The role played by the plant extract in the synthesis of nanoparticles is that, the functional groups present in some compounds of the extract act as reducing and capping agents. This was confirmed by the FTIR analysis of the nanoparticle. Prominent bands of absorbance were observed at around 1073.19, 1371.14, 1661.37, 2910.66 cm^{-1}. The observed peaks denote the presence of alcohol (-OH), nitro ($-NO_2$), imine (-C=N-) and alkane (-C-H) groups respectively. These groups can be responsible for efficient capping and stabilization of AgNPs.



3.3. XRD studies

The Bragg's reflections were observed in the XRD pattern at 2Θ = 28.42, 32.84, 38.73, 46.75, 55.39 and 57.99. These reflections clearly indicated the presence of (110), (111), (200) and (211) sets of lattice planes and so they can be indexed as face-centered-cubic (FCC) structure of silver. By using Scherrer's formula, crystalline size of AgNPs was calculated as 30.99 nm.



In the present study, green synthesis of Silver nanoparticles at room temperature is reported. The method was found to be easy, cheap, environmental friendly and time saving. $AgNO_3$ was reduced to AgNPs with the help of rice grass extract which acted as reducing and stabilizing agent. This is an efficient alternative to the energy consuming physical and chemical methods which pose serious threat to the environment. The biogenically synthesized silver nanoparticles will have great significance in the field of nanomedicine, agriculture etc.

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