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Rapid Biosynthesis of Silver nanoparticles using Fenugreek leaves

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Abstract: Spherical shaped silver nanoparticles were synthesized using Fenugreek leaves extract and the prepared nanoparticles were characterized for their structural, optical and morphological properties. The Fourier transformer infrared spectroscopy reveals the presence of polyphenolic compounds in fenugreek leaves extract which acts as a reducing agent for the transformation of silver sulphate into silver nanoparticles. The x-ray diffraction pattern substantiate the hexagonal system of silver nanoparticles, absence of impurities ascertains the higher order purity of the biosynthesized silver nanoparticles. The observed absorption peak at 418nm corresponds to surface plasmon resonance property of silver nanoparticles. The green synthesized silver nanoparticles with average size ranging below 50 nm imaged using High Resolution Transmission Electron Microscopy.
Keywords: Silversulphate, Polyphenols, Fenugreek leaves, Nanotechnology, Silvernanoparticles.

Introduction and Experimental

The synthesis of nanoparticles of noble metals such as silver exhibited significantly distinctchemical, physical and biological properties from their bulk counterparts over the past decade. Traditionally, Silver is extensively used as a disinfecting agent and in some countries it is also used as an ingredient in cuisine[1].Green chemistry, have developed as a naive and possible substitute to more complex chemical synthetic protocols to obtain Silver nanoparticles.Fenugreek is an expedient plant and is cost effective. Besides, it possesses phytochemicals such as polyphenols and alkaloids that can be used as a reducing agent in the synthesis of metal nanoparticles.

Synthesis and Characterization of Silver Nanoparticles

Fenugreek leaves were washed thrice, 20gwas weighed and mixed with 150ml of Millipore water and then heated at 80°C. The mixture was further filtered thrice using whatmann no.1 filter paper. The filtrate is called fenugreek leaf extract (FLE). The FLE was then added to the0.02M silver sulphatesolution drop wise, at a ratio of 4:1 as reported earlier[2]. Then this mixture was refluxed at 80 - 90° degree for 2 hours to obtain colloidal silver nanoparticles which is further dried and stored.

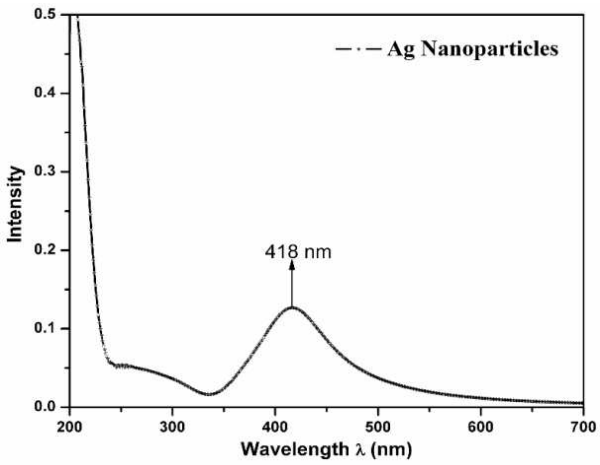
The characteristic absorption peak of silver nanoparticles were examined using UV-visible spectrum, recorded using UV-Vis spectroscopy (T90 PG UV/VIS) in the range between 250 – 800nm.The particles were

characterized for their size and crystallinity using RIGAGU X-ray diffractometer. The crystalline size was calculated using *Scherrer's* formula d =0.94 λ/βcosθ.High ResolutionTransmission Electron Microscopy (HR-TEM) image was taken using FEI–TECHNAI G2 Series – 250 kV. In order to identify the groups of the phytochemicals capped on the surface of the particles, the Fourier Transform Infra-red spectrum were documented in the range 4000 to 400 cm^{-1} using Perkin – Elmer Spectrum.

Results and Discussion

The analysis of UV-Visible spectroscopy data revealed an appearance of surface plasmon resonance peak (SPR) at the 418 nm wavelength corresponds to silver nanoparticles formation[3] .

The transmission electron micrograph in Figure. 2 indicates the dispersity and morphology of the silver nanoparticles. The segregation of these silver nanoparticles may be due to the capping of phytochemicals such as polyphenols [2].



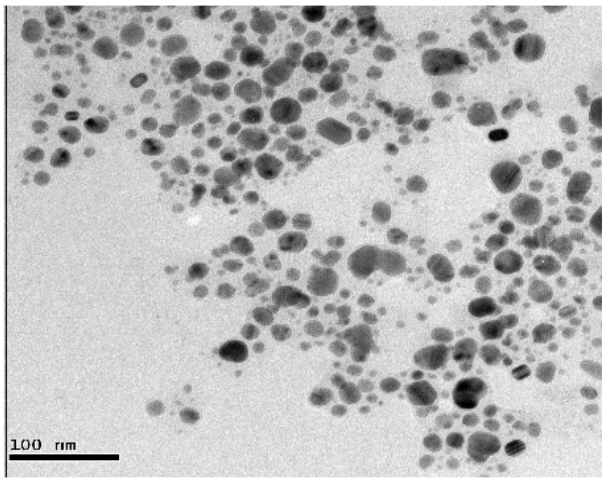


Figure 1.UV-visible spectrum of silver nanoparticles. **Figure 2.** HR-TEM of Silver nanoparticles.

The XRD pattern of silver nanoparticles isshown in the figure3 represents the crystalline nature and purity of the silver nanoparticles.The peaks totally formed were coherentwith standard data for silver (JCPDS 87 – 0720) [4].

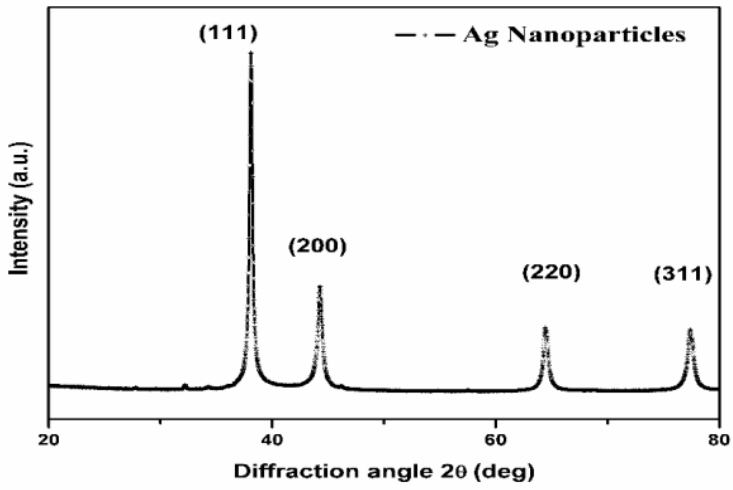


Figure 3. XRD spectrum of silver nanoparticles

Figure 4 reveals the FTIR spectrum of FLE and Silver nanoparticles. From the peak shifts in the FTIR results, the phytochemicals such as polyphenols (-OH group), amides and aminespresent in the FLEcaps the silver nanoparticles surface [2], thereby restricting the aggregation of silver nanoparticlesand stabilize them.

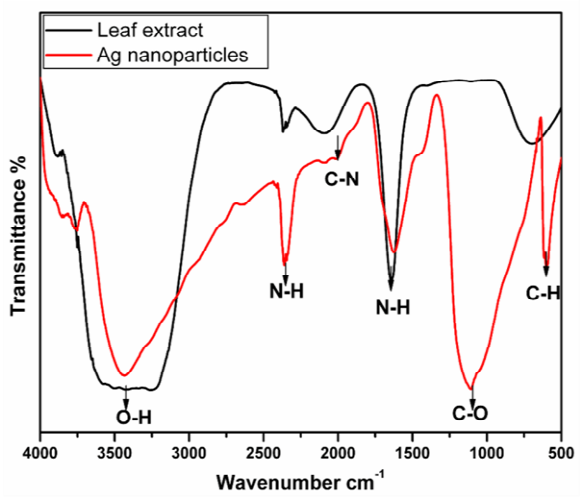


Figure 4.FTIR spectrum of germinated fenugreek seeds extract and silver nanoparticles

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