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ORIGINAL ARTICLE

Catalytic Activity of Silver Nanoparticles based on Medicinal Plant *Emblica officinalis*

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ABSTRACT
Biosynthesis or Green Synthesis of metal nanoparticles is simple, cost-effective, environmentally benign, and reduces harmful chemical handling. Silver nanoparticles of well-balanced form and size were produced from silver nitrate solution using Emblica officinalis fruit extract. The surface plasmon resonance peak at 450 nm was used in UV–vis spectroscopy to explain silver nanoparticle stability and bio-reduction. X-ray diffraction (XRD) revealed that face-centered cubic (FCC) is crystalline, with an average crystalline size of 20.21 nm. The various shapes of silver nanoparticles were confirmed by FESEM and EDX. Methylene Blue wasreduced by the produced nanoparticle.
Key-words: *Green Synthesis, FESEM, Catalytic, Methylene blue.*

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INTRODUCTION

The field of nanotechnology is one that is rapidly expanding and can be utilised to build structures on the nanoscale. The study and creation of particles with a dimension ranging from 1 to 100 nanometers is the focus of the field of nanotechnology known as nanoproducts. *Emblica officinalis* Gaertn.or *Phyllanthus emblica* Linn, more popularly known as Indian gooseberry or amla, is the plant that is considered to be the single most significant medicinal herb in the Ayurvedic system of traditional medicine that is practised in India. Methods that are non-hazardous, widely available, inexpensive, and favourable to the environment include bio-inspired synthesis processes that use plants [1]. In addition, it has been suggested that amla has radiomodulatory, chemomodulatory, and chemopreventive effects, as well as free radical scavenging, antioxidant, anti-inflammatory, antimutagenic, and immunomodulatory activities. These are all qualities that are useful in the treatment and prevention of cancer. The current work investigated the catalytic capabilities, and it also emphasised the qualities of AgNPs that demand further investigation to prove its activity and value as a cancer preventative and therapeutic medicine in humans.

MATERIAL AND METHODS

A. Procurement of Principal Medicinal Molecules and Plant

The chemicals silver nitrate ($AgNO_3$) and methylene blue were acquired from Titan biotech, New Delhi. The fruits of the *Emblica officinalis* plant were acquired from local market in Agra, Uttar Pradesh.

B. Preparation of Plant Extract

The fruits of *Emblica officinalis* were first washed in regular water and then given a final rinsing in distilled water. After that, a crusher and a blender were used to pulverise the dried fruits into a fine and a coarse powder, respectively. The plant powder was initially put in a thimble before being subjected to 25–30 cycles of heating and cooling in a Soxhlet device containing methanol. The thimble was created from a sheet of Whatman filter paper No. 01.

Qualitative Estimation of Phytochemical using Biochemical Assays
To identify phytoconstituents in plant extract, such as flavonoids, alkaloids, glycosides, terpenoids, steroids, flavones, tannins, phenols, and saponins, qualitative screening test procedures from Roy et al. [2] were utilised.

C. Green Synthesis of Silver Nanoparticle
Silver nanoparticles was prepared by adding 100ml aqueous solution of 1 mM silver nitrate + 10 millilitres of plant extract and incubated for 15 minutes at 60–80 degrees Celsius on mixing with magnetic stirrer. After 20 minutes solution was left for 24 hours at ambient temperature. Appearance of a brown color was indicated the synthesis of AgNPs which was confirmed by UV-visible spectrophotometry. The AgNPs were separated from solution using centrifugation at 12000xg. The AgNPs washing of was done two or three times in distilled water. Finally, dried in a hot air oven and preserved in sterile vials [3].

D. Characterization of EOAgNPs
1) ***UV-vis spectrophotoscopy:*** *Emblica officinalis* based silver nanoparticle (EOAgNPs) production was studied between 200 and 800 nm.
2) **XRD (X-ray Diffraction):** The EO AgNPs particle size was investigated using X-ray diffraction technique. The instrument used was a Bruker D8 Advance powder X-ray diffraction (XRD) system. After that, the diffractogram was analysed with the software Origin 6.1, and the average crystalline size was determined by applying the Scherrer formula [4].

$$Dp = (0.94 \times \lambda) / (\beta \times \cos\theta)$$

Where, Dp = Average Crystallite size, β = Line broadening in radians i.e. peak Full Width at Half Maximum (FWHM), θ = Bragg angle in radians i.e. peak positions, λ = X-Ray wavelength. Typically, instruments are sets with X Ray wavelength of LASER at 0.15418 (Cu K-alpha). X-rays have a wavelength that can range anywhere from 0.01 to 10 nanometers. As a consequence of X-Ray's readily penetration efficiency of the crystal structure, X-ray spectroscopy is a very helpful technique that can be used to characterize AgNPs [5].

3) **FESEM (Field emission Scanning Electron Microscopy) Analysis**
EOAgNPs' morphology was evaluated using a thin film of AgNPs (1 mg) created on a carbon tape followed by coating it with platinum. The image was taken with a 15 kV Jeol JSM-7610FPlus Field-Emission Scanning Electron Microscope.

E. Catalytic Activity
The reduction of methylene blue by $NaBH_4$ was used to test catalysis reaction. The methylene blue (Qualigens Corporation) was reduced by using EOAgNPs as a catalyst and tested in two reactions. First reaction was of 20 ml methylene blue solution + 2 ml of aqueous fruit extract + 1 ml of water. In the second reaction was of 0.2 ml extract + 2 ml EOAgNPs + 1 ml of $1x10^{-4}$ M methylene blue + 1 ml of fresh $NaBH_4$ aqueous solution (0.1 $molL^{-1}$). The reactions were read after 30 minutes between 400 and 700 nm using ultraviolet–visible spectrophotometer. The λ max of absorption was compared to methylene blue [6].

RESULTS
Yield of extract
An extract with a weight of 31.60% (25.26 of 79.93 g) was produced after *Emblica officinalis* was crushed into a powder and put through 25 cycles of the Soxhlet apparatus using 350 ml of methanol as the solvent.

Qualitative estimation of phytochemicals
Qualitative tests of the extract identified a wide variety of bioactive compounds, including tannins, saponins, cuamrins, quinines, phenol, sugars, glycosides, and flavonoid.

Confirmation of AgNPs synthesis by UV analysis
Emblica officinalis converted Ag^+ into Ag•(AgNPs) in 45 minutes to 24hrs. After adding plant extract, the solution became dark brown, indicating AgNPs production at pH 7. It showed a strong broad absorbance peak at max 450 nm.

An XRD analysis
XRD analysis verified the silver nanoparticles' crystalline structure (Figure 3). On matching XRD pattern with the Joint Committee of Powder Diffraction standard (JCPDS) file for Silver: 04-0783 the 2θ values

had prominent peaks at 38.52°, 44.28°, and 63.97°. The peak indexing revealed that the aforementioned 2θ-values correspond to the (111), (200), and (220) Bragg's reflection planes for face-centered cubic crystallographic planes of silver crystals. Scherrer's formula revealed that EOAgNPs were having average size 20.21 [7].

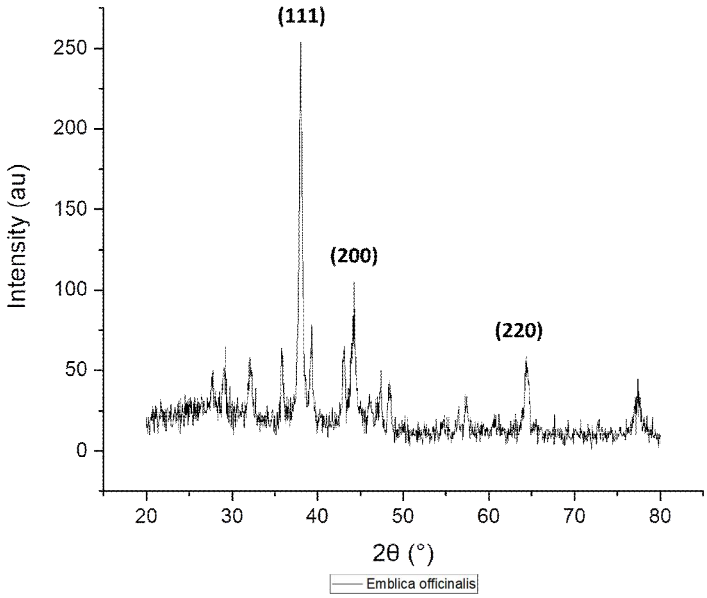

Figure 1: XRD pattern of TBAgNPs

FE-SEM analysis

The size and form of EOAgNPs were visualised using FE-SEM. The FE-SEM analysis showed that synthesized AgNPs were almost spherical, rhombus and parallogram in shapes and having an average size range of 43.6nm to 85.8nm.

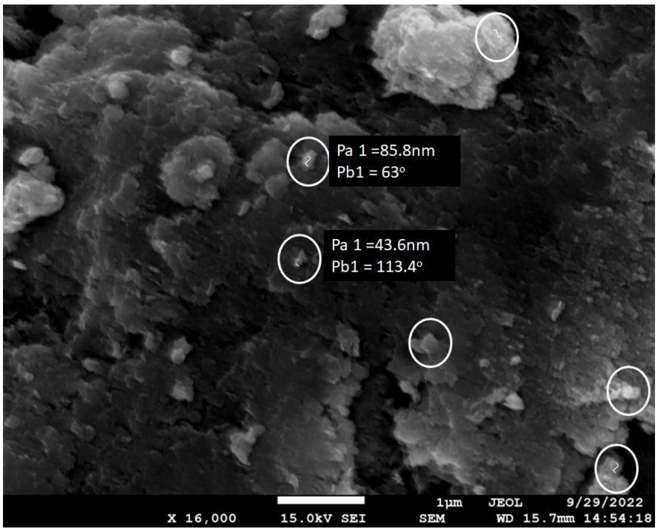

Figure 2: FESEM images of *E. officinalis* AgNP.

Catalytic Activity of *E. officinalis*

Methylene blue (MB) is an aromatic dye that can be found in the waste water from the textile and printing industries. The industrial wastewater causes many health problems with the eyes, skin, and digestive system. In this case, AgNPs are used to clean up polluted water by treating it with EOAgNPs. Due to the catalytic degradation reaction of AgNPs, the colour of the reaction mixture went from dark blue to light blue over time. The absorption spectra of the reaction mixtures showed that these results were correct (figure 3). At 680 nm, the absorption band for MB dye can be seen. As time goes on, it becomes clear that the reaction mixture is breaking down because of catalysis. The surface plasma resonance of AgNPs is the cause of this drop in absorption intensity. So, it's clear from the results that the EOAgNPs that were made are good catalysts that break down methylene blue dye. This method can be used to clean the water that comes out of textile factories [8].

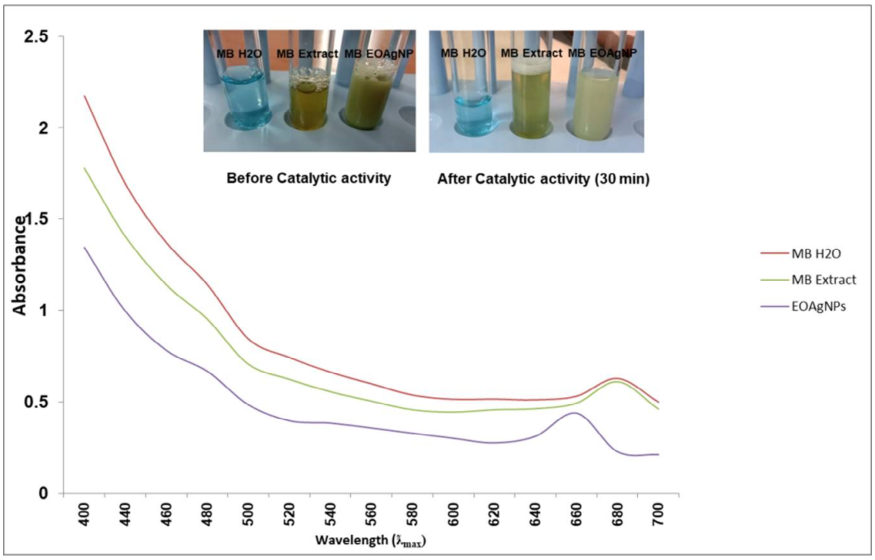

Figure 3 : Catalytic activity of *Emblica Officinalis*

DISCUSSION

Badoni *et al.* [9] examined an aqueous extract of *E. officinalis* and identified tannins, saponins, phenols, polysaccharides, and glycosides, but no alkaloids, proteins, quinones, coumarins, flavonoids, or sterols. But, in addition to tannin, saponin, phenol, carbohydrates, and glycosides, we also detected quinones, coumarins, and flavonoids in our extract. Our results were in consistent with Srivasuki, [10] and Dasaroju & Gottumkala, [11].

AgNPs are known to exhibit a UV–Visible absorption maximum in the range of 400–500 nm because of surface plasmon resonance [12]. Peak appearance near lower range (blue shift) indicates small nanoparticles and towards higher range (red shift) indicates larger nanoparticles. The statement is in consistent to Duan and Huang [13]. Therefore a peak raised was indicatedan aggregation or precipitation of nanoparticles. The blue shifts are due in part to quantum confinement of excitations, although other factors may also contribute. Peak below 390nm (blue shift)also means there is occurrence of impurities like organic species, solvent etc.

Table 1: Showing correlation between nanoparticle size vs absorbance peak-

S. No.	Particle Size (nm)	Absorbance peak (wavelength in nm)	Reference
1	10-14	384-414	Mulfinger et al. [14]
2	60-80	438-441	Nair and Pradeep [15] Agustina et al., [16]
3	35-50	427	Agustina et al., [16]
4	95	481	MdAlim-Al-Razy et al., [17]
5	110	505	MdAlim-Al-Razy et al., [17]
5	43-85	450	Present observation

The particles were found to be polydispersed, as evidenced by the UV-Visible spectra, which showed a prominent broad peak at 450 nm [18].

XRD results indicate the presence of AgNP with face-centered cubic silver planes, with the strongest peak at 38 degrees. Debye Scherrer's formula calculated AgNP's crystal size 20.2nm using XRD data. FESEM analysis indicatedalmost spherical, rhombus and parallogram in shapes of EOAgNPs with an average size range of 43.6nm to 85.8nm. The growth of nanoparticles wasnon-homogeneous while agglomeration of nanoparticles was not observed. Agglomeration didn't appear, indicated the stability of nanoparticles. Table 1 shown the particle size and UV spectrum matched with each other.

A cationic dye called methylene blue (MB) is used to test the catalytic activity of the synthesized AgNPs. The ability of AgNP to act as a catalyst could be used to reduce water-based MB to Leuco MB in the presence of $NaBH_4$. To evaluate the catalytic activity of biosynthesized AgNPs, the reduction of MB to an inert solution was utilised as a model reaction. The colour of an MB solution changed when $NaBH_4$ was added to it. The process was seen using UV-Vis spectrophotometry in the 400-700 nm wavelength range at room temperature. The absorption maxima of MB in aqueous solutions are located at 680 &660 nm

(Figure 3)in absence and presence of AgNPs, respectively, showed MB was broken down by AgNPs for 30 minutes. The slight downward trend in the maximum absorption shows that the number of MB has gone down. It was found that silver nano colloids speed up the reduction process because the MB solution's absorption intensity dropped quickly when they were present. The BH_4ions are nucleophilic, while the AgNPs are electrophilic and take electrons from the BH_4 ions and put them on the MB. The transfer of electrons from BH_4 to MB is made easier by AgNPs (acceptor). The reduction of MBis kinetically restricted without catalyst, even though it is thermodynamically favorable. This is caused by the large potential difference between donor and acceptor molecules [19]. At different times, the absorption spectra showed that the MB dye's intensity peaked and then went down. The balanced size and shape of the elemental silver nanoparticles led to the recommendation of the *Phyllanthus emblica* fruit extract as a powerful reducer. Catalytic properties and structure analysis of EOAgNPs is useful for environmental remediation as well as medical purposes.

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CONFLICT OF INTEREST

NIL

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