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COMPARATIVE STUDY ON VARIOUS NANOPARTICLES SYNTHESISED FROM LEAF EXTRACT OF *Simarouba glauca*

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Abstract

Nanomaterials are intrinsically better in terms of performance than other substances used in water treatment because of their high surface area (surface/volume ratio). Owing to these characteristics, these may be used in future at large scale for water purification. Among nanoparticles, nanosilver has become one of the most popular nanoparticles due to its applications in diverse areas. Improvement in sustainable and eco-friendly protocols for synthesis of silver nanoparticles is a significant step in the field of application nanotechnology. One approach that shows vast potential is based on the biosynthesis of nanoparticles using plant extracts. In this exploration, the concentrate of the leaves of Simarouba glauca was utilized as a lessening and balancing out specialist for the blend of attractive silver nanoparticles from a suitable proportion of silver nitrate and zinc oxide using zinc hyrdoxide. The response arrangement demonstrated an assimilation top somewhere in the range of 400-800 nm in UV-Vis spec., which affirmed the presence of nanoparticles. The nanoparticles size is portrayed by TEM and the morphology was described by SEM with EDX. The glass like structure and surface adjustment was described by XRD and FT-IR.

Keywords: **Silver nitrate, Zinc hydroxide, UV spectroscopy, Scanning Electron microscope**

I. INTRODUCTION

Nanotechnology is another period in designing field. "Nano" is arised from Greek word which signifies 'predominate'. Nanotechnology can be portrayed as the control of issue at nano level, which is acquired by certain synthetic, natural just as actual cycles. It suggests the formation of variable sizes, shapes, substance organizations and so forth and their likely use for human advantages. Nanoparticles have size going basically between 1 to 100 nm. Nanotechnology gives data about the physical, compound qualities of nanoparticles and how the issue controls at the nano level [1,2].

Nanoparticles are comprised of natural and inorganic materials. As nanoparticles are little in size, they have novel properties. Nanoparticles have actual properties paying little heed to its size, size frequently tells about the physical and substance properties. That is the means by which the properties of these particles change as their size approaches the nano range. Actual properties of nanoparticles incorporate enormous surface region and one of a kind states of the particles. Zinc oxide particles have more UV obstructing properties. Due to this property zinc oxide NPs are generally utilized in the planning of sun screen salves. Other actual property is shading, for an eg: gold and dim silicon are red in shading. Gold nanoparticles were dissolving at low temperature. Because of its more modest size bunches of properties are there like retention of sunlight based radiation is a lot higher in nanoparticles. Another actual property is the capacity to frame suspensions. This is accomplished by the solid communication between the molecule surface and the dissolvable [3,4].

II. OBJECTIVES OF THE WORK

Nanoparticles are synthesised by the greener synthesis method by mixing proper salts with plant extract as reducing as well as stabilizing agent.

III. MATERIALS AND METHODS

Fresh leaves of *Simarouba glauca* were collected locally from Kerala, India. Silver nitrate and Zinc hydroxide were purchased from local market.

A. PREPARATION OF *Simarouba glauca* LEAVES

Fresh leaves of *Simarouba glauca* collected locally and washed with Tween 80 solution to remove the dirt and repeat washed with deionised water to wash away the soap then dried the leaves. All the dried leaves are cut in to small pieces.

B. PREPARATION OF *Simarouba glauca* LEAF EXTRACT

5 gms of fresh leaves of *Simarouba glauca* placed along with 100 ml deionised water in a water bath at 90 ^oC for 1 hour: after cool down, extract was filtered by passing through 0.22 micron nylon membrane filter under 15psi suction pressure to avoid large particles, similar method is followed in (Aparajita Verma *et al*; 2016)

C. SYNTHESIS OF SILVER NANOPARTICLES

100 mL, 0.01N solution of silver nitrate was prepared in an Erlenmeyer flask. Then 10 mL of plant extract was added to 90 mL of silver nitrate solution. This setup was incubated in a dark chamber to minimize photo-activation of silver nitrate at room temperature. Reduction of Ag^+ to Ag^0 was confirmed by the colour change of solution from colourless to brown. Its formation was also confirmed by using UV-Visible spectroscopy [2, 3].

D. SYNTHESIS OF ZINC OXIDE NANOPARTICLES

For the preparation of zinc oxide nanoparticles 10ml of the extract was mixed with 20ml of 0.05M zinc acetate dehydrate solution maintained at a pH of 12 and the mixture was stirred on a magnetic stirrer for around 2 Hrs. Then the solution was centrifuged and the white residue was transferred on to a petriplate and the solution was kept in a hot air owen for around 8-12 Hrs and the white powder was later obtained. The material was mashed in a mortar-pestle so as to get a finer nature for characterization.

IV. CHARACTERIZATION

A. UV- Vis spectroscopy
B. Scanning electron microscope (SEM)
C. Transmission electron microscope (TEM)
D. X-ray Diffraction (XRD)

V. RESULTS AND DISCUSSION

A. PREPARATION OF *Simarouba glauca*

5 gms of fresh leaves of *Simarouba glauca* was placed in beaker along with 100 ml deionised water in a water bath at 90^o C for 1 hour: after cool down, extract was filtered by passing through 0.22 micron nylon membrane filter under 15psi suction pressure to avoid large particles.

B. GREENER SYNTHESIS OF SILVER NANOPARTICLES

Addition of plant extract into the beakers containing aqueous solution of silver nitrate led to the change in the colour of the solution to yellowish to reddish brown within reaction duration. This is the indication of formation of silver nanoparticles**.** (Aparajita Verma *et al*; 2016).

Fig I. Silver nanoparticle solution

Fig Ii. Zinc oxide nanoparticle

C. CHARACTERIZATION

1. UV Visible Spectroscopy

The maximum absorption was obtained at 420 nm. UV-Vis spectra of the plant extract show no evidence of absorption in the range of 400–800 nm, and the plant extract solution exposed to $AgNO_3$ ions shows a distinct absorption at around 420 nm which corresponds to surface plasmon resonance of silver nanoparticles established at 420 nm in previous studies. (Aparajita Verma *et al*; 2016).

The synthesized ZnO nanoparticles were initially identified using UV-Vis Spectrophotometer. A peak ranging between 340 and 380 nm was obtained which indicates the presence of ZnO nanoparticles

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2. Field Emission-Scanning Electron Microscope (FE-SEM)

Scanning electron microscopy provided the morphology and size details of the silver nanoparticles and zinc oxide nanoparticles. The SEM analysis shows that high density AgNPs synthesized by *Simarouba glauca* leaf extract and they that relatively spherical and uniform in size.

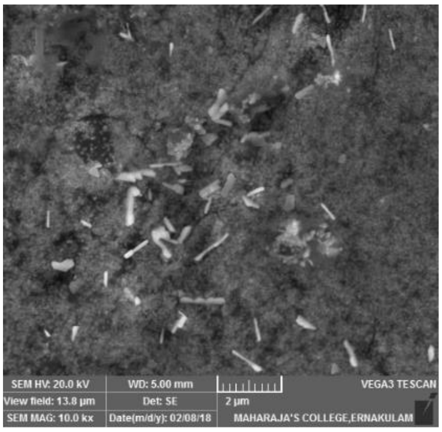

FIG III. FE-SEM images of silver NPs by using *Simarouba glauca* leaf extract

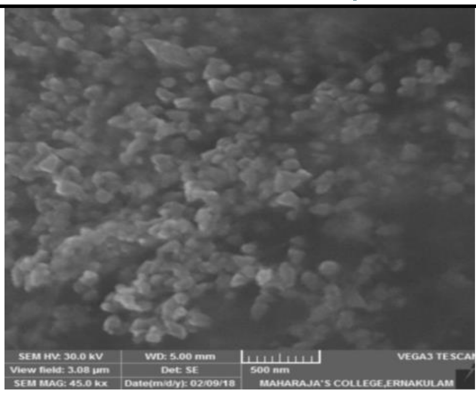

FIG IV. FE-SEM images of zinc oxide NPs by using *Simarouba glauca* leaf extract.

The SEM image of the zinc oxide nanoparticles is slightly rod hexagonal given in the Figure.

3. High Resolution-Transmission Electron Microscope

Transmission electron microscopy (TEM) analysis is used to identify the size, shape and morphology of nanoparticles. TEM image of the sample reveals that the synthesized silver nanoparticles are spherical shape with an average particle diameter in the range of 27–36 nm. The TEM image of the silver nanoparticles is shown in the Figure. (Aparajita Verma *et al*; 2016).

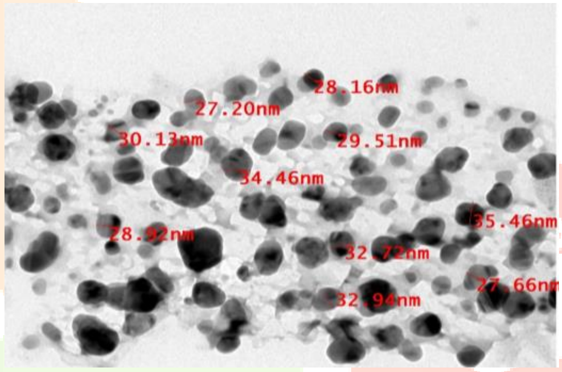

Fig V HR-TEM images of silver NPs by using *Simarouba glauca* leaf extract as reducing agent.

The TEM image of ZnO nanoparticles clearly shows that the particles are rod hexagonal in shape and the size of the nanoparticles ranges from 30-45nm

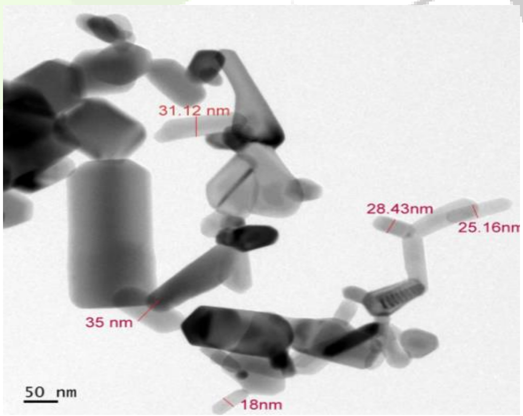

Fig VI HR-TEM images of zinc oxide NPs by using *Simarouba glauca* leaf extract as reducing agent.

4. XRD

XRD pattern of the obtained silver nanoparticles synthesized using the leaf extract shows strong diffraction peaks at 37, 44, 66 and 77 degrees of 2θ which corresponds to (111), (200), (220) and (311) crystal planes. The diffraction pattern indicated that the sample is the silver nanoparticles. The sharp peaks indicate that silver nanoparticles are crystalline in nature..

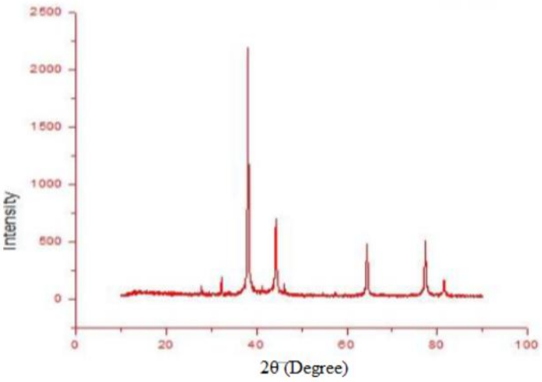

Fig VII XRD pattern of silver nanoparticles by using *Simarouba glauca*

XRD spectrum of the as prepared ZnO nanoparticles was carried out using 2θ values ranging from 10 to 80° the 2θ values with (hkl) plane at 31.5°, 34.2°, 36.1°, 47.4°, 56.5°, 62.8°, 67.8°, 68.9°and 76.9° were observed. The spectrum confirms the hexagonal zinc oxide structure for ZnO nanoparticles.

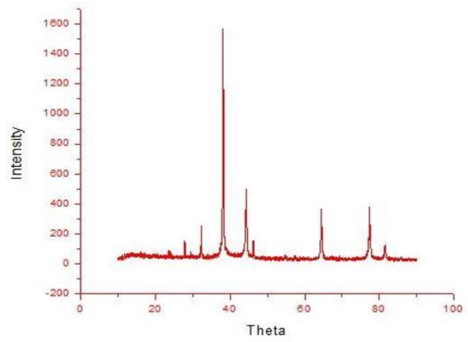

Fig VIII XRD pattern of zinc oxide nanoparticles by using *Simarouba glauca*

5. FTIR

A broad band between 3100-3400 cm^{-1} is indicating a hydroxyl group (O-H) stretching vibrations. The band at 1600 cm^{-1} corresponds to C=O stretching and band at 1300cm^{-1} indicating methyl group, which is in good correlation with that of the other reports. These bands indicate the presence of terpenoids in *Simarauba glauca* leaf extract. It can be inferred that terpenoids present in leaf extract acts as stabilizing or capping agents.

The IR spectrum was taken using a Perkin Elmer FT –IR instrument operating at a resolution of 4000-400 cm-1 in the percent transmittance mode. In addition to the absorption bands of the biomolecules used as reduction and stabilization (capping) agents, the absorption peak at various wavelength indicates the presence of ZnO nanoparticles.

CONCLUSION

We can utilise the plant parts for the production of NPs. In this work silver nanoparticles are synthesised using *Simarouba glauca* leaf extract act as reducing and capping agent. Simple, clean, reproducible, more stable product method greener synthesis is used for the production of NPs. Hence avoided the residual chemicals; toxic by-products by using deionised water as solvent. The polyol compounds present in the leaf extract will act as both stabilizing as well as reducing agents.

The morphology, size, crystalline structure, surface stabilization and presence were confirmed by doing characterization such as FE-SEM, HR-TEM, XRD, FT-IR, UV-Vis spec and with the help of a permanent magnet. Absorption peaks obtained from UV-Vis spec and are 400-800 nm indicated the presence of silver nanoparticles and a peak ranging between 340 and 380 nm indicates the presence of ZnO nanoparticles in the sample. FE-SEM images states that the NPs are in agglomerated in nature and are cubical in shape. The crystalline structure and surface stabilization is determined by FT-IR and XRD.

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