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Green Synthesis of AgO Nanoparticles By Using Aegle Marmelos (Linn) Rind Peel Extract and Its Potential Applications

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ABSTRACT

Green method of synthesis of nanoparticles (NPs) is growing field of science & technology. During the last few decades the use of these nanoparticles in various fields have been increased tremendously. Due to very wide range of application of metal oxide nanoparticles the interest of researcher in this field is growing rapidly. Various Researchwork in this aspect has shown how one can utilize this technology to its full capabilities. So, a variety of methods including biological, chemical and physical were applied for advancement of metal nanoparticals. In this proposed research work we are trying to provide a clean eco-friendly approach of the synthesis of very popular and one the most useful silver nanoparticles. We have characterized the green synthesized nanoparticles by using various standard analytical tools like UV visible spectroscopy, FTIR and SEM analysis. We also evaluated the antioxidant property of the synthesized nanoparticles by using the available standard procedure.

Keywords: Nanoparticles, Antioxidant activity,Silver Nanoparticles, Metal Oxide, Green Synthesis

I. INTRODUCTION

Nanotechnology has become the most rapidly developing fields of science in the last several years[1]. It is a multidisciplinary discipline that brings together chemistry, material physics, biology, engineering, and material scientific knowledge[2]. In the fields of technology and nanotechnology, significant advancements are being made to complement the benefits of life sciences, medical care, and current technology, as well as in other fields. It has also been extensively utilised for treating cancer, diabetes, allergies, infection, and inflammation among many. As a result of its distinct characteristics, nanoparticles are used in broad variety of applications including medicines, cosmetics, sources ofrenewable energy, environmental cleaning, and in biomedical devices. Unquestionably, silver particles and silver-based combinations are exceedingly toxic to microorganisms, including many bacterial species, as shown by several studies. [3].

Blending of the nanoparticles can be accomplished byusing variety of techniques such as chemical reactions, method of co-precipitation, solid reactions, sol gel process etc. One of themajor problembeing faced with chemical as well as physical techniques is that it is costly and require use of toxic and hazardous chemicals, which causes unwanted environmental as well as biological hazards [4]. In last few years, the green method for synthesis of various nanoparticles havebeen foundto be advantageous over the conventional synthesis, primarily because it does not use high energy, pressure,temperature, or uses toxic chemicals. Green nanoparticles, on the other hand, have the potential to be used in biomedical and food applications[5]. Because of its sobriety, plant extraction for the manufacture of nanoparticles is receiving more attention in the recent past. Additionally, the cycles are very adaptable and may be more cheap than other options. Plant extracts have the potential to function as deficiency agents as well as stabilising agents in the creation of nanoparticlesaccording to the researchers[6,7].

Bael is the common name for the plant Aegle marmelos (Linn) Correa, which is a member of the Rutaceae family. It is cosmopolitan in nature, having spread across India's deciduous woods. Originally from India, this plant may be found almost everywhere, even in the country's capital, Delhi. It is mentioned in almost all of the old Ayurvedic books, such as the Sushrut Samhita, the

Siddha Samhita, the Unani and the Charaka Samhita, among other works, that the tree has medicinal characteristics and advantages. Baels are medium-sized deciduous trees with distinctive branches that are encircled by scented trifoliate leaves. Bales are native to India and are found in many parts of the world. As a result of its incredibly nutritious and healthy fruits, the Bael tree is becoming more popular in both the Indian and worldwide markets, according to market research. The use of cutting-edge logical methods has been applied to these plants in the recent past, revealing their various medicinal properties, which include anticancer, antibacterial, antifungal activity, anti-diabetic activity, cell reinforcement, hepatoprotective and haemolytic activity, larvicidal and anti-inflammatory activity, among other things. Caumarins, steroids, alkaloids, tannins, and other chemicals are found in it [8,9].

Fig.1. Aegle Marmelos Fruit

The current study describes the use of silver nitrate solution and methanolic extract of Aegle marmelos fruit peel waste in order to accomplish environmentally friendly silver nanoparticle production. The isolated methanolic Aegle marmelos fruit extract was also tested for its anti-oxidant potential, and the results were promising.

2. Material and Methodology

For preparing nanoparticles, Aegle marmelosfruit was taken up from Sudhowala, Dehradun, Uttarakhand,India. Chemicals,solvents and other instrumentswere used from chemistrylaboratory, School of applied and life sciences, Uttaranchal University, Uttarakhand, India.

2.1. Extract preparation and Synthesis of Nano particles:

The fruit peel was washed many times to eliminate dust particles on it and was dried under the sun. The fruit peel was squashed to powder structure and disintegrated in methanol (100ml) and left for 48 hours. The sample was put in Soxhlet mechanical assembly for extraction at 45-50 ℃ for 4 hours. After the extraction the arrangement was separated and was concentrated utilizing a rotating evaporator.

Silver nps were prepared by employing silver nitrate solution in the synthesis process. Silver nanoparticles were created at room temperature by combining 5 ml of (rind) extract with 15 ml of prepared silver nitrate solution. Approximately 5 minutes after the start of the experiment, the colour of solution changed from clear to dark yellow, suggesting the creation of silver nanoparticles. After 10 minutes, the colour started deepening and changed into dark brown in appearance. The formed nanoparticles were separated by centrifugating it at 4000 rpm for 20 minutes[10].

2.2. Anti Bacterial Activity:

Sterile disc of size 0.5 cm diameter were generated by utilizing Whatman filter paper No.1 and employed for the current experiment. The extract was put into the sterile disc. The discs were allowed to dry under laminar air flow. Then another dosage of extract was administered. Assay of the antibacterial activities were done using Disc diffusion method. Nutrient agar plates were made and the test bacterial strain was deposited on the Nutrient agar surface using sterilized cotton swab. The antibiotic disc filled with plant extract wasplaced on the surface of the Nutrient agar plates[11].

Bacterial Strain	**Zone of Inhibition (mm)**	
	Disc 1	**Disc 2**
Escherichia coli	17	16
Staphylococcus aureus	15	16
Pseudomonas aeruginosa	14	14

Table.1. Anti Bacterial Activity

2.3Anti-oxidant activity:

Stock solutions (1 mL each) of the methanolic extract, ascorbic acid, and rutinwere prepared in methanol. 2 ml of freshly manufactured 80 g/ml DPPH methanol solution was added to each tube, andwere incubated for 30 min at room temperature. DPPH was detected at 517 nm through a blank solution containing same amount of extract or standard as the test sample but without the presence of DPPH. [12] The percent inhibition of free radical DPPH was estimated using the general formula:-

$$\text{Scavenging activity (\%)} = (Ab_c - Ab_s) \div Ab_c \times 100$$

Where Ab_c= Absorption of control and Ab_s= Absorption of sample

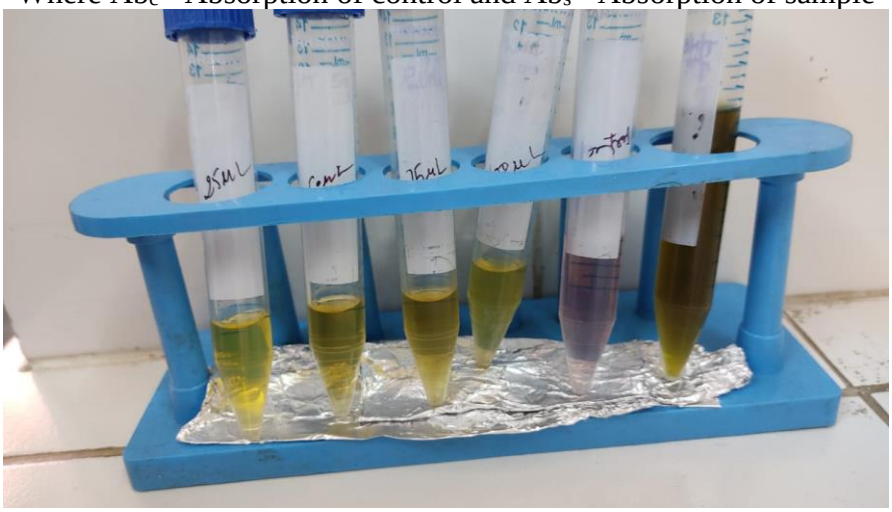

Fig.2. Samples of Angle marmelos rind at different concentration (µL) in DPPH

After performing the expirementantioxidant acitivity of AgNPS

Sample	Concentration	UV absorbance at 517nm	DPPH scavenging activity (%)	Percentage (%)
Antioxidant activity of AgNPS	25 µL	0.419	2.486 - 0.419 ÷ 2.486 × 100	83.14
	50 µL	0.351	2.486 - 0.351 ÷ 2.486 × 100	85.88
	75 µL	0.321	2.486 - 0.321 ÷ 2.486 × 100	87.08
	100µL	0.242	2.486 - 0.242 ÷ 2.486 × 100	90.26
Ascorbic acid Sample	25 µL	0.318	2.486 - 0.318 ÷ 2.486 × 100	87.20
	50 µL	0.293	2.486 - 0.293 ÷ 2.486 × 100	88.21
	75 µL	0.183	2.486 - 0.184 ÷ 2.486 × 100	92.59
	100 µL	0.126	2.486 - 0.106 ÷ 2.486 × 100	94.93

Table 2 .DPPH scavenging activity

Figure 3 shows the graphical representation of antioxidant activity

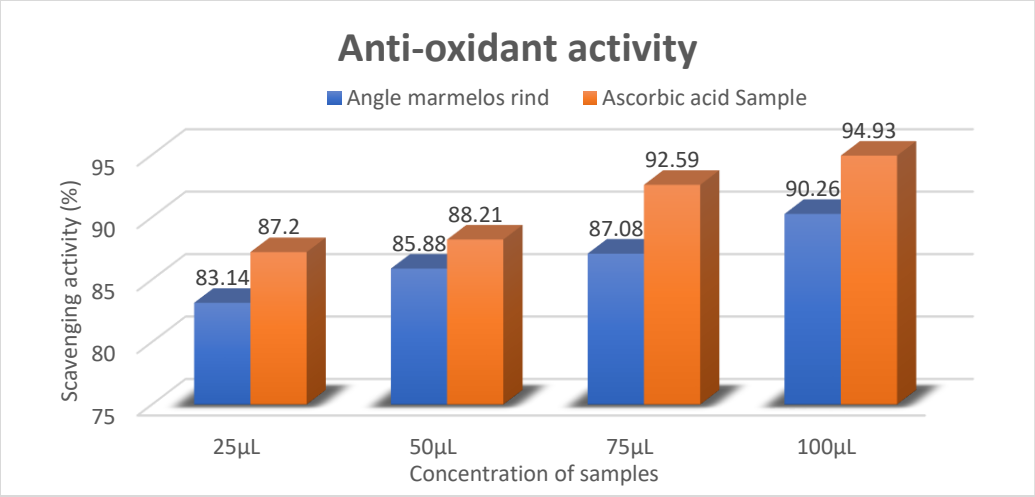

Fig.3. Anti-oxidant activity comparison graph

3. Characterization of formed NPs:

The formation of silver nanoparticles was confirmed by using UV-Vis spectrophotometer having wavelength range of 200-800 nm. After combining Aegle marmelos (rind) extract in aqueous solution of the silver ions, the UV–visible spectrum was monitored to confirm the reduction of pure silver ions to silver nps. The UV-Visible absorption spectrum of Ag nanoparticles is shown in Figure 4. Silver nanoparticles solution had an absorption band near 440 nm, showing that silver nanoparticles had been synthesised.The absorption is influenced by particle size, chemical environment, and dielectric media. [13].

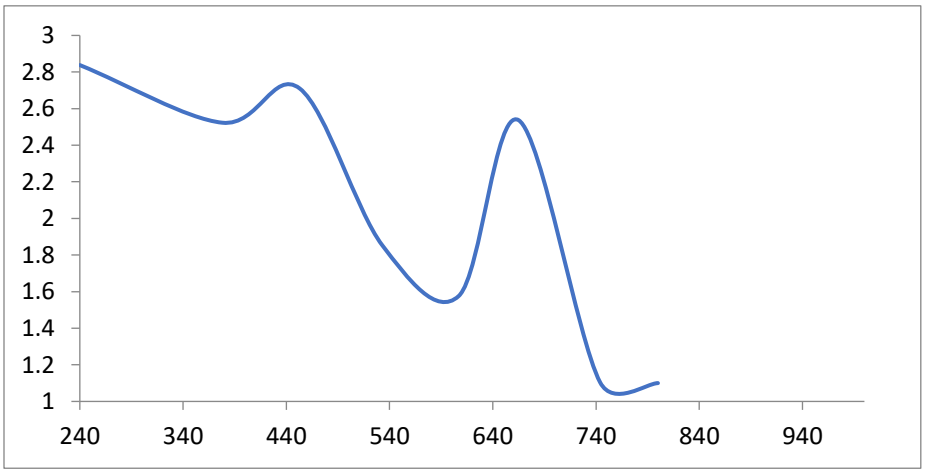

Fig.4. UV-Visible spectra of synthesized silver nanoparticle

SEM examination was used for identification of the shape and also for the morphology of produced nanoparticles. Figure 5. shows SEM images of the produced silver nanoparticles. Nanoparticles having spherical shape, as well as rod and square shapes, are visible in the figure.

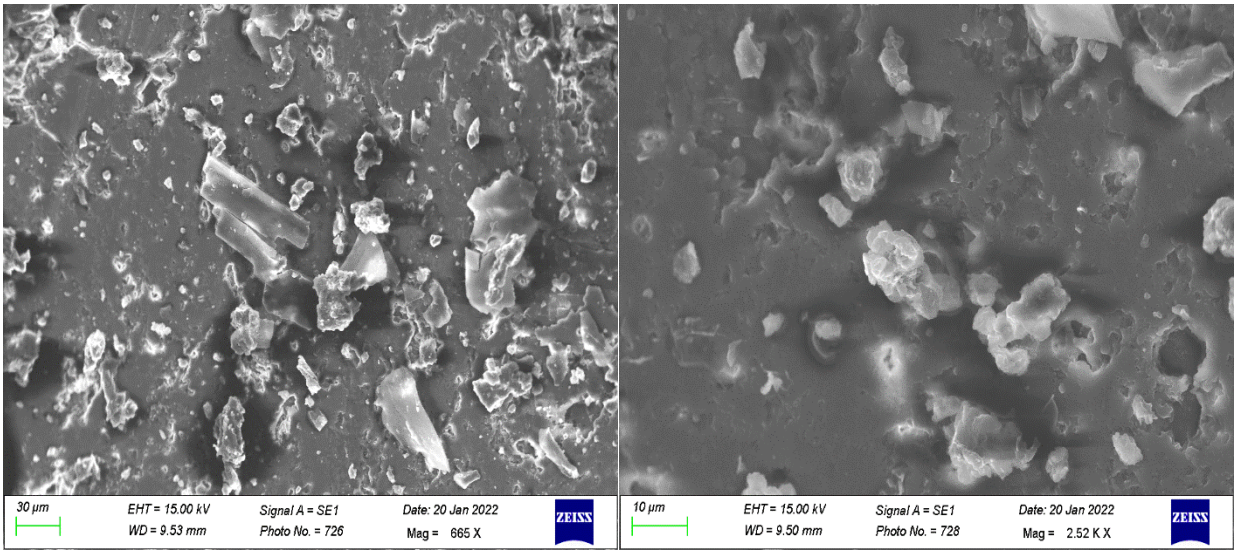

Fig. 5: SEM analysis images of silver nanoparticles

The FT-IR investigation was done to see the functional groupspresent in Aegle marmelos (rind) extract which is responsible for the synthesis and stability of the formed silver nanoparticles. It exhibited great number of absorption peaks, resulting in the rind extract's description. The stretching frequency of the –OH bond of the alcohol group is measured at 3559 cm^{-1}, indicating intermolecular hydrogen bonding. Because of the –NH stretching of the amine functional group, the absorption band at 3466 cm^{-1}can be seen. The C-H stretching frequency, mostly multiple bonding system, is reflected by a peak of 3286 cm^{-1}. The appearance of stretching in nitro N-O has a peak equivalent to 2148.49 cm-1. C-C stretching frequency are 1641.05 cm^{-1}. The -C-Br stretch of the band 521.949 cm^{-1} is due toalkyl halide.[14]

S.No.	Peak	Compound Group
1.	3832.484	Hydroxyl compound
2.	3559.393	Hydroxyl compound
3.	3466.206	(-amine NH)
4.	3405.384	Cyclo alkane
5.	3286.502	Carbonyl compounds

6.	2984.891	Phenol ring
7.	2148.495	C≡C stretching
8.	1641.041	C–O–C group
9.	1054.857	C–H
10.	1015.108	C–S linkage
11.	521.949	Halogen compound [Bromo compounds] (C–Br)

Table.3. FTIR Result

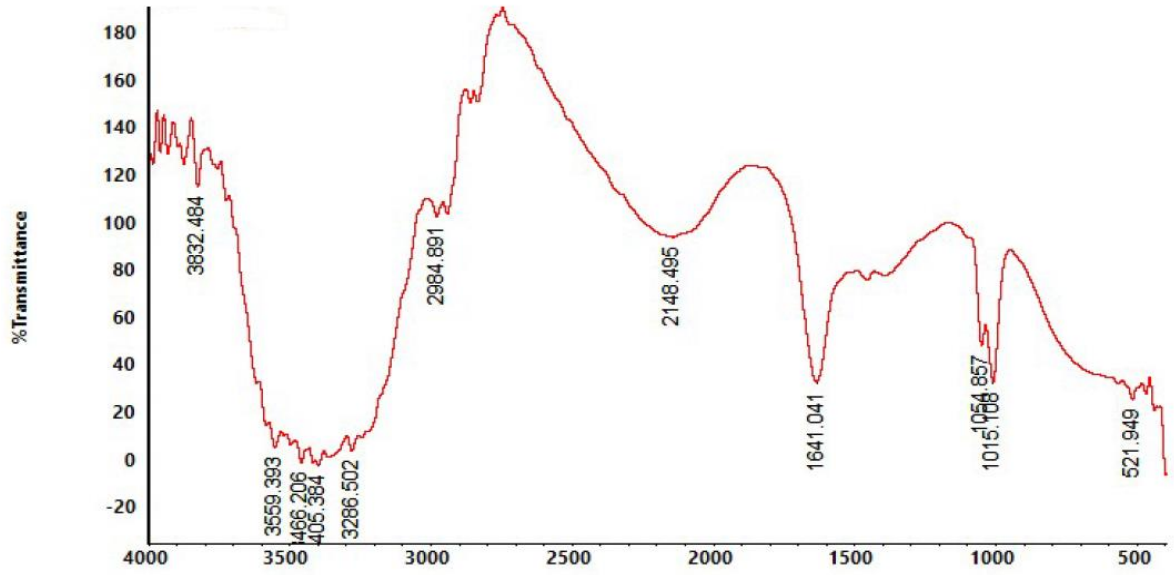

Fig.6. FT-IR spectra of silver nanoparticle

4. RESULT

In nanotechnology, the development of consistent and ecologically safe technologies for the amalgamation of metallic nanoparticles is a essential requirement. The purpose of this study is to come up with a simple way to make 'Green' silver nanoparticles. We tried developing asimple, quick, eco-friendly, and cost-effective technique for generating stable silver nanoparticles by reducing silver nitrate solution by using Aegle marmelos (rind) extract. The properties of the generated silver nanoparticles were investigated using UV-Visible spectroscopy, FTIR, SEM, and its anti-oxidant activity was performed. The produced silver nanoparticles with an average size of about 10-30 μm were found to be stable in the experiments.

According to the findings of this research, the use of Aegle marmelos rind for the production of silver nanoparticles is encouraged, and it may also be employed as an antioxidant and antibacterial agent. Thus, this eco-friendly approach is cost-effective and efficient method of producing Ag NPs, and it may pave the way for additional A. marmelos research in the biomedical and nanotechnology industries in the future.

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