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Eco-Friendly Techniques for the Synthesis of Silver Oxide Nanoparticles: A Comprehensive Review

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ABSTRACT: The environmentally friendly synthesis of silver oxide nanoparticles (Ag2O NPs) has appeared as a long-term and efficient alternative to traditional fabrication methods. Conventional techniques often include dangerous substances, high temperatures, and expensive instrumentation, posing significant risks to both Human health and the natural world. In contrast, green synthesis leverages Natural resources that are renewable, like plant extracts, microbial cultures, or bio polymeric matrices to act as both reducing and stabilizing agents. This approach is not only cost-effective and easily scalable but also minimizes the environmental footprint by using eco-friendly solvents, primarily water and ethanol, under mild reaction conditions. To ensure the quality and structural properties of the synthesized (Ag2O) NPs, various characterization techniques are employed. Field emission scanning electron microscopy (FESEM) and scanning electron microscopy (SEM) are critical for investigating the morphology, particle size distribution, and surface topography at high resolution. These are complemented by X-ray Diffraction (XRD) for crystallinity, Fourier-transform Infrared Spectroscopy (FTIR) for functional group analysis, and electron microscopy for structural integrity. Due to their unique physicochemical attributes, green synthesized (Ag2O) nanoparticles exhibit exceptional performance in photo catalysis, antibacterial activity, and various biomedical applications. This review oriented abstract emphasizes the ecological and functional superiority of green methodologies, highlighting their pivotal role in advancing environmentally responsible nanotechnology.

Keywords: Nanoparticles, Silver Oxide, Green Synthesis, Synthesis Methods

1. INTRODUCTION

Present the document here, and if needed, add a nomenclature in a box that has the same font size as the rest of the page. Now, headers, subheadings, images, and formulas are the only elements that divide the paragraphs. 10.0 points and bolded section titles, and numbered. Additional guidelines for authors are provided below. Applications for silver oxide (Ag2O) include photocatalysis, batteries, sensors, antimicrobial compounds, and catalysis. Strong oxidants, toxic reducing agents, or organic solvents are frequently used in traditional chemical processes to produce Ag2O, and they may produce dangerous byproducts [1]. By employing renewable reagents, safe solvents (water), energy-efficient techniques, and waste reduction, green chemistry approaches seek to manufacture Ag2O with the least possible negative effects on the environment and human health [2]. Consequently, silver oxide is used in the photovoltaic industry and as a photocatalyst., as well as for energy storage in a variety of plasmon photonic devices, alkaline batteries, and as an active cathode material in silver oxide-zinc alkaline batteries. Metal grids can benefit from the strong electrical conductivity, optical transparency, and flexibility offered by silver and silver oxide NWs [3]. In laboratory procedures, silver oxide is employed as a reagent to create a variety of chemical compounds. It yields soluble derivatives when dissolved in solutions of ammonium hydroxide. Additionally, alkali hydroxide is produced

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when silver oxide combines with alkali chloride solutions [4]. It is frequently used in the synthesis of transition metal carbene complexes, which are organometallic compounds with an organic ligand that is divalent. For instance, silver oxide easily forms the appropriate complexes by reacting with ligand precursors [5]. Because of their special qualities and multifunctionality, Ag2O nanoparticles have drawn the most attention among the various MNPs examined in nanomaterial research [6]. Sensing, electrochemical conductivity, catalysis, optoelectronics, drug delivery, and nanodevice manufacturing are among the extremely notable intrinsic properties [7]. Global interest in the study of nanostructured materials has grown significantly in recent years. This is due to the exceptional qualities that nanostructured materials display, such as improved mechanical, electrical, optical, and elastic capabilities [8]. Furthermore, nanomaterials are more likely to crystallize naturally. To become an ideal crystal, a crystal must be stretched in all directions to infinity; however, as real-world crystals have finite sizes, there are no ideal crystals. The diffraction peak widens when there is a departure from perfect crystallinity [9]. Ag2O NPs have drawn a lot of interest because of their physicochemical properties, photo- and electro-catalytic activities, and localized surface plasmon resonance (LS-PR), which make them appropriate for a variety of applications [10]. For a variety of applications, green-synthesised Ag2ONPs hydrophilicity, stability, and wide surface area are especially advantageous. Consequently, because they have less adverse effects, the use of plant extract, yeast, bacteria, and fungus has improved green synthesis. Moringa oleifera, Phoenix dactylifera, Syzygium cumini, Erythrina variegate, and Hagenia abyssinica are among the several natural reducing agents, have been used recently to prepare nanoparticles [11]. Ag2ONPs are also utilized in the production of lotions, mineral-based sunscreen, ointments, bioimaging, and medication delivery. Additionally, the Ag2ONPs have demonstrated strong antibacterial activity [12]. Ag NPs, have shown broad-spectrum antibacterial activity against a variety of dangerous pathogens. However, the conventional synthesis of AgNPs sometimes uses dangerous compounds, which raises concerns. regarding possible detrimental effects on the environment and human health [13]. The fundamental idea behind the green biosynthetic approach was bioremediation, a process that recovers metals from previously contaminated soils by utilizing the natural processes of plants. In addition to collecting metals, plants also deposit them as nanoparticles. In conclusion, the biosynthetic process, or biosynthesis, uses reducing agents derived from bacteria and plants to produce nanoparticles [14].

2. METHODOLOGY

2.1 FICUS BENGHALENSIS PROP ROOT EXTRACT FBPRE [15]

To start a reaction, 10 mL of FBPRE was added to 90ml of a 1mM silver nitrate solution in 250ml Erlenmeyer flasks, in order to create silver oxide nanoparticles (Ag2O NPs). Mixture, and ambient conditions were used for the reaction. The reaction mixture's hue changing from pale yellow to dark brown serves as the first indication that silver nanoparticles are being produced. After centrifuging the resultant product for 15 minutes at 12,000 rpm, it was repeatedly washed with large volumes of Ethanol and deionized water to guarantee that the free substances are separated from the Ag2O NPs. The resulting material was used for additional characterisation and antibacterial research after being freeze-dried to create a powder.

2.2 SYNTHESIS AG2O BY FACILE GREEN SYNTHESIS [16]

Ag2O NPs were green synthesis by burning the desiccated leaves of the Centella Asiatica plant. Silver nitrate stoichiometric ratios (analytical grade, 99.0% purity - Sigma). Then a silica crucible was filled with powdered finely ground C. Asiatica plant leaves, where they were swirled for five to ten minutes using a magnetic stirrer.. Before the mixture was put in, a high-temperture furnace was preheated to (600 ± 10) °C. A very porous white powder was the result of the process. Using dried Tridax plant leaves, Ag2O NPs were created using the same process. The produced Ag2O NPs were then put through a number of characterizations.

2.3 SYNTHESIS OF AG2O BY GREEN SYNTHESIS [17]

In order to create silver oxide nanoparticles (Ag2O NPs), a reaction mixture was created by filling 250 ml Erlenmeyer flasks with 90 ml of 0.458 g of silver nitrate solution and 10 mL of Ficus benghalensis prop root extract (FBPRE). A magnetic heating stirrer was then used to continue the process at 80°C. Silver's initial confirmation. The color of the reaction mixture turns from bright yellow to dark brown over the course of four hours, producing nanoparticles. After the manufacturing of silver nanoparticles was finished, the resultant product was centrifuged for 30 minutes at 4000 rpm. To guarantee that the free entities were separated from the silver nanoparticles, it was then repeatedly washed with a lot of ethanol and deionized water. To create powder, the resulting material was allowed to dry at room temperature. The following concentrations of Ag2O NPs were prepared right before use by serially diluting Phosphate buffered saline (PBS) stock solution (PH 7.4): 25, 50, 100, 200, and 300 µg/ml.

2.4 AG2O SYNTHESIS USING AN ECO-FRIENDLY GREEN R. VIRGATA AQUEOUS EXTRACT [18]

The extracted materials, which included R. virgata aqueous extract (RVAE) and R. virgata ethanol extract (RVEE), were used to synthesize Ag2O NPs(Aq) with RVAE and Ag2O NPs(Et) with RVEE. 180 ml of AgNO3 (1 mM) was

slowly added dropwise to 20 ml of the extracted material for this purpose. To prevent photodegradation, the flasks were entirely covered with aluminum foil. Both extracts showed a hue shift from light brown to brownish black. The UV4000, UV-Vis spectrophotometer (Germany) was used to quantify the surface plasmon resonance, or SPR, in the between 300 and 800 nm. The resulting solutions underwent a 15-minute, 10,000rpm centrifugation. Using nano-pure water, the pellets at the falcons' bottoms were cleaned three times. After being oven dried, the materials, Which were presumed to be Ag2O NPs, were thoroughly characterized.

2.5 SYNTHESIS AG2O BY GREEN SYNTHESIZED FROM THE MEDICINAL PLANT CYATHEA NILGIRIENSIS HOLTTUM [19]

DDW of 50ml and 10mL of Cyathea nilgiriensis aqueous extract were combined with precisely 0.1 M of AgNO3 and stirred magnetically for four hours at 80°C. The complex that developed was ultra-centrifuged for 10 minutes at 10,000 rpm, washed with water, and then centrifuged again for 10 minutes at 5,000 rpm. To create biosynthesized Ag2O nanoparticles, the complex residue was first dried for eight hours at 40°C in an oven, and then it was calcined at 600°C in a muffle furnace.

2.6 SYNTHESIS AG2O BY BIO-SYNTHESIS [20]

Deionize water DW (150 ml) of DW were used to solubilize 0.6 grams of silver nitrate. 200 milliliters of distilled water were used to solubilize 0.4 grams of Coiandrum sativum seed in order to create a sample of silver ion solution. About 25 minutes were needed to prepare Ag2O NPs at a temperature of about 70 ˚C. Silver oxide nanoparticle production was indicated by the reaction mixture's color changing from yellow to dark brown every five minutes.

2.7 SYNTHESIS AG2O BY GREEN BIO-SYNTHESIS [21]

Silver nitrate solution AgNO3 (4.5 g, 0.04 mol) 20ml was mixed with 60mL of the plant extract H. hirsuta in a 250mL beaker and stirred at 5000 rpm for 10 minutes at room temperature. when five minutes, the color changed and a brown-black precipitate appeared, indicating the development of biosynthesized Ag2O NPs. This was confirmed by UV-vis spectroscopy when the pH was adjusted to 8 using NaOH solution (0.1 M). After centrifuging the combination at 10,000rpm at ambient temperature to extract the supernatant, the precipitate was washed two times using DW and methyl alcohol, dried in an oven set to 70 °C for the entire night, and then placed in a glass container for additional examination.

2.8 SYNTHESIS AG2O BY A FACILE GREEN CO-REDUCTION METHOD [22]

Aqueous leaf extract (20gm)and 1 mM silver nitrate (AgNO3) solution were used as reducing mediator and Ag+ ion sources, respectively, for the synthesis of Ag2O-NPs. The leaf extract was prepared according to the previously published protocol, wherein 75 mL of AgNO3 solution was gradually mixed with 25 ml of leaf extract solution (pH 6.0) for 15–20 minutes at 35± 2 °C while being constantly swirled with a magnetic stirrer. The production of Ag2O NPs was identified by the color changing from colorless to brown in the precursor solution. After centrifuging the resulting particles for 20 minutes at 12,000 rpm, they were cleaned three times with Milli-Q H2O and dried at 100 ± 2 °C. Ultimately, the collected particles were stored for later use in a hermetically sealed bottle.

2.9 SYNTHESIS AG2O BY GREEN LAWSONIA INERMIS (HENNA) [23]

Silver oxide nanoparticles were created using plant extract of Lawsonia inermis (henna) and silver nitrate (AgNO3) supplied by Gentham Life Sciences LTD, U.K. the green-synthesis method. After dissolving AgNO3 in 100 milliliters of distilled water, (1M) of aqueous AgNO3 solution was created. The dissolution was carried out for one hour at 75 °C while being enthusiastically mixed at 700 rpm. Next, 100mL of AgNO3 aqueous solution was gradually mixed with 100mL of the henna plant extract, agitated constantly, and subjected to heat at 75 °C for one hour. A deep brown water colloidal solution of the green produced Ag2O NPs is then beginning to develop.

2.10 SYNTHESIS STARCH-CAPPED SILVER OXIDE AG2O NPS [24]

Silver oxide nanoparticles with a starch cap were made at ambient temperature. In a round-bottom flask, varying amounts of starch (0.5–2% (w/v)) were mixed with a silver nitrate solution (20 mL, 0.1 M) while being stirred. Next, 20 mL of NaOH solution (0.1 M) was added to the combination of reactions. At room temperature, this was further swirled for two hours. A precipitate of Ag2O nanoparticles was obtained by centrifuging the resulting solution and extracting it with acetone. After that, it was described and allowed to dry at ambient temperature.

2.11 SYNTHESIS AG2O BY EVOLVULUS ALSINOIDES PLANT [25]

Silver oxide nanoparticles were created in a round bottom (RB) flask by combining 10mL of Evolvulus alsinoides plant extract (EAAO) with 5 g of AgNO3 in 40mL of DW. To make the mixture uniform, the aforementioned mixture

was agitated for four hours. This reaction mixture was stored at 100°C in an air-hot oven. Centrifugation was used to gather the brown EAAO precipitate, which was then rinsed three times with distilled water. The precipitate was first allowed to dry at ambient temperature before being dried in a hot air oven for one hour at 120 degrees Celsius. However, in order to create Ag2O nanoparticles (AO) without the need of plant extract, a silver nitrate solution was made using NaOH.

2.12 GREEN ULTRASOUNDASSISTED SYNTHESIS (UAS) OF AG2O QDS [26]

Ag2O QDs were created by bio-reducing the Ag2O quantum dots generated by UAS and phytosynthesis (AgNO3) with M. pulegium and F. carica aqueous extracts using ultrasonic irradiation (WUC-D, Korea). This was accomplished by combining 25 mL of 26 × 10–4 mol L−1 AgNO3 solution and 12.5 mL of aqueous extract. After that, the mixture was placed in an ultrasonic bath (40 kHz, r.t.). until the solution stopped changing color. The phyto-reduction of Ag+ ions to Ag0 was verified. occurs entirely in three minutes by changing the reaction mixture's initial color. After centrifuging the suspension for 10 minutes at 6000 rpm, DDW was used to wash it. The precipitated Ag2O QDs were dried in a vacuum drier set at 45°C for 24 hours. Consequently, the UAS approach was used to create Ag2O QDs from F. carica extract (UAS/FCE-Ag2O QDs) and extract of M. pulegium (UAS/MPE-Ag2O QDs).

2.13 SYNTHESIS AG2O BY PUNICA GRANATUM LEAF EXTRACT [27]

For five hours at 65°C, 20 mL of the extracted material was added to 40 mL of a solution made up of 0.2M AgNO3 and 0.1M NaOH, while being constantly stirred. Following precipitation, the sample was cleaned many times using distilled water before being dried in a 16-inch drier set at 70°C for 12 hours. then claimed for three hours at 450°C in an oven.

2.14 SYNTHESIS AG2O BY OCIMUM GRATISSIMUM LEAF EXTRACT [28]

After filling a clean Erlenmeyer flask with 1.00 cm3 of Ocimum gratissimum extract, 9.00 cm3 of 0.10 M aqueous silver nitrate solution was added to the extract. A magnetic stirrer was used to agitate the mixture for half an hour. Drops of sodium hydroxide (1.00 M) were added while swirling to bring the PH down to 10 and boost the amount of Ag2O NPs that were formed. As the stirring proceeded, the color changed from a somewhat yellowish brown to a dark brown hue. The Ag2O-NPs' production was validated by the color shift from yellowish brown to dark brown. To give the particles time to settle, the admixture was left at ambient temperature for two hours after ten minutes of stirring. The prepared solution was filtered through What man No. 1 filter paper to extract the Ag2O NPs once the nanoparticles had fully formed and were in the form of a dark brown aqueous colloidal mixture. Following thorough drying, the dark brown colloidal product was calcined at 400 °C for three hours, a black Ag2O-NPs was produced.

2.15 BIOSYNTHESIS OF SILVER OXIDE (AG2O) NANOPARTICLES [29]

Ag2O NPs were prepared using silver nitrate (AgNO3) and silver sulphate (Ag2SO4). 10 milliliters of plant leaves In a 250 ml flask utilized for this investigation, the excerpt solution was progressively added to 20 ml of (1mM) initial solution while being stirred at 40°C. The temperature of the solution was then increased to 90°C. A discernible color shift and the development of a brown-black solid after five minutes demonstrated the biological synthesis of Ag2O-NPs. This was accomplished by bringing the PH down to about 12 with a 1M NaOH solution. The substance was then washed with methanol and rinsed many times with DW. Then To produce silver oxide nanoparticles, they were calcined at 550 °C for six hours after being dried in an oven at 80 °C for two hours. After that, these nanoparticles were kept for later examination in a glass container.

2.16 SYNTHESIS AG2O BY HOJA SANTA (PIPER AURITUM) EXTRACT [30]

P. auritum extract was(15ml)mixed to 50 mL of an AgNO3 (3 mM) solution, and For twenty-four hours, the solution was maintained at room temperature with continuous stirring in the dark. The solution was then centrifuged for 30 minutes at 25 °C and 6000 rpm using a Labo-Gene LZ-1580R, and the pellet was dried for 8 hours at 80 °C in an oven.

2.17 BACTERIAL SCREENING FOR THE ABILITY TO SYNTHESIZE AG2O NPS [31]

To the 100 ml culture supernatant, 50mL of AgNO3 solution (1mM) was introduced. The flask was then incubated for 48 hours at 130 rpm at 37°C. Any color changes in the supernatant throughout the biosynthesis of Ag2O NPs were visually observed.

2.18 AG2O NP BIOSYNTHESIS EMPLOYING LEAF EXTRACTS FROM PHRAGMANTHERA MACROSOLEN L. [32]

To guarantee ideal solubility and suitable reaction conditions, 1.67 g of AgNO3 was solubilized in 80mL of DW during the synthesis procedure instead of ethanol. We added 20 milliliters of plant extract to the mix after the silver nitrate had fully dissolved. To ensure even mixing and promote the interaction between the extract's bioactive ingredients and the silver nitrate, the admixture was constantly swirled for 45 minutes at ambient temperature. It's interesting to note that precipitation happened spontaneously during the reaction process and didn't require the addition of any bases, such NaOH or KOH. The solution's pH, which was tested at about 3.8, was found to be slightly acidic, which let Ag2O NPs form successfully. Following the formation of precipitation, the samples were repeatedly cleaned with distilled water and ethanol. After filtering, it was dried for four hours at 90 °C in an oven. This technique, which makes use of the stabilizing and reducing qualities of the plant extract, enables the environmentally friendly creation of NPs without the use of aggressive chemical reagents. Ultimately, the test samples were retained for further analysis and use.

2.19 GREEN SYNTHESIS OF AG2O NPS USING P. MACROSOLEN L. LEAF EXTRACTS [33]

80mL of 0.1 M (1.69 g) AgNO3 was mixed with 10mL of the unique leaf extract from the plant P. macrosolen L. while being constantly stirred. A few drops of NaOH and H2SO4 were used to change the PH to 3, 6, 9, and 12. Ag1, Ag2, Ag3, and Ag4 were the labels assigned to the prepared samples, accordingly. To investigate the impact of annealing temperature, after being gathered, After being dehydrated in an oven at 90 °C, the precipitate was calcined in a tube furnace at temperatures of 300, 400, and 500 °C. After that, the precipitate was stored for further analysis and use.

2.20 SYNTHESIS AG2O BY GREEN SYNTHESIS [34]

Ag2O nanoparticles were created using AgNO3 as a starting material. Initially, 50 mL of DI was used to dissolve 0.85g (0.1 M) of silver nitrate. water by stirring it continuously. The dissolved AgNO3 was then mixed with 10mL of aloevera extract, added slowly. The PH was then raised from 6.7 to 11 by gradually stirring in 0.16g (0.2 M) of sodium hydroxide still the The solution's hue changed to dark brown. Instead of colorless. After achieving a brown hue, what filter paper was used for filtering, the precipitate was collected, and it was then dried for two hours at 80 °C. Finally, pastel dried Ag2O was ground into a powder and gathered using a mortar.

2.21 GREEN SYNTHESIS OF AG2O NPS [35]

Two hundred milliliters of DW were employed to solubilize 3.5 grams of AgNO3. The produced extract was gradually added to the AgNO3 solution drop by drop until the solution's color darkened and its PH remained between 9 and 11, at which point we were able to acquire the precipitates. The solution was dried after being centrifuged for 10 minutes at 7000 rpm. After that, it was annealed for 12 hours at 400 °C. Ultimately, a fine powder was obtained by grinding the precipitate that had been synthesized.

2.22 GREEN SYNTHESIS OF AG2O NPS BLUMEA SINUATA [36]

At room temperature, A magnetic stirrer was used to mix 80 mL of the aqueous plant extract in a 250 mL beaker. After that, 20 mL of a 20 mM (67.948 mg) AgNO3 solution was gradually added to the pH 7 agitated solution of aqueous plant extract. For a full day, the entire reaction mixture was constantly swirled. After afterward, there was a discernible shift in color ranging from deep green to dark brown, suggesting the Ag2O NPs' creation. After centrifuging the deep brown reaction mixture for ten minutes at 8000rpm, the pellet that was produced was cleaned three times with 70% ethanol. After being dried at room temperature, the obtained pellet was used to characterize and investigate its antioxidant and antibacterial qualities.

2.23 GREEN SYNTHESIS OF AG2O NANO PARTICLES [37]

2.85g of sodium hydroxide solubilized in 20mL of DW was heated and stirred magnetically to maintain a steady temperature of 70 °C. 50mL of cold Quercus robur leaf extract (T~5 ◦C) was used to dissolve 1.2 g of AgNO3, which was then agitated plant extract aqueous solution extract while being heated and stirred for 45 minutes. The development of silver oxide nanoparticles was indicated by the appearance of brown pellets. After being filtered and repeatedly cleaned with ethanol and deionized water, the suspension was vacuum dried for 48 hours at 45 °C before being ground into a fine powder.

2.24 ENVIRONMENTALLY FRIENDLY SYNTHESIS OF AG2O NANOPARTICLES [38]

To create NPs in an eco-friendly way, silver ion reduction was employed. Aqueous solution with a concentration of 1 mm Ag ions (90 ml) was progressively enhanced, drop by drop, with 5mL of leaf extract. The creation of silver

nanoparticles was first confirmed visually. Upon mixing the reductant (leaf extract) and AgNO3, after five minutes of constant stirring, the reaction's color changed from a dark green solution to a golden-brown tint, signifying the synthesis of silver particles. After being centrifuged for 15 min at 10,000rpm at 40°C, the generated NPs were dried. for an hour at 100 °C in a hot air oven. Ultimately, a glass bottle was used to retain the gathered Ag-NPs for additional characterization.

Table 1. - Show some properties of different synthetic methods

No.	Type of reaction	Temperature	Solvent	Time	Particle Size	Ref.
1-	Stirred	Room Temp.	D.W	3 hr	42.7 nm	15
2-	Stirred	Room Temp.	---------	5-10 min	11-12 nm	16
3-	Stirred	80°C	D.W	4 hr	10-26 nm	17
4-	Stirred	Room Temp.	D.W	---------	20-22 nm	18
5-	Stirred	80°C	Double D.W	4 hr	<100 nm	19
6-	Stirred	70°C	D.W	25 min	57.31 nm	20
7-	Stirred	Room Temp.	D.W	10 min	15.51 nm	21
8-	Stirred	32±2 °C	D.W	15-20 min	81 nm	22
9-	Stirred	75 °C	Aqueous Medium	1 hr	39.1 nm	23
10-	Stirred	Room Temp.	D.W	2 hr	2-14 nm	24
11-	Stirred	100 °C	DI.W	4 hr	47 nm	25
12-	Ultrasonic irradiation	Room Temp.	DI.W	3 min	9 nm	26
13-	Stirred	65 °C	D.W	5 hr	24-36 nm	27
14-	Stirred	Room Temp.	Methanol	30 min	20-100 nm	28
15-	Stirred	90 °C	D.W	5 min	77-109 nm	29
16-	Stirred	Room Temp.	D.W	24 hr	13.62 nm	30
17-	Stirred	37 °C	Nutrient broth	48 hr	17.2 nm	31
18-	Stirred	Room Temp.	D.W	45 min	20-47 nm	32
19-	Stirred	Ambient Temp.	DI.W	---------	20-100 nm	33
20-	Stirred	Room Temp.	DI.W	---------	10-46 nm	34
21-	Stirred	Room Temp.	DI.W	---------	54 nm	35
22-	Stirred	Room Temp.	Aqueous Medium	24 hr	7.98 nm	36
23-	Stirred	70 °C	D.W	45 min	15-40 nm	37
24-	Stirred	Room Temp.	Double D.W	5 min	31.82 nm	38

3. CONCLUSION

Green synthesis of silver oxide nanoparticles has become a popular and economical substitute for traditional chemical and physical processes. In contrast to conventional methods, green pathways use natural extracts, safe solvents like ethanol or water, and gentle conditions that reduce energy use and harmful byproducts. These techniques not only lessen the impact on the environment but also offer strong control over the dimensions and form of the particles, which have a direct impact on Ag2O biological and catalytic uses. Furthermore, without the use of dangerous reagents, plant-mediated and biomolecule-assisted syntheses increase yield, speed up reactions, and make product purification easier. The methodologies under evaluation show that using green synthesis to produce Ag2O nanoparticles satisfies sustainability principles and creates a plethora of options for medicinal, photocatalytic, and environmental applications. The authors advise using the method described by [Bioengineered (2022)] to produce Ag2O nanoparticles while upholding green chemistry's tenets.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

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