



Antibacterial Applications of Biosynthesized AgNPs: A Short Review (2015-2020)

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Abstract

Bacterial resistance to a wide spectrum of antimicrobial medicines has evolved as a major public health concern. Antibiotics are medications that are used to kill microorganisms that could cause serious illness or death. Nanotechnology has exploded as a significant and appealing field of research, with innovative features and functionalities in a variety of fields. Silver is a versatile antibacterial and anticancer medicinal agent in the form of nanoparticles. Silver Nanoparticles (AgNPs) have been implicated in a wide variety of medicinal benefits. This review article addresses antibacterial applications of biosynthesized AgNPs that have been researched over the last decade. AgNPs' antimicrobial potential against a variety of bacterial agents is discussed.



Article History

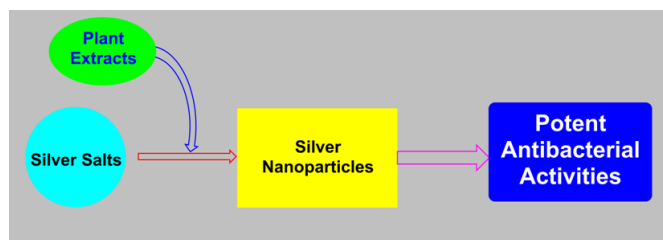
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Graphical Abstract



Introduction

Thinking about the commonness of different diseases, infections brought about by any type of

microorganism ought not to be messed with; they can go through fundamental changes and cause serious medical problems. Antimicrobial resistance

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is quickly becoming one of the most severe medical problems of current day.¹⁻³ Even after significant advancements in antimicrobial therapy, infectious diseases triggered by microorganisms remain a major public health issue owing to the rise of susceptibility to currently accessible antibacterial medications.⁴ Bacterial resistance to a wide variety of antimicrobial drugs is becoming a leading health concern.^{5,6} Antibiotics are substances that are used to destroy bacteria that can cause life-threatening conditions.^{7,8} In light of these pressing concerns of modern time, it is critical to establish new antimicrobial agents that are more selective and reliable in their antimicrobial potential.^{9,10}

Numerous antimicrobial agents are targeted and developed in order to tackle the problem of antimicrobial resistance.¹¹⁻¹³ Organic chemists are targeting the synthesis of variety of potent heterocyclic compounds and are also successful in developing new antimicrobial agents.¹⁴⁻²⁰ However, research from last ten years has proved that the AgNPs are proved as potent antimicrobial agents.²¹⁻²⁵ From ancient times, it has been established that silver is a very good medicinal elements. From this perspective researchers have adopted many bio strategies based on plants to develop more powerful antibacterial AgNPs.^{26,27} To their credit, AgNPs are synthesized by various green approaches with good efficacy in the antibacterial action.^{29,29} Through use of silver as an anticancer and antibacterial agents has developed exponentially.^{30,31} It has been proved that various plants contain organic compounds that are capable of producing AgNPs from silver salts.^{32,33} Plant extracts such as stem, root, nuts, bark, and marine bio resources are among the numerous green resources used for the synthesis of AgNP's. The extracts obtained from plants are found to be the best alternative for the synthesis of AgNP's due to their easy accessibility, nontoxic quality, and inclusion of exceptional bioactive compounds with high therapeutic attributes. Plants are being used in the synthesis of AgNPs, and particles of various shapes and sizes have indeed been produced. Given the significance of the above reasons, this review article focuses on antibacterial applications of biosynthesized AgNPs that have been studied over the last decade. The antimicrobial ability of AgNPs against a wide spectrum of bacteria is addressed.

Biosynthesis and Antibacterial Properties of AgNPs

The therapeutic potential of AgNPs in treating diseases is promising in the realm of bio-Nano medicine. AgNPs are candidates for ground-breaking applications in the biomedical industry as antibacterial, antifungal, antioxidant, and anticancer agents due to their small stature, large surface area, and chemical characteristics, and these applications are well established. The traditional chemical methods were used to generate nanoparticles, however, these methodologies are connected with dangerous materials that are unsafe.

Plant-mediated biosynthesis of nanoparticles, on the other hand, is growing rapidly owing to its low toxicity, resource efficiency, eco-friendliness, and quickness. Plants based natural sources include bioactive compounds such as flavonoids, proteins, polysaccharides, polyphenols, terpenoids, tannins, alkaloids, ketones, aldehydes, amines, etc., which function as reducing, bolstering, and capping agents in the transformation of metal ions to metal nanoparticles, resulting in the generation of desirable nanoparticles with preconfigured characteristics. Among the several biosynthesized metal nanoparticles, AgNPs were selected as the favourites in the realm of antibacterial applications. In the following sections, we'll go over some of the best instances from 2015 to 2020.

Year 2015

The selected examples (year 2015) of antibacterial applications of biosynthesized AgNPs is given in Table 1. Saravanakumar *et al.*³⁴ reported, the biosynthesis of AgNPs using *Cassia tora* leaf extract. This is an easy, cost-effective, fast, and environmentally friendly way to make AgNPs that can be accomplished in a short while. Furthermore, this process could be used at room temperature. This method yielded spherical AgNPs with well-defined characteristics which were uniformly polydispersed with face centered cubic geometry. Importantly, no capping agent was used in the AgNP synthesis. Gram positive (*S. aureus*, *B. subtilis*) and Gram negative (*E. coli*, *P. aeruginosa*) bacteria were tested for antibacterial activity. Gram negative bacteria were shown to have a larger inhibitory effect than Gram positive bacteria in their research. Miri *et al.*³⁵ used

Prosopis frakta leaves extract to demonstrate a green, simple, and single-pot process for the biosynthesis of antibacterial AgNPs. This method is fast, reliable, and environmentally friendly, and it can be used to make all sorts of metal nanoparticles from a wide range of extracts. The obtained AgNPs had a spherical form, with a mean diameter of about 8.5-11 nm, according to spectral analysis. These findings show that organic biomolecules in Prosopisfrakta extract showing reducing as well as capping nature. The antimicrobial action of Ag-NPs was tested against *S.aureus*, *B.subtilis*, and *E.coli*,

P.aeruginosa. Antibacterial activity was comparable to that of the control group. According to Kokila *et al.*³⁶ AgNPs were produced via the direct interaction of silver nitrate with Cavendish banana peel extract in aqueous media, without the use of any external reagents. As a result, this reaction pathway satisfies all of the requirements for a completely environmentally friendly chemical process. The antibacterial effect of synthesized AgNPs displayed high antimicrobial activity against *S.aureus*, *B. subtilis*, *K.pneumonia* and *E.coli*.

Table 1: Selected examples of antibacterial applications of biosynthesize AgNPs (Year 2015)

Year	Biogenic resource	Antibacterial activity against	Ref.
2015	Cassia tora leaf extract	<i>S. aureus</i> , <i>B. subtilis</i> , <i>E. coli</i> , <i>P. aeruginosa</i>	34
2015	Prosopisfrakta leaves extract	<i>S. aureus</i> , <i>B. subtilis</i> , <i>E. coli</i> , <i>P. aeruginosa</i>	35
2015	Cavendish banana peel extract	<i>S. aureus</i> , <i>B. subtilis</i> , <i>K. pneumonia</i> , <i>E.coli</i> .	36
2015	Ethanolic extract of Rosa indica petals	<i>E. coli</i> , <i>K. pneumonia</i> , <i>S.mutans</i> , <i>E. faecalis</i>	37
2015	Psidiumguajava leaf extract	<i>P. aeruginosa</i>	38

Manikandan *et al.*³⁷ made AgNPs (AgNPs) using Rosa indica petals' ethanol extract and tested them against human pathogenic bacteria. AgNPs were round in shape and spaced widely apart when they were produced. The size of AgNPs was determined as 23.52 and 60.83 nm. The defined AgNPs demonstrated a more effective antibacterial property. The presented AgNPs showed a more compelling antibacterial effect against *E. coli*, *K. pneumonia*, *S. mutans*, *E. faecalis*. Bose *et al.*³⁸ reported a very quick, efficient, cost-effective, and environmentally friendly approach for AgNP biosynthesis using leaf extract of Psidiumguajavathat showed capping as well as reducing behaviour. Because of its well-known therapeutic benefits and the fact that it is freely available throughout the year and in all seasons, this plant was chosen for this study. They used UV-vis and TEM experiments to confirm the AgNPs. The AgNPs' size was obtained in the 10–90 nm range. According to TEM results, the AgNPs were in spherical form. Green manufactured nanoparticles rendered from guava leaf extract can effectively suppress bacteria, according to their research.

Year 2016

The selected examples (year 2016) of antibacterial applications of biosynthesize AgNPs is given in

Table 2. Allafchian *et al.*³⁹ performed the synthesis of AgNPs using extract of Phlomis plant as an innovative approach. The crystalline structural characterization of AgNPs was identified using the XRD process. The XRD predicted a particle size of 25 nm. Bacterial strains like *S. aureus*, *B. cereus*, *S. typhimurium* and *E. coli* were examined for evaluating the antibacterial potential of AgNPs. The antimicrobial activity of the biosynthesized nanoparticles was impressive. Benakashani *et al.*⁴⁰ examined Capparis spinosa leaves as reducing extract for the synthesis of AgNPs. Using *C. spinosa* extract, AgNPs were successfully synthesised, and the nature of the synthesised nanoparticles was investigated using various analytical techniques. Bacterial strains like *E. coli*, *S.typhimurium*, *S.aureus*, and *B. cereus*, were used to assess the antibacterial effects of NPs provided by *C. spinosa*. In comparison to ionic silver, the synthesised AgNPs displayed excellent antibacterial and antimicrobial activity based on disc diffusion performance. Anandalakshmi *et al.*⁴¹ have reported the synthesis of AgNPs using Pedalium murex leaf extracts with dual functions, as well as antimicrobial effects of synthesised AgNPs against *Escherichia coli*, *Klebsiella pneumoniae*, *Micrococcus flavus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Bacillus*

pumilus, and *Staphylococcus aureus*. The particle size ranged from 20 to 50 nanometers, and the crystal structure was fcc. The biosynthesized AgNPs' antibacterial activity was found to be effective. The process is safe for the environment and presents no danger to it.

Table 2: Selected examples of antibacterial applications of biosynthesize AgNPs (Year 2016)

Year	Biogenic resource	Antibacterial activity against	Ref.
2016	Phlomis plant extract	<i>S. aureus</i> , <i>B. cereus</i> , <i>S. typhimurium</i> , <i>E. coli</i>	39
2016	Capparisspinosa leaves extract	<i>E. coli</i> , <i>S. aureus</i> , <i>S. typhimurium</i> , <i>B. cereus</i> ,	40
2016	Pedalium murex leaf extract	<i>E. coli</i> , <i>M. flavus</i> , <i>K. pneumoniae</i> , <i>B. subtilis</i> , <i>B. pumilus</i> , <i>P. aeruginosa</i> , <i>S. aureus</i>	41
2016	Tamarixgallica plant extract	<i>E. coli</i>	42
2016	Thevetiaperuviana leaf extract	<i>E. coli</i> , <i>P. aeruginosa</i> , <i>K. pneumonia</i> , <i>S. aureus</i> , <i>S. typhi</i> , <i>B. subtilis</i>	43

J.L. López-Miranda and colleagues⁴² developed fast-biosynthesized AgNPs with diameters ranging from 5 to 40 nm using plant extract of Tamarixgallica. The AgNPs, which were synthesized by reducing the silver ions using plant extract of Tamarixgallica. The biosynthesis of spherical AgNPs has a high rate of bio-reduction, with a reaction time of less than 5 minutes. The synthesized AgNPs were shown the antibacterial potential against *E. coli* bacterial

strain. O.O. Oluwaniyi *et al.*⁴³ used the aqueous leaf extract of Thevetiaperuviana to study AgNP biosynthesis. The AgNPs were confirmed using XRD, SEM and TEM. The AgNPs are spherical in form and have an average diameter of 18.1 nm. The AgNPs developed were effective in suppressing the microbial infections. In the antimicrobial analysis, the zone of inhibition was between 10 and 20 mm.

Table 3: Selected examples of antibacterial applications of biosynthesize AgNPs (Year 2017)

Year	Biogenic resource	Antibacterial activity against	Ref.
2017	Mangifera indica leaves extract	<i>E. coli</i> , <i>S. aureus</i>	44
2017	Calliandrahaematocephala leaf extract	<i>E. coli</i>	45
2017	Novosphingobium sp. THG-C3	<i>S. enterica</i> , <i>B. subtilis</i> , <i>B. cereus</i>	46
2017	Artemisia vulgaris leaves extract	<i>E. coli</i> , <i>S. aureus</i>	47
2017	Melissa officinalis	<i>E. coli</i> , <i>S. aureus</i>	48

Year 2017

The selected examples (year 2017) of antibacterial applications of biosynthesize AgNPs is given in Table 3. The AgNPs were produced utilising a new eco-friendly synthesis approach that utilised Mangifera indica leaves and were tested for antibacterial activity by D. Sundeep and co-workers.⁴⁴ According to the XRD peaks, the crystalline size of the bio-synthesized AgNPs was 32.4 nm. The antibacterial efficiency of the bio-source synthesised AgNPs was studied on *E. coli* and *S. aureus*, and the results explored that the AgNPs had potential antibacterial activity. S. Raja and colleagues⁴⁵

revealed that Calliandrahaematocephala leaf extract was used to successfully synthesise AgNPs. XRD was used to determine the crystalline nature and purity of AgNPs, revealing the presence of (111) and (220) lattice planes in the fcc structure of metallic silver. The antibacterial study against pathogenic *E. coli* bacteria yielded encouraging findings. J. Du and colleagues⁴⁶ reported on the production of AgNPs and their antibacterial activity using a soil-isolated bacterial strain, Novosphingobium sp. THG-C3. The synthesised AgNPs were shown spherical shape with the particle size from 8 to 25 nm. The XRD pattern revealed planes (111), (200),

(220), (230) and (311). *S. aureus*, *P. aeruginosa*, *C. tropicalis*, *E. coli*, *C. albicans*, *V. parahaemolyticus*, *S. enterica*, *B. cereus* and *B. subtilis* were among the pathogens that the synthesised AgNPs were found to be effective. When combined with conventional antibiotics, the AgNPs increased antibacterial action against *S. enterica*, *P. aeruginosa*, *V. parahaemolyticus* and *E. coli*. The *Novosphingobium* sp. THG-C3 strain produces AgNPs that are very basic, green, and cost-effective, and could be employed as an antibacterial agent.

T. Rasheed *et al.*⁴⁷ investigated into the reducing ability of *Artemisia vulgaris* leaves extract (AVLE) to synthesise AgNPs. The presence of a dark brown colour meant the nanoparticles had accomplished their synthesis. The green synthesised nanoparticles demonstrated strong antibacterial efficacy against harmful bacteria as compared to AVLE alone. In vitro antioxidant studies, AgNPs (AV-AgNPs) demonstrated good antioxidant capabilities. Furthermore, the nanoparticles were highly cytotoxic to the HeLa and MCF-7 cell lines. In the study of de Jess Ruz-Baltazar and research group,⁴⁸ *Melissa officinalis* performed the role of reducing agent for the bio-reduction of silver ions in the green synthesis path. AgNPs have been shown to have antibacterial action against *E. coli* and *S. aureus*.

Melissa officinalis was found to be capable of producing AgNPs with regulated properties and good inhibition of the bacteria used.

Year 2018

The selected examples (year 2018) of antibacterial applications of biosynthesised AgNPs is given in Table 4. M.P. Patil *et al.*⁴⁹ have devised a facile and environmentally friendly one-step synthesis of AgNPs employing *Madhuca longifolia* flower extract as a stabilising and reducing species. With a scale of 30–50 nm, the AgNPs were spherical and oval in shape. The presence of a brown colour in the reaction mixture is a main sign of AgNP production confirmed by a peak at 436 nm. The synthesised AgNPs were shown good potential *E. coli*, *S. saprophyticus*, *B. cereus*, *S. typhimurium*. The flower of *M. longifolia* was found as good source of AgNPs, which can be used as an antibacterial agent in therapeutics. Silver nitrate and methanolic root extract of *Rhazya stricta*, a member of the Apocynaceae family, were employed to synthesise AgNPs by A. Shehzad and colleagues.⁵⁰ The addition of xylitol to nanoparticles made them more stable and diffused. Aside from that, the plant extract and nanoparticles were tested for their antimicrobial properties against *E. coli* and *B. subtilis*. The synthesised AgNPs had a diameter of 20 nm and a spherical form.

Table 4: Selected examples of antibacterial applications of biosynthesised AgNPs (Year 2018)

Year	Biogenic resource	Antibacterial activity against	Ref.
2018	<i>Madhuca longifolia</i> extract	<i>B. cereus</i> , <i>S. saprophyticus</i> , <i>E. coli</i> , <i>S. typhimurium</i>	49
2018	<i>Rhazya stricta</i> root extract	<i>B. subtilis</i> , <i>E. coli</i>	50
2018	Gum kondagogu	<i>S. aureus</i> , <i>P. aeruginosa</i> , <i>E. coli</i> (25922), <i>E. coli</i> (35218)	51
2018	<i>V. officinalis</i> leaf extract	<i>Y. ruckeri</i> , <i>L. monocytogenes</i> , <i>V. cholerae</i>	52
2018	<i>Rheum turkestanicum</i> shoots extracts	<i>S. aureus</i> , <i>B. subtilis</i> , <i>E. coli</i> , <i>P. aeruginosa</i>	53

A.J. Kora *et al.*⁵¹ have explored the antibacterial activity of AgNPs rendered from gum kondagogu (5 nm) against *S. aureus*, *P. aeruginosa*, *E. coli* bacterial species. To investigate the route of antibacterial action of AgNPs, a systematic exploration was done by this group of researchers using various susceptibility assays. In their investigation, the biogenic AgNPs were discovered to be more

active antibacterial agents. The nanoparticles demonstrated strong anti-biofilm action against test strains at 2 g mL⁻¹, suggesting that they could be used to treat biofilm-related drug-resistant bacterial illnesses. Their discoveries checked the job of responsive oxygen species and layer harm in the antibacterial movement of silver nanoparticles. In light of their promising antibacterial activity,

AgNPs could be used in a number of environmental and medicinal applications. N. Sanchooli and colleagues⁵² acquired AgNPs were gotten by combining silver nitrate and *V. officinalis* leaf separate. To characterise the synthesised AgNP, they used various analytical techniques. The anti-biogram and lowest inhibitory concentration of the nanoparticles produced were determined using agar well diffusion and broth micro dilution, respectively. *V. officinalis* AgNPs showed broad spectrum antibacterial action according to their findings.

M.E.T. Yazdi *et al.*⁵³ published their findings on the manufacture of AgNPs from *Rheum turkestanicum* aqueous shoot extract at room temperature, as well as antibacterial activity against human pathogenic bacteria. Biosynthesised AgNPs were observed to have prevalent antibacterial action against human pathogenic pathogens. Based on their findings, this process can be used to make large-scale preparations of other noble metals for a variety of purposes.

Table 5: Selected examples of antibacterial applications of biosynthesize AgNPs (Year 2019)

Year	Biogenic resource	Antibacterial activity against	Ref.
2019	Gongronema Latifolium leaf extract	<i>E.coli</i> , <i>S.aureus</i>	54
2019	Parkiaspeciosa leaf extract	<i>E.coli</i> , <i>S.aureus</i> , <i>P. aeruginosa</i> , <i>B. subtilis</i>	55
2019	Combretumerythrophyllum leaves extract	<i>S. aureus</i> , <i>S.epidermidis</i> , <i>E.coli</i> <i>P. vulgaris</i>	56

Year 2019

The selected examples (year 2019) of antibacterial applications of biosynthesize AgNPs is given in Table 5. S.O. Aisida *et al.*⁵⁴ utilized a fluid concentrate of new leaf of *Gongronema Latifolium* (FLGL), a herbaceous blooming plant, as a fuel specialist in the biogenic union of AgNPs. Using varying AgNO₃ concentrations and a set amount of FLGL, the characteristics of produced AgNPs were examined. Using solid agar plates enriched with varying doses of nano-sized AgNPs, antibacterial action of AgNPs was exhibited on *E. coli* and *S. Aureas* bacterial strains. According to the varied characterizations of AgNPs, the difference in AgNO₃ concentration as well as the incubation duration had a vital influence in regulating particle sizes and dispersions. Their investigation of the XRD uncovered single-phase crystalline structures with diameters ranging from 9 to 31 nm. According to their SEM and TEM analysis, the produced AgNPs have a spherical shape with a bioactive chemical coating and 19 nm diameter for the greatest concentration. They discovered that the inhibiting region had a stronger bactericidal effectiveness than Ciprofloxacin against bacterial strains (the positive control).

V. Ravichandran *et al.*⁵⁵ reported the eco-friendly synthesis of AgNPs that was accomplished using *Parkiaspeciosa* leaf aqueous concentrate for the bio-source-reduction of silver ions. To validate the

synthesis of AgNPs, the researchers employed UV–Vis spectroscopy. The highest absorbance of the synthesised AgNPs was observed at 410.5 nm using spectrophotometry. The extent of leaf extract, pH, temperature, silver nitrate concentration, and time, had been all spectrophotometrically tuned. The average particle size of AgNPs was confirmed by SEM, TEM, and DLS analysis, and was determined to be 31 nm, 35 nm, and 155.3 d.nm, respectively. The antibacterial studies against *S.aureus*, *E. coli*, *P. aeruginosa*, and *B.subtilis*, were significant. The suggested approach for production of AgNPs utilising *Parkiaspeciosa* leaf extract is both environmentally benign and practical. O.T. Jemilugba and colleagues⁵⁶ have introduced interestingly a basic, green, savvy, and harmless to the ecosystem procedure for the production of AgNPs using *Combretum erythrophyllum* plant leaves' aqueous extract. UV–Vis, TEM, FT-IR, XRD, and DLS methods were used to characterise the Ag-NPs that were generated. The particles were round fit and equitably dispersed, as indicated by the TEM picture, with a particle size of 13.62 nm. *S. aureus*, *S.epidermidis*, *E. coli* and *P. vulgaris* pathogenic were used to check the antibacterial potential. The combined Ag-NPs were powerful against *S. epidermidis* and other *Staphylococcus* species involved in different dermatological diseases, rather than streptomycin, which was inadequate against *S. epidermidis* and other *Staphylococcus*

species associated with other dermatological contaminations.

Year 2020

The selected examples (year 2019) of antibacterial applications of biosynthesize AgNPs is given in Table 6. M. Gomathi *et al.*⁵⁷ have reported green synthesis of AgNPs (Ag NPs) using aqueous reducing leaf extract of *Gymnemasylvestre*. The band at 442 nm in their UV-visible absorption studies obviously demonstrated the creation of Ag

NPs in the aqueous medium. The XRD spectral studies revealed that the synthesised samples possessed fcc structure, and the EDX research additionally checked the presence of Ag metal NPs by the energy top at 3 keV. According to TEM analysis, most of the created Ag NPs were circular fit, with a size of 20 to 30 nm. The biomolecules involved in the reduction process in *Gymnemasylvestre* plant extracts were assessed using FT-IR. The integrated Ag NPs showed high antibacterial viability against *S. aureus* and *E. coli* in their examination.

Table 6: Selected examples of antibacterial applications of biosynthesize AgNPs (Year 2019)

Year	Biogenic resource	Antibacterial activity against	Ref.
2020	<i>Gymnemasylvestre</i> leaf extract	<i>S. aureus</i> , <i>E. coli</i>	57
2020	<i>Muntingiacalabura</i> leaf extract	<i>E. coli</i> , <i>B. cereus</i>	58
2020	<i>Ziziphusjoazeiro</i> leaf extract	<i>S. aureus</i> and <i>E. coli</i> .	59
2020	<i>Menthaaquatica</i> leaf extract	<i>P. aeruginosa</i> , <i>E. coli</i> , <i>B. cereus</i> , <i>S. aureus</i> ,	60

M.A. Ahmad and his colleagues⁵⁸ studied the environmentally friendly synthesis of AgNPs using *Muntingiacalabura* leaf extract as reducing and stabilising agents, as well as the antibacterial properties of the AgNPs generated. The generation of AgNPs was monitored using a UV-Vis spectrophotometer. The size and form of AgNPs were determined using TEM. The elemental analysis was interpreted using EDS. In a microbiological inhibition assay, *Muntingia* leaf mediated AgNPs suppressed the development of *Escherichia coli* and *Bacillus cereus*, as shown by the existence of an inhibition region. The green synthesis of AgNPs as antibacterial agents was described by M.L. Guimares *et al.*⁵⁹ They used *Ziziphusjoazeiro* leaf extract as a green reaction medium for the production of AgNPs. At neutral pH, they obtained particles with a smaller size and a lower aggregation degree. *S. aureus* and *E. coli* were used to test the antibacterial activity. A. Nouri and colleagues⁶⁰ used *Menthaaquatica* leaf extract as a capping and reducing agent to synthesise ultra-small AgNPs utilising a green biogenic approach. Biosynthesized AgNPs were characterised using a variety of analytical techniques. Their findings showed that using ultrasound throughout the synthesis process can result in smaller AgNPs with improved antibacterial activity.

Conclusion

In summary, this review article addresses the antibacterial uses of biosynthesized AgNPs that were investigated between 2015 and 2020. AgNPs' antibacterial potential against a wide variety of microorganisms is discussed. AgNPs appear to be frequently used as an antibacterial agent against *E. coli* and *S. aureus* bacterial strains, according to our study. This review will be beneficial in the development of antibacterial agents based on biosynthesized AgNPs.

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Conflict of Interest

Authors declare no conflict of interest.

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