ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 5, Issue – 4, August - 2022, Page No. : 233 - 238

Green Synthesis of Nanoparticles Derived from Plant Extracts

[1]Dr. Mary Sheloni Missier, PhD Student, Saveetha Dental College and Hospital, Assistant Professor, Rajas Dental College and Hospital, Kavalkinaru.

[2]Dr. S.P Saravana Dinesh, Professor, Department of Orthodontics, Saveetha Dental College and Hospital, SIMATS, Saveetha University, Chennai, Tamilnadu.

[3]Dr. Srirengalakshmi Muthuswamy Pandian, Reader, Department of Orthodontics, Saveetha Dental College and Hospital, SIMATS, Saveetha University, Chennai, Tamilnadu.

[4]Dr. Amalorpavam. V, Assistant Professor, Rajas Dental College and Hospital, Tirunelveli, Tamilnadu.

Corresponding Author: Dr. Mary Sheloni Missier, PhD Student, Saveetha Dental College and Hospital, Assistant Professor, Rajas Dental College and Hospital, Kavalkinaru.

Citation of this Article: Dr. Mary Sheloni Missier, Dr. S.P Saravana Dinesh, Dr. Srirengalakshmi Muthuswamy Pandian, Dr. Amalorpavam. V, "Green Synthesis of Nanoparticles Derived from Plant Extracts", IJDSIR- August - 2022, Vol. – 5, Issue - 4, P. No. 233 – 238.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Metal and metal oxide nanoparticles have been studied extensively over the last two decades in health, cosmetics, agriculture, and other disciplines, with encouraging findings thus far. Because of their toxicity, scientists may now synthesise nanoparticles made of metallic or metallic oxide materials, but these nanoparticles are no match for the toxicity of biological barriers. Nano particles formed of metals and metal oxides are a serious concern for green synthesis. Extraction of plant extract and subsequent creation of nanoparticles is currently considered the gold standard. Anti-bacterial properties have been demonstrated for nano particles. This study focuses on plant-derived nanoparticles, looking at how they're made, what they look like, and how they may be used in the real world.

Keywords: Nanoparticles, Plant extract, Antibacterial property.

Introduction

A vast range of potential applications can be found in nano technology, which is a multi-disciplinary field. Nanoparticles are at the heart of nano technology, which spans a wide range of scientific fields. "Nanoparticle" is a term used to describe particles with a diameter of less than 100 nano metres. In nano technology, research into nanoparticles and the processes that go into making, composing, and characterising them fall under the broad umbrella term. Gold and silver have been utilised to make nano particles for the past two decades. Nanoparticle manufacturing must be done in a way that minimises the risk of negative side effects. Nanoparticles produced from fungi and bacteria as well as plant extracts are now available in various shades of green. [2]

Green Synthesis of Nanoparticles

In order to synthesise nanoparticles, the following must be met

An environmentally acceptable solvent should be used, as should an effective reducing agent.

• Non-hazardous substance for the purpose of stabilising

Chemically manufacturing nanoparticles, on the other hand, is prohibitively expensive and environmentally detrimental. This means that they can be used in medical procedures because they are both safe for the patient and non-toxic to the environment. To make nanoparticles, plant phytochemicals can be extracted from the roots and leaves of the plant as well as from the seeds and stems. Nanoparticles can be made from the bottom up or the top down.

Go from the top to the bottom of the pyramid

Nano particles can be created by combining atoms and molecules, or allowing them to self-assemble into bigger nuclei. A nanometre-sized particle is the end result of this process.

A well-thought-out course of action cutting, grinding, and spitting are only some of the procedures used to create nano particles from bulk materials suitable for litho graphic applications. When adjusting the temperature, concentration of plant extract and pH of the incubation time, it is possible to control the size and shape of nano particles.

Different Types of Plant-Derived Nanoparticles

Biologically produced silver nanoparticles (AgNPs)

Silver metal ion solution, along with a biological reducer, is the simplest method for producing them [7,8]. Polysaccharides and phenolics can be utilised to stabilise and lower the concentration of Ag ions. [9]. We used Azadirachta indica (neem), lemon and cucumber extracts, and Capsicum annus extracts to decrease the $AgNO_3$ solution to nano particles (green chilli). In addition to their unique qualities, such as minimal toxicity, good biocompatibility, and easy surface functionalization, they are also easy to make. Gold metal ions are reduced by biological complexes using a variety of chemical moiety reducers, resulting in gold nanoparticles. Gold ions can be reduced and AuNPs topped off in plant extracts only if biomolecules such as phenols, flavonoids, proteins, and so on are present [14]. After 10 minutes of spinning the lemon extracts at 10,000 rpm, nylon mesh was added to the mixture. Over a period of several minutes, one millilitre of boiling H_2O_2 trihydrate was vigorously and consistently mixed. The juice is added to the host solution at the end of the process. Dark violet gave way to ruby red in a seamless transition. Colloidal solution can be stored in a new container and re-mixed for additional 20 minutes once it reaches room temperature before being used again. There is a resonance peak in the 530–550 nm region of wavelengths.

Biomedicine, cosmetics, optics, and electronics all use it. Nanoparticles of zinc oxide (ZnO NPs). Trials have shown that they can be produced cheaply, safely, and quickly. It is possible to make ZnO NPs from plant materials such as flower and root tissues. Because of their high band gap and substantial exciton binding energy, they display a wide range of semiconducting properties. [15,16]

Copper nanoparticles (Cu NPs) made from plant extracts are less expensive than gold and silver. [17] A UV visible spectrometer signal at 578nm [18] indicates their presence. Tiny titanium dioxide nanoparticles can be used to manufacture a wide range of items from plastics and paper to cosmetics and food (TiO2NPs). Utilizing these nanoparticles in colloidal form reduces water pollution. Tin oxide nanoparticles are formed when plant extracts and TiO2 salt combine. Room temperature TiO2 salt and Annona leaf extract creates TiO2NPin at the same time in an aqueous solution. [19] TiO2 nanoparticles with diameters ranging from 25 to 110 nm were synthesised using Catharanthus roseus leaf extract as a starting material. Nanoparticles made from Moringa oleifera leaf extract were found to be more effective at healing wounds. They are useful in the battle against fungi, bacteria, and poisons because of their characteristics. Using their help, sensors can be constructed. Flowers, leaves, stems, and seeds are all used to create these nanoparticles. Section on harvesting and processing plants includes information on how to gather plants and extract the clear liquid that collects in their parts.

Platinum is used in numerous other fields besides biomedical research. Nanoparticles produced by plants can be used in a variety of ways. Manufacturing, electronics, environmental protection, and biology all make substantial use of these materials. They are in high demand on the business sector because of their vast range of applications. A common rule of thumb is that natural nanoparticles pose less of a threat to human health than synthetically made ones.

Oxidative stress from mitochondria and other sources can damage cell membranes, proteins, and DNA, resulting in age-related malfunction and illness. If antioxidant properties can help repair this damage, it could be a benefit. In terms of anti-oxidant power, there are AgNPs, AuNPs and AgNPs made from C. inerme leaf extract, as well as NiONPs, made from stevia leaf extract, in these plant derivatives.

Citrus fruit ZnO NPs and ZnO NPs derived from Eucalyptus globules extract (a fungicide) were found to be useful in the fight against the soft rot bacterial pathogen Dickeyadadantii [16]. Flax seedlings' antioxidant responses can be boosted by ZnO NPs, despite their modest toxicity. Lemon-derived TiO2NPs are just as effective as ZnO NPs against Dickeyadadantii [16]. Salt may have less of an impact on wheat when AgNPs made from wheat extracts are used [25].

Nanotechnology can be used to diagnose cancer in oncology patients. [26] They have anticancer properties for the most part. When tested against normal human breast cells, MCF-12A, ZnO NPs derived from Cassia auricular leaf extract showed tumoricidal activity against MCF-7 breast cancer cells. The apoptosis of HepG2 cancer cells exposed to antioxidants was reduced by Trachysper mumammi seeds extract-derived green AuNPs.

With terrible side effects, chemotherapeutic medicines were initially used to treat leishmaniasis. Nanoparticles, which have unique qualities like reduced toxicity, bioavailability, biodegradability, and tailored drug delivery, are increasingly being studied in this field. Leishmania amazonensis was successfully treated with AgNPs containing corncob xylan (Nanoxylan). Antibiotic-resistant bacteria have recently emerged, and as the bacterial genome evolves, this will only become worse. Antibiotic-resistant bacteria can be effectively treated and prevented from spreading by using biogenic NPs.

The shigellosis-causing agent Shigella flexineri was successfully eradicated with AgNPs produced from Carissa carandas leaf extract. According to this work, Stevia leaf extract-derived Pd-Ag nanostructures slow down E. coli growth. In the fight against multidrug-resistant bacteria that cause ventilator-associated pneumonia, AgNPs from Sisymbrium irio are highly effective. Many human diseases are resistant to Clerodane druminerme leaf extract's antibacterial and antifungal activities [22]. Anti-bacterial activity is attributed to the synergistic effect of physiologically active Phyto chemicals, according to the scientists. S. aureus and E. coli have been shown to be inhibited by ZnO NPs from Cinnamomum verum bark extract ZnO NPs. Both Gram-positive and Gram-negative bacteria are vulnerable to MnO NPs produced from the leaf extract of the Abutilon indicum plant. An anti-fungal characteristic of bio mediated NPs is their capacity to enhance ROS production.

An example of the species Matric aria chamomilla is found in the chamomile family. When exposed to UV radiation, AgNPs in waste water treatment are effective against Rhodamine B [31]. Photocatalytic Abutilon indicum leaf extract can remove a variety of pollutants, including heavy metals Cr (VI), according to recent studies. [32] Photocatalytic H2 was produced from stevia leaf extract using Pd-Ag bimetallic NPs.

Conclusion

Plants can be used to make environmentally beneficial nano particles due to their low toxicity, accessibility, and affordability. They can be utilised in medicine, agriculture, cosmetics, sensors, and dyes, for example. They can also be used to purify water and catalyse reactions through the use of light. Drug delivery technologies created in the medical industry may be the sole chance for future generations of patients. These nanoparticles are popular with humans and animals because of their low toxicity.

References

1. Nadeem, M.; Tungmunnithum, D.; Hano, C.; Abbasi, B.H.; Hashmi, S.S.; Ahmad, W.; Zahir, A. The current trends in the green syntheses of titanium oxide nanoparticles and their applications. Green Chem. Lett. Rev. 2018, 11, 492–502.

2. Jadoun, S.; Arif, R.; Jangid, N.K.; Meena, R.K. Green synthesis of nanoparticles using plant extracts: A review. Env. Chem. Lett. 2021, 19, 355–374.

3. Nath, D.; Banerjee, P. Green nanotechnology—A new hope for medical biology. Environ. Toxicol. Pharmacol. 2013, 36, 997–1014.

4. Razavi, M.; Salahinejad, E.; Fahmy, M.; Yazdimamaghani, M.; Vashaee, D.; Tayebi, L. Green chemical and biological synthesis of nanoparticles and their biomedical applications. In Green Processes for Nanotechnology; Springer: Berlin/Heidelberg, Germany, 2015; pp. 207–235.

5. Narayanan, K.B.; Sakthivel, N. Green synthesis of biogenic metal nanoparticles by terrestrial and aquatic phototrophic and heterotrophic eukaryotes and biocompatible agents. Adv. Colloid Interface Sci. 2011, 169, 59–79.

6. Siddiqi KS, Husen A (2016) Green synthesis, characterization and uses of palladium/platinum nanoparticles. Nanoscale Res Lett 11:482. https:// doi. org/ 10.1186 /s11671-016-1695-z

7. Silva Viana, R.L.; Pereira Fidelis, G.; Jane Campos Medeiros, M.; Antonio Morgano, M.; Gabriela Chagas Faustino Alves, M.; Domingues Passero, L.F.; Lima Pontes, D.; Cordeiro Theodoro, R.; Domingo's Arantes, T.; Araujo Sabry, D.; et al. Green Synthesis of Antileishmanial and Antifungal Silver Nanoparticles Using Corn Cob Xylan as a Reducing and Stabilizing Agent. Biomolecules 2020, 10, 1235.

8. Micky maray, S. One-step Synthesis of Silver Nanoparticles Using Saudi Arabian Desert Seasonal Plant Sisymbrium irio and Antibacterial Activity Against Multidrug-Resistant Bacterial Strains. Biomolecules 2019, 9, 662.

9. Tolaymat, T.M.; El Badawy, A.M.; Genaidy, A.; Scheckel, K.G.; Luxton, T.P.; Sui dan, M. An evidence-based environmental perspective of manufactured silver nanoparticle in syntheses and applications: A systematic review and critical appraisal of peer-reviewed scientific papers. Sci. Total Environ. 2010, 408, 999–1006.

10. Ghosh, P.; Han, G.; De, M.; Kim, C.K.; Rotello, V.M. Gold nanoparticles in delivery applications. Adv. Drug Deliv. Rev. 2008, 60,1307–1315.

11. Jain, P.K.; Lee, K.S.; El-Sayed, I.H.; El-Sayed, M.A. Calculated absorption and scattering properties of gold nanoparticles of different size, shape, and composition: Applications in biological imaging and biomedicine. J. Phys. Chem. B. 2006, 110, 7238–7248.

12. Jeong, S.; Choi, S.Y.; Park, J.; Seo, J.H.; Park, J.; Cho, K.; Lee, S.Y. Low-toxicity chitosan gold nanoparticles for small hairpin RNA delivery in human lung adenocarcinoma cells. J. Mater. Chem. 2011, 21, 13853–13859.

13. Sperling, R.A.; Gil, P.R.; Zhang, F.; Zanella, M.; Parak, W.J. Biological applications of gold nanoparticles. Chem. Soc. Rev. 2008, 37,1896–1908.

14. Parveen, K.; Husain, F.M.; Qais, F.A.; Khan, A.; Razak, S.; Afsar, T.; Alam, P.; Almajwal, A.M.; Abul meaty, M.M.A. Microwave-Assisted Rapid Green Synthesis of Gold Nanoparticles Using Seed Extract of Trachyspermumammi: ROS Mediated Biofilm Inhibition and Anticancer Activity. Biomolecules 2021, 11, 197.

15. Zaeem, A.; Drouet, S.; Anjum, S.; Khurshid, R.; Younas, M.; Blonde au, J.P.; Tungmunnithum, D.; Giglioli - Guivarc'h, N.; Hano, C.; Abbasi, B.H. Effects of Biogenic Zinc Oxide Nanoparticles on Growth and Oxidative Stress Response in Flax Seedlings vs. In Vitro Cultures: A Comparative Analysis. Biomolecules 2020, 10, 918.

16. Hossain, A.; Abdallah, Y.; Ali, M.A.; Masum, M.M.I.; Li, B.; Sun, G.; Meng, Y.; Wang, Y.; An, Q. Lemon-Fruit-Based Green Synthesis of Zinc Oxide Nanoparticles and Titanium Dioxide Nanoparticles against Soft Rot Bacterial Pathogen Dickeyadadantii. Biomolecules 2019, 9, 863.

17. Cherian, T.; Ali, K.; Squib, Q.; Faisal, M.; Wahab, R.; Mussarat, J. Cymbopogon Citratus Functionalized Green Synthesis of CuO-Nanoparticles: Novel Prospects as Antibacterial and Antibiofilm Agents. Biomolecules 2020, 10, 169.

18. Karimi, J.; Mohsen Zadeh, S. Rapid, green, and eco-friendly biosynthesis of copper nanoparticles using flower extract of Aloe vera. Synth. React. Inorg. Metal. -Org. Nano-Metal. Chem. 2005, 45, 895–898.

19. Roopan SM, Bharathi A, Prabhakarn A et al (2012) Efcientphyto-synthesis and structural characterization of rutile TiO2 nano-particles using Annona squamosa peel extract. Spectro Chim Acta Part A Mol Bio mol Spectrosc. https://doi.org/10.1016/j.saa.2012.08.055

20. Sivaranjani V, Philominathan P (2016) Synthesize of Titanium dioxide nanoparticles using Moringa oleifera leaves and evaluation of wound healing activity. Wound Med. https://doi.org/10.1016/j.wndm.2015.11.002

21. Singh, R.; Hano, C.; Nath, G.; Sharma, B. Green Biosynthesis of Silver Nanoparticles Using Leaf Extract of Carissa carandas L. and Their Antioxidant and Antimicrobial Activity against Human Pathogenic Bacteria. Biomolecules 2021, 11, 299.

22. Khan, S.A.; Shahid, S.; Lee, C.-S. Green Synthesis of Gold and Silver Nanoparticles Using Leaf Extract of Clerodendruminerme; Characterization, Antimicrobial, and Antioxidant Activities. Biomolecules 2020, 10, 835.

23. Srihasam, S.; Thyagarajan, K.; Korivi, M.; Lebaka, V.R.; Mallem, S.P.R. Phytogenic Generation of NiO

Nanoparticles Using Stevia Leaf Extract and Evaluation of Their In-Vitro Antioxidant and Antimicrobial Properties. Biomolecules 2020, 10, 89.

24. Ahmad, H.; Venugopal, K.; Rajagopal, K.; De Britto, S.; Nandini, B.; Pushpalatha, H.G.; Konappa, N.; Uday Shankar, A.C.; Geetha, N.; Jogaiah, S. Green Synthesis and Characterization of Zinc Oxide Nanoparticles Using Eucalyptus globules and Their Fungicidal Ability Against Pathogenic Fungi of Apple Orchards. Biomolecules 2020, 10, 425.

25. Wahid, I.; Kumari, S.; Ahmad, R.; Hussain, S.J.; Alamri, S.; Siddiqui, M.H.; Khan, M.I.R. Silver Nanoparticle Regulates Salt Tolerance in Wheat Through Changes in ABA Concentration, Ion Homeostasis, and Defense Systems. Biomolecules 2020, 10, 1506.

26. Anjum, S.; Is Haque, S.; Fatima, H.; Farooq, W.; Hano, C.; Abbasi, B.H.; Anjum, I. Emerging Applications of Nano technology in Healthcare Systems: Grand Challenges and Perspectives. Pharmaceuticals 2021, 14, 707.

27. Saleem, K.; Khursheed, Z.; Hano, C.; Anjum, I.; Anjum, S. Applications of Nanomaterials in Leishmaniasis: A Focus on Recent Advances and Challenges. Nanomaterials 2019, 9, 1749.

28. Silva Viana, R.L.; Pereira Fidelis, G.; Jane Campos Medeiros, M.; Antonio Morgano, M.; Gabriela Chagas Faustino Alves, M.; Domingues Passero, L.F.; Lima Pontes, D.; Cordeiro Theodoro, R.; Domingo’s AR antes, T.; Araujo Sabry, D.; et al. Green Synthesis of Antileishmanial and Antifungal Silver Nanoparticles Using Corn Cob Xylan as a Reducing and Stabilizing Agent. Biomolecules 2020, 10, 1235.

29. Andleeb, A.; Andleeb, A.; Asghar, S.; Zaman, G.; Tariq, M.; Mehmood, A.; Nadeem, M.; Hano, C.; Lorenzo, J.M.; Abbasi, B.H. A Systematic Review of Biosynthesized Metallic Nanoparticles as a Promising Anti-Cancer-Strategy. Cancers 2021, 13, 2818.

30. Khan, S.A.; Shahid, S.; Shahid, B.; Fatima, U.; Abbasi, S.A. Green Synthesis of MnO Nanoparticles Using Abutilon indicum Leaf Extract for Biological, Photocatalytic, and Adsorption Activities. Biomolecules 2020, 10, 785.

31. Alshehri, A.A.; Malik, M.A. Phyto mediated Photo-Induced Green Synthesis of Silver Nanoparticles Using Matric aria chamomilla L. and Its Catalytic Activity against Rhodamine, B. Biomolecules 2020, 10, 1604.

32. Mallik arjuna, K.; Nasif, O.; Ali Alharbi, S.; Chinni, S.V.; Reddy, L.V.; Reddy, M.R.V.; Sreeramanan, S. Phytogenic Synthesis of Pd-Ag/rGO Nanostructures Using Stevia Leaf Extract for Photocatalytic H2 Production and Antibacterial Studies. Biomolecules 2021, 11, 190.