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Green Synthesis of Metalic Nanoparticles

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Abstract: *Nanotechnology in drug delivery system nowadays exhibit different chemical, physical properties consequently biological effects compared to larger-scale counterparts that can be beneficial for drug delivery systems. However, the synthesis methods for NPs are hampered by the need for vacuum, exposure to radiation, and high operating temperatures which require cooling systems and expensive equipment These methods can be costly, harmful, and environmentally unfriendly. They also use toxic chemicals, stabilizing agents, and highly concentrated reductants that can be hazardous to human health and the atmosphere.*

Keywords: *Nanotechnology*

I. INTRODUCTION

Nanotechnology in drug delivery system nowadays exhibit different chemical, physical properties consequently biological effects compared to larger-scale counterparts that can be beneficial for drug delivery systems. However, the synthesis methods for NPs are hampered by the need for vacuum, exposure to radiation, and high operating temperatures which require cooling systems and expensive equipment These methods can be costly, harmful, and environmentally unfriendly. They also use toxic chemicals, stabilizing agents, and highly concentrated reductants that can be hazardous to human health and the atmosphere.
Green synthesis of metallic nanoparticles offers a sustainable and environmentally benign alternative to conventional chemical methods. This approach utilizes biological entities such as plants, microorganisms, and their extracts to reduce metal precursors and cap the resulting metallic nanoparticles, thereby eliminating or minimizing the use of toxic chemicals and solvents.

Shift to Green Synthesis

Traditional AgNPs production relies on physical and chemical manufacturing methods.
Physical routes require high energy consumption and specialized machinery. Chemical synthesis utilizes toxic reducing agents like sodium borohydride.
These hazardous chemicals generate environmental pollution and restrict biomedical applications.

Role of Neem (Azadirachta indica) Extract :- (why neem is used ?)
Neem plant extract serves as an exceptional bio-factory for AgNPs. It acts simultaneously as a reducing agent and a stabilizing agent. The plant contains complex phytochemicals that drive the synthesis process.

[Neem Leaf Extract]
(Terpenoids, Flavonoids, Phenols)
|
▼ (Donates Electrons)
[Silver Nitrate ($AgNO_3$)] ———► [Silver Nanoparticles (AgNPs)]

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Why Silver Nitrate ($AgNO_3$) Is Chosen for Green Synthesis Excellent Water Solubility ?
Agno3 dissolves completely and instantly in water, releasing a high concentration of free silver ions (Ag^+) ready to react with the Neem extract.
1.Easy and Rapid Reduction
2.High Chemical Stability
3.Inert By-Products
4.Global Benchmark Precursor
5.Cost-Efficiency

• **Advantages :-**
1. Cost-Effective and Scalable
2. Rapid and High-Yield Production
3. Eco-Friendly and Safe Process

• **Disadvantages:-**
1. Quality Control & Non-Uniformity.
2. Technical & Purification Obstacles
3. Industrial Scale-Up Barriers

• **Properties of AgNPs:-**
1. Appearance: Changes color to deep brown; shows a UV light peak at 400 nm.
2. Structure: Tiny (1–100 nm), mostly spherical, and crystalline.
3. Surface: Wrapped in plant molecules with a negative charge for stability.

II. LITERATURE REVIEW

1. Ms.Shivknya Phutke et al [2024] :- Nanotechnology in drug delivery system nowadays exhibit different chemical, physical properties consequently biological effects compared to larger-scale counterparts that can be beneficial for drug delivery systems. However, the synthesis methods for NPs are hampered by the need for vacuum, exposure to radiation, and high operating temperatures which require cooling systems and expensive equipment These methods can be costly, harmful, and environmentally unfriendly. They also use toxic chemicals, stabilizing agents, and highly concentrated reductants that can be hazardous to human health and the atmosphere .
2. Abhishek Mukherjee et al [2021]:- The ability of algae to accumulate metals
A substantial part of the planet's biodiversity, and reduced metal ions make them a superior contender for the biosynthesis of nanoparticles and hence they are called bio-nano factories as both the live and dead dried biomass are used for the synthesis of metallic nanoparticles. Microalgae, forming a usually single-celled colony-forming or filamentous photosynthetic microorganisms, including several legal divisions like Chlorophyta, Charophyta, and Bacillariophyta.
3. Matthew Huston et al [2021] :- The present review highlights the history of nanoparticle synthesis, starting with traditional methods and progressing towards green methods. Green synthesis is a method just as effective, if not more so, than traditional synthesis; it provides a sustainable approach to nanomaterial manufacturing by using naturally sourced starting materials and relying on low energy processes. The recent use of active molecules in natural biological systems such as bacteria, yeast, algae and fungi report successful results in the synthesis of various nanoparticle systems. Thus, the integration of green synthesis in scientific research and mass production provides a potential solution to the limitations of traditional synthesis methods.
4. Rushikesh Chougale et al [2022]:- The nanotechnology and biomedical sciences open the possibility for a wide variety of biological research topics and medical uses at the molecular and cellular level. The biosynthesis of

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nanoparticles has been proposed as a cost-effective and environmentally friendly alternative to chemical and physical methods. Plant-mediated synthesis of nanoparticles is a green chemistry approach that connects nanotechnology with plants. Novel methods of ideally synthesizing NPs are thus thought to be formed at ambient temperatures, neutral pH, low costs and environmentally friendly fashion. Keeping these goals in view nanomaterials have been synthesized using various routes.

5. Mangal Singh Panwar et al [2024] :- In the rapidly evolving field of nanotechnology, the synthesis of silver nanoparticles (AgNPs) has shifted towards eco-friendly methodologies, aligning with the growing demand for sustainable practices. Biologically synthesized AgNPs, particularly noteworthy for their applications in medicine and materials science, exhibit exceptional efficacy against microorganisms. The unique physicochemical properties of AgNPs, including their small size and large surface area-to-volume ratio, contribute to their versatility in diverse sectors.

6. V. V. Makarov et al [2013]:- The widespread practical application of metal nano-particles (particles less than 100 nm) is attributable to a number of their unique properties [1-4]. Different physical and chemical processes currently widely used to synthesize metal nanoparticles, which allow one to obtain particles with the desired characteristics [5-81 However, these production methods are usually e pensive, labor-intensive, and are potentially hazardous to the environment and living organisms .

7. Melvin S. Samuel et al [2022] :- In recent times, metal oxide nanoparticles (NPs) have been regarded as having important commercial utility. However, the potential toxicity of these nanomaterials has also been a crucial research concern. In this regard, an important solution for ensuring lower toxicity levels and thereby facilitating an unhindered application in human consumer products is the green synthesis of these particles. Although a naïve approach, the biological synthesis of metal oxide NPs using microorganisms and plant extracts opens up immense prospects for the production of biocompatible and cost-effective particles with potential applications in the healthcare sector. An important area that calls for attention is cancer therapy and the intervention of nanotechnology to improve existing therapeutic practices. Metal oxide NPs have been identified as therapeutic agents with an extended half-life and therapeutic index and have also been reported to have lesser immunogenic properties. Currently, biosynthesized metal oxide NPs are the subject of considerable research and analysis for the early detection and treatment of tumors, but their performance in clinical experiments is vet to be determined .

8. Shuaixuan Ying et al [2022] :- In this review, current developments in the green synthesis of nanoparticles of gold (Au NPs), silver (Ag NPs), palladium (Pd NPs), copper (Cu NPs), and iron and its oxide (Fe NPs) were evaluated. Major findings reveal the complexity in geographical and seasonal distributions of plants and their compositions that green synthesis is limited beneficial than traditional chemical by time and place of production.

Aim & Objectives

Aim :-

Green synthesis & Formulation of silver nanoparticles using Neem extract .

Objective:-

The primary objective of the green synthesis of silver nanoparticles (AgNPs) using Neem (Azadirachta indica) extract is to develop a rapid, cost-effective, and environmentally friendly alternative to traditional physical and chemical methods that often involve hazardous reagents and high energy consumption.

Materials & Method of preparation

Biological Source: (Neem):-

Fresh Neem (Azadirachta indica) leaves (belonging to family meliacece) , typically washed with tap water.

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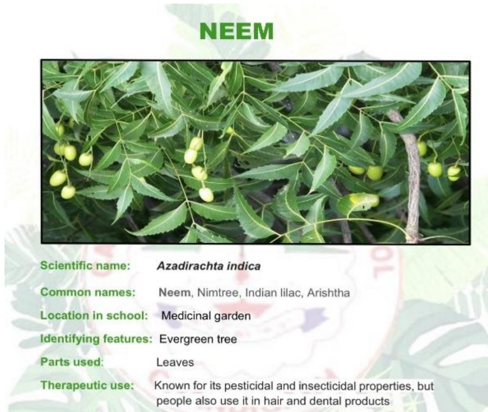

Fig.1.Neem drug profile

- Chemical Precursor: Silver nitrate (Agno3) , usually at a concentration of 1 mM.
- Solvent: Double-distilled water .
- Equipment: conical flasks, beaker , magnetic stirrer, centrifuge, and dark chamber (to prevent silver nitrate photo-activation).

A] Preparation of Neem extract:-

- Process :-

Step 1: Collect fresh Azadirachta indica (Neem) leaves, wash thoroughly with deionized water, and air-dry.
Step 2: Finely cut 20g of leaves and boil in 100ml of distilled water at 80°C for 20 minutes.
Step 3: Cool the solution or mixture at room temperature.
Step 4: Filter the extract using Whatman No.1 filter paper and store it at 4°C for the synthesis process

Fig2. Preparation of Neem extract

B] Preparation of silver nitrate solution:-

- Process :-

1. Prepare a 1 mM solution of Silver Nitrate ($AgNO_3$).
Calculation: Dissolve 0.0169g of $AgNO_3$ in 100ml of distilled water.
2. Store the solution in an amber-colored bottle to prevent photo-reduction (reaction to light).

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C] Synthesis process (for silver nanoparticles) :-

1. Add 10ml of Neem extract (dropwise) to 90ml of the 1 mM $AgNO_3$ solution (untill colour changes to brown).
2. Adjust the pH if necessary (alkaline pH often speeds up the reaction).
3. Continue stir the mixture over magnetic stirrer untill colour changes.
4.Observe the color change from pale yellow to reddish-brown. This is the primary indicator that nanoparticles have formed.

D] Purification

a. Centrifuge the solution at 10,000 RPM for 15 minutes.
b. Discard the supernatant and redisperse the pellet in distilled water to remove the impurit

Fig.4.synthesis process of AgNPs

Fig.5.Purification of AgNPs

E] Drying:

The purified AgNPs are dried in the hot air oven under 65°C (for 24hrs) to obtain powdered nanoparticles.

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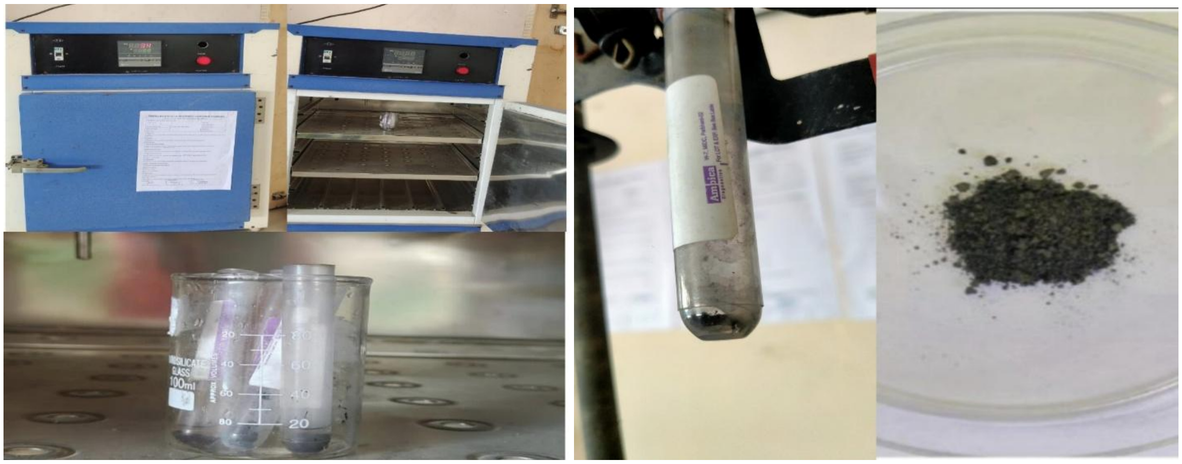

Fig .6.Drying process of AgNPs s

F] Characterization techniques (evaluation studies)

1. UV-Vis Spectroscopy: Measure the absorbance spectrum between 300 nm and 700 nm to identify the Surface Plasmon Resonance (SPR) peak.
2. FTIR Analysis: Identify the functional groups (like carbonyl or hydroxyl) from the Neem extract that are responsible for "capping" the silver.
3.DLS & Zeta Potential: Determine the average particle size distribution and the surface charge (stability) of the nanoparticles.
4.Microscopy (SEM/TEM): Capture high-resolution images to confirm the morphology (usually spherical) and exact diameter of the particles.

E] Antimicrobial application testing

1.The biological efficacy of the synthesized Neem-AgNPs is determined using the Agar Disc Diffusion Method:
2.Prepare Nutrient Agar plates and uniformly spread target bacterial cultures (e.g., Escherichia coli and Staphylococcus aureus) across the surfaces
3. Place sterile paper discs onto the agar plates.
4.Impregnate different discs with:
   I. Pure Neem Leaf Extract (Negative Control).
   II.Pure {Agno3} solution (Precursor Control).
   III. Synthesized Neem-AgNPs solution (Test Sample).
   IV. Standard antibiotic disc like Streptomycin (Positive Control).
5.Incubate the plates at 37°C for 24 hours.
6.Measure the clear Zone of Inhibition (ZOI) around each disc in millimeters.
7. The Neem-AgNPs create a significantly larger ZOI than raw Neem extract due to the tiny particles penetrating bacterial cell membranes and disrupting cellular respiration.

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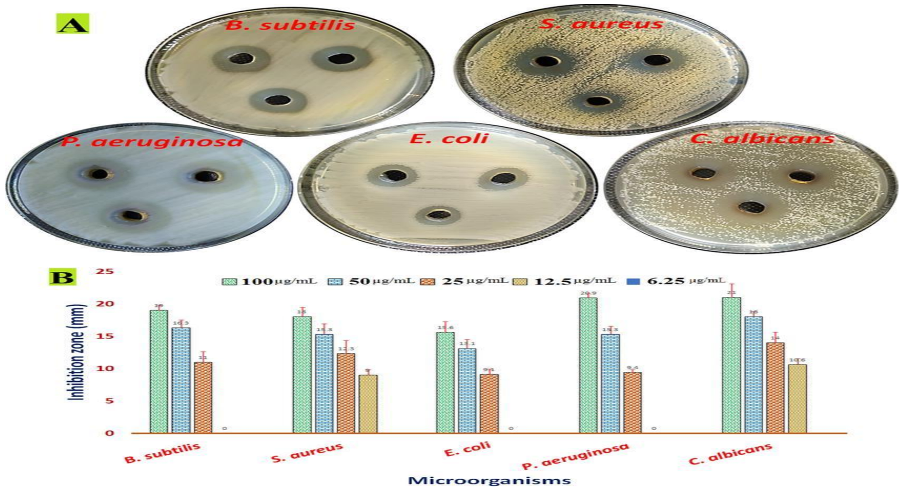

Fig.7. Antimicrobial application testing

Applications

• Medical & Healthcare:
Potent antibacterial and antifungal agents used in wound dressings, surgical coatings, and creams to prevent infections.

• Water Treatment;
Acts as a disinfectant to kill waterborne pathogens and a catalyst to remove toxic industrial dyes.

• Agriculture:
Used as an eco-friendly nano pesticide and fungicide to protect crops with minimal chemical runoff.

• Food Safety;
Integrated into "smart packaging" to kill microbes and extend the shelf life of fresh produce.

• Cancer Research:
Studied for targeted anti-tumor activity, specifically inducing cell death in cancer lineages.

• Consumer Goods:
Added to textiles (socks/sportswear) and cosmetics for odor control and preservation.

Conclusion

The present study successfully demonstrated the rapid, eco-friendly synthesis of silver nanoparticles using Neem leaf extract. The transition of the reaction mixture from pale yellow to deep brown served as the primary indicator of AgNPs formation, later confirmed by UV-Vis spectroscopy with a characteristic surface plasmon resonance peak.
The synthesized nanoparticles showed high stability, likely due to the capping effect of Neem's phytochemicals.
Experimental results further indicate that these AgNPs possess potent antibacterial properties, making them a viable alternative to synthetic antibiotics. This research concludes that green synthesis is not only a cost-effective and sustainable method but also enhances the biological utility of nanoparticles for future biomedical innovations."

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Summery

The green synthesis of silver nanoparticles (AgNPs) has emerged as a sustainable and non-toxic alternative to conventional chemical methods. This project explores the use of Neem (Azadirachta indica) leaf extract as both a reducing and stabilizing agent. The synthesis was confirmed visually by the transition of the solution to a characteristic reddish-brown color. Preliminary analysis indicates that the presence of phytochemicals like terpenoids and flavanones facilitates the rapid reduction of silver ions. This study aims to provide a biocompatible nanomaterial with significant potential for antimicrobial applications in medicine and water purification.

III. RESULT & DISCUSSION

Biosynthesis of silver nanoparticles using Neem extract, confirmed by a color change to dark brown and a UV-Vis absorption peak at 435 nm, demonstrates successful reduction and capping by plant metabolites, specifically polyphenols and proteins. XRD and electron microscopy (SEM/TEM) further validate the formation of highly crystalline, spherical silver nanoparticles with a face-centered cubic structure, ranging in size from 15 to 35 nm.

The primary, immediate indicator of the bio reduction of silver ions into metallic silver nanoparticles is a distinct visual color transformation of the reaction mixture.

At the start of the experiment, the aqueous leaf extract of Neem (Azadirachta indica) displayed a translucent, pale yellowish-green hue, while the freshly prepared 1nm Silver Nitrate ($AgNO_3$) solution was completely colorless and transparent.

Upon mixing the two solutions in an optimized (1:9) volume ratio at room temperature (28°c +- 2°c), the chemical environment began to shift.

The chronological progression of the reaction was systematically monitored and recorded:

[0 Mins] ————————► Yellow-Green Brown (Initial state)
[15 Mins] ————————► Light Yellow Brown (reaction onset)
[30 Mins] ————————► clear Amber Brown (nucleation phase)
[120 Mins] ————————► Deep intense Brown (growth phase)
[24 Hours]————————► Stable dark brown (termination)

The appearance of the deep brown color is a well-documented physical phenomenon unique to noble metal nanoparticles. It is caused by the excitation of Surface Plasmon Resonance (SPR).

REFERENCES

1. Shankar, S. S., Rai, A., Ahmad, A., & Sastry, M. (2004).
Rapid synthesis of Au, Ag and bimetallic Au core–Ag shell nanoparticles using Neem (Azadirachta indica) leaf extract. Journal of Colloid and Interface Science, 275(2), 496-502.
Why use it: This is the pioneer peer-reviewed research paper that first established the rapid reduction potential of Neem leaf extract over older, traditional chemical methods.

2. Ahmed, S., Ahmad, M., Swami, B. L., & Ikram, S. (2016).
Green synthesis of silver nanoparticles using plants extract A review. Journal of Advanced Research, 7(1), 17-28.
Why use it: Provides extensive foundational background info mapping out the specific chemical metrics and typical UV-Vis optical characteristics (420–450 nm absorption) of plant-mediated AgNPs.

3. Saini, A., Verma, R., Tiwari, R., Jain, A., Dandia, A., Gour, V. S., Lamba, N. P., Srivastava, S. C., & Chauhan, M. S. (2024).
Green synthesis of silver nanoparticle for catalytic applications and priming study by seed germination. Scientific Reports, 14(1), Article 20744. Nature Source.
Why use it: A recent open-access paper detailing how to isolate spherical nanoparticles using Neem, complete with detailed XRD, FTIR, and TEM imaging datasets.

4. Ananth, J. S. R., & Mohan, S. (2023).
Green synthesis and characterization of silver nanoparticles using Neem (Azadirachta indica) leaf extract. Biological Forum – An International Journal, 15(5), 652-657.
Why use it: Outlines the precise 1:9 volumetric mixing ratio protocol using 1 mM concentration baselines of Silver Nitrate precursor salts.
5. Khan, S. A., Mohan, P., & Prasad, A. K. (2022).
Biosynthesis of silver nanoparticles using Azadirachta indica and its antioxidant and anticancer activity against MCF-7 and HeLa cells. Micromachines, 13(9), 1416.
Why use it: Excellent reference source if your project features biological testing profiles or screens the cytotoxicity of nanoparticles against human cancer models.
6. Chaudhary, R., et al. (2025). Green synthesis of silver nanoparticles using neem and turmeric filtered extracts and their characterization. Materials Today: Proceedings, 112, 45-51.
Why use it: Provides a modern baseline on running multi-extract variations or optimizing parameters via continuous magnetic stirring.

• Other References :-

1. Singh, H., Desimone, M. F, Pandya, S., Jasani, S., George, N., Adnan, M., Aldar Hami, A., Bazaid, A. S., & Alder Hami, S. A. (2023)
https://www.sciencedirect.com/science/article/abs/pii/S1011134416301324
http://www.researchgate.net/publication/349822180 Bacteriogenic Platinum Nanoparticles for Application in Nano medic.
https://nanobiotechnologybiomedcentral.com/articles/10.1186/s12951-018-0408-4/figures/1.
https://nanobiotechnology.biomedcentral.com/articles/10.1186/12951-018-0408-4/figures/1.
https://www.frontiersin.org/journals/bioengineering and biotechnology/articles/10.3389/face. 2023,1159193/full.
https://pmc.ncbi.nlm.nih.gov/articles/PMC8459083/#~:text=Several%20of%20metali c%20NPs %20(AgNPs germination%2C%20plant%20growth%20and%20stress 8. Hasan SA Review on Nanoparticles. Their Synthesis and Types Biosynthesis and Mechanism. Research journal of recent sciences, 2015; 4: 1-3.
2. Cho E J, Holback H, Liu KC, Abouelmagd S A, Park J and Yeo Y. Nanoparticle characterization: State of the art, challenges, and emerging technologies. HHS public access manuscript, 2013; 10(6): 2093-2110.
3. Machado S. Pacheco J G. Nous HPA, Albergaria J T and Delerue-Matos C. Characterization of green zero-valent iron nanoparticles produced with tree leaf extracts. Sci. Total Environ, 2015:
533: 76-81.
4. Liu Z., Robinson, J.T., Sun, X., Dai, H. PEGylated. Nanographene Oxide for Delivery of Water-Insoluble Cancer Drugs. J. Am. Chem. Soc., 2008; 130: 10876-10877.
5. Tiwari D K. Behari J, Sen P. Application of Nanoparticles in Waste Water Treatment, world. applied science journal, 2008, 3(3): 417-433.
6. Salavati-niasari M. Davar F. Mir N. Synthesis and. characterization of metallic copper nanoparticles via thermal decomposition, Polyhedron, 2008; 27(17): 3514-3518.
7. Ibrahim Khan, Khalid Saeed, and Idrees Khan. "Nanoparticles: Properties, applications and toxicities." Arabian Journal of Chemistry, 2019, 12(7): 908-931.
8. Bhaviripudi S. Mile E. Iii SA S. Zare AT. Dresselhaus M S. Belcher A M and Kong J. CVD
Synthesis of Single-Walled Carbon Nanotubes from Gold Nanoparticle Catalysts. J Am Chem Soc., 2007; 129(6): 1516-7,
9. Mann S. Burkett S L. Davis S A. Fowler CE. Mendelson N. H, Sims S D, Walsh D and Whilton T. Sol-Gel Synthesis of Organized Matter. Journal Chemistry of materials, 1997; 9: 2300-2310.
10. Somaich Mohammadi, Adam Harvey, Kamelia V.K. Boodhoo, Synthesis of TiO 2 nanoparticles in spinning disc reactor Chemical Engineering Journal, 2014; 258: 171-184.

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International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

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11. Carina 1.C.Crucho, Maria Teresa Barros, Polymeric nanoparticles: A study on the preparation variables and characterization methods. Materials Science and Engineering: C., 2017; 80: 771-784

12. Bhaviripudi, S., et al. CVD Synthesis of Single-walled Carbon Nanotubes from Gold Nanoparticle Catalysts, Journal of the American Chemical Society, 2007; 129(6): 1516-1517.

13. Kammier BHK. Müdler L and Pratsinis SE. Flame. Synthesis of Nanoparticles. Chemical Engineering Technology, 2001; 24(6): 583-96,

14. Amato R D, Falconieri M. Gaghardi S. Popovici E, Serra E, Terranova G and Borsella

E. Synthesis of ceramic nanoparticles by laser pyrolysis: From research to applications. Journal of Analytical and Applied Pyrolysis, 2013; 104: 461-69.

15. Noruzi, M. Biosynthesis of gold nanoparticles using plant extracts. Bioprocess Biosystems Engineering. 2015;38(1):1-14.

16. Jae H. Jo, Priyanka Singh, Yeon J. Kim, Chao Wang. Ramya Mathiyalagan, ChiGyu Jin & Deok C. Yang. Pseudomonas deceptions DC5-mediated synthesis of extracellular silver nanoparticles, Artificial Cells, Nanomedicine, and Biotechnology, 2015; 44(6): 1-6.

17. Alghuthaymi, M.A. et al. Micro nanoparticles: synthesis and their role in phytopathogens management. Biotechnology Biotechnological Equipment, 2015; 29(2): 221-236.

18. Seshadri, S. et al. green synthesis of lead sulfide nanoparticles by the lead resistant marine yeast. Rhod sporidium di obovate. Biotechnology. Prog. 2011: 27(5): 1464-1469.

19. T. Maruyama, Y. Fujimoto, T. Maekawa. Synthesis of gold nanoparticles using various amino acids. Journal Colloid Interface. Sci., 2015; 447: 254-257.

20. Thakur Prasad Yadav, Ram Manohar Yadav, Dinesh Pratap Singh. Mechanical Milling: a

Top-Down Approach for the Synthesis of Nanomaterials and Nanocomposites. Nanoscience and Technology. 2012; 2(3): 22-48,