International Journal of Pharmaceutical Biological and Chemical Sciences (IJPBCS)
ISSN: 2278-5191 (Online)
IJPBCS | VOLUME 13| ISSUE 1 | JAN-MAR 2024 | 01-05
Original Research Article – Pharmaceutical Sciences

SYNTHESIS, CHARACTERIZATION AND ANTI MICROBIAL ACTIVITY OF SILVER NANOPARTICLES BY USING CHEMICAL SOURCES

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ABSTRACT

Silver has been recognized as a nontoxic, safe inorganic antibacterial/antifungal agent used for centuries. Silver demonstrates a very high potential in a wide range of biological applications, more particularly in the form of nanoparticles. Environmentally friendly synthesis methods are becoming more and more popular in chemistry and chemical technologies and the need for ecological methods of synthesis is increasing; the aim is to reduce polluting reaction by-products. Another important advantage of green synthesis methods lies in its cost- effectiveness and in the abundance of raw materials. During the last five years, many efforts have been put into developing new greener and cheaper methods for the synthesis of nanoparticles. The cost decrease and less harmful synthesis methods have been the motivation in comparison to other synthesis techniques where harmful reductive organic species produce hazardous by- products. This environment-friendly aspect has now become a major social issue and is instrumental in combatting environmental pollution through reduction or elimination of hazardous materials. This research describes a brief overview of the research on green synthesis of silver nanoparticles using natural sources.

Key words:
Synthesis, Characterization Anti-Microbial activity, Silver Nanoparticles.

INTRODUCTION OF NANOPARTICLES

A nanoparticle or ultrafine particle is a particle of matter 1 to 100 nanometers (nm) in diameter. The term is sometimes used for larger particles, up to 500 nm, or fibers and tubes that are less than 100 nm in only two directions. At the lowest range, metal particles smaller than 1 nm are usually called atom clusters instead.

Nanoparticles are distinguished from microparticles (1-1000 µm), "fine particles" (sized between 100 and 2500 nm), and "coarse particles" (ranging from 2500 to 10,000 nm), because their smaller size drives very different physical or chemical properties, like colloidal properties and ultrafast optical effects or electric properties

Being much smaller than the wavelengths of visible light (400-700 nm), nanoparticles cannot be seen with ordinary optical microscopes, requiring the use of electron microscopes or microscopes with laser. For the same reason, dispersions of nanoparticles in transparent media can be transparent,[6] whereas suspensions of larger particles usually scatter some or all visible light incident on them. Nanoparticles also easily pass through common filters, such as common ceramic candles, so that separation from liquids requires special nanofiltration techniques. nanoparticles and the influence of the method on their size and morphology.[1]

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Nanotechnology is a mindset, even though the scientific community is fascinated with the field of nanoscience, most of the ongoing discussions, definitions, and attention is focused on nanotechnology. As such, it represents a broad term which demonstrates the apotheosis of man's ceaseless urge for knowledge having practical potential. The meaning of the term nanotechnology is any technology operating on the nanoscale which has applications in the real world, that is, to employ single atoms and molecules to form functional structures [3].

Antimicrobial Activity

Antimicrobial susceptibility testing can be used for drug discovery, epidemiology and prediction of therapeutic outcome. Antimicrobial technologies employed for preservation, disinfection, and sterilization are widely used for industrial and medical purposes in reducing or eliminating microorganisms. But in the development and application of these technologies, there are at least two major considerations: the desired antimicrobial effects (the most obvious reason behind employing these technologies) and safety requirements. Therefore, the objective of the desired end point with an antimicrobial process is important in its choice and application. This can range from the unique control of an individual type of microorganism (eg, in a biosafety or research laboratory that may only be used for a certain type of microorganism), to the control of a range of potential pathogenic or spoilage microorganisms (eg, in environmental disinfection requirements in food production, research laboratory, general microbiology detection laboratories, and health care facilities), and to the complete eradication of all types of harmful or product degrading microorganisms in higher risk situation (as during the administration of injectable drugs or surgical intervention with devices) [4, 5].

Introduction To Silver Nanoparticles

Silver nanoparticles (AgNPs) are increasingly used in various fields, including medical, food, health care, consumer, and industrial purposes, due to their unique physical and chemical properties. These include optical, electrical, and thermal, high electrical conductivity, and biological properties. Due to their peculiar properties, they have been used for several applications, including as antibacterial agents, in industrial, household, and healthcare-related products, in consumer products, medical device coatings, optical sensors, and cosmetics, in the pharmaceutical industry, the food industry, in diagnostics, orthopedics, drug delivery, as anticancer agents, and have ultimately enhanced the tumor-killing effects of anticancer drugs. Recently, AgNPs have been frequently used in many textiles, keyboards, wound dressings, and biomedical devices. Nanosized metallic particles are unique and can considerably change physical, chemical, and biological properties due to their surface-to-volume ratio; therefore, these nanoparticles have been exploited for various purposes. Recently, AgNPs have shown much interest because of their therapeutic applications in cancer as anticancer agents, in diagnostics, and in probing [7, 8, 9].

MATERIALS AND METHODS

Materials

Silver Nitrate, Polyvinyl pyrrolidone, Tri-Sodium Citrate, was from Qualigens Fine Chemicals, Mumbai. The other reagents and chemicals used in the study are analytical grade only, was from Qualigens Fine Chemicals, Mumbai. The other reagents and chemicals used in the study are analytical grade only.

EXPERIMENTAL WORK:

METHODOLOGY

Preparation Of Silver Nano Particles by Using Siver Nitrate, Polyvinyl pyrrolidone and Tri- Sodium Citrate

Preparation of silver nitrate solution

Take 100ml of beaker and wash the beaker with water for removal of previous experiment particles and place the beaker in hot oven. After washing allow water particles to evaporate in oven**.** Take 100ml of distilled water [10, 11].

Preparation of polyvinylpyrrolidone solution:

Weigh the 0.5gm of polyvinylpyrrolidone and mix it into 50ml of distilled water. It should dissolve in warm water and keep it aside Preparation of 1%Tri-sodium citrate solution: weigh the 1gm of trisodium citrate and mix it into a 100ml of distilled water in beaker. Keep it aside [12, 13].

Preparation of silver nanoparticles:

Take 100ml of beaker wash it and keep it in a hot air oven. Take the 20ml of silver nitrate into the beaker from the prepared solution and add the 10ml of polyvinylpyrrolidone into the beaker and 15ml of tri sodium from above the 1% solution. Heat the mixed liquid until the colour changes. Take the beaker and magnetic bead and keep on magnetic stirrer with hot plate for few minutes. Make up to 100ml in a beaker, the colour changed is seen since it indicates the presence of silver nanoparticles [14, 15].

The above pictures show the colour change from lime yellow to black colour due to the formation of AgNPs.

UV SPECTROSCOPY:

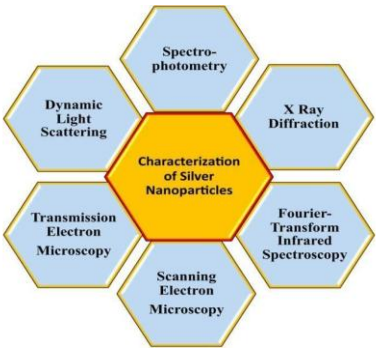

Figure 2: Various Techniques Used for Characterization of Silver Nanoparticles.

This technique is most widely utilized to characterize metallic nanoparticles by monitoring their stability and synthesis. The synthesis of a metallic nanoparticle from its salt provides a characteristic peak with strong absorptions in the visible region. Various studies have revealed that, in general, the absorption band at around 200–800 nm wavelength is best for the characterization of particles in the size range of 2–100 nm. The valence and conduction bands in silver nanoparticles are very close to each other. Electrons move freely in these bands and give rise to a surface plasmon resonance absorption band. The silver nanoparticle's absorption depends upon the chemical surroundings, dielectric medium and particle size. Examination and study of the surface plasmon peak is well known for several metal nanoparticles having a size range of 2–100 nm. The stability of silver nanoparticles produced through biological methods was examined for about 12 months and a surface plasmon resonance peak at the same wavelength was found using UV spectrophotometry.

- Samples (1 mL) of the suspension were collected periodically to monitor the completion of bio reduction of Ag^+ in aqueous solution,
- followed by dilution of the samples with 2 ml of deionized water and subsequent scan in UV spectra, between wave lengths of 200 to 700 nm in a spectrophotometer (SHIMADZU- 1601,) having a resolution of 1 nm.
- UV spectra were recorded at intervals of 0 min, 15 min, 30 min, 45 min, 60 min and 24 h.
- Absorption spectra of AgNPs formed in the reaction media has absorption maxima in the range of 425 to

475 nm due to surface plasmon resonance of AgNPs.

- The UV spectra recorded implied that the most rapid bio reduction was achieved. This was denoted by broadening of the peak which indicated the formation of poly dispersed large nanoparticles due to slow reduction rates. The formation of AgNPs occurred rapidly within the first 15mins only and the AgNPs in solution remained stable even after 24 h of completion of reaction.

Anti-Microbial Activity:

Preparation Of Culture Media:

- A bacterial or fungal strain of interest is grown in pure culture.
- Using a sterile swab, a suspension of the pure culture is spread evenly over the face of a sterile agar plate.
- The antimicrobial agent is applied to the center of the agar plate (in a fashion such that the antimicrobial doesn't spread out from the center).
- A hole can be bored in the center of an agar for a liquid substance.
- The agar plate is incubated for 18-24 hours (or longer if necessary), at a temperature suitable for the test microorganism.
- Streptomycin is used as standard solution and plant extracts are used as test solution.
- If an antimicrobial agent leaches from the object into the agar and then exerts a growth- inhibiting effect, then a clear zone (the zone of inhibition) appears around the test product.
- The size of the zone of inhibition is usually related to the level of antimicrobial activity present in the sample or product – a larger zone of inhibition usually means that the antimicrobial is more potent.
- The two plant extracts (Neem & Amla) and (Moringa oleifera & citrus sinesis) show the 2.1 cm zone of inhibition.
- The extract (Neem, onion and tomato) shows 1.5 cm of zone of inhibition.
- The extract (citrus sinesis and neem) showed 1.1 cm of zone of inhibition.
- The standard drug (streptomycin) shows 3cm of zone of inhibition.

Measures of Zone of Inhibition:

- zone of inhibition is measured using a ruler, calipers or a template
- Its size is measured in millimeters and is usually rounded off to the closest millimeter.
- The diameter of the antibiotic disk is also included in the measurement.
- These measurements are done by the naked eye without the help of any instrument.

RESULT AND DISCUSSION:

The standard drug Streptomycin shows more Anti-Microbial activity as compared to control (aqueous). The sample solution shows less anti-microbial activity as compared to standard drug. The results demonstrated that synthesis of silver nanoparticles occurred by reduction of Ag^+ ions. During this process, the colour of the reaction mixture was converted from Yellow to brown, indicating the presence of silver nanoparticles. The wavelength absorbed at 300 to 500nm.

Silver Nanoparticles (AgNPs)are one of the most vital and fascinating nanomaterials among several metallic nanoparticles that are involved in biomedical applications. AgNPs play an important role in nanoscience and nanotechnology, particularly in Nanomedicine.

CONCLUSION

This research, we presented a detail overview about NPs, their types, synthesis, characterizations, physiochemical properties and applications. Through different characterization techniques such as UV Spectrophotometer that NPs have size ranges from few nanometers to 500 nm. While morphology is also controllable. Due to their tiny size, NPs have large surface area, which make them suitable candidate for various applications. Beside this, the optical properties are also dominant at that size, which further increases the importance of these materials in photocatalytic applications. Synthetic techniques can be useful to control the specific morphology, size and magnetic properties of NPs. Though NPs are useful for many applications, but still there are some health hazard concerns due to their uncontrollable use and discharge to natural environment, which should be consider for make the use of NPs more convenient and environmentally friendly. The plant extracts of (Neem and amla) and (citrus sinensis and moringa oleifera) have shown greater Anti-microbial activity compared to others. Synthesis of nanoparticles by using plants like neem, amla, citrus synesis, moringa oleifera are useful and these plants show good anti-microbial actions.

Acknowledgements

Our Heartful gratitude for the invaluable support and contributions received throughout the duration of

"Synthesis characterization and antimicrobial activity of silver nanoparticles using various plant sources". We profusely thank and respect our Management and Nalanda College of Pharmacy for infrastructure and all other essential facilities and encouragement given to me during the project work. We take this golden opportunity to express my humble gratitude and respect to my research guide Mr. Bheema Naik Angothu in the Department of Pharmaceutical Chemistry, Nalanda College of Pharmacy. We feel proud to say that it has been the most fruitful and enjoyable experience to work under untiring guidance. We highly elated in manifesting a sense of gratitude to our honorable Professor and Principal, Dr. K. N. Venkateswara Rao, who permitted us to do this project and showered his blessings and guidance whole heartedly in every walk for our successful career.

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