# GREEN SYNTHESIS AND PREPARATION OF COLD CREAM WITH SILVER NANO PARTICLES WITH LEAF EXTRACT OF *ALOE BARBADENSIS MILLER*

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**Abstract:**
In nanotechnology, nano materials are created at molecular level which exhibit qualities quite different from the bulk material. Bulk silver, when reduced to nano-level, shows remarkable changes in the properties making it more environments friendly and useful. Nano silver exhibits unique physical and chemical properties compared to "conventional" silver (e.g., macro scale "bulk" silver). Nano silver of different shapes can be synthesized using various synthesis processes. such as electron irradiation, laser ablation, chemical reduction, biological artificial methods, photochemical methods and microwave processing.
In present work firstly we prepared the ethanolic extract of Aloevera and Silver nanoparticles (AgNPs) were synthesized by bio reduction of $Ag^+$ ions (from silver nitrate $AgNO_3$), using aqueous or ethanolic *Aloe vera* extracts as reducing, stabilizing, and size control agent and characterized by microscopy and UV. With prepared silver nano particles cold cream was prepared and compared physicochemical parameters i.e viscosity, globule size ,spredability with the control cold cream which is prepared without silver nano particles

**Keywords:** Nanomaterials, Silver nanoparticles (AgNPs), ethanolic extract, *Aloe vera*, reducing agent, stabilizing agent, Microscopy, UV, cold cream, viscosity, globule size, spredability.

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## INTRODUCTION

Silver has too much of modern industrial uses and is considered a store of wealth. However, the story of this legendary precious metal begins with its use by ancient civilizations. Silver has many attributes that made it so valuable to early peoples. It is malleable, ductile, lustrous, resilient, conductive, antibacterial, and rare. Also, it was used as a precious commodity in currencies, ornaments, jewelry, electrical contacts and photography, among others. Although bulk silver is widely known for their brilliant surfaces and colors, there is a drastic color difference when the metal reduces in dimensions. Even though the craftsmen did not know nanoparticles in that period, the mixing of the metal chlorides with molten glass led to the formation of metallic nanoparticles of different shape and size, therefore the physical formats of the metal nanoparticles had interesting interactions with light and produced visibly beautiful colors. The metal chlorides materialized and formed nanoparticles in the molten glass before cooling, making art, one of the first uses for nano technology. Nowadays, the nanoparticles are an important field of the modern research dealing with design, synthesis, and manipulation of particle structures ranging from approximately 1 to 100 nm. Nanoparticle research is currently an area of intense scientific research, due to a wide variety of potential applications in fields such as healthcare, cosmetics, food and feed, environmental health, mechanics, optics, biomedical sciences, chemical industries, electronics, space industries, drug-gene delivery, energy science, optoelectronics, catalysis, single electron transistors, light emitters, nonlinear optical devices, and photo-electrochemical area.

The silver nanoparticles have been widely used in the fields of chemistry and related branches due to their high surface to volume ratio and excellent conducting capability.

Examples of the consumer products that include nano silver including computers, mobile phones, automobile appliances, food packaging materials, food supplements, textiles, electronics, household appliances, cosmetics, medical devices, imaging techniques, and water an environment dis-infectants.

The knowledge of the silver nano materials synthesis methods is important due to an extensive application and area of use perspective.

The main problem in synthesizing the silver nanoparticles is the control of their physical properties such as obtaining uniform particle size distribution, identical shape, morphology, nano particle coating or stabilizing agent, chemical composition or type and crystal structure.

The methods can be classified and categorized that they follow common approaches and the differences such as reactants and the reaction conditions.

The conventional synthesis methods contain the use of citrate, boro hydride, two-phase systems (water-organic), organic reducers such as cyclodextrin, and micelles and/or polymer in the synthesis process.

The unconventional methods contain laser ablation, radio catalysis, vacuum evaporation of metal, irradiation, photolithography, electrode position and the electro condensation. The common fabrication of the nanoparticles includes chemical and physical processes. The top-down approach uses macroscopic initial structures, which can be externally controlled in the processing of nanostructures.

The reduction of metals, electrochemical methods, and decomposition are the examples of the bottom-up methods. In addition, the synthesis approaches can be classified as either green or non-green. Green synthetic systems use environmentally friendly agents such as sugars, plant extracts, bacteria and fungi to form and stabilize nano silver. It is important to measure nano silver concentration, size, shape, surface charge, crystal structure, Surface chemistry, and surface transformation in nanoparticle synthesis.

The characterization and detection techniques for the nano silver contain transmission electron microscopy (TEM), scanning electron microscopy (SEM), electrospray scanning mobility particle sizer (ESMPS),zeta size analysis, atomic force microscopy (AFM), dynamic light scattering (DLS), Brunauer- Emmett-Teller analysis (BET), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), X-ray absorption near edge structure (XANES), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, nuclear magnetic resonance spectroscopy (NMR), inductively coupled plasma mass spectroscopy (ICP-MS), thermal gravimetric analysis (TGA), and atomic absorption spectroscopy (AAS).

**Green synthesis of silver nano particles**

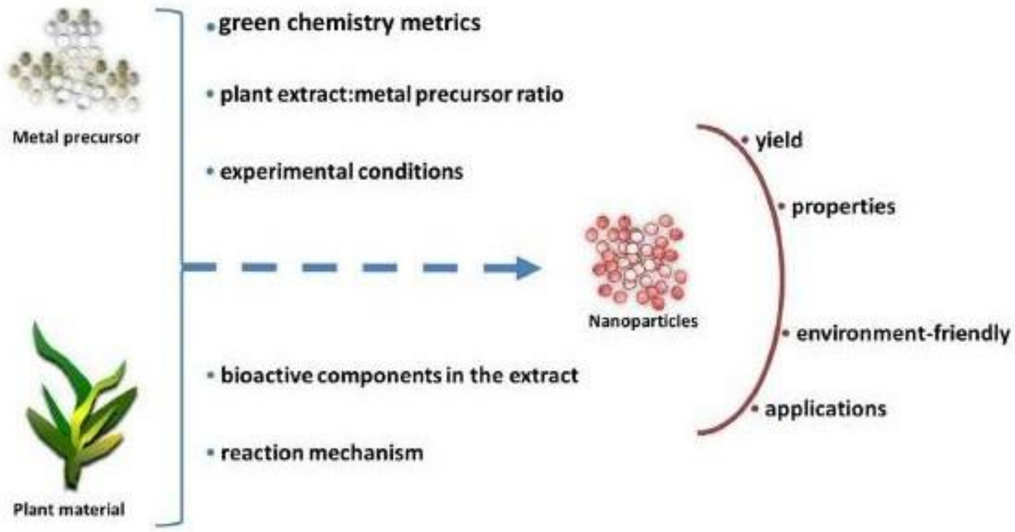


**FIG:1** Summary of important issues affecting the technology development of green synthesis of nanoparticles

Biosynthesis of the nanoparticles has received considerable attention due to the growing need to develop environmentally beneficial technologies in material synthesis. To illustrate, a great deal of effort has been put into the green synthesis of inorganic materials, especially metal nano particles using microorganisms and plant extracts. While microorganisms such as bacteria, algae, yeast, and fungi are continued to be examined so far for the intra and extracellular synthesis of metal nanoparticles, the use of parts of the whole plant in analogous with nanoparticles synthesis methodologies is an exciting possibility which is newly explored.

In the literature, various bacterial strains such as *Bacillus amyloliquefaciens, Acinetobacter calco aceticus Pseudomonas aeruginosa, Escherichia coli* and *Bacillus licheniformis* were used effectively for the synthesis of silver nanoparticles.

The benefits of using plants for the synthesis of the nanoparticles are that the plants are easily available and possess a large variety of active functional groups that can promote the reduction of silver ions. Most of the plant parts like leaves, roots, latex, bark, stem, and seeds are being used for the nanoparticle synthesis. Major compounds that ensure the reduction of the nanoparticles are biomolecules such as polysaccharides, tannins, saponins, phenolics, terpenoids, flavones, alkaloids, proteins, enzymes, vitamins, amino acids, and alcoholic component. The procedure for the nanoparticle synthesis of plants requires the collection of the part of the plant of interest from the available sites is done and then it is washed thoroughly several times with tap and distilled water to remove impurities of plants; followed with sterile distilled water to remove related wastes if any. Then, plant is dried clean and dry place in the shade for 10–15 days and then pulverized using a blender. For the plant broth preparation, an approximate amount of the dried powder is boiled with deionized distilled water. The resulting extraction is then filtered thoroughly until no insoluble material appears in the broth. Then a few mL of the plant extract is added to the silver nitrate solution whose concentration is kept at 1 mM. The reduction of Ag+ to Ag0 is confirmed by the color change of the solution. Its formation is confirmed by using UV-visible spectroscopy and transmission electron microscopy or scanning electron microscopy.

The most important plants like *Alternanthera dentate*, *Cymbopogon citratus*, *Argyreia nervosa*, phlomis, *Aloe vera*, *Carica papaya*, *Nelumbo nucifera*, *Moringa oleifera*, *Ziziphora tenuior*, *Centella asiatica*, *Swietenia mahagoni*, *bamboo hemicelluloses*, *Strychnos potatorum*, Pine, Persimmon, Ginkgo, Magnolia, and Platanus used by researchers in green synthesis.

Many different plant extracts have been used in the synthesis of silver nanoparticles with the aim of producing Ag-NPs presenting different morphologies. TEM and SEM studies have shown that the presence of reducing agent in a plant-mediated synthesis of Ag-NPs, where the plant extract acts as reducing agents, shapes the nanoparticle during its growth.The use of medicinal plants in the synthesis of Ag-NPs is not only used for size and shape control, but also for providing plant antimicrobial properties to Ag-NPs.

These features attract researchers to synthesis nanoparticles through biological routes (microorganisms and plant) for production of metal and semiconductor nanoparticles which are biologically compatible through controlled nucleation and growth. Green nanotechnology appears to be a very effectual and sound technology.

Bio-nanoparticle synthesis using plants is unique compared to chemical and physical methods because its cost effectiveness, eco-friendly and scale up process for large scale synthesis are easier. Moreover, there is no requirement of using high pressure, energy, temperature and toxic chemicals. It also reduces the work and cost involved in isolation, maintenance and preparation of microbial culture in the case of microbial routes for synthesis of nanoparticles.

Reduction of Ag+ ions to Ag0 nanoparticles was performed in a medium of *Aloe vera* extract in which no extra reducing agent was used. The silver nanoparticle sizes were found to be in a range of 70.70–192.02 nm and controllable by varying temperature and time conditions of the hydrothermal process.

## MATERIALS AND METHODS

**MATERIALS**: Aleovera is collected from local market, Analytical grade silver nitrate($AgNO_3$), ethanol absolute is utilized from our college.

## METHODS:

### *Aloe Vera* Extracts Preparation

Raw *Aloe vera* plants collected from market thoroughly washed several times with water to remove the soil &contaminants and air dried in shaded place.

15 g of inner leaf juice of *Aloe vera* leaves was heated at 80°C for 1 hour and then dried. It was used for both aqueous and ethanol extracts, using a ratio of 0.1 : 3, dry material to solvent. The resulting extracts were used in all synthesis after being filtered by gravity.[12,13]

### Preparation of Silver Nanoparticles (AgNPs)

The AgNPs were prepared by chemical reduction of an aqueous solution, 12 mM of $AgNO_3$. 50 mL of this solution is added to 30 mL of either aqueous or ethanol *Aloe vera* extract. The whole reaction was carried out in presence of air and constant and neutral pH. The mixture was vigorously stirred at temperature of 57°C during 3 h and then heated 2°C/min to reach 80°C holding for 2 hours until obtaining a translucent solution with small suspended particles that could be removed by simple filtration (0.45 $\mu$m).[14,6]

**Fig no:2** Photography while forming the silver nano particles

### Characterization of Silver Nanoparticles

### UV-Visible Spectroscopy Analysis

Synthesis of silver nanoparticles is visually confirmed by the transformation of the pale white colored silver nitrate solution into dark brown colored solution. Primarily the formation of silver nanoparticle is confirmed by the absorption spectra of the synthesized silver nanoparticles solution. The synthesized silver nanoparticles are scanned in the range 200-800nm. This is done to obtain the Surface Plasmon Resonance peak centered at maximum absorbance. The lambda max helps us to determine the presence of silver in the solution. The electronic bond transitions of π and σ is the basic principle of UV-Vis spectroscopy. Distilled water is kept as blank and double beam spec analysis with sample is performed. The reduction of silver nitrate (Ag+ ions) to silver nanoparticles (Ag0 ) is monitored by analyzing the samples. The analysis is carried out at UV-Vis Double Beam Spectrophotometer .[15,6]

**Microscopic observation**:

Prepared silver nano particles were focused under Microscopy by mounting it over the glass slide and image was shown in fig no-4.

### Scanning Electron Microscopy

It is important to study the morphology of the synthesized silver nanoparticles. The morphology of the silver nanoparticles changes before and after sorption. Thus, SEM images of the silver nanoparticles before and after sorption are taken. The micrographs are recorded using JEOL – Scanning Electron Microscope (SEM), JSM – 5610LV, with an accelerating voltage of 20KV, at high vacuum (HV) mode. [16,6]

## COLD CREAM FORMULATION

To prepare 50 g cold cream, 10 g of bee wax was added to 30 g of liquid paraffin in a water bath at 90 $^{o}$C for the oil phase. 0.5g borax was dissolved in 9.5 ml of distilled water at 50$^{o}$ C to prepare the aqueous phase. The aqueous phase was used to dissolve the silver nanoparticles and the mixture was slowly added with continuous stirring to the oil phase to form a cold cream silver nanoparticles. Another cold cream without the nanoparticles was also formulated to serve as control.[6]

**Table No-1** Formulation of control and Silver nano particle Cold creams

| Ingredient Name | Control Cold Cream | Silver nano Particle Cold Cream |
|---|---|---|
| Bees wax | 10gm | 10gm |
| Liquid Paraffin | 30 gm | 30 gm |
| Borax | 0.5 gm | 0.5 gm |
| Water | 9.5 ml | 9.5 ml |
| Silver Nano Particles | - | 100 mg |
| Total weight | 50 gm | 50 gm |

Prepared cold creams were observed visually. Silver nano particle cold cream appeared in light brown colour and control cold cream was in white colour.

## EVALUATION OF CREAM FORMULATIONS [6]

### Determination of the physical appearance of the formulated cream

The prepared creams were inspected visually for color uniformity, homogeneity, texture and consistency. Homogeneity and the cream texture were examined by rubbing a small quantity of the cream formulation between the thumb and index finger. Consistency and presence of coarse un dissolved materials were used to evaluate if the cream is homogenous and smooth or not.

## DETERMINATION OF SPREADABILITY

1g of the cream was applied in between two glass slides pressed thoroughly to remove air and provide a uniform film of the cream between the slides for 5 min upper slide is removed and then placed with afresh slide and with the help of timer the time taken for the upper glass slide to move over the lower plate was noted.

## DETERMINATION OF PH

The pH of the cream was determined using a pH meter at room temperature. 1g of cream was weighed and dissolved in 100 ml of oil and allowed to stand for 2 h. The pH were taken in triplicates.

## DETERMINATION OF THE VISCOSITY

The viscosity of the creams at different shear rates was determined using a Brookfield model DVE51 viscometer, spindle no S – 64 at 20 rpm at a temperature of 25 $^{o}$C and the determinations were done in triplicate and the average was recorded.

## DETERMINATION OF TYPE OF EMULSION (DILUTION TEST)

Dilution test of the formulated cream was done according to the standard procedure from book. The emulsion was diluted with both oil and water. The diluents were observed for stability. The o/w type emulsion is stable on dilution with water but not stable when diluted with oil. Oil in water emulsion can be easily diluted with an aqueous solvent, whereas water in oil emulsion can be diluted with an oily liquid.

### Globule size

To determine the globule size, 1 ml of cream was diluted with 10 ml of glycerin. Few drops of the diluent was placed on a glass slide and observed under the microscope using an eyepiece micrometer. The diameters of 200 particles were determined randomly.

## PHASE SEPARATION

To determine the phase separation of the formulated cream samples, the formulated cream was kept intact in a closed container at room temperature and away from light. An indication of phase separation was carefully observed every 24 h for 30 days.

## Results & Discussion:

***Aloe vera* extraction:** Extraction of the leaves of ***Aloe-vera*** was done using methanol and water and the extract were used to synthesize Ag NPs.

**Preparation of Silver Nanoparticles (AgNPs)**
Ag NPs were synthesized using both the aqueous and methanol extract without the need for additional stabilizing agent. Formation of nanoparticles was observed as a color change from yellow to brown (using aqueous extract) and from light yellow to yellowish brown (using methanol extract).

**UV-Visible Spectroscopy Analysis**
The UV-Vis Spectra of SNPs biosynthesized using the crude aqueous and methanol fruit extract is shown in the Fig. 2. The spectra shows absorption peak at about 600 nm for both aqueous and methanolic SNPs which is characteristic of SNPs.

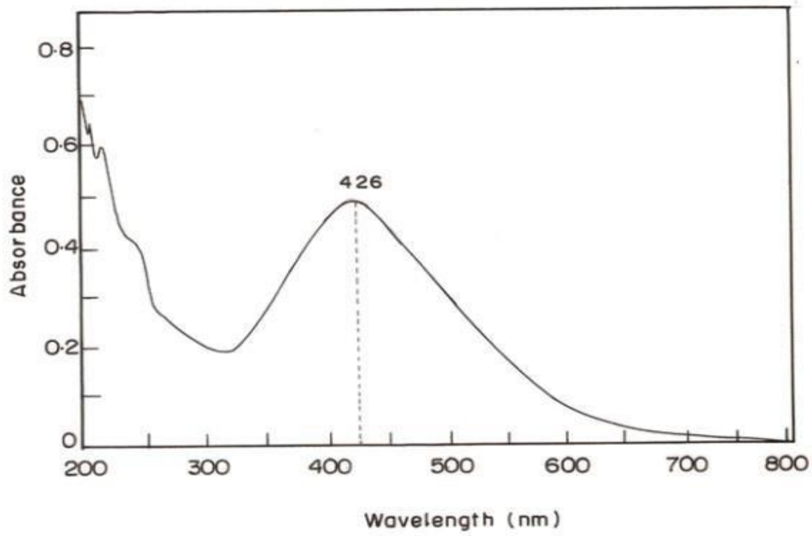


**fig no 3 :** UV spectrum of prepared silver nano particle

**Microscopic observation**: Prepared silver nano particles were focused under Microscopy by mounting it over the glass slide and image was shown in fig no-4.

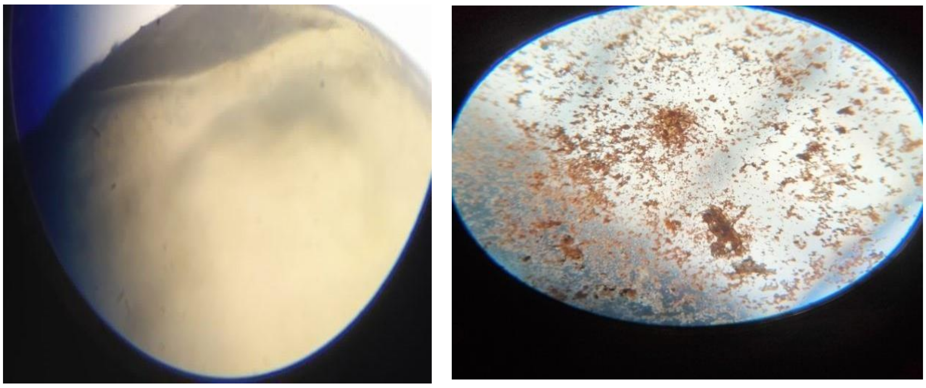

**Fig no-4** Microscopic image of Silver Nano Particles

**Formulation of Cold Cream**
As for the Table no 1 Silver nano particle cold cream and cold cream without silver nano particles (control) were prepared for comparison.

**EVALUATION OF CREAM FORMULATIONS**

**Determination of the physical appearance of the formulated cream**
Control cold cream is in white color with visual observation and silver Nano particle cream is in brown color.

**Determination of Spread ability**
The time taken for the top glass to slide over the bottom glass is shown in table no-2. Spread ability results of the creams indicate that the viscosity of the creams gave cream spread by a small amount of shear.

**Determination Of pH**
pH of the formulated cold cream samples and control cold cream was evaluated by digital pH meter. The mean pH of the Ag NPs cold cream biosynthesis using extract of Aloevera and

Control creams are 6.0, and 5.9, respectively. The pH of the cold cream prepared with alovera all within the normal range of 6–7 while the control cream is slightly acidic. This implies that these creams can be applied on the skin with decreased risk of skin irritation. The human skin has a slightly acidic pH of about 5.5 which allows it to fight infection and other environmental toxins. Use of products that alter the skin pH can affect its protective function. Hence topical products are expected to have a pH range of 6–7 to avoid alteration of the skin pH. Results were shown in table no-2.

Viscosity is a rheological property of a material which can affect its flow properties. In semi-solid formulations such as creams consisting of two immiscible materials, rheological properties like viscosity and thixotropy .The viscosity of the formulated cold cream samples is shown in table no2. The cold cream sample formulated using Ag NPs biosynthesized from methanol extract of Aloevera had higher viscosity compared to control cold cream samples. Results shown in table no-2.

**Table no-2** Evaluation of silver nano particle cold cream

| Parameter | Silver Nano Particle Cold Cream | Control cold cream |
|---|---|---|
| **Visual observation** | **Light brown** | **White** |
| **Spread ability** | 14 ± 2 sec | 12 ± 2sec |
| **Ph** | 6.5 | 5.4 |
| **Dilution test** | Diluted with oil phase | Diluted with oil phase |
| **Viscosity** | 4525cp | 3850cp |
| **Mean Globule size** | 258μm | 195 μm |

**Determination of Globule size** To gain insight on the stability of the formulated sample cream, the globule size and shape were measured and observed using a microscope.. Particle size of the formulated cold cream samples Measurement of the particle size of the cream globules indicates μm and results shown in table no2.

**Dilution Test Of The Formulated Cold Cream Samples**

The solubility of the formulated cream was found to be in liquid paraffin and not water; hence the emulsion is water/oil type of emulsion.

**Phase separation**

There was no evidence of phase separation after 30 days of observation, indicating that the cream formulations are stable.

**SUMMARY AND CONCLUSION**

The crude fruit extracts of Aloevera contain bioactive metabolites with functional groups which were effective in reducing and capping silver ions to nanoparticles. The cream formulations had lower antimicrobial activity compared to the AgNPs formulated cream. The aqueous extract of Aloevera fruits can be used to effectively synthesize SNPs and to the best of our knowledge, this is the first study to use Aloevera leafs extract in synthesis of AgNPs with simple method.

The biologically synthesized AgNPs of the crude aqueous extract of Aloevera can be used as growth inhibitors of micro-organisms and can be applied in various medical processes, water treatment and antimicrobial control systems.

The SNPs can be formulated as creams for the topical treatment of various bacterial and fungal skin infections when the safety of Ag SNPs is established.

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