Facile Green Fabrication of Gold Nanoparticles using *Desmostachya Bipinnata* and its Biomedical Application Studies

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Abstract:- Gold nanoparticles has many applications in medical field such as drug delivery, bio-imaging, cancer therapy etc. Green fabrication of gold nanoparticles was studied using *Desmostachya bipinnata* (Halfa grass or Darbha). The aqueous extract of this used as reducing agent, mixed with the Chloroauric acid solution and the mixture was kept under continuous stirring. The color change of the solution into ruby red indicates the formation of gold nanoparticles was observed. The synthesized gold nanoparticles was characterized using UV- Visible spectrophotometer, the SPR band formed at 560.0 nm. Further, the synthesised gold nanoparticles were subjected to antioxidant property and anti-bacterial activity.

**Keywords**:- Green Fabrication, Gold Nanoparticles, UV-Visible Spectrophotometer, Antioxidant Property, Antibacterial Activity.

I. INTRODUCTION

A metal nanoparticle has wide range of applications in the field of industry, medicine, agriculture etc. Gold nanoparticles compared to other metal nanoparticles as significant importance due to its optical property of SPR band formation from visible to IR region and also due to its biocompatibility and non-toxicity [1]. It has been utilized in microchip and sensor manufacturing, drug delivery, disease diagnosis and treatment [2]. The nanoparticles can be synthesised by various physical and chemical method, but it as major disadvantages like high cost, release of unwanted substances, use of toxic chemical, requires maintenance of temperature, pressure etc [3]. To overcome this drawback, the biological method of gold nanoparticles synthesis has been attracted in the present study, the aqueous extract of *Desmostachya bipinnata* is utilized. The plant *Desmostachya bipinnata* belongs to Poaceae family, commonly known as Halfa grass or Darbha. It is a sacrificial grass [4]. It has been used in human history as medicinal appliances. The stem extract of the grass used as diuretic. Leaves are utilized for cuts and wounds [5]. To treat irregular menses, jaundice and asthma root extract is used. Traditionally in India it has been used as folklore medicine to cure various ailments [6].

II. EXPERIMENTAL

A. Chemicals

The 99.9% pure Chloroauric acid was purchased from Loba Chem Pvt Ltd, Chennai. The double water, ascorbic acid and Muller Hinton Agar medium were purchased and chemicals prepared were standard and merck.

B. Collection of Plant and Extract Preparation

Disease free plants were collected from our campus GKM CET, Kanchipuram District. The plants were segregated into parts and washed with distilled water to remove the dust and sand particles. 5g of fresh leaves were taken in 250 mL conical flask and 50 mL of deionised water were added to it. The flasks were kept for boiling at 80°C on the heating mantel for 30 minutes. After boiling, the crude extract was filtered using Whatmann Filter paper No:1. The filtrate was stored at frozen condition for the further use. The presence of bio molecules in the extract was analysed by using standard procedure.

C. Green Fabrication of Gold Nanoparticles

1mM concentration of Chloroauric acid solution was prepared using deionised water. 5 mL of plant extract was added to 45 mL of 1mM of Chloroauric acid solution. The solution mixture was kept under heat treatment by continuous stirring. The color change of the solution from light green into ruby red indicates the gold nanoparticles formation. Further, it was confirmed by using UV-VISIBLE Spectrophotometer, in the range of 400-800 nm.

D. Antioxidant Property

Hydrogen peroxide scavenging assay is utilized to study the antioxidant property of the synthesised gold nanoparticles. 40 mM of H\(_2\)O\(_2\) was prepared with PBS buffer 7.4 pH. The PBS buffer without H\(_2\)O\(_2\) is used as blank. The ascorbic acid is used as standard. The different concentrations of gold nanoparticles were analyzed with H\(_2\)O\(_2\) mixed PBS buffer solution. The solution mixture was kept for 10 minutes incubation and analysed 560 nm using UV-VISIBLE spectrophotometer. The percentage of inhibition was measured using the formula:

\[
\%\text{Inhibition} = \frac{\text{Absorbance}_{\text{control}} - \text{Absorbance}_{\text{sample}}}{\text{Absorbance}_{\text{control}}} \times 100
\]
**E. Antibacterial activity**

Well diffusion method was used to study the antibacterial activity of the synthesised gold nanoparticles using Muller Hinton Agar Media. One day culture of *E. coli* and *B. substilus* were used for the study. The media was prepared and poured onto the sterile petriplate and allowed to solidify and the wells were punched using sterile cork borer. The wells were loaded with colloidal nanoparticle solution and plant extract. Nalidixic acid (Na\(^{30}\)) is used as control.

**III. RESULT AND DISCUSSION**

The green route to synthesise gold nanoparticle is simple, less cost and non-toxic method. The gold nanoparticle was synthesized using aqueous extract of *Desmostachya bipinnata*, and the plant extract was analysed for the presence of biomolecules compounds which acting as reducing agent and stabilizing agent to reduce the gold ions into gold nanoparticles. The presence of bioactive compounds such as follows:

A. **Green Synthesis of Gold Nanoparticles**

The gold nanoparticles were synthesized by addition of aqueous extract of *Desmostachya bipinnata*. The color change of the solution was visually observed that light green into ruby red color. The pH of the solution was 6.85. (Figure 1)

![Desmostachya bipinnata mediated synthesized gold nanoparticles](image1)

**Table:** Presence of Bioactive Compounds in Aqueous Extract *Desmostachya Bipinnata*

<table>
<thead>
<tr>
<th>S. NO</th>
<th>PHYTOCHEMICALS</th>
<th>AQUEOUS EXTRACT OF FRESH LEAVES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>Desmostachya bipinnata</em></td>
</tr>
<tr>
<td>1</td>
<td>Carbohydrates</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Tannins</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Saponins</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Flavonoids</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Alkaloids</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Quinones</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>Glycosides</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Cardiac glycosides</td>
<td>+</td>
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<tr>
<td>9</td>
<td>Terpenoids</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>Phenols</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>Coumarins</td>
<td>+</td>
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<tr>
<td>12</td>
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<td>+</td>
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<td>13</td>
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<td>14</td>
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</tr>
<tr>
<td>15</td>
<td>Anthraquinones</td>
<td>-</td>
</tr>
</tbody>
</table>

![UV-Visible Spectra of Desmostachya Bipinnata Synthesised Gold Nanoparticles](image2)

B. **UV-Visible Spectrometer Analysis**

The colloidal solution synthesised gold nanoparticles were analysed using UV-Visible spectrometer. The SPR band obtained at 560.0 nm. (Figure 2)

**C. Antioxidant Property**

The antioxidant property of *Desmostachya bipinnata* synthesized gold nanoparticles was studied using Hydrogen peroxide scavenging assay. The different concentrations of gold nanoparticles were assessed at 560 nm using PBS buffer with H\(_2\)O\(_2\). The ascorbic acid was used as standard. (Figure 3)
**D. Antibacterial Activity**

The antibacterial activity of *Desmostachya bipinnata* synthesised gold nanoparticles were studied using well diffusion method using (figure 4, 5) *E. coli* and *B. substilus*. Zone of inhibition was measured in mm (table 2).

<table>
<thead>
<tr>
<th>S. No</th>
<th>Microorganism</th>
<th>Zone of inhibition in mm</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Plant extract</td>
<td>Synthesized gold nanoparticles</td>
</tr>
<tr>
<td>1</td>
<td><em>E. coli</em></td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td><em>B. substilus</em></td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 2: Zone of Inhibition (Control: 16 mm)

**IV. CONCLUSION**

Biosynthetic route of nanoparticles synthesis is tremendous, ecofriendly and emerging as safer and alternate to conventional methods. Thus the present investigation deals with *Desmostachya bipinnata* mediated synthesis of gold nanoparticles was done and was confirmed by color change into ruby red color and further confirmed by UV- Visible spectra of SPR band obtained at 560.0 nm. The antioxidant property of the *Desmostachya bipinnata* mediated synthesised gold nanoparticles showed gradual raise of scavenging activity against hydrogen peroxide. The antibacterial activity showed maximum zone inhibition in *E. coli* and followed by *B. substilus*. Hence, the research is further extended to investigation of *Desmostachya bipinnata* mediated synthesised gold nanoparticles as drug delivery systems. Thus, biosynthesis of gold nanoparticles eye opens the young scientists to utilize the green route to fabricate nanoparticles for medical applications.

**REFERENCES**


