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Green Silver and Gold Nanoparticles Methods of Biological Synthesis and Prospects for Biomedical Uses

Mia Kirshner*

Department of Chemical and Biomolecular Engineering, California Institute of Technology, Pasadena California, USA

Introduction

Nanoparticles, particularly those composed of metals like silver, gold, and green nanoparticles, have garnered substantial interest in the scientific and medical communities due to their diverse properties and potential applications. Green, silver, and gold nanoparticles each offer distinct advantages for biomedical uses, ranging from antimicrobial treatments to cancer therapies. The biological synthesis of these nanoparticles is gaining significant attention because of its eco-friendly, cost-effective, and sustainable nature compared to conventional chemical methods. This approach utilizes natural resources, such as plant extracts, microorganisms, or enzymes, to synthesize nanoparticles, making it a promising alternative to more traditional techniques that often involve toxic chemicals [1].

Description

The biological synthesis of nanoparticles refers to the method of producing nanoparticles using biological materials such as plants, fungi, bacteria, or algae. One of the main advantages of this method is that it avoids the toxic chemicals and solvents that are typically used in chemical synthesis, making it more environmentally friendly. Additionally, it offers the possibility of scaling up production while maintaining the stability and uniformity of the nanoparticles. In this process, various types of plant extracts, such as those from green tea, medicinal herbs, or even fruits and vegetables, serve as reducing agents that assist in converting metal ions into their respective nanoparticles. This method has shown promise for producing nanoparticles with a broad range of sizes, shapes, and surface properties, which is critical for tailoring nanoparticles to specific biomedical applications [2].

Gold nanoparticles have also garnered significant interest in biomedical applications, primarily due to their unique optical, electronic, and chemical properties. Gold nanoparticles are biocompatible, non-toxic, and highly stable, which makes them ideal candidates for use in medical diagnostics, drug delivery, and imaging. Their size and shape can be easily modified, allowing for targeted drug delivery to specific cells or tissues. Additionally, gold nanoparticles can be functionalized with various ligands, antibodies, or drugs to enhance their therapeutic potential. One of the most notable applications of gold nanoparticles is in cancer therapy, where they are used in photo thermal therapy. In this technique, gold nanoparticles are delivered to tumor sites, and upon exposure to near-infrared light, they generate heat, which helps destroy cancer cells. Moreover, gold nanoparticles can be used in diagnostic imaging due to their strong surface Plasmon resonance, which enhances their ability to scatter light and provide detailed images [3].

The use of green nanoparticles in medicine holds significant promise due to their antimicrobial, anticancer, and anti-inflammatory properties. The antioxidant and anti-inflammatory effects of green nanoparticles can help in the treatment of various diseases, including neurodegenerative disorders and cardiovascular diseases. Studies have shown that green nanoparticles can be used as effective carriers for targeted drug delivery, where they can deliver drugs directly to the site of disease, thereby minimizing side effects and improving therapeutic outcomes. In addition to their medical uses, green nanoparticles have potential applications in environmental remediation, where they can be employed to remove toxins and pollutants from the environment [4].

The biological synthesis of silver, gold, and green nanoparticles has many advantages over traditional chemical and physical synthesis methods, including the use of renewable resources, the avoidance of toxic chemicals, and the potential for large-scale production. However, there are still challenges that need to be addressed before these nanoparticles can be widely adopted in clinical settings. For instance, the reproducibility of nanoparticle synthesis using biological methods can sometimes be problematic, and the stability of the nanoparticles may vary depending on the biological material used. Additionally, the scale-up of nanoparticle production from laboratory to industrial levels is still a challenge that requires further research and development [5]. Despite these challenges, the future prospects for the use of green, silver, and gold nanoparticles in biomedicine are promising. Continued research into the biological synthesis of these nanoparticles could lead to the development of more effective and environmentally friendly methods for producing nanoparticles at a larger scale. Furthermore, as our understanding of the interactions between nanoparticles and biological systems improves, we may see an increase in the use of these nanoparticles in a wide range of medical applications, from drug delivery to cancer therapy and diagnostics. The development of green nanoparticles, in particular, could provide a more sustainable approach to Nano medicine, offering a safer and more cost-effective alternative to traditional methods.

Conclusion

Green, silver, and gold nanoparticles are versatile and promising candidates for a wide range of biomedical applications. The biological synthesis of these nanoparticles offers numerous advantages, including eco-friendliness, sustainability, and biocompatibility, making them ideal for use in medical treatments and diagnostics. While there are still challenges to overcome, particularly in terms of reproducibility, stability, and scale-up, the future of Nano medicine looks bright. With ongoing advancements in nanoparticle synthesis and a deeper understanding of their interactions with biological systems, these nanoparticles have the potential to revolutionize medicine, providing new treatments and therapies for a variety of diseases.

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Conflict of Interest

None.

***Address for Correspondence:** Mia Kirshner, Department of Chemical and Biomolecular Engineering, California Institute of Technology, Pasadena California, USA; E-mail: miakirshner@gmail.com*

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