Biosynthesis of Zinc Oxide Nanoparticles Using Vaccinium arctostaphylos Extract

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Abstract

Nanotechnology — the science and application of technology on the atomic and molecular scale — is among the most significant emerging technologies of the 21st century, profoundly influencing global economic and industrial development. Given the environmental effects of nanoparticles, biological synthesis methods have recently attracted great attention. In this project, zinc oxide (ZnO) metal nanoparticles were synthesized biologically using Vaccinium arctostaphylos (bilberry) extract, and their formation was confirmed through various analytical techniques. The synthesized nanoparticles exhibited desirable morphology and purity.

Introduction

Nanotechnology can be considered as a field of science and engineering where materials and devices are designed, synthesized, and applied at scales below 100 nm. Because of their unique properties, nanoparticles have wide applications in developing new and effective therapeutic and pharmaceutical tools. Traditional physical and chemical synthesis methods often involve toxic reagents and high costs, leading to environmental concerns. Hence, green and biological synthesis approaches have gained much attention as safe, eco-friendly, and cost-effective alternatives.

Method Summary

Dried fruits of Vaccinium arctostaphylos were ground and soaked in ethanol to obtain the plant extract. The extract was then mixed with zinc nitrate [Zn(NO3)2·4H2O] to initiate nanoparticle synthesis. After adjusting the pH to around 6 using NaOH, the mixture was stirred magnetically and heated. The resulting precipitate was washed, centrifuged, dried, and calcined to obtain pure ZnO nanoparticles.

Results and Discussion

The ZnO nanoparticles synthesized through this green method showed spherical morphology under SEM imaging, with particle sizes in the nanometer range. XRD analysis confirmed the crystalline structure of ZnO, and EDX results demonstrated high elemental purity. The biosynthetic method proved to be efficient, non-toxic, and environmentally sustainable.

Conclusion

In conclusion, this study presents a simple, eco-friendly, and low-cost method for synthesizing zinc oxide nanoparticles using Vaccinium arctostaphylos extract. The biologically produced nanoparticles are suitable for various biomedical and industrial applications due to their purity and favorable properties.

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