IOCFB 2024 Conference
The 1st International Online Conference on Functional Biomaterials
10–12 July 2024 | Online

# Phytosynthesis of Core-Shell Nanoparticles of Selenium and Silver for Biomedical and Environmental Applications

Jainisha Thadhani*, G. Roshan Deen*, Fryad Henari
Materials for Medicine Research Group, School of Medicine, Royal College of Surgeons in Ireland, Medical University of Bahrain, Kingdom of Bahrain

## INTRODUCTION

The development of nanoparticles (1-100nm) by green methods has gained considerable research attention in medical applications such as cancer therapy, tissue engineering, and target-specific drug delivery due to its high surface area-to-volume ratio. In addition to their non-toxicity, surface functionality, and stability, using green methods of synthesis helped us overcome constraints posed by organic hazardous materials. (1)

Bimetallic nanoparticles are preferred over monometallic ones due to their superior catalytic properties and greater surface area, enhancing their adsorption power. BNPs have shown great promise when used in the diagnostics field and as a result can be found in MRI contrast agents, environmental catalysts, and wound dressings, they are also used to reduce side effects and toxicity of pharmaceutical drugs. (9)

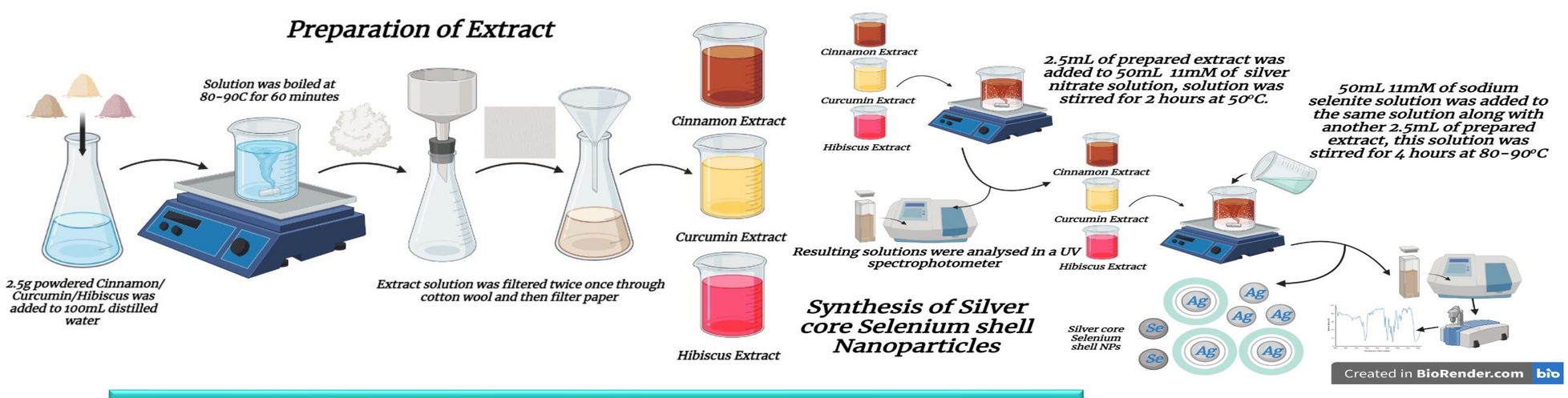
We experimented with creating a silver/selenium core with a selenium/silver shell with the use of cinnamon, turmeric, and hibiscus extracts. Silver core nanoparticles are known to be agreeable with biological components like antibodies in addition to their uniformity and antimicrobial properties, making them a viable candidate for human application. (1-3,7,8)

Cinnamon is rich in cinnamaldehyde touted for its benefits, such as inhibiting the growth of A. flavus, a fungi that contributes to food spoiling (4). Making cinnamon a great candidate for aiding as a reducing agent in nanoparticle synthesis. Like cinnamon, hibiscus is packed with antioxidants to help the body fight free radicals in conditions like hypertension and scalp dermatitis. Research also suggests hibiscus has anti-hyperlipidemic and blood-glucose-lowering effects in humans (5). Due to the ancient use of curcumin as an anti-inflammatory, it was an essential choice to experiment with its usage in the synthesis of nanoparticles. Curcumin, the active ingredient in turmeric, has shown its effectiveness in managing a diverse array of diseases ranging from arthritis to metabolic syndromes. The magically aligned contrast between the hindrance of using curcumin due to its slow metabolism and the fast absorption of nanoparticles makes this an ideal candidate for such an experiment (6).

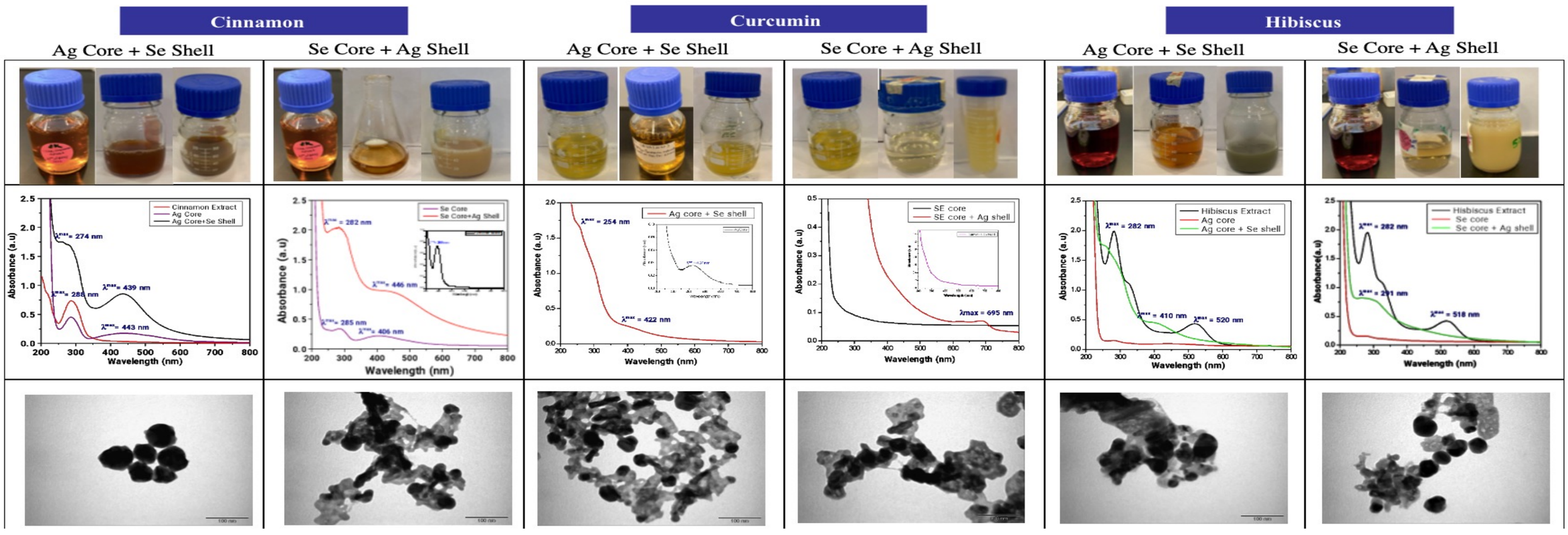
## AIM

- To synthesize core-shell nanoparticles of silver and selenium using three different plant products
- To use cinnamon, hibiscus, and curcumin extracts as reducing and stabilizing agents without the need for toxic chemical reducing and stabilizing agents
- To investigate the biomedical and environmental applications of the new materials

## METHOD




## RESULTS & DISCUSSION




- The surface plasmon resonance peaks of silver/selenium and their corresponding shells indicate the formation of core-shell nanoparticles.
- The TEM results depict that the size of the core-shell particles is below 100 nm.
- The particles exhibit various morphologies like spherical and plate-like
- The dark contrast indicates that the nanoparticles are capped/decorated with phytochemicals present in the plant extracts
- This was further confirmed by infrared spectroscopy (data not shown)

## CONCLUSION AND ONGOING WORK

- Stable core-shell nanoparticles based on selenium and silver were successfully prepared using various plant extracts. The phytochemicals present in plants acted both as chemical reducing and stabilizing agents. The potential application of these materials as antimicrobials, in cancer therapy/diagnosis, and environmental remediation is currently under investigation.

## REFERENCES

1.Acharya D, Mohanta B, Pandey P. Green synthesis of Silver and Silver-gold core-shell nanoparticles using Pineapple leaf extract (Ananas comosus) and study of their antibacterial properties. International Journal of Nano Dimension.
2. Khan I, Saeed K, Khan I. Nanoparticles: Properties, applications and toxicities. Arabian Journal of Chemistry.
3. Tang S, Zheng J. Antibacterial Activity of Silver Nanoparticles: Structural Effects. Advanced Healthcare Materials.
4.Qu S, Yang K, Chen L, Liu M, Geng Q, He X et al. Cinnamaldehyde, a Promising Natural Preservative Against Aspergillus flavus. Frontiers in Microbiology.
5.Philip D. Green synthesis of gold and silver nanoparticles using Hibiscus rosa sinensis. Physica E: Low-dimensional Systems and Nanostructures.
6.Hewlings S, Kalman D. Curcumin: A Review of Its Effects on Human Health. Foods.
7.Olawale F, Ariatti M, Singh M. Biogenic synthesis of silver-core selenium-shell nanoparticles using Ocimum Tenuiflorum L.: response surface methodology-based optimization and biological activity. Nanomaterials. 2021 Sep 27;11(10):2516.
8. Narayanan K, Sakthivel N. Biological synthesis of metal nanoparticles by microbes. Advances in Colloid and Interface Science
9.Sharma G, Kumar A, Sharma S, Naushad M, Dwivedi RP, ALOthman ZA, Mola GT. Novel development of nanoparticles to bimetallic nanoparticles and their composites: A review. Journal of King Saud University-Science. 2019 Apr 1;31(2):257-69.