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ANTIBACTERIAL PROPERTIES OF SILVER NANOPARTICLES SYNTHESIZED USING *PIPER LETLE L.* LEAF EXTRACT

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Introduction

- The multidrug-resistant bacteria is recognized to be one of the most important current public health problems.
- Silver nanoparticles (AgNPs) are effective antimicrobial agents to control broad-spectrum pathogenic microorganisms including multidrug-resistant bacteria.
- The traditional chemical synthesis method commonly employs non-biodegradable toxic chemicals as reducing agents, restricting the biomedical applications of prepared nanoparticles.
- The bio-constituents present in the plant extracts could be utilized as both reducing and capping agents for green synthesis of AgNPs.
- *Piper betle L.* (PBL) has been used as a traditional Vietnam medicinal plant for masticatory, containg phenolic compounds, amino acids, proteins, several terpenes and terpenoids, which possess strong reducing power.

Objective

- Investigate a green approach for preparation of AgNPs by the reduction of Ag^+ ions to Ag^0 with bio-reductants in the PBL leaf extract.
- Identify the antibacterial activity of the biosynthesized AgNPs on two gram-negative bacteria (*Escherichia coli (E. Coli)* and *Pseudomonas aeruginosa (P. aeruginosa)*) and one gram-positive bacteria (*Staphylococcus aureus (S. aureus)*).

Experiment

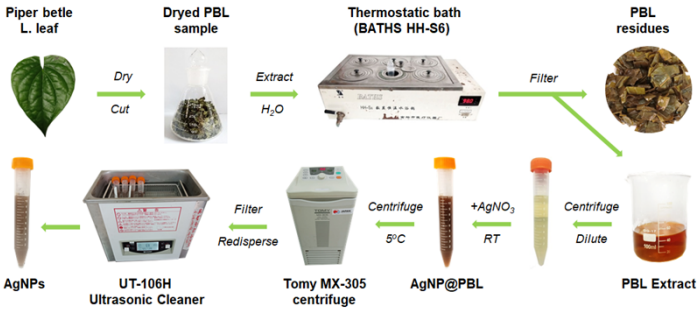

***Fig. 1.** Schematic illustration of the aqueous extraction process of PBL and the synthesis of AgNPs using the PBL extract.*

Results

1. UV-Vis Spectroscopy

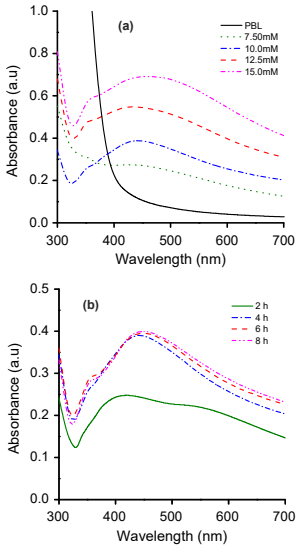

***Fig. 2.** UV/Vis spectra of AgNPs using PBL extract as a function of (a) Ag^+ concentration, (b) Reaction time.*

2. Morphological and Structural Studies

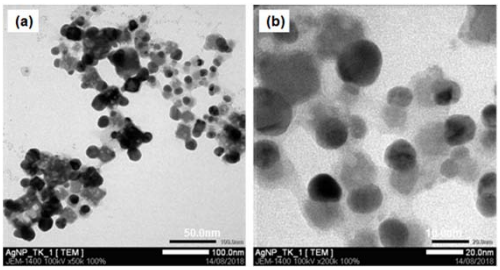

***Fig. 3.** TEM micrographs of AgNPs synthesized at the chosen condition (10 mL diluted PBL extract, 1mL $AgNO_3$ 10 mM and 4 h reaction time) with different magnification: (a) ×50k and (b) ×200k*

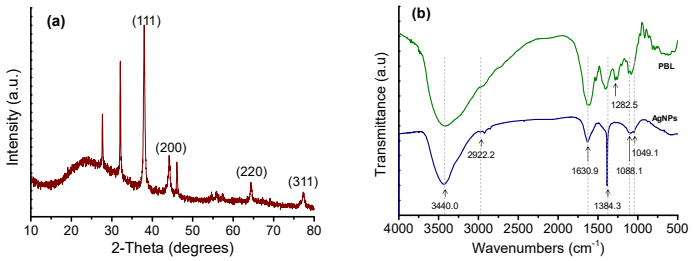

***Fig. 4.** (a) XRD pattern of AgNPs and (b) FTIR spectra of PBL and AgNPs.*

3. Antimicrobial Activities

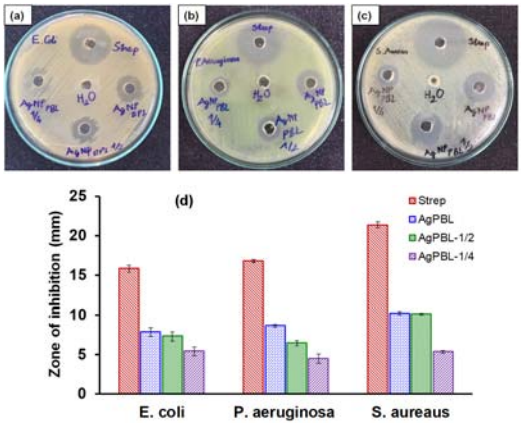

***Fig. 5.** The photographs showing zone of inhibition of the AgNPs against (a) E. coli, (b) P. aeruginosa and (c) S. aureus: negative control (H_2O); positive control (Streptomycin 30 μg/mL); AgPBL (AgNPs 100 μg/mL); AgPBL-1/2 (AgNPs 50 μg/mL) and AgPBL-1/4 (AgNPs 25 μg/mL); (d) Quantitative evaluation of antibacterial activity of the AgNPs against the pathogenic bacteria ((±SD, n = 3).*

Conclusions

- Silver nanoparticles with an average size of 10-20 nm were synthesized *using Piper betle L. leaf extract.*
- AgNPs were characterized using UV-Vis, TEM, XRD and FTIR techniques.
- AgNPs exhibited potential antibacterial activities against *Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus* bacteria.

Acknowledgments

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