The 5th ENFO Student Research Workshop (ENFO-SRW)

SYNTHESIS OF SILVER NANOPARTICLES USING ESSENTIAL OILS AND PRELIMINRARY EXAMINATION OF ITS ANTIBACTERIAL ACITIVITY

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ABSTRACT

In this study, silver nanoparticles (AgNPs) were synthesized green chemically from diluted acetone essential oil. The influencing parameters when synthesizing such as the effect of essential oils, the effect of pH, the effect of the concentration of the essential oil, the effect of the concentration of silver nitrate, the effect of temperature, the antibacterial ability. Structural features of biosynthesized AgNPs were determined by color observation, methods such as UV-Vis absorption spectroscopy, Dynamic Light Scattering and Transmission Electron Microscopy, which showed the spherical shape of AgNPs with the size of 28 – 80 nm. In addition, there is antibacterial activity of the suspension system of AgNPs as against gram-negative and gram-positive bacteria such as *Staphylococcus Aureus* (*S.aureus*), *E.coli*, *Bacillus cereus*.

MATERIAL & METHOD

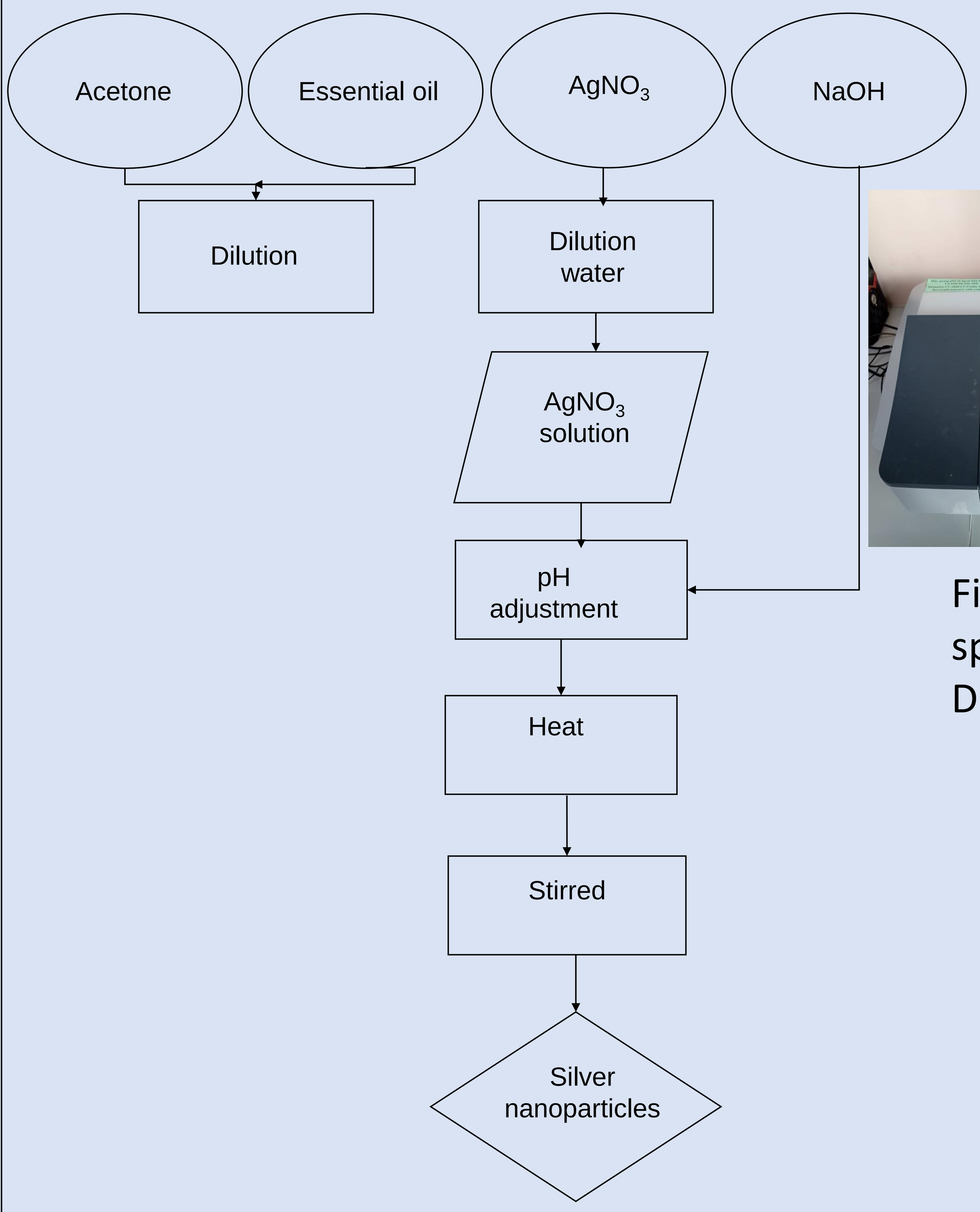


Figure 1 UV – Vis spectrophotometer and DLS instrument

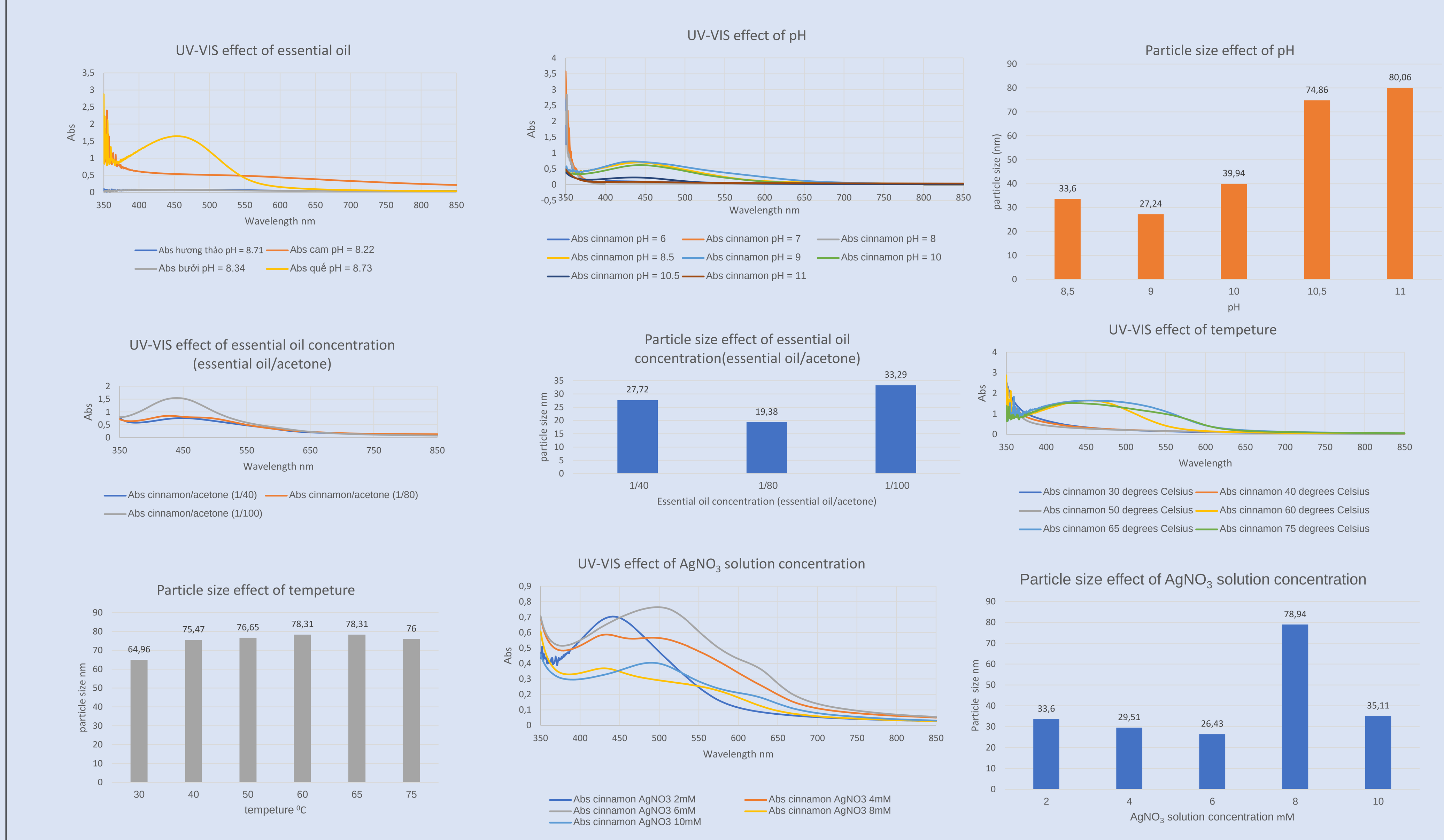
The experiments are performed sinilarly as follows:

- The main material used is: essential oil (rosemary, orange, grapefruit, cinnamon), acetone & $AgNO_3$ solution
- Reaction time: 30 minutes
- $AgNO_3$ solution at different concentrations from 2 mM, 4 mM, 6 mM, 8 mM, 10 mM
- Essential oil at different concentrations (Essential oil/acetone) (w/w) from 1/40, 1/80, 1/100
- The pH of the solution is adjusted from 6 – 11 depending on the experiments
- Temperature from 30, 40, 50, 60, 65, 75 ^{0}C

INTRODUCTION

Biological method using plants or plant extracts to synthesize nanoparticle synthesis is widely used today, and to reduce hazardous chemical waste to the environment. The chemical composition shows that cinnamon essential oil has eugenol and cinnamaldehyde as a reducing agent silver potential for the synthesis of nanoparticles. The possible reduction mechanism is given by proton donor of the eugenol and cinnamaldehyde structure, reducing Ag^+ to Ag^0 and thus forming nanoparticles. In addition, phytochemicals present in essential oils can also interact on the surface of nanoparticles, leading to stabilization and preservation.

RESULTS



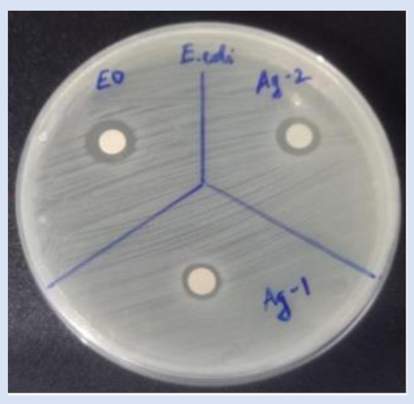


Figure 2 Evaluation of antibacterial ability of AgNPs (Ag-1) and controls (Ag-2, EO) on plates with *Escherichia coli* strain

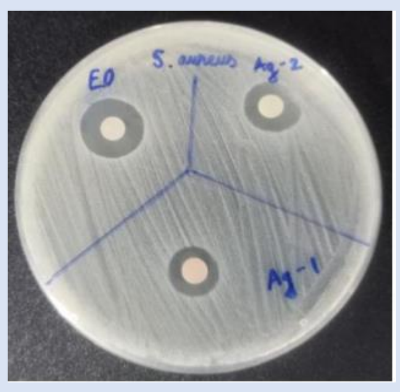


Figure 3 Evaluation of antibacterial ability of AgNPs (Ag-1) and controls (Ag-2, EO) on plates with *Staphylophocus aureus* strainc

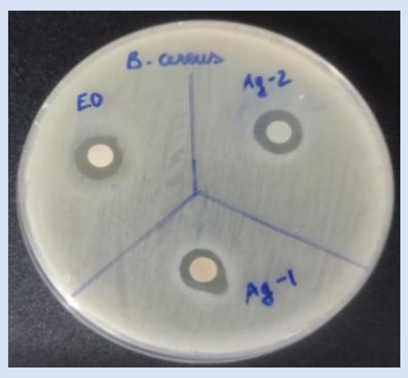


Figure 4 Evaluation of antibacterial ability of AgNPs (Ag-1) and controls (Ag-2, EO) on plates with *Bacillus cereus* strain

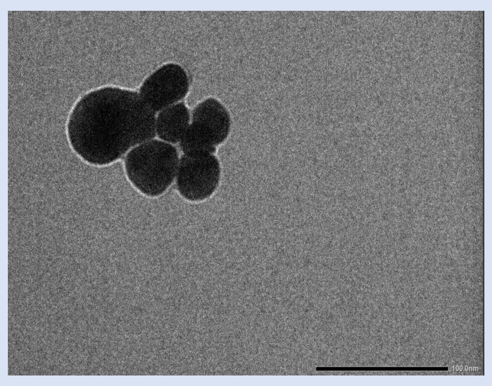


Figure 5 Image of TEM of AgNPs

DISCUSSION

The optimum essential oil is cinnamon
The optimal pH is 8.5 – 9
The optimum $AgNO_3$ concentration is 2 mM
The optimum essential oil concentration (essential oil/acetone) is 1/40
The optimum tempeture is 60 – 65 ^{0}C
Effective antibacterial ability against *Bacillus cereus* strain
The results are similar to Maciel, M.V.O.B et al., and Vinicius de Oliveira Brisola Maciel et al. on the pH effect. However, the study did not investigate cinnamon essential oil; the concentration of essential oil (essential oil/acetone) and the temperature of the survey were lower than in the article; The concentration of $AgNO_3$ investigated was higher than that of the article, but when measuring UV-Vis and DLS still gave similar results at 400-450 nm and DLS at 27-80 nm.

CONCLUSIONS

This study synthesized a stables AgNPs suspension system from essential oils. The formation of silver nanoparticles was observed through color change the color of the solution changed from opalescent yellow to transparent yellow-brown, and was proved by UV-Vis absorption spectroscopy. The particle size of silver nanoparticles was determined by DLS instrument. The antibacterial activity of silver nanoparticle solution was determined by effective antibacterial activity against *Bacillus cereus* strain.

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