Application of Modified Clay as Active Ingredient in Cosmetic Product

Warissara Henglee and Kanchana Dumri*
Division of Biochemistry and Biochemical Innovation, Department of Chemistry,
Faculty of Science, Chiang Mai University
***Corresponding Author's Email: kanchana.d@cmu.ac.th**

FACULTY OF SCIENCE
CHIANG MAI UNIVERSITY

Abstract

Clay is widely used as a raw material in various industries due to its unique chemical, thermal, physical, and biological properties. This study focuses on developing a prototype facial mask product using a complex of organoclay and biogenic silver nanoparticles (AgNPs) as the active ingredient. The organoclay was prepared by modifying bentonite with berberine at a ratio of 1:500. A total of 100 mL of deionized water was added to the mixture, which was shaken at 160 rpm at room temperature for 24 hours and dried overnight. Seven plant extracts—*Centella asiatica* (gotu kola), *Hibiscus sabdariffa* (rosella), *Rosa hybrida* (pink rose), *Clitoria ternatea L*. (butterfly pea), *Morus alba L*. (mulberry), *Pouteria campechiana* (canistel), and *Punica granatum L*. (pomegranate)—were selectively used for the green synthesis of AgNPs. The synthesis utilized a 10% w/v plant extract solution and 1.00 mM silver nitrate ($AgNO_3$) in a 1:9 ratio, stirred at room temperature. Preliminary results from UV-visible spectroscopy confirmed the formation of AgNPs in four extracts: pink rose, butterfly pea, mulberry, and canistel, exhibiting maximum wavelength (λ_{max}) values between 422-434 nm. Nanoparticle size analysis revealed the ranging of AgNPs from 37.7 to 102.6 nm. The composite of organoclay synthesized with biogenic AgNPs from these four extracts, leveraging their specific and antimicrobial properties, demonstrates significant potential as a key active ingredient for future clay mask products.

Introduction

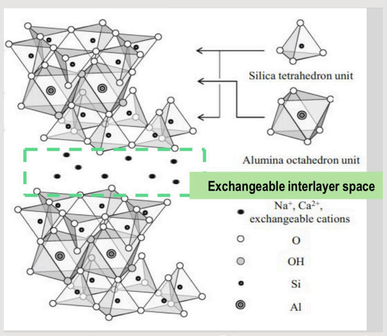


Figure 1 Structure of bentonite clay.

Bentonite clay

- Structural expansion to increase absorption
- Exchangeable interlayer with **Cations** (*e.g.*, elements, cationic alkaloid)

Alkaloid berberine

- Cationic alkaloid

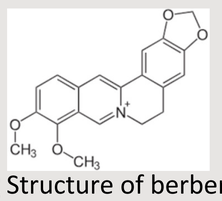


Figure 2 Structure of berberine.

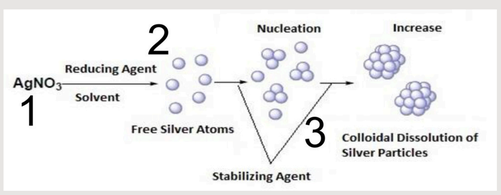


Figure 3 Silver nanoparticles synthesis.

Silver-nanoparticles

- Strong anti-bacterial property.
- Used extensively in various applications. (*e.g.*, health industry, food storage)

Green synthesis

- Can be performed in one step (Reducing).
- microbial, algae and **plant**

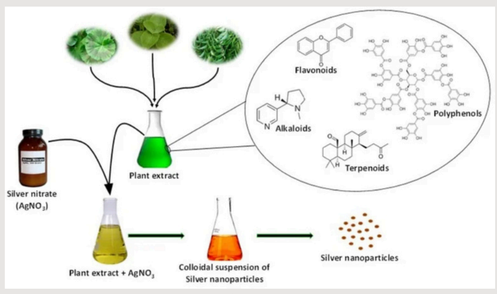


Figure 4 Green synthesis.

Method

Modification of bentonite clay by using berberine

Bentonite + Berberine → Shaked 24 h and centrifuged →  Dried 65°C overnight → Grounded and sieved →  Modified bentonite (Organoclay) → Characterizetion by SEM

Synthesis of silver nanoparticles (AgNPs)

Chemical synthesis

$AgNO_3$ + $C_6H_5O_7Na_3$ → Stirred at room temp →  Green-grey and shiny solution of AgNPs

Green synthesis

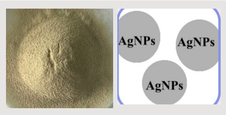
Plant extracts + $AgNO_3$ → Stirred at room temp →  AgNPs was observed by color change

AgNPs was scanned by UV-Vis spectrophotometer and measurement size by Nano particle size analyzer.

Effect of plant extract concentrations on biogenetic synthesis

Plant extract were diluted to various concentrations. → Synthesis of AgNPs by Green synthesis → AgNPs was scanned by UV-Vis spectrophotometer.

Organoclay-green AgNPs composite



Organoclay + Green-AgNPs → Stirred for 3 hr. → Centrifuged/wash (twice) → Dried 65°C overnight → Grounded and sieved →  Organoclay composite

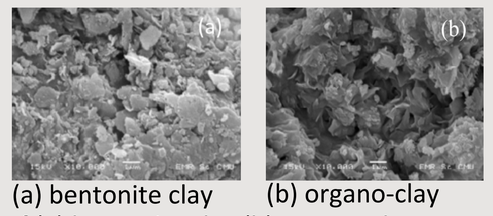
Prototype formulation

Define the Product Objective →  Organoclay composite → Formulation of skin care ingredients →  Prototype

Results

SEM analysis

The SEM results showed increased distance between organoclay blocks, leading to a higher area-to-volume ratio and better absorption.



(a) bentonite clay (b) organo-clay

Figure 5 SEM images of the morphological surface of (a) bentonite clay (b) organo-clay.

UV-Vis spectrophotometer and Nano particle size analyzer

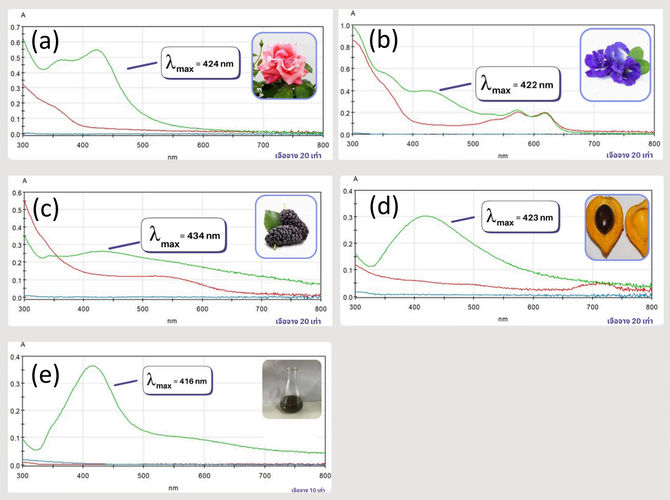


Figure 6 UV-Vis spectra of AgNPs formulation following as (a) Rose, (b) Butterfly pea, (c) Mulberry, (d) Canistel and (e) Chemical.

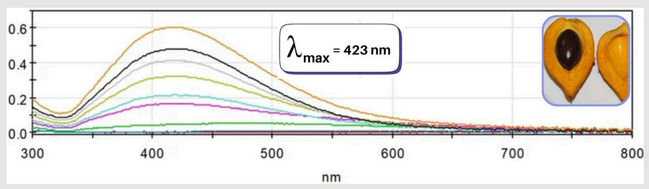
Table 1 Maximum wavelength of AgNPs

	UV-Vis spectrum
Type	λ_{max} (nm)
Rose	424
Butterfly pea	422
Mulberry	434
Canistel	423
Chemical	416

Table 2 Size of AgNPs

	Nano particle size
Type	Size (nm)
Rose	37.7
Butterfly pea	102.6
Mulberry	99.9
Canistel	70.3
Chemical	79.4

Effect of plant extract concentrations on biogenetic synthesis



Higher extract concentration, increases nanoparticle yield.

Figure 7 UV-Vis spectra of AgNPs formulation in various concentrations.

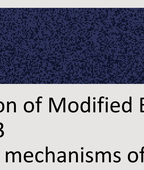
Organoclay-green AgNPs composite

(a) (b) (c) (d)

Figure 8 Composite of organoclay-green AgNPs (a) rose, (b) butterfly pea, (c) mulberry and (d) canistel.

Prototype product

Anti-aging formulation



Ingredients
- Organoclay-Green AgNPs powder
- Kaolinclay
- Beta-carotene (antioxidants) from canistel
- Vitamin A, C, E

Figure 9 Clay mask product for anti-aging.

Conclusion

- The results revealed that silver nanoparticles could be synthesize by aqueous extract as natural reducing agent through green synthesis.
- The sizes of silver nanoparticles synthesized by biogenic and chemical synthesis.
- Higher extract concentration increased nanoparticle yield, showing a concentration-dependent effect.
- Organoclay-green AgNPs composite was successfully prepared and used as active ingredient for prototype facial mask product.

Acknowledgements

- Advisor: Assist. Prof. Dr. Kanchana Dumri
- Members of CB2428: Naphatsawan Phinhom and Phasit Pattanothai
- Central laboratory officer: Yaravee Nacharad and Pornchai Chanta
- Department of Chemistry, Faculty of Science, Chiang Mai University

References

- S. Tha-in, H. a. Dau, and K. Dumri . The Enhanced Carbamate Adsorption of Modified Bentonite with *Coscinium fenestratum. International Journal of Environmental Science and Development.* 2013
- P. Nie, Y. Zhao, and H. Xu . Synthesis, applications, toxicity and toxicity mechanisms of silver nanoparticles: A review. *Ecotoxicol Environ Saf*. 2023.
- B. Pillay, A. Amobonye, P. Bhagwat, and S. Pillai. Beauveria bassiana facilitated silver nanoparticles in cosmetic formulation: Antimicrobial, antioxidant, and photocatalytic activity. *Nano-Structures & Nano-Objects*. 2024