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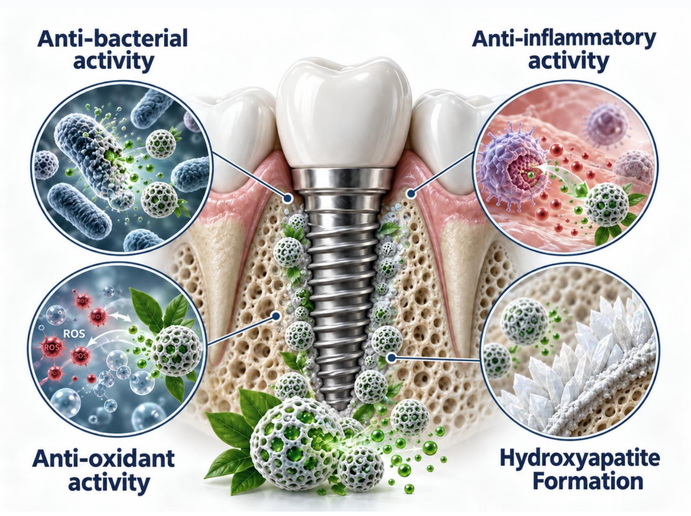
FOSTERING THAILAND FUTURE ADVANCING INNOVATION AND NATIONAL IMPACT

Advancing the Thai medicinal herb *Clinacanthus nutans* for biomedical applications using mesoporous bioactive glass nanoparticles

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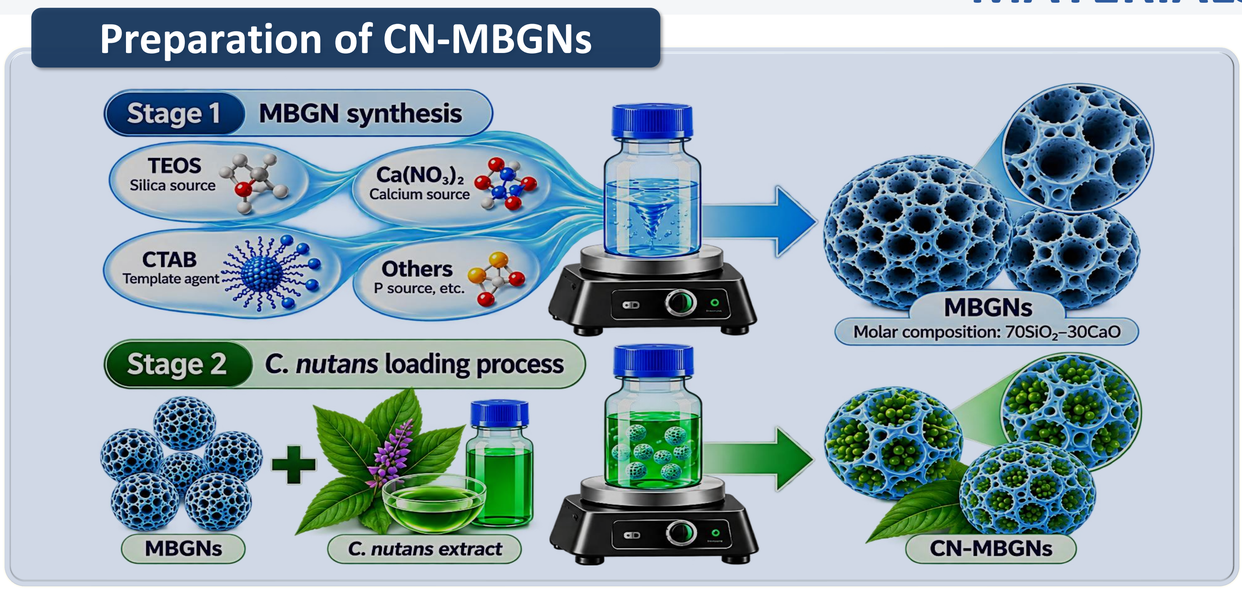


INTRODUCTION

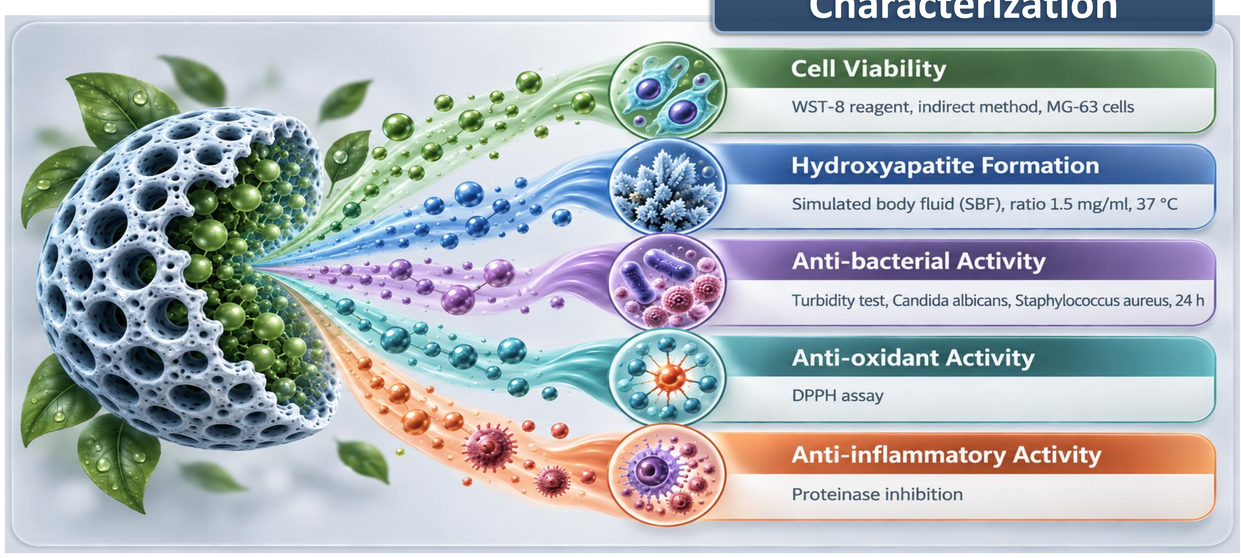
Clinacanthus nutans (C. nutans), a local medicinal herb widely used in Thai traditional medicine, has gained increasing attention because of its **anti-inflammation**, **antioxidant** and **antibacterial properties** [1]. Although C. nutans has long been used in Thai traditional medicine, its **application** in **drug delivery** remains **largely unexplored**. **Mesoporous bioactive glass nanoparticles** (MBGNs) offer an **effective carrier** for the delivery of natural bioactive compounds owing to their high specific surface area, well defined mesoporous structure, excellent bioactivity and biocompatibility [2]. Therefore, **combining** the **advantages** of MBGNs with the therapeutic potential of C. nutans is a promising approach for **developing multifunctional biomaterials**. In this study, C. nutans-loaded MBGNs (CN-MBGNs) were successfully developed, and were systematically characterized in terms of morphology, structure, cytocompatibility, antioxidant activity, and antibacterial performance for biomedical applications, particularly in **regenerative medicine**, **bone graft**, and **other therapeutic applications**.

MATERIALS & METHOD

Preparation of CN-MBGNs



Characterization



RESULTS

1. Morphology (SEM)

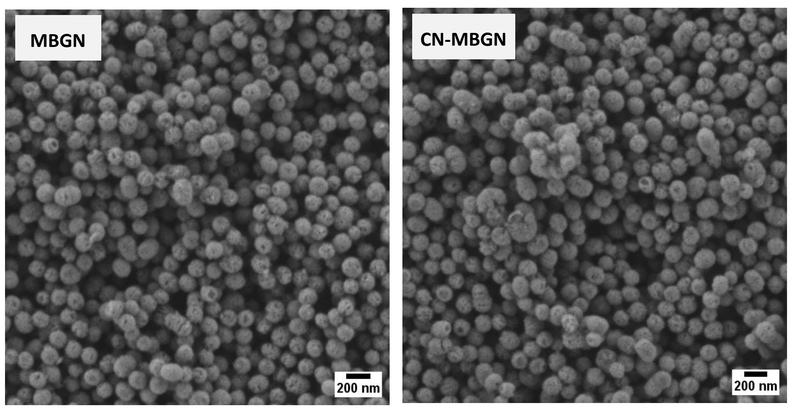


Figure 1 SEM images showing the microstructure of MBGN and CN-MBGNs

MBGN and CN-MBGN were **spherical morphology** with surface nanopores **(particle size ~ 150 nm)**. Thus, this study revealed that **adding CN did not affect the size and shape characteristic of particles.**

2. Textural properties (BET)

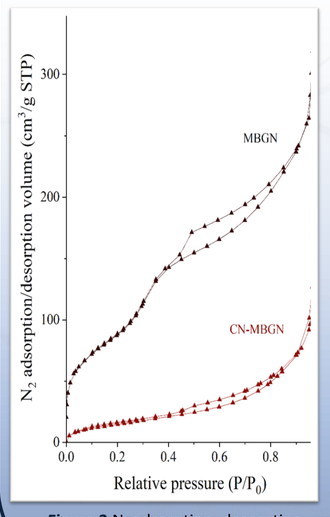


Figure 2 N_2 adsorption–desorption isotherms for powders.

Table 1 Textural properties of powders MBGN and CN-MBGN

Name	Specific surface area (SSA, m^2/g)	Total pore volume (TPV, cm^2/g)
MBGN	336.12	0.76
CN-MBGN	**56.97**	**0.34**

The N_2 adsorption-desorption isotherm of the obtained MBGN and CN-MBGN exhibited a **type IV isotherm** as defined by IUPAC , indicating they are **mesoporous** materials (mesoporous range **2 nm – 50 nm**).

The SSA and TPV of the CN-MBGN was **reduced,** probably **occupation of** mesopores of the MBGN by **CN extracts**.

3. Cell Viability

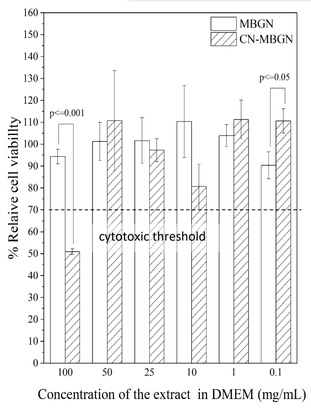


Figure 3 WST activity of MG-63cells cultured on the MBGN suspension

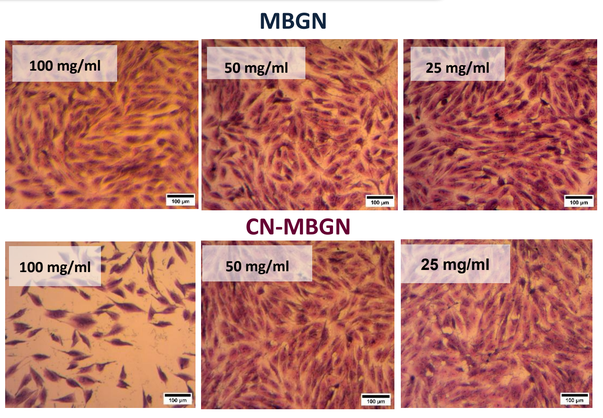


Figure 4 Light microscopy images of MG63 cell morphology exposed to MBGN & CN-MBGN suspension at concentrations of 100, 50, and 25 mg/mL

Exposing **MG-63** osteoblast-like cells to **100 mg/mL** of the CN-MBGN suspension for 24 hours triggers **cytotoxicity and apoptosis**. However, reducing the concentration to **50 mg/mL** results in cell viability exceeding 70%, suggesting **no cytotoxic** effect on MG-63 cells. Consequently, this dosage was selected for further in vitro functional investigations.

4. Hydroxyapatite Formation

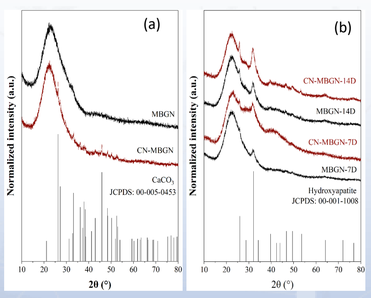


Figure 5 XRD patterns of MBGN (a) before and (b) after SBF testing

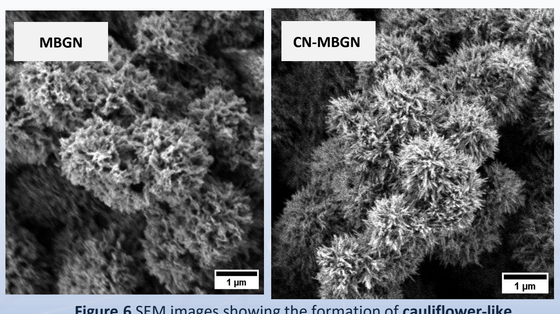


Figure 6 SEM images showing the formation of **cauliflower-like hydroxyapatite (HA)** structure after SBF testing for **14 days**

The bioactivity of CN-MBGN samples in terms of **HA formation** on the surface of samples immersed in SBF was confirmed by SEM images, and XRD analysis. The XRD peaks of HA on the **CN-MBGN** are **more intense** and **sharper** than on the **MBGN**, demonstrating good **bioactivity** and good potential for used in **bone grafting and tissue engineering** application in the future.

5. Anti-oxidant property

CN -loaded into MBGN have demonstrated anti-oxidant properties, which can lead to a **decrease in allergic tissue injury [3]**.

Samples	IC50 (%)	SD
MBGN	n.d.	n.d.
CN-MBGN	**8.5**	**0.5**

6. Anti-inflammatory property

CN-MBGN sample has been attributed anti-inflammatory properties that **help expedite the healing process [3]**.

Samples	(%)	SD
MBGN	n.d.	n.d.
CN-MBGN	**16.1**	**3.6**

7. Anti-bacterial property

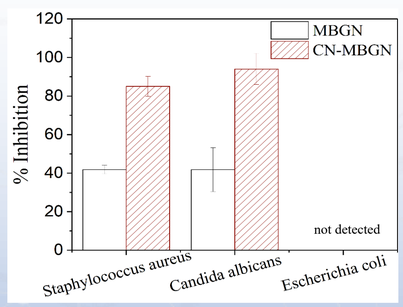


Figure 7 Inhibition of MBGN and CN-MBGN against bacterial

Compared to MBGN, **CN-MBGN** exhibits **high activity** against ***Staphylococcus aureus*** and ***Candida albicans*** due to the presence of CN, indicating its **intrinsic antimicrobial capabilities** and making it a promising candidate for antibacterial applications.

Conclusions and Future work

- CN-MBGNs exhibited **bioactivity** in SBF, **biocompatibility** with MG-63cells, antibacterial activity, anti-inflamtory properties, and **antibacterial** properties against ***Staphylococcus aureus*** and ***Candida albicans,*** making it a good candidate for **bone tissue engineering**.
- **The CN released** from MBGNs in SBF/PBS will be analyzed by **HPLC or UV-Vis**
- The CN-MBGN will be evaluated for their antiviral activity against **Herpes simplex virus (HSV)**.

Acknowledgement

Fundamental Fund (FF) 2026, Thailand Science Research and Innovation (TSRI), and National Science, Research and Innovation Fund (NSRF) for financial support

References

[1] L. W. Khoo *et al.*, "A Comprehensive Review on Phytochemistry and Pharmacological Activities of Clinacanthus nutans (Burm.f.) Lindau," *Evidence-Based Complement. Altern. Med.*, vol. 2018, no. 1, Jan. 2018.

[2] U. Pantulap, I. Unalan, K. Zheng, and A. R. Boccaccini, "Hydroxycarbonate apatite formation, cytotoxicity, and antibacterial properties of rubidium-doped mesoporous bioactive glass nanoparticles," *J. Porous Mater.*, pp. 685–696, 2024.

[3] C.-M. Lin, H.-H. Chen, C.-W. Lung, and H.-J. Chen, "Antiviral and Immunomodulatory Activities of Clinacanthus nutans (Burm. f.) Lindau," *Int. J. Mol. Sci.*, vol. 24, no. 13, p. 10789, Jun. 2023.



CPS-P-025