

## Development of dual-carrier CMC-PEG/LDH nanocomposite hydrogel for the sustained release of *Mikania cordata* phytochemicals

Ananthalingam N., Wijayarathna C. D., and De Silva H. I. C.\*

Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka.

\* hicdesilva@chem.cmb.ac.lk

*Mikania cordata* (Burm. f.) B.L. Robinson is a medicinal plant of the Asteraceae family, demonstrating anti-inflammatory, antimicrobial, and wound-healing properties. However, poor bioavailability due to instability and rapid clearance of its phytochemicals hinders its potential. This study developed a dual-carrier nanocomposite hydrogel system composed of Mg-Al layered double hydroxide (LDH) nanoparticles and citric acid crosslinked carboxymethyl cellulose (CMC)-polyethylene glycol (PEG) hydrogel for the sustained release of *M. cordata* phytochemicals. Pristine LDH was synthesized by the co-precipitation method by mixing  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  and  $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  at a 2:1 molar ratio under a nitrogen atmosphere at pH 10. The leaves were extracted via ethanol maceration, and the plant extract was loaded into LDH using the solvent-assisted ion exchange method. The resulting MC-LDH nanocomposite was incorporated into the hydrogel by incorporating a MC-LDH suspension in a CMC and PEG (2:1.2 w/w) blend through *in situ* gelation and crosslinking with citric acid (20% w/CMC). Structural characterizations using FTIR, UV-Vis, and XRD suggest the presence of phytochemicals in the

plant extract and their potential intercalation into the LDH structure while preserving LDH crystallinity. An increase of +0.599 Å in basal spacing ( $d_{003}$ ) and a near-constant  $d_{110}$  support the likelihood of guest molecule intercalation while maintaining LDH structural integrity. The presence of FTIR peaks in MC-LDH that resemble those of the *M. cordata* extract, and are absent in pristine LDH, supports the possible intercalation of phytochemicals with the LDH matrix. Encapsulation efficiencies were 81.53% for LDH and 72.89% for the hydrogel ( $p < 0.05$ ), demonstrating strong loading capacity. Swelling studies showed excellent water absorption (162%). Drug-release profiling revealed that the hydrogel significantly prolonged release compared to MC-LDH alone, releasing only 70% in 3 hours versus 95% from MC-LDH ( $p < 0.001$ ), confirming dual-stage sustained release behavior. The system demonstrates strong potential as a wound dressing material.

### Keywords:

*Mikania cordata*; LDH nanocomposite; hydrogel; sustained release; wound dressing