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Synthesis and evaluation of micronutrients incorporated hydrogel seed coating on seed germination and seedling growth

K. B. C. D. Dhanapala[1], G. Senevirathne[2], M. Gimhani[2], S. Chathurika[3] and L. Weerasinghe[1]*

[1] *Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura*

[2] *Sri Lanka Institute of Nanotechnology, Mahenwattha, Pitipana, Homagama, Sri Lanka*

[3] *Department of Urban Bioresources, Faculty of Urban and Aquatic Bioresources, University of Sri Jayewardenepura*

**Corresponding author: laksiri@sjp.ac.lk*

Hydrogels based on modified ultra-short peptide sequences are considered as effective low molecular weight hydrogelators. Among these, fluorenylmethyloxycarbonyl (Fmoc) dipeptide-based hydrogels exhibit a higher swelling capacity and some other unique properties such as extended stability, low toxicity, and high biocompatibility. In this study, the effect of micronutrient incorporated Phe (Fmoc)-Gly dipeptide-based hydrogel seed coating for germination and seedling growth of maize seeds was investigated. Phe (Fmoc)-Gly dipeptide was synthesized using the solid-phase peptide synthesis and characterized using ^{1}H NMR spectroscopy. The hydrogelation of Phe (Fmoc)-Gly was conducted using pH trigger method and the gel was obtained with 0.2% concentration of the dipeptide at pH 4. The formulation of micronutrients incorporated hydrogel seed coating based on Phe (Fmoc)-Gly was developed using 4% - carboxymethylcellulose and 5% calcium chloride as the cross-linker. After the application of seed coating, the germination and seedling growth study were carried out using coated seeds and non-coated control for 07 days. The germination percentage of non-coated control and coated seeds were not significantly different throughout the tested germination period. The increase of mean fresh weight and the mean dry weight of seedlings of coating treatments compared to the non-coated controls also observed to be not significant. To the best of our knowledge, this is the first study describing the development of a micronutrient incorporated Phe(Fmoc)-Gly dipeptide-based hydrogel to investigate the effect on seed germination and seedling growth.

Key words:
dipeptides. hydrogel, coating, germination, seedlings, growth

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Encapsulation of chlorhexidine in zincite form of porous zinc oxide nanoparticles for intraoral applications

R. M. G. Rajapakse[1]*, Ushani Karunarathne[1], Ruwan D. Jayasinghe[2], and P. V. Kalani S. Hettiarachchi[2]

[1] *Department of Chemistry, Faculty of Science, University of Peradeniya*

[2] *Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya*

**Corresponding author: rmgr@pdn.ac.lk*

Chlorhexidine (CHX) is widely used in pharmaceutical formulations due to its low toxicity and antimicrobial properties. Most of the oral treatment methods for CHX are ineffective since CHX has a poor thermodynamic stability. In order to increase the thermodynamic stability and controlled release, CHX is encapsulated in synthesized thermodynamically stable and nontoxic zincite form of porous zinc oxide nanoparticles (ZnONPs) and characterized both zinc oxide (ZnO) and CHX encapsulated ZnONPs. The X-ray diffractometry and particle size analysis show that the synthesized ZnO particles in the nano-range between 10 nm to 100 nm. The FT-IR spectrum of the CHX encapsulated ZnONPs show the characteristic transmission band for OH stretching at 3454.56 cm^{-1} which clearly confirms the interaction between the amine ($-NH_2$) groups in CHX and the hydroxyl (-OH) groups in ZnO has resulted in the binding of CHX to the ZnONPs. This is further

complemented by the hollow and porous morphology of particles observed in scanning electron microscopy (SEM) images. The thermogravimetric analysis further confirms the binding of CHX to the ZnONPs by second weight loss of 14.91% in the CHX encapsulated ZnO nanoparticles sample between 400-650 °C that is due to thermal decomposition of CHX. This is a way forward for safe and convenient intraoral dental applications.

Keywords:
Chlorhexidine, Zinc oxide, Nanoparticles, Encapsulation

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Modification of Sri Lankan vein graphite with copper (II) oxide on silicon dioxide to enhance the photocatalytic dye-degradation

Myuraanjali Ravichandran and Savidya Jayawardena*
College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka.
**Corresponding author: savidya@ichemc.edu.lk*

One of the major issues with water contamination is related to the wastewater discharged by the textile industry which releases approximately 20% of the dye produced worldwide as waste into industrial effluents. The dyes in wastewater are highly stable, coloured pigments that cause serious disruption to aquatic ecology. Methylene blue (MB) is a prominent cationic dye used for various applications, including the colouring of paper and the dying of fabric. Ingestion of MB can cause an elevated heart rate, vomiting, diarrhoea, and gastrointestinal system irritation. Consequently, the elimination of MB from industrial effluent has become one of the main environmental challenges. In this research, adsorption of MB dye onto surface-modified graphene oxide (GO) synthesised using Sri Lankan vein graphite was achieved under different optimized conditions. To determine the efficiency of each composite, photocatalytic degradation was observed under two conditions as dark and UV. Graphene oxide was synthesized from 4 μm graphite flakes using the Modified Hummers Method. The surface modification was attained with copper(II) oxide on silicon dioxide nanocomposite, which was prepared through the pyrolysis of silica gel in copper(II)nitrate trihydrate. The degree of photocatalysis was measured through UV–Vis spectroscopy at a maximum wavelength of 662 nm. The absorbance of the aqueous dye solution was measured with varying GO/nanocomposite ratios and contact times. The results clearly indicated that ratio of three parts of GO to one part of copper (II) oxide on silicon dioxide has the fastest rate of dye removal of 90% within 120 minutes after irradiation. Further, an increase in dye removal percentage was observed with increasing contact time between the dye and the surface-modified GO. More than 80% of photodegradation of dye was achieved with a contact time of 120 minutes.

Keywords:
Methylene Blue, Graphene Oxide, Photocatalysis, Photodegradation.