

# Biodegradable Microgels for sustained release of nutrients

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## ABSTRACT

The present disclosure relates to a method to fabricate biodegradable, pectin-based urea cross-linked microgels (OPCU MGs) for the sustained release of nutrients. The method includes oxidizing pectin with sodium periodate ( $\text{NaIO}_4$ ) to obtain oxidized pectin (OPC), followed by crosslinking aldehyde (-CHO) groups of OPC with amine ( $-\text{NH}_2$ ) groups of urea to form urea cross-linked pectin microgels (OPCU MGs). A calcium phosphate (CaP) layer is synthesized in situ onto the OPCU MGs, followed by doping with zinc ( $\text{Zn}^{2+}$ ) and magnesium ( $\text{Mg}^{2+}$ ) to obtain dopant-incorporated CaP-OPCU MGs. The final product is dried to form a stable, OPCU MGs powder. The OPCU MGs enable controlled nutrient release, reducing nutrient leaching, improving soil fertility, and enhancing plant growth.

## KEY APPLICATION AREAS

1. **Agricultural nutrient management:** Controlled and sustained delivery of essential nutrients to crops.
2. **Controlled-release fertilizers:** Slow release of urea and other nutrients in soil to reduce nutrient losses.
3. **Soil fertility enhancement:** Improved availability and uptake of nitrogen, phosphorus, zinc, and magnesium.
4. **Crop growth and seed germination:** Application for improving seed germination and promoting plant growth.
5. **Sustainable agriculture:** Biodegradable alternative to conventional non-biodegradable fertilizer carriers.
6. **Precision nutrient delivery:** Targeted and controlled delivery of nutrients to the soil and crops.

## POTENTIAL USE

1. Sustained release of urea fertilizer in agricultural soil.
2. Controlled delivery of phosphorus through calcium phosphate incorporated into the microgel system.
3. Supplementation of micronutrients such as zinc and magnesium for improved plant growth.
4. Reduction of nutrient leaching and premature loss of fertilizers from soil.
5. Improvement of nutrient-use efficiency and plant nutrient uptake.
6. Enhancement of seed germination and early-stage crop growth.
7. Application as a biodegradable carrier for controlled nutrient delivery in sustainable farming systems.
8. Use in crop production systems requiring slow and sustained nutrient availability.
9. Potential replacement of conventional non-biodegradable fertilizer delivery carriers to minimize environmental impact.
10. Application in soil nutrient-management systems for improving soil fertility and crop productivity.