UNIVERSITY OF MINNESOTA
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Biodegradable lactose-based hydrogel

A method to produce biodegradable lactose-based hydrogel from lactose-containing dairy waste.

Applications

- Hydrogels used in agriculture, consumer, pharmaceutical, medical products and processes

Overview

Several million tons of lactose and lactose-rich milk permeate is produced as byproducts every year. To utilize these waste products, few methods to prepare lactose-containing polymers have been proposed. Of those methods, many rely on multistep synthesis of monomers often involving protecting group chemistry and organic solvents.

Applying green chemistry principles, researchers at the University of Minnesota have developed a simple, novel method for the preparation of hydrogels composed of lactose containing polymers. This method involves an environmentally friendly, atom-economical reaction conducted in water to synthesize lactose-based methacrylic monomers, and methacrylic acid as a byproduct. This method allows for synthesis of the hydrogel through a simple pH adjustment of the reaction mixture followed by photopolymerization. In addition to the light-induced polymerization, the entire process is carried out in a single pot, making this process highly energy efficient, enabling synthesis at ambient temperature, and polymerization at high rates. The researchers have demonstrated that the water uptake, rheological and other physical properties can be tuned easily by varying the ratio of methacrylic anhydride to lactose. In addition, the process was shown to produce hydrogel with comparable properties with milk permeate (as received from a cheese processing plant) in place of reagent-grade lactose.

Key Benefits & Differentiators

Process:

- Utilize lactose-containing waste streams from dairy and/or food processing
- Efficient conversion of raw materials production, atom-economic, one-pot
- No added photoinitiator; photopolymerization with low intensity UV light
- Ambient temperature synthesis in water (no organic solvents needed)
- Green chemistry

Hydrogel:

- Compressive elastic moduli: 12 to 735 kPa; failure strains: 57 to 25%
- Equilibrium water contents up to 260%; 4000% upon lyophilization and rewetting
- Can be freeze-dried to make a powdered form that can be rewetted
- Chemical structure indicates potential biodegradability

Phase of Development

Technology ID

2019-025

Category

Engineering & Physical Sciences/Chemicals
Engineering & Physical Sciences/Materials
Engineering & Physical Sciences/Sustainable Technology
Life Sciences/Industrial Biotech
Life Sciences/Medical Devices
Agriculture & Veterinary/Ag Biotechnology
Agriculture & Veterinary/Food Science & Nutrition

Learn more

Material produced at lab scale and experimentally characterized.

Researchers

Marc Hillmyer, PhD

McKnight Presidential Endowed Chair, Distinguished University Teaching Professor, Center for Sustainable Polymers Director, Chemistry

External Link (chem.umn.edu)

Publications

Atom-Economical, One-Pot, Self-Initiated Photopolymerization of Lactose Methacrylate for Biobased Hydrogels.

ACS Sustainable Chemistry & Engineering (2020). ,

Ready for Licensing

This technology is now available for license. The University is seeking partners to fund testing and further development of this hydrogel material. Please contact us to share your business' needs and your licensing interests in this technology. The license is for the sale, manufacture or use of products claimed by the patents.