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A self-assembled ECOWEB reservoir for the greener innovative topical delivery system

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PURPOSE OF THE ABSTRACT

The most recent innovative nanotechnology can solve the problems encountered in the early days of green chemistry.1 Green chemistry, also known as sustainable technology for the environmentally friendly inventions, aims to minimize chemical uses and harmful effects throughout the entire process of the production, waste treatment, and recycling in all chemical fields.2 Among the commonly used natural materials in the industry are biopolymers, such as polysaccharides, proteins, and glycoproteins. These materials are offer greener solutions for personal care products.3 In the last decades, conventional nanoparticle-mediated delivery systems with these biopolymers have been developed and integrated in a variety of technologies, such as protein nano-cages as carriers and green synthesis of enzyme/metal-organic framework composites.4,5 It is well known that biopolymers play a key role in greener biological processes due to their nature-derived eco-friendly properties such as biodegradability and high cellular uptake efficiency with minimal toxicity.6 In the present study, we designed a sustainable emulsion technology for eco-friendly topical delivery system with only biopolymers. The system was developed as a self-assembled system consisting of a 100% biodegradable and stimuli-dependent nano-sized reservoir. In line with the goals of green chemistry, we designed the system using only nature-derived biomaterials and safer chemicals. First, we used the amphiphilic particle, ZEIN, which is a water-insoluble prolamin with a strong absorbing ability at interfaces between two immiscible phases to form pickering emulsions.7 ZEIN is generally recognized as safe (GRAS) and edible ingredient by the Food and Drug Administration and is extensively used in food industry.8 Second, we used polysaccharides to enhance water solubility and encapsulation stability due to the hydrophilic structure of polysaccharides.9 Today, while numerous phytochemicals from plants are used for pharmaceuticals and personal care industry, these materials are usually of water-insoluble types. Therefore, much research has been conducted to enhance solubility of phytochemicals, as well as to protect the active molecules from oxidation and degradation in formula.10 However, although many nanoparticle-mediated core-shell structures and newly designed technologies have been proposed to solve these problems, synthetic materials have usually been used.10 Synthetic surfactants, such as polyethylene glycols, have been broadly used in a variety of industries; however, several reports have raised concerns aboutallergenic and liver toxicity of PEGs to the human body in pharmaceutical use.11,12 Along with eco-friendly properties, safety is another key factor for personal care product users. Accordingly, the development of natural and nature-derived materials is the only viable solution for sustainable growth.The newly designed encapsulation system proposed in the present study uses only biopolymers, i.e. nature-derived and edible coating materials. The Korean ginseng saponin was applied as a phytochemical material to prove the efficacy and stability of this encapsulating system. In the manufacturing process, the phase-separation and Pickering emulsion technology were used, and the prolamine, ZEIN, was self-assembled on the interfaces of phytochemicals and hydrophilic polysaccharides to support interfacial stability in the formula. In a specific pH condition, the system had a net-like morphology in emulsion and was named ECOWEB. This system can be applied to release, in a controlled manner, the phytochemicals for cosmeceuticals. In the future, this system will be manufactured on a large scale

and its efficacy and stability will be compared to those of the conventional encapsulating system. The proposed ECOWEB system is the first newly-designed self-assemble reservoir for cosmeceutical industry and a powerful tool for the greener innovative topical delivery system.

FIGURES

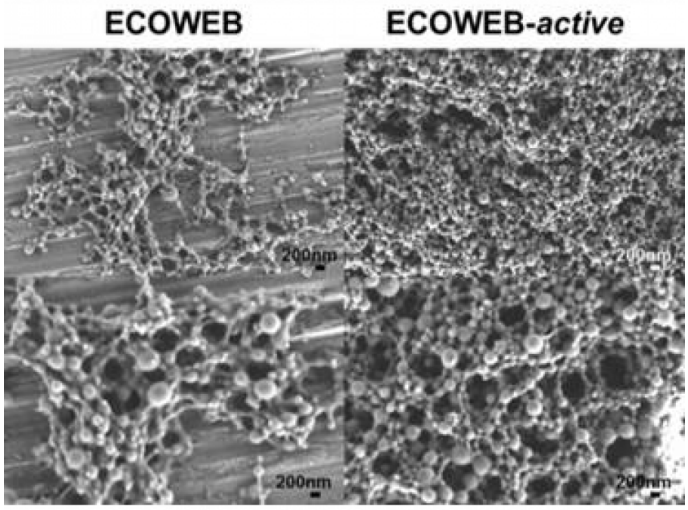

FIGURE 1

Characterization

SEM Images of the ECOWEB system with or without active materials.

FIGURE 2

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KEYWORDS

Sustainable technology | Edible polymer | Topical delivery | Green chemistry

BIBLIOGRAPHY

[1] S. Falsini, U. Bardi, A. Abou-Hassan and S. Ristori., Green. Chem., 2018, 20, 3897

[2] United States Environmental Protection Agency. 2018-11-10.

[3] DJ. McClements, CE. Gumus, Adv. Colloid. Interface. Sci., 2016, 234, 3-26.

[4] S. Bhaskar, S. Lim, NPG. Asia. Materials, 2017, 9, e371

[5] Y. Yin, C. Gao, Q, Xiao, G, Lin, Z. Lin, Z. Cai, H. Yang, ACS Appl. Mater. Interfaces., 2016, 8, 42, 29052–29061

[6] I. Vroman, L. Tighzert, Materials (Basel)., 2009, 2, 2, 307–344

[7] M. Pascoli, R. de Lima, L. F. Fraceto, Front. Chem., 2018, 6, 6

[8] N. T. Weissmueller, H. D. Lu, A. Hurley, R. K. Prud'homme Biomacromolecules, 2016, 17, 11, 3828–3837

[9] O. Almrhag, P. George, A. Bannikova, L. Katopo, S. Kasapis, Int. J. Biol. Macromol. 2012, 51, 1-2, 138-145

[10] D. J. McClements, Biotechnol. Adv., 2018, S0734-9750, 18, 30136-8

[11] Ka. Wylon, S. Dölle, M. Worm, Allergy. Asthma. Clin. Immunol., 2016, 13, 12, 67

[12] M. Schlapschy, U. Binder, C. Börger, I. Theobald, K. Wachinger, S. Kisling, D. Haller, A. Skerra., Protein. Eng. Des. Sel, 2013, 26, 8, 489-501