The Summer Undergraduate Research Fellowship (SURF) Symposium
7 August 2014
Purdue University, West Lafayette, Indiana, USA

Characterization of Swelling Ratio and Water Content of Hydrogels for Cartilage Engineering Applications

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ABSTRACT

Due to the high prevalence of arthritis and cartilage-related injuries, tissue engineers are studying ways to grow cartilage tissue replacements. Resilin, an elastomeric protein found in insect cuticles, is known for its extraordinary resilience and elasticity. In previous studies, recombinant resilin-based hydrogels, or cross-linked protein networks, exhibited potential for use in cartilage tissue scaffolds. Our lab successfully developed resilin-based proteins with a sequence based on the mosquito gene and showed that resilin-based hydrogels possess mechanical properties of the same order of magnitude as native articular cartilage. In addition, these mechanical properties can be controlled by changing the protein concentration. To understand how these resilin-based hydrogels will behave in physiological environments, it is necessary to characterize their physical properties, such as swelling ratio and water content. In this study, we developed a protocol to fabricate hydrogels and characterize their swelling ratio and water content using bovine serum albumin (BSA) as a model protein and a cross-linker, tri(hydroxymethyl)phosphine (THP). Hydrogels of varying diameters (4mm and 6mm) and protein concentrations (8 – 14 wt%) were fabricated at 37^{o}C in silicone molds. To mimic a physiological environment, hydrogels were stored in phosphate buffered saline (PBS). Each hydrogel was weighed until fully swollen, indicated by a constant weight for 3 time points. Freeze-drying was performed to obtain dry hydrogels. The swelling ratio and water content were calculated using the final swollen weight and the dry weight. Results showed that size did not significantly affect swelling ratio or water content of 8, 12, and 14 wt% BSA gels but did affect 10 wt% hydrogels. Furthermore, an increase in protein concentration resulted in a decrease in swelling ratio and water content. Because this procedure allowed successful characterization of BSA hydrogels, this protocol will be adapted to characterize our own resilin-based protein hydrogels in future studies.

KEYWORDS

Tissue engineering, hydrogels, resilin, cartilage engineering

REFERENCES

Renner, J. N., Cherry, K. M., Su, R. S.-C., & Liu, J. C. (2012). Characterization of Resilin-Based Materials for Tissue Engineering Applications. *Biomacromolecules, 13*(11), 3678-85.

Li, L., Teller, S., Clifton, R. J., Jia, X., & Kiick, K. L. (2011). Tunable Mechanical Stability and Deformation Response of a Resilin-Based Elastomer. *Biomacromolecules, 12*(6), 2302-10.

Su, R. S.-C., Kim, Y., & Liu, J. C. (2014). Resilin : Protein-based elastomeric biomaterials. *Acta Biomaterialia, 10*(4), 1601-11.