Swelling and Rheological Characterization of Biodegradable Dextran-based Hydrogels

Dileep R. Janagam[1], Giase L. Ndifon[2], Tao L. Lowe[1]
[1]Department of Pharmaceutical Sciences, University of Tennessee Health Science Center, Memphis, TN
[2]Undergraduate Summer Research Internships**,** University of Tennessee Health Science Center, Memphis, TN

Statement of Purpose: Biodegradable hydrogel scaffolds offer a three-dimensional structure that serve as temporary supports for cell growth and new tissue development. Physical, chemical and mechanical properties of these hydrogels have a significant impact on the tissue regeneration. The degradation of the hydrogels with time facilitates more space for the growth of new cells and also increases the mass traposrt through pores formed through degradation for the diffusion of nutrients in and metabolic wastes out. The objective of this study is to evaluate the rheological and swelling behavior of the biodegradable dextran-based hydrogels degrading as a function of time.

Methods: A series of biodegradable hydrogels are synthesized through free radical polymerization of N-isopropylacrylamide (NIPAAm) monomer and a hydrolytically degradable oligolactate 2-hydroxyethyl methacrylate (DexlactateHEMA) macromer at different weight feeding rations of NIPAAm:Dex-lactateHEMA 5:4 (H54) and 4:5 (H45) (w/w). Gels with higher the macromer have greater cross-linking density. The swelling and degradation properties of the hydrogels are evaluated by immersing the xerogels in PBS and weighing the samples at selected time points. The rheological properties of the hydrogels are measured by using TA AR-G2 Rheometer. Rheological and mechanical properties of the hydrogels incubated in PBS over time are currently under investigation.

Results: Swelling and degradation rates of the hydrogel with weight feeding rations of the monomer NIPAAm to macromer Dexlactate HEMA 5:4 were slow when compared to the gels with feeding ratio 4:5 (Figure 1). The rheological results confirm that the hydrogels are viscoelastic. The hydrogels are characterized by higher storage modulus (G') compared to loss modulus (G"). The average G' and G" of the hydrogles H54 and H45 are around (11kPa, 0.3 kPa) and (5 kPa, 0.1kPa). Figure 2 compares the storage modulus of H54 and H45 hydrogels with different crosslinking. The cross linking density of the hydrogels strongly affects the swelling and degradation kinetics, and storage and loss moduli of the hydrogels.

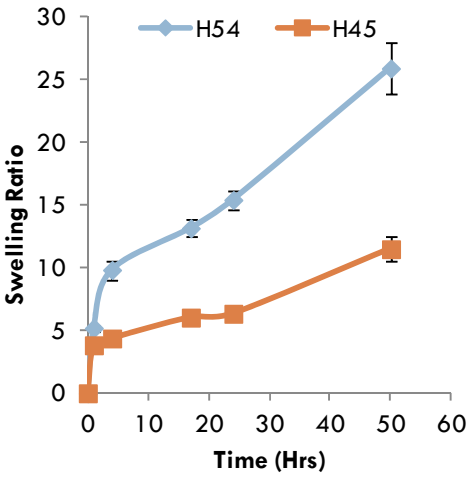

Figure 1. Effect of cross-linking on swelling ratios of the hydrogels

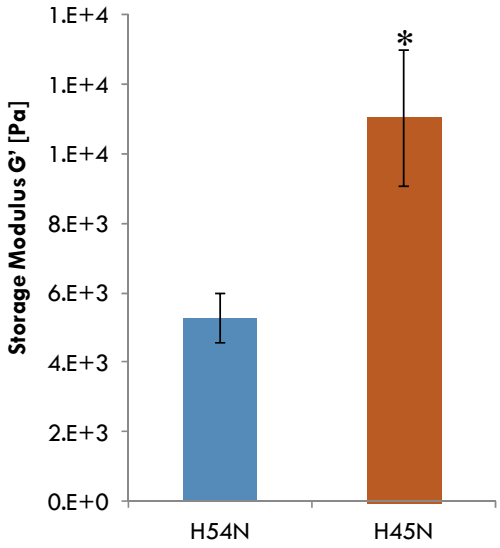

Figure 2. Effect of cross-linking on storage modulus of the hydrogels H45 and H54

Conclusions: The deigned viscoelastic hydrogel system has a great potential to be tuned to have desired physical, chemical and mechanical properties for tissue engineering.