TISSUE ENGINEERED HYDROGELS FOR GENE THERAPY

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ABSTRACT

Polyethylene glycol (PEG) hydrogels are crosslinked polymeric networks with an affinity for water,[1] characterized by their ability to imitate the mechanical properties of soft tissue as well as support their biocompatibility.[2] Their advantages include the following: (1) injectibility; (2) gelation at physiological conditions; (3) form no byproducts; (4) ability to be persistent or degradable; (5) acts as a carrier for biomolecules and genetic materials.[3, 4, 5] Within gene therapy – the treatment of diseases using genetic material – hydrogels have proven versatile as a mechanism for delivery of genetic material, particularly due to the greater relative control over the release profile and mechanical properties. With the growing number of diverse applications, there is a greater need to reverse engineer hydrogels from end-user specifications (using a predictive model) rather than determining them empirically.

In this study, four methods for the theoretical calculation of network formation were combined with suitable reaction rate equations to predict gelation and degradation to produce profiles as seen in Figure 1. The predicted rates were then compared to empirical values determined via *in-situ* ^{1}H-NMR spectroscopy and rheological assays. Swelling and stiffness tests were also performed to observe trends in water uptake and mechanical strength of different hydrogels respectively.

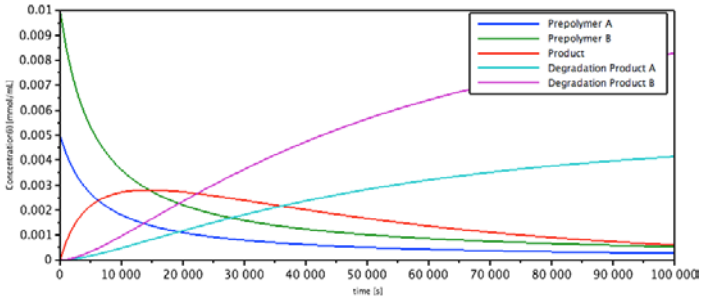

Figure 1: Theoretical Concentration Profile for formation and degradation of a hydrogel

It was shown that two methods, were able to accurately predict the trends in gelation time, but not the absolute values. However, when an empirically determined steric coefficient was included, the margin of error decreased significantly. Moreover, strong trends were seen in the swelling and stiffness tests and it is expected that these results can be incorporated into a model that produced quantitative data.

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