Title :
Mathematical model for Diffusion of hGH in Decaying Polymer Scaffold

Abstract :
In this study, diffusion model took into account the linear decay of the polymer scaffold, which aswe found greatly affect the diffusion of hGH. To do this we used a time dependent diffusivity, instead of the more commonly used constant diffusivity. We believed that such modeling would provide a better representation of an actual system, since polymers degrade in slow, yet steady, manner. It was difficult, however, to observe the effect of having time-dependency in diffusivity without a comparison. To do this, we solved a similar diffusion model that uses the same constants and assumptions; however this equation does not take into account the time-dependent linear decay of the scaffold polymer. When we used MATLAB to create a surf plot of this simpler model, the diffusion profile appeared similar. However, the total depletion in this model took more than 150 days (Figure 6). This was expected, as lack of scaffold decay would result in a constant and low diffusivity. Without the degradation of the polymer scaffold, the hGH molecules would have more difficulty escaping the polymer film. Compared to this model, our time-dependent diffusivity model shows a rapid diffusion period after day 10 due to the increase in pore size in the polymer scaffold, providing easier diffusion route for the hGH. Although a constant diffusivity model represents a common diffusion profile, it was not a good representation of drug diffusion through decaying polymer scaffold. The resulting 150 days depletion time was much longer than the experimented value. Thus, weconcluded that our model more realistically represented the hGH diffusion through PLG scaffold film.

Keywords :
Mathematical modeling of diffusion, partial diffretential equations, biodegradable scaffold, growth hormone