Characterization and Statistical Optimization of Polymeric Nanoparticles for Growth Factor Delivery

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Abstract:

Growth factors are natural molecules with a protein or steroid structure. These factors are involved in the growth and differentiation of many cells and are a type of cytokine. The main positive and negative role of growth factors in stimulating cell proliferation and in regulating cell growth has been increasingly evaluated in recent years. Growth factor release systems are designed to be extensively shaped and made from a variety of synthetic and natural materials. In this research, chitosan/alginate nanoparticles were optimized for recombinant human bone morphogenetic protein-2 (rhBMP-2) with the response surface methodology method with three variables; stirring rate=900-1300 rpm, chitosan/alginate molecular weight ratio=1-3, pH=4.8-5.5, and the responses included size, ζ-potential, polydispersity index, loading efficacy, cumulative release and morphological degradation time. Then, morphological properties of the optimum formulation and MTT assay for 24hrs and 48hrs were evaluated for NIH 3T3 cell line as post characterization. The findings showed that the optimum conditions for the mentioned variables were stirring rate =1100 rpm, pH=5.15, Cs/Alg Mw ratio=1.75 based on numerical optimization and average particle size and loading efficacy at optimum conditions were 253 nm and 67%, respectively. Other responses were as follows: cumulative release=66 %, ζ-potential=35mV, polydispersity index=0.5 and morphological degradation time =7 days. Finally, these nanoparticles can suggest as a good carrier for rhBMP-2 delivery.

The rhBMP-2-loaded chitosan/alginate nanoparticles (Cs/Alg/B NPs) were prepared using the ionic gelation (IG) method. The current research was conducted to optimize the effective factors for entrapping rhBMP-2 in Cs/Alg NPs using response surface methodology (RSM) and the Box–Behnken design (BBD). The variables were the Cs/Alg molecular weight (Mw) ratios (1–3), pH (4.8–5.5), stirring rates (900–1300 rpm) and the responses included size, ζ-potential, polydispersity index (PDI), loading efficacy (LE), cumulative release (CR), and morphological degradation time (MDE). Then, the morphological properties of optimum formulation were studied for post-characterization. In the next step, the MTT assay for the optimized run was done for 24 and 48 hours.

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