Optimization of biodegradable sponges as controlled release drug matrices: I. effect of moisture level on chitosan sponge mechanical properties

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Abstract

Cross-linked chitosan sponges as controlled release drug carrier systems were developed. Tramadol hydrochloride, a centrally acting analgesic, was used as a model
drug. The sponges were prepared by freeze-drying 1.25% and 2.5% (w/w) high and low M.wt. chitosan solutions, respectively, using glutaraldehyde as a cross-linking agent. The hardness of the prepared sponges was a function of glutaraldehyde concentration and volume where the optimum concentration that offered accepted sponge consistency was 5%. Below or above 5%, very soft or very hard and brittle sponges were obtained, respectively. The determined drug content in the prepared sponges was uniform and did not deviate markedly from the calculated amount. Scanning electron microscopy (SEM) was used to characterize the internal structures of the sponges. The SEM photos revealed that cross-linked high M.wt. chitosan sponges have larger size surface pores that form connections (channels) with the
interior of the sponge than cross-linked low M.wt. ones. Moreover, crystals of the incorporated Tramadol hydrochloride were detected on the lamellae and within pores in both chitosan sponges. Differences in pore size and dissolution medium uptake
capacity were crucial factors for the more delayed drug release from cross-linked low M.wt. chitosan sponges over high M.wt. ones at pH 7.4. Kinetic analysis of the release data using linear regression followed the Higuchi diffusion model over 12 hours.
Setting storage conditions at room temperature under 80–92% relative humidity resulted in soft,elastic, and compressible sponges.

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