Ionically Cross-Linked Alginate Hydrogels as Drug Delivery Systems for Analgesics in Broiler Chickens

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Thesis Abstract

Treating birds with analgesic drugs requires continuous injections of near lethal concentrations to maintain the therapeutic dose in the blood plasma. This is due to birds having higher metabolic rates than mammals. Therefore, there is a need to develop drug delivery systems that can control and slow down the release of analgesics in birds. This study was designed to analyse the sustained release of the model analgesics, sodium salicylate and sodium aspirin, from ionically cross-linked alginate hydrogels, in *in vitro* and *in vivo* experiments using broiler chickens as the model bird. Analgesic loaded hydrogels separated into two layers, unlike the homogeneous blank hydrogels. This was labelled as the separation effect. Swelling studies indicated the absence of the insoluble cross-linked alginate material in the hydrogels where the separation effect occurred, with most of the hydrogels dissolving back into the medium. The highest equilibrium swelling percentage achieved in the loaded hydrogels was 68 %. In comparison, the highest equilibrium swelling percentage in the blank hydrogels was 622 %. *In vitro* drug release profiles showed that the hydrogels released up to 100 % of the sodium salicylate within 3.33 hours. In contrast, the hydrogels containing sodium aspirin released only 35 % of the encapsulated drug. Hydrogels containing a drug concentration of 150 mg/mL were injected into the model birds at a dose rate of 150 mg/Kg. No chicken reacted negatively to the hydrogel injection. *In vivo* results indicate sustained release of the model analgesic from the hydrogels compared to the release from the aqueous solutions of the drug. The effective concentration for an analgesic effect of sodium salicylate was maintained by the group injected with an aqueous solution of sodium salicylate 18 hours after the injection. The groups injected with the hydrogel with the maximum calcium chloride content saw the largest sustained release, with the plasma concentration of sodium salicylate remaining over the effective concentration for up to 36 hours after the injection.

Keywords: Sodium salicylate, sodium aspirin, hydrogel, analgesia, sustained release, broiler chicken.

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