

Synthesis, Characterization and Swelling Studies of Methotrexate Incorporated Hydrogels Using Natural Polymers and a Cross Linker; Preliminary Study to a Nano-hydrogel

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The hydrogel can be defined as a three-dimensional polymer/s network with cross-linker/s which able to absorb and retain water or biological fluid. This water retention does not dissolve or disturb the basic structure. They are more potent to use in medicine as they can mimic the properties and composition of biological tissues/ cells and as they can carry drugs. Rapid release of drugs from hydrogels is an issue and to address it, nano-hydrogels are developed. Typically pore sizes range from 1nm to 100nm in nano-hydrogels. The primary objective of this study was to develop a hydrogel to transport drug methotrexate (MTX) via the oral route and to advance it to a nano-hydrogel using the results. Characterization, swelling studies, and *in-vitro* drug release are secondary objectives of the study. Two natural polymers; Carboxymethyl Cellulose (CMC) and Chitosan (CHN), and one natural cross-linker; Citric Acid (CA) were used in this study as natural substances exert minimum adverse effect to the environment and human. Three hydrogels were prepared as (1) CMC+CA+MTX, (2) CMC+CHN+MTX, and (3) CMC+CHN+CA+MTX in distilled water. Freeze drying was done to obtain dry samples. Based on Scanning Electron Microscope (SEM) images, the pore size of hydrogel 1 varied between 6-9 μm and hydrogel 2 varied between 6-8 μm . Hydrogel 3 showed special pocket like features other than its pores where size ranged from 200nm-1.6 μm . Swelling studies were done at 37 °C in pH 2.2 and pH 7.4 using phosphate buffers separately for all three hydrogels. Results showed that hydrogel 1 was swollen up to 642% at pH 2.2 and up to 924% at pH 7.4. Hydrogel 2 swollen up to 590% at pH 2.2 and 462% at pH 7.4. Hydrogel 3 swollen up to 430% at pH 2.2 and up to 404% at pH 7.4. *In-vitro* release studies are being carried out at the moment. According to the results, prepared hydrogels showed different swelling behaviours at different pH values. The highest swelling was for hydrogel 1 at pH 7.4 and the lowest was for hydrogel 3 at pH 7.4. Hydrogel 3 showed the lowest swelling behaviour in both pH values and it can be due to the highest crosslinking nature compared to others. Therefore, it can be concluded that hydrogel 3 is more potent to develop a nano-hydrogel as it is more cross-linked and it has folded pocket like structures where size is near to nano level.

Keywords: Nano-hydrogel, Hydrogel, Methotrexate