

The Effect of the Combination of Methotrexate Nanoparticles and TiO₂ on Breast Cancer

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Abstract : Methotrexate (MTX) is a stoichiometric inhibitor of dihydrofolate reductase, which is essential for DNA synthesis. MTX is a chemotherapeutic agent used for treating many types of cancer cells. However, cells' resistant to MTX is very common and its pharmacokinetic behavior is highly problematic. of MTX within tumor cells, we propose encapsulation of antitumor drugs in nanoparticulated systems. Chitosan (CS) is a naturally occurring polymer that is biocompatible, biodegradable, non-toxic, cationic and bioadhesive. CS nanoparticles (CS-NPs) have been used as drug carrier for targeted delivery. Titanium dioxide (TiO₂), a natural mineral oxide, which is used in biomaterials due to its high stability and antimicrobial and anticorrosive properties. TiO₂ showed a potential as a tumor suppressor. In this study a new formulation of MTX loaded in CS NPs (CS-MTX NPs) and coated with Titanium oxide (TiO₂) was prepared. The mean particle size, zeta potential, polydispersity index were measured. The interaction between CS NPs and TiO₂ NPs was confirmed using FTIR and XRD. CS-MTX NPs was studied in vitro using the tumor cell line MCF-7 (human breast cancer). The results showed that CS-MTX has a size around 169 nm and as they were coated with TiO₂, the size ranged between and depending on the ratio of CS-MTX to TiO₂ ratio used in the preparation. All NPs (uncoated and coated carried positive charges and were monodispersed. The entrapment efficacy was around 65%. Both FTIR and XRD proved that TiO₂ interacted with CS-MTX NPs. The drug invitro release was controlled and sustained over days. Finally, the studied in vitro using the tumor cell line MCF-7 suggested that combining nanomaterials with anticancer drugs CS-MTX NPs may be more effective than free MTX for cancer treatment. In conclusion, the combination of CS-MTX NPs and TiO₂ NPs showed excellent time-dependent in vitro antitumor behavior, therefore, can be employed as a promising anticancer agent to attain efficient results towards MCF-7 cells.

Keywords : Methotrexate, Titanium dioxide, Chitosan nanoparticles, cancer

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