Abstract

THESIS TITLE: A Study on the Synthesis of Phytochemical Incorporated Biopolymer-based Materials for Evaluating Therapeutic Potentials

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Multifunctional biomaterials have been very popular in revolutionizing the areas of biomedical applications. The promising pharmacological potentials of phytochemical incorporated biopolymeric nanomaterials have led researchers to explore their *in vitro* biological potentials and preliminary *in vivo* efficacy. These biocomposites can be extensively used in drug delivery because of their wide range of versatility, nontoxicity, stability, high drug loading capacities, sustained drug release properties, biocompatibility compared to other synthetic or inorganic materials. The therapeutic properties of these biocomposites are introduced by incorporating phytochemicals i.e. piperine and thymoquinone over conventional antibiotics to overcome the problem of bacterial resistance.

To understand the plausible effect of fabricated biocomposites we have used naturally abundant, biodegradable biopolymers like guar gum, sodium alginate, carboxymethyl cellulose, chitosan and psyllium husk mucilage. Our study involves nanonization of bio active hydrophobic phytochemicals encapsulating efficient drug delivery vehicle which will overcome the problem of instability in therapeutic applications. The sustained release behaviour of phytochemicals from polymeric vehicles makes these biocomposites useful for prolonged persistence at the site of infection during drug administration.

In the study we have reported the synthesis of some biocomposites such as thymoquinone and piperine encapsulated guar gum delivery-vehicle; thymoquinone incorporated chitosan-sodium alginate and chitosan- psyllium husk mucilage composite films; piperine encapsulated guar gum-psyllium husk mucilage nanocomposites and guar gum-carboxymethyl cellulose nanocomposites. The physical characterizations of these biocomposites have performed by techniques such as X-Ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), Dynamic Light Scattering (DLS) study, Ultraviolet-Visible Spectroscopy (UV-Vis), Field Emission Scanning Electron Microscopy

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(FESEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM) etc. *In vitro* biological characterizations establish the efficacy of these functionalized biomaterials which involve estimation of minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), estimation of intracellular reactive oxygen species (ROS) generation etc. in different pathogenic bacterial strains. We have observed the pH dependent release behaviour of phytochemicals from the biopolymer-based drug delivery system and evaluated the biocompatibility in normal human cell line. We have also measured cytotoxicity, intracellular ROS, GSH and NADPH levels, mitochondrial membrane potential, nuclear damage to evaluate anticancer potentials. We have observed the hepatoprotective effect of piperine in acute liver injury in mice model by measuring intracellular ROS generation in hepatocytes, serum levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and histopathological study etc.

Moreover, our synthesised phytochemical incorporated biopolymer-based materials possess commendable ameliorative attributes that could be effectively used against diverse pathological conditions and these may bring back cost effective, biocompatible natural phyto-components in further usage.

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