Chemo-Hydrothermal Method Increases Biocompatibility and More in Chitosan

Over the past few decades, research has shown that chitosan is a good candidate for oral and nasal drug delivery systems because it is non-toxic, as well as environmentally and medically safe. One opportunity that remains to be realized is using chitosan to effectively deliver anticancer drugs to tumors through intravenous injection. Two major challenges are that chitosan is not soluble at blood pH conditions (i.e. around 7.4), and that it has limited water dispersibility.

To overcome these challenges, two methods could potentially be employed. The first method involves particle surface modification to introduce hydrophilic moieties such as carboxyl, hydroxyl, or ethylene oxide. A second less cumbersome approach is chemically or hydrothermally treating chitosan in order to cleave longer polymer chains into shorter sizes, thereby introducing more hydrophilic groups.

Advantages
UCF researchers have invented a novel method and composition in creating a water-soluble chitosan polymer and a chitosan-based composite particle. Through this process, the chitosan composition becomes fluorescent, completely water-soluble, and remains stable at a neutral pH. This method and composition provides a potential feed additive for factory farm animals, resulting in a reduced need for prophylactic antimicrobials and a reduced bacterial load, thus effectively guarding against bacteria such as E.coli and Enterococci. The fluorescence developed through this synthesis may prove to be useful in bioimaging applications. The composition can also serve as a catalyst for the electrochemical reduction of carbon dioxide.

Technical Details
This chemo-hydrothermal method is a one-step, one-pot synthesis. When the chitosan and a chemical cross-linker, such as tartaric acid, are cooked together under high pressure, its chemical properties remain unaltered. The chitosan-and-tartaric-acid composites form soluble nanoparticles that are also capable of solubilizing other insoluble materials, such as metal particles and metal oxide particles. When copper is added to this mixture, uniform-sized nanocomposites are formed and the pH level is raised to 7, making the composition neutral.

Figure 1. Morphological study of the effect of hydrothermal treatment on chitosan, copper and copper-chitosan. Scanning Electron Microscopy (SEM) of (a) RT chitosan, (b) RT copper, (c) RT copper-chitosan, (d) HT chitosan, (e) HT copper, (f) HT copper-chitosan indicating significant changes in morphology as a result of HT treatment.

Benefits
• Improved water solubility and dispersibility
• Increased biocompatibility

Applications
• Antimicrobials
• Drug delivery
• Tissue engineering
• Bioimaging
• Biosensing
• Catalysis

Tech Field
Advanced Materials

Keywords
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Patent Pending

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