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Authors: Yinghao Fu, Congming Xiao

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A facile physical approach to make chitosan soluble in acid-free water

Yinghao Fu Congming Xiao*

College of Material Science and Engineering of Huaqiao University, Quanzhou, 362021, China

* Corresponding author, congmingxiao@hqu.edu.cn, Tel: 86-0595-22691357

Abstract: We changed the situation that chitosan was only dissolved in diluted acid through mild physical treatment. In viewing of the usual methods to modify chitosan are chemical ones, we established the approach by using a water-soluble chitosan derivative as the model polymer. Its water-solubility was modulated via changing the concentration of solution and varying the precipitants. Such a physical method was adopted to treat chitosan. One gram chitosan was dissolved in a mixture of 100mL 10% acetic acid and 50mL methanol, and then precipitated from a precipitant consisted of 10mL ethanol and 90mL acetate ester. The treated chitosan became soluble in acid-free water completely, and its solubility was 8.02mg/mL.

Keywords: Chitosan; water-soluble; acid-free; facile physical treatment

Introduction

Solubility is a very important issue for the modification, processing, and applications of polymers. In general, the water-solubility of crystalline polysaccharides such as cellulose and chitosan is poor [1, 2]. Chitosan is the second abundant natural biopolymer and has been receiving growing attention for decades. It is one of the most promising candidates for biomedical, food packaging, and eco-friendly applications [2-4]. Chitosan is linear, rigid and semi-crystalline. It can dissolve in dilute acid at pH below its PKa (ca 6.3). However, it is insoluble in neutral and alkali aqueous medium, neither in any organic solvents [2]. The poor solubility of chitosan is regarded as a hindrance for its potential applications.

Several strategies such as modification and degradation have been adopted to improve the solubility of chitosan. Degradation is usually performed through enzymatic or acidic hydrolysis [5, 6] and redox reaction [7]. Reducing the molecular

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