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Synthesis and Characterization of Water Soluble Ferulic Acid-Grafted Chitosan

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Abstract : Chitosan is a derivative of chitin, which is a second most naturally abundant polysaccharide found in crab shells, shrimp shells, and squid pens. The applications of chitosan in pharmaceutical, cosmetics, food and packaging industries have been reported owing to its general recognition as safe, excellent biodegradability and biocompatibility, as well as ability to form films, membranes, gels, beads, fibers and particles. Nevertheless, chitosan is an amino polysaccharide consisting of strong inter- and intramolecular hydrogen bonds which limit its solubility in neutral pH water resulting in restricted utilization. Chemical modification is an alternative way to impede hydrogen bond formation. The objective of the present research is to improve water solubility and antioxidant activity of chitosan by grafting with ferulic acid. Ferulic acid was grafted onto chitosan at the C-2 position via a carbodiimide-mediated coupling reaction. Different mole ratios of chitosan to ferulic acid (i.e. 1.0:0.0, 1.0:0.5, 1.0:1.0, 1.0:1.5, 1.0:2.0, and 1.0:2.5) and various reaction temperatures (i.e. 40, 60, and 80 °C) were used. The reaction was performed at different times (i.e. 1.5, 3.0, 4.5, and 6.0 h). The obtained ferulic acid-grafted chitosan was characterized by FTIR and 1H NMR technique. The influences of ferulic acid on crystallinity, solubility and radical scavenging activity of chitosan were also investigated. Ferulic acid grafted chitosan was successfully synthesized as confirmed from (i) the appearance of FTIR absorption band at 1517 cm-1 belonging to C=C aromatic ring of ferulic acid and the increased C–H stretching band intensity and (ii) the appearance of proton signals at δ = 6.31-7.67 ppm ascribing to methine protons of ferulic acid. The condition in which the reaction temperature of 60°C, reaction time of 3 h and the mole ratio of chitosan to ferulic acid of 1:1 gave the highest ferulic acid substitution degree, i.e. 0.37. The resulting ferulic acid grafted chitosan was soluble in water (1.3 mg/mL) due to its reduced crystallinity as compared with chitosan and also exhibited 90% greater radical scavenging activity than chitosan. The result suggested the utilization of ferulic acid grafted chitosan as an antioxidant material.

Keywords : antioxidant property, chitosan, ferulic acid, grafting
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