

**CHITOSAN BIO-INSPIRATION MATERIAL:
A CONTROLLED STRUCTURE AT MOLECULAR LEVEL BY
BALANCING OF HYDROPHOBICITY AND HYDROPHILICITY**



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ABSTRACT

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The present dissertation proposes (i) the use of γ -ray irradiation to control the molecular weight of chitosan in the range as desired and (ii) the change of chitosan flake to nanosphere by simple reaction without specific processing technique. In the case of (i), at 20 kGy of γ -ray dose, the molecular weight of chitosan decreases for 50 % in dry solid and aqueous wet state, for 55 % in aqueous with 0.05-1 % $K_2S_2O_8$, and for 85 % in aqueous with 0.5-2 % H_2O_2 .

For chitosan acetic acid solution, chitosan loses its primary structure after the exposure to γ -ray at 20 kGy. Radicals initiate mainly chain-scission rather than cross-linking. The model reaction with *N,N'*-carbonyldiimidazole (CDI) clarifies the increase in the reactivity of irradiated chitosan. In the case of (ii), the modification of irradiated chitosan flake with hydrophobic phthalimido group and hydrophilic poly(ethylene glycol) methyl ether (mPEG) chain gives colloidal phenomena in both protic and aprotic solvents to form nanospheres at the sizes of 80-500 nm as observed by transmission electron microscope (TEM). The sizes are dependent on the chain length and content of mPEG conjugated on chitosan chain. The nanospheres perform effective drug incorporation by simply mixing with drug solution as demonstrated by stearylamine model molecule.

บทคัดย่อ

นางสาว รังรอง ยกสำน: ไคโตซาน วัสดุที่ได้แนวความคิดจากกลไกธรรมชาติ: รูปแบบโครงสร้างที่ควบคุมในระดับโมเลกุลด้วยความสมดุลของความเป็นขั้วและไม่เป็นขั้ว (Chitosan Bio-Inspiration Material: A Controlled Structure at Molecular Level by Balancing of Hydrophobicity and Hydrophilicity) อ. ที่ปรึกษา : รองศาสตราจารย์ ดร. สุวบุญ จิรชาญชัย และ ศาสตราจารย์ ดร. มิชรุ อากาชิ, 159 หน้า ISBN 974-9651-00-6

วิทยานิพนธ์ฉบับนี้เสนอ (1) การฉายรังสีแกมมาเพื่อการควบคุมมวลโมเลกุลของไคโตซานในระดับที่ต้องการและ (2) การเปลี่ยนไคโตซานจากรูปของเกล็ดเป็นรูปของอนุภาคกลมระดับนาโนเมตรโดยไม่ใช้กระบวนการขึ้นรูปใดๆ ในกรณีที่ (1) ที่ปริมาณรังสีแกมมา 20 กิโลเกรย์ มวลโมเลกุลของไคโตซานลดลง 50 เปอร์เซ็นต์ในสภาวะเกร็ดผงแห้งและในน้ำ และ 55 เปอร์เซ็นต์ในสภาวะไคโตซานในน้ำที่มี 0.05-1 เปอร์เซ็นต์ของโปดัสเซียมเปอร์ซัลเฟต และ 85 เปอร์เซ็นต์ในสภาวะไคโตซานในน้ำที่มี 0.5-2 เปอร์เซ็นต์ของไฮโดรเจนเปอร์ออกไซด์ สำหรับสารละลายไคโตซานกรดอะซิติก ไคโตซานสูญเสียโครงสร้างหลักหลังจากการฉายรังสีที่ 20 กิโลเกรย์ ราคัลการกระตุ้นการตัดมากกว่าการเชื่อมสายโซ่พอลิเมอร์ ปฏิกริยาดันแบบกับเอ็นเอ็น-คาร์บอนิลไดอิมิดาโซล (CDI) แสดงให้เห็นถึงความว่องไวต่อปฏิกิริยาของไคโตซานที่ถูกฉายรังสีที่เพิ่มขึ้น ในกรณีที่ (2) การปรับโครงสร้างไคโตซานที่ถูกฉายรังสีด้วยหมู่พอลิโดซึ่งไม่มีขั้วและสายโซ่โพลีเอทิลีนไกลคอลเมทิลอีเทอร์ (mPEG) แสดงปรากฏการณ์คอลลอยด์ในตัวทำละลายทั้งโพรติกและอะโพรติกเพื่อที่จะแสดงอนุภาคกลมระดับ 80-500 นาโนเมตรจากการวิเคราะห์ด้วยกล้องจุลทรรศน์อิเล็กตรอนแบบส่องผ่าน (TEM) ขนาดของอนุภาคขึ้นอยู่กับความยาวและปริมาณของพอลิเอทิลีนไกลคอลเมทิลอีเทอร์บนสายโซ่ไคโตซาน อนุภาคกลมระดับนาโนเมตรแสดงการตรึงยาอย่างมีประสิทธิภาพเพียงผสมกับสารละลายยาดังแสดงให้เห็นในตัวอย่างของโมเลกุลดันแบบสเตียรอยด์

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