

**PREPARATION OF CHITOSAN-COATED BACTERIAL CELLULOSE BY
DBD PLASMA TREATMENT**



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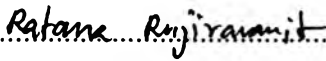
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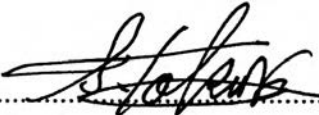
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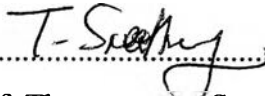
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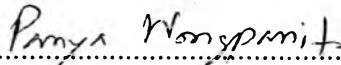

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ABSTRACT

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Navaporn Kaerkitcha: Preparation of Chitosan-Coated Bacterial Cellulose by DBD Plasma Treatment

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Keywords: Bacterial cellulose/ Chitosan/ Dielectric barrier discharge plasma/ Antimicrobial activity/ Releasing property

Bacterial cellulose (BC) is a natural biopolymer having ultrafine structure, high chemical purity, and high ability to maintain the proper moisture level. Because of its unique properties, BC is an interesting material to be used in medical applications, including wound dressing. However, BC itself cannot prevent the wound from infection therefore in this study, BC pellicle produced by *Acetobacter xylinum* was modified by coating with chitosan, a natural antimicrobial agent. To improve the interaction between BC and chitosan, the surface of the BC was treated with dielectric barrier discharge (DBD) plasma prior to chitosan coating. The chitosan content coated on the plasma treated BC, determined by the Kjeldahl method, was higher than that of the non-plasma treated one. Such amounts of chitosan were gradually released from the surface of the BC when immersing in phosphate buffered saline and acetate buffer solution. The chitosan-coated BC has high swelling ratio, resulting in high water absorption capacity. The chemical structure, chemical composition and surface morphology of the samples were also characterized by FTIR, XPS, and SEM, respectively. With the treatment of BC in the 1.00 % (w/v) chitosan solution, the samples showed strong antimicrobial activity against both *Escherichia coli* (Gram-negative) and *Staphylococcus aureus* (Gram-positive), as evidenced by the colony counting method.

บทคัดย่อ

นวพร เกื้อกัจจา : การเตรียมแบคทีเรียเซลลูโลสที่เคลือบด้วยไคโตซาน โดยเทคนิคการปรับปรุงพื้นผิวด้วยไดอิเล็กทริกแบริเออร์ดิสซาร์จพลาสมา (Preparation of Chitosan-Coated Bacterial Cellulose by DBD Plasma Treatment) อ.ที่ปรึกษา : รศ. ดร. รัตนา รุจิรวนิช และ ศ.ดร. เซอิจิ โทคุระ 86 หน้า

เส้นใยเซลลูโลสที่สังเคราะห์จากเชื้อแบคทีเรีย เป็นพอลิเมอร์ชีวภาพที่มีโครงสร้างเป็นเส้นใยขนาดเล็กที่มีความละเอียดสูง มีความบริสุทธิ์ทางเคมีสูง และสามารถรักษาสภาวะชุ่มชื้นให้อยู่ในสภาวะที่เหมาะสมได้ดี ด้วยคุณสมบัติที่โดดเด่นนี้ แบคทีเรียเซลลูโลสจึงเป็นวัสดุที่น่าสนใจในการนำประยุกต์ใช้ในเชิงการแพทย์ เช่น การใช้เป็นวัสดุปิดแผล อย่างไรก็ตามโดยตัวของแบคทีเรียเซลลูโลสเองนั้น ไม่มีคุณสมบัติในการป้องกันการติดเชื้อของบาดแผล ดังนั้นในงานวิจัยนี้แผ่นแบคทีเรียเซลลูโลสที่ผลิตจากเชื้อ *Acetobacter Xylinum* จึงได้ทำการปรับปรุงสมบัติของแบคทีเรียเซลลูโลสด้วยการเคลือบพื้นผิวด้วยไคโตซาน ซึ่งเป็นสารทางธรรมชาติที่มีฤทธิ์ในการป้องกันการติดเชื้อโรคต่างๆของบาดแผลได้ และเพื่อเป็นการเพิ่มความสามารถในการยึดเกาะกันระหว่างแบคทีเรียเซลลูโลสกับไคโตซาน จึงได้มีการปรับปรุงพื้นผิวของแบคทีเรียเซลลูโลสด้วยเทคนิคพลาสมาแบบไดอิเล็กทริกแบริเออร์ดิสซาร์จก่อนที่จะนำไปเคลือบด้วยไคโตซาน ผลจากการวิจัยพบว่า ปริมาณของไคโตซานซึ่งวิเคราะห์ด้วยเทคนิค Kjeldahl ที่เคลือบอยู่บนพื้นผิวของแบคทีเรียเซลลูโลสที่ทำการปรับปรุงพื้นผิวด้วยเทคนิคพลาสมา มีปริมาณมากกว่าบนพื้นผิวของแบคทีเรียเซลลูโลสที่ไม่ได้ทำการปรับปรุงพื้นผิวด้วยเทคนิคพลาสมา และไคโตซานที่เคลือบอยู่นี้จะค่อยๆ ถูกปลดปล่อยออกมาจากพื้นผิวของแบคทีเรียเซลลูโลส เมื่อทำการแช่วัสดุในสารละลายบัฟเฟอร์ของฟอสเฟตและอะซีเตต นอกจากนี้พบว่าแบคทีเรียเซลลูโลสที่เคลือบพื้นผิวด้วยไคโตซานมีการคูดน้ำและความชื้นในอัตราที่สูง งานวิจัยนี้ยังทำการศึกษาโครงสร้างทางเคมีของวัสดุด้วยเทคนิค FTIR ศึกษาส่วนประกอบทางเคมีด้วยเทคนิค XPS และศึกษาโครงสร้างทางจุลภาคด้วยเทคนิค SEM นอกจากนี้ยังพบว่า การเคลือบพื้นผิวของแบคทีเรียเซลลูโลสด้วยสารละลายไคโตซาน 1.00 % (w/v) จะทำให้วัสดุมีประสิทธิภาพในการป้องกันเชื้อแบคทีเรียสองชนิดได้แก่ *Escherichia coli* (Gram-negative) และ *Staphylococcus aureus* (Gram-positive) ซึ่งยืนยันได้จากผลการทดสอบฤทธิ์ในการป้องกันเชื้อโรคด้วยเทคนิคการนับจำนวนเชื้อ

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