

**PREPARATION OF BACTERIAL CELLULOSE IMPREGNATED WITH
SILVER NANOPARTICLES AS AN ANTIMICROBIAL WOUND DRESSING**

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ABSTRACT

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Bacterial cellulose was produced by *Acetobacter xylinum* (TISTR 975). Bacterial cellulose is an interesting material for using as a wound dressing since it provide moist environment to a wound resulting in better wound healing. However, bacterial cellulose itself has no antimicrobial activity to prevent wound from infection. To achieve antimicrobial activity, silver nanoparticles were impregnated into the bacterial cellulose by immersing the bacterial cellulose in silver nitrate solution. Sodium borohydride was then used to reduce the absorbed silver ion (Ag^+) inside of bacterial cellulose to metallic silver nanoparticles (Ag^0). Silver nanopartilces displayed an optical absorption band around 420nm. The red shift and broadening of the optical absorption band was observed when the mole ratio of NaBH_4 to AgNO_3 ($\text{NaBH}_4:\text{AgNO}_3$) was decreased, indicating the increase in particle size and particles size distribution of silver nanoparticles that was investigated by transmission electron microscope. The formation of silver nanoparticles was also evidenced by X-ray diffraction. The antimicrobial activity of the silver nanoparticle-impregnated bacterial cellulose was measured by two methods. The first is an inhibition zone method, growth inhibition ring of *Staphylococcus aureus* and *Escherichia coli* were 3.5 and 2 mm, respectively. The second method is a colony forming unit count method, 99.7 % reduction in viable *Escherichia coli* and 99.9% reduction in viable *Staphylococcus aureus* were observed after 24 hours.

บทคัดย่อ

ธวัชชัย มณีรุ่ง : การเตรียมวัสดุปิดแผลจากเส้นใยเซลลูโลสที่สังเคราะห์จากเชื้อแบคทีเรียที่มีฤทธิ์ในการต้านเชื้อจุลินทรีย์ (Preparation of bacterial cellulose impregnated with silver nanoparticles as an antimicrobial wound dressing) อ. ที่ปรึกษา : ผศ.ดร. รัตนา รุจิรวนิช และ ศ.ดร.ไชยฉิ โทกุระ 58 หน้า

เส้นใยเซลลูโลสที่สังเคราะห์จากเชื้อแบคทีเรีย (*Acetobacter Xylinum*) จะถูกผลิตอยู่ในรูปของโครงสร้างสามมิติที่ไม่มีการถักทอ (3-Dimensional non-woven network) ซึ่งมีลักษณะคล้ายเส้นใยระดับนาโนที่ได้จากกระบวนการปั่นด้วยไฟฟ้าสถิต (Electrospinning) และจากโครงสร้างดังกล่าวนี้เองจึงทำให้เส้นใยเซลลูโลสที่สังเคราะห์จากเชื้อแบคทีเรียที่ผลิตออกมาอยู่ในรูปของวัสดุไฮโดรเจลซึ่งเป็นคุณสมบัติที่เหมาะสมสำหรับการนำมาใช้เป็นวัสดุปิดแผล เนื่องจากมันสามารถรักษาภาวะชุ่มชื้นของบาดแผลไว้ได้ซึ่งจะช่วยให้กระบวนการรักษาบาดแผลเป็นไปได้ง่ายขึ้นทั้งยังสามารถดูดซับของเหลวที่จะไหลออกมาจากบาดแผล (Wound exudates) ได้ นอกจากนี้วัสดุปิดแผลที่ดีควรมีคุณสมบัติอย่างอื่นเพิ่มเติม อาทิเช่น ความสามารถในการป้องกันการติดเชื้อของแผล เป็นต้น แต่เนื่องจากตัวของเส้นใยเซลลูโลสเองไม่มีคุณสมบัติดังกล่าว ดังนั้นในงานวิจัยนี้จะทำการสังเคราะห์อนุภาคระดับนาโนเมตรของโลหะซิลเวอร์ลงไปบนเส้นใยเซลลูโลสที่สังเคราะห์จากเชื้อแบคทีเรียเพื่อให้ได้วัสดุปิดแผลที่มีคุณสมบัติในการรักษาภาวะความชุ่มชื้นและคุณสมบัติในการป้องกันการติดเชื้อของบาดแผลโดยใช้กระบวนการเคมีรีดักชันของสารประกอบซิลเวอร์ในเตรดด้วยโซเดียมโบโรไฮไดร (NaBH₄) ต่อสารประกอบซิลเวอร์ในเตรด (AgNO₃) ต่อการสังเคราะห์อนุภาคระดับนาโนเมตรของโลหะซิลเวอร์หลังจากนั้นเส้นใยเซลลูโลสที่สังเคราะห์จากแบคทีเรียที่มีอนุภาคระดับนาโนเมตรของโลหะซิลเวอร์ฝังอยู่จะถูกวิเคราะห์โดยใช้ UV-visible spectrophotometer, X-ray diffraction, Transmission electron microscopy และความสามารถในการต่อต้านเชื้อจุลินทรีย์ของเส้นใยเซลลูโลสที่สังเคราะห์จากแบคทีเรียที่มีอนุภาคระดับนาโนเมตรของโลหะซิลเวอร์ฝังอยู่จะถูกตรวจสอบด้วยเชื้อจุลินทรีย์ *Escherichia coli* และ *Staphylococcus aureus*

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