

**PROCESS OPTIMIZATION DESIGNS BASE ON SILK FIBROIN PROTEIN
IN UNIQUE FIBROUS MORPHOLOGY FOR WOUND DRESSING
APPLICATION**

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ABSTRACT

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Nowadays, there are numerous researches regarding to the relative efficiency of the various kinds of material for effective wound healing. Biopolymers and fabrication techniques have been studied not only for covering in order to prevent infection but also have extraordinary properties which promote the healing process. In this work, Thailand domesticated, *Bombyx mori*, silk fibroin fibres, which is well known in the textile industry for centuries, was used to develop as active wound dressing . Silk fibroin from the silk cocoon is generally defined as an attractive biomaterial because of its unique characteristics such as high mechanical strength, excellent biocompatibility, controllable structure and morphology, and wide variety of constructive properties on tissue engineering. One of the most effective methods for this is electrospinning, a proven technique that precisely creates the fibrous structure that can mimic nanofibrillar structure and the biological functions of the natural extracellular matrix. Electrospun fibrous mats also combine extremely large surface area to volume ratios with high porosity, features that are needed for the application of these materials in wound healing. In this study, we aimed to optimize the preparation process of ultra-fine silk fibroin fibers for wound dressing application. These findings open an exciting opportunity to fabricate biocompatible scaffold structures that could be used as next generation effective wound healing materials.

บทคัดย่อ

เจษฎา ชูติกักคิวงค์ : การออกแบบกระบวนการขึ้นรูปเส้นใยที่เหมาะสมสำหรับ โปรตีนไหมไฟโบรอินเพื่อการใช้งานเป็นวัสดุปิดแผล (Process Optimization Designs Base on Silk Fibroin Protein in Unique Fibrous Morphology for Wound Dressing Application) อ. ที่ปรึกษา: ศาสตราจารย์ ดร. พิชญ์ สุภผล และ ดร.อุรษา รัชต์ตานนท์ชัย 118 หน้า

ในปัจจุบัน ได้มีงานวิจัยจำนวนมากศึกษาเกี่ยวกับประสิทธิภาพของวัสดุหลากหลายชนิด เพื่อช่วยในการรักษาแผล โพลีเมอร์ชีวภาพและเทคนิคในการขึ้นรูปวัสดุ จึงได้มีการศึกษาเพิ่มเติมไม่เพียง แต่สำหรับป้องกันแผลจากสิ่งแวดล้อมภายนอก หรือเพื่อป้องกันการติดเชื้อ แต่ยังมีคุณสมบัติ พิเศษที่ช่วยส่งเสริมกระบวนการหายของแผล ในงานวิจัยนี้ ได้ทำการปรับปรุงพัฒนา เส้นไหมสายพันธุ์ท้องถิ่นในประเทศไทย ซึ่งเป็นที่รู้จักกันดีในอุตสาหกรรมสิ่งทอมานานหลายศตวรรษ เพื่อใช้ในการพัฒนาวัสดุปิดแผลที่มีประสิทธิภาพ เส้นไหมที่สาวออกจากรังไหมแล้ว จะถูกนำมาสกัดอยู่ในรูปของ โปรตีนไหมไฟโบรอิน ซึ่งโดยทั่วไปว่าเป็นวัสดุที่มีความน่าสนใจสูง เนื่องจากคุณสมบัติที่เป็นเอกลักษณ์ เช่น ความแข็งแรง, มีความเข้ากันได้ทางชีวภาพที่ดี, มีโครงสร้างและสัญญาณวิทยาที่สามารถควบคุมได้, และมีความหลากหลายของคุณสมบัติที่สร้างสรรค์ทางด้านวิศวกรรมชีวภาพ หนึ่งในวิธีการที่มีประสิทธิภาพมากที่สุดสำหรับการขึ้นรูปสำหรับแผ่นปิดแผล คือ เทคนิคอิเล็กโตรสปินนิง ซึ่งมีการพิสูจน์แล้วว่า มีความแม่นยำในการสร้างโครงสร้างเส้นใย ที่สามารถเลียนแบบโครงสร้างเส้นใยนาโน และการทำงานทางชีวภาพของเอ็กตราเซลล์ลูล่า เมทริก ในร่างกาย เส้นใยอิเล็กโตรสปินนิงยังมีความสามารถรวมถึงในเรื่องของพื้นที่ผิวที่มีขนาดใหญ่ เทียบกับอัตราส่วนโดยปริมาตร และมีความเป็นรูพรุนสูง ซึ่งเป็นคุณสมบัติที่มีความจำเป็นสำหรับการใช้งานวัสดุเหล่านี้ในรูปแบบของวัสดุที่ใช้ในการรักษาแผล ในงานวิจัยนี้ เรามีวัตถุประสงค์เพื่อ คิดค้นวิธีเพิ่มประสิทธิภาพของกระบวนการเตรียมเส้นไหมไฟโบรอินสำหรับทำแผ่นปิดแผล ซึ่งการค้นพบนี้ จะเปิดโอกาสในการคิดค้นเพิ่มเติมสำหรับการสร้างวัสดุโครงสร้างที่มีความเข้ากันได้ทางชีวภาพ และสามารถนำมาใช้เป็นวัสดุปิดแผลที่มีประสิทธิภาพต่อไป

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ABBREVIATIONS

AAS	Atomic absorption spectroscope
DMEM	Dulbecco's modified Eagle's medium
DMF	Dimethyl formamide
DMSO	Dimethyl sulfoxide
EDC	One-ethyl-3-(dimethylaminopropyl) carbodiimide hydrochloride
EFS	Electric field strength
e-spinning	Electrospinning
e-spun	Electrospun
eSF	Electrospun silk fibroin
FT-IR	Fourier-transform infrared spectroscopy
HFF	Human foreskin fibroblast
HPLC	High pressure liquid chromatography
MTT	Methyl 4-hydroxybenzoate
NHS	N-hydroxysuccinimide
NHDF	Normal human dermal fibroblast
PBS	Phosphate buffer saline
PCL	Poly (ϵ -caprolactone)
PEO	Poly(ethylene oxide)
RH	Relative humidity
SEM	Scanning electron microscopy
SF	Silk fibroin
SFM	Serum-free medium
TCPS	Tissue-culture polystyrene plate
UV	Ultra-violet
XPS	X-ray photoelectron spectroscopy