

**DEGRADATION AND BIOLOGICAL EVALUATION OF IMMOBILIZED-
ELECTROSPUN POLYCAPROLACTONE FOR BONE TISSUE
ENGINEERING**

Piyada Poomsurard

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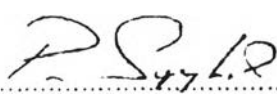
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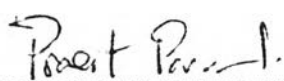
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By: Piyada Poomsurard
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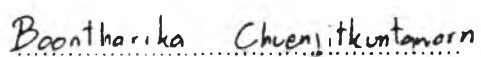

..... College Dean
(Asst. Prof. Pomthong Malakul)

Thesis Committee:


.....
(Prof. Pitt Supaphol)


.....
(Prof. Prasit Pavasant)


.....
(Asst. Prof. Manit Nithithanakul)


.....
(Dr. Boontharika Chuenjitkuntaworn)

ABSTRACT

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Keywords: Polycaprolactone/ Electrospinning/ Degradation/ Bovine Serum Albumin

Polymeric scaffolds for bone tissue engineering application have been produced and developed to mimic the native extracellular matrix (ECM). In this study, polycaprolactone (PCL), the promising biodegradable polymer candidate in this field, have been used to produce fibrous scaffolds, fabricated by electrospinning technique. The obtained PCL fiber mats were first modified the surface to promote their biocompatibility and the subsequent immobilization of bovine serum albumin (BSA) onto their surfaces. The result shows that the aminolyzing time did not influence on the mechanical properties of PCL fibrous scaffolds. In order to meet the concept of being scaffolds, biomaterials are expected to have the rate of degradation matching the rate of tissue regeneration. Hence, the degradation behaviours play an important role in the tissue engineering. In this study, PCL nanofibrous scaffolds have been systematically investigated up to 30 days in enzymatic solution at 37°C. The scaffolds were examined in terms of weight loss and pH change, also using Differential Scanning Calorimetry (DSC) and Scanning Electron Microscopy (SEM) were investigated. Moreover, the PCL fibrous scaffolds were evaluated in vitro with mouse calvaria-derived preosteoblastic cells (MC3T3-E1). The biological evaluation illustrated that no toxic was released and harm to cells.

บทคัดย่อ

ปิยดา ภูมิสุราษฎร์ : การสลายตัวและการทดสอบทางชีวภาพของเส้นใยอิเล็กทรอนิกส์โพรสปีน พอลิคาโพรแลคโตนที่มีการตรึงโปรตีนสำหรับงานวิศวกรรมเนื้อเยื่อกระดูก (Degradation and Biological Evaluation of Immobilized-Electrospun Polycaprolactone for Bone Tissue Engineering) อ.ที่ปรึกษา: ศ. ดร. พิชญ์ ศุภผล 46 หน้า

โครงเนื้อเยื่อ (scaffolds) จากพอลิเมอร์ถูกนำมาใช้และพัฒนาเพื่อจำลองและเลียนแบบพฤติกรรมของสารเคลือบเซลล์ (extracellular matrix) ในงานวิจัยนี้ พอลิคาโพรแลคโตน (PCL) ซึ่งเป็นพอลิเมอร์ที่สามารถย่อยสลายได้ทางชีวภาพได้ถูกนำมาผลิตเป็น เส้นใยอิเล็กทรอนิกส์โพรสปีน โดยวิธีปั่นเส้นใยด้วยไฟฟ้าสถิต เพื่อนำมาประยุกต์ใช้ในงานทางการแพทย์ เส้นใยอิเล็กทรอนิกส์โพรสปีนที่ได้จะถูกนำไปปรับปรุงพื้นผิว เพื่อให้วัสดุมีความเข้ากันได้ดีกับเนื้อเยื่อ (biocompatibility) และจากการทดลอง พบว่า เวลาที่ใช้ในการปรับปรุงพื้นผิวของวัสดุ ไม่ส่งผลกระทบต่อสมบัติเชิงกลของวัสดุ หลังจากนั้น จึงนำโปรตีนโบวิน เซรัม อัลบูมิน มาตรึงที่ผิวของวัสดุ และเพื่อที่จะตอบสนองแนวคิดของการเป็นโครงเนื้อเยื่อ วัสดุชีวภาพดังกล่าวจึงควรมีอัตราการสลายตัวที่เหมาะสมกับอัตราการเกิดใหม่ของเนื้อเยื่อ จะเห็นได้ว่าพฤติกรรมของการสลายตัวของวัสดุ มีบทบาทสำคัญในด้านวิศวกรรมเนื้อเยื่อ ดังนั้นในงานวิจัยนี้จึงได้ศึกษาพฤติกรรมการสลายตัวของวัสดุชีวภาพในสารละลายบัฟเฟอร์ที่มีเอนไซม์ไลเปส ที่อุณหภูมิ 37°C เป็นเวลา 30 วัน วัสดุจะถูกศึกษาในแง่ของการสูญเสียน้ำหนัก การเปลี่ยนแปลงค่า pH และการเก็บรักษาน้ำ นอกจากนี้ ยังศึกษาสมบัติทางความร้อน โดยใช้ DSC และ ศึกษาสมบัติทางกายภาพ จาก SEM นอกจากนี้ยังได้นำวัสดุไปทดสอบทางชีวภาพ ด้วยเซลล์ mouse calvaria-derived preosteoblastic (MC3T3-E1) เพื่อศึกษาความเป็นพิษของวัสดุ และพบว่า สารที่ถูกปลดปล่อยออกมาจากวัสดุ ไม่มีความเป็นพิษ หรือเป็นอันตรายต่อเซลล์

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ABBREVIATIONS

ATR-FTIR	Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy
BSA	Bovine Serum Albumin
DC	Direct Current
DCM	Dichloromethane
DMF	N,N'-dimethylformamide
DSC	Differential Scanning Calorimetry
HMD	1,6-Hexamethylenediamine
IPA	Isopropanol
PCL	Polycaprolactone
PBS	Phosphate Buffer Saline
SEM	Scanning Electron Microscopy
SFM	Serum Free Media
TCPS	Tissue Culture Polystyrene
T_g	Glass Transition Temperature
T_m	Melting Temperature
UV-vis	Ultraviolet-visible
XPS	X-ray Photoelectron Spectroscopy