

**ELECTROSPUN POLY( $\epsilon$ -CAPROLACTONE)/POLY(3-HYDROXYBUTYRATE-CO-3-HYDROXYVALERATE) FIBROUS SUBSTRATES FOR BONE TISSUE ENGINEERING**



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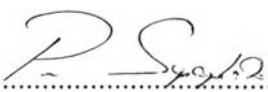
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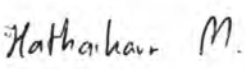
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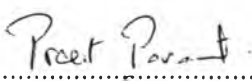
  
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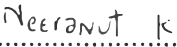
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## ABSTRACT

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Fibrous substrates of the blend solutions of Poly( $\epsilon$ -caprolactone) (PCL)/Poly(3-hydroxybutyrate-*co*-3-hydroxyvalerate) (PHBV) in a mixture of chloroform and *N,N*-dimethylformamide (DMF) were fabricated by electrospinning. The effect of the solution concentration on the morphology, mechanical integrity, and physicochemical properties of the obtained fibrous substrates was examined. The fibrous substrate prepared from 10 wt% PCL/PHBV solution exhibited the smoothest surface topography and the lowest static water contact angle, which have been reported to be suitable for cell growth. Taking into account the osteoconductivity of hydroxyapatite (HAp) and the osteoinductivity of bone proteins (i.e., type I collagen (COL), fibronectin (FN), and crude bone protein (CBP)), HAp and bone proteins-loaded HAp nanoparticles were incorporated into the PCL/PHBV fibrous substrates. The potential use of these fibrous substrates as bone scaffolds was assessed *in vitro* with mouse-calvaria-derived preosteoblastic cells (MC3T3-E1) in terms of the attachment, proliferation, alkaline phosphatase (ALP) activity, and mineralization. Furthermore, the capability of the PCL/PHBV fibrous substrate as a drug carrier was also investigated by the incorporation of doxycycline hyclate (DOXY). The release characteristics of DOXY from DOXY-loaded PCL/PHBV fibrous substrates were carried out by the total immersion method in a phosphate buffer solution. *In vitro* antibacterial activity of these fibrous substrates was also tested against Gram-negative *Pseudomonas aeruginosa* and Gram-positive *Staphylococcus aureus*.

## บทคัดย่อ

แพรววี เกษสุวรรณ : แผ่นเส้นใยอิเล็กทรอนิกส์โครสปีนพอลิคาโพรแลคโตน/พอลิไฮดรอกซีบิวทีเรต-โค-ไฮดรอกซีวาลเอร์เรตสำหรับงานวิศวกรรมเนื้อเยื่อกระดูก (Electrospun Poly( $\epsilon$ -caprolactone)/Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) Fibrous Substrates for Bone Tissue Engineering) อ. ที่ปรึกษา : ศ.ดร. พิชญ์ ศุภผล 154 หน้า

แผ่นเส้นใยอิเล็กทรอนิกส์โครสปีนของสารละลายผสมพอลิคาโพรแลคโตน/พอลิไฮดรอกซีบิวทีเรต-โค-ไฮดรอกซีวาลเอร์เรตในตัวทำละลายผสมคลอโรฟอร์มและไดเมทิลฟอร์มาไรม์ด์ สามารถเตรียมได้จากกระบวนการปั่นเส้นใยด้วยไฟฟ้าสถิต ในงานวิจัยนี้ได้ศึกษาผลกระทบของความเข้มข้นของสารละลายพอลิเมอร์ผสมต่อลักษณะพื้นผิว คุณสมบัติเชิงกล และคุณสมบัติทางเคมีกายภาพของแผ่นเส้นใย แผ่นเส้นใยที่เตรียมจากสารละลายผสมเข้มข้น 10 เปอร์เซ็นต์โดยน้ำหนักให้แผ่นเส้นใยที่มีลักษณะพื้นผิวเรียบและมีความชอบน้ำมาก ซึ่งเหมาะแก่การเจริญเติบโตของเซลล์กระดูก นอกจากนี้ไฮดรอกซีอะพาไทต์ที่มีโปรตีนกระดูก (เช่น คอลลาเจน, ไฟโบรเนคติน และ โปรตีนกระดูกรวม) ถูกนำมาผสมลงในแผ่นเส้นใยเพื่อพัฒนาคุณสมบัติการเหนียวสำหรับการสร้างกระดูกใหม่ และเนื่องจากความต้องการที่จะประยุกต์ใช้แผ่นเส้นใยอิเล็กทรอนิกส์โครสปีนเหล่านี้สำหรับเป็นวัสดุทดแทนกระดูก จึงได้มีการศึกษาความเข้ากันได้ทางชีวภาพของวัสดุกับเซลล์กระดูก (MC3T3-E1) โดยทดสอบการเกาะของเซลล์, การเจริญเติบโตของเซลล์, การสร้างคอลลาเจน และการสะสมแร่ธาตุของเซลล์ นอกจากนี้ยังได้มีการทดสอบความสามารถของแผ่นใยในการเป็นสารตัวนำพา โดยผสมสารละลายของแผ่นเส้นใยกับยาดีออกซีไซคลินไฮคลอไรด์และศึกษาการปลดปล่อยตัวยาจากแผ่นเส้นใย โดยใช้วิธีการแช่ในสารละลายฟอสเฟตบัฟเฟอร์ รวมถึงได้มีการทดสอบแผ่นเส้นใยที่มีตัวยานี้ในการด้านเชื้อแบคทีเรียอีกด้วย

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