

**UTILIZATION OF ELECTROSPUN POLY(VINYL ALCOHOL) AND  
CELLULOSE ACETATE FIBER MATS AS CARRIERS FOR TOPICAL  
RELEASE OF NSAIDS AND VITAMINS**



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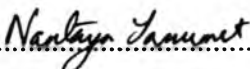
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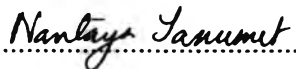
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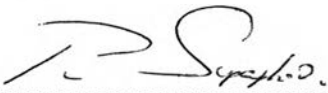
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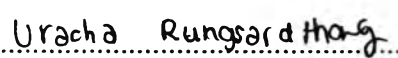
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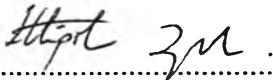
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## ABSTRACT

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Pattama Taepaiboon: Utilization of electrospun poly(vinyl alcohol) and cellulose acetate fiber mats as carriers for topical release of NSAIDs and vitamins

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Mats of poly(vinyl alcohol) (PVA) and cellulose acetate (CA) nanofibers were successfully prepared by the electrospinning process and were developed as carriers of drugs and vitamins for transdermal drug delivery system. Four types of non-steroidal anti-inflammatory drugs (NSAIDs) of varying water solubility, i.e. sodium salicylate (SS), diclofenac sodium (DS), naproxen (NAP), and indomethacin (IND) were incorporated in the mats of PVA nanofibers. Due to the high amounts of SS released from the mats of SS-containing PVA nanofibers, cross-linking of the polymer matrix (PVA) was required in order to retard the rate of drug (SS) released. Cross-linking of the SS-loaded electrospun PVA mats was achieved by exposing the mats to the vapor from 5.6 M aqueous solution of either glutaraldehyde or glyoxal for various exposure time intervals. Moreover, mats of CA nanofibers were also developed as carriers for delivery of the model vitamins, i.e., vitamin A acid (Retin-A) and vitamin E (Vit-E). The morphological appearance of the electrospun nanofibers containing NSAIDs and vitamins depended on the nature of the polymers, the solvent, the drugs, the vitamins, and their solutions. Chemical integrity of the drugs within the drug-loaded as-spun mats, thermal property, swelling and weight loss behavior of neat and drug-loaded as-spun mats in an aqueous medium was studied. In addition, the release characteristics of NSAIDs and vitamins from electrospun nanofibers were investigated. Two types of release study, i.e. total immersion and transdermal diffusion through a pig skin, were carried out.

## บทคัดย่อ

ปีทมา เต้ไพบูลย์ : การประยุกต์ใช้แผ่นเส้นใยอิเล็กโตรสปินพอลิไวนิลแอลกอฮอล์และเซลลูโลสอะซิเตตเป็นวัสดุนำส่งเฉพาะที่ของยา NSAID และวิตามิน (Utilization of Electrospun Poly(vinyl alcohol) and Cellulose Acetate Fiber Mats as Carriers for Topical Release of NSAIDs and Vitamins) อ. ที่ปรึกษา : รองศาสตราจารย์ ดร. พิชญ์ สุกผล และ ดร. อรุชา รังสาดทอง 183 หน้า

งานวิจัยนี้เป็นการนำกระบวนการปั่นเส้นใยด้วยไฟฟ้าสถิตมาใช้เพื่อขึ้นรูปเส้นใยพอลิไวนิลแอลกอฮอล์และเซลลูโลสอะซิเตต เส้นใยที่ได้จะถูกนำมาพัฒนาเป็นวัสดุนำส่งยาต้นแบบรวมทั้งสารจำพวกวิตามิน เพื่อใช้สำหรับสำหรับกระบวนการนำส่งยาผ่านทางผิวหนัง ยาต้นแบบในงานวิจัยนี้เป็นยาแก้ปวดในกลุ่มเอ็นเซดที่มีความสามารถในการละลายน้ำต่างกันทั้งหมด 4 ประเภท ได้แก่ โขเดียมซาลิไซเลต ไดโครฟีแนคโซเดียม นาพรอกเซนและ อินโดเมทาซิน ยาเหล่านี้จะอยู่ในเส้นใยพอลิไวนิลแอลกอฮอล์ นอกจากนี้ เพื่อที่จะควบคุมอัตราการปลดปล่อยของยา จึงได้มีการเชื่อมโยงเส้นใยพอลิไวนิลแอลกอฮอล์โดยวิธีการอั้งไอระเหยของสารละลายกลูตาโรลดีไฮด์และ สารละลายไกรออกซอลด้วยระยะเวลาที่ต่างกัน ตามด้วยการให้ความร้อนในตู้อบสุญญากาศ นอกจากพอลิไวนิลแอลกอฮอล์แล้ว เส้นใยเซลลูโลสอะซิเตตที่ได้จากกระบวนการปั่นเส้นใยด้วยไฟฟ้าสถิตยังถูกนำมาพัฒนาเพื่อให้นำส่งสารจำพวกวิตามิน ในงานวิจัยนี้ได้ใช้วิตามินอี และวิตามินเอเอซิดเป็นสารที่ต้องการนำส่ง ลักษณะพื้นผิวของเส้นใยที่ได้ขึ้นกับสมบัติของยาต้นแบบหรือ วิตามินที่รวมอยู่ด้วย งานวิจัยนี้ได้มีการศึกษาสมบัติทางความร้อน ความแข็งแรงเชิงกล การบวมน้ำและการสูญเสียมวลเนื่องจากการละลายน้ำของเส้นใยทั้งที่มียาต้นแบบและไม่มียาต้นแบบรวมถึงวิตามินด้วย และได้ทำการทดลองเพื่อศึกษาการปลดปล่อยยาจากเส้นใยพอลิเมอร์โดยใช้วิธีการทดลองแบบจุ่ม และการทดลองการปลดปล่อยยาแบบจุ่มผ่านผิวหนังโดยใช้หนังหมู

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**ABBREVIATIONS**

PVA	Poly(vinyl alcohol)
CA	Cellulose acetate
SS	Sodium salicylate
DS	Diclofenac sodium
NAP	Naproxen
IND	Indomethacin
Vit-E	Vitamin E or $\alpha$ -tocopherol
Retin-A	All-trans retinoic acid or vitamin A acid
NSAID	Non-steroidal anti-inflammatory drug
TDDS	Transdermal drug delivery system
NHDF	Normal human dermal fibroblast cell
SEM	Scanning electron microscope
$^1\text{H-NMR}$	$^1\text{H}$ -Nuclear magnetic resonance
TGA	Thermogravimetric analysis
DSC	Differential scanning calorimeter
HPLC	High pressure liquid chromatography

**LIST OF SYMBOLS**

$\gamma$	Surface tension
$\rho$	Density
$V_*$	Critical Potential
$V_c$	Critical Voltage
DC	Direct current
$E'$	Storage modulus (Pa/s)
$T_m$	Melting temperature
$T_d$	Degradation temperature
$M$	Weight of sample after submersion in the testing solution
$M_i$	Initial weight of the sample in its dry state
$M_d$	Weight of the sample after submersion in the testing solution in its dry state
$M_r$	Weight of a model drug or vitamins that were released from the sample
$M_t$	Accumulative amount of drugs released at an arbitrary time $t$
$M_\infty$	Accumulation amount of drugs released at an infinite time
$n$	Characteristic exponent
$k$	Rate parameter ( $s^{-0.5}$ )