

การพัฒนาเทคนิคการเคลือบเพลตด้วยฟลูอิดไอซ์เบคที่เสริมด้วยไฟฟ้าสถิต

นางสาวภานิชา กิตติรังสี

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเกษตรศาสตรมหาบัณฑิต

สาขาวิชาเกษตรอุตสาหกรรม ภาควิชาเกษตรอุตสาหกรรม

คณะเกษตรศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

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DEVELOPMENT OF PELLET COATING TECHNIQUE USING
ELECTROSTATIC ENHANCED FLUIDIZED BED

Miss Panicha Kittirungsi

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ในอุตสาหกรรมผลิตยาที่มีการใช้ฟลูอิดไคซ์เบดสำหรับทำให้ผลิตภัณฑ์แห้งและเคลือบผลิตภัณฑ์
วัตถุประสงค์ของการศึกษานี้ คือ เพื่อพัฒนาเทคนิคการเคลือบเพลเลตด้วยฟลูอิดไคซ์เบดที่เสริมด้วยไฟฟ้า
สถิตและศึกษาผลของตัวแปรในกระบวนการเคลือบต่อประสิทธิภาพในการเคลือบและคุณสมบัติทาง
เคมีกายภาพของเพลเลตที่เคลือบได้ ตัวแปรที่ศึกษา ได้แก่ ชนิดของเพลเลตยาที่ใช้เป็นแกน สารก่อฟิล์ม
และศักย์ไฟฟ้าที่ป้อนแก่หัวฉีด เพลเลตยาโพรพาราโนลอลไฮโดรคลอไรด์และเพลเลตยาไดโคลฟีแนค
โซเดียม (50 % โดยน้ำหนัก) ซึ่งใช้เป็นเพลเลตแกน ผลิตโดยใช้กระบวนการเอ็กซ์ทรูชัน-สเฟียโรไนเซ
ชันถูกนำมาเคลือบด้วยไฮดรอกซีโพรพิลเมธิลเซลลูโลสที่เตรียมในรูปแบบสารละลายในน้ำหรือเอธิล
เซลลูโลสที่เตรียมในรูปแบบกระจายตัวในน้ำ โดยป้อนศักย์ไฟฟ้าขนาด 4 กิโลโวลต์แก่หัวฉีด ผลของ
เพลเลตที่เคลือบได้ถูกนำไปเปรียบเทียบกับกระบวนการเคลือบแบบเดิมที่ไม่ใช้ไฟฟ้าสถิต

ผลการศึกษาพบว่าเพลเลตที่ผ่านการเคลือบยังคงมีลักษณะกลมและมีคุณสมบัติการไหลที่ดี
ฟิล์มเคลือบมีลักษณะเป็นเนื้อเดียวกันเมื่อใช้เพลเลตยาไดโคลฟีแนคโซเดียมเป็นแกน นอกเหนือจากผล
ของสภาวะที่ใช้เคลือบ ผลการวิเคราะห์รูปร่างเพลเลตพบว่า ชนิดของเพลเลตยาแกนและศักย์ไฟฟ้าที่
ป้อนแก่หัวฉีดมีผลต่อความหนาของชั้นฟิล์มเคลือบอย่างมีนัยสำคัญ ($p < 0.05$) อย่างไรก็ตามการป้อน
ศักย์ไฟฟ้าแก่หยดละอองของสารก่อฟิล์มไม่มีผลต่อประสิทธิภาพในการเคลือบอย่างมีนัยสำคัญ ($p >$
 0.05) แต่มีผลเพิ่มสภาวะผลิตซ้ำได้ ชนิดของสารก่อฟิล์มจัดเป็นตัวแปรสำคัญที่มีผลต่อการปลดปล่อย
ตัวของเพลเลตที่เคลือบแม้ว่าจะมีผลจากปัจจัยอื่นร่วมด้วย ผลจากการศึกษาชี้ให้เห็นว่ากระบวนการ
เคลือบที่ใช้เทคนิคทางไฟฟ้าสถิตในฟลูอิดไคซ์เบดจะมีความซับซ้อนโดยธรรมชาติ อย่างไรก็ตามเทคนิค
นี้อาจจะมีประโยชน์ทางเภสัชกรรม เมื่อมีการควบคุมตัวแปรในกระบวนการเคลือบอย่างระมัดระวัง

ภาควิชา.....เภสัชอุตสาหกรรม..... ลายมือชื่อนิสิต..... *จิตติมา ชัชวาลย์สายสินธ์*
สาขาวิชา.....เภสัชอุตสาหกรรม..... ลายมือชื่ออาจารย์ที่ปรึกษา..... *จิตติมา ชัชวาลย์สายสินธ์*
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PANICHA KITTIRUNGSI: DEVELOPMENT OF PELLET COATING
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 THESIS ADVISOR: JITTIMA CHATCHAWALSAISIN, Ph.D., THESIS
 COADVISOR: NARUEPORN SUTANTHAVIBUL, Ph.D., 145 pp.

Fluidized bed has been used in the pharmaceutical industry for drying and coating products. The present study was aimed to develop pellet coating technique using electrostatic enhanced fluidized bed and investigate the effect of process variables on the coating efficiency and physicochemical properties of coated pellets. The variables studied were types of drug core pellets, film formers and electrical potential applied to the nozzle. Propranolol hydrochloride and diclofenac sodium pellets (50 %w/w) were prepared by extrusion-spheronization technique and used as the core pellets. The core pellets was coated with either the aqueous solution of hydroxypropylmethylcellulose or ethylcellulose aqueous dispersion. Electrical potential was applied to the nozzle at the magnitude of 4 kV. The resulting coated pellets were compared with those obtained from the conventional technique, i.e. fluidized bed with non-applied electrical potential.

It was found that the coated pellets remained round shaped and free-flowing. The coating of diclofenac sodium core pellets resulted in homogeneous film regardless of the effect of coating conditions. In all cases, an image analysis showed that the film thickness was significantly influenced by types of drug core pellets and applied electrical potential ($p < 0.05$). However, applying charged droplets to core pellets was not proved to significantly enhanced the coating efficiency ($p > 0.05$) but rather improved its reproducibility. The drug released was primarily controlled by types of film former, although there were some influences from other process variables. The results showed that, no matter how complex the nature of electrostatic fluidized bed coating was, this technique may be useful for pharmaceuticals when process variables are carefully controlled.

Department....Manufacturing pharmacy Student's signature: *P. Kittirungsai*
 Field of study.....Industrial pharmacy..... Advisor's signature: *J. Chatchawalsaisin*
 Academic year.....2007..... Co-advisor's signature: *M. Suttavibul*

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LIST OF ABBREVIATIONS

%	Percentage
µg	Microgram (s)
µm	Micrometer (s)
µl	Microliter (s)
°C	Degree celcius (centigrade)
CLSM	Confocal Laser Scanning Microscopy
cm	Centrimeter (s)
DS	Diclofenac sodium
EC	Ethylcellulose
et al.	<i>et alii</i> , 'and others'
g	Gram (s)
h	Hóur (s)
HCl	Hydrochloride
HPLC	High performance liquid chromatographic
HPMC	Hydroxypropylmethylcellulose
kg	Kilogram(s)
kV	Kilovolt (s)
MCC	Microcrystalline cellulose
MeOH	Methanol
mg	Milligram (s)
min	Minute (s)
ml	Milliliter (s)
mm	Millimeter (s)
nm	Nanometer (s)
pH	The negative logarithm of the hydrogen ion concentration
PL	Propranolol hydrochloride
rpm	Revolutions per minute
RSD	Relative standard deviation
s	Second (s)
SD	Standard deviation

SEM	Scanning electron microscopy
SLS	Sodium lauryl sulfate
UV	Ultraviolet
w/w	Weight by weight