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OPTIMIZATION FOR SPRAY DRYING  
OF PROBIOTIC BACTERIA

KANOKWAN SARINYAWAT

MASTER OF SCIENCE  
IN BIOTECHNOLOGY

THE GRADUATE SCHOOL  
CHIANG MAI UNIVERSITY  
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**KANOKWAN SARINYAWAT**

**A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN  
PARTIAL FULFILLMENT OF THE REQUIREMENTS  
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IN BIOTECHNOLOGY**

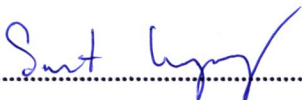
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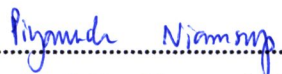
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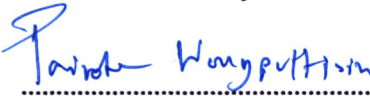
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ชื่อเรื่องวิทยานิพนธ์	การหาสภาวะที่เหมาะสมสำหรับการทำแห้งแบบพ่นฝอยของ แบคทีเรียโปรไบโอติก
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## บทคัดย่อ

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การหาสภาวะที่เหมาะสมในการทำแห้งแบบพ่นฝอยเชื้อแบคทีเรียโปรไบโอติก 1% (w/v) ของเชื้อ *Lactobacillus casei* sub.sp. *paracasei* F-19, *L. plantarum* V299 และ *L. fermentum* 2311M ใน 15% (w/v) สารละลายนมผงพร่องมันเนย โดยสภาวะในการทำแห้งแบบพ่นฝอยในการศึกษานี้ได้แก่ อัตราการป้อนสารละลาย 25 ml/min, แรงลมที่หัวพ่นฝอย 15 kg/cm<sup>2</sup> และ อุณหภูมิลมออกที่ 65°C, 75°C และ 85°C พบว่าการทำแห้งแบบพ่นฝอยของเชื้อ *L. casei* sub.sp. *paracasei* F-19 มีอัตราการรอดชีวิตสูงสุดเป็น 72%, 47% และ 35% ตามลำดับ, *L. plantarum* V299 มีอัตราการรอดเป็น 55%, 49% และ 18% ตามลำดับ และ *L. fermentum* 2311M มีอัตราการรอดชีวิตต่ำสุดคือ 24%, 20% และ 10% ตามลำดับ อุณหภูมิลมออกยังส่งผลต่อความชื้นเช่นกัน โดยความชื้นของผลิตภัณฑ์ที่อุณหภูมิลมออก 85°C มีค่าน้อยที่สุดคือ 3.2% ถึง 3.8% ความชื้นที่อุณหภูมิลมออก 75°C คือ 5.2% ถึง 5.6% และที่อุณหภูมิลมออก 65°C มีความชื้นมากที่สุด 7.9% ถึง 8.4% เมื่อนำผลิตภัณฑ์ที่ได้จากการทำแห้งแบบพ่นฝอยที่อุณหภูมิลมออกเท่ากับ 75°C ของจุลินทรีย์โปรไบโอติกทั้ง 3 สายพันธุ์มาเก็บรักษาไว้ที่อุณหภูมิ 4°C และอุณหภูมิห้องในถุงอะลูมิเนียม เป็นเวลา 30 วัน พบว่าเมื่อเก็บไว้ที่อุณหภูมิ 4°C ปริมาณเซลล์ที่มีชีวิตลดลงประมาณ 2 log cycle และลดลงประมาณ 4 log cycle เมื่อเก็บไว้ที่อุณหภูมิห้อง และจากการศึกษาการทำแห้งแบบพ่นฝอยโดยใช้เชื้อโปรไบโอติกผสมกับวิปิ้งครีม โดยใช้อุณหภูมิลมออกที่ 75°C พบว่า *L. casei* sub.sp. *paracasei* F-19, *L. plantarum* V299 และ *L. fermentum* 2311M มีอัตราการรอดเป็น 22%, 21% และ 8% ตามลำดับ มีความชื้นเท่ากับ 5.5%, 5.0% และ 4.8% ตามลำดับและผงผลิตภัณฑ์ที่ได้มีความละเอียดดี ไม่จับกันเป็นก้อน



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## ABSTRACT

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Evaluation of optimum condition for spray drying of probiotic bacteria, *Lactobacillus casei* sub.sp. *paracasei* F-19, *L. plantarum* V299 and *L. fermentum* 2311M in 15% (w/v) skim milk solution. Conditions of spray drying were done with 25 ml/min of feed rate, 15 kg/cm<sup>2</sup> of air atomization and the air outlet temperature at 65°C, 75°C and 85 °C. Spray dry of *L. casei* sub.sp. *paracasei* F-19 had highest survival rate 72%, 47% and 35% respectively, *L. plantarum* V299 had survival rate at 55%, 49% and 18%, respectively and *L. fermentum* 2311M had lowest survival rate 24%, 20% and 10%, respectively. Moisture content of product was related with air outlet temperature too. At 85°C of air outlet temperature yielded lowest moisture content from 3.2% to 3.8%, at 75°C of air outlet temperature were 5.2% to 5.6%, moisture content is nearly standard of milk powder and the highest moisture content obtained from air outlet temperature at 65°C were 7.9% to 8.1%. The sample of probiotic with skim milk powder were stored at 4°C and at room temperature in aluminum bags for 30 days. The viable cells decreased 2 log cycle after stored at 4°C and decreased approximately 4 log cycle after stored at room temperature. Another experiment of spray drying probiotic in whipping cream at 75°C of air outlet temperature the survival rate viable of *L. casei* sub.sp. *paracasei* F-19, *L. plantarum* V299 and *L. fermentum* 2311M were 22%, 21% and 8%, respectively. Which had moisture content at 5.5%, 5.0% and 4.8%, respectively and the product particle were very fine and non-caking.

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**ABBREVIATION AND SYMBOLS**

cfu	colony forming units
cfu/g	colony per gram
cfu/ml	colony per milliliter
g	gram
hrs	hours
kg/cm <sup>2</sup>	kilogram per square centimeter
min	minute
ml	milliliter
rpm	revolutions per minute
w/v	weight per volume
μm	micrometer
°C	degree Celsius
%	percent