

**RADIATION SYNTHESIS OF A NOVEL ANTIBACTERIAL HYDROGELS  
AS WOUND DRESSING**

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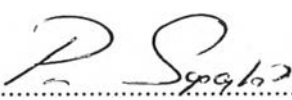
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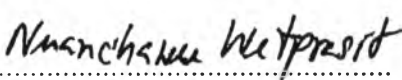
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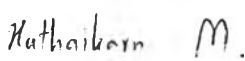
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## ABSTRACT

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The poly (vinyl alcohol) (PVA) hydrogels were prepared by Gamma-irradiation technique that can produce the cross-linking network of PVA molecules. This work wanted to improve the water absorption and moisture retention of the PVA hydrogels by adding Carboxymethyl chitosan (CM-chitosan) into PVA hydrogels. CM-chitosan was synthesized by using monochloroacetic acid. The optimum condition used 10 % w/v of PVA and 15 % (w/w of PVA) of CM-chitosan, the blended solution was irradiated at 35 kGy. It was found that, the water absorption and water losing rate of the obtained hydrogels were about 311.54 % and  $-4.62 \times 10^{-4}$  g/min respectively. To enhance the antibacterial activity of the blended hydrogels, *N*-trimethyl chitosan chloride (TMC) was added into the blended hydrogels. TMC was synthesized by using methyl iodide. The antibacterial activity was investigated by using colony count method. The result showed that an antibacterial activity of the blended hydrogels was increased with TMC content. The cytotoxicity of the antibacterial hydrogels was assessed by using an indirect cytotoxicity test against mouse fibroblast cells (L929) indicated that both the PVA hydrogels and the blended hydrogels released no substances at levels that were harmful to these cells. Therefore, the fabricated hydrogels can be used as a wound dressing for medical application.

## บทคัดย่อ

นันทวัน นิธิประภาวัฒน์ : การเตรียมแผ่นปิดแผลต่อต้านแบคทีเรียชนิดไฮโดรเจลด้วยเทคนิคการฉายรังสี (Radiation Synthesis of A Novel Antibacterial Hydrogels as Wound Dressing) อ.ที่ปรึกษา : รศ.ดร. พิชญ์ สุภผล 109 หน้า

การเตรียมแผ่นปิดแผลชนิดไฮโดรเจลโดยใช้เทคนิคการฉายรังสีแกมมาของสารละลายพอลิไวนิลแอลกอฮอล์สามารถทำให้เกิดพันธะเชื่อมขวางระหว่างโมเลกุลของพอลิไวนิลแอลกอฮอล์ (PVA) ได้ส่งผลให้สารละลายพอลิไวนิลแอลกอฮอล์คงรูปร่างและมีลักษณะเป็นเจลใส ในงานวิจัยนี้ศึกษาและปรับปรุงประสิทธิภาพของการดูดซึมน้ำและอัตราการสูญเสียน้ำของแผ่นปิดแผลชนิดไฮโดรเจลพอลิไวนิลแอลกอฮอล์โดยผสมคาร์บอกซีเมทิลไคโตซาน (Carboxymethyl chitosan) ซึ่งสังเคราะห์จากการทำปฏิกิริยาระหว่างไคโตซานกับโมโนคลอโรอะซิติกแอซิด พบว่า สภาวะที่เหมาะสม คือ สารละลายพอลิไวนิลแอลกอฮอล์เข้มข้น 10 %w/v สารละลายคาร์บอกซีเมทิลไคโตซานเข้มข้น 15 %w/v of PVA และพลังงานของการฉายรังสีแกมมาเท่ากับ 35 kGy ทั้งนี้แผ่นปิดแผลไฮโดรเจลที่เตรียมได้สามารถดูดซึมน้ำได้ 311.54 เท่า และมีอัตราการการสูญเสียน้ำเท่ากับ  $-4.62 \times 10^{-4} \text{ g/min}$  จากนั้นปรับปรุงความสามารถการต่อต้านแบคทีเรียแผ่นปิดแผลไฮโดรเจลพอลิไวนิลแอลกอฮอล์ผสมคาร์บอกซีเมทิลไคโตซาน โดยผสมเอ็นไตรเมทิลไคโตซานคลอไรด์ (*N*-trimethyl chitosan chloride) ลงในไฮโดรเจลดังกล่าว ซึ่งเอ็นไตรเมทิลไคโตซานคลอไรด์สังเคราะห์จากการทำปฏิกิริยาระหว่างไคโตซานกับเมทิลไอโอไดด์ จากนั้นศึกษาความเป็นพิษต่อเซลล์โดยวิธีอ้อมด้วยเซลล์ชนิด L929 (mouse fibroblast cells) และประสิทธิภาพการต่อต้านแบคทีเรียของแผ่นปิดแผลชนิดไฮโดรเจลโดยใช้เทคนิคการนับจำนวนเซลล์ของแบคทีเรีย พบว่า ไฮโดรเจลผสมที่เตรียมได้ทุกชนิดไม่เป็นพิษต่อเซลล์ และสามารถเร่งการเจริญเติบโตของเซลล์ได้ เมื่อทดสอบประสิทธิภาพการต่อต้านแบคทีเรียในระยะเวลา 24 ชั่วโมง พบว่า สามารถการต่อต้านแบคทีเรียเพิ่มขึ้นเมื่อปริมาณเอ็นไตรเมทิลไคโตซานคลอไรด์เพิ่มขึ้น ดังนั้นแผ่นปิดแผลชนิดไฮโดรเจลพอลิไวนิลแอลกอฮอล์ผสมคาร์บอกซีเมทิลไคโตซานและเอ็นไตรเมทิลไคโตซานคลอไรด์จึงเป็นวัสดุที่สามารถนำไปพัฒนาเป็นแผ่นปิดแผลเพื่อใช้ในอนาคคได้

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**ABBREVIATIONS**

ATCC	=	American Type Culture Collection
D	=	Diameter
DMST	=	Department of Medical Sciences Culture Collection
g	=	Gram
h	=	Hour
H	=	Height
kGy	=	KiloGray ( $\gamma$ -radiation unit of measure)
m	=	Meter
min	=	Minute
mg	=	Milligram
ml	=	Milliliter
mm	=	Millimeter
MRSA	=	Methicillin resistance <i>Staphylococcus aureus</i>
nm	=	Nanometer
rpm	=	Round per minute
w/v	=	Weight/Volume
w/w	=	Weight/Weight
$\gamma$	=	Gamma
$\mu$ l	=	Microliter