

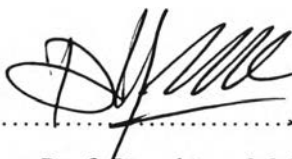
**DEVELOPMENT OF BACTERIAL CELLULOSE-BASED WOUND
DRESSING MATERIALS: EFFECT OF CELL IMMOBILIZATION**

Mongkol Tipplook

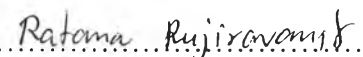
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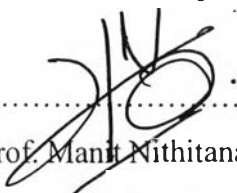
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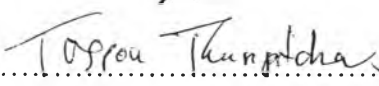
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ABSTRACT

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Bacterial cellulose (BC) pellicle is a polysaccharide produced by *Acetobacter xylinum*. BC pellicle is a good candidate for being used as a wound dressing material because it can provide a moist and promote the wound healing process. However, in a large scale production of BC pellicle the uniformity of thickness of BC pellicle and its durability are matters of great concerns. In this study, *Acetobacter xylinum* cells were immobilized on surfaces of a cotton fabric before cultivation in a culture medium in order to produce a BC composite reinforced with the cotton fabric. Furthermore, a surface treatment of the cotton fabric by using plasma and chemical treatments were performed in order to enhance the attachment of the bacterial cells on the surfaces. The results on cytotoxicity evaluated by MTT assay indicated that the BC composites were non-toxic to L929 cells. The SEM images showed that the density of cellulose fibers attached on the cotton fabric was greater than non-immobilized one. Although the production yields of BC composites obtained by applying cell immobilization techniques were slightly less than that produced by traditional techniques (non-immobilization), the use of less starting cell inoculum and the uniformity of BC deposited on the cotton fabric are the benefits of applying cell immobilization on the production of BC composites.

บทคัดย่อ

มงคล ทิพย์ปลุก : การพัฒนาวัสดุวัสดุปิดแผลจากแบคทีเรียเซลลูโลสคอมโพสิตโดยอาศัยกระบวนการตรึงเซลล์ (Development of bacterial cellulose-based wound dressing material: Effect of cell immobilization) อ. ที่ปรึกษา : รศ.ดร. รัตนา รุจิรวนิช 124 หน้า

แบคทีเรียเซลลูโลสคือเส้นใยเซลลูโลสบริสุทธิ์ที่สังเคราะห์ขึ้น โดยกระบวนการเมตาบอลิซึมของแบคทีเรีย *Acetobacter xylinum* ซึ่งเป็นตัวเลือกที่ดีที่สามารถนำมาประยุกต์ใช้ในการผลิตเป็นผลิตภัณฑ์ปิดแผลเนื่องมาจากความสามารถที่จะมอบความชุ่มชื้นให้แก่บาดแผลในขณะที่ใช้งานซึ่งเป็นปัจจัยสำคัญในกระบวนการหายของแผล แต่ก็ประสบปัญหาในแง่ของการผลิตในกระบวนการอุตสาหกรรมแบบต่อเนื่องเพราะการควบคุมปริมาณของแบคทีเรียเซลลูโลสนั้นควบคุมได้ยากส่งผลให้ผลิตภัณฑ์ที่ผลิตได้นั้นความหนาไม่สม่ำเสมอ จากปัญหาดังกล่าวงานวิจัยนี้จึงได้มีการประยุกต์ใช้กระบวนการผลิตโดยใช้เทคนิคการตรึงเซลล์ โดยจะทำการตรึงเซลล์ไว้บนผิวของผ้าฝ้ายก่อนที่จะมีการนำไปเพาะเลี้ยงในอาหารเลี้ยงเชื้อ ทั้งนี้การประยุกต์ใช้ผ้าฝ้ายนั้นนอกจากที่จะเป็นวัสดุที่สามารถใช้ตรึงเซลล์ได้แล้วยังสามารถที่จะเสริมสร้างความแข็งแรงให้กับแผ่นปิดแผลที่ผลิตได้อีกด้วย การปรับสภาพผิวผ้าฝ้ายก็เป็นอีกปัจจัยสำคัญที่ช่วยเสริมสร้างประสิทธิภาพให้การผลิตและเพิ่มการยึดเกาะของเซลล์ได้ โดยในงานวิจัยนี้ใช้การปรับปรุงด้วยเทคนิค Dielectric barrier discharge plasma (DBD plasma) และใช้สารเคมี ผลจากการทดลองพบว่า แผ่นปิดแผลคอมโพสิตที่ผลิตได้ไม่แสดงความเป็นพิษต่อเซลล์ไฟโบรราส L929 ที่มาจากหนูทดลอง ลักษณะทางสัญญาณวิทยาก็แสดงให้เห็นว่าจำนวนของเซลล์แบคทีเรียที่มีชีวิตในขณะที่เลี้ยง 2 วันมีปริมาณที่ใกล้เคียงกัน ปริมาณการผลิตเส้นใยเซลลูโลสโดยอาศัยกระบวนการตรึงเซลล์นั้นมีค่าที่น้อยกว่าแต่ก็ไม่มากนักเมื่อเทียบกับไม่ตรึงเซลล์ ถึงแม้ว่ากำลังการผลิตน้อยกว่าแต่การใช้หัวหัวเชื้อเริ่มต้นที่น้อยกว่าและมีความเป็นไปได้ที่จะผลิตในอุตสาหกรรมแบบต่อเนื่องได้ จึงเป็นข้อที่ได้เปรียบของกระบวนการตรึงเซลล์ที่จะนำมาประยุกต์ใช้ในการผลิตแบคทีเรียเซลลูโลสคอมโพสิต

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TABLE OF CONTENTS

	PAGE
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgments	v
Table of Contents	vi
List of Tables	xi
List of Figures	xiii

CHAPTER

I	INTRODUCTION	1
II	LITERATURE REVIEW	3
	2.1 Wound	
	2.1.1 Wound Healing Process	3
	2.1.1.1 Homeostasis	3
	2.1.1.2 Inflammatory	3
	2.1.1.3 Proliferation	4
	2.1.1.4 Remodeling	4
	2.2 Bacterial Cellulose	5
	2.2.1 Cellulose	5
	2.2.2 Principal Pathways to Cellulose	6
	2.2.3 Bacterial Cellulose Synthesis using <i>Acetobacter xylinum</i>	8
	2.2.4 Structure of Bacterial Cellulose	11
	2.2.5 Bacterial Cellulose in Wound Dressing Applications	14
	2.2.5 Literature review of Bacterial Cellulose in Biomedical Applications	18
	2.3 Plasma Technology	21
	2.3.1 Basic Principle	21

CHAPTER	PAGE
2.3.2 Classification of Plasma	22
2.3.3 Dielectric Barrier Discharge (DBD) Plasma	24
2.3.4 DBD Structure	25
2.3.4 Plasma Substrate Interaction	27
2.3.4.1 Plasma Etching	28
2.3.4.1 Chain Scission	28
2.3.5 Literature Review of Bacterial Cellulose in Biomedical Applications	29
2.4 Immobilization of Bacterial	33
2.4.1 Classification of Immobilization technique	37
2.4.1.1 Adsorption	37
2.4.1.2 Covalent binding	38
2.4.1.3 Affinity	40
2.4.1.4 Entrapment	40
2.4.1.5 Metal linked	41
2.4.2 The Material that Applying to fabricate supporter	42
2.4.2.1 Alginate	42
2.4.2.2 Chitin and Chitosan	43
2.4.2.3 Collagen	43
2.4.2.4 Caragenan	44
2.4.2.4 Gelatin	44
2.4.2.5 Cellulose	45
2.4.2.6 Starch	46
2.4.2.7 Pectin	46
2.4.2.8 Zeolite	47
2.4.2.9 Ceramic	48
2.4.2.10 Silica	48
2.4.2.11 Glass	49

CHAPTER	PAGE	
III	EXPERIMENTAL	49
3.1	Materials	49
3.2	Methodology	49
3.2.1	Production of Bacterial Cellulose and Bacterial Cellulose Composites	49
3.2.1.2	Culture Medium	49
3.2.1.3	Culture Condition	49
3.2.1.4	Preparation of Pure Bacterial Cellulose	50
3.2.1.5	Preparation of BC/Cotton Composite Non-Immobilization	50
3.2.1.6	Preparation of BC/Cotton Composite by Using Immobilization	50
3.2.1.7	Purification of Bacterial Cellulose and Bacterial Cellulose Composites	50
3.3	Charaterization	51
3.3.1	Fourier Transform Infrared Spectroscopy (FTIR)	51
3.3.2	Scanning Electron Microscope (SEM)	51
3.3.4	Water Absorption capacity	51
3.3.5	Water Vapor Transmission Rate (WVTR)	52
3.3.8	The MTT Cytotoxicity Test	52
3.3.8	The Cytocomplativity Test	53
IV	RESULTS AND DISCUSSION	54
4.1	Production of Pure Bacterial Cellulose	54
4.1.1	Effect of Cultivation Time on the Weight Bacterial Cellulose	56
4.1.2	Functional Groups of Pure Bacterial	59
4.1.3	Morphology of Pure Bacterial Cellulose	59
4.2	Production of BC/Cotton composite	60
4.2.1	Functional Groups	60

CHAPTER	PAGE
4.2.2 Morphology	62
4.2.3 Production yield BC/Cotton composite	65
4.3 Production of BC/Cotton Composite Treated Surface	
DBD Plasma	69
4.3.1 Morphology	69
4.2.2 Functional Groups by ATR-FTIR	70
4.2.3 Functional Groups by XPS	71
4.2.4 Hyhrophilicity by Contact angle	73
4.2.5 Water adsorption of Fabric	75
4.2.6 Production yield	76
4.4 Production of BC/Cotton Composite Using Absorption	
Immobilization Technique	78
4.4.1 Morphology	78
4.5 Production of BC/Cotton composite using absorption	
and crosslink immobilization techniques	79
4.5.1 Morphology	79
4.5.2 Production Yield	83
4.5.3 Water vapor transmission rate (WVTR)	89
4.5.4 Water Absorption Capacity	90
4.5.5 Dry rate	91
4.5.6 <i>Cell Acetobacter Xylinum in Culture Medium</i>	92
4.5.7 <i>The MTT Cytotoxicity Assay</i>	94
4.5.8 <i>The Cytocomplatibility</i>	97
4.5.9 <i>Antibacterial Property</i>	99
V CONCLUSION	99

CHAPTER	PAGE
REFERENCES	102
APPENDICES	109
Appendix A Preparation of Pure Bacterial Cellulose	109
Appendix B Preparation of BC/Cotton Composite	111
Appendix C Preparation of BC/Cotton Composite Treated Surface by DBD Plasma Non-Immobilization	115
Appendix D Preparation of BC/Cotton Composite by Immobilization Techniques	117
CURRICULUM VITAE	131

LIST OF TABLES

TABLE	PAGE
2.1 Bacterial cellulose producers	7
2.2 Comparison between bacterial cellulose (BC) and plant cellulose (PC)	11
2.3 Properties of bacterial cellulose and how they relate to the properties of an ideal wound dressing material	16
2.4 history of develop microbial immobilization	36
A1 The Production of Pure Bacterial Cellulose 1-9 Days in Wet State	109
A2 The Production of Pure Bacterial Cellulose 1-9 Days in Dry State	110
B1 The Production of BC/Cotton 2 Days in Wet State	111
B2 The Production of BC/Cotton 2 Days in Dry State	112
B3 The Thickness of BC/Cotton 2 Days in Wet State	113
B4 The Thickness of BC/Cotton 2 Days in Dry State	114
C1 The Production of BC/Cotton 2 Days Treated Surface by DBD Plasma in Wet State	115
C2 The Production of BC/Cotton 2 days Treated Surface by DBD Plasma in Dry State	116
D1 The Production of BC/Cotton 2 Days Treated Surface by DBD Plasma in varies Different of Cotton Fabric Wet State	117
D2 The Production of BC/Cotton 2 Days Treated Surface by Acetic Acid, varies Different Concentration of Acetic Acid in Wet State	118
D3 The Production of BC/Cotton 2 Days Treated Surface by Acetic Acid, varies Different Concentration of Acetic Acid in Dry State	119
D4 The Production of BC/Cotton 2 Days Treated Surface by Citric acid, varies Different Concentration of Citric Acid in Wet State	120
D5 The Production of BC/Cotton 2 Days Treated Surface by Citric Acid, varies Different Concentration of Citric Acid in Dry State	121

TABLE	PAGE
D6 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Wet State, treated by DBD Plasma	122
D7 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Dry State, Treated by DBD Plasma	123
D8 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Wet State, Without Surface Treatment	124
D9 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Dry State, Without Surface Treatment	125
D10 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Wet State, Treated Surface by Acetic Acid	125
D11 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Dry State, Treated Surface by Acetic Acid	127
D12 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Wet State, Treated Surface by Citric Acid	128
D13 The Production of BC/Cotton 2 Days by Using Absorption and Crosslink Immobilization Technique in Wet State, Treated Surface by Citric Acid	129
D14 The Cytotoxicity of Bacterial Cellulose	130

LIST OF FIGURES

FIGURE	PAGE
2.1 Different types of wound	3
2.2 The phases of continuous wound healing	5
2.3 The structural of cellulose	6
2.4 Pathways to the cellulose	7
2.5 Characteristic of <i>Acetobacter Xylinum</i>	8
2.6 SEM image of cellulose	9
2.7 Pathways of carbon metabolism in <i>Acetobacter xylinum</i>	9
2.8 Formation of bacterial cellulose	10
2.9 TEM image of bacterial cellulose ribbon produced by a bacterial cell	10
2.10 SEM image of a bacterial cellulose network including the bacterial cell	11
2.11 Schematic model of BC microfibrils	11
2.12 Outline of intra and intermolecular hydrogen bonds among cellulose chains	12
2.13 BC pellicle formed	13
2.14 Wound dressing from bacterial cellulose	14
2.15 The product of bacterial cellulose under Xcell brand	16
2.16 Morphology of the BC/alginate sponge	18
2.17 SEM images of surface morphology of BCA-30% aloe vera film in dry form	19
2.18 FE-SEM morphology of MMT, BC	20
2.19 Constituents of plasma	21
2.20 Basic of generate plasma and Typical voltage and power waveform outputs for DBD plasma system	22
2.21 Different types of plasma	23
2.22 The plasma instrument	25
2.23 Typical DBD electrode arrangements	26
2.24 Typical DBD electrode arrangements	26
2.25 DBD obtained in the actuator	27

FIGURE	PAGE
2.26 Different of plasma etching	28
2.27 Cotton fabric after DBD plasma treatment	29
2.28 Surface morphology of polyester fabric after treated by plasma	31
2.29 DBD plasma-treated PP film	33
2.30 Different types of immobilization	34
2.31 Microbial on the surface of substrate	35
2.32 Adsorption Immobilization methods	38
2.33 Covalent Binding Immobilization methods	39
2.34 Affinity Binding Immobilization methods	40
2.35 Entrapment Immobilization methods	41
2.36 Metal ion Immobilization methods	42
2.37 Immobilization microbial by alginate	42
2.38 Immobilization microbial by chitosan	43
2.39 Immobilization microbial by collagen	44
2.40 Immobilization microbial by carrageenan	44
2.41 Immobilization microbial by alginate and gelatin	45
2.42 Immobilization microbial by cellulose	46
2.43 Immobilization microbial by ceramic	48
2.44 Immobilization microbial by silica	49
4.1 Cultivation of <i>Acetobacter xylinum</i> strain TISTR 975 : forming of the gelatinous bacterial cellulose pellicles.	54
4.2 Purification of bacterial cellulose.	55
4.3 SEM images show the surface morphology of bacterial cellulose	56
4.4 Bacterial cellulose pellicle produced by <i>Acetobacter xylinum</i> TISTR 975 under different cultivation time 1-9 days.	56
4.5 Bacterial cellulose pellicle produced by <i>Acetobacter xylinum</i> TISTR 975	57
4.6 Comparison of wet weight of bacterial cellulose pellicle under different cultivation time (2-9 days)	58

FIGURE	PAGE
4.7 Comparison dry weight of bacterial cellulose pellicle under different cultivation time (2-9 days)	58
4.8 FTIR spectra of pure BC	59
4.9 SEM images show the surface morphology of pure bacterial cellulose	60
4.10 FTIR spectra of cotton fabrics	61
4.11 FTIR spectra of nylon fabric	61
4.12 Surface morphology of cotton fabric	62
4.13 SEM images show the surface morphology of different types of cotton fabric	63
4.14 SEM images show the surface morphology of BC/cotton composites	63
4.15 SEM images show the cross-section morphology of BC/cotton composites	64
4.16 The interaction between BC fibrils and cotton fabric	65
4.17 Production yield wet and dry weight of BC/Cotton composite by varies different density of cotton fiber on fabric	66
4.18 Thickness of BC/Cotton composite by varies different density of cotton fiber on fabric	66
4.19 Comparison the production yield wet state	67
4.20 Comparison the production yield dry state	68
4.21 Photoes comparison the production yield wet state	68
4.22 morphology the effect of DBD plasma treatment time on the surface roughness of cotton fabric	69
4.23 ATR-FTIR spectra chemical functional group of cotton fabric after treated via DBD plasma	71
4.24 XPS-Y scan mode, chemical functional group of cotton fabric	72
4.25 XPS-narrow mode, chemical functional group of cotton fabric	72
4.26 Hydrophilicity of cotton fabric treated by DBD plasma varies Treatment times	73
4.27 Comparison hydrophilicity of cotton treated different treatment times by DBD plasma	75

FIGURE	PAGE
4.28 Comparison water absorption capacity of cotton treated different treatment times by DBD plasma	76
4.29 Comparison the production yield of BC/Cotton composite treated by DBD plasma in wet state	77
4.30 Comparison the production yield of BC/Cotton composite treated by DBD plasma in dry state	77
4.31 morphology <i>Acetobacter xylinum</i> on cotton fabric cultivated 0, 24, 48 hours	78
4.32 morphology <i>Acetobacter xylinum</i> on cotton fabric cultivated 48 hours	80
4.33 Attachment of bacterial cellulose fibers on the surface of cotton fibers for	81
4.34 morphology <i>Acetobacter xylinum</i> on cotton fabric cultivated 48 hours	82
4.35 Comparison of wet weights of pure BC pellicle and BC/cotton composites obtained by applying treated surface by acid	84
4.36 Comparison of dry weights of pure BC pellicle and BC/cotton composites obtained by applying treated surface by acid	85
4.37 Comparison of wet weights of pure BC pellicle and BC/cotton composites obtained by applying immobilization	86
4.38 Comparison of dry weights of pure BC pellicle and BC/cotton composites obtained by applying treated surface by acid	87
4.39 Comparison of wet weights of pure BC pellicle and BC/cotton composites obtained by applying immobilization	87
4.40 Comparison of dry weights of pure BC pellicle and BC/cotton composites obtained by applying immobilization	88
4.41 Comparison on the water vapor transmission rates	91
4.42 Comparison on the water dry rates	92
4.43 Comparison on the colony of bacterial dispersed in culture medium	93
4.44 Comparison on the colony of bacterial dispersed in culture medium	94
4.45 Optical microscope image of survival of rat dermal skin fibroblast cell L929	96

FIGURE	PAGE
4.44 No cell rat dermal skin fibroblast	97
4.47 Applying cell rat dermal skin fibroblast after 24 hours	97
4.48 Applying cell rat dermal skin fibroblast after 48 hours	97
4.49 Applying cell rat dermal skin fibroblast after 48 hours	97
4.50 antimicrobial property	99
4.51 BC/Cotton composite on human skin	100