INVESTIGATION OF PROPERTIES OF BACTERIAL CELLULOSE FOR WOUND DRESSING APPLICATIONS

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Degree of Master of Science

Department of Chemical and Process Engineering

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Thesis/Dissertation submitted in partial fulfilment of the requirements for the degree Master of Science

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DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Master under our supervision.

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(Dr. F.M. Ismail) Date

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(Dr. T.R. Chinniah) Date

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(Prof. Ajith De Alwis) Date

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(Prof. M. Wijerathne) Date

Abstract

Bacterial cellulose (BC), an exo-polysaccharide produced by *Acetobacter xylinum*, shows numerous properties such as purity, nano size, higher mechanical strength, absorbancy, crystallinity and mouldability than plant cellulose. Hence it exhibits number of applications in medical and industrial fields.

In this study, *Acetobacter xylinum* species isolated from Kombucha, a mixed culture was identified and isolated by streak plate method, Gram staining, morphology and formation of HALO area on $CaCO_3$ added differential media. It was confirmed by its ability to form pure cellulose in static fermentation. Optimum storing temperature of *Acetobacter xylinum* was found to be – 70 °C, retaining its activity and purity. In media optimization, control sample showed a dry yield of 1.08 g/l/cm^2 at pH 5.0 which was comparable with the yields of BC in coconut water supplemented with different carbon and nitrogen sources. Chemical structure of BC fibrils biosynthesized in different media confirmed a structure similar to pure cellulose by FTIR spectroscopy and SEM confirmed nano size and network structure. Mechanical tests revealed increased tensile strain from 0.09 to 0.339, decreased tensile stress from 52.89 to 10.93 Nm^{-2} and Young's modulus from 588.93 to 32.3 MPa when moisture content of BC was increased from 0 to 25 %. Fluid re-absorption in 24 hours decreased with increasing moisture content from 1342.83 % to 175.83 % and 919.72 % to 114.88 % in deionized water and saline respectively. Therefore dried BC could hold 7-8 times fluid capacity than wet BC. Mechanical test applied on dried (2-3 % moisture) and wet (25-30 % moisture) BC at swollen state in deionized water and saline at 24 hours confirmed Young's modulus and fluid re-absorption tend to decrease with increasing moisture content.

This study confirms coconut water by itself as a nutrient rich substrate for BC production. Further, investigations proved the ability to produce cellulose based biomaterial consisting nano-scale fibre structure with considerable strength as appropriate for wound dressing applications.

Key words: bacterial cellulose, *Acetobacter xylinum*, coconut water, wound dressing

DEDICATION

TO MY HUSBAND

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LIST OF ABBREVIATIONS

ATP	Adenosine Tri Phosphate
BC	Bacterial Cellulose
BHI	Brain Heart Infusion
CS	Cellulose Synthase
CW	Coconut Water
DI	De-ionized
FBP	Fructose-1, 6- biphosphate
FK	Fructokinase
FRAC	Fluid Re-absorption Capasity
Fru-6-P	Fructose-6-phosphate
Fru-bi-P	Fructose -1,6-bi-phosphate
FTIR	Fouir Transforn Infra Red
G6PDH	Glucose -6-phosphate dehydrogenase
1PFK	Fructose-1-phosphate kinase
Glc6(1)P	Glucose-6(1)-phosphate
HS	Hestrin and Scramm
MW	Molecular weight
PGA	Phosphogluconic acid
PGI	Phosphoglucoisomerase
PGM	Phosphoglucomutase
PTS	System of phosphotransferases
SEM	Scanning Electron Microscope
UDPGlc	Uridinediphosphoglucose
WD	Wound Dressing
WHC	Water Holding Capasity

LIST OF APPENDICES