INVESTIGATING PRODUCTION, PROPERTIES AND APPLICATIONS OF BACTERIAL CELLULOSE GENERATED USING COCONUT WATER AS A SUBSTRATE MEDIUM

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(08/8013)

Degree of Master of Science

Department of Chemical and Process Engineering

University of Moratuwa

Sri Lanka

December 2010

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Thesis/Dissertation submitted in partial fulfillment 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/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other 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.

S. G. Walliwala Date

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Prof. (Mr.) A.A.P. De Alwis Date

Dr. (Mrs.) F.M. Ismail Date

ABSTRACT

This study was carried out to investigate a promising application area of coconut water that is discharged in desiccated coconut industry as a waste. Bacterial cellulose (BC) is a highly hydrated, pure, extra-cellular product formed by bacterial species related to the genus *Acetobacter*. Production of BC using a substrate containing coconut water, was selected among available options. Due to its unique characteristics, BC has found applications in numerous fields like medical, food, paper, textile, electrical and electronic.

A detailed study was performed to understand the production, properties and application potential of BC. A set of batch experiments was carried out in laboratory scale to observe the effect of process parameters on BC production in static fermentation. Experimental results revealed that area at air/liquid interface of the fermentor, initial sucrose content, initial $NH_4H_2PO_4$ content, initial pH of the medium and the period of shaking at the initial stage of fermentation have a significant influence on BC yield. However, no significant effect was observed on BC yield when varying the volume of culture. Additionally, the batch experiment carried out in aerated fermentation resulted no visible BC production.

A set of experiments performed using purified, fresh BC proved that BC has more than 80% (wet basis) water holding capacity. Furthermore, it was found that mechanical strength of BC can be enhanced using evaporation and vacuum drying methods more than freeze drying. Additionally, an increase in moisture absorbency was observed when decreasing the particle size of evaporation-dried BC due to increased surface area.

Experiments that were carried out to find application areas revealed that BC has the potential of functioning as a wound dressing, an adsorbent and as a proton exchange membrane whereas the residual fermentation broth as a substrate for anolite in microbial fuel cells. Finally, finding membrane characteristics, developing BC as a wound dressing and improving BC yield and rate of production by eliminating limitations in static condition, were recommended as the areas that will be worthwhile for future work.

DEDICATION

This thesis is dedicated with profound gratitude

To

My parents

ACKNOWLEDGEMENT

I take this opportunity to show my gratitude to those who supported, encouraged and guided me to complete my research successfully.

- Prof. A.A.P. De Alwis and Dr. F.M. Ismail (Dept. of Chemical & Process Engineering, University of Moratuwa) for being the supervisors of my research and guiding me in the correct path while providing valuable advices and encouragement.
- Dr. A.D.U.S. Amarasinghe and Dr. Shantha Walpolage (Senior Lecturers, Dept. of Chemical & Process Engineering, University of Moratuwa) for being my progress review committee members and giving me relevant and valuable suggestions.
- University Research Grants for providing me necessary funding and Post Graduate Studies Division, University of Moratuwa for approving this research project.
- Dr. Asoka Dangolla, Senior Lecturer, Veterinary Medicine, University of Peradeniya, for giving me the opportunity to do animal trials of the BC wound dressing and valuable information and support given.
- Dr. (Mrs.) C. Jayasekera, Director, Coconut Research Institute, Lunuwila for supplying the required bacterial culture. Specially, Mr. A.N. Ajith Kumara, Technical Officer, Coconut Processing Research Division for the great support given regarding collecting the culture.
- Mr. Sena Peiris, Director, National Cleaner Production Center (NCPC) for giving opportunity to gather necessary information from workshops carried out.
- Mr. P.K.K. Panduwawala, Managing Director and Mr. Anil Hemachandra, Factory Manager, Belummahara DC mill and Mr. R.M.P Ratnayake, Managing Director, R.M.P. Coconut Products (Pvt) Ltd. for arranging the factory visits and required information provided.
- University canteens staff for providing fresh coconut water for carrying out experiments.

- Miss. Amali Wahalathanthri, Mr. M.P.A.J. Kumara, Mrs. S.M.N.D. Martino, Mr. J. Wijesinghe, Mr. Ranjith Masakorala and all the other non-academic staff of the Dept. of Chemical & Process Engineering, University of Moratuwa for their support given in various occasions.
- My mother and other family members for the great encouragement and support provided throughout the project.
- Mrs. Irosha Kularatna, Ms. Umanga De Silva, Ms. Thanuja Gunasinghe, Mrs. Gayani Jayatunga, Mrs. Gayani Karunaratna, Ms. Nimalika Perera, Mr. Himantha Cooray, Ms. Jayani Anurangi, Ms. Nipunika Gamage, Ms. Thilini Dharmasena and all the post graduate students of the Dept. of Chemical & Process Engineering, University of Moratuwa for their support to make my research period an enjoyable one. Specially, Mrs. Mihiri Gunathilake Wanniarachchi for providing me the Microbial Fuel Cells to carry out the laboratory experiments whenever needed.

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ABBREVIATIONS

ATP	Adenosine Triphosphate
BC	Bacterial Cellulose
CMS	Carboxymethyl Starch
COD	Chemical Oxygen Demand
DC	Desiccated Coconut
DO	Dissolved Oxygen
FAS	Ferrous Ammonium Sulfate
GMP	Good Manufacturing Practices
LBSS	Hank's Balanced Salt Solution
MFC	Microbial Fuel Cell
$NH_4H_2PO_4$	Ammonium Dihydrogen Phosphate
OCV	Open Circuit Voltage
PDL	Periodontal Ligament
PEM	Proton Exchange Membrane
TEA	Triethanolamine
UTS	Ultimate Tensile Strength
UV	Ultra Violet