



***Development of Nanocrystalline Cellulose
Incorporated with Biopolymers for
Industrial Applications***

A Thesis
Submitted by

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(M.Sc. Inorganic Chemistry 2010)

*For the Requirement of the Degree
of
Doctor of Philosophy (Ph.D)
to
Chemistry Department
Faculty of Science
Ain Shams University*

2017



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DEDICATION

*First Of All, I Dedicate This Work to
my Beloved Mother, my Husband Dr. Aly,
& my Lovely Son Mohamed*

ALSO

*To My Whole Family & Dear Friends
Deep Gratefulness*

for

*Their Patience, kind support, &
continuous encouragement during the
whole time of my Ph.D. thesis*

Mona Al-Shemy

Acknowledgments

*First and foremost, all praises and sincere thanks be to
ALLAH.*

I wish to express my sincere appreciation to **Prof. Dr. Abd El-Gawad Mohamed Rabia**, Professor of Organic Chemistry, Faculty of Science, Ain Shams University, for his valuable guidance, helpful suggestions, continuous encouragement, supervision and support during this work.

I would like to express my sincere thanks, full respect and deep gratitude to **Prof. Dr. Atef Abd Alaziz Ibrahim**, Professor of Cellulose and Paper Department, National Research Centre, for his patient supervision, inspiring guidance, critical comments, suggestions, and the never-ending support he displayed throughout this study.

I sincerely express my deepest gratitude to **Prof. Dr. Amira Mohamed El-Shafei**, Professor of Textile Research Division, National Research Centre, for her support, enthusiasm, valuable discussion, criticism and keen interest in the present work.

Thanks, appreciation and gratitude are due to **Prof. Dr. Abeer Mohamed Adel**, Professor of Cellulose and Paper Department, National Research Centre, for her kind academic supervision,

valuable advice, unlimited support, encouragement and suggestions contributing to the success of this thesis

I sincerely express my deepest gratitude to *Prof. Dr. Mohamed El-Skafawy*, Professor of Cellulose and Paper Department, National Research Centre, for providing necessary knowledge and laboratory facilities during this work.

I wish to express my warm and sincere thanks and appreciation to my colleague *Dr. Fatma Nady Taha*, for supporting and helping me solving problems during my work. Really I don't find any word to express my thanks and my gratitude to her.

I would like to thank *Cellulose and Paper Department, National Research Centre, and Faculty of Science, Ain Shams University*, for all the facilities provided.

Finally, I would like to thank *my mother & my husband Dr. Aly El Sayed* for their love, support and devotion throughout my Ph.D. fulfillment.

Mona Tawfik Kamer Al-Shemy



Abstract

Packaging has increasingly become a dominant factor in the global market competitiveness: this implies also obtaining new raw materials with improved packaging properties. Material from locally cultivated date palm was used as a packaging additive, showing potential in improving strength and barrier properties. In particular, date palm sheath (DPS) cellulose nano-crystals (CNCs) were prepared by ammonium persulfate (APS) treatment of unbleached, bleached and mercerized fibers. The influence of the reaction parameters on the CNCs were studied. Besides APS extraction, CNCs were also isolated from DPS fibers using mineral acids (sulfuric & phosphoric). The effect of cellulose polymorphs on CNC isolation were studied too. The characteristics of DPS-CNCs prepared by APS treatment were compared with those of CNCs obtained by the two acid hydrolysis treatments. The CNCs degree of substitution and surface charge density were determined by conductometric titration and zeta potential measurements, respectively. A significant particle size reduction, surface charge density diminishing, and thermal stability enhancement ensued as a consequence of cellulose mercerization. The elucidation of the structure of the prepared compounds were done via several techniques. The packaging processing with the extracted CNCs includes bio-composite and antimicrobial food package formation and jute package modulation. All the prepared bio-composites at optimum conditions showed enhanced mechanical, barrier, thermal and antimicrobial properties.

Key words

Cellulose nano-crystal (CNC) ; Degree of oxidation ; Degree of substitution ; Cellulose polymorphs ; Bio-composite ; Food package ; Mechanical properties ; Water vapor permeability ; Water sorption isotherm ; BET model ; β -Cyclodextrin ; Clove oil ; Jute ; Thermal stability.

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