Improvement and Development of Some Biomaterials by Ionizing Radiation for Possible Practical Uses

THESIS

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By

Salah Lotfy Ahmed Khalil Saad
(B.Sc.1989 - M.Sc. 2000)
National Center for Radiation Research and Technology
Atomic Energy Authority

SUPERVISED
BY

Prof. Dr. Nadia M. Abdallah
Prof. of Biochemistry
Biochemistry Department
Ain Shams University

Prof. Dr. El-Sayed A. Hegazy
Prof. of Radiation Chemistry
Head of National Center for Radiation
Research and Technology
Atomic Energy Authority.

Ass. Prof. Gilane M. Sabry
Ass. Prof. of Biochemistry
Biochemistry Department
Ain Shams University

Ass. Prof. Hanaa K. Mohamed
Ass. Prof. of Radiation Chemistry
Polymer Chemistry Department
Atomic Energy Authority

Faculty of Science
Ain Shams University
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No word can express my gratitude toward my

mother

Special gratitude to my wife

my Son & daughter

I declare that this thesis has been composed by myself and that the work of which it is a record has been done myself.

It has not been submitted for a degree at this or any other university.

Salah Lotfy Ahmed

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Abstract

This study deals with, **First:** irradiation of various physical forms of starch (solid and solution) with ^{60}Co gamma rays and electron beam investigate the effect of ionizing radiation on the molecular weight (M_W) of starch. Ultrasound irradiation was investigated to compare its degradation effect with ionizing radiation. Viscometer, rheometer and multi-angle static laser light scattering were employed to study the effect of radiation on starch. Influence of gases saturation during gamma treatment was studied. **Second:** Radiation induced graft copolymerisation of acrylamide (AAm) and acrylic acid (AAc) individually onto polypropylene fibers followed by chemical treatments were prepared as polymeric support for enzyme immobilization. Degrees of grafting were determined for each system. Structural changes and thermal properties of the grafted copolymers were studied. **Third:** Amyloglucosidase (GluA) was covalently immobilized on PP-g-AAm and PP-g-AAc fibers by carbodiimide (CDI) as coupling agents. The relative activities, stability, effects of pH, buffer concentration and temperature on immobilization were investigated. The K_m values for the immobilized GluA on the PP-g-AAc and PP-g-AAm fibers are approximately two and four fold higher than that for the free GluA respectively. The decrease in V_{max} value as a result of immobilization is considered to be associated with the increase in K_m value, since the lower the K_m value, the greater the affinity of the enzyme for the substrate.

Key words: Radiation; starch, degradation, grafting, polypropylene fibers, enzyme immobilization

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List of Abbreviations

τ	Shear stress (Pa)
γ	Shear rate (s−1)
η	Melt viscosity (Pas)
ΔHf	Heat of fusion
ηred	Reduced viscosity
[η]	Intrinsic viscosity
a & k	Mark-Houwink parameter
AAc	Acrylic acid
AAm	Acrylamide
DLS	Dynamic light-scattering
DP	Degree of Polymerization
DSC	Differential scanning calorimeter
DT	Decomposition temperature
ELISA	Enzyme-Labeled Immunosorbent Assay
FDT	Final decomposition temperature
FTIR	Fourier Transform Infrared
GluA	Glucoamylase (Amyloglucoamylase)
IDT	Initial decomposition temperature
kGy	Kilo Gray
K_m	Michaelis-Menten constant
τmax	Maximum shear stress (Pa)
Mrad	Mega Radiation Absorbed Dose
Mv	Viscosity-average molecular weights
Mw	Molecular weight
PKa	Dissociation constant
PP	Polypropylene
PP-g-AAc	Polypropylene grafted acrylic acid
PP-g-AAm	Polypropylene grafted acrylamide
RG	Radius of gyration
SEM	scanning electron micrographs
SLS	Static light-scattering
TGA	Thermogravimetric Analysis
Tm	Melting temperature
V_{max}	Maximal velocity
Xc	Crystallinity

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