



Faculty of Science

Application of Radiation Technology in Development of Some Polymeric Materials for Industrial Purposes

Thesis Submitted to
Faculty of Science - Ain Shams University

**In Partial Fulfillment of the Requirements of the Ph.D.
Degree in Chemistry**

**By
Ahmed Eid El-Sayed Swilem
(M.Sc. 2012)**

Under supervision of :
Prof. Dr. Ashraf A. M. Hamed
Prof. of Organic Chemistry
Faculty of Science – Ain Shams University

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

Prof. Dr. Hassan A. Abd El-Rehim
Prof. of Radiation Chemistry
National Center for Radiation Research
and Technology - Atomic Energy Authority

**Chemistry Department
Faculty of Science
Ain Shams University**

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THESIS SUPERVISORS

APPROVED

Prof. Dr. Ashraf A. M. Hamed

Faculty of Science, Ain Shams University.

Prof. Dr. El-Sayed A. Hegazy

National Center for Radiation Research and Technology,
Egyptian Atomic Energy Authority.

Prof. Dr. Hassan A. Abd El-Rehim

National Center for Radiation Research and Technology,
Egyptian Atomic Energy Authority.

Head of Chemistry Department

Prof. Dr. Ibrahim H. Badr



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REFeree COMMITTEE

APPROVED

Prof. Dr. Ashraf A. M. Hamed

Professor of Organic Chemistry, Faculty of Science,
Ain Shams University.

Prof. Dr. El-Sayed A. Hegazy

Professor of Radiation Chemistry,
National Center for Radiation Research and Technology,
Egyptian Atomic Energy Authority.

Prof. Dr. / Mahmoud A. Abd El-Ghaffar

Professor of Polymer Chemistry, National Research Center.

Prof. Dr. / Hosam A. Shawky

Professor of Water Chemistry, Desert Research Center.

Head of Chemistry Department

Prof. Dr. Ibrahim H. Badr

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Abstract

The present study has been organized in two main parts:

Part 1. This part describes a novel multistep physicochemical approach for the immobilization of D-glucosamine (GlcN) on poly(lactic acid) (PLA) surface in order to enhance its cytocompatibility for tissue engineering applications. The GlcN-functionalized PLA surface is prepared by firstly introducing poly(acrylic acid) spacer arms *via* plasma- *post-irradiation* grafting technique. Factors affecting grafting yield are controlled to produce a suitable spacer for bioimmobilization. Afterwards, covalent coupling or physical adsorption of GlcN with/on the poly(acrylic acid) spacer is carried out. The modified surfaces are characterized by Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR), X-ray Photoelectron Spectroscopy (XPS), Contact angle measurements, and Atomic Force Microscopy (AFM). The cytocompatibility of the modified surfaces is assessed using primary mouse embryonic fibroblast (MEF) cells.

Part 2. In this part, novel antibacterial food packaging films based on low-density polyethylene (LDPE) and 4-allylanisole (ALY; a model essential oil) are produced by loading firstly the essential oil into various solid carriers, and then melt compounding with the polymer matrix. This technology aims at enhancing the thermal stability of the essential oil and sustaining its release over storage period. In addition, in order to evaluate the suitability of these emerged antibacterial films in packaging of foods which are intended to be sterilized with ionizing radiation, the effects of gamma irradiation on the properties of these films

are studied. The physico-chemical characteristics as well as the ALY release and antibacterial activity of the prepared films as affected by the type of the solid carrier and gamma irradiation are investigated.

Keywords: poly(lactic acid); plasma; D-glucosamine; tissue engineering; low-density polyethylene; composites; allylanisole; antibacterial food packaging.

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