
**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**

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**(M.Sc. 2012)**

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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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