



**Study of radiation induced changes in some biomaterials
characteristics**

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By

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List of Abbreviations

Cs	Chitosan
D-MEM	Dubeglo Modified Egales Medium
DSC	Differential Scanning Colorimetry
DTG	Differential Thermogravimetric
EDAX	Energy Dispersive X-Ray
FCC	Face Centered Cubic
FDA	Food and Drug Administration
FTIR	Fourier Transform Infrared
HA	Hydroxyapatite
MH	Mueller-Hinton broth
OCP	Octa Calcium Phosphate
PVA	Poly vinyl alcohol
PVP	Poly vinyl pyrrolidone
SAED	Selected Area Electron Diffraction
SEM	Scanning Electron Microscope
SF	Silk Fibroin
SN	Silver Nanoparticles
SNCC	Silver-Nanoparticles-Chitosan Composites
SPR	Surface Plasmon Resonance

TEM	Transmission Electron Microscope
TGA	ThermoGravimetric Analysis
UV-Vis	UltraViolet Visible
XPS	X-Ray Photoelectron Spectroscopy
XRD	X-Ray Diffraction

Abstract

Biomaterials have been increasingly applied to improve surgical procedures of missed bones or to restore the quality of life especially for elderly people. Every year, several millions of patients worldwide need bone grafts and other orthopedic as well as dental surgeries, therefore, the demand for these biomaterials increases every year. However, it is crucial that these materials should be non-toxic, biocompatible and immunogenic.

Biomaterials have several medical applications such as their main use in medical sutures and as substitutes for heart valves and cruciate ligaments in addition to their uses at blood vessels defects as well as dental and bone surgeries.

This study aims to synthesize biomaterials formed of phosphatic/silk fibroin/chitosan /nanosilver by using gamma radiation and study their effects on the physical and chemical properties of the developed nanoparticles.

To overcome bacterial infection that occurs during or after biomaterials implantation surgeries, silver nanoparticles enveloped by chitosan were prepared by gamma ray irradiation (15-110 kGy). Different concentrations of silver nitrate were used to optimize its concentration in the synthesis process.

Phosphatic biomaterials had been developed from either hydroxyapatite or octacalcium phosphate (matrix) to reinforced organic silk fibroin (filler) by a ratio of 70:30 %. Silk fibroin was prepared from natural silk fibroin cocoons which is non-immunogenic. Two extraction protocols were used

being CaCl_2 and LiBr to obtain silk fibroin solution and comparing between them.

Promising bone-like material composed of 70% inorganic phosphate (hydroxyapatite and octacalcium phosphate) and 30% organic composite (silk fibroin and silver nanoparticles) was developed. The obtained novel biomaterial is green synthesized and biocompatible, biodegradable with effective bactericidal activity.

XRD analysis used in order to study the crystallinity of the developed composites, the results confirmed that the obtained crystalline silver nanoparticles were enveloped by chitosan. The optimum dose among the applied ones (15-110 kGy) found to be 75 kGy.

XPS technique was used to study the chemical structure and chemical bonds present in the developed composites and the results confirmed all incorporated elements into the composite.

The results of TEM proved higher crystallinity for silk proteins extracted by using CaCl_2 relative to that extracted by LiBr . Moreover, the obtained silver nanoparticles were separate spherical in shape and ranged between (7-22 nm).

FTIR results confirmed the successful interaction between phosphatic and organic phases of silk fibroin and chitosan.

Surface zeta potentials were measured using the laser zeta sizer and indicates that, the samples possess highly positive charges especially at acidic pH that enhance its antibacterial activity.