Anti-Angiogenic Efficacy of Chitosan- Gallium Nanoparticles and Low Doses of γ-irradiation on Mice Bearing Ehrlich Carcinoma

A Thesis
Submitted for the degree of Master of Science as a Partial Fulfillment for requirements of the Master of Science in Biochemistry

By

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B.Sc. Biochemistry/Chemistry (2012)

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Dedication

I dedicate this work with all my love to my family and for all my friends and those from whom I have learned, whenever and wherever they are.

Riham Mahmoud

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Contents

List of Abbreviations

5-FU	5-Fluorouracil
Ab	antibody
Ang's	Angiopoietins
ATI	After Tumor Inoculation
ATP	Adenosine triphosphate
BAX	Bcl 2–associated X protein
BCAAs	Branched-Chain Amino Acids
Bcl.2	B-cell lymphoma-2
bFGF	basic Fibroblast Growth Factor
BSSP4	Brain-Specific Serine Protease 4
Ch.GaNPs	Chitosan Gallium nanoparticles
ChNPs	Chitosan nanoparticles
CRP	C-Reactive Protein
CSFs	Colony-Stimulating Factors
CYP450	Cytochromes P450
DLL4	Delta like ligand 4
DNA	Deoxyribonucleic Acid
dNTP	deoxyribonucleotide triphosphate
DSBs	double strand breaks
DTNB	5, 5'dithiobis-(2-nitro-benzoic acid)

E.IR	Ehrlich carcinoma irradiated group
EAC	Ehrlich ascites carcinoma
EC	Ehrlich carcinoma
ECF	extracellular fluid
ECM	Extracellular Matrix
EGF	Epidermal Growth Factor
ELISA	Enzyme Linked Immune Sorbent Assay
EPR	Enhanced Permeability and Retention
ETC	Electron Transport Chain
Ga	Gallium
GBM	glioblastoma multiforme
GSH	Reduced Glutathione
GSH-Px	Glutathione Peroxidase
GSSG	Glutathione in oxidized form
Gy	Gray
HIFs	Hypoxia-Inducible Factors
HO-1	Hemeoxygenase-1
HRP	Horseradish Peroxidase
i.p	intraperitoneal
IC_{50}	half maximal inhibitory concentration
IFN-γ	Interferon-gamma
I-kB	Inhibitor kappa B

IL-1b	Interleukin 1-beta
IR	Ionizing Radiation
LET	Linear Energy Transfer
MDA	Malondialdehyde
MMP	Matrix Metalloproteinases
MPS	Macrophage Phagocytic System
mROS	mitochondrial ROS
MT	Metallothionein
MTD	Maximum Tolerated Dose
N.C	Normal control
NADH	Nicotinamide adenine dinucleotide
NADPH	Nicotinamide Adenine Dinucleotide
NCRRT	National Center for Radiation Research and Technology
NF-κB	Nuclear Factor-κB
NOXs	NADPH oxidases
NPs	Nanoparticles
O.D	optical density
PBS	Phosphate buffer solution
PDGF	Platelet-derived growth factor
PlGF	Placental growth factor
r.p.m	Revolutions Per Minute

RNA	Ribonucleic Acid
ROS	Reactive Oxygen Species
S.C	subcutaneous
SPSS	Statistical Package for Social Science
TBA	Thiobarbituric acid
TCA	Trichloro acetic Acid
TEM	Transmission Electron Microscope
Tf	Transferrin
TFR	Transferrin receptor
TGF-α	Transforming growth factor-α
Th	T helper cell
TMB	Tetramethylbenzidine
TNF-α	Tumor Necrosis Factor-Alpha
TSTA	Tumor Specific Transplantation Antigen
VCAM-1	vascular cell adhesion molecule 1
VEGF	Vascular endothelial growth factor
VEGFR	Vascular endothelial growth factor receptor
WHO	World Health Organization

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