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DNA Condensation Using Cationic Dendrimer

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Dedication

I dedicate this thesis to all of my wonderful family members who have supported me throughout my life and allowed me to achieve my goals

To my father Ibrahim, who helped in making my educational decisions and sent me on the path to my graduate career; to my mother Nadia, who raised me to be the person I am today. She has been with me on every step of the way, through good and bad times. Thank you for all the unconditional love, guidance, and support that you have always given me, and for helping me to succeed and instilling in me the confidence that I am capable of doing anything I put my mind to. To my husband , Ahmad , for his encouragement and support; to my supporting brother, my nice sister and my son Mahmoud who gave me more reasons to succeed; and to any future child... I just don't know who you are yet. Thank you for everything. I love you!

Declaration

I hereby declare that this thesis is based on the results found by myself. Materials of works found by other researchers are mentioned by references. This thesis, neither in whole or in part, has been previously submitted for any degree

The work was done under the supervision of Dr. Khawla Qamhieh, at Al – Quds University, Palestine

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Abstract

The complex build-up of biomaterials consist of biopolymers, namely DNA, and the soft particles poly amidoamine (PAMAM) dendrimers of generation G1, G2, G3, G4, G6 and G8 have been studied by using a new developed theoretical model by Qamhie and co-workers who described the interaction between linear polyelectrolyte (LPE) chain and ion-penetrable sphere. Many factors are investigated such as the dendrimer size generation, the Bjerrum length, salt concentration, and rigidity of the LPE chain (Persistence length) that affect the dendrimer/LPE complex.

Through the complexation of LPE chain with one dendrimer, it has been found that the wrapping degree of the chain around dendrimer increases by increasing the dendrimer's generation, the Bjerrum length, and the salt concentration and it decreases by increasing the Persistence length. It has been found that the optimal wrapping length of the LPE chain around dendrimer depends only on the dendrimer generation. In addition the effect of 1:1 salt concentration on complexation of DNA plasmids with one dendrimer of different generation has been studied.

Complexes formed between multiple PAMAM dendrimers and oppositely charged LPE chain depends on the generation of dendrimer. It has been shown that the optimal wrapping length increases while the linker between dendrimers decreases. This result is in agreement with the previous result of Qamhie and co-workers studies for other generations of dendrimers.

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List of Abbreviations:

Symbol	Abbreviation representation
DNA	Deoxyribonucleic acid
LPE	Linear Polyelectrolyte
PAMAM	Poly(amido amine)
N_{ch}	Number of the monomers on the chain
Z_{dend}	Number of functional groups of dendrimer
TEM	Transmission electron microscopy
MD	Molecular Dynamic
BD	Brownian Dynamic
CG	Coarse – grained
bp	base – pair
l_{opt}	The optimal wrapping length of chain around dendrimer
l_{iso}	The length of the chain needed to neutralize the charge of dendrimer
DLS	Dynamic Light Scattering
l_p	The persistence length of LPE chain
PEG	Poly(Ethylene Glycol)
N_{exp}	The number of dendrimer bound per DNA molecule

Chapter ONE
INTRODUCTION