



**Faculty of Science
Chemistry Department**

**"Synthesis and evaluation of some surface active
agents based on Michael addition reaction and
their application in some vital fields"**

*A Thesis Submitted for Degree of Ph.D. in
Chemistry*

By

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(M.Sc. Organic Chemistry)

To

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Ain Shams University, Cairo, Egypt

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2018



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DEDICATION

To My PARENTS

*I have to thank Allah for choosing both of you to be my
parents.*

Thank you for supporting me

TO MY DEAR HUSBAND,

MY DEAR DAUGHTERS

AND SON

TO MY FAMILY

Thank you for supporting and helping me

Aim of the work

This work aimed to prepare different surface active agent compounds in the form of dendrimers with different generations based on Michael addition reaction, elucidate their chemical structures, evaluate their surface activity and finally, apply them in different vital fields. So, the main target of this thesis can be summarized as follows:

- 1- **Synthesis** of different generations of polyamidoamine (PAMAM) cationic surfactants using piperazine as core center molecule and ethylene diamine as a repeated unit. This synthesis produced generations of different dendrimer surfactants terminated with methyl ester PAMAM-COOCH₃ and amine PAMAM-NH₂ end groups.
- 2- **Confirmation** of the chemical structures of the synthesized compounds using FTIR, ¹H-NMR and Elemental analysis.
- 3- **Evaluation** of the surface activity and thermodynamic parameters of the synthesized compounds using surface tension technique at 25°C.
- 4- **Application** of the synthesized dendrimer surfactants in different vital fields:

4.1- **Biological Applications:**

- a- **Antimicrobial activity:** Evaluation of all the synthesized polyamidoamine cationic surfactants as biocides against different pathogenic bacterial and fungal species.
- b- **SRB:** Evaluation of some selected PAMAM-COOCH₃ and PAMAM-NH₂ compounds against sulfate reducing bacteria.
- c- **Anti-tumor Agents:** Evaluation of all the synthesized polyamidoamine cationic surfactants as anti-tumor agents against breast cancer cell.

4.2- **Drug Delivery Applications**

- a- **Solubility Study of a Hydrophobic Drug** using the synthesized polyamidoamine cationic surfactants as solubilizing agent for a poorly soluble drug (coenzyme Q10).
- b- **Dissolution Study** selection of the compounds that gave the highest solubility value to be evaluated in dissolution study of both coenzyme Q10 and Ledipasvir drug.
- c- **The toxicity test:** Evaluating the toxicity of two of the prepared compounds.

Abstract

Title: "Synthesis and evaluation of some surface active agents based on Michael addition reaction and their application in some vital fields".

By

Fatma Mahmoud Abd Elhafiz Ahmed

Chemistry Department, Faculty of Science, Ain Shams University

Degree: Doctor of Philosophy in Organic Chemistry,
Faculty of Science, Ain Shams University, 2018.

Different generations of cationic hyperbranched polyamidoamine (PAMAM) quaternary ammonium salt dendrimers terminated with methyl ester and amine end groups were synthesized. Preparation of these dendrimers was carried out via alternative steps of aza Michael addition reaction (of piperazine as core center molecule) and amidation reaction (by ethylene diamine). Each step was followed by quaternization using alkyl bromide with different chain length (4, 8 or 12) carbon atoms. The chemical structures of the prepared dendrimers were confirmed using FTIR, ¹H-NMR spectra and elemental analysis. Also their surface activity has been studied and their surface parameters including surface and interfacial tension, emulsification power, critical micelle

concentration, effectiveness, efficiency, maximum surface excess and minimum surface area were determined. The prepared quaternized dendrimers were applied in different fields where most of them revealed significant results. First, the dendrimers were tested as antimicrobial agents against different strains of bacteria, yeast and fungi, where the results showed that they have significant results as antimicrobial agents. Then, the compounds which gave the most significant biocidal activity were selected to be evaluated against sulfate reducing bacteria. Also, the synthesized polyamidoamine cationic surfactants were applied as anti-tumor agents against breast cancer cell, in which they showed good activity. Finally, in the field of drug delivery, all the synthesized polyamidoamine cationic surfactants were used as solubilizing agents for a poorly soluble drug (coenzyme Q10). The compounds that gave the highest solubility value were selected to be evaluated in the dissolution study of both coenzyme Q10 and Ledipasvir drug. Finally, the toxicity test was performed for two selected compounds from the prepared dendrimers and the results proved safety of these compounds.

Key words: Piperazine; ethylene diamine; Michael addition reaction; hyperbranched polyamidoamine, antimicrobial agents, anticancer and drug delivery.

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