



**Synthesis and evaluation of some cationic surfactant  
derived from heterocyclic compounds as biocides**

**A Thesis**

**Submitted in partial fulfillment of the requirements for Ph.D.  
degree in Chemistry**

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## Approval Sheet

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derived from heterocyclic compounds as biocides**

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**ABSTRACT**

**Title:** Synthesis and evaluation of some cationic surfactant derived from heterocyclic compounds as biocides

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**Degree:** Doctor of Philosophy in Organic Chemistry, Faculty of Science, Ain Shams University, 2017.

**Abstract**

Development of effective anti-microbial agents has been hindered by the emergence of bacterial strains with multi-drug resistance. In this work, we report an efficient synthesis of silver nanoparticle (AgNP) by capping with a synthetic cationic surfactants-based heterocyclic antipyrine. The synthesized antipyrine cationic surfactants were characterized by FT-IR and <sup>1</sup>H-NMR and their AgNPs were also delineated by TEM, DLS and UV-vis techniques. These AgNPs-capped cationic surfactants have average particle size of ~15–30 nm. These surfactants could self-assemble to form micelles in an aqueous medium and the critical micelle concentration (CMC) values as well as the surface parameters were determined at 20, 40 and 60 °C. The synthesized

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antipyrine cationic surfactants and their AgNPs were tested against growth of both Gram positive (*Bacillus subtilis* and *Staphyl. aureus*) and Gram negative (*Pseudomonas aeruginosa* and *E. coli.*) bacterial strains as well as fungi (*Candida albicans* and *Aspergillus niger*). It was found that the AgNPs significantly enhanced the biocidal activities of the synthesized antipyrine cationic surfactants. A strong structure-activity relationship was observed as a function of AgNPs functionality; providing guidance to activity prediction and rational design of effective antimicrobial nanoparticles. We propose that the antipyrine cationic surfactants-capped AgNPs can have potential biocidal application against pathogenic bacteria.

**Keywords:** Silver nanoparticles, heterocyclic antipyrine, cationic surfactants, surface activity, biocidal activities, Structure-activity

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**LIST OF ABBREVIATIONS**

<b>Symbol</b>	<b>Abbreviation</b>	<b>unit</b>
C	Molar concentration	$\text{ML}^{-1}$
$\gamma$	Surface tension	$\text{mNm}^{-1}$
$\Pi$	Effectiveness	$\text{mNm}^{-1}$
$\text{Pc}_{20}$	Efficiency	$\text{ML}^{-1}$
CMC	Critical micelle concentration	$\text{mML}^{-1}$
$\pi_{\text{cmc}}$	The effectiveness	$\text{mNm}^{-1}$
$\gamma_o$	surface tension of bi-distilled water	$\text{mNm}^{-1}$
$\gamma_{\text{cmc}}$	surface tension of aqueous surfactant solution at critical micelle concentration	$\text{mNm}^{-1}$
$\text{Pc}_{20}$	The efficiency	$\text{mNm}^{-1}$
$\Gamma_{\text{max}}$	maximum surface excess	$\text{mol.cm}^{-2}$
$A_{\text{min}}$	minimum surface area	$\text{\AA}^2 \text{ molecule}^{-1}$
$\Delta G$	free energy	$\text{kJ/mol}$
$\Delta S$	entropy	$\text{kJ.mol}^{-1}$ $\text{K}^{-1}$
$\Delta H$	enthalpy	$\text{Kcal.}$ $\text{mol}^{-1}$

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