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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Title of thesis

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ABSTRACT

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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 ^{1}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

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

Symbol	Abbreviation	unit
C	Molar concentration	ML^{-1}
γ	Surface tension	mNm^{-1}
Π	Effectiveness	mNm^{-1}
Pc_{20}	Efficiency	ML^{-1}
CMC	Critical micelle concentration	mML^{-1}
π_{cmc}	The effectiveness	mNm^{-1}
γ_o	surface tension of bi-distilled water	mNm^{-1}
γ_{cmc}	surface tension of aqueous surfactant solution at critical micelle concentration	mNm^{-1}
Pc20	The efficiency	mNm^{-1}
Γ_{max}	maximum surface excess	$mol.cm^{-2}$
A_{min}	minimum surface area	A^2 $molecule^{-1}$
ΔG	free energy	kJ/mol
ΔS	entropy	$kJ.mol^{-1}$ K^{-1}
ΔH	enthalpy	Kcal. mol^{-1}

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