

## ORIGINAL PAPER

## Micelle nano-reactors as mediators of water-insoluble ligand complexation with Cu(II) ions in aqueous medium

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Complexation reactions between water-soluble and -insoluble reactants were shown to occur in aqueous media in the presence of normal or reverse surfactant micelles, in significantly higher yields at lower temperatures compared to those achieved in neat organic solvents. The highest yield enhancement in the complexation of novel water-insoluble bis(2-amino-1,3,4-thiadiazolyl)methane and 1,4-bis(2-amino-1,3,4-thiadiazolyl)benzene ligands with Cu(II) ions was achieved in the sodium bis(2-ethylhexyl)sulfosuccinate (AOT)–heptane–water reverse micellar system at the hydration ratio of 15. The results revealed that AOT normal micelles cause a change in the reaction mechanism together with the enhancement of the complex formation. The observed micellar effects were rationalized on basis of the properties of bulk solvents, surfactants and ligands, considering the solvation and hydration ratios of reverse micelles. The results have proved the dependence of complex yield on the amount and accordingly also on the properties of water in the micellar core, indicating that the yield can be maximized by the optimization of the hydration ratio.

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**Keywords:** micellar effects, Cu(II) complex, bis(2-amino-1,3,4-thiadiazolyl)methane, 1,4-bis(2-amino-1,3,4-thiadiazolyl)benzene, SDS, AOT

## Introduction

Synthesis of poly functionalized cyclic compounds containing heteroatoms and their metal complexes, both expected to have biological activities, has been a popular area of research in recent decades (Görgülü & Çukurovalı, 2002; Koparır et al., 2005; Atalay et al., 2006). Some 2,5-disubstituted-1,3,4-thiadiazoles, their Schiff bases and metal complexes have been reported to exert antibacterial, antifungal, and pharmacological activities (Terzioğlu & Gürsoy, 2003; Mohamed & Sharaby, 2007). They also constitute new materials with special characteristics (Maradiya & Patel, 2002). Antibacterial potency of a ligand generally increases upon its complexation, which has drawn attention to complexation reactions. Thiadiazolyl compounds with two thiadiazole rings carrying amino groups in

2-positions and their Cu(II) complexes were synthesized for the first time in our laboratory (Adıgüzel et al., 2011a, 2011b).

All reaction characteristics can be changed by performing the reaction in micellar solutions instead of pure bulk solvents (Taşcıoğlu, 1996). Surfactant micelles work as nano-sized reactors. Micelle-bound reactants reside in microenvironments with quite different properties from those of pure bulk solvents. This leads to the “medium effect” of the micelles, in addition to their “concentration effect” (Taşcıoğlu, 1996). Medium effect of surfactant micelles arises from the combination of cage, pre-orientation, microviscosity, polarity, and charge effects. Thus, ionization equilibria of the substrates interacting with micelles by hydrophobic and electrostatic forces change, which is reflected in the stability constants of their complexes

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