

# Study of Micellization of Sodium Dodecyl Sulfate in Non-Aqueous Media Containing Lauric Acid and Dimethylsulfoxide

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Received: 3 May 2012 / Accepted: 18 January 2013 / Published online: 7 February 2013  
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**Abstract** Interactions between dimethylsulfoxide (DMSO), lauric acid (LA) and anionic surfactant, sodium dodecyl sulfate (SDS) in non-aqueous media have been studied in detail using conductometric, volumetric, and ultrasonic speed techniques. Conductivities, densities and ultrasonic speeds of  $1 \times 10^{-3}$  to  $11 \times 10^{-3}$  m SDS solutions in a mixture of LA (0.10 m) and DMSO between 298.15 and 313.15 K have been measured. The experimental data have been correlated against temperature and concentration of SDS using standard relations. The critical micelle concentration (CMC) values have been determined by using different methods like conductance, density and ultrasonic speed. All the methods yielded identical CMC values. The measured data were used to calculate various useful thermodynamic parameters like standard free energy,  $\Delta G_{\text{mic}}^{\circ}$ , enthalpy,  $\Delta H_{\text{mic}}^{\circ}$ , and entropy,  $\Delta S_{\text{mic}}^{\circ}$ , of micelle formation. From the density data of the surfactant, the change of the apparent molar volume upon micellization has been calculated. Density and ultrasonic speed data were used to evaluate the apparent molar adiabatic compressibility for the micelle of the surfactant at different temperatures over a wide concentration range.

**Keywords** Sodium dodecyl sulfate · Lauric acid · Dimethylsulfoxide · Micellar properties

## Introduction

The studies of interactions between surfactants and biomolecules are of immense significance due to their

applications in biological systems, pharmaceuticals and biotechnological processes [1–3]. Surface-active agents possess both nonpolar hydrophobic groups (their tails) and polar hydrophilic groups (their heads) in the same molecule and, hence, are amphiphilic in nature. These amphiphilic molecules form aggregates (micelles) over a narrow concentration range called the critical micelle concentration, CMC. Amphiphiles are not only highly interesting from a physicochemical view-point but also are fundamental to life because of the fact that living things are made up of colloids comprising of a wide variety of amphiphiles [2]. The aggregation phenomenon of amphiphilic molecules involves contributions from both repulsive and attractive interactions. In ionic surfactants, especially, the repulsive forces originate primarily from electrostatic repulsion between the polar head groups, whereas attractive interactions have generally been attributed to hydrophobic interactions between the nonpolar tails of the surfactant monomers [4–6]. Understanding the factors that control the self-assembly of amphiphilic molecules is central to a wide range of applications [7, 8]. Amphiphiles are able to form aggregates only when they are present in a suitable solvent. As a result, the physicochemical properties of a given surfactant solution can be greatly modified by varying the solvent properties. The usual way to vary the solvent properties is to use pure solvents of different polarity, mixed solvents containing either mixtures of water and non-aqueous solvent or mixtures of two non-aqueous solvents, electrolytes, polar organics, and nonpolar organics in aqueous and non-aqueous solvents [2, 4, 5, 9–19]. In the recent past, there have been several studies on the micellar behavior of surfactants in aqueous plus non-aqueous mixed solvents. Investigation on the effect of added nonelectrolytes on the micellization of surfactants is important because such studies provide knowledge about the role of

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