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Reactivity of a lipophilic ingredient solubilized in anionic or cationic surfactant micelles

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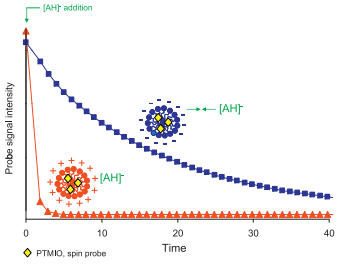
HIGHLIGHTS

- The location of a lipophilic spin probe was measured in surfactant solutions.
- The probe partitioned between micelle and aqueous environments.
- The probe in anionic micelles decreased its reactivity with the anionic reactant.
- The probe in cationic micelles increased its reactivity with the anionic reactant.

GRAPHICAL ABSTRACT



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ABSTRACT

The aim of this work was to investigate the location and reactivity of a lipophilic spin probe, 4-phenyl-2,2,5,5-tetramethyl-3-imidazoline-1-oxyl nitroxide (PTMIO) in anionic (sodium dodecyl sulfate, SDS) or cationic (dodecyl trimethylammonium bromide, DTAB) surfactant micelles. The analysis of electron paramagnetic resonance (EPR) spectra of PTMIO in micellar systems showed that probe molecules partitioned between two populations: a more mobile fraction in the aqueous phase and a less mobile fraction in the micelle. The fraction of PTMIO incorporated in surfactant micelles increased with surfactant concentration. The rate of the reduction of the nitroxide group of PTMIO by the negatively charged, water-soluble ascorbate decreased when the probe was solubilized in anionic SDS micelles and increased when it was solubilized in cationic DTAB micelles. Thus, both the surface charge as well as the solubilization capacity of the micelles controlled the reactivity of the lipophilic molecule.

1. Introduction

A wide range of lipophilic ingredients (*e.g.*, flavors, pigments, vitamins, drugs, antimicrobials or phytochemicals) are added to food, beverage, pharmaceutical and cosmetic products to produce a desired functionality. Various formulation strategies are used to disperse lipophilic ingredients into aqueous media including emulsions, nanoemulsions and solid lipid nanoparticles [1–4]. Emulsion-based delivery systems often contain appreciable amounts of non-adsorbed emulsifiers in the aqueous phase surrounding the dispersed lipid particles. Non-adsorbed surfactant molecules form micelles when their concentration exceeds a particular level know as the critical micelle concentration (CMC). Surfactant micelles consist of a hydrophilic shell and a hydrophobic core that are capable of incorporating lipophilic molecules [5–7]. Consequently, it is possible for any encapsulated lipophilic component within an emulsion-based delivery system to partition between the non-polar regions of the lipid droplets and the surfactant micelles [8–10]. Surfactant micelles may, therefore, play an important role in the solubilization and localization of lipophilic ingredients in multiphase systems. Accordingly, surfactant micelles have been described as acting as a separate phase from water, which constitutes the basis of the pseudophase model [11].

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