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Microscopic and transition investigation on the effect of cholesterol in AOT solution

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ABSTRACT

The effects of cholesterol on vesicle were studied in this paper. Anionic bis-(2-ethylhexyl)sulfosuccinate (AOT) surfactant and brine water were used to prepare the vesicle. Effects on vesicle size were observed using polarized light microscopy (PLM) and dynamic light scattering (DLS), whereas thermal properties were measured using differential scanning calorimeter (DSC). The results were compared among AOT solutions before and after the addition of various amounts of cholesterol, showing difference in vesicle size, microscopy scale, hydrodynamic diameter, and main transition temperature (T_m). These changes were attributed to the entrapment of cholesterol molecules in the hydrophobic part of vesicles.

1. Introduction

Various types of research on vesicles have been carried out through the decades. Vesicles can function as medical carriers [1,2] and can be used in the production of nanoparticles [3]. There have been a number of studies on how bis-(2-ethylhexyl)sulfosuccinate (AOT) vesicles interact with other materials which affect the properties of vesicles or the surfactant itself, especially in terms of surfactant aggregation, vesicle size, rigidity, stability, and turbidity of the solution.

Researches regarding the effects of cholesterol in surfactant-based vesicles were reported using various types of surfactant. These reports concluded that the presence of cholesterol in vesicles induces higher in both vesicle stability and drug entrapment efficiency [4,5]. In addition, cholesterol is also known for its improvement of vesicle fusion and motion [6], changes in surfactant bilayer main transition temperature (T_m) [7], and formation of highly ordered L_o phase, which improves the activity of surfactants [8].

Previous research examined the effects of cholesterol in various types of surfactant-based vesicles, such as egg phosphatidycholine [4,9], nonionic [5,10], and cationic [11] but not much reports were done on anionic surfactant. In this paper, we report that anionic AOT surfactant with two alkyl-chains provides the similar results with other types of surfactant, which cholesterol would also induce anionic vesicles formation. However, the result obtained shows differences where the amount of cholesterol used to interact with anionic surfactant in our report was lesser compared with that of other research [10,11].

Studies on interacting cholesterol had been done on various types of surfactant but not much on anionic surfactant. Therefore, our study was based on whether anionic surfactant shares the same changes as other surfactants by investigating the interaction between a double short alkyl chain anionic surfactant molecule of AOT and cholesterol molecule. The AOT–cholesterol mixture vesicle solutions are prepared with the aid of brine solution. AOT surfactant with different amounts of cholesterol was compared and noted. Our observation had shown changes in vesicle size, vesicle solution size distribution, and vesicle phase transition temperature by using polarized light microscope (PLM), dynamic light scattering (DLS), and differential scanning calorimeter (DSC).

2. Experimental section

2.1. Materials

The surfactant bis-(2-ethylhexyl)sulfosuccinate (Aerosol OT/AOT, 98%) and white cholesterol powder ($C_{27}H_{46}O$, 95%) were purchased

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from Sigma and used as received. Brine solutions were prepared with sodium chloride salt (Univar Australia) and ultra pure water (Maxima Ultra Pure Water, Elga-Prima Corp, UK) with a resistivity of 18 MΩ/cm at 0.05 M.

2.2. Preparation of vesicle solutions

Both AOT and cholesterol were dissolved separately in chloroform. An AOT solution was prepared at 3% (w/w) in brine water as standard

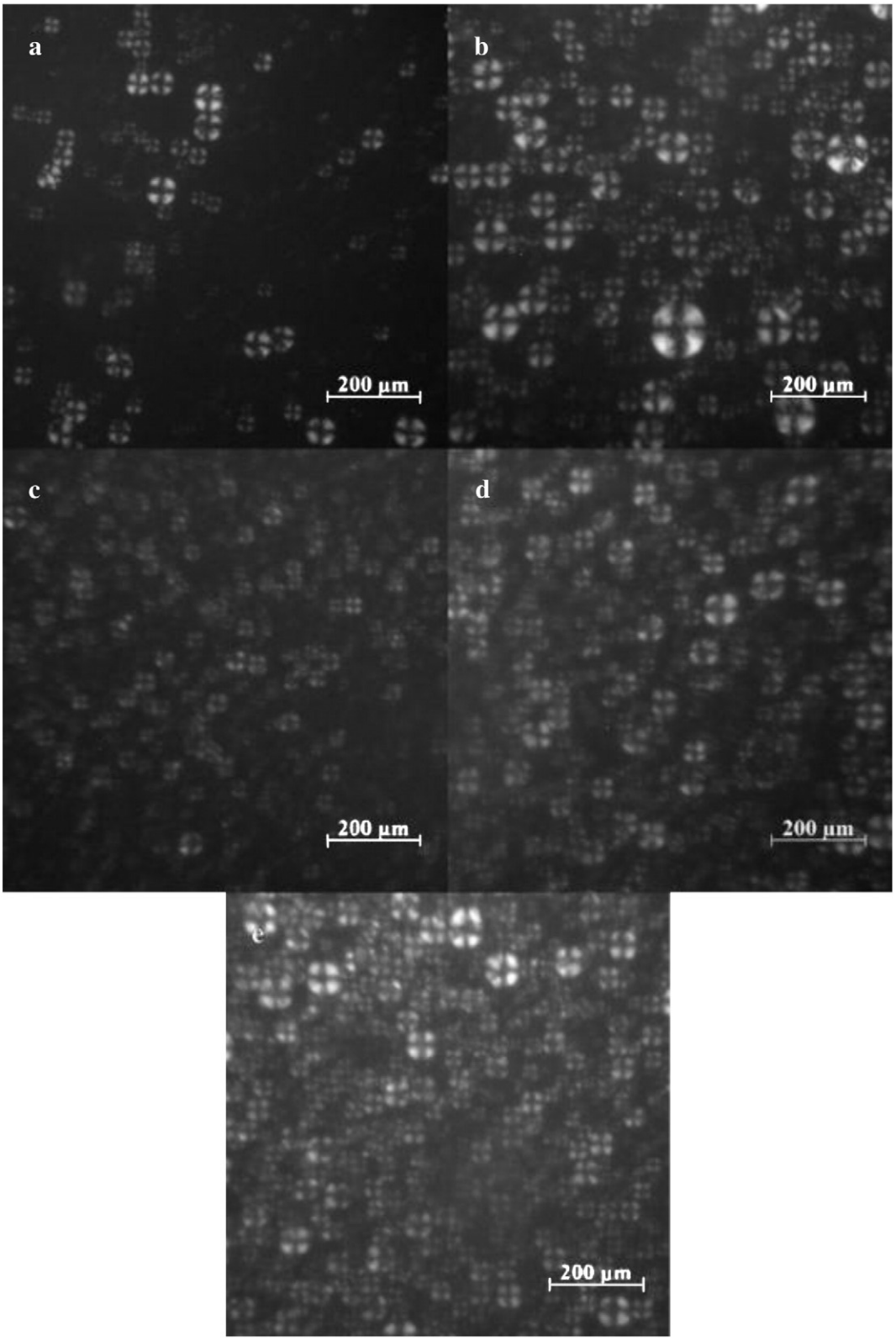

Fig. 1. Polarized images of progressive increase in amount of cholesterol in AOT solution (w/w): (a) AOT solution, (b) 0.5%, (c) 1.0%, (d) 1.5%, (e) 2.0%.