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Microemulsions and liquid crystalline formulated with triacylglycerols: Effect of ethanol and oil unsaturation

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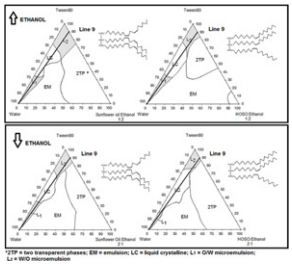
HIGHLIGHTS

- Both ethanol and oil unsaturation exerted influence on phase diagram properties.
- Lower ethanol concentration produced mesophase with gel-like structure.
- Liquid crystalline zone showed shear-thinning, thixotropy and viscoelastic behavior.
- High ethanol content masked the oil unsaturation influence.

GRAPHICAL ABSTRACT



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ABSTRACT

Pseudo-ternary phase diagrams were constructed in order to evaluate the effect of the prevailing oil unsaturation and cosurfactant concentration on the phase behavior of systems prepared with sunflower oil or high oleic sunflower oil (HOSO), water, Tween 80 and ethanol. The phase diagrams showed small areas of one single translucid phase with production of water-in-oil (L_2) and oil-in-water (L_1) microemulsions. A higher cosurfactant concentration increased microemulsion area and allowed solubilize more water using lower surfactant content. Moreover, small angle X-ray scattering (SAXS) measurements showed that depending of the composition the surfactant self-assembly led to lamellar ($L\alpha$) or hexagonal (H_1) structures. Microemulsions showed Newtonian behavior, while $L\alpha$ and H_1 showed shear-thinning behavior, viscoelasticity and thixotropy. This more complex rheological behavior was accentuated at lower cosurfactant concentration and with the less unsaturated oil, showing that both oil unsaturation and ethanol content exerted influence on systems properties. However, the higher concentration ethanol masked the effect of oil unsaturation.

1. Introduction

Microemulsions are spontaneously formed and macroscopically homogeneous due their droplets size, which are in colloidal domain. Therefore, microemulsions are isotropic, transparent and thermodynamically stable mixtures usually composed by oil, water and surfactant [1,2]. An interfacial tension near zero or a more flexible interface is required to form a microemulsion, which is generally achieved with the additional use of cosurfactants [3]. Nevertheless, depending on the concentration of these ingredients, a surfactant self-assembly can occur assuming a large variety of morphologies, such as lamellar, cubic or hexagonal phases [4] and these systems are denominated as liquid crystalline. The microemulsions and liquid crystalline characterization can be performed with a large variety of methods as nuclear magnetic ressonance (NMR), dynamic light scattering (DLS), small-angle neutron scattering (SANS), small-angle X-ray scattering (SAXS), polarized light, conductivity and viscosity measurements [5,6]. In addition to viscosity, other rheological measurements could be used to identify and characterize the microemulsions, helping to define the phase diagram boundaries. Steady-state and oscillatory measurements are useful to identify the structure dependence

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