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Physicochemical characterization of sodium stearoyl lactylate (SSL), polyoxyethylene sorbitan monolaurate (Tween 20) and κ-carrageenan

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ABSTRACT

Surfactant-polymer mixtures are common in food, cosmetic and pharmaceutical products. These components can interact with each other. The interactions depend on the type of polymer and surfactant, the purity of the ingredients, the ionic content and their concentration. Therefore, the data presented here provide valuable information that could be useful for those working with these mixtures in different applications, particularly in blends with polyelectrolytes and their counterions. This article contains experimental data about the physicochemical characterization of sodium stearoyl lactylate (SSL), polyoxyethylene sorbitan monolaurate (Tween 20) and κ-carrageenan. Techniques included atomic absorption, DSC, FTIR-ATR, NMR, and surface tension.

Specifications Table

Subject area	*Chemistry*
More specific subject area	*Physical chemistry*
Type of data	*Tables and figures*

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How data was acquired	*Atomic absorption spectrometer 3110 (Perkin Elmer); Spectrophotometer with an ATR universal accessory (Spectrum 400, Perkin Elmer Cetus Instruments); Microcalorimeter μDSC 7 Evo (Setaram); Microtensiometer EZPiplus (Kibron) and spectrometer AVANCE-III 500 (Bruker)*
Data format	*Analyzed results*
Experimental factors	*Commercial forms were used without further purification*
Experimental features	*Physicochemical properties were determined for κ-carrageenan and two surfactants (SSL and Tween 20) by using atomic absorption, infrared and nuclear magnetic resonance, calorimetry, and measurements of surface tension*
Data source location	*Authors' affiliation*
Data accessibility	*Data are presented in this article*

Value of the data

- Intrinsic ions content is a key factor in mixtures of ionic components, like κ-carrageenan and SSL, because interactions between them can be affected by the presence of salts.
- DSC analysis, IR and NMR spectra are used to identify the components and to determine their purity, which are relevant characteristics since the presence of distinct species could modify their behavior.
- Surface tension is useful to know the adsorption parameter of surfactants and how it changes in a mixture with other components.

1. Data

SSL had sodium as the primary ion and small quantities of other ions, whereas Tween 20 only had traces of ions. κ-carrageenan was found mainly as the potassium salt form since it is the primary ion. The IR spectrum of SSL showed typical carbonyl, ether groups, and aliphatic linear chain bands. Tween 20 showed an OH band, and characteristic carbonyl and ether groups bands. The spectrum of κ-carrageenan showed sulphate ester and glycosidic linkage bands, which are not due to the presence of ι-carrageenan because the NMR spectra show a kappa: iota hydrogen molar ratio of 1:0.073. The melting transition temperature of SSL was 54.6 °C and the recrystallization temperature 40.5 °C. Tween 20 did not show any apparent change over the working temperature range. The thermal behavior of κ-carrageenan depends on the ionic content since its gelation is affected by the presence of K^+ ions. Therefore, the addition of KCl increased the transition temperature and enthalpy compared with κ-carrageenan without the salt. The addition of KCl modified the critical micelle concentration (CMC) of SSL solutions because of the chemical nature of the surfactant. This effect was not observed for Tween 20. The CMC values were higher for SSL due to electrostatic repulsion between its head groups. The same behavior was observed in mixtures of κ-carrageenan with the individual surfactants.

2. Experimental design, materials and methods

2.1. Materials

Materials included food-grade κ-carrageenan (Ingredients Solutions, USA) without further purification, powder sodium stearoyl lactylate (Palsgaard, Juelsminde, Denmark), liquid Tween 20 (Hycel de México S.A. de C.V., Mexico), and potassium chloride (Merck, Germany). Solutions were prepared in deionized water; its resistivity was greater than 50 $k\Omega \cdot m$ and its total organic carbon (TOC), less than 30 ppb.