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Modified Polysaccharide as Emulsifier in Oil-in-Water Emulsions

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Abstract : Emulsions are commonly used in applications involving oil/water dispersions, where handling of interfaces becomes a crucial aspect. The use of emulsion technology has greatly evolved in the last decades to suit the most diverse uses, ranging from cosmetic products and biomedical adjuvants to complex industrial fluids. The stability of these emulsions is influenced by factors such as the amount of oil, size of droplets and emulsifiers used. While commercial surfactants are typically used as emulsifiers to reduce interfacial tension, and therefore increase emulsion stability, these organic amphiphilic compounds are often toxic and expensive. A suitable alternative for emulsifiers can be obtained from the chemical modification of polysaccharides. Our group has been working on modification of polysaccharides to be used as additives in a variety of fluid formulations. In particular, we have obtained promising results using chitosan, a natural and biodegradable polymer that can be easily modified due to the presence of amine groups in its chemical structure. In this way, it is possible to increase both the hydrophobic and hydrophilic character, which renders a water-soluble, amphiphilic polymer that can behave as an emulsifier. The aim of this work was the synthesis of chitosan derivatives structurally modified to act as surfactants in stable oil-in-water. The synthesis of chitosan derivatives occurred in two steps, the first being the hydrophobic modification with the insertion of long hydrocarbon chains, while the second step consisted in the cationization of the amino groups. All products were characterized by infrared spectroscopy (FTIR) and carbon magnetic resonance (13C-NMR) to evaluate the cationization and hydrofobization degrees. These modified polysaccharides were used to formulate oil-in water (O:W) emulsions with different oil/water ratios (i.e 25:75, 35:65, 60:40) using mineral paraffinic oil. The formulations were characterized according to the type of emulsion, density and rheology measurements, as well as emulsion stability at high temperatures. All emulsion formulations were stable for at least 30 days, at room temperature (25°C), and in the case of the high oil content emulsion (60:40), the formulation was also stable at temperatures up to 100°C. Emulsion density was in the range of 0.90-0.87 s.g. The rheological study showed a viscoelastic behaviour in all formulations at room temperature, which is in agreement with the high stability showed by the emulsions, since the polymer acts not only reducing interfacial tension, but also forming an elastic membrane at the oil/water interface that guarantees its integrity. The results obtained in this work are a strong evidence of the possibility of using chemically modified polysaccharides as environmentally friendly alternatives to commercial surfactants in the stabilization of oil-in water formulations.

Keywords : emulsion, polymer, polysaccharide, stability, chemical modification
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