**A study of the physical properties of oleogels based on PUFA-rich oils**

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ABSTRACT

As is widely known, the consumption of solid and semisolid fats, containing trans fatty acids (TFAs) and saturated fatty acids (SFAs), leads to negative effects on human health. Conversely, polyunsaturated fatty acids (PUFAs), precursors of essential fatty acids, have proven to be highly beneficial to health in terms of immune system and blood pressure regulation, cholesterol metabolism, and neurological and cognitive functions. Oleogelation is currently being studied to produce low SFAs and TFAs-free semisolid systems capable of replacing solid fats. Oleogels are composed of liquid oil entrapped within a thermo-reversible and three-dimensional gel network formed by gelling molecules added at low concentrations. The aim of this work was to study the physicochemical properties of monoglyceride (MG) oleogels formulated with PUFA-rich oils in order to develop fat materials with a high-nutritional lipid profile. Five differents oils were selected based on their high-PUFA content: sunflower (45.39%), chia (84.01%), flaxseed (68.29%), soybean (60.00%), and sesame (38.88%) oils. Oleogels were prepared by mixing each oil with 6 or 10 wt% MG as gelator at 80 °C, followed by cooling at 5°C. For characterization, X-ray diffraction analysis (XRD), polarized light microscopy, differential scanning calorimetry (DSC), rheology, textural analysis, and oil binding capacity (OBC) were used. The main results are summarized below. The desired β' polymorphism for shortening replacement purposes was obtained in all oleogels except for those made of chia oil. In all oleogels there was more than one polymorphic form, which was also evidenced through the melting profiles of the samples. The crystal morphologies of the different oleogels were similar, needle-like crystals forming clusters, showing smaller crystal lengths (Lc) those formulated with the lowest MG concentration. Lc ranged between 29-51 µm and 43-64 µm for 6 and 10 wt% MG oleogels, respectively. The oleogel properties generally improved when the concentration of MG was increased in the formulation. OBC values for all oleogels were higher than 93.3%, indicating the formation of crystalline networks with high oil retention capacity. A highlighted result was that 6 wt% flaxseed oleogel showed no significant differences in OBC in comparison with all 10 wt% oleogels. With regards to textural parameters, 10 wt% flaxseed oleogel had the highest values of hardness (5.7 N) and adhesiveness (12.2 N.s). Using chia oil at both MG concentrations resulted in oleogels with the highest elastic modulus. Overall, PUFA-rich oils were able to produce high-elasticity strong oleogels with texture properties similar to those of spreadable commercial margarines, suggesting that these materials could be used to replace harmful fats without compromising functionality.

KEYWORDS: oil structuration, monoglyceride, unsaturated oil, fat substitution, functionality.