Development and physical characterization of novel food-grade W/O emulsions stabilized by stearic acid and guar gum

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In a system with a comparable oil and water content, the creation of a W/O or O/W emulsion could depend on the emulsifier type, and the gelling/structuring agents used.
The objective of this research was to analyze the effect of the formula composition on the physical properties and stability of food-grade emulsions containing a similar amount of water and oil and to develop W/O emulsion systems to be used as hard fat replacer or as ingredient in vegetable creams, or spreads.
A D-optimal mixture design was selected and a special regression cubic model was chosen. Five independent factors were chosen: sunflower oil, water, a mixture of sorbitan oleate and soy lecithin as emulsifier (4:1 ratio), stearic acid, and guar gum. The ingredients varied in a restricted range: oil and water content from 40 to 55%, emulsifier system from 1 to 5%, stearic acid from 0 to 3%, and finally guar gum from 0 to 0.3%.
32 formulations, including 3 replications, come out and were characterized in terms of particle size distribution (PSD), apparent viscosity after preparation and physical stability over time.
29 out of 32 formulations were W/O emulsions, with PSDs varying from bimodal to unimodal and D4,3 values ranging from 8 to 150 µm. Almost all formulations behaved like shear-thinning fluids, differing in apparent viscosity values. The most stable formulations were those with the 0.3% of guar gum. Analysis of variance revealed that formulation significantly affected emulsion properties. The parameters significantly affected by the formulation were used as response variables in different regression models. Several PSD and rheological parameters were explained through a special cubic model for, highlighting that the components interact with each other. Linear models were used to explain physical stability in terms of Turbiscan stability index (TSI).
Different suitable W/O formulations were found, minimizing both D4,3 and TSI values, at different levels of the rheological parameters, through the desirability function. These findings may provide an effective strategy to regulate the structure of functional multiphase ingredients, such as multiple emulsions, and to design foods with enhanced nutritional value, eventually including bioactive compounds.