Limoncello, and the art of mixing water and oil

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Oil and Water do not mix. Fortunately, as many products we eat are emulsions, i.e, a mixture of two liquids that would ordinarily not mix together. Milk, mayonnaise, butter, … and Limoncello, are all examples of emulsions, made of fat droplets dispersed in water. Despite similar chemical compositions, the physical properties of these emulsions strongly differs. The reason for the diversity of physico-chemical properties of emulsions arises mostly from the structure of the system at the microscopic scale.

In most of the cases, a significant amount of energy is required to emulsify water and oil. In addition to that, in order to provide stability to the emulsion, the presence of stabilizers is required. Differently, meta-stable emulsions can be prepared when three liquids, two partly miscible liquids (water and oil) and a common solvent, such as ethanol, are mixed. Close to the phase-separation boundary, strong composition fluctuations take place. In this portion of the phase diagram, called 'Ouzo region', the formation of 100-1000 nm sized oil rich domains are found. The name 'Ouzo' derives from the famous Greek liquor, which exhibits a typical opalescence when diluted with water, due to the formation of anethole (the oil) rich droplets.

In this contribution, an overview on the general properties of emulsions is given. Focus is put on Limoncello, the famous Italian liquor based on lemon essential oils. In contrast to similar, 'Ouzo-like' systems, Limoncello shows and exceptional stability. This peculiarity of Limoncello is explored using small-angle neutron scattering, which can be employed to probe with high detail the size and composition of the emulsified droplets.

Reference:

[1] ACS Omega 2018, 3, 11, 15407-15415