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How to use Arabic gum to stabilize emulsions? A story of proteins and polysaccharides

M Atgié, O Masbernat and **K Roger**
CNRS, France

Arabic gum is a natural product issued from Acacia trees, which has been used for centuries as a stabilizer in various formulations. The origin of this hydrocolloid's remarkable properties remains challenging to fully elucidate, since the gum is in fact composed of several species. Arabic gum contains various proteins and polysaccharides, some of them covalently linked, which all possess different interfacial properties. In the literature, the gum was mainly divided into three main fractions: polysaccharides, glycoproteins and covalent protein/polysaccharides conjugates. These complexes are described as the good stabilizing species of the blend when formulating emulsions. However, we show that, in fact, all the species contain a protein fraction. In addition, no limited coalescence regime was observed when the "good stabilizing specie" was in insufficient amounts to cover the interfaces, despite its large adsorption energy. We instead observe a slow and continuous coalescence of the emulsions, over weeks, which contrasts to the expected behaviour from pickering emulsions. We have developed methods, to separate the different species of the gum according to their size and amphiphilic property. In order to elucidate the contributions of each species to emulsion stabilization, we have coupled two types of separation methods. Emulsion-mediated separation, coupled with liquid chromatographic analysis, shows which species adsorb at the oil/water interface as a function of gum concentration, pH and salinity. We identify that an acidic pH is crucial for emulsification, which is always empirically in the case of current gum applications, but hadn't been rationalized before. This was confirmed with interfacial tension measurements and elucidated through SAXS measurements. We also obtained the quantitative variation of the interface's composition with the gum concentration. Most species of the gum are shown to adsorb at the interfaces, but their stabilizing properties largely vary due to differences in adsorption energies and/or steric repulsion barriers. Arabic gum must thus be viewed as a continuum of amphiphilic species with different properties (figure), which should help rationalize formulations using this original gum. Our work also opens new perspectives in the use and analysis of complex mixtures.

marina.atgie@ensiacet.fr

Complex coacervation and hydrocolloids: Encapsulation and delivery of bioactive ingredients

Wei Zhang
DSM Notional Products Canada Inc., Nova Scotia, Canada

Complex coacervation had been proved to be one of the great technology breakthroughs since 1950's in the field of microencapsulation technologies. Together with interfacial polymerization technology, the two technological milestones laid the foundations for microencapsulation technology to build on, advance and thrive in many industrial applications up to this day. The very first success story with complex coacervation technology was the microcapsules invented for carbonless applications that dominated the market for so many years until the electronic era came and paperless technologies challenged its monopoly position. From its infancy days, this complex coacervation technology has been entangled with hydrocolloids and advanced ever since. The very first hydrocolloids used for constructing the coacervates were gelatin and gum Arabic. As the technology advanced, many hydrocolloids have been exploited and innovative hydrocolloid ingredients have been discovered and/or developed over the decades. The complex coacervation technology has been extensively studied and successfully applied in many areas. Encapsulation and delivery of bioactive and nutraceuticals in forms of microcapsules or nanocapsules have been one of the active fields to this day. Examples will be given to elucidate their structures, properties and performances, all together which lead to commercial successes. Nowadays, the waves of technological innovation and advancements have brought the complex coacervation technology into a new era and expanded it from microencapsulation into nanoencapsulation technology. Along the way, it took the innovative food hydrocolloids with it creating novel encapsulation and delivery tools for bioactive ingredients in the biomedicine world.

wei-w.zhang@dsm.com