
Using non-thermal processing to develop novel structures

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In food industry, powders play an important role in manufacturing. The commonly used process used in an industrial level is spray drying. In this unit operation, the particles are exposed to heated air, with detrimental effects on thermosensitive ingredients, such as vitamins, colours and flavours that are present in the formulation. The energy consumption in spray dryers is very high (up to 13GJ/h with evaporation rates up to 4 tons/h). Given that, alternative processes that consume less energy and show a high retention of the inclusions is needed. In this context, electrospraying is an alternative process. Electrospraying is an emerging technology used to produce particles in the sub-micron scale. During this process, an electrical field is being created between polymer solution or emulsion and a grounded collector which leads to the production of particles. The whipping of the polymer jet caused by applying high voltage leads to solvent evaporation during the flight towards the collector. The fact that no heat is required, is especially interesting in the food manufacturing industry, as we will achieve higher retention of the colourings, vitamins and flavours. Comparing energy required for lab-scale process of spray-drying and electrospraying, shows that there is up to 20% reduction of the energy used. However the effect that the process has on the powder and on the starting solution is not fully understood. In this study we gain fundamental understanding of how the food materials (plant proteins and cellulose) interact during and after the processing and what influences the process optimization (material properties, flow rate, applied voltage, viscosity, and interfacial tension). The structural changes of proteins in solution, i.e. their aggregation or denaturation upon interaction with cellulose have been investigated by small and wide angle X-ray scattering. Viscosity and processing conditions showed to play a significant role on the particle's microstructure and stability. Taking all the above into account, electrospraying is an emerging technology that can be used to reduce the energy consumption.