(P9) **Modelling ice crystal growth and morphology in food systems with low water content**

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Freezing is one of the most important processing techniques, and also one of the most energy demanding operations, employed in the food industry. During freezing, water crystallisation takes place and since the properties and morphology of the frozen product are determined by the shape and size of the formed ice crystals, controlling the formation and growth of those crystals becomes critical to define the microstructure and quality of frozen foodstuffs. The energy requirements of freezing could be significantly reduced by processing systems with low water content, as the system would contain less available water to freeze. However, ice crystal formation in such conditions can be challenging.

In this work, ice crystal formation in food model systems (aqueous solutions of sucrose up to 60% w/w) has been studied using a mathematical modelling-based approach. A single droplet crystallisation model has been employed to investigate the effect of solute concentration and process conditions on ice crystal growth rate. Complementary, a 2-D mathematical model has been developed to study the effect of different process conditions on the crystals morphology and size distribution. The proposed model has been implemented and solved using the phase field method, which relates the solid-liquid interfacial dynamics to the underlying thermodynamics of state transformations, while eases the computational treatment of the phase change interface.

Overall modelling –based approaches as the one here presented can result into useful tools to help in the control of microstructural pattern formation during freezing processes, as well as in the design of crystallisation industrial processes.