Pyrolysis of sucrose and quercetin for the formation of novel food structures

EKAETTE I. (1,2), CHEN J. (1), AYRANCI C. (1), MCDERMOTT M. (1)
1 University of Alberta, Edmonton, Canada
2 McGill University, Montreal, Canada

Crystal engineering through solid solutions is common in pharmaceutical drug formulations, metal alloys, and ceramics manufacturing. However, due to the organic complexity of foods, the use of solid solutions for fine tuning of structural and physicochemical properties is limited. In this study, pyrolysis was employed as the approach for developing solid solutions between the single component molecular crystals of sucrose as the solvent, and the solid-state crystalline quercetin as the solute. The presence of quercetin as an antioxidant will create new caramel polymer properties, and solve the problem of radicals and toxic degradation products found in caramel products. The objectives of this study were to: 1) Develop a new food product via solid solution processing. 2) Enhance the food safety of caramels using a potent antioxidant. 3) Establish a relationship between physical structure and polymer design. Methods: A factorial design was employed. Sucrose and quercetin mixture with 1-5% (w/w) of quercetin was heated in a tube furnace at target temperatures of 160-250 ºC, under nitrogen atmosphere (0.5 mL/min), for duration of 15-45 min. Results show the formation of dark brown to blackish foam products treated at and above 185°C. As the temperature increased from 185 to 250ºC, the recovered mass decreased from 88% to 67%, while the height of the foam structure increased from 1 to 11 mm. Scanning electron microscopy (SEM) images showed that the pore sizes were >100µm as observed at 185°C. Control sole quercetin samples did not show melting within the temperatures studied, as expected. Quercetin melts at 316°C. Other investigations to distinguish the formation of solid solutions from composite materials include characterization methods such as volume by air pycnometry, pores size and quantity by X-ray Microscopy, crystal structure by X-ray Diffraction, thermal stability by DSC, chemical structure by FTIR and NMR, hardness, water solubility, and antioxidant capacity. Conclusion: Edible caramel foam structures have been produced from sustainable materials, with enhanced nutraceutical benefits. The significance of this study will add knowledge towards crystal engineering (the synthesis and modificatiion of crystal structures) in food applications.