
Manufacturing programmable liquid-filled channels in 3D printed ink-gel structures to deliver personalized doses of micro-nutrients.

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Recent advances in 3D Food Printing have been shown the opportunities to renew the human food interactions introducing innovative possibilities in the field of digital food manufacturing, on-demand production, new sensory perceptions, and customized food products. With the improvement of engineering aspects such as the increased printing speed and multi-materials deposition, the goal of designing and developing 3D printed food thought to fulfill the nutritional requirements of each person, is receiving large attention from researchers and private companies for the future of the personalized food industry. We used a 3D digital approach to design and realize 3D printed structures to deliver personalized doses of micronutrients. First, the specific requirements of some micronutrients, such as iron, calcium, zinc, etc., have been defined for different consumer's groups. Second, programmable void channels of different dimensions, shapes and positions have been designed and built into edible 3D printed ink-gel structures during the printing process. Finally, specific doses of minerals such as iron, calcium, etc., have been incorporated in the gels, by filling the generated voids-channels with solutions of such micronutrients at different concentrations. The accuracy of replicating the digital models has been studied by analyzing 2D/3D micro-CT images of the printed structures. Also, the 3D printed foods have been described for their mechanical properties and the acceptance considering the effects of the spatial distributions of the liquid-filled channels in the 3D space on the sensory perception. The utilized strategy proved the potential of using 3D Food Printing to create on-demand food structures based on desired shape, dimensions, sensory properties and personalized quantity of micronutrients. Further experiments will expand this strategy to other nutrients and for different printed food materials (i.e. cereal-based structures).