**3D Printing for Nutrient-Enriched Gluten-Free bio-inks**

Eftychios Apostolidis, Evgenia N. Nikolaou, Evangelia D. Karvela, Athina Stergiou, Eirini K. Nikolidaki, Vaios T. Karathanos

*Department of Nutrition and Dietetics, Harokopio University of Athens, Greece*

Polysaccharides and plant proteins, owing to their abundance in nature, are among the most promising natural materials for replacing synthetic polymers in various applications. Moreover, they are cost-effective, easy to process, and biodegradable, making them ideal for food applications. 3D food printing is an emerging technology that has been receiving significant interest for its ability to produce customized food products with tailored shapes, flavors, colors, and textures 1,2. Recently, to meet 3D printing requirements and enhance product characteristics and shelf stability, structural compounds such as hydrocolloids are often added to modify matrix properties, followed by further processing 2. Within this context, drying with freeze or oven drying method comprises a common post-processing method for food processing and storage for managing the characteristics of 3D printed products 3.

The objective of this study was the development of an advanced customized extrusion 3D printer setup for producing gluten-free foods designed as enrichment substrate matrices for incorporating industrial agricultural by-products, such as olive leaves and stems. Characteristically, food bioinks were primarily developed using starches from various botanical sources (potato, corn), plant protein concentrates (pea, rice, fava), and the hydrocolloid κ-carrageenan at different concentrations, and were assessed for their potential as functional food matrices. For this reason, the prepared 3D printed structures were subjected to two different drying operations (air and freeze drying). The extrudability (appearance-dimension closest to the CAD designed geometric model) and the mechanical strength as a function of shrinkage were used to determine extruded samples printability, where significant differences were demonstrated with respect to bioink composition. According to our results the incorporation of agro-bioproducts did not seem to interfere with printability in comparison with the control samples, while significant differences were demonstrated as a function of composition. All in all research findings suggest the potential use of post processing techniques and the use of agricultural industrial by-products as functional ingredients, for improving the nutritional content in 3D food printing applications.

References

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