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Development of NADES-annatto seed extract for enhancing 3D-printed food designed for dysphagia patients

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Dysphagia, or difficulty in chewing and swallowing, is common among the elderly and those with neurological disorders, often impairing nutrition and well-being [1]. 3D food printing offers a promising solution by enabling precise control of food texture and shape, enhancing safety, appeal, and suitability for dysphagic individuals [2]. In this study, gelatin and starch were used to create edible hydrogels, enriched with bioactive compounds extracted from annatto seeds (Bixa orellana L.), rich in carotenoids [3]. To ensure a sustainable approach, we employed Natural Deep Eutectic Solvents (NADES) made from choline chloride and lactic acid, using ultrasound-assisted extraction. The resulting extract was evaluated for its pH, viscosity, color, and content of bioactives like bixin, norbixin, total carotenoids, using spectrophotometry and HPLC. Antioxidant activity was measured using ABTS and FRAP assays. Three types of hydrogels were formulated: control (C), with only the NADES (CC:LA), and incorporating the NADES-annatto extract (NE). These samples were analyzed for firmness, adhesiveness, and rheological behavior. We then used 3D printing to produce cube-shaped samples and bear-shaped gummies, applying different printing settings based on the formulation. The printed-shape accuracy was assessed through image analysis using ImageJ. Bear-shaped samples were evaluated visually, while cube-shaped ones were stored at 4 °C, 100% relative humidity for 24 hours. To determine if the gummies were appropriate for individuals with dysphagia, we conducted texture profile analysis (TPA) and fork pressure tests according to IDDSI standards. Overall, our findings show that NADES-based extraction effectively recovers bioactive compounds and, when combined with 3D printing, supports the creation of functional, appealing, and nutritionally enriched foods. This approach offers a promising path for producing dysphagia-friendly products with green and innovative technologies.

References

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