Comparison of potato protein aggregates obtained by high pressure and heat treatment for potential use as nano-vehicles for hydrophobic bioactive molecules

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The potato starch industry in the European Union alone generates close to 6 million tons of potato fruit juice (PFJ), a highly polluting waste product that is only marginally profitable as fertilizer or animal feed. PFJ contains up to 2% of crude proteins that are essentially wasted nutrients, and though their extraction and isolation have been exhaustively studied, their properties and applications in the food industry remain insufficiently documented. Patatin is a globular protein that makes up 35 to 40% of the total soluble proteins found in potatoes, and has successfully been extracted from PFJ in its quasi-native form and commercialized as a nutritious isolate with a high degree of purity and numerous associated functionalities like gelling, emulsifying and foaming properties. The aim of this work is twofold: (1) to study and compare the aggregation pathways of a patatin-rich isolate via two processes: heat treatment and high hydrostatic pressure and (2) to characterize the obtained aggregates from a physico-chemical and functional point of view in order to select promising structures for the encapsulation of a bioactive molecule. For that, patatin dispersions (1 and 4% w/w) at pH 6 and 7 were subjected to varying temperatures (45, 50, 55°C) or pressure levels (400,600 MPa) for time intervals going from 30 minutes up to 48 hours. The characteristics of the formed assemblies were studied at the micro, meso and macroscopic scales using dynamic light scattering, differential scanning calorimetry, dynamic rheology, fluorescence spectroscopy (in-situ, under high pressure), circular dichroism, size exclusion chromatography, and electrophoresis. The results indicated the pH dependency of the aggregation kinetics and the final sizes of the structures formed for each process, with aggregates twice as large at pH closer to the isoelectric point. At moderate temperatures, micrometric aggregates were obtained within minutes, while high pressure generated smaller aggregates after much longer treatment durations. Insights on protein denaturation, unfolding, protein-protein and protein-bioactive molecule interactions were also acquired. This work shows that the functionality of this plant-based protein can be improved and that this by-product can be valorized as a nano-vector for hydrophobic bioactive molecules in the field of functional ingredients.