Combined enzymatic and mechanical treatment allows production of low viscous suspensions of high cellulosic dietary fibre by-products

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High cellulosic by-products are often produced in the vegetable industry as is the case of pea hulls. Due to their high content of dietary fibre (>80 wt%), they have a high nutritional value. However, their incorporation in foods is limited because of their insolubility and a grainy mouth feeling due to the dense and compact structure of the cell wall. On a molecular scale, the cell wall is composed of two main networks: cellulosic polymer chains crosslinked with hemicelluloses and pectin. Additionally, cellulose has a hierarchical macrostructure composed of macro-, microfibres and fibrils, all of them densely linked by hydrogen bonds. Most approaches to upgrade high cellulosic dietary fibre are mechanical treatments focused on modifying the macromolecular scale (*i.e* reducing the particle size). However, by decreasing the size of particles, the viscosity considerably increases due to the increase of number of particles, surface area, and exposed amount of hydrophilic groups. Hence, a combination of enzymatic and mechanical approaches is a powerful option in which the cell wall integrity is broken by decreasing the molecular weight of the main polymers and by shear forces that reduces the particle size, resulting in a less viscous and more soluble fibre.

The aim of this work was to produce stable and low viscous suspensions of high cellulosic dietary fibre by-product. To that end, enzymatic treatments varying the time of hydrolysis and the ratio of commercial enzymes (cellulase, hemicellulase and pectinases) were conducted before high-pressure homogenization (microfluidization). The stability against sedimentation, viscosity and particle size of the produced suspensions were measured. Additionally, the resulting dietary fibre was characterised in terms of insoluble, alcohol-insoluble and soluble fractions, including the neutral sugar composition of a set of selected samples.

Results have shown that a combination of mechanical and enzymatic treatments reduces the particle size and insoluble mass leading to lower viscosity when compared to samples only mechanically treated. Stable low viscous suspensions were obtained when a higher amount of cellulase was employed in the enzymatic treatment since the enzymatic degradation of the cellulose resulted in a high decrease of insoluble mass after the enzymatic treatment. Also, enzymatic treatment with high content of hemicellulases were more efficient to produce stable low viscous suspensions than those with a high content of pectinase. Presumably, in terms of cellulosic degradation, hydrolysing the hemicellulose network may result in a more open structure that facilitates the hydrolysis of cellulose. Also, from a macromolecular point of view, degrading the hemicellulose network affects the cellulose macrostructure since hemicelluloses and celluloses are cross-linked.

The results of this work open the application of enzyme mixture combined with mechanical treatments to produce low viscous dietary fibres that have the potential of being incorporated in food liquid matrices, with a minor impact on the sensorial properties, resulting in a new generation of dietary fibre containing products.

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