Enzymatic engineering of plant-based dietary fibre hydrogels from agricultural side streams

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Dietary fibre intake in Western societies does not reach the recommended nutritional guidelines, due to the prevalence of refined ingredients in our food products. This is commonly referred to as "the fibre gap", which is partially responsible for the large occurrence of metabolic diseases in our societies. On the other hand, agricultural side streams and food waste constitute a huge environmental burden, accounting for 8 to 10% of the total greenhouse gas emissions. Such agricultural side streams are precisely rich in cell wall dietary fibres, that end up discarded due to their insoluble nature and poor organoleptic properties. However, cell wall dietary fibres have huge potential for the development of new food ingredients and materials with innovative functional properties and health benefits. One of the challenges for the upcycling of agricultural side streams is their heterogeneous composition and insoluble structure, which hinders the development of effective processing technologies.
In this presentation we will discuss some of the challenges and opportunities that green chemistry and biotechnology provide for the upcycling of agricultural side streams into functional and healthy plant-based dietary fibre ingredients. We have developed processes using subcritical water for the extraction of complex dietary fibres from insoluble side streams from cereal [1,2] and fruit [3] processing. Controlling the extraction conditions (ie temperature, pH, time) enables to tune the molecular structure of the target dietary fibres in terms of molecular weight and degree of substitution [4,5] , preserving their bioactive (antioxidant) properties. The application of enzyme technology using specific hydrolase families based on substrate recognition affinity enables the production of prebiotic oligosaccharides with tailored molecular structures from insoluble and recalcitrant agrifood side streams. These specific oligosaccharide structures promote the growth of beneficial gut bacteria and the production of short chain fatty acids [6] . Moreover, functional dietary fibre hydrogels and emulsifiers can be produced using oxidative enzymes with radical scavenging activity. [7-9] The network structure of the hydrogels and their rheological properties can be further controlled by auxiliar hydrolytic enzymes [10] . This presentation highlights how development of integral biorefinery approaches for the maximised use of side streams is necessary for achieving a true circular food system.

Keywords:
Plant-based hydrogels, dietary fibres, antioxidant properties, enzyme technology, glycosyl hydrolases, oxidative enzymes, rheological properties

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