**Crafting sustainable polysaccharide ingredients for precision nutrition**

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Polysaccharides play a pivotal role in human nutrition and food structure design. Although they represent a large share of the commodity and ingredient market, they are vastly underutilised within the food industry. The complexity of polysaccharide structures and the intricacy of their interactions make the task of rational material design difficult, and sheds uncertainty to the practical question of what carbohydrates to eat to stay healthy. In this presentation, I will present featured research outputs on the design of polysaccharide assemblies for optimum functionality and metabolic response. Firstly, I will cover the design of enzyme-resistant starch within the food matrix (*in situ*), linking starch sequencing through enzymatic fingerprinting with *in planta* starch synthesis to moderate food texture and starch digestion rates in high-moisture starchy foods. Sometimes however, amyloplasts fail to synthesize our desired starch molecules, necessitating precision modification and transformation processes based on a deep understanding of starch structure. We addressed this limitation by using shear-induced fragmentation (via twin-screw extrusion) or our developed green esterification reaction (using specific food-compatible deep eutectic solvents as chaotropic agents and reaction promoters). Secondly, and moving towards non-starch polysaccharides, I will go through some of the key aspects governing the successful integration of dietary fiber into food matrices. Last, I will cover our latest findings revealing how polysaccharides can interact with endogenous polyphenols (PPs) and the potential of these interactions to protect PPs from thermal degradation and cause sustained changes in gut microbiota ecology - aiming to design polysaccharide-PP assemblies for colonic health. These findings support creating next-generation, less-processed precision nutrition ingredients from upcycled fruit and vegetable pomaces rich in polyphenol-infused plant cell walls. This talk is intended to guide the development of targeted polysaccharide assemblies with programmable interactions, physiological responses, and techno-functional properties.