Development of a Sustainable Bioprocess for the Production of Novel Xylooligosaccharides (XOS)

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The growing demand of novel food products for well-being and age related issues coupled with increasing health care expenditure has attracted global attention on prebiotics. Xylooligosaccharides (XOS) are prebiotic nutraceuticals that can be sourced from lignocellulosic biomass, such as agro-residues. The use of agro-residues as raw materials is encouraging to the food ingredient industries, as they are inexpensive, abundant and renewable in nature. XOS beneficial effects include, besides the selective growth stimulation of beneficial gut microflora, enhanced mineral absorption, cholesterol lowering, glucose homeostasis, pathogen exclusion, antioxidant and anticarcinogenic activities, among others.

XOS are oligomers built from xylose units linked through β-(1,4)-xylosidic bonds. These compounds are obtained though the hydrolysis of xylan, the main constituent of hemicelluloses present in the lignocellulosic biomass. Particularly, XOS can be produced chemically, through auto-hydrolysis, enzymatic hydrolysis or a combination thereof. The chemical or auto-hydrolytic processes originate undesired by-products, including toxic compounds, while the use of enzymes presents high efficiency and specificity, being a more environment-friendly approach. However, xylan is generally present as a xylan-lignin complex in the lignocellulosic biomass. Thus, XOS are mainly produced by a combination of methods, including a first step of fractionation of the lignocellulosic material to obtain soluble xylan followed by its hydrolysis by xylanolytic enzymes. The low yields associated to the xylan extraction step in addition to the cost of producing or purchasing commercially available xylanases, may compromise the economic viability of the production process.

An alternative production process is presented for XOS production from agro-residues by single-step fermentation using two Trichoderma strains. Direct fermentation proved to be a promising strategy for XOS production, presenting advantages over the use of commercial enzymes. This study provides new insights towards the bioprocess integration, enabling further developments of low-cost bioprocesses for the production of these valuable compounds.