A novel perspective on pectin extraction

The classical (current) extraction of pectin is based on an acid-catalyzed process, using nitric, hydrochloric or sulphuric acid. The reaction takes place at low pH and high temperatures for several hours. The main disadvantage of this technology, and one which raises environmental concerns, is generation of large volumes of acidic effluent, which require further treatment before release. The main focus of this PhD study was to replace acid with enzymes and thereby achieve sustainable, green production of pectin. The first goal was to prove that an enzyme-based process could generate pectin with the same yields and functional properties as an acid-based process. 13 commercial enzymes were selected for the primary screen and 4 were examined in larger scale extractions. The best enzyme, Laminex C2K, gave a yield of 23%, had a molecular weight of 69 kDa, and possessed functional properties comparable with pectins obtained in a classical way. In the future it would be beneficial to optimize the Laminex C2K production strain (Penicillium funiculosum) by molecular design to delete the residual pectinolytic activity and include plant cell wall hydrolases. Pectin production is complex and therefore its optimization is a long process because the evaluation of the final product quality is accomplished at the end of the procedure, employing time-consuming off-line laboratory tests. Fourier transform infrared spectroscopy (FTIR) and carbohydrate microarrays, combined with chemometrics, were evaluated for their abilities to predict of pectin yields and assess pectin traits during the pectin extraction process. Using crude lime peel extracts, both FTIR and carbohydrate microarray analysis showed predictive and descriptive abilities with respect to acid and enzymatically extracted pectins. Furthermore, FTIR determined the optimal extraction time for both the enzymatic and acidic extraction processes. The combined results suggested major differences in the crude pectin extract traits of enzymatically vs. acidically extracted pectin with respect to the degree of esterification, purity, and abundance of rhamnogalacturonan I pectic regions. Although the major pectin applications still include gelling, thickening and stabilization, other novel uses employ its prebiotic potential, anti-cancer properties and heavy metal detoxification ability (Hotchkiss, Rastall, Gibson, Eliaz, Liu, & Fishman, 2009). Sunflower pectin was extracted and fractionated into three fractions according to size, SPF<50, SPF50-100 and SPF>100, using 50 and 100 kDa membranes. The density of Bifidobacterium spp. was significantly higher (p<0.05) after fermentation on SPF>100 kDa. All three sunflower pectin fractions did not influence the level of Lactobacillus spp., Bacteroidetes and Firmicutes.