Valorization of onion skin wastes: subcritical water extraction of pectin and membrane downstream processing

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Onion skin wastes (OSW) represent around 10% of the total onion production and end up in landfills because they are not suitable for human consumption or animal feeding. Nevertheless, this non-edible brown skin and external layers of onions are rich in phenolic compounds, mainly flavonoids such as quercetin and derivatives [1], which are high-added value natural antioxidants. Additionally, onion skin has gained attention as a good source of pectin [2]. Pectin, a complex polysaccharide composed by uronic acids (66.4%) and neutral sugars (galactose, arabinose, xylose, mannose, glucose or rhamnose) in variable composition, is the major structural component onion cell walls (42.4%). Considering that according to FAO, 2020 onion worldwide production was 104 Mt, there is a great potential for the valorization of the OSW through the recovery of pectin.

In this work the valorization of OSW using subcritical water (SubW) was studied in a batch extractor at temperatures up to 165 ºC and extraction times up to 180 min. The extraction of pectin was temperature sensitive, reaching a maximum at 125 ºC after 150 min (49% extraction yield of galacturonic acid). The molecular weight of the extracted pectin was measured and several families were detected, being the one with a weight average molecular weight of 80 kDa the most abundant. It was observed a decrease in the pectin MW with the temperature and the extraction time (which was modeled according to a modified version of the Ekenstam equation), which suggest that a careful selection of the extraction conditions must be carried out in order to prevent the pectin degradation. Besides pectin molecular weight loss, high temperatures and long extraction times led to the appearance of free sugars (glucose, galactose, arabinose and xylose), and the formation of organic acids (acetic, formic and levulinic) and other degradation products such as furfural and HMF. The separation of these impurities from the pectin were completely achieved by using two ceramic membranes (TAMI Industries) of 100 and 10 kDa operated in diafiltration mode, since a removal >99% of the impurities was obtained. Moreover, the membrane downstream processing was useful to fractionate the SubW extracted pectin: on one hand the valuable low molecular weight hairy RG-I region and on the other linear homogalacturonan (HG) region, in contrast to the conventional acid water extraction processes, which yielded the mainly the linear one.

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