Valorization of wheat bran by subcritical water fractionation

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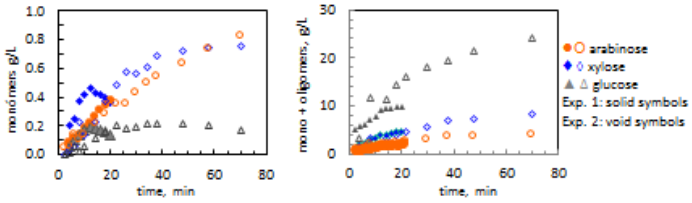

Lignin	Exp. 1. Raw WB	Residue Exp. 1	Exp. 2. Raw WB	Residue Exp. 2
Insoluble	6.60±0.34	17.38±0.46	8.58±0.22	31.52±0.06
Soluble	1.43±0.04	7.92±0.23	4.23±0.07	3.98±0.06
Total	8.03±0.38	25.3±0.69	12.81±0.29	35.50±0.12

Wheat is the second most important crop grown in Spain behind barley, with approximately 40% of the national production being cultivated in Castilla y León. The total production in Spain was around 5 Mt in 2019. Wheat Bran (WB) is the main byproduct generated in the wheat milling process, being around the 16% of wheat grain. Part of it is used as animal food, but wheat bran is a source of valuable bioactive compounds and strategies for its valorization should be developed. In this work, subcritical water (scW) has been used to recover such components. scW refers to water in liquid state in the range 100 °C (boiling point) to 374 °C (critical point) under pressure. Most of the water properties change enormously when heated under pressure offering a wide range of possibilities of extraction and fractionation of the different components in WB. Tercerilla WB, kindly provided by the company Emilio Esteban, has been characterized according to the protocols of the US National Renewable Energy Laboratory, NREL. Two different experiments have been performed in a pilot plant with a 20 L capacity reactor. In the first one, WB with a particle size, tp<0.25 mm, and a WB concentration, c=2.5 %, was treated at 179 ± 4 °C, while in the second experiment, WB with tp<0.5 mm and c=15 % was treated at 167 ± 3 °C. The different liquid fractions obtained with time were analyzed for their monomer and oligomer content of arabinose, xylose and glucose (see graphical abstracts) and the monomeric sugars degradation products furfural, hydroxymethyl furfural (HMF), and acetic, formic, levulinic and succinic acids. The residue was analyzed for lignin (see graphical abstracts) and elemental analyses. The most important contribution to the sugars yield is due to the presence of oligomers (see Fig. 1), arabinose being the sugar with the highest monomer yield. Also, the lower the WB concentration the higher the yields, probably due to external diffusion limitations due to agitation problems in the reactor. In fact, for c=2.5 %, the total sugars (monomers + oligomers) yield has been very high for all sugars. The high yield evaluated for glucose is due to the high concentration of starch in the WB used, which is solubilized in water under subcritical conditions.

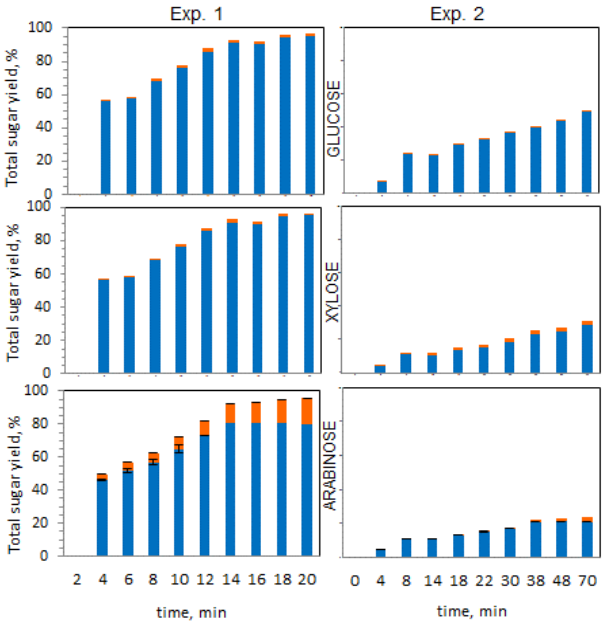

Figure 1. Total sugar yield. ■ monomer, ■ oligomer

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