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Scaling Up Subcritical Water Extraction of Feruloylated Arabinoxylans from Wheat Bran

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PURPOSE OF THE ABSTRACT

Feruloylated arabinoxylan (F-AX), a valuable hemicellulose with bioactive properties, has the potential to be developed into various prebiotic and bio-based material applications. Conventional methods of extracting F-AX from cereal biomass use alkali conditions to loosen up the cross-linked native structures in which these hemicelluloses are present in the plant cell walls. As a consequence, alkali extraction tends to release the ferulic acid bound to the arabinoxylan, thus losing its bioactive properties. A novel method to extract F-AX is to use subcritical water extraction (SWE). At subcritical conditions, water undergoes physical changes, such as reduction of dielectric strength, viscosity and surface tension, while remaining at liquid state. By incorporating SWE technology that simply uses water as solvent, enzymatic reactions and an agricultural by-product, namely wheat bran, we proposed a more sustainable biorefinery process to obtain F-AX. Our previous study has shown that F-AX can be extracted and fractionated from destarched wheat bran using subcritical water extraction at 160°C pH 7 [1]. Thus, the aim of this study is to further optimise the pretreatment conditions at laboratory scale and validate the process at pilot scale (33 times). Our results showed that enzymatic removal of residual starch in the wheat bran was critical, as it considerably enriched the F-AX content in the SWE extracts. Longer extraction times led to higher F-AX content as observed by the time evolution of the SWE, however, with a slight reduction in molecular weight due to hydrolysis of the polysaccharides. At pilot scale, the time evolution profile was similar to that of laboratory scale, but somewhat slower, indicated by the need of even longer extraction times to obtain F-AX rich extracts. In terms of the polysaccharides extracted at pilot scale, we observed similar molecular characteristics to that of laboratory scale, suggesting the possibility to extract F-AX at larger scales.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

feruloylated arabinoxylans (F-AX) | subcritical water extraction (SWE) | wheat bran | pilot scale

BIBLIOGRAPHY

(1) Ruthes, A.C., et al., Green Chem. 2017, 19(8), 1919-1931.