

Hydrothermal treatment of wheat bran under mild acidic or alkaline conditions to boost polyphenol recovery and produce ferulic acid-enriched extracts

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Abstract

Ferulic acid recovery from wheat bran (WB) using conventional extraction methodologies and solvents is particularly low, because a large fraction of ferulic acid is bound to chains of arabinoxylans via ether or ester linkages. Alkaline or acid catalysis may greatly improve ferulic acid extraction yield, yet there is rather a lack of systematic studies on this issue. Hydrothermal treatment is a very promising means in this context, and it involves treating of the lignocellulosic material with water at relatively high temperatures for given resident time, the maxima of which are interdependent. The addition of certain catalysts (acid/alkali) may significantly increase the efficiency of the process, which involves breaking down ether and ester bonds, such as those that bind ferulic acid onto WB arabinoxylans and lignin. On this conceptual basis, this project was undertaken to establish a hydrothermal process, aimed at maximising ferulic acid release/recovery from WB, and examining the role of acid/alkaline catalysis, under mild conditions. Aqueous solutions of either citric acid or sodium carbonate were used, and the assessment of the extracts obtained was accomplished through the determination of ferulic acid content. The most efficacious treatment was performed with 5% citric acid, at 24 h, which afforded 18.77 mg ferulic acid equivalents (FAE) g⁻¹ dry mass (DM). Hydrothermal treatment with a 5% sodium carbonate solution were proven highly effective, giving a YTP of 22.33 mg FAE g⁻¹ DM, at 24 h. Switching sodium carbonate concentration from 5 to 10% provoked an increase in YTP from 22.33 to 23.60 mg FAE g⁻¹ DM, giving a non-significant difference of 5.4%. By contrast, raising citric acid concentration from 5 to 10% had as a result the increase of YTP from 18.77 to 23.76 mg FAE g⁻¹ DM, which represented a by 21% difference. Liquid chromatography-mass spectrometry analysis revealed that, while sodium carbonate-catalysed treatments gave extracts enriched in ferulic acid, citric acid catalysis resulted in extracts dominated by a ferulate derivative. The results indicated that effective recovery of polyphenols from wheat bran may be accomplished by both citric acid- and sodium carbonate-catalysed hydrothermal treatment. There were significant differences in the polyphenolic

composition of the extracts, since ferulic acid was released only under alkaline conditions. Hydrothermal treatment under mild alkaline conditions is proposed as a very effective, green means of producing high-purity ferulic acid from wheat bran.

Keywords: ferulic acid, hydrothermal treatment, polyphenols, wheat bran

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