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# Valorization of wheat bran: the role of microwaves in the recovery of feruloylated arabinoxylooligosaccharides with hot compressed water

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## PURPOSE OF THE ABSTRACT

Wheat bran is mainly used as a low value ingredient in animal feed (Prückler et al. 2014) and its conversion into higher commercial value-products would be extremely valuable to the wheat industry. Feruloylated oligosaccharides (FOs) are principally oligosaccharides of B-(1-4)-linked xylopyranosyl units with arabinofuranosyl side groups, some of which are substituted with ferulic acid. FOs exhibit prebiotic and antioxidant properties both in vivo and in vitro. These beneficial antioxidant activities and associated health benefits contribute to FOs being considered as functional food ingredients in a wide range of food products (Zhao et al., 2018). Wheat bran FOs have been released by enzymatic or acid hydrolysis but these technologies present drawbacks related to costs, long operation times or recovery. The use of pressurized water as solvent can overcome these difficulties. Many works in the literature attribute to the microwave assisted extraction (MWE) an improvement of the extraction yield of phenolics, but the effect of non-thermal effects postulated by many authors is not clear. The main purpose of this works is the use of pressurized water to maximize the extraction of FOs, and to compare conventional heating with microwave heating.

MATERIALS AND METHODS

Wheat bran was provided by Emilio Esteban S.A. (Valladolid, Spain) and prior to its use was enzymatically destarched. The chemical composition of destarched wheat bran (DWB) is shown in table 1.

Pressurized Water Extractions (PWE) were performed in a 300 mL stirred autoclave (Autoclave Engineers). Pressurized Microwave Assisted Extraction (PMWE) experiments were performed in a Monowave 300 microwave (Anton Paar GmbH). The initial concentration in all the experiments was 40 g DWB/L. Oligosaccharides are determined after an acid hydrolysis of the extract according to the LAP by NREL described by Sluiter et al. (2008). Sugars are quantified by HPLC using a Supelcogel Pb column and milli Q water as mobile phase, coupled with an IR detector. Degradation products (furfural and 5-HMF) were quantified with a Sugar SH 1011 (Shodex) column, with sulfuric acid 0.01 N as mobile phase and UV-Vis set at 254. Quantification of ferulic acid (FA) and other phenolic compounds was performed using a Cortecs T3 column in a gradient mode of acetonitrile (solvent A) and 4% acetic acid in Milli-Q water (solvent B). Bounded FA was determined after an alkaline hydrolysis with NaOH 2 M for 3 hours as described by Barberousse, et al. (2009).

RESULTS

The severity factor, as it was defined the first time by Overend et al. (1987) is used for discussion. R0=t*exp((T-100)/14.75), being t time in minutes, T temperature in ºC.

A maximum of total organic carbon in the extract was observed for log(R0) = 3.6-3.7, that corresponds to temperatures of 200°C and extraction times of 3,5 min. Under such conditions 85% of initial xylose is extracted

and 95% of arabinose. The trend for glucose is similar, with a maximum extraction yield of 36%. Bigger values of log(R0) lead to degradation of sugars, evidenced by the increment in 5-HMF content and furfural.

Fig. 1 shows FA extraction yield. A clear maximum at the same value of log(R0) around 3.6, is obtained for both techniques, and free FA and Total FA follow the same trend.

ORAC and TPC values increased constantly with R0 up to values of log(R0) =6, indicating that antioxidant activity is not only influenced by the amount of esterified ferulic acid but might be related to other compounds or the influence of sugars in these analytical techniques.

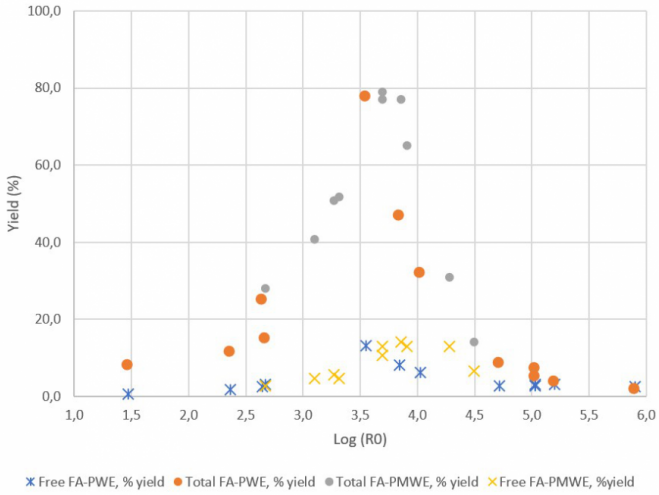
CONCLUSIONS

Pressurized water is an excellent solvent for the extraction of FOs from wheat bran.

Not clear differences could be observed with the use of microwaves. indicating that the non-thermal effect does not exist. The use of microwaves does not improve neither the extraction yield nor the hydrolysis process, since the values of FOs and total FA and free FA are identical for both techniques.

## FIGURES

| Ash | Proteins | Starch | Extractives | Lignin | Gluc | Arab | Xyl | Arab/Xyl | FA | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.5 ± 0.1 | 16.3 ± 1.1 | 0.5 ± 0.0 | 5.5 ± 0.0 | 28.5 ± 1.1 | 11.9 ± 1.0 | 11.3 ± 0.5 | 19.5 ± 1.2 | 0.6 | 0.5 ± 0.0 | 96.0 ± 5.0 |




### FIGURE 1

Table 1. Chemical composition of destarched wheat bran (expressed in % dry matter) (Gluc=Glucose; Xyl=Xylose; Arab=Arabinose; FA = ferulic acid). Mean ? SD; n = 3.

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### FIGURE 2

Figure 1. Total and free Ferulic Acid extraction vs log(R0), by PMWE and PWE

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## KEYWORDS

Wheat bran | ferulic acid | oligosaccharides | pressurized water


## BIBLIOGRAPHY


Barberousse, H., et al. (2009) J. of the Sci. Food and Agric. 89(10), 1634-1641

Overend, R. P. et al, (1987). Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 321(1561), 523-536

Prückler, M., et al. (2014), LWT Food Science and Technology, 56, 211 221

Sluiter, et al. (2008) Technical Report NREL/TP-510-42623.

Zhao W. et al., Glycoconjugate Journal (2018) 35:547–559