HIGH-INTENSITY ULTRASOUND TREATMENT FOR THE INACTIVATION OF POLYPHENOL OXIDASE FROM WHEAT BRAN

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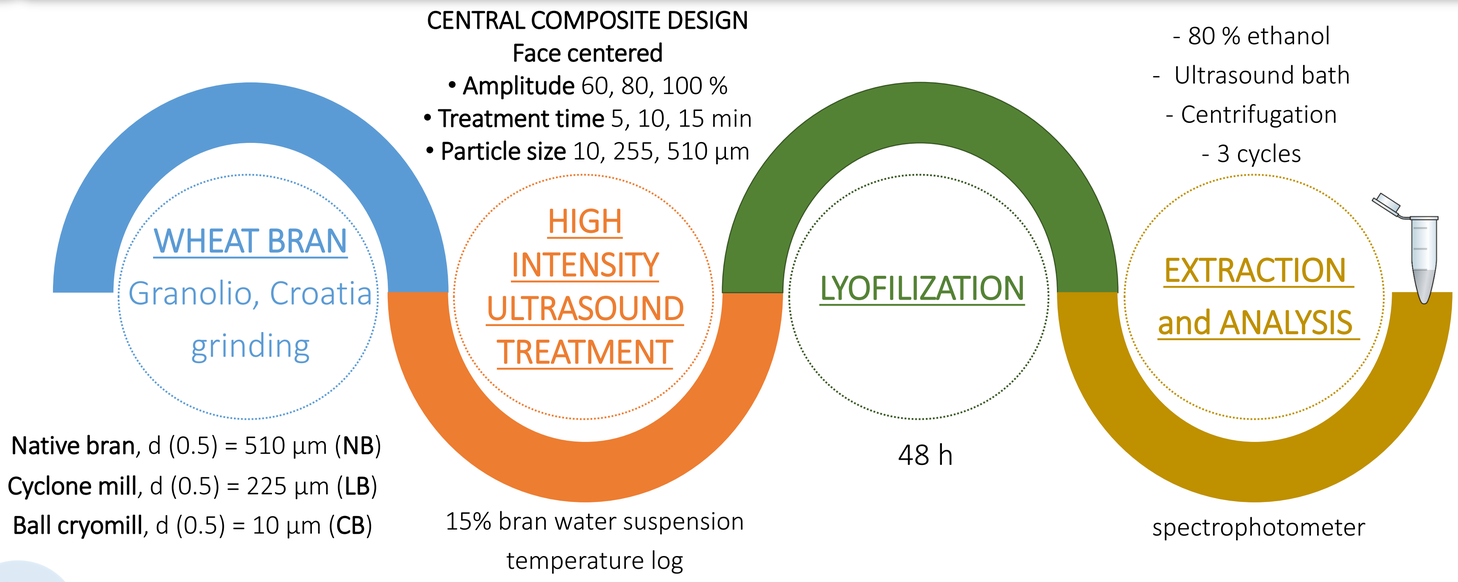
INTRODUCTION

Wheat bran, a by-product of industrial wheat grain milling, is a rich source of dietary fibre and bioactive compounds beneficial for human health. At the same time, wheat bran containes polyphenol oxsidase (PPO) which generates undesirable browning of wheat-based products. Dominant phenolic acids, including ferulic and *p*-coumaric acid, are a potential substrates for the PPO reactions. High-intentity ultrasound is a novel technology, mostly used for extraction of bioactive compounds.

AIMs

- To investigate the effect of high-intensity ultrasound (400 W) treatment on the content of PPO, total phenolic compounds (TPC), and antioxidant activity of different particle size wheat bran.
- Optimization of wheat bran high-intensity ultrasound treatment

MATERIAL & METHODS



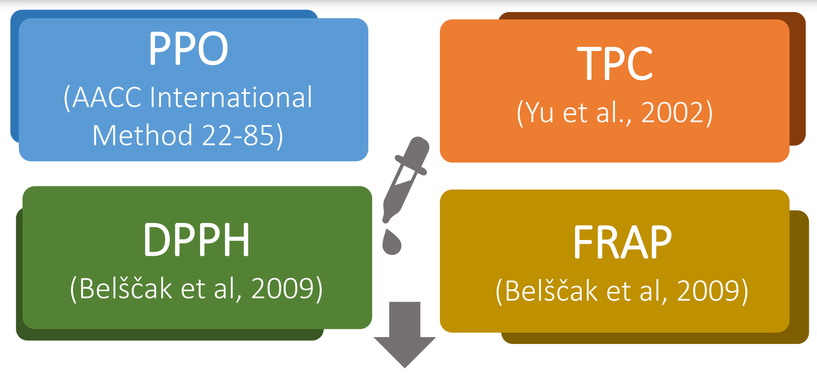


Table **1. Optimization criteria** (Design Expert v.11, Stat-Ease, USA)

	PPO	TPC	FRAP	DPPH
Minimize	x			
Maximize		x	x	x

RESULTs

Data shown in Fig. 3, 4 and 5 are means ± standard deviation (n = 3). Means denoted by a different letter indicate significant differences between treatments within the same method (Tukey's test, $p<0.05$). 50 µm 255 µm 510 µm

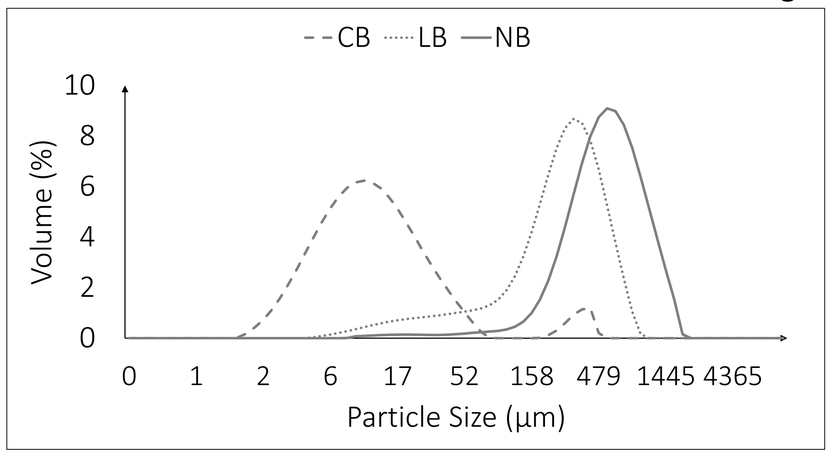


Fig.1 Wheat bran particle size distribution

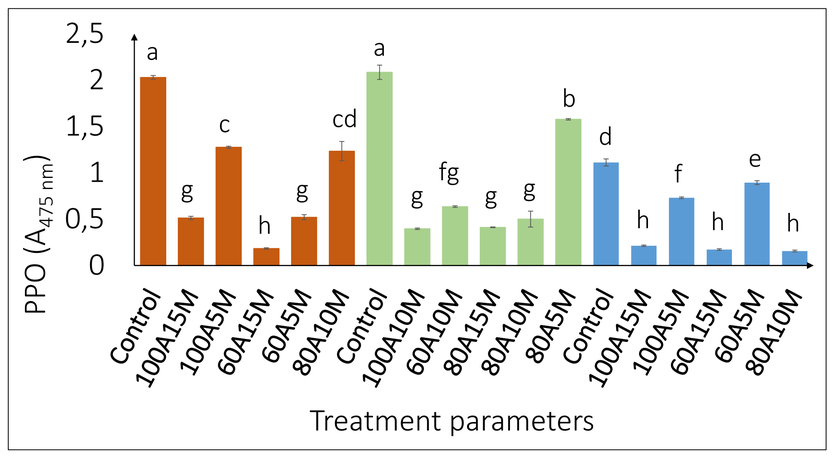


Fig. 3 PPO activity depending on the treatment

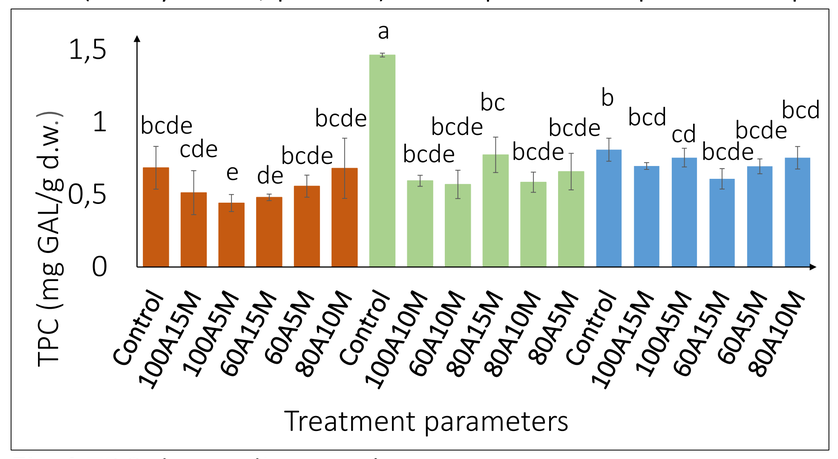


Fig.4 TPC depending on the treatment

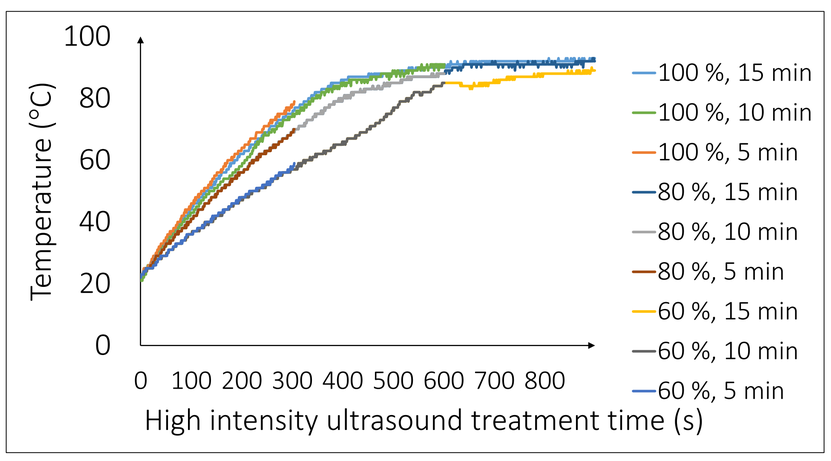


Fig.2 Temperature kinetics during ultrasound treatment

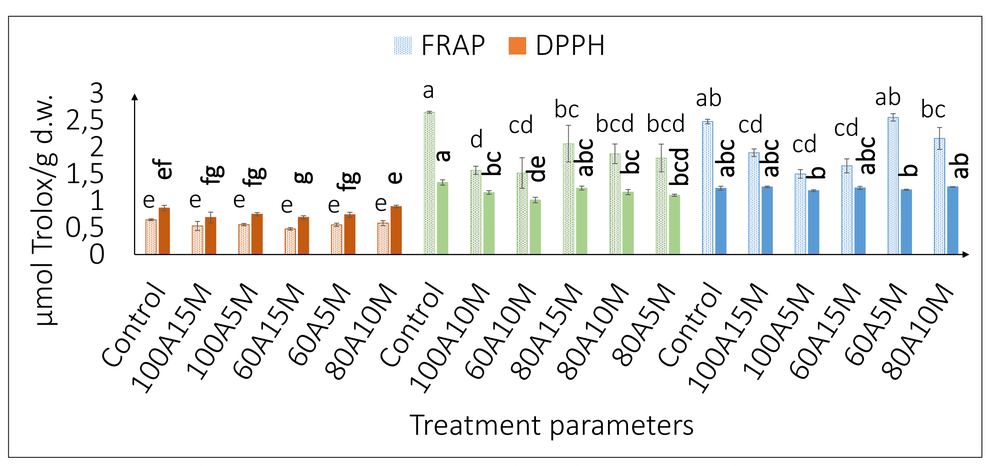


Fig.5 Antioxidant activity measured with FRAP and DPPH assay

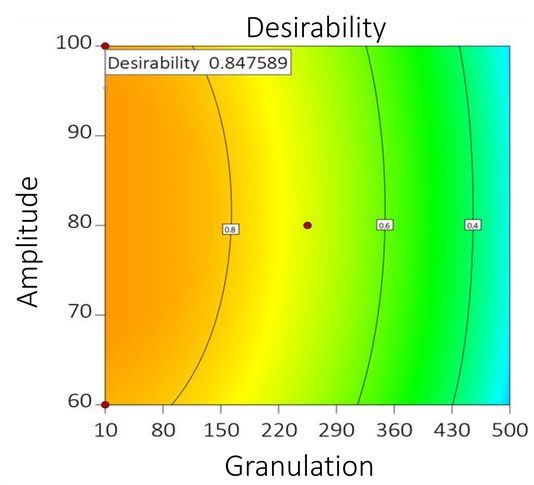


Fig. 6 Desirability of wheat bran high-intensity ultrasound treatment depending on the granulation and amplitude

CONCLUSIONs

1. The ultrasound treatment significantly reduced the PPO activity from 2.0 to 0.1 A_{475nm}. Decrease of wheat bran particle size and prolongation of ultrasound treatment time had the most significant effect on PPO inactivation.

2. TPC was significantly influenced by the particle size ($p=0.003$). The highest content of TPC was observed in bran grinded in cyclone mill (1.463 mg GAL/g d.w.). TPC was not significantly effected by the high-intensity ultrasound treatment.

3. Similary to TPC, antioxidant activity measured by FRAP and DPPH methods was influenced by the particle size ($p<0.001$). Further, DPPH was dependent on the square of ultrasound amplitude ($p=0.01$). The TPC positively correlated with FRAP and DPPH method ($r=0.606$, $p=0.006$; $r=0.592$, $p=0.008$ respectively).

4. In optimized conditions, the ultrasound treatment (62-96% amplitude for 11-15 min) successfully inactivates the PPO of wheat bran, especially after ultra-fine grinding, with minimum degradation of targeted bioactive compounds (up to 13% and 27% for TPC and FRAP, respectively), and without the use of chemicals.

REFERENCES

Belščak A, Komes D, Horžić D, Ganić KK, Karlović D. Comparative study of commercially available cocoa products in terms of their bioactive composition. Food Res Int. 2009;42(5):707-16.

Jang, J. H., Moon, K. D. (2011) Inhibition of polyphenol oxidase and peroxidase activities on fresh-cut apple by simultaneous treatment of ultrasound and ascorbic acid. *Food Chemistry*, *124*(2), 444-449.

Niu, M., Hou, G. G., Li, X., Wang, L., Chen, Z. (2014) Inhibitory effects of ultrasound combined with ascorbic acid or glutathione on enzymatic darkening of whole-wheat raw noodles. *LWT-Food Science and Technology*, *59*(2), 901-907.

Yu, L., Perret, J., Davy, B., Wilson, J., Melby, C.L. (2002) Antioxidant properties of cereal products. Journal of Food Science, 67(7), 2600-2603.

Zhu, X. L., Dai, Q. Y., Cai, W. R., Ma, J., Gu, R. (2010) Response surface methodology for optimizing the ultrasonic-assisted extraction of rice bran extract with both high total phenolic content and total antioxidant capacity. *Food Science*, *2010*(20), 7.

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