

Ultrasonically modified enzyme activity, antioxidant capacity and physicochemical properties of cereal brans and their application in flat bread production

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Introduction

Oat (OB) and barley (BB) bran are rich in β -glucan and minerals, which have positive effects on health. However, endogenous β -glucanase can reduce the physiological benefits of β -glucan. To produce high-quality bakery products like flatbreads (FB) with maximum fiber content and physiological effects, preserving β -glucan molecular structure is crucial. Additionally, antioxidants in oat and barley bran must be removed to enhance mineral bioavailability. Achieving this balance is challenging. The aim of this research was to minimize β -glucanase activity and β -glucan degradation using ultrasounds (U) while reducing phytic acid (PA) to increase mineral bioavailability. The rheology and hydration properties of bran were monitored. The application of ultrasounded bran was investigated for sourdough fermentation and making more nutritious flat bread.

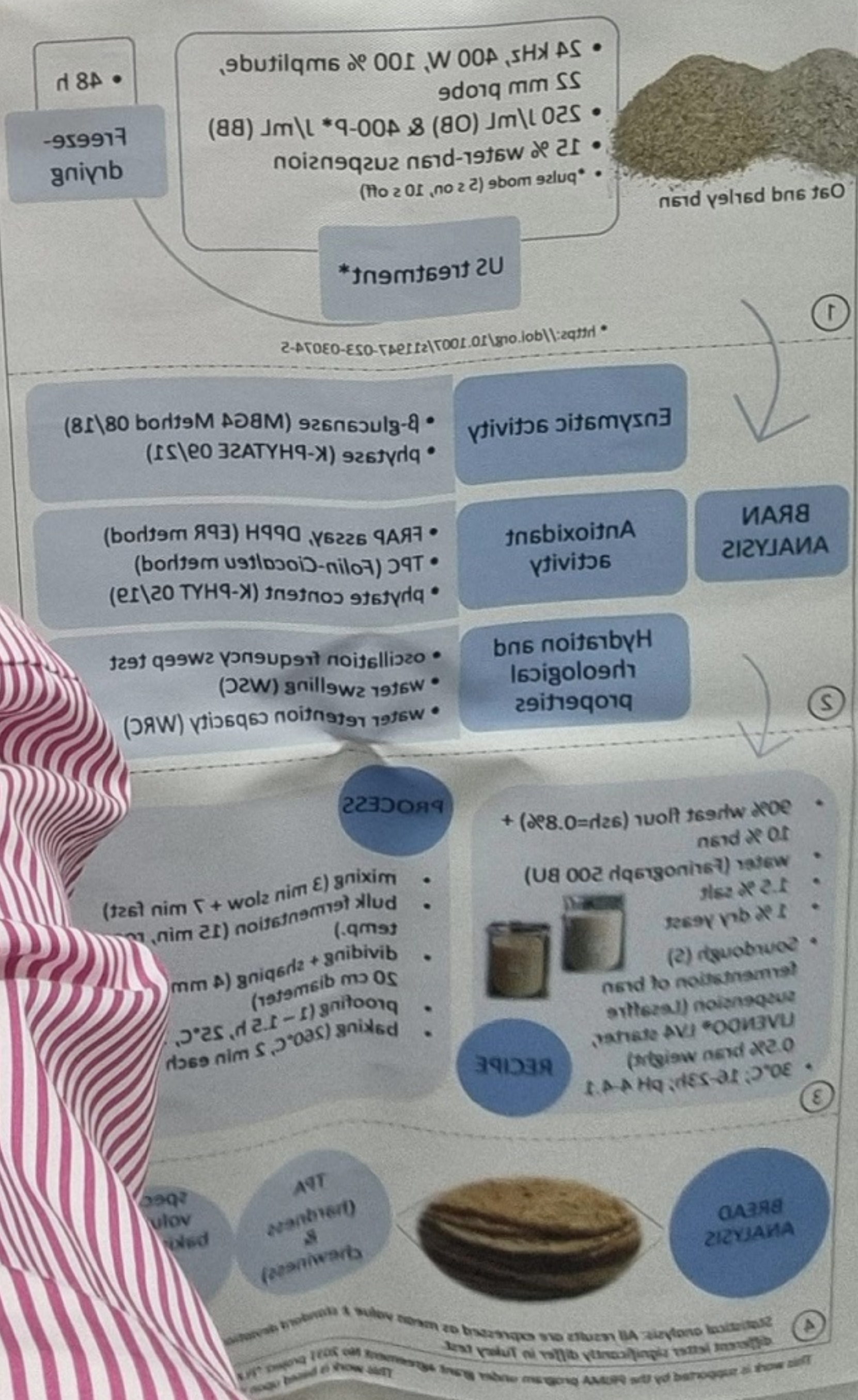
Aim

Ultrasound (U) treatment of bran
 To investigate:

- enzymatic activity (β -glucanase and phytase)
- β -glucans, phytates, phenolics and antioxidant activity
- hydration, rheological and fermentation properties
- texture and color
- baking loss
- volume and shape

Bran application in wheat flat bread
 To investigate:

Materials & Methods



Results

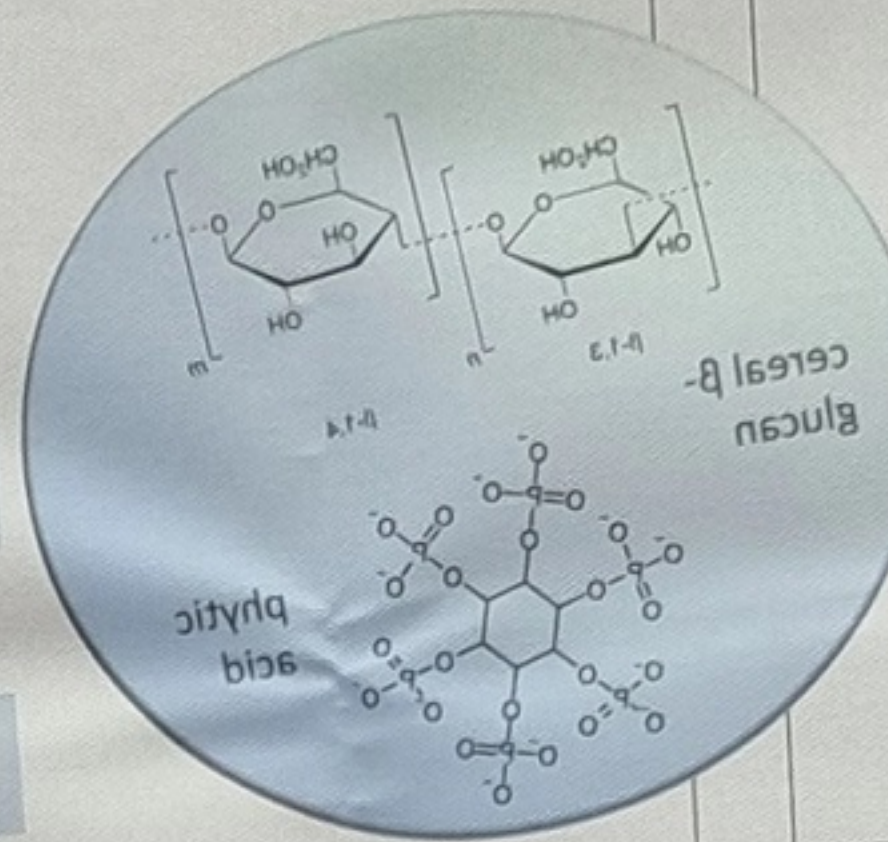
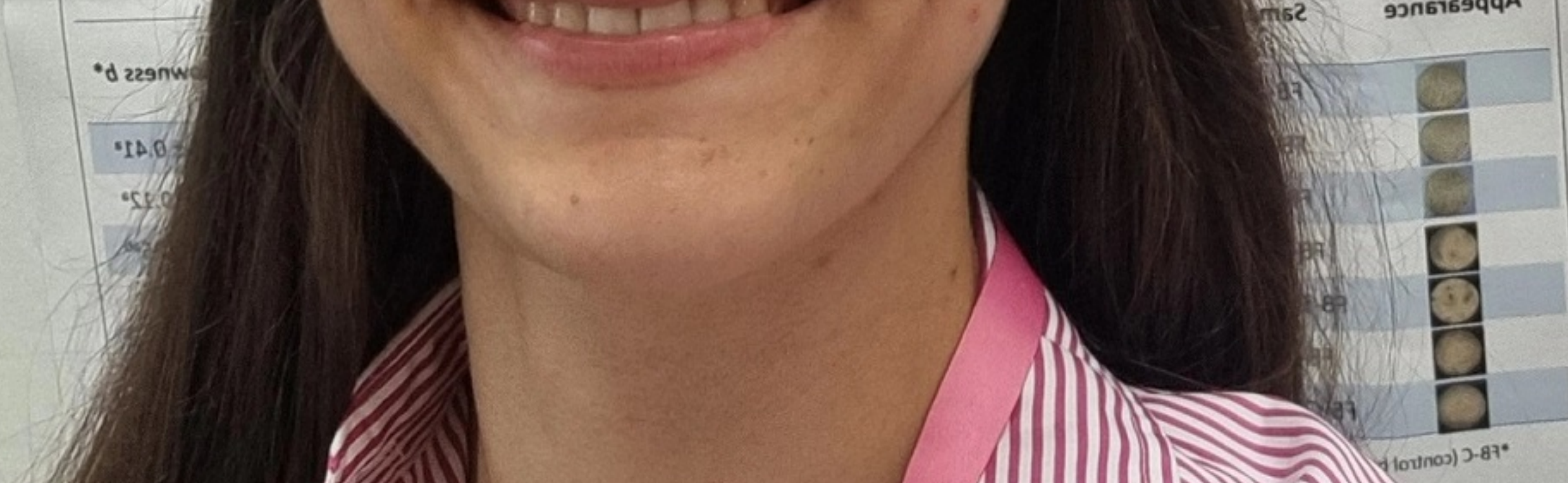
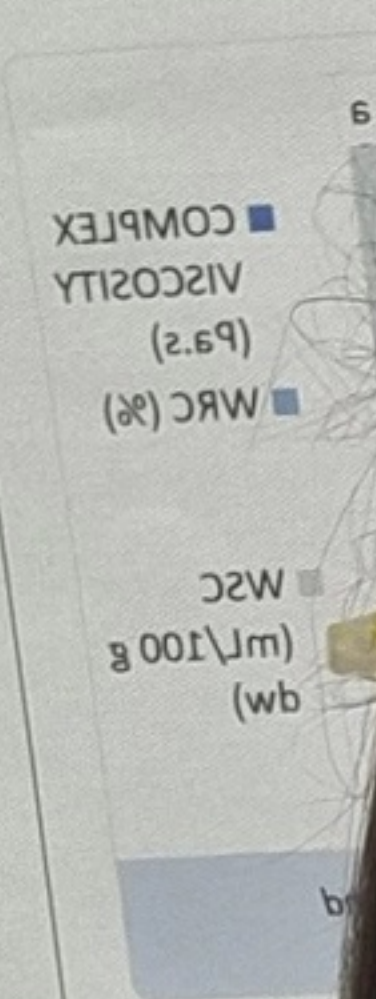
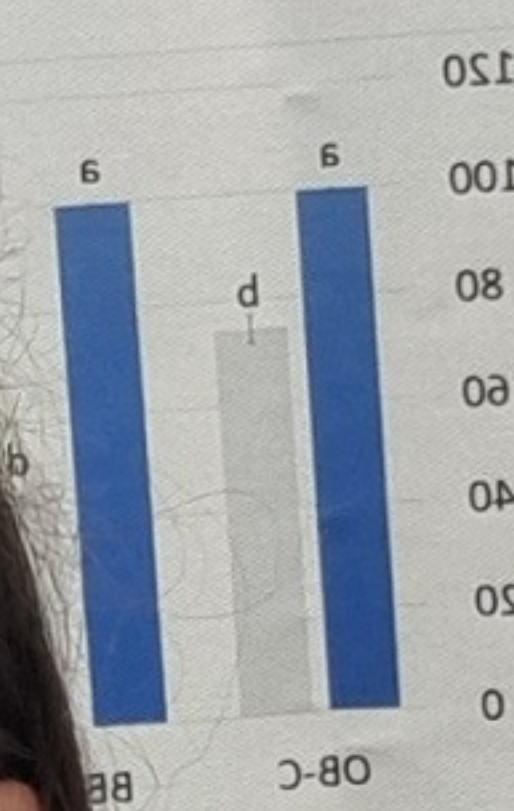


Table 1. Effect of U2 treatment on reduction of phytates content (PA), phytase activity, phenolics (TPC) and antioxidant activity (DPPH, FRAP) of oat and barley bran

Sample	PA reduction (%)	Phytase activity (%)	TPC reduction (%)	FRAP reduction (%)	DPPH scavenging (%)
OB-U2	17.43 \pm 0.31	85.23 \pm 3.11	9 \pm 0.84	50.06 \pm 0.17	27.11 \pm 0.69
BB-U2	38.1	100	12.84 \pm 0.46	39.32 \pm 0.49	25.07 \pm 1.66
BB-C	100	100	-	-	36.37 \pm 0.32
OB-C	-	-	-	-	-





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Introduction

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Results

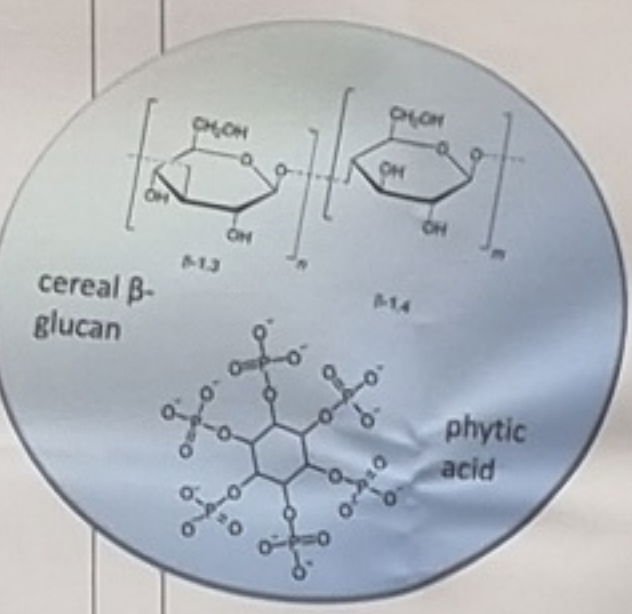


Table 1. Effect of US treatment on reduction of phytates content (PA), phytase activity, phenolics (TPC) and antioxidant activity (DPPH, FRAP) of oat and barley bran

Sample	PA reduction (%)	Phytase activity (%)	TPC reduction (%)	FRAP reduction (%)	DPPH scavenging (%)
OB-C	/	100 ^a	/	/	36.37 ± 0.35 ^b
BB-C	/	100 ^a	/	/	52.07 ± 1.66 ^a
OB-US	17.43 ± 0.31 ^b	82.52 ± 3.77 ^b	9 ± 0.84 ^b	20.06 ± 0.17 ^a	27.11 ± 0.69 ^c
BB-US	38.78 ± 0.11 ^a	7.37 ± 0.64 ^c	38.72 ± 0.46 ^a	15.84 ± 0.4 ^b	39.35 ± 0.49 ^b

Aim

Ultrasound (US) treatment of bran	Bran application in wheat flat bread
To investigate:	To investigate:
<input type="checkbox"/> enzymatic activity (β -glucanase and phytase) <input type="checkbox"/> β -glucans, phytates, phenolics and antioxidant activity <input type="checkbox"/> hydration, rheological and fermentation properties	<input type="checkbox"/> volume and shape <input type="checkbox"/> baking loss <input type="checkbox"/> texture and color

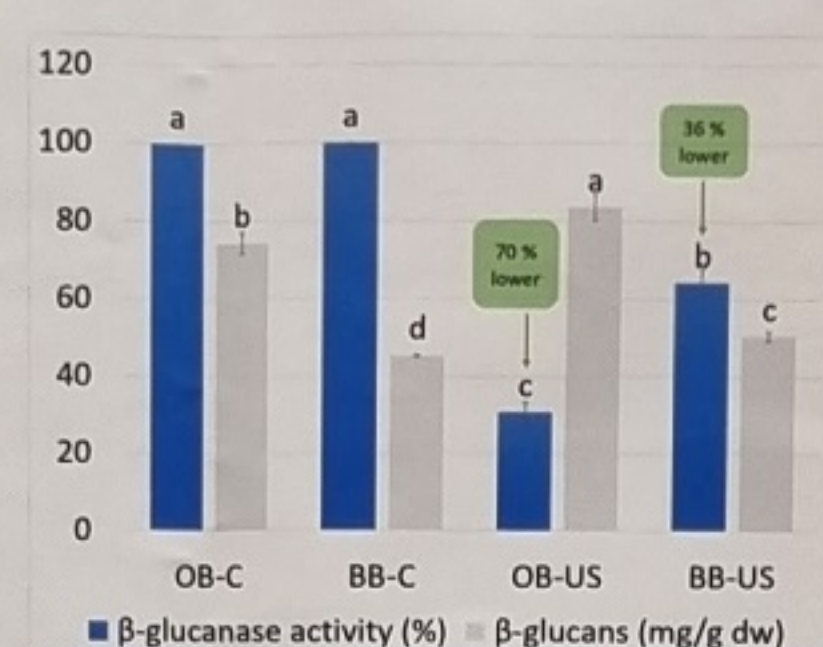


Figure 1. Effect of US treatment on β -glucanase activity and β -glucans content in oat and barley bran

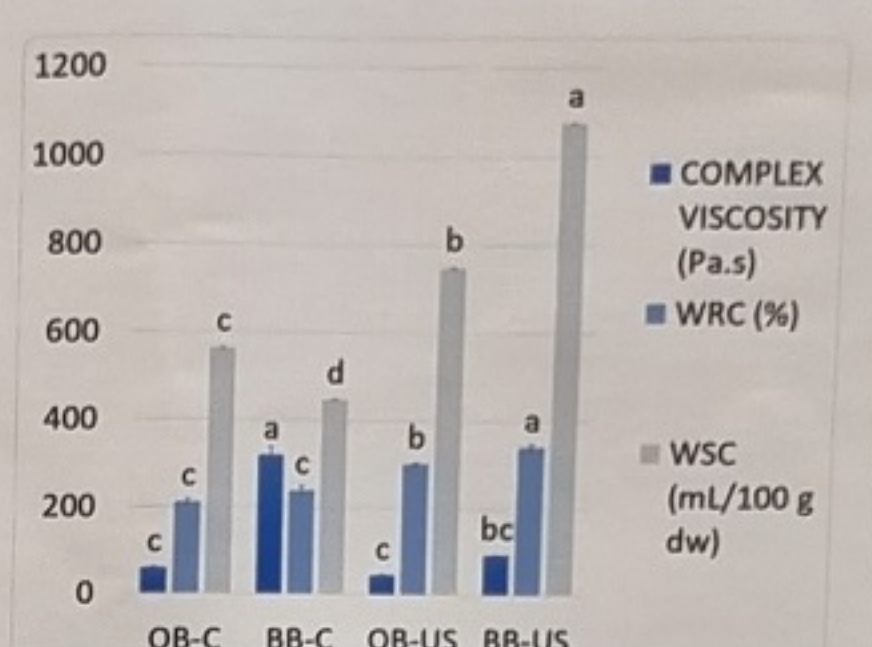


Figure 2. Effect of US treatment on viscosity and hydration (WRC, WSC) of oat and barley bran

Materials & Methods

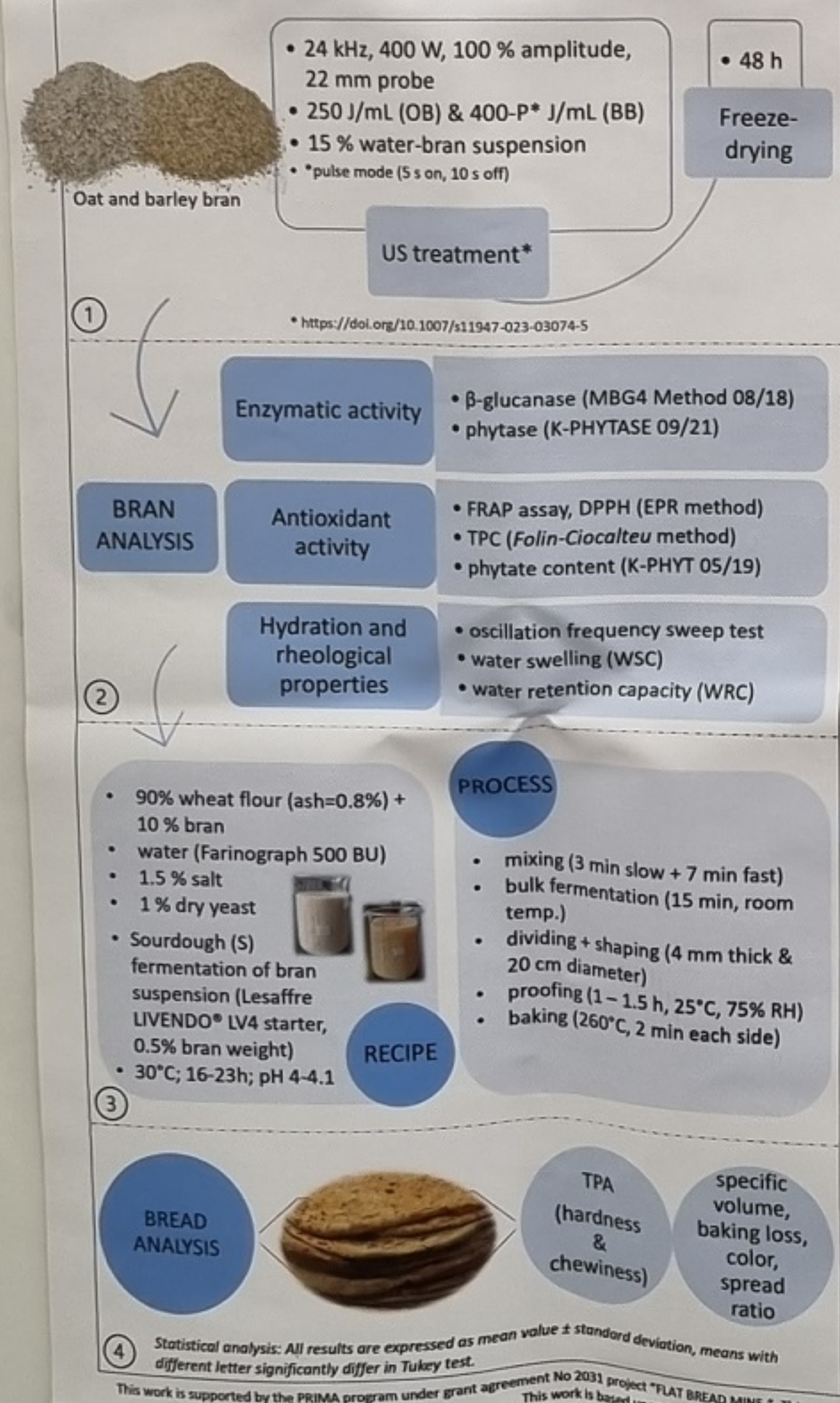


Table 2. Physical properties of flat breads (FB) enriched with (pre-treated) oat and barley bran

Appearance	Sample	Specific volume (mL/g)	Spread ratio	Baking loss (%)	Lightness L*	Redness a*	Yellowness b*
	FB-C*	2.34 ± 0.2 ^b	18.27 ± 0.72 ^b	14.78 ± 1.1 ^b	47.06 ± 0.35 ^b	0.87 ± 0.15 ^a	7.54 ± 0.41 ^a
	FB-BB	2.55 ± 0.1 ^b	20.98 ± 0.57 ^{ab}	12.31 ± 0.38 ^d	44.95 ± 0.1 ^b	0.77 ± 0.02 ^a	6.22 ± 0.12 ^a
	FB-OB	2.60 ± 0.1 ^b	20.68 ± 0.23 ^{ab}	13.30 ± 0.56 ^c	46.69 ± 0.44 ^b	0.90 ± 0.11 ^a	7.13 ± 0.25 ^{ab}
	FB-BB-S	2.87 ± 0.06 ^a	20.74 ± 0.71 ^{ab}	17.83 ± 0.25 ^a	54.72 ± 0.14 ^a	0.5 ± 0.03 ^a	3.65 ± 0.03 ^b
	FB-BB-US-S	2.85 ± 0.10 ^a	20.18 ± 0.44 ^{ab}	16.98 ± 0.33 ^a	56.19 ± 1.72 ^a	0.75 ± 0.37 ^a	4.62 ± 1.22 ^b
	FB-OB-S	2.75 ± 0.19 ^{ab}	19.31 ± 0.97 ^b	17.25 ± 0.13 ^a	53.54 ± 0.66 ^a	0.47 ± 0.13 ^a	3.10 ± 0.47 ^b
	FB-OB-US-S	2.62 ± 0.06 ^{ab}	22.13 ± 1.34 ^a	17.25 ± 0.62 ^a	55.22 ± 1.42 ^a	0.66 ± 0.17 ^a	3.98 ± 0.84 ^b

*FB-C (control bread with wheat flour)

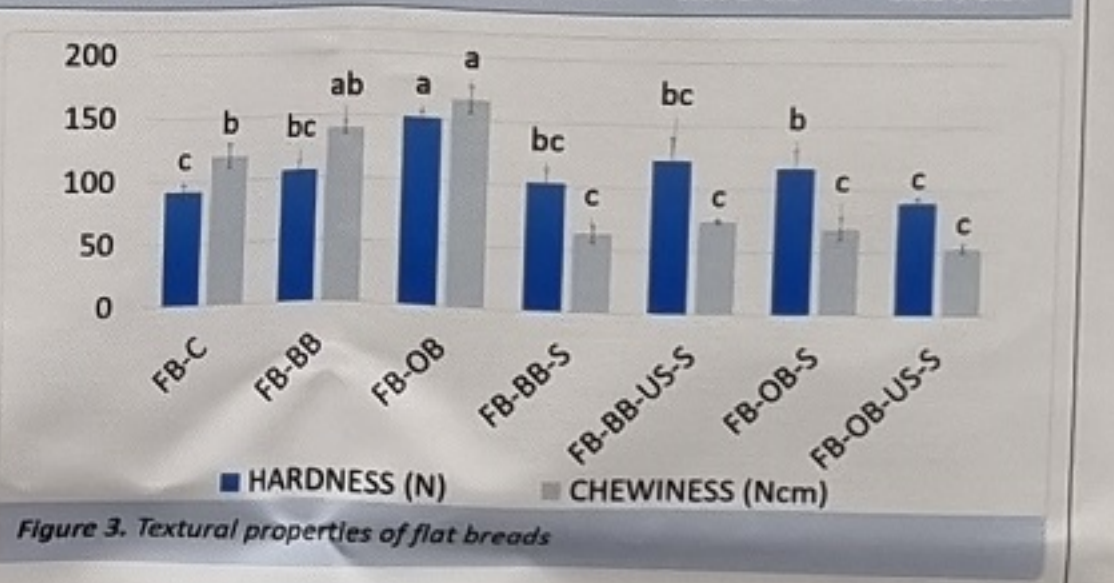


Figure 3. Textural properties of flat breads

Main findings & Conclusions

- Oat bran is high in β -glucans but also has high β -glucanase activity.
- Ultrasound is useful in the inactivation of endogenous β -glucanase and reduction of phytates in cereal bran when applied to a water-bran suspension.
- Ultrasound is a simple technique that can modify rheology and hydration properties of oat and barley bran for flatbread production.
- Ultrasonically treated bran can be fermented to sourdough and used in making flatbreads of improved volume, texture and color.

Statistical analysis: All results are expressed as mean value ± standard deviation, means with different letter significantly differ in Tukey test.
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