# PHYSICO-CHEMICAL PROPERTIES OF GLUTEN-FREE BREAD WITH MILLET BRAN DEPENDING ON THE PARTICLE SIZE


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## AIM

Millet bran is an edible by-product, rich in dietary fibre and other bioactive compounds often deficient in a gluten-free diet. The aim of this work was to investigate the influence of adding proso millet bran of different particle sizes, with or without xylanase, on physical properties and the content of bioactive compounds of gluten-free bread.

## METHODS

### *Physical properties*

Specific volume: AACC method 10-05.01

Crumb colour: spectrophotometer CH-3500 D (Konica Minolta, UK)

Texture profile analysis: TA-HDplus texture analyser (Stable Micro Systems, UK) with test speed 2 mm/sec, 50% strain

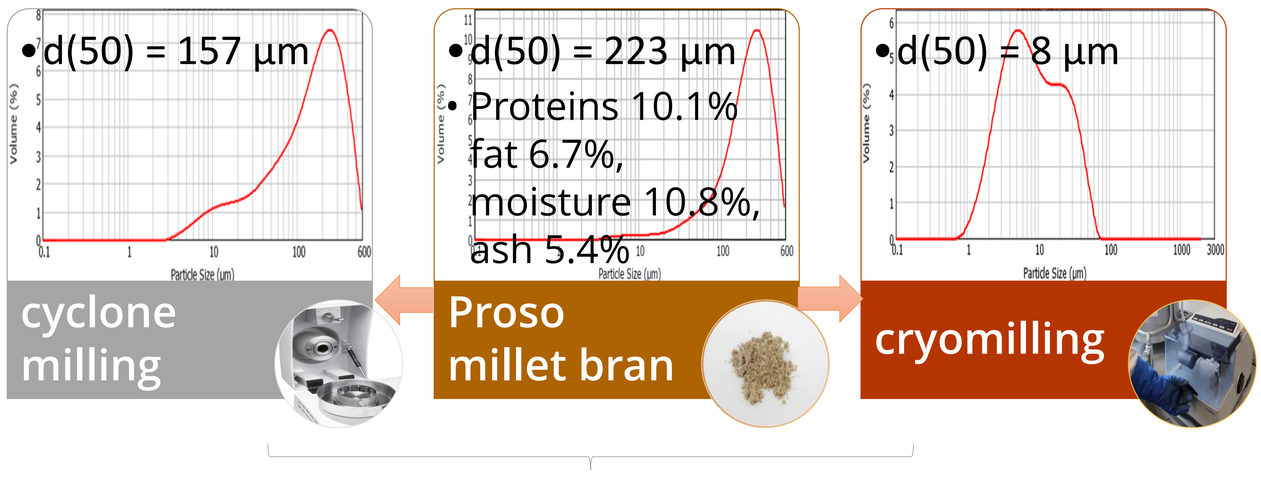
### *Nutritional aspects*

Dietary fibre content: AOAC 2011.25 method, K-INTDF 08/18

Total free phenolics content (TPC): Folin-Ciocalteu method

**Data analysis**: factorial ANOVA and Tukey test at $p<0.05$ (Statistica 12, StatSoft, USA)

## MATERIALS




### Application in bread making

- PRESOAKING: bran (40 g) + water (100 mL) ± xylanase (10 XU/g bran) (Bio-Cat, USA) in shaking water bath at 55°C / 16h / pH 5.6
- 10% of rice flour was replaced with soaked bran
- optimization of water addition for baking (on flour/bran basis): 102% for bread with added coarse or medium size bran, and 97% for bread with ultra-fine bran

### Basic recipe (Yano et al. 2017)

| Ingredient | Weight (g) |
|---|---|
| rice flour | 400 |
| water | 356 |
| sugar | 16.7 |
| instant yeast | 5.7 |
| salt | 5.3 |
| butter | 4.2 |

## RESULTS

**Table 1. Physico-chemical properties of gluten-free bread depending on the bran particle size and xylanase addition compared to the control bread without bran** (mean ± standard deviation; means with different letters within the same coloumn are significantly different)

| Bread section | Bran size | Xyl (XU/g bran) | Specific volume (mL/g) | *L** | *a** | *b** | Hard-ness (N) | Resili-ence | Cohesi-veness | Chewi-ness (N) | IDF (g/100g) | SDFP (g/100g) | SDFS (g/100g) | TPC (µg/100g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | none | 0 | 1.52$^{ab}$± 0.03 | 79.07$^{a}$± 0.21 | -0.40$^{a}$± 0.04 | 14.78$^{a}$± 0.14 | 27.2$^{b}$± 2.0 | 0.37$^{a}$± 0.01 | 0.62$^{a}$± 0.01 | 16.4$^{a}$± 1.6 | 0.83$^{a}$± 0.01 | 0.27$^{c}$± 0.01 | 0.73$^{a}$± 0.01 | 121$^{a}$±6 |
|  | coarse | 0 | 1.68$^{c}$± 0.04 | 56.11$^{c}$± 0.30 | 5.38$^{b}$± 0.09 | 18.63$^{c}$± 0.25 | 26.6$^{b}$± 0.6 | 0.30$^{cd}$± 0.01 | 0.57$^{bc}$± 0.02 | 14.6$^{b}$± 0.5 | 3.17$^{d}$± 0.06 | 0.27$^{c}$± 0.06 | 0.45$^{d}$± 0.01 | 240$^{c}$±10 |
|  | coarse | 10 | 1.62$^{c}$± 0.03 | 55.23$^{d}$± 039 | 5.21$^{b}$± 0.17 | 17.85$^{b}$± 0,33 | 27.2$^{b}$± 0.8 | 0.28$^{d}$± 0.01 | 0.54$^{c}$± 0.01 | 14.2$^{b}$± 0.7 | 3.19$^{d}$± 0.05 | 0.23$^{bc}$± 0.01 | 0.48$^{c}$± 0.01 | 215$^{bc}$±1 |
|  | medium | 0 | 1.50$^{a}$± 0.06 | 56.87$^{b}$± 0.33 | 5.28$^{b}$± 0,13 | 19.52$^{d}$± 0.34 | 31.2$^{a}$± 0.9 | 0.28$^{cd}$± 0.01 | 0.54$^{c}$± 0.01 | 16.5$^{a}$± 0.7 | 3.00$^{cd}$± 0.07 | 0.35$^{d}$± 0.04 | 0.42$^{d}$± 0.01 | 243$^{c}$±2 |
|  | medium | 10 | 1.59$^{b}$± 0.04 | 54.58$^{e}$± 0.44 | 5.39$^{b}$± 0.09 | 19.44$^{d}$± 0.24 | 26.2$^{b}$± 1.1 | 0.30$^{c}$± 0.01 | 0.55$^{c}$± 0.01 | 14.0$^{b}$± 0.6 | 2.91$^{c}$± 0.03 | 0.36$^{d}$± 0.02 | 0.61$^{b}$± 0,01 | 221$^{bc}$±8 |
|  | ultra-fine | 0 | 1.56$^{ab}$± 0.05 | 53.15$^{f}$± 0.50 | 6.14$^{c}$± 0.26 | 22.00$^{f}$± 0.41 | 25.5$^{b}$± 1.0 | 0.32$^{b}$± 0.01 | 0.57$^{bc}$± 0.02 | 14.5$^{b}$± 0.5 | 2.74$^{bc}$± 0.05 | 0.13$^{ab}$± 0.04 | 0.51$^{c}$± 0.01 | 249$^{c}$±5 |
|  | ultra-fine | 10 | 1.56$^{ab}$± 0.06 | 51.23$^{g}$± 0.51 | 5.97$^{c}$± 0.15 | 20.87$^{e}$± 0.21 | 22.1$^{c}$± 1.3 | 0.32$^{b}$± 0.02 | 0.59$^{ab}$± 0.02 | 13.1$^{b}$± 1.0 | 2.61$^{b}$± 0.03 | 0.06$^{a}$± 0.01 | 0.51$^{c}$± 0.01 | 200$^{b}$±9 |

Xyl – xylanase, IDF – insoluble dietary fibre, SDFP – fibre soluble in water but not in 78% ethanol, SDFS – fibre soluble in water and 78% ethanol

## MAIN FINDINGS AND CONCLUSION

- Rice bread was low in fibre (1.8 g/100 g), whilst the bread with added bran was a source of fibre ranging from 3.2 to 3.9 g/100 g (of which 18-25% was soluble) (Table 1) depending on the bran particle size and xylanase addition.
- TPC of rice bread was 121 µg/100 g bread, whereas in breads with millet bran it ranged from 200 to 249 µg/100 g (Table 1). TPC was significantly ($p<0.001$) lower upon adding xylanase.
- Compared to the control, breads with added bran had specific volume unchanged or even improved up to 11% (Table 1).
- After adding bran, as well as xylanase, crumb colour was darker while yellow and red colour were more pronounced (Table 1).
- All properties of enriched breads were influenced by the interaction of bran particle size and xylanase addition, except crumb springiness and SDFP content.
- The most positive effect of xylanase addition in terms of higher SDFS content (45%), improved bread volume (6%), crumb softness (16%), resilience (7%), and lower chewiness (15%) was evident when the medium particle size bran was used.
- In conclusion, proso millet bran can be successfully used for enrichment of gluten-free bread with dietary fibre and phenolic compounds, but its particle size should be considered.


**REFERENCE**

Yano, H., Fukui, A., Kajiwara, K., Kobayashi, I., Yoza, K. I., Satake, A., Villeneuve, M. (2017) *LWT-Food Science and Technology*, *79*, 632-639.



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