

Impact of millet and agro-industrial by-products on the technological quality and shelf life of gluten-free bread

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INTRODUCTION & AIM

Challenges of typical gluten-free bread (GFBs)

- Low content of dietary fibre and micronutrients
- High glycaemic index
- Rapid staling → crumb hardening → reduced shelf life and consumer acceptance



This study aimed to evaluate the effect of gluten-free (GF) raw materials such as rice bran (RB), millet and extruded soybean expeller (SEE) on the staling kinetics and physico-chemical quality of GFBs.

METHOD

Rice bran, extruded soybean expeller and millet



Milling: HC-1000Y mill (Arcano, China)

Sieving: 840 µm mesh (Zonytest, Argentina)



GFB-O: optimal; GFB-C: control

Ingredient mixing → Fermentation (30 °C, 90 % RH) → Baking (180 °C, 20 min)



Storage analysis: Moisture content, water activity, and crumb firmness were measured during 0–168 h at 25 °C, 70 % RH (LDPE bags).

Hardness was fitted to the Avrami model to describe staling.

RESULTS & DISCUSSION

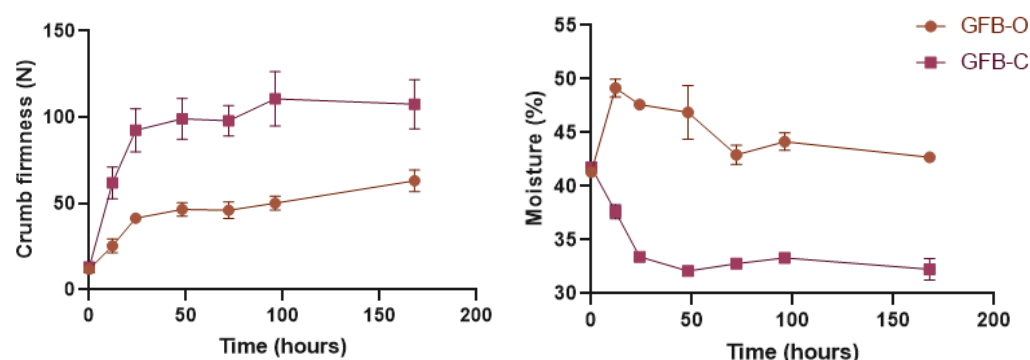


Figure. Storage tests for GFB-O and GFB-C breads.

GFB-O



GFB-C

Table. Avrami model parameters for storage tests of optimal and control gluten-free breads.

Parameter	GFB-O	GFB-C
F_0	12.06	12.74
F_∞	78.23	111.69
k (hours)	0.01	0.05
n	0.70	0.62
R^2	0.987	0.973

GFB-O showed lower hardness and better moisture retention, with Avrami parameters ($F_{inf} = 23.4$ N, $k = 0.035$ h⁻ⁿ, $n = 0.24$) indicating slower staling and prolonged freshness, whereas GFB-C ($F_{inf} \approx 120$ N, $k = 0.05$ h⁻ⁿ, $n = 1$) staled faster

CONCLUSION

These results demonstrate that the addition of RB, millet, and SEE could modify the bread matrix, improving the technological properties and shelf life of FGFBs.

REFERENCES

de Escalada Pla, M., Rojas, A. M., & Gerschenson, L. N. (2013). Effect of butternut (*Cucurbita moschata* Duchesne ex Poir.) fibres on bread making, quality and staling. *Food and Bioprocess Technology*, 6(3), 828–838. <https://doi.org/10.1007/s11947-011-0744-y>

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