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Development of gluten-free sourdough bread enriched with broccoli by-products

Jhazmin Quizhpe, Pablo Ayuso, María de los Ángeles Rosell , Pascual García-Pérez, Rocío Peñalver, Gaspar Ros and Gema Nieto .

Department of Food Technology, Food Science and Nutrition, Faculty of Veterinary Sciences, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, Murcia, Spain; jhazminedith.quizhper@um.es; pablo.ayuson@um.es; mariaangeles.rosellp@um.es; pascual.garcia@um.es; rocio.penalver@um.es; gros@um.es; gnieto@um.es.

INTRODUCTION

Coeliac disease is a genetically predisposed chronic autoimmune disease (HLA-DQ2 and HLA-DQ8 alleles) characterized by an adverse immune response to gluten, which damages the lining of the small intestine, affecting nutrient absorption. The most effective current treatment is a strictly gluten-free diet. However, commercially available gluten-free products have nutritional limitations, as they are often low in fiber, protein, vitamins and minerals, as well as having a high glycemic index and lower quality fats derived from less nutritious flours or corn starch. On the other hand, broccoli is a vegetable that contains numerous bioactive compounds such as glucosinolates and isothiocyanates, antioxidant compounds, vitamins and fiber, making it a food with multiple health benefits [1]. However, during its production and processing, large volumes of by-products are generated, which poses an environmental challenge.

OBJECTIVES

The aim of this study was to use broccoli by-products from the agri-food industry for the production of a gluten-free functional bakery product (sourdough bread) as a source of dietary fiber to cover the fiber deficiencies of commercial gluten-free foods, especially for celiac patients. For this purpose, a treatment with lignocellulosic enzymes was applied to the by-products to enhance the conversion of insoluble dietary fiber into soluble dietary fiber, providing greater benefit to the consumer of gluten-free products.

RESULTS AND DISCUSSION

Gluten-free sourdough bread formulations enriched with broccoli extract showed a significant improvement in their nutritional profile compared to a commercial gluten-free product. The results showed a lower glycemic index and higher antioxidant capacity, suggesting a potential health benefit. Enzymatic treatment of broccoli extract significantly increased the total dietary fiber content (13.65%), total phenolic compounds (461.36 mg gallic acid equivalents/gram) and improved the antioxidant capacity of the product. Furthermore, in the organoleptic evaluation, the enzymatically treated broccoli extract bread scored better in terms of taste and texture than the untreated bread and was preferred to the commercial bread by people who regularly consume gluten-free products [2,3].

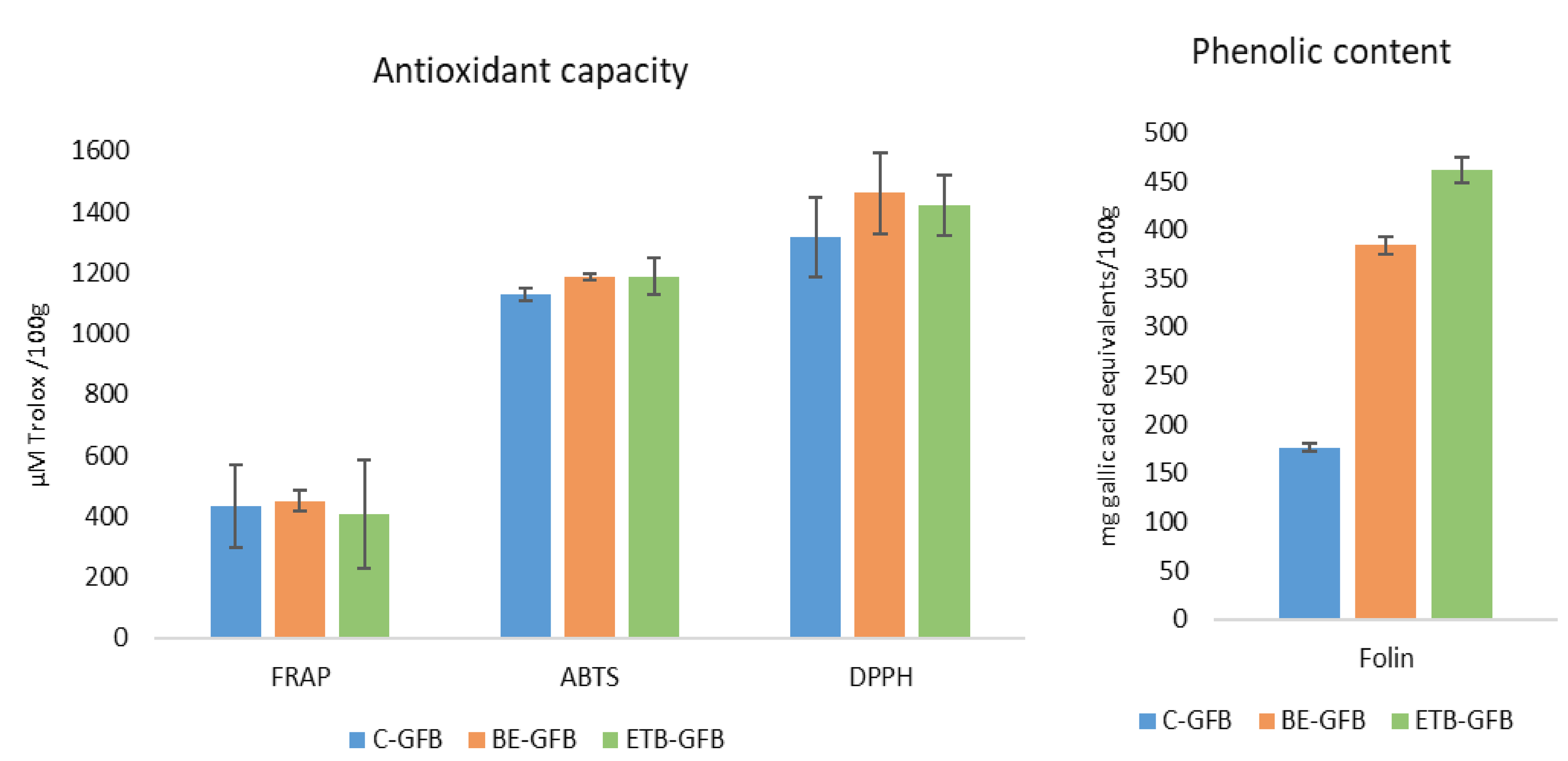

Figure 1. Antioxidant capacity and phenolic content of the different breads. C-GFB: Commercial gluten-free bread; BE-GFB: Broccoli extract gluten-free bread; ETB-GFB: Enzyme-treated broccoli extract gluten-free bread.

CONCLUSION

In conclusion, the incorporation of broccoli agri-food industry by-products in functional gluten-free sourdough breads resulted in an improvement in nutritional, antioxidant and hypoglycemic properties, with organoleptic acceptability. This represents a novel and effective strategy for the valorization of broccoli by-products as enhancers of the nutritional profile of gluten-free bakery products.

MATERIALS AND METHODS

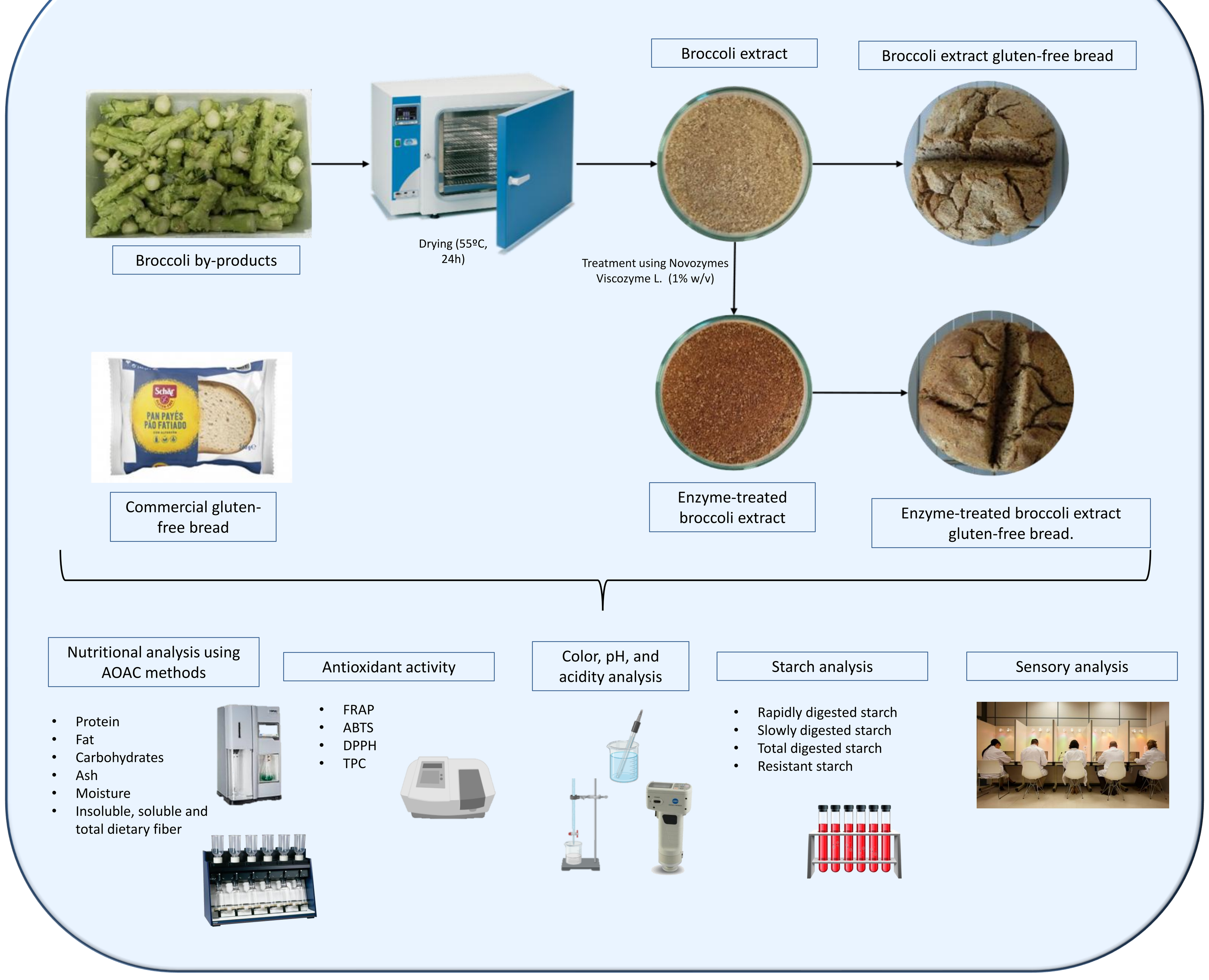

Table 1. Proximal composition of the different breads (g/100g).

	Commercial GF bread	Broccoli extract GF bread	Enzyme-treated broccoli extract GF bread
Moisture (%)	40.36 ± 0.16b	35.04 ± 0.72a	33.31 ± 1.51a
Protein (%)	3.66 ± 0.12a	6.56 ± 0.085b	7.18 ± 0.07c
Fat (%)	0.50 ±0.15a	2.36 ± 0.93a	2.44 ± 0.12a
Ash (%)	1.47 ± 0.03a	2.31 ± 0.21a	2.21 ± 0.28a
IDF (%)	3.45 ± 0.62a	10.02 ± 0.12b	10.99 ± 1.01b
SDF (%)	0.26 ± 0.03a	1.52 ± 0.15b	2.66 ± 0.15c
TDF (%)	3.72 ± 0.59a	11.54 ± 0.04b	13.65 ± 0.86b
Carbohydrates (%)	50.29 ± 0.68b	42.20 ± 1.40a	41.20 ± 2.70a
Energy content (Kcal/g)	220.29 ± 3.64a	216.26 ± 2.46a	215.53 ±10.00a

a–c: Different letters within in the same row indicate significant differences between samples ($p < 0.05$). GF: Gluten-free; IDF: insoluble dietary fiber; SDF: soluble dietary fiber; TDF: total dietary fiber.

Table 2. Starch analysis of the different breads (g/100g)

	Commercial GF bread	Broccoli extract GF bread	Enzyme-treated broccoli extract GF bread
Rapidly digested starch	49.12 ± 0.11c	30.97 ± 0.11b	29.24 ± 0.16a
Slowly digested starch	14.12 ± 1.68a	14.22 ± 0.97a	15.53 ± 4.02a
Total digested starch	50.00 ± 0.27b	45.11 ± 0.54a	49.80 ± 0.44b
Resistant starch	3.01 ± 0.05b	1.29 ± 0.18a	1.39 ± 0.05a

a–c: Different letters within in the same row indicate significant differences between samples ($p < 0.05$). GF: Gluten-free

REFERENCES

1. Quizhpe, J., Ayuso, P., Rosell, M. de los Á., Peñalver, R., & Nieto, G. (2024). Brassica oleracea var italica and Their By-Products as Source of Bioactive Compounds and Food Applications in Bakery Products. *Foods 2024, Vol. 13, Page 3513*, *13*(21), 3513. https://doi.org/10.3390/FOODS13213513
2. Drabińska, N., Ciska, E., Szmatowicz, B., & Krupa-Kozak, U. (2018). Broccoli by-products improve the nutraceutical potential of gluten-free mini sponge cakes. *Food Chemistry*, *267*, 170–177. https://doi.org/10.1016/J.FOODCHEM.2017.08.119
3. Krupa-Kozak, U., Drabińska, N., Baczek, N., Šimková, K., Starowicz, M., & Jeliński, T. (2021). Application of Broccoli Leaf Powder in Gluten-Free Bread: An Innovative Approach to Improve Its Bioactive Potential and Technological Quality. *Foods 2021, Vol. 10, Page 819*, *10*(4), 819. https://doi.org/10.3390/FOODS10040819

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