# Okara-enriched gluten-free bread: the changes in antioxidant properties during *in vitro* digestion

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## Introduction

Soybeant and its products are well know for thair helth benefits such as antioxsidant capacity. Okara, by-product of soy milk was used to produce an eco-innovative gluten-free bread consisted of a mixture of buckwheat (45%), rice (33%) and millet (22%) flower. The aim of this study is to determine the changes in antioxidant capacity of soluble and insoluble fractions of gluten-free bread enriched with okara during *in vitro* gastrointestinal digestion (GID).


**Figure 1. Okara-enriched gluten-free bread**

## Materials and metods

Changes in antioxidant capacity were monitored after the oral, gastric, and intestinal phases using two antioxidant assays: total antioxidant capacity (ABTS) and total antioxidant reducing capacity (TPC).

## Results

Results of the ABTS and TPC assays show that the antioxidant capacity of the soluble fractions increased during *in vitro* digestion (97 ± 14,23 to 306,7 ± 13,10 mg Trolox/100 g and 91,83 ± 1,08 to 263,17 ± 9,03 mg GAE /100 g, respectively). Antioxidant capacity of the soluble fraction measured by ABTS assay remained the same after oral and gastric phases and then increased after intestinal phase, while measured by TPC assay results showed that the antioxidant capacity of the soluble fraction increased after each stage of digestion.

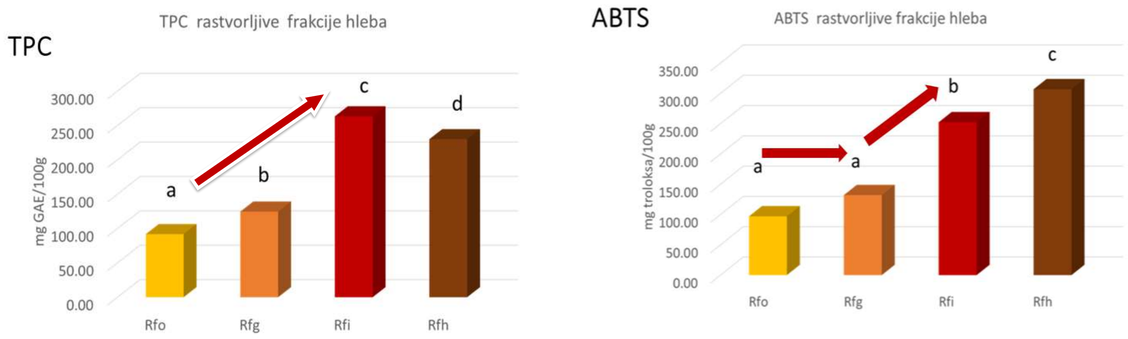


**Figure 2. Graphic representation of TPC and ABTS values of soluble fractions of analyzed bread samples. Abbreviations: Rfo - soluble fraction of okra-enriched bread digest after oral digestion; Rfg - soluble fraction of digesta of bread enriched with okra after gastric digestion; Rfi - soluble fraction of digesta of bread enriched with okra after intestinal digestion; Rfh - soluble fraction of undigested bread enriched with okra in water.**

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For the insoluble fraction, results showed that antioxidant capacity measured by ABTS assay did not change during or after *in vitro* GI digestion compared to the control, while TPC results showed that the antioxidant capacity of the insoluble fraction decreased after the gastic phase compared to the end of oral phase and reached the highest value after the intestinal phase.

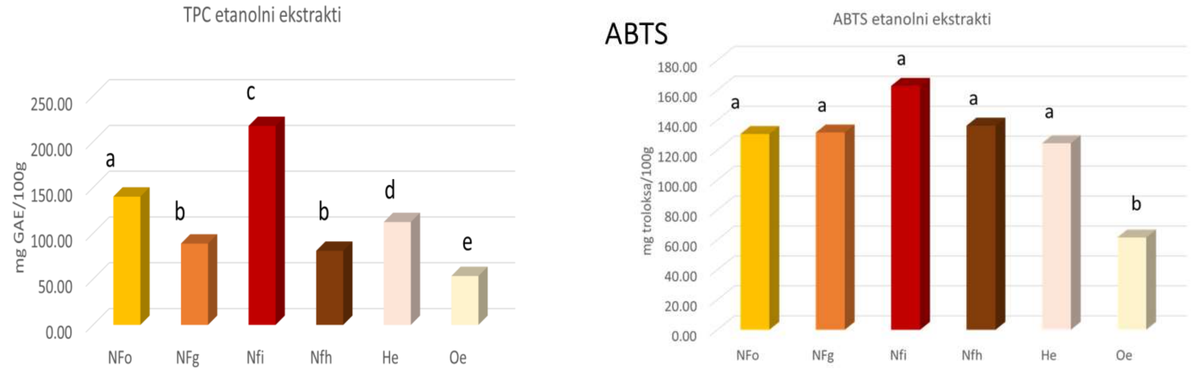


**Figure3. Graphic representation of TPC and ABTS ethanol extracts: Nfo-ethanol extract of the insoluble fraction of digesta of okra-enriched bread after oral digestion; Nfg - ethanolic extract of the insoluble fraction of digesta of okra-enriched bread after gastric digestion; Nfi- ethanolic extract of the insoluble fraction of digesta of okra-enriched bread after intestinal digestion; Nfh - ethanolic extract of the insoluble fraction of undigested bread enriched with okra in water; He-ethanol extract of undigested bread enriched with okra; Oe - ethanolic extract of undigested okara.**

## Conclusion

Antioxidants from okara and gluten-free flours contributed significantly to the antioxidant capacity of the bread studied, regardless of the assays applied. The overall effect of *in vitro* GI digestion on the antioxidant capacity of the digest, considered as the sum of the antioxidant capacity of the insoluble and soluble fractions after the intestinal phase, was three to four times higher than the antioxidant capacity of whole undigested bread, depending on the antioxidant assay applied (TPC or ABTS).

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## References

Kumar V., Rani A., & L., H. (2016). Investigations of amino acids profile, fatty acids composition, isoflavones content and antioxidative properties in soy okara *Asian Journal of Chemistry, 28*(4), 903-906

Thakur, S., Singh, N., Kaur, A., & Singh, B. (2017). Effect of extrusion on physicochemical properties, digestibility, and phenolic profiles of grit fractions obtained from dry milling of normal and waxy corn. *Journal of Food Science, 82*(5), 1101-1109.

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