Fruit powders as potential functional ingredients in white chocolates

Rita Végh[1*], Mariann Csóka[1], László Sipos[2]

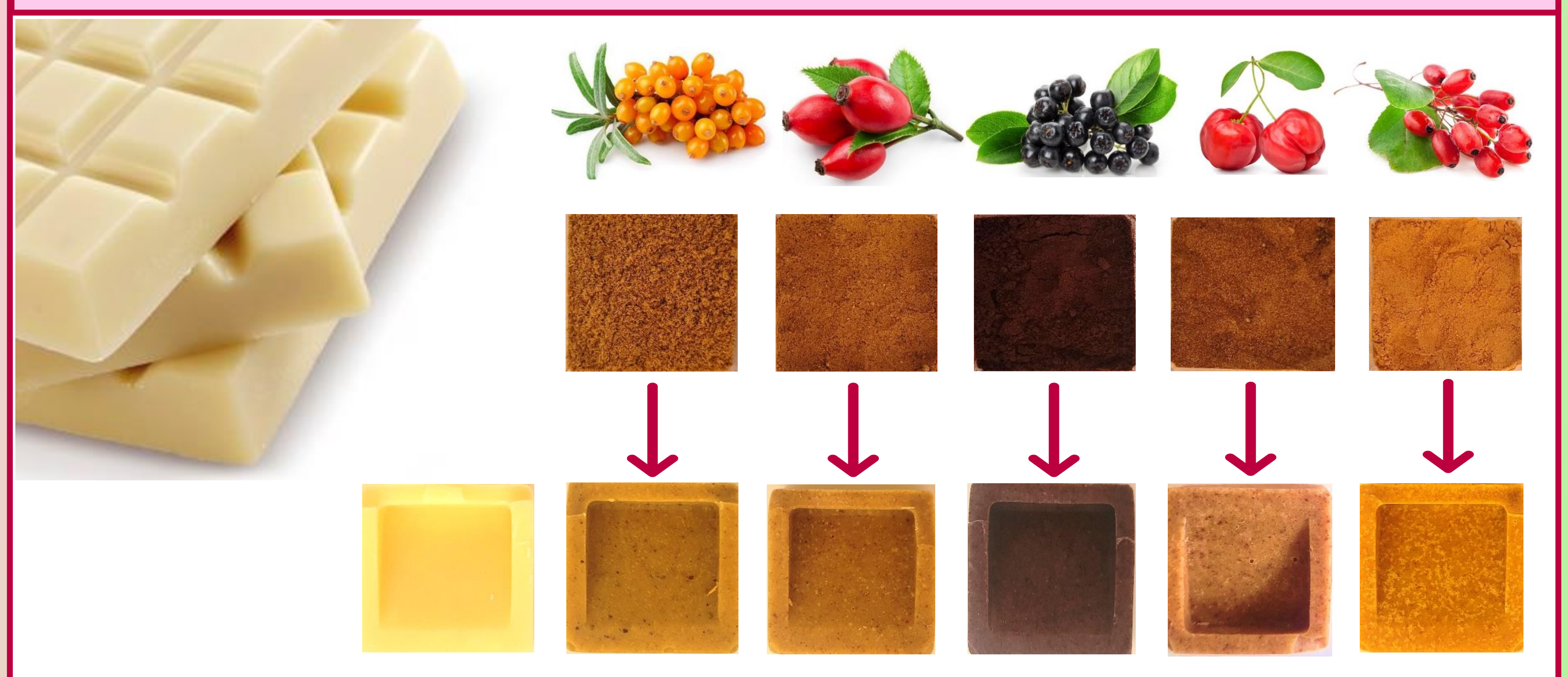
[1] Hungarian University of Agriculture and Life Sciences, Department of Nutrition, *e-mail: Vegh.Rita@uni-mate.hu

[2]Hungarian University of Agriculture and Life Sciences, Department of Postharvest, Commercial and Sensory Science

Objectives

These days, powders made from antioxidant-rich fruits and marketed as superfoods have become increasingly popular among health-conscious consumers. Consequently, there is a great scientific interest in the nutritional quality, sensory acceptance and potential health-promoting properties of fruit powder-enriched foods. The aim of our research was to compare five commercially available berry powders based on their applicability to increase the antioxidant potential and consumer acceptance of white chocolates.

Materials & Methods



Powders from five berries marketed as antioxidant rich superfoods were purchased from online stores. These included powders of sea buckthorn (**S**) (*Hippophae rhamnoides*), rose hip (**R**) (*Rosa canina*), black chokeberry (**B**) (*Aronia melanocarpa*), acerola cherry (**A**) (*Malpighia emarginata*) and goji berry (**G**) (*Lycii fructus*). Chocolates were created by enriching conventional white chocolate, melted at 45±2 °C, with 10% of fruit powder.

Total phenolic content and antioxidant capacity tests

Extraction was conducted as follows: 1.00 g of chocolates was weighed in centrifuge tubes. A mixture of 10 ml of ethanol:distilled water (60:40) was added to the tubes and vigorously mixed. The resulting suspensions were treated in an ultrasonic bath for 1 hour and then centrifuged at 12,000 rpm for 10 minutes. A small volume of the supernatants were transferred to Eppendorf tubes.

TPC

The total polyphenol content (TPC) was determined using the method proposed by Singleton and Rossi (1965). Gallic acid solutions of known concentrations were used for calibration.

FRAP

CUPRAC

DPPH

The antioxidant capacity of the chocolates was evaluated using three methods based on different mechanisms, namely ferric reducing antioxidant capacity (FRAP) assay (Woisky and Salatino, 1998), copper ion reducing antioxidant capacity (CUPRAC) assay (Apak and co-workers, 2007) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay (Blois, 1958). For calibrations, trolox or ascorbic acid standard solutions were utilized.

Consumer preference test

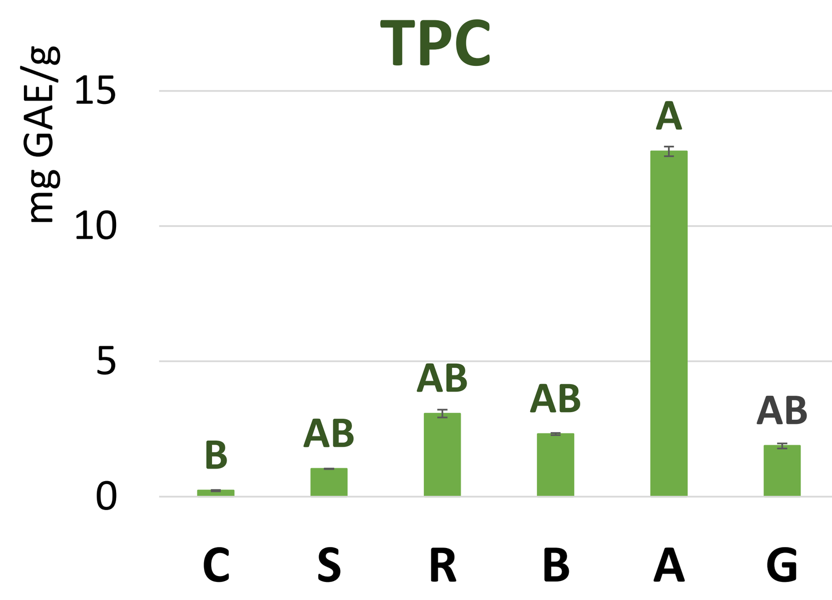
Hungarian consumers (19 women and 11 men) aged between 19 and 60 years were participated in the sensory test. Participants rated the chocolates on a 9-point liking scale for ten sensory attributes. The test was conducted in accordance with international standards (ISO 11136:2014) and the World Medical Association Code of Ethics (Declaration of Helsinki).

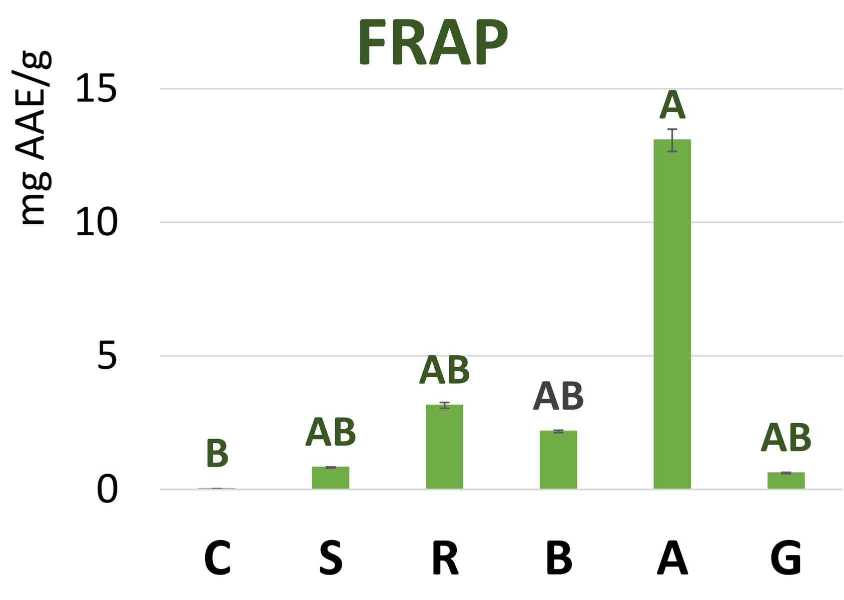
Statistical analysis

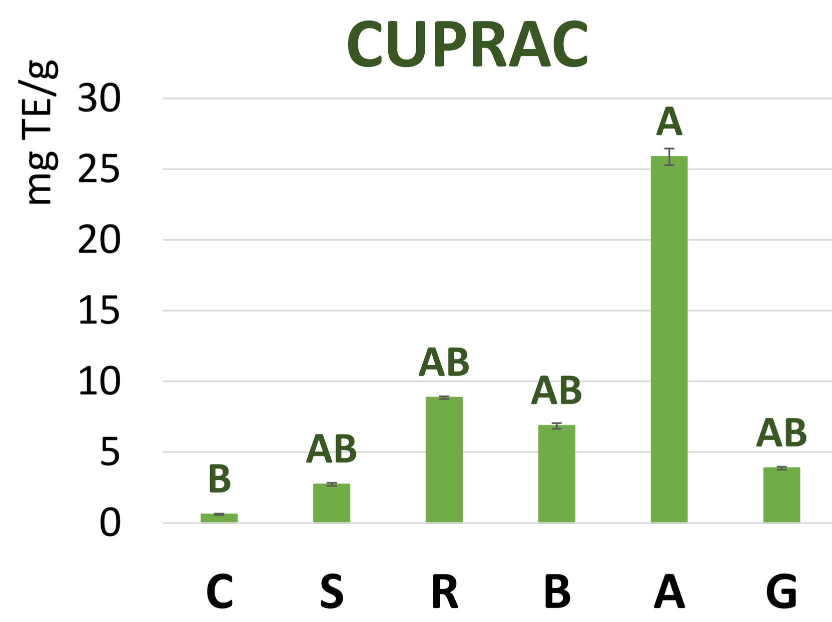
TPC and antioxidant capacity of the samples were determined by three parallel measurements. Consumer preference was assessed based on 40 observations. Results are expressed as mean±standard deviation. For the antioxidant properties, statistical differences were determined using Kruskal-Wallis test and Dunn's pairwise comparison with Bonferroni correction (α = 0.05). For sensory data, ANOVA with Tukey HSD post hoc test was used to determine statistical differences (α = 0.05). XLSTAT software was used for statistical evaluation.

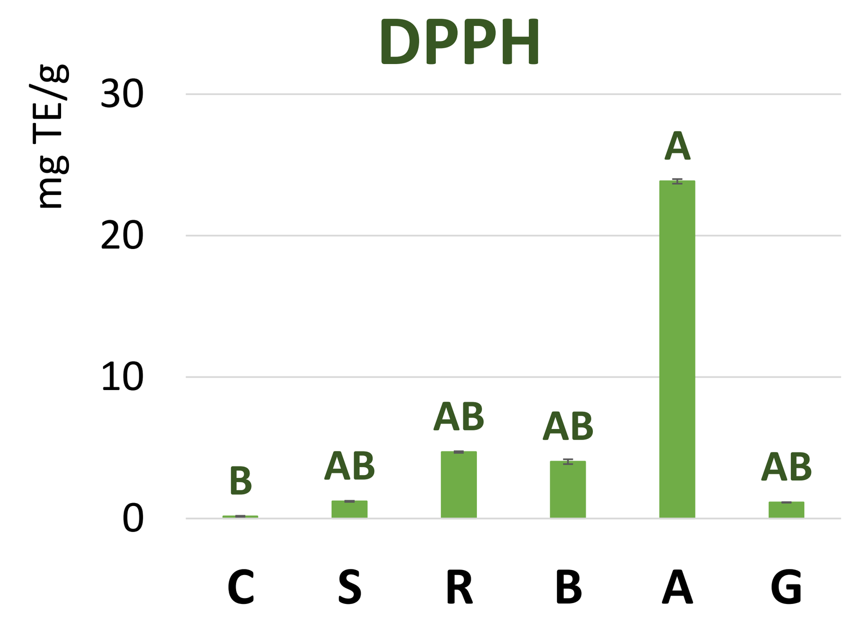
Results & Discussion

The addition of each fruit powder increased the total phenolic content (TPC) and antioxidant capacity (FRAP, CUPRAC, DPPH) of white chocolate. Acerola cherry powder is by far the most effective to improve the antioxidant potential followed by rose hip and black chokeberry powders. DPPH assay resulted in lower antioxidant capacity values compared to the CUPRAC assay, which may be attributed to the fact that the DPPH assay has a limited ability to measure lipophilic and highly pigmented antioxidants.



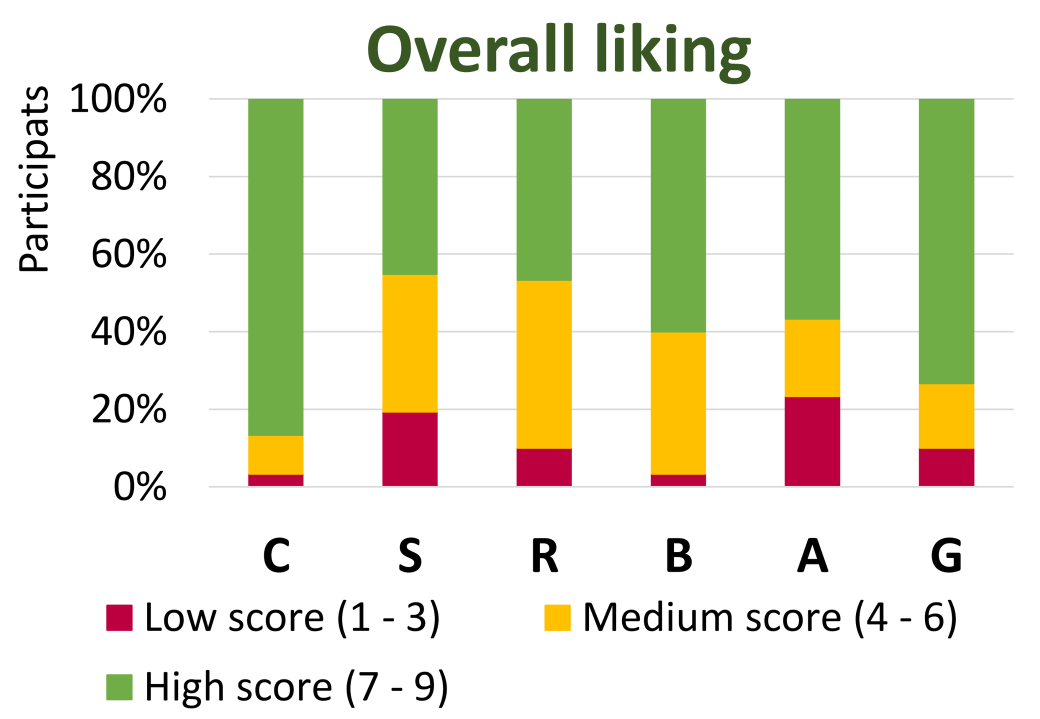






Results of the sensory test indicate that most consumers prefer the control chocolate over the berry powder enriched chocolates, however, no significant differences were observed between the mean overall liking scores. Goji berry powder appears to be the most accepted by consumers as an ingredient in white chocolate, while sea buckthorn- and rose hip powder-enriched chocolates are least preferred. The acerola powder-enriched product can be characterized by a divisive consumer preference. Based on text responses, a significant proportion of assessors found the fruity and/or sour taste of the product too strong, while an other large group of consumers particularly liked these characteristics.

	C	S	R	B	A	G
colour	7.4 ± 1.7^{a}	5.9 ± 1.7^{b}	5.5 ± 2.3^{b}	7.6 ± 1.3^{a}	5.9 ± 2.1^{b}	6.3 ± 2.2^{ab}
shine	6.7 ± 1.6^{a}	5.6 ± 2.3^{a}	5.5 ± 2.0^{a}	6.4 ± 1.8^{a}	5.7 ± 2.2^{a}	6.3 ± 1.7^{a}
odour	6.9 ± 1.3^{a}	5.8 ± 1.8^{a}	6.0 ± 1.2^{a}	6.2 ± 1.2^{a}	6.0 ± 1.7^{a}	6.7 ± 1.6^{a}
overall flavour	7.4 ± 1.4^{a}	6.0 ± 2.2^{ab}	5.8 ± 2.1^{b}	6.5 ± 1.6^{ab}	5.9 ± 2.9^{ab}	7.0 ± 1.9^{ab}
sweet taste	7.6 ± 1.4^{a}	6.1 ± 1.7^{bc}	6.6 ± 1.4^{abc}	6.6 ± 1.7^{abc}	5.4 ± 2.6^{c}	6.9 ± 1.8^{ab}
sour taste	5.0 ± 2.0^{a}	5.4 ± 2.0^{a}	5.0 ± 2.4^{a}	4.8 ± 1.8^{a}	6.1 ± 2.8^{a}	5.3 ± 2.4^{a}
fruit flavour	4.7 ± 2.1^{b}	5.4 ± 2.3^{ab}	5.4 ± 2.1^{ab}	5.2 ± 1.6^{ab}	6.6 ± 2.4^{a}	5.7 ± 2.3^{ab}
hardness	6.0 ± 2.1^{a}	5.6 ± 2.0^{a}	6.2 ± 1.6^{a}	5.8 ± 1.9^{a}	5.9 ± 2.1	6.2 ± 2.0^{a}
texture	6.8 ± 1.8^{a}	5.9 ± 2.4^{a}	5.9 ± 2.2^{a}	6.4 ± 1.7^{a}	6.6 ± 2.0	6.5 ± 1.9^{a}
overall liking	7.4 ± 1.4^{a}	6.0 ± 2.1^{a}	6.0 ± 1.9^{a}	6.7 ± 1.7^{a}	6.2 ± 2.7	6.7 ± 2.1^{a}



References

Apak, R., Güçlü, G., Demirata, B., Ozyürek, M., Celik, S. E., Bektaşoğlu, B., Berker, K. I., Ozyurt, D. (2007): Comparative evaluation of various total antioxidant capacity assays applied to phenolic compounds with the CUPRAC assay. *Molecules*, 12.1496–1547.

Singleton, V. L., Rossi, J. A. (1965): Colometry of total phenolics with phosphomolibdic-phosphotungstic acid reagents. *American Journal of Enology and Viticulture*, 16.144–158.

Blois, M. S. (1959): Antioxidant determination by the use of stable free radical. *Nature*, 181.1199–1200.

Woisky, R. G., Salatino, A. (1998): Analysis of propolis: Some parameters and procedures for chemical quality control. *Journal of Apicultural Research*, 1998, 37, 99–105.

ISO 11136:2014 (2014): Sensory Analysis–Methodology—General Guidance for Conducting Hedonic Tests with Consumers in a Controlled Area. International Organization for Standardization: Geneva, Switzerland.

Conclusions

Our results indicate that fruit powders are well applicable as functional ingredients in white chocolates. Acerola cherry powder was the most effective for improving the nutritional quality of white chocolates. The control chocolate showed the highest overall liking score, but no significant differences were observed between the samples regarding this parameter. Based on our results, acerola cherry powder is the most suitable for the development of an antioxidant-rich white chocolate. However, an enrichment level less than 10% is recommended due to the strong sour taste of the acerola powder-enriched chocolate.

Acknowledgements: This research was supported by the ÚNKP-22-3-II-MATE-23 New National Excellence Program of the Ministry for Innovation and Technology. Authors acknowledge the Doctoral School of Food Science of Hungarian University of Agriculture and Life Sciences.