**Castanea sativa** bud-derivatives: an innovative green extraction and re-use strategy to valorize food supplement by-products

Federica Turin1, Dario Donno2, Gabriele Beccaro2, Paola Zunin1, Silvia Catena1, Raffaella Boggia1

1Department of Pharmacy, University of Genova, 16148, Genova, Italy
2Department of Agriculture, Forestry and Food Science, University of Torino, Largo Braccini 2, 10095, Grugliasco, Turin, Italy

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**Introduction**

Bud-derivatives, obtained macerating meristematic tissues of trees and plants, represented a category of natural products commercialized in the Europe Community as plant food supplements. They are very expensive products compared to other botanicals, since the collection period of their raw materials is extremely limited over time1. In this study, a re-use procedure based on an innovative green extraction to valorize Castanea bud-by-products (CBs) is presented.

Pulsed Ultrasound-Assisted Extraction (PUAE)2 has been employed to extract further valuable material from CBs, using the same solvent of the corresponding commercial Glycric Macerate (GM). Design of Experiment (DOE) and Untargeted spectroscopic fingerprints were employed to screen the best extraction conditions. Targeted chromatographic fingerprints have been used to compare the most promising extracts with the corresponding commercial GM.

This study takes place in the context of an EU INTERREG Alcotra (France-Italy) cooperation project called FINNOVER (2017-2020)3.

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**Materials and methods**

CBs were collected from plants spontaneously grown in the valleys of Chisone, Pellice, Germanasca, Bronda, and Varaita (Turin, Italy, March 2017) and were used by an Italian company of food supplements (Geal Pharma, Bricherasio, Turin) for the production of the corresponding GMs according to the European Pharmacopeia 8th edition. A 24 fractional factorial design (8 experiments plus 3 central point experiments) was carried out to optimize the PUAE process conditions. A data matrix A152x11 (training set) of 11 rows (DOE extracts) and 27 columns (untargeted spectroscopic fingerprints: UV-Vis absorbances at 230-500 nm) was prepared.

**Untargeted fingerprints**

**Results**

The PC1 scores of the test set, were close to those ones of the “best” DOE extract (CA 08) for both the considered dilutions. Since X0 resulted the most important variable in building the model, further experiments were planned setting it to 1/20, 1/15 and 1/10 (experiments: CA: R20, CA: R15, CA: R10) hoping both to improve the extraction yield and to save extraction solvent. The extract CA: R10 resulted the most promising, since it seemed even more similar to the commercial product and thus deserving of further HPLC compositional investigation. Their targeted phytochemical fingerprints are reported and compared with that of one of the corresponding commercial GM. Flavonols, phenolic acids expressed as benzoic and cinnamic acids, catechins, tannins as polyphenolic markers, as well as organic acids and vitamin C, were considered into account. Qualitatively, the chromatographic profiles of both CA: R10 and commercial GM are almost identical, showing that PUAE is able to extract something still useful and valuable from the bud bagasse. In particular, CA: R10 extract has a content in secondary metabolites of 160.42 mg/g of fresh weight marcs, which represents about the 12% of the corresponding commercial GM (1276.17 mg/g of fresh weight buds).

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**Conclusions**

The valorisation of bud marcs remaining after the production of GMs, in this case study of C. sativa, could have a significant economic impact for the commercial producers, representing an important innovation in this sector.

A green and relatively low-cost re-use strategy has been presented, which is also applicable for different herbal preparations, to obtain value-added products from food supplement by-products in alternative to incineration or composting.

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3) Commisso, S., Deodato, S., Borroni, G. and Balbo, E. Untargeted fingerprints for orthogonal discriminant factor analysis and a full factorial fractional design. Journal of the Science of Food and Agriculture 93, 1839-1849. 10.1002/jsfa.6741

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