



Università
degli Studi di
Messina

DIPARTIMENTO DI SCIENZE BIOMEDICHE,
ODONTOIATRICHE E DELLE IMMAGINI
MORFOLOGICHE E FUNZIONALI




Società Chimica Italiana
Gruppo Interdivisionale
Chimica degli Alimenti

 ITA
CHEMFOOD



CHIMALI 2023 MARSALA



XIII CONGRESSO NAZIONALE DI CHIMICA DEGLI ALIMENTI

LIBRO DEGLI ABSTRACTS (ERRATA CORRIGE)

www.chimali2023.it

29 – 31 maggio 2023

Hotel Resort Villa Favorita,
Marsala (TP)

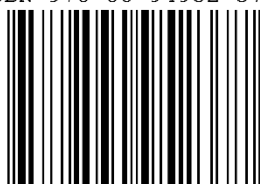
XIII CONGRESSO NAZIONALE DI CHIMICA DEGLI ALIMENTI

29 – 31 maggio 2023
Hotel Resort Villa Favorita, Marsala (TP)

www.chimali2023.it

ISBN 978-88-94952-37-7
© Società Chimica Italiana

ISBN 978-88-94952-37-7



9 788894 952377

Thermal degradation kinetics of red cabbage (*Brassica oleracea* L. var *capitata* f. *rubra*) anthocyanins

Laura De Marchi¹, Laura Salemi¹, Maria Bellumori², Federica Mainente¹, Ilaria Fierri¹,
Roberto Chignola¹, Gianni Zoccatelli¹

¹Dept of Biotechnology, University of Verona, Stara del Grazie 15, Verona, Italy

²NEUROFARBA Dept, University of Firenze, Via Ugo Schiff 6, Sesto Fiorentino, Firenze, Italy
gianni.zoccatelli@univr.it

Anthocyanins (ACNs) are flavonoids characterised by red colour and high solubility in water expressed in several fruits and vegetables. They are frequently used as natural pigments for food applications, though their importance in the last years increased due to their potent antioxidant and anti-inflammatory properties. These characteristics are believed to be the rationale for the capacity of ACNs to counteract degenerative diseases like type-2 diabetes, cardiovascular pathologies and cancer [1]. Red cabbage (*Brassica oleracea* L. var *capitata* f. *rubra*, RC) is acknowledged as one of the most important sources of ACNs. These are almost entirely represented by glycosylated cyanidins, most of which (generally >80%) are acylated with hydroxycinnamic acids (HCAs). Acylated ACNs (AACNs) are known to possess higher stability than ACNs, especially towards basic pH, due to their capacity of π -stacking of acyl groups with the pyrilium group (also named intramolecular co-pigmentation), which reduces the nucleophile attack of water and the subsequent formation of a pseudobase or a chalcone [2]. However, data about their thermal stability are controversial since Wiczkowski et al. [3] showed that the stewing process of RC leads to a higher degradation of AACNs than non-acylated ACNs. We aimed to study the thermal stability of ACNs, total phenolic content (TPC, by Folin Ciocalteu assays), and the antioxidant capacity (by ABTS and FRAP assays) of a model RC water extract (pH 3.3) subjected to an accelerated storage test (40°C x 30 days). HPLC-DAD-ESI-MS served to identify the single ACNs and to study their degradation kinetics. Free ACNs analysed by differential pH method showed a 1st-order degradation kinetics as described for other sources like cherry [4], with a $t_{1/2}$ of 17.4 days. On the contrary, the behaviour of TPC, ABTS and FRAP did not obey the same kinetics, showing time-dependent oscillations, especially in the case of FRAP. The trends are probably caused by the accumulation of degradation products characterised by antioxidant capacity during incubation. Kinetics study of the single molecules separated by HPLC (520 nm) confirmed a 1st order degradation kinetics for all ACNs ($R^2 > 0.988$, $P < 0.01$), even though different stability was observed depending on the bound HCAs ($t_{1/2}$: from 13.3 to 32.7 days). In contrast to previous results [2], some AACNs showed a faster degradation than the non-acylated form. In particular, as previously reported [3], mono- and di-acylated sinapoyl- AACNs were more susceptible than those bound to p-cumaric and ferulic acids. The results suggest that the degradation pathway of RC ACNs/AACNs follows first an oxidation/cleavage of the flavonoid core instead of deacylation or deglycosylation steps since mono-acylated and non-acylated forms did not show fluctuations during storage nor cyanidin aglycone was detectable. The higher antioxidant capacity of sinapic acid could help explain the rapid oxidation of anthocyanins bound with this HCA. Indeed, its faster reactivity could lead to the formation of AACNs bound to oxidised sinapoyl moieties unable to adequately protect the flavonoid core by π -stacking.

References

- [1] A. Durazzo, M. Lucarini, E. B. Souto, C. Cicala, E. Caiazzo, A. Izzo, E. Novellino, A. Santini, *Phytotherapy Research*, **2019**, 33, 2221.
- [2] M. Moloney, R. J. Robbins, T. M. Collins T. Kondo, K. Yoshida, O. Dangles, *Dyes and Pigments*, **2018**, 158, 342.
- [3] W. Wiczkowski, D. Szawara-Nowak, J. Topolska, *Food Chemistry*, **2015**, 167, 15.
- [4] J. Chen, J. Dua, M. Lia, C. Lia, *LWT*, **2020**, 128, 109448.

Anthocyanin nanoencapsulation through waste valorisation: whey protein / high methoxy apple pectin complex coacervation

Ilaria Fierri¹, Laura De Marchi¹, Roberto Chignola¹, Giacomo Rossin¹, Federica Mainente¹, Anna Perbellini¹, Maria Bellumori², Ines Mancini³, Gianni Zoccatelli¹

¹Department of Biotechnology, University of Verona, Strada Le Grazie 15, Verona, Italy

²Department NEUROFARBA, University of Florence, via Schiff, Sesto Fiorentino, Firenze, Italy

³Department of Physics, University of Trento, Via Sommarive, 14, Povo, Trento, Italy

ilaria.fierri@univr.it

Anthocyanins (ACNs) are a class of water-soluble polyphenols with remarkable antioxidant capacities. Their bright red colour and several health benefits, in particular for the prevention of many non-communicable diseases, raised considerable interest for potential employment as natural colourants and nutraceuticals [1]. In this scenario, red cabbage (*Brassica oleracea* L. var. capitata f. rubra, RC) is acknowledged as an important source of ACNs, which are mainly represented by glycosylated and acylated cyanidins. The amount and identity of the carbohydrate residues and their different acylation can positively increase the stability of ACNs, delaying their irreversible degradation [2]. However, these molecules are still inherently vulnerable to many environmental stresses, a condition that severely hampers their application [3] and that can be prevented through encapsulation. This represents an approach often employed to protect liable substances and simultaneously promote their functionality and vehiculation in living organisms [4]. Coacervation is a relatively simple encapsulation process involving the electrostatic interaction between two oppositely charged biopolymers, such as proteins and polysaccharides. This study aims to optimise a coacervation protocol involving whey proteins (WP) and high methoxy apple pectin (HMP), two food industry by-products, to encapsulate RC ACNs extracted from discarded stems and leaves. ACNs were quali/quantitatively characterised by HPLC-ESI-MS-DAD. Different blending methods were tested: the addition of 2% w/v HMP to a pre-heated solution (60°C, 40 mins) of 5% w/v WP (ratio 1:1) gave the best results in terms of size, polydispersity index and ζ -potential (371.0 ± 7.0 nm, PDI < 0.25, ζ -potential: -14 ± 0.31 mV). Increasing concentrations of RC extract (36 - 1041 mg/L ACNs) significantly modified the dimensions but not the superficial charge of the nanoparticles. Fourier-transform (FT) IR confirmed the anthocyanin inclusion into the coacervate. The total encapsulation efficiency (EE%) was $29,4\% \pm 0,5$, even though each ACN displayed different behaviour ($p < 0.05$), with a retention that seemed to be dependent on the acylated and glycosylated moieties. In particular, diacylated and/or triglycosylated ACNs were entrapped more efficiently compared to the non-acylated/monoacylated-diglycosylated forms, suggesting that the physiochemical characteristics of each ACN may affect the interaction with the protein-polysaccharide shell.

Even though further efforts are needed to elucidate the nature of the interaction between the different ACNs and the shell components and whether this could influence their bioaccessibility, these results outline a stable and cost-effective process to valorise agri-food by-products in a circular economy perspective and that could be potentially employed to encapsulate ACNs from other sources.

References

- [1] R. Mattioli, A. Francioso, L. Mosca, P. Silva, *Molecules*, **2020**, 25, 1.
- [2] J. E. Farr, G. T. Sigurdson, M. M. Giusti, *Food Chemistry*, **2019**, 278, 443.
- [3] B. Enaru, G. Dreţcanu, T. D. Pop, A. Stănilă, Z. Diaconeasa, *Antioxidants*, **2021**, 10, 1.
- [4] J. Grgić, G. Šelo, M. Planinić, M. Tišma, A. Bucić-Kojić, *Antioxidants*, **2020**, 9(10), 923.

INDICE DEGLI AUTORI

LEGENDA:

C = Comunicazione

Chignola R.

C19, C51