SUPPLEMENTARY MATERIAL

Sustainable micro-scale extraction of bioactive phenolic compounds from *Vitis vinifera* leaves with ionic liquid-based surfactants

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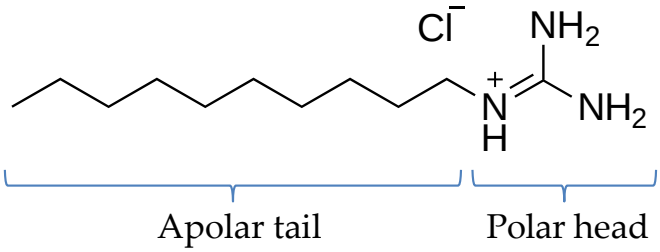
A) C_{10}Gu-Cl

MW = 235.18 g·mol^{-1}
CMC = 21 mM



B) $C_{16}C_4$Im-Br

MW = 428.28 g·mol^{-1}
CMC = 0.1 mM

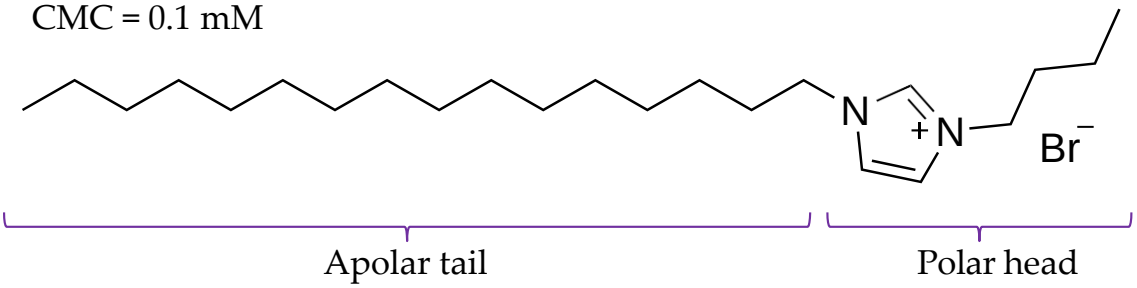


Figure S1. Chemical structure and main characteristics of the IL-based surfactants used in this study.

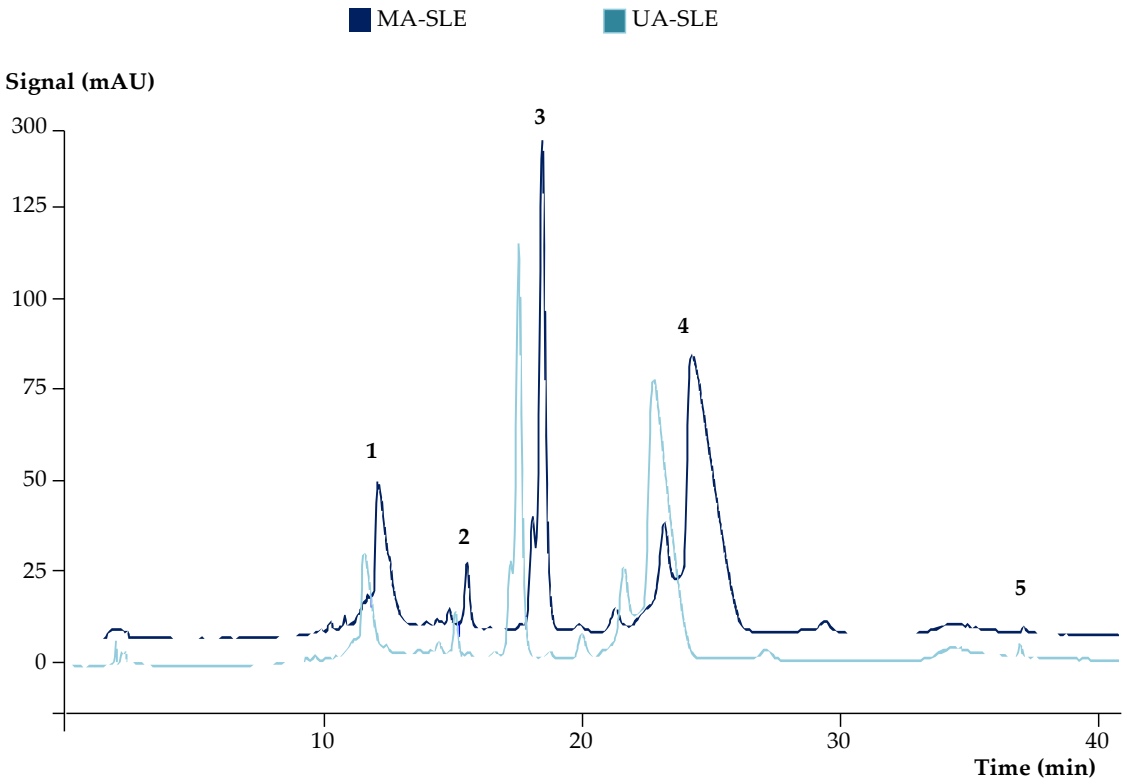


Figure S2. Representative chromatograms obtained for the analysis of the Piedmont leaves (Italian cultivar mix) using the proposed MA-SLE-HPLC-PDA method with the $C_{16}C_4$Im- Br IL-based surfactant, and the UA-SLE-HPLC-PDA method (reproduced from Acquadro *et al.*, 2020). There is an offset of 4% in the signal axis to overlap the chromatograms. 1: CA, 2: RU, 3: QUGlucos, 4: QUGlucur, 5: QU.

Acquadro, S., Appleton, S., Marengo, A., Bicchi, C., Sgorbini, B., Mandrone, M., Gai, F., Peiretti, P. G., Cagliero, C., & Rubiolo, P. (2020). Grapevine Green Pruning Residues as a Promising and Sustainable Source of Bioactive Phenolic Compounds. *Molecules*, *25*, 464.

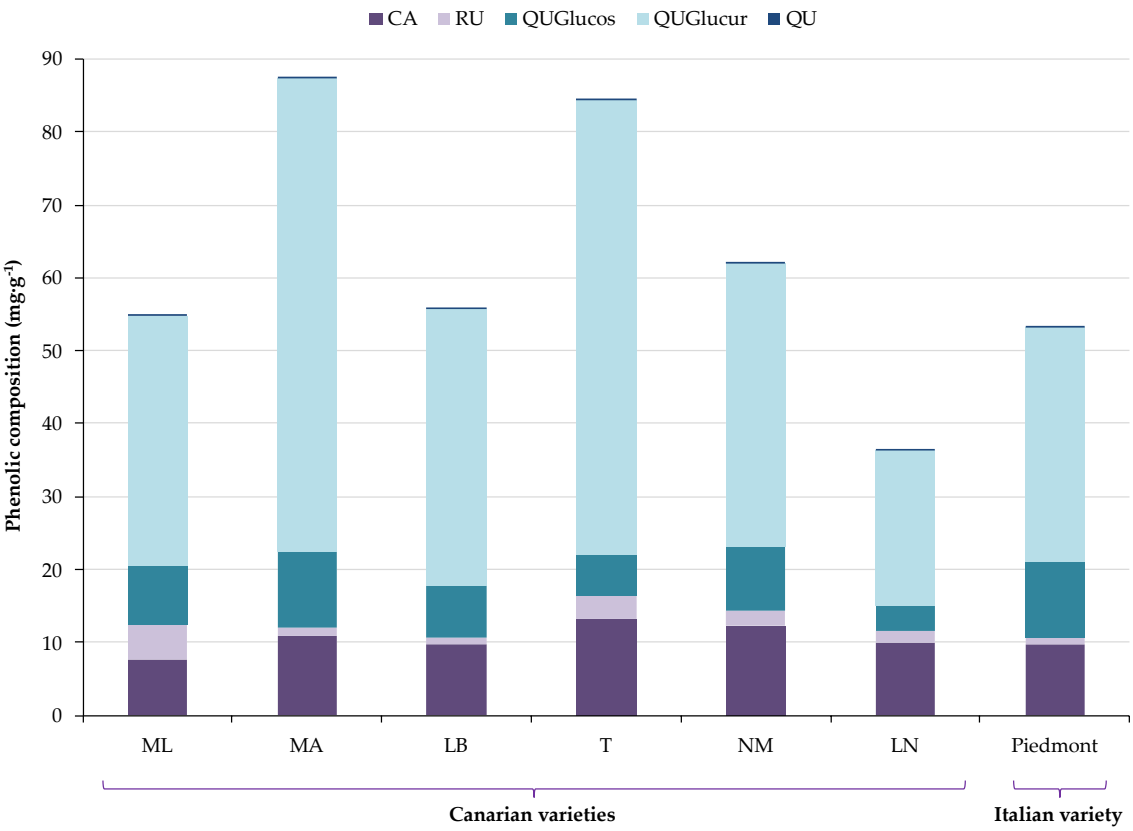


Figure S3. Phenolic composition of the different *Vitis vinifera* varieties analyzed in this study with the proposed MA-SLE method using the $C_{16}C_4$Im-Br IL-based surfactant.

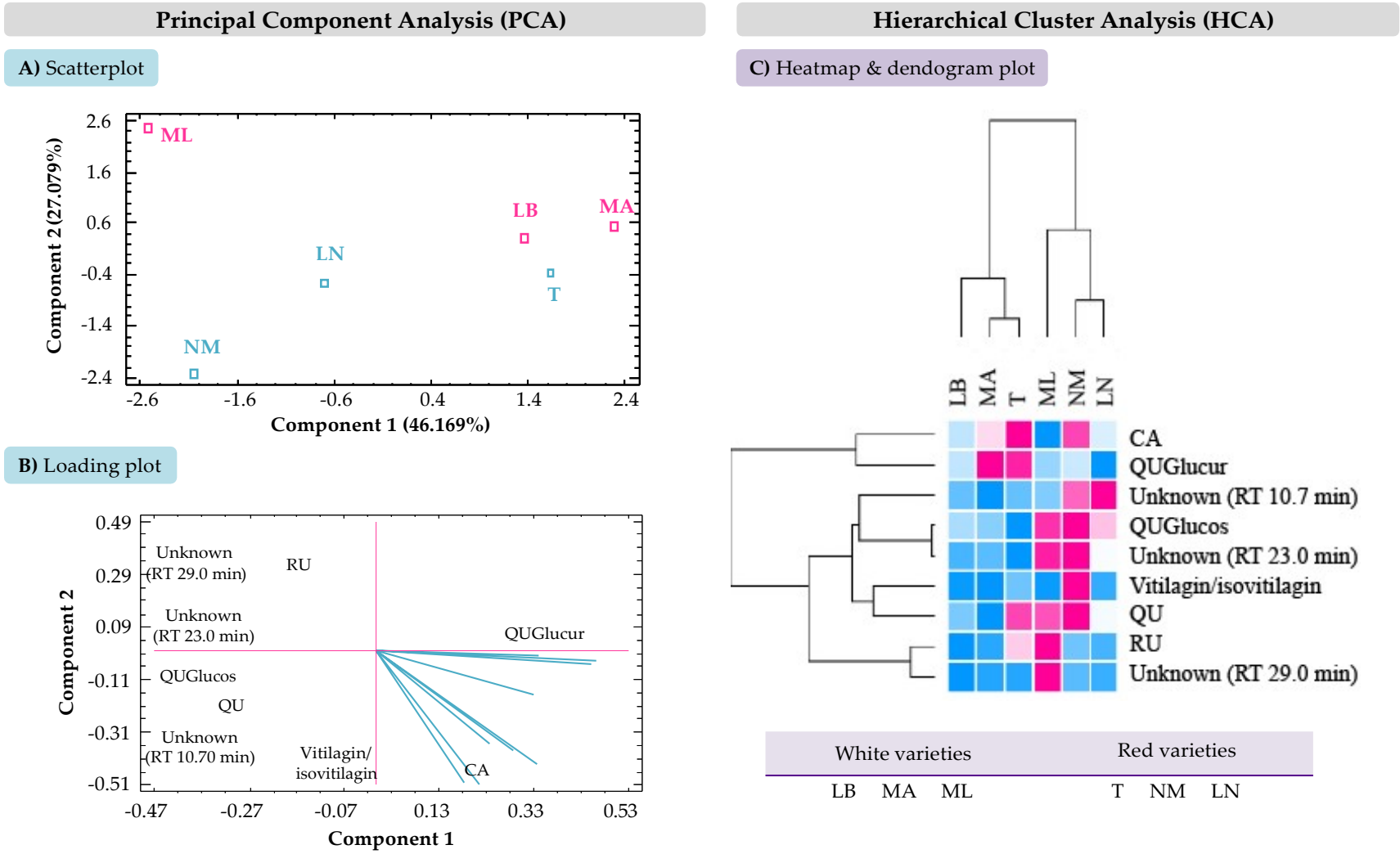


Figure S4. Results obtained with different statistical analysis using the data obtained for the analysis of Canarian cultivars with the proposed method: **A)** Scatterplot of the scores obtained for the different varieties of Canarian cultivars by Principal Component Analysis (PCA). **B)** Loading plot showing the weights of the phenolic compound on the principal components. **C)** Correlation between the Canarian varieties and the phenolic content by hierarchical clustering (HCA) using one minus Pearson's correlation coefficient.

Table S1. Design matrix for the screening analysis, a 2^3 factorial design and 3 central points, in the optimization of the MA-SLE method.

Experiment	IL-based surfactant concentration (mM)	MW temperature (°C)	MW time (min)
1	2.5	55	15
2	2.5	55	40
3	2.5	75	15
4	2.5	75	40
5	12.5	55	15
6	12.5	55	40
7	12.5	75	15
8	12.5	75	40
9	7.5	65	27.5
10	7.5	65	27.5
11	7.5	65	27.5

Table S2. Matrix of the experiments of the Doehlert design used in the optimization of the MA-SLE method, including the coded values and the operating values.

Experiment	IL-based surfactant concentration (mM)		MW time (min)	
	C_1	X_1	C_2	X_2
1	0	1.3	0	32.5
2	1	2.5	0	32.5
3	0.5	1.9	0.866	50
4	-1	0.1	0	32.5
5	-0.5	0.7	-0.866	15
6	0.5	1.9	-0.866	15
7	-0.5	0.7	0.866	50
8	0	1.3	0	32.5
9	0	1.3	0	32.5

C_1 and C_2 are the coded values for the levels of IL-based surfactant concentration (mM) and time of MW treatment (min), respectively.

The relationship between coded and real values is given by: $C_i = \frac{X_i - X_i^o}{\Delta X_i} \alpha$

where C_i is the coded value for the level of factor i, X_i is its real value in an experiment, X^o_i is the real value at the center of the experimental domain, ΔX_i is the step of variation of the real value, and α is the coded value limit for each factor.

The number of experiments required (N) is given by $N = k^2 + k + C_0$, where k is the number of variables and C_o is the number of center points.

Table S3. Several quality analytical parameters of the HPLC-PDA method.

Compound	λ[a] (nm)	Linear range (mg·L^{-1})	Slope ± SD[b]	$S_{y/x}$[c]	R^2[d]	LOD[e] (mg·L^{-1})	LOQ[f] (mg·L^{-1})
CA	320	5 – 650	11154 ± 664	272	0.997	3.0	5.0
RU	360	5 – 500	19604 ± 2422	872	0.992	1.0	3.3
QUGlucos	360	5 – 500	13460 ± 513	199	0.999	1.0	3.3
QUGlucur	360	5 – 500	5560 ± 283	110	0.998	1.0	3.3
QU	360	5 – 500	20014 ± 937	338	0.999	0.5	1.7

[a] wavelength used for quantification

[b] standard deviation within the calibration range for n = 7 calibration levels

[c] standard deviation of the residuals or error of the estimate

[d] determination coefficient

[e] limit of detection, determined by decreasing the concentration of the standards until a S/N ratio of 3 was obtained

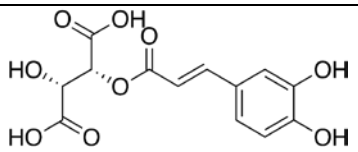
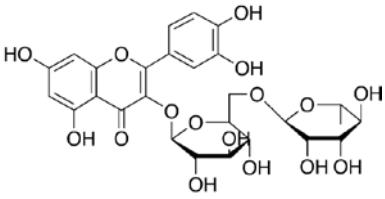
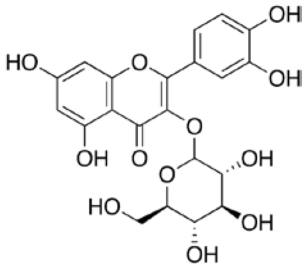
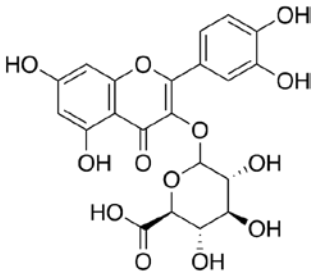
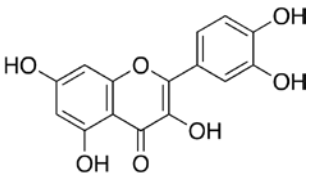
[f] limit of quantification, estimated as 10/3 times the LOD, and experimentally verified using standards at the predicted concentrations

Tables S4. *Vitis vinifera* leaves varieties from Canary Islands, employed for the determination and quantification of phenolic markers.

Variety name (abbreviation)	Classification	Leaf anatomy[a]
Malvasía Lanzarote (ML)	White v.	
Moscatel Alejandría (MA)	White v.	
Listán Blanco (LB)	White v.	
Tintilla (T)	Red v.	
Negro Moll (NM)	Red v.	
Listán Negro (LN)	Red v.	

[a] photos of the samples used in the study

Table S5. Chemical structures and physicochemical properties of the phenolic compounds determined in this study, obtained from SciFinder® 2020 database.

Analyte	Chemical structure	Type	MW (g·mol^{-1})	pK$_a$	Log K$_{ow}$[a]
CA		phenolic acid	312.23	2.18	1.15
RU		flavonoid	610.52	6.17	-0.90
QUGlucos		flavonoid	464.38	6.17	-0.11
QUGlucur		flavonoid	478.36	2.76	0.62
QU		flavonoid	302.24	6.31	1.99

[a] logarithm of octanol/water partition coefficient at 25 ºC.