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Supplementary material

Towards better quality criteria of European honeydew honey: phenolic profile and antioxidative capacity

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Table S1. Parameters of descriptive statistics of the physicochemical parameters of the honeydew honey

Botanical origin	Parameter	ω [%]	EC [mS/cm]	pH	SR [α 20]	FA [meq/kg]	LA [meq/kg]	TA [meq/kg]
Abies alba Mill. (n = 22)	mean	15.8	0.91	4.6	49.5	30.6	3.1	33.7
	mediana	15.8	0.91	4.7	61.5	25.5	2.0	27.3
	st dev	1.6	0.13	0.5	28.8	13.7	3.3	16.1
	range	13.3-19.7	0.69-1.11	3.7-5.3	3.1-85.5	14.3-56.8	0.2-14.7	15.8-66.8
Conifers (n = 17)	mean	16.2	0.97	4.5	32.6	31.7	2.6	34.4
	mediana	16.8	0.98	4.5	24.47	24.7	1.5	26.2
	st dev	1.7	0.18	0.4	30.4	15.9	2.8	18.3
	range	13.1-19.3	0.72-1.25	3.7-5.1	0.6-84.3	18.5-64.8	1.0-9.6	20.1-70.3
Quercus ilex L. (n = 15)	mean	15.0	1.29	4.7	24.6	35.4	2.3	37.8
	mediana	14.7	1.32	4.7	8.0	33.4	2.0	36.5
	st dev	1.3	0.15	0.4	31.5	9.7	1.9	10.5
	range	13.2-17.8	1.01-1.47	3.9-5.2	1.7-97.2	26.5-66.4	0.5-7.1	27.5-70.9
Quercus frainetto Ten. (n = 4)	mean	14.9	1.13	4.1	61.4	78.6	16.5	95.1
	mediana	14.9	1.13	4.1	81.8	78.6	16.5	95.1
	st dev	1.2	0.14	0.4	53.5	30.9	14.1	44.9
	range	14.0-15.7	1.03-1.23	3.8-4.3	0.7-101.8	56.8-100.3	6.6-26.4	63.4-126.8
Acer monspessulanum L. (n = 6)	mean	15.0	0.99	4.4	55.4	40.0	5.4	45.4
	mediana	14.9	1.02	4.3	66.1	37.7	5.8	43.5
	st dev	0.7	0.25	0.4	31.3	18.4	3.8	22.0
	range	14.3-16.1	0.73-1.30	3.7-4.9	7.1-90.3	22.3-61.6	1.0-9.1	24.3-70.2

Table S2. Presence of certain phenolic compounds in the honeydew honey samples

Peak No	t_R, min	Compound name	Botanical origin of honeydew honey[b]				
			Conifers	Silver fir	Evergreen oak	Hungarian oak	Montpellier maple
1	4.20	Dihydroxybenzoic acid hexoside	+	+	+	+	+
2	4.44	Protocatechuic acid[a]	+	+	+	+	+
3	4.51	Hydroxybenzoic acid hexoside I	+	+	+	+	+
4	4.74	Caffeic acid hexoside I	+	+	+	+	+
5	4.91	Aesculetin 6-*O*-glucoside (Aesculin)[a]	+	+	+	+	+
6	4.92	Hydroxybenzoic acid hexoside II	+	+	+	+	+
7	5.10	Caffeic acid hexoside II	+	+	+	+	+
8	5.26	5-*O*-Caffeoylquinic acid[a]	+	+	+	+	+
9	5.41	*p*-Hydroxybenzoic acid[a]	+	+	+	+	+
10	5.48	Gentisic acid[a]	+	+	+	+	+
11	5.62	*p*-Hydroxyphenylacetic acid[a]	+	+	+	+	+
12	5.63	Vanillic acid[a]	+	+	+	+	+
13	5.77	Aesculetin[a]	+	+	+	+	+
14	5.80	Caffeic acid[a]	+	+	+	+	+
15	5.83	Quercetin 3-*O*-(2"-hexosyl)hexoside	–	–	+	–	+
16	6.13	Methoxy kaempferol 3-*O*-(2"-hexosyl)hexoside	+	+	+	+	+
17	6.39	Kaempferol 7-*O*-(6"-hexosyl)hexoside	+	+	+	+	+
18	6.44	Quercetin 3-*O*-(6"-rhamnosyl)glucoside (Rutin)[a]	+	+	+	+	+
19	6.45	Kaempferol 3-*O*-(2"-rhamnosyl)hexoside	+	+	+	–	+
20	6.68	*p*-Coumaric acid[a]	+	+	+	+	+
21	6.71	Quercetin 3-*O*-glucoside[a]	+	+	+	+	+
22	7.02	Sinapic acid[a]	+	+	+	+	+
23	7.03	Naringenin 7-*O*-(2"-rhamosyl)glucoside (Naringin)[a]	+	+	+	+	+
24	7.04	Ferulic acid[a]	+	+	+	+	+
25	7.17	Quercetin 3-*O*-rhamnoside[a]	+	+	+	+	+
26	7.90	Coniferyl aldehyde[a]	+	+	+	+	+
27	7.98	Luteolin 7-*O*-rhamnoside	–	–	+	–	–
28	8.24	Quercetin[a]	+	–	+	+	+
29	8.40	Kaempferol 7-*O*-rhamnoside	–	–	+	–	–
30	8.59	Eriodictyol[a]	+	+	+	+	+
31	8.69	Luteolin[a]	+	+	+	+	+

32	9.33	Tectochrysin	−	−	+	−	−
33	9.44	Naringenin[a]	+	+	+	+	+
34	9.52	Apigenin[a]	+	+	+	+	+
35	9.53	Genistein[a]	+	+	+	+	+
36	9.66	Methoxy kaempferol	+	+	+	+	+
37	9.70	Kaempferol[a]	+	+	+	+	+
38	9.74	Pinobanksin[a]	+	+	+	+	+
39	9.87	Isorhamnetin[a]	+	+	+	+	+
40	9.94	Chrysoeriol[a]	+	+	+	+	+
41	10.19	Dimethyl quercetin	−	−	+	−	−
42	10.65	Rhamnetin	+	+	+	+	+
43	10.67	Rhamnocitrin	−	+	+	+	−
44	10.75	Genkwanin[a]	+	+	+	+	+
45	11.02	Tricin	+	+	+	+	−
46	11.30	Benzyl caffeate	−	+	+	+	−
47	11.61	Chrysin[a]	+	+	+	+	+
48	11.70	Pinocembrin[a]	+	+	+	+	+
49	11.82	Kaempferide[a]	+	+	+	+	+
50	11.84	Galangin[a]	+	+	+	+	+
51	12.20	Acacetin[a]	+	+	+	+	+
52	12.72	Pinobanksin 3-*O*-propionate	−	−	+	+	−

[a] Confirmed using standards;

[b] Phenolic compound was considered present in honeydew honey of particular botanical origin if it was found in more than 80% samples of that origin: "+" detected; "−" not detected.

Table S3. Kruskal Wallis test

Parameter	Kruskal Wallis	
	P	**Multiple Comparison Z-value Test**[a]
EC	< 0.0001	E(S,M,C)[b]
FA	0.0211	S,C(E,H)
SR	0.0233	H(C,E)
TA	0.0262	S(E,H) C(E)
TPC	< 0.0001	S,C(M,H,E)
RSA	< 0.0001	S,C(M,H,E)
CV	< 0.0001	S,C(M,H,E)
PrA	< 0.0001	S(M,H,E)
HPA	< 0.0001	S(M,H,E) C(M,H,E)
VA	0.0196	C,H(M,E)
CouA	0.0003	E(S,C,H)
FA	0.0032	E(S,C,H)
Lut	0.0434	H(M,C)
Nar	0.0024	H(S,M,E)
Que	0.0016	S(E,H)
Api	< 0.0001	S(E,C)
Gen	0.0061	S,C(M,H,E)
Kfrl	0.0027	S(E,C)

[a] Regular test: Medians significantly different if z-value > 1.9600

[b] S - Silver fir; M - Montpellier maple; C - Conifers; H - Hungarian oak; E - Evergreen oak

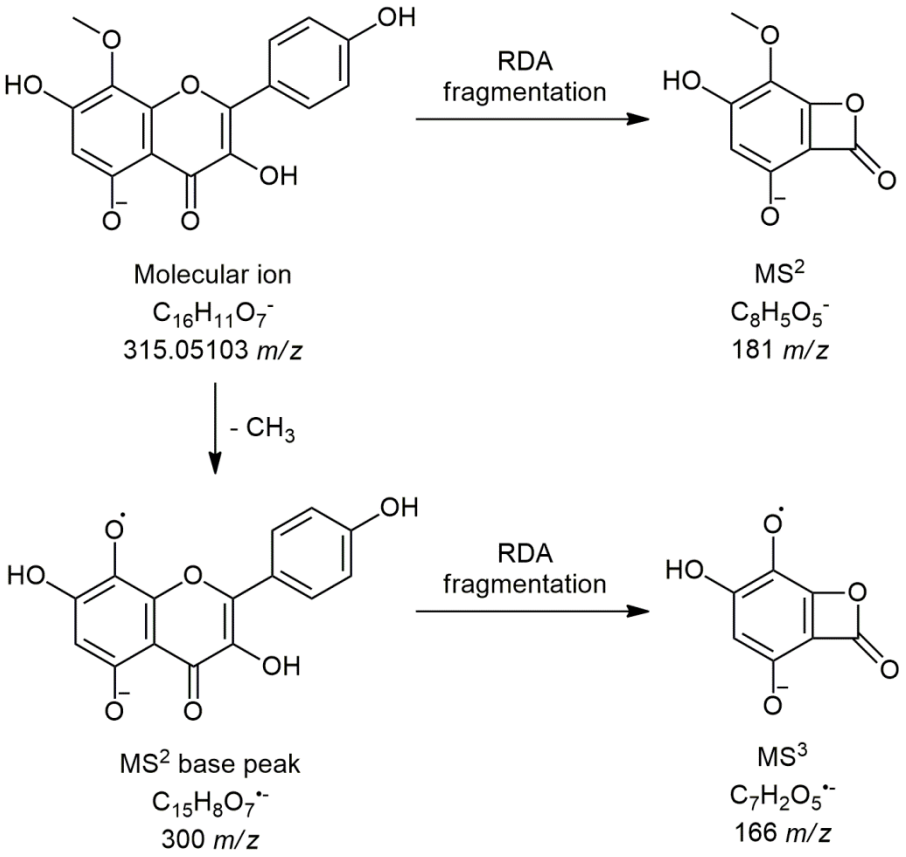

RDA
fragmentation
Molecular ion
C16H11O7-
315.05103 m/z
MS2
C8H5O5-
181 m/z
- CH3
MS2 base peak
C15H8O7•-
300 m/z
RDA
fragmentation
MS3
C7H2O5•-
166 m/z

Figure S1.

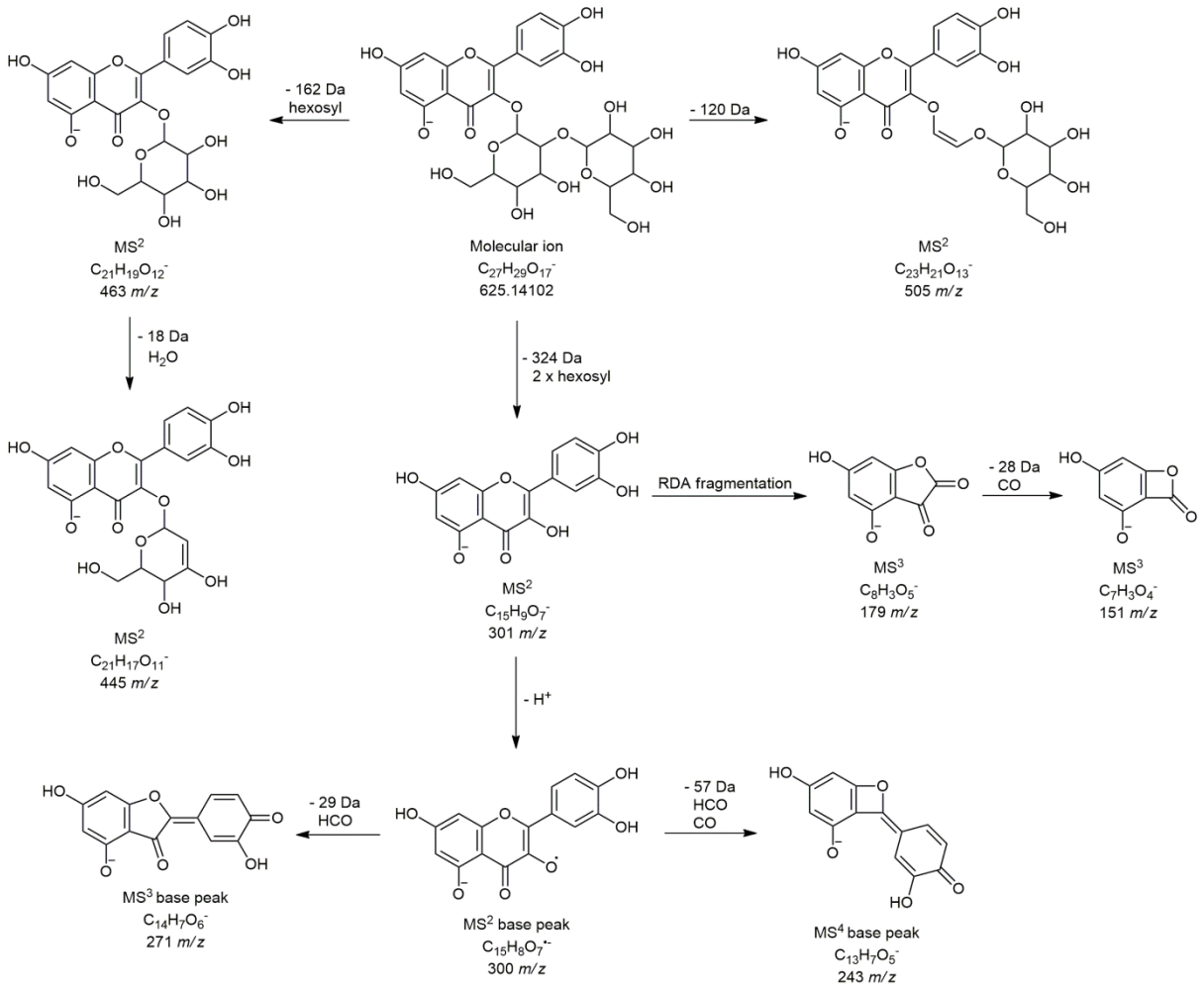
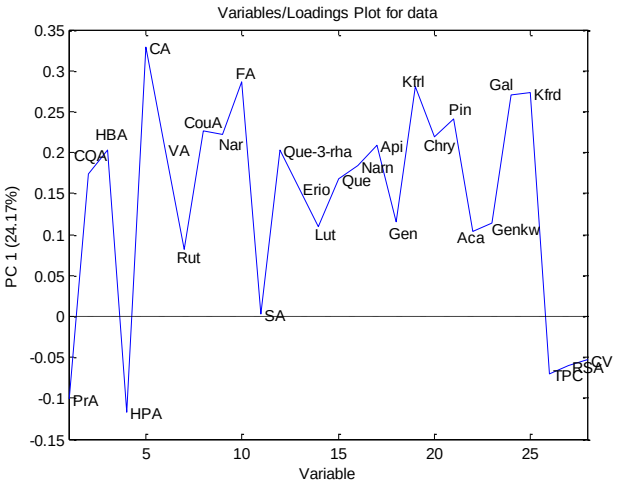
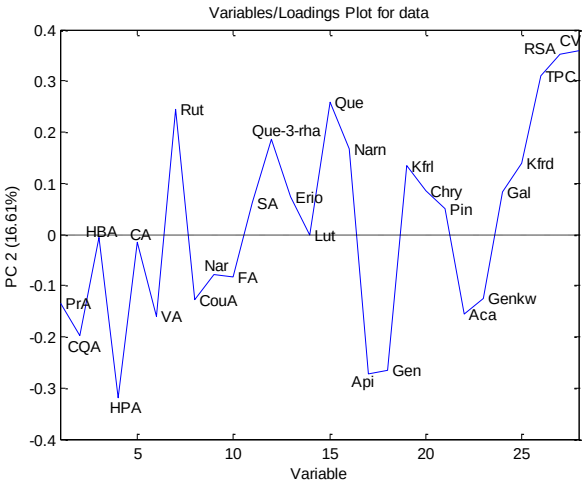
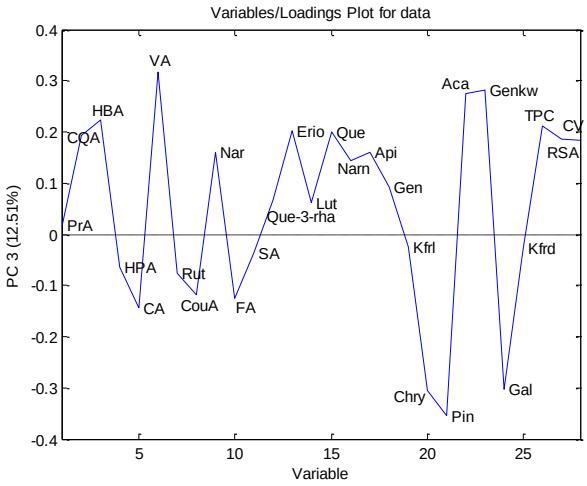
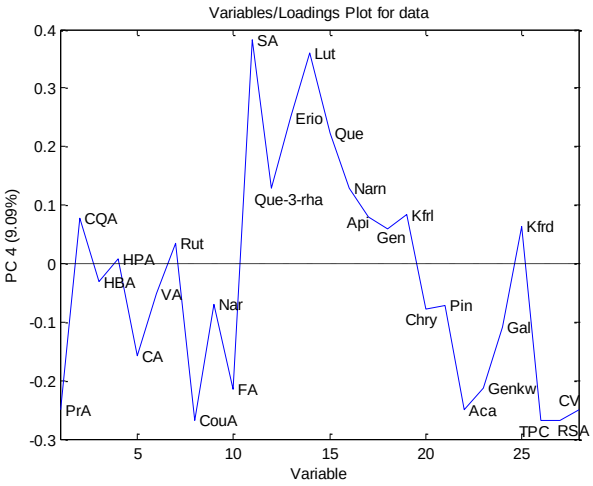

- 162 Da
hexosyl
- 120 Da
MS2
C21H19O12-
463 m/z
Molecular ion
C27H29O17-
625.14102
MS2
C23H21O13-
505 m/z
- 18 Da
H2O
- 324 Da
2 x hexosyl
MS2
C21H17O11-
445 m/z
RDA fragmentation
MS2
C15H9O7-
301 m/z
MS3
C8H3O5-
179 m/z
- 28 Da
CO
MS3
C7H3O4-
151 m/z
- H+
- 29 Da
HCO
- 57 Da
HCO
CO
MS3 base peak
C14H7O6-
271 m/z
MS2 base peak
C15H8O7•-
300 m/z
MS4 base peak
C13H7O5-
243 m/z

Figure S2.


Variables/Loadings Plot for data
PC 1 (24.17%)
Variable
CA
FA
Kfrl
Gal
Kfrl
Pin
HBA
CQA
CouA
VA
Nar
Chry
Que-3-rha
Api
Nam
Que
Erio
Lut
Gen
Aca
Genkw
Rut
SA
CV
RSA
TPC
PrA
HPA


Variables/Loadings Plot for data
PC 2 (16.61%)
Variable
RSA
CV
TPC
Rut
Que
Que-3-rha
Nam
Kfrl
Kfrd
Chry
Pin
Gal
SA
Erio
HBA
CA
Lut
Nar
FA
PrA
CouA
Genkw
Aca
VA
CQA
Api
Gen
HPA


Variables/Loadings Plot for data
PC 3 (12.51%)
Variable
VA
Aca
Genkw
HBA
TPC
CV
CQA
Erio
Que
Nar
Api
RSA
Nam
Gen
Lut
PrA
Que-3-rha
SA
HPA
Kfrl
Kfrd
Rut
CA
CouA
FA
Chry
Pin
Gal


Variables/Loadings Plot for data
PC 4 (9.09%)
Variable
SA
Lut
Erio
Que
Que-3-rha
Nam
Api
Kfrl
Gen
Kfrd
CQA
Rut
HPA
HBA
VA
Nar
Chry
Pin
CA
Gal
FA
Genkw
PrA
CouA
Aca
CV
TPC
RSA

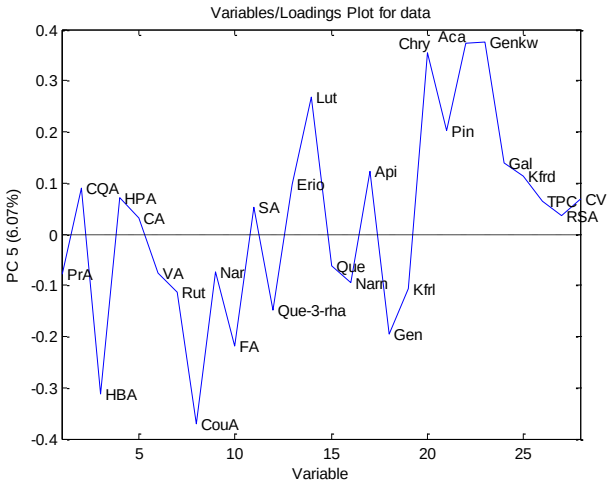

Variables/Loadings Plot for data
PC 5 (6.07%)
Variable
Chry
Aca
Genkw
Lut
Pin
Gal
Kfrd
Erio
Api
CQA
HPA
TPC
CV
CA
SA
RSA
PrA
VA
Nar
Que
Rut
Nam
Kfrl
Que-3-rha
Gen
FA
HBA
CouA

Figure S3.