<*Arabian Journal of Chemistry*>

Supporting Information

Holistic quality evaluation of Saposhnikoviae Radix (*Saposhnikovia divaricata*) by reversed-phase ultra-high performance liquid chromatography and hydrophilic interaction chromatography coupled with ion mobility quadrupole time-of-flight mass spectrometry-based untargeted metabolomics

Simiao Wang[1,2,a], Yuexin Qian[1,2,a], Mengxiao Sun[1,2,a], Li Jia[1,2], Ying Hu[1], Xue Li[1,2], Hongda Wang[1,2], Jinhai Huo[3], Weiming Wang[3,*], Wenzhi Yang[1,2,*]

[1] *State Key Laboratory of Component-based Chinese Medicine, Tianjin University of Traditional Chinese Medicine, 10 Poyanghu Road, Jinghai, Tianjin 301617, China*

[2] *Tianjin Key Laboratory of TCM Chemistry and Analysis, Tianjin University of Traditional Chinese Medicine, 10 Poyanghu Road, Jinghai, Tianjin 301617, China*

[3] *Institute of Chinese Materia Medica, Heilongjiang Academy of Chinese Medicine Sciences, Harbin 150036, China*

[a] These authors contributed equally to this work.

[*] Corresponding author:

E-mail addresses: zyyjy@163.com (W.M. Wang), wzyang0504@tjutcm.edu.cn (W.Z. Yang).

Contents

developed UHPLC-UV method.

Validation of a UHPLC-UV approach for quantitative determination of prim-O-glucosylcimifugin (PGC) and 4'-O-β-D-glucosyl-5-O-methylvisamminol (GMV)

Preparation of the solutions of standards and samples

Stock solutions of PGC and GMV (1 mg/mL) were prepared in HPLC-grade methanol and stored at 4°C. Working solutions were prepared by appropriate dilutions of the stock solutions in methanol, including 10 different concentration levels: 5 μg/mL, 10 μg/mL, 25 μg/mL, 50 μg/mL, 150 μg/mL, 300 μg/mL, 500 μg/mL, 600 μg/mL, 800 μg/mL, and 1000 μg/mL. The obtained standard solutions were centrifuged at 14,000 rpm for 10 min, and the resulting supernatant was stored at 4°C prior to the UHPLC-UV analysis.

LOD, LOQ, and Linearity

The limit of detection (LOD, S/N = 3) and limit of quantification (LOQ, S/N = 10) were determined for each analyte under the optimized chromatographic conditions. The linear calibration curve was constructed as a function of the concentration of the standard constituents (x) versus their peak area (y) for PGC and GMV at different concentration levels. The results are presented in Table S5.

Precision

Intra-day and inter-day precisions and accuracy were determined by assaying 3 different concentrations of PGC and GMV. The experiment was repeated by three times on the same day and also on three consecutive days. Precision was expressed in terms of the RSD (%) of the determined contents of two analytes. The results are given in Table S6.

Repeatability

Six samples of the Saposhnikoviae Radix sample No. 23 were accurately weighed and extracted in parallel. The content was calculated according to the regression equation curve. The results are presented in Table S7.

Stability

The same Saposhnikoviae Radix sample (No. 23) was determined at 0 h, 2 h, 4 h, 6 h, 8 h, 14 h, 24 h, 36 h, and 48 h, to evaluate the stability. The contents of two analytes were calculated according to the regression equation curves. The results are presented in Table S8.

Recovery

Nine copies of 125 mg (a half of the amount for preparing the test solution) of Saposhnikoviae Radix were weighed, and each three copies were added with three concentration levels of mixed standard solutions (high, medium and low equivalent to the 150%, 100%, and 50% of the original amount). The samples were extracted by the method described for preparing the test solution. Recovery was measured according to the equation: (Determined amount – Original amount)/Spiked amount×100%. The results are presented in Table S9.

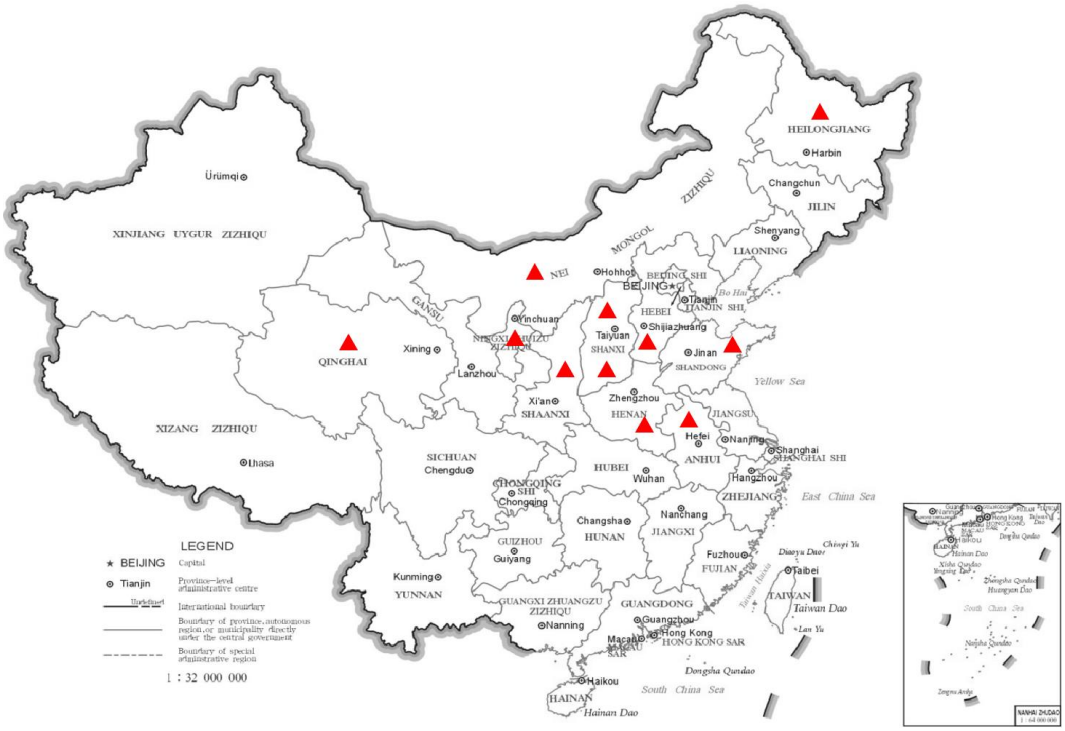

Fig. S1 A distribution illustration map of China for the 64 batches of *Saposhnikovia divaricate* samples analyzed in the current work.

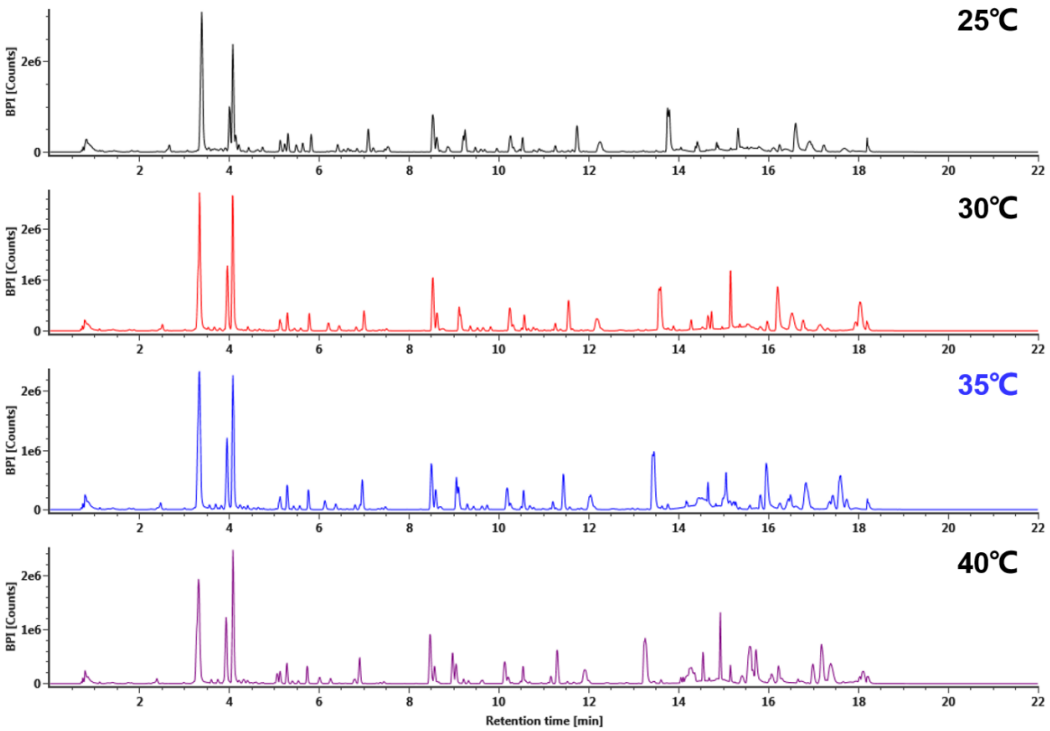

Fig. S2 Comparison of column temperature (BEH C18 column) in UHP-RP mode for separating the multicomponents from *Saposhnikovia divaricata*.

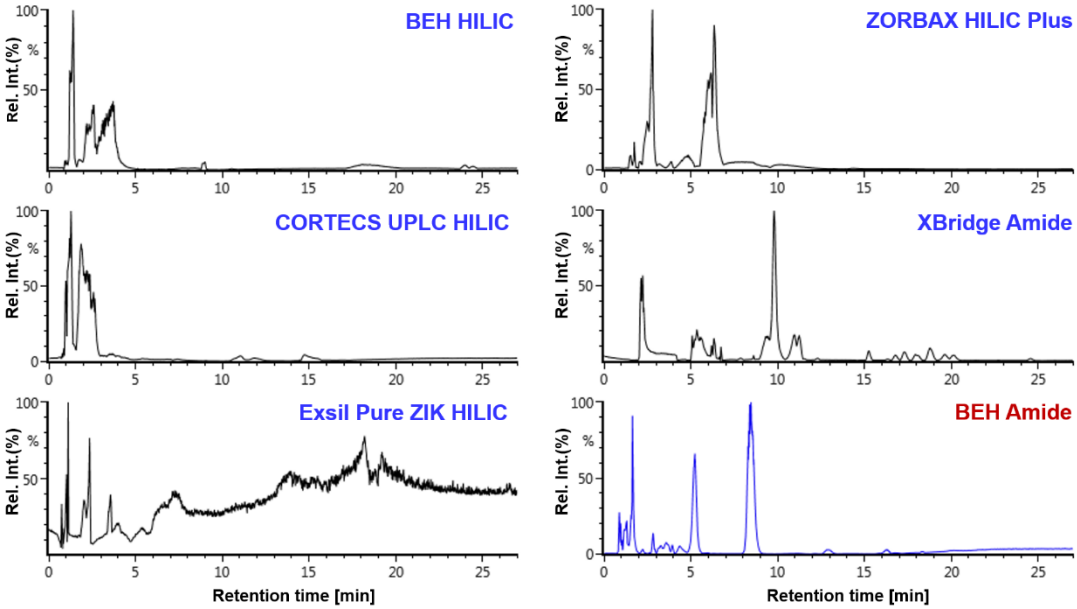

Fig. S3 Comparison of six candidate HILIC columns for separating the multicomponents from *Saposhnikovia divaricata*.

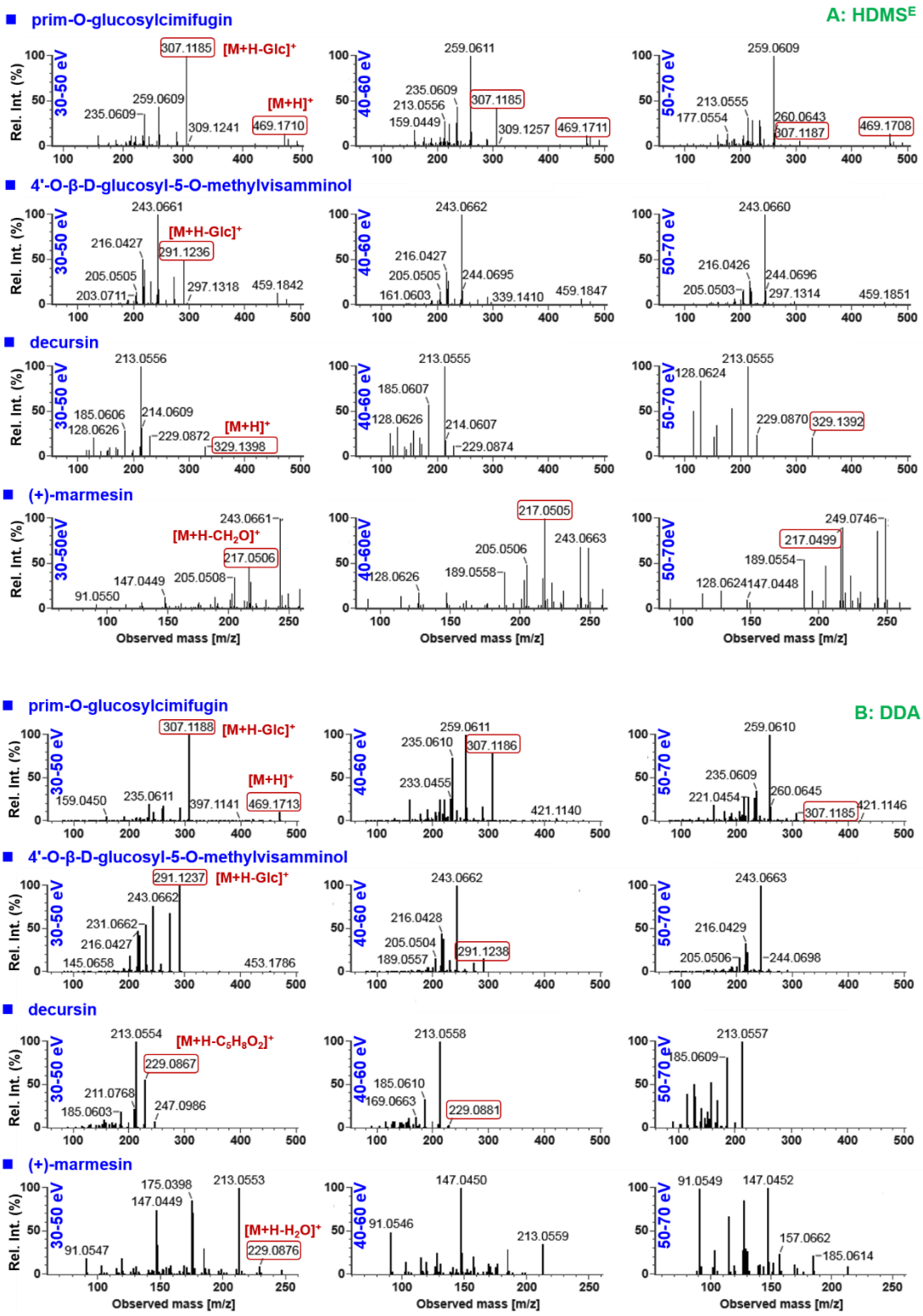

Fig. S4 Optimization of the collision energy for HDMS^{E} (**A**) and DDA (**B**) using four representative reference compounds.

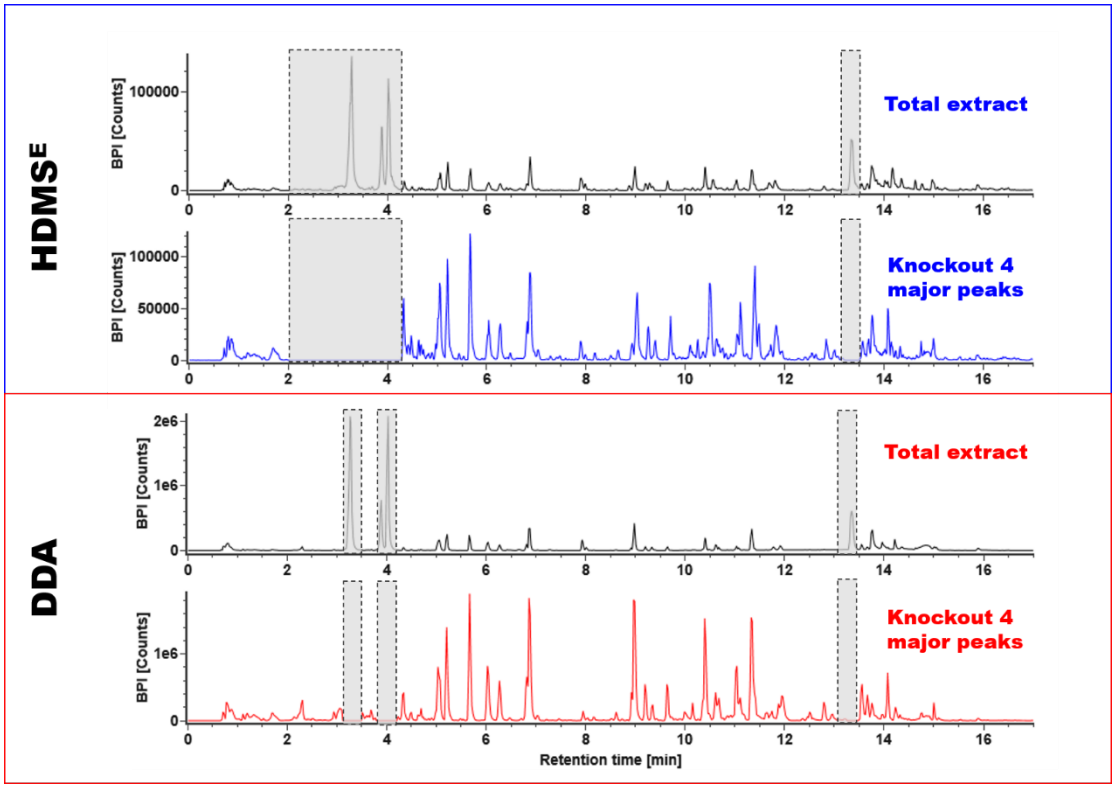

Fig. S5 Base peak chromatograms obtained by HDMS^{E} and DDA prior to (1 mg/mL of Saposhnikoviae Radix; 3 µL injected) and after (10 mg/mL of Saposhnikoviae Radix; 3 µL injected) knocking out the major components. The elutes at 2–4.25 min and 13.2–13.5 min in HDMS^{E} and 3.1–3.5 min, 3.78–4.2 min, 13.24–13.48 min, 18–18.5 min in DDA, were automatically switched to waste.

Table S1 Information of 64 batches of *Saposhnikovia divaricata* samples analyzed in the current work.

Number	Age (year)	Origin
1	1	Neimenggu
2		
3		
4		
5		
6		
7		
8		
9	2	
10		
11		
12		
13		
14		
15		
16		
17		
18	3	
19		
20		
21		
22		
23		
24		
25		
26	1	Hebei
27		
28		
29		
30		
31	2	
32		
33		
34		
35		
36	3	
37		
38		

39		
40		
41		
44	3	Henan
45		Heilongjiang
46		Henan
47		Inner Mongolia
48		Hebei
49		Qinghai
50	1	Shanxi (山西)
51		Anhui
52		Shandong
53		Shanxi (陕西)
54		Gansu
55		Ningxia
42	1	
43		
56	2	
57		
58		
59		Heilongjiang
60	3	
61		
62		
63	4	
64		

Table S2 Information of 24 reference compounds used in the current work.

No.	Compound	M.F.	Exact Mass	Subclass
1	psoralen	$C_{11}H_6O_3$	186.0317	Coumarin
2	5-methoxypsoralen	$C_{12}H_8O_4$	216.0423	
3	methoxsalen	$C_{12}H_8O_4$	216.0423	
4	isopimpinellin	$C_{13}H_{10}O_5$	246.0528	
5	imperatorin	$C_{16}H_{14}O_4$	270.0892	
6	phelloterin	$C_{17}H_{16}O_5$	300.0998	
7	isoimperatorin	$C_{16}H_{14}O_4$	270.0892	
8	(+)-marmesin	$C_{14}H_{14}O_4$	246.0892	
9	nodakenin	$C_{20}H_{24}O_9$	408.1420	
10	umbelliferone	$C_9H_6O_3$	162.0317	
11	7-hydroxy-6,8-dimethoxychromen-2-one	$C_{11}H_{10}O_5$	222.0528	
12	scopoletin	$C_{10}H_8O_4$	192.0423	
13	decursin	$C_{19}H_{20}O_5$	328.1311	
14	5-methoxyfuro[2,3-h]chromen-2-one	$C_{12}H_8O_4$	216.0423	
15	4'-O-*β*-D-glucosyl-5-O-methylvisamminol	$C_{22}H_{28}O_{10}$	452.1682	Chromone
16	cimifugin	$C_{16}H_{18}O_6$	306.1103	
17	prim-O-glucosylcimifugin	$C_{22}H_{28}O_{11}$	468.1632	
18	sec-O-glucosylhamaudol	$C_{21}H_{26}O_{10}$	438.1526	
19	tectochrysin	$C_{16}H_{12}O_4$	268.0736	Flavonoid
20	quercetin	$C_{15}H_{10}O_7$	302.0427	
21	rutin	$C_{27}H_{30}O_{16}$	610.1534	
22	wogonin	$C_{16}H_{12}O_5$	284.0685	
23	*trans*-ferulic acid	$C_{10}H_{10}O_4$	194.0579	Organic acids
24	adenosine	$C_{10}H_{13}N_5O_4$	267.0968	Nucleoside

Table S4 Information of the multicomponents characterized from Saposhnikoviae Radix in the current work.

NO.	Observed RT (min)	Observed *m/z*	Exact Mass	Formula	Mass error (ppm)	Adducts	Observed CCS (Å²)	ESI-MS²	Identification	Subclass	Data Source
1	0.93	261.1851	260.1776	$C_{17}H_{24}O_2$	0.7	+H	171.63	243.0655,229.0502,217.0498,205.0497,189.0551, 165.0918,149.0238,119.0855,91.0544	panaxydol	Polyacetylene	HILIC/HDMS^E
2	0.94	329.1385	328.1311	$C_{19}H_{20}O_5$	0.3	+H	177.49	307.1179,290.1150,261.1123,243.0655,229.0502, 217.0498,205.0497,189.0551	deltoin	Coumarin	HILIC/HDMS^E
3	0.97	261.1127	260.1049	$C_{15}H_{16}O_4$	2.2	+H	154.31	205.0507,177.0562,163.0403,135.0433	5-methoxy-7-(3,3-dimethylallyloxy)coumarin	Coumarin	HILIC/DDA+HDMS^E
4	1.15	268.1049	267.0968	$C_{10}H_{13}N_5O_4$	3.2	+H	154.49	226.0623,136.0623,119.0364,94.0401	adenosine*	Nucleotide	RP+HILIC/DDA+HDMS^E
5	1.32	283.2645	282.2559	$C_{18}H_{34}O_2$	4.7	+H	189.81	262.2537,256.2638,243.0655,236.1492,219.0652, 191.0696	oleic acid	Aliphatic acid	HILIC/DDA+HDMS^E
6	2.44	485.1658	484.1581	$C_{22}H_{28}O_{12}$	0.9	+H	—	467.1522,409.1139,323.1132,305.1032,277.1081, 259.0972,247.0609,235.0602,217.0867,205.0505, 189.0562,159.0460	Didehydro prim-O-glucosylcimifugin-H_2O	Chromone	RP/DDA
7	3.01	355.1030	354.0951	$C_{16}H_{18}O_9$	1.7	+H	212.19	308.1224,290.1152,259.0611,243.0660,235.0609, 219.0661,193.0502	undulatoside A	Chromone	RP/ HDMS^E
8	3.19	321.0973	320.0896	$C_{16}H_{16}O_7$	1.3	+H	—	303.0870,273.0400,249.0400,235.0249,221.0447, 205.0507,191.0348,175.0407,147.0446,125.0606	Divaricatacid	Chromone	RP/DDA
9	3.25	469.1710	468.1632	$C_{22}H_{28}O_{11}$	1.3	+H	212.04	421.1137,397.1137,307.1183,289.1078,259.0608, 235.0607,219.0659,159.0447	prim-O-glucosylcimifugin*	Chromone	RP+HILIC/DDA+HDMSE HDMS^E

10	3.40	223.0610	222.0528	$C_{11}H_{10}O_5$	3.4	+H	198.72	207.0301,179.0344,162.0322,134.0363,123.0447, 105.0338,91.0546	isofraxidin	Coumarin	HILIC/DDA+HDMS^E
11	3.66	365.1240	364.1158	$C_{18}H_{20}O_8$	2.4	+H	184.67	307.1184,289.1081,259.0609,235.0610,213.0554, 159.0452	1'-O-glucosylcimifugin	Chromone	RP+HILIC/HDMS^E
12	3.67	615.2281	614.2211	$C_{28}H_{38}O_{15}$	-0.4	+H	—	453.1764,333.1346,291.1230,273.1127,231.0654, 216.0424	Eleutherinoside B	Chromone	RP/DDA
13	3.72	263.0921	262.0841	$C_{14}H_{14}O_5$	2.7	+H	155.08	243.0663,216.0430	(-)-cis-khellactone	Coumarin	RP/HDMS^E
14	3.79	193.0502	192.0423	$C_{10}H_8O_4$	3.6	+H	128.01	178.0275,161.0246,150.0317,137.0589,133.0291, 122.0366,105.0338,94.0428	scopoletin*	Coumarin	RP+HILIC/DDA+HDMS^E
15	3.84	247.0971	246.0892	$C_{14}H_{14}O_4$	2.7	+H	150.49	213.0558,185.0620,175.0408,148.0510,147.0446, 119.0495,91.0567	decursinol	Coumarin	RP+HILIC/DDA+HDMS^E
16	3.87	455.1555	454.1475	$C_{21}H_{26}O_{11}$	1.5	+H	208.95	313.1268,291.1233,259.0610,233.0453,221.0452, 177.0555,147.0448,91.0553	11-hydroxy-sec-O-glucosylhamaudol	Chromone	RP/HDMS^E
17	3.92	223.0610	222.0528	$C_{11}H_{10}O_5$	3.9	+H	137.30	162.0322,134.0376	7-hydroxy-6,8-dimethoxychromen-2-one*	Chromone	RP/DDA+HDMS^E
18	4.02	307.1183	306.1103	$C_{16}H_{18}O_6$	2.3	+H	167.19	259.0608,235.0606,221.0452,205.0505,177.0555, 161.0606,133.0656	cimifugin*	Chromone	RP+HILIC/DDA+HDMS^E
19	4.15	363.1450	362.1366	$C_{19}H_{22}O_7$	3.2	+H	186.44	259.0627	lindiol	Acid esters	RP+HILIC/HDMS^E
20	4.31	453.1761	452.1682	$C_{22}H_{28}O_{10}$	1.3	+H	198.69	363.1443,291.1233,273.1128,243.0658,231.0659, 216.0425,145.0656	4'-O-β-D-glucosyl-5-O-methylvisamminol*	Chromone	RP+HILIC/DDA+HDMS^E
21	4.33	539.1764	538.1686	$C_{25}H_{30}O_{13}$	0.9	+H	216.76	453.1753,333.1314,291.1227,273.1123,243.0653, 231.0654,216.0420,203.0708	4'-O-β-D-glucosyl-5-O-methylvisamminol-MAL	Chromone	RP/HDMS^E

22	4.35	467.3005	466.2931	$C_{26}H_{42}O_7$	0.3	+H	194.51	333.1314,307.1177,291.1227,273.1123,243.0653, 216.0420,203.0708,189.0552	Didehydro prim-O-glucosylcimifugin	Chromone	RP/HDMS^E
23	4.42	571.2036	570.1949	$C_{26}H_{34}O_{14}$	2.6	+H	226.51	307.1187,277.1074,259.0972,205.0509	4′-O-β-D-apiofuranosyl-(1→6)-O-β-D-glucopyranosylvisamminol	Chromone	RP+HILIC/HDMS^E
24	4.42	489.3138	488.3049	$C_{36}H_{40}O$	-2.8	+H	199.70	457.1592,307.1177,277.1074,259.0966,217.0491, 205.0501,177.0557	23-(9-Anthryl)-5α-21,24-dinorchola-17,22-dien-3-on	Chromone	RP/HDMS^E
25	4.48	619.2023	618.1949	$C_{30}H_{34}O_{14}$	0.2	+H	239.32	567.3377,505.2668,469.1701,395.1682,307.1176, 259.0601,235.0600,151.0395	prim-O-glucosylcimifugin-5-Hydroxy-4-(Hydroxymethyl)-5,5-dimethyl-2-oxo-2,5-dihydro-3-furancarboxylic acid	Chromone	RP/HDMS^E
26	4.50	511.3267	510.3193	$C_{28}H_{46}O_8$	0.3	+H	205.35	469.1701,395.1682,307.1176,235.0600,205.0500, 151.0395	prim-O-glucosylcimifugin-Acetic acid	Chromone	RP/HDMS^E
27	4.73	675.2280	674.2211	$C_{33}H_{38}O_{15}$	0.5	+H	255.64	469.1698,307.1174,290.1160,235.0608,207.0653, 175.0402	prim-O-glucosylcimifugin-7-Hydroxy-4-methoxymethylcoumarin	Chromone	RP/HDMS^E
28	4.83	603.2074	602.1999	$C_{30}H_{34}O_{13}$	0.3	+H	233.94	453.1767,291.1226,273.1121,231.0657,216.0417, 203.0709,151.0398	4'-O-β-D-glucosyl-5-O-methylvisamminol-5-Hydroxy-Vanillic acid	Chromone	RP/HDMS^E

29	4.96	293.1028	292.1947	$C_{15}H_{16}O_6$	2.9	+H	163.01	275.0953,259.0617,247.0615,221.0458,205.0516, 147.0440	(3S)-2,2-dimethyl-3,5-dihydroxy-8-hydroxymethyl-3,4-dihydro-2H,6H-benzo-[1,2-b;5,4-b']dipyran-6-one	Chromone	RP+HILIC/DDA+HDMS[E]
30	5.02	659.2335	658.2262	$C_{33}H_{38}O_{14}$	0.1	+H	245.55	453.1753,291.1226,273.1121,231.0656,216.0425, 175.0393	4'-O-β-D-glucosyl-5-O-methylvisamminol+$C_{11}H_{10}O_4$	Chromone	RP/HDMS[E]
31	5.06	291.1234	290.1154	$C_{16}H_{18}O_5$	2.4	+H	162.09	244.0698,220.0704,206.0536,151.0393	5-O-Methylvisamminol	Chromone	RP+HILIC/DDA+HDMS[E]
32	5.07	247.0972	246.0892	$C_{14}H_{14}O_4$	2.8	+H	149.77	229.0873,213.0554,185.0611,175.0404,148.0519, 147.0449,119.0499,91.0548	(+)-marmesin*	Coumarin	RP+HILIC/DDA+HDMS[E]
33	5.16	303.0508	302.0427	$C_{15}H_{10}O_7$	3.0	+H	162.26	257.0453,229.0502,201.0555,183.0449,153.0187, 137.0240,121.0290	quercetin*	Flavonoids	RP/DDA+HDMS[E]
34	5.20	277.1078	276.0998	$C_{15}H_{16}O_5$	2.7	+H	199.75	260.0948,244.0697,230.0534,206.0540,205.0498, 173.0530	hamaudol	Chromone	RP/DDA+HDMS[E]
35	5.21	349.1285	348.1209	$C_{18}H_{20}O_7$	0.8	+H	180.54	313.0165,277.1078,259.0974,244.0737,217.0503, 205.0505	divaricataester B	Chromone	RP+HILIC/HDMS[E]
36	5.22	305.1024	304.0947	$C_{16}H_{16}O_6$	1.3	+H	166.46	216.0425	Oxypeucedanin hydrate	Coumarin	RP+HILIC/HDMS[E]
37	5.24	439.1603	438.1526	$C_{21}H_{26}O_{10}$	1.0	+H	198.26	277.1078,259.0972,217.0503,205.0502,189.0555, 165.0192,97.0296	sec-O-glucosylhamaudol*	Chromone	RP+HILIC/DDA+HDMS[E]
38	5.38	387.1087	386.1002	$C_{20}H_{18}O_8$	3.3	+H	—	147.0445	clemiscosin A	Coumarin	RP/DDA

39	5.67	525.1612	524.1530	$C_{24}H_{28}O_{13}$	1.7	+H	219.54	461.1410,333.0271,277.1071,259.0967,241.0859, 217.0499,205.0500,189.0550	7-（1,3-Benzodioxol-5-yl）-6H，7H，8H-chromeno [3'，4'：5,6] pyrano [3,2-c] chromene-6,8-dione-CH_4O_3	Chromone	RP/HDMS^E
40	5.70	543.1289	542.1213	$C_{30}H_{22}O_{10}$	0.6	+H	—	439.0843,368.0917,340.0573,311.0914,277.1059, 191.0365	7-（1,3-Benzodioxol-5-yl）-6H，7H，8H-chromeno [3'，4'：5,6] pyrano [3,2-c] chromene-6,8-dione-γ-Hydroxybutyric acid	Chromone	RP/DDA
41	5.75	479.1555	478.1475	$C_{23}H_{26}O_{11}$	1.6	+H	212.97	231.1037,175.0394	sapodivarin	Coumarin	RP/DDA+HDMS^E
42	5.80	349.0922	348.0845	$C_{17}H_{16}O_8$	1.1	+H	—	289.0713,274.0464,260.0322,247.0245,235.0242, 219.0294,203.0348,191.0374	2,2'-[(6-Oxo-7,8,9,10-tetrahydro-6H-benzo[c]chromene-1,3-diyl)bis(oxy)]diacetic acid	Chromone	RP/DDA
43	6.03	611.1600	610.1534	$C_{27}H_{30}O_{16}$	-1.0	+H	242.00	469.1712,324.0931,308.0685,259.0974,205.0500, 131.0500,103.0547	rutin	Flavonoids	RP/HDMS^E
44	6.05	163.0397	162.0317	$C_9H_6O_3$	4.5	+H	—	92.0267	umbelliferone	Coumarin	RP/DDA
45	6.10	187.0397	186.0317	$C_{11}H_6O_3$	4.1	+H	125.20	131.0499,115.0549,103.0551	psoralen*	Coumarin	RP/DDA+HDMS^E
46	6.31	335.1130	334.1053	$C_{17}H_{18}O_7$	1.3	+H	178.45	291.1247,277.1081,259.0972,243.0665,229.0498, 217.0509,205.0502,177.0553	Byakangelicin	Coumarin	RP/HDMS^E
47	6.38	217.0502	216.0423	$C_{12}H_8O_4$	3.0	+H	153.64	202.0273,174.0320,161.0605,145.0289,118.0422, 103.0545,89.0389	methoxsalen*	Coumarin	RP/DDA+HDMS^E

48	6.48	481.1709	480.1632	$C_{23}H_{28}O_{11}$	0.9	+H	212.67	277.1074,259.0968,241.0869,217.0499,205.0501, 189.0551,177.0558	Hamaudol-$C_8H_{12}O_6$	Chromone	RP/HDMS^E
49	6.81	247.0607	246.0528	$C_{13}H_{10}O_5$	2.5	+H	143.07	217.0142,189.0195,161.0245,133.0287,105.0336	isopimpinellin*	Coumarin	RP/DDA+HDMS^E HILIC/HDMS^E
50	6.87	335.1131	334.1053	$C_{17}H_{18}O_7$	1.7	+H	176.64	275.0923,260.0691,246.0530,233.0455,221.0450, 205.0510,187.0398,159.0451,131.0521	divaricatol	Chromone	RP/DDA+HDMS^E HILIC/HDMS^E
51	6.87	277.1077	276.0998	$C_{15}H_{16}O_5$	2.2	+H	157.67	260.0999,245.0770,230.0552,206.0542,178.0599, 166.0240	norcimifugin	Chromone	RP/DDA+HDMS^E HILIC/HDMS^E
52	7.04	207.0660	206.0579	$C_{11}H_{10}O_4$	3.9	+H	135.12	163.0396,145.0288,135.0447,123.0085,118.0421, 89.0388	Scoparone	Coumarin	RP/HDMS^E
53	7.05	217.0501	216.0423	$C_{12}H_8O_4$	2.8	+H	132.85	202.0268,174.0319,146.0370,131.0500,118.0417, 89.0386	Isobergapten*	Coumarin	RP/DDA+HDMS^E
54	7.39	317.1022	316.0947	$C_{17}H_{16}O_6$	0.8	+H	—	257.0820,245.0814,233.0819,217.0500,205.0502, 189.0564	methoxy-8-(3-hydroxymethyl-but-2-enyloxy)-psoralen	Coumarin	RP/DDA
55	7.46	389.1606	388.1522	$C_{21}H_{24}O_7$	2.8	+H	195.89	277.1073,259.0987,205.0509	Cis-3'-isovaleryl-4'-acetylkhellactone	Coumarin	RP+HILIC/HDMS^E
56	7.59	345.1344	344.1260	$C_{19}H_{20}O_6$	3.4	+H	186.59	270.0533,229.0508	(3'S)-hydroxydeltoin	Coumarin	RP/HDMS^E
57	7.65	285.0769	284.0685	$C_{16}H_{12}O_5$	4.0	+H	156.98	270.0535,242.0595,229.0497,215.0720,179.0507, 151.0547	wogonin*	Flavonoids	RP/DDA+HDMS^E
58	8.70	261.1851	260.1776	$C_{17}H_{24}O_2$	0.6	+H	179.97	217.0497,205.0506,177.0557,163.0401,135.0430	falcarindiol	Coumarin	RP/DDA+HDMS^E
59	9.02	259.0971	258.0892	$C_{15}H_{14}O_4$	2.3	+H	152.89	243.0655,229.0500,215.0711,205.0499,189.0551, 177.0548,165.0189,103.0554	4-Methoxy-5-isopropylfuro[2,3:6,7]coumarin	Coumarin	RP/HDMS^E

60	9.03	319.1183	318.1103	$C_{17}H_{18}O_6$	2.2	+H	171.24	259.0974,244.0737,230.0578,217.0503,205.0503, 189.0552,177.0558,149.0240,121.0293,105.0701	3'-O-Acetylhamaudol	Chromone	RP+HILIC/DDA+HDMS^E
61	9.17	375.1445	374.1366	$C_{20}H_{22}O_7$	1.8	+H	190.44	275.0922,259.0614,246.0528,233.0451,221.0455, 205.0508,187.0399,177.0563,159.0445	ledebouriellol	Chromone	RP+HILIC/HDMS^E
62	9.25	275.0919	274.0841	$C_{15}H_{14}O_5$	1.8	+H	158.89	259.0605,245.0449,231.0656,217.0497,205.0500, 187.0394,175.0398	Didehydro Hamaudol	Chromone	RP/HDMS^E
63	9.26	375.1057	374.1022	$C_{19}H_{18}O_8$	-4.7	+H	195.09	275.0914,260.0677,246.0520,233.0448,221.0449, 205.0500,203.0347,187.0394,177.0553,159.0450	chrysosplenetin B	Flavonoids	RP/HDMS^E
64	9.31	195.1386	194.2740	$C_{12}H_{18}O_2$	3.5	+H	—	91.055	Neocnidilide	Esters	RP/DDA
65	9.31	233.0453	232.0372	$C_{12}H_8O_5$	3.6	+H	137.23	218.0218,173.0238,134.0371	5-Hydroxyxanthotoxin	Coumarin	RP+HILIC/HDMS^E
66	9.35	301.1081	300.0998	$C_{17}H_{16}O_5$	3.4	+H	164.58	230.0227,218.0219,217.0143,189.0197,162.0324, 134.0369,106.0412	phelloterin	Coumarin	RP/DDA+HDMS^E
67	9.67	329.1390	328.1311	$C_{19}H_{20}O_5$	2.1	+H	179.24	229.0867,213.0555,185.0604,155.0861,131.0496, 115.0550	decursin*	Coumarin	RP+HILIC/DDA+HDMS^E
68	9.74	271.0972	270.0892	$C_{16}H_{14}O_4$	2.6	+H	—	203.0350,147.0449,131.0497,119.0493,91.05541	imperatorin	Coumarin	RP/DDA
69	10.08	269.0817	268.0736	$C_{16}H_{12}O_4$	3.2	+H	153.81	269.0826,254.0583,226.0635,197.0614,181.0660, 152.0634,124.0167	tectochrysin	Flavonoids	RP/DDA+HDMS^E
70	10.36	561.2819	560.2774	$C_{34}H_{40}O_7$	-4.9	+H	245.04	439.2212,337.2736,283.0192,263.2372,245.2267, 91.0547	Pregnanetriol-4,9-Dioxo-4,9-dihydronaphtho[2,3-b]furan-2-carboxylic acid	Chromone	RP/HDMS^E
71	10.36	579.2927	578.2880	$C_{34}H_{42}O_8$	-4.4	+H	246.01	561.2829,539.3177,473.1597,439.2212,361.2928, 337.2736,259.0967,205.0501,91.0547	Pregnanetriol-4,9-Dioxo-4,9-dihydronaphtho[2,3-b]furan-2-carboxylic acid-H_2O	Chromone	RP/HDMS^E

72	10.46	261.1854	260.1776	$C_{17}H_{24}O_2$	2.0	+H	168.91	215.0865,202.0790,156.0814,130.0658	Falcarindiol isomer	Polyacetylene	RP/HDMS^E
73	10.69	137.1329	136.1252	$C_{10}H_{16}$	2.9	+H	181.88	91.0553	α-pinene	Volatile oil	RP/HDMS^E
74	10.74	347.1496	346.1416	$C_{19}H_{22}O_6$	2.1	+H	181.90	259.0987,244.0744,230.0593,229.0506,217.0500, 205.0507,189.0556	3'-O-i-butyrylhammaudol	Chromone	RP/DDA+HDMS^E HILIC/HDMS^E
75	10.88	245.1911	244.1827	$C_{17}H_{24}O$	4.7	+H	—	217.0133,189.0184	Panaxynol	Polyacetylene	RP/DDA
76	11.02	203.1803	202.1722	$C_{15}H_{22}$	4.5	+H	146.60	188.0929,172.0765,91.0551	1-(1,2,2-trimethylcyclopentyl)-4-methylbenzene	Aromatic hydrocarbon	RP/HDMS^E
77	11.10	555.2929	554.2880	$C_{32}H_{42}O_8$	-4.2	+H	249.37	478.3288,459.2485,415.2252,313.2739,283.0173, 155.0112	(2E)-1-[2,4-Dihydroxy-3-(3-methyl-2-buten-1-yl)phenyl]-3-[2,2-dimethyl-8-(3-methyl-2-buten-1-yl)-2H-chromen-6-yl]-2-propen-1-one-$C_2H_8O_4$	Chromone	RP/HDMS^E
78	11.14	261.1860	260.1776	$C_{17}H_{24}O_2$	4.4	+H	172.31	245.0815,227.0712,217.0867,213.0559,170.0976, 156.0813,130.0661	(8E)-heptade-ca-1,8-dien-4,6-diyn-3,10-diol	Polyacetylene	RP/HDMS^E
79	11.15	343.1236	342.1162	$C_{12}H_{22}O_{11}$	0.4	+H	226.49	307.0722,277.0008,237.0057,216.9800,198.9693, 186.9695,174.9696,114.9482	sucrose	Saccharides	HILIC/HDMS^E
80	11.17	427.1749	426.1679	$C_{24}H_{26}O_7$	-0.6	+H	205.21	327.1236,245.0818,217.0863,191.0354,175.0398, 128.0621	(-)-praeruptorin B	Coumarin	RP/DDA+HDMS^E HILIC/HDMS^E
81	11.29	127.0395	126.0317	$C_6H_6O_3$	4.1	+H	152.16	114.9482	5-hydroxymethyl-furfurol	Aldehydes	HILIC/HDMS^E

82	11.42	359.1494	358.1416	$C_{20}H_{22}O_6$	1.3	+H	185.49	259.0972,244.0735,217.0502,205.0502,189.0553, 177.0555,149.0244,121.0294,105.0703	3'-O-angleoyl-hamaudol	Chromone	RP+HILIC/DDA+HDMS[E]
83	11.67	283.2631	282.2559	$C_{18}H_{34}O_2$	-0.1	+H	194.07	182.0972	(E)-16-methylheptadec-2-enoic acid	Aliphatic acid	RP/HDMS[E]
84	11.69	327.1238	326.1154	$C_{19}H_{18}O_5$	3.3	+H	171.28	281.1184,245.0816,227.0711,215.0722,199.0764, 128.0629	2-[Bis(5-methyl-2-furyl)methyl]-5-methoxybenzoic acid	Aromatic compounds	RP/HDMS[E] HILIC/DDA+HDMS[E]
85	11.90	225.2215	224.2140	$C_{15}H_{28}O$	0.8	+H	173.81	205.0510,184.0742,124.9998	β-Eudesmol	Volatile oil	RP/HDMS[E]
86	12.05	309.2788	308.2715	$C_{20}H_{36}O_2$	0.0	+H	197.99	161.0969,135.0443	ethyl linoleate	Esters	RP/DDA+HDMS[E]
87	12.85	731.4010	730.3928	$C_{40}H_{58}O_{12}$	1.2	+H	280.80	713.3959,469.1705,397.1135,307.1180,290.1139, 159.0446	prim-O-glucosylcimifugin-(9E,12E)-octadeca-9,12-dienoic acid	Chromone	RP/HDMS[E]
88	13.38	203.1800	202.1722	$C_{15}H_{22}$	2.9	+H	146.86	202.0789,145.1027,131.0858,119.0851,105.0705	1-methyl-4-[(1R)-1,2,2-trimethylcyclopentyl]benzene	Aromatic hydrocarbon	RP/DDA+HDMS[E]
89	13.60	279.2323	278.2246	$C_{18}H_{30}O_2$	1.5	+H	172.67	267.0002,250.9694	alpha-calendic acid	Aliphatic acid	RP/DDA+HDMS[E] HILIC/HDMS[E]
90	13.59	237.1858	236.1776	$C_{15}H_{24}O_2$	3.7	+H	173.07	217.0506,195.1187,184.0740,167.0739,152.9045, 91.0542	15-hydroxycaryophyllene oxide	Bicyclosesquiterpene oxide	RP/HDMS[E]
91	13.64	355.2852	354.2770	$C_{21}H_{38}O_4$	2.5	+H	198.51	335.1677,319.1984	glycerol monolinoleate	Esters	RP/HDMS[E]
92	13.69	337.2743	336.2664	$C_{21}H_{36}O_3$	1.7	+H	199.87	277.1076,263.2397,243.0169,215.0190,185.0116, 105.0703,91.0553	Pregnanetriol	Alcohol	RP/HDMS[E]

93	13.77	707.4003	706.3928	$C_{38}H_{58}O_{12}$	0.2	+H	280.21	559.4277,469.1701,451.1605,307.1178,235.0610, 161.0966,135.0448	prim-O-glucosylcimifugin-Palmitic Acid	Chromone	RP/HDMS^{E}
94	13.96	133.0652	132.1575	C_9H_8O	3.1	+H	120.26	89.0388	trans-Cinnamaldehyde	Aldehydes	RP/DDA+HDMS^{E}
95	13.99	733.4161	732.4085	$C_{40}H_{60}O_{12}$	0.4	+H	283.21	508.4166,469.1703,307.1176,235.0606,89.0392	prim-O-glucosylcimifugin-Oleic acid	Chromone	RP/HDMS^{E}
96	14.09	715.4059	714.3979	$C_{40}H_{58}O_{11}$	1.0	+H	274.50	453.1750,395.2704,291.1230,273.1123,231.0655, 203.0717	4'-O-β-D-glucosyl-5-O-methylvisamminol-(9E,12E)-octadeca-9,12-dienoic acid	Chromone	RP/HDMS^{E}
97	14.09	737.3870	736..3823	$C_{42}H_{56}O_{11}$	-3.4	+H	276.19	715.4049,453.1750,291.1230,273.1123,231.0655, 216.0422,203.0717,189.0551	4'-O-β-D-glucosyl-5-O-methylvisamminol-(11Z)-Retinal	Chromone	RP/HDMS^{E}
98	14.33	263.2377	262.2297	$C_{18}H_{30}O$	3.0	+H	169.45	148.9914,122.9745	10,12-Octadecadiyn-1-ol	Alcohol	RP+HILIC/HDMS^{E}
99	14.36	281.2482	280.2402	$C_{18}H_{32}O_2$	2.5	+H	—	270.0544,174.8647,119.0870,105.0735,91.0553,81.0692	Linoleic acid	Aliphatic acid	RP/DDA
100	14.57	357.3009	356.2927	$C_{21}H_{40}O_4$	2.7	+H	—	326.9680,324.9860,268.9987,252.9676	9-octadecenoic-2,3-dihydroxypropyl ester	Esters	RP/DDA
101	14.76	691.4052	690.3979	$C_{38}H_{58}O_{11}$	0.0	+H	273.86	635.4804,605.4192.519.2613,495.5683,453.1755, 291.1230,273.1125,231.0654,216.0423,203.0705, 189.053	4'-O-β-D-glucosyl-5-O-methylvisamminol-Palmitic Acid	Chromone	RP/HDMS^{E}
102	14.85	717.4208	716.4136	$C_{40}H_{60}O_{11}$	-0.1	+H	276.85	635.4860,628.3736,611.3543,520.5825,453.1752, 291.1229,273.1122,231.0652,216.0419	(3-Hydroxy-2-butanyl)dioxidanyl-rutin	Flavonoids	RP/HDMS^{E}

103	15.02	591.3289	590.3244	$C_{36}H_{46}O_7$	-4.6	+H	245.01	569.3468,508.5807,403.1757,361.1281,290.1150, 261.1125,243.1019,191.0708,177.0551	(6bR,8aS,11R,12bS,14aR)-2,5-Dihydroxy-4,6b,8a,11,12b,14a-hexamethyl-10-oxo-5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14,14a-hexadecahydro-3-picenyl 4-hydroxy-3-methoxybenzoate	Chromone	RP/HDMS^E
104	15.03	569.3469	568.3400	$C_{34}H_{48}O_7$	-0.6	+H	243.00	551.3367,459.2377,307.1179,261.1130,191.0711	2-(3,4-Dihydroxyphenyl)-3-hexadecyl-5,6,7-trimethoxy-4H-chromen-4-one	Flavonoids	RP/DDA+HDMS^E HILIC/HDMS^E

*: the components identified by comparing with the reference compounds.

Table S5 LOD, LOQ, and Linearity results.

Analyte	Regression equation (y = ax + b)	Linearity range (μg/mL)	LOD (ng/mL)	LOQ (ng/mL)	r^2
PGC	y = 10.806x + 16.14	5−1000	40	55	0.9999
GMV	y = 11.58x − 22.466	5−1000	50	60	0.9994

Table S6 Precision results (*n*=3).

Analyte	Concentration (μg/mL)-D1	RSD (%) Inter-day	Concentration (μg/mL)-D2	Concentration (μg/mL)-D3	RSD (%) Intra-day
PGC	78.92	0.11	77.67	77.15	1.11
	78.75		77.73	78.66	
	78.76		77.89	76.37	
	150.11	1.47	146.93	149.92	1.41
	154.25		150.80	150.24	
	150.73		147.31	150.07	
	235.82	1.45	231.30	230.62	1.23
	230.13		226.19	230.79	
	229.86		226.51	231.27	
GMV	82.69	0.05	81.41	80.87	1.03
	82.61		81.53	82.35	
	82.63		81.72	80.36	
	154.71	1.44	151.56	154.64	1.37
	158.93		155.44	154.95	
	155.45		152.07	154.90	
	241.05	1.36	236.59	236.18	1.19
	235.51		231.58	236.20	
	235.43		231.90	236.84	

Table S7 Repeatability results (*n*=6).

Sample	PGC		GMV	
	Concentration (μg/mL)	RSD (%)	Concentration (μg/mL)	RSD (%)
1	54.99	1.58	43.77	1.49
2	55.04		43.96	
3	53.73		42.89	
4	54.48		43.48	
5	56.38		44.88	
6	54.95		43.87	

Table S8 Stability results.

Time（h）	Concentration (μg/mL)	
	PGC	GMV
0	57.24	45.37
2	56.36	44.79
4	56.85	45.21
6	58.30	46.19
8	57.98	46.07
14	56.84	45.14
24	56.73	45.08
36	57.50	45.62
48	58.08	46.09
RSD (%)	1.19	1.12

Table S9 Recovery results (*n*=3).

Analyte	Original amount (mg)	Added amount (mg)	Measured amount (mg)	Recovery(%)	RSD (%)
PGC	0.2753	0.1553	0.4335	101.89	1.72
	0.2768	0.1553	0.4388	104.30	
	0.2753	0.1553	0.4319	100.88	
	0.2753	0.3106	0.5968	103.50	0.70
	0.2751	0.3106	0.5926	102.23	
	0.2757	0.3106	0.5970	103.45	
	0.2742	0.4659	0.7411	100.22	1.19
	0.2748	0.4659	0.7314	98.00	
	0.2748	0.4659	0.7334	98.43	
GMV	0.2319	0.1186	0.3517	101.02	0.15
	0.2332	0.1186	0.3527	100.81	
	0.2319	0.1186	0.3514	100.73	
	0.2319	0.2371	0.4740	102.08	0.70
	0.2318	0.2371	0.4761	103.04	
	0.2323	0.2371	0.4733	101.64	
	0.2310	0.3557	0.5892	100.71	
	0.2316	0.3557	0.5819	98.51	1.19
	0.2316	0.3557	0.5831	98.85	

Table S10 Contents of PGC and GMV in *S. divaricata* as determined using the developed UHPLC-UV method.

Sample	Content (mg/g)		Sum (%)	Sample	Content (mg/g)		Sum (%)
	PGC	GMV			PGC	GMV	
1	2.06	0.93	0.30	33	1.12	0.42	0.15
2	2.48	0.96	0.34	34	2.89	1.48	0.44
3	0	0	0.00	35	0.55	0.26	0.08
4	1.86	1.60	0.35	36	2.41	1.60	0.40
5	2.06	1.11	0.32	37	2.29	0.35	0.26
6	1.46	1.87	0.33	38	1.84	0.96	0.28
7	3.86	3.02	0.69	39	1.76	1.20	0.30
8	3.07	1.40	0.45	40	1.97	1.24	0.32
9	1.59	1.07	0.27	41	8.98	1.25	1.02
10	2.06	1.23	0.33	42	2.79	2.28	0.51
11	2.94	2.09	0.50	43	2.67	1.70	0.44
12	2.25	1.02	0.33	44	2.32	0.67	0.30
13	2.27	1.15	0.34	45	0.95	0.91	0.19
14	2.44	2.42	0.49	46	1.54	1.21	0.28
15	0.54	0.58	0.11	47	3.30	2.15	0.55
16	1.91	1.51	0.34	48	1.89	0.96	0.29
17	2.18	1.37	0.36	49	1.93	1.03	0.30
18	2.41	2.34	0.48	50	3.13	2.28	0.54
19	2.60	1.19	0.38	51	5.27	3.81	0.91
20	2.60	1.74	0.43	52	3.44	1.34	0.48
21	1.84	1.09	0.29	53	2.23	0.76	0.30
22	1.59	1.16	0.28	54	1.63	1.02	0.27
23	2.27	1.80	0.41	55	3.02	1.10	0.41
24	1.87	0.60	0.25	56	6.83	7.78	1.46
25	2.13	1.95	0.41	57	6.40	8.57	1.50
26	1.46	2.10	0.36	58	6.07	7.61	1.37
27	2.65	1.09	0.37	59	3.86	4.41	0.83
28	1.64	0.70	0.23	60	6.26	5.80	1.21
29	2.47	0.43	0.29	61	4.74	6.02	1.08
30	2.41	0.85	0.33	62	2.67	2.65	0.53
31	1.55	1.11	0.27	63	2.57	3.01	0.56
32	1.81	0.69	0.25	64	2.21	2.05	0.43