

**Supplementary data to:**

**An effective negative pressure cavitation-microwave assisted extraction for  
determination of phenolic compounds in [*P. calliantha* H. Andr.]**

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**Table S1** Box-Behnken design along with the predicted and experimental values of arbutin, epicatechin, catechin, hyperin, 2'-O-galloylhyperin and chimaphilin.

No.	Negative pressure (X <sub>1</sub> , MPa)	Liquid/solid ratio (X <sub>2</sub> , mL/g)	Concentration of ILs (X <sub>3</sub> , M)	Y <sub>1</sub> <sup>a</sup> (mg/g)	Y <sub>2</sub> <sup>b</sup> (mg/g)	Y <sub>3</sub> <sup>c</sup> (mg/g)	Y <sub>4</sub> <sup>d</sup> (mg/g)	Y <sub>5</sub> <sup>e</sup> (mg/g)	Y <sub>6</sub> <sup>f</sup> (mg/g)
1	-1(-0.06)	-1(60)	0(0.05)	2.050	0.695	0.045	1.040	4.037	0.321
2	1(-0.08)	-1(60)	0(0.05)	2.471	0.809	0.038	1.188	4.701	0.386
3	-1(-0.06)	1(80)	0(0.05)	2.329	0.782	0.050	1.246	4.541	0.364
4	1(-0.08)	1(80)	0(0.05)	2.513	0.945	0.040	1.506	5.612	0.393
5	-1(-0.06)	0(70)	-1(0.25)	2.002	0.767	0.046	1.222	4.455	0.313
6	1(-0.08)	0(70)	-1(0.25)	2.361	0.862	0.0425	1.374	5.009	0.369
7	-1(-0.06)	0(70)	1(0.75)	2.108	0.879	0.048	1.401	5.107	0.339
8	1(-0.08)	0(70)	1(0.75)	2.382	0.885	0.045	1.412	5.144	0.356
9	0 (-0.07)	-1(60)	-1(0.25)	2.002	0.638	0.046	1.016	3.704	0.314
10	0(-0.07)	1(80)	-1(0.25)	2.197	0.815	0.049	1.300	4.738	0.344
11	0(-0.07)	-1(60)	1(0.75)	1.976	0.684	0.048	1.090	4.591	0.309
12	0(-0.07)	1(80)	-1(0.25)	2.424	0.866	0.052	1.313	5.034	0.379
13	0(-0.07)	0(70)	0(0.50)	2.550	1.019	0.054	1.624	5.920	0.399
14	0(-0.07)	0(70)	0(0.50)	2.540	1.006	0.055	1.604	5.846	0.397
15	0(-0.07)	0(70)	0(0.50)	2.557	0.995	0.054	1.587	5.784	0.400
16	0(-0.07)	0(70)	0(0.50)	2.592	0.987	0.056	1.573	5.735	0.405
17	0(-0.07)	0(70)	0(0.50)	2.487	1.051	0.056	1.675	6.104	0.389

<sup>a</sup> The extraction yield of arbutin. <sup>b</sup> The extraction yield of epicatechin. <sup>c</sup> The extraction yield of catechin. <sup>d</sup> The extraction yield of hyperin. <sup>e</sup> The extraction yield of 2'-O-galloylhyperin. <sup>f</sup> The extraction yield of chimaphilin.

**Table S2** Significance of regression coefficient for arbutin, epicatechin, catechin, hyperin, 2'-O-galloylhyperin and chimaphilin.

Variables	Eq (1)		Eq (2)		Eq (3)		Eq (4)		Eq (5)		Eq (6)	
	F-value	<i>p</i> -value	F-value	<i>p</i> -value	F-value	<i>p</i> -value	F-value	<i>p</i> -value	F-value	<i>p</i> -value	F-value	<i>p</i> -value
Model	30.67	0.0002	21.34	0.0003	33.91	< 0.0001	25.81	0.0001	21.72	0.0003	25.81	0.0001
X <sub>1</sub>	68.74	0.0008	14.17	0.0070	17.86	0.0039	45.30	0.0003	17.74	0.0040	45.30	0.0003
X <sub>2</sub>	41.68	0.0121	33.44	0.0007	58.18	0.0001	36.06	0.0005	27.43	0.0012	36.06	0.0005
X <sub>3</sub>	4.83	0.0253	5.35	0.0539	5.07	0.0591	2.94	0.1299	12.72	0.0091	2.94	0.1299
X <sub>1</sub> X <sub>2</sub>	5.04	<0.0001	0.47	0.5160	1.36	0.2814	4.41	0.0739	1.08	0.3329	4.41	0.0739
X <sub>1</sub> X <sub>3</sub>	0.65	0.0008	1.56	0.2518	2.21	0.1810	4.81	0.0644	1.75	0.2272	4.81	0.0644
X <sub>2</sub> X <sub>3</sub>	5.74	0.0227	0.0035	0.9542	0.41	0.5446	5.23	0.0561	2.29	0.1741	5.23	0.0561
X <sub>1</sub> X <sub>1</sub>	7.50	0.3410	9.44	0.0180	17.63	0.0040	7.86	0.0264	15.24	0.0059	7.86	0.0264
X <sub>2</sub> X <sub>2</sub>	27.12	0.8231	75.45	< .00001	134.59	< 0.0001	21.38	0.0024	67.84	< 0.0001	21.38	0.0024
X <sub>3</sub> X <sub>3</sub>	103.29	0.5155	40.16	0.0004	48.90	0.0002	94.05	< 0.0001	36.84	0.0005	94.05	< 0.0001
Lack of fit	3.18	0.1467	3.47	0.1303	2.06	0.2478	3.80	0.1150	2.94	0.1621	3.80	0.1150
R <sup>2</sup>	0.9753		0.9648		0.9679		0.9776		0.9654		0.9707	
Adjusted R <sup>2</sup>	0.9435		0.9196		0.9265		0.9487		0.9210		0.9331	

**Table S3** Extraction rate constants (K) and equilibrium concentrations ( $C_{\infty}$ ) of target compounds extracted by different methods

Compounds		NMAE	MAE	NPCE
Arbutin	K ( $\text{min}^{-1}$ )	0.229	0.173	0.083
	$C_{\infty}$ (mg/g)	2.630	2.079	2.120
	Optimum time (min)	15	25	>25
Epicatechin	K ( $\text{min}^{-1}$ )	0.292	0.124	0.094
	$C_{\infty}$ (mg/g)	1.094	0.969	0.744
	Optimum time (min)	10	20	25
Hyperin	K ( $\text{min}^{-1}$ )	0.302	0.136	0.104
	$C_{\infty}$ (mg/g)	1.614	1.379	1.198
	Optimum time (min)	12	20	>25
2'-O-galloylhyperin	K ( $\text{min}^{-1}$ )	0.247	0.141	0.093
	$C_{\infty}$ (mg/g)	5.977	5.391	5.607
	Optimum time (min)	13	25	>25
Chimaphilin	K ( $\text{min}^{-1}$ )	0.341	0.220	0.086
	$C_{\infty}$ (mg/g)	0.406	0.368	0.379
	Optimum time (min)	5	7	>25

**Table S4** The repeatability and reproducibility of NMAE, MAE and NPCE (n=5).

Analyte	NMAE		MAE		NPCE	
	Repeatability (RSD%)	Reproducibility (RSD%)	Repeatability (RSD%)	Reproducibility (RSD%)	Repeatability (RSD%)	Reproducibility (RSD%)
Arbutin	4.8	7.2	3.7	6.7	5.3	8.1
Epicatechin	5.4	8.8	4.1	7.4	4.8	7.9
Catechin	5.1	7.9	5.2	8.1	5.8	8.2
Hyperin	5.2	7.8	3.3	5.9	4.4	7.5
2'-O-Galloylhyperin	4.6	7.2	3.4	6.2	5.2	7.9
Chimaphilin	5.4	8.0	4.6	6.3	5.6	8.4

**Table S4.** Extraction rate constants (K) and equilibrium concentrations ( $C_{\infty}$ ) of target compounds extracted by different methods

Compounds		NMAE	MAE	NPCE
Arbutin	K ( $\text{min}^{-1}$ )	0.229	0.173	0.083
	$C_{\infty}$ (mg/g)	2.630	2.079	2.120
	Optimum time (min)	15	25	>25
Epicatechin	K ( $\text{min}^{-1}$ )	0.292	0.124	0.094
	$C_{\infty}$ (mg/g)	1.094	0.969	0.744
	Optimum time (min)	10	20	25
Hyperin	K ( $\text{min}^{-1}$ )	0.302	0.136	0.104
	$C_{\infty}$ (mg/g)	1.614	1.379	1.198
	Optimum time (min)	12	20	>25
2'-O-galloylhyperin	K ( $\text{min}^{-1}$ )	0.247	0.141	0.093
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Chimaphilin	K ( $\text{min}^{-1}$ )	0.341	0.220	0.086
	$C_{\infty}$ (mg/g)	0.406	0.368	0.379
	Optimum time (min)	5	7	>25

The equations of the BBD test.

$$Y_1 = -0.350 - 67.090X_1 + 0.011X_2 + 3.247X_3 - 704.750X_1^2 - 1.340 \times 10^{-3}X_2^2 - 4.184X_3^2 - 0.593X_1X_2 - 8.500X_1X_3 + 0.025X_2X_3 \quad (1)$$

$$Y_2 = -2.371 - 67.898X_1 + 0.076X_2 + 1.245X_3 - 523.206X_1^2 - 1.507 \times 10^{-3}X_2^2 - 1.760X_3^2 + 0.122X_1X_2 - 8.896X_1X_3 - 4.236 \times 10^{-4}X_2X_3 \quad (2)$$

$$Y_3 = -0.364 - 10.955X_1 + 1.183X_2 + 0.044X_3 - 76.764X_1^2 - 4.115 \times 10^{-5}X_2^2 - 0.034X_3^2 - 7.700 \times 10^{-4}X_1X_2 + 0.130X_1X_3 - 2.065 \times 10^{-4}X_2X_3 \quad (3)$$

$$Y_4 = -4.690 - 128.060X_1 + 0.143X_2 + 1.883X_3 - 976.508X_1^2 - 2.698 \times 10^{-3}X_2^2 - 2.602X_3^2 + 0.279X_1X_2 - 14.179X_1X_3 - 6.077 \times 10^{-3}X_2X_3 \quad (4)$$

$$Y_5 = -17.147 - 485.296X_1 + 0.450X_2 + 7.788X_3 - 3.714 \times 10^3X_1^2 - 7.836 \times 10^{-3}X_2^2 - 9.240X_3^2 + 0.015X_1X_2 - 51.689X_1X_3 - 0.059 \times 10^3X_2X_3 \quad (5)$$

$$Y_6 = -0.035 - 11.003X_1 + 1.325 \times 10^{-3}X_2 + 0.337X_3 - 120.675X_1^2 - 1.990 \times 10^{-4}X_2^2 - 0.668X_3^2 - 0.093X_1X_2 - 3.873X_1X_3 + 4.038 \times 10^{-3}X_2X_3 \quad (6)$$