Electronic Supplementary Information

Simple and selective detection of quercetin in extracts of plants and food samples by dispersive-micro-solid phase extraction based on core-shell magnetic molecularly imprinted polymer

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1. Figures

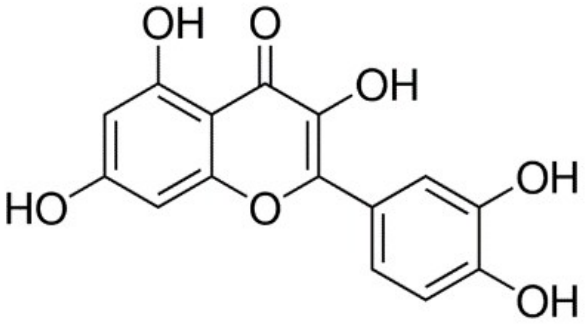


Figure S1. Chemical structure of quercetin.

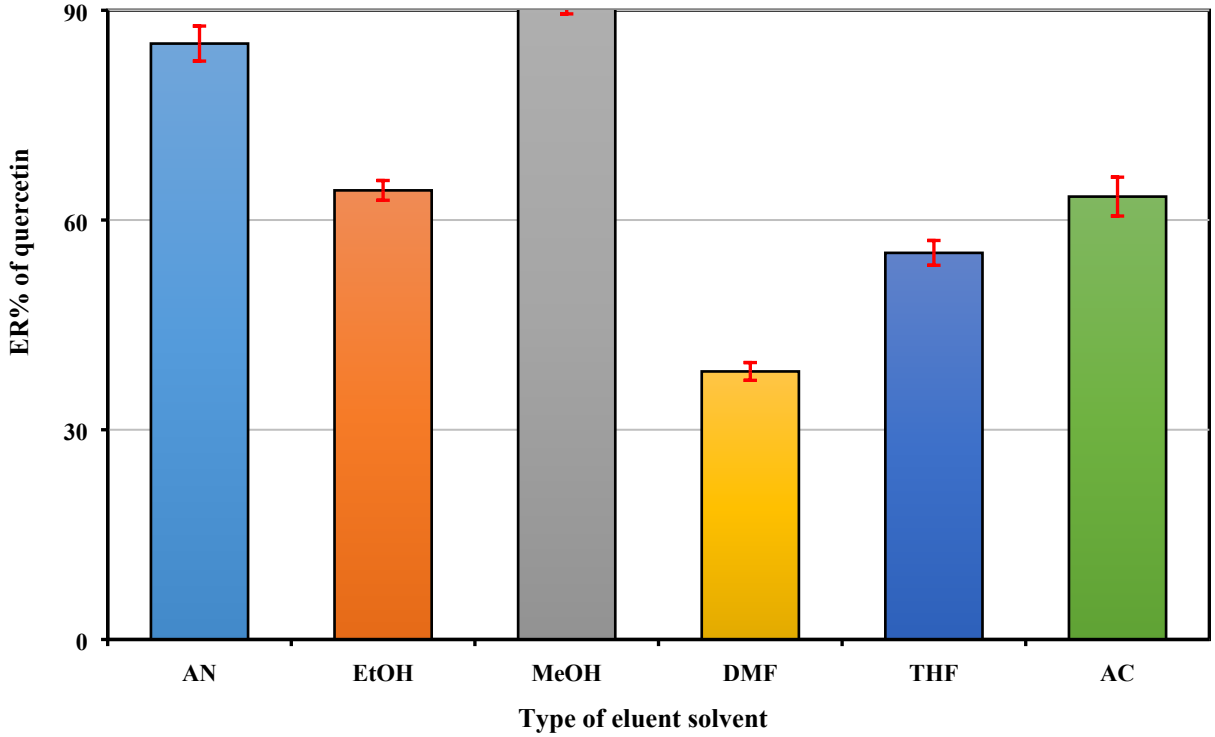


Figure S2. Effect of extraction solvents on quercetin extraction by D-μ-SPE-HPLC-UV. Extraction conditions were as follows: water sample volume: 15 mL; volume of extraction solvent: 0.30 mL; sorbent mass: 20 mg; extraction time: 5 min; pH 5.0. (AN: Acetonitrile; EtOH: Ethanol; MeOH: Methanol; DMF: Dimethylformamide; THF: Tetrahydrofuran; AC: Acetone).

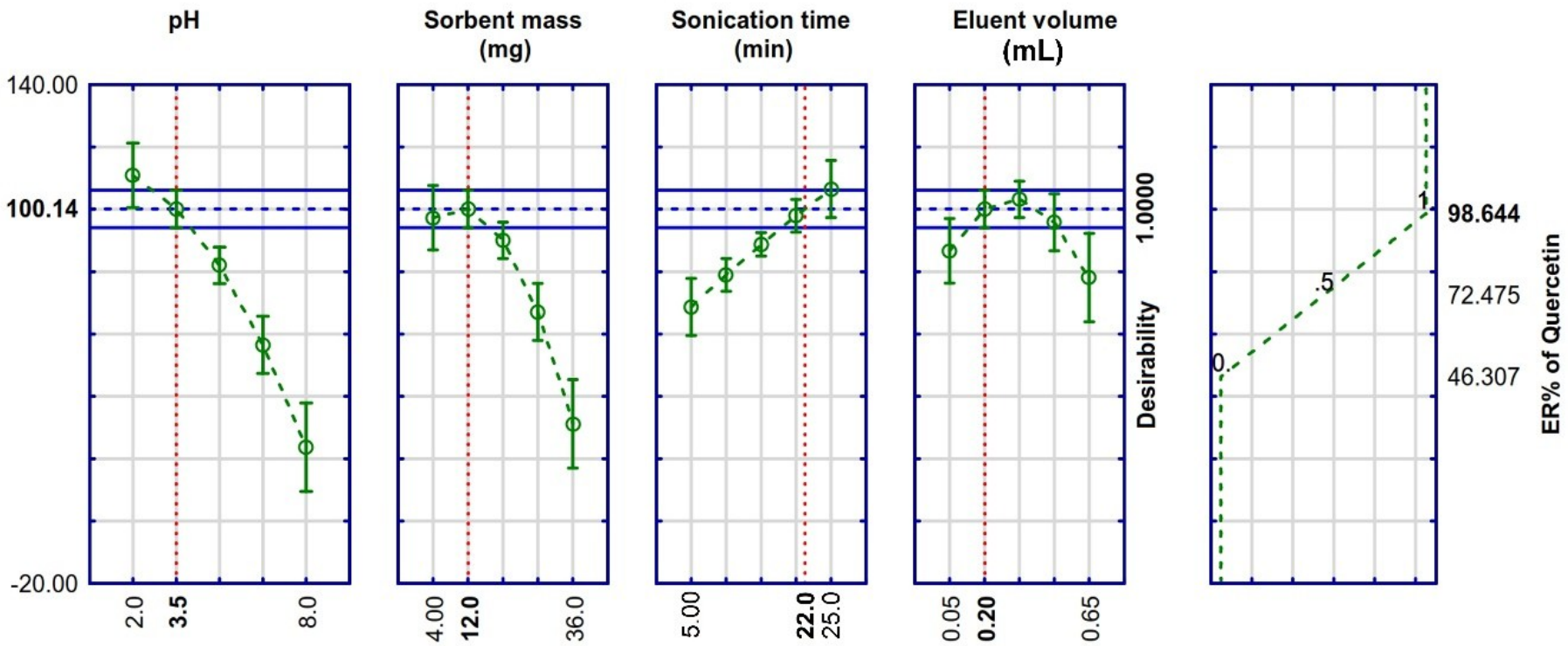


Figure S3. Results of process optimization for ER% of quercetin.

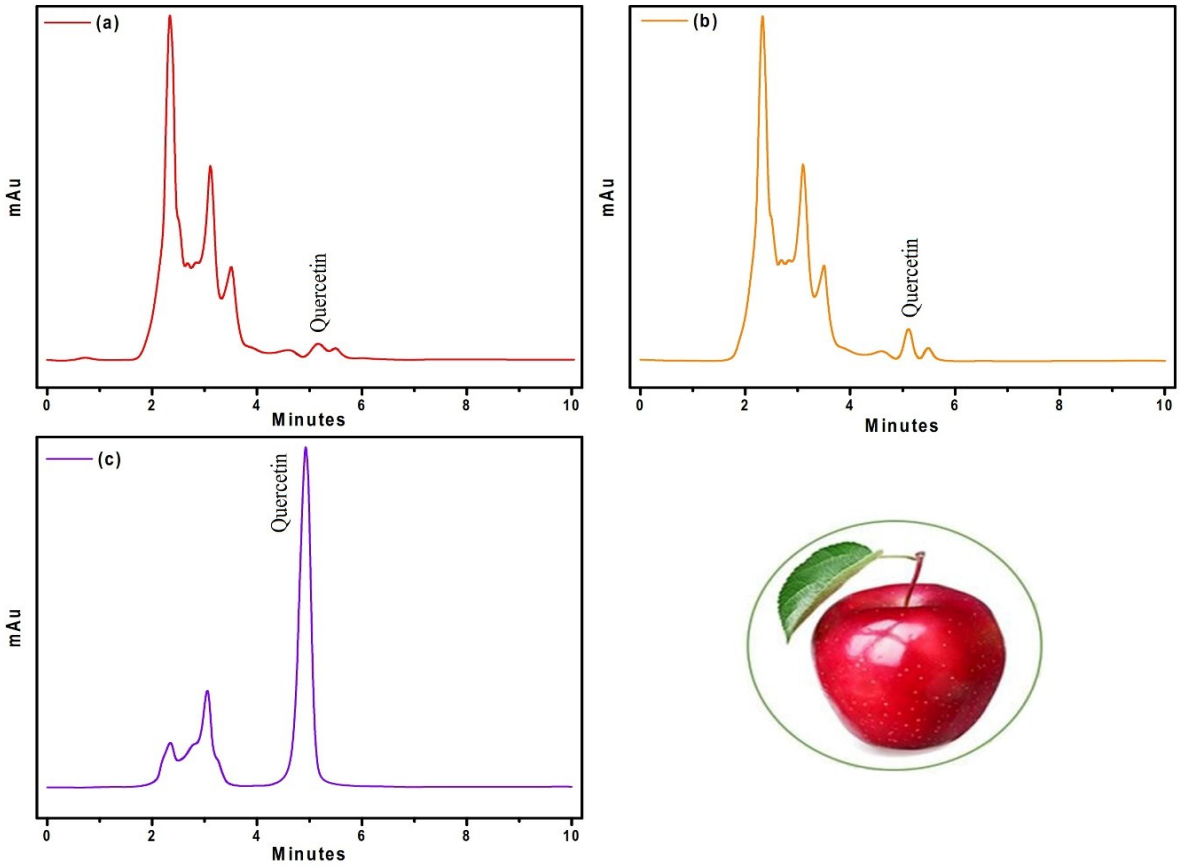


Figure S4. Typical chromatogram of the apple juice sample. (a) The blank sample without spiking, (b) spiked samples (100 μg L^{-1}) without extraction, and (c) quercetin extracted from real samples spiked with 100 μg L^{-1} of quercetin by D-μ-SPE-HPLC-UV method at optimum extraction condition.

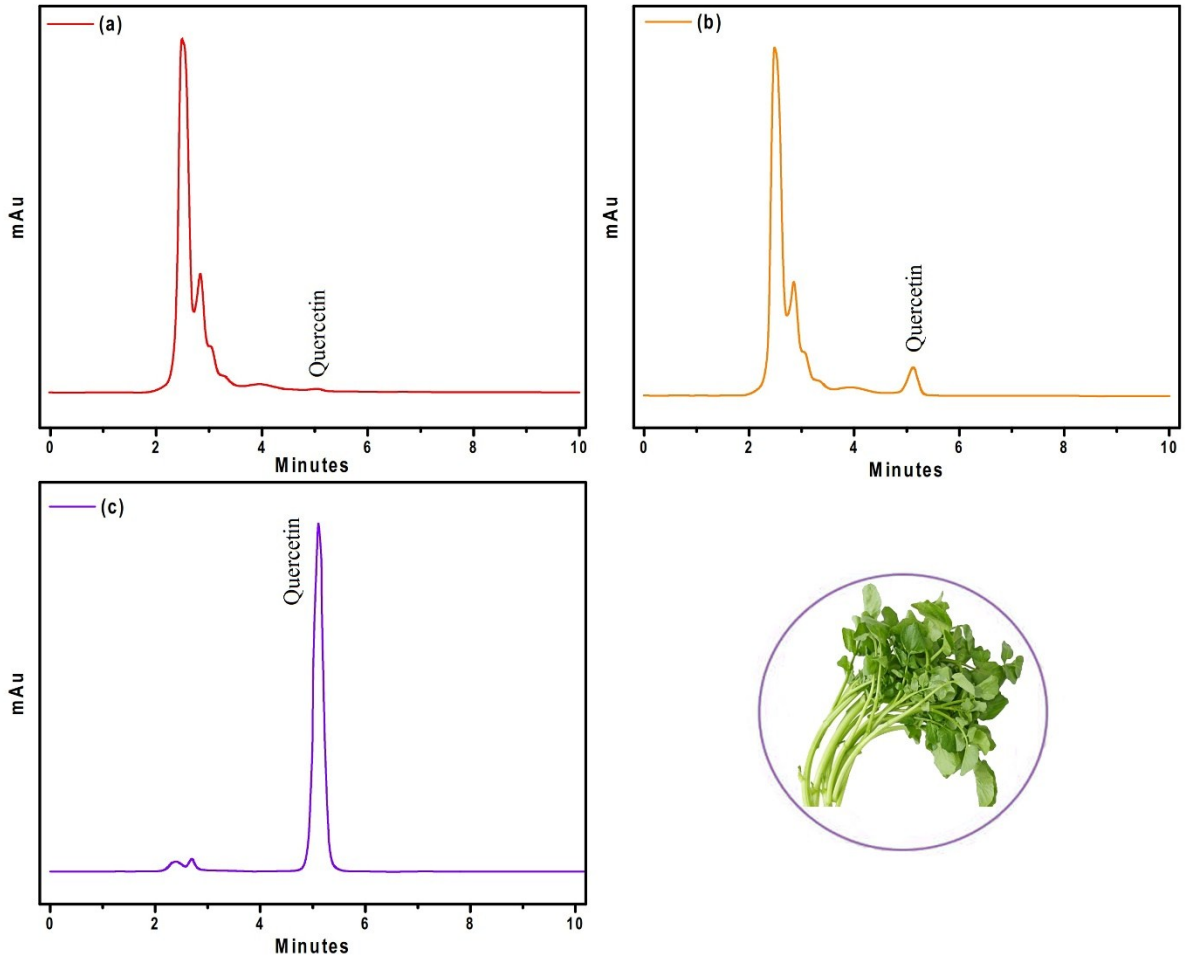


Figure S5. Typical chromatogram of the watercress (*Nasturtium officinale*) sample (a) the blank sample without spiking, (b) spiked samples (100 µg L^{-1}) without extraction and (c) quercetin extracted from real samples spiked with 100 µg L^{-1} of quercetin by D-µ-SPE-HPLC-UV method at optimum extraction condition.

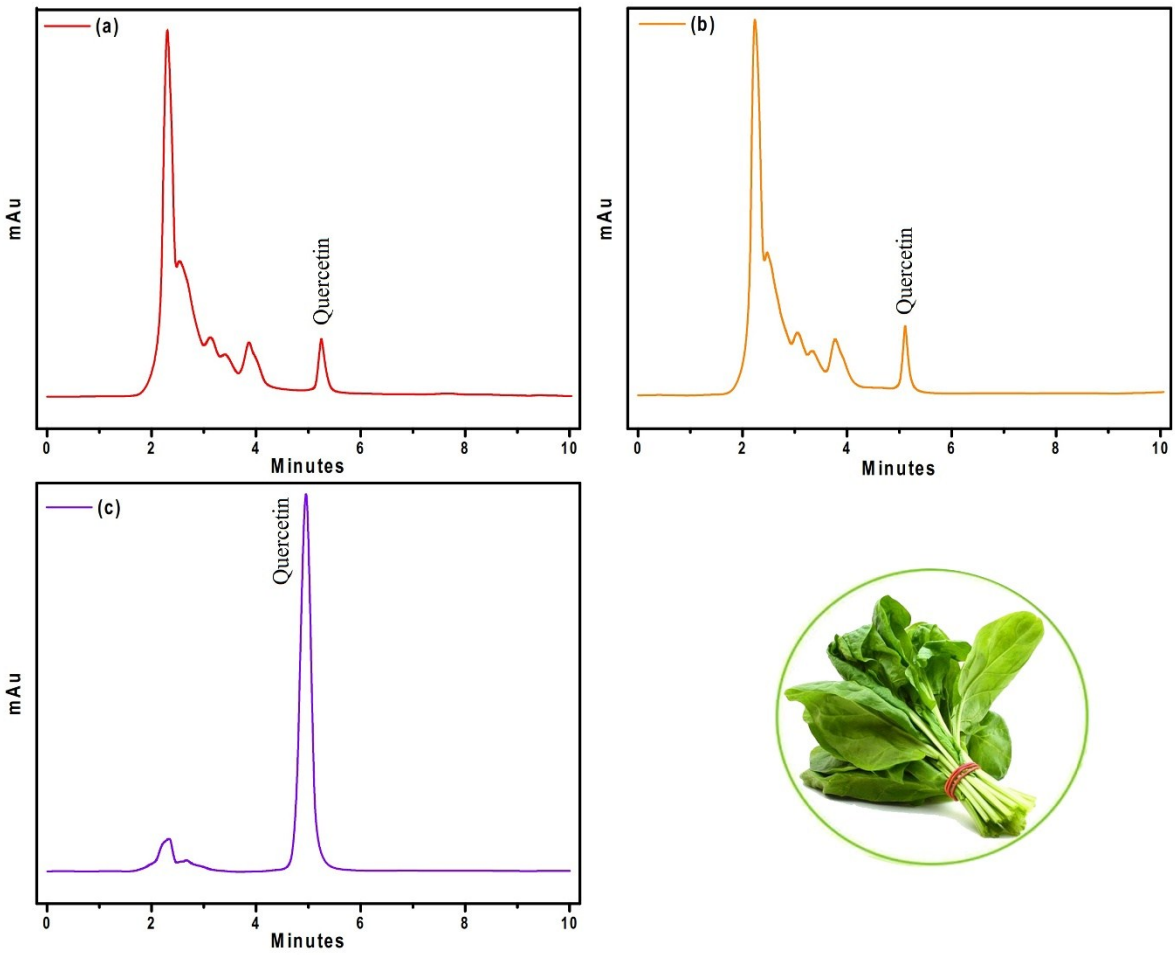


Figure S6. Typical chromatogram of the Spinach (*Spinacia oleracea*) sample (a) the blank sample without spiking, (b) spiked samples (100 µg L^{-1}) without extraction, and (c) quercetin extracted from real samples spiked with 100 µg L^{-1} of quercetin by D-µ-SPE-HPLC-UV method at optimum extraction condition.

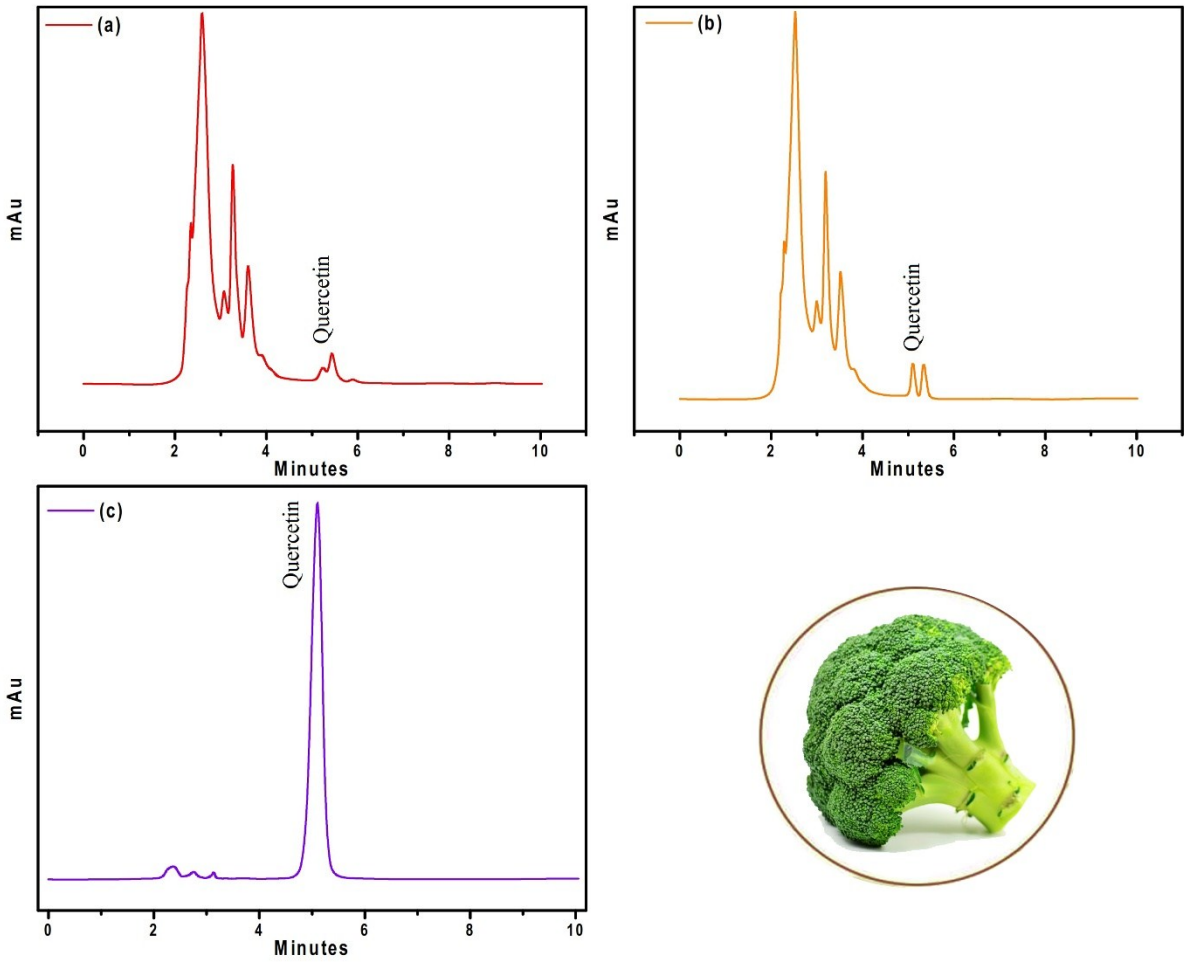
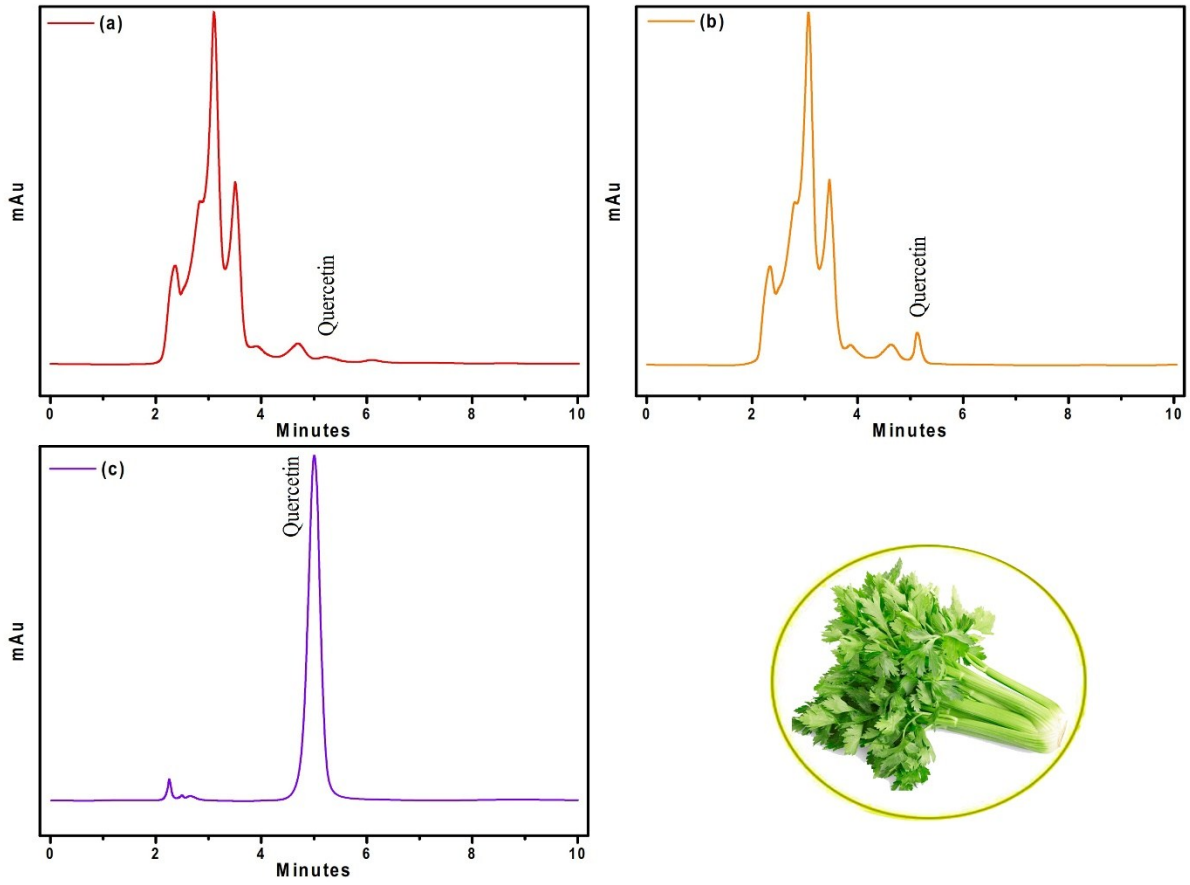


Figure S7. Typical chromatogram of the broccoli sample (a) the blank sample without spiking, (b) spiked samples (100 µg L^{-1}) without extraction, and (c) quercetin extracted from real samples spiked with 100 µg L^{-1} of quercetin by D-µ-SPE-HPLC-UV method at optimum extraction condition.



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74 **Figure S8.** Typical chromatogram of the celery (*Apium graveolens*) sample (a) the blank
75 sample without spiking, (b) spiked samples (100 μg L^{-1}) without extraction, and (c) quercetin
76 extracted from real samples spiked with 100 μg L^{-1} of quercetin by D-μ-SPE-HPLC-UV
77 method at optimum extraction condition.

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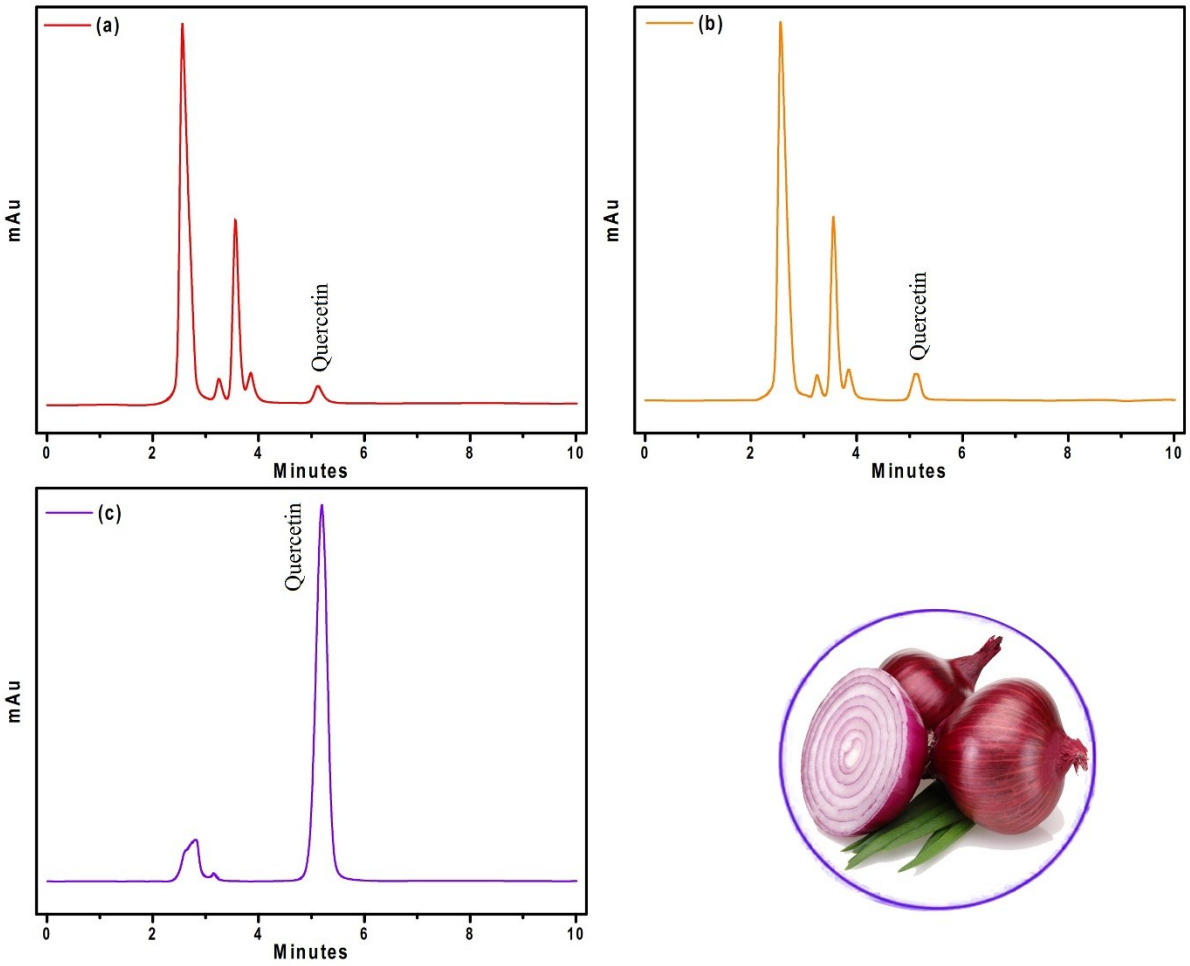

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80 **Figure S9.** Typical chromatogram of the red onion sample (a) the blank sample without
81 spiking, (b) spiked samples (100 μg L^{-1}) without extraction, and (c) quercetin extracted from
82 real samples spiked with 100 μg L^{-1} of quercetin by D-μ-SPE-HPLC-UV method at optimum
83 extraction condition.

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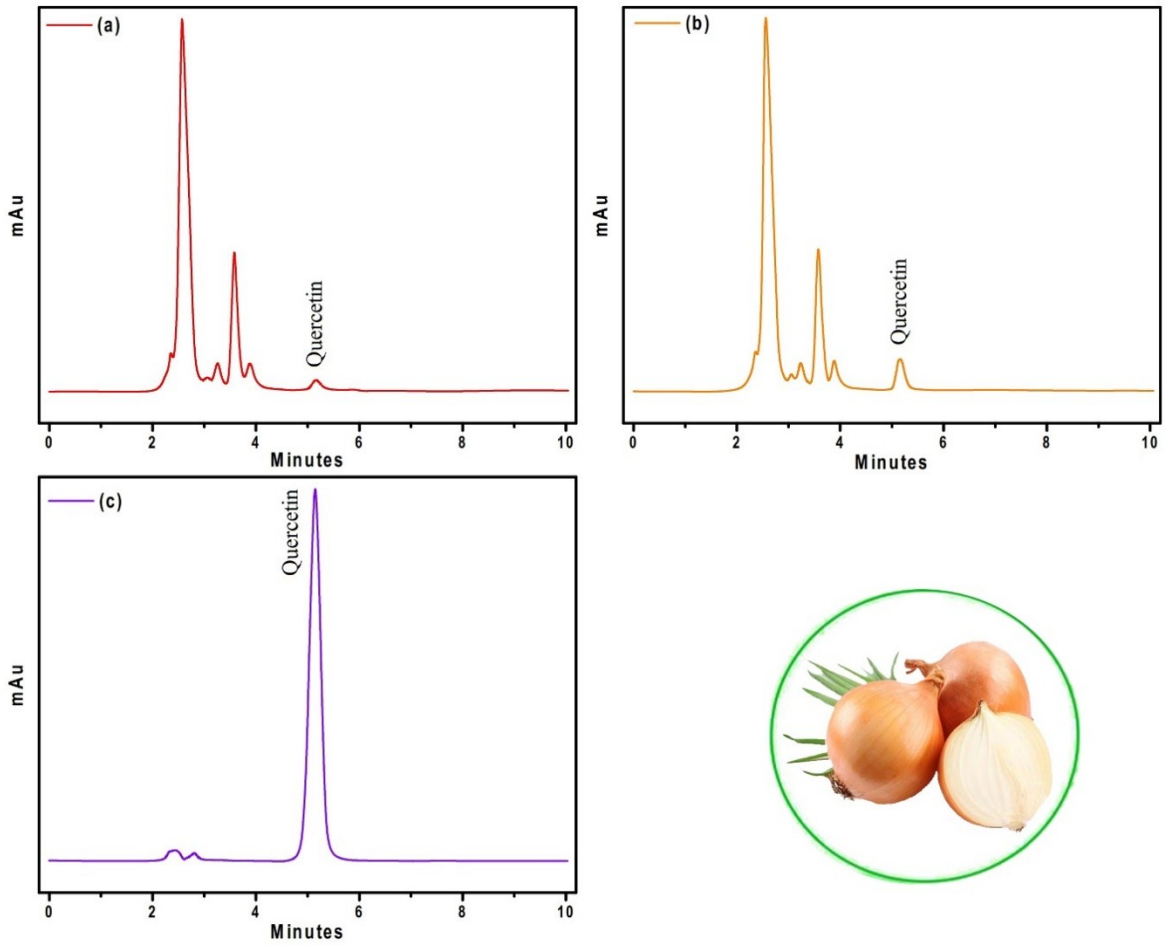

Figure S10. Typical chromatogram of the white onion sample (a) the blank sample without spiking, (b) spiked samples (100 µg L^{-1}) without extraction, and (c) quercetin extracted from real samples spiked with 100 µg L^{-1} of quercetin by D-µ-SPE-HPLC-UV method at optimum extraction condition.

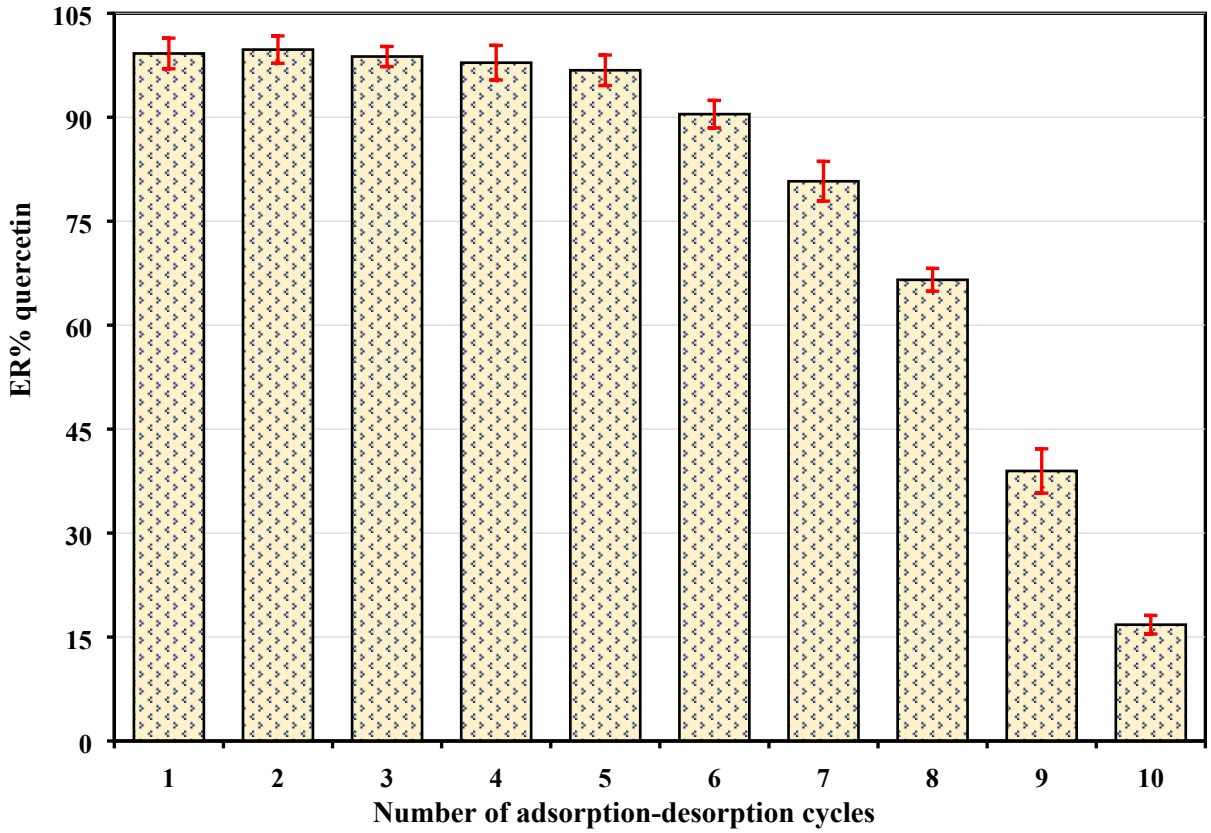

Figure S11. Ten cycles of adsorption/desorption of analyte onto sorbent.

2. Tables

Table S1. ANOVA table for the presented model for the prediction of quercetin recovery using CCD.

Source	Sum of squares	Degree of freedom	Mean square	*F* value	*p* value
Model	4748.2	14	339.2	71.1	< 0.0001
X_1	446.7	1	446.7	93.7	0.0002
X_2	32.6	1	32.6	6.8	0.0475
X_3	316.8	1	316.8	66.5	0.0005
X_4	929.5	1	929.5	194.9	< 0.0001
X_1X_2	356.4	1	356.4	74.7	0.0003
X_1X_3	0.6	1	0.6	0.1	0.7473
X_1X_4	83.4	1	83.4	17.5	0.0086
X_2X_3	57.3	1	57.3	12.0	0.0180
X_2X_4	132.8	1	132.8	27.9	0.0033
X_3X_4	34.5	1	34.5	7.2	0.0433
X_1^2	316.0	1	316.0	66.3	0.0005
X_2^2	970.4	1	970.4	203.5	< 0.0001
X_3^2	2.0	1	2.0	0.4	0.5425
X_4^2	628.7	1	628.7	131.9	< 0.0001
Residual	23.8	5	4.8		
Lack-of-fit	17.6	2	8.8	4.2	0.1334
Pure error	6.2	3	2.1		
Corr. total	4772.0	19			

Table S2. Analytical characteristics of the D-μ-SPE-HPLC-UV method.

Quantitative analysis	
Sample volume (mL)	15
Extraction solvent (mL)	0.20
Linear range (μg L^{-1})	0.6-5500
LOD (μg L^{-1})	0.113-0.117
Reproducibility (RSD, %)	<6.0
Repeatability (RSD, %)	<3.0
LOQ (μg L^{-1})	0.377-0.391

Table S3. Comparison of the characteristic performance data obtained by using D-μ-SPE-HPLC-UV with those of other preconcentration techniques for quercetin determination in different samples.

Detection method	ER (%)	Precision (% RSD)	LOD (μg L^{-1})	LOQ (μg L^{-1})	Linear range (μg L^{-1})	Time (min)	Ref.
HPLC-UV-IDLLME	96.20-98.30	1.70-4.90	0.26	0.78	0.5–1000	5.0	16
RP-HPLC-UV	97.27-99.98	0.23-0.91	0.79	-	19-280	15	65
RP-HPLC-UV	95.92-98.10	2.83-3.62	0.52	1.91	20.0-2000	20	66
RP-HPLC-UV	95.90-104.10	9.70-16.5	1.0	1.61	1.638 - 81.90	30	17
RP-HPLC-UV	95.50-102.50	1.25-3.13	85	283	714-28560	20	67
HPLC-UV-SPE	92.36-99.41	1.50-9.40	0.35	7-35	20–1000	45	68
HPLC-CL-IL-PLE	93.70–105.2	1.50-5.70	3.8	-	10-500	12	69
CE-ED	96.84-98.76	2.06-3.14	57.43	-	150-3000	10	70
CV and LSV	-	1.10-3.50	0.100	-	0.23-314	15	71
D-μ-SPE-HPLC-UV	95.44-106.89	0.89-5.63	0.113-0.117	0.377-0.391	0.6-5500	22	This work

HPLC: High performance liquid chromatographic

IDLLME: Inverted dispersive liquid-liquid microextraction

RP-HPLC: Reversed-phase high performance liquid chromatography

CL: Chemiluminescence

IL-PLE: Ionic liquid-based pressurized liquid extraction

CE-ED: Capillary electrophoresis with electrochemical detection

CV: Cyclic voltammetry

LSV: Linear sweep voltammetry