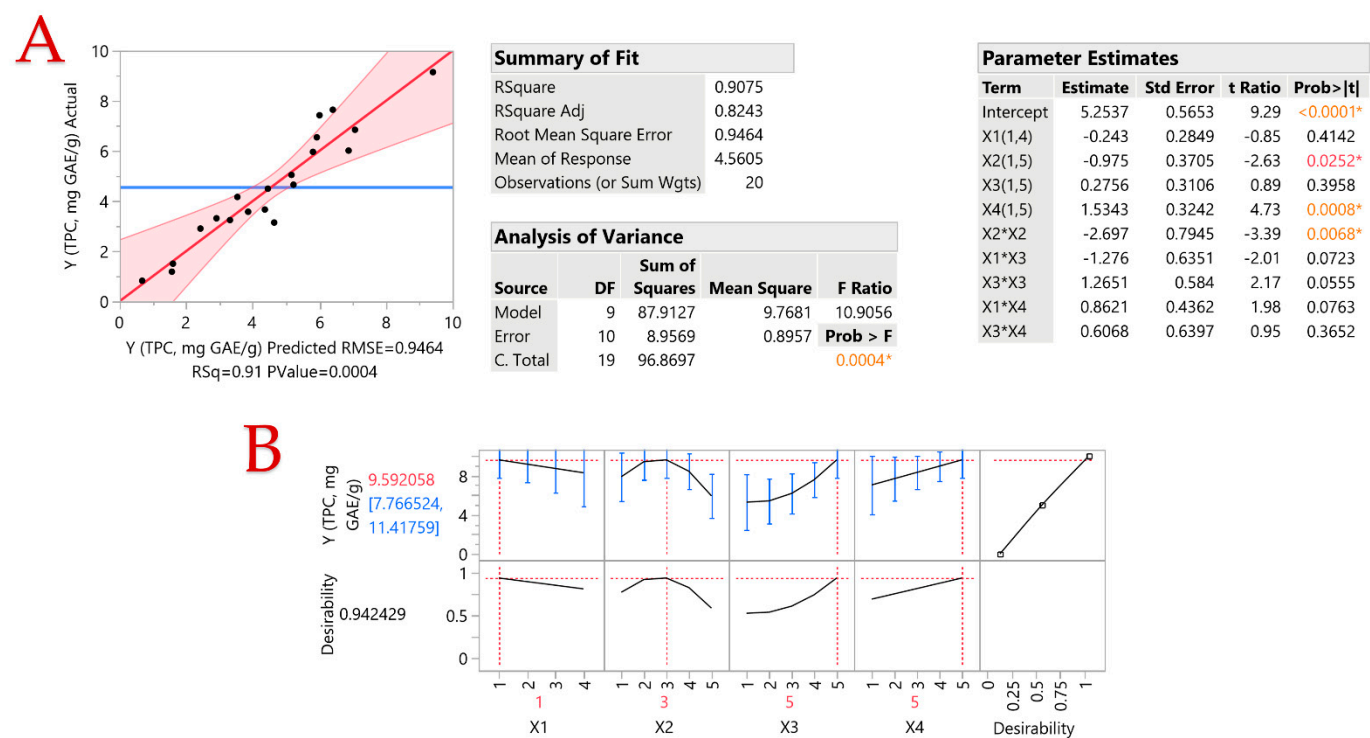


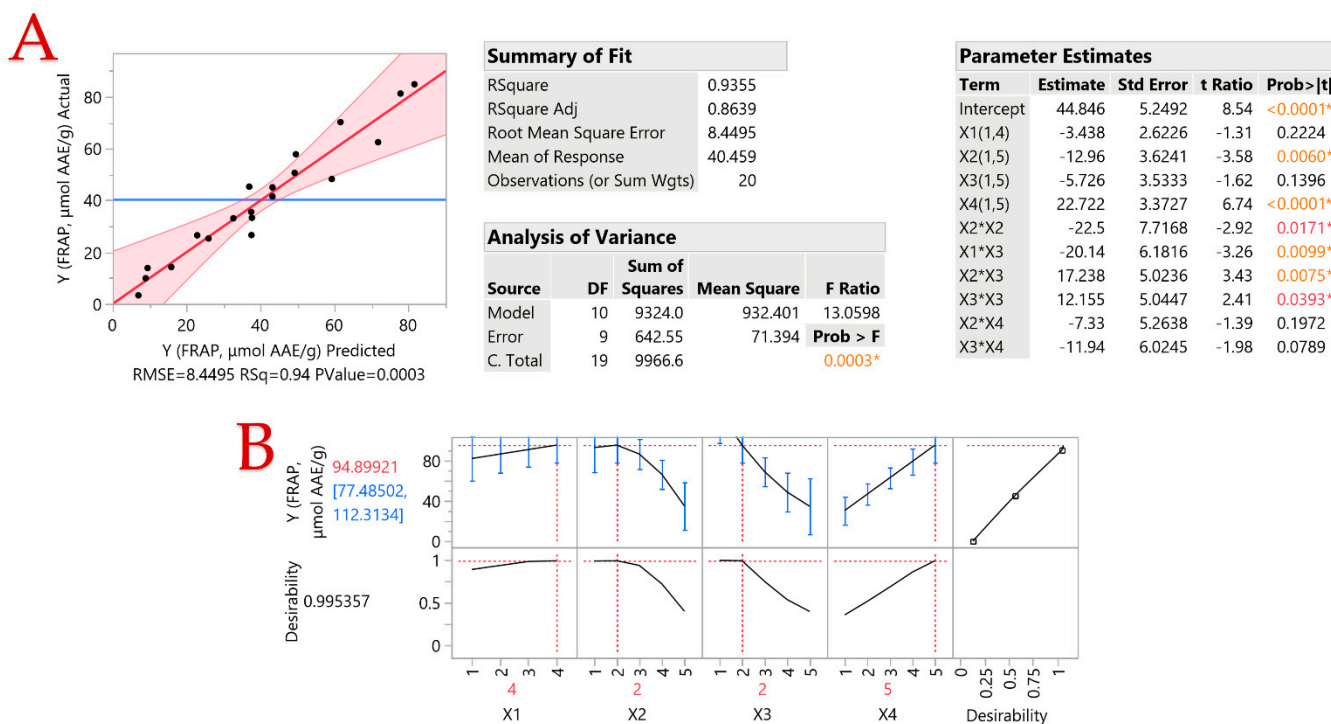
# Optimization of Carotenoids and Other Antioxidant Compounds Extraction from Carrot Peels Using Response Surface Methodology

Martha Mantiniotou, Vassilis Athanasiadis \*, Dimitrios Kalompatsios, and Stavros I. Lalas

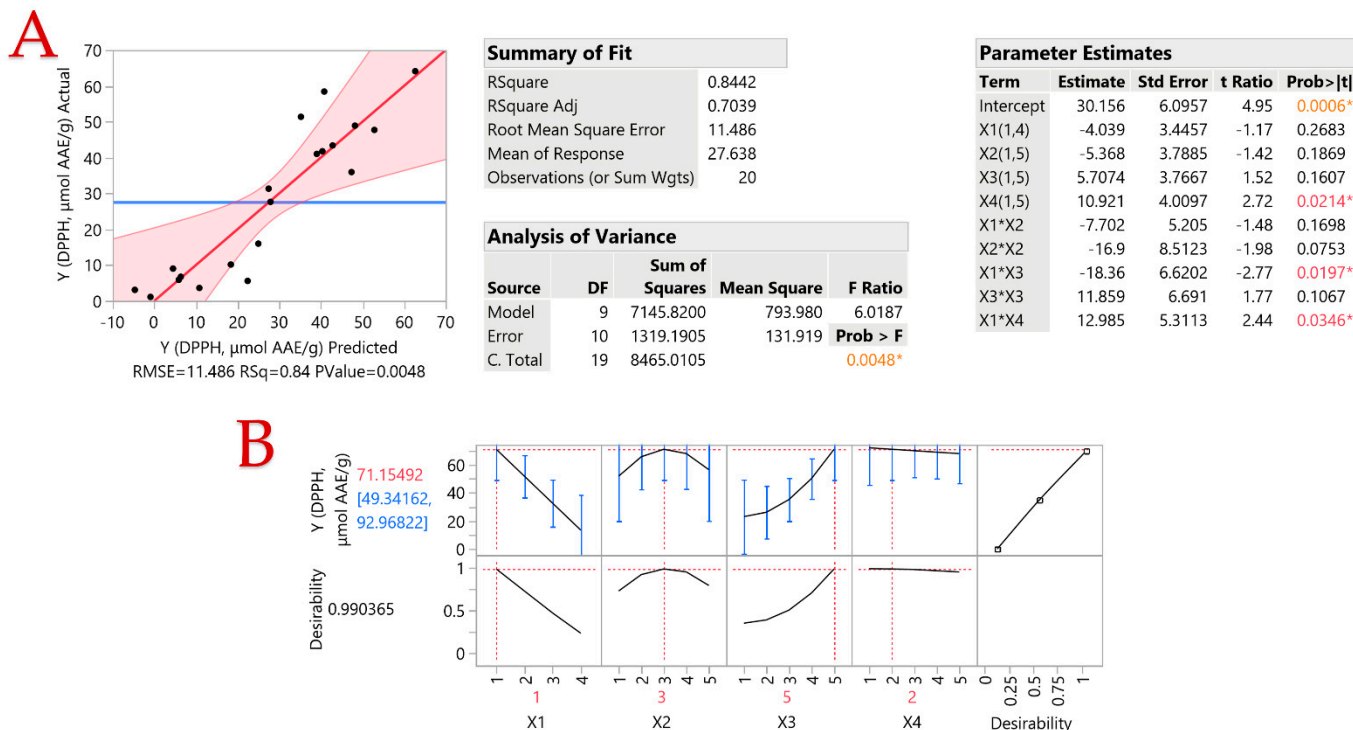
Department of Food Science and Nutrition, University of Thessaly, Terma N. Temponera Street, 43100 Karditsa, Greece; mmantiniotou@uth.gr (M.M.); dkalompatsios@uth.gr (D.K.); slalas@uth.gr (S.I.L.)  
\* Correspondence: vaathanasiadis@uth.gr; Tel.: +30-24410-64783



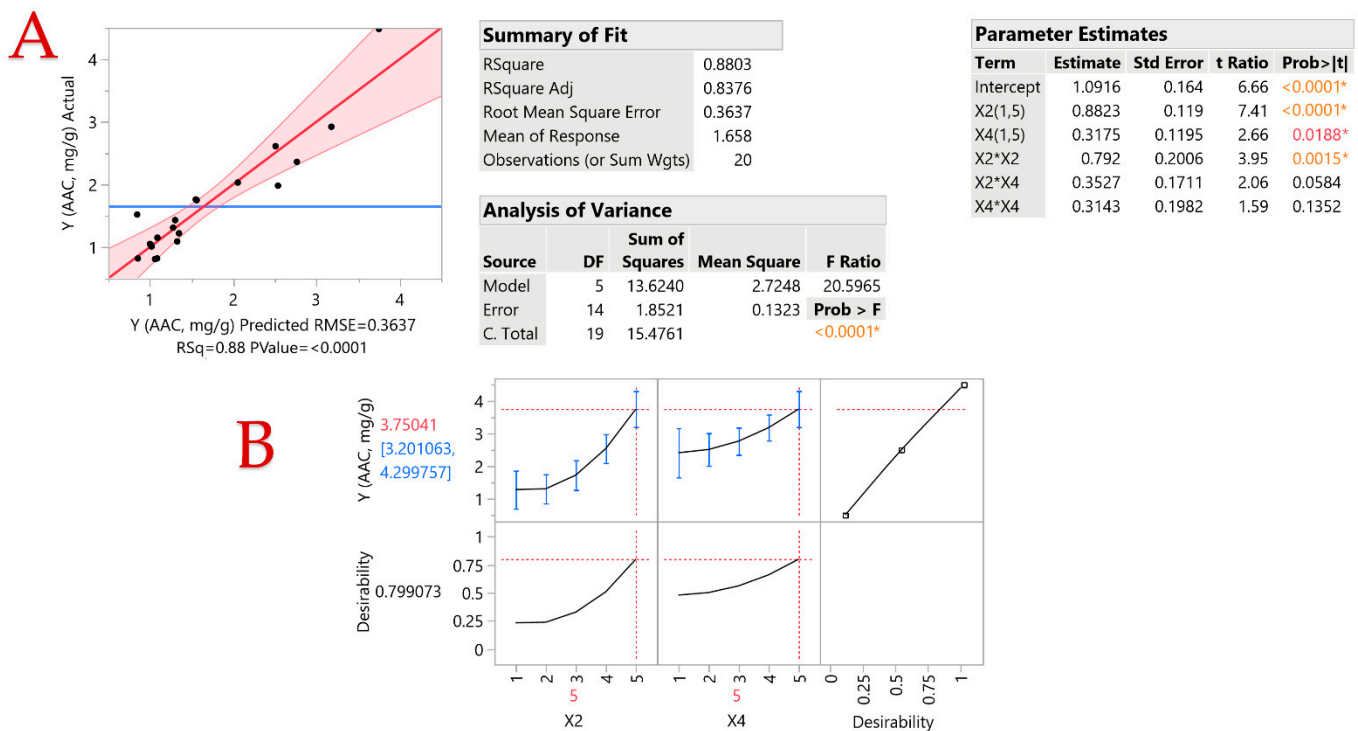
**Figure S1.** Plot **A** displays the actual response versus the predicted response (Total polyphenol content – TPC, mg GAE/g) for optimizing carrot peel extracts using hydroethanolic solutions, different extraction techniques, and parameters, and plot **B** displays the desirability function. Asterisks and colored values denote statistically significant values, while inset tables include statistics relevant to evaluating the resulting model.



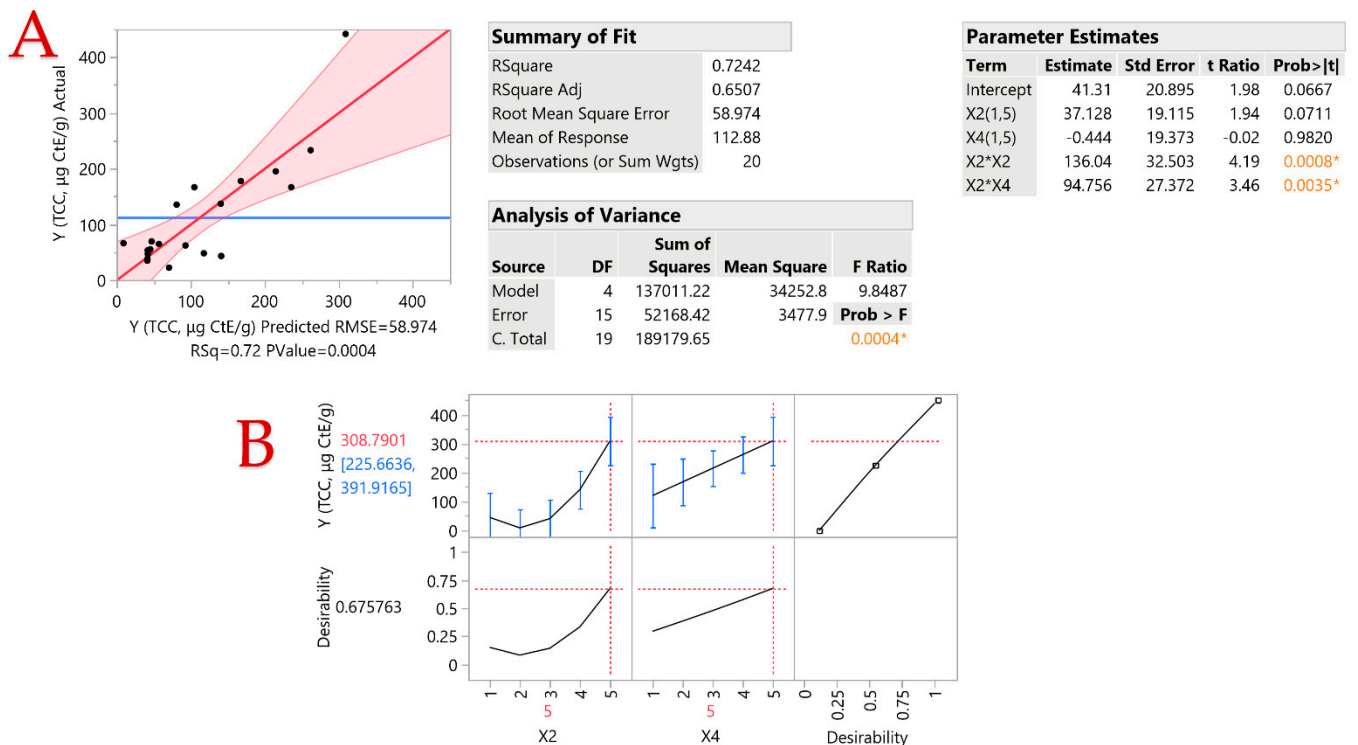
**Figure S2.** Plot A displays the actual response versus the predicted response (FRAP,  $\mu\text{mol AAE/g}$ ) for optimizing carrot peel extracts using hydroethanolic solutions, different extraction techniques, and parameters, and plot B displays the desirability function. Asterisks and colored values denote statistically significant values, while inset tables include statistics relevant to evaluating the resulting model.



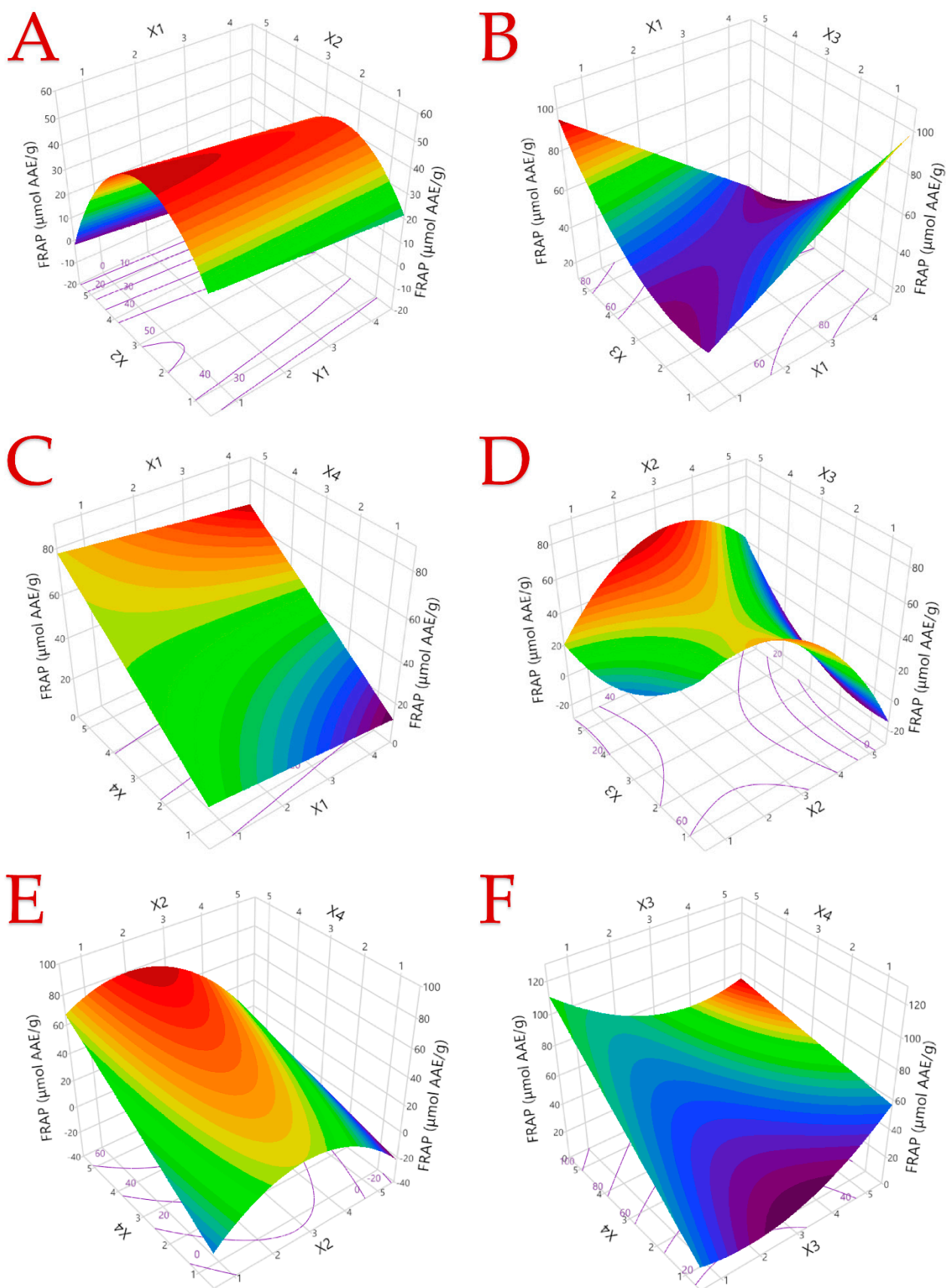
**Figure S3.** Plot A displays the actual response versus the predicted response (DPPH,  $\mu\text{mol AAE/g}$ ) for optimizing carrot peel extracts using hydroethanolic solutions, different extraction techniques, and parameters, and plot B displays the desirability function. Asterisks and colored values denote statistically significant values, while inset tables include statistics relevant to evaluating the resulting model.



**Figure S4.** Plot **A** displays the actual response versus the predicted response (Ascorbic acid content – AAC, mg/g) for optimizing carrot peel extracts using hydroethanolic solutions, different extraction techniques, and parameters, and plot **B** displays the desirability function. Asterisks and colored values denote statistically significant values, while inset tables include statistics relevant to evaluating the resulting model.

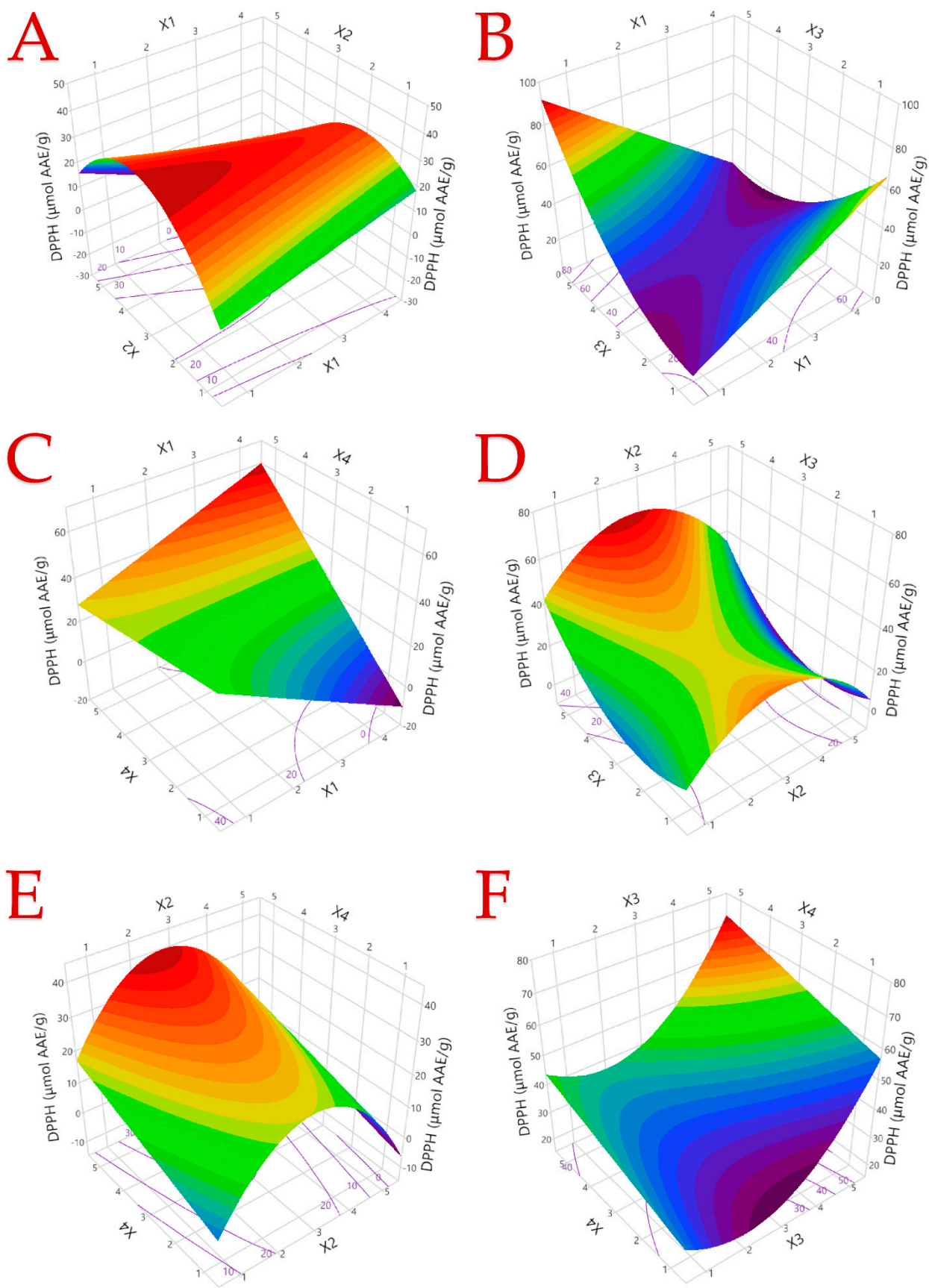


**Figure S5.** Plot **A** displays the actual response versus the predicted response (Total carotenoid content – TCC, µg CtE/g) for optimizing carrot peel extracts using hydroethanolic solutions, different extraction techniques, and parameters, and plot **B** displays the desirability function. Asterisks and colored values denote statistically significant values, while inset tables include statistics relevant to evaluating the resulting model.

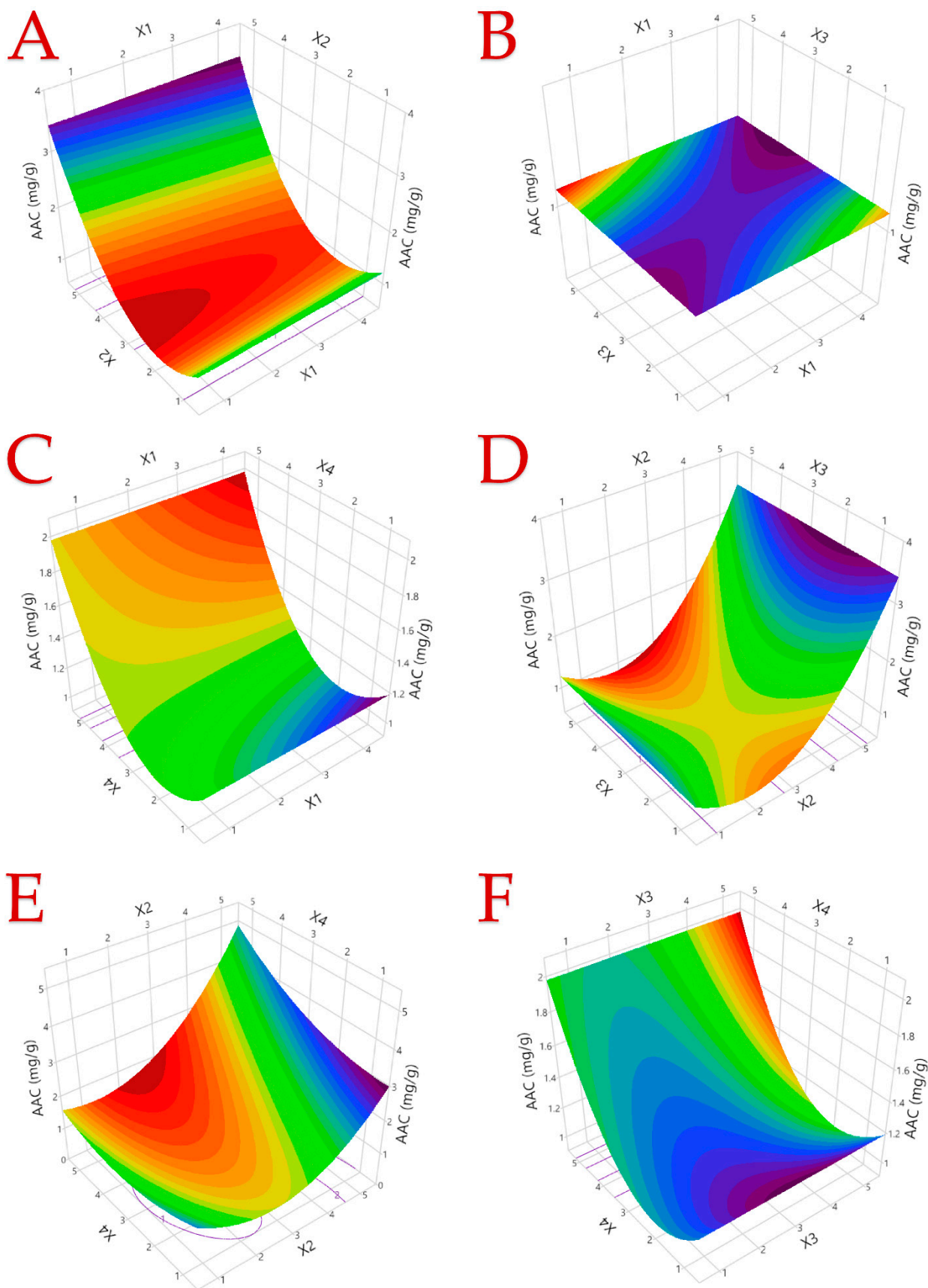


**Figure S6.** The optimal extraction of the carrot peels is depicted in 3D graphs, illustrating the effects of the process variables on the response, specifically the FRAP ( $\mu\text{mol AAE/g}$ ). Plot (A) shows the covariation of  $X_1$  and  $X_2$ ; plot (B), displays the covariation of  $X_1$  and  $X_3$ ; plot (C), represents the covariation of  $X_1$  and  $X_4$ ; plot (D), demonstrates the covariation of  $X_2$  and  $X_3$ ; plot (E), exhibits the covariation of  $X_2$  and  $X_4$ ; plot (F), reveals the covariation of  $X_3$  and  $X_4$ .

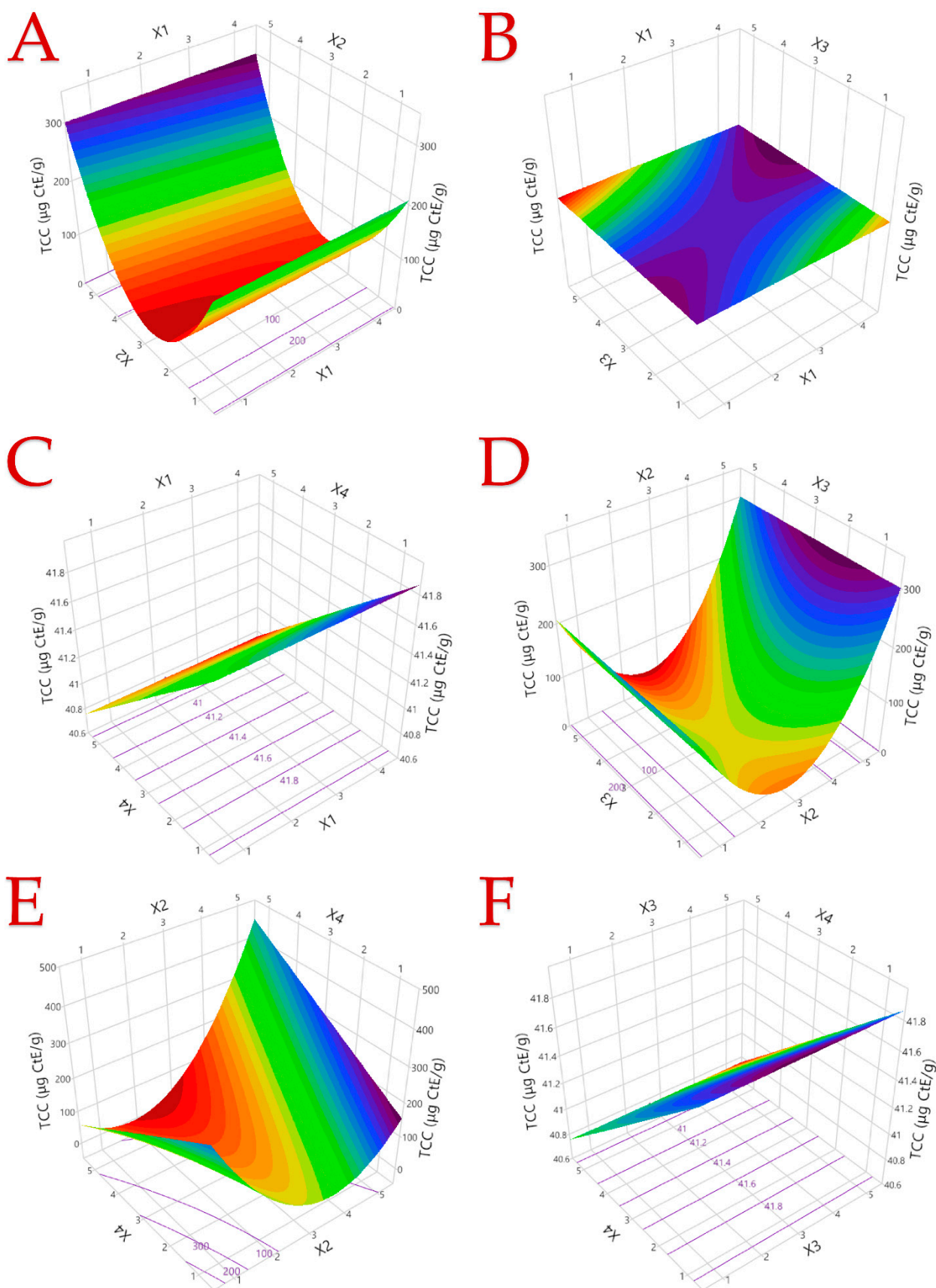




**Figure S7.** The optimal extraction of the carrot peels is depicted in 3D graphs, illustrating the effects of the process variables on the response, specifically the DPPH ( $\mu\text{mol AAE/g}$ ). Plot (A) shows the covariation of  $X_1$  and  $X_2$ ; plot (B), displays the covariation of  $X_1$  and  $X_3$ ; plot (C), represents the covariation of  $X_1$  and  $X_4$ ; plot (D), demonstrates the covariation of  $X_2$  and  $X_3$ ; plot (E), exhibits the covariation of  $X_2$  and  $X_4$ ; plot (F), reveals the covariation of  $X_3$  and  $X_4$ .



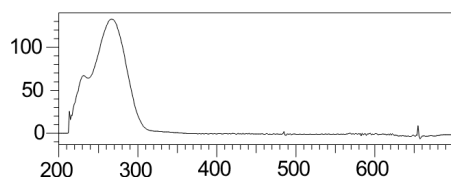
**Figure S8.** The optimal extraction of the carrot peels is depicted in 3D graphs, illustrating the effects of the process variables on the response, specifically the ascorbic acid content (AAC, mg/g). Plot (A) shows the covariation of  $X_1$  and  $X_2$ ; plot (B), displays the covariation of  $X_1$  and  $X_3$ ; plot (C), represents the covariation of  $X_1$  and  $X_4$ ; plot (D), demonstrates the covariation of  $X_2$  and  $X_3$ ; plot (E), exhibits the covariation of  $X_2$  and  $X_4$ ; plot (F), reveals the covariation of  $X_3$  and  $X_4$ .



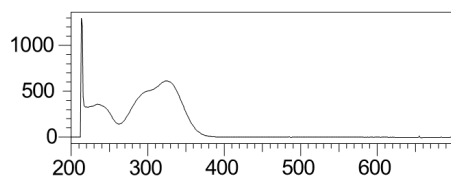
**Figure S9.** The optimal extraction of the carrot peels is depicted in 3D graphs, illustrating the effects of the process variables on the response, specifically the total carotenoid content (TCC,  $\mu\text{g } \beta\text{-carotene equivalents (CtE)/g}$ ). Plot (A) shows the covariation of  $X_1$  and  $X_2$ ; plot (B), displays the covariation of  $X_1$  and  $X_3$ ; plot (C), represents the covariation of  $X_1$  and  $X_4$ ; plot (D), demonstrates the covariation of  $X_2$  and  $X_3$ ; plot (E), exhibits the covariation of  $X_2$  and  $X_4$ ; plot (F), reveals the covariation of  $X_3$  and  $X_4$ .

## Phenolic acids

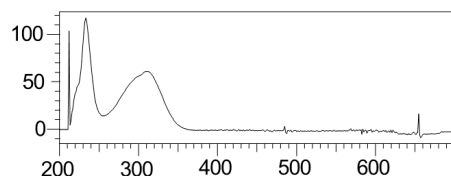
Compound :  **$\beta$ -Resorcylic acid**  
Retention Time : **11.778**



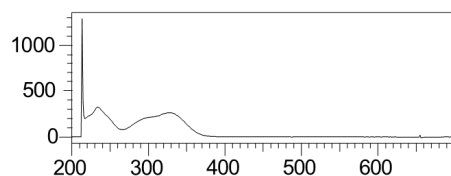
Compound : **Chlorogenic acid**  
Retention Time : **16.774**



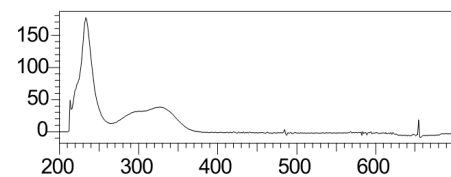
Compound : **Pyrocatechuic acid**  
Retention Time : **21.114**



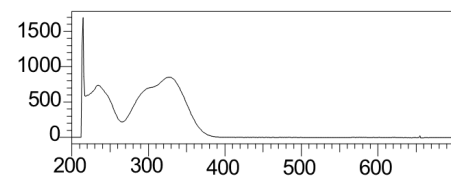
Compound : **Caffeic acid**  
Retention Time : **23.094**



Compound : ***p*-Coumaric acid**  
Retention Time : **25.462**

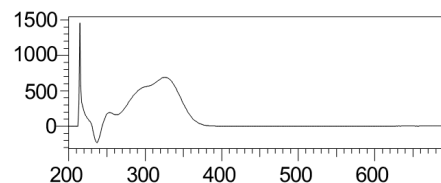


Compound : **Ferulic acid**  
Retention Time : **26.616**

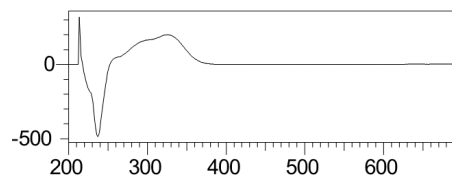


## Flavonoids

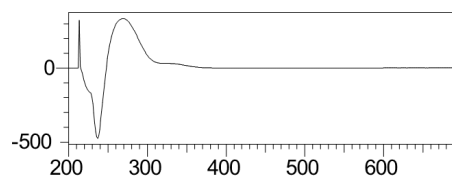
Compound : **(+)-Catechin (hydrate)**  
Retention Time : **5.768**



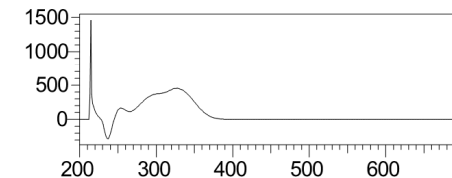
Compound : **Rutin**  
Retention Time : **5.952**



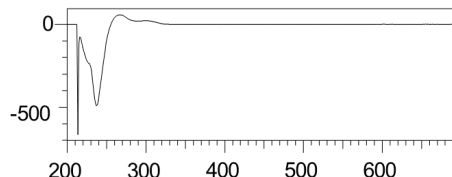
Compound : **Quercetin-3-O-galactoside**  
Retention Time : **6.813**



Compound : **Apigenin-7-O-glucoside**  
Retention Time : **7.935**



Compound : **4'-Hydroxychalcone**  
Retention Time : **19.353**



Compound : **Chrysin**  
Retention Time : **20.627**

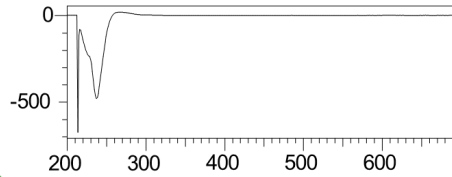
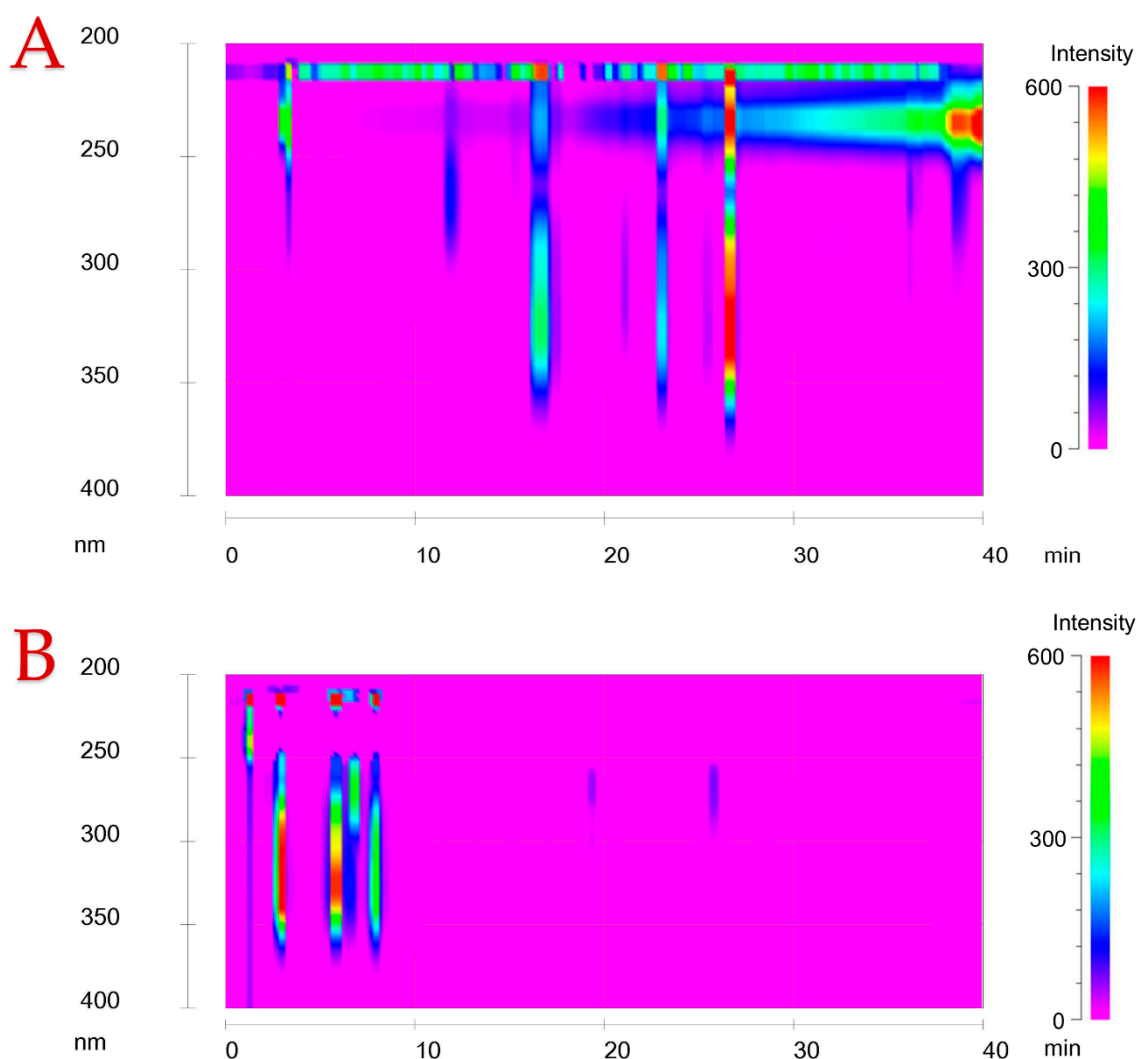


Figure S10. UV spectrum index for phenolic acids and flavonoids.





**Figure S11.** Two-dimensional (2D) contour plots of chromatographs for phenolic acids (A) and flavonoids (B).

**Table S1.** Equations of calibration curves for the phenolic compounds identified through HPLC-DAD.

Phenolic Compounds (Standards)	Equation	R <sup>2</sup>	Retention Time (min)	UVmax
<i>Phenolic acids</i>				
β-Resorcylic acid	$y = 73,173.40x + 374,752.17$	0.996	11.778	265
Chlorogenic acid	$y = 47,940.59x + 729,821.30$	0.992	16.774	323
Pyrocatechuic acid	$y = 189,392.56x + 1,430,809.22$	0.990	21.114	310
Caffeic acid	$y = 836,011.57x + 606,104.54$	0.994	23.094	327
<i>p</i> -Coumaric acid	$y = 54,706.25x + 346,333.79$	0.993	25.462	325
Ferulic acid	$y = 233,188.64x + 1,666,648.36$	0.991	26.616	325
<i>Flavonoids</i>				
(+)-Catechin (hydrate)	$y = 81,185.19x + 811,110.11$	0.996	5.768	326
Rutin	$y = 35,025.67x + 191,393.19$	0.993	5.952	325
Quercetin-3- <i>O</i> -galactoside	$y = 46,400.91x - 239,005.52$	0.994	6.813	268
Apigenin-7- <i>O</i> -glucoside	$y = 52,641.52x - 43,026.57$	0.996	7.935	326
4'-Hydroxychalcone	$y = 4486.07x + 39,932.36$	0.993	19.353	264
Chrysin	$y = 63,810.72x + 501,708.84$	0.997	20.627	264