

Supplementary Material

Determination of carminic acid in foodstuffs and pharmaceuticals by microchip electrophoresis with photometric detection

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Table S1. Some parameters of analytical methods used for determination of carminic acid.

Method	Sample	Sample pretreatment	LOD ($\mu\text{mol L}^{-1}$)	Ref.
Spectrophotometry	confectionery, beverages	dissolved in water, filtered (0.45 μm pore size), CPE (Triton X-100)	0.024 ¹	[1]
Square-wave stripping voltammetry	beverages, ice cream	spiked carbonated beverages – mixed with acetate buffer, deoxygenated; ice cream – mixed with warm water	0.001 ¹	[2]
Differential pulse polarography	confectionery, fruit flavored milk drinks	confectionery – diluted in B-R buffer; milk drinks – diluted in acetonitrile, centrifugated, diluted in B-R buffer	0.16	[3]
HPLC-UV-Vis	vitamins	dissolved in hot water, centrifuged, filtered (0.40 μm pore size)	4.9 ¹	[4]
HPLC-UV-Vis	16 different food types	ground, LLE (0.05 mol L ⁻¹ NaOH), centrifuged, filtered (0.45 μm pore size)	0.8 ¹	[5]
HPLC-UV-Vis	saffron	aqueous extracts prepared according to the ISO 3632-2, filtered (0.45 μm pore size)	0.06	[6]
HPLC-UV-Vis	beverages, milk products	beverages – filtered (0.45 μm pore size); high lipid samples – LLE (water/hexane); high protein samples – stirred with NH ₄ OH, adjusted to pH 2, centrifuged, filtered (0.45 μm pore size)	2.0	[7]
HPLC-FD			3.0	
HPLC-MS/MS	beverages	carbonated beverages – degassed; alcoholic beverages – evaporation of ethanol, adjusted to pH 3.0-3.5, SPE (HLB cartridge), filtered (0.22 μm pore size)	0.006	[8]
CE-UV-Vis	confectionery, beverages, fruit flavored milk drinks	confectionery – blended with ethanol, decanted; carbonated beverages – degassed; milk drinks – diluted with ethanol, adjusted to pH 2.0, centrifuged; SPE (PA column), LVSS	0.053	[9]
CE-UV-Vis	beverages, ice lollies, syrups	beverages, ice lollies – diluted with water; syrups – diluted with water, filtered	4.3	[10]
CE-UV-Vis	fruit flavored milk drinks	diluted with ethanol, adjusted to pH 2.0, centrifuged, SPE (PA column)	≤ 0.81	[11]
CE-UV-Vis	beverages	filtered (0.45 μm pore size), diluted with water, adjusted to pH 2.5, dSPME with dASNP	0.12	[12]
MEEKC-UV-Vis	beverages, ice lollies	beverages – degassed; ice lollies – melted; SPE (PA column) only for CE	3.7	[13]
CE-UV-Vis			1.2	
MCE-PD	candies, pharmaceuticals, radler, saffron	candies, pharmaceuticals – dissolved in water, filtered (0.45 μm pore size); radler – degassed; saffron – ground, suspended in water, sonicated, filtered (0.45 μm pore size); adjusted to pH of the BGE	0.069	this work

BGE – background electrolyte; B-R buffer – Britton-Robinson buffer; CE – capillary electrophoresis; CPE – cloud point extraction; dASNP – diamino moiety functionalized silica nanoparticles; dSPME – dispersive solid-phase microextraction; FD – fluorescence detection; HLB – hydrophilic-lipophilic balance; HPLC – high performance liquid chromatography; LLE – liquid-liquid extraction; LVSS – large-volume sample stacking; MCE – microchip electrophoresis; MEEKC – microemulsion electrokinetic chromatography; MS/MS – tandem mass spectrometry; PA – polyamide; PD – photometric detection; SPE – solid-phase extraction; UV-Vis – Ultraviolet-visible

¹ expressed for carmines

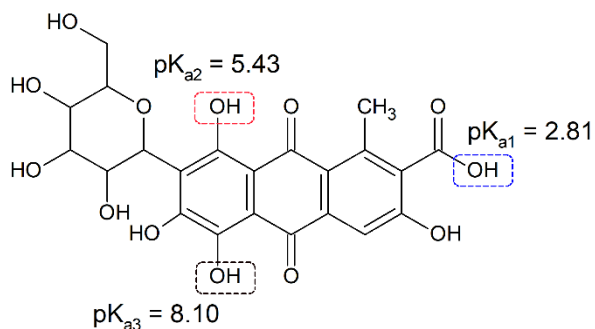


Figure S1. Structure of carminic acid with pK_a values. The pK_{a1} belongs to the carboxyl group (blue dashed frame) which has the most acidic hydrogen in molecule of carminic acid. The second most acidic hydrogen comes from the hydroxyl group (red dashed frame) with the pK_a value of 5.43. The other hydroxyl group (black dashed frame) is also able to lose acidic hydrogen but it is the weakest acidic group in the molecule with pK_{a3} of 8.1.

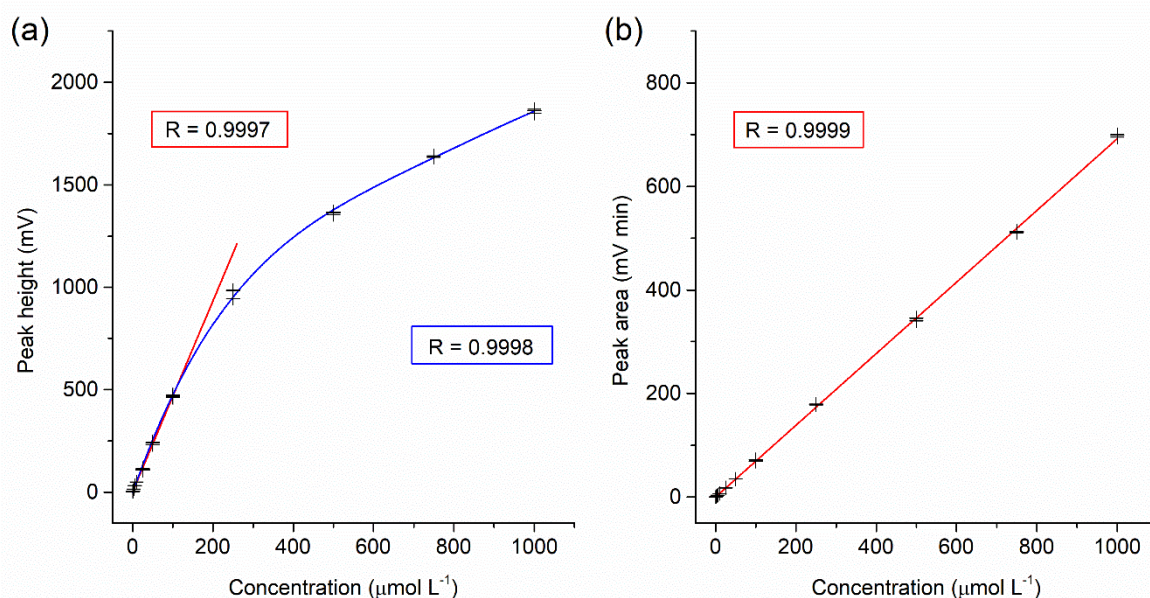


Figure S2. Linear dynamic range for: (a) peak height; and (b) peak area of carminic acid.

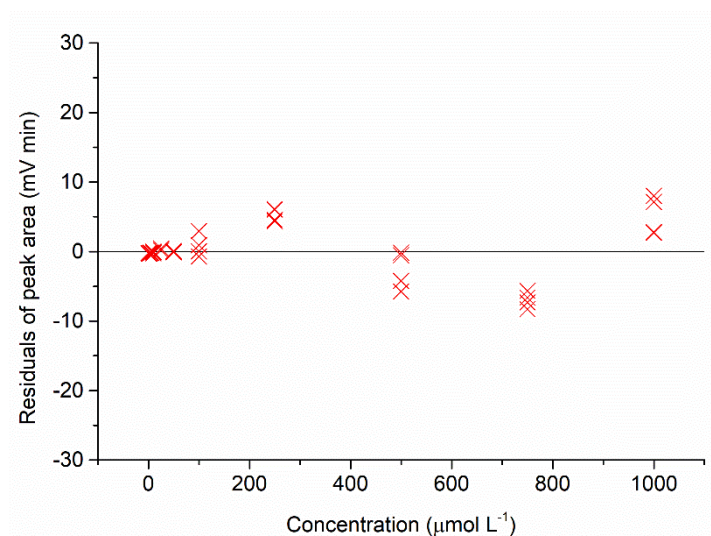


Figure S3. Plot of residuals of peak area.

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