Supporting Information

Use of Charged Nanoparticles in NMR-based Metabolomics for Spectral Simplification and Improved Metabolite Identification

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Abstract

This Supporting Information provides additional information about the measurements of SNP properties (TEM, ζ-potential, DSL) and analyzes the reproducibility of metabolite mixture with SNPs.

TEM, ζ-potential, and DLS measurements

The transmission electron microscope (TEM, see Figure 1 of main text) image was recorded on FEI/Philips CM-200T microscope at an accelerating voltage of 200 kV. To prepare the TEM sample, approximately 10 μL of 350-fold diluted original colloid was dispersed on a 400 mesh copper grid supported by carbon film and vacuumed to dry. Images were analyzed using ImageJ[1] to show size distribution. Dynamic light scattering (DLS) and ζ-potential measurements were performed at 25 °C using Malvern Zetasizer Nano ZS equipped with 633 nm He-Ne laser and 173° back scatter detector. The sample concentrations were adjusted in order to meet the DLS and ζ-potential measuring criteria respectively, typically within 2-20 mg/mL range. The data were analyzed using Malvern Zetasizer Software.

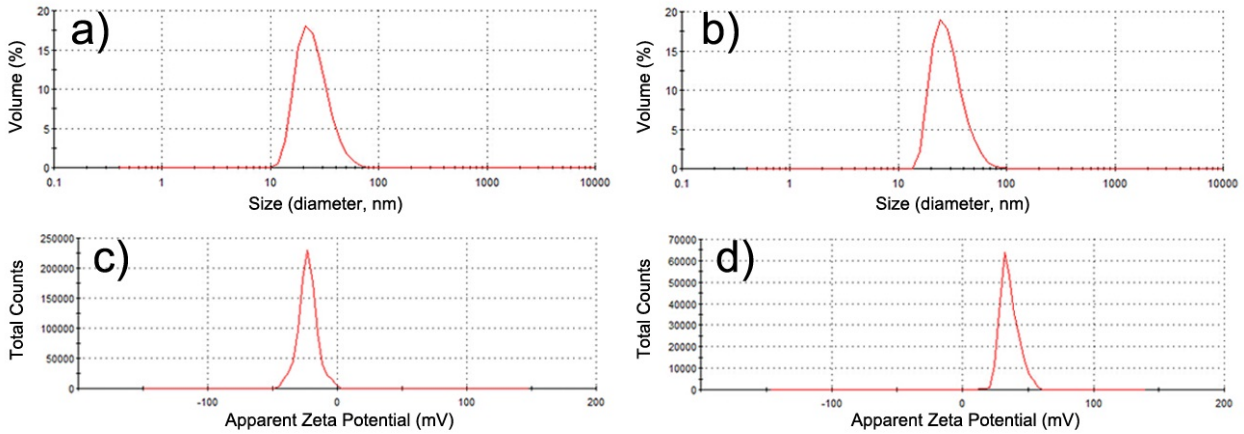

Figure S1. Dynamic light scattering (DLS) size distribution of (a) anionic SNPs and (b) cationic SNPs by volume. The hydrodynamic diameters of anionic and cationic SNPs were determined to be 25.3 ± 8.9 nm and 29.6 ± 10.4 nm (average ± standard deviation), respectively. ζ-potentials of (c) anionic SNPs at pH 5.5 and (d) cationic SNPs at pH 7.0 were measured to be -23.0 ± 7.4 mV and +35.7 ± 6.9 mV (average ± standard deviation), respectively.

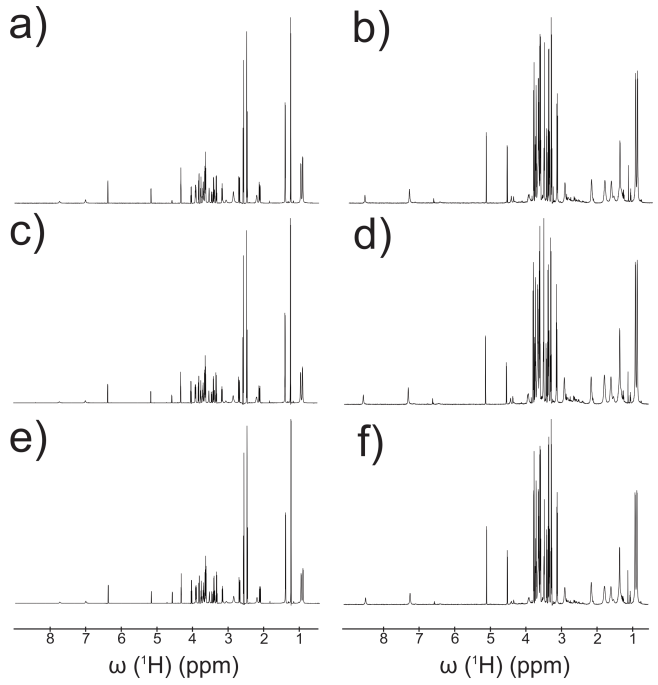

Figure S2. 1D ^{1}H NMR spectra of independently prepared replicate samples. (a), (c), (e): ten-compound model mixture with addition of anionic SNPs; and (b), (d), (f): ten-compound model mixture with addition of cationic SNPs. The three spectra on the right were scaled to show more details. These results demonstrate the high degree of reproducibility of the nanoparticle sample preparation protocol for metabolite mixtures (see also Table S1).

Table S1. Average suppression factors of individual metabolites due to the addition of SNPs to the the ten-compound model mixture.

Metabolite	Anionic SNP		Cationic SNP	
	1D peak attenuation[a]	2D peak attenuation[a]	1D peak attenuation[a]	2D peak attenuation[a]
Lysine (+1)	212.1±10.4	NA[b]	18.8±1.6	9.9±1.6
Arginine (+1)	28.5±3.2	NA[b]	14.4±1.3	17.1±3.5
Histidine (+1)	12.5±1.7	7.7±1.0	12.5±0.8	NA[b]
Citric acid (-3)	1.3±0.2	1.1±0.1	284.7±2.3	NA[b]
Lactic acid (-1)	1.3±0.2	1.0±0.1	221.9±11.3	NA[b]
Shikimic acid (-1)	1.1±0.1	1.0±0.1	27.8±2.4	39.4±7.3
Alanine (0)	2.4±0.2	1.1±0.1	18.8±1.0	4.8±0.9
Dimethylglycine (0)	93.5±13.8	6.7±0.2	111.1±19.0	175.9±11.3
Glucose (0)	1.0±0.1	1.0±0.1	1.3±0.1	1.3±0.2
Valine (0)	5.9±0.2	2.0±0.1	8.3±0.3	4.1±0.5

[a] The average ratio between peak intensities before and after SNP addition for each metabolite. Uncertainties were determined as standard deviations based on three independently prepared replicate samples.

[b] Peaks were below the detection limit.

Reference

(1) Schneider, C. A.; Rasband, W. S.; Eliceiri, K. W. *Nat. Meth*. **2012**, *9*, 671-675.