ELECTRONIC SUPPLEMENTARY INFORMATION

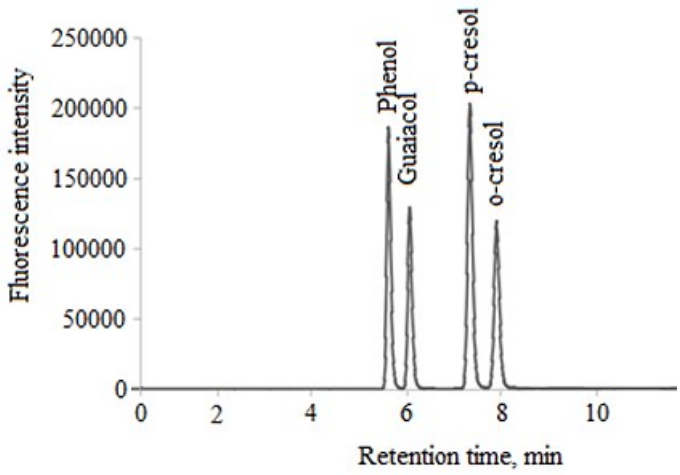
to the paper

Magnetic headspace adsorptive microextraction using Fe_3O_4@$Cr(OH)_3$ nanoparticles for effective determination of volatile phenols

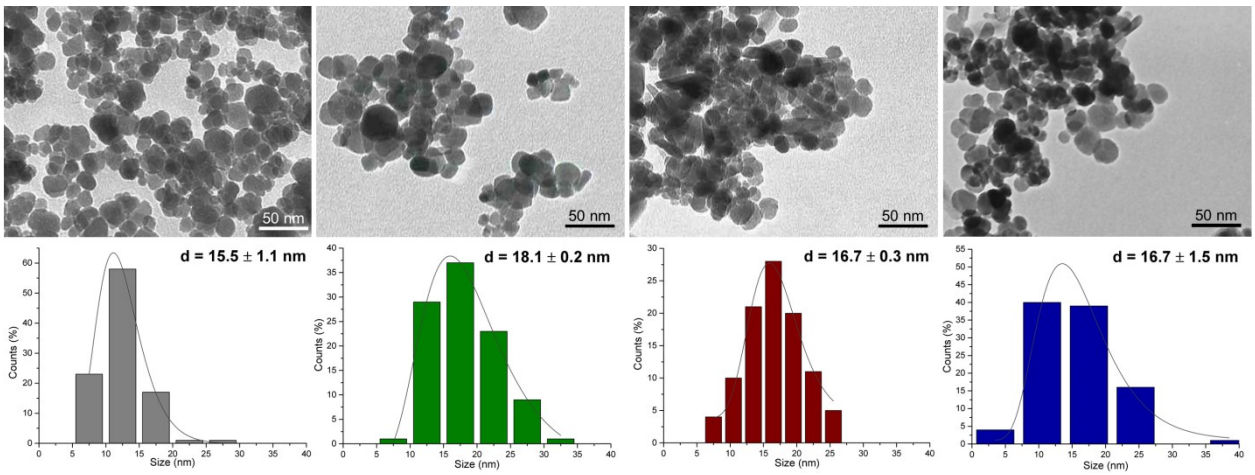
Irina Timofeeva[a*], Mariya Alikina[a], Mikhail Osmolowsky[a], Olga Osmolovskaya[a], Andrey Bulatov[a]

*Corresponding author. Tel.: +7 952 2021787

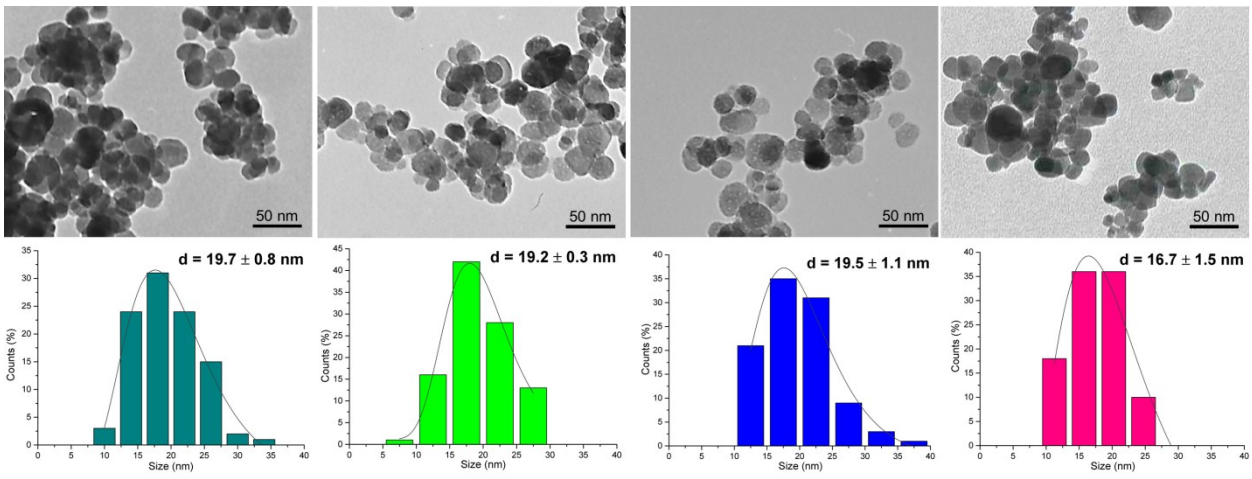
E-mail address: i.i.timofeeva@spbu.ru (Irina Timofeeva)



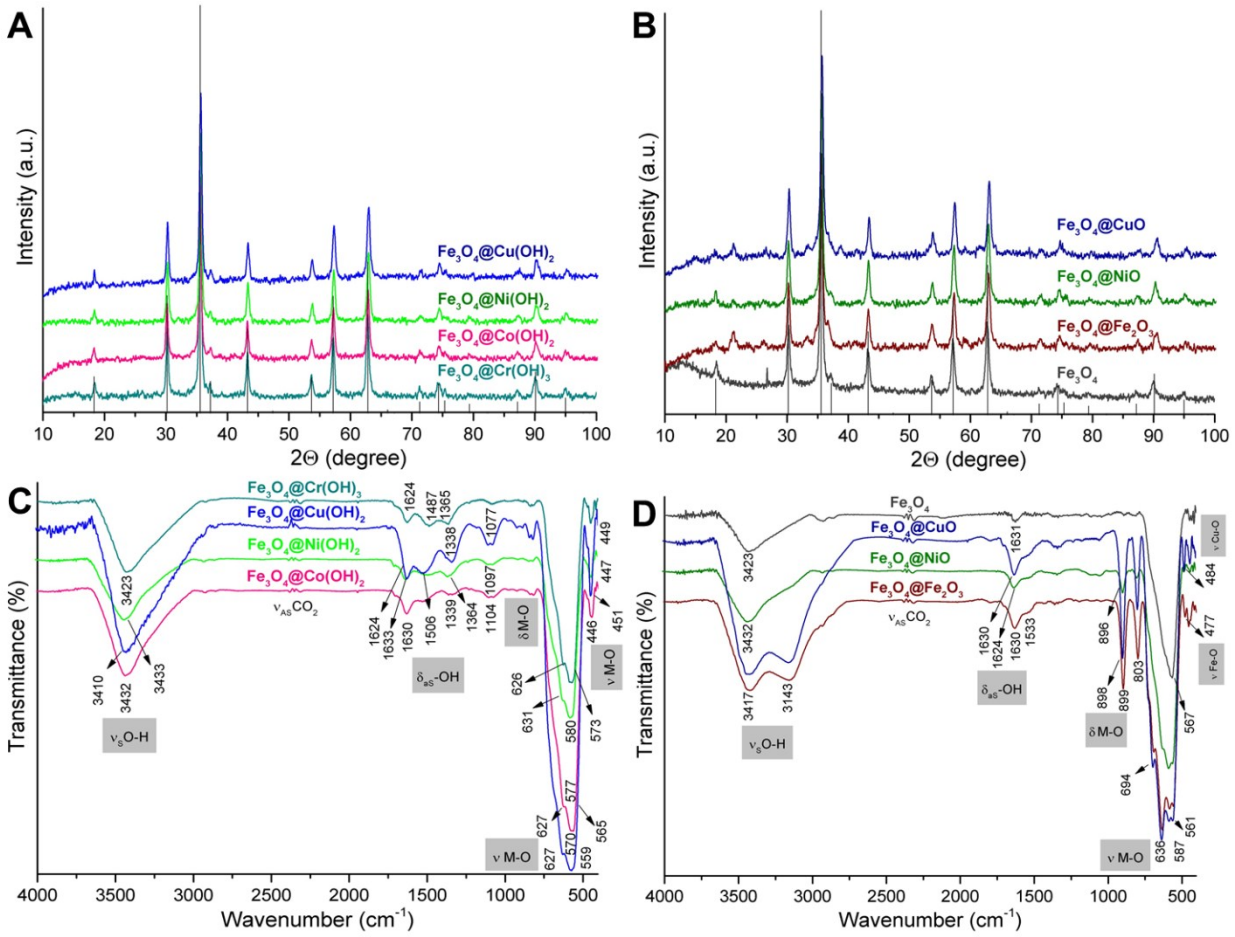
ESI Fig. 1. Chromatogram of phenols' solution with concentration of each analyte equal to 1 mg L^{-1} (mobile phase: acetonitrile and 0.1 % HCOOH (40:60, v/v), flow-rate of 1 mL min^{-1}, an excitation wavelength of 270 nm and emission wavelength of 310 nm).



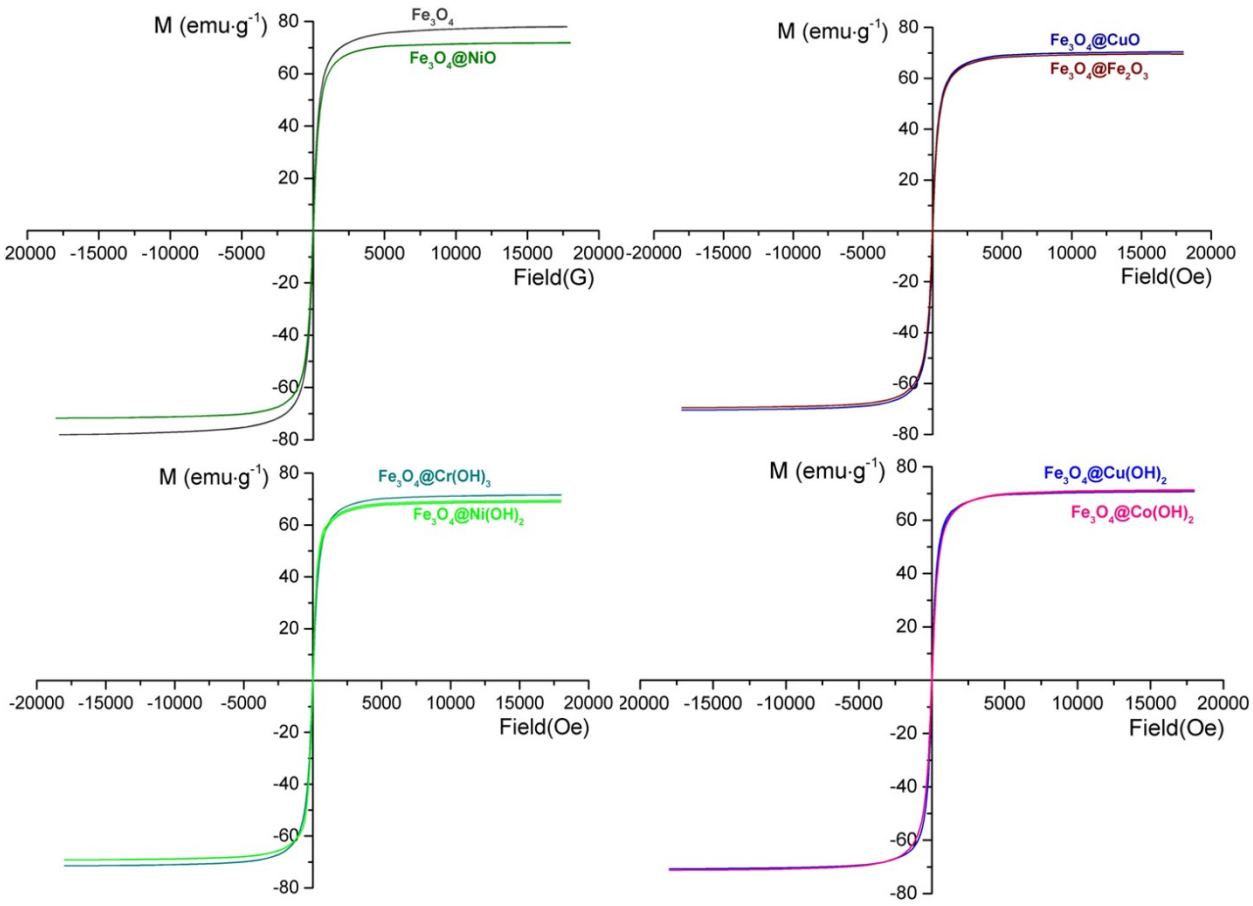
ESI Fig. 2.A. TEM images and size distribution of as-prepared Fe_3O_4, Fe_3O_4@NiO, Fe_3O_4@Fe_2O_3 and Fe_3O_4@CuO (from left to right).



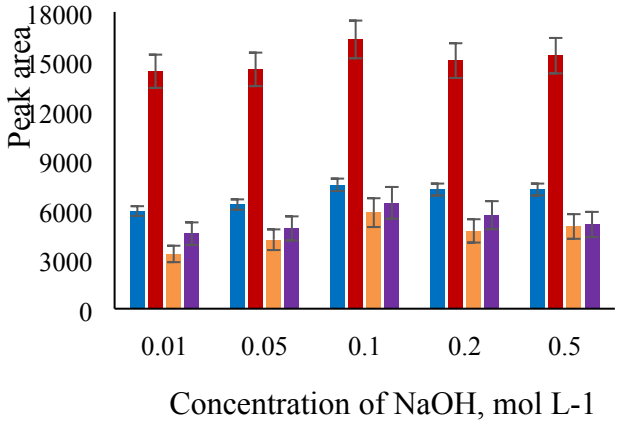
ESI Fig. 2.B. TEM images and size distribution of as-prepared Fe_3O_4@$Cr(OH)_3$, Fe_3O_4@$Ni(OH)_2$, Fe_3O_4@$Cu(OH)_2$, Fe_3O_4@$Co(OH)_2$ (from left to right).



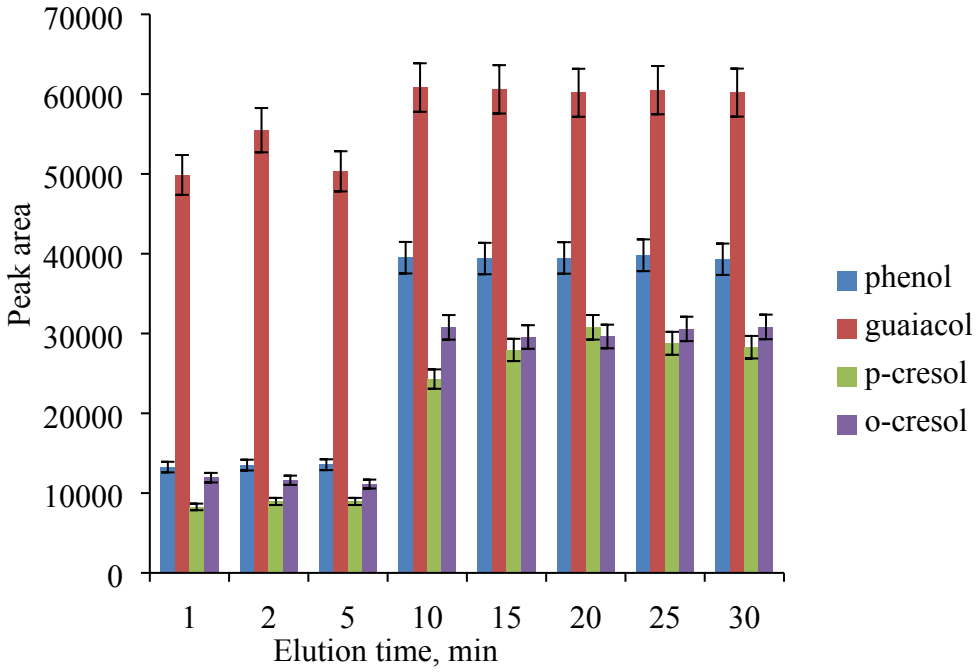
ESI Fig. 3. XRD pattern (A and B) and FTIR data (C and D) of MNPs.



ESI Fig. 4. VSM data of MNPs.



ESI Fig. 5. Effect of NaOH concentration (C(phenols) – 0.5 mg kg^{-1}; 10 mg of Fe_3O_4@$Cr(OH)_3$; 90 ºC; extraction time – 10 min; elution time – 30 min; NaOH volume – 0.5 mL).



ESI Fig. 6. Effect of elution time (0.1 mL of 0.1 mol L^{-1} NaOH; concentration of each phenol in sample – 0.5 mg kg^{-1}).

ESI Table. Comparison of the developed and previously reported methods for the determination of phenols in food samples.

Sample	Volume/ mass of sample	Analytes	Extraction technique	Method of detection	LOD	Linear range	RSD,%	Recovery, %	Extraction time, min	Ref.
smoked sausage	1 g	guaiacol, 4-methylguaiacol, syringol, eugenol, trans-isoeugenol	SPE	GC-MS	0.1 μg kg^{-1}	-	<20	91-113	-	1
smoked herring	2 g	phenol, p-cresol, o-cresol, guaiacol, 4-methyl guaiacol, 4-ethyl guaiacol, syringol, eugenol, 4-propyl guaiacol, isoeugenol,2-chlorophenol	SPME	GC-FID	1 mg kg^{-1}	-	5.45 - 8.70	-	55 min	2
smoked sausages	0.25 g	phenol, o-cresol, m-cresol, p-cresol, isoeugenol, guaiacol	USLE-GD	FI-CL, HPLC-FLD	0.01 mg kg^{-1}	0.038–40 mg kg^{-1}	4-6	-	25 min	3
smoked sausage, fish	0.2 g	phenol, o-cresols, p-cresols eugenol, isoeugenol, guaiacol	DEM-MME	HPLC-FLD	0.3 – 1.0 μg kg^{-1}	1-5000 μg kg^{-1}	4.5-8.0	-	17 min	4
milk	5 mL	guaiacol, eugenol, phenol, 2-ethylphenol	Vac-HSSPME	GC-FID	0.14-13 μg L^{-1}	1–1000 μg L^{-1}	0.3-10	-	20 min	5
smoked sausages	0.5 g	phenol, guaiacol, p-cresol, o-cresol	MHS-AME	HPLC-FLD	0.2 μg kg^{-1}	0.5 - 2500 μg kg^{-1}	1-8	90-118	20 min	This work

SPE - solid-phase extraction
SPME - solid-phase microextraction
USLE-GD – ultrasound assisted solid-liquid extraction with GD separation
FI-CL – flow injection chemiluminescence
DEM-MME – deep eutectic mixture membrane-based microextraction
Vac-HSSPME - vacuum headspace solid-phase microextraction
MHS-AME - magnetic headspace adsorptive microextraction

1 M. Pöhlmann, A. Hitzel, F. Schwägele, K. Speer, W. Jira, *Meat Science*, 2012, **90 (1)**, 176-184.
2 T. Sérot, C. Lafficher. Optimisation of solid-phase microextraction coupled to gas chromatography for determination of phenolic compounds in smoked herring. *Food Chemistry*, 2003, **82(4)**, 513–519.
3 C. Vakh, E. Evdokimova, A. Pochivalov, L. Moskvin, A. Bulatov, *Food Chemistry*, 2017, **237**, 929-935.
4 A. Shishov, S. Gagarionova, A. Bulatov. *Food Chemistry*, 2020, 126097. DOI: 10.1016/j.foodchem.2019.126097
5 M.J. Trujillo-Rodríguez, V. Pino, E. Psillakis, J.L. Anderson, J.H. Ayala, E. Yiantzi, A.M. Afonso, *Analytica Chimica Acta*, 2017, **962**, 41-51.