Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary data

Adsorptive removal of Aflatoxin B_1 from Water and Edible Oil by Dopamine-Grafted Biomass Chitosan-Iron-Cobalt Spinel Oxides Nanocomposite : Mechanism, Kinetic, Equilibrium, Thermodynamics, and Oil Quality

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Text S1. *Characterization instruments*

The surface and pore size of adsorbents were investigated by SEM (Transmission Electron Microscopy, Tecnai F30TEM operating at 300 *Kv*), and TEM (Transmission Electron Microscopy, Philips 501 microscope ,80 kV voltage). The XRD patterns were recorded on a powder X-ray diffractometer (X-Ray Diffraction, Bruker D8 Advance diffractometer, CuKa radiation, 40 Kv, 20 miliamper, Time Per Step=1 s; scan step 0.05̊; 2θ from 10 to 70). Fourier-Transform Infrared, (Shimadzu Varian 4300Fourier Transform Infrared spectrometer, KBr pellets) was used to collect

the FT-IR spectra of DC/CFSO NCwith potassium bromide pellets. The DLS (Dynamic Light Scattering, (DLS, Zetasizer Nano-ZS-90 (ZEN 3600, Malvern Instrument) provided direct visualization of the size of the DC/CFSO NCNPs. A vibrating sample magnetometry (Vibrating-Sample Magnetometer, BHV-55 VSM) was employed to assess magneticproperties of samples. Thermal stability of samples was assessed by TGA (Thermogravimetric Analysis, Perkin-Elmer TG-DTA 6300, heating rate of 15 °C/min).

Text 2S. *Safety precautions*

Protective masks, eye protection, gloves, and clothing were worn as safety precautions while working with AFB_1 stock solutions and executing the related investigation. The AFB_1 solution should be keep in a well-ventilated place and all the tests performed under the standard hood. Also, the hands and face after working with substance should be washed carefully. The whole of the glass instruments were immersed and decontaminate in a NaClO (aq) for 24 h, washed with liquid detergent and distilled water, and dried at oven at 50 °C for next experiment.

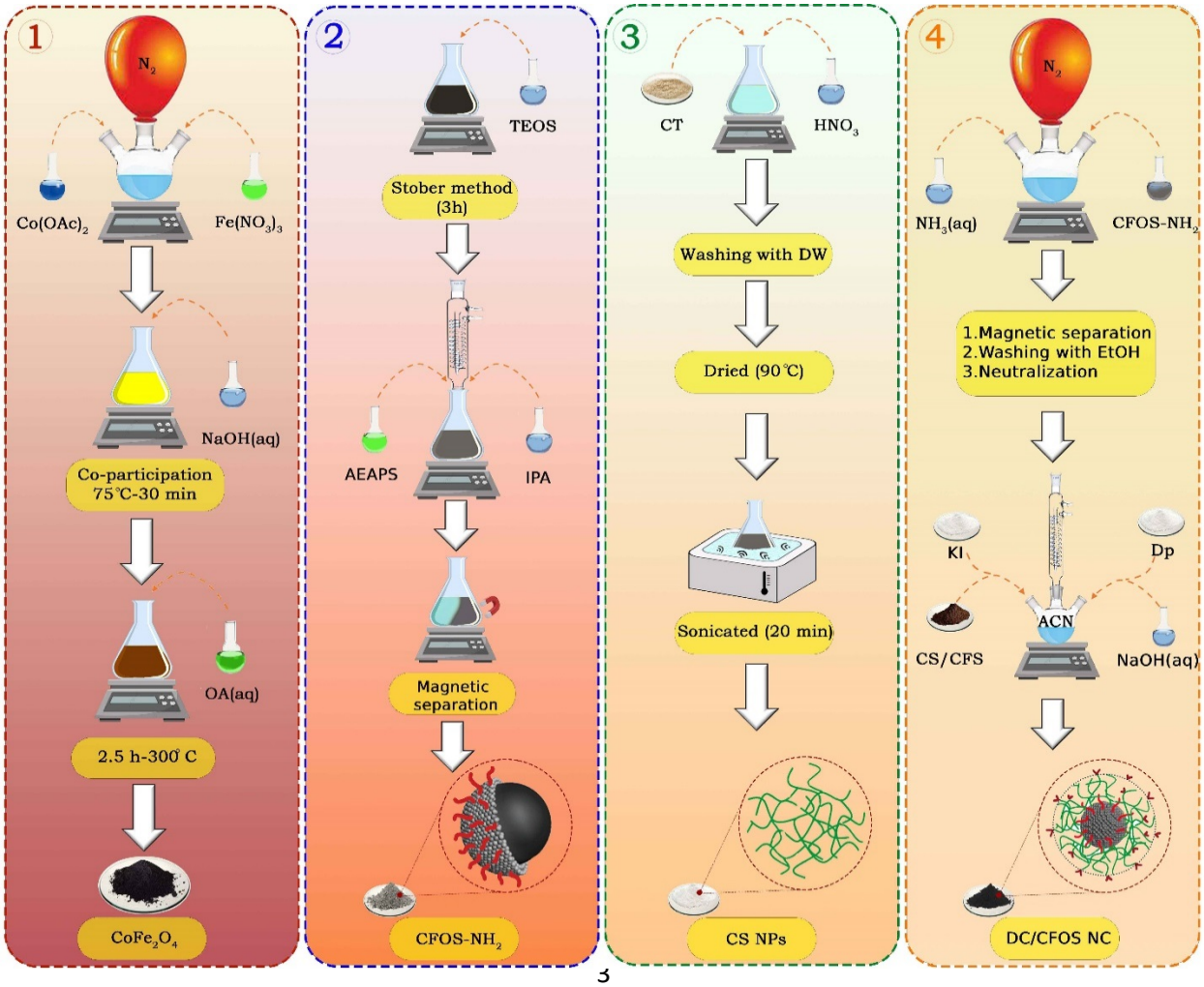


Fig 1S. Schematic present of preparation of DC/CFSO NPs in detail.

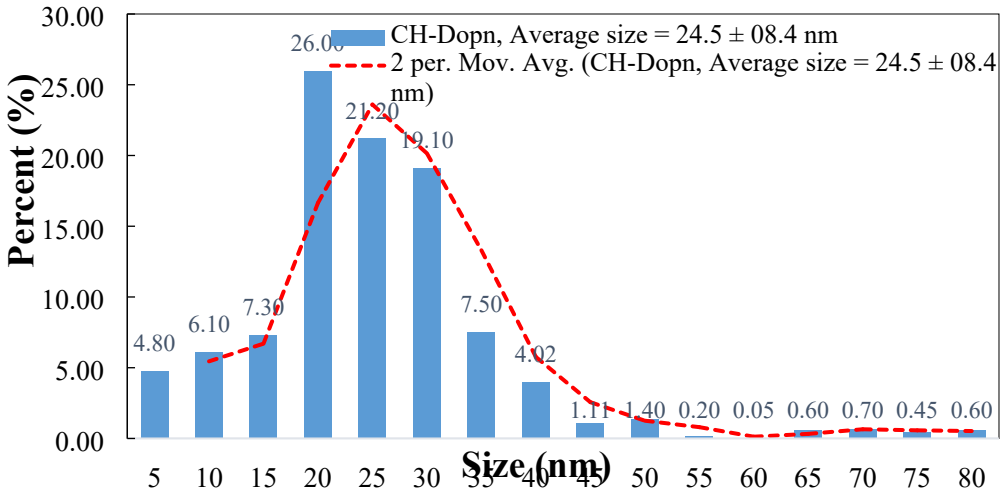


Fig 2S. DLS diagram of prepared Mt-CS/CFS NS.

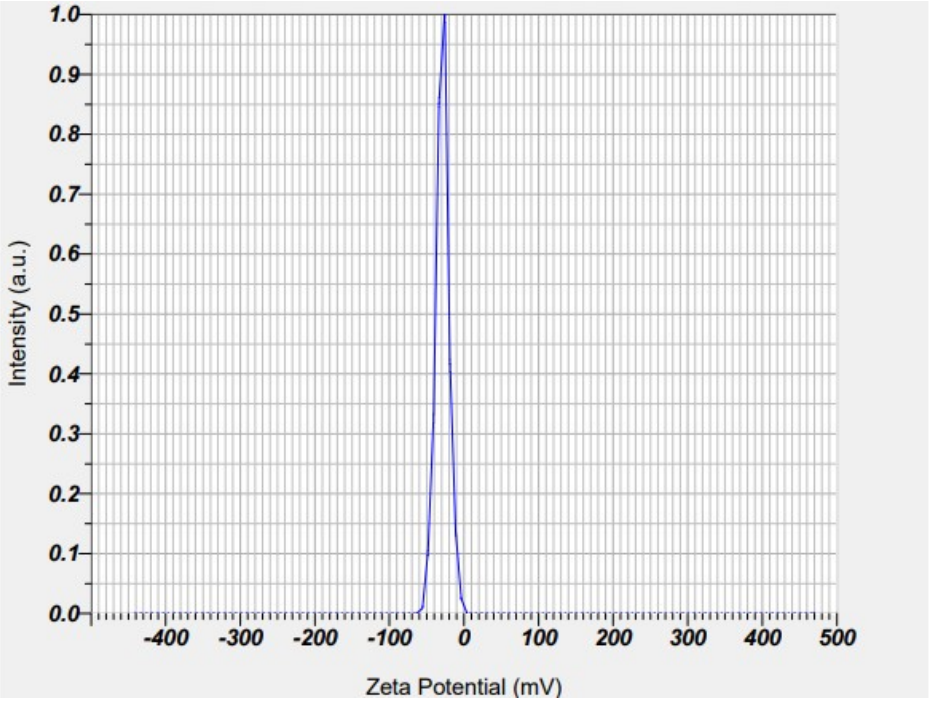


Fig 3S. ζ-potential of prepared Mt-CS/CFS NS.

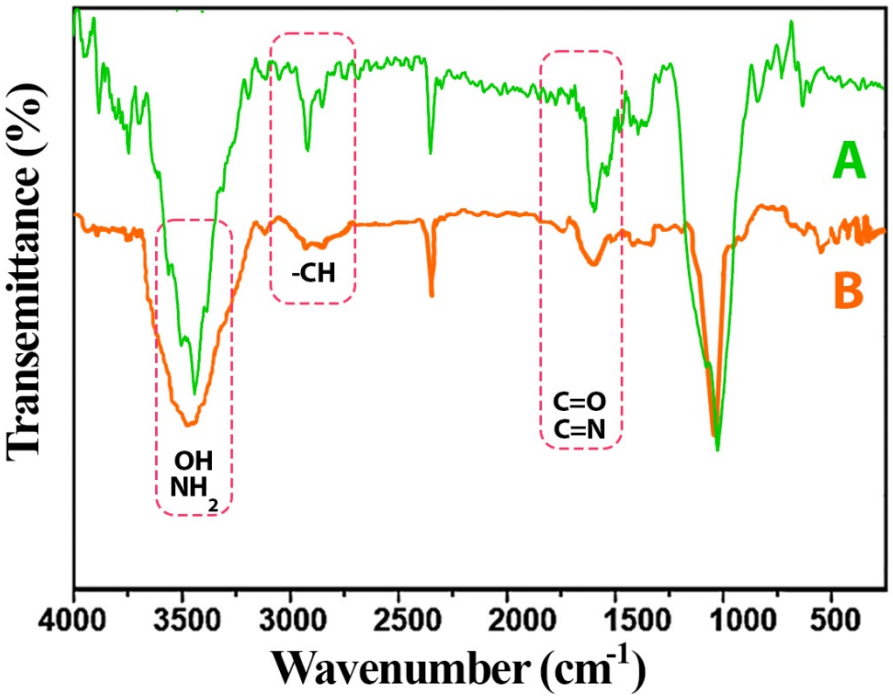


Fig.4S. FTIR spectra of (**A**) fresh DC/CFOS NC and (**B**) acid-treated DC/CFOS NC.

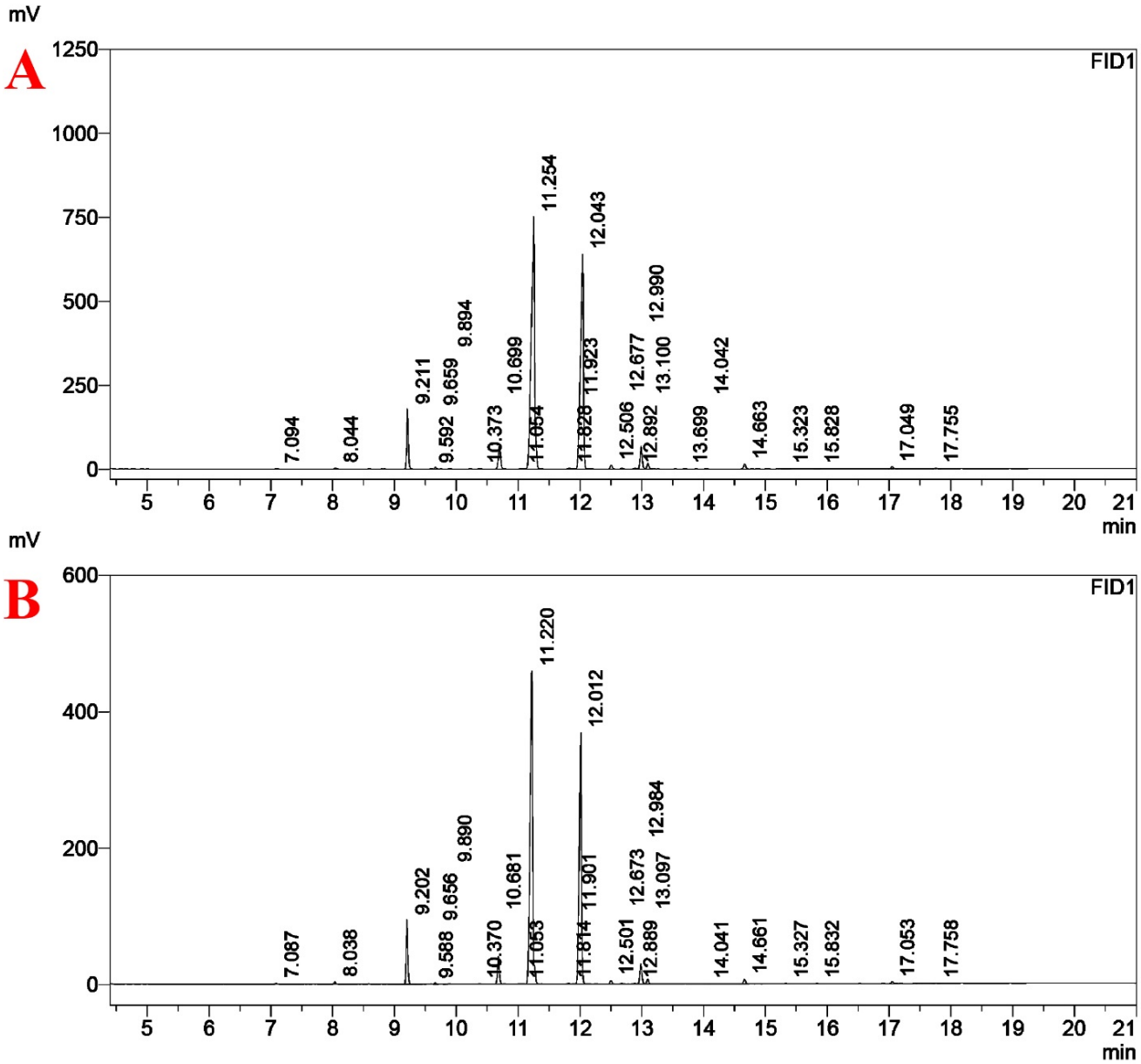
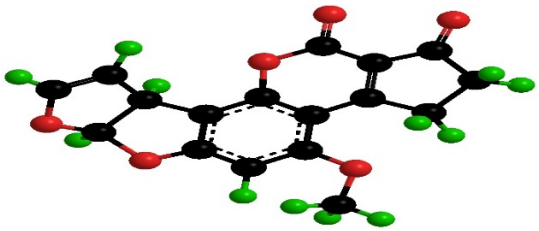


Fig.5S. GC analysis of edible oil before and after adsorption.

Table 1S. A number of major characteristics of aflatoxin B_1.



Parameter	Comments
Molecular formula	• $C_{17}H_{12}O_6$
Molar mass	• 312.06 $g.mol^{-1}$
IUPAC name	• 4-methoxy-2,3,6a,9a-tetrahydrocyclopenta[c]furo[3',2':4,5]furo[2,3-h]chromene-1,11-dione
Melting point	• 653.59 K
Boiling point	• 877.83 K
Wavelength (λ_{max})	• 364 nm
CAS number	• 1162-65-8
Physical state	• Solid / Powder
Color	• White
Classification	• Carcinogenic mycotoxins
Produced by	• Aspergillus flavus and Aspergillus parasiticus
Acute toxicity	• Oral, rat; LD_{50}: 6.0 $mg.kg^{-1}$ • Oral, mouse; LD_{50}: 9.0 $mg.kg^{-1}$ • Oral, monkey; LD_{50}: 2.2 $mg.kg^{-1}$
Adverse effects	• Carcinogenicity • Damage to the epithelium • Inflammation • Reduction of nutrient absorption (malnutrition) • Reduction of bone/tissue growth • Hepatotoxicity • Reproductive toxicity/ Teratogenicity • Germ cell mutagenicity

Table 2S. ANOVA for RSM quadratic model.

ANOVA for Response Surface Quadratic Model

Analysis of variance table

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Model	5059.25	14	361.37	10.54	< 0.0001	significant
A-Temperatu	*4.92*	*1*	*4.92*	*0.14*	*0.7106*	
B-Time	*792.80*	*1*	*792.80*	*23.12*	*0.0003*	
C-[AFB1]	*940.43*	*1*	*940.43*	*27.43*	*0.0001*	
D-[DC/CFOS	*1960.74*	*1*	*1960.74*	*57.19*	*< 0.0001*	
AB	*16.81*	*1*	*16.81*	*0.49*	*0.4953*	
AC	*118.81*	*1*	*118.81*	*3.47*	*0.0838*	
AD	*7.02*	*1*	*7.02*	*0.20*	*0.6578*	
BC	*1.10*	*1*	*1.10*	*0.032*	*0.8603*	
BD	*254.40*	*1*	*254.40*	*7.42*	*0.0165*	
CD	*118.81*	*1*	*118.81*	*3.47*	*0.0838*	
A^2	*253.24*	*1*	*253.24*	*7.39*	*0.0167*	
B^2	*9.91*	*1*	*9.91*	*0.29*	*0.5993*	
C^2	*16.12*	*1*	*16.12*	*0.47*	*0.5041*	
D^2	*709.81*	*1*	*709.81*	*20.70*	*0.0005*	
Residual	480.01	14	34.29			
Lack of Fit	*478.48*	*10*	*47.85*	*125.26*	*0.0002*	
Pure Error	*1.53*	*4*	*0.38*			
Cor Total	5539.26	28				

Table.3S. Screening data of various adsorbent.

Absorbent system	Sample	Q_{max} ($mg.g^{-1}$)	Removal (%)	Comments	[Ref]
Cu-BTC MOF-derived porous carbonaceous materials [30.0 mg]	Vegetable oil	16.67	90.0	• T: 25.0 °C • *t*: 30 min • [AFB_1]: 5.0 $\mu g.mL^{-1}$	[1]
1.5NZMT[1][3.0 mg]	Water	4.87	~80.0	• pH: 3.5 • T: 37.0 °C • *t*: 120 min • [AFB_1]: 3.300 $mg.L^{-1}$	[2]
0.5OP-10Mt[2][0.01 g]	Water	2.78	58.73	• pH: 3.5 • T: 37.0 °C • [AFB_1]: 4.0 $mg.L^{-1}$	[3]
1.0OP-10Mt [0.01 g]	Water	2.69	49.73	• pH: 3.5 • T: 37.0 °C • [AFB_1]: 4.0 $mg.L^{-1}$	[3]
2.0OP-10Mt [0.01 g]	Water	2.72	53.74	• pH: 3.5 • T: 37.0 °C • [AFB_1]: 4.0 $mg.L^{-1}$	[3]
PDA/PEI-coated membranes[3]	Apple juice	-	71.10	• pH: 5.2 • [AFB_1]: 100 $\mu g.kg^{-1}$	[4]
0.45SDB[4]-6-K-9@Fe_3O_4 [50.0 mg]	Peanut oil	0.1354	~70.0	• T: 65.0 °C • *t*: 120 min • [AFB_1]: 200 $ng.mL^{-1}$	[5]
MMS[5][0.1 g]	Water	1118.69 $\mu g.g^{-1}$	94.59	• pH: 11.0 • T: 20.0 °C • t: 120 min • [AFB_1]: 0.2 $\mu g.mL^{-1}$	[6]
FNHMS[6]-0.4 [10.0 mg]	Water	27.34	~100	• pH: 7.0 • T: 37.0 °C • *t*: 240 min • [AFB_1]: 4.0 $mg.L^{-1}$	[7]
MCSC[7]-10 [0.2 $mg.mL^{-1}$]	Water	24.99	>95.0	• pH: 7.0 • T: 25.0 °C • *t*: 240 min • [AFB_1]: 20.0 $mg.L^{-1}$	[8]
Activated carbon [0.5 $mg.mL^{-1}$]	Water	20.00	>99.0	• pH: 7.0 • T: 37.0 °C • *t*: 60 min • [AFB_1]: 20.0 $mg.mL^{-1}$	[9]
Banana peel [6.0 $mg.mL^{-1}$]	Water	8.40	94.9±0.4	• pH: 7.0-8.0 • T: 22.0 °C • *t*: 18 min • [AFB_1]: 20.0 $\mu g.mL^{-1}$	[10]
Durian peel [5.0 $mg.mL^{-1}$]	Water	13.02	98.40	• pH: 7.0 • T: 37.0 °C • *t*: 90 min • [AFB_1]: 1.0 $\mu g.mL^{-1}$	[11]

Magnetic graphene oxide [10.0 mg]	Vegetable oil	1.68	86.30	• T: 37.0 °C • *t*: 40 min • [AFB_1]: 16.1 $\mu g.L^{-1}$	[12]
Magnetic attapulgite [3.0 mg]	Peanut oils	0.0529	86.80	• T: 50.0 °C • *t*: 60 min • [AFB_1]: 33.8 $\mu g.kg^{-1}$	[13]
PDA-PS NFsM[8][2.5 mg]	Edible oil	7.73-9.13 $ng.mg^{-1}$	84.80-86.50	• T: 25.0 °C • *t*: 60 min • [AFB_1]: 50.0 $\mu g.L^{-1}$	[14]
PDA-PS NFsM [2.5 mg]	Liquor	7.73-9.13 $ng.mg^{-1}$	88.10	• T: 25.0 °C • t: 60 min • [AFB_1]: 50.0 $\mu g.L^{-1}$	[14]
PDA-PS NFsM [2.5 mg]	Soy sauce	7.73-9.13 $ng.mg^{-1}$	88.70	• T: 25.0 °C • *t*: 60 min • [AFB_1]: 50.0 $\mu g.L^{-1}$	[14]
PDA-PS NFsM [2.5 mg]	Rice vinegar	7.73-9.13 $ng.mg^{-1}$	85.50	• T: 25.0 °C • *t*: 60 min • [AFB_1]: 50.0 $\mu g.L^{-1}$	[14]
Pal-Mt[9][0.01 g]	Water	8.59	>80.0	• pH: 6.5 • T: 37.0 °C • [AFB_1]: 100 $mg.L^{-1}$	[15]
Fe_3O_4@Au-MIP[10]	Non-alcoholic beer	8.975	94.47-97.31	• *t*: 60 min • [AFB_1]: 1.0 $mg.L^{-1}$	[16]
PCL-g-C_3N_4/CQDs[11][0.05 g]	Water	-	>96.88	• pH: 8.5 • T: 45.0 °C • *t*: 30 min • [AFB_1]: 0.5 $\mu g.mL^{-1}$	[17]
MRHB[12]	Peanut oil	951.1 $\mu g.g^{-1}$	>95.0	• T: 45.0 °C • *t*: 60 min • [AFB_1]: 10.0 $\mu g.mL^{-1}$	[18]
MCM[13]-41 [1.0 $mg.mL^{-1}$]	Edible oils	215.93 $ng.mg^{-1}$	80.35	• T: 25.0 °C • *t*: 120 min • [AFB_1]: 250 $ng.mL^{-1}$	[19]
NMMS[14][11.0 mg]	AFB_1 solution	169.88 $\mu g.g^{-1}$	93.43	• pH: 7.0 • T: 20.0 °C • *t*: 120 min • [AFB_1]: 0.2 $\mu g.mL^{-1}$	[20]
SFHA[15][10.0 mg]	Water	-	99.70	• pH: 2.0-11.0 • T: 40.0 °C • [AFB_1]: 100 $\mu g.kg^{-1}$	[21]
Cu-MONT [10.0 $mg.mL^{-1}$]	Water	66.225	>93.0	• pH: 3.0 • [AFB_1]: 1.60 $mg.L^{-1}$	[22]
FM@GO@Fe_3O_4[16][15.0 mg]	Vegetable oil	0.3533 $\mu g.mg^{-1}$	>70.0	• T: 50.0 °C • *t*: 600 min • [AFB_1]: 50.0 $\mu g.kg^{-1}$	[23]
GT-Fe-NPs[17][1.0 $mg.mL^{-1}$]	Water	131-139 $ng.mg^{-1}$	85.0-90.0	• pH: 7.0 • T: 37.0 °C • *t*: 45 min • [AFB_1]: 100 $ng.mL^{-1}$	[24]

(8:1) Al-Fe PILC[18][40.0 mg]	Water	0.67	-	• pH: 2.0 • T: 37.0 °C • *t*: 60 min • [AFB_1]: 4.0 µg.mL^{-1}	[25]
DC/CFOS [2,5 mg/L]	Water	3.449	97.40	• pH: • T: 25°C • *t*: 100 min • [AFB_1]: 50.0 µg.mL^{-1}	***This work***
DC/CFOS [2,5 mg/L]	Edible oil	3.127	92.60	• pH: 2.0 • T: 25 °C • *t*: 110 min • [AFB_1]: 2.50 µg.mL^{-1}	***This work***
DC/CFOS [2,5 mg/L]	Corn oil	3.106	91.70	• pH: 2.0 • T: 25 °C • *t*: 110 min • [AFB_1]: 2.50 µg.mL^{-1}	***This work***

[1] Organo-montmorillonites modified by binary surfactant mixtures.
[2] Octylphenol polyoxyethylene ether.
[3] Polydopamine and polyethyleneimine.
[4] Magnetic soybeans dreg-based biochar.
[5] Magnetic mesoporous silica.
[6] Functionalized nanoflower-like hydroxyl magnesium silicate.
[7] Copper silicate composites with novel duster-like hollow mesoporous structure.
[8] Polydopamine modified nanofibers membrane.
[9] Polygorskite-montmorillonite.
[10] Molecular imprinted polymer coupled with Fe_3O_4-Au nanocomposite.
[11] Polycaprolactone membranes anchored to g-C_3N_4.
[12] Magnetic rice husk-based biochar.
[13] Rice husk-based mesoporous silica.
[14] Amino-grafted magnetic mesoporous silica.
[15] Sodium-free humic acid.
[16] A hierarchical fungal mycelia@graphene oxide@Fe_3O_4.
[17] Fe nanoparticles using green tea.
[18] Aluminum-iron-pillared montmorillonite.

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