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Biosorption Potential of *Phanerochaete chrysosporium* for Arsenic, Cadmium, and Chromium Removal from Aqueous Solutions

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Biosorption potential of *Phanerochaete chrysosporium* for arsenic, cadmium and chromium removal from aqueous solutions

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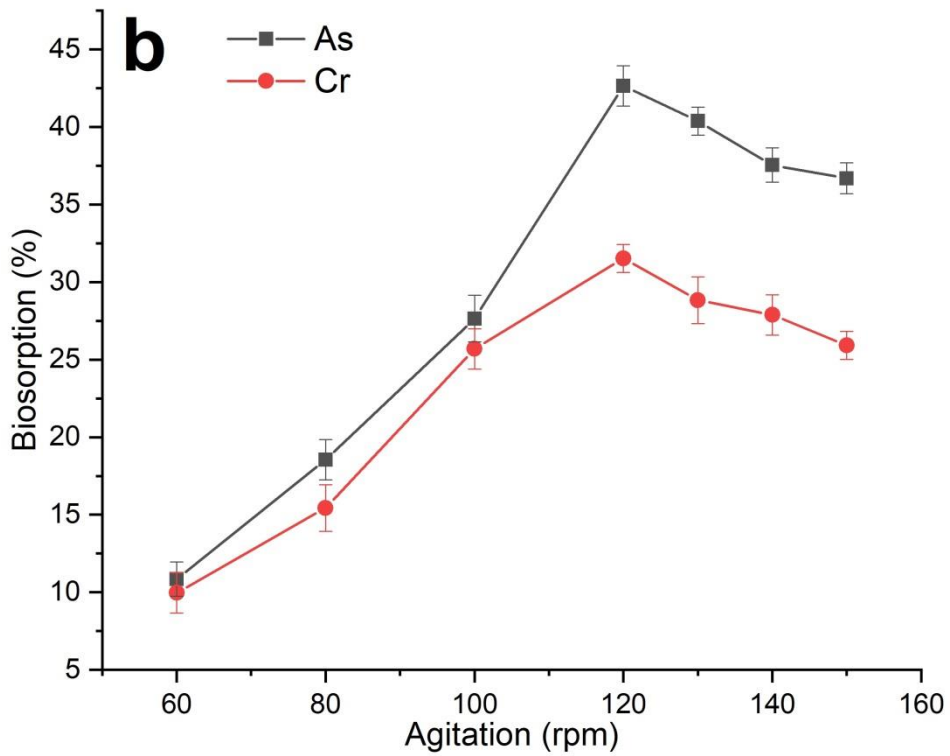
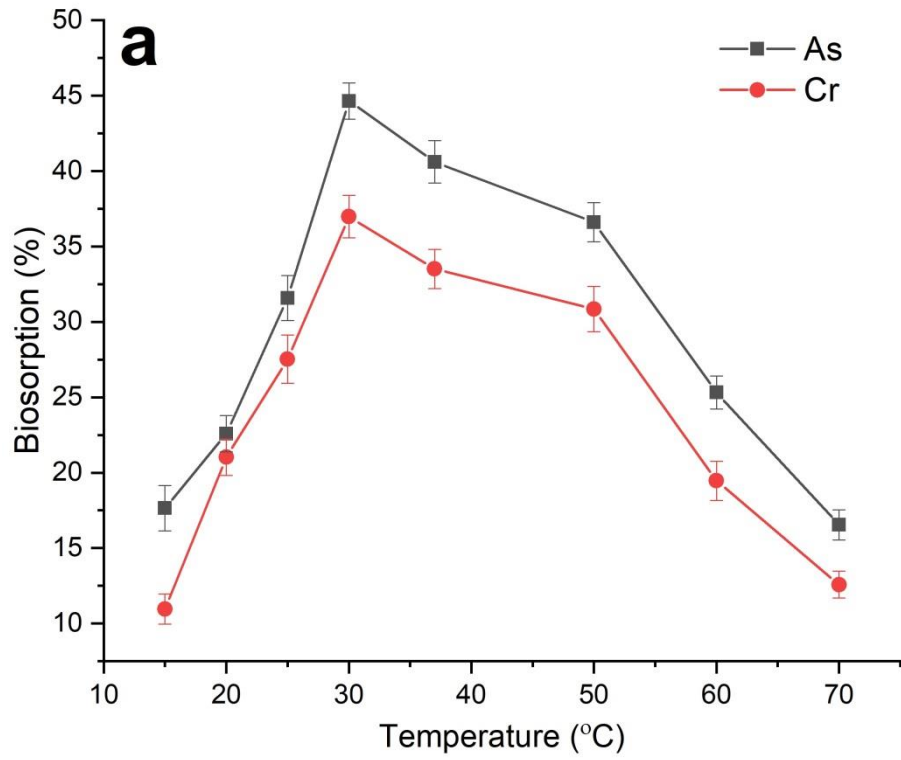


Figure S1 Effect of temperature and agitation on the As and Cr biosorption efficiency by *P. chrysosporium*.

Table S1 Independent components and their values used for individual and simultaneous removal of metal ions in central composite design (CCD).

Factor Name	Units	+α	+1	0	-1	-α
pH	-	10.70	9.00	6.50	4.00	2.30
Fungal biomass	mg	552.27	450.00	300.00	150.00	47.73
Metal Concentration (for individual metal)	mg L ⁻¹	110.45	90.00	60.00	30.00	9.55
Metal Concentration (for mixed metal)	mg L ⁻¹	331.36	270.00	180.00	90.00	28.64

Table S2 Analysis of variance (ANOVA) for the experiments of CCD for individual metal removal a) As b) Cd and c) Cr

Individual metal removal

(i) As

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	17846.69	9	1982.97	175.17	< 0.0001	Significant
A-pH	235.01	1	235.01	20.76	0.0010	
B-As Conc	2345.74	1	2345.74	207.22	< 0.0001	
C-Fungal biomass	3346.97	1	3346.97	295.66	< 0.0001	
AB	74.87	1	74.87	6.61	0.0278	
AC	97.78	1	97.78	8.64	0.0148	
BC	105.86	1	105.86	9.35	0.0121	
A ²	11345.47	1	11345.47	1002.22	< 0.0001	
B ²	428.10	1	428.10	37.82	0.0001	
C ²	635.51	1	635.51	56.14	< 0.0001	
Residual	113.20	10	11.32			
Lack of Fit	70.74	5	14.15	1.67	0.2946	not significant
Pure Error	42.47	5	8.49			
Cor Total	17959.89	19				

R²	0.9937
Adjusted R²	0.9880
Predicted R²	0.9666

(ii) Cd

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	7010.00	9	778.89	38.92	< 0.0001	Significant
A-pH	1139.86	1	1139.86	56.96	< 0.0001	
B-Cd Conc	1885.71	1	1885.71	94.23	< 0.0001	
C-Fungal biomass	202.77	1	202.77	10.13	0.0098	
AB	43.83	1	43.83	2.19	0.1697	
AC	9.73	1	9.73	0.4862	0.5015	
BC	1.56	1	1.56	0.0778	0.7860	
A ²	3398.62	1	3398.62	169.82	< 0.0001	
B ²	132.61	1	132.61	6.63	0.0277	
C ²	543.85	1	543.85	27.18	0.0004	
Residual	200.13	10	20.01			
Lack of Fit	122.52	5	24.50	1.58	0.3143	not significant
Pure Error	77.61	5	15.52			
Cor Total	7210.13	19				

R²	0.9722
Adjusted R²	0.9473
Predicted R²	0.8496

(iii) Cr

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	14255.27	9	1583.92	50.60	< 0.0001	Significant
A-pH	7868.19	1	7868.19	251.36	< 0.0001	
B-Cr Conc	740.02	1	740.02	23.64	0.0007	
C-Fungal biomass	2005.69	1	2005.69	64.07	< 0.0001	
AB	2.74	1	2.74	0.0874	0.7735	
AC	47.18	1	47.18	1.51	0.2477	
BC	171.10	1	171.10	5.47	0.0415	
A ²	2754.51	1	2754.51	88.00	< 0.0001	
B ²	10.04	1	10.04	0.3206	0.5837	
C ²	819.46	1	819.46	26.18	0.0005	
Residual	313.03	10	31.30			
Lack of Fit	206.34	5	41.27	1.93	0.2433	not significant
Pure Error	106.69	5	21.34			
Cor Total	14568.30	19				

R²	0.9785
Adjusted R²	0.9592
Predicted R²	0.8825

Table S3 Analysis of variance (ANOVA) for the experiments of CCD for mixed metal removal a) As b) Cd and c) Cr

Mixed metal solution:

a) As

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	3966.54	9	440.73	171.35	< 0.0001	Significant
A-pH	66.56	1	66.56	25.88	0.0005	
B-metal Conc	681.11	1	681.11	264.80	< 0.0001	
C-Fungal biomass	546.04	1	546.04	212.29	< 0.0001	
AB	1.26	1	1.26	0.4884	0.5006	
AC	19.92	1	19.92	7.75	0.0193	
BC	38.00	1	38.00	14.77	0.0032	
A ²	2418.53	1	2418.53	940.29	< 0.0001	
B ²	244.50	1	244.50	95.06	< 0.0001	
C ²	213.91	1	213.91	83.17	< 0.0001	
Residual	25.72	10	2.57			
Lack of Fit	4.01	5	0.8028	0.1849	0.9562	not significant
Pure Error	21.71	5	4.34			
Cor Total	3992.26	19				

R²	0.9936
Adjusted R²	0.9878
Predicted R²	0.9840

b) Cd

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	497.14	9	55.24	26.82	< 0.0001	Significant
A-pH	41.95	1	41.95	20.37	0.0011	
B-metal Conc	67.93	1	67.93	32.98	0.0002	
C-Fungal biomass	10.58	1	10.58	5.14	0.0469	
AB	2.90	1	2.90	1.41	0.2630	
AC	0.0109	1	0.0109	0.0053	0.9435	
BC	0.0257	1	0.0257	0.0125	0.9134	
A ²	322.66	1	322.66	156.66	< 0.0001	
B ²	30.61	1	30.61	14.86	0.0032	
C ²	66.28	1	66.28	32.18	0.0002	
Residual	20.60	10	2.06			
Lack of Fit	14.02	5	2.80	2.13	0.2128	not significant
Pure Error	6.58	5	1.32			
Cor Total	517.73	19				

R²	0.9602
Adjusted R²	0.9244
Predicted R²	0.7757

c) Cr

Source	Sum of Squares	df	Mean Square	F-value	p-value
Model	2129.64	9	236.63	33.77	< 0.0001 Significant
A-pH	225.39	1	225.39	32.17	0.0002
B-metal Conc	303.94	1	303.94	43.37	< 0.0001
C-Fungal biomass	350.54	1	350.54	50.03	< 0.0001
AB	49.45	1	49.45	7.06	0.0240
AC	55.39	1	55.39	7.90	0.0184
BC	12.18	1	12.18	1.74	0.2168
A ²	1024.35	1	1024.35	146.18	< 0.0001
B ²	108.93	1	108.93	15.54	0.0028
C ²	125.33	1	125.33	17.89	0.0017
Residual	70.07	10	7.01		
Lack of Fit	47.79	5	9.56	2.15	0.2110 not significant
Pure Error	22.28	5	4.46		
Cor Total	2199.71	19			

R²	0.9681
Adjusted R²	0.9395
Predicted R²	0.8120

Table S4 Final equation for coded factors of individual and mixed metal removal by *P. chrysosporium*

Individual metal	Coded Equation
As	$B_{As} = 92.18 - 4.14 (A) - 13.10 (B) + 15.65 (C) + 3.05 (AB) - 3.49 (AC) + 3.63 (BC) - 28.05 (A^2) - 5.45 (B^2) - 6.64 (C^2)$
Cd	$B_{Cd} = 55.13 - 9.13 (A) - 11.75 (B) + 3.85 (C) + 2.34 (AB) - 1.10 (AC) + 0.44 (BC) - 15.35 (A^2) - 3.03 (B^2) - 6.14 (C^2)$
Cr	$B_{Cr} = 76.37 - 24.00 (A) - 7.361 (B) + 12.11 (C) - 0.58 (AB) + 2.42 (AC) + 4.62 (BC) - 13.82 (A^2) + 0.83 (B^2) - 7.54 (C^2)$
Mixed metal	
As	$B_{As} = 44.04 - 2.20 (A) - 7.06 (B) + 6.32 (C) + 0.39 (AB) - 1.57 (AC) + 2.17 (BC) - 12.95 (A^2) - 4.11 (B^2) - 3.85 (C^2)$
Cd	$B_{Cd} = 14.36 - 1.75 (A) - 2.23 (B) + 0.88 (C) + 0.60 (AB) - 0.03 (AC) + 0.05 (BC) - 4.73 (A^2) - 1.45 (B^2) - 2.14 (C^2)$
Cr	$B_{Cr} = 29.15 - 4.06 (A) - 4.71 (B) + 5.06 (C) + 2.48 (AB) - 2.63 (AC) + 1.23 (BC) - 8.43 (A^2) - 2.74 (B^2) - 2.94 (C^2)$