

# **Removal of Trace Arsenic Based on Biomimetic Separation**

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**Figure S1.** Photograph of *Sedum spectabile*

**Table S1. Comparison of Pb Contents in Roots and Leaves of Tested Plants Cultivated under Pb<sup>2+</sup> Stress <sup>a</sup>**

The Tested Plants	Pb Content in Root Cultivated under Pb <sup>2+</sup> Stress (mg/g)	Pb Content in Root Cultivated without Pb <sup>2+</sup> Stress (mg/g)	Pb Content in Leaves Cultivated under Pb <sup>2+</sup> Stress (mg/g)	Pb Content in Leaves Cultivated without Pb <sup>2+</sup> Stress (mg/g)
<i>Iris tectorum Maxim</i>	2.73	0.97	0.09	0.04
<i>Hemerocallis fulva</i>	1.22	0.03	0.11	0.01
<i>Philodendron 'con-go'</i>	4.74	0.01	0.57	0.02
<i>Echevaria glauca</i>	4.83	≤0.02	≤0.02	≤0.02
<i>Echevaria secunda</i>	5.77	≤0.02	≤0.02	≤0.02
<i>Sedum spectabile</i>	16.21	≤0.02	≤0.02	≤0.02

<sup>a</sup> Plants was cultivated in culture medium A (see below), the duration of the cultivation is 5 week (without Pb<sup>2+</sup> stress in the first week), 15–25 °C, total volume of culture solution is 200 mL. Every 7 days, about 20 mg of Pb<sup>2+</sup> ions was added into the culture medium, and totally 80 mg of Pb<sup>2+</sup> ions was added.

Culture Medium	Ca(NO <sub>3</sub> ) <sub>2</sub> (mg/L)	KNO <sub>3</sub> (mg/L)	NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub> (mg/L)	MgSO <sub>4</sub> (mg/L)	NH <sub>4</sub> Cl (mg/L)	MgCl <sub>2</sub> (mg/L)
A	820	607	115	241	–	–



**Table S2. Comparison of Pb Contents in Roots and Leaves of *Sedum Spectabile* Cultivated under Pb<sup>2+</sup> Stress <sup>a</sup>**

Duration of the Cultivation (week)	Pb Content in Root Cultivated under Pb <sup>2+</sup> Stress (mg/g)	Pb Content in Leaves Cultivated under Pb <sup>2+</sup> Stress (mg/g)
5	16.21	≤0.02
9	34.58	0.05

<sup>a</sup> *S. spectabile* was cultivated in culture medium A, 15–25 °C, total volume of culture solution is 200 mL. Every 7 days, about 20 mg of Pb<sup>2+</sup> ions was added into the culture medium.

**Table S3. Comparison of Elemental Contents of *Sedum Spectabile*'s Roots Cultivated under the Pb<sup>2+</sup> Stress <sup>a</sup>**

Elements <sup>b</sup>	Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated under Pb <sup>2+</sup> Stress (mg/g) <sup>c</sup>				Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated without Pb <sup>2+</sup> Stress (mg/g)			
	Culture	Culture	Culture	Culture	Culture	Culture	Culture	Culture
	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	A	B	C	D	A	B	C	D
Pb	34.58	26.45	27.29	25.18	≤0.02	≤0.02	≤0.02	≤0.02
Ca	8.42	14.82	14.28	9.63	7.28	9.33	13.04	8.51
Mg	2.53	3.62	3.27	3.18	2.16	2.49	3.06	2.34
P	4.12	2.49	3.75	2.79	2.61	2.03	2.69	2.02

<sup>a</sup>The duration of the cultivation is 9 weeks (without Pb<sup>2+</sup> stress in the first week), 15–25 °C, and total volume of culture solution is 200 mL. <sup>b</sup>The contents of Fe, Cu, Zn, Mo, Ni, Mn, Co, etc, in roots were comparatively low, and not listed in the table. <sup>c</sup>Every one week, 20 mg of Pb<sup>2+</sup> ions was added into each culture medium, and totally 160 mg of Pb<sup>2+</sup> ions was added.

**Table S4. Comparison of Elemental Contents of *Sedum Spectabile*'s Roots Cultivated under the Hg<sup>2+</sup> Stress <sup>a</sup>**

Elements <sup>b</sup>	Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated under Hg <sup>2+</sup> Stress (mg/g) <sup>c</sup>				Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated without Hg <sup>2+</sup> Stress (mg/g)			
	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium
	A	B	C	D	A	B	C	D
	Hg	9.15	7.28	7.98	8.08	≤0.02	≤0.02	≤0.02
Ca	13.38	18.87	11.78	12.05	26.25	20.01	24.04	24.56
Mg	4.62	4.22	4.68	2.87	5.48	5.60	5.82	4.97
P	2.22	3.53	2.40	1.42	3.64	2.35	4.01	2.89
Fe	1.24	1.75	2.68	1.89	0.30	0.46	0.79	0.32
Zn	0.07	0.19	0.26	0.12	0.03	0.05	0.02	0.02

<sup>a</sup>The duration of the cultivation is 9 weeks (without Hg<sup>2+</sup> stress in the first week), 25–35 °C, and total volume of culture solution is 200 mL. <sup>b</sup>The contents of Cu, Mn, Mo, Ni, Co, etc, in roots were comparatively low, and not listed in the table. <sup>c</sup>Every 7 days, 20 mg of Hg<sup>2+</sup> ions was added into each culture medium, and totally 160 mg of Hg<sup>2+</sup> ions was added.

**Table S5. Four Formulations in Hydroponic Culture**

Culture Medium	Ca(NO <sub>3</sub> ) <sub>2</sub> (mg/L)	KNO <sub>3</sub> (mg/L)	NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub> (mg/L)	MgSO <sub>4</sub> (mg/L)	NH <sub>4</sub> Cl (mg/L)	MgCl <sub>2</sub> (mg/L)
A	820	607	115	241	–	–
B	820	607	–	241	93	–
C	820	607	115	–	–	190
D	–	–	–	–	–	–

**Table S6. Instrumental Parameters and Operating Conditions for ICP-OES**

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Radio frequency (R.F.) power	1.2 kW
Plasma gas flow rate	15 L/min
Flow rate of Argon auxiliary	1.5 L/min
Nebulizer gas flow rate	0.9 L/min
Precision (general)	1–3%
As analytical line ( $\lambda$ )	193.6 nm (detection limit 0.03 mg/L)
S analytical line ( $\lambda$ )	180.7 nm (detection limit 0.04 mg/L)
Ca analytical line ( $\lambda$ )	396.8 nm (detection limit 0.003 mg/L)
Mg analytical line ( $\lambda$ )	279.6 nm (detection limit 0.02 mg/L)
P analytical line ( $\lambda$ )	213.6 nm (detection limit 0.05 mg/L)
Fe analytical line ( $\lambda$ )	259.94 nm (detection limit 0.002 mg/L)
Cu analytical line ( $\lambda$ )	324.75 nm (detection limit 0.005 mg/L)
Mn analytical line ( $\lambda$ )	257.61 nm (detection limit 0.005 mg/L)
Zn analytical line ( $\lambda$ )	213.9 nm (detection limit 0.005 mg/L)
Mo analytical line ( $\lambda$ )	202.03 nm (detection limit 0.004 mg/L)
Ni analytical line ( $\lambda$ )	231.60 nm (detection limit 0.01 mg/L)
Co analytical line ( $\lambda$ )	228.62 nm (detection limit 0.005 mg/L)

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**Table S7. Comparison of Growth Status of *Sedum Spectabile* with and without As(III) Stress <sup>a</sup>**

Cultural Environment	Culture	Height of the Plant before	Height of the Plant after Cultivation
	Medium	Cultivation (cm)	(cm)
With As(III) stress <sup>b</sup>	A	26	27
	B	27	28
	C	28	29
	D	27	28
Without As(III) stress	A	21	24
	B	21	22
	C	22	23
	D	24	26

<sup>a</sup>The duration of the cultivation is 9 weeks (without As(III) stress in the first week), and total volume of culture solution is 200 mL, 25–35 °C. <sup>b</sup>Every 7 days, about 8 mg of As(III) was added into each culture medium, and totally 64 mg of As(III) was added.

**Table S8. Comparison of Growth Status of *Sedum Spectabile* with and without As(V) Stress <sup>a</sup>**

Cultural Environment	Culture Medium	Height of the Plant before Cultivation (cm)	Height of the Plant after Cultivation (cm)
With As(V) stress <sup>b</sup>	A	23	24
	B	21	22
	C	22	23
	D	27	28
Without As(V) stress	A	23	26
	B	22	25
	C	24	26
	D	23	25

<sup>a</sup> The duration of the cultivation is 9 weeks (without As(V) stress in the first week), and total volume of culture solution is 200 mL, 25–35 °C. <sup>b</sup> Every 7 days, about 8 mg of As(V) was added into each culture medium, and totally 64 mg of As(V) was added.

**Table S9. Comparison of Elemental Contents of *Sedum Spectabile*'s Roots Cultivated under the As(III) Stress <sup>a</sup>**

Elements <sup>b</sup>	Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated under As(III) Stress (mg/g) <sup>c</sup>				Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated without As(III) Stress (mg/g)			
	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium	Culture Medium
	A	B	C	D	A	B	C	D
	As	0.60	1.83	0.76	0.23	≤0.02	≤0.02	≤0.02
Ca	14.16	21.39	19.19	15.81	22.43	22.04	23.07	12.75
Mg	4.69	7.52	2.62	4.90	4.26	6.49	4.77	4.05
P	2.74	3.40	2.22	3.94	3.09	1.91	3.26	2.22
Fe	0.56	0.34	0.17	0.23	0.27	0.15	0.14	0.18
Zn	0.02	0.12	0.04	0.07	0.01	0.07	0.02	0.02

<sup>a</sup> The duration of the cultivation is 9 weeks (without As(III) stress in the first week) , and total volume of culture solution is 200 mL, 25–35 °C. <sup>b</sup>The contents of Cu, Mo, Ni, Co, etc, in roots were comparatively low, and not listed in the table. <sup>c</sup>Every 7 days, 8 mg of As(III) was added into each culture medium, and totally about 64 mg of As(III) was added.

**Table S10. Comparison of Elemental Contents of *Sedum Spectabile*'s Roots Cultivated under the As(V) Stress <sup>a</sup>**

Elements <sup>b</sup>	Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated under As(V) Stress (mg/g) <sup>c</sup>				Contents of Elements in <i>S. Spectabile</i> 's Roots Cultivated without As(V) Stress (mg/g)			
	Culture	Culture	Culture	Culture	Culture	Culture	Culture	Culture
	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	A	B	C	D	A	B	C	D
As	0.50	0.78	0.21	0.28	≤0.02	≤0.02	≤0.02	≤0.02
Ca	17.49	10.15	14.08	11.71	10.02	5.60	8.19	7.72
Mg	2.59	2.57	3.07	2.00	3.03	1.68	2.15	2.15
P	5.06	1.37	3.09	2.42	4.99	2.33	4.62	2.85
Fe	1.05	0.99	0.73	1.05	0.57	0.13	0.25	0.76
Cu	0.89	0.12	0.07	0.06	≤0.01	≤0.01	≤0.01	≤0.01
Zn	0.04	0.07	0.04	0.03	0.01	0.02	0.02	0.01

<sup>a</sup> The duration of the cultivation is 9 weeks [without As(V) stress in the first week], and total volume of culture solution is 200 mL, 25–35 °C. <sup>b</sup> The contents of Zn, Mo, Ni, Co, etc, in roots were comparatively low, and not listed in the table. <sup>c</sup> Every 7 days, 8 mg of As(V) was added into each culture medium, and totally about 64 mg of As(V) was added.

**Table S11. Simulated Oxidation of As(III) to As(V) in Plant's Roots <sup>a</sup>**

Oxidizing Agent	Molar Ratio of Oxidizing Agent to As (mol/mol)	pH	As(III)-Oxidized (%)
H <sub>2</sub> O <sub>2</sub>	6:1	3–4	85.0
Fe <sup>3+</sup>	6:1	3–4	0.0
Air <sup>b</sup>	–	4–5	0.0

<sup>a</sup>Initial concentration of As(III) (added in the form of Na<sub>3</sub>AsO<sub>3</sub>/NaAsO<sub>2</sub>) = 16.97 mg/L, total volume of solution = 200 mL, temperature = 30 °C, treatment time = 24 h. <sup>c</sup>Continuously provided

**Table S12. Simulated Reduction of As(V) to As(III) in Plant's Roots <sup>a</sup>**

Reducing Agent	Molar Ratio of Reducing Agent to As (mol/mol)	As(V)-Reduced (%)
Cysteine	2:1	65.2
Vitamin C	1:1	22.5
H <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	1:1	4.7

<sup>a</sup>Initial concentration of As(V) (added in the form of Na<sub>3</sub>AsO<sub>4</sub>) = 16.89 mg/L, total volume of solution = 200 mL, pH 4–5, temperature = 30 °C, treatment time = 24 h