The role of biomass elemental composition and ion-exchange in metal sorption by algae

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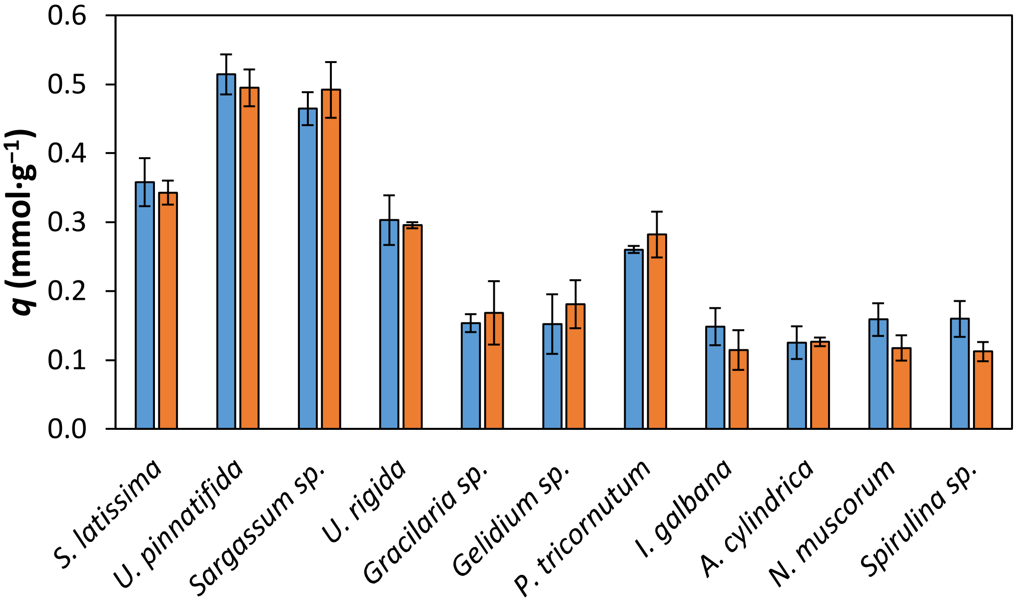

Figure S1. Sorption capacity (q, mmol·g^{-1}) of the screened biomass after 6 h (blue bars) and 24 h (orange bars).

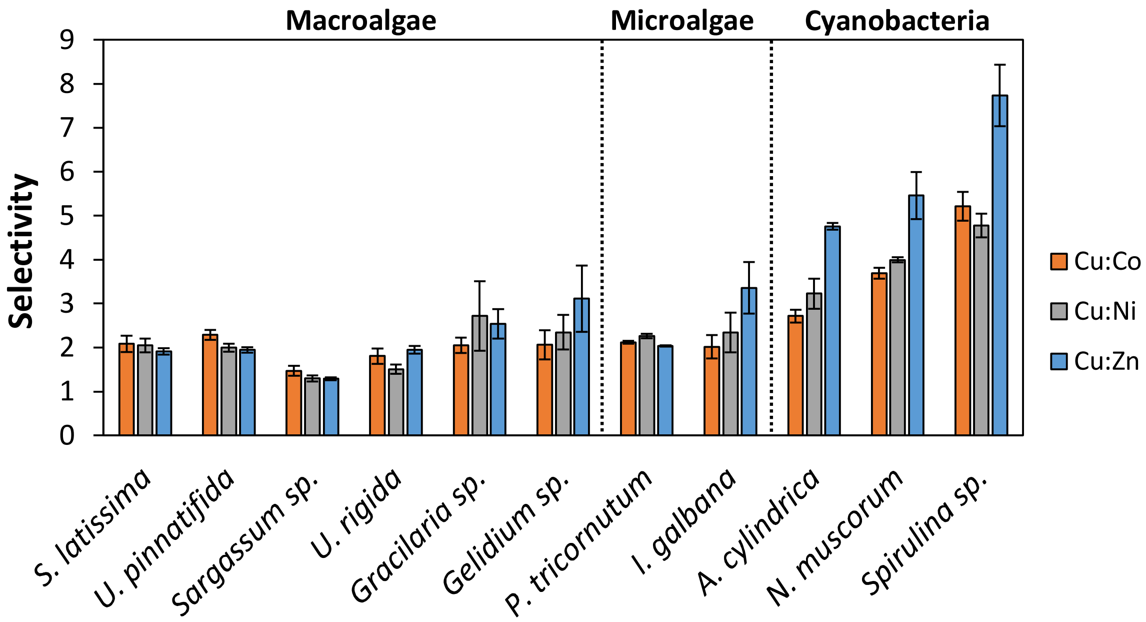

Figure S2. Selectivity of the screened non-living biomass.

Table S1. Complexation constant of different ions with simple carboxylic acids, hydroxide ion and amino acids at 298 K and 0 ionic strength.[1–3]

	Log K					
Ion	Acetic acid	Oxalic acid	Citric acid[a]	Hydroxide ion	Glycine	Alanine
Ca^{2+}	1.2	3.0	3.2	1.3	–	–
K^{+}	–	-0.8	0.6	-0.5	–	–
Co^{2+}	1.5	4.7	5.0	4.3	5.1	–
Cu^{2+}	2.2	6.2	5.9	6.3	8.6	8.6
Ni^{2+}	1.4	5.2	5.4	4.1	6.2	5.8
Zn^{2+}	1.6	3.4	5.0	5.0	5.4	5.0

[a] 298 K, 0.1 ionic strength

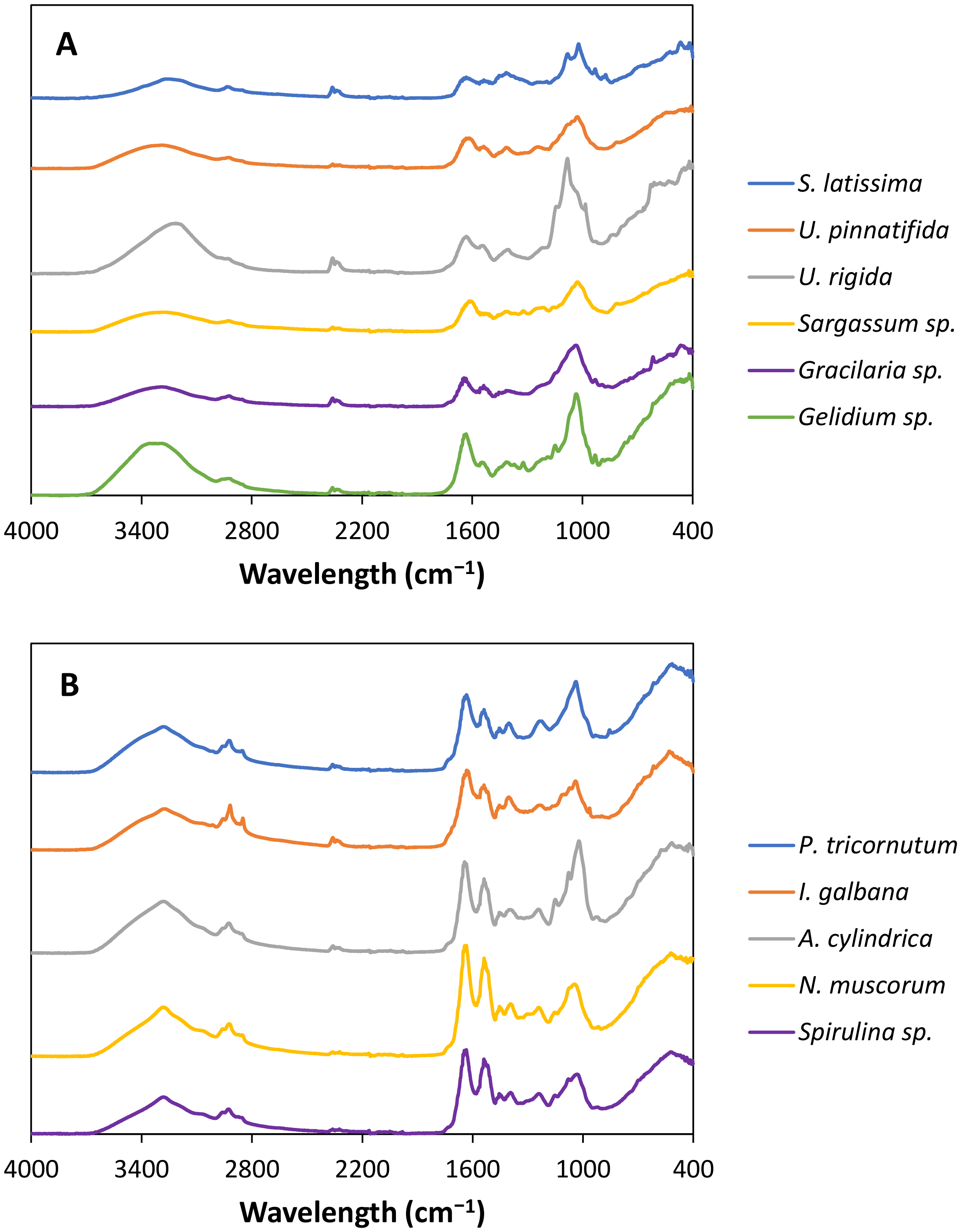

Figure S3. FTIR spectra of the evaluated (A) macroalgae and (B) microalgae and cyanobacteria before metal sorption.

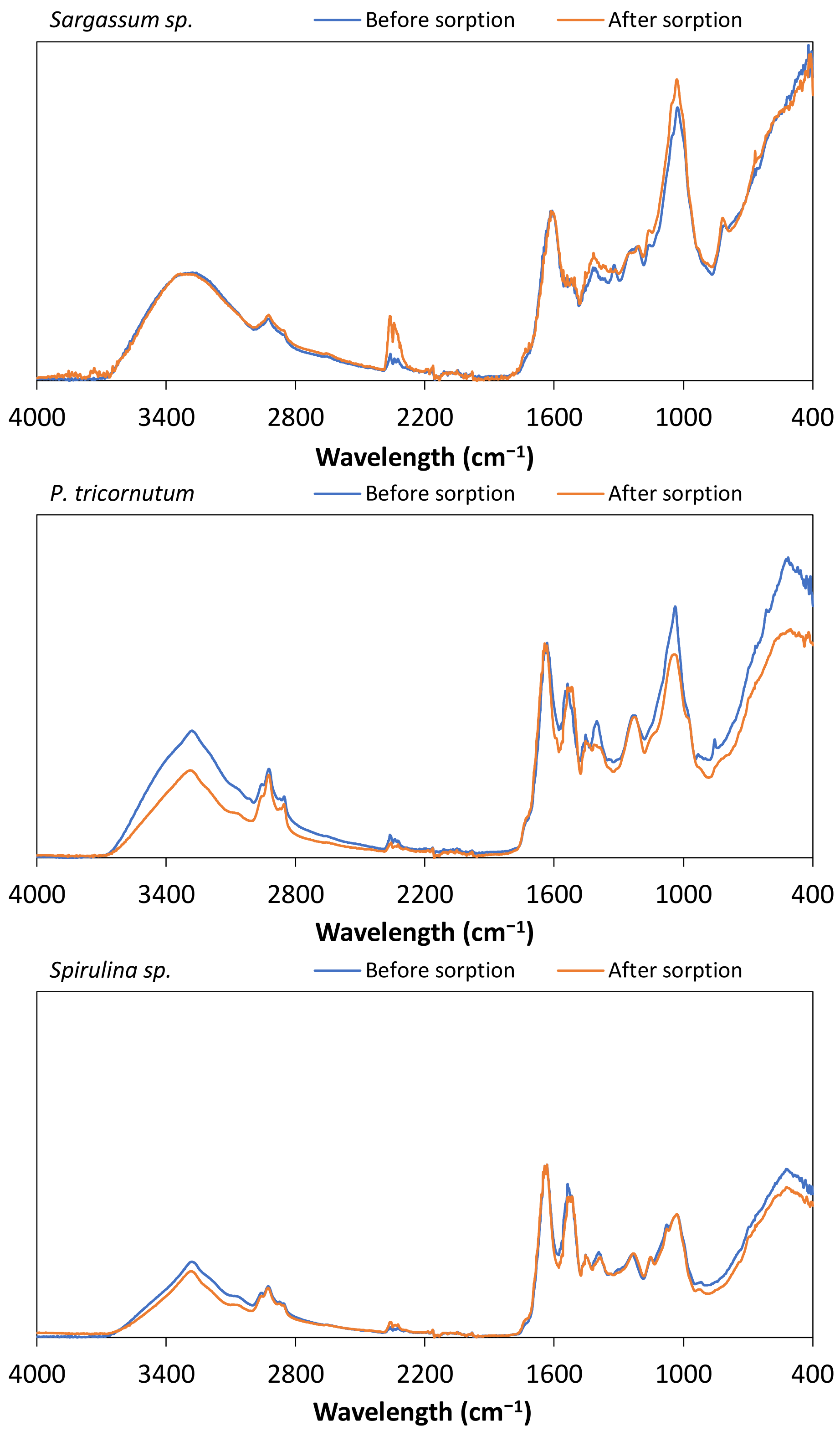

Figure S4. FTIR spectra of Sargassum sp., P. tricornutum and Spirulina sp. before (blue line) and after (orange line) sorption. All spectra were normalized in the peak ≈ 1640 cm^{-1}.

Table S2. Multi-elemental composition per kg of the screened biomass before metal sorption.

	Composition (mmol·kg^{-1})											
Biomass	Cl	K	Ca	Mn	Fe	Ni	Cu	Zn	Br	Sr	I	Pb
S. latíssima	5982 ± 139	3260 ± 111	571 ± 145	4.5 ± 0.9	74 ± 0.8	0.09 ± 0.03	0.35 ± 0.05	2.4 ± 0.3	18 ± 2	3 ± 1	60 ± 5	0.58 ± 0.06
U. pinnatifida	4491 ± 151	2454 ± 100	464 ± 16	0.40 ± 0.02	4.9 ± 0.1	–	0.23 ± 0.01	1.9 ± 0.1	4.33 ± 0.07	13.6 ± 0.4	3.9 ± 0.3	0.268 ± 0.002
Sargassum sp.	356 ± 52	1181 ± 130	660 ± 48	1.08 ± 0.08	7.1 ± 0.6	0.25 ± 0.03	0.25 ± 0.03	1.61 ± 0.04	1.7 ± 0.1	16 ± 2	–	0.65 ± 0.06
U. rigida	2479 ± 275	938 ± 72	172 ± 11	4.9 ± 0.3	26 ± 3	0.11 ± 0.01	0.43 ± 0.03	1.9 ± 0.2	9.2 ± 0.1	0.40 ± 0.07	–	–
Gracilaria sp.	2416 ± 110	2531 ± 77	116 ± 2	7.55 ± 0.08	29 ± 3	0.076 ± 0.004	0.19 ± 0.01	0.9 ± 0.1	5.5 ± 0.2	0.13 ± 0.02	0.12 ± 0.07	0.07 ± 0.04
Gelidium sp.	1656 ± 125	1165 ± 39	113 ± 3	1.15 ± 0.02	5.1 ± 0.8	0.100 ± 0.007	0.182 ± 0.006	1.0 ± 0.2	18 ± 1	0.08 ± 0.02	0.8 ± 0.0	–
P. tricornutum	1370 ± 77	1252 ± 63	573 ± 78	2.36 ± 0.04	24 ± 1	0.024 ± 0.008	0.262 ± 0.002	1.7 ± 0.2	1.30 ± 0.08	2.6 ± 0.5	–	–
I. galbana	1874 ± 105	502 ± 29	231 ± 20	1.3 ± 0.1	6.0 ± 0.3	0.043 ± 0.008	0.30 ± 0.01	3.2 ± 0.2	2.00 ± 0.07	0.26 ± 0.02	–	–
A. cylindrica	95 ± 11	319 ± 27	124 ± 12	0.69 ± 0.08	28 ± 4	0.037 ± 0.006	0.25 ± 0.01	0.7 ± 0.3	0.11 ± 0.07	0.11 ± 0.08	–	-–
N. muscorum	65 ± 9	347 ± 41	56 ± 6	1.6 ± 0.1	36 ± 3	0.06 ± 0.05	0.29 ± 0.02	0.57 ± 0.05	0.08 ± 0.01	0.03 ± 0.07	–	–
Spirulina sp.	69 ± 8	664 ± 82	230 ± 33	0.69 ± 0.06	16 ± 3	0.04 ± 0.01	0.5 ± 0.1	1.9 ± 0.3	0.10 ± 0.02	0.08 ± 0.02	–	–

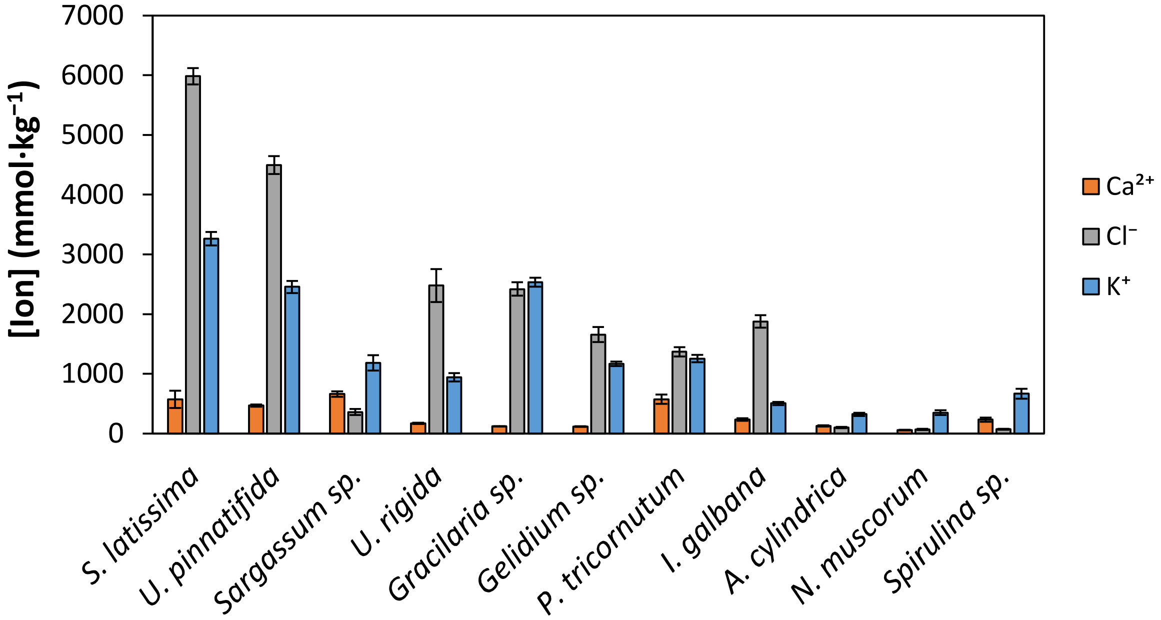

Figure S5. Ca^{2+}, Cl^- and K^+ concentration *per* kg of non-living dried biomass pre-sorption.

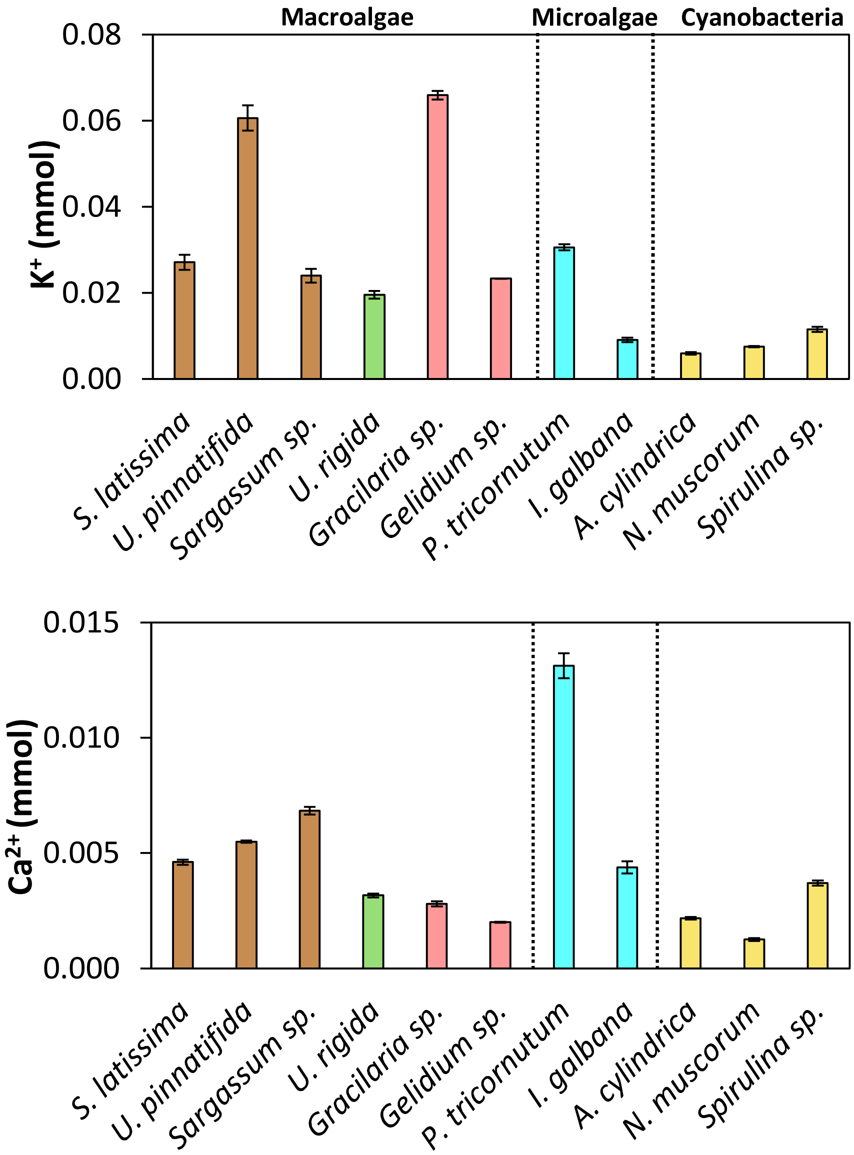

Figure S6. Release of calcium and potassium (mmol) from the biomass to the multi-elemental metal solution.

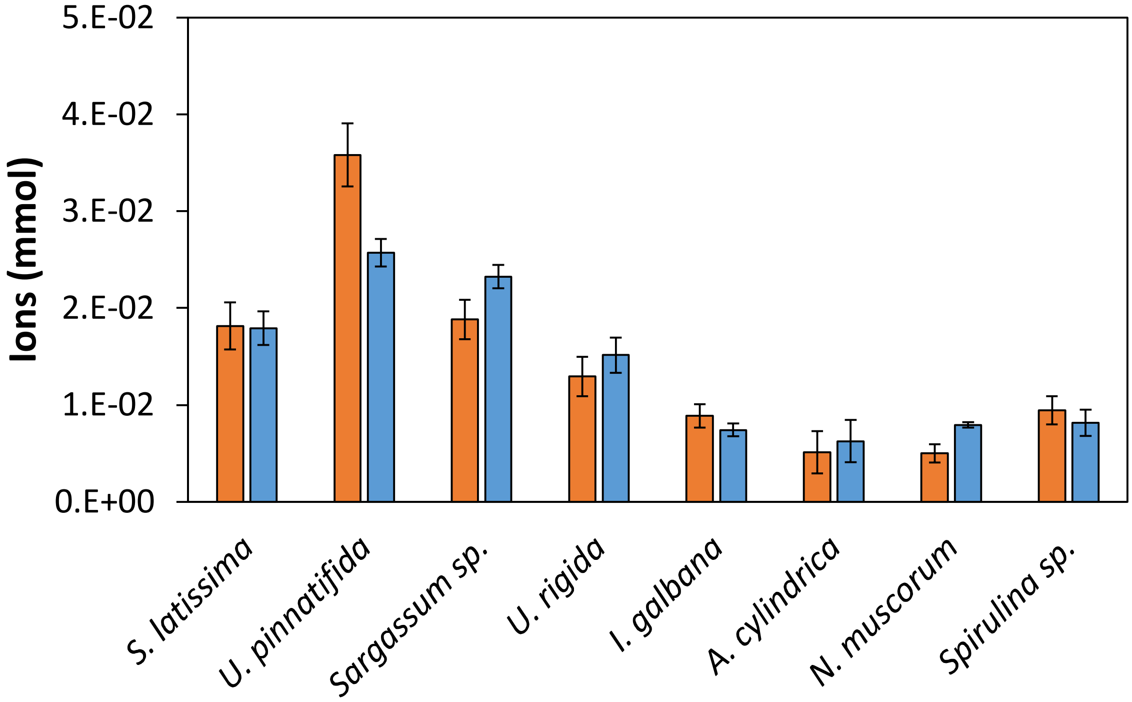

Figure S7. Comparison of the sum of released ions (orange bars) after charge normalization and amount of sorbed metals (blue bars).

References

[1] A.E. Martell, R.M. Smith, Other Organic Ligands, 1st ed., Springer New York, NY, 1977. https://doi.org/10.1007/978-1-4757-1568-2.

[2] R.M. Smith, A.E. Martell, Critical Stability Constants: Inorganic Complexes, 1975. https://doi.org/10.1007/978-1-4613-4452-0.

[3] A.E. Martell, R.M. Smith, Critical stability constants: Amino acids, Plenum Press, New York; London, 1974.