

Supplementary Table S1. Composition of the different seaweed size fractions.

| Size fractions (µm) | Seaweed composition (wt%) | | | | | | | |
|------------------------|---------------------------|------------|-----------|-----------|------------|-----------|-----------|------------|
| | 3,6-Angal | Galactose | Xylose | Glucose | Protein | Sodium | Potassium | Sulfate |
| <50 | 12.8 ± 0.7 | 24.7 ± 0.4 | 0.6 ± 0.1 | 1.3 ± 0.1 | 17.0 ± 0.1 | 7.5 ± 0.1 | 9.1 ± 0.1 | 13.6 ± 0.1 |
| 50-100 | 11.6 ± 2.2 | 23.0 ± 3.3 | 0.5 ± 0.2 | 1.2 ± 0.1 | 18.3 ± 0.1 | 5.5 ± 0.1 | 7.3 ± 0.1 | 12.9 ± 0.1 |
| 100-150 | 11.6 ± 2.4 | 22.6 ± 2.6 | 0.5 ± 0.1 | 1.0 ± 0.1 | 18.2 ± 0.1 | 6.2 ± 0.1 | 7.2 ± 0.1 | 13.1 ± 0.1 |
| 150-250 | 11.7 ± 1.9 | 22.1 ± 0.4 | 0.5 ± 0.1 | 0.9 ± 0.1 | 17.7 ± 0.1 | 5.5 ± 0.1 | 6.2 ± 0.1 | 17.4 ± 0.1 |
| 250-500 | 14.3 ± 3.6 | 26.1 ± 2.3 | 0.5 ± 0.1 | 1.2 ± 0.1 | 16.9 ± 0.1 | 6.7 ± 0.1 | 7.7 ± 0.1 | 13.7 ± 0.1 |
| 500-1000 | 12.9 ± 0.9 | 25.5 ± 1.3 | 0.4 ± 0.1 | 1.0 ± 0.2 | 18.1 ± 0.3 | 6.2 ± 0.1 | 6.6 ± 0.1 | 13.2 ± 0.1 |
| 1000-2000 | 15.2 ± 3.2 | 28.9 ± 3.1 | 0.7 ± 0.1 | 1.9 ± 0.1 | 17.7 ± 0.6 | 6.9 ± 0.1 | 7.2 ± 0.1 | 12.4 ± 0.1 |
| >2000 | 16.6 ± 5.7 | 26.9 ± 4.7 | 0.7 ± 0.1 | 0.7 ± 0.1 | 16.1 ± 0.1 | 6.6 ± 0.1 | 7.4 ± 0.1 | 14.7 ± 0.1 |

Values are mean ± standard deviation, n = 2. 3,6-Angal = 3,6-Anhydrogalactose

Supplementary Table S2. Filtrate conductivity and pH values of filtrates extracted from each size fractions at various extraction times and temperatures.

| T (°C) | Fraction size (μm) | Conductivity (μS/cm) | | | pH | | |
|--------|--------------------|----------------------|------------|------------|-----------|-----------|-----------|
| | | 15 min | 30 min | 120 min | 15 min | 30 min | 120 min |
| 22 | <50 | 5000 ± 99 | 5010 ± 56 | 5235 ± 63 | 6.9 ± 0.1 | 6.9 ± 0.1 | 6.9 ± 0.1 |
| | 50-100 | 4770 ± 70 | 4695 ± 21 | 4875 ± 304 | 6.8 ± 0.1 | 6.8 ± 0.1 | 6.8 ± 0.1 |
| | 100-150 | 4675 ± 63 | 4535 ± 35 | 4785 ± 7 | 6.7 ± 0.1 | 6.8 ± 0.1 | 6.8 ± 0.1 |
| | 150-250 | 4755 ± 120 | 4585 ± 63 | 4940 ± 70 | 6.7 ± 0.1 | 6.7 ± 0.1 | 6.7 ± 0.1 |
| | 250-500 | 4620 ± 42 | 4610 ± 113 | 4645 ± 91 | 6.7 ± 0.1 | 6.7 ± 0.1 | 6.7 ± 0.1 |
| | 500-1000 | 4650 ± 28 | 4625 ± 63 | 4605 ± 21 | 6.8 ± 0.1 | 6.8 ± 0.1 | 6.9 ± 0.1 |
| | 1000-2000 | 4750 ± 56 | 4775 ± 91 | 4745 ± 77 | 6.7 ± 0.1 | 6.7 ± 0.1 | 6.7 ± 0.1 |
| | >2000 | 4715 ± 49 | 4725 ± 21 | 4760 ± 183 | 6.8 ± 0.1 | 6.7 ± 0.1 | 6.8 ± 0.1 |
| 45 | <50 | 5365 ± 636 | 5630 ± 50 | 5080 ± 50 | 6.8 ± 0.1 | 6.8 ± 0.1 | 6.9 ± 0.1 |
| | 50-100 | 5035 ± 134 | 5050 ± 11 | 5090 ± 56 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.7 ± 0.1 |
| | 100-150 | 5130 ± 311 | 5015 ± 77 | 5065 ± 120 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.6 ± 0.1 |
| | 150-250 | 4795 ± 374 | 5050 ± 14 | 5220 ± 56 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.5 ± 0.1 |
| | 250-500 | 4810 ± 42 | 5245 ± 431 | 5385 ± 134 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.6 ± 0.1 |
| | 500-1000 | 4855 ± 35 | 5075 ± 190 | 5245 ± 417 | 6.7 ± 0.1 | 6.7 ± 0.1 | 6.7 ± 0.1 |
| | 1000-2000 | 5020 ± 28 | 5185 ± 374 | 5350 ± 650 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.6 ± 0.1 |
| | >2000 | 5060 ± 14 | 5525 ± 21 | 5185 ± 459 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.6 ± 0.1 |
| 90 | <50 | 5535 ± 63 | 5760 ± 50 | 5840 ± 50 | 6.9 ± 0.1 | 6.9 ± 0.2 | 6.9 ± 0.1 |
| | 50-100 | 5300 ± 134 | 5070 ± 113 | 5845 ± 56 | 6.8 ± 0.1 | 6.7 ± 0.1 | 6.6 ± 0.1 |
| | 100-150 | 5360 ± 311 | 5360 ± 77 | 5815 ± 120 | 6.7 ± 0.1 | 6.7 ± 0.1 | 6.5 ± 0.1 |
| | 150-250 | 5650 ± 374 | 5280 ± 14 | 5710 ± 56 | 6.6 ± 0.1 | 6.8 ± 0.2 | 6.4 ± 0.1 |
| | 250-500 | 5525 ± 42 | 5275 ± 431 | 5625 ± 134 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.5 ± 0.2 |
| | 500-1000 | 5470 ± 35 | 5415 ± 190 | 5345 ± 417 | 6.6 ± 0.1 | 6.7 ± 0.1 | 6.6 ± 0.2 |
| | 1000-2000 | 5430 ± 28 | 5460 ± 374 | 5650 ± 650 | 6.6 ± 0.1 | 6.6 ± 0.1 | 6.5 ± 0.1 |
| | >2000 | 5515 ± 14 | 5695 ± 21 | 5685 ± 459 | 6.7 ± 0.1 | 6.7 ± 0.1 | 6.5 ± 0.1 |

Values are mean ± standard deviation, $n = 2$.