

Supporting Information

Unveiling the Antioxidant Potential of Halophyte Plants and Seaweeds for Health Applications

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Figures

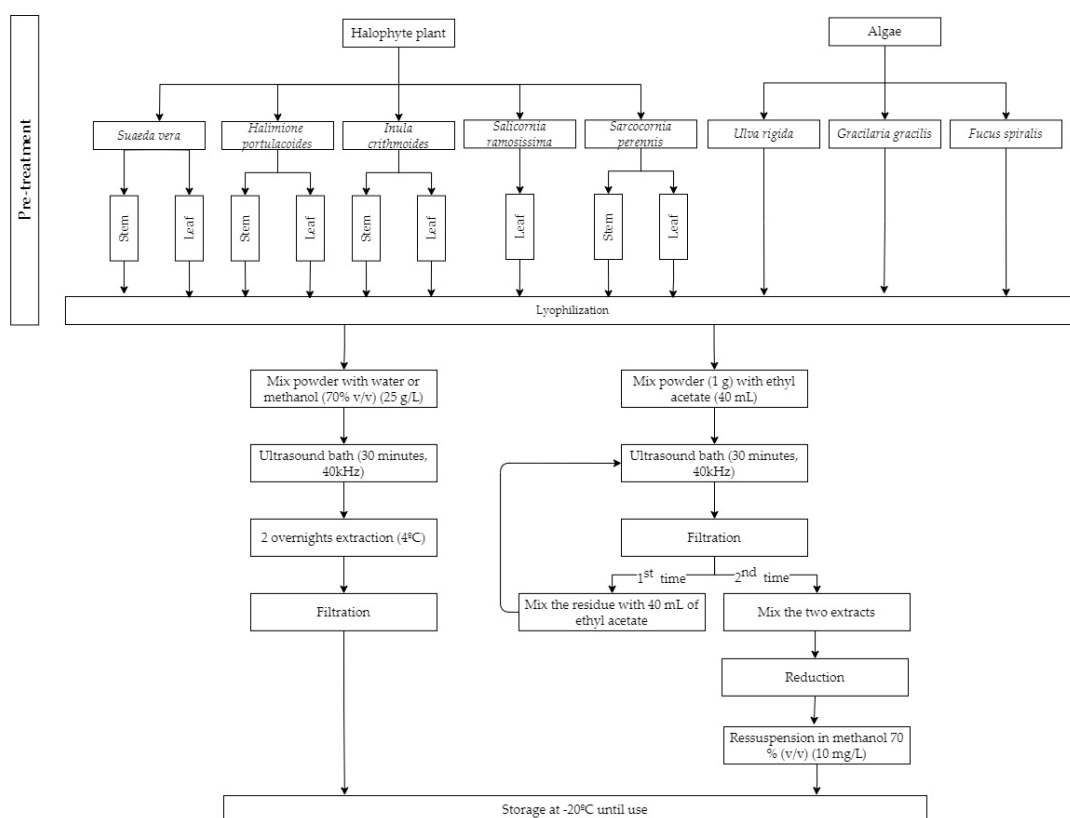


Figure S1. Workflow of the processing and extraction methodologies followed for halophytes and seaweeds.

Tables

Table S1. Results (mean \pm s.d.) of the different assays performed (Lowry, ABTS, DPPH, FRAP, TPC and TFC) on halophyte plants. * - statistical differences compared to the leaf of the corresponding halophyte plant. *p < 0.05; ** p < 0.01; p < 0.001; p < 0.0001

| Lowry | | | |
|--------------------------------|--------------------|----------------------------------|--------------------------------|
| | | Leaves (mg soluble protein/g DW) | Stem (mg soluble protein/g DW) |
| <i>Suaeda vera</i> | Ethyl acetate | 24.09 \pm 1.53 | 6.25 \pm 0.22 |
| | Methanol 70% (v/v) | 86.34 \pm 20.58 | 6.21 \pm 0.34*** |
| | Water | 147.20 \pm 16.63 | 5.31 \pm 0.70*** |
| <i>Halimione portulacoides</i> | Ethyl acetate | 12.42 \pm 0.18 | 6.38 \pm 0.07 |
| | Methanol 70% (v/v) | 19.34 \pm 0.54 | 10.07 \pm 1.02 |
| | Water | 48.77 \pm 9.91 | 13.05 \pm 0.80*** |
| <i>Inula crithmoides</i> | Ethyl acetate | 10.27 \pm 0.17 | 10.67 \pm 0.35 |
| | Methanol 70% (v/v) | 52.55 \pm 1.33 | 15.71 \pm 1.14*** |
| | Water | 339.00 \pm 2.2.5 | 49.13 \pm 10.57*** |
| <i>Salicornia ramosissima</i> | Ethyl acetate | 7.01 \pm 0.10 | --- |
| | Methanol 70% (v/v) | 60.02 \pm 6.02 | --- |
| | Water | 59.70 \pm 1.29 | --- |
| <i>Sarcocornia perennis</i> | Ethyl acetate | 99.82 \pm 15.42 | 57.14 \pm 0.49*** |
| | Methanol 70% (v/v) | 28.46 \pm 1.87 | 6.63 \pm 0.88* |
| | Water | 14.23 \pm 2.66 | 18.74 \pm 1.50 |
| ABTS radical scavenging assay | | | |
| | | Leaves (mg TE/g DW) | Stem (mg TE/g DW) |
| <i>Suaeda vera</i> | Ethyl acetate | 3.34 \pm 0.19 | 0.15 \pm 0.10*** |
| | Methanol 70% (v/v) | 4.25 \pm 0.07 | 1.27 \pm 0.11*** |
| | Water | 1.40 \pm 0.00 | 0.18 \pm 0.01*** |
| <i>Halimione portulacoides</i> | Ethyl acetate | 0.62 \pm 0.09 | 0.35 \pm 0.08 |
| | Methanol 70% (v/v) | 7.92 \pm 0.42 | 1.32 \pm 0.06*** |
| | Water | 0.45 \pm 0.04 | 0.43 \pm 0.06 |
| <i>Inula crithmoides</i> | Ethyl acetate | 1.13 \pm 0.03 | 1.40 \pm 0.10 |
| | Methanol 70% (v/v) | 4.66 \pm 0.01 | 3.63 \pm 0.23*** |
| | Water | 1.50 \pm 0.00 | 0.84 \pm 0.03*** |
| <i>Salicornia ramosissima</i> | Ethyl acetate | 1.04 \pm 0.04 | --- |
| | Methanol 70% (v/v) | 4.61 \pm 0.03 | --- |
| | Water | 0.74 \pm 0.08 | --- |
| <i>Sarcocornia perennis</i> | Ethyl acetate | 5.53 \pm 0.09 | 5.18 \pm 0.26 |
| | Methanol 70% (v/v) | 3.00 \pm 0.39 | 2.34 \pm 0.12*** |
| | Water | 0.92 \pm 0.04 | 0.54 \pm 0.02* |
| DPPH assay | | | |
| | | Leaves (μ g TE/g DW) | Stem (μ g TE/g DW) |
| <i>Suaeda vera</i> | Ethyl acetate | 2.89 \pm 0.20 | 0.40 \pm 0.34*** |
| | Methanol 70% (v/v) | 6.03 \pm 0.02 | 0.61 \pm 0.13*** |
| | Water | 9.01 \pm 0.78 | 0.11 \pm 0.01*** |
| <i>Halimione portulacoides</i> | Ethyl acetate | 0.68 \pm 0.16 | 0.29 \pm 0.03 |
| | Methanol 70% (v/v) | 0.68 \pm 0.02 | 1.10 \pm 0.11 |
| | Water | 0.18 \pm 0.02 | 0.40 \pm 0.04 |
| <i>Inula crithmoides</i> | Ethyl acetate | 0.78 \pm 0.04 | 0.33 \pm 0.10 |

| | | | |
|--------------------------------|--------------------|---------------------------------|-------------------------------|
| | Methanol 70% (v/v) | 7.31 ± 0.67 | 1.17 ± 0.05**** |
| | Water | 1.39 ± 0.57 | 0.62 ± 0.28 |
| <i>Salicornia ramosissima</i> | Ethyl acetate | 0.50 ± 0.22 | --- |
| | Methanol 70% (v/v) | 2.22 ± 0.23 | --- |
| | Water | 0.54 ± 0.10 | --- |
| | | | |
| <i>Sarcocornia perennis</i> | Ethyl acetate | 5.33 ± 0.53 | 1.70 ± 0.18**** |
| | Methanol 70% (v/v) | 0.73 ± 0.19 | 1.32 ± 0.06 |
| | Water | 0.37 ± 0.02 | 0.25 ± 0.13 |
| | | | |
| FRAP assay | | | |
| | | Leaves (μmol GAE / g DW) | Stem (μmol GAE / g DW) |
| <i>Suaeda vera</i> | Ethyl acetate | 8.32 ± 0.14 | 0.76 ± 0.11**** |
| | Methanol 70% (v/v) | 9.13 ± 0.25 | 2.72 ± 0.13**** |
| | Water | 13.52 ± 0.37 | 0.67 ± 0.22**** |
| | | | |
| <i>Halimione portulacoides</i> | Ethyl acetate | 3.53 ± 0.12 | 0.60 ± 0.11**** |
| | Methanol 70% (v/v) | 4.26 ± 0.34 | 3.31 ± 0.16 |
| | Water | 1.95 ± 0.02 | 2.52 ± 0.34 |
| | | | |
| <i>Inula crithmoides</i> | Ethyl acetate | 1.54 ± 0.03 | 2.01 ± 0.06 |
| | Methanol 70% (v/v) | 14.49 ± 0.46 | 5.89 ± 0.45**** |
| | Water | 7.84 ± 0.43 | 0.82 ± 0.05**** |
| | | | |
| <i>Salicornia ramosissima</i> | Ethyl acetate | 2.06 ± 0.05 | --- |
| | Methanol 70% (v/v) | 11.37 ± 0.89 | --- |
| | Water | 2.71 ± 0.03 | --- |
| | | | |
| <i>Sarcocornia perennis</i> | Ethyl acetate | 19.05 ± 0.67 | 6.52 ± 0.27**** |
| | Methanol 70% (v/v) | 6.96 ± 0.21 | 4.05 ± 0.12**** |
| | Water | 3.26 ± 0.06 | 2.79 ± 0.09 |
| | | | |
| TPC | | | |
| | | Leaves (mg GAE / g DW) | Stem (mg GAE / g DW) |
| <i>Suaeda vera</i> | Ethyl acetate | 3.13 ± 0.17 | 0.50 ± 0.02**** |
| | Methanol 70% (v/v) | 2.51 ± 0.23 | 0.94 ± 0.07**** |
| | Water | 4.50 ± 0.17 | 0.02 ± 0.02**** |
| | | | |
| <i>Halimione portulacoides</i> | Ethyl acetate | 1.51 ± 0.04 | 0.64 ± 0.01**** |
| | Methanol 70% (v/v) | 1.39 ± 0.12 | 0.98 ± 0.08 |
| | Water | 0.38 ± 0.02 | 0.41 ± 0.03 |
| | | | |
| <i>Inula crithmoides</i> | Ethyl acetate | 1.42 ± 0.04 | 1.81 ± 0.06 |
| | Methanol 70% (v/v) | 4.18 ± 0.21 | 2.00 ± 0.21**** |
| | Water | 1.97 ± 0.30 | 0.45 ± 0.11**** |
| | | | |
| <i>Salicornia ramosissima</i> | Ethyl acetate | 1.35 ± 0.07 | --- |
| | Methanol 70% (v/v) | 3.22 ± 0.19 | --- |
| | Water | 0.88 ± 0.18 | --- |
| | | | |
| <i>Sarcocornia perennis</i> | Ethyl acetate | 8.87 ± 0.18 | 5.95 ± 0.34**** |
| | Methanol 70% (v/v) | 1.82 ± 0.19 | 1.32 ± 0.10* |
| | Water | 0.79 ± 0.07 | 0.62 ± 0.23 |
| | | | |
| TFC | | | |
| | | Leaves (mg QE / g DW) | Stem (mg QE / g DW) |
| <i>Suaeda vera</i> | Ethyl acetate | 12.68 ± 0.74 | 2.43 ± 0.24 |
| | Methanol 70% (v/v) | 14.03 ± 0.87 | 2.32 ± 0.15* |
| | Water | 11.70 ± 1.19 | 0.47 ± 0.03* |
| | | | |
| <i>Halimione portulacoides</i> | Ethyl acetate | 7.45 ± 0.46 | 3.10 ± 0.61 |
| | Methanol 70% (v/v) | 3.76 ± 0.30 | 4.50 ± 0.90 |

| | | | |
|-------------------------------|--------------------|-------------------|-------------------------|
| | Water | 0.08 ± 0.08 | 0.78 ± 0.03 |
| | Ethyl acetate | 9.33 ± 0.48 | 9.59 ± 0.69 |
| <i>Inula crithmoides</i> | Methanol 70% (v/v) | 47.27 ± 14.22 | $13.51 \pm 5.25^{****}$ |
| | Water | 2.46 ± 0.09 | 1.28 ± 0.09 |
| | Ethyl acetate | 5.91 ± 0.67 | --- |
| <i>Salicornia ramosissima</i> | Methanol 70% (v/v) | 30.91 ± 6.10 | --- |
| | Water | 0.50 ± 0.02 | --- |
| | Ethyl acetate | 13.48 ± 1.07 | $24.89 \pm 8.65^*$ |
| <i>Sarcocornia perennis</i> | Methanol 70% (v/v) | 5.55 ± 0.37 | 3.95 ± 0.08 |
| | Water | 1.07 ± 0.11 | 0.86 ± 0.03 |

Table S2. Results (mean \pm s.d.) of the different assays performed (Lowry, ABTS, DPPH, FRAP, TPC and TFC) on seaweed.

| Lowry | | |
|-------------------------------|--------------------|--|
| | Ethyl acetate | 6.00 ± 0.28 mg soluble protein/g DW |
| <i>Gracilaria gracilis</i> | Methanol 70% [v/v] | 6.98 ± 0.32 mg soluble protein/g DW |
| | Water | 4.99 ± 0.28 mg soluble protein/g DW |
| | Ethyl acetate | 6.18 ± 0.13 mg soluble protein/g DW |
| <i>Fucus spiralis</i> | Methanol 70% [v/v] | 7.61 ± 1.39 mg soluble protein/g DW |
| | Water | 44.73 ± 4.00 mg soluble protein/g DW |
| | Ethyl acetate | 6.18 ± 0.03 mg soluble protein/g DW |
| <i>Ulva rigida</i> | Methanol 70% (v/v) | 33.40 ± 2.05 mg soluble protein/g DW |
| | Water | 15.33 ± 2.77 mg soluble protein/g DW |
| ABTS radical scavenging assay | | |
| | Ethyl acetate | 0.30 ± 0.02 mg TE/g DW |
| <i>Gracilaria gracilis</i> | Methanol 70% (v/v) | 0.02 ± 0.01 mg TE/g DW |
| | Water | nd |
| | Ethyl acetate | 0.65 ± 0.02 mg TE/g DW |
| <i>Fucus spiralis</i> | Methanol 70% (v/v) | 3.61 ± 0.10 mg TE/g DW |
| | Water | 1.40 ± 0.00 mg TE/g DW |
| | Ethyl acetate | 0.32 ± 0.04 mg TE/g DW |
| <i>Ulva rigida</i> | Methanol 70% (v/v) | 0.70 ± 0.03 mg TE/g DW |
| | Water | 0.20 ± 0.01 mg TE/g DW |
| DPPH assay | | |
| | Ethyl acetate | 0.62 ± 0.09 μ g TE/g DW |
| <i>Gracilaria gracilis</i> | Methanol 70% (v/v) | 0.14 ± 0.02 μ g TE/g DW |
| | Water | 0.13 ± 0.02 μ g TE/g DW |
| | Ethyl acetate | 0.81 ± 0.22 μ g TE/g DW |
| <i>Fucus spiralis</i> | Methanol 70% (v/v) | 0.49 ± 0.06 μ g TE/g DW |
| | Water | 1.13 ± 0.35 μ g TE/g DW |
| | Ethyl acetate | 0.35 ± 0.03 μ g TE/g DW |
| <i>Ulva rigida</i> | Methanol 70% (v/v) | 0.37 ± 0.00 μ g TE/g DW |
| | Water | 0.44 ± 0.05 μ g TE/g DW |
| FRAP assay | | |
| | Ethyl acetate | 0.04 ± 0.03 μ mol GAE / g DW |
| <i>Gracilaria gracilis</i> | Methanol 70% (v/v) | 0.11 ± 0.02 μ mol GAE / g DW |
| | Water | 0.56 ± 0.00 μ mol GAE / g DW |
| | Ethyl acetate | 0.86 ± 0.16 μ mol GAE / g DW |
| <i>Fucus spiralis</i> | Methanol 70% (v/v) | 3.31 ± 0.19 μ mol GAE / g DW |
| | Water | 4.15 ± 0.12 μ mol GAE / g DW |
| | Ethyl acetate | 0.07 ± 0.08 μ mol GAE / g DW |
| <i>Ulva rigida</i> | Methanol 70% (v/v) | 2.54 ± 0.07 μ mol GAE / g DW |

| | | |
|----------------------------|--------------------|---|
| | Water | $1.40 \pm 0.19 \mu\text{mol GAE} / \text{g DW}$ |
| TPC | | |
| <i>Gracilaria gracilis</i> | Ethyl acetate | $0.34 \pm 0.08 \text{ mg GAE} / \text{g DW}$ |
| | Methanol 70% (v/v) | $0.36 \pm 0.28 \text{ mg GAE} / \text{g DW}$ |
| | Water | nd |
| <i>Fucus spiralis</i> | Ethyl acetate | $0.70 \pm 0.09 \text{ mg GAE} / \text{g DW}$ |
| | Methanol 70% (v/v) | $0.94 \pm 0.06 \text{ mg GAE} / \text{g DW}$ |
| | Water | $1.59 \pm 0.32 \text{ mg GAE} / \text{g DW}$ |
| <i>Ulva rigida</i> | Ethyl acetate | $0.29 \pm 0.04 \text{ mg GAE} / \text{g DW}$ |
| | Methanol 70% (v/v) | $0.74 \pm 0.07 \text{ mg GAE} / \text{g DW}$ |
| | Water | $0.29 \pm 0.01 \text{ mg GAE} / \text{g DW}$ |
| TFC | | |
| <i>Gracilaria gracilis</i> | Ethyl acetate | nd |
| | Methanol 70% (v/v) | $0.80 \pm 0.36 \text{ mg QE} / \text{g DW}$ |
| | Water | nd |
| <i>Fucus spiralis</i> | Ethyl acetate | nd |
| | Methanol 70% (v/v) | $9.37 \pm 1.50 \text{ mg QE} / \text{g DW}$ |
| | Water | $2.69 \pm 0.09 \text{ mg QE} / \text{g DW}$ |
| <i>Ulva rigida</i> | Ethyl acetate | $6.90 \pm 1.20 \text{ mg QE} / \text{g DW}$ |
| | Methanol 70% (v/v) | $7.78 \pm 0.49 \text{ mg QE} / \text{g DW}$ |
| | Water | $1.44 \pm 0.08 \text{ mg QE} / \text{g DW}$ |