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Characterization of 17 elements in ten edible seaweed species from Greenland

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1 Summary
Greenland seaweeds are of interest for local and global consumption. We investigated ten species for their content of essential, trace and toxic elements: As, Ca, Cd, Cr, Cu, Fe, Hg, I, K, Mg, Mn, Na, Ni, P, Pb, Se and Zn. The elemental composition was statistically significantly different (p < 0.05) between species with the exception of Cr, Fe and Pb. High levels of iodine were found in certain seaweeds (all brown algae): *Alaria esculenta* (Cr and I), *Ascophyllum nodosum* (I), *Laminaria solidungula* (I), *Saccharina latissima* (I), *Saccharina longicuris* (I) and *Saccharina nigripes* (I). Through consumption of 2 g dried seaweed of these species, the upper tolerable level of iodine of 600 µg/day for adults (EFSA) is exceeded.

2 Methodology
Samples harvested in the field (figure 1) were freeze dried, pulverized and quantified by inductively coupled plasma mass spectrometry (ICP-MS). The quality of the analytical method was assured by simultaneous analysis of certified reference materials and adherence to European standard methods (EN 13805, EN 15763 and EN 15111).

To detect statistically significant differences between species, analysis of variance (ANOVA) and Tukey multiple comparisons of means tests were carried out. Principal component analysis (PCA) was carried out to detect patterns in the dataset.

3 Conclusion: how much is safe to eat?

<table>
<thead>
<tr>
<th>Species</th>
<th>2 g serving</th>
<th>Why not?</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Agarum cloathratum</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Alaria esculenta</em></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td><em>Ascophyllum nodosum</em></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td><em>Fucus distichus</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Fucus vesiculosus</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Laminaria solidungula</em></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td><em>Palmaria palmata</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Saccharina latissima</em></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td><em>Saccharina longicuris</em></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td><em>Saccharina nigripes</em></td>
<td></td>
<td>I</td>
</tr>
</tbody>
</table>

Figure 3: How much is safe to eat? Calculation based on dry weight of seaweed and and tolerable daily intake levels set by the European Food Safety Authority (EFSA) for a 60 kg adult person.

4 PCA results
PCA reveals patterns in element content that follow the family level (figure 2).

5 Acknowledgements
The PhD project of Katharina Johanna Kreissig and thus this study is funded through a scholarship from the Greenland Research Council.

6 Sustainable development goals

2 Zero hunger
12 Responsible consumption and production
14 Life below water

Figure 1: Sampling locations in Greenland.

Figure 2: Principal component analysis of element content grouped by algal family. Fucaceae and Laminariaceae are well separated.