Conference on

Healthy, Safe and Sustainable Foods of the Future

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Can we make new healthy foods out of starfish and other underutilized marine raw materials?

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Blue biomasses and healthy foods

- Globally 211 million tons blue biomass/year
- Up to 70% of currently harvested blue biomasses are wasted or end up as low value products
- Some biomasses are still underexploited
Extraction of healthy omega-3 oils from starfish powder

Production of Omega-3 oil from starfish meal

• Benefits the mussel industry
• New highly available and sustainable source of Omega-3 fatty acids
• Value creation from underutilized biomass

• Use of green extraction technology

<table>
<thead>
<tr>
<th></th>
<th>Krill oil</th>
<th>Cod liver oil</th>
<th>Concentrated fish oil</th>
<th>Starfish oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA (% of fatty acids )</td>
<td>15,3</td>
<td>9,6</td>
<td>33</td>
<td>5,1-8,1</td>
</tr>
<tr>
<td>DHA (% of fatty acids )</td>
<td>8,4</td>
<td>11,4</td>
<td>22</td>
<td>3,7-4,8</td>
</tr>
<tr>
<td>Phospholipids (g/100 g)</td>
<td>48</td>
<td>0</td>
<td>0</td>
<td>Ca. 30 %</td>
</tr>
<tr>
<td>Astaxanthin</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Total vitamin E (ug/g)</td>
<td>760</td>
<td>350</td>
<td>Yes, added</td>
<td>24-45</td>
</tr>
</tbody>
</table>

Sørensen et al. 2022. . *Foods* 11, 2998
Extraction of proteins from red seaweed

Highest protein extraction efficiencies

- Alcalase® 0.2% w/w ~ 60%
- Viscozymes® 0.2% w/w ~ 50%

Rich in branched chain amino acids (isoleucine, leucine and valine): 23 % of the amino acid content

Carrageenan rich seaweed after protein extraction

Naseri et al. (2020) *Foods*, 9, 1072
Production of vitamin D, proteins and omega-3 PUFA in microalgae

- *Chlorella minutissima*
- *Nannochloropsis oceanica*
- *Arthrospira maxima*
- *Rhodomonas salina*

UVB dose:
- 0 kJ/m²/day
- 3 kJ/m²/day
- 6 kJ/m²/day
- 16 kJ/m²/day
- 22 kJ/m²/day

*Nannochloropsis oceanica:
Omega-3 PUFA content: Ca. 21 mg/g dry matter
Vit D₃ content: Ca. 285 ng/g dry matter

Ljubic et al. (2021) *Algal Research*, 59, 102472
Some challenges

Extraction and production technologies
- Low growth rates and yield (microalgae)
- Lack of optimal enzymes for blue biomasses
- Non-sustainable processing technologies
- Poor understanding of integration of enzymatic and green extraction technologies

Odour removal
- Undesired off-odours and flavours in blue side-streams and biomasses
- Lack of efficient odour&flavour removal technologies

Translation and scalability
- Poor understanding of techno-economic feasibility and environmental benefits of new extraction principles
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