Cultivated kelp as a possible source for feed protein

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Promac – Energy efficient processing of macroalgae in blue-green value chains
District heating need in Ålesund
R&D-partners

- Møreforsking
- SINTEF
- NIBIO
- NTNU
- Norwegian University of Science and Technology
- Norwegian University of Life Sciences
- Matis
- Ceva
- SLU
Industry partners

- TAFJORD
- Felleskjøpet
- Firmenich
- Hortimare
- THE NORTHERN COMPANY
- MARINOX
- LEGASEA
- Orkla Foods Norge
Promac – PROCESS

2015-2018

Cultivation and harvest

Pre-treatment (ensiling, preservation, rinsing, etc.)

Drying

Processing

Fresh drying (<24 hours)

Batch drying

Non-drying processes

Feed products
Human food products
Bioeconomy ingredients

Oterhals et al., unpubl.
Cultivated kelp as potential feedstock for proteins

• Potential
  – Two fast growing biomass producers in *Saccharina latissima* and *Alaria esculenta*

• Challenges
  – Narrow window for harvesting due to biofouling
  – Scarce knowledge about effects of season on protein & amino acids in these kelps
Comparative study

Species
- *S. latissima*
- *A. esculenta*

Season for harvest
- MAY
- JUNE

Origin
- Cultivated (kelp)
- Wild

Yield
- Biomass
- Protein
- Amino acids

Discuss use in salmon feed
Biomass production

- Saccharina 2 m
- Saccharina 5 m
- Saccharina 8 m
- Alaria 2 m
- Alaria 5 m
- Alaria 8 m

(Phot: SINTEF)
Protein content

Protein % (of dw; sum AA)

- Saccharina, wild
- Saccharina, cultivated
- Alaria, wild
- Alaria, cultivated

JUNE  MAY
Amino acids in Saccharina, cultivated

30-80 g amino acids /m cultivation rope in sea

essential aa

<table>
<thead>
<tr>
<th>Glutamic acid + Glutamine</th>
<th>Aspartic acid + Asparagine</th>
<th>Alanine</th>
<th>Leucine</th>
<th>Phenylalanine</th>
<th>Valine</th>
<th>Lysine</th>
<th>Glycine</th>
<th>Serine</th>
<th>Isoleucine</th>
<th>Arginine</th>
<th>Threonine</th>
<th>Proline</th>
<th>Tyrosine</th>
<th>Cystine (Cys-Cys)</th>
<th>Methionine</th>
<th>Histidine</th>
<th>Tryptophan</th>
<th>Taurin</th>
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AA % (dw)
Amino acids in Alaria, cultivated

Not essential aa
Amino acids in Alaria, cultivated

10-30 g amino acids per m cultivation rope in sea

essential aa

### Amino Acid Composition

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<thead>
<tr>
<th>Amino Acid</th>
<th>May</th>
<th>June</th>
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<tr>
<td>Alanine</td>
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**Note:** AA % (dw)
Cultivated vs wild Alaria

Alaria, JUNE

- AA % (dw)

Cultivated
Wild

- Alamine
Glutamic acid + Glutamine
Aspartic acid + Asparagine
Leucine
Lysine
Phenylalanine
Valine
Serine
Glycine
Isoleucine
Threonine
Arginine
Cystine (Cys-Cys)
Proline
Tyrosine
Ammonia
Histidine
Methionine
Taurine
Tryptophan
Harvest in JUNE

Saccharina and Alaria, JUNE

AA % (dw)

- Glutamic acid + Glutamine
- Aspartic acid + Asparagine
- Alanine
- Leucine
- Glycine
- Lysine
- Valine
- Phenylalanine
- Serine
- Isoleucine
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- Taurin

Saccharina and Alaria
Expected growth in Norwegian salmon production – and in feed demand

DKNVS/NTVA (Olafsen et al., 2012)
Amino acids for salmon feed

AA-profiles in salmon feed, Saccharina and Alaria

All essential aa present in the kelps
Not balanced
- Met: 1:5 (Saccharina), 1:3 (Alaria)
- Lys: 1:3 (Saccharina), 1:2 (Alaria)

Marine grower feed, 40–45% crude protein
- Saccharina JUNE, AA% (dw)
- Alaria JUNE, AA % (dw)
Species:

- *S. latissima* 3X higher biomass production.
  - Poor seedlings quality of *A. esculenta* (?)

- *A. esculenta* is higher than *S. latissima* in:
  - Total protein
  - All amino acids
Season:

- **A. esculenta**
  - Total protein highest in JUNE
  - Essential AA highest in MAY

- **S. latissima**
  - Total protein and essential AA highest in MAY

- **Biomass**
  - More than doubles from MAY to JUNE
As protein source for feed (salmon):

- All essential amino acids present
- AA profile is not balanced
  1. Add extra AA
  2. Use excess AA as energy
- The content is low... (10-80g protein/m)
MILLING and HEATING

Photo: SINTEF
HYDROLYSIS

Photo: SINTEF
PRODUCT

Photo: SINTEF
PRODUCT

Photo: SINTEF
Thank you 😊