National Algaepilot Mongstad
Norway

Production of microalgae for aquaculture

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How to Farm a Better Fish?

The world now produces more farmed fish than beef – and that’s just the beginning.

Feeding the World

By 2050 we’ll need to feed 2 billion more people. How can we do that without overwhelming the planet?
• Aquaculture has supplied more than half of the World’s fish for food since 2013
• UN FAO: Aquacultured fish expected to reach 100 mill tonnes by 2025
• Growth in salmon will be slower because of the high demand for fishoil and fishmeal
• Large feed volumes are required to drive the sustainable growth
• Novel feed resources are introduced
• The sustainable growth should not rely on resources competing with human food
• WWF: Norway is leading the development of sustainable aquaculture
Still a gap to bridge for commodities from microalgae
Commercial production challenges:

- Product costs
- Scale
- Production chain analysis
- Market development
Roadmap for microalgae based aquafeed

- **Algae biology**
- **Screening & Develop new prod strains**
- **Optimize cultivation conditions**
- **Upscale production**
- **Processing**
- **Feed formulation and development**
- **Demonstrate functionality**

**Institutions Involved**
- University of Bergen
- Uni Research
- SINTEF F&A
- University of Tromsø
- SINTEF M&C
- NTNU
- NMBU
- UiS CORE
- NIVA
- MicroA
- Nofima
- Polarfeed
- NTNU
- Skretting
- EWOS
- Biomar
- Marine Harvest
- Marine Harvest
## Roadmap for microalgae based aquafeed

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<table>
<thead>
<tr>
<th>Feed formulation and development</th>
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</thead>
<tbody>
<tr>
<td>Nofima</td>
</tr>
<tr>
<td>Polarfeed</td>
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</tr>
</tbody>
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**National Algepilot Mongstad**

- Connect research with industry
- Strengthen competence & capacity
- Produce sufficient volumes of algae for application testing
National Algaepilot Mongstad

University of Bergen  6 mNOK
Seafood Research Fund  3 mNOK
Government  6 mNOK
Hordaland County  2 mNOK
Municipality councils  1 mMOK
18 mNOK = 1.9 m€

National platform for the industrialization of microalgae
We develop the full microalgae production chain: from bioprospecting to process optimization and biomass production at pilot scale...development of new valuable products from microalgae
Microalgae show great potential as functional ingredients in aquaculture feeds

Experiments:
- *Nannochloropsis* and *Phaeodactylum* (whole cells, disrupted, residual biomass, oil)
- Diets with 1 – 8 % inclusion rates
- Tested on: salmon, gilthead seabream, senegalese sole

Demonstrated benefits on:
- **Animal welfare** (stress resistance, immunity, improved survival of larvae)
- **Consumer quality traits** (more vivid and typical external pigmentation)
- **Reduce reliance on finite marine-harvested resources** (e.g. replacement of fish meal (80%) and fish oil (30%) )
Miracles
Aquaculture feed
Food & Nutraceuticals
Non-food specialties
Bioprospecting + strain selection – Nordic climate

Search for: strains with high EPA/DHA content.
Assumption: Microalgae from northern high latitudes are expected promising candidates, as low growth temperatures can increase fatty acid unsaturation.

Sampling
Isolation
Cultivation
Screening
Selection

58 events
110 plates
149 clonal cultures

30 strains:
- Growth
- Fatty acids

Promising strains:
growth rates > 0.7 d^{-1}
EPA/DHA >3% DW
→ 8 selected for further characterization
Conclusions

- Nordics are promising for prospecting microalgae with high EPA
- EPA content was predominantly higher in the stationary phase
- EPA contents of >6 % DW in stationary phase are higher than typically found
- First report on a high EPA content for *A. septentrionalis* and *Entomoneis sp.*

Steinrucken et al. 2017
Bioprospecting + strain selection – Nordic

Comparison under Nordic outdoor conditions in flat-panel PBRs
Compared vs. Commercial *Phaeodactylum* reference strain
Industrial symbiosis for development of new value chains
Preliminary experiments – integration with waste streams

Municipality Biodegradable Waste

Insect manure

Fish manure
Thank you for your attention

Questions?