## Microalgae for salmon feed

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Dominic Nanton



#### **EWOS AS**

- Leading producer and supplier of salmonid feed
- Focus on use of sustainable raw materials
- Long experience with testing and use of new raw materials
- Have tested different algae products in later years



### Algae in salmon feed



- Priorities for use in salmon feed:
  - Marine omega-3 (EPA+DHA) source to replace fish oil.
  - Protein alternative for fishmeal replacement.
  - Astaxanthin less interesting due to relatively low current price.

### Marine omega-3 in salmon feed



- Fish oil is major marine omega-3 fatty acid (EPA+DHA) source in current salmon diets with fish meal supplying minor amounts.
- EPA+DHA varies between fish oil species sources and within batches from same source.
- Relatively low EPA+DHA required in feed for optimal growth of salmon.
  - 0.5-1% EPA+DHA of diet estimated.
- Surplus EPA+DHA in salmon feed mainly to enrich fillet for human health.
  - Feed and fillet EPA+DHA levels correlated.
  - Predict EPA+DHA in fillet with EWOS oilMIX model.
- EPA+DHA in salmon fillet important for human health.
  - Health claims for EPA+DHA focused on cardiovascular disease (CVD) but benefits also reported in brain function, mental health and inflammatory disease areas.
  - American Heart Association recommends those without CVD eat oily fish at least twice a week.
  - Human daily intake guidelines for EPA+DHA:
    - 500 mg per day from ISSFAL,
    - 250 mg per day from EFSA (EU).

### Sustainable global fish oil supply





▶ 8 year average is ca. 1 million tons of fish oil per year.

### Aquaculture is major user of fish oil



- Aquaculture is largest user of fish oil and salmonids are largest users of fish oil in aquaculture.
- Fish oil for direct human consumption also uses an increasingly large amount of fish oil.



source: IFFO, 2010

# Increased fish oil demand for **EWOS** direct human consumption and salmonid feed

 Nearly 10% per year omega-3 industry growth (DHC).

3.6% average growth in salmonid production last 5 years.



### Alternative marine omega-3 sources

- Krill oil
  - Likely under 5K tons by 2017.

- GMO plant oil
  - EPA/DHA-enriched (ca. 4-10 years).
  - SDA-enriched GMO plant oil shorter term.



- Currently low volumes and high prices.
- EWOS activities:
  - CO2Bio
  - industry partner on research project collaborations
  - algae product screening









### EPA/DHA algae in salmon feed issues



- Algae oil needs to be price competitive with fish oil on EPA+DHA per weight of product basis to get into feed formulation.
- EPA/DHA algae may be simpler to use as extracted oil for coating pellet but this can add extra cost. Potential reasons below:
  - High fat algae meal exceeds maximum fat level in meal mix for proper pellet expansion in extruder.
  - Low EPA+DHA level with high carbohydrate/ indigestible protein/ ash in algae meal takes up too much space in formulation.
  - Negative effect of EPA/DHA algae meal on fish performance, health or fillet quality.
  - Poor nutrient digestibility of algae meal due to cell walls.
  - EPA/DHA not stable in algae meal through extrusion.

### Algae as fish oil replacement in salmon feed

- Extracted algae oil example to directly replace fish oil as EPA/DHA source:
  - 15-30% EPA+DHA of total FA or higher.
  - Mix of EPA and DHA.
  - Low omega 6 (<5% of total FA).
  - Low saturated FA (≤ ca. 20-30% of total FA; negative effect on fat digestibility).



### Algae as protein source in salmon feed

- Potential defatted byproduct from algae biofuel and nutraceutical industries.
- Algae as protein source in salmon feed:
  - Greater than 60-65% protein DM to directly replace fishmeal and avoid taking up space in formulation.
  - Similar amino acid composition to fishmeal to avoid supplementation of deficient amino acids.
  - Highly digestible protein (ca. 90%).
- Price competitive with plant protein concentrate alternatives to fishmeal to get into feed formulation.
  - Fishmeal is unique ingredient required for optimal growth at low levels.
- Evaluate potential negative effect of algae meal on fish performance, health and fillet quality.

Thanks for your attention

