Feed The World Plenary Session

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October 2, 2015
Opportunity for Algae Meal to Replace Fishmeal in Aquafeeds and Soymeal in Livestock Feeds

Fishmeal trades at ~4x the price of soymeal historically

Aquaculture growing rapidly and in need of protein; Fish capture peaked in 1990s & is now in decline

Source: FAO, "THE STATE OF WORLD FISHERIES AND AQUACULTURE 2014"

Source: prices for fishmeal and soymeal from http://www.indexmundi.com

Source: FAO, "THE STATE OF WORLD FISHERIES AND AQUACULTURE 2014"
Algae is Key to Sustainable Omega-3 Production

Algae Meal Co-Product Can Replace Fishmeal Too!

Fish Oil / Omega-3 Food Chain

Marine microalgae → Zoo-plankton → Herbivorous/planktivorous fish → Smaller carnivorous fish → Larger carnivorous fish (e.g., Salmon)

Fish Oil with Omega-3 + Mercury, Dioxins, & PCBs

Sustainable Omega-3 Production Direct from Algae

Cellana “Cuts Out the Middle-Fish”™

Marine microalgae → Algae Oil with Omega-3s

Vegetarian, Low-Cost, Sustainable Omega-3s without Mercury, Dioxins, or PCBs from Fish
Multi-Product Business Model: up to 4 Products From Each Strain Via ALDUO™ + “Conventional” Upstream/Downstream Processes

• “Off-the-shelf” ag inputs + sunlight + CO₂ + ALDUO™ =

• Existing or new & improved separation/extraction techniques = + +

ReNew™ Algae

ReNew™ Feed

ReNew Omega-3

ReNew™ Fuel

GalilAlgae (aquaculture feed)

NESTE

cellana™

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<tr>
<th>Crop</th>
<th>Water Footprint (Liters)</th>
<th>Emissions (kg CO₂e)</th>
<th>Land Use (m²)</th>
<th>Grain for Feed (kg)</th>
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Lowest Carbon, Land, Water Footprints Compared to Other Sources of Protein/Feed and Fuels

Lower Carbon Footprint

Lower Arable Land Footprint

Lower Fresh Water Footprint

- Carbon Footprint of Conventional Feeds & Fuels: <10%
- Arable Land Footprint of Conventional Feeds & Fuels: <10%
- Fresh Water Footprint of Conventional Feeds & Fuels: <20%
Over 6 MT of Cellana’s ReNew™ Feed Used in Diverse & Successful Feed Trials

- **Successful large-scale feed trial for Salmon, Carp, & Shrimp**
    - Cellana’s ReNew Feed was acceptable for the three animals at the maximum levels tested (Salmon 10%, Carp 40%, Shrimp 40%)

- **Successful large-scale feed trial for Broiler Chicks**
  - *Potential and Limitation of a New Defatted Diatom Microalgal Biomass in Replacing Soybean Meal and Corn in Diets for Broiler Chickens*, Xin Gen Lei (Cornell) *et al.*, J. of Agricultural & Food Chemistry, 61(30), pp. 7341-8, July 2013
    - Cellana’s ReNew™ Feed could substitute for 7.5% of soybean meal alone, or in combination with corn, in diets for broiler chicks when appropriate amino acids are added

- **Successful large-scale feed trial for Broiler Chicks and Weanling Pigs**
    - Broilers fed 15% Cellana’s ReNew™ Feed had 16% greater gain/feed efficiency than the control diet over the 42-day period.
Two experiments were conducted to determine the nutritional and metabolic impacts of defatted green microalgal (Desmodesmus sp.) biomass (DGM), protease, and nonstarch polysaccharide degrading enzymes (NSPase) in diets for weanling pigs and broiler chicks. Pigs fed 10% DGM for 28 days had growth performance comparable to the controls, but 23–39% lower (P < 0.05) plasma urea nitrogen concentrations. Broilers fed 15% DGM had 16% greater (P < 0.05) gain/feed efficiency than the control (0.78 vs 0.67) over the 42 day period. Supplemental protease (0.06%) decreased (P < 0.03) plasma uric acid concentrations in pigs on day 14, whereas supplemental NSPase showed negative effects in broilers. Dietary inclusions of DGM or enzymes altered (P < 0.05–0.1) hepatic and muscle protein levels of key regulators in the mTOR pathway. **In conclusion, weanling pigs and broiler chicks tolerated dietary inclusions of 10 and 15% DGM, respectively,** and adding protease might help digestion.
Enhanced pigmentation of salmon fillet with Cellana algae meal (Omega-3 strain)

Feed without alga  Feed with 12.5% alga