Fishmeal and fish oil for aquaculture feed - Nutritional quality

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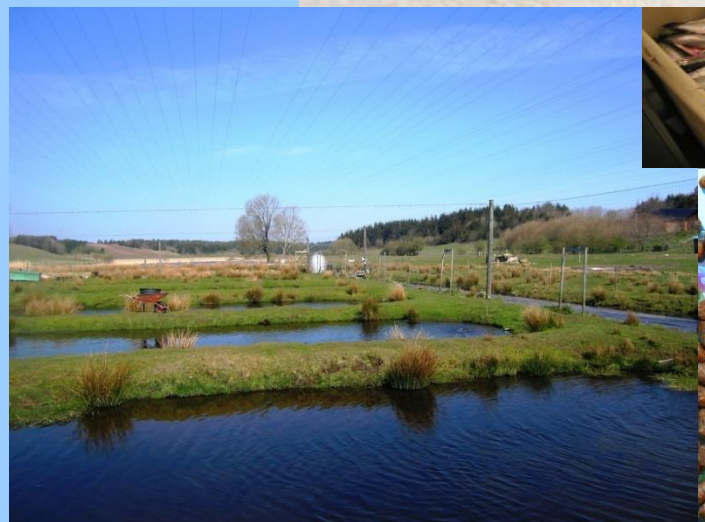
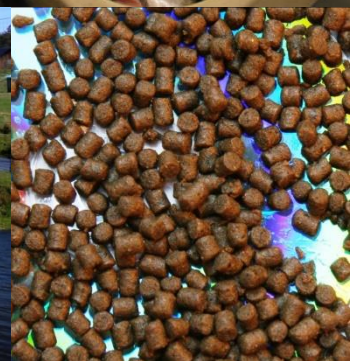




Introduction

Feed for aquaculture production must:

- **Fulfil species specific nutrient requirements, incl. specific amino acids (AA) and fatty acids (FA)**
- **Well-balanced, to secure optimal performance, fish health, high product quality, and low environmental impact**

→ **Fishmeal and fish oil**

Fishmeal (FM) and Fish Oil (FO)

- **Natural ingredients in diets for carnivorous fish and shrimps**
- **Provides required dietary nutrients (all life stages), i.e.**
  - **Amino acids (Protein building blocks)**
  - **Omega-3 fatty acids (EPA & DHA)**
    - **Cell membranes/brain development**
    - **Preventing cardiovascular disease**
    - **Improving immune defence**
  - **Cholesterol & phospholipids**
  - **Vitamins and minerals**

Fishmeal (FM) and Fish Oil (FO)

Challenges:

- **Limited availability**
- **Feed development using alternative protein ingredients**
- **Price competition**
- **Low Fishmeal feeds!**

➡ **Less dependency on FM and FO for aquaculture feed**

What then makes FM a
unique high valued resource?
Oppertunities? – Strategic use!

Organic aquaculture

Priority of sourcing of feed ingredients for organic aquaculture feed (EU reg.):

1. **Organic feed products of aquaculture origin**
2. **Fishmeal & fish oil from organic aquaculture trimmings**
3. **Fishmeal & fish oil derived from trimmings of fish caught in sustainable fisheries**
4. **Organic feed material of plant origin (max. 60 %)**
5. **Fishmeal & fish oil derived from fish caught in certified sustainable fisheries (Amendment 2014).**

Sourcing of feed ingredients for organic aquaculture

Challenges:

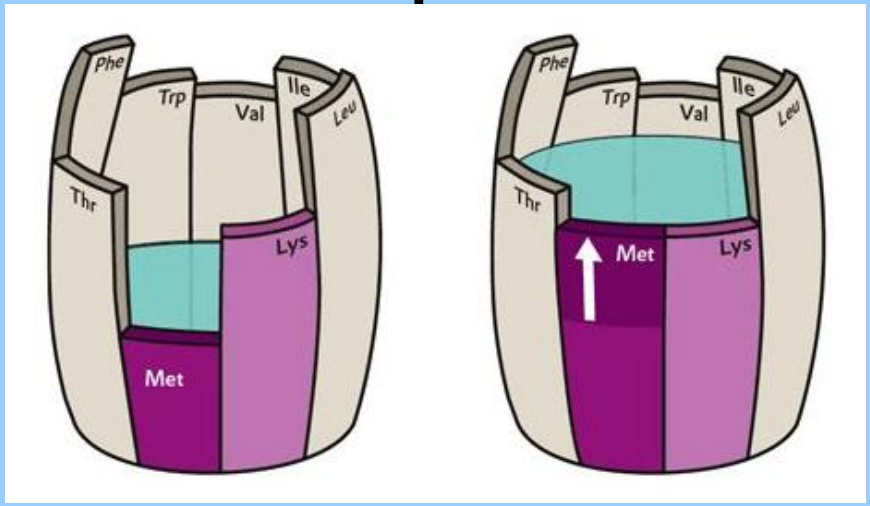
- Organic feed products of aquaculture origin and trimmings from organic aquaculture are only available in limited quantities
- Trimmings are not a well defined product, i.e. variation in protein (AA), lipid (FA), mineral content (high P)
- Trimmings can not be used in feed for the same species

Fishmeal replacement in organic aquaculture

➡ **Organic feed material of plant origin**

Challenge: Inadequate Amino Acid (AA) profile

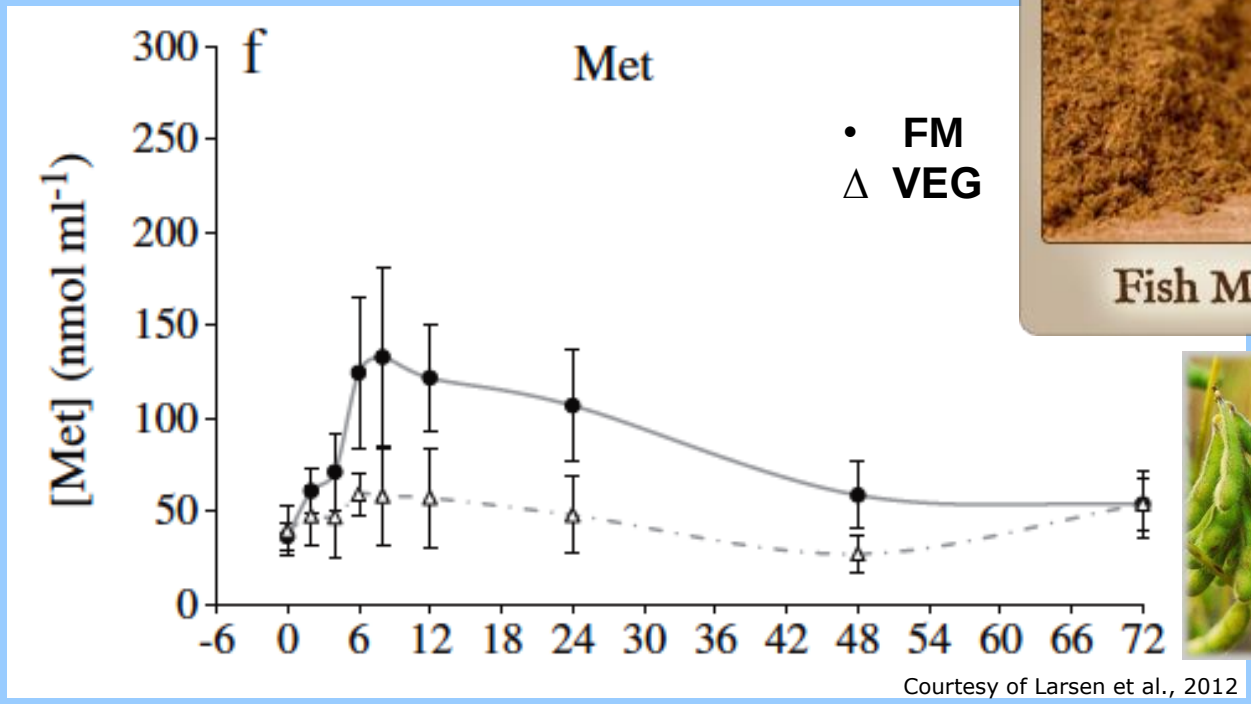
- **First limiting AA determines performance**
- **Synthetic AA not allowed**
- **Anti-nutrients**
- **Environmental impact**



Sourcing of feed ingredients in organic aquaculture

➡ Organic feed material of plant origin

Challenge: Differences in amino acid up-take pattern between FM and VEG based diets

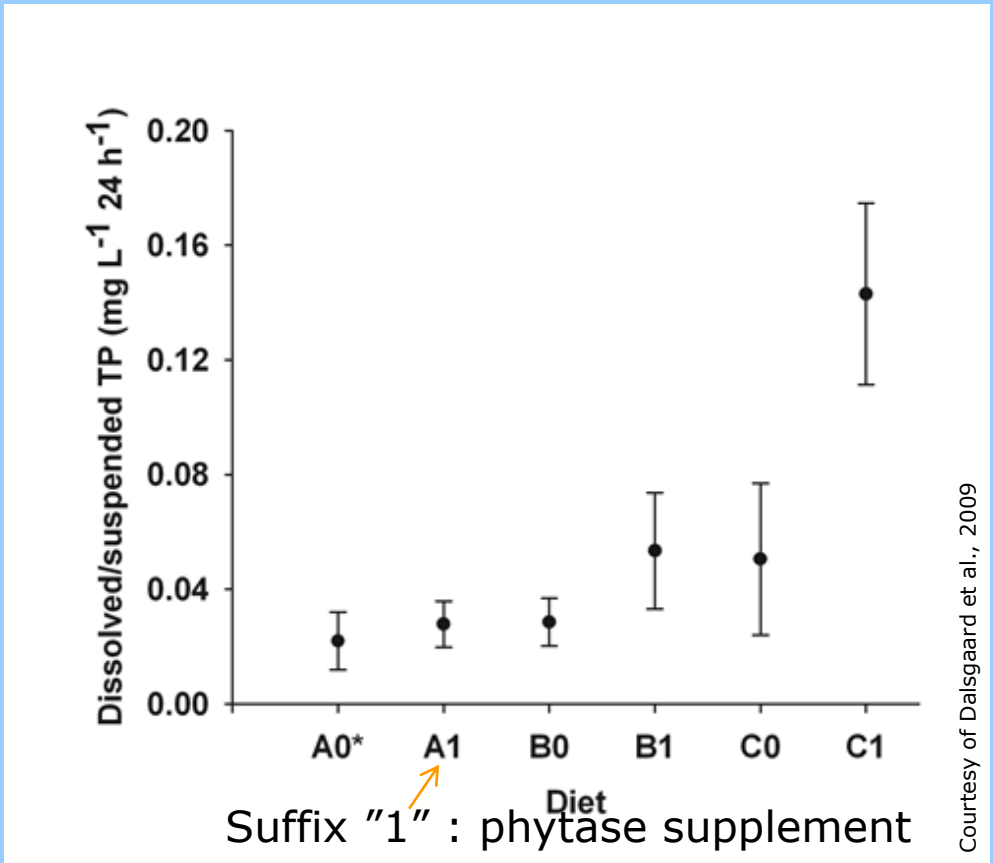


Courtesy of Larsen et al., 2012

Sourcing of feed ingredients in organic aquaculture

➡ Organic feed material of plant origin

Challenge: Limited phosphorus availability in plant ingredients (*phytase not permitted in organic feed)*



Courtesy of Dalsgaard et al., 2009

A, B,C: 0.29 % phytate-P
A: 0.89 % Total-P
B: 0.97 % Total P
C: 1.12 % Total P

Fish oil replacement

- Long chain high unsaturated omega-3 fatty acids (FA) are unique in fish oil/marine phyto-/zooplankton
- Required in carnivorous fish diets, e.g. EPA and DHA
- Plant oils contain only short chain omega-3 FAs
  - Limited – if any - innate capacity in carnivorous fish for converting short chain FAs into EPA/DHA

➡ Strategic use of available omega-3 resources

Alternative feed ingredients

- **Bacteria, fungi, algae**
  - **Single cell organisms (AA profile ≈ FM)**
  - **Waste may be substrate ≈ recycling nutrients**
  - **Marine micro algae ≈ EPA, DHA etc.**

- **Processed Animal Protein (PAP), blood meal**
  - **High protein/adequate AA content**

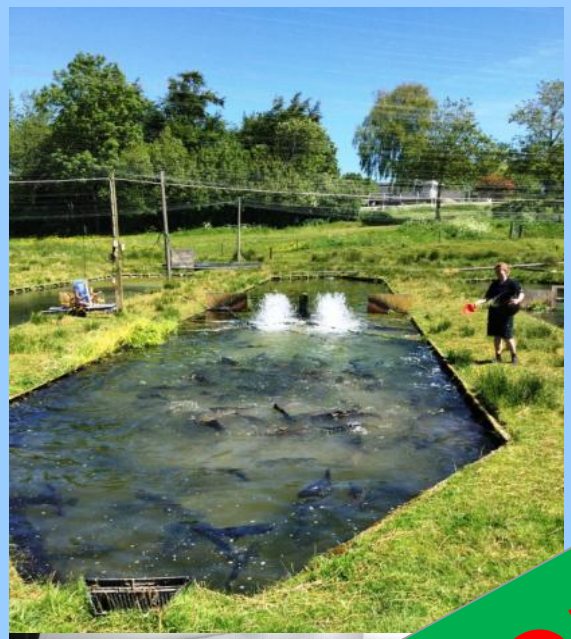
- **Insect meals**
  - **High protein/adequate AA/(FA) content**
  - **High productivity**

Perspectives and research gaps

Fishmeal as a source of AA and essential nutrients

- **Impact of processing methods on nutritional value of fishmeal?**
- **Nutritional value of «Raw fish pellet»?**
- **Nutritional value of solubles? – Macro-/ micro nutrients – Feed/Food?**

- **Impact of FM on fishhealth/stress tolerance and immune defence?**
- **Identification of unique nutrients in FM for humans (peptides, hormones, vit. etc.)?**
- ***Strategic use of FM and FO (e.g. fry feed)***



Thank you