Centre for Feed Technology

Quality and confidentiality in research
Centre for Feed Technology

By

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Vision:

Delivering quality in research & development in feed & nutrition
Outline of the presentation

- Description of Centre for Feed Technology, NMBU
  - Education in Aquaculture, Feed Technology, & relevant studies
  - Our philosophy & tools
  - Example of feed processing trials
- New sources for protein
  - How to process & proceed
- Summary
Master degree @ dept. Animal & Aquacultural Sciences

3 in English

- Feed Manufacturing Technology
- Aquaculture
- Erasmus Mundus – animal breeding (together with WUR)

1 in Norwegian - Animal science

- We offer possibilities for in-depth studies within animal husbandry and aquaculture, incl. feed
- Create your own subject profile
- Unique in the job market
- Global job opportunities
- Study catalogue (english: page 71 →)
- Performing research trials
- Part of research group
- Lecturing
- Supervising MSc-students
Extrusion line

- Flexible
  - 2 feeding bins
    - Allow e.g. one main mash, and
    - mixed with a second ingredient → easily performance of a regression design
  - Double conditioner
    - Retention time: 1 minute – 10 minutes
    - Up to 40% moisture in mash
      - (depending on mash)
Extrusion line

- Flexible
  - Liquid addition (other than H₂O)
    - Mixer
    - Conditioner
    - Extruder
  - H₂O addition
    - Mixer
    - Conditioner
    - Extruder
Extrusion line

- Flexible
  - Amountwise
    - Usually: 150 – 300 kgs/h
    - Down to 50 kg/h possible
    - Up to 500 kgs/h possible
Gentle Vacuum Coater GVC 1000

Developed by
• Amandus Kahl &
• Centre for Feed Technology
Connected Technologies at our Centre

- **Vacuum coaters**
  - 6 L (twin shaft, Forberg)
  - 150 L (Gentle Vacuum Coater)
  - 200 L (twin shaft, Dinnissen)

- **Mixers**
  - 6 L (twin shaft)
  - 40 L (twin shaft)
  - 100 L (twin shaft)
  - 400 L (twin shaft, electric heaters, insulated)

- **Dryers**
  - Fluidized bed
  - Batch dryers (6 units, ca 20 kg capacity each)

- **Grinding**
  - Hammer mill
  - Roller mills
  - UPZ-mill
Our philosophy:
Biological driven process development
The species available at NMBU for scientific experiments
Or, of we should speak it out:

To make feed as the animals demand
Need for protein sources

- Increased consumption of animal proteins is creating an immense demand of high quality feed.
- Researchers have focused on providing enough protein from plant sources.
- Marine derived ingredients in Norwegian salmon feed has decreased from 90% in 1993 to about 30% in 2013.
- Feed development can make sure that less human food crops, and more non-edible biomass, is used to feed animals, particularly in fish diets.

Picture 1 Source: http://www.petfoodindustry.com
Picture 2 Source: http://aquatechcenter.com/facilities/
Technology Transfer to Food Industry

• Assists with the development of new food products and technical solutions.

• Encouraging innovation, promoting the adoption of appropriate technology.

• At NMBU we have been sharing skills, knowledge, technologies, with students, universities and other institutions.

• Examples: Products from oilseeds, pulses and legumes.
• * Production of L-Phenylalanine by the enzyme method.
Ingredients – from the portfolio at NMBU
Ingredients – basic demands

• Optimal and renewable protein resources.

• Safe for animals and humans and without anti-nutrients or toxins.

• Has to be accepted by the animals, with optimal taste and flavor.

• Optimally balanced profile of amino acids.

• In addition, such ingredient should influence the best possible physical characteristics and technological quality of extruded or pelleted feed products.
Yeast and bacterial biomass

• Advances in fermentation technology, makes yeast economically more feasible

• A study carried out at the Norwegian University of Life Sciences showed *Candida utilis* and *Kluyveromyces marxianus* to be good protein sources in Atlantic salmon diets.

• These single-cell organisms showed possibility to replace up to 40% of protein from high-quality fishmeal, without any harmful effect on fish growth performance, digestibility or nutrient retention.

• Low levels (4%) of inactive brewer’s yeast improved growth performance and modulated intestinal microbiota in different fish species.
Microalgae

- Algae's are a promising alternative for enhancing the nutritional value of conventional aquatic feeds, as a partial substitute for fishmeal for intensive aquaculture.

- Excellent amino acid profile in its protein and with a high digestibility rate in the research model animals.

- The production of such protein does not compete with any other established food-protein sources.
Other bacterial biomass

• Bacterial Protein Meal (BPM), 2nd gen, produced by aerobic fermentation of natural gas as energy / carbon source and ammonia as N source from *Methylococcus capsulatus*, *Ralstonia*, *Brevibacillus agri* and *Aneurinibacillus*.

• Such material contain about 70% crude protein and up to 10% lipids.

• A study at NMBU showed that BPM in mink, as model animal for fish, had high fecal digestibility of N, about 80%. BPM gives the same retention of nitrogen, heat production and energy retention as fishmeal.

• When BPM made up 50% of dietary N there was no hostile effects for growth of the Atlantic salmon.
Locally produced novel feed ingredients may enhance product quality

- Novel feed ingredients based on local natural resources.
- Can increase food security, but also can improve product quality of milk and meat from cattle, pigs, poultry and fish.
- Novel feed ingredients that contain bioactive components, antioxidants or they can improve the flavor and odor of meat and milk products.
Tree biomass as feed, for bacteria

- NMBU research (in a centre named “Foods of Norway”) has recently demonstrated that salmon thrives on a feed with proteins derived from trees.

- Yeast was grown on sugars from tree biomass

- Trials with salmon showed positive effects of yeast on both appetite and growth as well as health (preliminary results, NMBU, 2017).

- Next step: Which effects can be found in pigs.

- Background:
  Yeast contains bioactive components that modulate the immune system. This experiment will help us study effects of feeding yeast on piglets' immunity and overall health.
Each scientist its project – but one thing in common

- A lot of new source, with each their requirement
- Many of the new ingredients are high in moisture content & they require more processing in order to produce dry feed.
- We develop solutions through
  - choosing the right equipment for processing,
  - parameter adjustments, and
  - machine optimization
    that can deal with the special characteristic of each material.
Choosing the right equipment

- Wet feed or liquid forms of feed can be added directly to the conditioner.
- These raw materials do not have to be dried first before they can be further processed.
- This can be applied for processed insects, fish hydrolysates or paste, mechanically de-bounded meat algae, etc.
- Proper processing of the dry ingredients is necessary in order to make this process work.
- Reducing the particle size in the milling process, precise dosing and achieving an homogeneous mix is very important for a successful production.
Process optimization – with a nutritional focus

When planning a feed production and feeding trial, we go carefully through the plan with the one in charge nutrition:

- Particle size
- Mixing time
- Liquid addition
- Screw configuration
- SME
- Temperature requirements
- Die characteristics
- Drying optimization
- Physical pellet properties
- Water activity (Aw)
- Packaging
Some issues of new feed materials

• Limited quantity

• Unknown physical properties

• Chemical interactions with other materials

• Necessity for new types of machines

• Manual handling- automated dosing and processing is in many cases impossible to conduct

This mix of different expertise and experience is necessary to find the right solutions that can be implemented to meet the need, for the new feed.
Classical example from our Centre

- Phytate in ingredients
  - Easy to solve: Add phytase in the feed (loads of commercial products)

Not that easy
Example, cont.

Solution: Degrade during processing

1/3 of IP6 after 10 min.

Denstadli et al., 2006
Example, cont.

Then

- Find a conditioner with 10 minutes retention time
  - (Like the one we have at Centre for Feed Technology)
Classical example –

conclusion of what is needed to succeed

- Knowledge about
  - Nutritional & physical demands
  - Feed technological hardware
- Infrastructure
  - Fish lab
  - Feed plant
  - Lab (nutritional & feed physical)
New ingredients - summary

- [even] more plant ingredients
  - Abundancy, price, lack of FM
  - Demand for purified protein concentrates
- New marine sources
  - E.g. Krill
  - Macroalgea
    - Direct or indirect
- Ingredients feeding on “non-feed”
  - Microalgea
  - Yeast (e.g. from wood or macroalgea biomass)
  - Insects (worms of these insects)
    - Added as a slurry, usually with DM 10 – 30%, or dry
    - Of slurry:, Viscosity: usually cP < 500

When adding more ingredients with «low nutrient density», it has to be compensated
Technology transfer - summary

• Feed sector focuses on efficiency
• Food sector focuses on uniformity of the pellets
• Same basic knowledge needed, but end use is different
  • ANF to increase productivity in production animals or reduce obesity danger in humans
• Pre-processing is similar, such as de-hulling, and/or starch purification
Thank you for your attention

The changing of screw configurations, by Olav Fjeld Kraugerud
Photo: Gisle Bjørneby

Centre for Feed Technology, NMBU (Fôrtek)