

Sustainable Feed for the Future

Innovations and Trends

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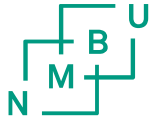
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Photo: Ingvar S. Olsen

Centre for Feed Technology - FôrTek



Unique and flexible collection of feed production equipment for pet/domestic animals and fish.

Introduction

- **Definition:** Animal feed technology involves scientific and technological processes to create nutritionally balanced feed that meets the needs of different livestock species;
- **Importance:** Essential for optimizing animal growth, reproduction, and overall health, contributing to food security and agricultural sustainability.

Future Feed Mill

A blend of technology, sustainability, quality assurance, and customer satisfaction and their needs in focus !!!

- Robotics
- Real time monitoring
- Internet of things
- Renewable energy
- Personalized nutrition
- LEAN culture



Overall goal

- Adoption of scientific principles for balanced nutrition;
- Use of novel feed raw materials and feed additives to produce the cheapest possible feed and enhance performance and animal health.



Key Drivers of Innovation in Animal Feed



Sustainability: Sustainable practices in feed production. Reduction of environmental footprint, including greenhouse gas emissions and land use.



Digitalization and precision feeding



Efficiency: Improvement in feed conversion ratios (FCR), leading to better productivity.



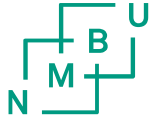
Animal Health: Use of feed to prevent diseases, enhance immunity, and reduce reliance on antibiotics.



Regulations: Compliance with EU policies on animal welfare, environmental protection, and food safety.

- Pushing the industry towards more sustainable, efficient, and health-focused practices, to meet the demands while minimizing its environmental impact.

Novel Ingredients in Animal Feed for Sustainable Future



- Insect Protein: Black soldier fly larvae and mealworms as sustainable protein sources; high feed conversion efficiency and low environmental impact (Kar *et al.*, 2021; Veldkamp & Bosch, 2015);
- Microalgae like *Spirulina* and *Chlorella* provide essential fatty acids, proteins, and antioxidants; beneficial for aquaculture and livestock (Mavrommatis *et al.*, 2023);
- Enhanced nutrient availability and gut health through the use 20% of fermented soy and 15% fermented grains (Sun *et al.*, 2024);
- By-products: Brewer's yeast (up to 40% protein replacement), distiller's grains (up to 30%), and fruit/vegetable residues; reduces waste and adds nutritional value to the pigs (Cruz *et al.*, 2019; He *et al.*, 2023; Chen *et al.*, 2023).

Precision Nutrition in Animal Feeding



- Customized Diets: Formulating diets based on species, age, growth stage, and health status;
Example: tailored amino acid profiles!
- Nutritional Modeling for precise diet formulation.
- Feed Formulation Software: Linear Programs for least-cost formulation integrate data on ingredient composition, costs, and nutritional requirements as well as carbon footprint.



Innovative Feed Additives: Where to add them during manufacturing?

- Probiotics and Prebiotics: Lactobacillus, Bifidobacterium, and inulin; promote beneficial gut microbiota, enhance digestion, and improve immunity (40-50 °C).
- Enzymes: Phytase, xylanase, and protease; break down anti-nutritional factors, improve nutrient absorption (60-70 °C).
- Antioxidants: Vitamin E, selenium, and plant extracts; prevent oxidative stress, improve meat quality (temperature resistant but where to add them?).
- Mycotoxin Binders: Clays, yeast cell walls, and synthetic polymers; bind and neutralize mycotoxins in contaminated feed (what to choose if many different mycotoxins are together?).

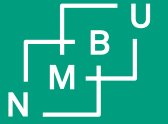
Integration of Technology in Feed Production

- Automation: Use of robotics and automated systems in feed mills for mixing, pelleting, and packaging; increases efficiency and consistency;
- IoT and Sensors: Monitoring feed quality, storage conditions, and animal feeding behavior in real-time; enhances traceability and quality control;
- Blockchain: Ensuring transparency and traceability in the supply chain; important for regulatory compliance and consumer trust;
- There is still some space for innovation!

CASE STUDY



IsDeCa[®] (innovation in mixing)



Source: NMBU

A breakthrough in feed mixing;
2019 Patented mixing technology.

What was the problem?!

- Needed controlled dynamic of the mixing materials with mixing elements;
- Low hygiene of the existing best mixers at the market;
- Novel materials in Europe are wet and adding of those in the dry powder produces large lumps, thus non-homogeneous mixing;
- Adding over 25% of water and fat-based materials is not possible with twin-shaft paddle mixers due to the *formation of large lumps*.

Twin-shaft mixer with 24 paddles – difficult cleaning



Caking and contamination



Why such innovation is better than twin-shaft paddle mixer?

Twin-shaft

45% water added – blocking of the machine, caking and large lumps

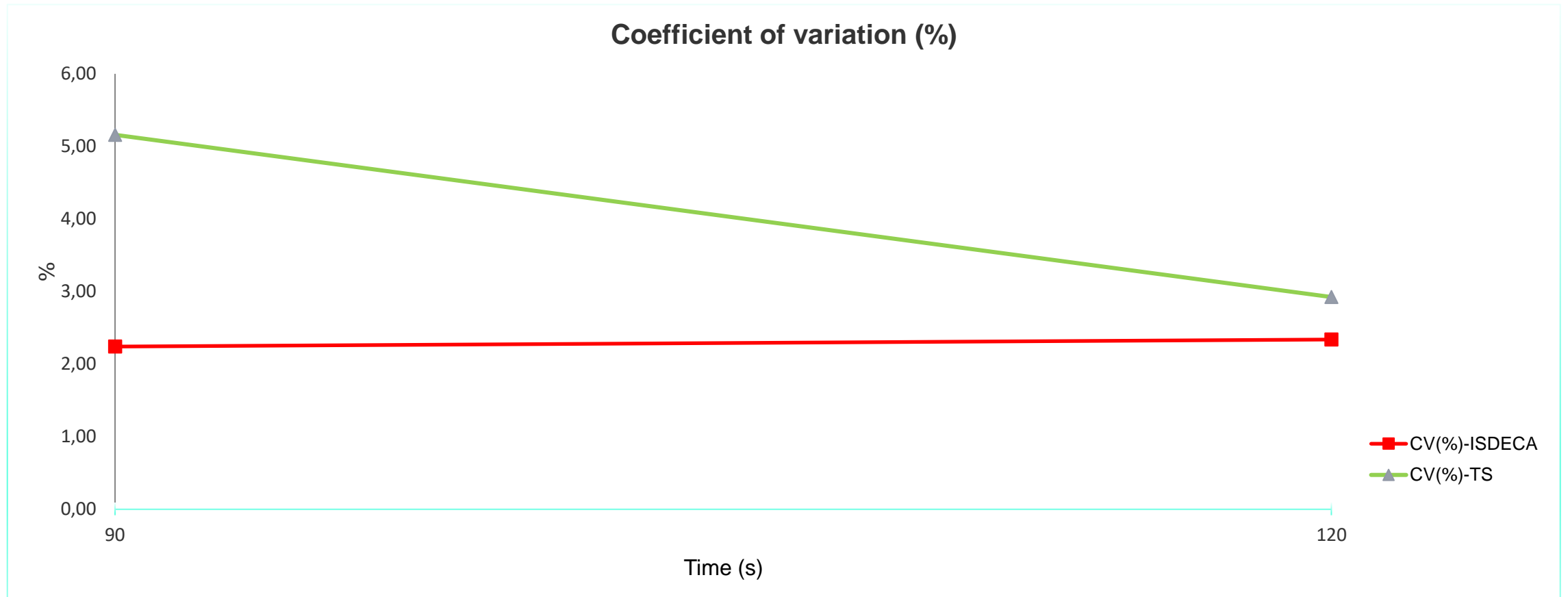
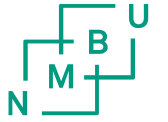


Innovative mixing

65% water added – no lumps and no blocking



Homogeneity (CV%) – shorter mixing time (HM SBM 2mm) – using 1000 lit. volume



Innovation for Sustainable Feed

Successful EU projects with innovative solutions:

- **Case Study 1:** Implementation of insect protein in a large-scale poultry farm in the Netherlands; improved growth rates and reduced environmental impact.
- **Case Study 2:** Use precision nutrition in dairy cattle with enhanced milk production, improved health markers, and lower feed costs.
- **Case Study 3:** The adoption of algae-based feeds in Norwegian salmon farms improved fish health and omega-3 content and reduced dependency on fishmeal.

Challenges and Opportunities

- **Challenges:** High costs of novel ingredients and technologies, regulatory hurdles, market acceptance, and consumer perception.
- **Opportunities:** Advances in feed technology offer potential for improved animal health and welfare, reduced environmental impact, and economic benefits for farmers and the feed industry.



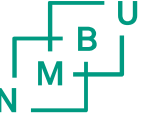
Future Trends in Animal Feed Technology



Artificial Intelligence: Predictive analytics for feed formulation and management; optimizing feed efficiency and animal health outcomes.



Sustainable Ingredients: Exploration of new protein sources like lab-grown meat by-products and bioengineered yeast proteins.



Conclusion

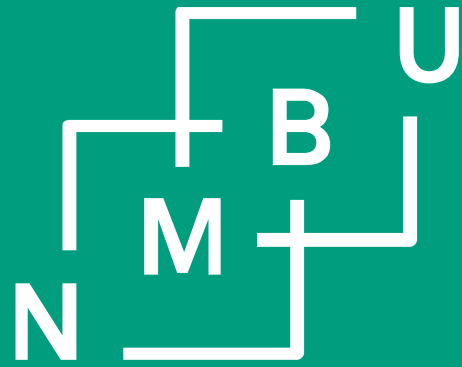
Advancements in animal feed technology are driven by sustainability and efficiency!

Continuous innovation is crucial for food security, animal welfare, and environmental sustainability.

Future Outlook: Trends toward more sustainable, efficient, and health-promoting feed technologies.

Thank you for your attention!

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