Innovations that Revolutionize Animal Nutrition

Feed formulation and production technology is gaining in importance due to the number of future global opportunities, challenges, and threats. The global demand for animal sourced food is expected to increase by 70% in 2050 due to growth of the world population, increased income, and urbanization (Alexandratos and Bruinsma, 2012; Boland et al., 2013). The world-wide demand for animal feed is expected to increase to 1500 Mton in 2050 with the major growth occurring in Asia and Africa. In addition, animal welfare, environmental pollution minimisation, use of novel ingredients, and the use of ingredients unsuitable for human consumption in relation to efficiency of production, are major challenges faced by the feed industry (Babinszky et al., 2019).

These challenges are leading to demands for innovation in several areas related to animal nutrition including feed technology.

Innovation involves embracing cutting-edge science from all disciplines, generating insights, increasing collaboration with end-user and other partners, turning products into solutions, and accelerating progress through science-based solutions.

Innovation focus areas in animal nutrition can be broadly classified into the following categories:

Early Life Nutrition

- Young animal vitality and later life performance
- Specific hatchery and nursery nutrition

Health & Welfare

- Supporting intestinal health
- Nutritional solutions for transition periods
- Nutritional solutions for specific challenges

Feed Efficiency

- Feed additives for production efficiency
- Reducing emissions
- High performance feeds for Maximum growth and feed efficiency potential

Application Solutions

- Precision feeding

- Recommendations for feed and feeding
- Models for quantitative nutrition and feed performance
- Optimised feed value and predictable performance

[Early Life Nutrition](#):

Influence of diet and environment are known to influence performance and health of animals with several empirical evidence. The right nutrition at the right time to both young born and maternal animals, especially during gestation, lactation and weaning, can have profound effects on the overall lifetime performance of the animal.

Diets can have an imprinting effect on expression of genes and done with epigenetics (The study of changes in gene activity that do not involve alterations to the genetic code but still get passed down to at least one successive generation) is at forefront.

Health & Welfare:

Animal Nutrition is an important part of the solution to help to contain [Antimicrobial Resistance (AMR)](#). The feed sector plays a critical role in supporting animals' optimal health with high resilience capabilities to stressors through safe and high-quality feed (feed formulation and processing) and access to nutritional innovation. It therefore is a key factor in the well-being of all livestock, fish, and companion animals.

Adequate animal nutrition (well-balanced and well-formulated feed) combined with good hygiene practices on farms and proper housing are key in promoting animal health and welfare. A balanced diet of compound feed supported by specialty feed ingredients/additives meets the animal's physiological requirements and maintains the balance of the gut flora. [Gut health](#) is in fact a key factor in keeping animals healthy and resilient to stressors, such as heat or pathogens.

The health and welfare problems caused by poor digestibility of proteins include wet litter in poultry resulting in breast blister and hock burn, whilst a high concentration of ammonia resulting from the decomposition of N-rich compounds in the excreta can cause serious respiratory problems in both pigs and poultry (Elling-Staats et al. 2021; Gilbert et al. 2018). Furthermore, poor quality or digestibility of proteins often acts as a predisposing factor for necrotic enteritis in meat chickens (Palliyeguru et al. 2009; Wu et al. 2014).

Animal feed must contain proteins that supply amino acids for body tissue growth, reproduction, and components of key metabolites. Proteins come from a variety of sources, mainly plant and animal origin (including insects), although proteins produced from single cell organisms such as microorganisms and algae specifically grown for feed use are becoming increasingly common.

The protein digestibility value for feed depends largely on the protein sources used in the formulation and, to a lesser extent, the age of the animal.

Feed Efficiency:

Currently the livestock industry's focus is no longer only directed at the feed as end-product – with just wanting to increase the nutritional value of ingredients and end-products but also on production feed technology concomitant attention for product quality, mill capacity, environmental impact/emissions control, and production costs. There are well-known beneficial effects of ingredient and feed processing technologies (van der Poel and Marchal, 2019) and these include:

Producing a homogeneous mixture of diet ingredients (meal, pellets).

Decrease negative effects of antinutritional factors in ingredients (trypsin inhibitors, lectins, glucosinolates).

Increase feed safety (reduction in micro-organisms).

Increase nutrient digestibility/absorption (better feed efficiency).

Increase feed intake (less spoilage).

Find a balance between feed efficiency and animal health

Managing immunity and gut microbiome through nutrition offers enormous untapped potential for improving overall health. Pre- and pro-biotic molecules in feed, are added with focus on innate immunity. Products are already making an impact such as in reducing the need for antibiotics, with focus on reducing antimicrobial resistance. Phytogenic, or plant-based, substances with anti-bacterial properties, are increasingly being identified, combined, and added to animal feed to alter the gut microbiome, improve immunity, and protect against specific diseases. Novel or alternative animal feeds such as insect-based protein, seaweeds, single cell protein and microalgae are opening opportunities for precision nutrition.

Feeding animals according to stage of life, gut health and environmental factors offers benefits for health and welfare as well as sustainability and traceability.

Applications Solutions:

The solutions and tools to achieve precision animal nutrition includes more precise ration formulation based on nutritional value of each batch of ingredient, effective utilization of available feed resources with the aim of maximizing the animals' response to nutrients. Information on the raw material and feed data nutritional value through tools such as Near Infra Red Spectroscopy ([NIRS](#)) or Inline NIR can help the nutritionists in decision making. On farm and feed plant, feed formulation have been optimised with use of feed formulation software with training and experience.

Models are domains available to where nutritionists can make decision to optimise to get the best return by adapting the feeding programs as raw materials and end-product (meat) market prices change. For e.g., the Broiler Model from Trouw Nutrition

Conclusion:

Animal production and health challenges are ever evolving. Farm animal productivity is on average 30-40% below their genetic potential because of suboptimal management, nutrition and health. Feed and technology involved in the processing of ingredients and the manufacture of animal feeds is an integral part of animal production systems to provide high-

quality and nutritious food. Innovation focus areas in animal nutrition have been highlighted namely early life nutrition, heath & welfare, feed efficiency and application solutions. Accurate and fast testing will be essential to account for the variability within ingredients and the different practices used in the equipment and raw material processing, as well as in feed mills. Big data will play a pivotal role to model specific aspects of feed manufacturing and would enable the development of a model integrating characteristics of diet ingredients, recipe, and processing conditions. Collaboration between skilled data scientists, feed manufacturing technologists and nutritionists, using advanced data analytics is, pivotal for future innovations in animal nutrition.

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