EUROPEAN

FEED

TECHNOLOGY

CENTER

VISION & SRIA DOCUMENT 2030

FEED FOR FOOD PRODUCING ANIMALS

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By:

EUFETEC

FOREWORD

The European feed sector is the major supplier to livestock farmers and a key influencer of livestock performance by providing feeds to be efficiently converted into livestock products.

The quality and safety of animal feed is a key factor within an integrated European approach to supply sufficient, safe, high-quality and healthy foods based on products from animal origin (eggs, milk and meat) to meet EU domestic demand and growing export opportunities.

In addition, feed and feed production technologies also need to help the livestock sector addressing the challenges of sustainability and resilience. The feed sector already plays a crucial role in improving the sustainability of arable crop processing industries by upgrading their co-products into feed materials for use directly by the livestock producer or via the feed compounder, and ultimately into high value animal food products while strengthening the economic viability of the livestock holdings.

Various challenges, hence opportunities, lay ahead for the European livestock sector, which can be summarised under three main topics: i) Optimisation of nutrient resource efficiency, ii) Healthy animals for healthy humans and iii) Socially responsible livestock farming. These are all factors increasingly being demanded by processors and retailers within the EU but also providing significant EU export opportunities.

Most of these challenges have a clear feed dimension:

- Resource efficiency in the livestock sector is about how to convert feed resources in the most efficient way.
- Healthy animals is about how to feed nutrients to animals under optimal management to resist disease.
- Socially responsible livestock farming from a nutrition perspective is how to minimise the negative impact of livestock farming on the environment through e.g. precision feeding and GHG mitigation strategies, taking into consideration the existing legal standards on e.g. animal welfare.

The first way to address these challenges is to transfer knowledge into practical solutions for the farmers. For example, the genetic potential production of animals today is not evenly optimised, with significant differences on various parameters between the most and the least efficient farmers. Raising the efficiency of the least efficient farmers to the level of the best must be a primary target.

The second way to address the challenges is to develop innovative technological solutions to improve knowledge further, for example, the nutritional interaction with, and between, other factors such as genetics, animal health & animal welfare, environmental footprint etc.

In order to realise this vision, several industry organisations across the EU active in the sector of feed for food producing animals decided to establish the European Feed Technology Center (EUFETEC) in close collaboration with the academic world and research institutes. EUFETEC has the ambition to initiate and coordinate a European response to the three priority feed and livestock industry challenges detailed above, via the establishment of a Strategic Research and Innovation Agenda.

Accelerated Research and Technology Development – based on an innovative approach – will be crucial in order to develop feed solutions addressing the diverse challenges to be faced by the EU livestock sector while remaining competitive, meeting the EU demand and export opportunities for food products, and permanently at the cutting-edge in terms of technology while meeting the increasingly demanding legal EU standards.

It is also essential to optimise existing synergies between all sectors of the livestock chain so that progress in one sector can be enhanced via expanding know-how and experience in other sectors. This requires coordination between EUFETEC and the European Technology and Innovation Platforms dedicated to Animal Health (ETP-GAH), Animal Breeding (FABRE) and Aquaculture (EATiP), all gathered into the Animal Task Force (ATF).

1. THE EU LIVESTOCK AND FEED SECTOR IN FIGURES

The EU livestock production accounts for almost half (40%) of the overall EU-27 agricultural output. In 2011, 5 million farmers raised livestock with a total value of 156 billion € (figure 1).

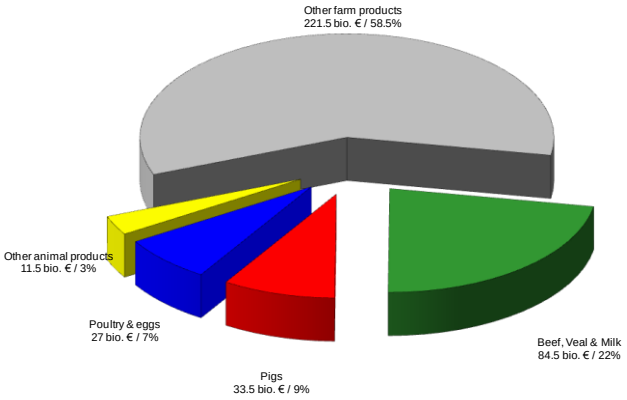

Figure 1: Value of farm production in 2011 in the EU-27 (source: EUROSTAT)

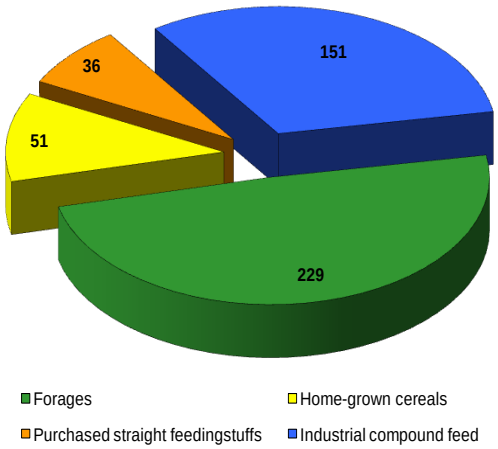

Figure 2: Origin of feed (in mio T) in the EU-27 in 2011 (source : FEFAC)

The European feed sector is the most important agricultural input industry in Europe and is an essential supply partner to the livestock industry. Farm animals in the EU-27 consume an estimated 467 million tons of feed a year (figure2), of which 150 million tons are produced by the compound feed manufacturers. Feed is the major single cost factor for the livestock farmers, e.g. representing up to 85 % of the production cost for poultry (figure 3).

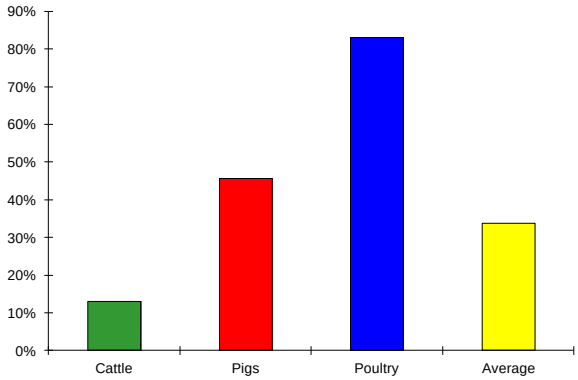

Figure 3: Value of purchased compound feed in total animal output value in 2011 (source: FEFAC)

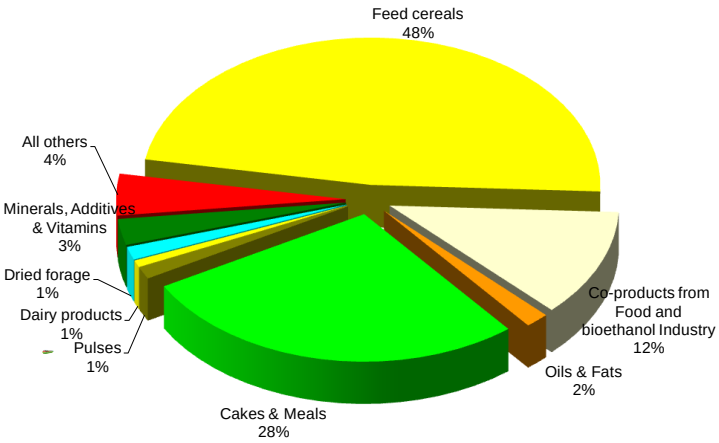

Figure 4: Use of feed materials by the EU-27 feed industry in 2011 (source: FEFAC)

The overall objective of the EU feed industry is the sustainable competitiveness of the EU livestock sector through the supply of safe, competitive and sustainable feed. The nutritional requirements of animals vary according to, species the stage of development and production, e.g. milk yield and daily liveweight gain. The feed industry applies its nutritional knowledge to determine the appropriate combination of feed ingredients to supply the optimal balance of nutrients to produce sustainable and cost effective diets for animals facilitated by a comprehensive understanding of the nutritional characteristics of feed ingredients as well as by an accurate assessment of animal nutritional needs. Feed processing technology like milling, pelleting and extrusion enables the industry to more accurately meet the nutrient requirements of the animals: no more, no less. Other processes like heat treatment can additionally improve feed, digestibility, efficiency, utilisation and microbiological safety.

As a customer of, arable crop farmers, food, drink and biofuels industries and as a supplier to livestock farmers, the feed industry acts as a pivotal link between arable crops and animal production. Feed is a major outlet for cereals which represent just less than half of the feed materials used by the compound feed industry in 2011. The European feed industry is valorising also a very significant amount of co-products from the food & drink and biofuel industries. An average compound feed formula constitutes of 40 % of these co-products (co-products from food & drink and bioethanol industry + cakes and meals) (figure 4). Regarding protein, the most important feed materials are soybean meal, mainly imported from third countries and rape seed meal from the European crushing industry. The industry also uses protein rich co-products from the starch and ethanol industries and digestible fibre rich co-products from beet sugar industry plus numerous liquid feeds.

The feed industry is very reactive to agricultural policy incentives in relation to consumption of feed materials. When the Common Agricultural Policy (CAP) is successful in making feed materials competitive for feed use, the answer in terms of consumption by the feed industry is clear. This has been the case with cereals. The average use of cereals was 32% before the CAP reform in 1991. It increased very rapidly to reach the current level, mainly at the expense of tapioca which used to be imported from Thailand and Indonesia. This could be the case for EU protein crops if an ambitious protein plan was developed within the EU. Such a plan would help reduce the dependency on imports for protein rich materials.

The ability of the feed industry to add value to the co-products from the food & drink and biofuels industries (like cereal bran, oil meals, distillers' grains, sugar beet pulp, etc.) makes it an important contributor to the economic viability of these industries. This reduces pressure on human edible resources and improves synergies between the food and feed outlets.

The European compound feed industry is a growing industry and turnover is now estimated at 45 billion € (excluding pet food and not accounting for the feed material supply businesses). It offers direct employment for approximately 110,000 people in approximately 4,500 plants. Many of these plants are situated in rural areas, which offer few employment opportunities. Most (85%) of the (compound) feed plants are SMEs, with in 2012 an average annual production of 38,000 t of compound feed per plant.

2. VISION OF THE EU FEED SECTOR

2.1. The road to 2030

The European animal nutrition industry will be a key pillar for a sustainable and globally competitive livestock industry, supplying significant amounts of human food dietary proteins and energy to consumers, to EU and export consumers, as well as a broad range of products and services benefiting the European society as a whole.

Although animal production and animal nutrition can be regarded generally as mature industries in Europe, they will undoubtedly undergo a significant transformation and further diversification to meet changing market demand, while adapting to climatic change and societal demands.

Animal nutrition science has already made very significant contributions to nutrient efficient livestock production, fostering the safety and dietary quality of animal products for human consumption, enhancing the animal health and welfare status of farm animals and reducing greenhouse gas emissions and land use linked to livestock production on a unit product base (e.g. per litre of milk or kg of meat and eggs). Many of these have been driven by commercial initiatives at multiple points in supply chains. However the animal nutrition sector faces important scientific challenges and bottlenecks in order to tackle the EU strategic 2020 agenda goals, in particular nutrient resource efficiency.

Further significant knowledge gains and knowledge transfer and management at farm level that enhance animal husbandry, animal welfare and resource efficiency must be achieved in the area of animal nutrition, while continually, reducing the need for interventions with antibiotics especially with regard to gut health related infections improving safety of both feed and food of animal origin. It is essential that any research project includes delivery of tools to allow for an efficient transfer of knowledge from the research side to the operational side, i.e. feed and livestock industries. It is also important that there is collaboration between nutrition, management and veterinary inputs. A review of the contribution of research carried out to meet the identified challenges should be performed at regular interval, and the added value of the research findings should be subject to validation by the feed and livestock industries. Key social, economic and environmental factors influencing this development must be analysed to assure the sustainability of animal nutrition in Europe in order to maintain its recognised role as global technology leader.

The European feed industry has the ambition and vision to supply nutrient conversion efficient, safe, sustainable and competitive animal feed to the livestock industry meeting the physiological nutritional needs of farm animals cost effectively:

- By supplying nutrients more efficiently, thus reducing the environmental impact of livestock production, while improving the nutritional profile of livestock products to human consumers and safety status of feed to food producing farm animals and the ultimate consumers,
- By enhancing their animal health and welfare status, thereby reducing the need for therapeutic treatment through preventive action.

2.2. Targets for 2030

Thanks to intensive nutritional research, in various areas, significant progress has been achieved over the last 25 years, helping farmers address numerous challenges. With the current level of knowledge, further improvement in the performance of livestock farms can be achieved by a better transfer of 'know-how' and further progress will be achieved by additional knowledge gains.

2.2.1. Resource efficiency

In terms of feed efficiency, an important indicator is the Feed Conversion Rate (FCR), i.e. the amount of feed needed to produce one unit of animal product. Over the last decades, the FCRs have reduced dramatically (see figure 5). This progress has not been evenly implemented at farm level, in particular due to divergences in livestock management skills and housing (see figure 6). Through further insight into animal nutrition and improved knowledge transfer, significant progress may be achieved in the middle term to narrow up the gap between the worst and the best performing farms. The challenge will however be to maintain and even improve the FCR of the most performing animals with, to some degree, alternative feed materials to those used today.

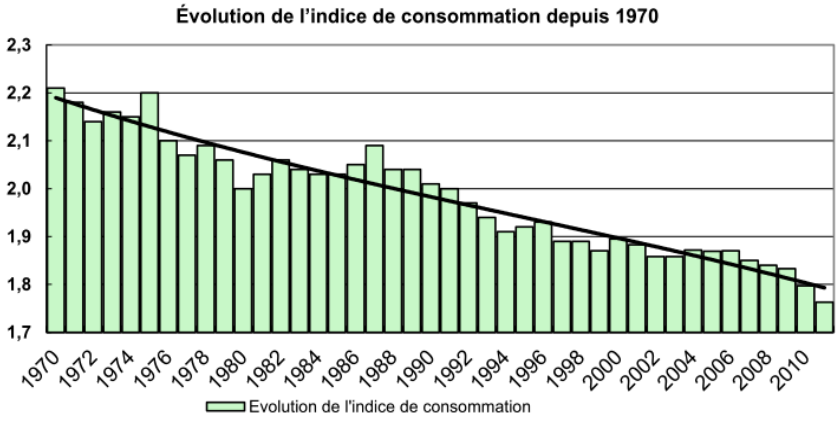

Figure 5: evolution of the feed conversion rate for broilers in France (source: ITAVI annual enquiry: Riffard C et Chenut R, 2012).

Productivity	20-25% worst herds	20-25% best herds
No of raised piglets / sow / year[1]	23.9	29.9
Feed conversion pigs (kg feed/kg animal)[1]	2.87	2.44
Milk production (l / cow / year)[2]	6,620	9,640

Figure 6: Difference between the worst and the best performing farms against several indicators in The Netherlands (source: 1. Benchmark Agrovision B.V., 20% best and worst – 2. CRV Annual Statistics 2010, 25% best and worst).

The 2030 target is for the EU feed sector a mean average FCR 30% lower than in 2010

2.2.2. Optimisation of animal health via nutrition

A sick animal is a less productive animal and gut health is an essential control element for the farmer to achieve optimal animal performance. Research has been performed in order to optimise animal health, in particular gut health, via innovative nutrition strategies, thus contributing to a better resistance of animals to diseases. However, there is still significant potential for gains (figure 7). Of course, such techniques may only be effective under good livestock management practice.

Figure 7: Examples of nutritional strategies for optimising gut health (Leo den Hartog – Wageningen University – FEFAC AGM - 2011)

The 2030 target for the EU feed sector is to contribute, via improved feed solutions, to an increase of the overall animal health situation in the EU and thereby to a reduction in the need for antibiotics.

2.2.3. Reduction of GHG emissions through feed formulation

Feed production and consumption by animals is amongst the most important contributor to the environmental impact of the livestock production, in particular to Green House Gas emissions. Several feed related factors intervene, including the selection of feed materials, feed formulation, physical characteristics of the feed, feed processing in the feed mill and on farm, farm forage production and storage techniques (including moist feeds), but also specific to the animal (e.g. genetics and health) or to the stockman (livestock management). Feeding solutions that contribute to reduce the Green House Gas emissions in monogastric

animals have been developed (see examples in figure 8). Research is on-going in ruminants to reduce methane emissions, which is where the largest potential of improvement exists. Research in the area of methane reduction via animal feeding is promising but still requires major scientific leaps to achieve desired reductions.

Sector	Technology	Land Use (M^2/kg feed)	GHG (Kg CO2/kg feed)	Resource efficiency (% co-products)
Pig Dutch	Conventional (baseline)	6.4	4.89	40.4
Pig Dutch	High energy feed	6.0 (-6.0%)	4.65 (-4.9%)	32.7 (-9.0%)
Broiler Dutch	Conventional (baseline)	4.9	3.5	33.4
Broiler Dutch	Local grains plus high protein concentrate	4.9 (=)	3.5 (-2.4%)	33.2 (=)
Layer Dutch	Conventional (baseline)	4.7	2.0	33.5
Layer Dutch	High fibre content	4.5 (-3.0%)	1.937 (-3.0%)	36.5 (+3.0%)

Figure 8: Blonk Milieu Advies, 2012

The 2030 target for the feed industry is to contribute to a reduction of GHG emissions by the livestock sector of 20% per kg animal product output.

2.2.4. Reduction of Nitrogen and Phosphorous in feed to reduce emissions.

Reducing the emissions of Nitrogen and Phosphorous into the environment has been a key priority for the livestock sector over the last 30 years. Feeding strategies, based in particular on the use of phytase to increase Phosphorous bioavailability and amino acids to balance the diets, enable a reduction in Phosphorous and Nitrogen in the diets and therefore their excretion (figure 9 and 10) respectively. According to feed companies, over the last 20 years since phytases have been employed, the matrix values for phytases of > 0.1% available phosphorus saves more than 7kg of di-calcium phosphate per tonne of feed.

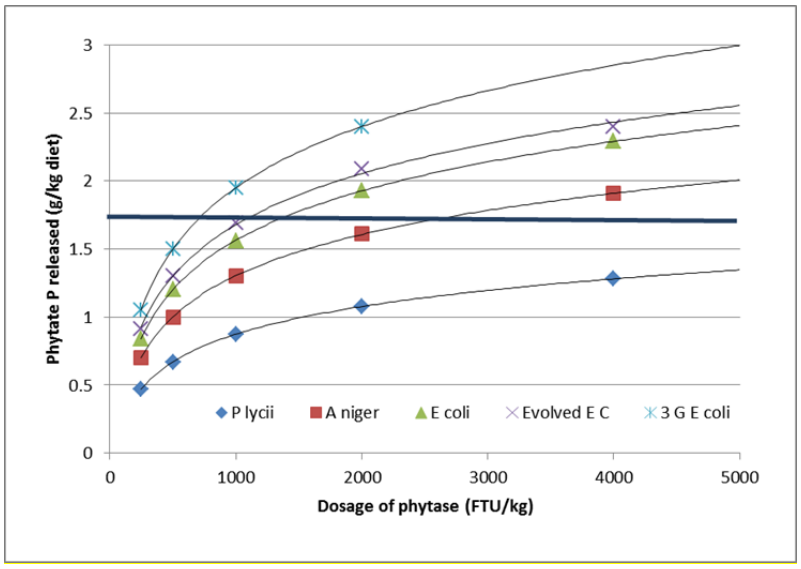

Figure 9: impact on the release of Phosphorous from phytate of the addition of increasing doses of different types of phytase in a diet with 0.22% phytate phosphorous or more. Source: AB Vista

Diet	Phosphorous digestibility	Overall SE
Low P	53.14	0.43
Low P + 500 U/kg phytase	63.04	0.49
Low P + 750 U/kg phytase	64.89	0.31

Figure 10: impact of the addition of phytase on digestibilty of phytate Phosphorous (source: Institute of Food, Nutrition and Human Health, Massey University, and Roche Vitamins Asia Pacific Pte. Ltd. – 2004 – Poultry science).

The 2030 target for the feed industry is a reduction by 30% of N and P ingestion and a reduction by 40% of N and P excretions

2.2.5. Resource depletion

The depletion of natural resources is connected strongly to resource efficiency and social concerns. The amount of products from marine origin has permanently decreased (figure 11). In the early 90's, 3.5 kg of wild fish was necessary to produce 1 kg of farmed fish. The "fish in – fish out" ratio was 0.8 kg:1 for salmon in 2010 and the potential for improvement is still tremendous.

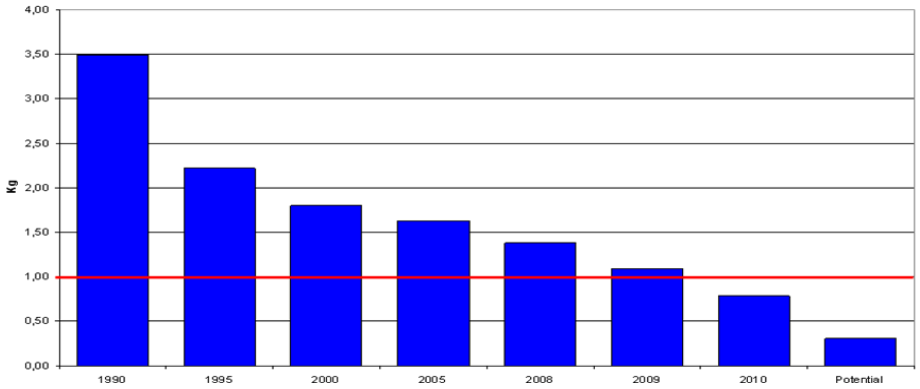

Figure 11: Kg salmon produced versus wild fish used in feed under experimental conditions (Source: FEFAC members)

The 2030 target for the aquafeed sector is 0.3 kg of wild fish to produce 1 kg of farmed fish.

3. STRATEGIC RESEARCH AND INNOVATION AGENDA

Innovation breakthroughs are needed in the animal feed/nutrition and livestock industries. The three top priorities named in this strategic research agenda "2030" are i) **optimising nutrient resource efficiency, ii) healthy animals for healthy humans and iii) socially responsible livestock farming**.

The European feed industry therefore focuses on precompetitive research activities in the three above mentioned areas, contributing to important breakthroughs towards competitive, sustainable farming of healthy animals in Europe.

To this end, the following key themes of strategic research needs have been identified for the three priority areas:

3.1. Optimising resource efficiency by using nutrients efficiently

Further reducing the "environmental footprint" of European livestock farming can be achieved by increasing resource efficiency with the help of new control tools, feed evaluation models, dynamic mechanistic animal models and animal response modelling (e.g. by applying nutrigenomics tools) (figure 12).

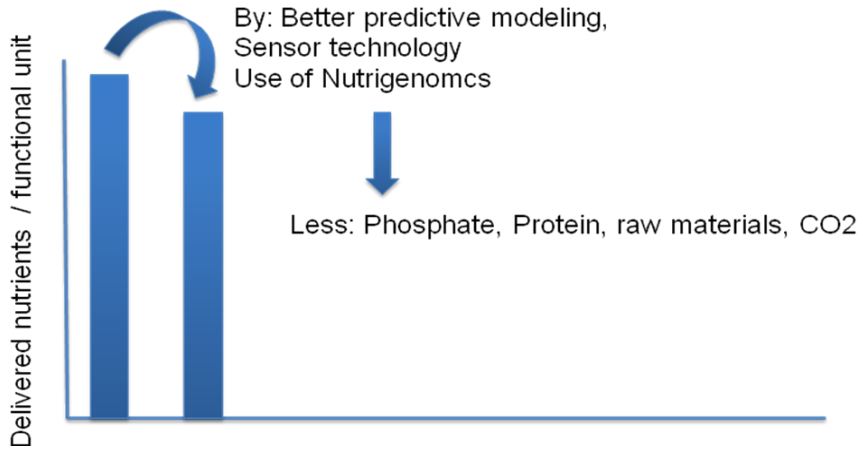

Figure 12: Optimising resource efficiency by using nutrients efficiently to reduce the ecological footprint of livestock farming thanks to innovative approaches of nutrition

Objective 1: Increasing nutrient use efficiency and reducing emissions

New and innovative models on the nutrition of farm animals are expected to significantly contribute to a further reduction of energy and nutrient losses (in particular N, Cu, Zn, P):

- Short term (3 years): new and/or improved feed evaluation models, based on more accurate estimations of the energy and nutrient supply from animal feeds and energy and nutrient requirements of farm animals
- Longer term (3-8 years): innovative nutrient-based (dynamic mechanistic) nutrition and response models, including dynamics and kinetics in digestion and metabolism

Furthermore there is a strong need to develop new (molecular) indicators for nutrient use efficiency in farm animals as well as a strong need to develop innovative sensors and intelligent models for monitoring and management of nutrient use (in)efficiencies at animal level (and also for animals in large herds).

Objective 2: Optimising the delivery of nutrients to animals

We also consider the need to address current significant knowledge gaps in the areas of residual feed intake and individual and "precision feeding", i.e. the ability to deliver the appropriate nutrients (and no less or more) at the right moment to the right animals depending on the animal's physiological characteristics, stage of development and production, while taking into account its genetic potential.

3.2. Healthy animals for healthy humans

Improving the immune system and general health of livestock, thereby reducing the need to use therapeutic medicines, is paramount when collaborating with other animal production related research agendas. The proposed research focuses on development and validation of innovative measurement techniques with respect to intestinal health and immunity and the corresponding use of innovative products and feed composition (figure 13).

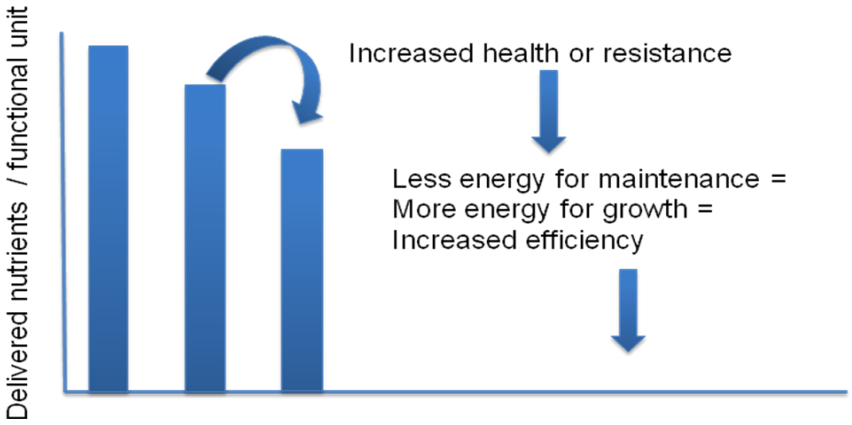

Figure 13: benefits of reducing the need for animal medicines and improving the welfare of animals on the improvement of feed efficiency

Objective 3: Understanding the complexity of interactions in the gut

The most important collective research needs relate to the improvement of animal health, including the unravelling of complex interactions between, nutrients, stressors and the microbiota in the gastrointestinal tract and the immune system.

Objective 4: Developing customised feeding strategies based on animal health status

We must also focus on fast indicators and sensors in order to be able to monitor the health of individual and groups of animals and develop appropriate customised feed strategies. Attention must be given to the question of how feed can promote the health of young animals (especially piglets and broilers) and to questions regarding the nutritional needs of animals with a high health status. Basic research in the development of immune enhancing strategies on a fundamental, pre-competitive level is of utmost importance to increase health status.

Objective 5: Improving knowledge on the impact of feed processing on gut health

Feeds undergo various processes, from grinding to pelleting, which all have their impact on the physical characteristics of the feed (e.g. size of the particles structure) which has been shown to have an impact on the gut flora balance. Further research is needed to evaluate the interaction between physical properties of feed and the mechanics of development of immunity and increased resistance of animals to pathogens.

Objective 6: Predicting, controlling and reducing feed hazards

Further research on the effect of low-level contamination, like mycotoxins, should be addressed. It is known that at 'sub-clinical' levels health status is being influenced, and

prevention strategies should be developed, including reduction of exposure and / or mitigation strategies thanks to e.g. screening techniques for the determination of low level contamination in large volumes of feed materials. Improved techniques for the control of microbiological contamination of feed, in particular but not only Salmonella, are essential to contribute to the continuous reduction and control of Salmonella prevalence in livestock holdings and therefore of human Salmonella cases. The control of adventitious presence of residues of coccidiostats or medicinal substances in feed for non-target species as a result of carry-over is a permanent challenge for the feed industry. Research in and transfer of technologies from other sectors and implementation of new monitoring techniques for an optimised measurement and prediction of substance-specific carry-over are crucial to reach the objective of minimising technically unavoidable carry-over effects in feed mills.

3.3. Socially responsible livestock farming

New techniques must be developed in order to facilitate socially responsible, healthy and efficient livestock farming which also accompany the implementation of new animals' welfare standards (figure 14).

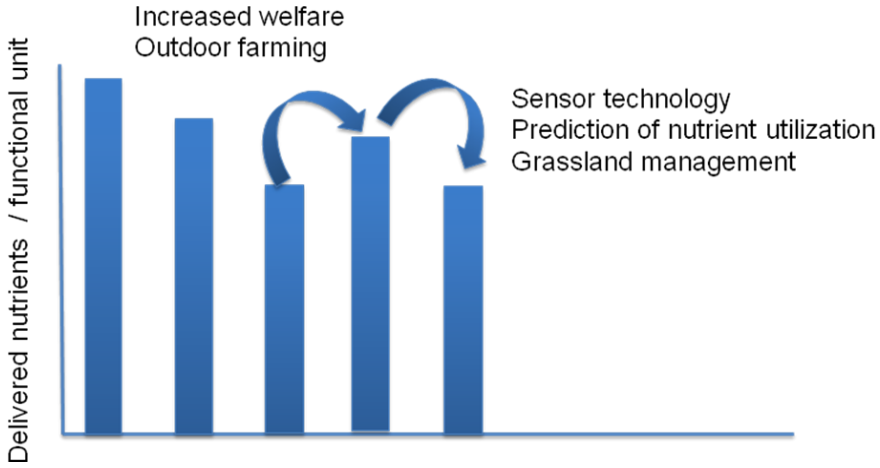

Figure 14: Research on socially responsible livestock farming to be able to feed animals properly in new farming systems and reduce emissions further: new animal welfare standards may in a first stage affect the performance of the livestock holding in terms of feed efficiency. Research adapted to the nutrition of animals raised according to new farming standards on animal welfare may allow to offset (partially) the efficiency gap.

Objective 7: Adapting/developing new feeding strategies to meet animal welfare challenges

Improved conditions fostering and mimicking natural animal behaviour (such as grazing) requires the adaptation of feed systems and the development of new indicators for the nutritional status of animals. Research can also contribute to the reduction of various animal welfare challenges via the feed itself. For example, consider the role of diet and satiation in the social behaviour and ethological welfare of animals, improving vitality and reducing early losses, the relationship between diet and the footpad quality of poultry and increasing the longevity and lifetime production of dairy cows, sows and laying hens.

Objective 8: Reducing livestock footprint

Our priorities with regard to caring for the environment are the reduction of greenhouse gas emissions throughout the whole chain and its economic and social impacts, development of practical and usable carbon and water footprints in the feed and animal production chain, water efficiency, biodiversity and sustainable use of feed materials, especially protein sources. Further harmonisation and transparency of the carbon footprint of feed production are of tremendous importance. This is being in particular addressed in the framework of the FAO/FEFAC/AFIA partnership on environmental benchmarking of feed.

Objective 9: Exploring and developing alternative, sustainable proteins sources

Especially for Europe the development of an alternative protein strategy is of strategic importance. Involvement in new developments for alternative protein sources (insects, algae) is a promising area, like the development of new European protein crops, including adapted European soybean seeds, or new protein extraction technologies. Close collaboration with plant breeding research will be very beneficial.

Objective 10: Exploring and developing alternative sources of energy

Although the focus has been put over the recent past on the need to secure a sustainable protein supply for animal feeding, sight should not be lost of the need to also find alternatives sources of energy at large due to growing competition for energy feedstock, e.g. bio-fuels, to allow the farming sector to continue fulfilling is primary mission, i.e. production of food. The feed sector shall therefore intensify research for those available feedstock resources that may be explored “more and better” in order to reduce its dependency on e.g. native cereals for its energy supply. This means exploring certain resources which would require specific technological treatment before meeting the EU feed safety requirements, such as the use of food products no longer destined for food use. This means also knowing better how to optimise the feed use of newly available resources such as co-products from non-food industry (biofuels).

Finally, certain resources may contain anti-nutrient factors or contaminants at low levels. Detoxification techniques should be developed to allow safe use of these new resources in animal feed, thus reducing the pressure on agricultural resources.

EUFETEC PARTNERS

European Feed Manufacturers' Federation (FEFAC), EU - www.fefac.eu

Belgian Compound Feed Industry Association (BEMEFA), Belgium - www.bemefa.be

Gent Feed Technology Centre (GeFeTeC, Belgium) - biot.hogent.be/lwt/GEFETEC.htm

EU Feed Additives & Premixtures Association (FEFANA), EU - www.fefana.org

Centre Technique de l'Alimentation Animale (TECALIMAN), France - www.tecaliman.com

Wageningen University and Research Centre (Wageningen UR), The Netherlands - www.wageningenur.nl

Confederacion Espanola de Fabricantes de Alimentos Compuestos para Animales (CESFAC), Spain – www.cesfac.es

University of Nottingham, United Kingdom - www.nottingham.ac.uk/biosciences

FINS, Serbia – www.fins.uns.ac.rs

Institute of Food Science and Nutrition (ISAN), Sacred Heart Catholic University of Piacenza, Italy -www.unicatt.it/piacenza

CONTACT

info@eufetec.eu

www.eufetec.eu