FEED EFFICIENCY, A COMPLEX MULTIFACTORIAL CONCEPT IN NUTRITION

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Resource availability is increasingly limited due to environmental pressures, global economics and worldwide regulations. The availability of nutrients is problematic, being crucial to meet the animal requirements. Therefore, feed efficiency is a popular topic to meet the demand for animal protein, with as little resources as possible, while maintaining overall human, animal and environment health.

Due to the exponential growth of the world population and rising incomes, an increase of the food consumption and of the demand for animal proteins is expected in the coming years. The OECD and FAO report on the agricultural outlook 2021-2030 predicts a further global increase of the consumption of eggs, meat, fresh dairy products and fish by 9.2%, 11.6%, 21.7% and 11.4%, respectively. On the other hand, availability of resources is increasingly limited due to environmental pressure, world economics and worldwide regulations restraining the overuse of limited ingredients. Not only the availability of feed materials can be problematic but also the availability of several nutrients (e.g. energy, protein) is crucial for meeting the strict requirements of animals. In this global context, feed efficiency has been a popular topic to meet the demand for animal protein with as little resources as possible, while maintaining human, animal and environment health and welfare.

But what is feed efficiency exactly? "Feed efficiency is generally seen as the ability of the animal to fix the maximum amount of nutrients provided by the ration using the concept of RFI (residual feed intake)" (Agricultural Systems, 2023) is one of the provided definitions. However, sources describe this concept all sensibly in different ways, showing the difficulties of outlining such a wide and multifactorial notion. One measurable parameter of the feed efficiency is the feed conversion ratio (FCR). Despite a, what seems to be, simple formula (feed intake divided by weight gain for growing animals), several additional parameters are often overlooked, such as the weight reference (e.g. FCR 2.5kg live weight in broilers), the number of animals (mortality corrected), or the method to measure feed intake (including feed spoilage). These discrepancies clearly highlight the difficulties for comparison and finding an ideal, valid across the globe. In light of this disparity, it becomes key to work together on defining and reaching an acceptable way to measure feed efficiency. Orffa, as a global leader in animal nutrition, invests in such research activities and defines feed efficiency as an essential feed solution area for the future.

THE KEY FOR GOOD PROFITABILITY IS THE EFFICIENT USE OF FEED MATERIALS

It's not a secret to anyone that feed is the main

driver of animal production costs, being responsible for around 60-70%. Limiting feed costs is therefore important to enhance the industry profitability and competitiveness. One of the solutions to reduce costs is the use of alternative raw materials, such as byproducts, allowing for lower prices and better availability. When talking about energy nutrition, alternative fats (e.g. meat and bone meal) and oils (e.g. oils from the food industry) are common, while grain byproducts (e.g. brewer's yeast, corn gluten feed) can be a solution for protein supply. The main issues of these alternative feed ingredients are their nutritional composition and, more precisely, their nutrient digestibility profile. As an example, soybean oil has a typical fat digestibility of 90% in broilers and 95% in swine, while it is 79% in broilers and 89% in swine for tallow fat (CVB Feed Table, 2021). This can be explained by the different fatty acid characteristics such as the unsaturated/saturated ratio or the melting point. As a result, tallow fat will be less digested and absorbed in the small intestine than a qualitative oil like soybean oil, resulting in less energy available for performance of the animal.

Orffa's science-driven approach tackles key challenges in animal nutrition across three core areas: Gut Health & Immunity, Feed Efficiency, and Mineral Nutrition. Orffa's feed efficiency solutions are specifically developed to be optimally active in the specific gastro-intestinal conditions (e.g. high-water level, pH, presence of pathogens), guaranteeing the most effective action for all animal species. As a result, nutrient utilization is enhanced even when using cheaper, less digestible ingredients, reducing waste and pressure on resources. The digestibility promoter Excential Energy Plus (Orffa Additives B.V.) is an effective additive, which is able to enhance the digestibility and absorption of fat, protein and fiber even in low digestibility raw materials. For the industry, it also means reduced feed costs for better profitability. Several meta-analyses prove the efficacy of Excential Energy Plus to promote feed efficiency (FCR: -4% in broilers (Figure 1), -5% in growing-finishing pigs and -6% in weaned piglets) and reduce diet costs (saving of >5 EUR/ton of feed, return on investment of 3.5), highlighting it as one of the most effective digestibility promoters, with more than 100 scientific and commercial studies across the globe.

FEED EFFICIENCY, NOT A STANDALONE CONCEPT

Feed efficiency, as the cost to produce 1kg of meat (or 1L of milk, or a dozen eggs), depends on a lot of different factors, that can be independent from feed millers' and farmers' control. One of such factors is the exposure to (chronic) stress, potentially impacting feed intake and digestive system of the animals. As such, the example of heat stress

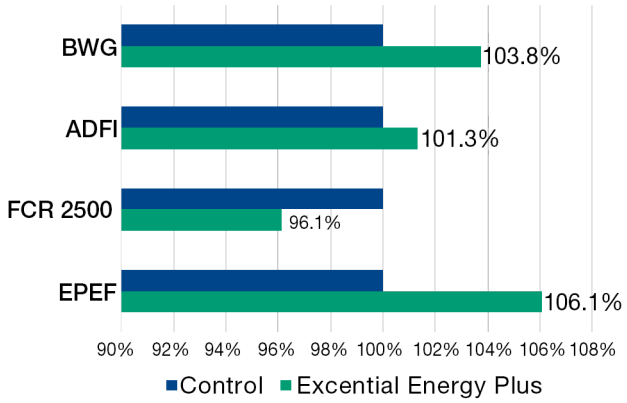

Figure 1. Example of meta-analysis in broilers with Excential Energy Plus.

is a current topic, and not limited only to tropical regions of the world, due to rising temperatures and global warming. Heat stress is caused by the negative balance between the heat generated by the animal and the heat dissipated in the environment. This type of stress results in several changes in behavior, metabolism and physiology, such as decreased feed intake, inflammation, immune dysfunction and metabolic disorders. For instance, Chen et al., 2025 states a decrease by 2.7% (and up to 19.2%) of the feed efficiency in heat-stressed dairy cows. Qualitative betaine sources, like Excential Beta-Key (Orffa Additives B.V.), are functional compounds well known as the most efficient donor of methyl groups, with only 55% efficiency from choline compared to betaine. Not only betaine can contribute to feed efficiency by sparing other nutrients (choline and methionine) in the liver, but it's also a protective osmolyte. Therefore, betaine will protect cell structures and maintain cellular activity against osmotic stress in challenging environments. Uyanga et al., 2022 proves the numerous benefits of betaine in such conditions on immune function, intestinal function, reproduction, cytoprotection and ultimately feed efficiency.

Moreover, the worldwide regulations are also impacting feed utilization. First of all, to counteract antimicrobial resistance, several regions are experiencing the challenge of rearing animals with a restricted use of antibiotics. However, the resulting increasing levels of bacterial pathogens or parasites have a detrimental impact on nutrient digestion and performance (e.g. impact on bile acids, natural emulsifiers). As a result, the use of digestibility promoters is crucial to restore performance. Moreover, when focusing on the EU market, a number of regulations such as the Regulation (EU) 2025/74, imposing a provisional anti-dumping duty on imports of lysine from China, could result in ingredients substitution (e.g. from single amino acids to imported soybean meal). This could negatively affect FCR levels of European animals due to potential nutritional imbalances. In these circumstances, several additives supporting the amino acid metabolism are valuable =

- Digestibility promoter that increase the digestibility and absorption of amino acids (e.g. sparing of 0.18 g lysine/kg of feed with Excential Energy Plus);
- Betaine that promotes the recycling of homocysteine into methionine (e.g. up to 10% of total methionine saved by Excential Beta-Key);
- Guanidinoacetic acid that spares dietary arginine being a precursor of creatine (e.g. with Excential Kiamino ((Orffa Additives B.V.)), Figure 2).

WHAT ABOUT ECO-EFFICIENCY?

Eco-efficiency is "based on the idea of 'doing more with less', that is, reducing the consumption of resources and the impact on nature while maintaining or increasing the value of the manufactured product" (Kopnina and Brewitt, 2018). While spe-

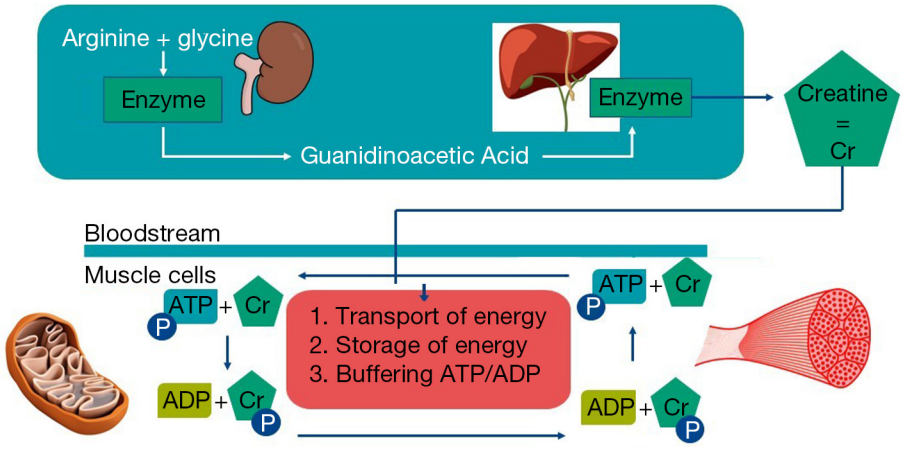

Figure 2. Mode of action of guanidinoacetic acid.

cifically targeting the environmental health, eco-efficiency clearly follows similar principles as feed efficiency, i.e. to consume as little feed as possible, in order to produce as much animal proteins as possible. As agriculture is regularly seen as a major contributor to greenhouse gas (GHG) emissions, it is vital that the stakeholders invest in a more sustainable livestock production, next to a profitable one. Amongst the GHG, carbon dioxide (CO_2) is often depicted as a main cause of climate change, proving the importance of reducing its emissions. Orffa developed specific feed solutions to minimize the release of CO_2. For example, Excential Energy Plus has proven benefits to reduce global warming potential, as well as terrestrial acidification potential, freshwater eutrophication and land use, while having a negligible production impact (Figure 3).

Moreover, the supplementation of individual, essential amino acids (AA) is decisive to limit environmental impact. First of all, supplementing individual AA enables to solve specific deficiencies with a balanced diet contrary to vegetal protein sources, following the precision nutrition concept. As a result, the protein supplementation is selective with controlled feed production costs, reaching an enhanced feed efficiency. On top of that, they allow low protein diets preventing an excessive nitrogen excretion, in the form of ammonia or urea for example.

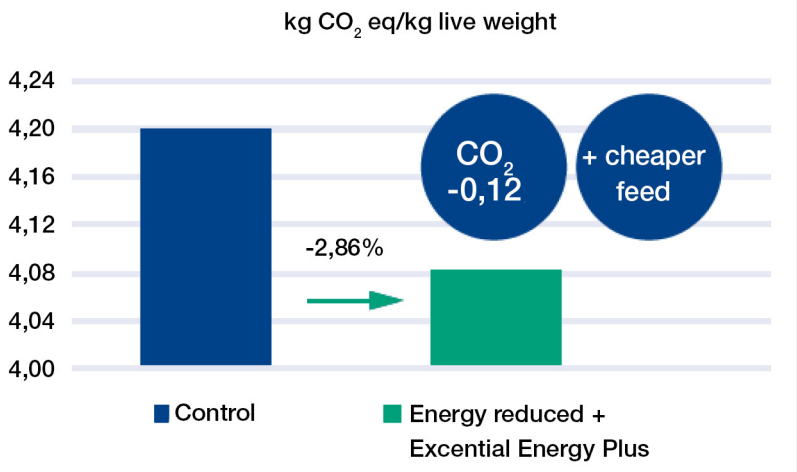

Figure 3. Life cycle assessment of Excential Energy Plus in poultry.

TAKE HOME MESSAGE: CONSIDER THE BIGGER PICTURE FOR AN OPTIMAL EFFICIENCY

It is clear that feed efficiency is not an easy challenge to solve and that it demands to work on multiple factors. Despite the link between feed intake and performance being the center of this concept, multiple parameters have to be taken into account, such as nutrient digestibility profile, feed costs, stress, sustainability and worldwide regulations. Orffa is consistently investing in nutritional solutions focusing on these different factors, resulting in better feed efficiency, such as with a digestibility promoter, betaine, guanidinoacetic acid and single amino acids. Moreover, it is key to not limit the industry intervention to feed additives. Important is to consider the whole diet formulation to have a better control over (alternative) raw materials, nutrient profile and overall costs. Orffa's vision is to be a concrete partner to its customer by helping reformulate diets and save costs. Since 2024, Orffa collaborates with A-Systems, a company servicing more than 800 customers in more than 70 countries, by utilizing the feed formulation software Allix3. Orffa invests in feed formulation via Allix3 to provide appropriate matrix values and assist its partners worldwide in setting up diet formulations to achieve an appropriate feed efficiency.

Literature references available on request.

About Aurélie Montagnon

Aurélie Montagnon is Global Solution Manager – Feed Efficiency at Orffa Additives BV. She graduated from ISARA, France in 2020, with an engineering master's degree in Agriculture, environment and resources management, with specialty in breeding, nutrition, environment and health.