Feed efficiency is about emulsification

Increasing the energy efficiency of fats and oils will contribute to more economical and sustainable animal production.

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Feed represents up to 70% of the total cost of animal production in modern capital-intensive systems. Within feed, energy is the major cost component in diets for high-performing animals. Energy is the critical dietary constituent that supports maintenance, as well as tissue growth. Knowledge of energy metabolism is essential for understanding feed efficiency. Due to their high energy density, fats and oils are important energy sources in feed formulation. Improving the energy efficiency of these raw materials is of interest from an economic point of view. Nutritional emulsifiers can be used to improve fat digestibility and, thus, improve energy efficiency, which will result in lower feed costs and contribute to more economical and sustainable animal production.

Mode of action

An emulsifier is a molecule with a water-soluble (hydrophilic) part and a fat-soluble (lipophilic) part. The combination of these two components in one molecule gives it the unique property that the emulsifier can dissolve both in fat and in water and can aid in mixing these two fractions. In the animal, fat digestion occurs in a few steps. Initially, large fat globules are emulsified in the watery environment of the gut. Normally, fat and water do not mix, and therefore, bile salts assist in this mixing process as natural emulsifiers. Smaller fat droplets are formed and increase the contact surface for the lipase enzyme. This enzyme, produced by the pancreas, breaks down fat. The next step is the formation of micelles. Micelles are water-soluble aggregates of lipid molecules containing both polar and non-polar groups. When micelles come into contact with the micro-villous membrane, they are disrupted, and the fatty acids are absorbed by the lipophilic cell membrane. Bile salts and monoglycerides aid as natural emulsifiers in the formation of micelles. Nevertheless, the capacity of these natural emulsifiers can be a limiting factor for fat digestion. Exogenous nutritional emulsifiers can therefore assist in improving fat digestibility and energy efficiency. Their positive effect will be more pronounced at higher levels of added fat. Even with highly digestible fats (e.g. soybean oil) there is a significant effect.

Table 1 – Observed effects in different animal species after on top supplementation of a nutritional emulsifier.

Animal specie	Country	Application period	BW (vs. control)	FCR (vs. control)
Broilers	Mexico	Day 1-42	+1.50%	-1.20%
Broilers	UK	Day 8-21	+7.43%	-7.57%
Broilers	Mexico	Day 1-42 (oil A)	+1.54%	-2.60%
		Day 1-42 (oil B)	+0.95%	-1.60%
Broilers	India	day 1-42 (oil C)	+6.19%	-1.22%
		day 1-42 (oil D)	+5.37%	-1.84%
Turkeys	Canada	Day 1-115	+1.51%	-2.29%
Swine (fatteners)	Philippines	Day 63-140	+7.61%	-9.92%
Swine (fatteners)	Belgium	4 months	+1.01%	-2.47%

Effects on digestibility

Nutritional emulsifiers are known for their effect on energy digestibility, especially in poultry. Increased fat digestion is of main focus, but the digestibility of other nutrients (e.g. crude protein) is also of interest. Several faecal metabolic studies by Orffa provide insight into these effects. Diets in these studies were formulated based on maize, soybean meal, wheat, meat and bone meal in varying concentrations. The oils added included vegetable oils (e.g. soybean oil, mixed vegetable fatty acids) and animal fats (e.g. poultry fat). After an adaptation period, faeces were collected at the end of the metabolic period for a number of consecutive days and analysed. The results show that adding a nutritional emulsifier increases energy, crude fat, dry matter and crude protein digestibility on average by 76 kcal/kg (AMEn), 2.81%, 1.41% and 1.68%, respectively. It is important to note that the increase in energy digestibility depends on the crude fat percentage in the diet.

Improving feed efficiency & saving costs

Based on this understanding of energy digestion using nutritional emulsifiers, it is possible to implement this strategy in commercial feeds. By supplementing a nutritional emulsifier and implementing its matrix value (e.g. AMEn = 200,000 kcal/kg) in feed formulation software it is possible to produce energy- reduced and cheaper diets without impacting performance. Given increasing raw material costs, the effect of the nutritional emulsifier provides an opportunity to reduce the negative impact on feed prices. The return on investment (in energy-reduced diets) ranges from 3:1 to 7:1, depending on the animal species. In addition to the application in energy-reduced diets there is also the possibility to supply a nutritional emulsifier on top in the feed. This will result in heavier animals needing less feed. Significant improvements in body weight (BW) and feed conversion ratio (FCR) can be seen (*Table 1*). These results also imply improved sustainability. Using less fat in the feed, in energy-reduced diets, and less feed, when supplied on top, results in more sustainable production.

Conclusions

A first observation is that a nutritional emulsifier can be used to improve energy, dry matter, crude fat and crude protein digestibility as shown in several faecal metabolic studies (and confirmed in energy-reduced validation tests). A second observation is that based on these improvements in digestibility, the nutritional emulsifier is able to save feed costs and improve performance. A third observation is that nutritional emulsifiers contribute to more sustainable feeds.

Nutritional emulsifiers can be used to improve fat digestibility and, thus, improve energy efficiency, which will result in lower feed costs.