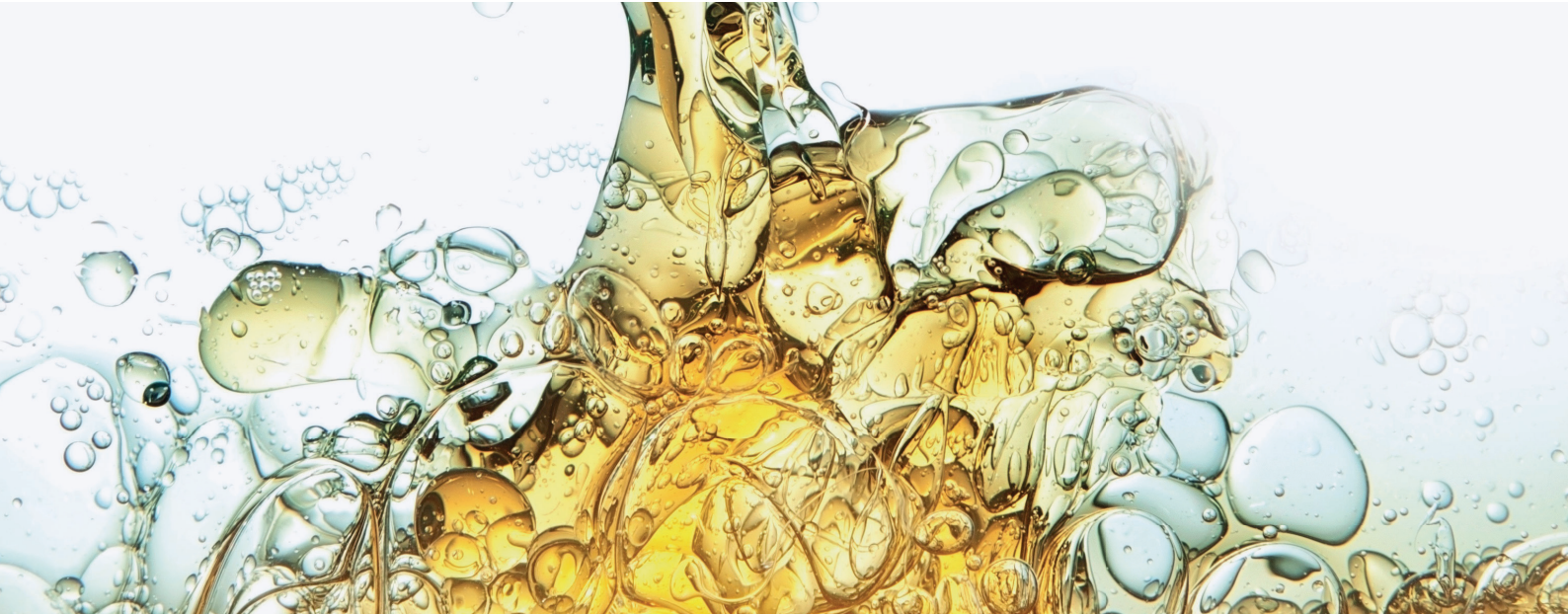


HOW TO CONFIDENTLY ENHANCE THE PRODUCTIVITY OF THE BROILER INDUSTRY WITH A NUTRITIONAL EMULSIFIER?

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Need for a scientifically proven nutritional emulsifier

Following the trend of the increasing world population, the demand for animal protein is rising globally. In order to meet this demand, optimal utilization of the feed is of great importance to improve animal productivity. By maximising the outputs (animal proteins) with minimal inputs, it will also contribute to a sustainable animal industry. However, several raw materials in animal diets are not able to be used efficiently, such as certain sources of fat and energy (e.g. recycled oils). Fat sources are one of the most expensive feed ingredients, combined with suffering from scarcity issues. Moreover, fat quality and stability can vary over time and per batch. These factors significantly impact the digestion and absorption of these nutrients in the gastrointestinal tract, as approximately 13% of the commonly used fat sources in broiler feed are shown to be undigestible.

Nutritional emulsifiers are feed additives that are more and more used in diet formulation, with the aim to enhance fat emulsification in the small intestine (Figure 1). Together with natural emulsifiers (e.g. bile salts), nutritional emulsifiers emulsify the fat globules coming from dietary fat in smaller droplets. Lipase, the digestive enzyme catalysing the hydrolysis of lipids, is therefore able to digest the fat in a more efficient

way. Nutritional emulsifiers are also able to emulsify free fatty acids, in order to enhance their absorption in the epithelial cell layer. As nutritional emulsifiers are tightly related to energy efficiency, these feed additives are able to liberate more energy from the diet for animals' performance. Therefore, nutritional emulsifiers can also be called animal productivity enhancers.

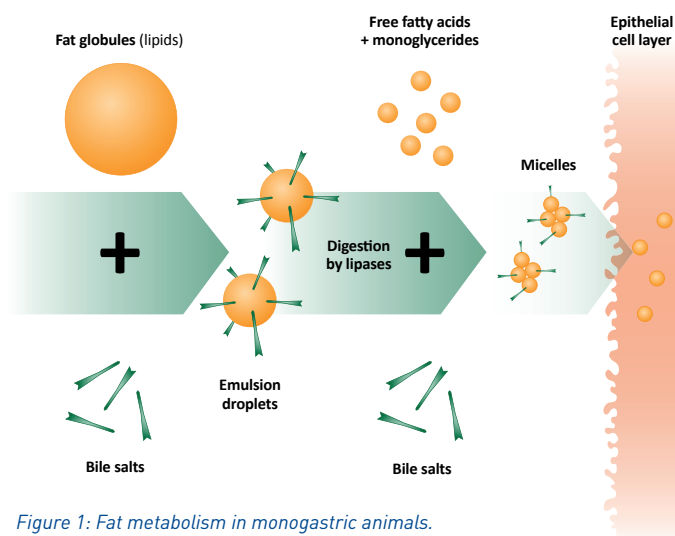


Figure 1: Fat metabolism in monogastric animals.

Excential Energy Plus is a nutritional emulsifier developed by Orffa Additives B.V. and is based on glyceryl polyethylene glycol ricinolate (GPGR). This GPGR, coming from castor bean oil, is specifically synthesised in a controlled production process to increase its emulsification properties in the watery conditions of the small intestine. The efficiency of Excential Energy Plus has been proven in more than 100 *in vivo* trials among different monogastric and ruminant animal species. However, the action of a nutritional emulsifier depends on several factors including, but not limited to; animal species, dosage, emulsifier active ingredient(s), period of supplementation and feed formulation.

Orffa conducted a meta-analysis on the effect of Excential Energy Plus as a broiler productivity enhancer, taking into account these different factors. Two different meta-analysis were implemented; one to compare the effects of Excential Energy Plus to a control diet without a nutritional emulsifier, and a second meta-analysis to compare the product to a diet with a different commercial available emulsifier.



The efficiency of **Excential Energy Plus** has been proven in more than 100 *in vivo* trials



Meta-analysis in broilers: Excential Energy Plus vs control

A systematic review of scientific and commercial trials with Excential Energy Plus has been carried out, selecting specific studies that meet the following criteria:

- Performed in broilers;
- Includes detailed information on the feed formulation and nutrient analysis;
- Assess the effect of Excential Energy Plus as productivity enhancer (top-dressing);
- Includes a control with a basal diet without emulsifier and iso-caloric with the treatment diet;
- Contains data on the growth performance, feed intake and feed efficiency of the birds;
- Performed before the end of 2023.

As a result, the following studies with trial details were taken into consideration:

Number of selected studies	10
Years of study completion	Between 2014 and 2023
Location of the study	Belgium, China, Colombia, India, Mexico, South Africa, United Kingdom
Total number of broilers	6652
Broilers breeds	Ross 308, Cobb 430, Arbor Acres
Broiler sex	Male, 50:50 male and female
Average days of life	37.1
Main formulated cereals	Corn-based (n=8), wheat-based (n=2)
Main formulated fat sources	Animal fat, full fat soybean, palm oil, recycled oils from restaurants, rice bran oil, soybean oil, sunflower oil
Average dietary nutrients	3042.4 kcal/kg (2713-3164) metabolizable energy 7.01% (4.95-8.30) crude fat 21.59% (21.30-21.80) crude protein
Dosage of Excential Energy Plus	350 ppm (n=10)

The following performance parameters for both treatments (control diet and Excential Energy Plus diet) were compiled for all studies, when available:

- Body weight gain (BWG; g/bird)
- Average daily gain (ADG; g/bird/day)
- Average daily feed intake (ADFI; g/bird/day)
- Feed Conversion Ratio (FCR), recalculated to a body weight of 2500g with the following formula:

$$FCR_{2500} = FCR - \left(\frac{Body\ weight\ (g) - 2500}{100} \times 0.04 \right)$$

- European Production Efficiency Factor (EPEF), calculated with the following formula:

$$EPEF = \frac{Liveability\ (\%) \times Body\ weight\ (kg)}{Days\ in\ life \times FCR} \times 100$$

Finally, the percentage of change when comparing the data in the Excential Energy Plus group with the control group was calculated with the following formula:

$$Percentage\ of\ change = \frac{Treatment\ group\ data - Control\ group\ data}{Control\ group\ data} \times 100$$

After studying the effect of each study, these percentages of change were averaged and plotted per treatment and for each performance parameter (Figure 2). To conclude, applying 350 ppm of Excential Energy Plus on-top of a basal broiler diet is expected to **improve growth performance by 3.8%, feed efficiency by 3.9% and production efficiency by 6.1%**.

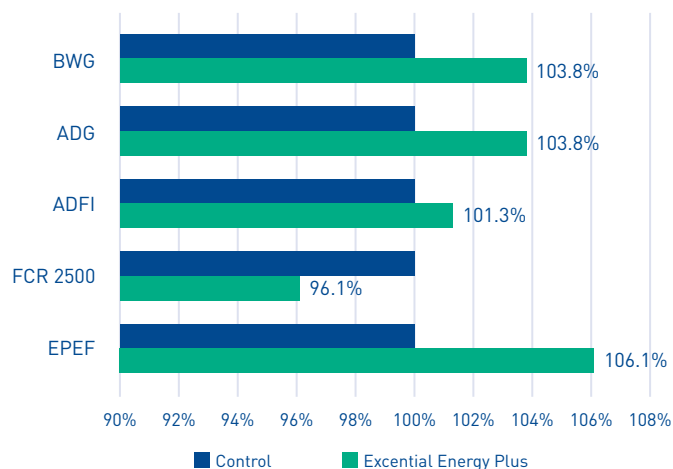


Figure 2: Results of the meta-analysis comparing control and Excential Energy Plus treatments in broilers.



Meta-analysis in broilers: Excential Energy Plus vs other emulsifiers

Nutritional emulsifiers can be based on several types of active ingredients, with all different areas of specialty. Measuring the hydrophilic-lipophilic balance (HLB) value of emulsifiers is an interesting way to classify the products and to find out whether they are lipophilic (for a mix of water in oil) or hydrophilic (for a mix of oil in water) (Figure 3). Lipophilic emulsifiers with a low HLB value, such as phospholipids, are commonly known as technical emulsifiers that improve the feed production process.

On the other hand, hydrophilic emulsifiers with a high HLB value, such as the specific GPGR used in Excential Energy Plus, are nutritional emulsifiers improving the emulsification in the watery environment of the gastro-intestinal tract. This clearly explains the need to differentiate the types of emulsifiers *in vivo*.

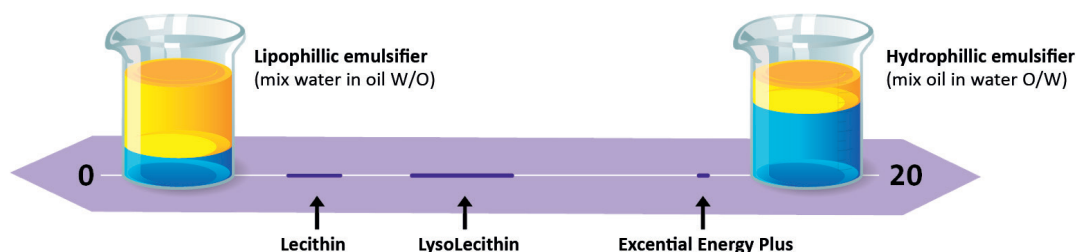


Figure 3: Hydrophilic-lipophilic balance value of emulsifiers.

A second meta-analysis has been conducted to differentiate emulsifiers with varying HLB values. For that purpose, a second systematic review of scientific and commercial trials with Excential Energy Plus has been carried out, selecting specific studies answering the following criteria:

- Performed in broilers;
- Includes detailed information on the feed formulation and nutrient analysis;

- Assess the effect of Excential Energy Plus as productivity enhancer (top-dressing);
- Includes a control with a basal diet, supplemented with another commercial available emulsifier, and iso-caloric with the treatment diet;
- Contains data on the growth performance, feed intake and feed efficiency of the birds;
- Performed before the end of 2023.

As a result, the following studies with trial details were taken into consideration:

Number of selected studies	7
Years of study completion	Between 2014 and 2021
Location of the study	Belgium, Colombia, India, Netherlands, Poland, United Kingdom
Total number of broilers	8455
Broilers breeds	Ross 308, Cobb 430
Broiler sex	Male, female, 50:50 male and female
Average days of life	34.1
Main formulated cereals	Wheat-based (n=6), corn-based (n=1)
Main formulated fat sources	Full fat soybean, palm kernel fatty acid, palm oil, poultry fat, soybean oil
Average dietary nutrients	2978.4 kcal/kg (2713-3164) metabolizable energy 6.89% (5.95-8.30) crude fat 21.00% (19.92-21.60) crude protein
Dosage of Excential Energy Plus	350 ppm (n=7)
Active ingredients of the other commercial available emulsifiers	Lysophospholipids (n=5), GPGR with a different HLB value compared to Excential Energy Plus (n=1), mixture of lysophospholipids, monoglycerides and synthetic emulsifier (n=1)
Dosage of the commercial available emulsifiers	500 ppm (n=6), 1000 ppm (n=1)

The same performance parameters as in the previous meta-analysis, for both treatments, were compiled. Afterwards, the percentage of change when comparing the data in the Excential Energy Plus group with the other emulsifier group was calculated similarly to the first analysis.

After studying the effect of each trial, the percentages of change were averaged and plotted per treatment and for each performance parameter (Figure 4). To conclude, applying 350 ppm of Excential Energy Plus is expected to **improve growth performance by 1.7%, feed efficiency by 2.8% and production efficiency by 2.5%**, compared to the use of another type of emulsifier at **higher dosages**.

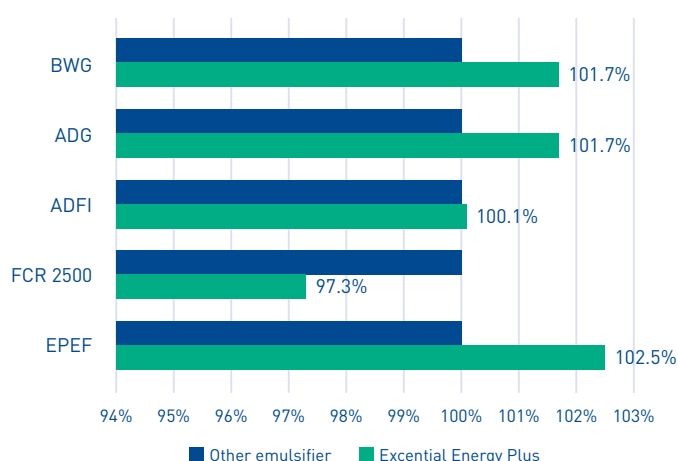


Figure 4: Results of the meta-analysis comparing commercial available emulsifiers and Excential Energy Plus treatments in broilers.

Take-home message

Nutritional emulsifiers are feed additives that allow for better digestion and absorption of the different nutrients in animal feed. By their key action in the fat and energy metabolism, they optimise the energy utilization of feed that can be used for growth performance. Excential Energy Plus has a well-proven record based on both scientific and commercial trials, to significantly improve growth, feed efficiency and production efficiency, resulting in higher profits for the farmer. Moreover, a large variety of emulsifiers exist, from technical to nutritional ones, but they can easily be classified by describing their active ingredients and HLB values. Excential Energy Plus, a nutritional emulsifier with a high HLB value, has been demonstrated to increase the performance to a higher extent than other types of emulsifiers, such as lysolecithin or GPGR with a different molecular structure.

Applying 350 ppm of Excential Energy Plus, on-top of a basal broiler diet without emulsifiers is expected to **improve growth performance by 3.8%, feed efficiency by 3.9% and production efficiency by 6.1%**. When applying the product and comparing results with another commercial available emulsifier, **growth performance is expected to improve by 1.7%, feed efficiency by 2.8% and production efficiency by 2.5%**. Trials in other animal species show comparable results as what was found for broilers.

