



NUTRITIONAL SOLUTION IMPROVING DIGESTIBILITY OF SOWS AND PIGLETS

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"Overall, it can be stated that nutritional emulsifiers have a great potential to improve health and performance in the swine industry. Benefits are related to the emulsification activity and thereby improving fat digestibility and energy efficiency. Nutritional emulsifiers offer a valid strategy to reformulate sow diets and to support piglets in the post-weaning stress period."

Health and performance of animals depend greatly on their diets and digestive system. Regarding diets, the used raw materials and the needed dietary nutrients are to be considered. It is also important to take into account the use of the nutrients in the metabolism of animals, for maintenance and production. Moreover, in the current agricultural world, sustainability is of great importance to minimize the environmental impact. One of the principles of sustainability, defined by the FAO (Food and Agriculture Organization), is improvement of the efficiency in the use of resources. Nutrients' digestibility and absorption are therefore key parameters to take into account when formulating a balanced ration for optimized performance, feed efficiency and sustainability. Several feed additives can support digestibility of key nutrients such as fat and energy. In this article, the functioning and benefits of using nutritional emulsifiers will be discussed. Nutritional emulsifiers are widely used in various species, including fattening pigs, but the application in sows and piglets is relatively new. New results in sows and piglets highlight the efficacy of nutritional emulsifiers. Especially during lactation,

nutritional emulsifiers could be interesting due to the possible transfer of nutrients via the colostrum and milk, which benefit piglets in the long run.

FAT METABOLISM AND NUTRITIONAL EMULSIFIERS

Fats and oils are important energy sources in feed formulation. That's why it is important to study the role of these ingredients in the metabolism of the animal, in order to optimize energy efficiency and animal production. In the digestive tract, fat globules are emulsified by bile salts which are excreted by the gall bladder. These bile salts form smaller fat droplets which will be further digested by lipases, enzymes catalyzing the hydrolysis of fats. The digestion of fats and oils will lead to the formation of free fatty acids and monoglycerides. Bile salts will again help with the emulsification of these fatty acids, creating micelles. Micelles are easier absorbed through the intestinal epithelial cell layer. Bile salts, so-called natural emulsifiers, are key components to improve fat digestibility as they help to create a higher amount of smaller droplets, increasing the surface of action and efficiency of the lipases.

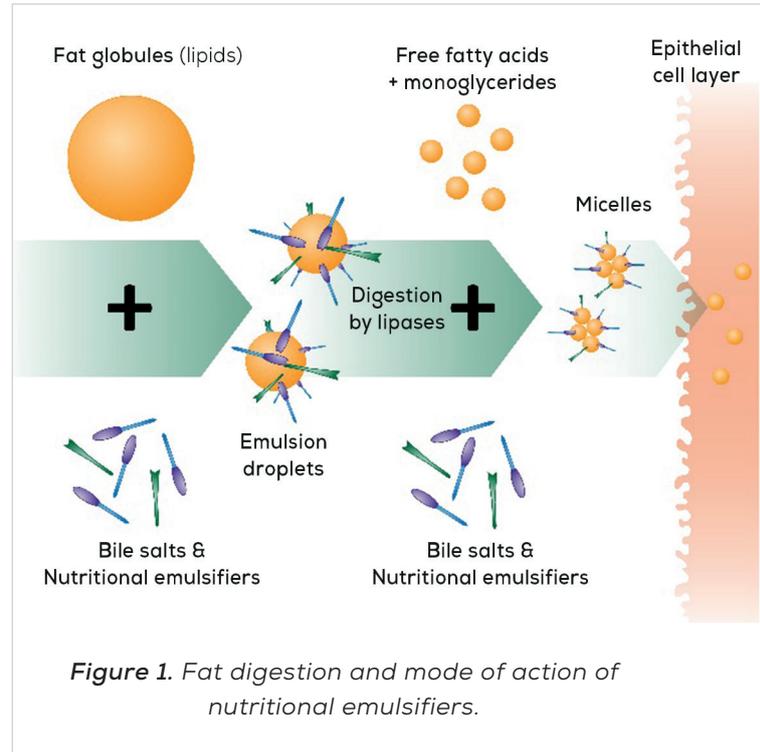


Figure 1. Fat digestion and mode of action of nutritional emulsifiers.

However, several parameters are impacting fat digestion, such as the level of fat inclusion, fat characteristics (e.g. ratio unsaturated/saturated fatty acids), diet (e.g. particle size) and physiology of the animal (e.g. age). For instance, gut health is an important factor that can impact bile salts and reduce their efficiency. This can be the case in young piglets which have a non-optimal intestinal environment. At weaning, when transitioning from liquid to solid feed, their digestive system is not fully developed and adapted, so digestion and absorption of nutrients like fats can be limited. At this stage, the use of a nutritional emulsifier can complement the action of bile salts. A nutritional emulsifier improves the emulsification of the fat globules in the gastro-intestinal tract, further enhancing the digestibility of fat and efficiency of energy (Figure 1).

DIET REFORMULATION AND DIGESTIBILITY

By optimizing fat digestion, nutritional emulsifiers improve nutrients' digestibility and energy efficiency. This is why they are already used in different animal species and different types of diets, with different fat/oil sources and levels. Use of nutritional emulsifiers can be explained by the flexibility in the types of inclusion in feed. Nutritional emulsifiers

can be used on-top of the initial diet or in energy diluted diets. On-top application will result in improved feed efficiency and performance, due to the better use of energy for growth and milk production. To reduce feed cost, nutritional emulsifiers can also be used in energy diluted diets. Lower fat inclusion will be compensated by a higher digestibility and absorption of sources which are high in energy. Reformulation can be done by determining matrix values and the energy upgrade of the additive, and including the nutritional emulsifier in a classical feed formulation tool, as an ingredient.

Both strategies were tested in a recent Brazilian trial, coordinated by the University of Sao Paulo. In total, 116 lactating sows were followed for 26 days, from 5 days before farrowing to weaning of their piglets. The sows were divided into three groups. A control group, on a basal diet. A second group on an energy reduced diet, which received the basal diet with a reduction of metabolizable energy by 50 kcal/kg feed and the inclusion of a nutritional emulsifier (Excential Energy Plus, Orffa Additives BV). The third group received the basal diet with the same nutritional emulsifier on-top. In total, the trial followed 1596 born piglets and 1451 weaned

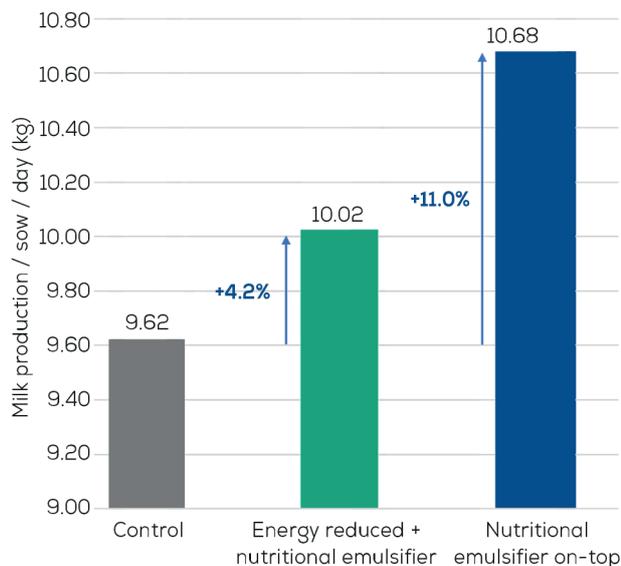


Figure 2. Daily milk production of sows fed a control diet or a similar diet with a nutritional emulsifier, either on-top or with energy reduction.

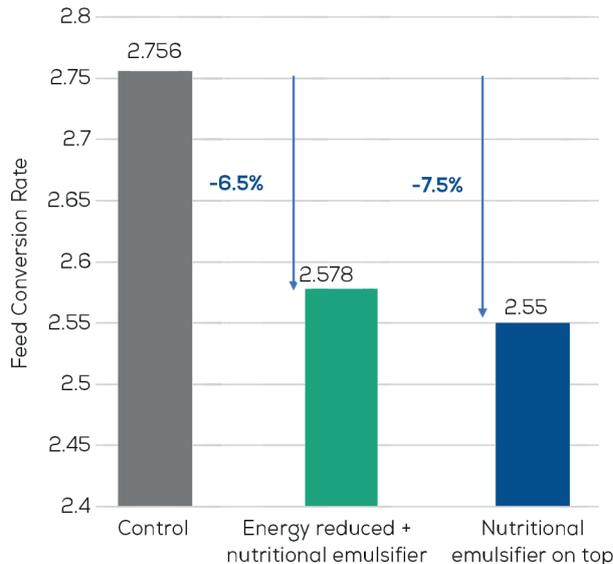


Figure 3. Feed conversion rate of sows fed a control diet or a similar diet with a nutritional emulsifier, either on-top or with energy reduction.

piglets, with a homogeneous distribution amongst the sows' groups.

It was clear that the addition of the nutritional emulsifier in lactation diets increased the piglet weight gain from birth till weaning for both inclusion strategies. Compared to the control group, piglet growth increased by 8.6% for the reduction of energy treatment and by 7.3% for the on-top treatment. Enhanced piglet growth can be explained by the numerical improvement of the milk production of the sows related to the addition of the nutritional emulsifier (Figure 2). Moreover, the feed conversion rate of the sows, measured by the kg of feed consumed divided by the kg of piglet weight gain, was numerically improved (Figure 3). No effects on sows' feed intake and piglets' mortality could be observed. Beneficial effects on health were observed by an improved colostrum Brix value. The Brix value was measured by a refractometer (a device measuring the refraction index) within 12 hours after delivery and is an estimation of the immunoglobulins G (IgG) in the colostrum. Higher IgG intake could result in an improved immune function of the suckling piglets. When classifying the proportion of sows

having a poor (< 19.9), limit (20 – 24.9), adequate (25 – 29.9) and good (> 30) Brix value, a higher proportion of sows having an adequate Brix value in the nutritional emulsifier treatments was observed (53% with energy reduction treatment and 58% with on-top treatment, compared to 38% for the control).

The combination of improved weight gain of the piglets, milk production and feed conversion rate of the sows showed that using a nutritional emulsifier, with on-top or reformulation feeding strategies, enables enhanced fat digestion and energy efficiency for optimal performance and health of sows and their piglets.

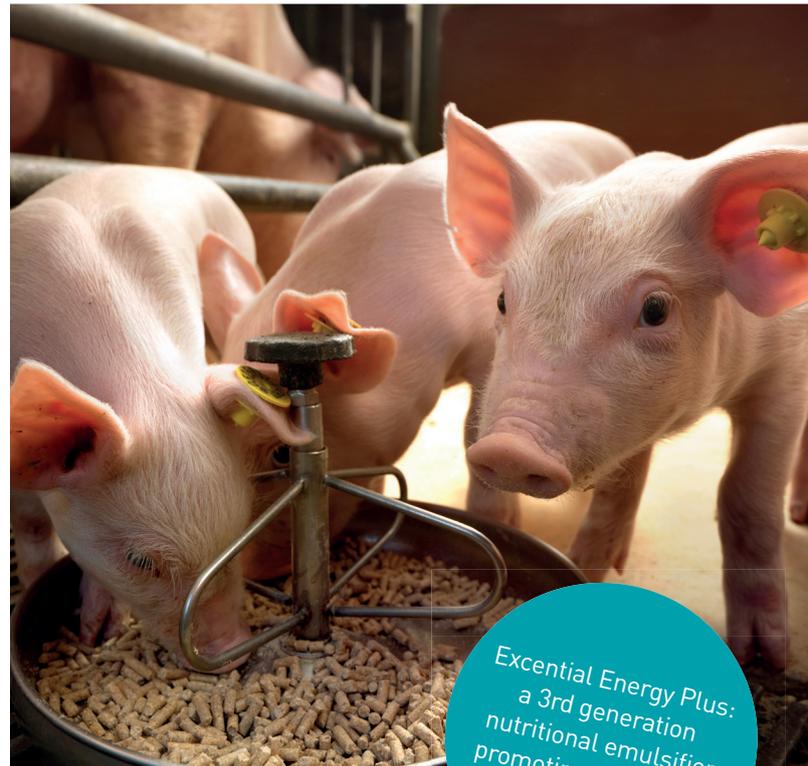
SUPPORT DURING POST-WEANING STRESS

As mentioned previously, the digestive system of piglets at weaning is still immature and limits the digestibility efficiency of nutrients. On top of that, weaned piglets suffer from post-weaning stress due to environmental and nutritional challenges. The weaning period can negatively impact their immune system, health status and overall production. In order to test the effect of nutritional emulsifiers to support

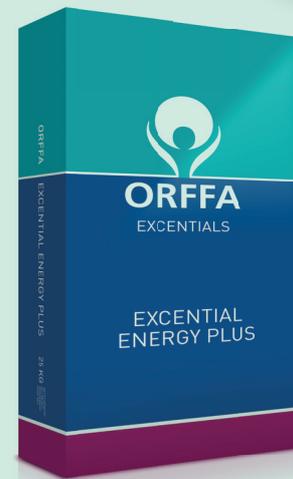
weaned piglets and compensate for the poorly adapted digestion, a trial was performed in Japan following 47 piglets for 7 days after weaning (at 21 days of age). The piglets were randomly divided over 2 treatments: a basal diet and the basal diet supplemented on-top with a nutritional emulsifier (Excential Energy Plus, Orffa Additives BV). The addition of the nutritional emulsifier significantly improved both the body weight gain and the feed conversion rate, compared to the control group (Figure 4). Moreover, the feed intake was significantly higher. The nutritional emulsifier was able to support the piglets' performance during the post-weaning stress period.

The nutritional solution does not only show its benefits to digestibility and metabolism of piglets in relation to performance. Health is also a key factor to analyze, as it impacts greatly the resilience of piglets during the challenging period of weaning and their digestive system functioning. An Argentinian trial, following 30 sows during 22 days, from 90 to 112 days of gestation, brings this type of insight. The trial was coordinated by the National Scientific and Technical Research Council (CONICET). Half of the sows received a basal gestation diet, while the other half received the same diet with a nutritional emulsifier (Excential Energy Plus, Orffa Additives BV) on-top. After inducing labor at 114 days of gestation, the litter size was standardized to 13-14 piglets per sow. Remaining piglets, which were not selected, were adopted by other sows and not taking part in the trial. After weaning at 22 days of age, the 380 selected piglets were monitored for 15 days and randomly divided into four treatments: basal diet for the sows and piglets; basal diet for the sows and nutritional emulsifier on-top for the piglets; nutritional emulsifier on-top for the sows and basal diet for the piglets; and nutritional emulsifier on-top for the sows and piglets.

The addition of the nutritional emulsifier to the diet of the piglets had several beneficial effects on the metabolism, intestinal morphology and activity of digestive enzymes. A significant increased



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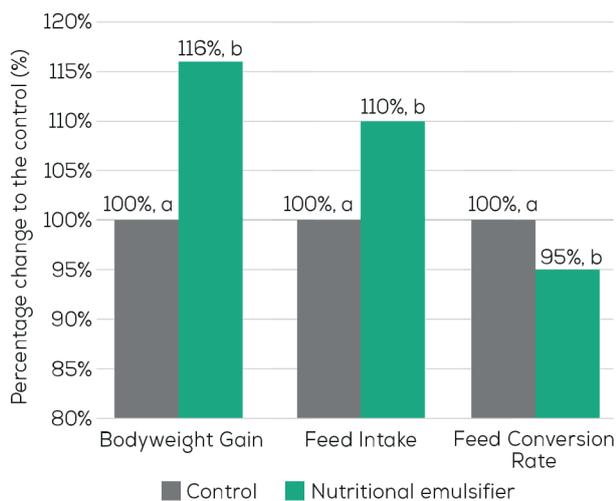


Figure 4. Percentage change to the control with the nutritional emulsifier treatment on the body weight gain, feed intake and feed conversion rate in weaned piglets ($P < 0.05$).

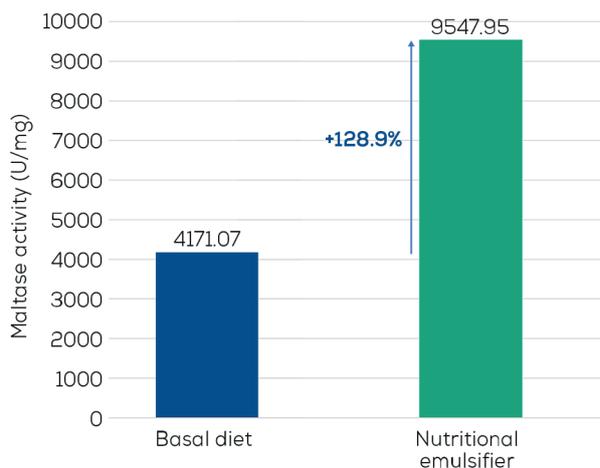


Figure 5. Intestinal maltase activity, when feeding the basal diet or the nutritional emulsifier to weaned piglets ($P < 0.05$).

concentration of citrulline in the plasma was observed in piglets receiving the nutritional emulsifier in their diet ($P < 0.05$). Citrulline is a marker of the metabolic activity and functional mass of enterocytes in the intestine. The observed higher level showed the effect of the nutritional emulsifier to support piglets' metabolism. Next to plasma components, a significant increased maltase activity was measured (Figure 5). In the digestive tract, maltase is an enzyme catalyzing the hydrolysis of maltose into glucose. Moreover, the addition of the nutritional emulsifier improved significantly the villus height, villi/crypt ratio and intestinal absorption surface in the jejunum and the ileum ($P < 0.05$). The treatment of the sows did not have any influence on the measured parameters. Combined, these results show the potential of a nutritional emulsifier to improve digestibility, absorption and intestinal health. The metabolism and digestive system of the piglet are better adapted to their new diet. This could lead, in the long run, to improved growth performance and feed efficiency of the pigs.

NUTRITIONAL EMULSIFIERS FOR A BETTER FEED EFFICIENCY

Overall, it can be stated that nutritional emulsifiers have a great potential to improve health and performance in the swine industry. Benefits are related to the emulsification activity and thereby improving fat digestibility and energy efficiency. Nutritional emulsifiers offer a valid strategy to reformulate sow diets and to support piglets in the post-weaning stress period. Focusing on feed efficiency is of vital importance nowadays in order to maximize the output of animals while keeping control of feed costs. In this way, margin and return on investment can be optimized. This is why different tools to improve digestibility are taken into account. Next to feed additives, choosing optimal ingredients with optimal digestibility coefficients and optimizing feed processing methods can benefit the animal industry. Nutritional emulsifiers, in combination with other strategies, can support the better use of raw materials and minimize the impact on the environment.

About Aurélie Montagnon

Aurélie Montagnon is Central Technical Manager at Orffa Additives BV. Aurélie 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.