“No antibiotics” means increased need for emulsification!

Rearing animals in antibiotic-free systems is a challenge. A big question is how to deal with increased pathogenic pressure and optimize gut health. When disbalanced, the microflora can have a big impact on the digestibility of nutrients. Fat digestibility, in particular, will be affected to a large extend by bacteria that impair the function of bile acids, vital components of the fat digestibility apparatus. These bacteria are more pronounced in disbalanced gastro-intestinal tracts and form especially a threat when the usage of antibiotics is limited. Low fat digestibility will imply a loss of energy which will not be available for growth. To counteract this suboptimal situation a nutritional emulsifier can be added to the diet. This additive does not only safe costs in healthy animals but also supports flocks with intestinal health issues.

Bile acids as natural emulsifiers

Fat digestion is to a large extend dependent on bile acids, next to pancreatic lipase and colipase. Bile acids, synthesized in liver cells, will act at the lipid/water interface and help in the formation of micelles, sphere-like aggregates of fat in water. Bile acid-containing micelles augment the activity of lipase towards the digestion of lipids. Prior to secretion in the intestine, conjugation with taurine or glycine takes place in liver cells to form conjugated bile acids (figure 1). Only conjugated bile acids are able to act efficiently as an emulsifier. The unconjugated forms are insoluble in water due to their specific molecular structure and subsequent acid-base properties. They will be excreted in feces. Both commensal, symbiotic and pathogenic intestinal bacteria are capable of hydrolyzing the amide bond and remove glycine and taurine. *Clostridium perfringens,* for example, was shown to express high levels of the bile salt hydrolase enzyme (*Knarreborg et al. 2002*). When hydrolyzed, the bile salt is in its unconjugated form and loses its ability to act as a natural emulsifier, resulting in a decreased fat digestion.

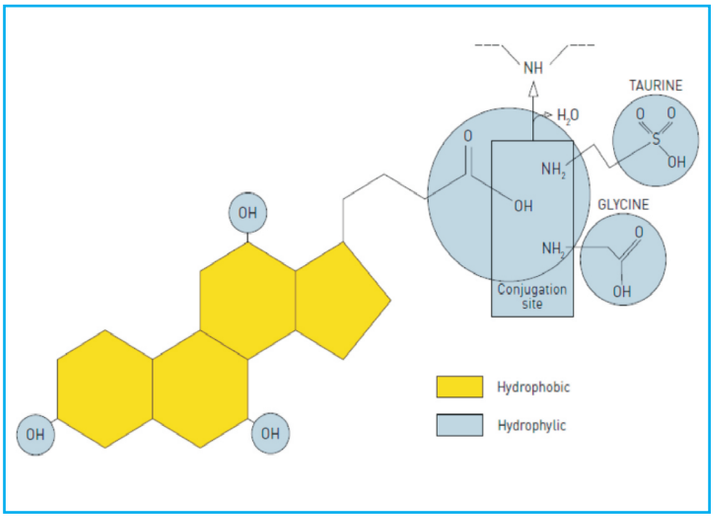

Figure 1: Conjugation with taurine or glycine to form a conjugated, active bile salt

Imbalanced microflora and its effect on fat digestibility

The influence of microbiota, antibiotics and conjugated bile acid concentration on the adsorption of fat was investigated in broilers (table 1). The group without antibiotics showed high numbers of *Clostridium perfringens* in the small intestine and lower amounts of conjugated bile acids. Lower amounts of conjugated bile acids reduced the absorption of fatty acids and fat soluble compounds (e.g. α-tocopherol). Lipase activity was also assessed and shown to be decreased in antibiotic free birds, suggesting an effect of the conjugated bile salts on the activity of lipase (*Knarreborg et al. 2003*).

The same trend was observed in another trial (table 2). In this study the effect of the microbiota on the conjugated bile acid status and subsequent fat digestion was compared between birds reared in sterilized conditions and conventional reared birds. Birds reared in sterilized conditions showed a higher lipid fecal apparent digestibility compared to conventionally reared birds, confirming the negative effect of some bacteria on fat digestion. This can be explained by the difference in the concentration of conjugated bile salts.

Table 1: Contents of the proximal part of the small intestine in chickens and ileal absorption coefficients at day 35 (*Knarreborg et al. 2004*)

Broilers, d35	With antibiotics	Without antibiotics
Contents of the proximal part of the small intestine		
Clostridium perfringens (log10 CFU/g digesta)	5,48[a]	7,14[b]
Conjugated bile acids (µmol/g digesta)	11,7[a]	8,88[b]
Ileal absorption coefficients		
Total fatty acid absorption (%)	82[a]	73[b]

[a,b] *Different superscript shows significant difference between groups (P<0,05)*

Table 2: Lipid fecal apparent digestibility (%) in broilers (*Maisionnier et al. 2003*)

Broilers, d21	Limited microflora (birds reared in sterilized conditions)	Conventional microflora (conventional reared birds)
Conjugated bile acids (µmol/g)	17[a]	3,3[b]
Lipid fecal apparent digestibility (%)	88,9[a]	81,4[b]

[a,b] Different superscript shows significant difference between groups (P<0,05)

The need for a nutritional emulsifier

Fat digestion is influenced by many factors (e.g. fat source, age). Less attention is given to the effect of the microflora. Considering the literature work stated above it should be an important factor to take into account. Orffa engineered a nutritional emulsifier to reach maximal potential in the intestinal environment and improve digestion. The most important parameter to choose the optimal emulsifier for every specific application is HLB (hydrophilic-lipophilic balance). An emulsifier with a low HLB is more fat soluble (lipophilic) and an emulsifier with a high HLB is more water soluble (hydrophilic). Due to the fact that an animal consumes almost twice as much water as feed, the intestine is a very watery environment. The goal of a nutritional emulsifier is to optimize the emulsification and micelle formation in the intestine and therefore an emulsifier with a high HLB (hydrophilic) is most efficient.

In recent years, several faecal metabolic studies with broilers have been performed by Orffa to examine the effects of the nutritional emulsifier, Excential Energy Plus. The results show that the nutritional emulsifier is able to increase energy (+76 kcal AMEn/kg), crude fat (+2.81%), dry matter (+1.41%) and crude protein (+1.68%) digestibility on average to a high extend versus the control treatment. The increase in digestibility seems to depend on the crude fat percentage in the diet.

Conclusion

A disbalanced microflora has an important negative effect on digestibility. To counteract this the activity of a nutritional emulsifier should be considered. Orffa's nutritional emulsifier has the proven ability to increase nutrient digestion, which is important in a healthy broiler, but crucial in a pathogen challenged bird.