Nutritional emulsifiers and their relation to gut health

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Rearing animals in antibiotic-free systems is a challenge. A big question is how to deal with increased pathogenic pressure and optimise gut health. When disbalanced, the microflora can have a big impact on the digestibility of nutrients. Fat digestibility, in particular, will be affected 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 are a particular threat when the use of antibiotics is limited.

Low fat digestibility will imply a loss of energy, which will not be available for growth.

To counteract this sub-optimal situation, a nutritional emulsifier can be added to the diet. This additive does not only save costs in healthy animals, but also supports flocks with intestinal health issues.

Bile acids as natural emulsifiers

Fat digestion is to a large extent dependent on bile acids (natural emulsifiers), 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 the faeces.

Some intestinal bacteria are capable of hydrolysing the amide bond and removing glycine and taurine. *Clostridium perfringens*, for example, has been shown to express high levels of the bile salt hydrolase enzyme. When hydrolysed, the bile salt is in its unconjugated form and loses its ability to act as an emulsifier, resulting in decreased fat digestion.

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 (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.

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 sterilised conditions and conventionally reared birds. Birds reared in sterilised

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

Broilers, day 35	With antibiotics	Without antibiotics
Concentrations in the 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 faecal apparent digestibility (%) in broilers (Maisionnier *et al.* 2003)

Broilers, day 21	Limited microflora (birds reared in sterilized conditions)	Conventional microflora (conventional reared birds)
Conjugated bile acids (µmol/g)	17[a]	3,3[b]
Lipid faecal apparent digestibility (%)	88,9[a]	81,4[b]

[a,b] *Different superscript shows significant difference between groups (P < 0.05)*

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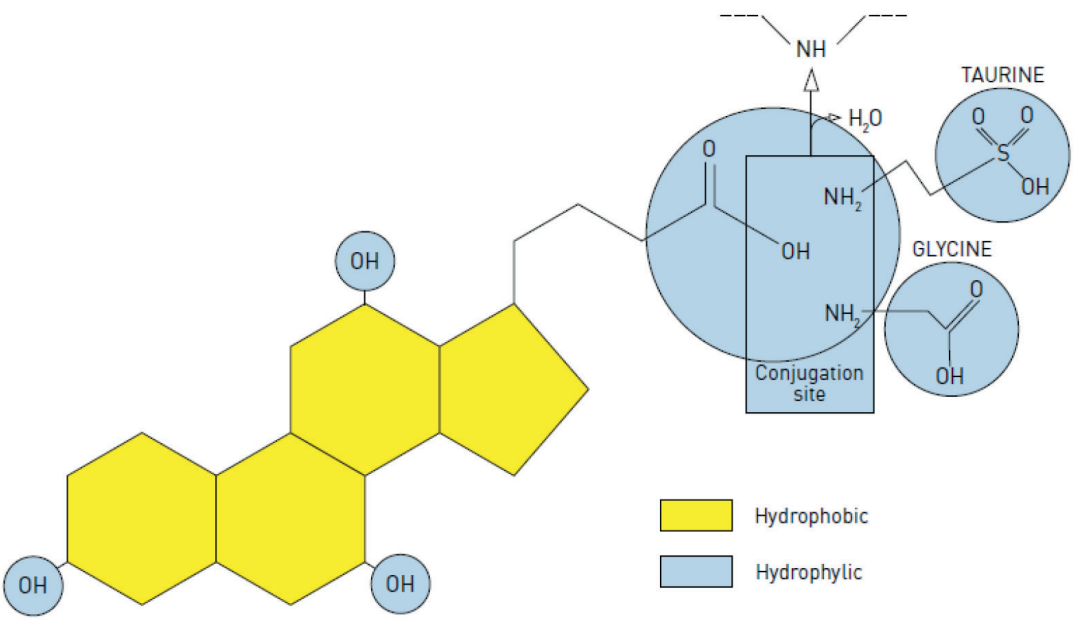
Figure 1: Conjugation with taurine or glycine to form a conjugated, active bile salt



conditions showed a higher lipid faecal 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 concentration of conjugated bile salts.

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. However, considering the findings of the studies and literature work stated above, it should be an important factor to consider.

Nutritional emulsifiers aim to reach maximal potential in the intestinal environment and improve fat digestion.

A 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 optimise the emulsification and micelle forming in the intestine and therefore an emulsifier with a high HLB (hydrophilic) is most preferred.

Conclusion

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

**References available on request*