Variation in dietary lipids potentially influences your poultry production

Dietary energy is the costliest nutritional component in poultry feed. The main source of energy is provided by supplemental fats and oils, in order to yield higher levels of metabolisable energy required for achieving an optimal bird performance. Including lipids in the diet improves fat digestibility and consequently the absorption of essential fat-soluble vitamins, fatty acids and pigments.

by Karen Bierinckx, Kemin, Belgium. www.kemin.com/emena

Moreover, through reducing the rate of passage of the digesta in the gastrointestinal tract, the overall absorption of all nutrients is enhanced.

Additionally, supplemental lipids positively affect feed dustiness and diet palatability.

Lipids in poultry diets

Nowadays, a variety of dietary fat sources are available for supplementation in poultry diets. The most common sources are vegetable oils like soybean oil and sunflower oil or animal fats such as lard and poultry oil.

However, since feed formulation is cost driven, the choice of dietary fat sources is often also price related. As a result, a variety of alternative fat sources like soap stocks and acid oils have entered the market.

Therefore, it becomes more relevant for producers and nutritionists to understand and properly evaluate the quality and true nutritional value of lipids.

The amount of essential energy birds can extract from lipids is species and age dependent and also varies with the biological composition of the fat/oil source, as described by Professor Julian Wiseman from Nottingham University in the UK.

Furthermore, the level of lipid oxidation can also reduce the energy supply and thus nutritional quality of the diet. Fat oxidation increases the presence of toxic compounds such as free radicals and aldehydes lowering the total energy value and also palatability of the feed.

In practice, lipids often contain so-called 'energy diluting factors', like moisture (M), impurities (I) and unsaponifiables (U) as a result of non-ideal processing, oxidation, transportation, storage or handling.

These three factors, commonly abbreviated as MIU can represent a substantial percentage of the lipid mass and although they do not contribute to the energy value, their presence needs to be taken into account.

Based upon animal trials assessing all these different parameters, The Wiseman Equation was developed to accurately estimate the apparent metabolisable energy (AME) and digestible energy (DE) a fat can contribute in feeds for broilers and pigs.

Lipid Evaluation Test

In 2014, Kemin designed an exclusive service called the Lipid Evaluation Test (LET), for assessing both the oxidative and nutritional quality of fats and oils used in the livestock industry.

The first part of LET looks into the oxidative status and stability of the fat by measuring:

- Active oxidation, measured by the presence of peroxides.
- Historical exposure to oxidation, determined by the presence of malondialdehyde (thiobarbituric acid reaction, TBA).
- The resistance to future oxidation, as measured by the Oxidative Stability Instrument (OSI).

The second part of LET evaluates the correct nutritional quality of the lipids by analysing the degree of saturation (i.e. the ratio of unsaturated over saturated fatty acids: U/S) and the percentage of free fatty acids (FFA).

Energy estimation is done based upon the empirical equation of Professor Wiseman, corrected for presence of energy diluting components MIU.

$$E = [A + B \bullet FFA + C \bullet e^{D(\frac{U}{S})}] \bullet (1 - \frac{MIU}{100})$$

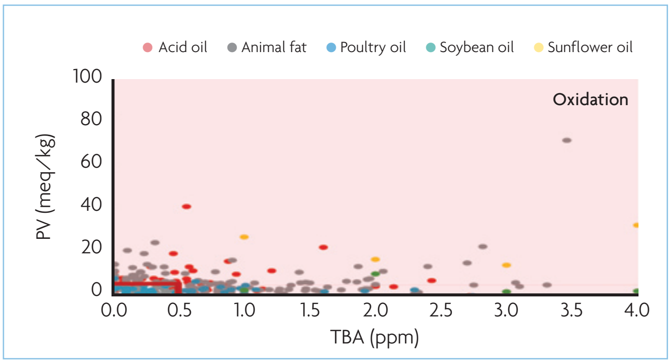

Fig. 1. Oxidative status measured by peroxides (PV) and thiobarbituric acid value (TBA) of acid oils, animal fats, poultry oils, soybean oils and sunflower oil in lipid evaluation test.

Table 1. Estimation of the average AME content of the five major lipid groups tested in the Lipid Evaluation Test (older broilers).

Oil/fat	AME LET (kcal/kg-1)	AME Literature (kcal/kg-1)
Soybean oil	7043-9299	8790
Animal fat	7541-9009	7484*
Acid oil	6487-9082	8100
Sunflower oil	8997-9262	8957
Poultry oil	7574-8647	8817

* Average energy value (kcal/kg-1) value of tallow and lard.

Extensive field survey

Over the past six years Kemin has been able to extensively evaluate the quality and nutritional value of various fat and oils collected across Europe.

In total, 932 unique lipid samples were analysed. The collection includes pure oils as well as processed products and industrial by-products. The majority of the samples is represented by five groups: soybean oil (SBo), animal fat (AF), acid oil (Ao), sunflower oil (SFo) and poultry oil (Po).

Oxidative status of lipids

The assessment of the oxidative quality was done by determination of two parameters: peroxide value for indication of ongoing oxidation and thiobarbituric acid value as a measure for historical oxidation. Results revealed that in almost two out of three lipid samples, oxidation was observed (Fig. 1).

Oxidation products were detected in 58% of soybean oil and 94% of sunflower oil samples, respectively. With regards to the animal fats, 48% of the samples were oxidised. Poultry oil was less sensitive to primary oxidation but showed in 39% of the samples to be previously exposed to oxidation.

41% of the acid oils, derived from industrial processing, were affected

Continued on page 28

Continued from page 27
by oxidation. The complex dataset confirms the importance of evaluation of these two parameters to proper estimate the oxidative quality of lipids.

Nutritional value of lipids

The nutritional value of all the lipid samples was determined as the apparent metabolisable energy (AME). Two different situations were considered: AME for young broilers (< 21 day old, YB) and older broilers (OB). The Wiseman Equation makes use of four empiric parameters (A, B, C and D), specific to species as well as age, and three specific chemical parameters: the degree of saturation expressed as the ratio between unsaturated and saturated fatty acids (U/S), the full fatty acid content (FFA, g/kg^{-1} fat) and the fatty acid chain length.

Due to the negative empirical value B, the formula gives a reduced energy value if there is an increase in FFA content. Also, empirical values C and D will have a negative impact on the energy value when in presence of saturated fatty acids.

Table 1 shows the energy values for young broilers found by the large scale LET assessment in comparison to the measured dietary energy values found in literature. The outcome shows a distinct difference between literature data and field data, clearly illustrating the importance of a thorough lipid evaluation. If not considered, it could easily result in an incorrect estimation of dietary energy in feed formulations.

Oil/fat	AME LET (kcal/kg^{-1})	AME LET incl. MIU (kcal/kg^{-1})	AME Literature (kcal/kg^{-1})
Soybean oil	7043-9299	4632-9002	8790
Animal fat	7541-9009	2121-8694	7484*
Acid oil	6487-9082	2702-8780	8100
Sunflower oil	8997-9262	7832-8985	8957
Poultry oil	7574-8647	6315-8016	8817

* Average energy value (kcal/kg^{-1}) value of tallow and lard

Table 2. Estimation of the metabolisable energy content of the five major lipid groups tested in the lipid evaluation test (older broilers).

Energy diluting components

Due to suboptimal processing, transportation, storing and handling of lipids, certain impurities such as moisture, insolubles and unsaponifiables (MIU) may increase within the fat source. As these do not provide an energy contribution, for an accurate result, a correction must be made in the calculation of the nutritional value of the lipid.

Extreme values of 54% moisture (animal fat) and 15.8% impurities (soybean oil) were documented during this field trial. In general, the unsaponifiable fraction brings the largest contribution to the MIU factor, especially in processed lipids like animal fats, poultry oil and industrial by-product acid oils; average values of 2.4, 2.3 and 5.1% were found respectively.

Inclusion of MIU in the nutritional value estimation, leads to an increase in energy variation.

Table 2 shows the energy values found for older broilers by the large scale LET assessment and the negative impact of energy diluting component MIU, in comparison to the measured dietary energy values found in literature.

Conclusion

The Lipid Evaluation Test enables us to make a more accurate assessment of the true quality and nutrient value of lipids used in poultry diets. It allows us to correctly estimate their metabolisable energy content and thus contribution to the bird's net energy requirements.

For evaluation of the oxidative status of fats or oils, two specific parameters, the peroxide and thiobarbituric acid value, are key to measure. The presence of energy diluting components such as MIU is also a measure of lipid quality, thus important to include in a LET. As these do not even provide a nutritional value, the AME calculation should be corrected.

The LET thus provides nutritionists and feed formulators with a suitable tool to get a full picture of the true nutritional profile of their chosen fats and oils in the diet, in order to minimise the potential variable results on animal performance and final product quality. ■