MAXIMIZING BROILER PRODUCTION GROSS INCOME

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OPTIMIZING NUTRIENT DENSITY

One of the challenges a broiler producer faces, is maximizing profit at least cost while ensuring a high broiler performance. One of the key factors of broiler performance when looking at feed is the dietary nutrient density. This nutrient density can be regulated by feed additives like hydrolyzed lecithin, better known as lysolecithins. Lysolecithins increase nutrient availability and reduce the need for high-density diets.

MINIMUM NUTRITION

Proper management of energy intake not only influences growth performance and feed digestibility but also affects the carcass traits and quality of the product. Usually, high-density diets are used to obtain high growth performances and improve feed conversion ratio (FCR) by reducing feed intake. However, as these diets are obtained by adding large amounts of oils and fats, they are rather costly and young animals like broilers produce insufficient amounts of bile salts and lipase needed for an efficient fat digestion of these high fat levels. Further increases in dietary density might only result in marginal improvements in performance that do not justify the costs anymore and can even lead to economic losses due to the excessive deposition of abdominal fat or metabolic disorders. As broilers eat with the goal of satisfying their energy requirements, high-density diets might lead to an insufficient intake of other key nutrients like protein and vitamins. Alternatively, lower dense diets are used to reduce feed costs but at the expense of broiler performance and product quality. Although, there is no clear conclusion yet on the discussion on optimal dietary density, it is clear that nutrient efficiency lies at the core of this discussion. This brings us to the concept of "minimum nutrition" which combines a reduced dietary nutrient density with the usage of digestive enhancers that enhance nutrient availability and utilization.

LYSOLECITHINS

Lysolecithins are natural biosurfactants that support the emulsifying action of bile acids, having both hydrophilic (water-soluble) and

lipophilic (fat-soluble) sides. This important feature enables lysolecithins to mix fat and water thereby promoting oil-in-water emulsions required for a proper fat digestion. Due to their structure, lysolecithins create finely dispersed emulsions containing small fat droplets. This creates a more hydrophilic environment needed for the optimal functioning of enzymes while providing more surface area for lipase to act on. Moreover, a more finely dispersed emulsion also reduces the barrier that fat forms for enzymes involved in starch and protein digestion, giving these enzymes better access to their substrates. By improving fat emulsification and raising the enzymatic potential of enzymes involved in fat, protein and starch digestion, lysolecithins increase nutrient digestibility. Additionally, lysolecithins create more stable and hydrophilic mixed micelles which transport the fat digestion products to the intestinal wall for absorption. Furthermore, lysolecithins act on a physiological level by altering the architecture and functioning of the intestinal membrane to support a higher nutrient absorption. Thereby, lysolecithins are efficient in increasing nutrient availability and utilization.

THE LAW OF DIMINISHING RETURNS

All biological processes react according to the law of diminishing returns. This law states that animal performance does not linearly increase with an increase in nutrient density. So, with each increase in nutrient density, the marginal benefit for growth performance decreases up to the point of maximum yield after which growth performance declines. As lysolecithins improve nutrient digestibility, they will increase the nutrient availability and thereby nutrient density. Lysolecithins support the animal in approaching its genetic potential following the law of diminishing returns.

TRIAL DESIGN

During a recent trial performed at a research facility in Thailand, the effect of FRA® LeciMax Dry on broiler performance (Cobb 500) with diets differing in nutrient density was tested. The product which is based on lysolecithins was given the entire trial period of 42 days. The broilers (±44 g) were divided over six treatment groups differing in energy level and supplementation of FRA® LeciMax Dry. A typical corn and soybean meal diet was used as a standard diet with soybean oil as a fat source. This diet had a metabolizable energy of 2908, 2986 and 3067 kcal per kg in the starter, grower and finisher phase, respectively. The higher nutrient densities were obtained by increasing the energy level through the addition of extra soybean oil (SBO) while reducing corn and soybean meal (Table 1).

Table 1. Experimental design

Treatment	Diet	FRA® LeciMax Dry (g/ton)
T1	Standard feed	-
T2	Standard feed	500
T3	SF + 25 kcal/kg	-
T4	SF + 25 kcal/kg	500
T5	SF + 100 kcal/kg	-
T6	SF + 100 kcal/kg	500

SF = Standard feed

TRIAL RESULTS

Increasing SBO level without adding FRA® LeciMax Dry improved growth performance slightly from T1 to T3 while there was no further improvement from T3 to T5. This indicated a maximum capacity of broilers to utilize the feed despite high nutrient availability and is in line with the law of diminishing returns (Table 2). In contrast, FCR was significantly reduced with T5 compared to T1 and T3, this was due to a significantly lower feed intake. When FRA® LeciMax Dry was added on top significant improvements in final body weight and body weight gain were observed between T1 and T2, and between T5 and T6. Both parameters were numerically improved with T3 and T4. These results indicate a better utilization of the higher availability of both energy and amino acids, the latter being often a limiting factor for growth in high fat diets as high fat levels compromise protein digestion. While the FCR did numerically and significantly decrease from T1 to T2 and from T3 to T4, respectively, adding FRA® LeciMax Dry to T5 did not further improve FCR in T6. This can again be explained by the law of diminishing returns. Moreover, the addition of FRA® LeciMax Dry on the lower nutrient dense diet (T2) yielded a similar growth performance as T3, T4 and T5. This means that a lower nutrient dense diet supplemented with lysolecithins can be used to prevent the high feed costs of a high-dense diet while maintaining growth performance.

Table 2. The effect FRA® LeciMax Dry of on broiler performance and nutrient density (day 0-42)

Treatment	FRA® LeciMax Dry	Final BW (g)	BWG (g)	FI (g)	FCR	Livability (%)	ND
T1	-	3463.9^{c}	3420.2^{c}	5383.5^{a}	1.574^{ab}	95.8	139.8
T2	+	3525.8^{ab}	3482.1^{ab}	5455.3^{a}	1.567^{ab}	97.2	143.9
T3	-	3488.2^{bc}	3444.5^{bc}	5428.6^{a}	1.576^{a}	95.8	140.9
T4	+	3509.7^{bc}	3466.0^{bc}	5400.0^{a}	1.558^{b}	95.1	145.1
T5	-	3485.3^{bc}	3441.6^{bc}	5284.6^{b}	1.536^{c}	96.5	144.4
T6	+	3572.8^{a}	3529.1^{a}	5435.1^{a}	1.540^{c}	95.8	148.6

BW: body weight; BWG: body weight gain; FI: feed intake; FCR: feed conversion ratio; ND: nutrient density.
^{a,b,c} Means within a column with no common superscript differ significantly (P<0.05).

The nutrient density in this trial was increased by the addition of soybean oil and/or FRA® LeciMax Dry. For each energy level, the nutrient density increased by 3.0% when adding FRA® LeciMax Dry on top confirming the higher nutrient availability. The broiler performance tended to be higher with a higher nutrient density. Following the law of diminishing returns, a decrease in marginal performance with the highest energy level was expected. However, as the results show this was not the case indicating that the maximum performance was not yet obtained within this nutrient density range.

Furthermore, as the nutrient density increased, gross income decreased. This is shown in Figure 1, where increasing the nutrient density solely by increasing the SBO levels resulted in a decrease in gross income per broiler. However, when lysolecithins were added, both nutrient density and performance increased because of higher energy and amino acids availability. This resulted in a higher economic output than with SBO alone. However, the extra benefit of FRA® LeciMax Dry decreased with T6 as compared to T2 and T4 even though T6 yielded a higher performance. This can be explained by the law of diminishing returns in which marginal returns become smaller as nutrient density increases.

This trial showed that it is more profitable to increase nutrient density with a combination of SBO and FRA® LeciMax Dry instead of SBO alone. Despite the fact that a maximum performance was not reached as indicated by the significant growth difference between T5 and T6, this was not the case for the gross income per broiler as Figure 2 shows. Based on the circumstances of these trial and the trial data, the maximum economical return would be obtained at a nutrient density of 146 with the addition of FRA® LeciMax Dry. This means that the energy level of this typical diet only can be increased by a level between 25 and 100 kcal/kg when FRA® LeciMax Dry at 500 g/ton is added to obtain the highest profit.

In conclusion, this trial confirmed that increasing nutrient density leads to improvements in growth performance and FCR but only to a certain point due to the limited capacity of broilers to utilize high-dense diets. After this point, it is necessary to add a digestive enhancer like lysolecithins to further optimize the feed utilization. Moreover, this trial showed that it is economically more interesting to add FRA® LeciMax Dry on top than adding more soybean oil in order to increase nutrient density, following the concept of "minimum nutrition". This enables a higher nutrient efficiency while maintaining growth performance.

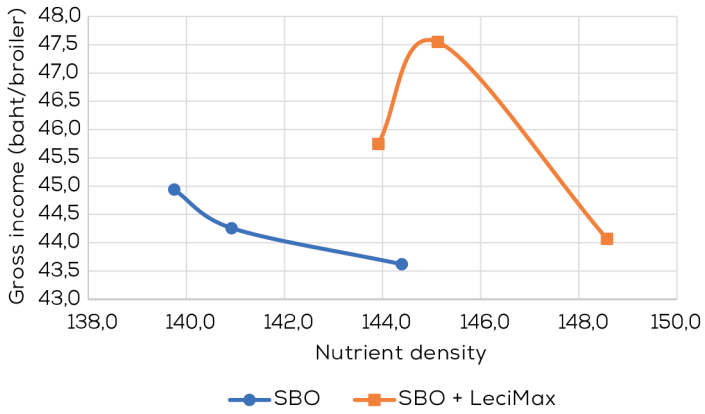

Figure 1. *The effect of nutrient density on gross income when only soybean oil (SBO) or both SBO and FRA® LeciMax Dry are added to increase nutrient density*

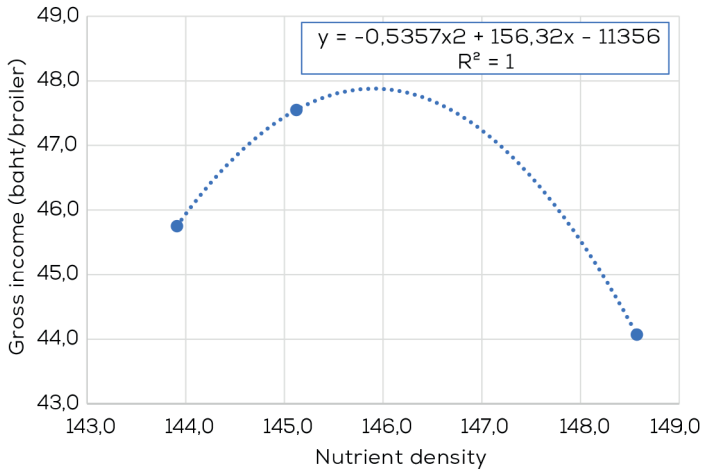

Figure 2. *The quadratic relation of nutrient density and gross income when soybean oil and FRA® LeciMax Dry are added to increase nutrient density*