

Broiler diets formulated without restriction in protein levels supplemented with commercially available amino acids

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Introduction

Although corn and soybean meal are excellent ingredients, they do not provide an exact balance of all amino acids to meet the absolute amino acid requirements (no deficiency or excess) for poultry. These feedstuffs contain high amounts of leucine and phenylalanine + tyrosine, but at the same time, they are deficient in others, such as lysine and methionine. Thus, diets formulated based on corn and soybean meal, meeting the requirements of the first limiting amino acid without commercially available amino acids supplementation, have excessive levels of essential and non-essential amino acids with protein levels above broiler requirements. The excess of amino acids cannot be stored, being respectively degraded and deaminated.

Diets supplemented with commercially available amino acids

After deamination, excess nitrogen is eliminated as uric acid, with high metabolic energy expenditure. Uric acid synthesis requires more ATP and organic carbon than urea (Steven, 1996). For instance, the uric acid biosynthesis from a ribose requires a total of 4.5 ATP per nitrogen, whereas 2 ATP per nitrogen is required for urea synthesis (Mapes and Krebs, 1978). Diets supplemented with commercially available amino acids, without considering a minimum of protein, is a practical strategy to reduce excess amino acids and nitrogen excretion, while supporting broiler performance and litter quality (Ospina-Rojas et al., 2014, Van Harn et al., 2019). It has been long known that is required to formulate broiler diets to meet amino acid requirements, not protein needs. The amount of dietary protein does not provide any indication of the nutritional value of a protein. The nutritional value of a protein depends on the amino acid composition it contains. Thus, diets with high protein do not guarantee that the birds are fed with adequate amino acids levels to meet their requirements and express their full genetic potential.

Lately, the raw material has been increased considerably impacting the poultry feed costs. Diet cost turned from USD 260/MT of feed in 2019 to USD 315/MT of feed in 2021 considering the current raw materials price in diets formulated exclusively with vegetable proteins (Figure 1). Clearly, it is increasingly important not to waste the protein portion of the diet, one of the most expensive ingredients in broiler diets. Therefore, from a nutritional and economic point of view, the adequate use of dietary amino acids is essential in all phases of production, otherwise, the inappropriate use increases production costs and environmental pollution as well as heat increment of birds.

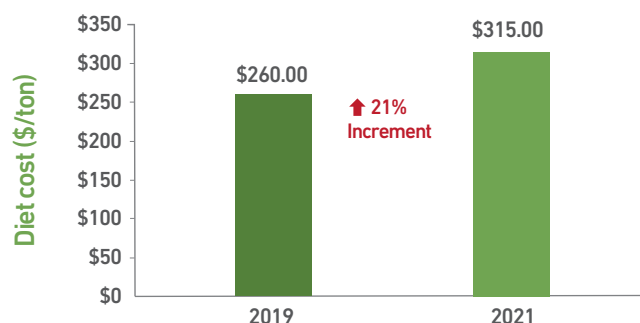


Figure 1. Feed cost changing with the raw materials price increment

Diets formulated without a minimum protein and supplemented with commercially available amino acid reduce the diet cost and nitrogen content in excess (Table 1). Valine (Val), arginine (Arg), and isoleucine (Ile)-supplemented diet without protein restriction reduces diet cost in USD 3 per ton of grower feed.

How much feed are your company producing per month?

Company with 20,000 tons of feed/month

Feed cost reduction = - USD 3/ton

Represents a saving of **USD 60,000/month**

Or

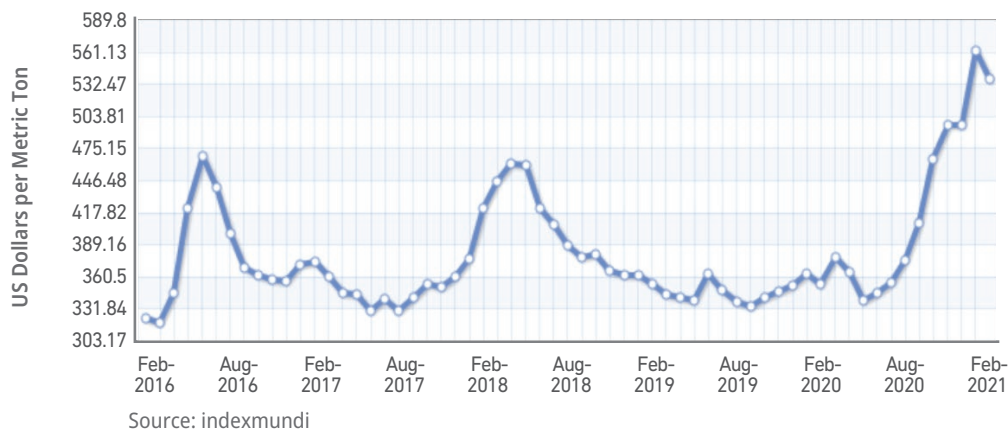
USD 720,000/year

Table 1. Ingredients and nutrient composition of broiler grower diets supplemented commercially available amino acid (11 to 24 d, as-fed basis).

Ingredients, %	Val, Arg, and Ile-supplemented diet	No Val, Arg, and Ile supplementation	Diff (Impact of no Val, Arg, and Ile supplementation)
Corn	56.5	50.9	
Soybean meal 45%	28.9	35.9	
Soybean meal oil	4	5	
DDGS	5	5	
L-Lys HCl	0.35	0.15	
L-Met	0.34	0.29	
L-Thr	0.13	0.05	
L-Val	0.1	---	
L-Arg	0.18	---	
L-Ile	0.06	---	
Other	4.44	2.71	
Cost (\$/ton)	315	318	+ USD 3
Calculated composition			
Crude protein (%)	19.7	21.5	+1.8%
AME (kcal/kg)	3,100	3,100	
SID Lys (%)	1.15	1.15	
SID TSAA/Lys	76	76	
SID Thr/Lys	67	67	
SID Trp/Lys	18	21	+3
SID Ile/Lys	68	72	+4
SID Val/Lys	76	76	
SID Arg/Lys#	115	115	
SID Leu/Lys	134	145	+11
Calcium (%)	0.87	0.87	
Available P (%)	0.44	0.44	
Sodium (%)	0.2	0.2	

Cj recommendations

The soybean meal price is at the highest in 5 years (Figure 2). A small dietary supplementation of less limiting amino acids such as Val, Ile, and Arg reduces soybean meal inclusion impacting positively dietary cost bringing out a good performance and health improvements. It is important to note that Arg is considered a functional amino acid as it participates in and regulates key metabolic pathways to improve the health, growth, development, and reproduction of animals (Wu, 2013). On another hand, Val and Ile are considered essential amino acids necessary for tissue maintenance and growth, belonging to the group of branched chain amino acids (BCAAs). It has been well known that BCAAs are not only substrates for building block protein, but they are also involved in intracellular signaling pathways on protein anabolism and stimulatory effects on protein synthesis by modulating the activation of mTOR and its downstream effectors (Suryawan et al., 2008).



**Figure 2. Historical prices of soybean meal in 5 years
(Soybean meal monthly price- US Dollars per Metric Ton, Feb 2016- Feb 2021 : 214.060 (66.21%))**

Benefits of diets formulated without restriction in protein levels and supplemented with the less limiting amino acids

- Saving in feed costs reducing protein sources inclusion.
- Amino acid content closer to broiler requirement reducing nitrogen excretion and metabolic energy expenditure (Aletor et al., 2000).
- Due to the less metabolic energy expenditure, lower is the heat increment and water intake (Alleman and Leclercq, 1997).
- A lower water intake reduces the risk of wet litter reducing the probability of footpad dermatitis, hock burns, and breast blisters (Van Harn et al., 2019).
- Fewer metabolites produced by bacteria metabolism from amino acids in excess in the gut improving intestine health (Zhou et al., 2020).
- Lower ammonia emissions from the litter (Ospina-Rojas et al., 2014), which might reduce birds' susceptibility to respiratory diseases considering that even low ammonia concentrations can cause irritation to the mucous membranes of the respiratory system (Kristensen and Wathes, 2000).

Conclusions

There is a cost-saving opportunity with the dietary use of the less limiting amino acids such as valine, isoleucine, and arginine. If only one essential amino acid is missing, the biological value of the protein is low. Diets formulated without restriction in protein levels result in an amino acid content closer to the broiler requirement improving the dietary amino acid profile.

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