



Dietary crude protein reduction improves performance in poultry

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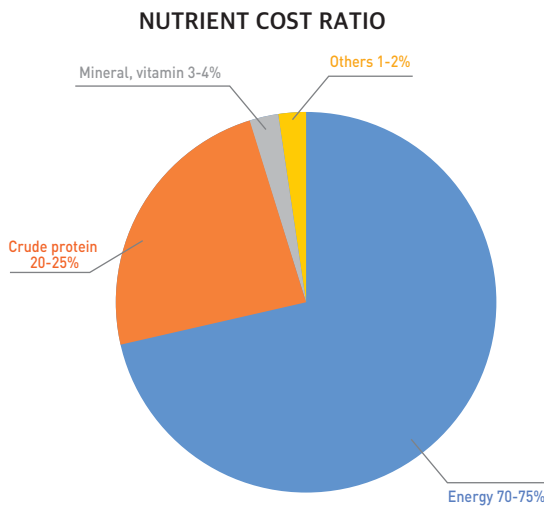
■ Overview

Feed cost minimization, environmental concern and antibiotics banning as growth promoters are consistently driving poultry nutritionists to improve the efficiency of feed utilization by formulating digestible, practical diets to avoid overfeeding with nutrients. Over the past few decades, numerous studies have been published on the use of synthetic amino acids (AA) in low protein (LP) diets with a number of potential benefits:

- Saving feed cost
- Improving gut health
- Improving nutrient digestion and absorption
- Reducing the nitrogen excretion and ammonia emission from broiler houses
- Reducing water intake, reducing the risk of wet litter
- Reducing heat stress

■ Dietary crude protein reduction saves feed cost

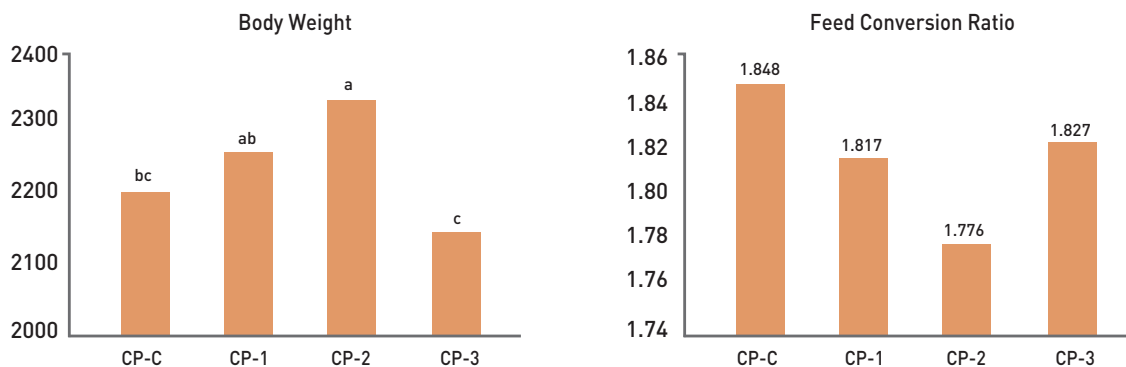
Meeting the nutritional requirements for growing birds constitutes the majority of costs associated with poultry production, constituting up to 70 percent of the total with about 95 percent is used to meet energy and protein requirements (Ravindran, 2013). Protein feedstuffs are consistently increasing in cost, a trend that has been exacerbated. Therefore, interest in feeding low-protein diets to poultry have increased in recent years. Using the ideal protein concept, reducing the level of crude protein (CP) in the diet, it is possible to achieve significant cost savings. Firman (1994) reported that it is possible to save five dollars per ton of feed by reducing the protein level in the diet of turkeys by one percent. In addition, calculation of the final profit based on the research of Van Harn et al. 2019, supplementation of amino acids in a 3% of CP reduction diet results in a higher economic effect than the control diet with a profit of 0.106 \$/bird.



Indexes	Control	CP-1%	CP-2%	CP-3%
Feed price (\$/kg)	0.45	0.445	0.441	0.437
Feed intake (kg)	3.682	3.689	3.626	3.637
Total feed cost (\$/bird)	1.657	1.642	1.599	1.589
Save cost (\$)		0.015	0.058	0.068
Live weight (kg)	2.416	2.431	2.447	2.448
Carcass price (1.2\$/kg weight)	2.899	2.917	2.936	2.938
Additional profit (\$)		0.018	0.037	0.038
Total additional profit (\$/bird)		0.033	0.095	0.106
1 million birds farm profit (\$)		33,295	95,034	105,931

■ Dietary crude protein reduction improves performance

Protein nutrition is an important nutritional indicator in rearing birds that has a direct effect on production health and product quality. But we need to be aware of that protein nutrition is actually amino acid nutrition because amino acids are the basic constituents of proteins. Ullrich et al. 2018, who reported that comparing to the control diet, feeding a diet with a 2 percent reduced protein content with the amino acid supplementation led to higher body weights and lower feed conversion ratio with 6% and 4%, respectively at day 35. In addition, it is also reported that broilers fed the CP-2% or CP-3% feeding program had an improved feed conversion ratio (van Harn et al., 2019).



■ Dietary crude protein reduction improves gut health

Intestinal health is vital importance for digestion, absorption, barrier function and homeostasis in the body. High protein diets might have negative effects on gut health and performance (Qaisrani et al., 2015; Apajalahti and Vienola, 2016).

Protein that was not digested up to the end of the small intestine can potentially be fermented by putrefactive bacteria in the caecum. Putrefaction produces many harmful and toxic compounds like amines, indoles, phenols, cresol and ammonia, which in high concentrations may have adverse effects on chicken growth and performance (Apajalahti and Vienola, 2016). Therefore, reduction of the protein bypassing the small intestine, by reducing the dietary CP content, might reduce the production of toxic protein fermentation metabolites in the caeca which then improves birds' gut health.

■ Dietary crude protein reduction reduces wet litter, footpad lesions, and nitrogen excretion

Feeding birds with high CP can result in an increase of the litter moisture and nitrogen content. It is well known that the most important factor causing footpad lesions is considered to be wet litter. It is reported that the incidence of footpad lesions decreased linearly with the reduction of the dietary CP content (Shepherd and Fairchild, 2010). The author also indicated that broilers fed the control feeding program had the lowest scores for litter quality and the highest footpad scores.

In addition, the moisture content of manure was one of the main factors contributing to the microbial activity in manure, and thus in the transformation of excreted nitrogen into ammonia (Méda et al., 2011), an element lead to the environmental issues arisen from intensive livestock production (Morse, 1995). Previous studies indicated that reducing dietary CP result in a decrease of the litter moisture and nitrogen content (Ferguson et al., 1998; Belloir et al., 2017; Kamran et al., 2010). This reduction in moisture content may be due to a lower water intake and water excretion by broilers fed the low CP diets (Alleman and Leclercq, 2007; Hernández et al., 2012). Francesch và Brufau also reported that the decrease in dietary CP was associated with a lower use of soyabean meal, which is very rich in potassium.

A decreased potassium content in the diet can lead to a lower water intake (Alleman and Leclercq, 2007; Francesch and Brufau, 2004). Indeed, several studies have shown a reduction in nitrogen excretion (Aletor et al., 2000; Bregendahl et al., 2002;) and water intake (Elwinger and Svensson, 1996; Alleman and Leclercq, 2007) by about 10% and 3% respectively with a 1 percentage point decrease in the dietary CP content in broilers.

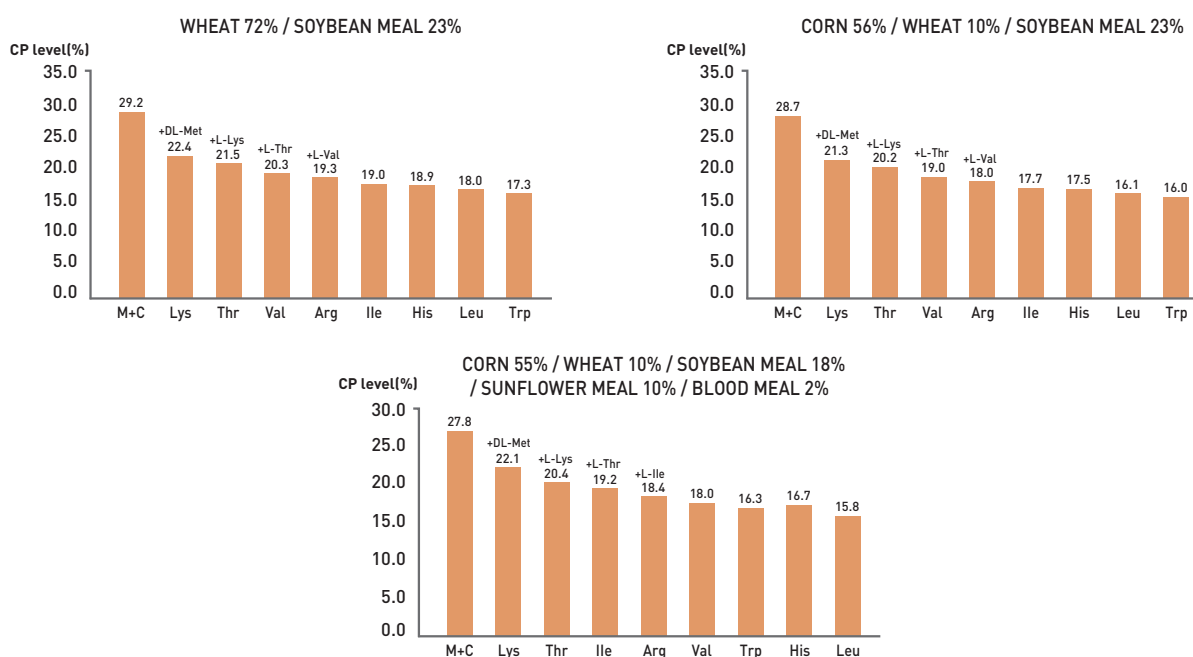
■ Dietary crude protein reduction reduces heat production

Periods of high environmental temperatures, often accompanied by high relative humidity, are common during summer in temperate regions or in a tropical climate (Awad et al., 2014). Heat stress can profoundly affect the productivity of a flock. Musharaf and Latshaw, (1999) who reported that protein ingestion cause a greater increase in heat production than carbohydrates or fat. It is well known that LP diets as a means of reducing metabolic heat production associated with protein catabolism (Awad et al., 2017). It is reported that providing heat-stressed broilers with dietary CP higher than their requirements was detrimental to weight gain, feed efficiency, and carcass composition (Cheng et al., 1997). In laying, heat stress is often overlooked as a cause for poor growth or subtle losses in egg production and shell quality. Previous researches reported that dietary protein reduction in heat-stressed chickens with adequate fortification of several essential amino acids may improve performance in broiler (McNaughton et al., 1978; Zaman et al., 2008).

■ What is the next limiting amino acid in dietary crude protein

To reduce dietary CP levels in poultry feed, it is necessary to know which indispensable amino acids become limiting in diets and what is the requirements of the broilers for particular amino acids. The usage of feed use amino acids (methionine sources, L-lysine sources, L-threonine) in broiler feed is well established. Depending on the requirement assumed for each amino acid, valine, isoleucine, tryptophan and arginine are generally considered as the next limiting amino acids in broiler feed.

Indeed, chosen feed ingredients in feed can impact the order in which amino acids become limiting in diets due to the diffidence of amino acid content among feed ingredients. Corrent and Bartelt (2011) indicated that valine is the diffidence of 4th limiting amino acid in vegetable broiler diets based on wheat or corn. Isoleucine becomes the 4th limiting amino acid, when blood cells or blood meal are used in formulations.



Source: Corrent and Bartelt (2011)

Conclusion

Formulating the dietary crude protein reduction with amino acid balance that meet poultry nutrient requirement is considered as a promising method to improve poultry production efficiency and bring economic benefits to farmers, increase animal welfare, as well as reducing environmental pollution.

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