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Formulation of Broiler Diets with No CP Minimums

Most broiler operators believed that broiler starter required 22 – 23 % crude protein, grower, 20 – 22% and finisher, 18 – 20%, for optimum performance. Even the government standard agency, SIRIM (1999), issued feed specifications guidelines for poultry with a minimum for crude protein. Because of this, practicing formulators tried to out-do each other by "pumping" in as much crude protein as economically viable to satisfy their clients' requirement.

Contrary to the broiler operators' belief, mono-gastric animals like chicken did not have a requirement for crude protein (CP) *per se*. Their requirement was for amino acids (AA) or more specifically, for digestible essential amino acids (DEAA). Because of this, it was better to formulate broiler feeds to meet the DEAA requirements rather than CP and/or total amino acids (TAA).

The notion of formulating diets with digestible amino acids (DAA), based on ideal protein concept, was nothing new. Broiler diets had been formulated by commercial feed-millers to meet minimum DEAA since true ileal digestibility coefficient of amino acids for the major feed raw materials became available. This, however, was done without removing the CP minimums.

This switch to formulate diets to meet minimum DEAA with no restriction on CP minimums had its advantage. When restriction of CP minimums was imposed, excess CP or AA, which could not be utilized by the chicken, had to be eliminated and this process required energy which could be better utilized for productive purposes.

How does one go about formulating diets with no minimum CP without compromising on the live performance and carcass quality?

Jiang (2008) recommended that broiler feeds should be formulation with minimums on 7 DEAA in order to attain a well balanced diet with no minimum on CP. The 7 were Lysine, Methionine+Cystine, Threonine, Tryptophan, Arginine, Isoleucine and Valine.

It was well established that the first 3 limiting DEAA in practical broiler diets were Lysine, Methionine+Cystine and Threonine. The 4th limiting DEAA, however, varied depending on the type of grain and other raw materials used in the feeds (Table 1)

Table 1 Fourth limiting DEAA in various types of broiler feeds

Dietary Type	**4th Limiting DEAA in Broiler Feeds**
Corn – SBM	Valine
Corn – SBM – Poultry Meal	Isoleucine
Corn – SBM – Meat Meal	Tryptophan
Wheat – SBM	Valine
Wheat – SBM – Poultry Meal	Isoleucine
Wheat – SBM – Meat Meal	Isoleucine
Sorghum – SBM	Arginine
Sorghum – SBM – Poultry Meal	Arginine
Sorghum – SBM – Meat Meal	Arginine

Because feed grade L-Lysine, DL-Methionine and L-Threonine were readily available, it was rather easy to formulate to meet the minimum specifications of these three AA. However, in real commercial situation, this was not the case because, diets could be deficient in other DEAA depending on types of feed ingredients used (Table 1).

No feed grade Arginine, Isoleucine and Valine were available yet. As such, these DEAA had to be drawn from feed raw materials like soybean meal and cereal grains, to meet the minimum specifications. Once the minimums of these 4th limiting DEAA were satisfied, such feeds would contain more than sufficient amount of other DEAA and non-DEAA for the chicken. Hence, there was no need to set minimum on CP if diets were formulated to meet the minimums of these seven DEAA.

Jiang (2008) was of the opinion that formulating broiler feeds with DEAA without CP minimums could lower the CP content of feeds. This would help to reduce nitrogen excretion to the environment, thus lower the pollution load. Besides, these feeds could also be lower in cost, thus could help to generate more profit while maintaining live performance for the farm operators.

To confirm the above notion, Jiang (2008) conducted a broiler trial in Bangkok Animal Research Center (BARC) using male Cobb-500 birds. In the trial, these birds were grown to 42 days of age in a closed house equipped with evaporative cooling system. Two sets of diets were formulated to meet the minimums of the seven DEAA with or without minimums on CP. Test diet formulations and nutrient composition were shown in Table 2.

Table 2 Composition and calculated nutrient contents of experimental diets

		Starter (Day 0 – 21)		Grower (Day 22 -35)		Finisher (Day 36 – 42)	
With (W) or Without (WO) CP minimum	**Unit**	**W**	**WO**	**W**	**WO**	**W**	**WO**
Feed Composition							
Corn	%	41.63	44.27	33.17	36.20	35.78	40.37
Cassava Chips	%	5.00	5.00	10.00	10.00	10.00	10.00
Rice Bran, full fat	%	5.00	5.00	10.00	10.00	10.00	10.00
Full fat SBM	%	8.00	8.00	16.29	13.74	12.52	8.66
SBM 47% CP	%	28.49	26.07	17.65	16.98	18.04	17.03
Fish Meal, 60% CP	%	2.00	2.00				
Rapeseed Meal, 33.7%	%	3.00	3.00	5.00	5.00	5.00	5.00
Soybean Oil	%	3.16	2.78	4.00	4.00	5.00	5.00
L-Lysine HCl	%	0.17	0.24	0.15	0.23	0.11	0.23
DL-Methionine	%	0.27	0.29	0.24	0.26	0.20	0.23
L-Threonine	%	0.05	0.08	0.04	0.08	0.03	0.08
MCP 15/21	%	1.24	1.27	1.38	1.42	1.32	1.39
Limestone, 39.7%	%	1.07	1.08	1.20	1.21	1.15	1.16
Salt	%	0.42	0.42	0.37	0.38	0.36	0.36
Premix	%	0.50	0.50	0.50	0.50	0.50	0.50
Total		100.00	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition							
Weight	unit	1.00	1.00	1.00	1.00	1.00	1.00
Dry Matter	%	88.29	88.23	88.56	88.53	88.60	88.55
ME for poultry	Kcal/kg	2900	2900	3000	3000	3050	3050
Crude Protein	%	22.50	21.72	20.00	19.16	19.00	17.73
Dig. Lys (poultry)	% calc	1.24	1.24	1.07	1.07	0.98	0.98
Dig. M+C (poultry)	% calc	0.92	0.92	0.81	0.81	0.75	0.75
Dig. Thr (poultry)	% calc	0.81	0.81	0.71	0.71	0.66	0.66
Dig Try (poultry)	% calc	0.22	0.21	0.19	0.18	0.18	0.17
Dig. Arg (poultry)	% calc	1.40	1.33	1.24	1.17	1.18	1.07
Dig. Val (poultry)	% calc	0.97	0.93	0.85	0.82	0.82	0.76
Dig. Ile (poultry)	% calc	0.88	0.84	0.76	0.72	0.73	0.66
Lysine	%	1.38	1.37	1.20	1.21	1.11	1.10
Met + Cys	%	1.01	1.01	0.91	0.91	0.85	0.84
Threonine	%	0.91	0.91	0.82	0.81	0.76	0.75
Tryptophan	%	0.26	0.25	0.23	0.22	0.22	0.20
Arginine	%	1.52	1.45	1.36	1.29	1.29	1.17
Valine	%	1.08	1.04	0.97	0.92	0.93	0.86
Isoleucine	%	0.97	0.93	0.86	0.81	0.81	0.74
Calcium	%	0.90	0.90	0.88	0.88	0.84	0.84
Phosphorus - avail	%	0.45	0.45	0.42	0.42	0.40	0.40
Sodium	%	0.20	0.20	0.17	0.17	0.16	0.16
Stored Feed Cost	**Thb/T**	**12156**	**11996**	**11761**	**11586**	**11586**	**11302**

Based on raw material prices in November, 2007, in Thailand.

Table 2 showed that, when CP minimums were removed, feed unit cost reduced by 160, 175 and 266 Thai Bahts per ton, or approximately RM16.00, 17.50 and 26.20/ ton, for starter, grower and finisher diets, respectively.

The birds grew to an average weight of 2887g with an average FCR of 1.64 on day 42. This growth performance was better than breed standard (2839g average weight and 1.70 FCR).

On day 21 (end of starter phase), there was no difference in average body weight of birds on diets with or without CP minimums, however, FCR was significantly (P<0,05) poorer in birds fed diet without CP minimum. No explanation was given by Jiang in his paper. Poorer FCR was still apparent during the growing phase. The difference, however, was not significant and was equalized during the finishing phase when the average body weight of birds fed diets without CP minimum overtook those birds on diets with CP minimums. By the time the birds reached the market, neither live body weight nor FCR was different between birds fed diets with or without CP minimums.

Total mortality and cull rates were low and not affected by dietary treatments (Table 3).

Table 3 Live performances of broiler birds fed diets formulated with or without CP minimums

Parameter	**Dietary Treatment**	**Day 21**	**Day 35**	**Day 42**
Body weight, g	W CP min	910	2236	2880
	W/O CP min	911	2220	2894
FCR	W CP min	1.26^{b}	1.51	1.64
	W/O CP min	1.28^{a}	1.53	1.64
Mortality & culls, %	W CP min	1.52	3.53	3.53
	W/O CP min	1.52	1.52	2.03

a-b : differ significantly at P<0.05

Between the two treatment groups, the differences in the dressing percentage, breast meat yield, thigh, drum stick and wing on day 42 were not significant (Table 4). However, fat pad was significantly bigger in birds fed diets with no CP minimum (P<0.05), indicating that the birds might be more efficient in utilizing ME when fed diets with CP minimums.

Table 4 Dressing percentage and part yields on day 42 of birds fed diets formulated with or without CP minimums.

	With CP minimums	Without CP minimums
Dressing, %	82.80	83.20
Breast meat yield, %	24.14	24.17
Thigh, %	15.89	15.71
Drum stick, %	12.27	12.16
Wing, %	9.04	9.06
Fat pad, %	1.60[a]	1.79[b]

[a-b] : differ significantly at P<0.05

This trial demonstrated that when broiler diets are formulated with seven DEAA by adhering to the ideal protein concept, there is no need to set CP minimums. The issue of over formulating with CP and the concern on heat increment to eliminate excessive nitrogen can then be avoided. Besides, removing CP minimums could save feed cost (Table 2) with no deleterious effect on live performance, dressing percentage and part yields. This could mean better profitability to the broiler operations and less pollution to the environment.

References:

1. Jiang, Zhirong, 2008. Formulate Broiler Diets with Digestible Amino Acids. Paper presented at Soybean Meal Quality Conference, 4 – 5 August, 2008 in Bangkok.

2. SIRIM, 1999. Specifications for Poultry Feeds – MS 20: 1999, 3rd Revision.