
SOON SOON OILMILLS TECHNICAL BULLETIN

Issue No. TB 15-01/2009 (Malaysian Edition)

Formulate Diets with Digestible Amino Acids



SOON SOON OILMILLS SDN BHD (37441-T)

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Formulate Diets with Digestible Amino Acids

For lack of information on digestibility coefficient of feed ingredients, many feed formulators continue to formulate feeds based on total amino acid (TAA) specifications and this could have negative impact on their production performance.

It is a known fact that not all amino acids (AA) in feeds can be digested by chicken. This is because AAs in feed ingredients are not 100% digestible. Variations in AA digestibility occur not only among different types of ingredients, but also different batches or sources of the same type of raw materials. Examples of this variation within the same type of ingredients like soybean meal are shown in Table 1:

Table 1 Digestibility of Amino Acids for Soybean Meals using IDEA

Novus IDEA Digestibility Coeff.	Lys	Met	M + C	Try	Thr	Arg	Ile	Val
Soon Soon	94.0	97.6	98.4	99.0	95.0	96.5	97.8	96.0
USA	92.9	96.0	96.7	99.1	93.6	95.5	96.2	94.3
Argentina	92.7	95.7	96.3	99.0	93.4	95.3	95.9	94.0
India 1	92.8	95.8	96.5	99.1	93.5	95.5	96.1	94.2
Thailand	91.6	94.1	94.6	99.0	92.1	94.4	94.3	92.4
India 2	92.3	95.1	95.7	99.1	92.9	95.0	95.0	93.5

Source: Novus International Inc, 2008

Using Immobilized Digestibility Enzyme Assay (IDEA), it was found that among six samples assayed, digestibility of lysine in soybean meals was highest at 94% for Soon Soon and lowest at 91.6% for sample from Thailand (Joardar, Schulz & Dowell, 2008). Similarly, digestibility of methionine was highest at 97.6% for sample from Soon Soon and lowest at 94.1% for sample from Thailand. Except for tryptophan, variations in digestibility were also found with other AA like threonine, arginine, isoleucine and valine assayed.

The variations in AA digestibility among different feed ingredients were even greater. Summary in Table 2 (compiled by Dr Creswell) indicated that mean lysine digestibility ranged from 50% in coconut meal to 91% in soybean meal (48% crude protein).

Table 2 Digestibility coefficients of amino acids for poultry compiled by Dr Creswell

Ingredient	Lys	Met	M+C	Trp	Arg	Thr	Ile	Val
Corn	85	94	93	80	95	88	92	92
Rice, brown	80	90	88	91	92	84	86	86
Sorghum	87	90	88	79	95	89	93	90
Wheat	84	90	91	97	87	83	90	88
Wheat bran	81	80	75	84	87	79	82	82
Wheat midds	71	84	73	84	88	75	82	82
Corn gluten feed	70	84	75	75	88	75	82	82
Corn gluten meal	88	96	91	85	95	91	94	94
Rice bran, extracted	73	77	72	79	86	68	74	75
Rice bran, full fat	74	78	72	79	86	69	75	76
Lupins	89	84	85	90	93	87	91	88
Peas	82	80	75	85	86	81	84	82
Rapeseed full fat	87	80	80	82	92	80	85	85
Rapeseed meal	78	87	84	80	89	84	87	88
Soybean, ffat, extr.	88	86	81	84	91	85	87	86
Soybean ffat, toasted	81	82	79	80	85	79	79	77
Cottonseed meal	63	72	71	80	85	67	73	76
Groundnut meal	78	86	82	76	89	83	89	89
Sbm 44	91	91	86	88	91	84	91	89
Sbm 48	91	92	88	88	93	88	92	91
Sunflower meal	80	91	85	88	93	83	89	86
Fishmeal 60-63	88	92	83	88	92	89	92	91
Fishmeal 65	89	92	89	90	93	91	93	92
Blood meal	89	92	86	89	89	89	83	90
Feather meal	65	74	68	83	83	73	86	82
Mbm (hi quality)	85	88	77	82	89	84	87	86
Mbm (lo quality)	76	80	69	74	81	76	79	78
Canola meal	79	89	81	83	89	78	89	81
Coconut meal	50	84	69	51	84	63	77	79
DDGS	68	86	82	84	85	75	82	81
Poultry meal	83	89	81	80	90	84	88	87
Sesame meal	88	94	88	80	92	87	92	91
Palm kernel meal	59	84	75	75	89	69	81	80

Values are taken largely from Ajinomoto "True Digestibility of Essential Amino Acids for Poultry"

In feed formulation, it is generally assumed that digestibility is 100% for crystalline AA such as feed grade L-Lysine, L-Threonine and DL-Methionine, which are widely used in commercial broiler rations today.

Large variations in digestibility of AA in feed ingredients made the practice of formulation based on TAA inconsistent. This is because when diets were formulated based on TAA, one ignores variations within same type and among different types of feed ingredients by assuming that all feed ingredients, including feed grade AA, had the same AA digestibility of 100%. Such assumption in formulation based on TAA leads to inaccuracy in evaluation and use of feed raw materials. Formulation based on TAA, while satisfying the TAA specifications, also leads to inconsistent and imbalanced DAA levels in feeds when different types of feed raw materials are used. This was demonstrated by Jiang (2008) in Table 3.

Table 3 TAA and DAA content of 4 broiler grower diets formulated on TAA basis

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
Corn	62.32	55.21	47.92	39.97
Soybean meal 47%	29.61	25.71	21.99	19.61
Soybean oil	3.83	4.93	6.05	6.64
DCP, salt, limestone, premix	3.70	3.63	3.54	3.32
L-Lysine	0.25	0.26	0.27	0.30
DL-Methionine	0.24	0.21	0.19	0.15
L-Threonine	0.05	0.04	0.04	0.01
Rice bran 13.8%		5.00	10.00	10.00
Rapeseed meal 33.7%		5.00	10.00	10.00
DDGS 27.7%				10.00
Total Amino Acids content				
Total Lysine, %	1.20	1.20	1.20	1.20
Total M + C, %	0.88	0.88	0.88	0.88
Total Threonine, %	0.78	0.78	0.78	0.78
Total Tryptophan, %	0.21	0.21	0.22	0.22
Total Arginine, %	1.27	1.26	1.26	1.26
Total Isoleucine, %	0.83	0.81	0.80	0.83
Total Valine, %	0.92	0.93	0.94	0.98
Total Amino Acids to Total Lysine Ratios				
M+C/Lysine	73	73	73	73
Threonine/Lysine	65	65	65	65
Tryptophan/Lysine	18	18	18	18
Arginine/Lysine	106	015	105	105
Isoleucine/Lysine	69	68	67	69
Valine/Lysine	77	78	78	82
Digestible amino acid content				
Digestible Lysine, %	1.08	1.07	1.05	1.04
Digestible M + C, %	0.79	0.72	0.65	0.63
Digestible Threonine, %	0.66	0.66	0.65	0.64
Digestible Tryptophan, %	0.18	0.18	0.18	0.18
Digestible Arginine, %	1.15	1.14	1.13	1.10
Digestible Valine, %	0.82	0.82	0.82	0.85
Digestible Isoleucine, %	0.68	0.67	0.67	0.69
Digestible amino acid to Digestible Lysine Ratios				
Dig M+C/Lysine	73	*67	*62	*61
Dig Threonine/Lysine	*61	*62	*62	*62
Dig Tryptophan/Lysine	17	17	17	17
Dig Arginine/Lysine	106	107	108	106
Dig Valine/Lysine	76	77	78	82
Dig Isoleucine/Lysine	*63	*63	*64	66

* Ratios lower than recommended values

In Table 3, four broiler grower diets were formulated on TAA basis to the same minimum TAA specification (Jiang, 2008). Diet 1 was a straight corn-soybean meal based diet, while Diets 2 to 4 contained different levels of rice bran, rapeseed meal and DDGS in addition to corn and soybean meal.

In Table 3, it was clearly shown that, on TAA basis, the AA levels of all 4 diets met or exceeded the specification/requirement. However, on digestible basis, it was found that digestible lysine levels were reduced as more by-products were included. Diet 4 contained 4% less digestible lysine than Diet 1. Similarly, digestible methionine, cystine and threonine were also lower in diets 2, 3 and 4 as more by-products were included.

Furthermore, AA profiles of Diet 2 to 4 were not balanced on DAA basis as was evident in the M+C/Lysine ratios of 67, 62 and 61%, respectively. These were below the recommended ratios of 72 – 74% (Table 4).

Table 4 Recommended digestible lysine specifications and the EAA/Lys ratios for maximizing live performance and production profit for today's broiler chickens

	Starter	Grower	Finisher
Digestible Lysine, % in diet	1.25	1.05	0.95
Other EAA to Lysine Ratios, %			
M+C/Lysine	72	73	74
Threonine/Lysine	65	66	67
Arginine/Lysine	105	105	105
Tryptophan/Lysine	17	17	17
Valine/Lysine	77	77	77
Isoleucine/Lysine	67	67	67

As Diets 2 to 4 were low in digestible lysine, and imbalanced in DAA, the live performance of chicken fed such diets would no doubt be negatively affected. Because of this, production cost would, most likely, be negatively affected as well.

From the above, it clearly demonstrated that there is merit to formulate feed based on DAA. Although this conversion from TAA to DAA formulation may require some effort updating the data base of the least cost feed program to include values for DAA, at the end of the day, this effort will pay dividend when more consistent and balanced feed begins to yield better and more efficient production performance.

Reference:

1. Jiang, Zhirong, 2008. Formulate Broiler Diets with Digestible Amino Acids. Paper presented at Soybean Meal Quality Conference, 4 – 5 August, 2008, Bangkok.
2. Joardar, D., Schulz, M. & Dowell, D., 2008. IDEA – A Rapid Protein Digestibility Assay for Soybean Meal. Paper presented at Soybean Meal Quality Conference, 4 – 5 August, 2008, Bangkok.