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Amino acid supplementation reduces protein levels in pangasius diets

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Better understanding of protein, amino acid nutrition will help nutritionists optimize performance

Pangasius are active eaters. Better understanding of their protein and amino acid requirements will help nutritionists optimize feed and fish performance while reducing the waste released from fish farms.

Ongoing research with various fish species has shown that balancing the amino acid profiles of diets with free amino acids can be an effective strategy in reducing levels of fishmeal and other dietary proteins while reducing the nitrogen excretions of the fish. Recent studies showed the approach was effective in significantly reducing dietary protein levels in feeds given to grass carp, hybrid tilapia and hybrid catfish.

Feeding trials conducted with *pangasius*

The authors conducted two feeding trials to evaluate the feasibility of reducing dietary protein levels from 28 percent to 25 percent for striped catfish, *Pangasianodon hypophthalmus*, that received diets with balanced amino acid profiles. Trial I was performed under practical conditions in collaboration with a major Vietnamese catfish producer. Groups of 240 fish with average initial body weights ranging 37-40 g were randomly distributed among 12, 3- x 2- x 3-m cages in a cage-cum-pond system at a stocking density of 13.33 fish/m^3.

Four experimental diets were formulated to contain 28 percent crude protein, a common level in commercial feed (diet 28CP) or reduced protein levels of 27 percent (27CP), 26 percent (26CP) or 25 percent (diet 25CP). Fish were fed one of the four experimental diets twice daily to apparent satiation for 90 days. The ingredients used included wheat, rice bran, soybean meal, wheat bran, meat and bone meal, poultry meal, tuna fishmeal and salmon fish oil. The diets were supplemented with DL-methionine, lysine hydrochloride and L-threonine (presented as free amino acids, Table 1) to meet the feed mill’s recommendations.

Figueiredo-Silva, Analyzed composition (% as fed) of experimental diets, Table 1

	Diet 28CP	Diet 27CP	Diet 26CP	Diet 25CP
Crude protein	28.40	26.80	26.00	25.00
Methionine	0.60	0.57	0.62	0.65
Methionine + cysteine	1.02	0.97	1.01	1.02
Lysine	1.44	1.38	1.43	1.38
Threonine	1.10	1.03	1.10	1.06
Free methionine[a]	0.172	0.171	0.228	0.276
Free lysinea,[ab]	0.051	0.096	0.237	0.249
Free threonine[a]	0.107	0.110	0.249	0.264

[a] Free amino acids represent mainly supplemental amino acids, but small amounts of free amino acids from ingredients such as fishmeal may also have been contributed.
[b] Values need to be divided by 0.78 to calculate levels of supplemental L-lysine hydrochloride.

Table 1. Analyzed composition (% as fed) of experimental diets fed to Pangasius in Trial I.

Promising results obtained in Trial I led to a second trial under laboratory scale (Trial II) in collaboration with the fisheries faculty of Kasetsart University in Bangkok, Thailand. For this trial, which assessed the possibility of reducing the dietary protein level down to 23 percent, groups of 10, 20-g fish were distributed in 12, 1,000-L tanks with 3 tanks/treatment. The pangasius were fed at a rate of 3 to 4 percent of body weight for 90 days.

Following an approach similar to that set out in Trial I, the experimental diets included a positive control containing about 26 percent crude protein (diet 26CP) and three diets with lower protein levels (about 24 percent in diet 24CP, 23 percent in 23CP and 23CP with extra methionine and lysine, Table 2). The amino acid profiles of the different diets were balanced with DL-methionine, L-lysine, L-threonine and L-tryptophan according to the guidelines of the Aquaculture Department of Vietnam Ministry.

Here, whether the responses of fish to reduced-protein diets might be improved by an extra level of methionine and lysine was evaluated. An extra 0.06 percent of DL-methionine and 0.06 percent of L-lysine were added to diet 23CP, resulting in diet 23CP-ExtraMet+Lys (Table 2).

Figueiredo-Silva, Analyzed composition of experimental diets, Table 2

	Diet 26CP	Diet 24CP	Diet 23CP	Diet 23CP-Extra Met+Lys
Ingredients (%)				
Fishmeal	5.00	5.00	5.00	5.00
Soybean meal	18.19	10.88	5.48	5.48
Dried distillers grains	15.00	15.00	15.00	15.0
Rapeseed meal	12.00	12.00	12.00	12.0
Fish oil	0.80	0.80	0.80	0.80
Soybean oil	2.42	1.58	1.72	1.72
Wheat flour	24.88	33.46	38.58	38.00
Defatted ricebran	16.00	16.00	16.00	16.00
Limestone/oyster shell	4.08	2.80	2.84	2.84
Other *	1.20	1.20	1.20	1.20
DL-methionine	0.15	0.18	0.20	0.30
Lysine	0.28	1.03	1.00	1.40
Threonine	–	0.05	0.14	0.20
Tryptophan	–	0.02	0.04	0.06
Analyzed Composition (% as fed)				
Crude protein	25.50	24.10	23.50	23.00
Crude fat	5.60	3.40	3.50	5.40
Methionine	0.56	0.59	0.58	0.64
Methionine + cysteine	0.97	1.00	0.99	1.03
Lysine	1.33	1.55	1.48	1.54
Threonine	0.96	0.93	0.96	0.95

* Other: 0.2% mineral premix, 0.2% vitamin premix, 0.5% choline, 0.2% vitamin C and 0.1% attractant.

Table 2. Analyzed composition of experimental diets fed to Pangasius in Trial II.

Striped catfish grew equally well

The striped catfish in Trial I grew equally well on diets having protein levels of 28 percent or 25 percent, provided the dietary amino acids were balanced. The responses of the fish to gradually reduced protein supplies under practical conditions are presented in Table 3.

Figueiredo-Silva, Growth performance of Pangasius fed diets, Table 3

	Diet 28CP	Diet 27CP	Diet 26CP	Diet 25CP
Initial body weight (g)	39.7 ± 1.2	36.7 ± 1.3	37.4 ± 0.5	37.0 ± 2.6
Final body weight (g)	239.6 ± 2.9[a]	212.6 ± 6.6[b]	223.9 ± 6.4[ab]	239.5 ± 19.6[a]
Weight gain (g)	199.8 ± 2.8[a]	175.9 ± 6.7[b]	186.5 ± 6.9[ab]	202.5 ± 17.3[a]
Feed-conversion ratio	1.19 ± 0.09[c]	1.45 ± 0.01[a]	1.39 ± 0.02[a]	1.30 ± 0.03[b]
Specific growth rate	2.00 ± 0.03[ab]	1.95 ± 0.05[b]	1.99 ± 0.05[b]	2.07 ± 0.04[a]
Protein efficiency ratio	2.80 ± 0.21[ab]	2.37 ± 0.02[c]	2.65 ± 0.04[b]	2.87 ± 0.08[a]

Means within a row with unlike superscript letters differ significantly ($P < 0.05$).

Table 3. Growth performance of Pangasius fed diets with different protein levels (Trial I).

At 1.4 to 3.3 percent, overall mortality was low in all treatments (data not shown), indicating that pond and water quality were correctly monitored and maintained. The reduction of dietary protein level from 28 to 25 percent in concert with amino acid supplementation showed very promising results in this species.

Specific growth rate (SGR) was similar among fish fed the control or protein-reduced diets (Table 3). Curiously, SGR and protein-efficiency ratio (PER) values were higher in fish fed diet 25CP than in those fed the 26CP or 27CP diets. Final body weight, weight gain and PER were significantly lower in fish fed 27CP relative to the control group. Although not statistically significant, a lower initial body weight together with a slightly lower supply of methionine, methionine + cysteine, lysine and threonine might have contributed to the lower performance of the 27CP compared to the 28CP and 25CP groups.

Altogether, the results from Trial I indicated that striped catfish can efficiently use free amino acids such as DL-methionine and suggested that a 0.08 percent difference in methionine and 0.05 percent difference in methionine + cysteine levels between the 27CP and 25CP diets may have been important factors in determining the performance of fish that received less protein.

Extra methionine, lysine supplementation allow further protein reduction

In Trial II, the reduction of dietary protein level from 26 to 23 percent did not significantly impact the SGR, PER or carcass quality of striped catfish (Table 4). The ability of fish fed the 23CP diet to reach a final body weight similar to those in the control group was, however, dependent on 0.06 percent higher dietary methionine and lysine levels and highlighted the need for accurate information on the amino acid requirements of this species.

Figueiredo-Silva, Growth performance and carcass quality of Pangasius fed diets, Table 4

	Diet 26CP	Diet 24CP	Diet 23CP	Diet 23CP-Extra Met+Lys
Growth Performance				
Initial body weight (g)	26.3 ± 0.6	26.4 ± 0.9	26.4 ± 0.8	26.5 ± 0.7
Final body weight (g)	66.8 ± 1.3[a]	63.3 ± 1.3[bc]	62.7 ± 2.1[c]	66.1 ± 1.8[ab]
Weight gain (g)	40.5 ± 1.8[a]	36.9 ± 1.9[bc]	36.3 ± 1.8[c]	39.7 ± 1.1[ab]
Feed-conversion ratio	1.60 ± 0.02	1.70 ± 0.10	1.70 ± 0.20	1.60 ± 0.10
Specific growth rate	1.04 ± 0.04	0.97 ± 0.05	0.96 ± 0.04	1.02 ± 0.001
Protein efficiency ratio	2.20 ± 0.03	2.20 ± 0.10	2.30 ± 0.20	2.50 ± 0.20
Carcass Quality				
Fillet (%)	44.5 ± 3.8	45.6 ± 1.2	43.0 ± 1.9	44.0 ± 2.6
Drip loss (%)	8.1 ± 1.0	8.0 ± 1.2	7.9 ± 0.5	7.1 ± 0.9
Brightness	44.7 ± 2.0	47.2 ± 1.4	45.7 ± 1.3	46.3 ± 2.1
Redness	4.7 ± 1.9	4.0 ± 0.8	4.7 ± 2.1	3.3 ± 2.2
Yellowness	8.5 ± 1.3	9.2 ± 1.4	7.3 ± 3.4	8.0 ± 1.4

Means within a row with unlike superscript letters differ significantly ($P < 0.05$).

Table 4. Growth performance and carcass quality of Pangasius fed diets with different protein levels (Trial II).

The finding that responses to reduced-protein diets seemed highly dependent on the level at which amino acids were added in the diets in relation to species-specific amino acid requirements agreed with 2010 findings by Dr. Dhanapong Sangsue and co-workers on hybrid catfish, *Clarias macrocephalus* x *Clarias gariepinus*.

Among other strategies, a better understanding of the protein and amino acid nutrition of *Pangasius hypophthalmus* will help nutritionists optimize the costs of feed and fish performance while reducing the nitrogen waste released from fish farms to the environment.

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