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Aquafeeds
Aquafeeds

Protein requirements for pacu

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1 April 2001 João Batista Kochenborger Fernandes, Ph.D. Dalton José Carneiro, Ph.D. Nilva Kazue Sakomura, Ph.D.

Sources and levels of protein in pacu fingerling diets in Brazil

Freshwater fish culture in Brazil has been expanding steadily during the last decade, mainly involving tropical native species. Pacu (*Piaractus mesopotamicus*) and tambaqui (*Colossoma macropomun*) present great potential for more intensive production.

The former species has excellent organoleptic qualities, easily adapts to grow-out tanks and ponds, and also has demand in the sportsfishing sector. In nature, pacu have diverse feeding habits that change seasonally. Published literature reports pacu stomach contents include mostly leaves and other plant matter, and some fish remains. Because of the species' natural feeding habits, it is relevant to evaluate the use of vegetable protein in aquafeeds for pacu culture.

Table 1. Porcentual and calculated composition of experimental diets for pacu fingerlings.

Ingredients	FM[3] 22	FM 26	FM 30	FM/SM[4] 22	FM/SM 26	FM/SM 30	SM[5] 22	SM 26	SM 30
Fishmeal	22.00	33.11	42.73	13.25	17.65	22.45	–	–	–
Soybean meal	–	–	–	14.90	20.70	26.12	29.43	41.60	52.71
Rice bran	29.40	28.40	19.63	18.14	10.05	5.42	15.00	10.00	10.00
Wheat bran	24.30	10.00	10.00	10.40	12.00	10.20	20.00	14.46	10.00
Corn	22.80	26.64	24.85	40.21	36.00	32.47	32.30	30.00	24.04
Soybean oil	0.50	1.00	2.00	2.00	2.50	2.63	1.49	1.81	1.17
Dicalcium phosphate	–	–	–	–	–	–	0.75	1.11	1.08
Salt (NaCl)	0.30	0.15	0.09	0.40	0.40	0.01	0.33	0.32	0.30
Vitamin premix	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Mineral premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Composition									
Dry matter	91.69	91.72	92.64	92.11	92.04	92.53	90.94	92.84	91.51
Crude protein	21.97	26.00	30.00	22.00	26.00	30.00	22.00	26.00	30.00
Ether extract	8.61	9.49	9.81	8.34	7.95	7.14	6.66	6.20	5.40
Nitrogen free extract	41.22	36.11	31.77	45.43	41.85	38.15	47.25	43.87	40.11
Calcium	1.41	2.07	2.64	0.90	1.18	1.49	0.33	0.44	0.47
Phosphorus	1.40	1.60	1.75	0.97	1.00	1.08	0.80	0.80	0.80
Crude fiber	4.68	3.64	2.89	3.70	3.37	3.09	4.73	4.48	4.64
Crude energy	4200	4200	4200	4200	4207	4216	4200	4200	4200
Methionine	0.54	0.70	0.84	0.46	0.55	0.64	0.33	0.38	0.43
Methionine + Cystine	0.85	1.03	1.20	0.78	0.91	1.05	0.69	0.79	0.89
Lysine	1.40	1.84	2.24	1.31	1.64	1.97	1.13	1.41	1.69
Threonine	0.88	1.09	1.27	0.87	1.03	1.20	0.81	0.97	1.12
Tryptophan	0.28	0.32	0.37	0.28	0.34	0.36	0.30	0.35	0.41

(1) Vitamin premix: vit. A - 12.000 IU; vit. D3 - 2.000 IU; vit. E - 20 IU; vit. K3 - 5mg; vit. B12 - 25mg; tiamin (vit. B1) -2mg; riboflavin (vit. B2) - 8mg; piridoxin (vit. B6) - 2mg; biotin - 100mg; folic acid - 0.5 mg; panthotenic acid - 15mg; niacin - 40mg and coline-350 mg
(2) Mineral premix: Iron -40 mg; copper -8mg; manganese -70mg; cobalt -0.5mg; iodine - 2mg; selenium -0.2mg and zinc - 50mg.
(3) Fish meal (4) Fish meal + Soybean meal (5) Soybean meal

Fishmeal replacement

Fishmeal is a typical ingredient in many aquafeeds, because of its high nutritional value and palatability. However, the high cost of fishmeal has motivated nutritionists to search for alternative sources of protein.

A study conducted at the Aquaculture Center of the Universidade Estadual Paulista (UNESP) in Brazil evaluated the replacement of fishmeal by soybean meal, and determined protein requirement levels for formulated pacu diets.

Table 2. Performance of pacu fingerlings fed with different sources and protein levels (100 days).

	Parameters			
	Intake (g)	WG (g)	SGR	FC
Sources				
Fishmeal	41.29	31.41	1.67	1.37
Fishmeal + soybean meal	45.59	34.94	1.80	1.23
Soybean meal	41.93	33.13	1.74	1.31
Levels				
22% CB	40.79	29.02 b	1.64 b	1.44 a
26% CB	41.93	33.89 a	1.77 ab	1.27 b
30% CB	43.11	36.57 a	1.80 a	1.19 b

WG - weight gain; SGR - specific growth rate; FC - food conversion; CB - crude protein
Means within a column followed by different letters are different (P<0.05) by Tukey test.

UNESP trial

The experiment used 4.6- to 11.3-gram fingerlings held in aquaria at 8 fish per 100 liters for 100 days. Water parameters (temperature, dissolved oxygen, pH, alkalinity, and conductivity) were maintained at levels adequate for the species.

The experimental design consisted of randomized blocks with nine treatments tested in a 3 × 3 factorial design. Three sources of crude protein were used: 100 percent fishmeal, 50 percent fishmeal plus 50 percent soybean meal, and 100 percent soybean meal. Three protein levels (22, 26, and 30 percent percent) were used (Table 1). Fish were fed pelletized diets *ad libitum* four times a day.

Table 3. Protein utilization and body composition (%) of pacu fingerlings with different sources and protein levels (100 days).

	PER	Body Composition					
		Water	Protein	Fat	NER	WGN	WGF
Sources				Averages			
Fishmeal	2.94	72.41 a	55.58	29.53	44.85	2.43	9.21
Fishmeal + soybean meal	3.27	71.85 b	54.39	26.55	49.64	2.43	8.29
Soybean meal	3.07	73.13 a	57.65	29.16	47.25	2.46	8.70
Levels							
22% PB	3.23	71.95 b	53.98	28.66	48.52	2.39 b	9.12
26% PB	3.13	72.28 b	55.47	28.62	47.78	2.44 ab	8.84
30% PB	2.92	73.16 a	58.16	27.95	45.43	2.49 a	8.25

PER - protein efficiency rate; NRE - nitrogen retention efficiency; WGN - weight gain nitrogen; WGF - weight gain fat
Means within a column followed by different letters are different (P<.05) by Tukey test.

Results

Results (Tables 2 and 3) indicated that fishmeal can be partially or totally replaced with soybean meal in pacu aquafeeds. These results are relevant to promote better, more cost-effective diets to support further pacu culture activities in Brazil and other countries.

Replacement in the experimental diets did not significantly affect weight gain, feed conversion, specific growth rate or protein efficiency rate of pacu fingerlings. The replacement also did not affect fish body composition, nitrogen-retention efficiency, or body nitrogen or fat compositions. A crude protein level of 26 percent produced the best results.

(Editor's Note: This article was originally published in the April 2001 print edition of the Global Aquaculture Advocate.*)*

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