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Plant proteins effectively replace fishmeal in shrimp feed trial

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Results comparable to those found in commercial facilities



Shrimp grew to over 20 grams in 18 weeks on an extruded diet without fishmeal.

The worldwide increase in marine shrimp production has been accompanied by a decrease in shrimp value and reduced profitability in recent years. Consequently, there has been a general interest in reducing shrimp production costs, especially the cost of feed.

Minimizing the inclusion of expensive ingredients of marine animal origin – mainly fishmeal – in feed is one way to lower expenses. Fishmeal is the most important and costly protein source in most aquafeeds, with commercial shrimp formulations including 25 to 50 percent fishmeal.

Recent studies have demonstrated that fishmeal can be included at lower levels with no adverse effects, and that less-expensive, high-quality plant protein sources can successfully replace fishmeal in shrimp feeds without compromising shrimp growth. In spite of these encouraging findings, the practical application of data from these studies has been limited because pond production conditions differ greatly from experimental laboratory conditions, where shrimp are not grown to commercial size and do not have access to natural food.

In order to evaluate the capacity of marine shrimp to use alternative feeds including plant proteins as substitute ingredients for fishmeal under practical pond conditions, the authors recently conducted a growth trial in a semi-intensive pond production system at the Claude Peteet Mariculture Center in Gulf Shores, Alabama, USA. The study was funded by the American Soybean Association.

Shrimp study

Pacific white shrimp (*Litopenaeus vannamei*) postlarvae were obtained from a commercial hatchery and maintained in a nursery system, where the shrimp were acclimated and quarantined for 19 days. After the nursery phase, juvenile shrimp with a mean weight of about 0.031 grams were stocked at a density of 35 shrimp per square meter in 16, 0.1-ha low-water-exchange ponds with aeration. The shrimp were cultured for 18 weeks.

Four commercially extruded diets formulated to contain 35 percent crude protein and 8 percent lipid were evaluated. These diets included varying levels of fishmeal, which was replaced by a combination of solvent-extracted soybean meal and corn gluten meal.

All diets included a fixed level of poultry byproduct meal and were formulated to correct nutritional imbalances (Table 1). Additional fish oil was added to the diets with reduced fishmeal to compensate for the loss of lipids normally supplied by the fishmeal. The shrimp were fed twice a day, with feed inputs back calculated from an expected weight gain of 1.2 grams per week, a feed-conversion ratio of 1.5:1, and 70 percent survival.

Amaya, Composition of test diets for Pacific white shrimp, Table 1

Ingredient	9% Fishmeal	6% Fishmeal	3% Fishmeal	No Fishmeal
Soybean meal (%)	32.48	34.82	37.17	39.52
Poultry by-product meal (%)	16.0	16.0	16.0	16.0
Milo (%)	35.47	33.82	32.33	30.68
Corn gluten meal (%)	–	1.67	3.17	4.84
Fish oil (%)	3.96	4.22	4.47	4.72
Dicalcium phosphate (%)	1.50	1.88	2.27	2.65
Others (%)	1.59	1.59	1.59	1.59
Crude protein (%)	35.7	35.9	36.2	36.6

Crude fat (%)	8.4	8.3	8.6	8.4
Crude fiber (%)	2.4	1.8	2.1	1.9
Ash (%)	8.2	7.9	7.9	8.1

Table 1. Composition of test diets for Pacific white shrimp with plant protein replacements for fishmeal.

Shrimp were sampled on a weekly basis to check for general health and growth. Water quality parameters, including dissolved oxygen, temperature, pH, and salinity, were monitored twice a day. Total ammonium nitrogen and turbidity were measured once per week.

Shrimp performance

Production performance was similar among all treatments at the end of the culture period. However, feed costs were reduced as more plant proteins were included in the diets (Table 2). The ponds yielded 5,363 to 6,548 kilograms per hectare of 18.4- to 20.7-gram shrimp with survival rates of 84 to 94 percent. Feed conversion ranged 1.12 to 1.38.

Amaya, Production parameters after 18 weeks for shrimp fed diets, Table 2

Parameter	9% Fishmeal	6% Fishmeal	3% Fishmeal	No Fishmeal
Final weight (g)	19.6	18.4	19.8	20.7
Yields (kg shrimp/ha)	5,847	5,363	6,548	6,347
Weight gain (g/week)	1.11	1.04	1.13	1.19
Feed-conversion ratio	1.24	1.38	1.12	1.14
Survival (%)	87.2	84.0	94.0	87.4
Feed price (U.S. \$/kg)	0.531	0.526	0.520	0.515

Table 2. Production parameters after 18 weeks for shrimp fed diets with varying levels of fishmeal and plant proteins. Performance differences between treatments were not statistically significant.

Comparable to those found in commercial shrimp production facilities, these results demonstrated that a combination of soybean meal and corn gluten meal can completely substitute for fishmeal in commercial shrimp feeds – without compromising the production performance of shrimp – and reduce feed costs.

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