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Alternatives to fishmeal perform well in low-salinity shrimp farm trial

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Trial replaced fishmeal with poultry meal, distillers dried grain and plant-based ingredients

The culture of Pacific white shrimp (*Litopenaeus vannamei)* is being carried out using low-salinity water in various locations across the globe. In western Alabama, USA, shrimp farmers have raised *L. vannamei* for nearly a decade using pond water supplied from inland low-salinity artesian well

Inland culture locates farmers closer to markets that normally do not have access to fresh shrimp. Land costs are lower than on the coast, and disease-causing vectors are fewer inland. However, one of the biggest operating costs is for the feed required to grow shrimp under semi-intensive conditions.

One of the more expensive ingredients in most commercial shrimp diets is fishmeal, which serves as an excellent source of nutrients, particularly protein. In recent years, alternative plant protein and plant-animal protein combinations have been explored as possible replacements for fishmeal in feed formulations.

While the success of alternative feed ingredients in traditional rearing environments with full-strength seawater has been well documented, there is limited knowledge on the response of shrimp to plant protein and plant-animal protein combinations when reared under low-salinity conditions.

Trial results are leading local shrimp farmers to consider alternatives to fishmeal in feed.

Farm trial

To test the viability of substituting fishmeal with alternative protein sources, the authors devised a farm trial in which fishmeal was replaced with poultry meal, distillers dried grain with solubles, and pea meal in combination with soybean meal and corn gluten meal in diets fed to juvenile shrimp reared in inland low-salinity water.

Four test diets formulated to contain 36 percent protein and 8 percent lipid were evaluated in a flow-through tank system at Greene Prairie Aquafarm low-salinity shrimp farm in Boligee, Ala., USA. Menhaden fishmeal in the feed was replaced on a weight to weight basis with poultry meal, distillers dried grain with solubles, and pea meal (Table 1), and protein levels were adjusted. For comparison, a commercial 35 percent-protein reference diet was used in production ponds for the trial. For a second frame of reference, a locally produced 36 percent-protein production diet was also used in the study.

Ingredient	Diet 1 Poultry Meal	Diet 2 Fishmeal	Diet 3 Distillers Grain	Diet 4 Pea Meal
Soybean meal	551.2	537.1	580.1	580.0
Milo	248.1	261.9	163.4	153.3
Poultry by-product	99.9	–	–	–
Menhaden	–	100.1	–	–
Peas, ground	–	–	–	100.0
Distillers grain	–	–	100.0	–
Corn gluten	–	–	48.3	48.3
Dicalcium phosphate	29.0	29.0	33.8	34.2
Fish oil	50.8	50.9	48.3	58.2
Squid meal	–	–	5.0	5.0

Table 1. Ingredient composition of diets for farm trial (g/kg dry weight).
* Other ingredients included in diets: vitamin and mineral premixes, lecithin, bentonite, copper sulfate, mold inhibitor.

Twenty 0.45-gram *L. vannamei* were stocked into each of 30, 600-liter tanks set up adjacent to a 1.6-ha commercial production pond with 4.0 ppt salinity. Low-salinity pond water was pumped into the tanks with the overflow draining back into the pond by means of a central stand pipe. Aeration was provided by two submersible diffusers per tank connected to a central blower.

Feed rations were calculated assuming a 1.75 feed-conversion ratio (FCR) and a doubling in size for the first week. Thereafter, a growth rate of 1 gram per week was assumed. Shrimp were fed twice daily for nine weeks. At the conclusion of the trial, shrimp were harvested, counted and weighed.

Shrimp that received feed with alternatives to fishmeal grew to sizes similar to those fed fishmeal-based diets.

Results

With values ranging 23.4 to 24.2 grams, there were no significant ($P > 0.05$) differences in mean final weight across all the treatments (Fig. 1). Although survival ranged 91 to 98 percent, the differences among diet treatments were not statistically significant.

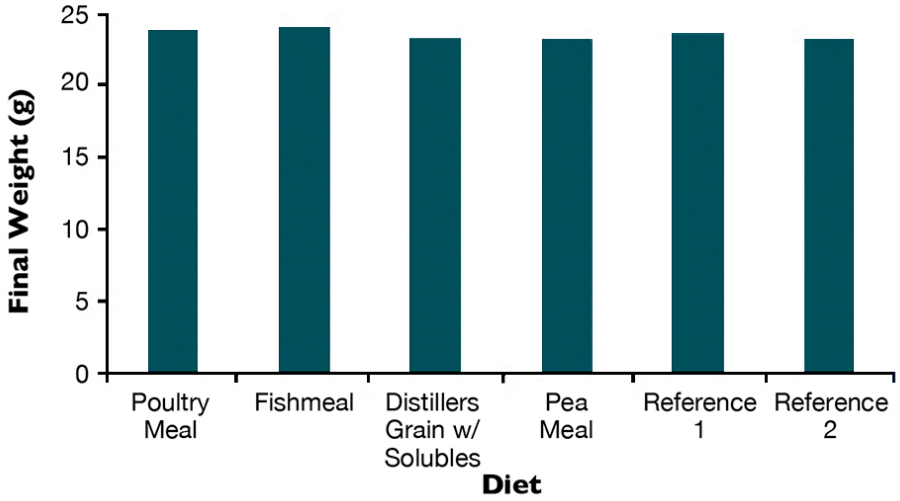

Fig. 1: Mean final weight of *L. vannamei* following nine weeks of culture in low-salinity water.

Throughout the experiment, shrimp displayed excellent growth, growing more than 2 grams per week with weight gain exceeding 5,100 percent in all treatments. In addition, FCRs ranged 0.70 to 0.73, suggesting some growth could have been a result of the high primary productivity of the pond water utilized in the study. There were no significant differences observed between the experimental diets utilizing alternative ingredients and the two commercial reference diets.

While the western Alabama farmers were initially concerned that their rearing environment with low salinity and unique ion profiles might be too harsh for removal of fishmeal from diet formulations, they are now more optimistic and open to alternative feed formulations. Farmers can save money and increase their profit margins by using production diets that contain plant protein or plant-animal protein combinations as alternatives to costly fishmeal.

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