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# Shrimp breeding for low-protein or vegetable-protein diets unnecessary

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## Study conducted at the Oceanic Institute



The breeding study was conducted in this tank field at the Oceanic Institute in Hawaii.

Most shrimp cultured today are fed diets with greater than 30 percent protein, with much of this protein obtained from fishmeal. Lowering the protein level should decrease feed costs and reduce the amount of nitrogenous wastes entering the production system and natural environment. Substituting an agricultural product for fishmeal should also

lower feed costs and lessen potential concerns about the sustainability of shrimp farming.

## Selecting shrimp for growth

The Oceanic Institute in Hawaii, USA, has been successfully selecting shrimp for improved growth at densities greater than 100 shrimp per square meter. However, these shrimp were selected for growth on a feed with greater than 30 percent protein and about 20 percent fishmeal.

A recent study was conducted at the Oceanic Institute to determine:

- The performance of shrimp fed a 25 percent protein feed compared with a standard 35 percent protein feed.
- The performance of shrimp fed a 35 percent vegetable protein feed (with protein originating from terrestrial plant crops) compared with a standard 35 percent protein feed.
- If there is a need to select separate lines of shrimp specifically for lower protein or vegetable-based protein diets.
- If shrimp selected for growth performed better on these diets compared to unselected controls.



Reading tag codes and weighing individual shrimp at harvest.

Shrimp were stocked in 48, 1,500-liter tanks at a density of 100 shrimp per tank for eight weeks with no water exchange. Average weight of shrimp at stocking was 2.9 grams. Shrimp were fed eight times a day (diet ingredients listed in Table 1) at 5 to 8 percent body weight per day.

**Table 1. Percent ingredients of three study diets.**

<b>Ingredient</b>	<b>Standard 35% Protein Diet (%)</b>	<b>25% Low-Protein Diet (%)</b>	<b>Vegetable 35% Protein Diet (%)</b>
Fishmeal – LT 94	19.60	14.00	0.00
Wheat, whole	50.62	36.16	48.83
Squid meal	2.50	1.79	0.00
Vital wheat gluten	4.00	2.86	17.30
Brewers yeast	3.00	2.14	5.00
Corn, starch	0.00	25.23	0.00
Protamino Aqua	3.00	2.14	3.00
Soybean meal	9.50	6.79	0.00
Soy protein concentrate	0.00	0.00	14.00
Arginine	0.00	0.00	0.20
Lysine HCl	0.00	0.00	0.82
Soy lecithin – CSM	2.00	2.00	2.00
Fish oil	3.28	4.40	5.35
Cholesterol-FG	0.23	0.23	0.23
Min Px – LV99.2 not chelated	+	+	+
Vitamin Px – LV99.1	0.40	0.40	0.40
Choline chloride	0.12	0.12	0.12
Stay C-35 (35% AA potency)	0.07	0.07	0.07
Potassium phosphate, dibasic	0.56	0.56	0.56
Sodium phosphate, dibasic	0.56	0.56	0.56
Calcium phosphate, monobasic	0.56	0.56	0.56
MgHPO <sub>4</sub> 3H <sub>2</sub> O	0.00	0.00	1.00
<b>Total</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
Crude protein	35.42	25.34	35.03
Crude lipid	9.00	9.17	9.00

## Study results

Shrimp grew about 30 percent faster when fed the 35 percent protein diet compared to the 25 percent protein diet. Shrimp grew about 20 percent faster when fed marine protein versus vegetable protein (Tables 2 and 3). Feed-conversion ratios were better when shrimp were fed the 35 percent protein diet.

Even though shrimp grew better when fed the 35 percent protein diet, it is unclear if this increase in weight gain is justified by the higher costs of this feed. For example, does the 20 percent increase in growth make up for the higher cost of the 35 percent standard feed over the 35 percent vegetable protein feed?

**Table 2. Growth performance of *Litopenaeus vannamei* fed 35% and 25% protein diets.**

	35% Protein Diet	25% Protein Diet
Weight gain (g)	9.8 ± 2.6	7.6 ± 2.6
FCR	1.9 ± 0.2	2.4 ± 0.3
% Survival	77.7 ± 11.7	80.8 ± 12.2

## Conclusion

Despite being selected for growth on diets with protein levels greater than 30 percent, the selected shrimp grew better than control shrimp on all diets (Tables 4 and 5). There was no interaction between families and diets, indicating the fastest-growing families grew the fastest no matter what diet they were fed. Consequently, it is not necessary to breed different lines of shrimp for specific diets.

**Table 3. Growth performance of *Litopenaeus vannamei* fed marine and vegetable protein diets.**

	35% Protein Diet	35% Vegetable Protein Diet
Weight gain (g)	10.2 ± 2.3	8.5 ± 1.8
FCR	1.9 ± 0.2	2.1 ± 0.3
% Survival	78.7 ± 12.2	81.3 ± 13.0

**Table 4. Growth performance of select and control *L. vannamei* fed 35% and 25% protein diets.**

	35% Protein Diet	25% Protein Diet
Weight gain		
Select	10.6 ± 2.4	8.3 ± 2.6
Control	8.3 ± 2.0	6.3 ± 2.0
% Survival		
Select	80.2 ± 12.8	78.8 ± 12.2
Control	74.8 ± 11.2	79.6 ± 12.3

**Table 5. Growth performance of select and control *L. vannamei* fed marine and vegetable protein diets.**

	35% Protein Diet	35% Vegetable Protein Diet
Weight gain		
Select	10.5 ± 2.3	8.7 ± 1.8
Control	9.3 ± 2.0	8.0 ± 1.4
% Survival		
Select	80.4 ± 12.5	81.1 ± 13.8
Control	73.1 ± 11.3	78.6 ± 12.4

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