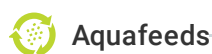




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Aquafeeds

Economic analysis of feeds for super-intensive white shrimp grow-out

1 May 2014

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Optimizing feed formulations can improve shrimp growth

Indoor super-intensive recirculating systems can produce large quantities of shrimp, but have high initial investment and operating costs. Feed typically accounts for more than 50 percent of the total production costs for shrimp culture. Optimization of feed formulations can significantly improve shrimp growth performance and minimize negative impacts on water quality.

Interactions among feed, water quality and productivity have been researched extensively in relation to super-intensive biofloc-dominated systems. The result has been the development of specially formulated feeds that enhance shrimp performance in limited-discharge systems.



The analyses examined the economics of the use of different feeds in covered raceway systems for the intensive culture of shrimp.

Study setup

A 2013 study by the authors evaluated the use of a commercial feed (CF-35) and an experimental feed (EXP) formulated for super-intensive biofloc-dominated production of *Litopenaeus vannamei* in production systems at the Texas A & M AgriLife Research Mariculture Laboratory in Corpus Christi, Texas, USA, along with the economic aspects related to their use.

A banner for Best Seafood Practices. On the left, there is a photo of a worker in a yellow protective suit and mask handling seafood. In the center, there is a photo of a fishing boat on the ocean. To the right of the photos, the text reads: "A comprehensive solution for the wild seafood supply chain." Below this text are three checkmarks with the following labels: "Crew rights", "Food safety", and "Environmental responsibility". On the far right, there is the Best Seafood Practices logo, which consists of a stylized fish icon and the text "Best Seafood Practices". Below the logo is a button that says "LEARN MORE" with a right-pointing arrow.

(<https://bspcertification.org/>).

The 77-day study was conducted in six, 40-m³ raceways lined with ethylene propylene diene monomer and filled with a mixture of aged biofloc-rich water and fresh natural seawater adjusted to 30 ppt. The raceways were stocked at a density of 324/m³ with 4.7-g juveniles produced from a cross between fast-growth genetic lines and Taura-resistant breeding lines. There was no water exchange, only evaporation



Shrimp production volume was higher and costs were lower with the specialized commercial feed.

replenishment.

The CF-35 feed was formulated to contain 35.78 percent crude protein, 8.72 percent lipid, 1.91 percent fiber and 9.61 percent ash, while the EXP feed had 39.54 percent protein, 9.19 percent lipid, 3.00 percent fiber and 12.32 percent ash. The study compared the two feeds with three replicates each.

Results

Production and preliminary financial results for each feed treatment are presented in Table 1. No significant difference was found between the treatments except for survival, which was higher for the CF-35 feed, which contained a bioactive natural additive. The high feed-conversion values observed suggested negative impacts from infections by *Vibrio parahaemolyticus* and/or *V. alginolyticus*, *V. owensii* and/or *V. communis*, as confirmed by histology. Harvested shrimp showed little if any sexual maturity and very little sex-related size variations.

Hanson, Production results for shrimp fed commercial or experimental diets, Table 1

Production Metric	CF-35	EXP
Stocking density (shrimp/m ³)	324	324
Survival rate (%)	93.1	83.4
Growth rate (g/week)	2.05	2.16
Stocking size (g)	4.7	4.7

Harvest size (g)	27.2	28.8
Feed-conversion ratio	1.59	1.72
Crop period (days)	77	77
Production (kg/m ³)	8.21	7.79

Table 1. Production results for shrimp fed commercial or experimental diets in super-intensive raceways.

For the economic analysis, study results were extrapolated to a single greenhouse system that consisted of eight, 500-m³ grow-out tanks and two, 500-m³ nursery tanks. For this analysis, the initial capital investment for the greenhouse was \$991,997. Other costs included shrimp sale prices of \$7.19/kg and \$8.80/kg, CF-35 grow-out feed at \$1.923/kg (\$1,923/mt), and the EXP diet at \$1.945/kg (\$1,945/mt). The juvenile production cost was U.S. \$20/1,000, and there was an 8 percent interest rate for loans.

From these figures, a 10-year cash flow based on production trial results was used to develop an enterprise budget that calculated the shrimp production costs and net returns, net present value, internal rate of return and payback period.

Table 2 presents the production performance with the two diets in the greenhouse scenario. The CF-35 diet produced 1,745/kg more crop than the EXP diet, and for the year, the former diet produced 8,203 kg more.

Hanson, Extrapolated shrimp production and sales for shrimp fed commercial or experimental diets, Table 2

	CF-35	CF-35	EXP	EXP
Selling price (U.S. \$/kg)	7.19	8.80	7.19	8.80
Production (kg/crop)	32,624	32,624	30,879	30,879
Annual crops	4.7	4.7	4.7	4.7
Annual production (kg)	153,334	153,334	145,131	145,131
Annual production (mt)	153.3	153.3	145.1	145.1
Total annual sales (U.S. \$ million)	1.10	1.35	1.05	1.28

Table 2. Extrapolated shrimp production and sales for shrimp fed commercial or experimental diets in super-intensive raceways.

Economics

The annual production for the CF-35 feed treatment amounted to \$1.10 million and \$1.35 million in sales at the \$7.19/kg and \$8.80/kg shrimp selling prices. For the EXP diet, sales were \$1.05 million and \$1.28 million at the \$7.19 and \$8.80/kg selling prices. The CF-35 feed had a positive net return at the

lower selling price compared to a negative net return for the EXP feed (Table 3). The cost of production for the CF-35 feed was \$6.71/kg of shrimp produced, and the production cost for the EXP feed was \$7.22/kg.

Hanson, Extrapolated production budget and financial indicators of profitability for shrimp fed commercial or experimental diets. Table 3

	CF-35	CF-35	EXP	EXP
Enterprise budget items (U.S. \$/kg)				
Gross receipts	7.19	8.80	7.19	8.80
Variable costs	5.43	5.43	5.87	5.87
Income above variable costs	1.76	3.37	1.32	2.93
Fixed cost	1.28	1.28	1.34	1.34
Total expenses	6.71	6.71	7.21	7.21
Net return	0.48	2.09	-(0.02)	1.59
Payback period (years)	4.5	2.0	11.1	2.5
Net present value (U.S. \$ million)	0.1	1.7	-0.7	1.1
Rate of return (%)	12	38	-1	29

Table 3. Extrapolated production budget and financial indicators of profitability for shrimp fed commercial or experimental diets in super-intensive raceways.

Using the 77-day experiment time as the production period for 4.7 crops/year assumes a year-round supply of postlarvae is available and back-to-back production is feasible in these systems. Given these assumptions, the 2.0-year payback period for the CF-35 feed treatment at the higher shrimp selling price was shortest, and the 11.1 years for the EXP feed treatment at the lower shrimp selling price was longest.

The net present value (NPV) figures calculated over a 10-year period had a similar order, with \$1.7 million NPV for the CF-35 feed and \$8.80/kg selling price and \$0.7 million NPV for the EXP feed and \$7.19/kg price. The internal rates of return (IRR) followed suit with a 38 percent and 29 percent IRR for the CF-35 and EXP feed treatments at the \$8.80/kg shrimp selling price and a lower IRR for the CF-35 feed treatment selling at \$7.19/kg.

(Editor's Note: This article was originally published in the May/June 2014 print edition of the Global Aquaculture Advocate.)

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