# Comparison of two commercial feeds for the production of marketable *Litopenaeus vannamei* in super-intensive biofloc-dominated zero exchange raceways

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# Introduction

- Feed accounts for more than 50% of total shrimp productions costs
- Feed also plays an important role in optimizing shrimp growth and can significantly affect the system's water quality
- Interactions between feed, WQ, and productivity resulted in the development of specially designed feeds for super-intensive biofloc-dominated shrimp production systems

# Objectives

- To evaluate the use of a commercial feed (HI-35) and an experimental feed (EXP) formulated for super-intensive biofloc-dominated shrimp production systems for *Litopenaeus vannamei* under no water exchange
- To study the changes in selected WQ indicators throughout the trial
- To demonstrate the benefit of using an in-line dissolved oxygen monitoring system as a management tool in a super-intensive, zero-exchange shrimp production system

# Materials & Methods

- Six 40 $m^3$ EPDM-lined RWs (Firestone Specialty Products, Indianapolis, IN) were filled with a mixture of biofloc-rich water (35 $m^3$) used in an earlier nursery trial, and natural seawater (5 $m^3$)
- Salinity was adjusted to 30 ppt
- RWs were stocked at 324/$m^3$ with juveniles (4.7 g) from a cross between Taura Resistant and Fast-Growth genetic lines (KAVA Farms, Los Fresnos, FL), with study duration of 77 d

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# Materials & Methods

- Each RW had eighteen 5.1 cm airlifts, six 1 m long air diffusers (AeroTube, Colorite Division, Tekni-Plex, Austin, TX) and a center longitudinal partition over a 5.1 cm PVC pipe with spray nozzles fed by a Venturi injector operated by a 2 hp pump
- Raceways were operated with no water exchange

- Evaporation was compensated for weekly using chlorinated municipal freshwater

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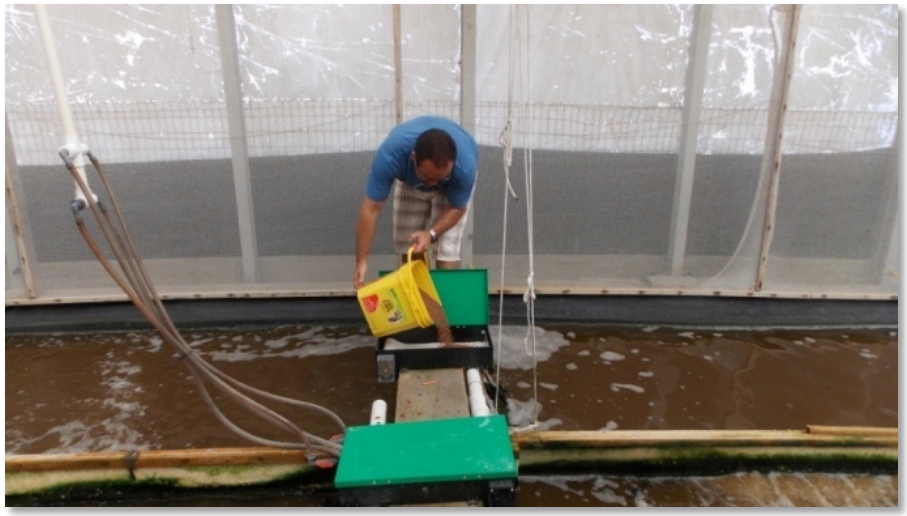
# Materials & Methods

Three RWs were fed HI-35 feed while the other three received EXP feed (Zeigler Bros., Gardners, PA)

| Component | HI-35 | EXP |
|---|---|---|
| Crude Protein (%) | 35.8 | 39.5 |
| Lipid (%) | 8.7 | 9.2 |
| Fiber (%) | 1.9 | 3.0 |
| Ash (%) | 9.7 | 12.3 |
| Carbohydrates | 37.2 | 31.0 |
| VPak™ | Yes | No |
| Price ($) | 1.92 | 1.94 |

# Materials & Methods

- Rations were initially determined using an assumed FCR of 1.4, growth of 1.5 g/wk, and mortality of 0.5%/wk, and were adjusted according to twice weekly growth samples
- Feed was distributed continuously 24/7 using belt feeders



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# Materials & Methods

- Every RW had an optical DO monitoring probe and YSI 5500D monitoring system (YSI Inc., Yellow Springs, OH)
- Temp., salinity, DO, and pH were monitored 2/d; TAN, $NO_2$-N, $NO_3$-N, reactive P, and VSS were monitored 1/wk, while settleable solids and TSS were measured every two days
- Alkalinity was monitored 2/wk and was adjusted to 180 mg/L (as $CaCO_3$) using sodium bicarbonate and soda ash

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# Materials & Methods

- Each RW was outfitted with a small commercial Foam Fractionator (VL 65 Aquatic Eco Systems, Apopka, FL) and a 450 L Settling Tank
- FFs & STs were used to control particulate matter and dissolved organics, originally targeting TSS and SS levels in the ranges of 200-300 mg/L and 10-14 mL/L, respectively

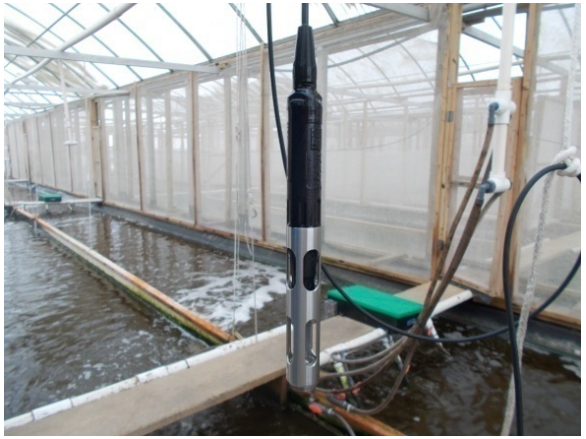
Foam Fractionator

Settling tanks

# Results

## DO Monitoring

- The optical DO probe and the monitoring system provided real-time information 24/7 even in the harsh biofloc environment
- The system enabled better scheduling of feeding and minimized DO fluctuations

# Daily WQ Data

| | HI-35 | | EXP | |
|---|---|---|---|---|
| | Mean | Min - Max | Mean | Min - Max |
| Temperature (°C) | 29.1 | 25.2-30.9 | 29.0 | 25.2-30.8 |
| DO (mg/L) | 5.1 | 4.2-6.5 | 4.9 | 3.7-6.1 |
| pH | 7.4 | 7.1-7.9 | 7.3 | 7.0-7.8 |
| Salinity (ppt) | 29.4 | 26.7-33.6 | 29.8 | 25.3-33.6 |

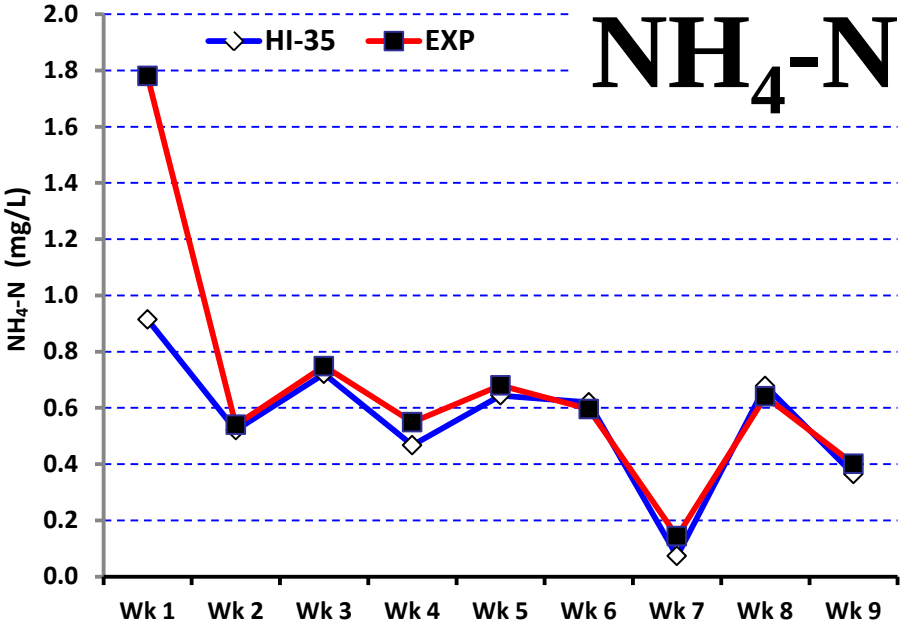
# Results

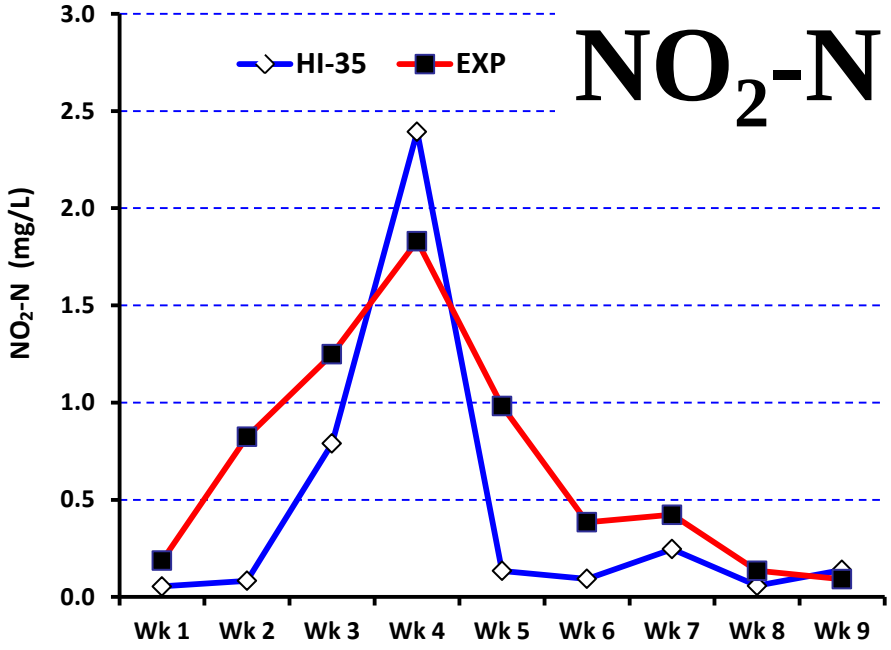
## Water Quality

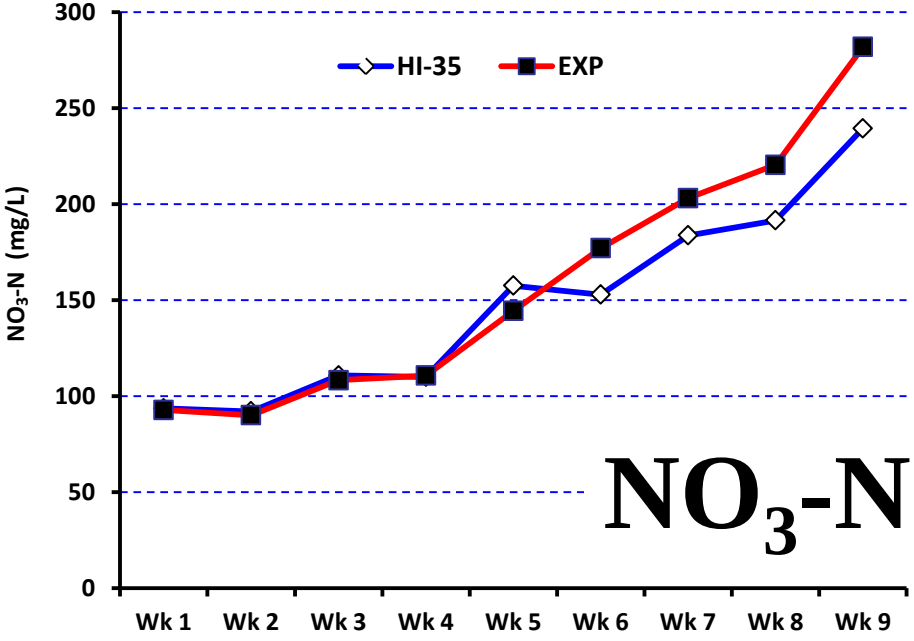
- Ammonia and nitrite levels remained low (< 3.35 and 5.19 mg/L, respectively) in all six raceways throughout the trial
- Nitrate increased from about 61 mg/L at the study initiation to a maximum of 401 mg/L at the end of the trial
- Although TSS levels in the EXP feed were higher these differences were not statistically different

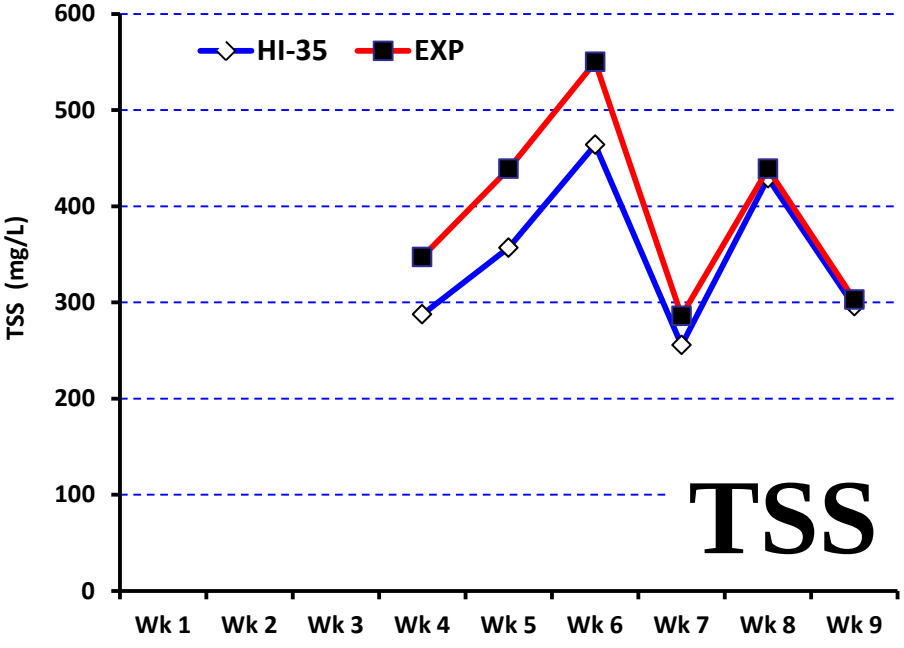
# Summary of alkalinity and particulate matter data

| | HI-35 | | EXP | |
|---|---|---|---|---|
| | Mean | Min-Max | Mean | Min-Max |
| ALK (mg/L) | 147 | 86-219 | 127 | 78-172 |
| TSS (mg/L) | 381 | 142-617 | 428 | 250-692 |
| VSS (mg/L) | 259 | 67-392 | 290 | 133-508 |
| SS (mL/L) | 14 | 0.5-30 | 12 | 0-40 |

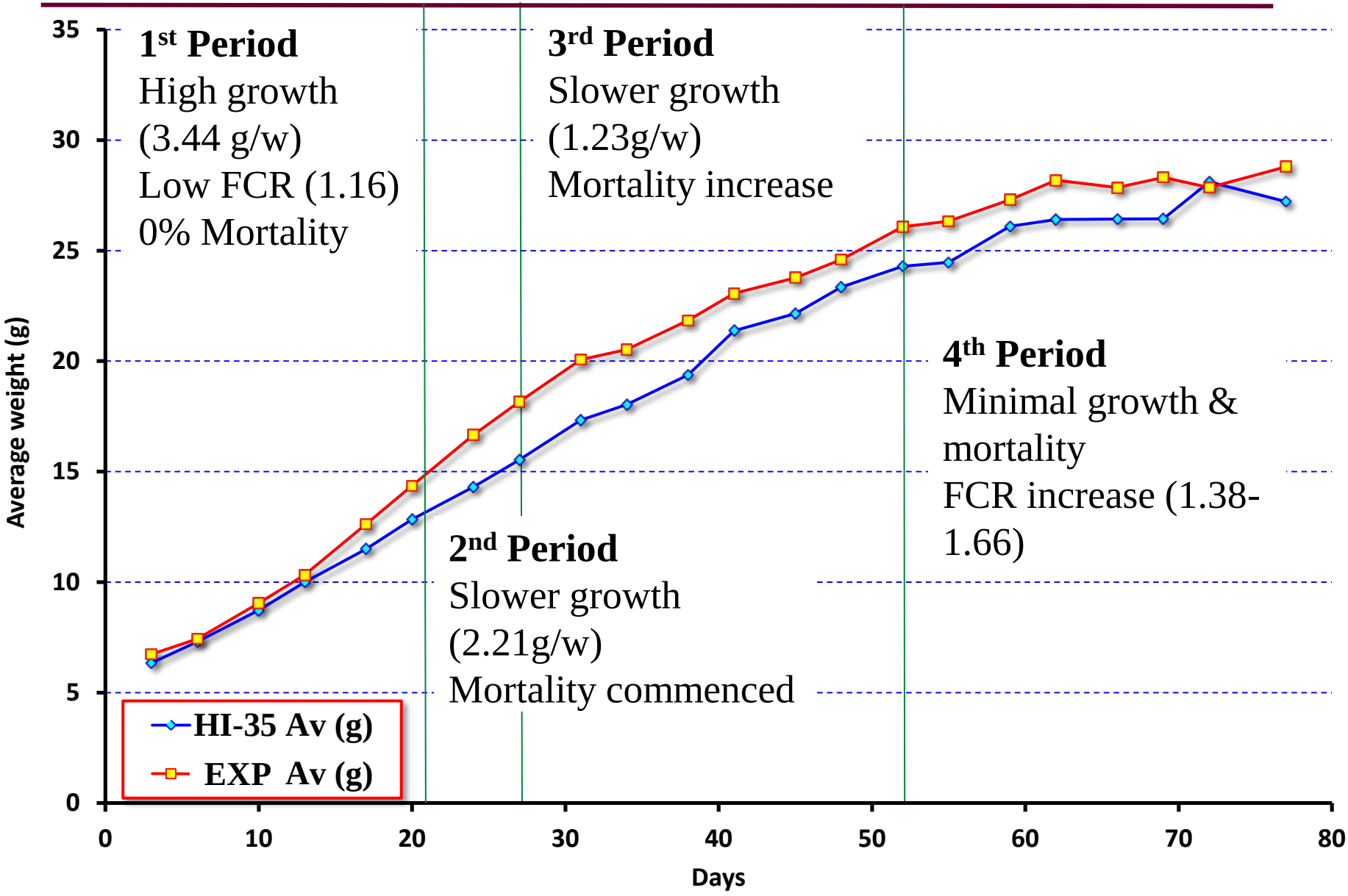

HI-35
EXP
NH4-N
NH4-N (mg/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Wk 1
Wk 2
Wk 3
Wk 4
Wk 5
Wk 6
Wk 7
Wk 8
Wk 9


HI-35
EXP
NO2-N
NO2-N (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Wk 1
Wk 2
Wk 3
Wk 4
Wk 5
Wk 6
Wk 7
Wk 8
Wk 9


HI-35
EXP
NO3-N
NO3-N (mg/L)
300
250
200
150
100
50
0
Wk 1
Wk 2
Wk 3
Wk 4
Wk 5
Wk 6
Wk 7
Wk 8
Wk 9


HI-35
EXP
TSS
TSS (mg/L)
600
500
400
300
200
100
0
Wk 1
Wk 2
Wk 3
Wk 4
Wk 5
Wk 6
Wk 7
Wk 8
Wk 9

# Growth Performance



# Results

## Histology

- Preliminary histology showed enteric and systemic bacterial infection, and indicated that the cause of the mortality was vibriosis

- 16S rRNA sequencing was performed on three representative isolates from live shrimp
- Results showed presence of *Vibrio parahaemolyticus*, *V. owensii*, *V. communis*, *V. alginolyticus*
- RT-PCR showed no TSV, YHV, IMNV or PvNV infections in any of the tested samples

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# Results

## Shrimp Performance

- No statistically significant differences were found in shrimp performance between treatments, except for survival
- Shrimp fed the HI-35 feed had higher survival than those fed the EXP
- The difference was attributed to the VPak™ in the HI-35 feed
- The high FCR values observed suggest negative impact from the confirmed *Vibrio* infections
- Harvested shrimp showed little sexual maturity or sex-related size variations

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# Shrimp Performance

| | HI-35 | EXP |
|---|---|---|
| Final Weight (g) | 27.2 ± 0.9 | 28.8 ± 1.8 |
| Growth (g/wk) | 2.05 ± 0.13 | 2.16 ± 0.31 |
| Total Biomass (kg) | 328.3 ± 12.4 | 311.8 ± 45.2 |
| Yield ($kg/m^3$) | 8.2 ± 0.3 | 7.8 ± 1.1 |
| FCR | 1.59 ± 0.01 | 1.72 ± 0.08 |
| Survival (%) | $93.1 \pm 3.1^a$ | $83.4 \pm 2.7^b$ |

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# Results

## Economics

- Although there was a little difference in cost between the two feeds (EXP: $1.94/kg vs. HI-35:  $1.92/kg), a preliminary economic analysis of profitability indicates that the HI-35 and EXP feeds would both be commercially viable when shrimp are sold at $4.00/lb.

# Conclusion

- Under the conditions of this study, the shrimp survived a *Vibrio* outbreak and a marketable sized product was produced

- Feeding the shrimp with feed supplemented with VPak™ resulted in significantly higher survival however, differences in yields were not statistically significant
- The results suggest closer look into feed supplement as a tool against *Vibrio* infections

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# Acknowledgements


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- Colorite Plastics for the air diffusers
- Firestone Specialty Products for the EPDM liner


ZEIGLER nutrition through innovation

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COLORITE PLASTICS A TEKNIplex Company

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