



# DIFFERENCES BETWEEN SEMI-INTENSIVE CONVENTIONAL AND SUPER-INTENSIVE BIOFLOC *Penaeus vannamei* CULTURE

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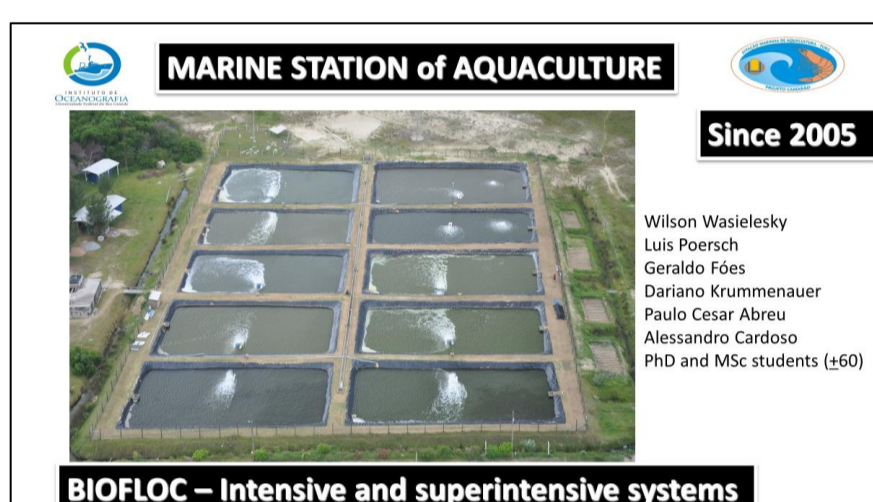
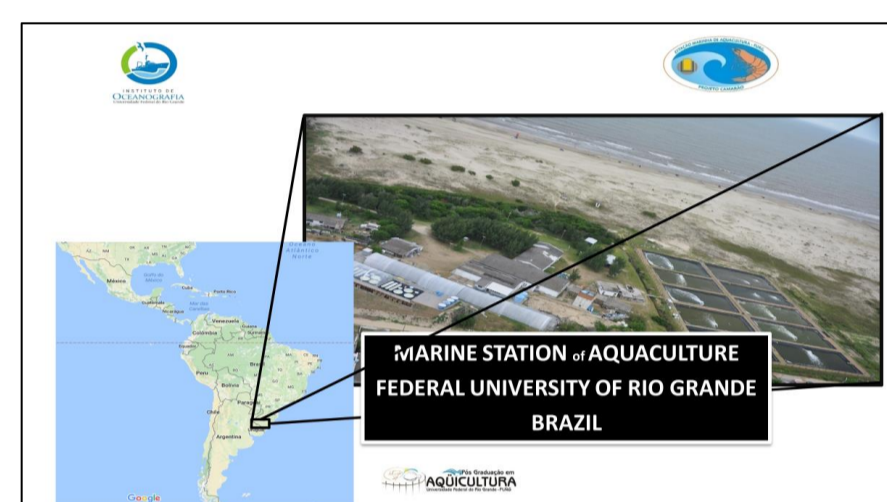
## INTRODUCTION

The semi-intensive culture systems in earthen ponds have been limited by several factors such as disease, weaknesses of the systems or competition by culture area with other industries. Several studies have focused on improving the new technologies necessary to increase shrimp production. The Biofloc Technology Culture Systems (BFT) in raceways is considered a revolutionary system in aquaculture, because its production of microorganisms helps in the maintenance of water quality, reduces feed conversion rates, and increases biosecurity, resulting in high production multiples crops. Additionally, BFT is considered environmentally friendly, with an ability to reuse the same water multiple times, thus avoiding pollution of coastal waters. Technological innovation permits increases in shrimp production capacity per unit area. The addition of new management tools such as air injectors (nozzles), artificial substrate, clarifiers and some procedures may allow unprecedented increases in the load capacity of these systems. For example, the demand for dissolved oxygen (DO) by shrimp is one of the main concerns as culture systems intensify. In intensive or super-intensive culture of shrimp can be possible if the system's aeration devices can meet the organism's oxygen demand. The number of devices to be used will depend on the water's salinity and temperature, stocking density, shrimp size, and in the BFT systems the amount of suspended solids. For this reason, studies and evaluations of the support capacity of each new aeration technology is important to maximize its effect. Therefore, several researchers have evaluated the influence of the limitation of different parameters and procedures. These are important challenges to overcome the production when working in BFT with high densities, and different devices and other procedures (Table 1), that can have significant impacts on shrimp development in super-intensive system.

## OBJECTIVE

The purpose of this study was to evaluate differences between semi-intensive conventional and super-intensive biofloc *Penaeus vannamei* culture

## MATERIALS AND METHODS



### Materials and Methods

- Water parameters – laboratory analysis
  - Total Ammonia Nitrogen – (UNESCO, 1983)
  - Nitrite – (Bendishneider & Robinson, 1952)
  - Nitrate – (Aminot & Chaussepied, 1983)
  - Alkalinity – (Strickland & Parsons, 1972)
  - Total suspended solids – (AOAC, 2000)
  - Turbidity – (turbidimeter)
  - Chlorophyll *a* – (Walchekmeyer, 1994)

### Materials and Methods

- Shrimp monitoring – every 7 days
  - Weekly growth rate (WGR) – 100 shrimp / tank
  - WGR = (final weight / number of weeks of culture)
  - Feed conversion ratio (FCR)
    - FCR = offered feed / biomass increment
  - Survival (%)
    - % = (final biomass (average individual weight) / number of individuals stocked) x 100
    - Transformed (arc sine  $\sqrt{x}$ ) before analysis
  - Productivity
    - Prod = (final biomass / tank volume)

## RESULTS

### Main differences between Biofloc Systems and Conventional Systems

<ul style="list-style-type: none"> <li>Culture facilities</li> <li>The use of microbial loop</li> <li>Nitrification process</li> <li>Alkalinity/pH/CO<sub>2</sub></li> <li>TSS</li> <li>Aeration Systems</li> <li>Vertical substrates</li> <li>Water management</li> <li>Reuse of water</li> <li>Stocking densities</li> <li>Feeding management</li> <li>Probiotics</li> </ul>	<ul style="list-style-type: none"> <li>Improvement of productivities in BFT systems</li> </ul>
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## Different facilities used in shrimp BFT culture

### FACILITIES: Lined pond and Raceways

## Results obtained in different experiments for shrimp BFT culture

### Effect of stocking densities - Carried out in 2007

Table 1. Performance parameters of *Litopenaeus vannamei* cultured in a biofloc technology system at different stocking densities over 75 days.

Parameters	150 shrimp/m <sup>2</sup>	300 shrimp/m <sup>2</sup>	450 shrimp/m <sup>2</sup>
Initial weight (g)	0.8 ± 0.07	0.8 ± 0.07	0.8 ± 0.07
Final weight (g)	15.6 ± 1.39 <sup>a</sup>	16.8 ± 1.07 <sup>a</sup>	16.3 ± 1.29 <sup>a</sup>
Survival (%)	82.5 ± 1.90 <sup>a</sup>	82.5 ± 1.90 <sup>a</sup>	75.0 ± 3.19 <sup>a</sup>
Biomass (kg/tank)	150.7 ± 20.0 <sup>a</sup>	363.3 ± 39.0 <sup>b</sup>	228.4 ± 44.8 <sup>a</sup>
FCR	1.68 ± 0.09 <sup>a</sup>	1.26 ± 0.09 <sup>a</sup>	2.04 ± 0.10 <sup>b</sup>
WGR (g/day)	0.85 ± 0.09 <sup>a</sup>	0.82 ± 0.09 <sup>a</sup>	0.47 ± 0.09 <sup>b</sup>
Productivity (kg/m <sup>2</sup> )	2.15 ± 0.17 <sup>a</sup>	4.09 ± 0.47 <sup>b</sup>	3.04 ± 0.19 <sup>a</sup>

FCR = feed conversion rate, WGR = weekly growth rate.  
<sup>a</sup>Means are means of replicates ± standard deviation. Different superscripts in the same row indicate significant differences (P < 0.05).

### Vertical substrates (Needlon)

Effects on nitrification, feeding and stocking densities

The number of vertical substrates would range from 100-200 % of lateral surface of the RW

### Water management – Reuse of biofloc water for better nitrification

Ammonia (mg/L)

Nitrite (mg/L)

That is, it is possible to work with high reuse rates (25 - 100 %)

On the other hand, what is the minimum inoculum to start a new cultivation????  
**Answer: At least 5 mg/L**

## RESULTS

### Aeration systems used in BFT Systems

### AERATION SYSTEMS FOR BFT SHRIMP CULTURE

Diffused Air X Vertical Pump X Propeller

Better biofloc formation, nitrification process and shrimp biomass was about 60% higher in blower (Diffused-air).

### Mixed aeration system: Injector (a<sup>3</sup>) and aerotubes

Vertical and horizontal movement of water

Vertical movement of water

## Water quality management in superintensive BFT system

### Total Suspended Solids control

Aquaculture Research

Effect of different total suspended solids levels on *Litopenaeus vannamei* (Biomass, 1991) BFT culture system during biofloc formation

Biofloc management with different three rates for solids removed in the *Litopenaeus vannamei* BFT culture system

TSS < 400mg/L  
SS < 20 m/L

TSS were kept below 500 mg/L  
Tool: Settling tanks

### Control of Alkalinity/pH/CO<sub>2</sub>

Application of different doses of calcium hydroxide in the feeding strategy of *Litopenaeus vannamei* with the biofloc technology (BFT)

Effect of calcium hydroxide, carbonates and sodium bicarbonate on water quality and nitrification process in *Litopenaeus vannamei* reared in biofloc technology (BFT)

Alk > 150mgCaCO<sub>3</sub>/L  
pH about 7.8 (7.4-8.2)  
< 20 mgCO<sub>2</sub>/L (5)

## Probiotic for vibrio control in BFT superintensive system

### Probiotics to avoid vibrio infection

The Effect of Probiotics in a *Litopenaeus vannamei* Biofloc Culture System Infected with *Vibrio parahaemolyticus*

Present study- Antagonism confirmed by quantification using FISH

## Higher stocking densities in BFT superintensive system

### Hyperintensive stocking densities for *Litopenaeus vannamei* grow-out in biofloc technology culture system

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Abstract: Searching for potential increases in shrimp yields, this study evaluated the effects of different stocking densities on water quality and production performance of juvenile shrimp, *Litopenaeus vannamei*, reared on a biofloc distributed system throughout 77 days. The experiment (2,7 x 0,54 m) was stocked at three densities: 400 (T400), 500 (T500), and 600 (T600) shrimp/m<sup>2</sup>.

Table 2 - Means and Standard deviation of the *L. vannamei* zootechnical performance parameters during 78 days BFT grow-out with different stocking densities. Initial and final weight (g), final biomass (kg tank<sup>-1</sup>), weekly growth (g week<sup>-1</sup>), feed conversion rate (FCR), survival (%), and yields.

Parameters	T400	T500	T600
Initial Weight	1.27 ± 0.54	1.27 ± 0.54	1.27 ± 0.54
Final Weight	12.3 ± 5.57 <sup>a</sup>	12.2 ± 3.90 <sup>a</sup>	10.2 ± 3.49 <sup>a</sup>
Initial Biomass	17.78	22.22	26.67
Final Biomass	140.83 ± 1.91 <sup>b</sup>	162.97 ± 0.16 <sup>b</sup>	174.25 ± 13.57 <sup>b</sup>
Weekly Growth	1.10 ± 0.11	1.09 ± 0.02	0.90 ± 0.08
FCR	1.79 ± 0.02	1.82 ± 0.02	2.09 ± 0.20
Survival	82.31 ± 9.13	76.67 ± 2.31	81.05 ± 11.08
Yield (kg m <sup>-2</sup> )	3.52 ± 0.05 <sup>a</sup>	4.02 ± 0.06 <sup>a</sup>	4.22 ± 0.20 <sup>a</sup>
Yield (kg m <sup>-3</sup> )	4.59 ± 0.07 <sup>a</sup>	4.03 ± 0.06 <sup>a</sup>	5.22 ± 0.20 <sup>a</sup>

No significant differences between 500 and 600 m<sup>2</sup>

## Advances of producing *L.vannamei* in superintensive BFT culture

### Advantages of producing in a BFT system

- Shrimp production with greater biosecurity;
- Work with less water use;
- Water reuse;
- Less amount of effluents;
- High biomass production per unit area;
- It is possible to produce in relatively small areas;
- Production throughout the year;
- Produce close to the consumer market;
- Supply the market with fresh produce;



## ACKNOWLEDGEMENTS

