GROWTH PERFORMANCE OF SUPER INTENSIVE *Litopenaeus vannamei* BFT CULTURE SYSTEM USING FISH MEAL ANALOG

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Table 24

FAO Fish Model: overall trends to 2022

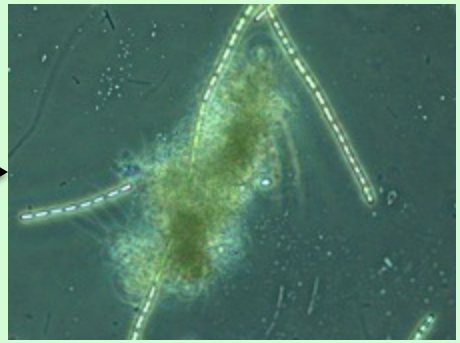
	Base period	2022 scenarios			
	2010–2012	Baseline	Intermediate	Optimistic	Mixed
		(Million tonnes in live weight equivalent)			
WORLD					
Total fishery production	**153.940**	**181.070**	**188.093**	**194.800**	**194.792**
Aquaculture	62.924	85.124	92.402	99.330	99.330
Capture	91.016	95.946	95.692	95.474	95.462
Fishmeal production (*product weight*)	6.103	7.021	7.358	7.679	7.734
Fish oil production (*product weight*)	0.980	1.079	1.087	1.094	1.088
Fish trade for human consumption	36.994	45.082	45.566	46.237	46.566
Fish supply for human consumption	131.741	160.514	167.397	173.969	174.032
Per capita apparent fish consumption (*kg*)	18.9	20.7	21.6	22.4	22.4

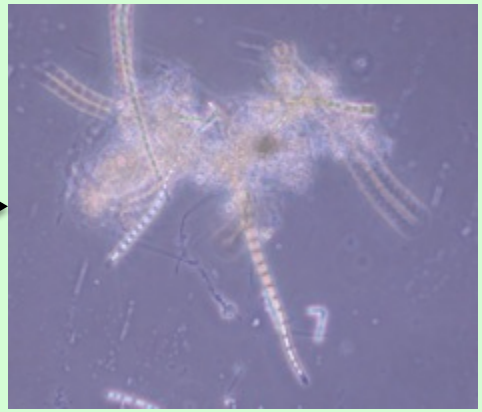
Aquaculture will increase about 50%, but fish oil and meal will increase about 15%.
How to do that???

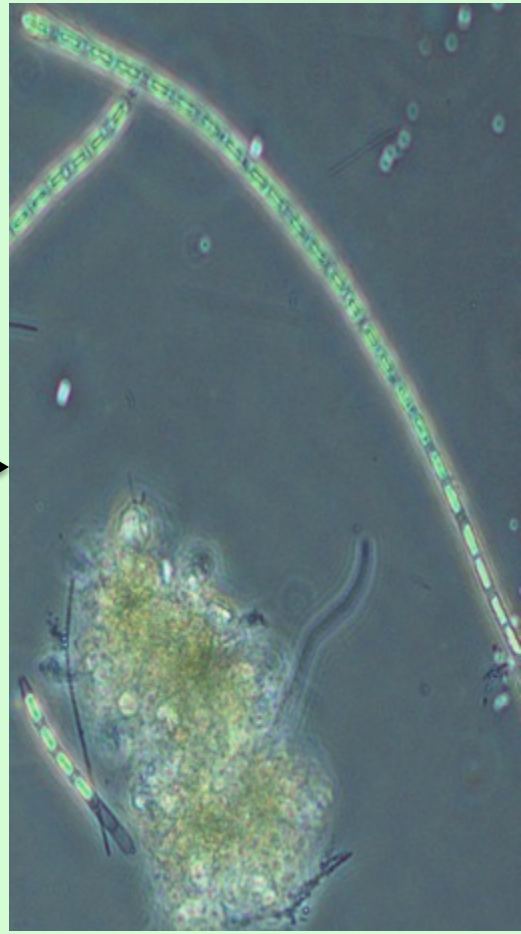
Alternative meals for shrimp diet

Authors		Species	Replaced
Davis & Arnold, (2000)	Soybean meal and poultry by-product meal	*Litopenaeus vannamei*	80%
Forster et al. (2003)	Meat and bone meal	*Litopenaeus vannamei*	25 e 75%
Samocha; et al. (2004)	Soybean meal	*Litopenaeus vannamei*	100%
Amaya et al. (2007)	Poultry by-product meal	*Litopenaeus vannamei*	16%
Cruz-Suarez et al. (2007)	Poultry by-product meal	*Litopenaeus vannamei*	80%
Suarez et al. (2009)	Soy protein concentrate	*Litopenaeus vannamei*	80%
Bauer et al. (2012)	Biofloc meal	*Litopenaeus vannamei*	100%
Molina-Poveda et al. (2013)	Tremoço meal	*Litopenaeus vannamei*	50%
Tan et al. (2005)	Meat and bone meal	*Litopenaeus vannamei*	80%
Hernández et al. (2008)	Pork meal	*Litopenaeus vannamei*	>35%

Several researchers are confirming that bioflocs system can contribute to shrimp, nutrition, growth, survival, FCR, decrease protein content in the feeds, immunity and so one.







Avnimelech Ballester Abreu Baloi Arantes Schveitzer Bratvold Browdy Lawrence Crab Burford Verstraete Schryver Ebeling Furtado Gaona Timmons Suita Poersch Wasielesky Krummenauer Foes Hargreaves Lee Jung Mcintosh Lara Emerenciano Peixoto Davis Soares Correa Kuhn Samocha Maicá MacGraw Moss Moss Ray Leffler Samocha Patnaik Scopel Viau Ballester Browdy Stokes Venero Lotz Arnold Coman Avnimelech Bratvold Burford Wasielesky Samocha Cohen Preston Ebeling Hari Verdegem Stokes McAbee Otoshi Schneider Avnimelech Tacon Gaxiola-Cortés Cuzon Seiffert Valenzuela Kuhn Silva Tacon Conquest Ray Decamp Atwood Stokes Tung Taw and so one

OBJECTIVE:

ANALYSE THE USE OF "FISH MEAL ANALOG" IN THE FEEDING OF *LITOPENAEUS VANNAMEI* IN A BFT CULTURE SYSTEM

Two Studies

1. The use of FMA in feeding of *L. vannamei* growout (From 1 to 10 g) in and BFT system;

2. The use of FMA in feeding of *L. vannamei* growout (From 10 to 20 g) in and BFT system.

Location of Study

- ✓ Marine Station of Aquaculture
- ✓ Institute of Oceanography, Federal University of Rio Grande, RS, Brazil
- ✓ 9 Raceways 35 m^2

METHODS

Three types of Isoproteic and isoenergetic feed were produced (38% CP and 7.5% EE), with different replacement of Fishmeal by Fishmeal Analog.

T0	T50	T100
0% FMA	50% FMA	100% FMA
100% FM	50% FM	0% FM

METHODS

Fishmeal Analog's ingredients
Meat Meal
Bone meal
Blood meal
Feather meal
Poultry by-product meal
Squid meal
Fish solubles
Fish oil
Lectin
Lysine
Hemoglobin
Cholesterol
Methionine
Tryptophan
Micro Minerals
Vitamins Premix
Amino Acids Premix

*Data provided by GUABI feeds – Centro-Oeste Rações LTDA

METHODS

Fishmeal analog's composition (%)	
Crude protein	47.4
Crude lipids	16.3
Linolenic acid	2.1
Phospholipids	3.5
Cholesterol	0.3
HUFA	1.7
Fibers	0.9
Ashes	16.2
Calcium	5.7
Total phosphorus	3.0
Total lysine	3.9
Total cysteine	0.9
Total methionine	1.4

*Data provided by GUABI feeds – Centro-Oeste Rações LTDA

METHODS

- ✓ Feeding rate was based on Jory et al. (2001)
- ✓ Belt feeder (12 hours)
- ✓ 10% of the feed was distributed in circular feeding trays

PRE-FERTILIZATION

METHODS

- The measurement of TA-N was performed every day;
- Organic Fertilization (C:N) 6:1 – with molasses
- Fertilization when ammonia achieved 1 mg/L;

Molasses from ECUADOR

Molasses from USA

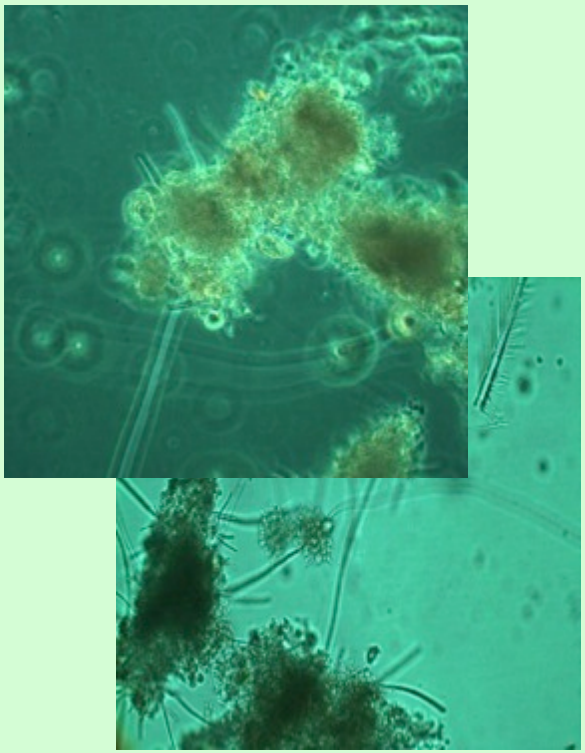
Molasses from BRAZIL

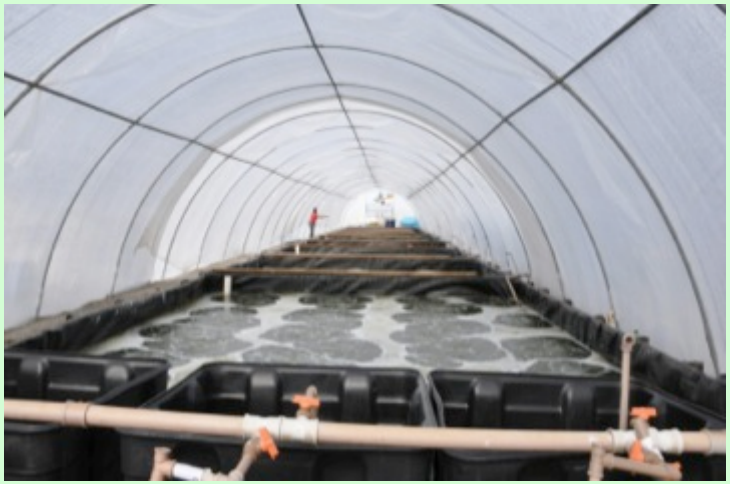
✓ Fertilization based on Avnimelech (1999) and Ebeling *et al*. (2006)

METHODS

Biofloc formation - Inoculum

- 20 % of aged inoculum was pumped from nursery system for better nitrifying process (Krummenauer et al. 2013)

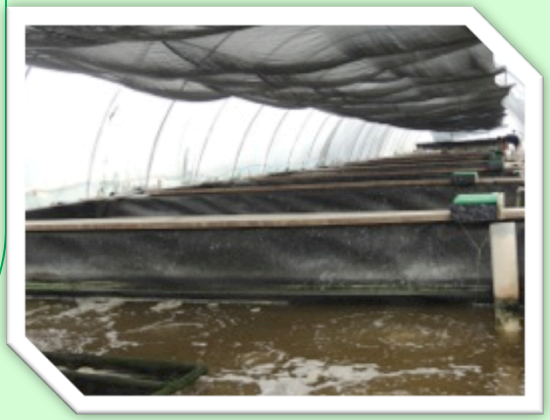




METHODS

- ✓ pH, temperature, dissolved oxygen and salinity were measured daily

- ✓ Analysis of ammonia, nitrite and nitrate every three days;
- ✓ Shrimps were sampled weekly to check growth;
- ✓ Counting total number of shrimps in the end of the experiment to determine the survival;
- ✓ Results were analyzed by one-way ANOVA ($\alpha=0.05$)

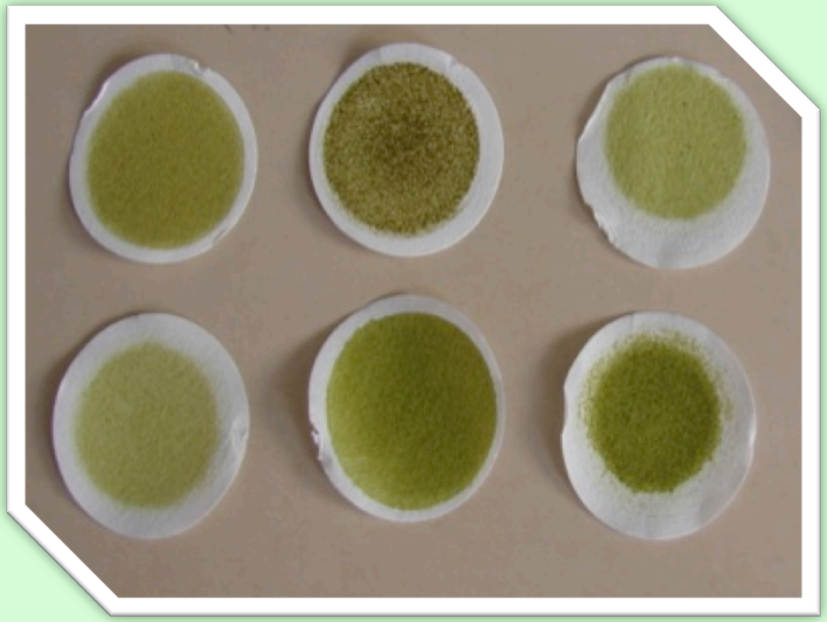


METHODS

Biofloc control:

- ✓ Total Suspended Solids (TSS)
- ✓ Bioflocs volume (Imhoff cones)

*(Three times / week)



METHODS

To control

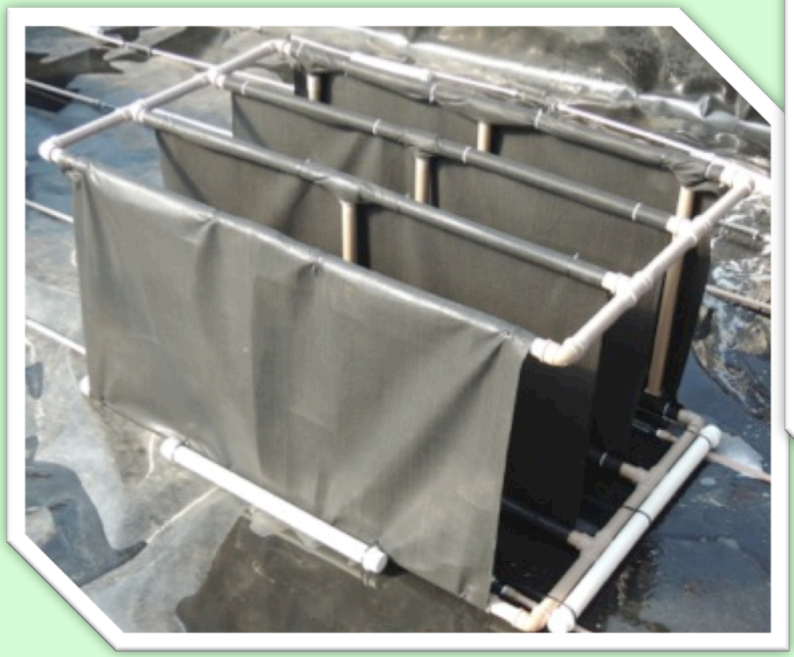
INLET

OUTLET

METHODS

ARTIFICIAL SUBSTRATE:

- ✓ 200% of surface area



METHODS

MULTI-STRAIN COMMERCIAL PROBIOTIC

Water

- ✓ 0.5 ppm /week
- ✓ Distribute the mixture in several locations around the tank.

Feed

- ✓ 3 g/kg diet
- ✓ Mix with the feed and let dry
- ✓ Feed was distributed in several locations around the tank.

Experiment 1

The use of FMA in feeding of *L. vannamei* growout (from nursed juveniles to 10 g) in and BFT system

METHODS

Greenhouse

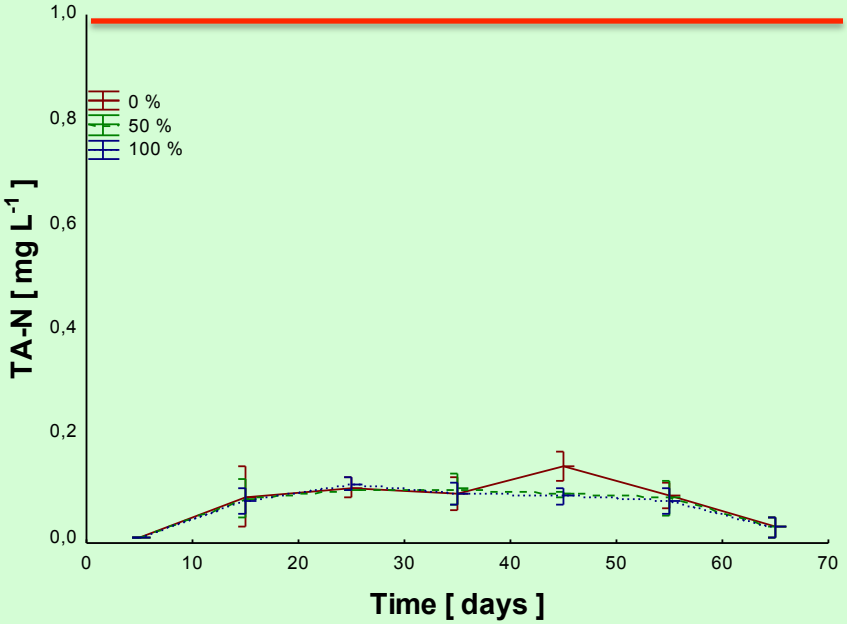
- ✓ 3 treatments - 3 replicates
- ✓ Stocking density: 400 shrimps.m^{-2}
- ✓ Initial weight: 2.64 ± 0.77 g (*L. vannamei* juveniles)
- ✓ Time: 70 days

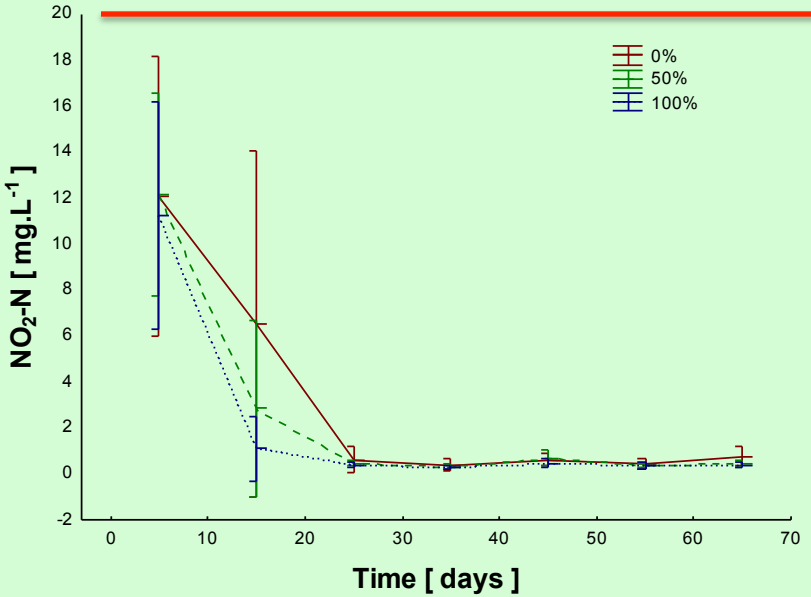
METHODS

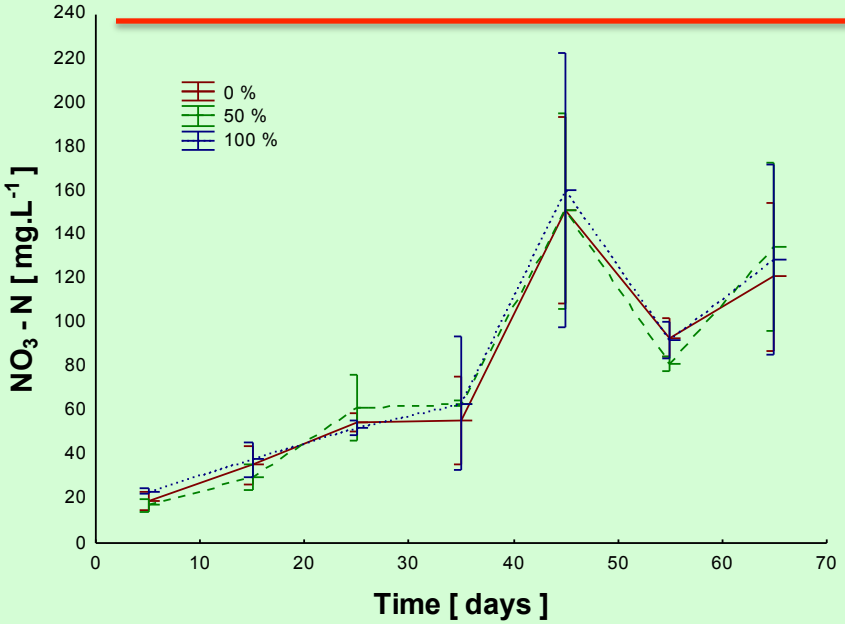
✓ Treatments:

- ✓ T0 - 0% FMA: Diet with 0% replacement of fishmeal by fishmeal analog;
- ✓ T50 - 50% FMA: Diet with 50% replacement of fishmeal by fishmeal analog;
- ✓ T 100 -100% FMA: Diet with 100% replacement of fishmeal by fishmeal analog

Ammonia, Nitrite and Nitrate



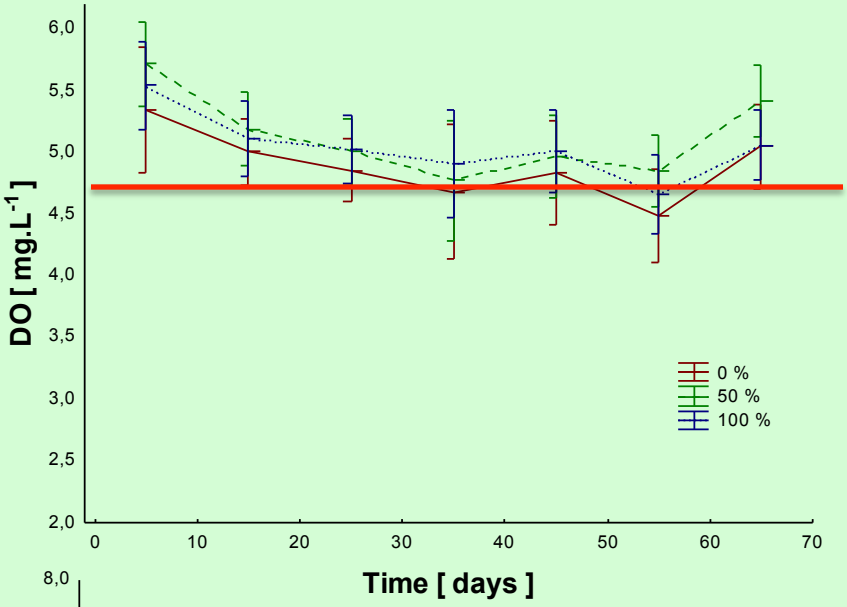


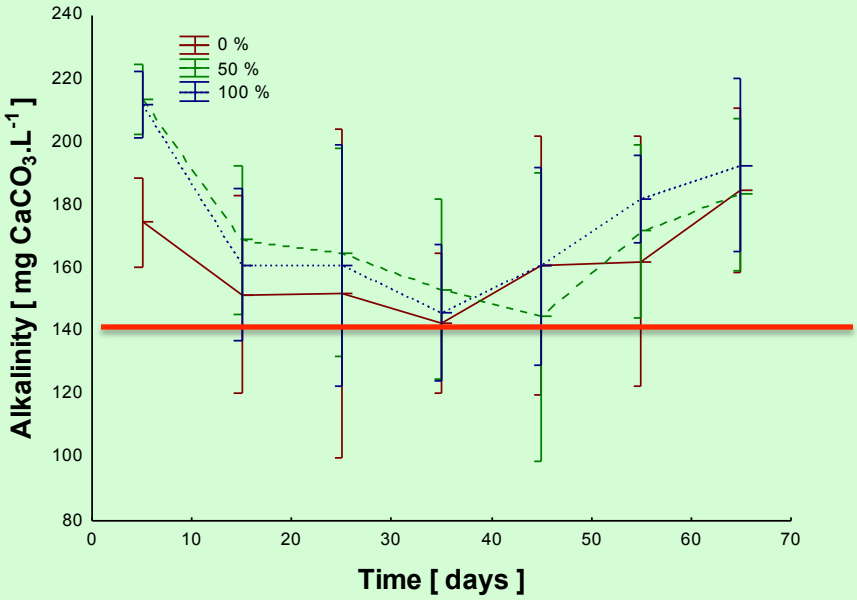


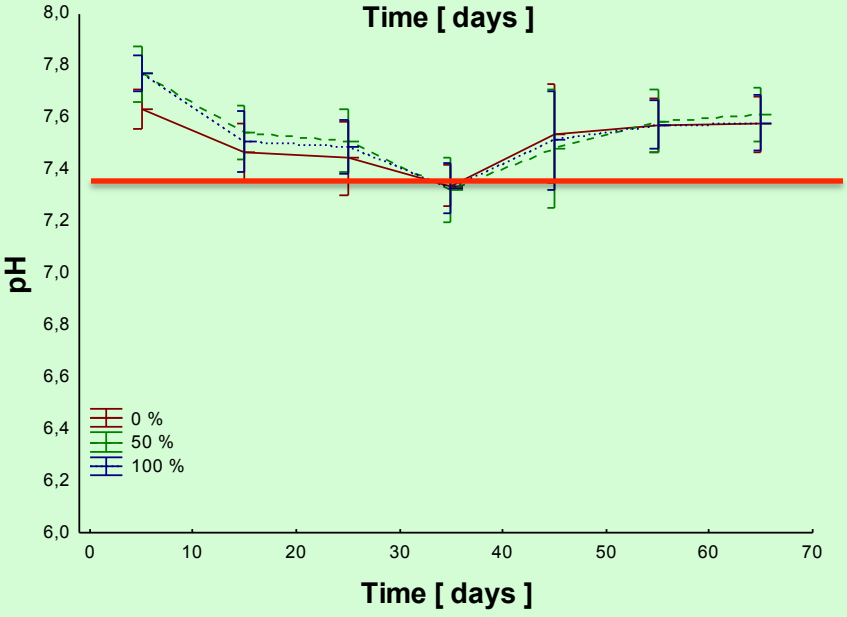
RESULTS

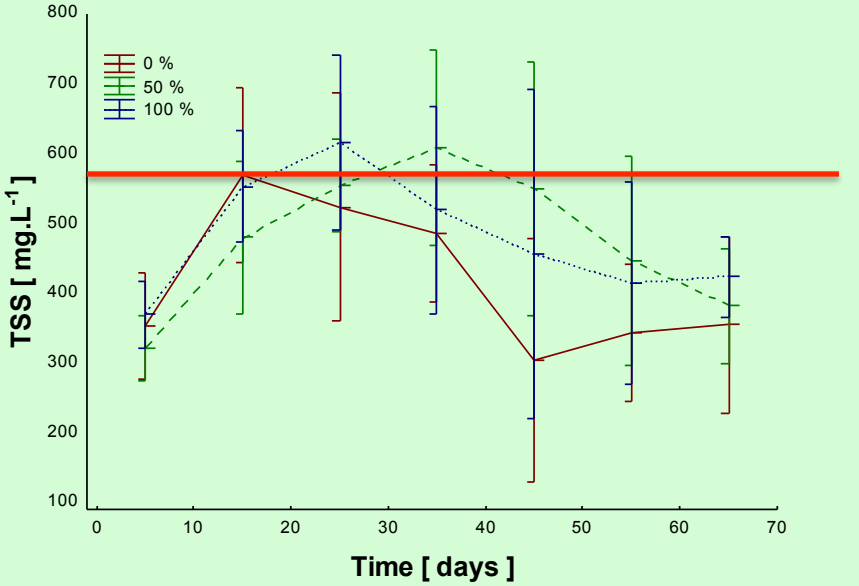
RESULTS

DO, Alkalinity, pH and TSS







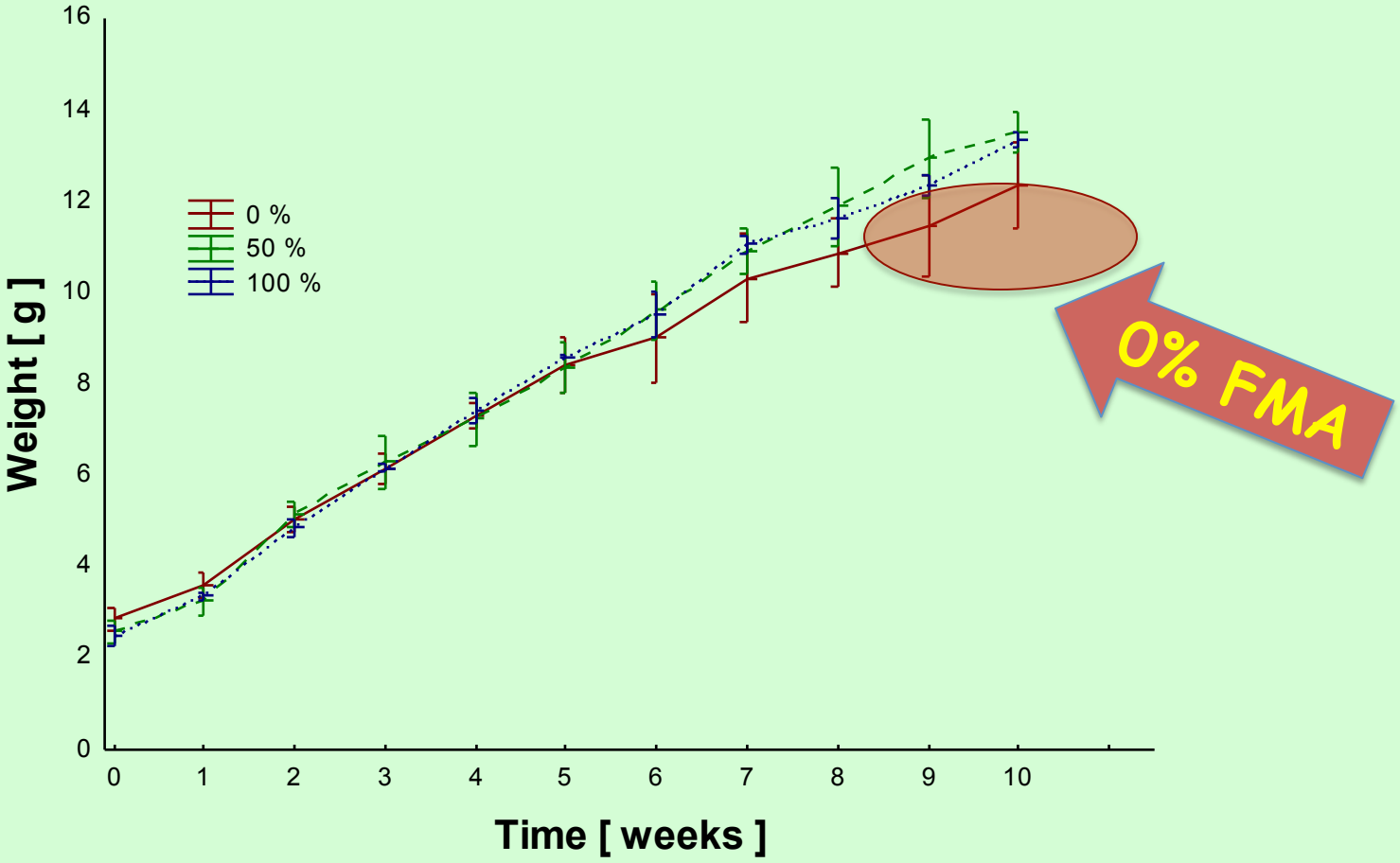


Water Quality parameters monitored during experimental period. Results shown as mean ± standanrd deviation.

Parameters	0 % FMA	50 % FMA	100 % FMA
DO ($mg.L^{-1}$)	4.89 ± 0.53	5.13 ± 0.45	5.04 ± 0.44
pH	7.51 ± 0.16	7.55 ± 0.16	7.54 ± 0.14
Salinity	23.04 ± 0.58	23.19 ± 0.48	23.63 ± 0.54
Alkalinity (mg $CaCO_3.L^{-1}$)	161.0 ± 34.56	170.60 ± 25.83	173.17 ± 21.61
TA-N ($mg.L^{-1}$)	0.07 ± 0.02	0.07 ± 0.02	0.07 ± 0.01
NO_2^--N ($mg.L^{-1}$)	3.02 ± 2.07	2.45 ± 1.15	2.03 ± 0.90
NO_3-N ($mg.L^{-1}$)	83.27 ± 16.71	83.89 ± 11.91	87.46 ± 19.88
PO_4-P ($mg.L^{-1}$)	2.80 ± 0.45	2.94 ± 0.63	3.03 ± 0.58
Settleable solids ($ml.L^{-1}$)	18.8 ± 4.90	25.1 ± 8.00	26.4 ± 8.70
TSS ($mg.L^{-1}$)	427.00 ± 122.75	477.06 ± 103.12	486.01 ± 110.94
Turbidity (NTU)	165.50 ± 52.65	207.82 ± 44.76	200.21 ± 52.54

($P>0.05$)

Growth


16
14
12
10
8
6
4
2
0
Weight [g]
0 %
50 %
100 %
0
1
2
3
4
5
6
7
8
9
10
Time [weeks]
0% FMA

Zootechnical parameters of of *L. vannamei* fed with diet including different replacement levels of fishmeal analog (FMA) in biofloc system. Results shown as mean ± standanrd deviation.

Parameters	0 % FMA	50 % FMA	100 % FMA
Initial weight (g)	2.64 ± 0.77	2.64 ± 0.77	2.64 ± 0.77
Final weight (g)	12.19 ± 2.98	13.51 ± 2.92	13.34 ± 3.49
Initial biomass (kg/tank)	36,96	36,96	36,96
Final biomass (kg/tank)	153.93 ± 4.55	158.72 ± 4.99	149.29 ± 2.72
Produced biomass (kg/tank)	116,97 ± 4.55	121,76 ± 4.99	112,33 ± 4.72
Final Yield ($kg.m^{-2}$)	4.40 ± 0.13	4.53 ± 0.14	4.26 ± 0.18
WGR ($g.week^{-1}$)	1.08 ± 0.10	1.11 ± 0.19	1.10 ± 0.14
Survival (%)	86.83 ± 7.68	82.17 ± 3.75	81.97 ± 4.79
FCR	1.47 ± 0.06	1.37 ± 0.06	1.50 ± 0.10

$P>0.05$

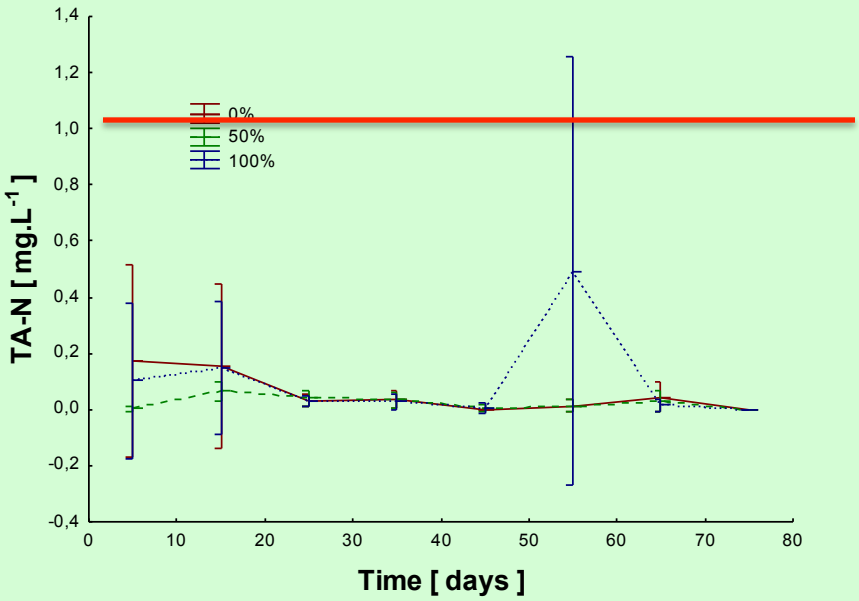
Experiment 2

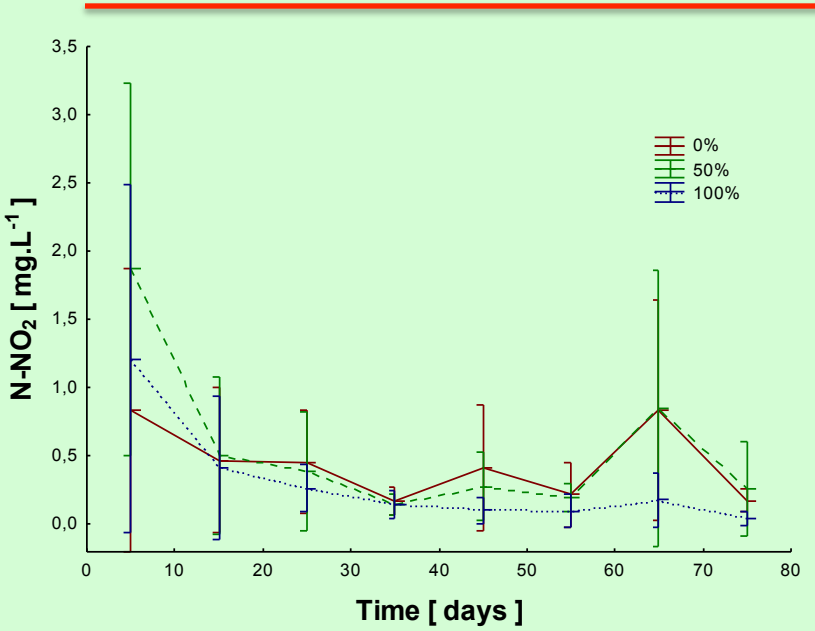
The use of FMA in feeding of *L. vannamei* Grow out (From 10 to 20 g) in and BFT system

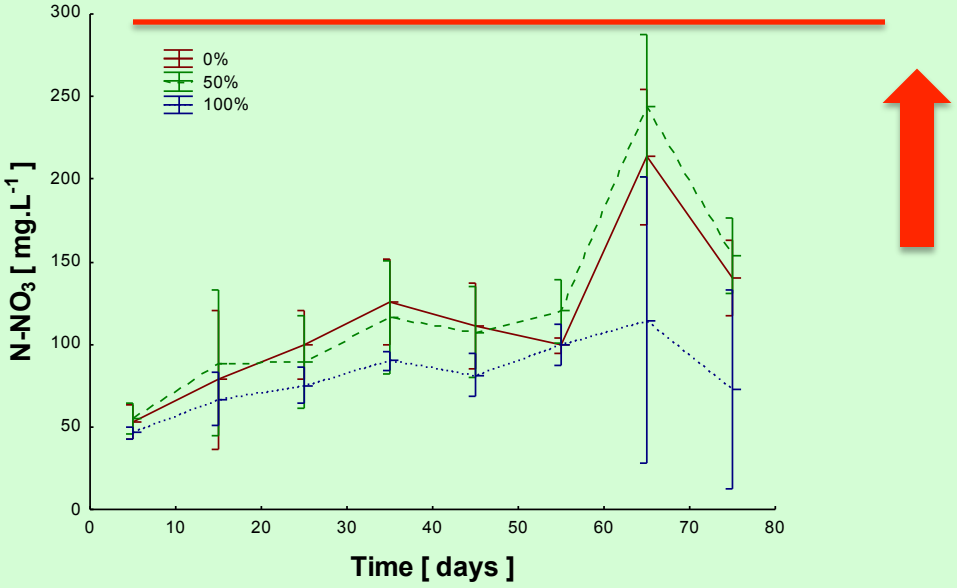
METHODS

- ✓ Nine 35.000 L lined greenhouse enclosed raceways
- ✓ Initial weight: 9.25± 1.24 g
- ✓ (shrimps from growout)
- ✓ Stocking density: 200 shrimps/m^2 or /m^3
- ✓ Period: 77 days
- ✓ Same methodology of first study and the same water

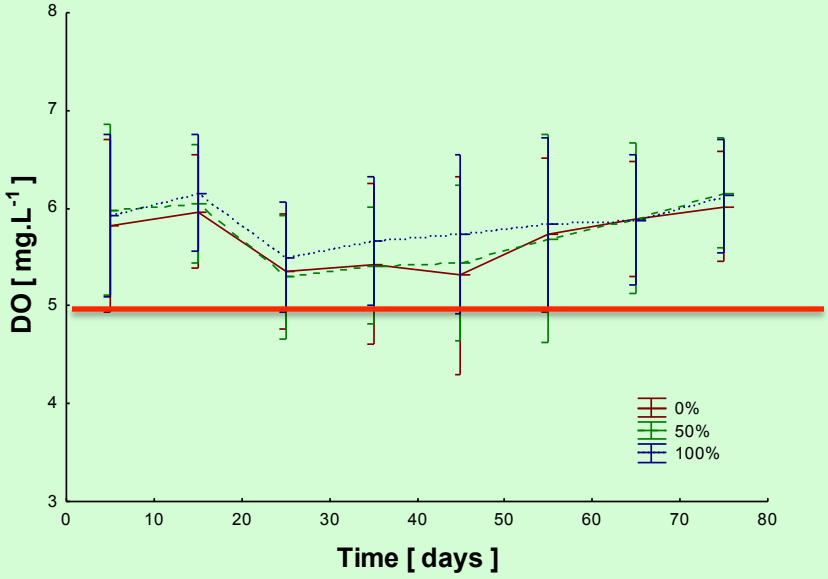
Ammonia, Nitrite and Nitrate

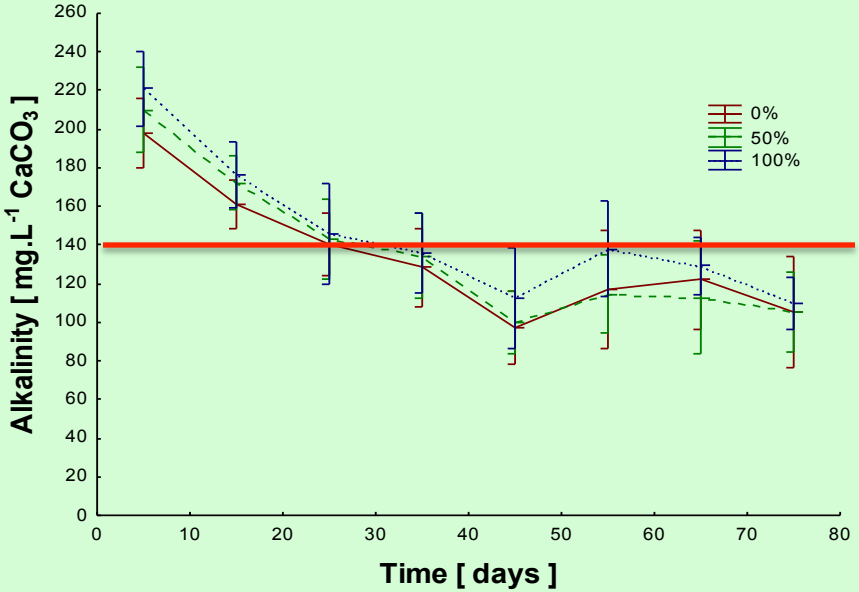


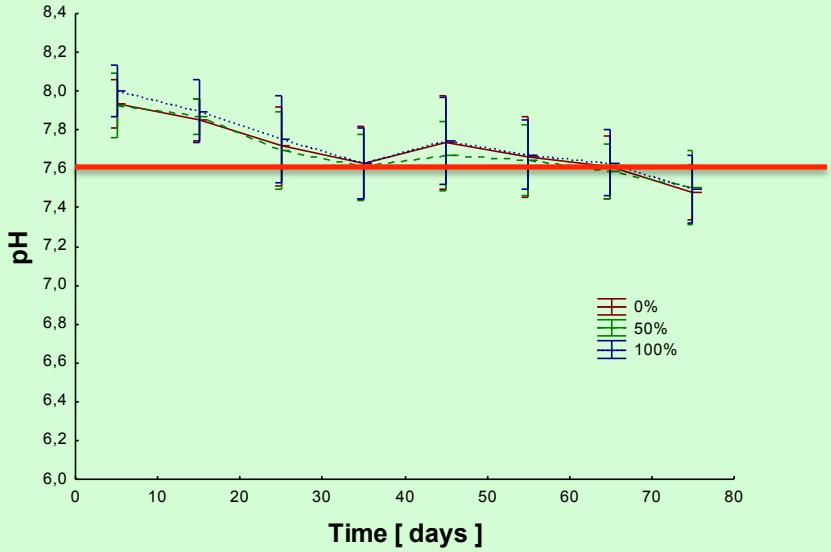


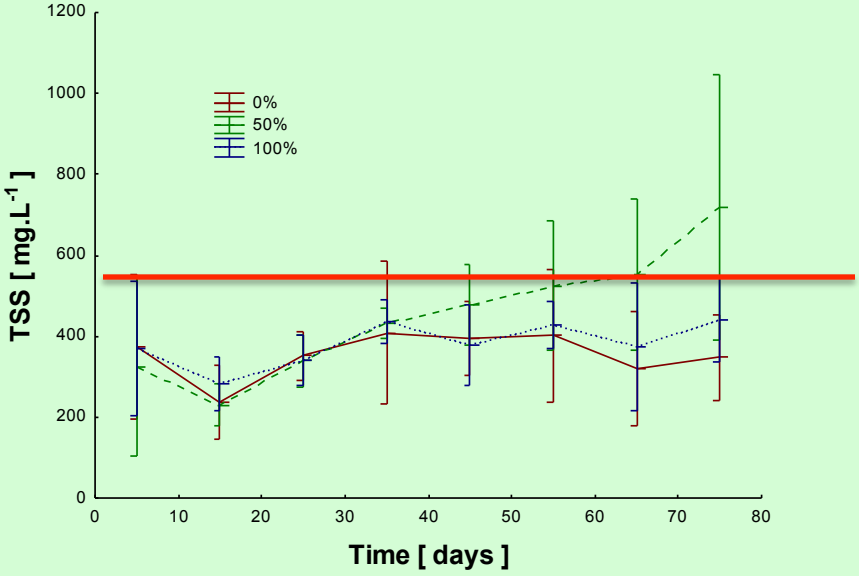


DO, Alkalinity, pH and TSS







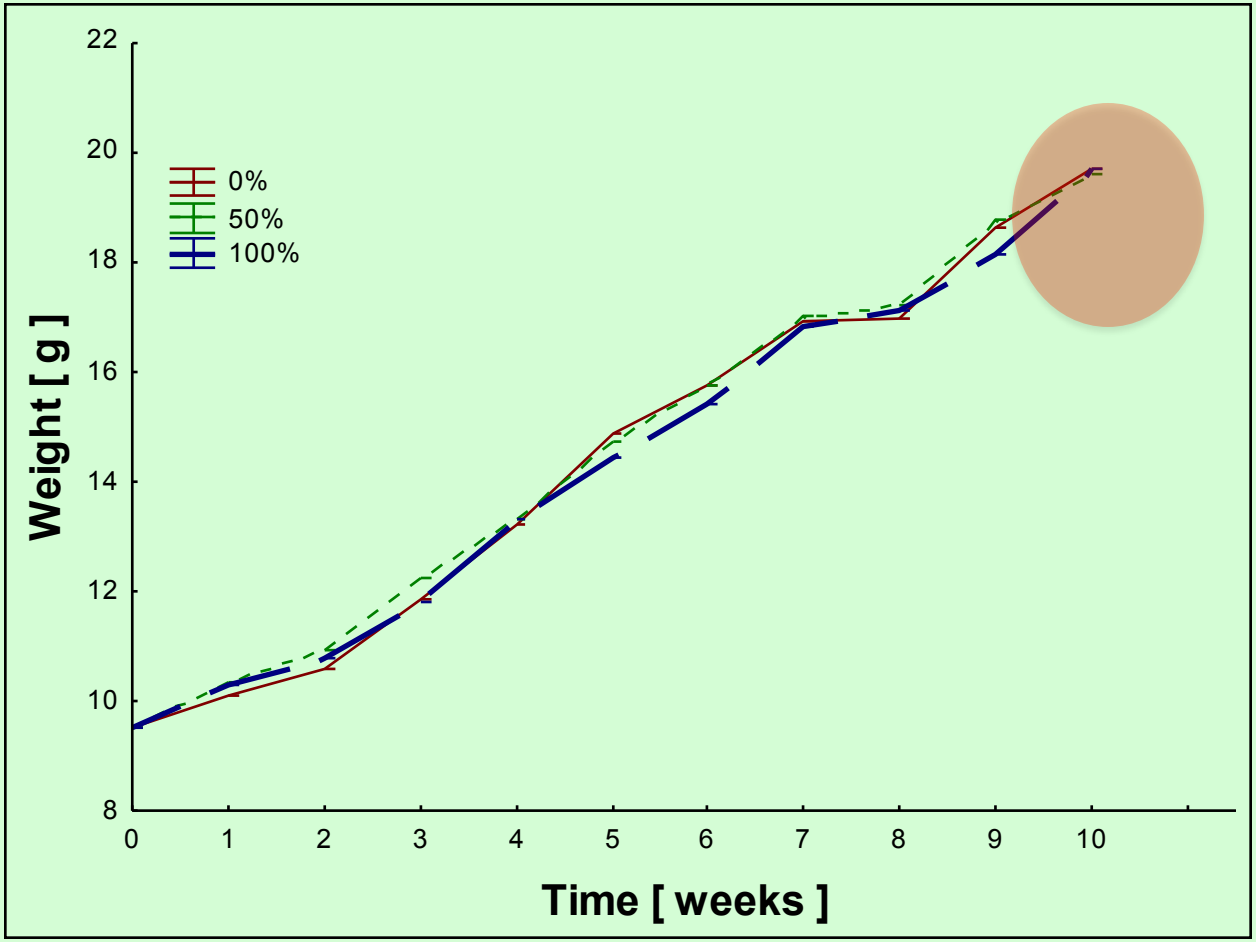


Water Quality parameters monitored during experimental period. Results shown as mean ± standanrd deviation.

	T0%	T50%	T100%
Temperature (°C)	27.5 ± 2.1	27.3 ± 2.3	27.5 ± 1.9
DO ($mg.L^{-1}$)	5.67 ± 0.79	5.71 ± 0.75	5.84 ± 0.72
pH	7.70 ± 0.31	7.70 ± 0.20	7.75 ± 0.22
Salinity	18.20 ± 0.54	18.17 ± 0.81	17.43 ± 0.99
Alkalinity ($mg.L^{-1}$ $CaCO_3$)	138.87 ± 37.16	142.27 ± 43.07	153.44 ± 42.43
TAN ($mg.L^{-1}$)	0.087 ± 0.2	0.054 ± 0.1	0.124 ± 0.3
NO_2-N ($mg.L^{-1}$)	0.48 ± 0.57	0.33 ± 0.54	0.60 ± 0.80
NO_3-N ($mg.L^{-1}$)	108.97 ± 57.26	114.43 ± 66.90	80.98 ± 39.30
PO_4-P ($mg.L^{-1}$)	2.56 ± 1.13	2.34 ± 0.85	2.03 ± 0.63
SS ($mL.L^{-1}$)	20.50 ± 14.70	40.28 ± 35.91	28.62 ± 19.2
TSS ($mg.L^{-1}$)	343.13 ± 141.26	430.83 ± 204.46	361.70 ± 121.03
VSS ($mg.L^{-1}$)	0.050 ± 0.1	0.067 ± 0.1	0.074 ± 0.1
Turbidity (NTU)	206.06 ± 78.04	305.61 ± 198.29	217.27 ± 95.41

$(P>0.05)$

Growth



Zootechnical parameters of of *L. vannamei* fed with diet including different replacement levels of fishmeal analog (FMA) in biofloc system. Results shown as mean ± standanrd deviation.

	0%	50%	100%
Inicial Weight (g)	9.25±1.24	9.25±1.24	9.25±1.24
Final Weight (g)	19.47±4,63	18.73±4.10	18.59±3.90
Inicial Biomass (kg)	64.75	64.75	64.75
Final Biomass (kg)	125.16±5.21	125.22±6.53	127.40±3.39
Produced Biomass (kg)	60.41±5.21	64.7±6.53	62.65±3.39
Inicial Productivity ($kg.m^{-2}$)	1.85	1.85	1.85
Final Productivity ($kg.m^{-2}$)	3.58±0.15	3.58±0.19	3.64±0.10
Weekly Growth (g)	0.93±0.09	0.86±0.12	0.85±0.11
Survival (%)	92.11±8.15	95.58±2.93	97.60±3.40
FCR	1.95±0.16	1.93±0.18	1.70±0.34

$P>0.05$

Conclusions

- ✓ Results confirm that biofloc present in BFT system can supply important nutrients not included in the feeds;
- ✓ It is possible to replace 100% of fishmeal with FMA in shrimp feeds, in BFT system.

Next Steps

- ✓ Elucidate how biofloc can contribute in shrimp nutrition when FMA is used;
- ✓ Low protein in FMA feeds;
- ✓ Low the cost of FMA.

ACKNOWLEDGEMENTS