EFFECTS OF AN ORGANIC CERTIFIABLE PLANT-BASED DIET IN CONJUNCTION WITH SOLIDS REMOVAL ON THE PRODUCTION OF SHRIMP *Litopenaeus vannamei* IN MINIMAL EXCHANGE SUPERINTENSIVE BIOFLOC SYSTEMS

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Biofloc-Based Systems

- Allow for high-density shrimp culture
- Reliant on a dense microbial community
  - nutrient cycling
  - supplemental nutrition
- May be able to use alternative feeds
- Need to optimize the microbial community structure

Experimental Design

- Two diets
  - Ziegler® Hyperintensive (36% CP, 9% fat)
  - Experimental plant-based feed (37% CP, 5% fat)
    - No fishmeal, no fish oil, no binder, organic certifiable
    - Eco-friendly
    - Cost-effective

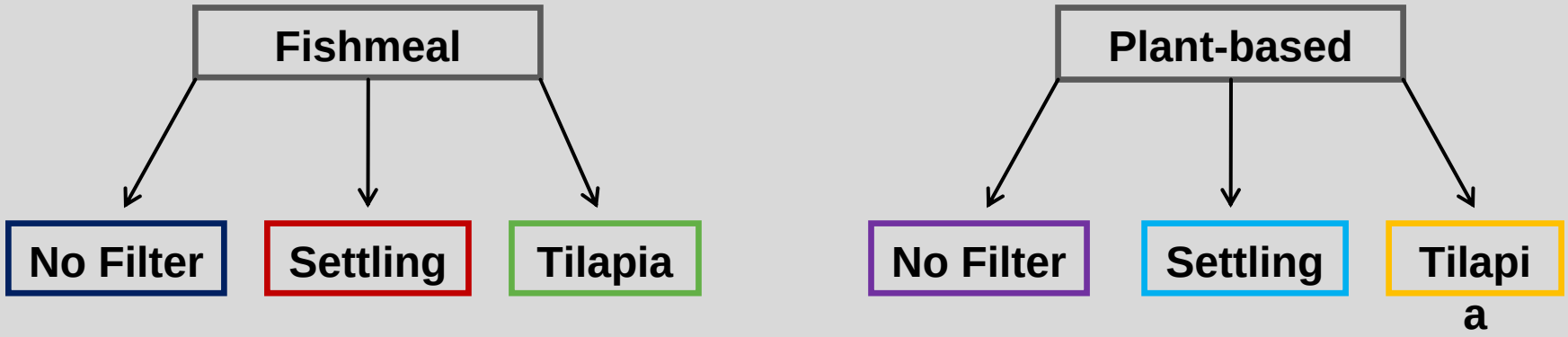
Ingredient	Percentage
Soybean meal (expelled)	55
Corn gluten meal	12
Whole wheat	11.14
Pea meal	10
Squid meal	2
CaP - dibasic	2
Vitamin premix	1.8
DHA (Docosahexaenoic acid) - AquaGrow®	1.39
Flax seed oil	1
ARA (Arachidonic Acid) - AquaGrow®	1
Soy oil	0.8
Lecithin (soy refined)	0.5
Betaine	0.5
Trace Mineral premix	0.5
Choline cloride	0.2
Cholesterol	0.1
Stay-C 250mg/kg using 35%	0.07

Experimental Design

- Settling Systems
  - Maintained turbidity of < 30 NTU
  - Emptied once per week, measured volume and solids
- Tilapia Systems
  - 2.87 ± 0.67 kg fish per system, 30.49 ± 9.95 g individual fish
- Both Systems
  - Approximately 200 L
  - Water airlifted

Experimental Design

- 24 outdoor, 3.5m diameter tanks
- Shrimp stocked at 460/m^3
- Six unique treatments



- Four replicate tanks for each treatment, randomly assigned

Hypotheses

1. The two diets will produce comparable shrimp production values

2. Tilapia will increase algal productivity

3. Settling solids will increase light penetration and algal productivity

4. Both tilapia and solids removal will improve shrimp production values

Water Quality

	Parameters Monitored Twice Daily			
	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Salinity (g/L)
Range	21.3 - 29.9	2.2* - 8.1	5.7 - 8.4	13.7 - 22.9
Mean	27.0	5.8	7.4	18.7

*DO was especially low on one sample date, excluding this date the lowest value was 3.1mg/L

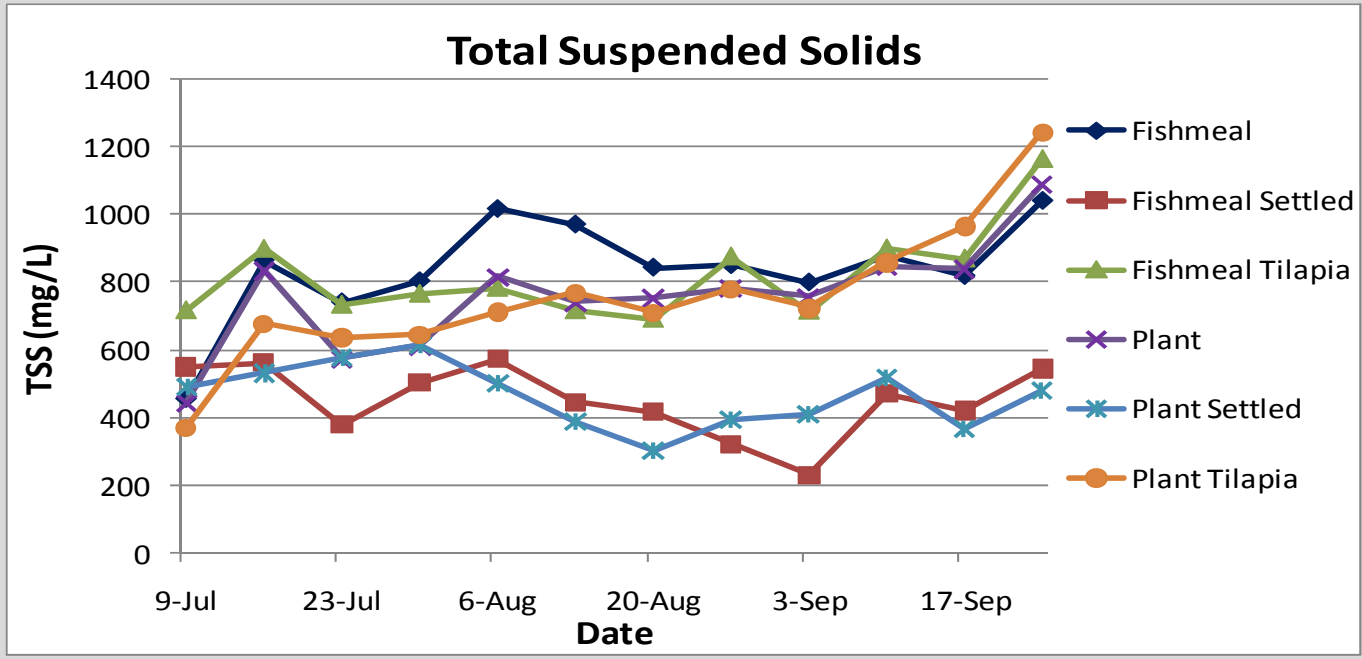
	Nitrogen Species		
	Ammonia (mg NH_3-N/L)	Nitrite (mg NO_2-N/L)	Nitrate (mg NO_3-N/L)
Range	0.0 - 2.9	0.0 - 5.5	23.7 - 169.1
Mean	0.4	1.0	70.9

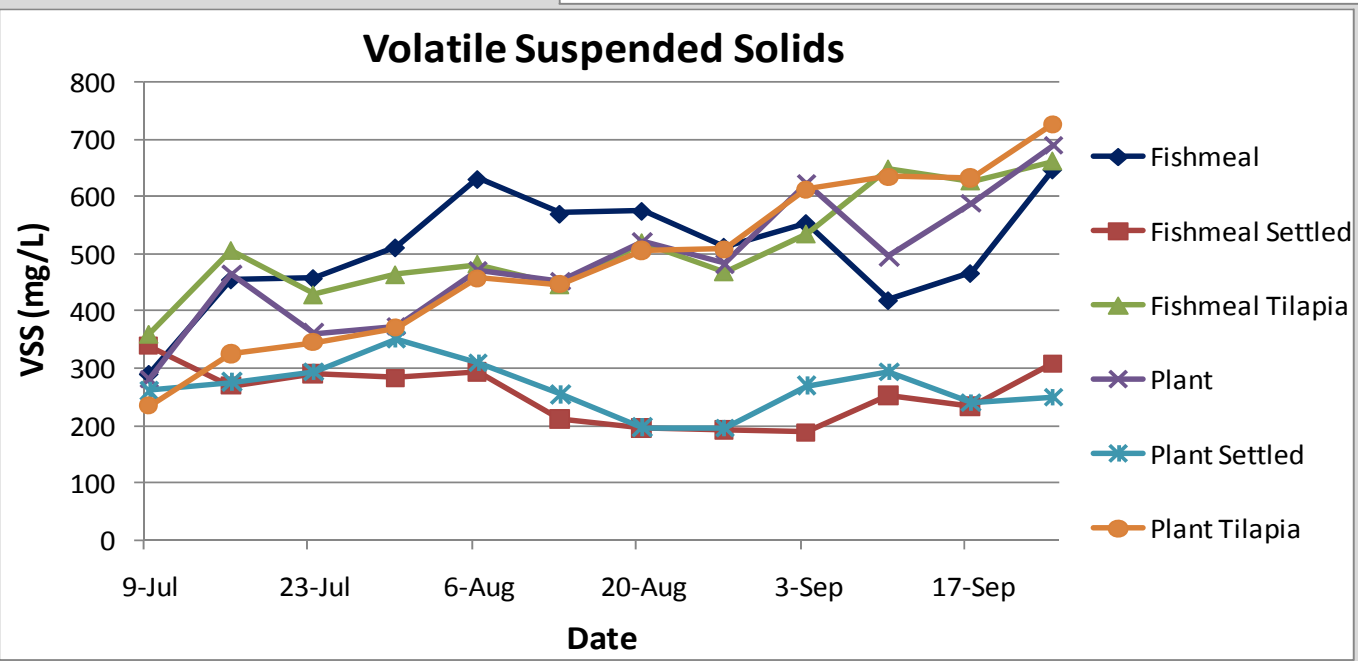
Ammonia and nitrite were sampled six times during the study, nitrate was sampled on four occasions. The first sample date for nitrate was one week after shrimp were stocked.

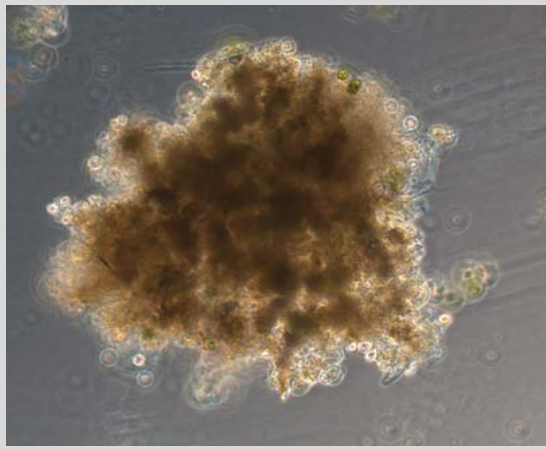
- Tables show data from all tanks during the 12 week experiment

Solids

- Significantly less solids in settled treatments ($P < 0.001$)



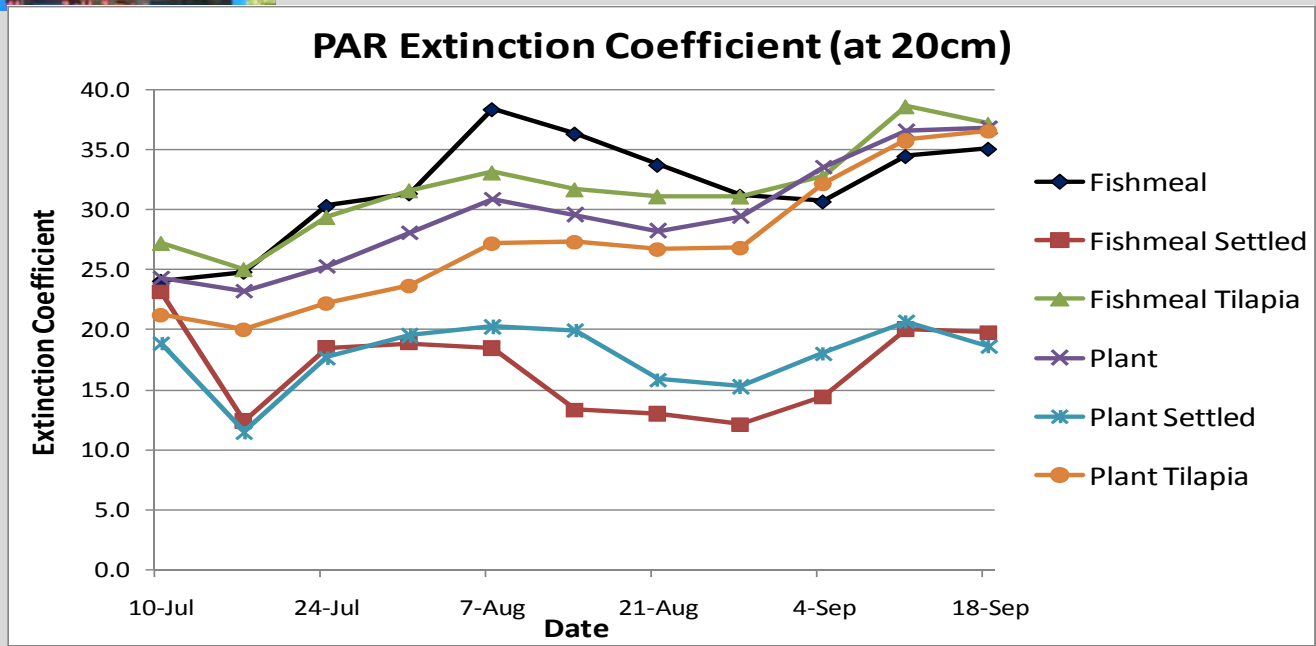




Photosynthetically Active Radiation (PAR)

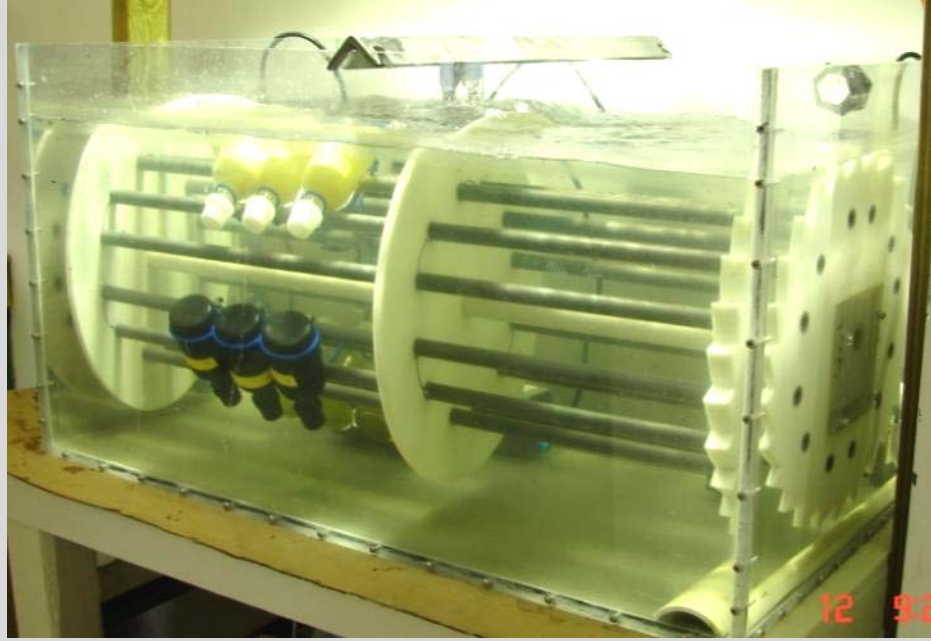
- Hand held light meter; one sensor above the water surface, the other 20cm below

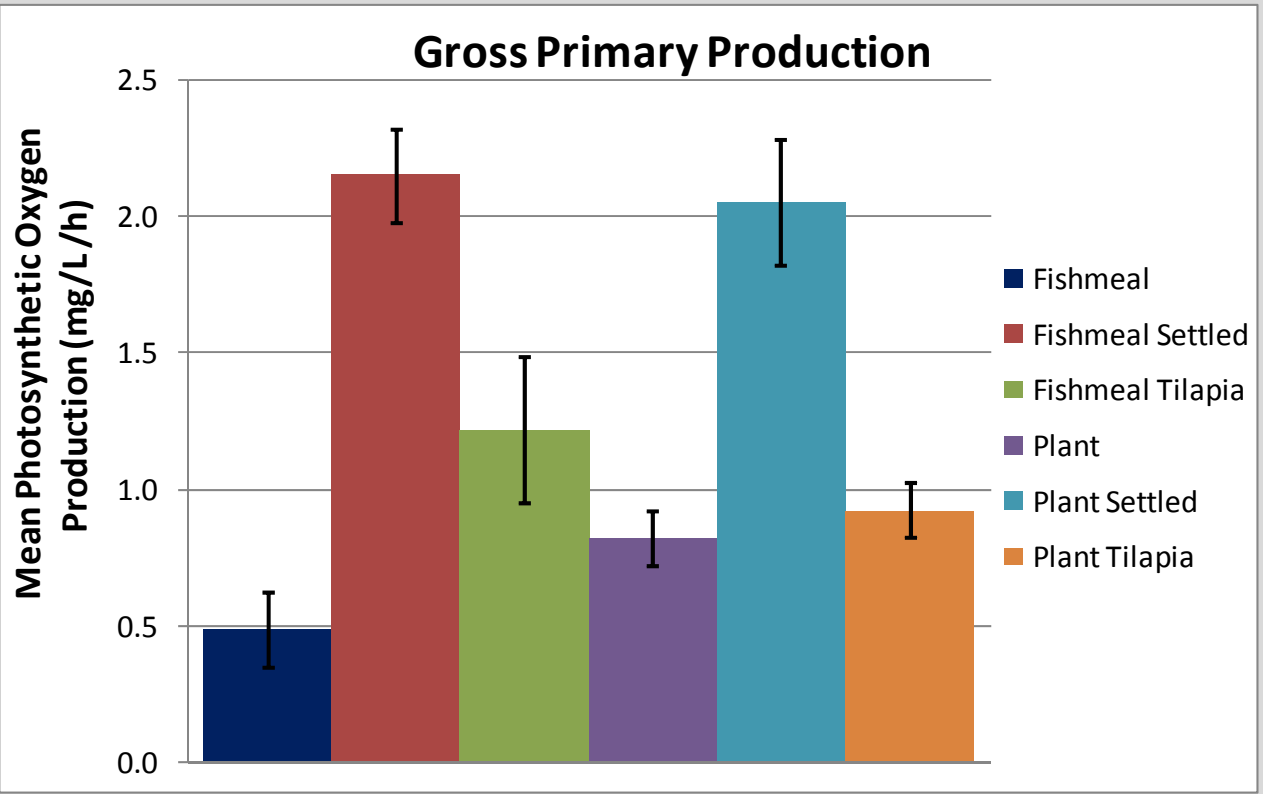
- Significantly lower PAR extinction coefficient in settled treatments ($P < 0.001$)



Primary Productivity

- Light/dark bottles
- Rotating device for particle suspension
  - Temperature and light controlled
  - Comparable to in situ conditions

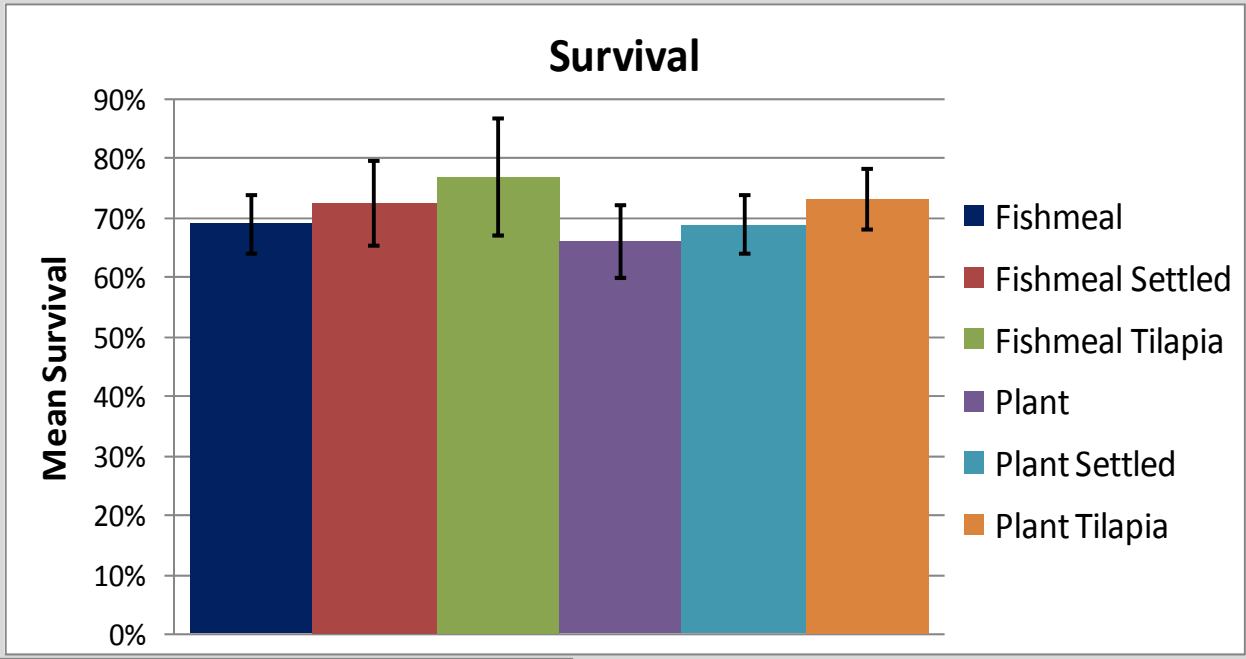


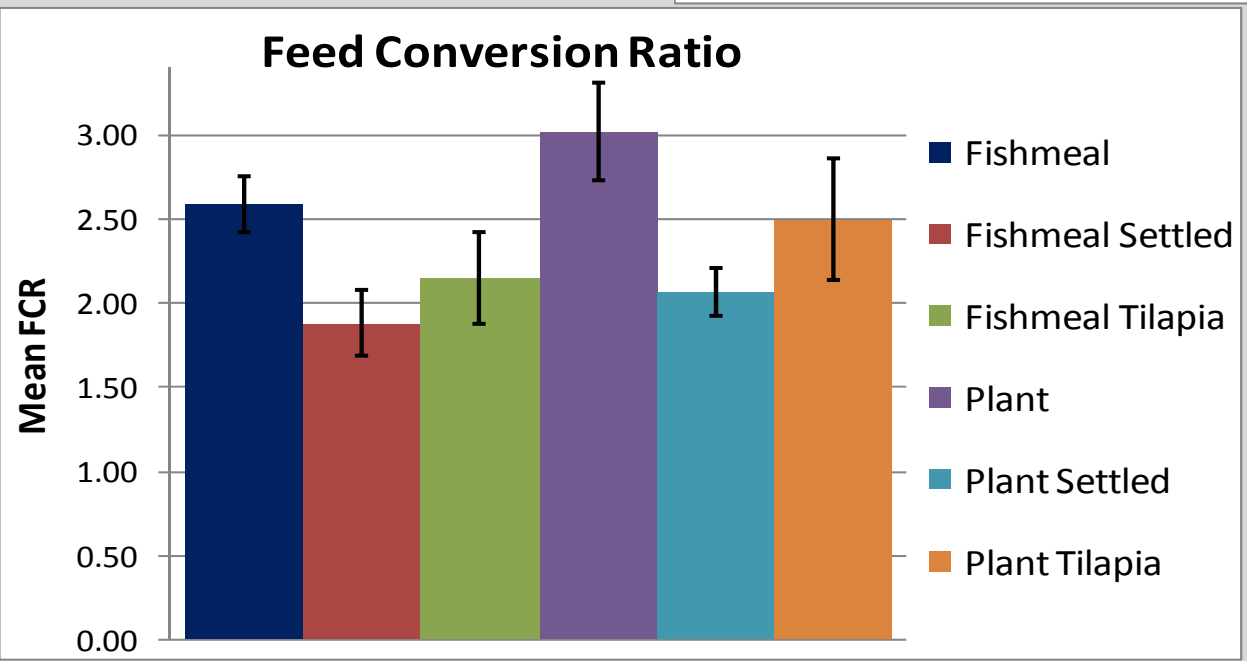


- Gross primary production was significantly greater in settled treatments ($P < 0.001$)

Shrimp Production

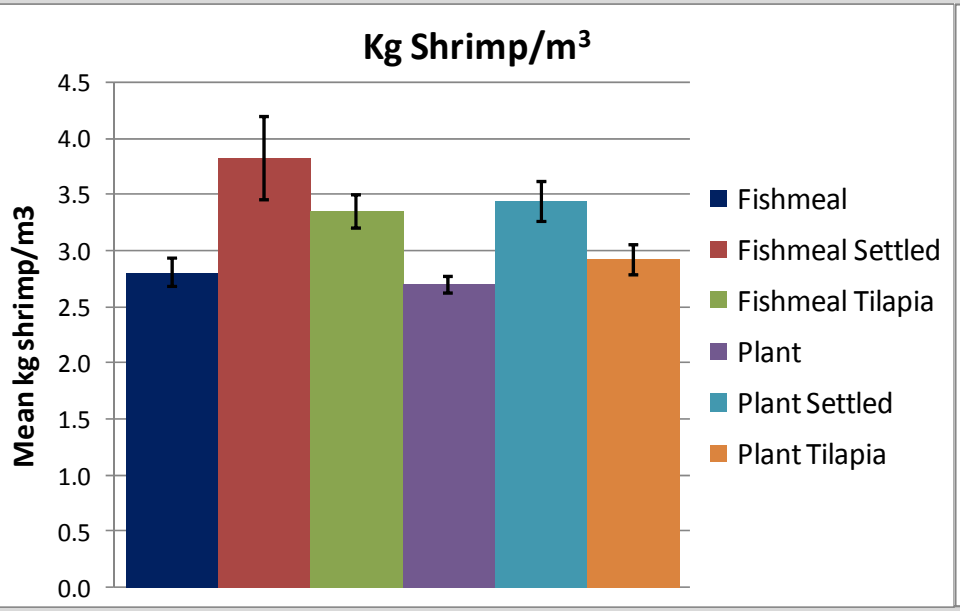
- No significant differences in survival between treatments

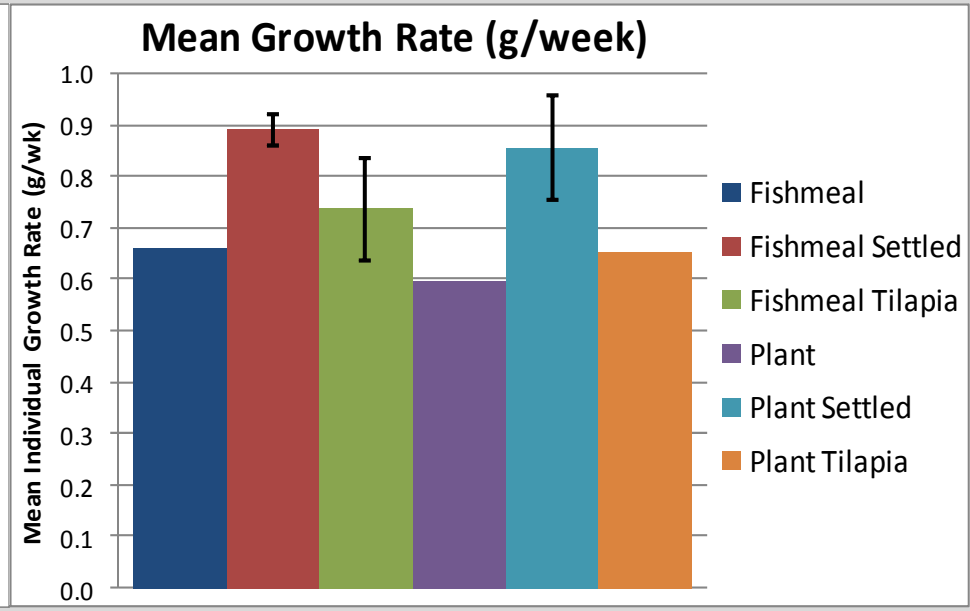




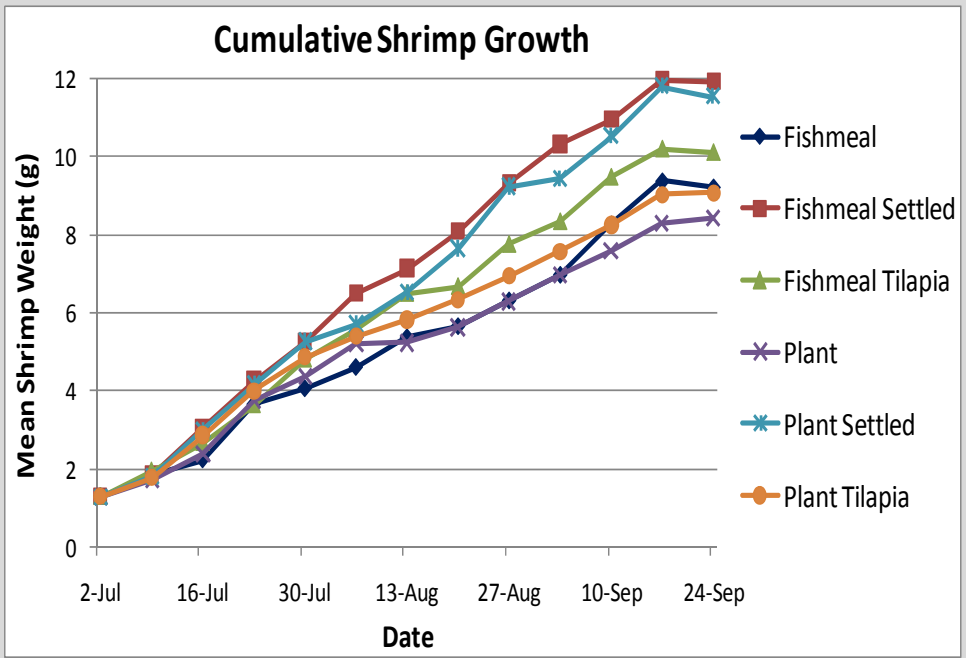
- FCR was significantly lower in settled treatments (P=0.006)

Shrimp Production



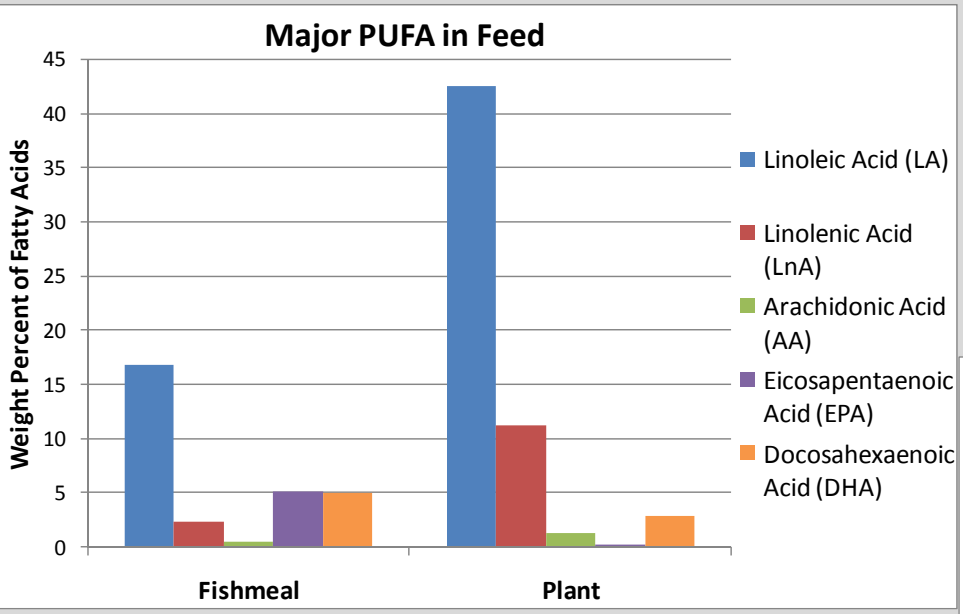


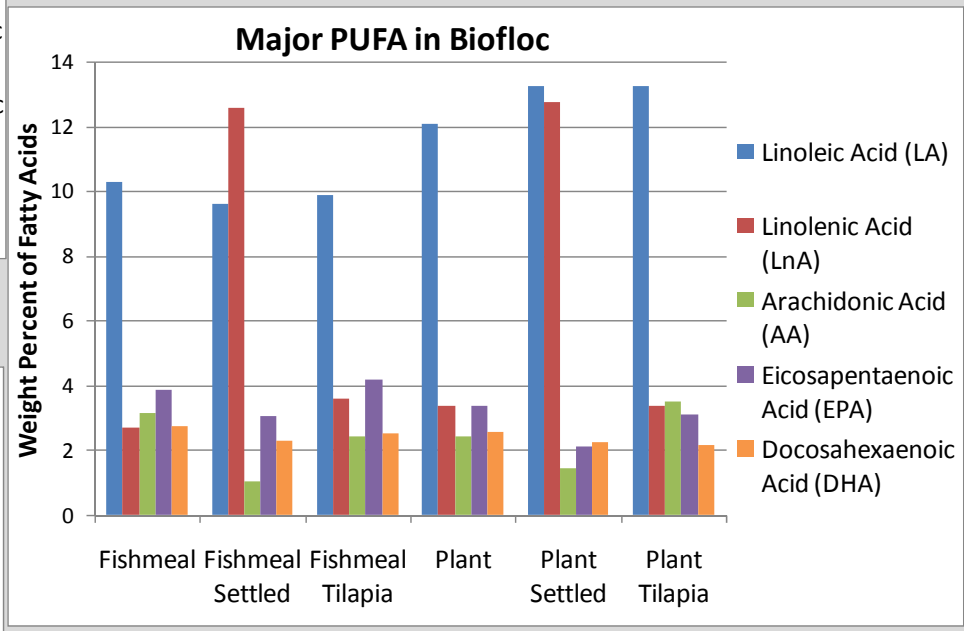
- Significantly higher biomass in settled treatments (P=0.003)

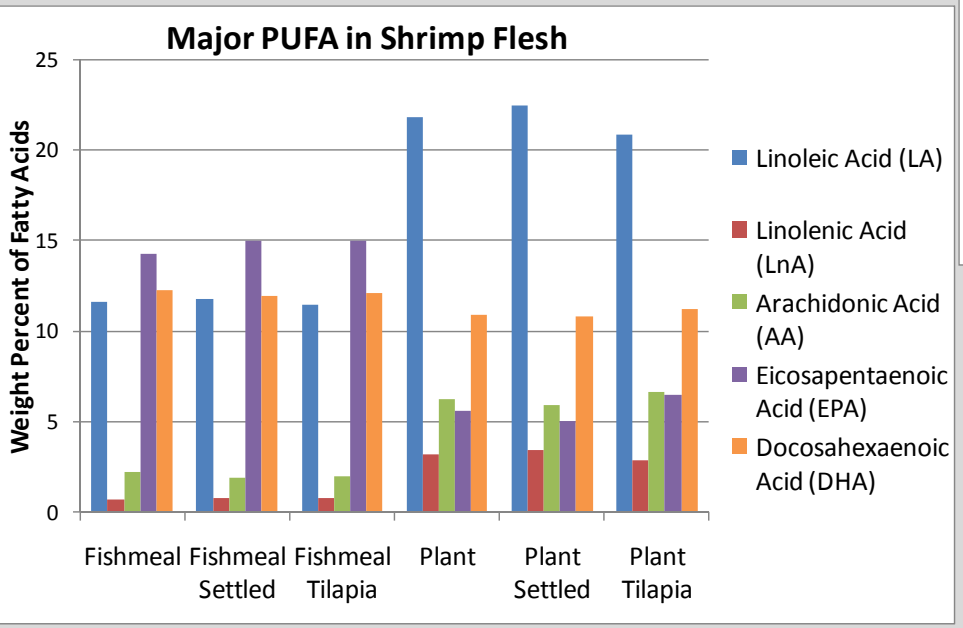


- Significantly higher growth rate in settled treatments (P<0.001)
- Significantly higher final mass in settled treatments (P<0.001)

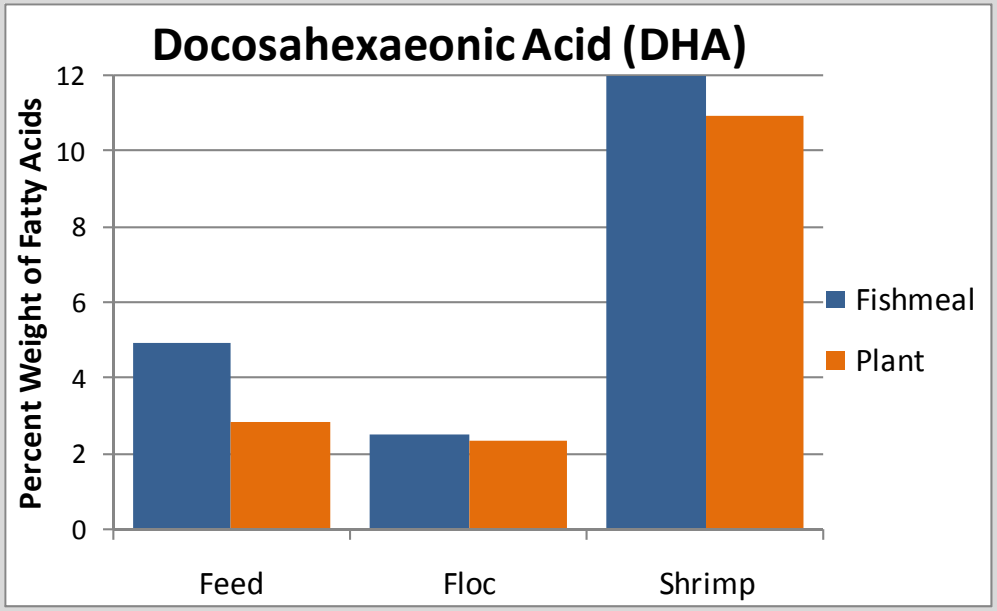
Comparison of Major PUFA in Feed, Biofloc, and Shrimp

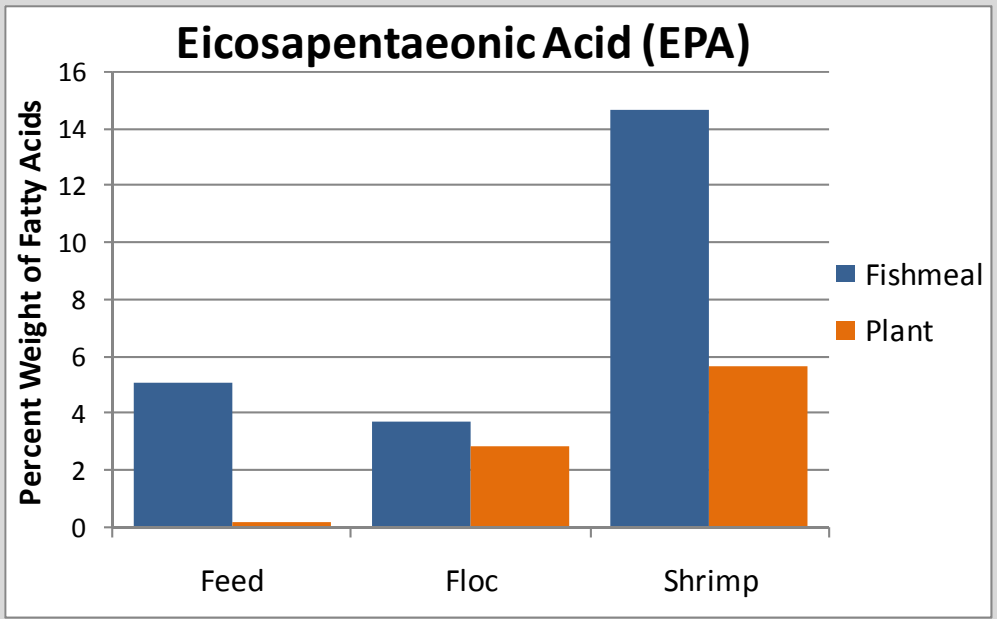






Comparing Major HUFA Levels in Feed, Biofloc, and Shrimp Based on Diet





- Large difference in FA levels between the two feed types
- Much less difference between biofloc from each feed type
- Substantially less difference between shrimp fed the two diets than between the diets
  - May expect a greater difference if shrimp gained nutrition only from feed

Summary

- Feeds
  - No significant differences
- Tilapia
  - No significant effect
- Solids Removal
  - Increases light availability
  - Increases algal production
  - Improves shrimp performance
- Fatty Acids
  - Microbial organisms may contribute

Conclusions and Future Work

- Plant-based feeds are a viable alternative in biofloc systems
  - Microbial interactions?
- Smaller tilapia in larger abundance are required for these systems
- Settling solids dramatically improves system performance
- The Near Future
  - More Fatty Acid Analysis, Sensory Analysis, Waste Management

Acknowledgements and Reference

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Thank You