

## Biofloc and it's use in Aquaculture

### Introduction:

- As the human population continues to grow, food production industries such as aquaculture will need to expand as well.
- Shrimp farming has become competitive and such as the technology utilized needs to be efficient in all aspects productivity, quality, sustainability, bio-security and to be in line with market demand.
- In order to preserve the environment and the natural resources, this expansion will need to take place in a sustainable way.

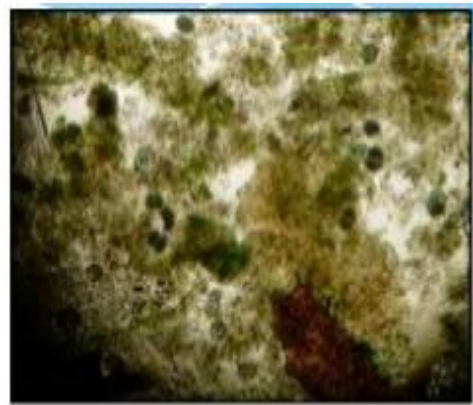
### Goals of Aquaculture

- The prime goal of aquaculture expansion must to be produce more aquaculture product without significant increasing the uses of the basic natural resources of water and land.
- The second goal is to develop sustainable aquaculture systems that will not damage the environment.
- The third goal is to build up systems providing an equitable cost/benefit ratio to support economic and social sustainability.

All these three prerequisites for sustainable aquaculture development can be met by biofloc technology.

### What is biofloc?

- It is a protein rich macro aggregate of organic material and macro-organism including diatoms, bacteria, protozoa, algae, fecal pellets, remaining of dead organisms and other



invertebrates.

## Brown flocc

## Green flocc

### Biofloc technology

- Biofloc technology is a technique of enhancing water quality in aquaculture through balancing carbon and nitrogen in the system.
- The technology has been recently gained attention as a sustainable method to control water quality with the added value of producing protein rich feed in situ.
- The basic technology developed by Dr. Yoram Avnimelech in Israel and initially implemented commercially in Belize by Belize Aquaculture.
- Biofloc technology has become a popular technology in the farming of pacific white shrimp, *Litopenaeus vannamei*.
- It is possible that this microbial protein has a higher availability than feed protein.
- The basic requirements for biofloc system operation include high stocking density, high aeration and line ponds.
- A crucial factor in the system is the control of biofloc in ponds during operation. Fish/shrimp are fed with a lot of feed.
- About 70-80% of it remains in the pond, in the water or the sediment.
- Ponds contain high load of nutrients.

### Conditions for bacteria

There is a lot of available food for bacteria. The pond is loaded with organic residues.

- The pond is fully aerated (needed for proper fish growth).
- The pond is well mixed (typically 24 hours a day)
- **The number of bacteria in such ponds is  $10^6$  up to  $10^9$  bacteria in one cm<sup>3</sup> of pond.**
- The pond becomes a biotechnological industry – Biofloc Technology

### Manipulating bacteria

- Normally, there is enough nitrogen in ponds for new cell production.
- By adding carbohydrate (e.g. starch, flour, molasse etc.) to the pond, heterotrophic bacterial growth is stimulated and nitrogen uptake through the production of microbial protein takes place.
- Then, there is a need for nitrogen.

- If carbon and nitrogen are well balanced in the solution, ammonium in addition to organic nitrogen waste will be converted into bacterial biomass.
- The way to do it: Keep C/N ratio higher than 10
- The bacteria now take the nitrogen from the water and control water quality

#### Mechanism of floc formation

- The fluctuation of microbial communities is a complex process.
- Within the floc's matrix a combination of physical, chemical and biological phenomena is operating.
- The exact mechanism and the methods to engineer microbiological floc's remain largely unknown.
- The main constituent that can be found within the floc matrix are the extracellular polymeric substances.



Biofloc collecting device

## STAGES

### FLOC Development stages (vol) in pond

**Stage 1 :** Floc found but cannot measured (subjective)

**Stage 2 :** Floc found in small quantity, < 1.0 ml/litre

**Stage 3 :** Floc found abundance, 1.0 – 5.0 ml/litre

**Stage 4 :** Floc found abundance, 5.1 – 10.0 ml/litre

**Stage 5 :** Floc found abundance, > 10.1 ml/litre

### Factor influencing floc formation and floc structure in bio-floc technology

- Mixing intensity
- DO
- Organic carbon source
- Organic loading rate
- Temperature
- pH

### Better nutrition by continuous consumption of biofloc

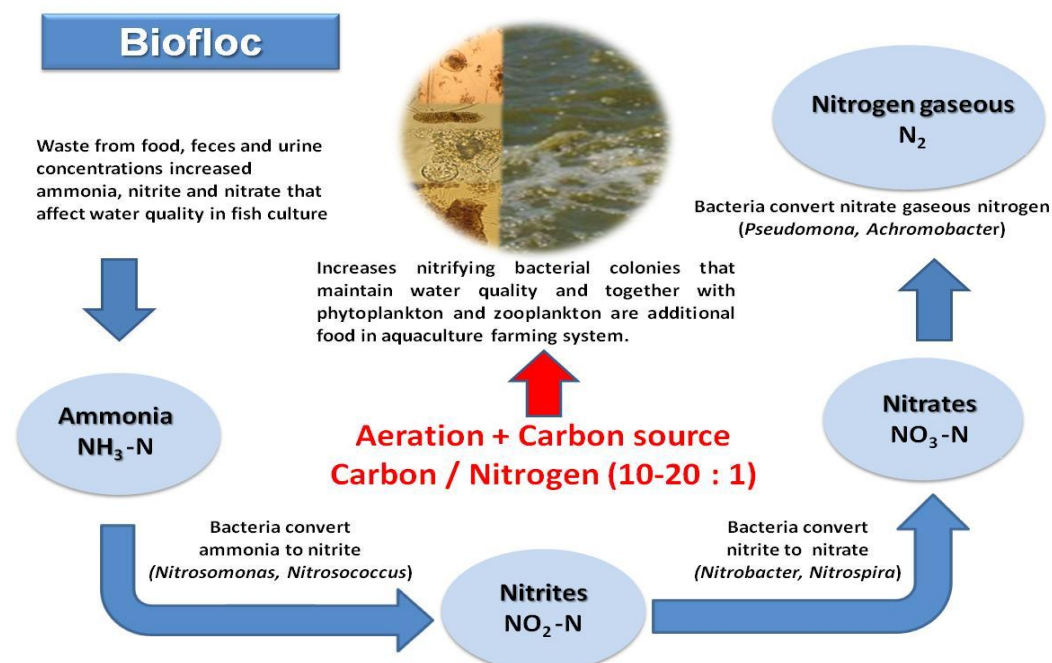
The growth enhancement of *L. vannamei* post larvae reared in nursery BFT is related to a better nutrition by continuous consumption of biofloc, which might positively influence grow-out performance of *L. vannamei*.

### Enhance growth performance

- Increase 50% to almost 80%

### Increase the survivability rate

- It ranges from 55.9% to 100% and 97% to 100% in nursery pond, respectively.
- **Maintain favourable water quality and enhance production.**
- **Decrease FCR and reduce cost of feed.**



**Advantages**

1. Bio-security (from water)- to date WSSV negative using system.
2. Zero water exchange- less than 100% exchange for whole culture period.
3. Production (caring capacity)- 5-10% better than normal system
4. FCR low- between 1.0 to 1.3
5. Production cost lower by around 15-20%.

**Disadvantages**

1. High energy input- paddlewheels
2. Power failure critical- maximum one hour at any time(better zero hour failure)
3. Technology similar but more advance- need to train technicians