

# INTEGRATION OF SUBMERGED SUBSTRATES IN BIOFLOC BASED SYSTEM

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Though shrimp feed forms more than 40–60 % of the total operational cost, major part of the feed remains either unused or excreted as toxic nitrogen metabolites in shrimp ponds, which generally leads to nutrient rich effluents at the end of harvesting. Optimum harvest of these nutrients and its conversion in to protein rich biomass becomes a major area of interest while exhorting for zerowater water exchange systems. As we know biofloc based systems utilizes the total ammonia nitrogen generated in the system for formation of protein rich flocculated microbial biomass in elevated C: N ratio which form an additional quality feed to shrimps. Many times if amount of floc generated exceed the shrimp consumption it can lead to high turbidity in water column and deposition of particles which demand pumping out the generated flocs. Incorporation of submerged substrates in biofloc system results in the development of microalgal complex over the submerged substrates known as “periphyton” has added advantage in enhancing aquaculture production through improved nutrients utilization and control of toxic nitrogen metabolites. These ecofriendly techniques like periphyton based farming systems utilizes the autotrophic food web or primary productivity as a potential food source for culture fishes whereas biofloc based techniques depends on the generation of microbial floc or heterotrophic food web through manipulation of C: N ratio.

Periphyton based farming are widely accepted technology in finfish culture in Asian countries for the fishes like tilapia, Indian major carps, milkfishes and mullets. Similarly, promising result in terms of growth performance, survival and production was observed with periphyton in nursery and growout rearing of penaeid shrimps like black tiger shrimps and pacific white shrimps. Recently, biofloc technology started getting momentum in intensive minimal water exchange shrimp farming systems where nutrient or generated waste is converted in to quality microbial protein through external addition ion of carbohydrate or reduction in protein content via manipulation of C: N ratio.



Periphyton on whole bamboo substrate

Though these techniques utilize autotrophic or heterotrophic food webs, integration of these techniques makes it standalone techniques and can enhance the productivity. Though biofloc technology became a highly soughtafter technology among the shrimp farmers, judicious manipulation of C: N ratio to maintain optimum biofloc becomes a major challenge. Moreover, high microbial load in the systems demands heavy aeration and pond modification with polythene lining or central drainage systems for periodical removal of unutilized bioflocs. At this juncture, application of immobile submerged substrates can help to trap the suspended microbial floc in the systems. Various researchers found that the use of submerged substrate and C: N ratio manipulation significantly affects the inorganic nitrogen and phosphorous in water column through uptake of inorganic N ions by bacteria for microbial protein synthesis.

As quality and quantity of periphyton developed on substrates, vary with type of ecosystem, type of substrate and nutrient availability, manipulation of C: N ratio can increase the heterotrophic bacterial population over submerged substrates which can be easily grazed by the shrimps than filtering from water column. When C: N ratio increased from 10 to 20, there was about 40-90 % increase in total heterotrophic bacterial load. Thus, heterotrophic community facilitated to maintain water quality through formation of single-cell bacterial protein that acted as protein source for shrimp leading to higher growth rate at high C: N ratio.

Availability of natural food in the form of epiphytic algae and heterotrophic microbial community compensates the higher protein requirement of shrimp juveniles and serves as supplementary nutrient for shrimp. In freshwater systems, increasing C: N ratio from 10 to 20 increased the net yield of freshwater prawn by 40 % and addition of periphyton substrates increased net yield by 23 %. Our experimental trials revealed that integration of submerged substrates improved 18 and 25% improvement in final body weight in substrate integrated C: N ratio manipulated systems compared to biofloc or periphyton based system alone respectively. Similarly, a better Food conversion ratio, protein efficiency ratio was noticed in integrated systems compared to either C: N ratio system or periphyton system. Since substrates reduce the turbidity by trapping suspended particles, their incorporation in floc system improves the transparency and clogging of respiratory systems of shrimps in floc system.



Shrimps grazing on substrate

## Conclusion

Periphyton in combination with high C: N ratio facilitates to maintain better water quality by reducing toxic metabolites like TAN, NO<sub>2</sub>-N and improved the FCR, growth rate and survival of the penaeids shrimps. Substrate allows the growth of epiphytic algal community and served as natural feed while the increase in C:N ratio converts toxic inorganic nitrogen waste into single-cell microbial protein which increases heterotrophic bacterial load and lower inorganic nitrogen content in water. In summary, high C: N ratio with substrate system increases the amount and quality of natural food available in the periphyton biomass for shrimp grazing.

## References

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