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Aquamimicry: New an innovative apporoach for sustainable development of aquaculture

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Abstract
Aquamimicry is an innovative technology can be efficiently employed to achieve sustainable aquaculture. It is mimicking the natural environment of organisms in a confined water conditions. The technology utilized the heterotrophic fauna rather than autotropic organisms. In this system suitable carbon ingredients (energy source) along with probiotics are added, which helps to utilize the unutilized nitrogen, generated through feed and excreta and finally converted to floc and help to maintaining the population of copepod as a source of proteinaceous feed. Aquamimicry is more or less similar to bio floc technology except few differences like the quantity of carbon source and the dominated communities are zooplanktons like copepod that will serve as supplemental nutrition to the cultured shrimp or fish and less feed input compare to bio floc technology. Further aquamimicry can be adopted in extensive and intensive system of farming with in the limited supply of aeration whereas, bio floc technology required a specialized management and heavy aeration provisions and mainly used in intensive systems. Feed accounts for more than half the production cost in most aquaculture practice and in aquamimicry system live feed (copepods) are generating within the system by adding suitable carbon sources which not only reduce the dependency on the supplementary feed but also help to maintain the good water quality and health of the organisms. Therefore, aquamimicry can be considered as an efficient technology which can reduce the production cost more sustainable manner and give better yield to the farmers.

Keywords: Aquamimicry, copepod, sustainable aquaculture

Introduction
Farming of aquatic organisms is an economic activity in most of the countries of the world which provides food security, livelihood opportunities to people aquaculture along with capture fisheries contribute to foreign returns. The estimated global aquaculture production is around 171 million tons in 2016. World per capita fish supply reached a new record high of 20.3 kg in 2016 [3]**.** Aquaculture sector provides livelihood opportunities to around 19.3 million people around the world [4]**.** Intensification of culture system especially in shrimp farming has lead to generation of wastes of equal proportion. Opting for more intensive practice by adopting higher stocking density, indiscriminate use of therapeutics has lead to water quality deterioration major problems and disease outbreak. Especially in the shrimp farming sector these problems are more pronounced, as in many Asian countries there are established shrimp industry. Therefore, the need of the hour is to develop technology which gives sustainable production also conserving the environment hand in hand. A technology which provides both economic and environmental sustainability is in need. Such an eco-friendly and greener alternative for production which do not relies in any harmful chemicals is the aquamimicry technology.

Aquamimicry is an innovative new concept of creating blooms of zooplankton mainly copepods, as which provided a good source of nutrition as supplementary form for the cultured shrimps and enhancing the growth of helpful bacteria to maintain optimum level of water quality parameter, which will simulate the estuarine conditions [9]. In aquamimicry phytoplankton and zooplankton blooms are generated using carbon source such as rice bran along with probiotics and blooms generated simulate natural pond condition, which also serve as supplemental nutrition to the farmed fish and shrimp accompanied by maintaining water quality [12]**.** It is a new age technology where production of zooplankton particularly copepods is enhanced condition heterotrophication (count of heterotrophic organisms are increased) rather than autotrophication.

Aquamimicry Vs Bio floc technology

There are some similarities between aquamimicry and biofloc technology, but there exist some core differences between both the technologies. Both biofloc technology and aquamimicry depend on external carbon source addition. Biofloc formation depends on the C: N ratio *i.e.* C: N ratio near to 15:1 is needed for the maintaining the bio floc [8]. But in aquamimicry such close monitoring of C: N ratio is not essential to maintain. In culture following aquamimicry concept once the shrimp is stocked in the pond the quantity of carbon source to be added in the system mainly depend on the type of system (extensive or intensive) and the turbidity level of the water. During the culture period additional probionts are added to the system in aquamimicry to enhance the growth of bio floc [9].

The carbonaceous substrate is supplied, carbon is derived bacteria from this source and nitrogen relies on ammonia which the metabolic waste produced by fish. Which is converted in to microbial protein [1]. Though bio floc technology is a cost effective method for controlling wastes generated in the aquaculture system [2], and lowering feed cost to a certain extent by acting as a live feed aggregates for the stocked fishes [1], it has added disadvantages like need of regular aeration to suspend the wastes generated in the system so that it can be actively metabolized by the bacteria to generate microbial protein [11]. Nitrification being accompanied by drop in pH and alkalinity, constant monitoring of C: N ratio to maintain the floc in biolfloc technology another simple concept of farming called copefloc technology have been initiated which does not demand use of feed or continuous aeration to maintain the system, rather a system is created which creates conducive environment for the natural production of zooplanktons like copepods for the stocked shrimp to feed upon [11].

Aquamimicry concept is believed to have been originated in Thailand during the disease outbreaks in 1990s [10].They initially used rice bran and later by standardization fermented rice bran was found effective. Rice bran is an agriculture waste which is usually used as an energy (carbon) source in fish diet. It is cheaply available and can be easily procures from the market. Rice bran contains appreciable levels of nutrients, but it has relatively higher fiber content [6]. By the process of fermentation fiber, lipid, ash and phytic acid content in the fermented substrate is reduced [5]

A technical cooperation project of JICA in the Philippines did a project to trying to emphasis the use and benefit of natural food that grows in the pond. In their project they supplementary feeding with rice bran was done totally negating the use of compound feed. When rice bran was used the FCR was 1.27. In the same culture condition compounded feed was given the profitability was around 17%, but when fermented rice bran was used profitability was around 40%. They reported that by fermentation the protein content increased. Also it became more digestible due to the fact that when fermentation occurred temperature of the rice bran rise to 50-60 ^{0}C [7].

The protocol for farming adopting aquamimicry practice is described below

Fermented rice bran (FRB) is initially created by adding water, probiotics and hydrolysing enzymes to finely grounded rice bran powder which is fermented for 24 hours. Here the rice bran act as a prebiotic and along with added probiotics bacteria a symbiotic effect is created. The FRB can be added @500-100 kg/ha. Within a week of administration of FRB (fermented rice bran), copepod bloom can be observed in the pond. Since prior to stocking of the PL copepods (live feed) is readily available for the PL without the use any harmful chemical. This is a very efficiency and environmental friendly method of production. PL can be stocked at a lower stocking density (10-20 individuals/m^2). During the grow out the ponds need to routinely seeded with FRB to sustain the copepod bloom and the dosage of the FRB is depended on the turbidity level.

Aquamimicry concept can also be adopted for intensive practice. Here from the grow out pond through the central drainage system water goes the sedimentation pond. In these ponds fishes like catfish or milkfish can be cultured based on the salinity. These fishes churn up the detritus and these detritus promote growth of oligochate worms which can be utilized by these fish. From the sedimentation pond it goes to biofilter pond where fishes like tilapia can be cultured. By this wastes in the water is reduced and it can be pumped back to grow out pond. This is the general aquamimicry practice adopted in Thailand for shrimp farming [12].

Advantages

- By adoption of this technology water quality fluctuation was not there and parameters will be in the optimal level.
- Improvement of overall nutrition of the shrimp as they feed on FRB and also on copepod generated by their addition.
- Black soil formation is also reduced.
- The production cost can also be reduced by adoption of this technology.
- The cultured organism is raised in a stress free condition as all the conditions favourable for pathogenic organism is not promoted.
- Decrease regularly causing common disease
- The pond condition mimicking the natural estuarine condition gives shrimp good growth.
- Decrease the food conversion ratio
- Minimizing water exchanges

Disadvantages

- Difficulty to apply this concept to indoor culture technique
- Use of relatively large treatment pond
- Potential chance of occurrence of new pathogen

Future prospects

The adaptation of this concept reportedly gave better results when compared to a biofloc based systems. However, it became essential to discharge excess unwanted sediments, which cannot recycle again. This aquamimicry concept not effectively working on larger pond and grow out and we are not getting sufficient productivity in larger pond by using this concept. The good quality shrimp can be produced at less cost and in a more sustainable manner, this concept is adopted throughout the globe. Some interpretation of the concept will undoubtedly become a new standard in shrimp farming and benefit future generation in aquaculture.

Success story

The shrimp farming with aquamimicry concept was successfully used by the farmers of the Andhra Pradesh, Indian. After the pre-stocking management of shrimp pond a healthy and active post larvae were stocked @ 40 PL/m^2,

aerators were provided to keep the optimum DO level. The provision of low cost supplementary feeding were maintained at low level and fermented rice bran (source of carbon) were used to develop the zooplankton (mainly copepods), further suitable probiotics were added (5-10 ppm) to maintain the water quality and plankton density. Time to time removal of sludge kept the bottom clean into the system. At the end of the culture period a total production of 5.53 tons with 94% survival rate were obtained. The economic analysis says that the incurred farm gate per kg cost of shrimp production was ₹.199 compare to ₹.330 in normal shrimp production, further it was noticed that the water quality and shrimp health was better in aquamimicry based culture compare to normal culture system.

Conclusion

Adopting aquamimicry in shrimp farming offers more sustainability than conventional farming. The inputs in production are nontoxic to shrimp and humans. There is no use of harmful chemicals, antibiotics in aquamimicry concept. Production cost to can be reduced by adopting this technology. These advantages give aquamimicry economic and environmental sustainability. Aquamimicry is a revolutionary concept to effectively provide a sustainable rival to the shrimp farming industry. It is an excision of aquatic technology interactively working together in mimicking the nature of aquatic ecosystems to made live food organism for the fish or shrimp. Shrimp produced this technology are red in colour due to (astaxanthin, amino acids and poly unsaturated fatty acids) which will increase the marketing value as“Organic shrimp” [10]. Organic coastal shrimp culture means farmer are manage practices of an organic standard for shrimp culture. It is mainly based on the holistic aquaculture management, eco-friendly and sustaining biodiversity.

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