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Research Article

Experimental Organic Farming of *Litopenaeus vannamei* (Boon, 1931) Near Vellar Estuary in Cuddalore District, Tamil Nadu

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ABSTRACT

Shrimp farming in India has recorded remarkable growth during the last three decades especially in coastal states. Optimum use of prospective areas and expanded farming practices has not only provided wonderful opportunity to farmers residing along coastal areas but also brought them prosperity. Most of the shrimp culture farmers were used chemicals for their culture. In the present study, an attempt has been made to culture *Litopenaeus vannamei* without any chemicals. The water was filled during high tide at least 2 hours every day based on seepage. This was continued until harvest. This activity actually brought minerals and fresh oxygen to the culture pond. The water quality variables were measured at regular intervals in organic shrimp pond during the production cycle (September 6th, 2022 and October 25th, 2022). Ninety eight percent survivals were noticed in the present experimental study. The average shrimp length was ranged from 10.8 cm to 13.8 cm and the size ranged between 10 g to 15 g. The animals were active, shown fast growth and disease free throughout the study period. To standardize the organic farming, the culture was terminated at 50 days of culture. The study indicates that organic farming discourages the use of various chemicals in all stages of culture. Chemical use is prohibited throughout the culture period. Hence, no health problems are reported which enhance consumer preference in future. The students and farmers were trained in the organic shrimp pond.

Keywords: Organic culture; *Litopenaeus vannamei*; Water quality; Organic farming; Shrimp

INTRODUCTION

Shrimp farming is more profitable and fast growing sectors in the aquaculture industry. The white leg Pacific shrimp, *Litopenaeus vannamei* is the main contributor in the shrimp culture production. It is the leading farmed shrimp globally, representing one of the most common aquaculture species. It is widely preferred due to its superior flesh quality, delicious taste and nutritional properties and also its ease of cooking. Besides the above, it is also suitable to culture a wide range of salinities and also high-density [1]. The Pacific white shrimp *L. vannamei* is one of the commercially important shrimp species in the world [2]. India is gifted with a long coastline and has a scope for large exploitation of marine wealth. In India, an estimated brackish water area suitable for shrimp culture is 11.91 lakh ha of which around 1.356 lakh ha area is currently under shrimp farming. *L. vannamei* is approved by the coastal aquaculture authority of India in the states of Andhra Pradesh, Tamil Nadu, Maharashtra, Gujarat, Orissa, Goa, and union territories of Diu and Pondicherry [3]. Most of the published work in *L. vannamei* was focused on stocking densities and the influence of environmental parameters on production. Mostly they have used chemicals and antibiotics for production. The chemicals used in shrimp production are accumulated in the tissues of shrimp, finally reach to the consumers and cause many health hazards. Recently a trend is developed in agriculture that consumers prefer organically produced agriculture products for consumption [4-8]. The consumers are ready to offer higher price for the organically produced shrimps. Hence, in the present study an attempt is made to culture *L. vannamei* in organic method.

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MATERIALS AND METHODS

The present study was under taken in aquaculture shrimp farm (valliviles) at Vellar estuary, Cuddalore district, Tamil Nadu. The culture period was 50 days (September 6th, 2022 and October 25th, 2022). The experimental pond was 1.5 m deep and the soil type was sandy. Pond was initially prepared by drying, tilting (to remove the pests and predators and oxidize bottom soil) and liming to correct the pH of the soil. Organic fertilizers were prepared in the pond site itself by using locally available ingredients (Table 1). They were applied to enrich the natural food organisms in the water [9]. Crab fencing and bird netting was done before pumping the water to prevent the entry of auto entrants [10].

Table 1: Fermentation ingredients for organic shrimp culture.

Ingredients	**Kg/ha**
Sugar	30
Rice bran	20
Wheat bran	20
Mytha	20
Guard	2 to 4 liter
Yeast	250 g

The water was pumped from Vellar estuary. The filter bag was checked properly and fitted in the inlet and outlet pipe. The culture pond (1.5 m deep) size is 0.7 ha and rectangular [11]. The minimum water level in the pond was 5 cm and daily water pumping was 5% to 15%. The seeds (PL10) were purchased from government recommended and registered Vandayar shrimp hatchery at Samiyarpettai, Cuddalore district, Tamil Nadu [12]. Before delivery, the seeds were confirmed negative for the White Spot Syndrome Virus (WSSV) by PCR. The seeds were transported in oxygenated double covered polythene bags with compressed ice packs between inner and outer covers of the bags to maintain optimum temperature in turn to keep less stress [13]. The entire set up was packed in a carton. The seeds were brought to the farm site and the bags were allowed to float on the pond water for some time to adjust the temperature.

Then pond water was added gradually into the seed bag to regulate the salinity and pH, subsequently they were released slowly into the pond water. Total stocking densities was 300000 seeds [14]. BMR feed pellets (carryon aqua agencies) were fed to the stocked post larvae for three times, daily at 7 am 12 am and 5 pm respectively. Feeding was done by following the feed chart. No water exchange was done for the entire culture period. But fresh estuary water was pumped daily during high tide to compensate the water loss by seepage and evaporation. To calculate the survival and health status of stocked seeds, sampling was done frequently. The water level was measured by using a standard scale with cm marking. Totally, 4 paddle wheel aerators were fixed for culture pond. The aerators were placed in such a way that it could dissolve maximum Dissolved Oxygen (DO) for the pond water and makes the culture environment friendly [15].

Water quality parameters

The physio chemical parameters such as temperature, pH, dissolved oxygen, salinity and ammonia were measured daily at morning 6 am. Temperature was measured by using thermometer, salinity was measured by using hand refractometer (Erma, Japan), pH of the water by using a calibrate pH pen (pH esp. 3 model) and dissolved oxygen was measured by modified Winkler's method described by Strickland and Parson [16]. Ammonia was detected by using standard method [17]. Average Daily Growth (ADG) was calculated by using the following formula;

ADG=Total weight gained by the shrimps/total days of culture.

RESULTS

Water quality parameters for the culture pond are summarized in Tables 2. Pond and estuary water pH, temperature and DO readings were recorded in Early Mornings (AM). DO values were fluctuated between 4.1 to 4.5 mg/l in pond and 4.0 to 4.4 mg/l in the estuary [18]. The pH of the pond water was ranged between 7.6-8.3 and in estuary water it was ranged from 7.9-8.1 the temperature of the pond water was varied between 27°C to 30°C and in estuary water it was between 25°C to 29°C. However, during the cloudy days, the temperature was recorded only 26°C. The salinity of the pond water was ranged between 22-28 ppt and in estuary water it was ranged between 2-29 ppt. Sometimes the estuary water salinity was decreased to 2 ppt due to sudden rain and freshwater inflow to the estuary [19].

The ammonium concentration in pond water was ranged from 0.10 mg/l to 0.25 mg/l and in estuary water it was ranged from 0 to 1 mg/l. Total hardness ranged from 4500-6620 ppm in pond water and 440-6250 ppm in estuary water. Carbonate in pond water was ranged between 10-20 in pond and 0-10 in estuary water. Bicarbonate in pond water was varied from 80-150 and it was 110-160 in estuary water. The total alkalinity of pond water was ranged between 80-150 ppm and in estuary it was varied from 120-170 ppm. The calcium levels in pond water varied between 220 mg/l-340 mg/l and in estuary it was 44 mg/

l-360 mg/l. Magnesium levels varied from 923-1416 in pond water and in estuary water it was varied between 80-1320. Shrimps were harvested in 50 days of culture period. The average body length of shrimps was 10.8-13.8 cm and weight 10-15.0 g (Table 3). At the end of culture, survival rate was calculated as 98 percentages.

Table 2: Water quality parameters and nutrients in the culture pond and estuary.

Parameters	**Pond**	**Estuary**
Temperature (°C)	27-30	25-29
Dissolved oxygen (mg/l)	4.1-4.5	4.0-4.4
pH	7.6-8.3	7.9-8.1
Salinity (ppt)	22-28	2-29
Ammonium (mg/l)	0.10-0.25	0-1
Total hardness (ppm)	4500-6620	440-6250
Carbonate (mg/l)	10-20	0-10
Bicarbonate (mg/l)	80-150	110-160
Total alkalinity (ppm)	80-150	120-170
Calcium (mg/l)	220-340	44-360
Magnesium(mg/l)	923-1416	80-1320

Table 3: The details of organic culture.

Parameters	**Pond**
Area (Ha)	0.7
Depth (M)	1.5
Initial stocking (numbers)	3000000
Density	42
Stocking date	06.09.2022
Harvest date	25.10.2022
Culture period (DOC)	50 days
Total feed consumed (kg)	1275
ABW (g)	10 to 15
Body length (cm)	10.8-13.8
Average growth per day (g)	0.3
Survival rate	98%

DISCUSSION

The physical parameters of water play a crucial role in the culture systems. Maintenance of water quality is essential for optimum growth and survival of shrimps. Excess feed, faecal matter and metabolites will exert tremendous influence on the water quality of shrimp farm. Temperature is one of the most important factors for driving marine shrimp growth. The optimum temperature for *L. vannamei* is ranged between 22°C to 29°C. Similarly, in the present investigation temperature of estuary and culture pond water is varied between 27°C to 30°C. Fast and Lannan stated that best shrimp growth is observed in a temperature range from 24°C to 30°C. Temperature can affect shrimp growth directly controlled by food consumption and nutrients availability in the food. Temperature has pervasive controlling effect on growth. Gunalan, et al., recorded temperature of 22°C to 29°C in the culture ponds of *L. vannamei*.

The dissolved oxygen is an important factor in aquaculture production. In many cases of shrimp culture system, low dissolved oxygen in the culture pond reported mass mortality. Thus, the best DO for shrimp is more than 4 ppm. In day time, the animal gets DO from phytoplankton photosynthesis. But in night not enough DO is available in the pond that will be compensated by providing aerators. In the present study 4 peddle wheel aerators are used to maintain dissolved oxygen in the pond especially in the night time. That is the reason why the oxygen levels of the present study are always ranging between 4.00 to 4.5 ppm in the culture pond. The dissolved oxygen is maintained >4 ppm in the culture ponds of *L. vannamei*. The DO values varied between 5.5 mg/l and 3.5 mg/l in the culture of *L. vannamei*. The dissolved oxygen is ranged between 3.0-4.5 mg/l in the study of surya. The dissolved oxygen is lies between 3.5-5.3 ppm in the culture of *L. vannamei*.

Most of the studies [13,14] stated that, ideal salinity for *L. vannamei* culture is 10-30 ppt. However, the shrimp tolerates the salinity even 2.45 ppt. Gunalan, et al., recorded the salinity range of 15-19 ppt for *L. vannamei*. IshfaqNazir Mira, et al. observed the salinity range of 10-25 ppt. Suriya, et al. maintained 15 to 38 ppt salinity for the culture of *L. vannamei*. In the present study the salinity is maintained at 22-29 ppt. Very rarely, 2 ppt salinity is recorded in the source water. But this is not affecting the shrimp culture. Since only little water is added from the water source.

The pH in the present study is ranged between 7.6 to 8.3 in the pond as well as source water. The favorable pH for *L. vannamei* culture is 7.6-8.6. Gunalan, et al. recorded the pH reading of 7.9 and 8.8 in the culture of *L. vannamei*. Similarly Suriya, et al. recorder the pH of 7.5 to 8.5.The pH value of *L. vannamei* farming is ranging between 7.5-8.5.

Ammonia level in the shrimp culture is less than 1 ppm, always promote better growth. Ammonia level in the cultured pond is varied from 0.0 ppm to 0.3 ppm. Ammonia level in the in the present study is varied from 0.10 ppm to 0.25 ppm. Suriya, et al. recorder the ammonium level of 0.00 to .36 ppm. The major source of ammonia in aquaculture pond is fertilizer and feed. The ammonia safer concentration for long term exposure for shrimp is 0.05 to 0.25 ppm.

In the present study, the total alkalinity of pond is ranging between 120-150 ppm. The optimum total alkalinity for *L. vannamei* culture is 100-200 ppm. Viral C Bajaniya, et al., reported that the total alkalinity of ponds lies between 140-300 ppm. IshfaqNazir Mira, et al., observed the water alkalinity of 100-200 ppm.

The water hardness differs from place to place. In the present study, the total hardness of pond is ranged between 5600-6620 ppm. The water hardness >1000 ppm in the culture of *L. vannamei*. Viral C Bajaniya, et al., recorded the total hardness ranging between 1990-12100 ppm. The value reported is higher than permissible range though the farmers are successfully culturing the *L. vannamei* in Gujarat as they were using water softener to reduce hardness. The Ca-Mg levels are ranging 1:2-1:3 and Iron <0.1 ppm. Similar pattern also reported in the present study. Minerals have many physiological functions to maintain acid-base balance. The Calcium (Ca) and Magnesium (Mg) are considered to be very important for molting and new shell formation. The ratios of Na: K and Mg: Ca plays in important role in physiological functions. In the present study mineral supplement is not given. The pond always getting minerals from the source water, since water is pumped regularly during high tide.

Density is one of the crucial factors for white leg shrimp, *L. vannamei* in determining the survival and growth. The stocking density differed from different authors. The present study, the stocking density is $42/m^2$. The growth of shrimps depends on the quality of feed. In the present study BMR feed is given. The amount of the feed is decided by experience and also following the feeding chat. Weekly monitoring of shrimps for their growth and wellbeing is essential. In the present study sampling is done frequently to know the health status and also calculate the survival percentage. Most of the previous studies indicate that the survival ranging between 80-90%. However, 98% is recorded in the present study. Regular monitoring of water quality parameters, good feed management and regular health checkup may be reason for higher survival. The fresh body weight of the present study at the time of harvest is 15.7 g whereas in conventional shrimp it is only 12.7 g. The result of the present study is quite encouraging.

The organic shrimp pond of the present study is surrounded by mangroves. Even the Vellar estuary located just opposite to the culture pond have many species of mangrove cover. Mangroves protect the ponds built behind them and influence considerably the water quality in shrimp farming areas. Mangroves may remove nutrients, heavy metals, suspended solids, and toxic hydrocarbons. Thus, coastal water quality may deteriorate through loss of the mangroves' filtering capacity. Conversely, mangroves can 'clean up' shrimp pond effluent. Robertson and Phillips, have calculated the areas of *Rhizophora* mangrove forest required to remove nutrients from shrimp pond effluents. These area estimates may be useful in local area planning. Thus, there are mutually supportive functions of aquaculture and mangroves and there is now growing interest in integrating mangrove and shrimp farming in the coastal zone. Indeed, if the benefits of mangroves to sustainable shrimp culture are more clearly recognized, shrimp farming may provide an additional economic justification to preserve mangroves. In Indonesia, Thailand, and the Philippines, a mangrove buffer zone between the sea and the shrimp ponds has been advocated. Such zones can potentially serve the interests of both the conservationists and the shrimp farmers. Further research on the mutual benefits between mangroves and aquaculture would be useful in order to develop planning guidelines.

CONCLUSION

Gopal Anand Kandikatla, et al., studied the effect of organic acids and probiotics in culture ponds of *L. vannamei* over a period of three consecutive years from 2011 to 2013. The effect of organic acids and probiotics created a healthy and suitable environment for the shrimp culture. They have decreased the pathogens thereby decreasing the onset of various diseases. The growth and survival rate have been greatly influenced. In the present study, fermentation mixture is prepared by using locally available low-cost ingredients. This fermentation mixture is acting as probiotics and the preparations also economically viable when compared to commercial probiotics. As commercial probiotics, the fermentation mixture likely to control vibrio as evidenced by considerable reduction in total vibrio counts in the culture pond. The organic fermentation probiotics created a healthy and suitable environment for the shrimp culture. Hence, the shrimps attained maximum growth (10-15 g) in shorter period (50 days). For the organic farming, only minimum investment is required. So, it is ideal for poor farmers to start farming. Chemicals and antibiotics are totally neglected. This organic farming is environment friendly and not pollutes the environment. The present culture is performed only for 50 days to standardize water quality parameters. The economics are not calculated because the investment mainly went to pond preparation, electrical expenses and aerators. Next culture, all the investment will go to the production of shrimps and it will lead to a profitable business. Besides the above, many farmers and students are trained to popularize the organic farming.

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