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Evaluation of Probiotics for Improving Physico-Chemical Parameters in Tiger Shrimp Culture Pond

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The effect of a commercial probiotics was tested in commercial tiger shrimp, *Penaeus monodon* (Fabricius) ponds (140+5 days/crop) for two culture periods in Kattumavadi, Tanjavur district, Tamilnadu. Totally 7.99kg/ha probiotics was applied to each experimental pond per crop and remaining ponds are treated as control. Commercial supplementary feed used and feed ration is adjusted to body weight of shrimp. The ponds were stocked with a density of 2300-3000 larval/ha. The water was exchanged in control ponds once in 3 days but not in experimental ponds throughout the culture in two crops. Totally 24 samples were collected for each parameters in each crop. Qualification methods for selected physico-chemical parameters in water and sediments adopted from APHA methods within 48 hrs. There are 11 water quantities parameters in the experimental ponds were analyzed. Among this dissolved oxygen, pH, transparency, salinity, and nitrate shows no significant variation. We found significant variation in BOD, COD, Ammonia, Phosphate, Nitrate and Organic matters. In brief the tested probiotics shows remarkable improvement in physico-chemical status of water and sediment in culture ponds.

Keywords: Crop, probiotics, ponds culture, Tiger shrimp.

Modern shrimp's culture was introduced in to India in coastal states including Tamilnadu in 1980. The tiger-shrimps, *Penaeus monodon Fabr* is the most preferred species for on form cultivation in India. More detailed information on its biology and taxonomy are given by George. 1969 Unfortunately the shrimp culture industry was devastated by continuous out breaks of both viral and bacterial diseases. The industry has been also blamed for degradation of local environment and coastal ecosystem. Thus environmental pollution and out breaks of diseases are the two major barriers at for shrimp culture globally. The field of probiotics has now emerged as a possible solution to these problems in shrimp culture. Simply it refers to artificial manipulation of microbial community of the culture systems by adding non-pathogenic bacterial species, which in turn prevents diseases and maintains ambient culture environment. Probiotics is defined as a live microbial adjunct, which has beneficial effects on the host by modifying the host associated or ambient microbial community, by ensuring improved use of feed or enhancing its nutritional value, or by improving the quality of the environment. They are antagonist bacterial strains, which control potential pathogens through competitive exclusion. Probiotics are sediment quality microbes which restores a healthy culture environment by bioremediation of organic wastes in the system. In spite of intensive research on probiotics in India is possibly due to sudden 'rise and fall' of the industry. However, few detailed

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investigation have been published so far on the application of commercial probiotics in shrimp culture. Ambient quality of these two media is very important for survival, growth and higher yield of cultivable species. Available investigations are in complete in many aspects. A comprehensive long term and on-farm study covering one more crops to assess the beneficial effects of probiotics on water and sediments quality of tiger shrimp culture ponds is lacking. Thus the present study is aimed to evaluate a commercial probiotics (BACIMOR-WAQ) for improving the physic-chemical status of tiger-shrimp culture ponds.

MATERIALS AND METHODS

This study was conducted in a private tiger-shrimp culture farm at Kattumavadi, Tanjavur District, Tamilnadu. It cultivated tiger-shrimp since 1986 in eight earthen ponds (size: 1.4 to 1.8 ha). The culture duration per crop is 140+5 days and two crops were raised per year. This study was conducted from 1997 to 1998 by sampling two crops in one annual cycle. This farm has adopted well standardized cultivation protocol, which mainly included three phase vix. Preparation of ponds, stocking the seedlings and post stocking managements. The seedlings used for culture are the post larval stage (moulted from zoea) and procured from a commercial shrimp hatchery and stocked in the ponds at a density of 2300-3000 larvae/ha. Each pond was aerated with six aerators for 24hr. for this study, four ponds were treated with a commercially available probiotics (BACIMOR-WSQ by trade name: Hi-Line Aqua, Chennai). It consists of spores of selected microbes in nutrient medium as dry formulation and applied to ponds as aqueous solution as prescribed by the manufacturer. It was first applied before stocking for 7 days and then doses were gradually increased during the late phase of the culture. Totally 7.99kg/ha was applied to each experimental pond per crop. The remaining four ponds were treated as controls. The shrimps in both control (C1, C2, C3 and C4) and experimental (E1, E2, E3 and E4) ponds were fed with commercially available supplementary feed and feed ration was adjusted according to the body weight of shrimp. The total feed supply to each control and experimental pond averaged 76 and 80kg/ha/crop respectively. The water was exchanged in control ponds once in 3 days, but not in experimental ponds throughout the culture in two crops. Totally 24 samples were collected for each parameters, in each crop. Each sample is the mean of two replicates. However values averaged for two crops (n=12) were used for final statistical analyses. All methods of qualification of selected physics-chemical parameters in water and sediment (see table 1) were adopted from all chemical analyses were used (rain size: 0.2mm) depending on the parameter analyzed. One-way AVOVA was employed to test the significant differences in all selected parameters of water sediments quality among the control, experimental and all eight ponds.

RESULTS AND DISCUSION

Table 1 presents the estimated data on selected eleven physic-chemical parameters of pond water and five chemical parameters of sediment in control and experimental ponds. The experimental ponds have shown relatively higher levels of pH, transparency and dissolved oxygen in the water than control ponds. Conversely, other chemical parameters of water quality viz., Total Suspended Solid (TSS), salinity, BOD, COD, ammonia, phosphate, nitrate and organic matter were found to be low in the experimental ponds, when compared to control ponds. All selected chemical parameters of sediment quality are comparatively low in their quantities in experimental ponds, when matched with data from control ponds. Table provides the one-way AVOVA matrix for testing the significant difference in selected parameters of water and sediment quality among control, experimental and all eight ponds. The inferences are (George, 1969). There are statistically significant differences in the estimates of eleven parameters of water quality among all eight ponds (Fuller, 1989). There are no statistically significant differences in dissolved oxygen among control (Austin and Day, 1990). There are no significant quantitative variation in the pH, transparency, salinity and nitrate among the experimental ponds (Maeda and Liao, 1992). There are statistically significant differences in the quantities of eight chemical parameters viz., salinity, BOD, COD, ammonia, phosphate, nitrate, pH, and organic matter in the water in the water among four control ponds (Matias *et.al*., 2002).

Table 1. Changes in physico-chemical parameters in tiger shrimp culture pond after the application of probiotics

	pH	Transparency	DO	TSS	Salinity	BOD	COD	Ammonia	Phosphate	Nitrate	Organic matter
C1	7.408±0.123	24.25±0.719	4.975±0.170	212.92±4.16	23.75±1.37	4.233±0.125	6.600±0.097	0.556±0.010	0.8883±0.0159	6.338±0.0039	0.293±0.012
C2	7. 550±0.083	26.91±0.336	4.975±0.180	245.42±6.15	19.25±1.14	4.883±0.096	6.208±0.147	0.502±0.004	0.8692±0.0115	0.6847±0.0070	0.325±0.012
C3	7.050±0.072	25.08±0.839	4.133±0.155	235.42±3.88	25.75±1.50	5.566±0.046	6.700±0.092	0.546±0.014	0.9170±0.0138	0.7519±0.0049	0.461±0.041
C4	7.550±0.039	31.91±0.743	4.958±0.112	251.08±4.91	25.20±1.24	5.200±0.104	6.500±0.137	0.520±0.002	0.8920±0.0089	0.6720±0.0065	0.420±0.002
E1	8.058±0.078	60.50±1.40	6.292±0.138	42.50±0.99	25.16±0.68	1.9333±0.062	2.291±0.048	0.149±0.001	0.1725±0.0065	0.1365±0.0010	0.163±0.002
E2	8.108±0.064	59.50±1.28	6.658±0.079	47.83±1.22	23.50±0.51	1.550±0.037	2.017±0.115	0.160±0.002	0.2045±0.0037	0.14070.0013	0.173±0.002
E3	8.108±0.039	56.58±1.23	6.216±0.093	40.17±1.01	25.58±1.13	1.600±0.083	2.042±0.125	0.162±0.002	0.1850±0.0055	0.1521±0.0009	0.192±0.000
E4	8.066±0.046	60.67±1.92	6.475±0.053	40.25±1.04	26.33±1.54	1.883±0.062	2.758±0.109	0.155±0.002	0.1967±0.0103	0.1894±0.0356	0.172±0.001

Difference in mean value between the control (f=3.08) experimental (f=11.03) and all ponds (f=407.64) are significant at $p<0.05$.
C1 to C4 are control ponds
E1 to E2 are experimental ponds

There are no statically significant differences in dissolved oxygen, ammonia, phosphate, BOD, and organic matter among the experimental ponds (Rengpipat *et.al*., 2003). There are statistically differences in all five chemical parameters in the sediment among the control, experimental and all ponds expect phosphate, which does not vary significantly in the sediment among control ponds. In brief, the tested probiotics has remarkably improved the physic-chemical status of the water as well as sediment of tiger-shrimp culture ponds.

pH of the water is alkaline in experimental ponds but lies within the limit (7.5-8.5) prescribed for culturing tiger shrimp. This could be due to buffering action of probiotics. The rapid decomposition of organic matter, excess feed and organic wastes especially in the pond sediment by probiotics in experimental ponds may result in low organic matter in the water bed sediment in them. This presumption was also supported by high transparency in the water of experimental ponds. Probiotic bacteria have been prescribed earlier for reducing the load of both dissolved and particulate organic matter in shrimp culture ponds commercial probiotics usually contains nitrifying bacteria as a component to enhance the nitrification (conversion of ammonia to nitrate and then nitrate). The low quantities of ammonia and nitrate by phytoplankton for growth by reducing the final stage conversion of nitrite into nitrate. The low nitrate levels in water sediment of the experimental ponds supported these views. The high density and chlorophyll 'A' biomass of phytoplankton and in turn high primary productivity in experimental ponds confirmed this view.

The high DO level in experimental ponds could be due to photosynthetic bacteria, present in the probiotic mixture as well as high density of phytoplankton. It may be also due to less demand for oxidation of organic matter as evidenced by low COD and BOD in the experimental ponds. Similarly reports have shown a increases on DO in the water of tiger shrimp ponds after treated with probiotics mainly containing photosynthetic bacteria. Rapid decomposition of organic matter in the sediment by probiotics together with efficient utilization of feed by shrimps under ambient environmental condition in experimental ponds may results in low TSS in the water. Since there is no water exchange in experimental ponds, they show high salinity. But it was usually rectified by addition of fresh water. However, such high salinity in the early phase of culture is useful as it increased the survival rate of the post larvae of tiger shrimp. Low phosphate content of the water and sediment in experimental ponds suggested its utilization for primary production by phytoplankton as reported earlier. This presumption was supported by high density of phytoplankton and higher level of primary productivity than control ponds in the experimental ponds. In contrast to these findings few reports have shown no improvements of water quality parameters in shrimp culture ponds after treatment with probiotics.

The sediment formation and its chemistry depends on many factors viz.., stability of pond walls types of soil, aeration rates quantity of unused feed and excrete of shrimp. The low quantity of nitrogen and phosphate in the water of experimental ponds is the reflection of their quantities in the sediment as the latter forms the major sink for chemical factors. Ammonia and nitrate from the sediment of the experimental ponds could be used by phytoplankton as supported by data on phytoplankton density and biomass in experimental ponds. It has been shown that phytoplankton in shrimp culture ponds prefer ammonia than nitrate. Low nitrogen in the sediment due to mineralization in shrimp farms increased the annual shrimp yield. The probiotics may enhance the mineralization of nitrogen both in the water and sediment of experimental ponds. The high yield and daily average production of shrimps in experimental ponds supported this presumption. In conclusion, the BACMOR-WSQ, a commercial probiotics significantly improve the physico-chemical status of tiger shrimp culture ponds.

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