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STRESS LEADS TO MORTALITY IN SEMI-INTENSIVE BRACKISH WATER SHRIMPS (*PENAEUS MONODON*) DUE TO IMPROPER POND MANAGEMENT

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ABSTRACT

A study on brackish water pond management was conducted in the semi intensive shrimp (*Penaeus monodon*) farming ponds in three different zones of Baloaore districts of Odisha. Three ponds from each zone (brackish water shrimps cultivated) along the respective cricks of Subarnarekha, Budhabalonga and Baitarani) were selected randomly. The pond management that includes water quality parameters (colour & transparency, temperature, , pH, dissolved oxygen, salinity, amonia-N, nitrate-N, nitrite-N) and feeding management (daily ration and FCR, feeding rate) of cultivated pond were studied for a complete culture period. From this study it was found that improper management of pond water developed unbearable environmental conditions by fluctuating the ranges of water quality parameters. Which in turn puts the shrimps into different kinds of stress. Prevailing of such stress for long time or beyond tolerance limit leads the shrimps to mortality. The analytical statistics like ANOVA and DMRT test were done to co-relate the percentage of mortality with different parameters of water and also themselves where they are found significant ($p<0.05$).

KEYWORDS: Shrimp, Semi-intensive, Management, Stress, Mortality

No: of Tables : 2 **No: of References: 22**

INTRODUCTION

The scientific method of shrimp culture such as Extensive, Semi-intensive and Intensive are of very recent concepts originated in Taiwan and have spread to other Asian countries like Philippines, Indonesia, Thailand, Malaysia, China and India (Risenberry,1990). A record production of 8-20mt /ha /crop has been achieved against world average production of 360kg/ ha/ crop. This high production brought in a good amount of foreign exchange, but at the same time it created negative impact on the environment and also on the shrimp culture industry with a significant degradation of the coastal environment (Joshi, 1997). Odisha is one of the important maritime states in Eastern region of India. In Odisha shrimp farming was started in late, but the farmers also faced the same problem of shrimp mortality in culture ponds like other marine states of India. Out of six coastal districts of Odisha, the study was conducted only in Balasore district as because it is an important shrimp farming zone of Odisha. The cause of shrimp mortality or even mass mortality was reported in the districts leading a huge loss to the shrimp farmers.

MATERIALS AND METHODS

Three ponds each (P-1, P-2, P-3) from three zone (brackish water shrimps cultivated sites) along the cricks of Subarnarekha- A, Budhabalonga -B and Baitarani-C) were selected randomly. The environmental conditions of the ponds were almost similar. Pond preparation was made according to recommended doses of manures and fertilizers. Ponds were aged for 4 days and allowed for growth of phytoplankton. Water depth of the ponds were maintained within 140 to 150cm and water exchange was made weekly twice with 10% of the volume throughout the culture cycle. Hatchery seed of (post-larvae) PL-25 were stocked with a density of 15PL/m^2. They were fed on various sizes of pellet feed (C.P. Brand) with a rate of 20-3% of their body weight and provided in 5 rations a day. Feeds were scattered over the pond water and allowed the animals to take. Adequate numbers (5) of aerators were supplied in the pond (1hac size) to maintain the oxygen level above 4mg/l.

The pond management that includes water quality parameters (colour & transparency, temperature, pH, dissolved oxygen, salinity, amonia-N, nitrate-N, nitrite-N), feeding management (daily ration and feeding rate) of cultivated pond were studied for a complete culture period. All the parameters were estimated as per instruction and recommendation (APHA, 1989). The analytical statistics like ANOVA and DMRT test were done to co-relate the percentage of mortality with different parameters and also themselves.

RESULT AND DISCUSSIONS

The pond management includes water quality parameters and feeding management of a cultivated pond. The purpose of pond management is to create a good and stable aquatic environment for the growing shrimps, so as to obtain maximum yield in the shortest possible time by maintaining a healthy and dynamic environment. Maintaining optimum levels of

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physico-chemical parameters and their balance diet induce growth of shrimp; while fluctuations impair the ecology, deteriorate the pond environment and then causes negative effect on shrimp's normal physiology and put them in stress.

Inter-relationship of hydro biological parameters in the cultured pond

Hydro biological parameters (colour & transparency, temperature, pH, dissolved oxygen, salinity, amonia-N, nitrate-N, nitrite-N) are inter related in stabilizing the whole pond eco-system. Fluctuation of water quality is considered as most critical for growth and survival of shrimp. Therefore, aquatic environment is artificially controlled by periodic water exchange, aeration and proper feeding schedule in cultured ponds.

The ideal colour of water due to planktonic bloom is brownish –green which is essential for successful shrimp culture (Kangekeo, 1990). Each plankton species has its own colour due to individual pigmentation. So the planktonic blooms are formed in different months of the culture cycle that expressed the colour of the pond according to dominance of planktonic population. Therefore, the colour is changed at different months of the culture cycle (Chanratchakool *et.al;* 1994). A frequent change in water colour (Brown, Brownish – green, green and dark green) was noticed in different months of a crop cycle and three locations (A,B and C) through out the present investigation. The change of water colour in the experimental ponds were found due to the formation of plank tonic blooms as reported by earlier authors (Kangekeo,1990; Chanratchakool *et.al;* 1994).

Planktonic bloom is essential for successful shrimp culture. The bloom consists of complex variety of organisms, including both microscopic plants (phyto planktons) and animals (zooplanktons). But phytoplanktons is always dominated over zooplankton in the shrimp culture ponds (Chanratchakool *et.al;* 1994) in the present study the abundance of phyto planktonic population was found to be fluctuative. It was found varying from 0.82 to 6.32 thousand cells per liter and also found significant ($P< 0.01$) for inducing the stress in shrimps during different months of cropping seasons. In the present study it was found that water transparency was observed fluctuated mainly due to variation in planktonic growth, which was influenced by periodic water exchange and nutrient released from waste feed. This was supported by the observations of NACA (1994). Nutrients (from uneaten feed, shrimp feces or excreted matters) added to shrimp ponds can affect environmental conditions within the pond and lead the shrimps to be under stress. In the present study the relationship of water quality parameters are given in (Table 1), and correlation of water quality and feeding scheduled in (Table 2).

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Table-1: Analysis of variance of sources with different water quality parameters (F- values) at location A, B & C.

Sources of variation	Degree of freedom (DF)	Plancton (t.cels/l)	Transparency (cm)	Water depth (cm)	Temp (^{0}C)	pH	DO_2 (mg/l)	Salinity (ppt)	Alkalinity (ppm)	NH_3-N (µg/l)	NO_3-N (µg/l)	NO_2-N (µg/l)
Due to location	2	12.38**	9.11**	0.29	9.94**	2.11	6.46**	7.34**	14.13**	1.05	1.59	6.60**
Due to crop	1	9.29**	2.14	0.29	0.00	0.00	4.98	0.88	0.17	9.03**	10.56**	17.49**
Due to pond	4	0.10	0.79	0.16	0.96	3.13*	2.33	2.70*	6.22**	2.32	2.38	2.02
Location x pond	2	21.05**	1.91	0.07	3.36*	2.12	0.81	0.62	2.84	0.15	0.39	0.77
Crop X Pond	4	0.24	0.730	0.10	1.25	0.60	0.65	0.73	3.36*	1.70	1.08	0.29
pond x Location	8	0.50	1.260	0.80	0.51	5.36**	3.65**	5.56**	3.11**	4.01**	4.19**	4.32**
Model	21	4.65**	1.87*	-0.40	2.09*	3.34**	2.57**	3.46**	5.01**	2.84**	2.89**	3.57**
Error	94	-	-	-	-	-	-	-	-		-	-
Corrected total	115	-	-	-	-	-	-	-	-		-	-

*Significant at 5% level (P≤ 0.05)

** Significant at 1% level (P ≤0.01

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Table-2: Correlation matrix (r) of mortality (%) with other variables at location A, B & C.

Locations / Variables	Location -A (n-2=23-2=)21 (r –value)	Location -B (n-2=22-2=)20 (r –value)	Location -C (n-2=19-2=)17 (r –value)
Water quality parameters			
Transparency(cm)	-0.73**	-0.59**	-0.5*
Water depth (cm)	0.15	0.56	0.34
Temp.^{0}C	-0.61**	-0.09	0.23
pH	-0.55**	0.69**	0.47*
DO_2 (mg/l)	-0.85**	-0.84**	-0.91**
Salinity (ppt)	-0.48**	-0.14	0.11
Alkalinity (ppm)	-0.18	0.41*	-0.04
NH_3- N(µg/l)	0.78**	0.95**	0.98**
NO_3-N (µg/l)	0.93**	0.96**	0.98**
NO_2-N (µg/l)	0.77**	0.81**	0.84**
Feeding schedule			
FCR	0.66**	0.88**	0.90**
Feeding rate%	0.26	0.27	0.26
Un consumed feed %	0.67**	0.71**	0.63*
Mortality %	1	1	1

***Significant at 5% level (P≤ 0.05)

** Significant at 1% level (P ≤0.01)

Temperature: Temperature is one of the important environmental factors that directly affects the penaeid shrimps in culture ponds (Vjyayan and Diwan , 1995). The temperature of water may rise to harmful levels by affecting the survival of shrimps, if the depth is too less or below 100cm (Smith, 1998). In the present experiment, the temperature was ranged from 26.83 to 33.6^{0}C in different locations which affect the shrimps significantly ($p<0.01$). Temperature variation affects the dissolved oxygen concentration in water which hampers on body metabolism and ammonia excretion and rate of feeding. The rate of respiration is directly proportional to the temperature and dissolved oxygen level in shrimps. Therefore, in the present study it

was found that the interactions of depth and temperature for causing mortality in shrimps were crop specific and area specific as stated earlier authors (Liu, 1990 and Smith, 1998).

pH : It is suggested that the pH range of 7.5 to 8.2 provides an ideal condition for successful shrimp culture. If the pH range goes above or below this recommended range , then shrimps are affected adversely due to fluctuations of pH range (Boyd, 1995). Higher pH hampers the dissociation of ammonia and which leads to ammonia poisoning. As ammonia concentration increases in water due to oxidation or ammonification of water, it decreases ammonia excretion by shrimps and these results in higher levels of ammonia concentration in blood to balance osmosis of body. Higher ammonia concentration in blood for a longer period leads to mortality of the shrimps in the pond (Rao,1997). The pH of brackish water is greatly influenced by the concentration of carbon dioxide. Increase in carbon dioxide in pond water reduces the pH. An impairment of osmoregulatory fluctuation and damage to gill tissue of shrimps at low pH level are also reported. In the present study pH was found ranging in between 5.73 to 9.92 which affected the shrimps significantly ($p<0.05$). So mortality in shrimps was observed in the present cultured ponds as seen by Allan and Maguire (1992). The stress condition made the shrimp susceptible to microbes to invade into the body through the injuries and shown the symptoms of disease and caused mortality as observed earlier (Lightner, 1993).

Dissolved Oxygen: Dissolved oxygen concentration is one of the major limiting water quality variables under intensive and semi- intensive shrimp culture system. Dissolves oxygen concentration regulates the respiratory metabolism of aquatic organisms but it should not be in critical level. The critical oxygen level (4.0 to 4.3 mg/l) hampers the production and survibility of shrimps (Rosas *et al.*, 1997). In the present study the level of oxygen was recoded in between 3.17 to 6.37mg/l. however in this study, the fluctuative range of dissolved oxygen in *P. monodon* culture ponds might have put the animals to remain under stress condition and lead to mortality as reported by earlier authors (Chanratchakool *et al.*, 1994; Rosas *et al.*, 1997). In the present study, dissolved oxygen was found to have significantly affected ($p<0.01$) on the mortality of shrimps.

Salinity: Penaeid shrimps exposed to sub-optimal and supra-optimal salinity ranges lead to physiological stress. About 40% mortality was seen in the monodon culture ponds with 5ppt salinity (Taylor *et al.*, 1996). In the extreme range of salinities, shrimp must expend considerable energy for osmoregulation at the expenses of other processes and get stressed (Vijayan and Diwan, 1995). However, in the present study the fluctuations of the salinity ranges in between 23.17 to 35.71ppt., was found to affect the shrimps significantly ($p<0.05$) in the pond ecosystem by putting them under stress. This observation was corroborated by Lakshmi, *et al.* (1978).

Ammonia-N, Nitrate-N and Nitrite-N: The crustaceans eliminate 90% of nitrogen in pond ecosystem in the form of ammonia-N (Mohanty *et al*.,1989). In water, ammonia-N occurs in two forms, Un-ionized ammonia and ammonium ion. Un-ionized ammonia is toxic to shrimps, but the ammonium ion is harmless except at extremely high concentrations. Ammonia which consist of an ionized (NH_3-N) and un-ionized (NH_4-N) fractions, is then frequently oxidized to nitrite and nitrate through the nitrification process by Nitrosomans and Nitrobecter species of Bacteria. These three forms of nitrogen are the most common pollutants and toxicants in shrimp culture ponds. They are toxic to the crustacean's particularly *P. monodon* (Chen and Chen, 1988). It is well known that crustaceans contain haemocyanin instead of haemoglobin in the blood to carry oxygen. Haemocyanin changes to methaemoglobin in presence of nitrite, which causes hypoxia and impairs the respiratory metabolism of penaeid shrimps (Chen and Lin,1995). Ammonia is also a neuro-toxic compound, capable of causing neurotransmission failure and nervous disorders related to loss of equilibrium and results erratic swimming of the cultured shrimps (Chen and Kou, 1992) the same was seen in the present study.

However, in the present investigation, the adverse effect of ammonia –N, nitrite-N and nitrate-N to *P. monodon* was found increased significantly ($p<0.01$) with the increase in culture period. The bad effect of the same compounds lead the animals (*P. monodon*) to remain under acute stress and to mass mortality as stated by Gopalkrishnon and Ramadhas (1996).

Conclusion: From this study it was found that improper management of pond ecology (water and feed) beyond tolerance ranges was prevailed in all ponds. High proteinous food was dumped in the pond to get high return. Believe of farmers that more feed supply could give more growth in short time. At the same time they were ignoring the concept of food consumed by the prawn or wasted into pond bottom. The accumulation of food in pond bottom gradually putrefied and destroyed the whole pond ecology, by changing the balance of different parameters from their optimum level. The unpleasant ranges of different parameters in turn put the shrimps into several kinds of stress. Prevailing of such stresses for long time or beyond the tolerance limit lead the shrimps to mortality.

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