Vet.Med.J.,Giza. Vol.56, No.1. (2008): 73-88.

MONITORING OF SOME PHYSICAL AND CHEMICAL WATER PARAMETERS IN HIGHLY INTENSIVE MARINE SHRIMP CULTURE UNDER HYPER SALINE CONDITIONS

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Received: 20. 2. 2008
Accepted: 9. 3. 2008

SUMMARY

As well as Penaeid shrimp growing out develops under median hyper saline levels of 43%0 in monitored growing out highly intensive cultured shrimp ponds, the physical and chemical water quality parameters were kept about optimal and appropriate levels for the cultured shrimp. Dissolved oxygen, log of hydrogen ion concentration, temperature, salinity, transparency, total nitrogen ammonia and nitrite nitrogen were continuously, regularly and daily measured for 152 days as the pond growing out period after 42 days of nursery period. In this study the minimal and the maximal ranges of the measured physical and chemical water quality parameters were around reared Penaes indicus shrimp capability to tolerate, alternate and accommodate its physiological life conditions for these monitored levels of these hydrological parameters. Although, some of these monitored parameters were deviated from the necessary optimal levels in some days in some studied ponds, then, controlling and correction of the impaired parameters were directly applied in any affected pond as quickly as deviation was discovered. Therefore, the productivity of monitored ponds at harvesting time was very good in all surveyed ponds (No. 1, 2, 3 and 4) and equals 22.174, 21.921, 22.330 and 22.227 mt / ha / crop as well as with appropriate survival rates of 77.9, 78.3, 76.8 and 77.5 % respectively. Feed conversion rates for surveyed ponds were high and equal as 2.69, 2.60, and 2.75 and 2.71 respectively. It is concluded that controlled water quality parameters in growing out highly intensive cultured shrimp ponds will lead to benefit results of good health and better quality shrimp production and acceptable survival rates with good harvesting productivity. It is advisable for

intensive shrimp growing out ponds that their physical and chemical water parameters must be under continuous, regular and daily observation and checking by physical detection and chemical analysis for obtaining good hygienic and economic product.

Keywords: water quality parameters in aquaculture, Penaes indicus

INTRODUCTION

Aquaculture represents one of the fastest growing food producing sectors in the world. One of these sectors is that of Penaeid shrimp aquaculture which is mainly as well marine shrimp as popular seafood, highly favored for human consumption world wide (Jory and Cabrera, 2005). Shrimp farming has been promoted as part of the 'Blue Revolution' which is aimed to supply food for hungers and at the same time reduces pressure on wild populations (Dao et al., 2004). Intensive development of shrimp farming has become a common trend in the whole world, where, shrimp account for around 20 % of the total value of internationally traded fisheries products (Kagawa, 2003). In the last two decades cultured shrimp has become an important source to meet the high demand for shrimp (Jory and Cabrera, 2005). Aquaculture intensification makes Thailand to be the country which is the highest in Asia and in the world for shrimp production (Tru, 1994). Shrimp farming, especially intensive type in the world like any new animal production industry has high risks and however, it has faced many difficulties due to impacts of environmental pollution and shrimp epidemics resulting in great damage (ACIAR, 1999). In the shrimp ecosystem there is a clear link between environmental conditions namely physical and chemical hydrological parameters and disease outbreak (Pillay, 2004). In brief words, the single most critical factor governing optimal growth, all shrimp activities, survival and production of shrimp is water quality (Villalon, 1991). Fluctuations in dissolved oxygen concentration (DO), temperature (temp), log of hydrogen ion concentration (pH), transparency (trans) and salinity (sal) and with high levels of ammonia, nitrite, nitrate, toxic compounds,Ö.etc will lead to increasing physiological stress and lowering immune response of aquatic organisms (Pillay, 2004). In case of optimal hydrological physico-chemical parameters of shrimp ecosystem and quality of food, the different tropical shrimp species may achieve a growth rate of more than 2 g a week (Boyd and Clay, 1998). Non infective cause of shrimp weight loss is inappropriate physical and / or chemical water parameters (Boyd, 1997). Then, several critical water parameters should be observed and checked regularly and daily, where, the cornerston of disease prevention is the creation and maintenance of excellent water quality. The proper physical parameters of the water for aquatic organisms may be somc what different on the basis of the type of the organism being kept and on the basis of the area of interest of the aquarist. DO is the most important of all water quality facters to good shrimp production (Jory and Cabrera, 2005). Surface water paddlewheel aerators are efficient and are the easiest to install and maintain (Boyd and Ahmad, 1987; Ahmed and Boyd, 1988). The water temp in the pond is a determining factor in the shrimp growth, where, P. indicus can not survive in cold weather (Bukhari, 1994), while, changing the pH by a small amount suddenly is more of chemical change and more stressful to shrimp than might frist appear. As well within pH range of 6.0 or 9.0, it exerts a dramatic infuence on the toxicity of unionized (free) ammonia (NH3) and hydrogen sulphide (H2S) as with lower pH of acidic side or as higher pH as alkaline or basic side (George, 1989). Salinity refers to the total amount of dissolved substanes and measures the total salts dissolved in water. It is usually expressed in terms of per thousand (0/00 = ppt) or its specific density. Measurement of transparency is highly subjective for monitoring water data as well as other hydrological parameters (Pillay, 2004). Water transparency is generally related to and is an index of phytoplankton biomass and its abundance present in the water column and it is measured with a Secchi disc, typically once per day at mid- morning (Jory and Cabrera, 2005). Also, the authors reported that its acceptable values are between 30- 50 cm and the readings of < 30 cm indicate high phytoplankton biomass or suspended sediment or both in the water column. Total nitrogen ammonia (TN-amm = NH4+NH3) and nitrogenous nitrite (N-NO-2) may be the substances those need to be diluted and removed and their sources are : dead corals, dead aquatic organisms, organic matter decomposition and over feeding (Jory and Cabrera, 2005). There are two types of ammonia as total nitrogen ammonia, which are none ionized (free ammonia = NH3) and ionized ammonia (ammonium = NH4). Free ammonia burns the gills of aquatic organisms (fish & shrimp) and extremely toxic form of inorganic nitrogen, while, ammonium is harmless (Bower and Bild Well, 1978; George, 1989). The toxicity of ammonia is influenced by the pH of the water and it is exacerbated by a low DO level. The nitrogen cycle (the nitrification cycle) is the process that converts ammonia into other relatively harmless nitrogen compounds, nitrite (NO-2) and nitrate (NO-3). NO-2 is less toxic than ammonia and it converts to the final product of breakdown as NO-3, which is relatively harmless. However, ammonia, NO-2 and NO-3 are controlled by properly estimated feed amount, use of bottom siphon, aeration machine and increase the rate of regular water exchange (Erazo- Paragdor, 2001).

According to Boyd and Tucker (1998), Treece and Yates (2000), Browdy and Jory (2001) and Whetstone et al. (2002) the water quality characteristics for shrimp culture in general are:-

Variable	Desired concentration
DO (mg/l) [dissolved O^2 gas]	5-15 (minimum = 2-3 for growth)
PH*	7-9
Sal (ppt)	5-35
Temp (oc)	26-29°c for growth (23-25°c is the minimum, while, 33-34°c is the maximum).
TN- amm (mg/l)	< 0.1
N- NO^2 (mg/l)	< 0.23

*pH directly influences shrimp {at pH of 4 and 11 = acid death point and alkaline death point respectively, at 4-5 = no reproduction, at 4-6 and at 9-11 = slow growth, at 6-9 = best growth as recorded by George (1989)}.

On the other hand, as reported by Van Olst et al. (1980), Wickins (1981) & (1982) and Kuo (1988) the desirable ranges and levels of water quality factors for Penaeid shrimp spp. culture are: temp = 26- 30°Ç, DO > 5 mg / L, pH = 7.8- 8.3, sal = 15- 30 ‰, TN-amm = 0.09- 0.11 mg / L and N-NO-2 = < 0.2- 0.25 mg /L.

This study was aimed to obtain a better survey of most important environmental hydrological physicochemical parameters of water in highly intensive shrimp growing out ponds. Also, to evaluate the shrimp productivity, survival rates and the feed conversion rates (FCR) at harvesting time in each surveyed pond under higher intensity, hyper salinity and the monitored hydrological parameters.

MATERIALS AND METHODS

Time and site of the survey:-

This survey was carried out from 22 April t September 2006. The site of the study is earthen coastal ponds (No. 1, 2, 3 and 4) i Fish Farming Center (FFC) at the Red Sea, 60 Km from Jeddeh City, The Kingdom of Arabia, where, this center is specialized fo search work and aquaculture improveme Saudi Arabia. These earthen ponds were with insulating rubber sheets of HDPE and graveled bottom. Each pond has boat sh sluice pipes for water exchange which were ed in a corner of the pond. Pond preparatio volved several sequential procedures b stocking including : pond draining and drying mapping, soil tilling, disinfection and liming tilization and weir gate preparation and ma nance.

Shrimp species of the study :-

All post larvae (PL) used in this survey were obtained from *P. indicus* after 42 days (6 weeks) of nursery culture of day 10 post larvae (PL_{10}). As reported by Jory and Cabrera (2005). *P. indicus* is a hyper saline resistant Indian white shrimp which is native to the Indian Ocean and it tolerates low water quality better than Penaeus monodon. It grows well at high densities and salinities, reaches sexual maturity and spawns in pond and is widly available in the wild. The FFC strain of *P. indicus* of this study has been reared through several seasons (more than 20 generations) from pond cultured broodstock selected from culture ponds held at the FFC, Jeddah, Saudi Arabia.

Feeding of shrimp:-

The shrimp in surveyed ponds were fed with pellets specially manifactured for shrimp growing out purpose. The feed was distributed every day by means of automatic feeders which have a correct spreading of feed all over the pond to avoid any concentration of feed in some parts of the pond where it will never be consumed. National Prawn Company (NPC), The Kingdom Of Saudi Arabia (KSA) [e.mail: arb @ ae. Net. SA] was the source of this shrimp ration. The ingredients of shrimp feed- grower were: - fish meal, soy bean meal, wheat, mineral and vitamin premixes, fish oil, lecithin and others.

As well as the feed needed for growing the shrimps in the ponds is the most important item in terms of production cost and it is the prevailling element hanging over the profitablity of the project. The composition of this shrimp feed grower was formed of:-

Moisture	11 %
Crude protein	40 %
Crude fat	5 %
Crude ash	9 %
Crude fiber	2 %
Calcium	1.5 %
Phosphorus	1 %

The feed distribution was made eight times a day and night to divide the quantities made available every day and improve the consumption. While, the night distribution was the most important of all since the shrimps are specially active at night. The quantity of feed to be provided every day shall be assessed taking into account the average weight and number of shrimps in the pond. Other criteria are also considered in the quantity of feed to be supplied are behavior and consumption of feed, species, age, size, the molting seasons, availability of natural food, quality of commercial feeds and water quality. As well as the feed pellets are compact enough that will be sinking down in the water, where, the shrimp feeding mostly on the pond bottom. In the best regulated feeding systems of shrimp aquaculture, up to 30 % of the feed is never consumed. Consequently, a considerable amount of waste accumulates in ponds in the form of uneaten feed, faeces, ammonia, phosphorus and carbon dioxide. The excess nutrients stimulate the growth of phytoplankton, which eventually die, sink and decompose on the bottom of the ponds consuming large amounts of oxygen in the process of decomposition.

The technical features of each pond and its cultured shrimp:

Area of the pond (as 30X 40m)= ....1200 m^2

Depth of the pond=....................................1.2 m

Density of the pond=.................120 shrimps / m^2

Stocked seed population=................144000 shrimps / pond

Age of seeds at beginning of nursery perio =...........10 days

Period of nursery of PL_{10} =......................42 days

Age of seeds at stocking for growing out =................. days

Mean seed weight (at stocking for growing out)= ....735 g / shrimp

Mean stocking biomass for growing out = ...105.84 Kg / pond

Feeding type =............................Pellets of industrial feed

Feeding frequency =....................3 times during the day and 5 times during night

Method of feeding = ...Automatic feeding

Mechanical aeration =.................3 hp / pond as 3 paddle wheels for each pond

Water exchange (% daily) =........................Pumping 25 %

Stocking date for growing - out =.................April 22, 2006

Harvesting date =..................................September 21, 2006

Period of growing- out after nursery period =........152 days

Total culturing period after spawning =.............. ..205 days

Collection of water samples:-

The water samples for chemical analysis were collected from the middle and from near the sluice gate (as 500 ml for each) from each pond and then mixed together. Chemical analysis of each mixture was directly carried out after collection for determination of TN-amm and NO_{-2}-N levels. The changing of water is performed through the water intake facility at the enterance of the pond as 25% daily at least. Water exchange is an effective tool for pond management, i.e to flush out wastes and also to improve DO levels.

Calculation of feed conversion rate (FCR):-

$$FCR = \frac{\text{Total feed weight used during growing out period till the harvesting time}}{\text{Total shrimp weight at harvesting time ñ shrimp weight before growing out}}$$

Devices and instruments used in the survey:-

1. Portable refractometer (Japanese salinometer, type of Bio- Marine AquaFuana) for measuring salinity in ‰ (ppt) or in specific density.
2. Portable pH meter ñ Hach / Sens ion 1 (American pH-meter / model 51700- 18) for measuring log of hydrogen ion concentration (pH) and temperature in °C or °F.
3. HQ10 Hach Portable LDO (American oxymeter / model 51815 ñ88) for measuring dissolved oxygen level in mg / L and temperature in °C or oF with recording date and time of measuring.
4. DR / 2400 Hach Portable Spectrophotometer (American portable laboratory) for water analysis by use of chemical reagents for detection of (TN-amm) and (NO_{-2}-N) levels or many other different minerals and substances in water samples. Chemical reagents which are used

for (TN-amm) detection are ammonia salicylate and ammonia cyanurate and for (NO-2-N) detection are NitriVer 3 (potassium Pyrosulfate).

5. Water transperancy is measured in centimeters utilizing the common Secchi disk as a 30 cm diameter disk painted a sharply contrasting black and white at the four quadrants.

Statistical analysis:-

Data were expressed as mean +/_ standard error of the mean (S.E.M.) in addition to the minimal and maximal levels of each parameter were estimated for each parameter in each pond. The data were statistically analyzed by Basic Statistics through Store Descriptive Statistics in Minitab Programme for statistical analysis to detect differences in the average levels of measured parameters.

RESULTS AND DISCUSSION

Shrimp farming in some countries faces a big environmental problems especially water qualitiy deterioration, abundant deposited alluvia, changes in environmental factors or parameters and development of disease carrying bacteria. Table (1) showed the means and standard errors of the different measured hydrological physicochemical parameters in the monitored ponds. These parameters in this survey were around levels required for shrimp rearing as reported by Boyd and Tucker (1998), Treece and Yates (2000), Browdy and Jory (2001) and Whetstone et al. (2002) in general. Also, maximal, minimal and median measured hydrological parameters were showed in table (2) for monitored P. indicus ponds were in the same limits of Penaeid spp. recorded by Van Olst et al (1980), Wickins (1981) & (1982) and Kuo (1988). In most cases of treatable conditions as repoted by Pillay and Kutty (2005) it is better to start with vigorous and large water changes with increasing value which is required from time to time because of: (1) to accelerate and synchronize the molting cycle of the stock, (2) as effective remedial action for DO depletion, (3) to decrease the algal bloom density in the pond and (4) to reduce organic load with temperature adjustments and just careful observation. The excessive organic matter (especially at night and early in the morning) is polluting as it blocks light and can inhibit algal oxygen production. DO is consumed by living activity of shrimp, microorganisms decomposing organic matters and other marine organisms (Dao et al., 2004). At these times dissolved oxygen content in surveyed ponds its minimal level as 3 mg / l which was dangerous and critical limit of DO might be ended with shrimp death or cease shrimp growth if it was neglected or left without correction. pH is an ecological factor that can be controlled in shrimp farming industry. The water pH in studied shrimp ponds was generally suitable for the growth of raised shrimp and was adjusted within suitable range. In the same manner, pH was sharply deviated to acid or alkaline bases in studied ponds should be corrected. Impaired DO and / or pH were directly treated and controlled by increasing: water exchange and aeration as soon as the condition was discovered. However, pond aeration is the primary life support system of many aquaculture ponds including intensive shrimp farming (Pillay and Kutty, 2005), where, operation of aeration machine provides a main source of DO. DO is fairly high during the day time (the mid afternoon) owing to oxygen production by phytoplankton during the photosynthesis process when solar intensity reaches its peak, as a result of oxygen releasing and carbon dioxide consuming by algae; and vice versa during night, while, DO level usually declines at night due to absorption of oxygen by phytoplankton at this time (Villalon, 1991). That is why three mechanical aeration devices are used in the surveyed shrimp ponds to maintain adequate DO level especially during night. One horse power of aeration will normally allow an additional 400 to 500 kg / ha / crop of shrimp production above that possible without aeration (Boyd,1997). Therefore, DO concentration in these ponds was relatively suitable during the whole growing- out period. There is a relation between DO content with other environmental factors such as temperature, pH, transparency and salinity (Boyd,1997). Therefore, correction and controlling any impairment of these parameters were occasionally in the same line of treatment. Villalon (1991) recorded that the major oxygen deficiency reasons are may be due to a high degree of photosynthetic activity as a result of photosynthetic respiration in a shrimp pond and / or may be caused by excessive biological oxygen demand (B.O.D.). The same author also added that the dial oscillation of pond water pH is directly associated with the photosynthetic activity of the phytoplankton population in the pond. In this survey pH increased to the basic side at the beginning of the growing-out period and reduced during the processing of farming time. *P. indicus* is fairly hypersaline resistant, and therefore, salinity in the surveyed shrimp ponds was more stable. There is a correlation between pH and salinity, while, salinity affects pH stability and this is in agreement with study of Nho (1994). In this study ponds aeration machine can be useful in breaking thermal stratification and reducing water temperature. Besides, with depth of 120 cm and water supply from the coastal well, the water temperature is more stable and there was no sharp fluctuations in water temperature in the surveyed shrimp ponds. Although water temperatures are strongly related to ambient atmospheric temperature as well as to wind conditions, they may be significantly influenced by the pond's water level (Villalon, 1991).

DO concentrations range from 4- 4.5 mg / L which are within the optimal levels desired by penaeid spp. (Robinson, 1979). Prologed low dissolved DO levels (hypoxia) cause muscle necrosis, asphyxiation and death (Erazo- Pagador, 2001). However, even coastal open water salinities at 42- 44 ‰ for the Red Sea, other ranges of

Table (1): Means of some physical and chemical water quality parameters of growing out highly intensive cultured shrimp ponds during rearing period.

Parameters \ Ponds	Pond No. 1	Pond No. 2	Pond No. 3	Pond No. 4
Dissolved oxygen (mg / L)	4.97+/- 0.050	4.72+/- 0.053	4.75+/- 0.056	4.92+/- 0.049
pH	7.62+/- 0.028	7.65+/- 0.026	7.62+/- 0.028	7.64+/- 0.028
Temperature (°C)	28.95+/- 0.100	28.90+/- 0.101	28.93+/- 0.099	28.93+/- 0.099
Salinity (‰)	43.33+/- 0.055	43.21+/- 0.068	43.23+/- 0.059	43.22+/- 0.062
Transparency (cm)	37.25+/- 0.759	39.33+/- 0.743	39.84+/- 0.779	36.65+/ 0.801
Total nitrogen ammonia (mg/L)	0.150+/- 0.0064	0.145+/- 0.0056	0.137+/- 0.0059	0.159+/- 0.0060
Nitrite nitrogen (mg/L)	0.0273+/- 0.0011	0.0311+/- 0.0010	0.0278+/- 0.0010	0.0301+/- 0.0010

Data were expressed as mean +/- standard error (Mean+/-SE).

water quality factors recorded by the FFC during study period for the same water as the source of all cultured facilities were also usually within the acceptable range shown as temperature, pH, DO, total ammonia nitrogen and nitrite nitrogen = 25.3- 32°C, 7.1- 7.5, 4.9- 5.2 mg / L, 0.02- 0.04 mg /L, 0.01- 0.03 mg / L respectively. During the survey time (summer), the water source (from coastal well) temperature tended to increase with time ranging from 28 to 32°C within the acceptable level for shrimp farming. As recorded by Boyd (2001) the sudden change in temperature caused shock to shrimp and as a result raised shrimp stopped eating, were less active, some or many shrimps were paralyzed and found dead. Villalon (1991) also recorded that the high degreee of water temperature oscillation during the 24 hrs cycle may result in unnessary stress to shrimp population. For all densities yields were significantly higher ($p<0.05$) in summer than in winter, which are attributed to favourable temperatures resulting in faster growth during summer (Bukhari, 1994). This was one of the reasons of high productivity of surveyed ponds. Sea temperature on the Red Sea Coast of Saudi Arabia range from 20- 32Oc, which are favourable for Penaeid shrimp production (Bukhari et al., 1991). While, prolonged low temperature causes incomplete molting, poor growth and muscle necrosis (Erazo- Pagador, 2001).

Bukhari (1994) found that at high salinities of 43 %0 and 50%0 for P. indicus its survival rat was the highest, its growth in size and length in mm were significantly higher and significantly better yields as were statistically revealed. This is attributed to that the Red Sea *P. inducus* prefer full strength or even higher salinity water once juvenile stages are reached as well as this shrimp from the Red Sea shows physiological adaptation to higher salinity in comparing with *P. indicus* of Indian Ocean (Bukhari, 1994).

Table (2): Minimal and maximal ranges and their median levels (in parentheses) of some physical and chemical water quality parameters of the monitored growing out highly intensive cultured shrimp ponds during rearing period

Parameters \ Ponds	Pond No. 1	Pond No. 2	Pond No. 3	Pond No. 4
Dissolved oxygen (mg / L)	3.1- 5.9 (5.1)	3.4- 5.9 (4.7)	3.0- 5.9 (5)	3.0- 5.9 (5)
pH	6.77- 8.28 (7.94)	6.8- 8.19 (7.94)	6.69- 8.28 (7.94)	6.69-:8.19 (7.96)
Temperature (°C)	25.7- 31.3- (28.9)	25.5- 31.3 (28.8)	25.6- 31.3 (28.9)	25.5- 31.3 (28.9)
Salinity (‰)	42- 44 (43)	42- 44 (43)	42- 44 (43)	42- 44 (43)
Transparency (cm)	20- 55 (30)	20- 55 (40)	20- 55 (40)	20- 55 (35)
Total nitrogen ammonia (mg/L)	0.01- 0.29 (0.155)	0.01- 0.29 (0.155)	0.01- 0.29 (0.155)	0.01- 0.29 (0.155)
Nitrite nitrogen (mg/L)	0.008- 0.059 (0.024)	0.008- 0.059 (0.029)	0.008- 0.059 (0.025)	0.008- 0.059 (0.029)

Salinity shock and prolonged low salinity (6- 15 ppt) causes red disease and muscle necrosis (Erazo- Pagador, 2001). Villalon (1991) found that in case of a high density of phytoplankton bloom the water exchange should be increased to 150% of the total daily requirement and draining should be increased proportionally. In addition, feed and all fertilization should be temporarilly suspended. Bukhari (1994) reported that water qualty factors including low pH and high (TN-amm) resulted in poor growth and in consequence poor food conversion ratios. In the present survey in the first months of stocking concentration of (TN-amm) was slightly increased related to the organic pollution, while, at the end of shrimp crop (TN-amm) was slightly increased without suffering of and affecting living activities of shrimp. Low pH only (acidic water = acidosis) causes low molting frequency, poor growth and yellow to orange to brown discoloration of the gills and appendage surfaces and the case ends with eventual death (Erazo- Pagador, 2001). This may be attributed to the decomposition of abundant organic matters and nutrients especially in pond sediment at the bottom by micro-organisms leading to release of TN-amm which increased by high temperature (Bower and Bild Well, 1978 and George, 1989). Nitrite content of the water body reflects the capability of organic substance decomposition and oxygen consumption, where, the concentration of NO_2 in farming ponds of the present study. It tends to gradually increase during the grow-out period due to an increase in feed amount and higher density stocking with increased shrimp biomass and faeces making the ambient environment is more richer in nutrients (Bower and Bild Well, 1978 and George, 1989). In surveyed ponds the (TN-amm) content in water could be decreased by increased water exchange rate in addition to the use of aeration paddle wheels. The subleathal levels of (TN-amm) increase the aquatic animal susceptibility to the unfavourable conditions e.g : fluctuating temperature, lack of oxygen, Ó.etc. Regular water changes as the frist line of defence are the cheapest, safest and most effective way of keeping nitrogenous compounds concentrations at responsible levels as the most important step in control diseases. The effectiveness of water changes is determined by its frequancy and the percentage of water that is replaced. The major causes of: oxygen depletion, eutropheuction, 30 % of feed in shrimp ponds is never consumed and usually no more than ° of organic carbon and other nutrients provided in the feed are recovered in the shrimp at harvest (Boyd and Clay, 1998).

Algal density as transparency demonstrates primary productivity of nutrient chain in water ecosystem. Increased algal density is a pollution indicator in water and dead algae deplet oxygen in water causing smell and toxic gas unfavourable for shrimp and other marine creatures and this is a sign of eutrophication (Boyd and Clay, 1998). The same author reported that the transparency in farming ponds changes with environmental factors such as light, temperature, salinity, nutrient, nitrogen, Ö. etc and consumption level of zooplankton in the pond and raised shrimp. In the present study increased algal density can be controlled by consumption of plankton by shrimp, increased water exchange, use of bottom siphon and operation of aeration machine.

Table (3) presented very valuable calculations in shrimp farming as good indicators of rearing process, management practices, good hydrological parameters better shrimp health and good quality. Although there were higher productivities in all surveyed ponds and acceptable survival rates, FCRs were not good. This may be attributed to high intensity, hypersalinity, increased use of food with increased size of shrimp and rearing long period.

However, in the present study results show good points of highly intensive farming form with adequate pond setting and application of scientific techenology in pond management and operation, thus, pond environmental pollution can be controlled. This was including sanitary practices including siphoning out of organic materials that accumulate in pond bottom, immediate removal of dead shrimps and careful control of any vegetation in ponds were applied. This is in agreement with basical condition of Erazo- Pagador (2001) for a high production and good quality on a not-large area unit. Besides, research results demonstrate the fact about ecosystem quality in intensive pond which can meet in general ecological requirements of indian shrimp (*P. indicus*). As well feeding quantity increases with shrimp size as leading to rise in organic residues in later months of the growing- out period. During this period of shrimp in surveyed ponds there was no use or application for any antibiotic, therapeutic or chemical, where, there was no disease problems. This was attributed to that the hatching seeds were free from pathogens with active control of farming environment to ensure shrimp health in the good prevention method.

It is concluded that application of modern technical measures with continuous regular daily observation and measurement of the hydrological physical and the chemical water quality parameters (which are indicators of good water quality) will lead to good hygenic management for growing out of good health, better quality shrimp production and good harvesting productivity. These practices must be carried out with side by side of control and removing pollution to reduce and prevent adverse impacts on quality and harvest production of shrimp in highly intensive shrimp ponds.

Table (3): Shrimp productivity and feed conversion rates in monitored ponds at harvesting time

No.	Ponds / Parameters	Pond 1	Pond 2	Pond 3	Pond 4
1	Average weight at harvesting (g / ind.)	23.72	23.33	24.23	23.9
2	Survival rate (%)	77.9	78.3	76.8	77.5
3	Total No. at harvesting (shrimp / pond)	112176	112752	110592	111600
4	Productivity (mt / ha / crop)	22.174	21.921	22.33	22.227
5	Feed conversion rate (FCR)	2.69	2.60	2.75	2.71

It is recommended that:

1. Government policies must encourge investment and support in technical farming meth-

ods for intensive shrimp culture on coastal small areas.

2. Reseach application about a suitable intensive farming model is necessary to find out a suitable ratio of waste discharge pond area and build a rational water treatment system before pond water effluents are poured into the surrounding water ways for protection of the ecosystem..
3. For monitoring and managing sources polluting water environment of coastal aquaculture, criteria for waste water quality discharged into natural waters can be served as a basic indicators of pollution.
4. The research should be expanded to other marine and freshwater culured organisms such as fish and shrimp spp. in other farms for more generalized information on environmental assessement.

ACKNOWLEDGEMENT

I would like to express the most sincere thanks and acknowledgement to the work team of Shrimp Department in The Fish Farming Center, Jeddah City, Kingdom of Saudi Arabia, for their sponsorship and help for reporting this monitoring and research work.

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استبيان لبعض مؤشرات المياه الفيزيقية والكيميائية للاستزراع العالى الكثافة للجمبرى البحرى تحت ظروف الملوحة العالية

صفوت ابراهيم يوسف شلبى

قسم الكيمياء الحيوية والتسمم الغذائى بمعهد بحوث صحة الحيوان التابع لمركز البحوث الزراعية - مصر

ان نمو تسمين الجمبرى من فصيلة البينيد عند مستويات ملوحة عالية بمتوسط ٤٣ فى الألف عند استبيان برك هذا الجمبرى المستزرعة للتسمين بكثافة عالية استلزمت الحفاظ على مؤشرات جودة المياه الفيزيقية والكيميائية عند مستويات نموذجية ومناسبة لاستزراع الجمبرى. وقد تم باستمرار وانتظام يوميا و ذلك خلال فترة التسمين لمدة ١٥٢ يوما وبعد فترة ٤٢ يوما من الحضانة قياس الأوكسجين الذائب و لوغاريتم تركيز أيون الهيدروجين ودرجة الحرارة والملوحة والشفافية والأمونيا النيتروجينية الكلية والنيتريت النيتروجينية. وفى هذه الدراسة فان المعدلات الدنيا والقصوى لمؤشرات جودة المياه الفيزيقية والكيميائية كانت حول امكانيات الجمبرى المربى من نوع بيانس أنديكس لتوفيق وتبديل وتكييف ظروف حياته الفسيولوجية لهذه المستويات من المؤشرات المائيه التى تم استبيانها. وعلى الرغم من أن بعض هذه المؤشرات التى تم استبيانها قد انحرفت عن المستويات المثالية الضرورية أثناء بعض أيام التسمين فى بعض البرك التى تحت الدراسة فان السيطرة والتصحيح للمؤشرات التى حدث بها الخلل كان يتم مباشرةً فى البركة التى تأثرت بسرعة بمجرد اكتشاف هذا الخلل. لهذا فان الانتاجية فى البرك التى تم استبيانها عند وقت الحصاد كانت جيدة جدا فى كل البرك رقم (١) و (٢) و (٣) و (٤) التى كانت تحت الفحص وكانت هذه الانتاجية تساوى ٢٢.١٧٤ ، ٢١.٩٢١ ، ٢٢.٣٣٠ و ٢٢.٢٢٧ طن مترى / هكتار/ للمحصول مثلما كانت نسب الاعاشة المناسبة التى تساوى ٧٧.٩ ، ٧٨.٣ ، ٧٦.٨ و ٧٧.٥ % على الترتيب. وكانت نسب التحويل الغذائى للبرك المدروسة عالية وتساوى ٢.٦٩ ، ٢.٦٠ ، ٢.٧٥ و ٢.٧١ على الترتيب.

ويستنتج من هذا أن مؤشرات جودة المياه التى تحت السيطرة فى تسمين برك الجمبرى المستزرعة عالية الكثافة سوف تؤدى لنتائج مفيدة للحصول على انتاج جمبرى ذو صحة وجودة جيدة ونسب اعاشة مقبولة مع حصاد انتاجية جيدة. وعليه ينصح فى برك تسمين الجمبرى المكثفة أن مؤشرات جودة المياه الفيزيقية والكيميائية يجب أن تكون تحت المراقبة والمعاينة المستمرة والمنتظمة واليومية بواسطة التعيين الفيزيقى والتحليل الكيميائى للحصول على منتج صحى واقتصادى.