EVALUATION OF EFFLUENTS FROM THE FRESHWATER PRAWN *MACROBRACHIUM AMAZONICUM* GROW-OUT PONDS

J.M.Kimpara, F.R.T. Rosa, W.C.Valenti

Centro de Aqüicultura - Universidade Estadual Paulista (Caunesp) Via de acesso Prof. Paulo Donato Castellane, s/n, CEP 14780-000 jmkimpara@gmail.com

INTRODUCTION

Aquaculture has grown largely in recent years and it may lead to a negative environmental impact. Generally, only 25% to 30% of nitrogen and phosphorus from fertilizers and feed are reverted in prawn and/or fish at harvest (Boyd and Tucker, 1998). Moreover, ponds frequently present higher nutrients concentration, plankton biomass, suspended solids, and biochemical oxygen demand concentrations in comparison to receiving water bodies (Schwartz and Boyd, 1994). Thus, effluents often present characteristics that differ from inlet water and may cause an impact on receiving environment and negative externality generated by the production system. Therefore, the objective of this study was to evaluate the effects of stocking and harvesting strategies on effluent characteristics of *M. amazonicum* grow-out ponds.

MATERIAL AND METHODS

The study was carried out at the Crustacean Sector, Aquaculture Center, Sao Paulo State University, Jaboticabal, Sao Paulo. Twelve 0.01-ha earthen ponds were stocked with juveniles as follows: 1- "upper" graded-juveniles (passed through a 5-6 mm bar grader); 2- "lowers"; 3- non-graded juveniles + culled-harvest as soon as prawns with commercial size were observed (approximately 7 g); 4- stocking non-graded juveniles. After 3.5 months, ponds were drained and harvested.

Prawns were fed a pelletized commercial diet (30% crude protein) at a rate of 9 to 3% of prawn biomass according to development phase. Effluent was sampled in the morning (06:30 to 07:00 h) and in the afternoon (15:30 to 16:00 h) for analysis of the variables: Temperature, dissolved oxygen, pH, turbidity, total suspended solids, pH, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, N-ammonia, N-nitrite, N-nitrate, N-Kjeldahl nitrogen, P-soluble orthophosphate and P-total phosphorus according to APHA (1998). Normal and homocedastic data were compared by analysis of variance (ANOVA) by F test (parametric) followed by Duncan test to compare the differences of mean values ($p>0.05$) among treatments and between inlet water and treatments using the SAS software (v. 8.2). Analysis of principal components was made using Statistica version 6.0

RESULTS

Water exchange rate was 29.0±1.6%.day^{-1}. Temperature in effluents was 27.2±0.1°C in the morning and 28.3±0.4°C in the afternoon. There was no significant difference between effluents and inlet water for temperature, total suspended solids, chemical oxygen demand, N-ammonia, N-nitrite and N-Kjeldahl nitrogen. Turbidity was significantly lower in inlet water (15±6) than upper effluent (25±10). Inlet pH (7.04±0.47) and biochemical oxygen demand (2.58±2.27) mean values were inferior to effluent values from all ponds, which varied from 7.59±0.39 to 7.65±0.33 and from 3.67±2.19 to 4.18±2.25, respectively. Dissolved oxygen and N-nitrate were significantly higher in inlet than in effluents. In inlet water, dissolved oxygen was 6.10±0.61, and in effluents values ranged from 3.43±0.94 to 3.77±0.97. Higher concentration of P-soluble orthophosphate was found in inlet water (46.80±56.80), and it differed statistically from upper (28.30±9.82) and lower (28.43±20.79) effluents. Culled-harvest effluent presented the highest concentration of P-total phosphorus (0.196±0.023) and differed from inlet mean value (0.101±0.021). No temporal variation pattern was observed for any of the studied variables.

Feed addition to ponds varied from 2988 kg.ha^{-1} in lower ponds to 4077 kg.ha-1 in upper ponds. Culled-harvest presented 23.14% of feeding reduction in comparison to traditional ponds.

The analysis of principal components resumed 84.14% of total variability in the first two components. The analysis showed three distinct groups: 1- inlet; 2- culled-harvest and 3- upper + lower + traditional. Total suspended solids, P-total phosphorus, N-Kjeldahl nitrogen and N-ammonia were highly and positively correlated to the first principal component. P-soluble orthophosphate and dissolved oxygen were positively correlated to component 2 but negatively correlated to component 1. N-nitrate and afternoon temperature were negatively correlated to components 1 and 2. Chemical oxygen demand, biochemical oxygen demand, pH, morning temperature, N-nitrite and turbidity were positively correlated to component 1 and negatively correlated to component 2.

DISCUSSION

Some of the measured water quality parameters have changed from inlet water to effluents as a consequence of aquaculture practices. Independently from the adopted farming strategy, pH and dissolved oxygen values were significantly different in inlet and effluents. Adding commercial feed and fertilizers, and using aerators seemed to have caused a higher turbidity. Similarly, lower biochemical oxygen demand mean concentration in inlet water was probably found as a consequence of higher organic matter input in rearing ponds and released in effluents. P-soluble orthophosphate concentrations decreased probably as a result of primary producers assimilation. The high chemical oxygen demand:biochemical oxygen demand ratio indicates the predominance of non-biodegradable particles. This fact suggests that aquaculture management is probably accumulating materials such as fiber, humic acid and chitin, and thus biological treatment for effluents from these rearing ponds would not be efficient. Therefore, it is necessary to add alternative physical treatments to these effluents.

Multivariate analysis showed that culled-harvest presented higher total suspended solids, P-total phosphorus, N-Kjeldahl nitrogen and N-ammonia concentration, which characterized a distinct group among all groups. Effluents differed from inlet water in many variables, especially in dissolved oxygen, pH and P-soluble orthophosphate, evidencing the effect of aquaculture practices on water quality.

CONCLUSION

Aquaculture practices increased significantly turbidity in effluents, which may be an erosion consequence of prawns swimming activity. Variable values did fit most of effluents regulation developed by several countries, except for dissolved oxygen. However, Best Management Practices (BMPs) might be adopted to fit legislation and improve the assimilation of nutrients in these aquaculture systems.

REFERENCES

American Public Health Association. APHA. 1998. Standard methods for the examination of water and waste water. 18.ed. APHA, Washington, DC, USA, pp. 4-81.

Boyd, C. E.; Tucker, C. S., 1998. Pond aquaculture water quality management. Kluwer academic publishers, Boston, MA. 700 pp.

Schwartz, M. F.; Boyd, C. E., 1994a. Channel catfish pond effluents. Progressive Fish-Culturist 56, 273-281.