EFFECT OF pH ON THE WASTE PRODUCTION OF CATFISH IN RUNNING WATER SYSTEM

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Abstract

The objective of this study was to observe the effect of pH on the waste production of African catfish, *Clarias gariepinus* in a running water system. Nine months old male catfish with a density of 64 and average weight of 50.00g were placed in a running water system. Water samples were collected twice daily and analyzed for ammonia nitrogen, phosphate and nitrate contents with HACH spectrophotometers DR2800. Temperature of water samples was also recorded for each sample. Results showed that pH>7.0 had significantly higher value (1.16±0.08 mg/L) as compared to that observed for pH<7.0 (0.94±0.06 mg/L). Strong positive correlation was also observed between pH and nitrate (r=0.26). No significant difference was observed for ammonia nitrogen, phosphate and temperature. This study allows to conclude that pH is one of the environmental factors that affect the production of the waste production contents (nitrate) in running water system which may have a substantial effect on the survival of the catfish.

Keywords: African catfish, pH, waste production
Introduction

The African sharptooth catfish (*Clarias gariepinus*) is an extremely suitable aquaculture species and is successfully cultured in many parts of the world due to fast growing rates and tolerates with adverse environmental conditions (Khwuanjai *et al*., 1997; Raihan, 2007). This species has a wide tolerance for various temperatures, as well as low oxygen and high salinity levels (Bovendeur *et al*., 1987).

Currently, re-circulating water system is the most popular system used in rearing catfish where water running with the aid of water filter. Thurstone (1981) reported that, at high stocking density of re-circulating water system, ammonia, the main end product of nitrogen metabolism in teleost fish, might reach acute toxic levels. However, with the efficient system of bio-filters with bacteria to break down ammonia to less toxic nitrite (NO$_2$) and nitrate (NO$_3$), the toxicity of the ammonia could be prevented. The NH$_3$ fraction of total ammonia nitrogen (TAN) depends largely on pH and, to a lesser extent, on temperature and salinity (Tomasso, 1994).

In Malaysia, under the *Rancangan Malaysia Kesepuluh*, the Ministry of Agriculture and Agro-Based Industry had allocated RM82 million to improve the aquaculture industry to ensure enough protein supply within the country (Berita Harian, 2009). This program was also focused in entrepreneur training and aquaculture rearer.

Most of the catfish rearers in Malaysia practice re-circulating water system by using water filter and pond system. In Bachok, Kelantan, the Kemubu Agricultural Development Authority (KADA) had allocated RM1.2 million to build a factory to process catfish meat for local consumption and export. The factory needed eight tones of catfish daily to be processed into fish sauce, fish balls and even fish burger (Bernama, 2009).
The correlation between pH value and the waste production of catfish is rarely studied. Therefore, this study was conducted to observe the effect of pH on the waste production of African catfish in running water systems.

**Materials and Methods**

Nine months old male African catfish, *Clarias gariepinus* 50.00g was selected in this experiment. This study was carried out for 16 days from 1 - 16 September 2010. The catfish with the density of 64 were placed in a running water system where the water was continuously flowing. The water volume was constant, 0.45m$^3$ and the aeration was given with a barometric pressure of 30 Hg. The catfish were fed twice daily with 56.72g pellet (40% of protein).

The water samples were collected, every morning, 9-10 am and evening, 4-5 pm. The water samples were analyzed for the content of the waste production (ammonia nitrogen, phosphate, nitrate) and water temperature. The waste production analysis was done using HACH DR 2800 spectrophotometer and the content of ammonia nitrogen, phosphate and nitrate in the water samples were traced using HACH reagents method.

Statistical analysis on data obtained were performed on a microcomputer using Statistical Package for Social Science (SPSS) program. Data were analyzed through analysis of variance (ANOVA), Karl-Pearsons Correlations Test with significant levels of P≤0.05.
Results and Discussion

Table 1: Water temperature and waste productions of catfish in running water system with pH <7.0 and >7.0

<table>
<thead>
<tr>
<th>Water pH</th>
<th>Ammonia Nitrogen (mg/L)</th>
<th>Phosphate (mg/L)</th>
<th>Nitrate (mg/L)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH&lt;7.0</td>
<td>0.50 ± 0.09\textsuperscript{a}</td>
<td>0.55 ± 0.08\textsuperscript{a}</td>
<td>0.94 ± 0.06\textsuperscript{a}</td>
<td>27.89 ± 0.16\textsuperscript{a}</td>
</tr>
<tr>
<td>pH&gt;7.0</td>
<td>0.41 ± 0.10\textsuperscript{a}</td>
<td>0.37 ± 0.04\textsuperscript{a}</td>
<td>1.16 ± 0.08\textsuperscript{b}</td>
<td>27.80 ± 0.19\textsuperscript{a}</td>
</tr>
</tbody>
</table>

\textsuperscript{a,b} superscript in the same column show significant difference (P≤ 0.05)

Figure 1: Bar chart shows the water temperature and waste productions of catfish in running water system with pH <7.0 and >7.0

The acidity and alkalinity of water is expressed as pH and the recommended pH range for aquaculture is 6.5 to 9.0. Fish and other vertebrates have an average blood pH of 7.4 and a desirable range for pond water pH should be close to that of fish blood (i.e. 7.0 to 8.0). Fish may become stressed and die if the pH drops below 5 (e.g. acidic runoff) or rises above 10 (e.g. low alkalinity combined with intense photosynthesis by dense algal blooms-phytoplankton or filamentous algae) (Wurts and Durborow, 1992).
Nitrate concentration and pH levels in aquatic environments may have a substantial effect on animal life such as fish. The main anthropogenic sources of nitrates in the environment are municipal and industrial wastes and artificial fertilizers. There is no direct carcinogenic effects of nitrates on humans, but it is supposed that neoplastic diseases in people are related to the formation of N-nitroso compounds, of which many are carcinogenic to animals (Michalski and Kurzyea, 2005).

Generally, the present result showed no significant difference for ammonia nitrogen, phosphate and water temperature for both acidic and basic water. However, a significant difference with higher value was observed in pH >7.0 for nitrate (1.16 ± 0.08 mg/L) as compared to that recorded in pH<7.0 (0.94 ± 0.06 mg/L) (Table 1; Figure 1). In addition, pH was positively correlated with nitrate (r=0.26) and negatively correlated with ammonia nitrogen, phosphate and water temperature. Junaidi and Hashida (2010) observed positive correlation for pH with ammonia nitrogen and nitrate for density of 35 catfish in stagnant water system. However, pH was found to be negatively correlated with ammonia nitrogen and nitrate for density of 70 catfish.

Nitrate, nitrite and ammonium are mutually related among each other in the nitrogen cycle. Nitrate is one of the inorganic ionic species of nitrogen besides nitrite and ammonium. The reactions of biochemical decomposition of organic nitrogen compounds and the reduction of nitrates by hydrogen sulfide will result in the forming of ammonium ions (Michalski and Kurzyea, 2005). In water, ammonia nitrogen occurs in two forms, un-ionized ammonia and ammonium ion. Un-ionized ammonia is toxic to fish, but the ammonium ion is harmless except at extremely high concentrations. A pH increase of 1 unit causes roughly a tenfold increase in the proportion of un-ionized ammonia (Boyd, C. E. and Frank, L. 1979).
Future studies should be carried out to observe the correlation between the nitrate concentration and pH with mortality of catfish because according to Muller (2001), nitrate concentrations and pH levels in aquatic environments could have a substantial affect on plant and animal life.

Conclusion
This study had shown that in a running water system, pH is a very important element which can influence the waste production contents (nitrate) and can directly affect the survival of catfish.

References


