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Evaluating Water Quality Parameters for Tank Aquaculture of Cat Fish in Cameroon

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Abstract

The water quality parameters were evaluated for feasibility of aquaculture in Catfish Clarias gariepinus for 56 days fishe of standard length 63.000 ± 2.361 mm were stocked in equal numbers in fifteen rectangular plastic tanks of size (0.32 m × 0.45 m × 0.24 m) in three replicates per treatment with water level maintained at 3/4 full. The water quality values were taken twice a week and recorded till the end of the experiment. The paired sample correlation was used to compare while the non-parametric tests were used to compare the significant differences for the four treatment groups. At the end of the 56 days study period, the non-parametric Spearman's Rho test also gave a negative correlation between weights gained and dissolved oxygen values for all treatments and within weeks.

Keywords: Catfish; Aquaculture; Water; Correlation; Dissolved oxygen; Temperature; Agricultural waste

Introduction

Food and physical characteristics of the water including temperature, dissolved oxygen, salinity and other interacting factors have a limiting effect on the site viability and carrying capacity hence fish survival, growth and health condition may be affected with one or more of these factors. By controlling the optimum feeding frequency, farmers can successfully reduce the feed cost, maximize growth and also able to manage other factors such as individual size variation and water qualities which are deemed important in rearing of fish in cultured conditions [1]. Many fish species are capable of efficiently converting organic waste such as sewage, piggery, poultry, cow dung as well as other organic industrial by-products and agricultural waste into useful protein, thus contributing to the management of waste in our environment [2,3].

The African catfish is suitable for aquaculture because it grows fast, feeds on a large variety of agriculture by products, tolerates high concentrations of ammonia (NH_3), nitrite (NO_2), and resist also low oxygen concentrations in water because the fish can be able to utilize atmospheric as well as dissolved oxygen due to the fact that it has well developed air breathing organs [4].

Although the African catfish are efficient opportunists and survivors, equipped to exploit whatever resources are available and have a wide tolerance to environmental extremes, their various tolerance limit based on field studies conducted by Bruton [5] are as follows; water temperature of 8 to 35°C; breeding >18°C, Water temperature range for egg hatching is 17 to 32°C, Salinity, 0 to 12 ppt, 0 to 2.5 ppt is optimal, Oxygen level ranges from 0 to 100% saturation. They are efficient and obligate air breather, which will drown if denied access to air but have strong resistance to desiccation as a result of their air breathing habits, wide pH tolerance and turbidity [6].

Pedini [7] reported that Sub-Saharan Africa is facing problems with regard to the adoption and sustainability of aquaculture and development momentum is yet to materialize. The code of conduct for responsible fisheries includes responsible practices to be observed with a view to ensuring the effective protection, conservation, management and development of living aquatic resources, with due respect to the ecosystem and biodiversity. Thus the main objectives in this research is to observe the water quality parameter that can effect tank aquaculture.

Material/Methods

This experiment was carried out in the Life Science Laboratory of the University of Buea, South West Region of Cameroon. This area is situated in the tropical region and characterized by mean monthly rainfall ranging from 2416 to 2465 mm. The mean monthly temperature ranges from 21-24°C.

Experimental design

The experiment was carried out using rectangular plastic tanks of 0.32 m × 0.45 m × 0.24 m installed in the University of Buea Lab. A total of 15 plastic tanks were used. Prior to the start of the experiment, the tanks were cleaned, and allowed to dry for 24 hours after which they were filled with dechlorinated water to 2/3 the volume. The tanks were aerated throughout the experiment using 2 mm pressure tubes connected from an aquarium air-pumps (Tetratec APS 150, Germany) in order to help replenish the amount of dissolved oxygen in the water found in the tanks and also to produce some current for the movement of food particles in the water. The instrument used in distributing air into the various plastic tanks was Robinet Metal S/S divider, made in China. Also the tanks were covered with a net of 2 mm mesh size in order to prevent the fishes in the tanks from skipping out and also to protect the tanks from foreign materials or predators. Five treatments were used with three replicates, where each of the replicates in the various treatments had labels T_0D_1, T_0D_2, T_0D_3 for treatment zero and T_1D_1, T_1D_2, T_1D_3 for treatment one, T_2D_1, T_2D_2, T_2D_3 for treatment two, T_3D_1, T_3D_2, T_3D_3 for treatment three and T_4D_1, T_4D_2, T_4D_3 for treatment four. Uneaten feed and faeces were siphoned every morning prior to feeding using an 8 mm pressure tube [8]. Water quality values were taken twice per week and mortality was recorded.

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Fish feeding and tank management

The fish were fed 5% of their body weight in two rations, during the morning at 7.00-8.00 am and the evening at 5.00-6.00 pm throughout the experiment [9]. Left over feed and faeces in each tank were siphoned every morning prior to feeding [10].

Monitoring of water quality

Physico-chemical parameters in the various fish tanks was taken twice per week for eight weeks specifically every Wednesdays and Saturdays during the early morning periods prior to siphoning and feeding [11,12]. The temperature was measured using EXTECH Instruments (EXTECH Digital Thermometer 39240), dissolved oxygen was measured using EXTECH Instruments (EXSTIK II, Dissolve Oxygen Module DO600, made in Taiwan), pH was measured using HANNA Instruments (Woonsocket RI USA, HI98107 made in Europe), electrical conductivity was measured using HANNA Instruments (MS Dist4, HI98304, made in Mauritius) while salinity and total dissolve solids (TDS) were calculated from the electrical conductivity readings as described by Paul Dohrman.

Results

Data processing and analysis

All data collected were analyzed using the Statistical Package for Social Sciences (SPSS) Standard version, Release 17.00 (SPSS Inc. 2008). Data were analyzed using the following systematic approach.

Water quality parameters for the various treatments

pH: pH for the various treatments were similar within each week and within treatments throughout the experimental period (Table 1).

Weekly temperature: Temperature values for the various treatments were similar within each week and within treatment throughout the experimental period (Table 2).

Dissolve oxygen: Dissolve Oxygen values for the various treatments

Case Summaries						
	pH for various Treatments					
Weeks	Control (N=51) Mean ± SEM	T1 (N=51) Mean ± SEM	T2 (N=51) Mean ± SEM	T3 (N=51) Mean ± SEM	T4 (N=51) Mean ± SEM	KW (P-Value)
W0	7.267 ± 0.049	7.333 ± 0.021	7.267 ± 0.021	7.333 ± 0.021	7.350 ± 0.022	χ^2=6.276 P=0.179
W1	7.333 ± 0.021	7.167 ± 0.021	7.283 ± 0.021	7.250 ± 0.022	7.333 ± 0.033	χ^2=16.741 P=0.002
W2	7.333 ± 0.021	7.200 ± 0.026	7.250 ± 0.022	7.250 ± 0.043	7.283 ± 0.054	χ^2=7.240 P=0.124
W3	7.400 ± 0.037	7.200 ± 0.052	7.283 ± 0.031	7.367 ± 0.021	7.383 ± 0.017	χ^2=14.703 P=0.005
W4	7.317 ± 0.031	7.250 ± 0.022	7.283 ± 0.048	7.333 ± 0.033	7.400 ± 0.000	χ^2=11.451 P= 0.022
W5	7.350 ± 0.034	7.267 ± 0.042	7.267 ± 0.033	7.383 ± 0.031	7.417 ± 0.017	χ^2=12.734 P=0.013
W6	7.283 ± 0.031	7.217 ± 0.031	7.317 ± 0.031	7.400 ± 0.026	7.417 ± 0.017	χ^2=18.031 P=0.001
W7	7.250 ± 0.043	7.283 ± 0.017	7.333 ± 0.033	7.350 ± 0.043	7.367 ± 0.033	χ^2=6.385 P=0.172
W8	7.233 ± 0.021	7.367 ± 0.021	7.333 ± 0.021	7.400 ± 0.000	7.433 ± 0.042	χ^2=16.470 P=0.002

Table 1: Weekly pH for various treatments.

Case Summaries						
	Temperature for Various Treatments					
Weeks	Control	Treatment 1	Treatment 2	Treatment 3	Treatment 4	KW (P-Value)
W0	21.800 ± 0.052	21.783 ± 0.017	21.817 ± 0.065	21.800 ± 0.052	21.833 ± 0.061	χ^2=0.283 P=0.991
W1	21.967 ± 0.042	21.983 ± 0.048	21.917 ± 0.060	21.933 ± 0.042	22.000 ± 0.045	χ^2=1.742 P=0.783
W2	21.367 ± 0.171	21.433 ± 0.171	21.350 ± 0.161	21.367 ± 0.143	21.450 ± 0.161	χ^2=0.975 P=0.914
W3	22.233 ± 0.141	22.283 ± 0.133	22.217 ± 0.119	22.217 ± 0.119	22.317 ± 0.117	χ^2=1.260 P=0.868
W4	22.550 ± 0.043	22.583 ± 0.040	22.500 ± 0.058	22.500 ± 0.058	22.567 ± 0.061	χ^2=1.921 P=0.750
TW5	22.417 ± 0.105	22.450 ± 0.118	22.417 ± 0.117	22.417 ± 0.119	22.583 ± 0.133	χ^2=1.299 P=0.862
W6	22.067 ± 0.067	22.100 ± 0.077	22.050 ± 0.085	22.100 ± 0.063	22.150 ± 0.109	χ^2=0.918 P=0.922
W7	22.617 ± 0.075	22.633 ± 0.061	22.567 ± 0.049	22.550 ± 0.043	22.717 ± 0.060	χ^2=4.395 P=0.355
W8	22.167 ± 0.042	22.167 ± 0.021	22.133 ± 0.055	22.200 ± 0.063	22.367 ± 0.112	χ^2=3.623 P=0.459

Table 2: Weekly temperature for various treatments.

were slightly different within each week and within treatments during the experimental period (Table 3).

Electrical conductivity: Electrical Conductivity for the various treatments was somehow similar within each week and within treatments although there were some insignificant variations during the experimental period (Table 4).

Case Summaries

Total dissolved solids

The Total dissolved Solids for the various treatments were also similar within each week and within treatments although there were some insignificant variations during the experimental period (Table 5).

The correlation between water parameters and growth performance was assessed using the non-parametric Spearman Rho's Correlation at the 0.05 significance level (Alpha=0.05) (Table 6). This shows that there is a negative correlation between weight gained and Dissolve Oxygen concentration in water between all the treatments during the experiment which is indirectly proportional. It shows that as the fish are increasing in weight, there is a significant drop in Dissolve Oxygen concentration from the initial week to the last week while the other water quality parameters did not vary significantly with weight gained.

R is the Rho's correlation; P is the 95% confidence level; pH W is the water acidity of the various weeks; TempW is the temperature at the various week; DOW is the Dissolve Oxygen value within the various weeks; ECW is the Electrical Conductivity Value within the weeks; TDSW is the Total Dissolved Solids within the weeks; SalW is the Salinity values at the various weeks.

Case Summaries						
	Dissolve Oxygen for Various Treatments					KW (P-Value)
Weeks	Control	Treatment 1	Treatment 2	Treatment 3	Treatment 4	
W0	3.582 ± 0.148	3.273 ± 0.429	3.677 ± 0.341	4.383 ± 0.184	4.400 ± 0.207	χ^2=13.312 P=0.010
W1	3.997 ± 0.382	3.928 ± 0.281	3.728 ± 0.163	4.288 ± 0.395	4.058 ± 0.319	χ^2=1.108 P=0.893
W2	3.365 ± 0.60	3.875 ± 0.377	4.082 ± 0.331	4.058 ± 0.344	4.190 ± 0.397	χ^2=2.626 P=0.622
W3	3.368 ± 0.164	2.808 ± 0.221	3.420 ± 0.181	3.852 ± 0.212	3.705 ± 0.158	χ^2=11.611 P=0.020
W4	2.560 ± 0.156	2.055 ± 0.209	2.385 ± 0.277	2.952 ± 0.406	3.555 ± 0.150	χ^2=12.26 P=0.015
W5	3.382 ± 0.273	2.753 ± 0.246	3.068 ± 0.375	4.097 ± 0.330	4.285 ± 0.103	χ^2=14.77 P=0.005
W6	3.097 ± 0.335	2.797 ± 0.387	3.210 ± 0.497	4.035 ± 0.395	4.757 ± 0.161	χ^2=13.05 P=0.011
W7	2.722 ± 0.287	2.568 ± 0.299	3.093 ± 0.501	2.838 ± 0.280	3.220 ± 0.390	χ^2=2.262 P=0.688
W8	3.163 ± 0.067	3.163 ± 0.316	3.060 ± 0.074	2.623 ± 0.113	3.033 ± 0.280	χ^2=4.903 P=0.297

Table 3: Weekly dissolve oxygen for various treatments.

	Electrical Conductivity for various Treatments					KW (P-Value)
Weeks	Control	Treatment 1	Treatment 2	Treatment 3	Treatment 4	
W0	0.345 ± 0.10	0.337 ± 0.009	0.320 ± 0.003	0.335 ± 0.003	0.313 ± 0.004	χ^2=13.163 P=0.011
W1	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	χ^2=0.000 P=1.000
W2	0.350 ± 0.022	0.350 ± 0.022	0.350 ± 0.022	0.367 ± 0.033	0.350 ± 0.022	χ^2 =0.125 P=0.998
W3	0.350 ± 0.022	0.350 ± 0.022	0.350 ± 0.022	0.350 ± 0.022	0.317 ± 0.017	χ^2=2.100 P=0.717
W4	0.383 ± 0.017	0.383 ± 0.017	0.333 ± 0.021	0.383 ± 0.017	0.350 ± 0.022	χ^2=5.800 P=0.215
W5	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 000	0.250 ± 0.22	χ^2=12.889 P=0.012
W6	0.283 ± 0.017	0.283 ± 0.017	0.283 ± 0.017	0.250 ± 0.022	0.250 ± 0.022	χ^2=3.683 P=0.451
W7	0.283 ± 0.017	0.283 ± 0.017	0.283 ± 0.017	0.283 ± 0.017	0.267 ± 0.021	χ^2=0.806 P=0.938
W8	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	0.300 ± 0.000	χ^2=0.000 P=1.000

Table 4: Electrical conductivity for various treatments.

Case Summaries						
Weeks	Total Dissolved Solids for Various Treatments					KW (P-Value)
	Control	Treatment 1	Treatment 2	Treatment 3	Treatment 4	
W0	0.228 ± 0.007	0.225 ± 0.006	0.210 ± 0.003	0.223 ± 0.003	0.207 ± 0.002	χ^2=13.055 P=0.011
W1	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	χ^2=0.000 P=1.000
W2	0.235 ± 0.016	0.235 ± 0.016	0.235 ± 0.016	0.247 ± 0.023	0.235 ± 0.016	χ^2=0.125 P=0.998
W3	0.235 ± 0.016	0.235 ± 0.016	0.235 ± 0.016	0.235 ± 0.016	0.228 ± 0.018	χ^2=0.126 P=0.998
W4	0.258 ± 0.012	0.2583 ± 0.012	0.223 ± 0.015	0.258 ± 0.012	0.235 ± 0.016	χ^2=5.800 P=0.215
W5	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	0.165 ± 0.016	χ^2=12.889 P=0.012
W6	0.188 ± 0.012	0.188 ± 0.012	0.188 ± 0.012	0.165 ± 0.016	0.165 ± 0.016	χ^2=3.683 P=0.451
W7	0.188 ± 0.012	0.188 ± 0.012	0.188 ± 0.012	0.188 ± 0.012	0.177 ± 0.015	χ^2=0.806 P=0.938
W8	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	0.200 ± 0.000	χ^2=0.000 P=1.000

Table 5: Total dissolved solids for various treatments.

Dependent (Weight gain)	pHW	TempW	DOW	ECW	TDSW	SalW
R	1.000	0.100	0.600**	-0.400*	-0.400*	-0.400*
P-Value	0.000	0.599	0.000	0.029	0.029	0.029
R	-0.872**	-0.205	-0.400	0.354	0.354	0.354
P-Value	0.001	0.570	0.252	0.316	0.316	0.316
R	0.300	0.564**	-0.800**	0.000	0.000	0.000
P-Value	0.107	0.001	0.000	1.000	1.000	1.000
R	0.100	-0.975**	0.100	-0.447*	-0.447*	0.100
P-Value	0.599	0.000	0.599	0.013	0.013	0.599
R	-0.667**	0.224	-0.600**	0.000	0.000	0.000
P-Value	0.000	0.235	0.000	1.000	1.000	1.000
R	-0.700**	-0.821**	-0.700**	0.866**	0.866**	0.866**
P-Value	0.000	0.000	0.000	0.000	0.000	0.000
R	-0.700**	-0.400*	-0.300	0.707**	0.707**	0.707**
P-Value	0.000	0.029	0.107	0.000	0.000	0.000
R	-0.600**	-0.564**	-0.051	0.000	0.000	0.000
P-Value	0.000	0.001	0.788	0.000	0.000	0.000

Table 6: Correlation test.

Discussion

The water quality parameters were similar to those reported by Sogbesan et al. [12]; Amisah et al. [13] and Eyo et al. [14]. There was a significant difference ($p<0.05$) within weeks for pH except for week 1, while the temperature had no significant difference ($p>0.05$) within weeks [15,16]. Also there was a significant difference ($p<0.05$) for dissolve Oxygen levels within weeks except for weeks 1,2,7 and 8 while the electrical conductivity, total dissolved solids and salinity had no significant difference ($p>0.05$)for weeks 2,3,4,6 and 7 within weeks while all the water quality parameters remained fairly non-significant between treatments throughout the experimental period. The reason for the significance of pH at week 1 can be due to the fact that at the beginning of the experiment, there was little or no dissolved feed materials and faeces in the plastic tanks which can cause a rise in pH. Also the Spearman rho's test gave a negative correlation between dissolve oxygen and weight gained and this was merely due to the fact that as the fish increases in size and in age, their activity and metabolism increases thereby increasing the demand for dissolve oxygen in the plastic tanks; but in the context of this study, water replacement and supply of oxygen in the tanks was constant in all the treatments as the weights in the various treatments was increasing thus causing a negative correlation between the dissolved oxygen concentration and weight gained.

Conclusion

All water quality parameters remained fairly non-significantly different within weeks and between treatments except for the fact that the Spearman rho's test gave a negative correlation between dissolve oxygen and weight gained thus making dissolve oxygen to have a significant effect with the weight gained. This was merely due to the fact that as the fish increases in size and in age, their activity and metabolism increases thereby increasing the demand for dissolve oxygen in the plastic tanks while oxygen supply remained constant thus it will be always important to increase the dissolve oxygen supply as weight gained increases.

References

1. Marimuthu KA, Muralikrishnanm S (2010) Effect of different-feeding frequency on the growth and survival of African catfish (*Clarias Gariepinus*) fingerlings. Advances in Environmental Biology 4: 187-193.
2. Olukunle AO, Ogunsanmi AO, Taiwo VO, Samuel AA (2002) The nutritional value of Cow blood on the growth performance, haemathology and plasma enzymes of hybrid cat fish. Nigerian Journal of Animal Science 5: 75-85.

3. Ugwumba AAA, Ugwumba AAO (2003) Aquaculture options and the future of fish supply in Africa. The Zoologist 2: 96-122.

4. De Graaf G, Janssen H (1996) Handbook on artificial reproduction and pond rearing of African cat fish Claris gariepinus in sub-saharan Africa. FAO Fisheries Technical Paper No.362. Rome. pp: 73.

5. Bruton MN (1988) Systematics and biology of clariid catfish. In: Hecht T, Uys W, Britz P (eds.) The culture of sharptooth catfish, Clarias gariepinus in southern Africa. South African National Scientific Programmes Report, No. 153. CSIR, Pretoria, South Africa.

6. Pouomogne V (2008) Capture-based aquaculture of Clarias catfish: case study of the Santchou fishers in western Cameroon. In: Lovatelli A, Holthus PF (eds.) Capture-based aquaculture. Global overview. FAO Fisheries Technical Paper. No. 508. Rome. pp: 93-108.

7. Pedini M (1997) Regional Reviews: Africa. In: FAO Fisheries Circular, No. 886 FIRI/C886. FAO Inland Water Resources and Aquaculture Service. Fishery Resources Division. Rome: Food and Agriculture Organization of the United Nations.

8. Diyaware MY, Modu BM, Yakubu UP (2009) Effect of different dietary protein levels on the growth performance and feed utilization of hybrid catfish (*Heterobranchus bidorsalis* x *Clarias anguillaris*) fry in North-east Nigeria. African Journal of Biotechnology 8: 3954-3957.

9. El-Saidy DMSD (2011) Effect of using Okara meal, a by-product from soymilk production as a dietary protein source for Nile tilapia (*Oreochromis niloticus L.*) mono-sex males. Journal of Aquaculture Nutrition 17: 380-386.

10. Kumar V, Akinleye AO, Makkar HPS, Angulo-Escalante MA, Becker K (2010) Growth performance and metabolic efficiency in Nile tilapia (*Oreochromis niloticus L.*) fed on a diet containing Jatropha platyphylla kernel meal as a protein source. J Anim Physiol Anim Nutr (Berl) 96: 37-46.

11. Tram NDQ, Ngoan LD, Hung LT, Lindberg JE (2010) A comparative study on the apparent digestibility of selected in hybrid catfish (*Clarias macrocephalus* x *Clarias gariepinus*) and Nile tilapia (Oreochromis niloticus). Aquaculture nutrition 17: 636-643.

12. Sogbesan OA, Ugwumba AAA, Madu CT (2006) Nutritive potentials and utilization of garden snail (*Limicolaria aurora*) meat meal in the diet of Clarias gariepinus fingerlings. African Journal of Biotechnology 5: 1999-2003.

13. Amisah S, Oteng MA, Ofori JK (2009) Growth and performance of the African cat fish, Clarias gariepinus fed varying inclusion level of Leucaena leucocephata leaf meal. J Appl Sci Environ Manag 13: 21-26.

14. Eyo AA, Falayi BA, Adetunji OM (2004) Response of genetically improved Heterobranchus Longifilles juveniles to different diets containing beans meal and extrude soya beans meal. J Appl Sci Environ Manag 8: 29-33.

15. El-Sayed AFM (2004) Protein nutrition of farmed tilapia: searching for unconventional sources. In: Bolivar RB, Mair GC, Fitzsimmons K (eds.) New Dimensions on Farmed Tilapia Proceedings of the Sixth International Symposium on Tilapia in Aquaculture. Philippines. pp: 12-16.

16. Pouomogne V (2007) Analysis of feeds and fertilizers for sustainable aquaculture development in Cameroon: FAO Fisheries Technical Paper. No. 497. Rome. pp: 381-399.

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