Direct Research Journal of Public Health and Environmental Technology
Vol.3 (1), pp. 9-16, January 2018
ISSN 4372-2603
DOI: https://doi.org/10.26765/DRJPHET.2018.1753
Article Number: DRJA724191753

Direct Research Journal of Public Health and Environmental Technology (DRJPHET)
http://directresearchpublisher.org/aboutjournal/drjphet/

Research Paper

The effect of rice bran and fish meal on heteroclarias and tilapia niloticus

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Received 10 December 2017; Accepted 8 January, 2018

A Feeding trial was conducted to assess the growth performance of *Heteroclarias* and *Clarias gariepinus* in a Polyculture with *Tilapia niloticus* fed twice daily, seven times a week on rice bran and fish meal containing 28% crude protein, 8% crude fat, 1.6 % crude fibre, 4.5% moisture and 6.2% ash at 3% bodyweight. The experiment lasted for a period of 12 weeks. Rice bran and Fish meal were used per feeding time for each of the species to assess their performance. The response to the feed and the species were compared. *Heteroclarias* performed better in terms of growth rate than *Clarias gariepinus*, while Polyculture of hybrid (*Heteroclarias*) with *Tilapia niloticus* performed better compared to the Polyculture of *Clarias gariepinus* with *Tilapia.*

Keywords: *Heteroclarias* and *Clarias gariepinus*, growth response, nutrient utilization

INTRODUCTION

A fish is any member of a paraphyletic group of organisms that consists of all gill bearing aquatic craniate animals that lack limbs with digits. Included in this definition are the living hagfish, lampreys and cartilaginous and bony fishes as well as various extinct related groups. Most fishes are ectothermic (cold-blooded),allowing their body temperatures to vary as ambient temperatures change, though some of the large active swimmers like the tuna and white shark can hold a higher core temperature (Popma and Masser, 1999). Fish are abundant in most bodies of water, they can be found in nearly all aquatic environments from high mountain streams (e.g. char and gudgeon) to the abyssal and even hadal depths of the deepest oceans (e.g. gulpers and angler fish). With 33,100 described species, fishes exhibit greater species diversity than any other group of vertebrates.

Fish is a vital source of high quality protein, providing approximately 16 percentage of the animal protein consumed by the world's population (FAO, 1997). Fish supplies less than 10 percent of animal protein consumed in the North American and Europe, but 17 percent in Africa, 26 percent in Asia and 22 percent in China (FAO, 2000).There is high demand for fish in Nigeria either as fresh, frozen or smoke dried throughout the year and this confers high economic value on fish. Fish and fish products provide as much as 17-63% protein intake of the large Nigerian populace (Abdullahi, 2001). This means that any shortfall in fish availability will affect the animal protein intake of the Nigerian populace.

Fish culture production in Nigeria includes stocking of lakes and production in ponds, cages and tanks (Ita, 1985). Ponds culture is the most prevalent (Akinwole and Faturoti, 2006). Virtually all aspect of pond culture of African catfish *Clarias gariepinus, Heteroclarias* and *Tilapia niloticus* in Nigeria has been developed and documented to ensure profitable production of the species. The appreciable quantity of water and large expense of land required for pond culture has however limited the expansion of fish (such as *Clarias gariepinus), Heteroclarias, heterobranchus*and *Tilapia niloticus)* cultured in Nigeria (Akinwole and Faturoti, 2006).

The African catfish (*Clarias gariepinus*), *Heteroclarias* and *Tilapia niloticus* are choice food specie in Nigeria.

They command high demand from consumers and are mostly preferred by A*qua culturists*. This is due to the ideal characteristic of this species (Eding and Kamsta, 2001) which includes high growth rate at high stocking densities, a high food conversion, good meat quality and smoking characteristic as well as years round production (Ita, 1985).

The major preliminary condition in setting up a polyculture system is to identify an ideal stocking ratio which takes into consideration the intensity of specie interaction and the utilization of different ecological stratas and a better valorization of the renewable resources of the water body.

Tilapia niloticus and the African catfish (*Clarias gariepinus*) are good water fishes for warm-water aquaculture. They are easily spawned, uses a wide variety of natural food as well as formulated feeds, tolerate poor water quality and grow rapidly at warm temperatures (Fasakin et al., 2005). These attributes along with relatively low input costs have made *tilapia niloticus* and *clarias gariepinus* the most widely cultured fresh fish in tropical and sub tropical countries (Fasakin et al., 2005).

The African catfish (*Clarias gariepinus*), *Heteroclarias* and *Tilapia niloticus* are choice food specie in Nigeria. They command high demand from consumers and are mostly preferred by Aqua culturists. This is due to the ideal characteristic as well as years round production (Ita, 1985). The major preliminary condition in setting up a Polyculture system is to identify an ideal stocking ratio which takes into consideration the intensity of specie interaction and the utilization of different ecological stratas and a better valorization of the renewable resources of the water body.

Dada and Olarewaju, (1995) found that the best growth performance and food utilization parameters for mud fish attained at 40% crude protein level when the fishes were fed with different levels of protein.

Utene, (1978) summarized the gross protein requirements of *Clarias gariepinus* as fingerlings to juvenile require 37.5% protein and fingerlings to Adult require 35.5% protein while Bedawi, (1985) reported that there is a wide array of food and feed stuff that are suitable for fish feeding and their quality is primarily assessed on their nutrients composition such as protein level. The aim of this study is to determine the growth performance of *Heteroclarias* and *Clarias gariepinus* in a Polyculture with *Tilapia niloticus* fed twice daily.

MATERIALS AND METHODS

Study area

The comparison of the growth performance between *Heteroclarias* and *Tilapia* was carried out at the biological garden of the faculty of science, University of Abuja, Federal Capital Territory, Gwagwalada-Abuja, Nigeria. Gwagwalada is one of the six municipal councils of the Federal Capital Territory of Nigeria, together with Abaji, Kuje, Bwari, Kwali and Abuja municipal councils (AMAC), the FCT also includes the city of Abuja. Gwagwalada is also the name of the main town the Area Council which has an area of 1,043 km^2 and a population of 157,770 (2006 census). Gwagwalada is where the University of Abuja is located on a latitude 9.06 N and longitude 7.49 E in a guinea savannah region, at a height of 536 m above sea level. The climate is marked by dry season of 5 month from December to April with temperature range of 24.6°C (minimum) and 38°C (maximum). The rainfall in Abuja is 1400-1600 mm which last for 6 months (i.e May to October each year).

Sample collection

Fingerlings of *Clarias gariepinus*, *Heteroclarias* and *Tilapia niloticus* were obtained from a private farm along kuje road, Gwagwalada, Abuja, Nigeria. The fishes were kept in a rearing pond to allow them to recover from the transportation stress and to acclimatize to their new environment. This goes to ensure there were no infections from source and also to select their sizes of fish to be cultured together. They were kept between ten (10) weeks to eleven (11) weeks. During this period the fishes were fed with plant protein (Rice bran) as supplementary feed.

Aquarium and treatments

Four big bowls each having a dimensions of 1.165 cm^2 was used in the experiments under laboratory condition. There were four (4) treatments namely Bowl A stocked with 15 *Heteroclarias*, Bowl B was stocked with 15 *Clarias gariepinus*, Bowl C had 15 *Heteroclarias* and 15 *Tilapia niloticus* while Bowl D had 15 *Clarias gariepinus* and 15 *Tilapia niloticus.*

No prophylactic treatment was given before acclimation. The fishes were starved for 24 hours so as to empty their gut content. This practice also helps to make the fish hungry. Before stocking, the initial total length (cm) and mean weights was recorded. The bowls were covered with mosquito net to prevent fingerlings from jumping out, inclusion of insects and other forging bodies (Lizards and geckos). De-chlorinated water was used throughout the experiments. Each of the cultured treatment was fed on 3% body weight of rice bran/fish meal of their total body based on the recommendation of Viveen et al. (1986). The daily ration was divided into two, one portion was fed in the morning at (8- 9 am) and the second portion in the evening at (5 – 6 pm). Feeds were dispensed evenly on the water surface in each pond to allow equal opportunity for feeding. Feeding in all ponds was generally completed between 10–15 min. On weighing days (once a week) the fishes were starved. Samplings for weight and length measurements were done using a scoop net. Fish weighs (g) were taking using a top loading balance. The fingerlings were weighed in groups once a week. The standard length of the fish was taken to the nearest cm with the aid of a measuring board (measuring ruler). Feeding rate was recalculated for increments of growth changes. The feeding trials lasted for 10 weeks. Depleted water was replaced with fresh water to a depth of 20 cm after each cleaning.

Determination of water quality parameters (physiochemical parameters)

Both surface and atmospheric temperatures were read to the nearest °C with a Mercury in-glass thermometer. Dissolved oxygen was determined with a spectrophotometer, using the phenothydrochorite method (Sastry et al., 1969). Ammonia and nitrite were determined by using urine analysis strip. pH was determined by using a digital pH meter.

RESULTS AND DISCUSSION

The result of comparison of growth performance between *Heteroclarias* with *Tilapia niloticus* were presented in (Table 1, 2, 3, 4, 5 and 6), while their physiochemical parameters were presented in (Table 6). Atmospheric temperature throughout the study varied between the ranges of 24°C and 27°C, with the highest water temperature occurring in the eight week of the experiment. Treatment A recorded the highest concentration of dissolved oxygen for all treatments 7.1mg/l while the lowest reading which ranged between 5.4mg/l to 4.7 mg/l were obtained for treatment A between the tenth to twelveth week of the study period. pH values in all four treatments had more or less similar readings between 7.3 and 8.2 (Table 6).

Values of the measurement of various production parameters showed that treatment A had the highest weight gain which are 0.58g – 0.90g, Specific Growth Rate 0.58cm – 2.43cm, Mean Growth Rate had 0.43cm – 4.82cm, Percentage Weight Gain 7.82 – 43.21 and Food Conversion Efficiency 1.14 – 6.31. The lowest values were obtained in treatment D.

At the end of the study period, treatment A also had the highest survival rate (75%) compared to (53.3%), (53.3%) and (50%) recorded in treatment B, C and D respectively. Ammonia concentration throughout the study period also had more or less similar readings for all treatments which ranged between 0.01 mg/l and 1.2 mg/l (Table 6). Nitrite concentrations are equally more or less similar in all treatments which ranged between 0.01 mg/l and 0.6 mg/l (Table 6). Table 1 shows the overall mean body weight of Heteroclarias after 12 weeks of study was 6.9 g, overall mean length was 7.51 cm, SGR = 0.93, MGR = 1.23, FCE = 2.43, %WG = 14.57, SR= 89.58. Table 2 shows the overall mean body weight of Heteroclarias after 12 weeks of study was 5.4 g, overall mean length was 6.33 cm, SGR = 0.73, MGR = 1.12, FCE = 2.12, %WG = 13.25, SR= 74.35

Table 3 shows the overall mean body weight of *Heteroclarias* and *tilapia* was 6.7g and 3.1g respectively, length weight of *Heteroclarias* and *tilapia* was 6.12 cm and 6.32 cm, SGR of *Heteroclarias* and *tilapia* was 0.86 and 0.62 respectively, MGR of *Heteroclarias* and *tilapia* was 1.20 and 1.18 respectively, RWG of *Heteroclarias* and *tilapia* was 2.11 and 2.08 respectively, FCE of *Heteroclarias* and *tilapia* was 2.31 and 2.14 respectively, % WG of *Heteroclarias* and *tilapia* was 13.82 and 12.82 respectively and SR of *Heteroclarias* and *tilapia* was 72.15 and 67.19 respectively.

Table 4 shows, the overall mean body weight of *clarias*and *tilapia* was 4.1g and 5.2g respectively, length weight of *clarias* and *tilapia* was 6.12 cm and 6.12 cm, SGR of *clarias* and *tilapia* was 0.58 and 0.61 respectively, MGR of *clarias and tilapia* was 1.12 and 1.10 respectively, RWG of *clarias* and *tilapia* 2.02 and 2.84 respectively, FCE of *Heteroclarias* and *tilapia* was 2.12 and 2.12 respectively, % WG of *clarias* and *tilapia* was 12.61 and 13.1 respectively and SR of *clarias* and *tilapia* was 68.1 and 72.81 respectively.

Table 5 and Figure 1 show treatment A had the highest growth performance and feed utilization in all treatment followed by treatment B, C and D respectively. The results of the comparison of the growth performance between *Heteroclarias*, *Clarias* and *Tilapia* fed 28% crude protein diet revealed that the fishes were able to utilize the diet effectively. The hybrid had the highest growth and feed utilization in all treatment followed by *Clarias gariepinus* and lastly the *Tilapia niloticus.* This results is in line with the work of Madu et al. (1991, 1992). Salami and Fagbenro, (1993) observed that hybrids in most cases were superior to their parental line in terms of growth, food conversion and diseases resistance.

The result is also in line with the report of Okoye et al. (2000) that the growth performance of pure strain of *clarias gariepinus*, hybrids of *Heterobranchus longfilis* and *Clariasgariepinus* (*Heteroclarias*) in polyculture with *Oreochromis niloticus*, was that the hybrid catfish (*Heteroclarias*) had the fastest growth rate and showed a better conversion of feed into fish than the pure *Clarias gariepinus.* However, the results are contrary to the work of Basavaraju and Varghese, (1980) who reported that the parental species of *Labeorehita* (female) and *Cirrhinusmrigala* (male) grew faster than the hybrids. Alikunhi et al. (1991) made similar observation and reported that the aggressive behavior of the *clarid* catfish was the highest in the hybrids catfish. Hogendoom and Koops, (1983) reported that hybrids (Common *carp* and

Table 1. The mean values for treatment A (*HETEROCLARIAS)*

Parameters	Total	Mean values
Weight (g)	82.8	6.9
Weight gain (g)	22.32	1.86
Length	90.2	7.51
Length gain (cm)	20.76	1.73
Specific growth rate (SGR)l	11.16	1.08
Mean growth rate (MGR)	14.76	1.23
Relative weight gain (RWG)	45.0	3.75
Food conversion efficiency	29.16	2.43
% Weight gain	174.84	14.57
Survival rate (%)	1074.96	89.58

Total = total values recorded for the study period
Mean values = Average mean for the study period

Table 2: The mean values for treatment B (*CLARIAS).*

Parameters	Total	Mean values
Weight (g)	64.8	5.4
Weight gain (g)	17.16	1.43
Length	75.96	6.33
Length gain (cm)	4.56	1.38
Specific growth rate (SGR)	8.76	0.76
Mean growth rate (MGR)	13.44	1.12
Relative weight gain (RWG)	34.32	2.86
Food conversion efficiency	25.44	2.12
% Weight gain	159	13.25
Survival rate (%)	892.2	74.35

Total = total values recorded for the study period
Mean values = Average mean for the study period

Table 3. The mean values for treatment C (HETERO*CLARIAS* and *TILAPIA).*

Parameters	Total (h)	Mean Values (h)	Total (t)	Mean Values (t)	Mean Values
Weight (g)	80.4	6.7	37.2	3.1	4.9
Weight gain (g)	20.64	1.72	5.04	0.42	1.07
Length	73.44	6.12	75.84	6.32	6.22
Length gain (cm)	19.44	1.62	6.48	0.54	0.93
Specific growth rate (SGR)	10.32	0.86	7.44	0.62	0.74
Mean growth rate (MGR)	14.4	1.20	14.16	1.22	1.14
Relative weight gain (RWG)	25.32	2.11	24.96	2.08	2.01
Food conversion efficiency	27.72	2.31	25.68	2.14	2.22
% Weight gain	165.84	13.82	153.84	12.82	13.32
Survival rate (%)	865.8	72.15	806.28	67.19	69.67

Total (h) = total values recorded in *Heteroclarias* for the study period
Mean values (h) = Average mean in *Heteroclarias* for the study period
Total (t) = total values recorded in *tilapia* for the study period
Mean values (t) = Average mean in *tilapia* for the study period
Mean values = Total mean values for the study period

Catla) attained an average weight of 21.0g in Polyculture with other carp species and 71g under monoculture system. Physiochemical parameters like pH, dissolved oxygen, atmospheric temperature and water temperature are normal ranged from and therefore had no significant effect on growth (Table 5 and Figure 2). For catfish the use of the atmospheric air for respiration is an added advantage and is ideal for high stocking density because it tolerates anoxic water (Hogendoom, 1989). It is known fact that catfish can live in poorly oxygenated waters. Temperature is a vital parameter for growth which ranged from 23 to 28°C and Degani et al. (1998) confirmed 27°C

Table 4. The mean values for treatment D (*CLARIAS* and *TILAPIA).*

Parameters	Total (c)	Mean Values (c)	Total (t)	Mean Values (t)	Mean Values
Weight (g)	49.2	4.1	62.4	5.2	4.65
Weight gain (g)	5.4	0.45	4.8	1.40	0.92
Length	73.44	6.12	73.44	6.12	6.12
Length gain (cm)	6.24	0.52	7.32	0.40	0.46
Specific growth rate (SGR)	6.96	0.58	13.2	0.61	0.59
Mean growth rate (MGR)	13.44	1.12	13.08	1.10	1.11
Relative weight gain (RWG)	24.24	2.02	25.44	2.84	2.43
Food conversion efficiency	25.44	2.12	25.44	2.12	2.12
% Weight gain	151.32	12.61	157.2	13.1	12.85
Survival rate (%)	817.2	68.1	873.72	72.81	70.45

Total (c) = total values recorded in *clarias* for the study period
Mean values (c) = Average mean in *clarias* for the study period
Total (t) = total values recorded in *tilapia* for the study period
Mean values (t) = Average mean in *tilapia* for the study period
Mean values = Total mean values for the study period

Table 5. The mean values for the four different treatments (A, B, C and D)

Parameter	TRTA	TRTB	TRTC	TRTD
Weight (g)	82.8	64.8	58.8	55.8
Mean Weight (g)	6.9	5.4	4.9	4.65
Length (cm)	90.2	75.96	74.64	73.44
Mean Length (cm)	7.51	6.33	6.22	6.12
Specific Growth Rate (Sgr)	11.16	8.76	8.70	10.08
Mean Growth Rate (Mgr)	14.76	13.44	14.28	13.12
Relative Weight Gain	45.0	34.32	25.14	24.84
Food Conversion Efficiency	29.16	25.44	26.7	25.41
Percentage weight gain	14.57	13.25	12.32	12.85
Survival Rate	89.58	74.35	69.67	70.45

TRT A = *Heteroclarias*
TRT B = *Clariasgariepinus*
TRT C = *Heteroclarias* and *Tilapia*
TRT D = *Tilapia* and *clarias*

Table 6. The physiochemical parameters for the different treatments (A, B, C and D).

Parameter	TRTA	TRTB	TRTC	TRTD
Atmospheric temperature (°C)	27.03	24.96	26.03	27.1
Water temperature (°C)	24.3	25.5	26.12	26.12
pH	7.4	7.6	7.5	7.54
Dissolved Oxygen	5.3	5.8	5.2	5.1
Ammonia (mg/l)	0.34	0.30	0.77	0.79
Nitrite (mg/l)	0.02	0.02	0.02	0.03

as the ideal temperature for growth. Although the higher the temperature, the better the specific growth rate, which is affected by body weight (Hongendoom and Koops 1993).

Throughout the production cycle, the nitrite level never reached significant level that could affect fish growth. The readings ranged between 0.01 mg/l and 0.05 mg/l, with treatment A having the lowest value of 0.01 mg/l while the highest value occurred in treatment C. High nitrite levels are dependent on nitrifying bacteria, which are generally slow growers. Nitrite levels greater than 0.06 mg/l are considered toxic for the culturing of catfishes are recommended by the Federal Ministry of Environment, 2006.

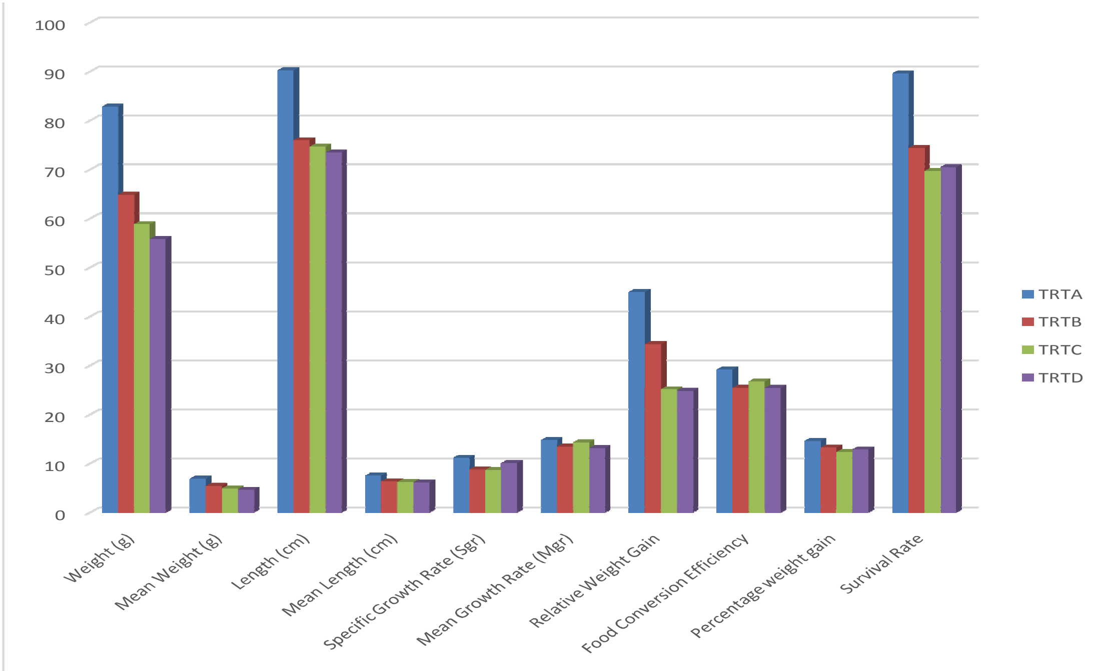

Figure 1. The comparison of the growth comparison and feed utilization in the different treatments.

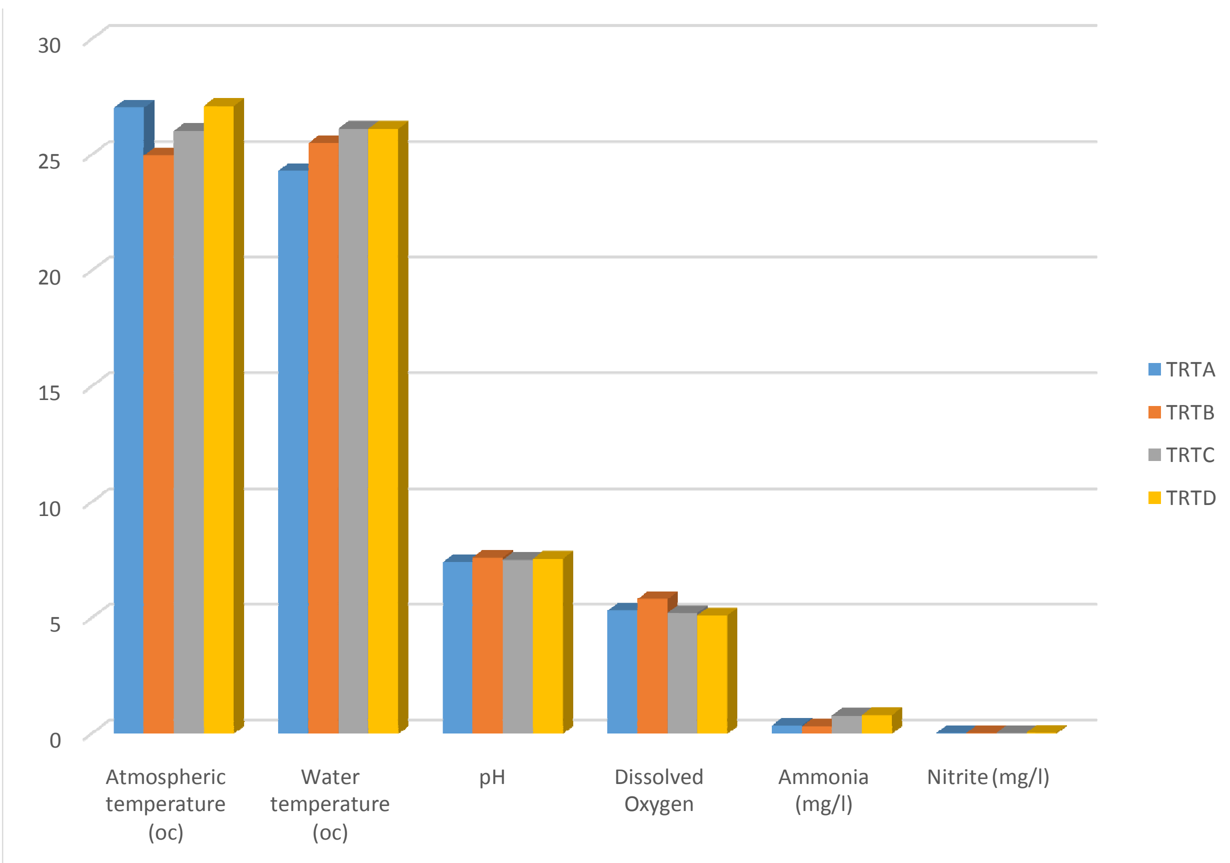

Figure 2. The mean variation of different physiochemical parameters of the different treatments.

Ammonia concentration throughout the study period for the four (4) treatments prevailed at 0.01mg/l to 1.4mg/l (Table 6). The highest level was recorded in treatment C (1.4mg/l). High concentration of ammonia occurred towards the end of the production cycles which could be attributed to increase in biomass. Although the concentration were within the tolerable range and the result agreed with Eding and Kamstra, (2001) which stated that values less than 8.8 mg/l are considered tolerable for the culturing of catfishes.

The survival rate of HxC hybrids was low in all stocking ratios. This is common in low and high Polyculture densities are reported by Eding and Kamstra. It was observed that hybrids exhibited a high degree of cannibalism and a resulting high individual growth rate with a corresponding low production (yield) due to high mortality rate. This could be explained by the fact that catfishes feed on one another. *Tilapia* yield decreased due to the presence of hybrid which led to competition for food (Lazerd, 1990). *Tilapia niloticus* uncontrolled high production ratio gives excessive recruitment and resulting low yields of harvestable size *Tilapia* from cultured pond (Guerrero, 1992).

At the beginning of the experiment concentration of oxygen were initially being higher but gradually reduced as the growth of fingerlings were achieved especially in treatment C. Dissolved oxygen fell as low as 3.4mg/l and this could be considered frequently below the optimum level for good growth of catfish (Akinwole and Faturoti, 2006). These low levels were attained as a result of metabolism of fish and bacteria decaying organic material such as underutilized feed were the major contributors to these demands. As stated by Brown (1957), the survival of catfishes is not dependent upon oxygen in the water since it is obtains energy by gulping air.

Values of the measurement of various production parameters in the four different treatment showed that the final weight gain of treatment A (0.71 g exceeded that of treatment B 0.69g) and also that of treatment C (0.54 g) exceeded that of treatment D (0.34 g).

Also the length gain of treatment A (0.86 cm) exceeded that of treatment C (0.69 cm) while the final length gain of treatment C (0.61cm) exceeded that of treatment D (0.47cm). The disparity in both the final weight gain and final length gain for the four treatments could be related to the fact that the fewer the fish, the more supplementary feed space and reduced competition among fish in the bowl.

Teng and Chin, (1988) among others have demonstrated that survival rate decreases and stocking density increases. The principle is also demonstrated to hold in this study. Percentage survival rate was higher in treatment A than in other treatment. The highest mortalities was recorded in treatment C and D and may be as a result of handling after the weekly sampling. This may mean that the fish in treatment C and D are most probably under stress than those in treatment A and treatment B.

Conclusion

Heteroclarias grow better than *Clarias gariepinus* in a polyculture system with *Tilapia niloticus* and is in line with the work of Okoye et al. (2000) that the growth performance of pure strain of *Clarias gariepinus*, hybrids of *Heterobranchus longfili* and *Clarias gariepinus* (*Heteroclarias*) in Polyculture with *Oreochromis niloticus*, was that the hybrid catfish (*Heteroclarias*) had the fastest growth rate and showed better conversion of feed into fish than the pure *Clarias gariepinus.* Findings in the study further prove the hardy nature of the hybrid (*Heteroclarias*) over *Clarias gariepinus* in terms of ability to withstand water quality, stress, disease resistance and survival at the same stocking density when reared in recirculating system. The pond culture of the hybrid (*Heteroclarias*) in Nigeria has the potential for economic success provided the problems of water quality and disease can be adequately contained. Regular monitoring of water quality parameters will make possible an evaluation of current pond management practices and will draw attention to deteriorating water quality and the need for corrective measures to be taken.

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