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# INFLUENCE OF TANKS LINER MATERIAL ON WATER QUALITY AND GROWTH OF *CLARIAS GARIEPINUS*

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## ABSTRACT
*Three tank liner materials: polyvinylchloride (PVC), polyethylene and polyester were evaluated in a 93 days experiment for their influence on culture water quality and growth performance of Clarias gariepinus. Fish of average weight of 5.03±0.21g were stocked at 375 per m$^3$ in tanks lined with the aforementioned materials. Fish were hand fed twice a day. Growth performance and water quality parameters were measured using standard methods. Average temperature of 25.09±1.14$^O$C was recorded in the tanks. Dissolved oxygen with the highest mean value of 5.41±0.96 mg/l was recorded in polyethylene lined tanks while the highest mean alkalinity value of 110.38±2043mg/l was obtained in polyester lined tank .Fish cultured in PVC lined tanks recorded the highest mean daily growth rate of 4.87±3.87g while polyester lined tanks recorded the lowest mean value of daily growth rate of 2.95±2.08g. Highest mean food conversion ratio was recorded in PVC lined tanks with the value of 1.59±0.70. Highest mean weight of 22.59±1.56g was obtained in PVC lined tanks while the least mean weight of 15.41±1,11g was obtained in polyethylene lined tanks. Fish cultured in PVC lined tanks had better growth performance when compared to other tanks liner materials. It would be beneficial with respect to fish growth and culture water quality, to use polyvinylchloride materials in lining fish culture ponds and rearing tanks.*

Keywords : Aquaculture, Liners, Fish Farming, Tank, *Clarias gariepinu*s

## INTRODUCTION
Nigeria has large natural resources to support aquaculture development: inland freshwater of 14 million hectares and available land area of 1.7 million hectares for aquaculture development (FDF ,2005).Constraints to increased fish production in Nigeria include poor infrastructures, high level of rural poverty, environmental pollution, climate change effects and degradation of coastal areas through human action (e.g. sand filling that destroys breeding grounds) (FDF, 2007).Fishing and fish farming provides employment for up to ten million people in Africa and provides a vital source of protein to 200 million people .In the light of current government efforts to accelerate the growth of aquaculture, there is the need to focus on urban cities where a sizable number of educated population resides .A sizable body of research conducted principally under the IDRC funded research initiatives on 'Cities Feeding People' programme confirms the significance of urban and peri-urban agriculture for employment, food security income generation (Smith,1996).One of its main characteristics of urban aquaculture is its integration into the local urban economic and ecological system. Many of the production systems appear to meet the growing needs among urban people for fresh and culturally preferred types of fish. Fish farming in or around cities varies from the relatively small-scale semi extensive culture system to the high-tech, intensive culture of catfish in concrete/plastic tanks. Wide range of production systems have been exploited for culturing fish. These systems include cages, raceways, tanks and ponds. Culture in earthen ponds remains the dominant production system in Nigeria (Susana and Graham, 2006).

Currently, earthen ponds are the dominant production system in Nigeria. With increased urbanization and the attendant increase in fish demand, large expanse of land required for intensive aquaculture in earthen pond is becoming seemingly unavailable in many areas. For Nigeria to make significant contribution in aquaculture at global level and meet her Millennium Development Goals (MDGs) of increasing fish production by over 250% by 2015, efforts need to be geared towards achieving higher production intensities. One way of achieving this is through the encouraging of urban aquaculture system. This system of production makes use of varieties of culture facilities that provide needed environment for the growth of the fish. The use of tanks represents a unique way to farm fish. Instead of the traditional method of growing fish outdoors in open ponds and raceways, this system rears fish at high densities, in indoor tanks with a "controlled" environment (FAO, 2010).Fish rearing tanks are containers serving as housing for the cultured fish. They could be of any shape and range of sizes. The size requirements will depend on several factors like the species, fish size, desired culture density and available space. Tanks can be made of any suitable material that should be easy to manage during production, allow flexible use and be made of non-toxic materials. Tanks can be constructed of plastic, concrete, fiberglass, treated plywood, cement blocks, epoxy coated steel, rubber, plastic sheeting or any other material that will hold water, not corrode, and are not toxic to fish (Akinwole,2011).Framed structures with liner materials that holds fish and water encourage fish farming in virtually any location. This paper report findings of a preliminary investigation into the effect of three different tank liner materials on the water quality and growth of the African catfish, *Clarias gariepinus.*

## METHODOLOGY

Three green coloured liner materials were evaluated in this experiment. These are flexible polyvinyl chloride (PVC), polyethylene (PET) and polyester (PES) materials. The rectangular shaped wooden frames for the tanks were constructed each with dimension (LxBxH) 50.25cm x 31.50cm x 20.50cm using softwood with plywood as base floor. The stability of the tanks depends on strength of the woods and liners materials used. The plywood support the base wood, it served as the intermediary between the base and the liner materials and also protects the liner materials from being punctured by nails or other external objects. Nine tanks were constructed to cater for three replicates each for the three liner materials serving as treatments in the experiment. *Clarias gariepinus* juveniles of average weight 5.03±0.21g were stocked at the rate of 375 fish per $m^3$. Fish were hand-fed to satiation twice a day with 3mm 45% crude protein Coppens® catfish grower floating pellets. The tanks were flushed and washed at time of sampling. Each tank was aerated throughout the culture period of 93 days.

Water samples were collected from the fish tanks in the morning hours before feeding and changing the water of the tanks to monitor dissolved oxygen (DO), pH, temperature, ammonia, alkalinity, nitrite, total dissolved solids and conductivity. As the experiment progressed, the water quality parameters were regularly monitored at nine days interval for the period of thirteen weeks. Temperature was measured with the use of mercury-in-glass thermometer. Dissolved oxygen, pH, conductivity and total dissolved solid (TDS) where measured directly with the use of electronic testing meter. Concentration of alkalinity, nitrite and ammonia were measured using the Hach® water test kit model FF-1A.

Fish in each tank were sampled at 9 days interval for mean weight gain to adjust the feed given to the fish. The experiment lasted for 93 days. At the end of the experiments, the fish were counted and weighted. Selected fish growth parameters; total weight gain, the daily growth rate, specific growth rate and feed conversion ratio were calculated using the procedure of Akinwole and Faturoti (2007). Data obtained were analyzed statistically using one-way analysis of variance in line with Gayanilo *et al.*( 1996).

## RESULTS AND DISCUSSION

*Water quality in Fish Rearing tanks*

Average temperature value of 25.09±1.14°C was recorded in all the tanks (table 1). The three liners showed no difference in their reaction to changes in temperature throughout the production periods. The lined tanks, exhibit the same characteristics in absorption and release of heat from and to the environment. The mean temperature recorded in all the tanks were within the range of 24°C and 31°C which Viveen *et al.*, (1985) stated that was good temperature for the culture of *Clarias species.* The highest mean DO value of 5.41±0.96mg/l was recorded in tanks lined with Polyethylene materials while the least DO value of 4.89±1.36mg/l was obtained in polyester lined tanks. Average DO values measured across the tanks were 5.15±1.04mg/l. The dissolved oxygen (DO) recorded in the tanks were adequate for fish culture as reported by Viveen *et al*, (1985) that DO values should be greater than 4mg/l in water used for catfish culture. The mean pH value in each tanks varies, these was shown in table 1. Tanks lined with Polyester materials recorded a maximum pH value of 6.62±0.30 while tanks lined with PVC materials recorded a pH value of 6.37±0.24 while the average pH values obtained across the tanks was 6.43±0.27. Tanks lined with polyester materials had mean nitrite value of 0.59±0.29mg/l while polyethylene and PVC lined tanks recorded 0.54±0.08mg/l and 0.54±0.11mg/l mean nitrite values respectively. The concentration of nitrite across the tanks is higher than the 0.25mg/l limit considered safe for fish health. Wedemeyer, (2001) state that high nitrite value oxidizes the iron in the haemoglobin, which reduces the oxygen that can be transported by blood and cause asphyxiation even when DO levels are not limiting. Nitrite toxicity is suppressed by other anions in the water such as chloride (Wedemeyer, 1996). Nitrite toxicity depend upon fish species and life stage, as well as the pH and presence of other anion in the water, as discussed by Wedemeyer, (1996). Boyd (1998) observed that ammonia concentrations of 0.63mg/l cause 95% reduction in catfish growth while no growth occurred at l.17mg/l. The mean values of the other water quality parameters tested, alkalinity, TDS and conductivity complies were all within recommended ranges for the culture of *Clarias gariepinus* as reported by Omitoyin (2007).

**Table 1: Mean values of selected water quality parameters in *Clarias gariepinus* rearing tanks lined with three materials.**

| | Fish rearing tanks lined with | | |
|---|---|---|---|
| Parameters | PVC | Polyethylene | Polyester |
| Temperature ($^0$C) | 25.09±1.14*[a] | 25.09±1.14 [a] | 25.09±1.14 [a] |
| pH | 6.37±0.24 [b] | 6.44±0. 22 [b] | 6.62±0.30 [b] |
| DO (mg/1) | 5.04±0.92 [c] | 5.41±0.96 [c] | 4.89±1.36 [c] |
| Alkalinity (mg/1) | 89.12±22.11[d] | 104.66±21.67[e] | 110.38±20.43[e] |
| Nitrite (mg/1) | 0.54±0.11[f] | 0.54±0.08 [f] | 0.59±0.29 [f] |
| TDS (mg/I) | 77.38±1.57[g] | 77.24±1.40 [g] | 77.34±1.49 [g] |
| Conductivity (mg/1) | 0.56±0.15 [h] | 0.50±0.07 [h] | 0.55±0.05 [h] |

*mean ±standard deviation of ten readings in three replicates of each treatment. Values in the same row with same superscripts are not significant (P>0.05)

*Fish growth*

The statistical analysis using one way ANOVA showed that there are no significant difference (P>0.05) in the fish growth parameters measured . The fish in the differently lined tanks have tendency to grow at the same phase but records obtained showed that fish in tanks lined with PVC materials recorded a significant (P<0.05) highest mean weight of 22.59±1.56g while tanks lined with Polyester materials recorded the mean weight of 15.31±2.39g and tanks lined with polyethylene materials recorded the least mean weight of 15.41 ±1.11g (table 2). The total weight gain measured in this study as depicted in table 2 showed that fish cultured in tanks lined with PVC materials recorded the highest total weight gain of 196.33±25.28g while tanks lined with polyester materials recorded a total weight gain of I39.10±36.33g and lined tanks polyethylene materials recorded the lowest total weight gain of 134.1 l±25.23g.

**Table 2: Mean value of growth parameters measured during production of Clarias gariepinus reared in tanks lined with three materials.**

| | Fish Rearing Tanks lined with | | |
|---|---|---|---|
| Parameters | PVC | Polyethylene | Polyester |
| Initial mean weight per fish (g) | 5.03 ± 0.21* | 5.03 ± 0.21 | 5.03 ± 0.21 |
| Culture duration (days) | 93 | 93 | 93 |
| Final mean weight per fish (g) | 22.59±1.56[a] | 15.41 ± 1.11[b] | 15. 31 ±2. 39 [b] |
| Total weight gain (g) | 196.33±25.28[c] | 134.11±25.23[d] | 139.10±36.3 [d] |
| Daily growth rate (g /fish/day) | 4.87±3.87[e] | 3.36±2.62[f] | 2.95±2.08[f] |
| Feed conversion ratio (FCR) | 3.65±6.64[g] | 2.36±1.93[h] | 1.59±0.70[h] |
| Specific growth rate (%) | 1.61±0.07[i] | 1.21±0.09 [j] | 1.29±0.17 [j] |
| Survival rate (%) | 98.58±3.36 [k] | 98.63±3.33 [k] | 98.98 ±2.28 [k] |

*mean ±standard deviation of three replicates. Values in the same row with same superscripts are not significant (P>0.05)

Highest survival rate was recorded in tanks lined with polyester materials with the mean value of 98.98±2.28%, while tanks lined with polyethylene and PVC materials recorded the mean survival rate value of 98.63±3.33% and 98.58±3.36% respectively. Highest mean specific growth rate of 1.61±0.07% was recorded in tanks lined with PVC materials while the mean specific growth rate of 1.19±0.17% was recorded in tanks lined with polyester materials and tanks lined with polyethylene materials recorded a least specific growth rate value of 1.21±0.09%. Tanks lined with polyester materials recorded a mean food conversion ratio of 1.59±0.70g while tanks lined with PVC and polyethylene materials recorded a mean food conversion ratio of 3.65±6.64g and 2.36±1.93g respectively.

## CONCLUSION

The three liner materials evaluated in this study maintained water quality parameters within the range required to culture *Clarias gariepinus.* PVC lined tanks tend to be more effective in enhancing fish growth when compared to the other liner materials; polyester and polyethylene.

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