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(Research Article)

Effect of tarpaulin pond on the growth and haematology of catfish (*Clarias gariepinus*)

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Abstract

The present comparative study investigated the haematological and growth parameters of catfish reared in both earthen and tarpaulin ponds. The growth response of the fish in both ponds such as overall weight gain, production index, survival rate, daily weight gain and length gain in the fish samples were determined. The overall weight gain in the catfish grown in earthen pond was higher (800 – 1000 g) than those from tarpaulin ponds (600 – 800 g). The production index of fish from earthen pond was higher than those of tarpaulin pond. The survival rate was higher in earthen pond (100%) than tarpaulin pond (80%). Moreover, daily weight gain and length gain were higher in earthen pond (12.50 g and 50 cm) than tarpaulin pond (10.00 g and 30 cm) respectively. Also, the haematological parameters such as the packed cell volume (PCV), haemoglobin concentration (HB), Red Blood Cell (RBC), White Blood Cell (WBC) count and other blood parameters of each of the blood sample, were determined using 5-part differential Haematology Auto-analyzer (Mindray BC 5300 model).Catfish from earthen pond recorded the highest haemoglobin value (8.68±0.15 g/dL) than that of tarpaulin pond (7.78±0.03g/dL) this means that the oxygen carrying capacity of blood of catfish from earthen pond is higher than those of tarpaulin pond. Packed cell volume (PCV) value was recorded the highest in earthen pond (25.00%) again than that of tarpaulin pond (23.50%). Earthen pond recorded the least white blood cell (WBC) count (5268.30±54.03 x 10^3/L) compared to that of tarpaulin pond (6170.50±37.09 x 10^3/L). Red blood cell (RBC) count was recorded the highest in earthen pond (2.74±0.01 x 10^6/L) than that of tarpaulin pond (2.18±0.01x 10^6/L). Blood of catfish from tarpaulin pond recorded the highest neutrophils (60%) than that of earthen pond (53%). Earthen pond recorded the highest leucocytes (40%) than that of tarpaulin pond (37%). Also, monocytes counts are higher in earthen pond (7%) than tarpaulin pond (3%). In conclusion, the results of the present study indicated that the type of pond material used to rear fish can alter growth and haematological parameters.

Keywords: Fish pond; Tarpaulin, Growth; Haematology; Catfish

1. Introduction

Fish is very important to humans because it contains protein of very high quality and also has sufficient amounts of all the essential amino acids required by the body for growth and maintenance of lean muscle tissue. The desire of fish farmers is to produce table-sized fish within the shortest possible time. Aquaculture alone has the potential to supply Nigeria's requirement for fish if properly utilized (Ayoola, 2011).

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. 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. Similarly, earthen pond system of production is characterized with low productivity. Therefore, 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

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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 water and culture facilities that provide needed environment for the growth of the fish (Akinyemi, 2008).

Fish ponds are artificial lakes (reservoirs) intended for fish breeding/farming. In the medieval times in Europe, fish ponds are typical in monasteries and castles. Fish ponds are common in Nigeria and other African countries, where common catfish may be kept. They not only provide source of income to small-scale farmers from the sale of these fishes, but could also meet irrigation needs and water for livestock (FAO, 2009).

Fish is a vital source of high-quality protein, providing approximately 16% of the animal protein consumed by the world's population (FAO, 2012). It is particularly an important protein source in regions where livestock is relatively scarce. FAO (2012) estimates that about one billion people world-wide rely on fish as their primary source of animal protein. With this increasing demand for intensive aquaculture, demand for more efficient diets for fish is rising (Agbo *et al*., 2011). Nigeria's aquaculture industry is currently faced with the problem of inadequate supply and prohibitive cost of quality fish feeds. The principal operating cost in the production of fish is feed and the main protein source has been the commercial fish meal, which is however scarce and expensive (Glencross *et al*., 2007).

The African catfish (*Clarias gariepinus*) is generally considered to be one of the most tropical catfish species for aquaculture and since the 1970's it has been a fish of great promise for fish farming in Africa. It has high growth rate, and is a very strong fish appreciated by a wide number of African consumers. They are found throughout Africa and the Middle East, and live in freshwater lakes, rivers, and swamps, as well as human-made habitats, such as oxidation ponds or even urban sewage systems. The African sharptooth catfish was introduced all over the world in the early 1980s for aquaculture purposes, so is found in countries far outside its natural habitat, such as Brazil, Vietnam, Indonesia, and India (Anoop *et al*., 2009).

Haematological (Blood) analysis is a valuable means of evaluating the physiological condition of cultured fish with respect to determining the effect of diets and other stress factors on fish health. Changes in haematology of fish in response to stressing agents are indicators of the stressful stage of fish, producing useful information to curb any unfavourable condition that may affect the fish health (Bello-Olusoji *et al*. 2006). Adeparusi and Ajayi (2004) reported that analysis of blood is an important factor that could be considered in fish feed assessment. The use of haematological values as indices of diagnosing diseases and stress induced condition as well as for feed assessment is well documented by (Yue and Zhou, 2008). The primary aim of this project is to determine the effect of tarpaulin type of pond on the growth and haematology of *Clarias gariepinus*.

2. Material and methods

2.1. Study Area

Rufus Giwa Polytechnic is located in Owo the headquarters of Owo Local Government Area of Ondo State. It is situated in the South – West geopolitical zone of Nigeria. All the tarpaulin and earthen fish ponds were constructed in the Animal Sanctuary Section of the Environmental Biology Garden of the Institution. They were also constructed to standard.

2.2. Experimental Fish

Fifty (50) fingerlings of similar sizes were selected from a unit stock obtained from the Department of Fishery and Aquaculture of the Rufus Giwa Polytechnic, Owo. The fingerlings used for the experiment were acclimatized for two weeks. The experiment was conducted for 10 weeks.

2.3. Growth Data Collection

Fishes were sampled fortnightly by draining water from the tarpaulin pond. All fingerlings from each pond were collected with a plastic filter basket, the length were recorded using meter rule and then weighed to nearest 0.01g using an electronic weighing balance (TD6002A model). Data obtained biweekly was used to determine mean weight gain. At the end of the experiment, results from weight data were used to determine growth response parameters such as mean weight gain, daily weight gain, relative weight gain, number of survival, number of deaths and production index using the formulae below:

$$\text{Mean weight gain (g) (MWG)} = Wt_2 - Wt_1$$

Where

Wt_2 = final mean weight of fish at time T_2
Wt_1 = initial mean weight of fish at time T_1

$$\text{Production index (PI)} = \frac{SR\ x\ (MFW - MIW}{Rearing\ period\ in\ days}\ \text{(Engle and Valderrama, 2011)}$$

Where
MFW = Mean final weigh
MIW = Mean initial weight

$$\text{Survival rate (SR)} = \frac{Total\ no\ of\ fingerlings\ that\ survived\ x\ 100}{Total\ no\ of\ fingerlings\ stocked}$$

$$\text{Daily weight gain (g/day) (DWG)} = \frac{Final\ mean\ weight - Initial\ mean\ weight}{Rearing\ period\ in\ days}$$

$$\text{Relative weight gain (\%) (RWG)} = \frac{Final\ mean\ weight - Initial\ mean\ weight\ x\ 100}{Initial\ mean\ weight}$$

Increase in length = final length – initial length

2.4. Haematological Analysis

Samples of fish were taken out individually from each pond using a plastic filter basket net and placed belly upward on a table. Blood samples of about 2.0 ml were collected from the ventral region near the anal opening using a 2.0 ml syringe and hypodermic needles. The blood samples were introduced into heparinized Ethylene Diamine Tetraacetic Acid (EDTA) anticoagulant tubes and capped sealed effectively to avoid escape for haematological analysis. The use of plastic syringe is a necessary precaution with fish blood because contact with glass will increase coagulation time and furthermore, the anticoagulants decreases clotting time. The packed cell volume (PCV), haemoglobin concentration (HB), Red Blood Cell (RBC), White Blood Cell (WBC) count and other blood parameters of each of the blood sample, were determined in Haematology Laboratory of the Federal Medical Center (FMC), Owo, using 5-part differential Haematology Auto-analyzer (Mindray BC 5300 model).

2.5. Statistical Analyses

Blood and growth were subjected to one-way analysis of variance (ANOVA) to evaluate mean differences at 0.05 significant levels. Results with $P \leq 0.05$ were considered significantly different. The statistical analyses were done using IBM SPSS Inc. (Windows version 22).

3. Results and discussion

Haematological parameters are very important factors used for the evaluation of fish physiological status. Their changes depend on fish species, age, and the cycle of the sexual maturity of spawners, diseases and pond used. Haematological components of blood are also valuable in monitoring feed toxicity especially with feed constituents that affect the formation of blood in culture fisheries (Oyawoye and Ogunkunle, 2018). Haematological parameters of catfish harvested from the two different types of fish ponds (Tarpaulin and Earthen) in Owo were shown in Table 1. Catfish from earthen pond recorded the highest haemoglobin value (8.68 ± 0.15^a g/dL) than that of tarpaulin pond (7.78 ± 0.03^c g/dL) this means that the oxygen carrying capacity of blood of catfish from earthen pond is higher than those of tarpaulin pond. Packed cell volume (PCV) value was recorded the highest in earthen pond (25.00%) again than that of tarpaulin pond (23.50%).

Earthen pond recorded the least white blood cell (WBC) count ($5268.30 \pm 54.03^a 10^3$/L) compared to that of tarpaulin pond ($6170.50 \pm 37.09^b 10^3$/L). This is an indication of pathological stress from the catfish from tarpaulin pond either cause of inflammation or disease by the pond type because under normal circumstance, WBCs are generally few in non-pathological stress system. Red blood cell (RBC) count was recorded the highest in earthen pond ($2.74 \pm 0.01^b\ 10^6$/L) than that of tarpaulin pond ($2.18 \pm 0.01^a\ 10^6$/L). Table 1 also contains white blood cell types counted in cat fish harvested from the two ponds. Amongst the white blood cell types, Eosinophil and basophil were not detected or counted. Eosinophils are seen in blood when there is an allergic reaction or serious inflammation in the system while Basophils are seen in autoimmune diseases. Blood of catfish from tarpaulin pond recorded the highest neutrophils (60 %) than that of earthen pond (53 %). Earthen pond recorded the highest leucocytes (40 %) than that of tarpaulin pond (37 %). Also, monocytes counts is higher in earthen pond (7 %) than tarpaulin pond (3 %).

Table 1 Haematological parameters of catfish grown in two different environments

Parameter	Tarpaulin	Earthen
PCV (%)	23.50	25.00
Haemoglobin (g/dL)	7.78±0.03[c]	8.68±0.15[a]
RBC ($x10^6$/L)	2.18±0.01[a]	2.74±0.01[b]
WBC ($x10^3$/L)	6170.50±37.09[b]	5268.30±54.03[a]
Neu (%)	60.00	53.00
Leu (%)	37.00	40.00
Mono (%)	3.00	7.00
Eos (%)	-	-

Values are Mean±SEM and those followed by different alphabeth across rows are significantly different at P<0.05

The haematological characteristics observed in the present study showed marginal differences when compared with that of *C. isheriensis* (Kori-Siakpere, 2007) and *C. buthupogon* (Kori-Siakpere and Egor, 2007). A high RBC and haemoglobin values for earthen pond in this study agreed with earlier works as expected for fast swimming tropical species (Kori-Siakpere and Egor, 2007; Annune and Ahuma, 2008) inhabiting pond water (Fänge, 2002; Alkahem *et al*., 2008). Similarly, the high WBC values agreed with Fänge (2002) submission of remarkable richness of fish blood in leucocytes, although it can be an indication of diseased conditions but their presence shows the fish are living well with requirements to fight off disease conditions.

The derived variable of PCV (or haemocrit) was observed to be lower than expected the reason could be as a result of size of fish used though the values are far above anemic. Kori-Siakpere and Egor (2007) and Annune and Ahuma (2008) earlier observations of low PCV values for both *C. buthupogon* (21) and *C. gariepinus* (22) respectively were consistent with our observations on *C. gariepinus*. It is therefore possible that the genus Clarias might have PCV value lower than other teleostan species. Changes in differential leukocyte count are recognized as a sensitive indicator of environmental stress and provide an overview of the integrity of the immune system (Cole *et al*., 2001).

The growth performance/response of African catfish studied in both earthen and tarpaulin ponds were represented in figure 1 - 5. The overall weight gain (Figure 1) in the catfish grown in earthen pond had a higher weigh gain range (800 – 1000 g) than those from tarpaulin ponds with range (600 – 800 g). The production index (Figure 2) also shown fish from earthen pond to have above (1250% g/day) than those of tarpaulin pond with slightly above (750% g/day). The survival rate (Figure 3) was slightly higher in earthen pond (100%) than tarpaulin pond (80%). Finally, daily weight gain (Figure 4) and length gain (Figure 5) were recorded higher in earthen pond (12.50 g and 50 cm) than tarpaulin pond (10.00 g and 30 cm) respectively.

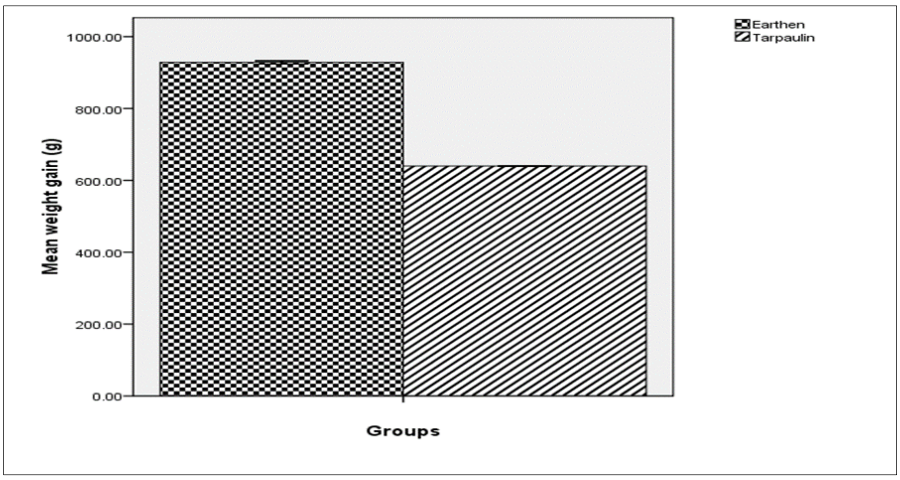

Figure 1 Overall weight gain in the fish grown in Tarpaulin and earthen ponds

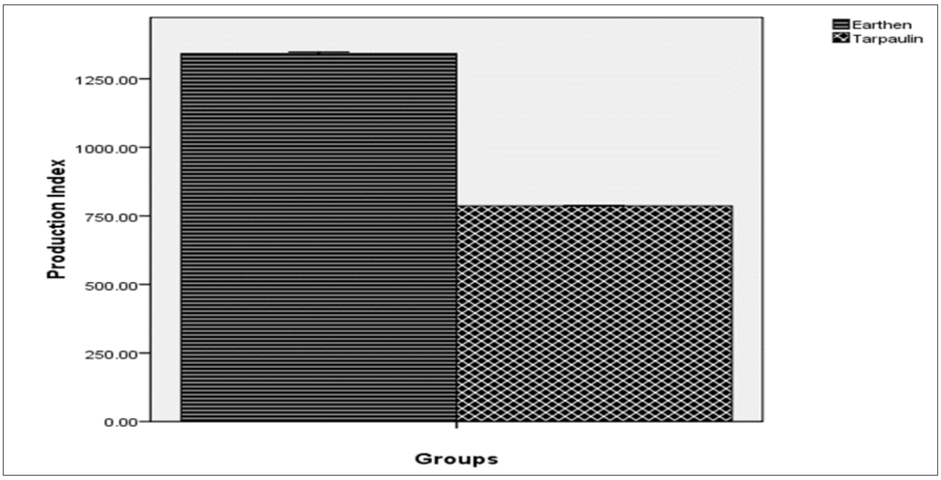

Figure 2 Production Index

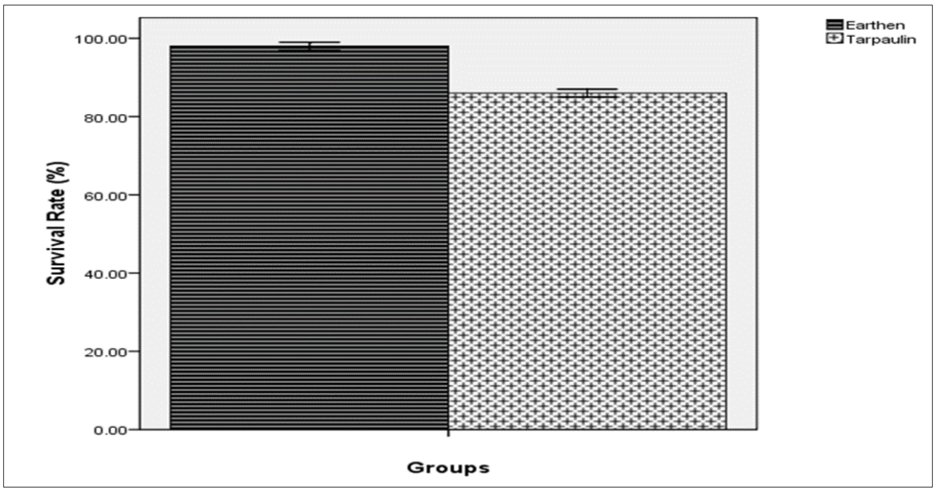

Figure 3 Survival rate of the fish samples

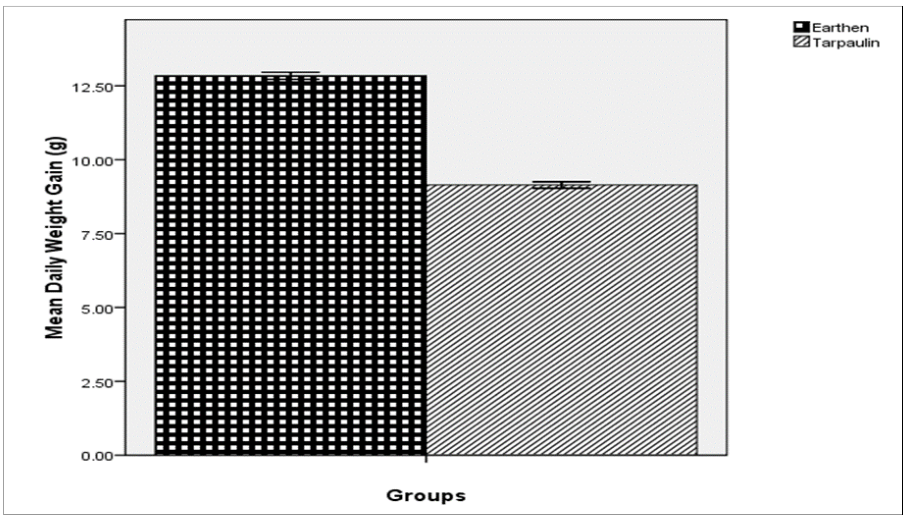

Figure 4 Daily weight gain

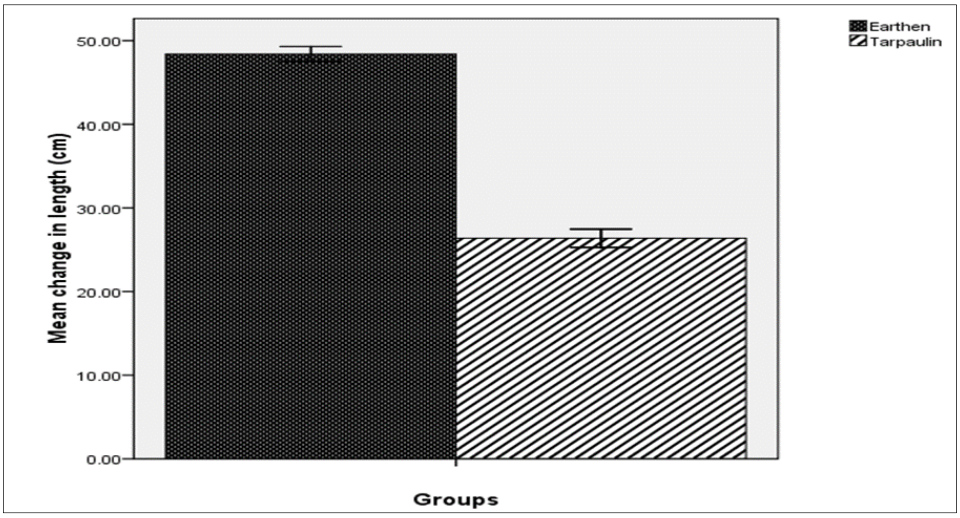

Figure 5 Length gain in the fish samples

Growth data parameters, survival and production index are great tools for evaluating the effect of different pond on fish production (Mustapha et al., 2014). Fish like other animals; require essential nutrients for metabolic activities like growth, reproduction, repairs, etc. However, they also need a conducive environment for their growth. Fish reared in earthen pond showed significant higher growth performance than those of tarpaulin pond. The earthen pond out-performed the tarpaulin pond in all the parameters used in this study. These results agree with Mustapha et al. (2014) and Ekanem et al. (2012) who reported higher growth performance for *C. gariepinus* fed floating diets in earthen pond than those of other ponds (Ajani *et al*., 2011).

4. Conclusion

In conclusion, the results of the present study indicated that the type of pond water used to rear fish can alter growth and haematological parameters. Though the hematological parameters of fish in both fish ponds are normal the growth parameters from the earthen pond out-performed that of tarpaulin pond. This indicates that earthen pond is a better alternative in rearing fish, catfish particularly than that tarpaulin pond. Since the earthen pond has proven to breed catfish with better growth performance and haematological parameters, its usage should be encourage and practiced. This is to ensure appropriate fish management and prevention of disease which is important in the part of food safety plan.

Compliance with ethical standard

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Disclosure of conflict of interest

The author declares no conflict of interest whatsoever.

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