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EFFECT OF CONCRETE POND ON THE GROWTH AND HAEMATOLOGY OF AFRICAN CATFISH (*Clarias gariepinus*)

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Abstract
This study compared the economic benefits based on growth performance and haematological parameters of catfish production under the earthen and concrete ponds in Owo, Ondo State, Nigeria. 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. 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 samples, were determined in Haematology Laboratory of the Federal Medical Center (FMC), Owo, using 5-part differential Haematology Auto-analyzer (Mindray BC 5300 model). Catfish from earthen pond recorded comparable haemoglobin value (8.68±0.15 g/dL) with that of concrete pond (8.15±0.03g/dL).. Packed cell volume (PCV) was higher in earthen pond (25.00 %) than that of concrete pond (24.81 %). Earthen pond recorded the least white blood cell (WBC) count (5268.30±54.03 x10^3/L) compared to that of concrete pond (5451.67±42.15 x10^3/L). Red blood cell (RBC) count was higher in earthen pond (2.74±0.01 x10^6/L) than that of concrete pond (2.52±0.01 x10^6/L). Blood of catfish from concrete pond recorded higher neutrophils (57 %) than that of earthen pond (53 %). Earthen pond recorded higher leucocytes, and monocytes than concrete pond. However, C. gariepinus grew faster in the earthen (natural) system than the concrete pond. The results obtained in the study could serve as valuable information for fish biologists, aquaculturists and environmentalists in pond water management and growth monitoring of cultivable organisms.

Keywords: Catfish, Environment, Growth, Haematology, Aquaculture

Introduction

Naturally, from time immemorial, fish production has been from the wild especially from the rivers, estuaries, brackish and marine waters. Fish is an important source of animal protein to households. However, as technology develops and alternative sources of fish production are sought by mankind, artificial construction of earthen and concrete ponds became widely used by producers of fish to the world economy. In Nigeria, aquaculture has been practised in various media ranging from concrete tanks to plastics, flow through systems, water re-circulatory system and earthen ponds (Yarhere, 2009).

Fish live in very intimate contact with the aquatic environment and are, therefore, very susceptible to the physical and chemical changes which may be reflected in their blood components. Blood is a good indicator to determine the health of an organism and also in diagnosing the functional status of the exposed animal to toxicants (Okechukwu, Auta and Balogun, 2007). Maheawaran *et al*. (2008) reported that a number of haematological indices, such as haematocrit, haemoglobin red blood cells among others are useful in the assessment of the functional status of the oxygen carrying capacity of the blood stream.

Luskova (2007) observed that changes in the haematological level of fish depend on species, age, the cycle of the sexual maturity of spawners and diseases status.
Stress-induced changes in the blood characteristics of *C. gariepinus* as a result of exposure to environmental pollutants, diseases or attack by pathogens have been reported. These indices have been employed in effectively monitoring the responses of fish stressors and thus, its health status under such adverse conditions. Fish are known to be in close relationship with the aqueous environment; hence the blood will reveal conditions within the body of the fish long before there is any visible manifestation of disease (Okechukwu *et al*., 2007).

Among the culturable species of food fish in Nigeria are carp, tilapia, catfish, et cetera. Meanwhile, catfish (*Clarias gariepinus*) is the

most sought after. It is very popular among fish farmers and commands very good commercial value in the markets. Consequently, the *Clarias gariepinus* is vital to the sustainability of the aquaculture industry in the country having in possession the following good qualities identified by Osawe (2007): they survive in different culture systems and diverse environments, grow very fast and have high fecundity, improved survival of the fry and adaptation to supplemental feed. These qualities have placed catfish farming in good position to serve as the only way of boosting fish production and thereby move the country towards self-sufficiency in fish supply. Resources have to be optimally and efficiently utilized to achieve economic optimum output and thus profitability. The efficiency of input utilization in any agricultural enterprise enhances the profitability of such enterprise. The ability of *Clarias gariepinus* producers to adopt new technology and achieve sustainable production depends on their level of technical efficiency.

The production environment for aquaculture in Nigeria is rapidly growing, especially in the South-Eastern and South-Western parts of the country. Many large scale and small scale aquaculture ventures are springing up, investing massively in both extensive earthen pond culture system and the semi-intensive and intensive concrete pond culture systems. The culture systems are being used to produce several thousand tonnages of fish per annum. However, a lot of differences in fish colouration, health and behavioural physiology have been observed in the fish reared under different fish culture systems.

Wilson and Taylor (2003) observed that slight changes in the micro or macro environmental conditions could result to changes in physiological well-being, quality of growth and protein profile in the animal flesh. However, the database of empirical studies of the Nigerian fish culture environment, particularly on the closed system, is just growing. Hence, this study was designed to determine the effect of concrete type of pond on the growth and haematology of *Clarias gariepinus*.

Materials and Methods

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. The concrete fish pond and earthen pond were constructed in the Animal Sanctuary Section of the Environmental Biology Garden of the Institution. They were also constructed to standard.

Experimental Fish: Fifty (50) fingerlings of similar sizes were selected from a unit stock obtained from the Department of Fishery and Aquaculture of Rufus Giwa Polytechnic, Owo. The fingerlings used for the experiment were acclimatized for two weeks as described by Torimino *et al.*(2014) and fed with standard fish feed. The experiment was conducted for 10 weeks.

Growth Data Collection: Fish were sampled weekly following the method described by Torimino *et al.* (2014), by draining water from the plastic container pond. All fingerlings from each pond were collected with a plastic filter basket, the lengths were recorded using meter rule and then weighed to nearest 0.01g using an electronic weighing balance (TD6002A model). Data obtained were 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 described by Okechukwu *et al.* (2007) and Torimino *et al.* (2014).

Haematological Analysis: Heamatological analysis was conducted following standard procedure described by Siti *et al*. (2021). 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 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 Centre (FMC), Owo, using 5-part differential Haematology Auto-analyzer (Mindray BC 5300 model).

Statistical Analyses: Data from blood and growth assays 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).

Results and Discussion

The growth performance of *C. gariepinus* studied in both concrete and earthen ponds were presented in Figures 1 - 5. The survival rate (Figure 1) was higher in earthen pond (100 %) than concrete pond (80 %). The daily weight gain (Figure 2) (12.50 g) and the overall weight gain (Figure 3) in the catfish grown in earthen pond had a higher weight gain range (800 – 1000 g) than those from concrete pond with range (600 – 800 g). The length gain (Figure 4) were recorded higher in earthen pond than concrete pond while the production index (Figure 5) also shows similar trend as catfish from earthen pond with (1250) than those of concrete pond with slightly above (750). The results obtained in this study were in line with the findings of Idodo-Umeh (2008) and Urban and Cook (2011) in their studies of growth performance of five freshwater fishes in Nigeria freshwater ecosystem as the earthen pond always outperformed other pond types.

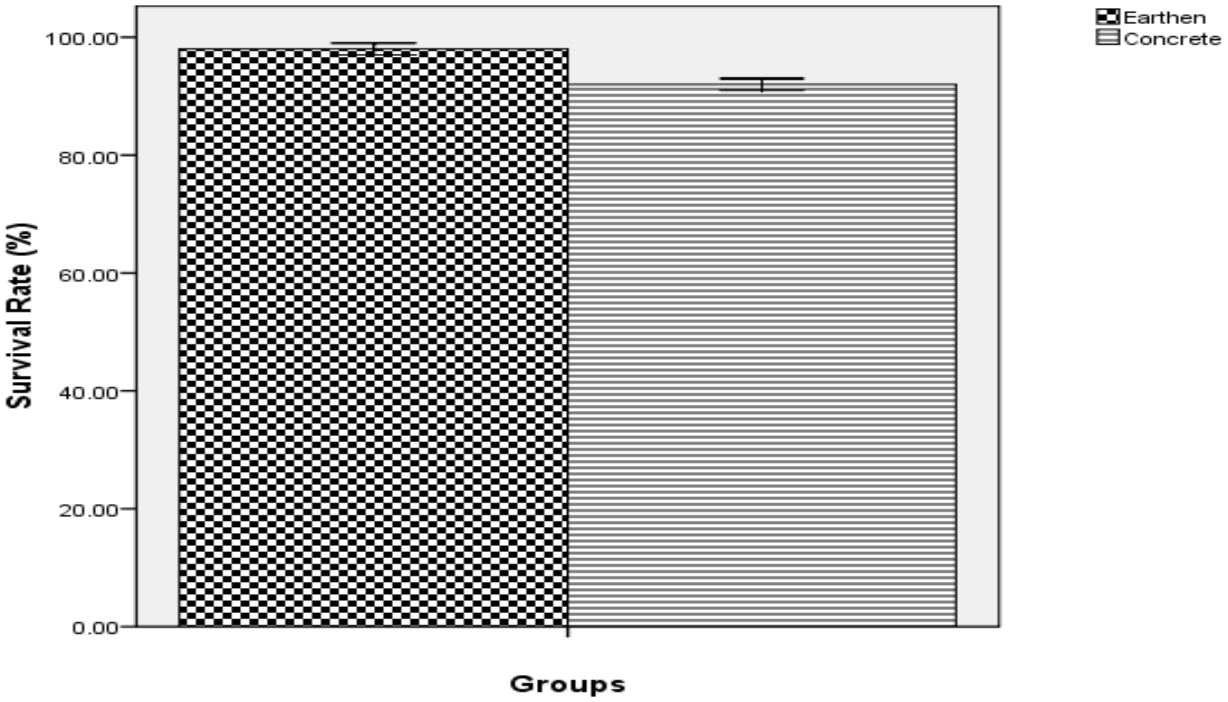

Figure 1: Survival rate of the fish grown in concrete and earthen ponds

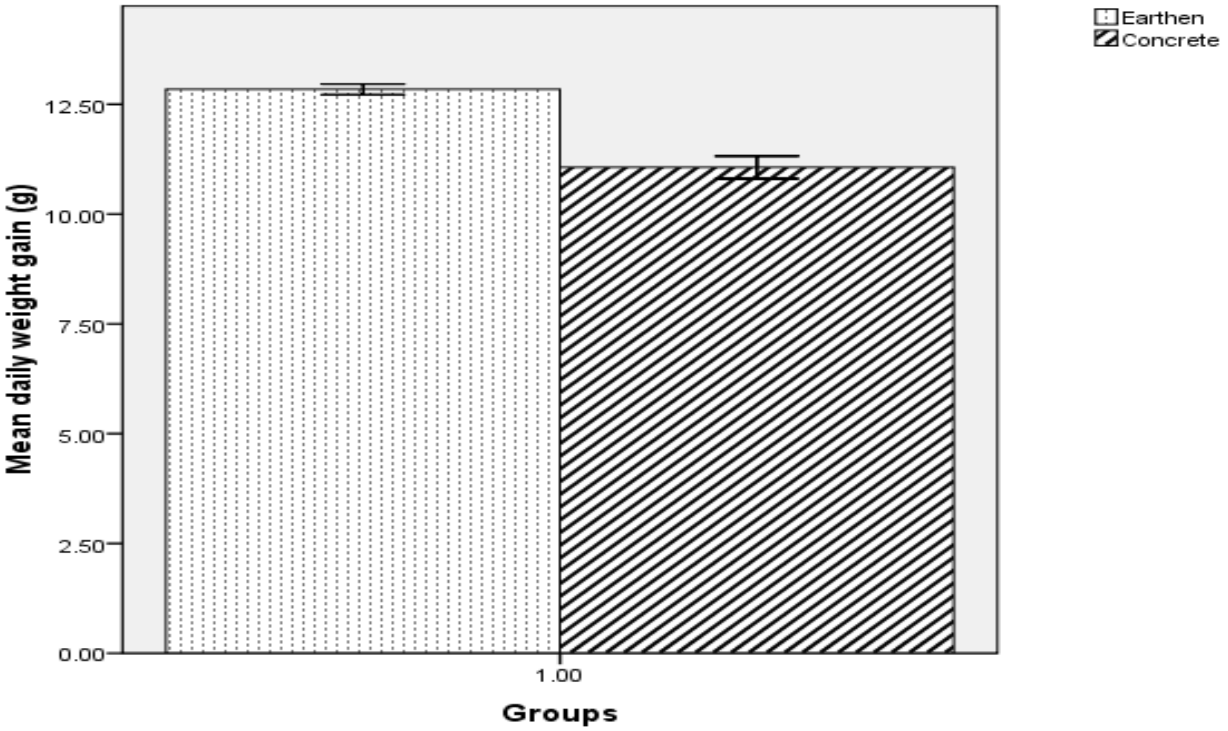

Figure 2: Daily weight gain in fish grown in concrete and earthen ponds

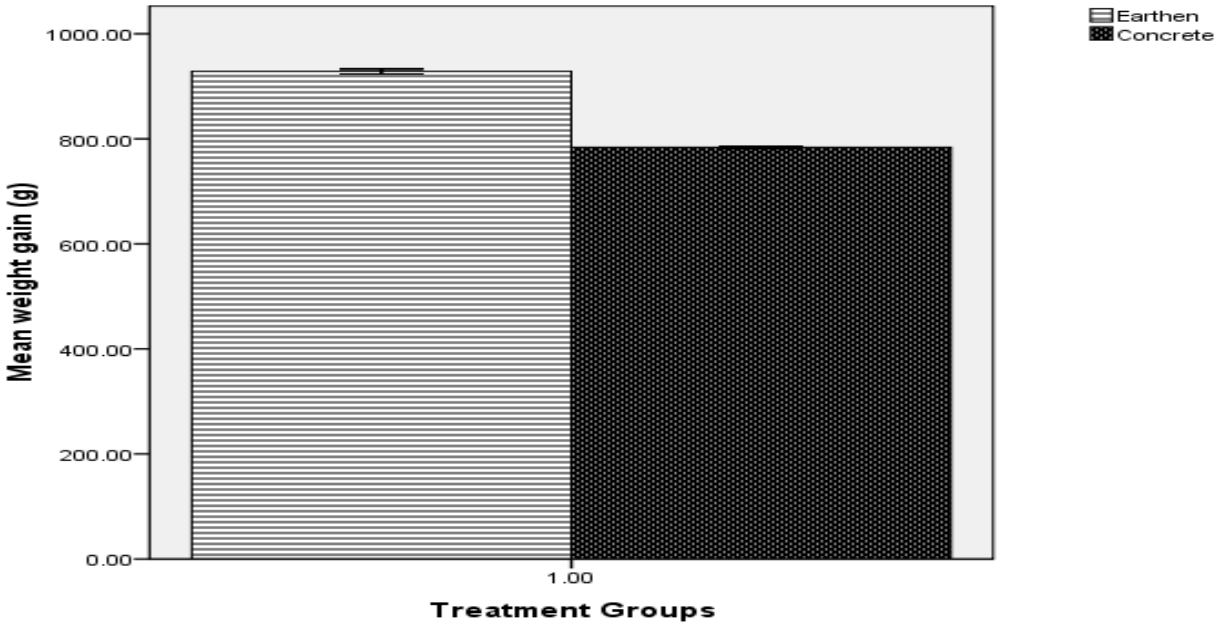

Figure 3: Overall weight gain in the fish grown in concrete and earthen ponds

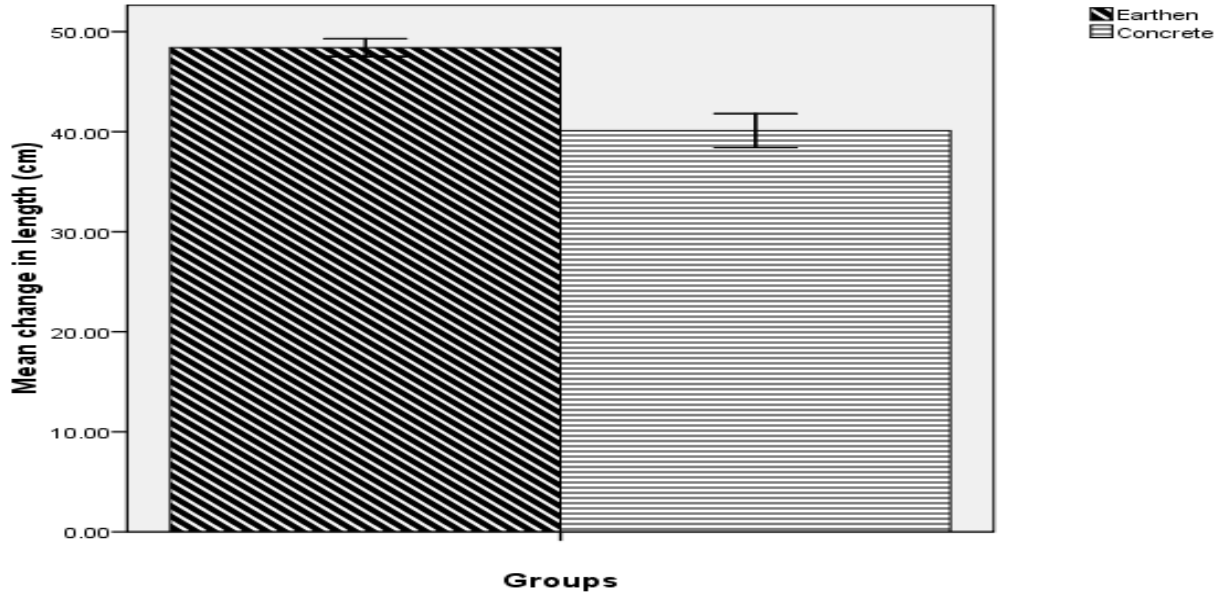

Figure 4: Length gain in the fish grown in concrete and earthen ponds

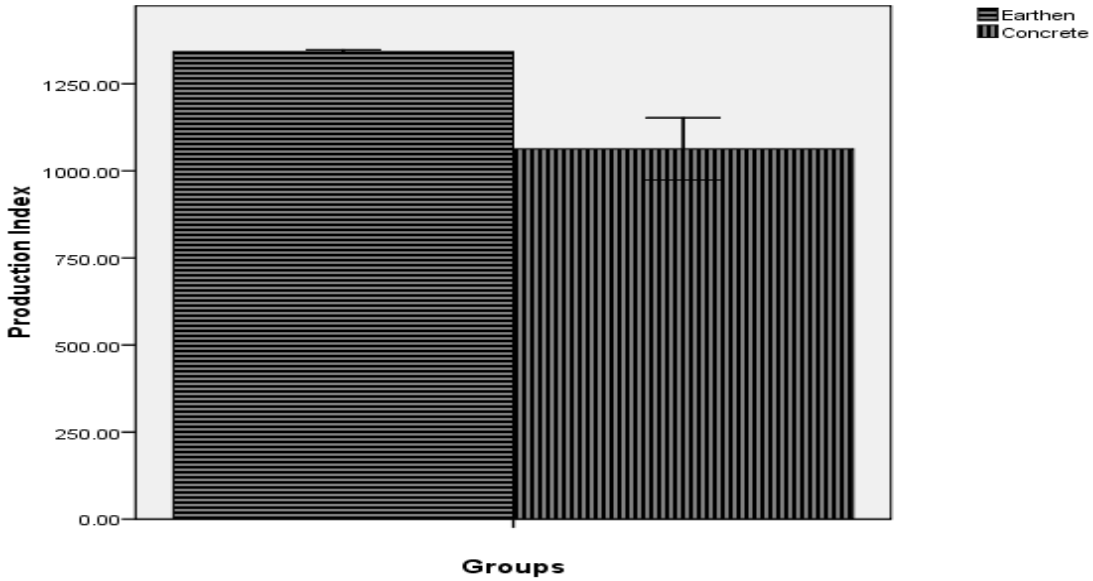

Figure 5: Production Index of fish grown in concrete and earthen ponds

Survival rate of fish and growth data parameters and production index are great tools for evaluating the effect of different ponds on fish production (Mustapha *et al.*, 2014). Fish like other animals; require essential nutrients for metabolic activities like growth, reproduction, repairs, et cetera. However, they also need a suitable environment for their growth. Fish reared in earthen pond showed significant higher growth performance than those of concrete pond. The earthen pond out-performed the concrete pond in all the parameters used in this study suggesting it to be a very suitable pond type for rearing catfish. 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).

Table 1: Haematological parameters of catfish grown in two different environments

Parameter	Concrete	Earthen
PCV (%)	24.81	25.00
Haemoglobin (g/dL)	8.15±0.03^{a}	8.68±0.15^{a}
RBC (x10^{6}/L)	2.52±0.01^{a}	2.74±0.01^{b}
WBC (x10^{3}/L)	5451.67±42.15^{a}	5268.30±54.03^{a}
Neu (%)	57.00	53.00
Leu (%)	38.40	40.00
Mono (%)	4.60	7.00
Eos (%)	-	-

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

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 (Concrete and Earthen) in Owo were shown in Table 1. Heamatological alterations are usually the first detectable and quantifiable response to environmental change (Wendeler, 2010). Packed cell volume (PCV) value was recorded slightly higher in earthen pond (25.00 %) again than that of concrete pond (24.81 %). Blood samples of catfish from earthen pond recorded higher haemoglobin value (8.68±0.15g/dL) than those of concrete pond (8.15±0.03 g/dL). This means that the oxygen carrying capacity of blood of catfish from earthen pond is slightly higher than those of concrete pond. Earthen pond recorded a comparable white blood cell (WBC) count (5268.30±54.03x10^{3}/L) compared to that of concrete pond (5451.67±42.15 x10^{3}/L). This is an indication of pathological stress from the catfish from concrete pond either caused by inflammation or disease by the pond type because under normal circumstance, WBCs are generally few in non-pathological stress system (Prasad and Mukthiraj, 2011). Red blood cell (RBC) count was higher in earthen pond (2.74±0.01x10^{6}/L) than that of concrete pond (2.52±0.01x10^{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. 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 concrete pond recorded the highest neutrophils (57 %) than that of earthen pond (53 %). Earthen pond recorded the highest leucocytes (40 %) than that of concrete pond (38.40 %). Also, monocytes counts are higher in earthen pond (7 %) than concrete pond (4.60 %). The results obtained in this study showed that there were no significant differences (p 0.05) in the haematological parameters of *C. gariepinus* raised in both concrete and earthen ponds. There has been no general agreement on the haematological values in fish. Prasad and Mukthiraj (2011) recorded RBC (2.04±0.43), WBC (2.18±0.84), Hb (6401±0.26) and PCV (23.78±3.80) in *Oreochromis mossambicus*. NIkolov and Boyadzieva-Doichinova (2010) demonstrated that the red blood cell counts were constant in the three species of freshwater fishes

(*Carassius gibelo, Alburmusal burnus* and *Scardinius erythrophthalimus*). Onunkwo *et al.* (2007) reported a higher thrombocyte values (21.65-47.24) than the red blood cells (2.42-3.22) in *Tilapia guineensis*. Ajiboye and Faturoti (2011) obtained Hb (7.06) PCV (37.53) RBC (1.39) and WBC (19.39) in *Synodontis nigrita*.

The haematological characteristics observed in the present study showed marginal differences when compared with that of *C. isheriensis* (Kori-Siakpere, 2017) and *C. buthupogon* (Kori-Siakpere and Egor, 2017). 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, 2017; Annune and Ahuma, 2008) inhabiting pond water (Fänge, 2002). 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* and *C. gariepinus* 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.

Conclusion and Recommendation

This study demonstrated that the blood parameters and growth of catfish cultured in concrete and earthen ponds were comparable. However, *C. gariepinus* grew faster in the earthen (natural) system than the concrete pond. The results obtained in the study could serve as valuable information for fish biologists, aquaculturists and environmentalists in pond water management and growth monitoring of cultivable organisms. Since the earthen pond has proven to breed catfish with better growth performance and haematological parameters, its usage should be encouraged and practised.

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