EFFECT OF DIFFERENT CARBON SOURCES (CORN FLOUR, SORGHUM AND RICE BRAN) ON THE GROWTH PERFORMANCE AND CONDITION INDICES OF THE AFRICAN CATFISH IN BIOFLOC CULTURE SYSTEM.

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ABSTRACT
Three different carbon sources (corn flour, rice bran and sorghum) were evaluated for their suitability in biofloc system. A sixty days (60) rearing trial was conducted where 8 circular plastic tanks (100 L) each were used as experimental units for different treatments and the control all in duplicate. Each tank was stocked with 25 fingerlings of the African catfish (*Clarias gariepinus*) with average body weight of 8.90±0.00g and the culture water was aerated. Length and weight of the fishes were monitored weekly and recorded. The use of corn, rice bran, and sorghum as carbon sources in this experiment Enhanced growth performance and nutrient utilization of the African catfish (*Clarias gariepinus*) fingerlins. After six weeks rearing period, the survival of fish in all treatments was not significantly different ($p <0.005$); control group (94%); corn treatment (98%), sorghum (90%) and rice bran (96%) (Table 1). Total weight was higher ($p < 0.005$) in corn treatments compared to control. Specific growth rate (SGR), showed significantly higher values among the treatments ($p < 0.05$). Corn is recorded to have higher liver weight than the control at ($p < 0.05$) but there is no significant difference between all the treatments (corn, rice bran and sorghum).
Key words: biofloc, carbon sources, catfish, growth performance

INTRODUCTION
Fish is considered to be one of the most important sources of food globally. Fish provide a reasonable amount of protein for the world growing population (Godfray *et al.*, 2010). For hunger to be completely eliminated in the future, intensive aquaculture production most been enhanced (FAO, 2016). Conventional farming requires regular water exchange, which contains a lot of aquaculture effluent that causes environment pollution and leading to unsustainable fish farming under condition of water shortage (Tidwell, 2012).

The Biofloc Technology (BFT) can be successful using different types of organic carbon. The way to go for the BFT is to use carbohydrates. There are many conditions for the selection of the type of carbon source like cost, biodegradability, local availability and efficient bacterial assimilation. Biofloc technology systems include the activation of heterotrophic bacteria by addition of carbon source in the aquaculture ponds. The bacteria consume nitrogen and increase the bacterial population in presence of carbon nitrogen ratio starting from 10:1 (Avnimelech, 1999). Biofloc system has a great advantage having to be nearly zero water exchange system and has no stress on fish due to water exchange (Crab *et al.,* 2012; De Schryver *et al.,* 2008; Nevejan *et al.,* 2018).

For hunger to be completely eliminated in the future, intensive aquaculture production most be enhanced (FAO, 2014). The cost of fish cultivation is very expensive mores especially in the third world countries like Nigeria; as such fish farmers are not generating a good profit in the business. The major challenges in fish farming includes: water and diseases management and cost of feeding, because conventional farming requires regular exchange of water which contains a lot of aquaculture effluent that causes environmental pollution and leading to unsustainable fish farming under condition of water shortage (Tidwell, 2012). It is necessity to develop a mechanism that can address the mentioned challenges that is cost effective.

Biofloc technology is considered as one of the cost effective and best way of fish management because of its ability to clean the water pollutant in fish ponds, and reduce the food intake of the fishes because it provides additional protein. Its ability to clean the water reduced the risk of infection because the pathogenic organism cannot survive in biofloc system. This research will reveal the potentiality of our native plants as carbon source in bioflock formation, thereby improving fish farming in our locality.

MATERIALS AND METHODS

Fish collection and acclimatization

The study was carried out from January – May 2021 at the Biological Garden and Biology Laboratory Department of Biology Faculty of Natural and Applied Sciences. Umaru Musa Yar'adua University, Katsina (UMYU).

African catfish (*Clarias gariepinus*) fingerlings were obtained from Hatchery Department of National Biotechnogy Development Agency (NABDA), Yankatako Katsina State of Nigeria. The fish was carried inside Jericane with a small hole on it for cross ventilation for the fish to breathe healthy and transported to the experimental site. The fish was then acclimatized for 10 days. After acclimatization period, 200 African catfish fingerlings with an average body weight of 8.46 ± 0.06 g were randomly distributed in 8 tanks.

Experimental design

Three different carbon sources; corn flour, rice bran and sorghum, were examined for their effect on: growth performance and body indices

The Fish were fed according to their body weight 5% twice daily (9:00am and 5:00pm).

Biofloc set up

Out dour type of biofloc system was adopted and the experiment was done by the use of plastic tanks. All biofloc systems require constant motion to maintain both high oxygen levels and to keep solids from settling. Areas without movement will rapidly lose oxygen and turn into anaerobic zones which release large amounts of ammonia and methane. To prevent this, every tank was connected to a well-planned layout of aerators. Electrical aerator (SB-2) were used. Biofloc systems require up to 6mg of oxygen per Littre per hour. The aerators were installed strategically so that a current is created in the tank. The carbon sources (Corn, Rice bran and Sorghum) used were purchased from different markets and processed for use in the experiment. For the corn and sorghum; the grains were purchased from Katsina Central Market. The grains were grinded and sieved into powdered form. For the rice bran, it was obtained from Dawanau market in Kano and grinded into foddered form before use.

Growth performance

- $\text{Survival (\%)} = \frac{\text{Number of harvested fish}}{\text{number of stocked fish}} \times 100$
- $\text{weight gain (\%)} = \frac{\text{Mean final weight} - \text{mean initial weight}}{\text{mean initial weight}} \times 100$
- $\text{Specific growth rate (\%/day)} = \frac{\ln \text{(Final weight - initial weight)}}{\text{number of days}} \times 100$

(Arjmandi *et al.*, 2020)

Statistical Analysis

All data was analyzed using IBM SPSS statistics 21. The data was presented as mean ± SD. Repeated-measures ANOVA was used to test for significant difference in growth performance of the fish within the experiment period.

RESULTS

Growth performance

The use of corn-flour, rice bran, and sorghum flour as carbon sources in this experiment supported the growth of catfish in biofloc. The survival of fish in all treatments did not deviate from that of a control group (94%); corn treatment (98%), sorghum (90%) and rice bran (96%) (Table 1). Total weight gain was higher (p < 0.005) in corn treatments compared to control. Specific growth rate (SGR), showed higher values among the treatments (p < 0.05) Compared to those of the control (Table 1)

Table 1: Growth performance of African Catfish (*Clarias gariepinus*) in Biofloc System Using Three Different Carbon Sources

Carbon sources				
Parameters	Corn	Rice bran	Sorghum	Control
Weight Gain (g)	302.93	261.37	241.13	216.34
Percentage survival (%)	98	96	90	94
Specific Growth Rate (%)	0.059	0.056	0.055	0.053

Condition indices

The experiment did not record any significant difference in respect of the gutted weight of the fish. Corn is recorded to have higher liver weight than the control at ($p < 0.05$) but there is no significant difference between all the treatments (corn, rice bran and sorghum). No significant difference was observed in gonad weight among all the treatments and the control

Table 2: Gutted weight, liver weight, and gonad weight of African Catfish (*Clarias gariepinus*) in Biofloc System Using Three Different Carbon Sources from UMYUK Biological Garden

Treatments	Total weight (g)	Gutted weight (g)	Liver weight (g) (HIS)	Gonad weight (g) (GSI)
Corn	32.71 ± 8.45^{a}	26.73 ± 6.52^{a}	0.61 ± 0.18^{a}	0.36 ± 0.13^{a}
Rice bran	30.98 ± 6.15^{a}	25.37 ± 4.88^{a}	$0.53\pm0.16a^{b}$	0.31 ± 0.11^{a}
Sorghum	30.70 ± 4.65^{a}	25.03 ± 4.57^{a}	0.51 ± 0.11^{ab}	0.29 ± 0.09^{a}
Control	31.00 ± 3.53^{a}	24.82 ± 2.22^{a}	0.42 ± 0.11^{b}	0.24 ± 0.56^{a}

Values with same superscript along the raw have no significant difference at ($p < 0.05$)

DISCUSSION

In this study, three commonly available carbon sources: corn flour, rice bran and sorghum flour were used to evaluate their potential in biofloc formation. The BFT may be considered to be a sustainable method to maintain water quality within an acceptable range for fish or shrimp species (Boyd and Zimmerman, 2000). The accumulation of high level of toxic ammonia and nitrate resulting to the low survival rates or decreased growth can be prevented and therefore, BFT make it possible to increase survival level and growth at zero water exchange or minimal low water replacement rates, and a potential additional natural food resource is provided, more specifically in the form of bioflocs (Mallasenand Valenti, 2006; Asaduzzaman *et al.,* 2008). Present study confirmed these statements with the lower survival rate (94%) in control, because, it did not receive any addition of carbon and hence, biofloc formation was limited or virtually absent. Increased survival rate in all other biofloc tanks were observed. Among biofloc tanks, corn flour added tank showed 98% survival rate which was highest among all tanks.

Carbon source significantly influence the nutritional composition of the bioflocs, and that could also be observed when looking at survival. The ability to both ingest and digest the biofloc determine the nutritional value of the bioflocs. Feed digestibility is generally less in the larval stages while the survival is measured in the post larval stage (Das *et al.,* 2007). However, the present study confirmed all the carbon sources which were used had higher survival than control and the growth rate was higher in corn flour treatment (98%), so, this indicates that; the digestibility of the corn flour tank biofloc was higher than other carbon sources bioflocs. The rice bran and sorghum bioflocs showed lesser digestibility. So, these biofloc fed animals showed a low survival when compared to corn treatment.

CONCLUSION

The result of this research showed that cornflour and sorghum could be used as the carbon source in the biofloc system for *C. gariepinus* with significant effect on the, survival and growth of the fish. The result also shows that the carbon sources used have no significantly effect on the condition indices of the fish. Further research to degrade the lignin in rice bran through fermentation could boost its carbon release for use in biofloc technology.

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