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Analysis

Growth and nutrients utilization of hybrid (*Clarias gariepinus x Heterobranchus bidorsalis*) fed varying level of cotton (*Gossypium Spp*) seed meal

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ABSTRACT

The study was carried out on growth and nutrients utilization of hybrid (*Clarias gariepinus x Heterobranchus bidorsalis*) fed varying level of cotton (*Gossypium Spp*) seed meal (CSM). Five experimental diets I,II,III,IV and V were formulated with cotton-seed (*Gossypium Spp*) meal substituting GNC at graded levels of 0% (I), 15% (II), 30% (III), 45% (IV) and 60% (V) and were fed to hybrid *(C. gariepinus x H. bidorsalis*) for 56 days, the experiment was conducted in 15 outdoor concrete circular tanks of (1x1m)^2

in the Department of Fisheries And Aquaculture, Usmanu Danfodiyo University, Sokoto, Nigeria. The result recorded 26.08 and 40.51 % crude protein contents for CSM and GNC respectively. The highest survival rate (92.33%) was recorded in fish fed D1which has 0% (CSM) with no significant difference from other dietary treatments. Fish fed D1I which has 15% (CSM) recorded the highest Body Weight Gain (WG) (72.60g), which did not differed ($p>0.05$) significantly with dietary treatments I (15), III (30%) and IV (45%) CSM. Whereas diet DV (60%) CSM recorded the least Weight Gain (38.40g) which differed significantly with the other dietary treatments; the Percentage Weight Gain (PWG) follows the same trend with significant difference. Fish fed diet II (15% CSM) recorded the best feed conversion ratio (FCR) of 2.44, the highest was recorded in fish fed diet V (60% CSM) which did not differed ($p<0.05$) with other dietary treatments. Cotton-seed meal can be used to substitute GNC up to 45% level of inclusion with no significant difference on growth and nutrients utilization indices. From the present study, it can be concluded there were decrease in growth with increase levels of CSM in the diets. The cotton seed meal (CSM) with crude protein content of 26.08% could substitute GNC up to 45% level of inclusion and can serve as good plant protein supplement for the fish. The study recommends studies on cost, anti nutrients, and digestibility of cotton-seed (*Gossypium Spp*) meal (CSM) for efficient utilization of cotton seed meal (CSM) to enhanced production and profitability of aquaculture through production of good quality and cheap fish feed.

Key word: Survival, Growth performance, Hybrid, cotton Seed Meal

INTRODUCTION

The demand of fish is increasing throughout the world due to the recognition of its nutritional values (Tingman *et al*., 2010). In addition the rise of food price and rapid human world population growth increase the demand of fish consumption (FAO, 2010; FOA 2012). For these reasons, there are varieties of fish species which get a special consideration to increase the world fish production.

Fish plays significant role in the diets of people. Fish are the superior source of animal protein contains (62-72%) protein, depending on the species, stage of growth and husbandry. Fish contribute about 40% of animal protein intake of an average person in Nigeria (Babbit, 1990). Nigerians are large fish consumers with total consumption estimated of more than 1.3 million metric tons per year. With only some 450,000 MT of domestic catch, Nigeria is one of the largest importers of fish and imports about 800,000 MT annually, contributing to a loss of jobs to overseas fishermen and this has unconstructive impact on the balance in trade (Miller and Atanda, 2004). Fish nutrition has improved in recent years with the development of new species specific diet formulation to support the expanding aquaculture industry and to satisfy increased demand for affordable high quality fish feed, fish and sea food production (Craige and Helfrich, 2002). One of the major factors militating against fish farming in Nigeria has been lack of adequate feed that are formulated to meet the nutrient requirements of culturable fish species. As such fishes do not attain market size at the right age (Mamman *et al*., 2013).

Nigerian fish farmers hardly use good quality fish feed pellets (Jamu and Ayinla, 2003; Omitoyin, 2007) due to high cost of fish feed ingredients particularly fishmeal. Omitoyin (2007) reported that a lot of fish farmers in Nigeria depend on imported quality fish feeds which are usually expensive. In aquaculture, the important efficiency of utilization of formulated feeds could not be over emphasized, it affects the economic returns of a culture facility and reduces environmental population (Hashim *et al*., 2000; Mihelakakis *et al*., 2002). Feed alone has been estimated to account for between 40-70% of intensive aquaculture operations (Pathmasethy, 1983).

Utilization of such commercially formulated feeds increases the cost of production thereby reducing the profit margin of fish farmers. The utilization of plant based protein in the diet of *Clarids* were reported in (Eyo, *et al*., 2004; Alegbeleye, *et al*., 2004; Konyeme *et al*., 2005; Mamman *et al*., 2013: Mamman *et al*., 2019). There was dearth of information on growth and nutrients utilization of *Clarias gariepinus* x *Heterobranchus longifilis*, fed cotton seed meal (CSM). The aim of this research to assess the growth and nutrient utilization of *Clarias gariepinus* x *Heterobranchus longifilis*, hybrid fingerlings fed vary level of cotton seed meal at different substitution level

MATERIALS AND METHODS

Experimental Site

The study was conducted at the outdoor hatchery facilities, Department of Fisheries and Aquaculture, Faculty of Agriculture Usmanu Danfordiyo Sokoto. Sokoto is located in the extreme North West of Nigeria; near the confluence of Sokoto River and River Rima. The state is within the longitude 11° 30-130° 50E and latitude 4°-6° 40N (Wikipedia 2018). Sokoto state is located in the dry

Sahel surrounded by sandy savannah and isolated hills with an annual average temperature of 28.3°C (82.9°) there are two seasons; the Dry and Wet season. Dry season begins in from October to April and extends to May/June in some parts. Wet season starts in May and ends September to October. Harmatan is experienced between November and February. Heat is more severe around March and April.

Source of Cotton-seed Meal

Cotton-seed meal cake was purchased from Kano, Tafawa Balewa Road, Nasarawa Local Government of Kano State, Nigeria. The seed meal cake was grounded using pestle and mortar, and sieved using 1.18mm laboratory sieve to remove the residues. The fine particles were used in combination with other ingredients to produce pelleted feed.

Procuring of other Feed Ingredients

The other feed ingredients that formed the ration include: groundnut cake (GNC), fish meal, maize, blood meal, bone meal, vitamin and mineral premix, palm oil and salt. They were sourced within Sokoto old market Shagon Goro.

Proximate Analysis

Proximate compositions of the feed ingredient were carried out at the chemical and physical Laboratory of the Faculty of Agriculture, Usmanu Danfodiyo University Sokoto. Percentage protein, fat, moisture, ash, fiber and nitrogen free extract (NFE) were determined for each ingredient following the method of AOAC (2000).

Experimental Diets

Five diets containing varying levels of cotton seed meal (CSM) at 0%, 15%, 30%, 45% and 60%. The diets were formulated following Pearson's square method. The diet contains 45% crude protein. The appropriate quantities of the ingredient in each diet were weighed and mixed thoroughly using electric feed mixer (Kenwood). Each diet was further mixed with warm water to make dough. The mixed dough was subjected to an electric power feed pelletizer (50/kg capacity/hour) of 4mm in diameter sizes. The palliated feeds were sundried and broken into smaller size appropriately acceptable to fish at the beginning of the experiment and stored in an air dried container before the commencement of the feeding trial.

Fish Sources and Management

A total of 300 *Clarias gariepinus* × *Hetrobranchus longifilis,* a hybrid fingerling were obtained from National Institute for Fresh Water Fisheries (NIFFR) New Bussa, Niger State. The fish were transported in a twenty five litters (25) half-filled plastic gerican with water. In the hatchery they were acclimatized for one week in two nursery pond of 750 liters capacity at the rate of 150 fish per pond, after which they were fed with 45% crude protein diets (control). They were then redistributed evenly and randomly to each pond of $(1x1m)^2$. All fish were feed daily at 10.00 am and 5.00 pm at 5% of their average body weight for 8 weeks of the feeding trial period. The ration was adjusted weekly based on the new weight gain in each pond. The ponds were cleaned and uneaten feeds together with fecal residues were siphoned out before feeding. The fish in each pond was weighed to ensure uniformity in size in each pond, and the five experimental diets were randomly allocated to the experimental ponds, in a completely randomized design (CRD) with three replicates. The water source for the experiment was University borehole, and Temperature and Dissolved oxygen were monitored. After acclimatization the fish, each tank was stocked with twelve fish. At stocking, body weight of 25g of fishes per pound. Water level was maintained in each tank and was washed completely every week, and new water was impounded to each tank.

Experimental Set-up

The experimental set-up consists of fifteen outdoor concrete tanks $(1x1m)^2$ of 404.4 liter capacity (0.87m,) the concrete tanks were cleared and cleaned. Each tank was assigned to each of five experimental diets containing different level of cotton-seed meal. The water level was maintained at 0.68m throughout the experimental period and the waste water was replaced every four days.

Water Quality Analysis

Water quality parameters such as Temperature, Hydrogen ion concentration (pH) and Dissolve Oxygen (DO) were determined in all the tanks using standard methods described by APHA (1980). Water temperature was taken with thermometer in ^oC. The thermometer was lowered into water and retained for about 2-5 minutes and the value recorded. P^H was determined by using rent

EIL model 7055 pH meter. The pH meter was lowered into the water sample for about 3-5 minutes and recorded. Dissolved oxygen was determined using YSI model 57 oxygen meter calibrated parts per million (ppm).

Measurement of Weight Increment

The body weight was recorded on weekly basis by weighing all the fingerlings in each experimental unit on an electric top loading weighing balance. The average weekly weight gain in each tank was obtained by subtracting the average weight of fingerlings during the previous week from the average weight during the current week, until end of the experiment (9 weeks).

Data collection

During or at the end of experiment the following data were collected;

Survival rate (SR)

$$SR = \frac{\text{Initial number of fish stocked} - \text{mortality}}{\text{Initial number of fish}} \times 100$$ Webster and Chhorn (2001)

Mean weight gain (g) = Final mean weight (g) - Initial mean weight (g)

Percentage Weight Gain

$$PWG = \frac{\text{Final mean weight} - \text{Initial mean weight}}{\text{Initial body weight}} \times 100$$ Webster and Chhorn (2001)

Specific Growth Rate (SGR)

$$SGR = \frac{In_{W2} - In_{W1}}{T_1 - T_2} \times 100$$ Stickney (1979)

Where In = Natural logarithm
$W_2 - W_1$ = final and initial weight of fish (g) and
$T_2 - T_1$ = period in days

Feed Conversion Ratio (FCR)

$$FCR = \frac{\text{Feed fed (g)}}{\text{Weight gain (g)}}$$ Hepher (1988)

Feed Efficiency Ratio

$$FER = \frac{\text{Weight gain (g)}}{\text{Feed fed (g)}}$$ Hepher (1988)

Protein Efficiency Ratio (PER)

$$PER = \frac{\text{Weight Gain (g)}}{\text{Crude Protein Consumed}}$$ Hepher (1988)

Apparent Net Protein Utilization (AppNPU)

$$APPNPU = \frac{N_b - N_a}{N_i} \times 100$$ Chow *et al.* (1985)

Where N_b = Body protein at end of the experiment
N_a = Body protein at the beginning
N_i = Amount of Nitrogen (protein ingested)

Statistical Analysis

The data on nutrient composition of cotton seed meal, growth performance and nutrient utilization obtained were subjected to analysis of variance (ANOVA) and the treatment means were separated using Duncan Multiple Range Test (Steel and Torrie, 1980). The analysis was carried out using SPSS version 20.0.

RESULTS

Proximate composition of cotton seed meal (CSM) and the remaining ingredients used in the study was presented in table 2. CSM contained 26.08 and 3.00 % crude protein and lipid respectively were as GNC contained 40.51 and 8.50 of cruder protein and lipids. Survival, growth and nutrients utilization were presented in table 3. Highest survival rate was recorded in fish fed diet I (control), the lowest survival rate was recorded in fed diet III and V with no significant (P. > 0.05) difference between the treatments. Fish fed diet II (15%) recorded the highest weight gain this is followed by those fed diet I (control 0%) which did not differed significantly with those fed diet III (30%) and IV (45%) respectively. Lowest weight gain was recorded in fish fed diet V (60%) with significant (P < 0.05) difference. The percentage Weight Gain and Feed Efficiency (FE) follows the same trend. Fish fed diet II recorded the lowest Feed Conversion Ratio (FCR), closely followed by those fed diet IV, III and I. The lowest value of FCR was recorded in those fed diet V with no significance (P > 0.05) differences with other dietary treatments. There was no clear trend with values recorded on Protein Efficiency Ratio (PER) and Apparent Net Protein Utilization (App NPU) in the present study. Carcass compositions of fish fed the experimental diets were presented in table 4. Fish fed diet II (15%) recorded the highest crude protein values, the crude protein content was recorded in fish fed diet III (30%) with no significance difference between the dietary treatments. Fish fed diet IV (45%) recorded the highest lipid content; the lowest value was recorded in those fed diet V (60%) and did not significantly differed.

Table 1. Gross composition of experimental Diets

INGREDIENTS	(0%)	(15%)	(30%)	(45%)	(60%)
Maize	9.41	4.01	11.60	2.80	3.82
GNC	13.86	10.65	6.70	3.17	0.00
Fish meal	5.54	5.68	5.36	5.08	5.21
Cotton seed cake		3.55	6.70	9.52	13.04
Blood meal	2.77	2.84	2.68	2.54	2.60
Bone meal	0.56	0.56	0.56	0.56	0.56
Palm oil	0.75	0.75	0.75	0.75.0	0.75
Salt	0.63	0.63	0.63	0.63	0.63
Vitamin premix	12.5	12.5	12.5g	12.5g	12.50
Mineral premix	0.13	0.13	0.13	0.13	0.13
	100	100	100	100	100
Crude protein	45	45	45	45	45
Metabolizable energy k/cal	3494.36	3469.91	3379.33	3298.30	3435.39
Calculation/C.p	44.3247	43.1204	39.3175	35.9162	35.3914

Table 2: Proximate Composition (%) of Ingredient

Ingredient	Moisture	Ash	Oil/lipid	Crude fibre	Crude protein	NFE
Cotton seed cake	3.00	7.00	3.00	14.50	26.08	46.42
GNC	8.00	8.50	8.50	4.00	40.51	30.49
Blood meal (BM)	10.50	13.00	0.50	0.50	51.54	23.96
Fish meal (FM)	10.00	10.00	0.50	Trace	71.00	8.50
Maize (M.Z)	5.50	9.50	1.50	3.00	10.41	70.09

Table 3: Growth performance and Nutrient Utilization of *C.gariepinus* fed Cotton Seed meal

	Diet/treatment				
Parameter	(0%)	(15%)	(30%)	(45%)	(60%)
Percentage survival rate	92.33±0.6[a]	91.33±1.2[a]	90.67±1.5 [a]	91.00±1.00[a]	90.69±1.23[a]
Specific growth rate	0.12±0.04	0.11±0.14	0.01±0.08	0.05±0.12	-0.20±0.10
Initial weight (g)	25.30	25.30	25.40	25.40	25.30
final weight (g)	95.61	97.90	82.40	80.90	63.70
Weight gain	70.31±5.40[b]	72.60±18.40[b]	57.00±9.60[b]	55.50±14.60[b]	38.40±7.20[a]
Percentage weight gain (%)	277.90±21.70[b]	286.96±74.00[b]	274.76.±41.55[ab]	218.50±58.70[b]	100.01±29.36[a]
Feed conversion ratio	2.71±0.03[a]	2.44±0.11[a]	2.62±0.11[a]	2.51±0.24[a]	3.12±0.39[a]
Feed efficiency ratio	0.41±0.01[b]	0.41±0.03[b]	0.38±0.02[b]	0.40±0.04[b]	0.323±0.040[a]
Protein efficiency ratio	14.97±3.32[b]	7.26±1.43[a]	10.31±5.29[ab]	15.17±1.98[b]	16.28±1.54[b]
Apparent net protein utilization	41.40±9.18[b]	20.06±3.96[a]	28.49±14.64[ab]	41.94±5.46[b]	45.00±4.31[b]

Means rows with the same letter are not significantly (P>0.05) different

Table 4: Proximate Composition (%) of experimental fish fed cotton seed meal

Parameters	Initial fish	Experimental diets				
		(0%)	(15%)	(30%)	(45%)	(60%)
Moisture	61.00	61.17±2.25	61.67±2.08	6 2.18±2.25	60.83±1.25	60.00±0.50
Ash	5.50	6.17±0.57	7.67±2.08	6.33±0.29	5.83±0.29	6.17±0.76
Lipid	1.00	1.67±0.29	2.00±0.50	1.67±0.29	2.17±0.58	1.50±0.50
Crude fiber	Trace	1.00±0.00	1.00±0.00	0.50±0.00	0.50±0.00	0.00±0.00
Crude protein	16.28	23.01±1.51	23.54±1.40	20.91±2.38	23.10±0.89	23.61±0.70
NFE	16.23	7.32±1.68	8.20±0.86	8.75±0.65	7.39±0.31	8.74±1.79

DISCUSSION

The crude protein content of cotton-seed meal in the presented in table 2. This value is higher than what was reported by Ashiru (2011) of 22.06%, Mujahid *et al.* (2000) of 17.74%. The variations in crude protein of cotton-seed have been attributed to the environmental condition in addition to varieties. The importance of crude protein to *Clarias gariepinus* x *Heterobranchus bidosalis* are for tissue building, body defence, growth, transportation of oxygen and reproduction.. The result of proximate analysis of the ingredients used in this study correlate with that of Nwandu *et al*. (2015) with the same test ingredient. Fish fed 15% CSM had significantly higher body weight gain than those fed 0, 30, 45 and 60% cotton seed meal. This suggested greater protein utilization in fish fed 15% Cotton-seed meal in the diet of *Clarias gariepinus x Heterobranchus* fingerlings. This conceded with the finding by Ashiru (2011) whose used 20% cotton seed meal, the result showed adverse effect on the final body weight of *Clarias gariepinus* and similar trained was also observed for Specific Growth Rate and Feed Conversion Ratio. Simon *et al.* (2008) obtained a similar trend for fish fed15% inclusion level of cotton-seed meal for *Clarias gariepinus* juveniles' diets, also recorded mean body weight gain of 67.18 and 48.13 for *Clarias* fed 45% and 60% inclusion level of cottonseed meal respectively.

Balogun *et al.* (2004) reported that, weight gain and standard length increases are known to be the most essential parameters for measuring fish responses to experimental treatments and liable indicator of growtht From the present study, this indicates that CSM could substitute groundnut cake at 15%.. Similarly, percentage weight gain and specific growth rate were in the same trend on *C. gariepinus* fed water hyacinth and mucuna beans replacement for plant protein sources (Konyeme *et al.,* (2005); Bekebile, (2005). These goes the trends with (Nwandu *et al.,* 2015), Mamman *et al.* (2013) reported similar views when fed *C.gariepinus* Juveniles with calabash seed meal. The lower mean body weight recorded in fish fed diet containing 45%, 30% and 60% cotton seed meal may also be due to the high level of cotton seed meal substitution.

There was a decrease in weekly feed intake with increasing level of cotton seed meal. The same was reported (Nwandu *et al.,* 2015). This may be a quality to the physical as well as chemical composition of the diets. Stickney (1979) reported that some chemicals and physical properties of diets such as texture, water stability and color could affect their acceptability. The proportion of cotton seed meal in the diets could have been an indicator for decreasing feeding intake. The lower values of feed conversion

ratio of (2.43±0.04 to 3.12±0.40) recorded in all the treatments suggested partial efficient utilization of the diets. Nwandu *et al.* (2015) reported similar values ca.

Stickney *et al.* (1979), reported that feed conversion ratio becomes lower as efficiency of utilization increases. However, the values recorded in the present study were not too far from Konyeme *et al*. (2005),Sotudo and Sule (2011) and Bekibele (2005) who reported the values of FCR of 3.75 and 2.66 when fed *C.gariepinus* with water hyacinths and mucuna bean as plant protein supplement.

The carcass composition of the experimental fish after the experiment revealed increase in crude protein, ash and moisture bud decrease in the ether extract in all the dietary treatment over the initial carcass composition. An inverse relationship between the body lipid and moisture was apparent, which was in line with what is been obtained in previous experiment (Mamman, 2013 and Nwandu., 2015) whose used calabash seed meal. The crude protein content at the beginning was 16.28% while the least crude protein content of the fish fed experimental diet was 18.81% and the highest was 24.33%, the same reported from (Nwandu *et al*., 2015), 46.77% while the least crude protein of the fish fed experimental diet was 50.38% and the highest was 60.88%. Protein is essential in the diet of fishes as sources of amino acid which are building blocks of flesh, enzymes, eggs and some hormones (Dupree and Hunner, 1984) and also this indicates reasonable protein accumulation due to optimal utilization for growth, reproduction and survival (Alegbeleye *el al*.,2004). The crude protein values were close to Bekibele (2005), Mamman (2013) and Nwandu (2015) when *C.gariepinus* was fed diet containing mucuna bean and calabash seed meal.

CONCLUSION

From the present study, it can be concluded that Cotton Seed Meal (CSM) with crude protein content 26.08 % and lipid of 3.0% could serve as both protein and energy supplement. *Clarias gariepinus x Hetrobranchus bidosalis* fed diet II (15% CSM) has the lowest FCR, highest WG, PWG and good quality body composition indices.

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Conflict of Interest:
The authors declare that there are no conflicts of interests.

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Data and materials availability:
All data associated with this study are present in the paper.

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