SSRG International Journal of Agriculture and Environmental Science
ISSN: 2394 – 2568 / https://doi.org/10.14445/23942568/IJAES-V9I2P103

Volume 9 Issue 2, 22-28, Mar-Apr 2022

Original Article

Growth Performance of *Clarias gariepinus* Fingerlings Fed Different Inclusion levels of Soaked Coffee (*Senna occidentalis)* Seed Meal

Michael Kesonga Garduga[1], Kefas Mathias[2], Solomon Kwano[3] and Amos Nuhu[4]

[1,2,3,4]*Department of Fisheries, Modibbo Adama University Yola, P. M. B. 2076, Adamawa State, Nigeria.*

Received Date: 15 February 2022
Revised Date: 31 March 2022
Accepted Date: 07 April 2022

Abstract *- Growth Performance of Clarias gariepinus fingerlings fed different inclusion levels of soaked (Senna occidentalis) seed meal was carried out for 40days. the coffee seed was soaked for 24 hours'; water was frequently added to soften the seed coats and de-coated. After then, the seeds were spread under the sun for several hours and mill to powder form. 40% crude protein diets were formulated using the Pearson square method in which coffee seed meals were included at different inclusion levels of D1-0%, D2-10%, D3-20%, D4-30%, and D5-40%. Proximate and Anti-nutrients analyses of raw and soaked Senna occidentalis seed meals were screened. 100 Clarias gariepinus fingerlings were acclimatized for 24hours and stocked in a 25L circular plastic bowl. the initial weight and length were taken at the beginning of the experiment and also weekly to adjust the quantity of feed given to the fish at 5% body weight. Water quality was measured. the cost-benefit analysis was also determined. the result of the experiment shows that the best mean weight gains, specific growth rate, feed conversion ratio protein efficiency ratio, and gross energy were from fish fed with D2. the temperature, dissolved oxygen, pH, and Ammonia concentration within the treatments were not significantly different (p<0.05). the highest gross profit and benefit-cost ratio were recorded in D2. Based on findings from this research, 10% inclusion of coffee seed meal can replace soybean without affecting the profit of the fish farmers.*

Keywords – *Senna occidentalis, Clarias gariepinus, Growth, Proximate Composition, and Anti-nutrients.*

I. INTRODUCTION

Fish is an important source of high-quality protein in the human diet, providing about 16% of the animal protein consumed by the world's population (Adewole and Olaleye, 2014). It accounts for 20% of animal protein consumed in Africa (Dulvy and Allison, 2009) and is also an important source of other nutrients such as vitamins A, B, D, and E as well as calcium, iron, and iodine (FAO, 2014). In aquaculture, fish requires adequate food supply in the right proportions and with proper nutritional contents needed for growth, energy, reproduction, movement, and other activities (Umaru*et al*., 2016). Fish feeds in a sustainable fish culture system (intensive), has been reported to account for 40-60% of the total recurrent cost of production which to a large extent determines the viability and profitability of a fish farming enterprise (Umaru*et al*., 2016). Although, few studies have compared the growth response of fish to local and imported feeds (Ekanem*et al*., 2012).

Research in fish nutrition is aimed at exploring alternative, cheaper protein sources for use as soya bean replacers in aquafeeds (Li *et al*., 2009). the decrease in global production of soya beans demonstrates that the sustainability of this industry will depend on the sustained supply of plant proteins for aquafeeds. the failure of aquaculture to meet the challenge of closing the widening gap between fish supply and demand in Nigeria results from several factors including a lack of quality fish feeds. insufficiency of nutrients from primary production (Edwards *et al.*, 2000). Better growth is only possible through the provision of high-quality feed to sustain the increased demand for quality feed (FAO, 2012; Daniel, 2017; Eunice *et al*., 2017).

Fish feed technology is one of the least developed sectors of aquaculture in Nigeria (Umaru*et al*., 2016). For aquaculture to be highly successful in Nigeria, there is a need for good quality and affordable feed (Glencross*et al*., 2007). It is necessary to reduce the dependence on soybean and groundnut by partial replacement with less popular wild legume seeds. However, the over-dependence has already caused a hike in the price of soybean meal; therefore, utilization of other inexpensive plant protein sources would be beneficial in reducing the feed cost (Yue and Zhou, 2009). Seeds of *Senna.occidentalis*is a good source of alternative plant proteins. the chemical composition as revealed by Augustine *et al*. (2013) indicated that the seed meal has promising nutritional value but also contains some anti-nutritional factors such as tannins, oxalates, phytates, and saponins, which will limit its utilization with adverse consequences on animal performance.

II. MATERIALS AND METHOD

A. Experimental Site

The experiment was carried out in the department of fisheries research farm of the faculty of agriculture, Modibbo Adama University Yola, Adamawa State. Adamawa state is located within the semi-arid zone of northern guinea savannah and lies between latitude 9.01^0 North and Longitude 12.04^0 East (Adebayo and Tukur, 1999). the climate is tropical with two distinct dry and wet seasons. the wet season commences in April and ends in late October, while the dry season starts in November and ends in April.

B. Collection and Processing of the Seed

The seeds were obtained from the university surroundings. the coffee seeds were soaked according to the method of (Waters-sayer, 1988) by first soaking the seeds for 24 hours at 100^0C, water was frequently added to soften the seed coats. the soaked beans seeds were pounded in a mortar and washed several times to remove seeds coats. the seeds were slowly sun-dried again for 3 hours at 30^0C until they become softer. the de-coated seeds were soaked by spreading in a basket and cover with the sack for 24 hours at 32^0C. After then, the seed was spread under the sun for several hours.

C. Determination of Nutrients and Anti-Nutrients Compositions

Proximate values (moisture, crude protein, fat, crude fiber, carbohydrate, and ash content) and anti-nutrients (tannin, oxalate, phytate, and saponin) were determined according to methods described by AOAC (2004).

D. Diet formulation

After preparing the ingredients, the feedstuffs were weighed and mixed in appropriate proportions to give the desired 40%CP level required by the fish.

Table 1. 40% Crude Protein diet with different inclusion levels of soaked *Sennaoccidentalis* seed meal

Ingredients	D1	D2	D3	D4	D5
Inclusion levels	0%	10%	20%	30%	40%
Fish meal (60%)	24.20	24.20	24.20	24.20	24.20
Soybean meal (48%)	24.20	21.78	19.36	16.94	14.52
Coffee seed meal (30%)	0.00	2.42	4.84	7.26	9.68
Groundnut cake (40%)	24.20	24.20	24.20	24.20	24.20
Maize (10%)	22.50	22.50	22.50	22.50	22.50
Vitamin premix	1.00	1.00	1.00	1.00	1.00
Calcium	2.00	2.00	2.00	2.00	2.00
Salt	0.40	0.40	0.40	0.40	0.40
Palm oil	1.00	1.00	1.00	1.00	1.00
Starch	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100
Calculated crude protein	40.03	39.57	39.12	38.66	38.20

E. Experimental design

Five experimental feeds with different percentage inclusion of coffee seed meals (D1-0%, D2-10%, D3-20%, D4-30, and D5-40%). A 25 L capacity plastic bowl was used with a water level of 15L.

F. Experimental procedure

100 *Clarias gariepinus* fingerlings were obtained from a reputable fish farm. They were acclimatized for 24 hours before the commencement of the experiment. the initial weight and length were taken using a sensitive weighing balance and meter ruler.

G. Growth and Nutrient Utilization Parameters

Mean weight gain (g)= $\frac{Wf - Wi}{n}$

Wf (final weight gain)

Wi (initial weight gain)

Survival [%] **=** final number of fish –initial number of fish /100

Condition factor [K]**:** This expresses the health status of fish as a result of the experimental treatment was computed at the beginning and end of the experiment using Fulton's Condition Factor Formula:

$K=100W/L^3$ where W is the weight of the fish and L is the length of fish

Specific growth rate [g/day]**:** this was determined as:

$$SGR\ (\%/day) = \frac{\log Wf - \log Wi}{t} \times 100$$

$$Relative\ growth\ rate\ (g) = \frac{Wf - Wi}{Wi} \times 100$$

Protein Intake (g/kg)= Total feed consumed [g] × crude protein in feed
Mean Feed Intake (%)= this is the amount of feed that was fed throughout the experiment
Feed Conversion ratio = quantity of feed fed (g) / weight gain (g)

Protein efficiency ratio = mean weight gain of the fish (g) /mean protein intake (g)

H. Economic Evaluation

The production cost in Naira of the experimental diets was calculated following the method of Sogbesan*et al.* (2006) based on the current market price of the Ingredients used for formulating the diets and fish cultured.

Estimated value cost analysis = cost of feeding + cost of fingerlings stocked

Net Production Value = Total weight gain× cost /kg
Gross Profit = Net profit – Investment cost analysis
Profit index = Net profit value /cost of feeding
Benefit-Cost Ratio = Net profit value / Investment cost analysis

I. Statistical Analysis

Raw data generated were subjected to a one-way analysis of variance (ANOVA), and means were separated and compared to find the levels of significance at $P < 0.05$.

III. RESULTS

Table 2 shows the proximate compositions of raw and soaked *Senna occidentalis*. the analysis reveals that the raw *Senna occidentalis*has a moisture content of 4%, ash 6%, crude protein 23.75%, crude fiber 5.2%, crude lipid 6.5%, nitrogen-free extract 54.55% while that of soaked has moisture 6%, ash 6%, crude protein 28.75%, crude fiber 4.9%, crude lipid 9% and the nitrogen-free extract 45.35%.
Table 3 shows the proximate analysis of the experimental diets. the crude protein ranges from 37.35 - 39.38%, crude lipid 19 - 24%, crude fibre 4.6 - 4.9%, ash 8 - 12%, moisture 8 - 12% and nitrogen-free extract 12.43 - 21.45%.
Table 4 shows the anti-nutrients compositions of *S. occidentalis*seed meal. It was found to contain Tannins 2.35, saponins 2.75, flavonoids 0.70, and steroid 1.36.

Table 5 shows the growth performance and nutrient utilization of *C. gariepinus* fingerling. Fish fed diets 1 and 2 gave better growth performance than others. Mean weight gain was highest in D2 and lowest in D1. There was no significant difference between the mean weight gain of D2 and others the feed intake decreases as the inclusion of *S. occidentalis* meal increases except for the control diet. the total protein intake was highest in D2 and lowest in D5. the best feed conversion ratio is in the sequence D1>D4>D5>D2>D3.

Table 6 shows water quality conditions in the experimental water with little variations throughout the experiment. Temperature ranges from 25.00 - 29.50°c, dissolved oxygen from 4.53 - 5.60mg/l, pH from 5.99 - 6.49 and ammonia from 0.48 - 3.62.

Table 7 shows thecost of feed, which has a range between 39.19 - 69.34 in which D2 has the highest value and D1 had the lowest value, cost of feeding was recorded as highest in D2 and lowest value in D1. the gross profit in D2 was highest and lowest in D1, the profit intake was recorded as highest in D5 and lowest in D4, and lastly, the Benefit-Cost Ratio was recorded as highest in D5 and lowest in D3.

Table 2. Proximate composition of raw and soaked *Senna occidentalis*seed meal(%)

Parameters	Raw	Soaked
Moisture	4.00	6.00
Ash	6.00	6.00
Crude protein	23.75	28.75
Crude lipid	6.50	9.00
Crude fiber	5.20	4.90
Nitrogen free extract	54.55	45.35

Table 3. Proximate compositions of the experimental diets (%)

Experimental diets	D1	D2	D3	D4	D5
Moisture (%)	12.00	10.00	8.00	8.00	10.00
Ash (%)	12.00	8.00	8.00	12.00	8.00
Crude protein (%)	39.38	39.00	38.75	38.13	37.35
Crude lipid (%)	19.50	24.00	19.00	20.50	21.50
Crude fiber (%)	4.70	4.90	4.80	4.60	4.70
Nitrogen free extract (%)	12.43	14.10	21.45	16.78	18.45

Keys:
D1-Control diet
D2-10% *Sennaoccidentalis*meal diet
D3-20%*Sennaoccidentalis*meal diet
D4-30%*Sennaoccidentalis*meal diet
D5-40%*Sennaoccidentalis*meal diet

Table 4. Qualitative and Quantitative (mg/100g)Phytochemicals present in rawand soaked*S.occidentalis*seed meal

	SOAKED	RAW	
Saponin	++	+++	
Tanins	+	+++	
Flavonoids	++	+	
Steroid	++	+	
Saponin (%)	2.75±1.34	1.00±0.28	
Tannin (%)	2.35±1.33	0.70±0.28	
Flavonoids (%)	0.70±0.14	1.35±0.63	
Steroid (%)	1.36±0.43	0.80±0.14	

Key:
+++ Highly present
++ Moderately present
+ Low

Table 5. Growth Performance and Feed Utilization of *C. gariepinus* Fed *S. occidentalis* Diets for 40 days

Parameters			D1	D2	D3	D4	D5
Initial weight(g)			5.20±1.41	5.45±0.49	5.30±0.42	5.35±0.91	3.50±0.42
Final weight(g)			12.12±0.17^{b}	19.36±2.40^{a}	17.23±1.08^{ab}	15.92±3.28^{ab}	16.52±3.00^{ab}
Initial Length(cm)			9.29±0.65	8.88±0.96	8.96±1.03	9.01±0.68	8.03±0.09
Final Length(cm)			8.60±3.25^{c}	12.50±0.98^{a}	9.72±1.87^{c}	11.15±0.21^{b}	11.50±2.06^{b}
Weight gain (g)			6.92±1.23^{b}	13.56±2.40^{a}	11.93±1.51^{ab}	10.57±2.36^{ab}	13.02±2.58^{a}
Mean Weight gain (g)			1.15±0.20^{b}	2.26±0.39^{a}	1.98±0.25^{ab}	1.76±0.39^{ab}	2.17±0.43^{a}
Survival rate (%)			95.00±7.07^{b}	100.00±0.00^{a}	100.00±0.00^{a}	95.00±7.07^{b}	100.00±0.00^{a}
Initial condition factor (k)			0.63±0.03	0.79±0.18	0.75±0.20	0.72±0.04	0.67±0.05
Final Condition factor (k)			2.91±2.80	0.99±0.11	2.05±1.02	1.14±0.17	1.14±0.41
Specific growth rate(%/day)			0.93±0.28^{b}	1.32±0.16^{ab}	1.28±0.15^{ab}	1.18±0.03^{b}	1.68±0.06^{a}
Relative growth rate(g/fish)			141.64±62.^{31c}	251.84±66.98^{ab}	226±46.72^{b}	196.77±10.44^{c}	370.39±28.83^{a}
Protein intake (g)			8017.20±792.55	9452.31±1241.52	8014.12±69.70	8298.37±1030.58	7474.97±816.28
Feed intake			200.28±19.79	242.26±36.16	204.86±1.78	214.65±26.65	195.68±21.36

Feed Conversion ratio			29.64±8.15^{a}	17.91±0.50^{b}	17.29±2.04^{b}	20.53±2.07^{ab}	15.15±1.36^{b}
Protein efficiency ratio			0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Mean feed intake (g)			5.00±0.49	6.05±0.90	5.12±0.04	5.36±0.66	4.89±0.53

The mean of Data on the same row with different superscripts is significantly different ($p<0.05$)

Table 6. Water Quality Parameter of Water used for Experiment for 40 days

	D1	D2	D3	D4	D5
Temperature(°C)	28.12±1.23	27.50±1.06	27.62±0.88	27.00±0.00	28.00±0.70
pH	6.35±0.21	6.15±0.05	6.26±0.38	6.24±0.37	6.12±0.47
Dissolved Oxygen (mg/l)	5.14±0.16	5.26±0.33	5.30±0.15	5.25±0.23	5.32±0.82
Ammonia(mg/l)	0.63±0.04	0.65±0.04	0.59±0.04	0.60±0.03	0.52±0.07

Table 7. Economic Evaluation of the Experimental Diets

Parameters	D1 (0%)	D2 (10%)	D3 (20%)	D4 (30%)	D5 (40%)
Estimated Investment Cost(Naira)	69.19±23.02	99.34±9.43	85.13±0.56	90.30±6.74	85.08±4.69
Net Production Value(Naira)	692.50±123.74	1356.00±240.41	11193.00±14293.45	1057.50±236.88	1302.50±258.09
Gross Profit(Naira)	623.30±100.72^{b}	1256.65±230.97^{a}	1107.87±150.75^{ab}	967.19±230.12^{ab}	1217.41±253.40^{a}
Cost of Feed(Naira)	39.19±23.02	69.34±9.43	55.03±0.42	60.30±6.74	55.10±4.71
Cost of Feeding(Naira)	33.19±23.02	63.34±9.43	49.03±0.42	54.30±6.74	49.12±4.71
Profit Intake	20.23±8.72	19.49±0.81	21.66±2.58	17.42±1.98	23.53±2.67
Benefit-Cost Ratio	10.27±1.63^{c}	13.59±1.12^{b}	7.65±10.65^{d}	11.64±1.75^{c}	15.24±2.19^{a}

The mean of Data on the same row with different superscript are significantly difference

IV. DISCUSSION

The protein contained in the soaked seed was higher with the value of (28.75) than the raw one (23.75) this is similar to the work of Emmanuel*et al.*(2017). This trend may be due to the effect of hydrolysis during the soaking with an increase in the content of the crude protein, a process often associated with microbial activities. Tamburawa (2010) reported that crude protein increased progressively with an increase in the duration of soaking *sennaoccidentalis*seed. Protein requirement is given high priority in any nutritional study because it is the single nutrient that is required in the largest quantity for growth and development and is also the most expensive ingredient in diet formulation (Lovell, 1989; NRC, 1993). Dietary lipids function as a ready source of energy for fish and also provide essential fatty acids which are needed for fish growth and survival. Fish generally require omega-3 fatty acids rather than omega-6 fatty acids in contrast to terrestrial animals which require omega-6 fatty acids (Kanazawa, 2000). Previous works of Oso*et al.,* (2011) showed the need to use plant meal in combined form to produce the cheapest and required nutrient for fish and this formed the basis of this research work. the replacement of fishmeal with alternate sources of protein has met with varying degrees of success, depending on the nature and composition of ingredients, inclusion level, and method of processing. the crude proteins from the five diets are within the requirements recommended for catfish *C. gariepinus*fingerlings in the tropics which are agreed with the work of (Oso*et al* 2011). the results obtained in these studies agreed with Fasakin*et al.* (2000), Ugwumba, *et al.* (2008) that relatively low fiber and high protein contents as revealed in the fish growth and better utilization by fish growth and feed conversion ratio in these studies. fiber has been documented to support or promote digestion in the feed at a minimal level. It was found that the moisture content of the experimental diets including control was below 20% and this corresponds with the theoretical range of moisture content in all low moisture food (Bradley, 1994). All the diets, however, did not exceed 75%. Any feed sample that does not exceed 75% moisture content is suitable to be utilized as foodstuff for animals. Therefore, *S. occidentalis* meal diets can be classified as low moisture, biological material; hence it is safe for biological spoilage.

The proximate composition of the formulated feeds given to *C. gariepinus*in the experimental diets agrees with the findings of Craig *et al.,* (2002) who stated that prepared or artificial diets may either be complete or supplemental hence they supplied all the ingredients necessary for optimal growth and health of the fish. Most fish farmers use complete diets containing all the required nutrients but yet the growth rate is not encouraging.

The phytochemical composition of *S. occidentalis*is capable of increasing maximum yield in Fingerlings production. Saponin is of great importance in medicine and used in hypercholesterolemia, hyperglycemia, antioxidant, anti-cancer, anti-inflammatory, and body loss. Meanwhile, Flavonoid is a natural biological response; it has a strong inherent ability to modify the body's reaction to allergen, viruses, and carcinogens (Egharevba*et al.,* 2010). Tannins have biological activities that are of benefit in the Production and management of many aliments owing to their antiviral, antibacterial, and anti-tumor activities (Egharevba*et al.,* 2010).

The increase in the weight gain recorded in all the treatments also indicated that the fish responded positively to all the diets and that the protein in *the Sennaoccidentalis* meal diet enhanced the growth of fish. This observation is in agreement with the report of Fagbenro (1996) as well as Osoi*et al.,* 2011. the growth performance of *C. gariepinus*fed varying inclusion levels of *S. occidentalis*seed meal showed that there was an increase in the growth of the fish at the end of the feeding trial. Statistically, there was a significant difference in the weight gain at $p \leq 0.05$; the diet fed with *S. occidentalis* revealed a significant increase in weight gain, specific growth rate, mean feed intake, relative growth rate, and protein intake than the control that have 0% *S. occidentalis,* this observation was also reported by (Dada *et al*., 2015;Adeparusi*et al*., 2010). the increase in the growth performance of *C. gariepinus*fingerlings agreed with the fact that seed meal; wild fruits have the potential in enhancing growth in African catfish (Ochokwu*et al*., 2014). the variations in condition factor (K) of fish may be due to the abundance of food, how they adapt to their habitats, and the development of their gonads (Ochokwu*et al*., 2014). the overall mean condition factor obtained in this study varied slightly with results from other studies. Fafioye and Oluajo (2005) recorded a mean condition factor of 0.79 for *C. gariepinus*in Epe lagoon and Anyanwu *et al*. (2007) recorded K of 0.654 for *C. gariepinus*reared in water recirculatory system. the values obtained in this study revealed that the fishes were in good condition.

The physicochemical parameters of water were within the acceptable range recommended for the rearing and culture of most tropical fish, including the African catfish (fafioye*et al*., 2005 Duniya, 2006),*C. gariepinus*like any other fish species requires an optimum level of these water parameters for optimum survival, growth, and production. Boyd and Lichotkopler (1979) reported that a pH of 6.5-9.0 and a temperature of 22-27°C give the best growth for cultured tropical fishes. Adesulu (2001) indicated that any dissolved oxygen value below 4mg/l begins to stress fishes and pH kills fish due to corrosive effect, such acidic water diminishes the appetites of fish and thus reduces their growth rate, at pH of 9 water becomes unproductive because carbon dioxide becomes unavailable in such water and at pH 11, fish dies. the hydrogen ion concentration (pH) in this study ranged between 5.99-and 6.49.

In the economic evaluation of feeding *Clariasgariepinus* fingerlingson experimental diets, D2 recorded the highest Benefit: Cost ratio. the positive Benefit: the cost ratio recorded in all the diets indicates that *Clarias*fingerling can be economically reared on all diets. However, the result further indicated that the inclusion of *Sennaoccidentalis*seed meal to 10% in the diet of *Clarias*can result in a better Benefit: Cost ratio than when fed with a fishmeal diet alone, which shows an increase in the fish value above the amount invested (Sogbesan*et al*., 2006)

V. CONCLUSION

From the result obtained in this study, it is concluded that the soaked processing technique is very effective in processing *Sennaoccidentalis* meal and it can relatively reduce anti-nutritional factors in the seed. When processed, catfish fingerlings *(Clariasgariepinus)*can make use of soaked *Sennaoccidentalis*seed meal at an inclusion level of up to 10 % in their diets to give an excellent performance in growth, nutrient utilization, and body composition without any adverse effect on their body. However, an increase above this percentage would lead to depression in their growth response.

VI. RECOMMENDATION

The inclusion of *S. occidentalis* seed meals in the diet of *C. gariepinus* gave a better growth performance at a 10% inclusion level. We recommend that further work should be carried out on the amino acid profile of the seed to evaluate any deficiency in the amino acid profile of the seed. Other processing methods should be employed to allow an increase in the inclusion level of *Sennaoccidentalis*meal in feed production.

REFERENCES

[1] H. A. Adewole and V. F. Olaleye, Growth Performance in ClariasgariepinusFingerlings fed Blood Meal – Bovine Rumen Digesta Blend Diets. Ife Journal of Science, 16 (3) (2014) 495-503.

[2] N. Dulvy and E. Allison, A Place at the Table?Nature Reports.Climate Change 3 (2009) 68–70.

[3] FAO,the State of World Fisheries and Aquaculture. FAO, Rome.(2014) 223.

[4] J. Umaru,J. Auta, S. Oniye and P. Bolorunduro, Growth and economic performance of African catfish, Clariasgariepinus (Burchell,1822) Juveniles to imported and local feeds in floating bamboo cages, International Journal of Fisheries and Aquatic Studies, 4(2), (2016) 221-226.

[5] A. P. Ekanem, V. S. Eyo, A. I. Obiekezie, U. I. Enin, and P. J. Udo,A Comparative Study of the Growth Performance and Food Utilization of the African Catfish (Clariasgariepinus). Fed Unical Aqua Feed and Coppens Commercial Feed.Journal of Marine Biology and Oceanography, 1 (2) (2012) 1-6.

[6] A. O. Tunde, O. S. Oluwagbemiga, A. Babatunde, and O.O. Oluseyi,the Growth Performance of African Catfish (Clariasgariepinus) Fed Commercially Prepared Imported Fish Feeds. International Journal of Agricultural Economics, 1(3) (2018) 57-61.

[7] P. Li, K. Mai, J. Trushenski, and G. Wu, (2009). New developments in fish amino acid nutrition: towards functional and environmentally oriented aquafeeds. Amino Acids, 37 (2009) 43–53.

[8] P. Edwards,C. K. Lin, and A. Yakupitiyage, Semi-intensive pond aquaculture. In: Beveridge, M.C.M. and McAndrew, B.J., (Eds.) Tilapias: Biology and Exploitation, Great Britain: Kluwer Academic Publishers. (2000) 327-375.

[9] FAO, the State of World Fisheries and Aquaculture. FAO, Rome. (2012) 209.

[10] N. Daniel, Status of aquaculture concerning nutrition and feed. International Journal of Fisheries and Aquatic Studies, 5(1) (2017) 333 345.

[11] I. Eunice, A.Adejoke, O. James, E. Josephine, and O. Grace, Effects of Varying Levels of Moringaoleiferaon Growth Performance and Nutrient Utilization of ClariasgariepinusPost-Fingerlings. American Scientific Research Journal for Engineering, Technology, and Sciences, 32(1) (2017) 79-95.

[12] B. Glencross, M. Booth, and G. Allan, A Feed Is Only as Good as Its Ingredients: A Review of Ingredient Evaluation Strategies for Aquaculture Feeds. Aquaculture Nutrition, 13(2007) 17–34.

[13] Y. R. Yue, and Q. C. Zhou, Effect of Replacing Soybean Meal With Cottonseed Meal on Growth, Feed Utilization, and Hematological Indexes for Juvenile Hybrid Tilapianiloticus .O. Aureus. Aquaculture, 284 (2009) 185-189.

[14] C. Augustine, B. S. Abdulrahman, B. Masudi, and A. M. Rahab, Comparative evaluation of the proximate composition and anti-nutritive components of Sennaobtusifolia(Cassia obtusifolia) and Sennaoccidentalis(Cassia occidentalis) indigenous to Mubi Area of Adamawa State Nigeria. International Journal of Management and Social Science Research, 3(2013) 9-12.

[15] A. A. Adebayo and A. L. Tukur, Adamawa State in maps publication Department of Geography, Federal University of Technology Yola, in Co-operate with paraclete publications. A division of paraclete and sons Nigeria, (1999).

[16] A. Waters-Bayer, Soybean Daddawa: An innovation by Nigerian women, (1988).

[17] AOAC, Association of Official Analytical Chemists), Official Methods of Analysis, Association of Official Analytical Chemists.17th Edition.Washington DC, USA. (2004) 67 - 78.

[18] O. A. Sogbesan, N. Ajuonu, B. O. Musa, andA. M. Adewole, Harvesting Techniques and Evaluation of Maggot Meal as Animal Dietary Source for 'Heteroclarias' in Outdoor Concrete Tanks. World Journal of Agricultural Science 2(4) (2006) 394-402.

[19] I.Emmanuel, O. Adeson,O. Adekunle, and O. Oluwafemi, Effect of Fermentation on the Physicochemical Properties and Nutritional Valuable Mineral of Locust Bean (Parkiabiglobosa). American Journal of Food Technology, 12(6) (2017) 379-384.

[20] Yashin, Y.I.; Ryzhnev, V.Y.; Yashin, A.Y.; Chernousova, N.I. Natural Antioxidants: Their Content in Foods and Impact of Human Health and Aging; TransLit: Moscow, Russia, 200

[21] Yashin, Y.I.; Ryzhnev, V.Y.; Yashin, A.Y.; Chernousova, N.I. Natural Antioxidants: Their Content in Foods and Impact of Human Health and Aging; TransLit: Moscow, Russia, (2009).

[22] M. S. Tamburawa, Effect of locust bean seed meal diets on the performance and carcass characteristics of Broiler chickens. A Ph.D. the proposal, Presented at the post-graduate seminar series of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University (A.B.U) Zaria, (2010).

[23] R. T. Lovell, Nutrition and Feeding of Fish.Springer Science and Business Media, USA.(1989) 267.

[24] NRC, Nutrition requirement of fish, Committee on Animal Nutrition, Board on Agriculture. National Research Council.National Academy Press, Washington, D.C, (1993).

[25] A. Kanazawa, Essential fatty acids and lipid requirements of fish. In nutrition and feeding in fish, Academic Press London. (2000) 70-87.

[26] O. A. Oso, R.Sobayo, V. Jegede, A.Fabiola, O. S.Iyasere, P. Dele, A.Bamgbose, and A. Cecilia, Animal Science Journal, 82(3) (2011) 468-474.

[27] E. A. Fasakin, B. A. Falaye, and A. A.Eyo, Inclusion of Poultry Manure in Diets for Nile Tilapia (Oreochromisniloticuslinn), Journal Fisheries Technology, 2 (2000) 51-56.

[28] A. A.A. Ugwumba, O. A. Sogbesan and A.A.A.Ugwumba,Nutritional values of Some Nonconventional Animal Feedstuffs used as Fishmeal Supplemented in Aquaculture Practices in Nigeria. Turkish Journal of Fisheries and Aquatic Science 8 (2008) 159-164.

[29] R. S. Bradley,H. F. Diaz, J. K. Eischeid, P. D. Jones,P. M. Kelly, and P. M. Goddess, Precipitation Fluctuation Over Northern Hemisphere Land Areas Since the Mid-19th Century. Science 237 (1994) 171-175.

[30] S. Craig, and I. A.Helfrich, Understanding Fish Nutrition, Feeds, and Feeding. Virgin Cooperative Extension Publication, (2002) 420-256.

[31] H. O. Egharevba and F. O. Kunle, Preliminary Phytochemical and Proximate Analysis of the leaves of Piliostigmathonningii(Schumach) Milne- Redhead. Ethnobotanical Leaflets, 14 (2010) 570-577.

[32] A. S. Fagberon, B. Newt and L. Musa, Effect of enclosure color on growth performance of Clariasgariepinus. Journal of Nigeria Science Sed. (1996) 49

[33] A. A. Dada, Use of fluted pumpkin (Telfairiaoccidentalis) leaf powder as feed additive in African catfish (Clariasgariepinus) fingerlings. International Journal of BiologicalChemical Sciences 9(1) (2015) 301-307.

[34] E. O. Adeparusi, A. A. Dada and O. V. Alale, Effects of Medicinal Plant (Kigelia Africana) on Sperm Quality of African Catfish ClariasGariepinus(Burchell, 1822) Broodstock.Journal of Agricultural Science 2 (1) (2010) 791-795.

[35] I. J. Ochokwu, L. U. Onyia, and K. O. Ajijola, Effect of Azanzagarckeana(Goron Tula) Pulp Meal Inclusion on Growth Performance of ClariasgariepinusBroodstock (Burchell, 1822). Nigeria Journal of Tropical Agriculture, 14 (2014) 134-146.

[36] O. O. Fafioye, S. O. fadage, A. A. Adebisi, andG. K. A.Omoyinmi, Effect of Dietary Soybean on Growth Performance and Body Composition of African Catfish (Clariasgaripinus,Burchell) Fingerlings. Turkish Journal of Fisheries and Aquatic Sciences, 5 (2005) 11-15.

[37] J. N. Duniya, Effect of processed locust bean seeds (Parkiabiglobosa) substituted diet on the growth of mud catfish (ClariasgariepinusBurchell) Unpublished Msc, thesis, Department of Biological Science, Faculty of Science, Ahmadu Bello University, Nigeria, (2006) 64.

[38] C. F. Boyd and F. Lichotkopler, Water quality management in pond fish culture. Researchand Development Series No.22.project AID/DSAN-G-0039, (1979) 30.

[39] E. A. Adesulu,Pisciculture: Essential production information, 1st Edition, Communiucation Limited, Lagos, Nigeria, (2001) 118.

[40] D. C. Anyanwu, Effects of some tropical plants leaf meals on the Performance of Heteroclarias (H. bidorsalis x C. gariepinus). Ph.D. Thesis, Fed. Uni. of Techno, Owerri, Imo State, Nigeria, (2007) 203.