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Growth and Haematological Characteristics of African Catfish (*Clarias Gariepinus* Burchel, 1822) Fed African Star Apple Kernel Diets

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Abstract

An investigation was conducted to determine the effect of feeding African Star Apple Kernel (*Chrysophyllum africanum*) based diets on the growth and haematological characteristics of African catfish (*Clarias gariepinus*) for 8 weeks. One hundred and thirty five African catfish fingerlings (mean weight= 2.8g) were allotted to three diets (CP=40%) in which African Star Apple Kernel meal substituted maize at 0%, 50% and 100% dietary levels respectively and fed at 5% biomass daily. Result on growth performance indicated significant (*P*<0.05) differences in weight gain, feed intake and Specific growth rate of fish between the control group and those fed the trial diets. However, blood analyses showed significant differences (p<0.05) in the values of haemoglobin, while red blood cell and packed cell volume of the trial fish were low compared to the control group. There was no significant difference in the leucocytes count among the groups.

Keywords: African Star Apple Meal, diets, *Clarias gariepinus*, response, blood

Introduction

Nutritionally, fish is about the cheapest and direct source of animal protein and micro nutrients for several millions of Africans (Bene and Heck, 2005). In Nigeria, fish is widely accepted by the populace, thereby making the demand for it to be on the increase. In recent time, a good amount of fish consumed by Nigerians is from aquaculture because the conventional fish catch from ocean and rivers are continually declining due to over fishing and environmental hazards (FAO, 2006) [19].

Jamiu and Ayinla (2003) [21] reported that feed accounts for minimum of 60% of the total cost of fish production in Africa including Nigeria and a major factor that determines the viability and profitability of fish farming enterprise. As aquaculture production becomes more and more intensive in Nigeria, fish feed will be a significant factor towards increasing the productivity and profitability of aquaculture (Akinrotimi *et al.*, 2007) [10]. The need to intensify the culture of the fish, so as to meet the ever increasing demand for fish has made it essential to develop suitable diets either in supplementary forms for earthen ponds or as complete feed in tanks and other artificial enclosures (Olukunle, 2006) [26].

For the purpose of nutritional and economic benefits, previous researchers have made attempts at increasing the use of nonconventional plants and animal materials to replace conventional feed ingredients like maize and fish meal in fish feed ration (Olatunde, 1996; Baruah *et al.*, 2003; Eyo, 2004; Agbabiaka, 2012; Agbabiaka *et al.*,2013b,c) [25, 11, 16, 6, 7, 8, 9]. According to Olurin *et al.* (2006) [27], maize is the major source of metabolisable energy in most compounded diets for catfish species. This is because it is readily available and digestible. However, the increasing and prohibitive cost of this commodity has necessitated the need to search for an alternative source of energy.

Recently, FAO(2006) [19] reported shortages in the production of cereals, a serious issue in many countries including Nigeria; this perhaps resulted in reporting the use of cereal products, especially maize in fish feed as becoming increasingly unjustified in economic terms (Tewe, 2004) [30]. There is therefore, the need to exploit cheaper energy sources to replace expensive cereals in fish feed formulation to relieve the food/ feed competition between man and animal for profit maximization.

Unorthodox feedstuff such as African Star Apple kernel is very appropriate for this purpose. The Crude protein content of raw Star Apple Kernel meal was found to be 10.13±0.12% (Agbabiaka *et al*., 2013a) [7, 8, 9] crude protein which is comparable to some orthodox energy feedstuffs such as maize and millet (CP = 9 – 10%) and tiger nut (7 – 9.5%) according to Aduku (1993) [4]. Oladele *et al*. (2009) and Agbabiaka (2012) [6] respectively. African star apple called *Chrysophyllum africanum* botanically, Agbalumo (Yoruba), Agwaluma (Hausa), Udara (Igbo) and Udari (Efik and Ibibio) belongs to the Sapotaceae family. It is a popular tropical fruit tree, and widely distributed in the low land rain forest zones. Distributed throughout the southern parts of Nigeria and frequently found in villages.

In Nigeria, *Chrysophyllum africanum* is associated with dry season (December-April) when cereal such as maize is usually scarce and has been enjoyed over the years by Nigerians as a fruit (Adewusi, 1997) [2]. But more studies are supporting its folklore use for treating diseases such as diabetes, heart disease and drug resistant bacteria. Culturally, African Star Apple (Udara) seeds are threaded as anklets in dancing in Nigeria. Also, young people use the seeds to play a peculiar outdoor game or the seed discarded (Adewusi, 1997) [2].

African star apple kernel is always regarded and seen as waste that has no economic value except for those that use it for traditional game, but using it to replace maize in the formulation of feed for livestock and fish will make it useful and also help to minimize the cost of feeding livestock and fish thereby reducing the competition between man and feed formulating industries on one hand and curtailing disposal/environmental problems also (Agbabiaka *et al.*, 2013a) [7, 8, 9].

Materials and Methods

Experimental site and sample preparation

The experiment was conducted at the Fish farm complex, Imo State Polytechnic Umuagwo-Ohaji. The sample (African Star Apple) used in this experiment were picked in the Polytechnic environment. The pulp (edible portion) was removed. The seed were dehulled to expose the mesocarp which was sun-dried for six days. The dried sample was ground into powder to form African Star Apple Kernel Meal (ASAKM) in order to facilitate pelleting. Sample of the African star apple meal was analysed for proximate composition as stipulated by AOAC (2000) [1] and shown in Table 1.

Table 1: Proximate Composition of African Star Apple Kernel Meal (ASAKM)

Nutrients	Concentration (%)
Moisture	14.66
Ash	7.25
Crude Protein	8.13
Crude Fat	9.72
Crude Fibre	1.22
Nitrogen Free Extracts	71.45

Feed formulation

The test ingredient (ASAKM) was incorporated with other feedstuffs to formulate three diets at 40% crude protein in which African star apple meal replaced maize at 0%, 50% and 100% respectively, while the control diet (0%) contained no African star apple meal. The diets produced were pelleted using 2mm die pelleting machine. The pelleted feeds were sundried to crispy for five days to prevent the growth of moulds and thereafter packed in waterproof bags and labelled accordingly before storage at room temperature.

Table 2: Composition of ASAKM Based Diets Fed to African Catfish Fingerlings

Dietary inclusion of ASAKM			
Ingredients	0%	50%	100%
Star Apple Kernel	0.00	5.00	10.00
Maize	10.00	5.00	0.00
Soya bean	53.00	53.00	53.00
Fish meal	26.00	26.00	26.00
Spent grain	6.00	6.00	6.00
Bone meal	2.00	2.00	2.00
Oil	2.00	2.00	2.00
Salt	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Premix	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Total	100.00	100.00	100.00

Experimental fish and design

One hundred and thirty five African Catfish (*Clarias gariepinus*) fingerlings with average of 2.8g body weight were purchased from a reputable commercial hatchery in Port Harcourt, Rivers State, Nigeria. The fish were fed with commercial feed for the period of seven days while undergoing acclimatization. Subsequently, they were randomly assigned to the three treatment diets at 45 fish per treatment in hapa nets measuring 1×1×1m suspended in outdoor concrete tank. Each treatment was replicated trice with fifteen fish per replicate. Thereafter, the fish were starved for 24-hours prior to the commencement of the feeding trial.

The experimental diets were fed to the fish at the rate of 5% body weight per day, shared twice between the hours of 8-9am and 5-6pm. The experiment lasted for the period of 8 weeks.

Data Collection and Statistical Analysis

The experimental fish (fingerlings) in each hapa were batch weighed at the beginning of the experiment (initial weight) and weekly thereafter, using a digital weighing balance. Fish were returned into their respective hapas thereafter; while feed intakes were adjusted according to the new body weight. Care was taken to curtail stressing the fish by making sure that the sampling/weighing was carried out in the morning between the hours of 7-8am when the sun is not yet out. The fish were not usually fed on sampling days to avoid regurgitation.

Data on the feed intake, weight gained and feed conversion ratio for the three groups were computed and subjected to Analysis of variance (ANOVA), where significant difference was detected, mean were separated using Duncan new multiple range test as outlined by Obi (1990).

Biological evaluation

- Feed Conversion Ratio (FCR) = $\frac{\text{Feed intake(g)}}{\text{Weight gain (g)}}$
- Weight gain(g) = Final weight(g)– Initial weight(g)
- Mean Growth Rate (MGR) = $\frac{\text{Weight gain(g)}}{\text{Time (days)}}$
- Specific Growth Rate (%/day) =

  $$\frac{\text{log Final Weight} - \text{log Initial Weight}}{\text{Time (days)}} \times \frac{100}{1}$$
- Protein Efficiency Ratio (PER) = $\frac{\text{Weight gain(g)}}{\text{Protein intake}}$
- Protein intake = Quantity of feed eaten × **%** Crude Protein in feed.

Haematological evaluation

At the last day of the feeding trial, two fish were taken from each of the replicates and put in separate water in bowls labeled accordingly. 150mg/liter of tricane methane sulphonate (MS222) was administered to the fish to tranquillize them as stated by Osuigwe *et al. (2005)* [29]. Blood samples were collected with hypodermic syringes (2ml) using heparinized tubes respectively. The blood samples collected were taken to the laboratory for haematological assessment such as Haemoglobin (Hb), Packed Cell Volume (PCV), Red blood cell (RBC), White blood cell (WBC), Mean cell volume (MCV), Mean cell haemoglobin (MCH), Mean cell haemoglobin concentration (MCHC) according to Campbell (1988).

Results And Discussion

The result of the proximate analysis of Star Apple Kernel meal is shown in Table 3, while Tables 4 and 5 represent the growth performance and haematological characteristics of fish fed ASAKM based diets respectively. The proximate analysis of the diets (Table 3) revealed that the crude protein content was highest in control (T_1) and reduced as the concentration of Star Apple Kernel meal (ASAKM) increased in the diets. This may be attributed to the inferior crude protein content (8.13%) of the raw test ingredient (ASAKM) compared to maize (10% CP) (Aduku, 1993; Agbabiaka *et al.*, 2013a) [4, 7,8, 9].

The crude fibre is relatively lower in ASAKM based diets compared to the control. However, it was expected that the experimental fish will consume more of Star Apple Kernel meal but the reverse was the case (Esonu *et al.*, 2001; Agbabiaka, 2012) [6]. This may be attributed to the inherent anti-nutritional factors of African Star Apple Kernel such as tannins, oxalate and phytate that inhibit feed intake and subsequently the utiization of nutrients for growth (Agbabiaka *et al.*, 2013a) [7, 8, 9].

The above reason was perhaps responsible for the poor growth rate exhibited by the fish on ASAKM diets (Table 4). The result on the growth performance of *Clarias gariepinus* fingerlings fed ASAKM diet shows that the highest mean weight gain of 25.50g was obtained in the control group (T_1), while the other treatments with ASAKM diets recorded the values of 14.50g and 13.50g for T_2 and T_3 respectively ($p<0.05$). There was also a significant ($P<0.05$) difference between the fish in control diet T_1 compared with T_2 and T_3 in feed intake and this is attributed to the anti-nutrients such as tannins and phytate that inhibits feed intake. Similar observation was reported when raw mango seed kernel diets were fed to fingerlings of *Clarias gariepinus* (Agbabiaka *et al.*, 2010) [5]. Generally, there was increased body weights of the fish from the commencement of the study to the end of the trail, this means that the diets were adequate in nutrients required for growth of the Clariid catfish especially the crude protein which is recommended to be 35-40% (Faturoti *et al.*, 1986; Fagbenro *et al.*, 1992; NRC, 1997) [18, 17, 23].

The erythrocytes count ranged of 2.78 – 4.60 x 10^6/mm^3 is above the range of (2.3 - 2.9 x 10^6) and (1.5 x 10^6/mm^3) described for catfish by Gabriel *et al.* (2004) [20] and Adeyemo *et al.* (2003) [3] respectively. Similar observation was noted by Osigwe *et al.* (2005) [29] who recorded (1.45 x 10^6/mm^3) but within the value of 3.50 ± 0.35 x 10^6/µl reported when ethanoic extracts of *Garcinia kola* seeds were fed to *Clarias gariepinus* brood stock by Dada and Ikuerowo (2009) [14].

The haemoglobin concentration ranged within 6.80-9.50g/dl. These values were slightly below the value of 9.60g/100ml recorded by Omitoyin (2006) [28] for African catfish juvenile fed poultry litter and 10.62g/100ml obtained by Osigwe *et al.* (2005) [29] who fed *Clarias gariepinus* with Jackbean meal based diets.

The packed cell volume (PVC) was highest in the control group (28.0%) while the least value of 23.0% was recorded in catfish group fed ASAKM at 100% dietary inclusion ($P<0.05$). These values were in agreement with Musa and Omoregie (1999) [22] who recorded a PVC range of 27.58 - 35.50% for catfish. There was no significant difference ($p>0.05$) in white blood cell count among the treatments.

The haematological values of the experimental fish presented in Table 5 generally showed that red blood cell, packed cell volume and haemoglobin respectively were low in the fish fed ASAKM diets compared with control; this may be due to the presence of phytin phosphate and phytic acid in Star Apple Kernel meal (Agbabiaka, *et al.,* 2013a) [7,8, 9]. These substances have been reported to chelate divalent metals such as iron, calcium and magnessium that are necessary for blood formation (Osuigwe *et al.*, 2005; Agbabiaka, *et al.,* 2013b) [29, 7,8, 9]. However, low feed intake can also be responsible for inadequate nutrient intake and resultant under utilization for blood formation and other metabolic activities.

However, the mean cell haemoglobin concentration (MCHC) reported in this study ranged between 29.60-30.00%, this is in agreement with Agbabiaka *et al.* (2013b) [7, 8, 9] who reported MCHC value of 29.9 ± 0.2% when tigernut based diets were fed to *Clarias gariepinus* but is slightly below the value of 33.97% recorded by Adeyemo (2003) [3] and Docan *et al.* (2010) for African catfish and *Silurus glanis* (European catfish) juvenile respectively. This may be due to species differences and age of the fishes that greatly influences value of blood profile and/or haematological indices (Docan *et al.* (2010).

Nevertheless, there was no mortality throughout the duration of the study. This shows that ASAKM was not lethal to the fish though it did not support growth appreciably, hence, may be recommended for ornamental fish feed fomulation instead of aquaculture fish species necessary to be fattened within a short period.

Table 3: Proximate Composition of the ASAKM Based Diets

Dietary Treatments			
Parameter	**T_1**	**T_2**	**T_3**
Moisture content	6.40	8.26	8.10
Ash	13.99	11.85	12.68
Crude Protein	39.93	37.37	36.77
Crude Fat	9.24	12.85	10.32
Crude Fibre	8.23	6.77	6.11
Nitrogen Free Extracts	22.21	24.90	26.02

Table 4: Growth Performance of African Catfish Fed ASAKM Based Diets

Dietary Treatments			
Parameters	**T_1**	**T_2**	**T_3**
Mean Initial Weight (g)	2.80^a	2.80^a	2.80^a
Mean Final Weight (g)	28.60^a	17.30^b	16.30^b
Mean Weight Gain (g)	25.50^a	14.50^b	13.50^b
Specific Growth Rate (%/day)	2.48^a	2.05^b	1.99^b
Feed Conversion Ratio	1.10^a	1.60^b	1.70^b
Protein Efficiency Ratio	2.27^a	1.67^b	1.60^b
Mean Growth Rate (g)	0.45^a	0.26^b	0.24^b
Protein Intake	11.24^a	8.69^b	8.45^b
Mean Feed Intake (g)	28.15^a	23.25^b	22.98^b

^{ab}Means within rows with same superscript are not significantly different ($P>0.05$)

Table 5: Haematology of African Catfish Fed ASAKM Based Diets

Dietary Treatments			
Parameters	**T_1**	**T_2**	**T_3**
Haemoglobin (g/dl)	9.50^a	7.20^{ab}	6.80^b
Packed Cell Volume (%)	28.00^a	24.00^b	23.00^b
Red Blood Cell (×10^6/mm^3)	4.60^a	3.45^a	2.78^b
White Blood Cell (×10^3/mm^3)	11.50^a	12.40^a	10.90^a
Mean Cell Volume (fl)	8.94^a	7.46^a	6.92^b
Mean Cell Haemoglobin (Pg)	3.10^a	2.10^a	2.50^a

Mean Cell Haemoglobin Conc. (g/dl)	30.00 [a]	30.00 [a]	29.60 [a]
Lymphocytes (%)	95.00 [a]	90.00[b]	93.00[ab]
Monocytes (%)	5.00 [a]	10.00[b]	7.00[c]
Basohpils (%)	0.00	0.00	0.00
Esinophils (%)	0.00	0.00	0.00
Neutrophils (%)	0.00	0.00	0.00

[abc] Means within rows with same superscript are not significantly different (P>0.05).

Conclusion and Recommendation

The result of this study has indicated that Star Apple Kernel meal has little or no deleterious effect on the health status of the trial fish since there was no mortality recorded throughout the trial period, hence, may be recommended for ornamental fish feed because of inferior growth of the trial fish species as shown in this study. However, further studies may be carried out with processed or enzyme supplemented Star Apple Kernel Meal.

References

1. AOAC. Official method of analysis. Association of Official Analytical Chemist (Ed. Herrick K), 17th Edition. Washington DC, USA, 2000.
2. Adewusi HA. The African Star Apple (*Chrysophyllum albidum*) indigenous knowledge from Ibadan, Southern Nigeria. In: proceeding of a National workshop on the potential of the star apple in Nigeria (eds) Denton O A, Lapido D O, Adetoro M A, Sarumi M B, 1997, 25-33.
3. Adeyemo O, Agbede SA, Olaniyan AO, Shoaga OA. The haematological response of *Clarias gariepinus* to change in acclimation temperature. Afri. J of Biomed. Res. 2003; 6:105-108.
4. Aduku AO, Tropical feedstuffs analysis table. Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria, 1993.
5. Agbabiaka LA, Ekeocha CA, Amadi SA. Performance of catfish (*C. gariepinus*) fingerlings fed mango seed kernel base diets as substitute for maize. International Journal of Tropical Agric. and Food Science. 2010, 4(4).
6. Agbabiaka LA. Evaluation of tigernut meal (*Cyperus esculentus L*) as replacement for maize in diets of broiler chicks and African catfish (*Clarias gariepinus* Burchell, 1822). Ph.D Thesis, Department of Animal science and Fisheries. Imo state University, Owerri, Nigeria, 2012, 174.
7. Agbabiaka LA, Nwankwo FC, Eke LO. Nutrients and phyto- chemical assay of African Star Apple kernel (*Chrysophyllum africanum*) as potential feedstuff in fish and livestock production. British Journal of Applied Sciences and Technology. 2013a; 3(4):1215-1219.
8. Agbabiaka LA, Madubuike FN, Ekenyem BU. Haematology and serum characteristics of African catfish (*Clarias gariepinus*) fed graded levels of tigernut based diets. American Journal of Experimental Agriculture. 2013b; 3(4):988-995.
9. Agbabiaka LA, Okorie KC, Ezeafulukwe CF. Plantain peels as dietary supplement in practical diets for African Catfish (*C. gariepinus*, Burchell 1822) fingerlings. Journal of Agriculture and Biology, North America. 2013c; 4(2):155-159.
10. Akinrotimi OA, Gabriel UU, Anyanwu PE, Anyanwu AO. Influence of sex, acclimation method and period on haematology of *Sarotherondon melanotheron*. Res. J Biol. Sci. 2007; 2(3):348-352.
11. Baruah K, Sahu NP, Debnath D. Dietary phytase: An idea approach for a cost effective and low polluting aqua feed. NAGA, 2003; 27(3):15-19.
12. Bene C, Heck S. Fisheries and the millennium development goals. Solution for Africa. NAGA 2002; 28:8-13.
13. Campbell TN, Avian Haematology and Cytology. Lowa state University press, USA, 1988.
14. Dada AA, Ikuerowo M. Effect of ethanoic extracts of Garcinia kola seeds on growth and haematology of catfish (*Clarias gariepinus*) broodstock. African Journal of Agricultural Research. 2009; 4(4):344-347
15. Docan A, Cristea V, Grecu L, Dediu L. Haematological response of the Europen catfish, *Silurus glarus* reared at different densities in flow through production system. Archive Zootechnica. 2010; 13(2):63-70
16. Eyo AA. Fundamental of fish nutrition and diet development an overview. In National Workshop on fish feed development and feeding practices in aquaculture (A.A Eyo (eds)) NIFFRI, New Bussa, 2003-2004, 65.
17. Fagbenro OA, Balogun AM, Anyanwu CN. Optimal dietary protein level for *Heterobranchus bidorsalis* fingerlings fed compound diets. The Israel Journal of Aquaculture- Bamidgeh. 1992; 44:87-92.
18. Faturoti EO, Balogun AM, Ugwu LLC. Nutrient utilization and growth responses of *Clarias lazera* fed different dietary protein levels. Nigerian Journal of Applied Fisheries and Hydrobiology. 1986; 1:41-43.
19. FAO Food and Agricultural Organisation, Rome production year book, 2006, 74.
20. Gabriel UU, Ezeri GNO, Opabunmi OO. Influence of sex, source, health, status and acclimation on the haematology of *Clarias gariepinus* (Bruchell 1822). African Journal of Biotech. 2004; 3(9):163-467.
21. Jamiu DM, Ayinla OA. Potential for the development of Aquaculture in Africa. *NAGA* 2003; 26(3):9-13.
22. Musa SO, Omoregie E. Haematological changes in mudfish, *Clarias gariepinus* (Bruchell 1822) exposed to malachite green. Journal of Aquatic. Science. 1999; 14:37-42
23. National Research Council, N.R.C., *Nutrient Requirements of warm water fishes*. National Academy Press, Washington, DC, USA, 1997, 148.
24. Obi IU. Statistical method of detecting differences between treatment means. 2nd edition. Snaap Press, Enugu, Nigeria, 1990.
25. Olatunde AA. Effect of supplementation of soyabean diet with L and D, L. methionine on the growth of mud fish (*C. angullaris*) Nigeria. J Biotech. 1996; 9(1):9-16.
26. Olukunle O. Nutritive potential of sweet potato peel and root replacement value for maize diet of African Catfish advanced fry. J Food Tech. 2006; 4(4):289-293.
27. Olurin KB, Olujo EA, Olukoya OA. Growth of African Catfish fingerlings, fed different levels of cassava. W. J Zool. 2006; (1):54-56.
28. Omitoyin BO. Haematological changes in the blood of *Clarias gariepinus (*Burchell 1822*)* Juvenile fed poultry litter. Livestock Research for Rural Development. 2006; 18(11):1-6.

29. Osuigwe DI, Obiekezie AI, Onuoha GC. Some haematological changes in hybrid catfish (*Heterobranchus longifilis* X *Clarias gariepinus*) fed different levels of raw and boiled jackbean (*Canavalia ensiformis*) seed meal. African Journal of Biochemistry. 2005; 4(9):1017-1021.
30. Tewe OO. Cassava for livestock feed in Sub-Sahara Africa. FAO Rome, Italy, 2004, 64.