

Influence of Candle Bush (*Senna alata*) on the Growth Metrics of African Catfish (*Clarias gariepinus*)

Olaniyi C.O, Fawole O.O, Abiodun-Adeyanju O.M, Opanike A.O, Awotunde M.O and Agbaje M. S.
Department of Fisheries and Aquaculture,
Ladoke Akintola University of Technology,
Ogbomoso, Oyo state, Nigeria
Corresponding e-mail: omabiodun-adeyanju@lautech.edu.ng

ABSTRACT

The effect of candle bush leaf meal (*senna alata*) was investigated on the growth performance of *Clarias gariepinus*, (mean body weight, 119.8g). Five diets with crude protein of 35% were formulated with varying inclusion levels of candle bush leaf meal. T1 (control) has 0 g of CBLM, while T2, T3, T4 and T5 has 0.02, 0.03, 0.04 and 0.05g/100g of the diets. A total of 105 juveniles of *C. gariepinus* were randomly distributed into 120-liter tank replicating twice at stocking density of 7 fish per tank and constant water level was maintained in the experimental tanks. The tank contained pond water (pH \approx 7.1, oxygen \approx 4.2 mg/l, temperature \approx 26. 2 °C). The fish were fed to satiation twice daily between 8.00hrs and 17hrs for a period of 84 days. Records of feed intake and weight gain were taken every two weeks. At the end of the feeding trials, Data collected on weight changes and feed-intake were subjected to one way analysis of variance (ANOVA) using Completely Randomized Design (CRD). The result of this study found that including 0.03g of candle bush leaf meal (CBLM) in catfish diets resulted in the best growth performance result.

Keywords: *Senna alata*, *Feed intake*, *Weight gain*, *Satiation*, *Feed conversion ratio*

INTRODUCTION

In Nigeria, fish farming continues to make substantial contributions to source of animal protein requirements for her teaming population. Fish products are relatively cheaper compared to beef, pork and other animal protein sources in the country (Ajibesin *et al.*, 2008). The culture of fish is receiving a lot of attention in Nigeria with the result that new cultivation techniques are being introduced and adopted. One can hardly speak about aquaculture today in Nigeria without the mentioning of artificial propagation of a culturable species, African Catfish (*Clarias gariepinus*) for commercial purposes. This fish species is most often chosen for its fast-growing nature and its acceptability to consumers especially in Africa, Nigeria included. Inyat and Salim (2011) pointed out that the story of the Nigerian aquaculture is essentially that of catfish farming. *Senna alata* belongs to the class *Fabaceae*. It is identified as an important medicinal and ornamental plant. *Senna alata* is a native of tropical America. It is now widespread in warm countries. It includes several medicinal values such as antimicrobial, antifungal anti – inflammatory, purgative and

antitumor. It is commonly called as candlestick plant (England), ringworm, wild senna (England), semaiagathi (Tamil). All the parts of this plant have medicinal properties. It is rich in important phytochemical constituents such as polysaccharides, glycosides, alkaloids, phenols, flavonoids, cardiac glycosides. Ancient histories the medicinal plants sources were used as the immune modulating agents in traditional medicines. Medicinal plants are used not only to treat diseases but also as a growth promoter. The research was carried out to investigate the potential of using candle bush (*Senna alata*) leaf meal as a dietary supplement in improving the growth performance of African catfish (*Clarias gariepinus*). Specifically, it aimed to assess its effects on growth metrics such as weight gain, feed intake, and feed conversion ratio in an effort to identify cost-effective feed alternatives for sustainable aquaculture.

Materials and methods

Experimental Site

The experiment was conducted at the fishery unit of the Teaching and Research Farm, Ladoke

Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria with coordinates Latitude: 8.1190° N and Longitude: 4.2420° E

Collection and Processing of *Senna alata*

Succulent leaves of candlestick (*senna alata*) were obtained from a local market Oja-Igbo, Ogbomosho, Oyo State, Nigeria. The leaves were air-dried and grounded into fine particles using mortar and pestle and then stored in a polythene bag to avoid mould.

Experimental Fish

A total of five hundred (500) juvenile African catfish (average weight 119.8g) were procure from a reputable fish farm in Ogbomoso. The fishes were acclimatized for the period of two weeks during which they were fed with floating feeds in order to empty their gut in readiness for experimental diets.

Experimental Diets.

Feed ingredients such as maize, wheat offal, groundnut cake, fish meal, soybean meal, oyster shell, bone meal, methionine and lysine were obtained from a reputable feed mill in Ogbomoso. Five diets with varying inclusion level of candle bush leaf meal were formulated, Diet 1(0g), Diet 2(0.02g), Diet 3(0.03g), Diet 4 (0.04g) and Diet 5(0.05g) per 100g of feed.

Experimental Procedure.

After acclimatization period, seventy (70) African Catfish Fingerlings were randomly selected and divided into five (5) treatments. The fish were stock at the rate of ten (7) per tank(120L). They were fed to satiation twice daily in the morning (8:00 AM) and evening (4:00PM).

Data Collection

Growth Performance

Using a weighing scale, the fish weight were recorded and feed intake data were as well collected. The data was collected fortnightly throughout the experimental period which lasted for a duration of 12weeks. From the data, the mean gain (MWG), percentage weight gain (PWG), specific growth rate (SGR), feed conversion ratio (FCR), protein intake and protein efficiency ratio (PER) parameters were calculated.

Table 1: Gross Composition of Experimental Diets

Ingredients	T1 Control	T2 (100g)	T3 (100g)	T4 (100g)	T5 (100g)
		0.02	0.03	0.04	0.05
Maize	20.60	20.60	20.60	20.60	20.60
Wheat offal	10.30	10.30	10.30	10.30	10.30
Soybean meal	33.30	33.30	33.30	33.30	33.30
Fish Meal	11.10	11.10	11.10	11.10	11.10
Bone meal	0.50	0.50	0.50	0.50	0.50
Oyster shell	0.50	0.50	0.50	0.50	0.50
V/Premix	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Vegetable oil	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
CBLMS	-	0.02	0.03	0.04	0.05

Chemical Analysis

At the beginning and the end of the feeding trial, proximate composition of Candle Bush (test ingredient) and experimental diets were determined according to the methods of AOAC (2002)

Statistical analysis

All data collected were subjected to one-way analysis of variance (ANOVA) using a completely Randomized Design (CRD) and means was separated by Duncan's Multiple Range Test using the same computer package.

RESULT(S)AND DISCUSSION

Proximate Composition of Test Ingredient

The proximate composition of Candle Bush leaves is as shown in Table 4.1. The Candle Bush leaves contained 92.80% dry matter, 13.75% crude protein, 15.10% crude fibre, 3.50%crude fat, 7.40% moisture content and 8.90% ash.

Table 2 Proximate Composition of Candle Bush leaf (*Senna alata*)

PARAMETERS	MC(%)	DM(%)	AC(%)	CFt(%)	CP(%)	CF (%)
QUANTITY	7.40	92.80	8.90	3.50	14.75	15.10

MC – Moisture content, DM Dry matter, AC– Ash content, CFt Crude Fat, CP–Crude protein, CF Crude fibre

Growth Performance of African Catfish Fed with Varying Levels of *Senna alata* Leaf Meal.

The results of the growth performance and feed utilization of African catfish fed varying levels of candle bush (*Senna alata*) were as shown in Table 3. It was observed that treatment 3 recorded the highest final mean weight (FMW) value 213.46g while treatment 1 had the lowest FMW value 175.80g. Highest values of Mean Weight Gain

(MWG) and percentage Weight Gain (PWG) (73.71g and 52.74%) respectively were found in treatment 3 while the lowest values of MWG (36.05g) and PWG (25.80%) were found in treatment 1. The highest average feed intake (FI) of (417.08g) was observed in treatment 5 while, the lowest value of FI (291.82g) was observed in treatment 1. Although values recorded for T2, T3, and T4 were not significant ($p>0.05$). It was found that Specific Growth Rate (SGR) was not significant across the treatments. The highest value (8.09g) of Feed Conversion ratio (FCR) was found in Treatment 1 while the least value (5.16) was found in treatment 3, even though the value for treatment 3 was not significantly different ($p>0.05$) from treatment 2. The protein intake (PI) recorded the highest value (145.94g) with treatment 5 while the lowest value of PI (102.14g) was recorded with treatment 1. However, there were no significant differences ($p>0.05$) among treatment 2 and 4. The highest Protein Efficiency Ratio (PER) of (1%) was obtained in treatment 3 (0.55%), although treatments 2 (0.52%) and 4 (0.46%) were not significantly different ($p>0.05$) while the lowest value of PER (0.35%) was recorded in treatment 1 even though treatment 5 (0.48%) was not significantly different ($p>0.05$).

Table 3 Growth performance of African catfish (*clarias gariepinus*) fed varying levels of candle bush (*senna alata*)

Parameter	T1	T2	T3	T4	T5	SEM
IMW(g)	139.75 ^b	139.75 ^b	139.75 ^b	139.75 ^b	139.75 ^b	2.57
FMW(g)	175.80 ^b	204.83 ^a	213.46 ^a	194.90 ^a	210.39 ^a	5.35
MWG(g)	36.05 ^b	65.08 ^a	73.71 ^a	55.15 ^{ab}	70.64 ^a	3.84
% WG(%)	25.80 ^b	46.57 ^a	52.74 ^a	39.46 ^{ab}	50.55 ^a	2.50
SGR(%)	0.12 ^b	0.20 ^{ab}	0.22 ^a	0.17 ^{ab}	0.21 ^{ab}	0.012
FI(g)	291.82 ^c	356.71 ^b	380.10 ^b	344.49 ^b	417.08 ^a	9.54
FCR	8.09 ^a	5.48 ^b	5.16 ^b	6.25 ^{ab}	5.90 ^b	0.61
PI(g)	102.14 ^c	124.85 ^b	133.04 ^{ab}	120.57 ^b	145.94 ^a	3.34
PER(g)	0.35 ^a	0.52 ^a	0.55 ^a	0.46 ^a	0.48 ^a	0.033

IMW - Initial mean weight, FMW - Final mean weight, MWG - Mean weight gain, %WG – percentage weight gain, SGR-specific growth rate; FI-feed intake, FCR -Feed conversion ratio, PI – Protein intake; PER- Protein efficiency ratio

DISCUSSION

The results presented on the growth performance and feed utilization of African catfish (*Clarias gariepinus*) fed varying levels of candle bush (*Senna alata*) indicate significant differences across most parameters, highlighting the effects of different dietary treatments on the fish. Candle bush was fed to *clarias gariepinus* in this experiment with varying inclusion levels in fish diet and also good source of protein which is in

the main nutrient required by the fish, according to (Akinrotimi *et al*, 2007). Candle bush is used traditionally in treating of Diabetes, Typhoid, Malaria, ringworm, scabies, blotch, herpes and asthma (Dada, 2020). The use of leaf meals as a possible fish meal substitute to reduce the cost of fish feed is receiving increasing attention by fish nutritionist around the world. African Catfish is known to diets; consuming fruits, seeds, leaves, aquatic animals and plankton.(Fasuyi, 2006). In the present investigation, all the experimental diets were accepted by the fish indicating that the levels of incorporation of *senna alata* leaf meal did not affect the palatability of the diets, this might be attributed to the processing techniques which involved drying and grinding techniques that might have reduced the antinutrient in *senna alata* leaf meal This observation corroborates the work of (Hosseini *et al.*, 2023) who reported reduction in antinutrient by different processing techniques resulted in better palatability and growth in fish.

The proximate composition of the experimental diet in the study revealed that all the diet met the target Crude protein requirement for *Clarias gariepinus*. Crude protein level in aquaculture feeds generally is between 18% to 20% for marine Shrimps, 20% to 30% for Tilapia, 38% to 42% for Striped bass and 35% to 40% for African catfish.

The results in this study revealed that the best value of mean weight gain, percentage mean weight gain, specific growth rate and protein efficiency ratio were achieved at 0.3g/kg of T3. This is an indication of better feed utilization by converting the feed to flesh by the fish. (Akinrotimi *et al.*, 2007) reported that protein efficiency ratio is a measurement of how well the protein sources could provide the essential amino acids requirement. Treatment 3 had the best results, however, an increase in the inclusion level above 0.03g/100g of feed might lead to a reduction in fish growth and weight gain.

All treatments started with the same initial mean weight (139.75g), which is crucial in ensuring uniformity and reducing variation in growth outcomes due to initial weight discrepancies. This consistency aligns with the findings of previous studies that emphasize the importance of starting with similar sizes in aquaculture experiments to avoid introducing errors in growth performance evaluations

Treatment 3 showed the highest final mean weight (FMW) of 213.46g, which is significantly higher compared to Treatment 1 (175.80g). This suggests that the inclusion of candle bush (*Senna alata*) in the diet of the fish had a positive effect on

their growth when compared to the control treatment (T1). Similar findings have been reported by other researchers, who observed improved growth rates in fish when supplemented with plant-based feed additives such as senna or other locally available plants (Akter *et al.*, 2024).

The highest MWG (73.71g) and PWG (52.74%) were found in Treatment 3, whereas the lowest MWG (36.05g) and PWG (25.80%) were observed in Treatment 1. This suggests that the addition of candle bush to the fish diet contributed to better weight gain. This is in agreement with findings from other studies where plant-based supplements enhanced fish growth by improving digestibility and nutrient uptake (Fagbenro *et al.*, 2010). However, it is notable that some treatments (T2, T4, and T5) showed improvements in growth parameters, but they were not significantly different from each other, implying a possible dose-dependent response to the dietary inclusion levels of candle bush.

Treatment 5 had the highest average feed intake (FI) at 417.08g, suggesting that the fish in this treatment consumed more feed, possibly due to the composition of the diet that was more palatable or nutritionally balanced. Studies have shown that the inclusion of herbal ingredients can sometimes increase feed intake in fish due to enhanced palatability (Hongyu *et al.*, 2017). Conversely, the lowest FI was observed in Treatment 1 (291.82g), possibly indicating that the fish were less inclined to consume the diet without the beneficial additions of plant material. The FCR value was highest in Treatment 1 (8.09), which is indicative of poor feed utilization, meaning that more feed was required to achieve weight gain. On the other hand, the lowest FCR value was found in Treatment 3 (5.16), which suggests more efficient feed utilization. Efficient feed conversion is critical in aquaculture, as it directly impacts the cost-effectiveness of production. The observed results support similar findings by Barad *et al.*, 2024, who reported that the addition of plant-based feed supplements can improve feed conversion efficiency. The highest protein intake (PI) was observed in Treatment 5 (145.94g), followed by Treatment 3, indicating that fish in these treatments were consuming more protein, which is likely to contribute to better growth.

These findings are consistent with the literature

where higher protein intake has been shown to positively affect growth performance in fish (Sankian *et al.*, 2017).

Interestingly, the highest Protein Efficiency Ratio (PER) was recorded in Treatment 3 (0.55%), which reflects superior protein utilization for growth compared to the other treatments. This suggests that while Treatment 5 provided the highest protein intake, Treatment 3 utilized it more efficiently.

These results demonstrate that varying levels of candle bush supplementation in the diets of African catfish can significantly impact their growth performance and feed utilization. The observed improvements in weight gain, feed intake, and feed conversion efficiency in treatments containing candle bush align with other studies where herbal additives were shown to enhance nutrient absorption and growth in fish (Wondiamagegn, 2024).

Additionally, the protein efficiency ratio highlights the importance of not only increasing protein intake but ensuring that fish can utilize that protein effectively, which is critical for optimizing aquaculture practices.

Overall, the study suggests that treatments with higher levels of candle bush could lead to better growth and feed utilization, thus potentially providing a sustainable and cost-effective feeding option for aquaculture operations. However, further studies are needed to determine the optimal inclusion levels of candle bush for maximum growth and feed efficiency in African catfish.

Conclusion and recommendation

In conclusion, the study demonstrates that incorporating varying levels of candle bush (*Senna alata*) into the diet of African catfish (*Clarias gariepinus*) significantly enhances growth performance, feed intake, and feed conversion efficiency. Fish fed with Treatment 3 (0.03g) had the best performance. However, caution should be taken while including candle bush leaf meal as increase beyond 0.03g/100g of feed might lead to reduction in weight gain. Treatment 3, with the optimal inclusion level, exhibited the best results in terms of weight gain, specific growth rate, and protein efficiency. These findings suggest that candle bush could be a viable, sustainable alternative feed ingredient in aquaculture. Further research is recommended to refine the optimal inclusion levels of candle bush for improved feed utilization and growth in African catfish.

References

- Ajibesin K. K., Ekpo B. A., Bala D. N., Essien E. E., and Adesanya S. A., (2008). "Ethnobotanical survey of Akwa Ibom state of Nigeria," *Journal of Ethnopharmacology*, 115(3): 387-408
- Akinrotimi, O.A., Gabriel, U.U., Owhonda, N.K., Onunkwo, D.N., Opara, J. Y., and Cliffe, P.T., (2007). Formulating an environmentally friendly feed fish for sustainable aquaculture development in Nigeria. *Agriculture Journal*, 2(5), 606-612.
- Akter S, Haque MdA, Sarker MdA-A, Atique U, Iqbal S, Sarker PK, Paray BA, Arai T and Hossain MB (2024) Efficacy of using plant ingredients as partial substitute of fishmeal in formulated diet for a commercially cultured fish, *Labeo rohita*. *Front. Sustain. Food Syst.* 8:1376112. doi: 10.3389/fsufs.2024.1376112
- AOAC. (2002). *Association of Official Analytical Chemists international (AOAC)*. Official methods of analysis, 17th edition AOAC International, Gaithersburg, MD, USA: 14
- Barad, R.R., Verma, D.K., Yusufzai, S.I., Shrivastava, V., Ram, A.R. (2024). Herbal Feed Additives: Natural Boost for Aquatic Health and Growth. In: Gabriel, N.N., Abasubong, K.P., Erasmus, V.N., Kamble, M.T. (eds) *Sustainable Feed Ingredients and Additives for Aquaculture Farming*. Sustainability Sciences in Asia and Africa(). Springer, Singapore. https://doi.org/10.1007/978-981-97-4279-0_18
- Dada, A. A. (2012). Effects of *Garcinia kola* seed meal on egg quality of the North African catfish, *Clarias gariepinus* (Burchell, 1822) broodstock. *African Journal of Food, Agriculture, Nutrition and Development*. 12:6447-6459.
- Fagbenro O. A, Adeparusi E. O and Jimoh W. A. (2010) Nutritional evaluation of raw sunflower and sesame seed meal in *Clarias gariepinus*: an assessment by growth performance and nutrient utilization. *African Journal of Agricultural Research*, Vol 5 (22) 3096- 3101.
- Fasuyi, O. (2006). Nutritional potential of some tropical vegetable leaf meals. *Journal of chemical composition and functional properties*. 5(2): 49-53.
- Hongyu Pu, Xiaoyu Li, Qingbo Du, Hao Cui, Yongping Xu, (2017). Research Progress in the Application of Chinese Herbal Medicines in Aquaculture: A Review, *Engineering*. Pages 731-737,
- Hossain, A., Hossain, M. A., Rasul, M. G., Akter, T., Zaman, M. F. U. and Islam, M. R. (2023) Efficacy of using sunflower meal as an ingredient and partial fishmeal replacer in practical feed formulated for stinging catfish (*Heteropneustes fossilis*). *Aquaculture Fish and Fisheries* (3) 237–246. <https://doi.org/10.1002/aff2.109>.
- Inayat, L. and Salin, M. (2005). Feed conversion ration of major carp fingerlings fed soya bean meal, maize gluten and maize. *Pakistan veterinary Journal* 25(1). 13-17.
- Sankian, Z., Khosravi, S., Kim, Y.O. *et al*. Effect of dietary protein and lipid level on growth, feed utilization, and muscle composition in golden mandarin fish *Siniperca scherzeri*. *Fish Aquatic Sci* 20, 7 (2017). <https://doi.org/10.1186/s41240-017-0053-0>
- Wondimagegn Tadesse Alem (2024). Effect of herbal extracts in animal nutrition as feed additives *Heliyon* Pp 1-8. <https://doi.org/10.1016/j.heliyon.2024.e24973>.