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Effect of Black Benniseed *(Sesamum Radiatum)* Leaf Diets as a Feed Binder on the Growth Performance of *Clarias Gariepinus* Fingerlings

***Usman, M. [1], Umaru, J.A. [2], Abari, M.A.[3], Abimiku, H.K.[4]**

[1,2,3]Department of Fisheries Technology, College of Agriculture, Science and Technology P.M.B 33, Lafia. Nasarawa State.

[4]Department of Fisheries Animal Science, College of Agriculture, Science and Technology P.M.B 33, Lafia. Nasarawa State.

ABSTRACT: This study investigated the effect of incorporating Black Benniseed (*Sesamum radiatum*) Leaf Meal (BBLM) as a natural feed binder on the growth performance and water quality of African catfish (*Clarias gariepinus*) fingerlings. Four experimental diets containing 45% crude protein were formulated: TD1 (control, 6% wheat flour), TD2 (2% BBLM), TD3 (4% BBLM), and TD4 (6% BBLM). Fish with an initial mean weight of about 10±0.02g were stocked in triplicate tanks and reared for 140 days under uniform management conditions. Results showed that growth performance improved with increasing levels of BBLM. Fish fed TD4 recorded the highest mean final weight (1100.55 ± 0.05 g), specific growth rate (3.35 ± 0.12), and protein efficiency ratio (2.22 ± 0.08), while the lowest feed conversion ratio (1.35 ± 0.03) was also observed in this group. Water physico-chemical parameters, including temperature (27.0–27.9°C), pH (7.02–8.26), dissolved oxygen (4.33–5.10 mg/L), and ammonia (0.30–0.42 mg/L), remained within the optimal range for *C. gariepinus* culture. The findings indicate that inclusion of BBLM up to 6% in 45% protein diets significantly enhances growth, feed utilization, and environmental quality without adverse effects on fish health. Therefore, BBLM can be recommended as a sustainable, low-cost, and eco-friendly alternative feed binder in aquafeed formulation.

KEYWORDS: Catfish, Black Benniseed, binder.

INTRODUCTION

Numerous natural binders have been employed to produce firm pellets with the purpose of increasing their stability in water and to reduce nutrient loss. Polysaccharides such as starch, cellulose etc are non-toxic and available in abundance and are gaining importance as promising biopolymers to be employed as binders (Volpe, *et al*., 2010). Few examples of these binders are corn starch, rice starch, yam starch, cassava starch, and so on. Binders have a significant role in aquaculture feed production, but due to high cost of conventional synthetic binders, pelleted feed production at on-farm level becomes difficult mostly for peasant and medium scale farmers. This makes farmers to resort to arbitrary inclusion of any available unconventional binding agents for feed production at any inclusion level (Orire, *et al.,* 2019).

The use of natural binding agents for enhancing on-farm floating feed may replace the expensive expanded floating feeds produced by extrusion (Singh, *et al*., 2008, Orire, *et al.,* 2019). The use of a vegetable, black benniseed **(***Sesamum radiatum*) leaf powder as a binder in aquaculture has not much been explored, hence the study.

MATERIALS AND METHODS

Experimental Design and Procedures

Twelve plastic containers of 1 x 1 x 1m^3 diameter were used for the experiment. Thesetup was a completely randomized design and all treatments were in triplicates. Three hundred (300) fingerlings were randomly distributed into twenty (12) experimental replicated plastic containers with 25 fingerlings per container with an initial weight of 10±0.02g. They were assigned to four (4) treatments and replicated thrice. Treatment 1 had fingerlings which were fed with diet containing 6% of wheat flour as a binder (control); fish in treatment 2 were fed with diet containing 2% of black benniseed (*Sesamum radiatum*) leaf powder as a binder; treatment 3 were fed with diets containing 4% of black benniseed leaf powder as a binder and treatment 4 were fed with diet containing 6% of black benniseed leaf powder as a binder. All the experimental fish were fed at 5% body weight. At the start of the feeding trial, the acclimated fish were deprived of feed for 24 hours and initial body weight were taken, this was to prepare them for the feeding trial.

Growth Parameters

At the end of 140 days feeding trial, the growth performances (WGR, SGR, FCR, survival, FER) of the catfish *Clarias gariepinus* were calculated. The WGR, SGR, Survival and FER were calculated as follows:

Weight Gain Rate (WGR) (%) =100 × (Wf – W0) / W0

Specific growth rate (SGR) = 100 × (lnWf - lnW0) / t

Survival (%) = 100 × final shrimp number / initial shrimp number

Feed efficiency ratio (FER) = (Wf – W0) / FI

Statistical Analysis

Data will be analyse using one way ANOVA and the difference among means will be tested for significance (p = 0.05). Means comparison was done using multiple range test (Steel and Torrie, 1960).

Results and Discussion

Table 1: Shows the percentage composition of the feed materials that was used for African catfish, *Clarias gariepinus*, using black Benniseed (*Sesamum radiatum*) as a binder.

INGREDIENTS	CONTROL) 6% WHEAT FLOUR.	2% BLACK BENNISEED LEAF MEAL	4% BLACK BENNISEED LEAF MEAL	6% BLACK BENNISEED LEAF MEAL
Fish meal	40.94	40.44	40.68	40.94
Soya bean cake	27.29	26.96	27.12	27.29
Groundnut cake	13.65	13.48	13.56	13.65
Yellow maize	4.09	7.42	5.89	4.09
Wheat bran	2.04	3.71	2.94	2.04
Fish oil	3	3	3	3
Lysine	0.5	0.5	0.5	0.5
Methionine	0.2	0.2	0.2	0.2
Multivitamins	0.1	0.1	0.1	0.1
Antibiotics	0.1	0.1	0.1	0.1
Enzymes	0.1	0.1	0.1	0.1
Vitamin C (antioxidant)	0.5	0.5	0.5	0.5
Fish premix	0.5	0.5	0.5	0.5
Bone meal	1	1	1	1
Binder	6	2	4	6
	100%	**100%**	**100%**	**100%**
Mean proximate composition of analyzed feeds				
Moisture	10.31±0.02	11.00±0.11	10.03±0.34	10.08±0.14
Ash	9.11±0.06	8.24±0.02	9.06±0.17	8.02±0.12
Crude protein	44.56±0.19	44.38±0.09	45.01±0.00	45.04±0.11
Crude lipid	10.23±0.00	11.41±0.17	9.21±0.28	5.05±0.00
Crude fibre	4.04±0.15	3.89±0.00	3.78±0.55	3.53±0.31

Table 2: Growth Performance of African Catfish (*Clarias gariepinus*) fingerlings experimented on Black Benniseed (*Sesamum radiatum*) Leaf Meal as a feed Binder.

PARAMETERS	TD1 CONTROL WHEAT FLOUR 6%	TD2 BBLM 2%	TD3 BBLM 4%	TD4 BBLM 6%
MIW	$10.02±0.02^{a}$	$10.00±0.04^{a}$	$10.08±0.06^{a}$	$10.04±0.03^{a}$
MFW	$909.40±0.12^{b}$	$809.21±0.12^{c}$	$950.54±0.03^{b}$	$1100.55±0.05^{a}$
MWG	$899.38±0.08^{b}$	$799.21±0.10^{c}$	$940.46±0.14^{b}$	$1090.51±0.05^{a}$
SGR	$3.22±0.02^{b}$	$3.14±0.07^{b}$	$3.24±0.11^{b}$	$3.35±0.12^{a}$
PWG (%)	$8883.2±0.10^{b}$	$7892.1±0.01^{c}$	$9230±0.12^{b}$	$10861±0,03^{a}$
INITIAL LENGTH (CM)	$11.08±0.02^{a}$	$11.06±0.03^{a}$	$11.02±0.04^{a}$	$11.04±0.05^{a}$
FINAL LENGTH (CM)	$54.11±0.00^{b}$	$50.54±0.05^{c}$	$55.21±0.09^{b}$	$56.33±0.03^{a}$
LENGTH INCREASE (CM)	$43.03±0.05^{b}$	$39.48±0.07^{c}$	$44.19±0.14^{b}$	$45.29±0.08^{a}$
FCR	$1.43±0.11^{b}$	$1.53±0.02^{b}$	$1.38±0.05^{a}$	$1.35±0.03^{a}$
PER	$1.55±0.14^{b}$	$1.46±0.11^{b}$	$1.61±0.04^{b}$	$2.22±0.08^{a}$
CONDITION FACTOR (K)	$0.57±0.10^{a}$	$0.63±0.03^{a}$	$0.52±0.00^{a}$	$0.62±0.06^{a}$
SURVIVAL RATE	$95±0.00^{a}$	$95±0.00^{a}$	$95±0.00^{a}$	$100±0.00^{a}$

BBLM= Black Benniseed Leaf Meal, MIW= Mean Initial Weight, MFW=Mean Final Weight, MWG= Mean Weight Gain, SGR= Specific Growth Rates, PWG= Percentage Weight Gain, FCR= Feed Conversion Ratio, PER= Protein Efficiency Ratio, Survival Rate.

Mean ± SD with different superscript (a, b, c) are significantly different ($P \leq 0.05$)

Table 3: Results of water physico-chemical quality parameters during the experiment

parameters	TD1 CONTROL WHEAT FLOUR 6%	TD2 BBLM 2%	TD3 BBLM 4%	TD4 BBLM 6%
Temperature (°C)	27.55 ± 0.10^{ab}	27.00 ± 0.04^{b}	27.55 ± 0.06^{ab}	27.90 ± 0.06^{a}
pH	7.80 ± 0.12^{b}	7.02 ± 0.08^{c}	8.26 ± 0.09^{a}	8.22 ± 0.00^{a}
DO mg/l	4.55 ± 0.01^{b}	4.33 ± 0.03^{b}	4.90 ± 0.52^{ab}	5.10 ± 0.02^{a}
Ammonia mg/l	0.39 ± 0.04^{ab}	0.42 ± 0.08^{a}	0.35 ± 0.05^{b}	0.30 ± 0.05^{b}

RESULTS AND DISCUSSION

The results of the present study showed that the inclusion of Black Benniseed Leaf Meal (BBLM) as a feed binder significantly influenced the growth performance of *Clarias gariepinus* fingerlings. Fish fed the diet containing 6% BBLM (TD4) exhibited the highest mean final weight (1100.55 ± 0.05 g), mean weight gain (1090.51 ± 0.05 g), and specific growth rate (3.35 ± 0.12), while the control diet (TD1) recorded lower performance. The progressive increase in weight gain and growth indices with higher BBLM inclusion suggests that BBLM improved feed utilization and binding efficiency, leading to better feed intake and nutrient absorption. These findings agree with the report of Olukunle (2011), who observed that plant-based feed binders improved feed texture and minimized nutrient leaching in fish diets. Similarly, Fagbenro and Arowosoge (1991) noted that diets with stable pellet structure enhance nutrient retention and reduce feed wastage, contributing to improved growth. The observed high growth in the 6% BBLM diet aligns with the results of Adebayo *et al*. (2018), who reported that natural feed binders such as cassava starch and mucilage promote weight gain and feed conversion in catfish culture.

The feed conversion ratio (FCR) ranged from 1.35 ± 0.03 to 1.53 ± 0.02, with the lowest value recorded in TD4 (6% BBLM), indicating efficient feed utilization. A lower FCR reflects better conversion of feed to body mass. The improved FCR values obtained in this study are comparable to those reported by Gabriel *et al*. (2007), who established that African catfish show optimal growth performance when feed binders improve pellet water stability and digestibility. The protein efficiency ratio (PER) increased from 1.46 ± 0.11 in TD2 to 2.22 ± 0.08 in TD4, implying that protein was efficiently converted into fish biomass as BBLM inclusion increased. This observation corroborates the report of Akinwole and Faturoti (2007), who emphasized that efficient nutrient utilization is closely linked to feed physical quality and protein digestibility.

The condition factor (K) values (0.52–0.63) obtained in this study indicate that the fish were in good physiological condition across all treatments. This is consistent with the findings of Bagenal and Tesch (1978), who noted that a condition factor around 1.0 indicates optimal well-being, while slightly lower values may occur under intensive culture conditions. The 100% survival rate in TD4 further demonstrates that BBLM inclusion supports good feed stability and environmental compatibility.

Water Quality Parameters

The water physico-chemical parameters remained within the acceptable range for Clarias gariepinus throughout the experimental period, indicating that BBLM inclusion had no detrimental effects on the aquatic environment.

Temperature values (27.00–27.90 °C) showed slight but significant variations ($p < 0.05$), with the highest temperature recorded in TD4. This range is suitable for catfish growth, as optimal metabolic and feeding activity typically occur between 26–30 °C (Boyd, 1990; Akinwole & Faturoti, 2007). pH values ranged from 7.02 to 8.26, indicating slightly alkaline conditions conducive to catfish health and enzymatic activity. These results are consistent with Gabriel *et al*. (2007), who reported that African catfish thrive best in water with pH 6.5–9.0.

The dissolved oxygen (DO) concentration ranged between 4.33 and 5.10 mg/L, significantly higher in TD4 (6% BBLM) than in the control ($p < 0.05$). According to Akinwole and Faturoti (2007), DO levels above 4 mg/L are essential for optimal feed utilization and growth in catfish. The slightly higher DO in the 6% BBLM group could be linked to lower feed wastage and reduced organic load in the tanks, which promote oxygen stability.

Ammonia concentrations (0.30–0.42 mg/L) were not significantly different among treatments ($p > 0.05$) and remained below the toxic threshold (< 1 mg/L), as reported by Boyd (1990). The lower ammonia values in TD3 and TD4 suggest improved feed digestibility and reduced metabolic waste accumulation, possibly due to the enhanced binding capacity of BBLM, which minimizes feed disintegration in water.

In conclusion, the combined analysis of growth and water quality results shows that the inclusion of BBLM up to 6% in diets containing 45% crude protein improved growth performance, feed utilization, and water quality without any adverse effects on fish

health. The improved water quality parameters further supported the higher survival and growth rates observed, confirming a strong relationship between feed quality, fish metabolism, and aquatic environment stability.

Thus, Black Benniseed Leaf Meal can serve as a cost-effective, eco-friendly, and nutritionally beneficial binder in aquafeed formulations for *Clarias gariepinus*, promoting sustainable aquaculture production.

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