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Growth Performance of Catfish Fed Bambara Leaf Diets: Clues Suggest Possible Use of the Botanical as a Growth Inhibitor in Insect Pest Control

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Abstract: *An interdisciplinary study was conducted to identify a plant material which will constitute major protein source and serve as cheaper and more profitable alternative to the conventional fishmeal while using the catfish (Clarias gariepinus Burchell) fingerlings as specimen to also test the growth inhibitory characteristic and toxicity of bambara (Vigna subterranean L. Verdc.) leaf, a potential botanical against insect pest infestations. One hundred and fifty fingerlings (1.5 g mean weight) were used for the study. Standard protocols were employed to acclimatize the experimental fish, prepare bambara leaf meal and formulate and standardized the diets. Bambara leaf incorporation levels tested were 0 (control with fishmeal and no bambara leaf), 7, 15, 22 and 30 %. The growth performance parameters evaluated were feed intake, feed conversion ratio, weight gain, specific growth rate, relative growth rate and mortality rate. Results showed that bambara leaf meal on its own did not effectively support the growth of the fingerlings and would need to be complemented with the conventional fishmeal. Findings provided important clues for the use of bambara leaf as a botanical/ growth inhibitor in the management of insect pests.*

Keywords: *Bambara, Catfish, Fishmeal, Growth inhibitory, Insect pests, Interdisciplinary.*

1. INTRODUCTION

The price of fishmeal (a major protein component of fish feed) might become prohibitive in future due to increasing demand and economic problems. The increasing demand and price of fishmeal coupled with fluctuation in global supply of the product have called for alternative protein sources in aqua feed [1]. There is need to urgently reduce the heavy reliance on fishmeal through the identification and introduction of alternative raw materials that will serve as the major sources of proteins and lipids in fish diets. Preferably, the raw materials should be of plant origin because plants are readily available and their materials are cheap. Plant leaves have been used by earlier workers as cheap and profitable alternative protein sources in fish rearing [2, 4]. However, leaf meals are rich in vitamin A [2, 4] and this further provides the rationale for research on plant leaves. Bambara groundnut plant (*Vigna subterrranea* L. Verdc.) is a novel legume native to West Africa and mainly cultivated by subsistence female farmers in different intercrop systems [5, 6]. Notably, the plant contains cysteine [7] and cysteine is of immense entomological importance. Cysteine is a natural protein with possible inhibitory effect against insect pest attack and many plant species possessing high level of cysteine proteinase inhibitor are naturally protected against insect pest infestations [8]. It has been stressed that bambara nut plant is under-utilized in Africa [6]. Therefore, the present study assesses bambara leaf for use as an alternative to fishmeal for the growth of catfish fingerlings while investigating its potential as a growth inhibitor for possible extension to insect pest control. It is of

entomological interest that pests do not constitute a serious challenge to bambara groundnut plant [9]. This further justifies the extension of bambara leaf to insect studies.

2. MATERIALS AND METHODS

The research was carried out at the Fish Production Unit of Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria for a period of 8 weeks. A total of 150 catfish (*Clarias gariepinus* Burchell) fingerlings with mean weight of 1.5 g were used for the investigation. Fingerlings acclimatized for 2 days in a plastic bowl during which they were not fed in order to empty their guts and prepare their appetite for new feed. The fish samples were stocked at the rate of 10 fingerlings per bowl. Bambara leaf meal was compounded with maize, groundnut cake, soybean, blood meal, cassava, starch, bone meal and vitamin/ mineral premix purchased from Ave Feed Mill, Enugu State, Nigeria. Table 1 presents the percentage composition of the ingredients in each experimental diet. Diets were formulated using algebraic method/ least cost formula [10]. Bambara leaf incorporation levels tested were 0 (control with fishmeal and no bambara leaf), 7, 15, 22 and 30 %. All diets were isonitrogenous at 40 % crude protein. The five treatments were laid out in randomized complete block design and replicated three times. The growth performance (progressive or inhibitory) indices evaluated were feed intake (FI), feed conversion ratio (FCR), weight gain (WG), specific growth rate (SGR), relative growth rate (RGR) and mortality rate (MR). Feed conversion ratio was calculated using the formula $\frac{FI}{WG}$ to determine the total weight of feed fed to fish to achieve a unit weight. Weight gain was determined by subtracting the initial weight (IW) of fish from the final weight (FW) of fish. The specific growth rate of fish was determined using the formula $\frac{LogeFW - LogeIW\ X\ 100}{t}$ where t is time in days. Relative growth rate was computed using the relation $\frac{FW - IW\ X\ 100}{IW}$. Mortality rate of the test fish specimens was determined employing the formula $\frac{Number\ of\ dead\ fish\ X\ 100}{Number\ of\ stocked\ fish}$. Data were run in SPSS (statistical package for the social sciences) version 20 and analyzed using analysis of variance. Upon significance of the F-test, means were separated using LSD (Least Significance Difference) at α level of 0.05.

Table1. *Percentage composition of the ingredients in each experimental diet*

Ingredients	0 %*	7 %*	15 %*	22 %*	30 %*
Fishmeal	30.00	23.00	15.00	8.00	0.00
Bambara leaf	0.00	7.00	15.00	22.00	30.00
Yellow maize	29.00	27.00	26.00	24.00	18.00
Groundnut cake	12.00	13.00	13.00	15.00	16.00
Soyabean meal	12.00	13.00	14.00	14.00	18.00
Blood meal	10.00	10.00	10.00	10.00	10.00
Vitamin/mineral premix	2.00	2.00	2.00	2.00	2.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Common salt	0.50	0.50	0.50	0.50	0.50
Bone meal	1.00	1.00	1.00	1.00	1.00
Cassava starch	1.00	1.00	1.00	1.00	1.00

**Dietary inclusion (%) of bambara groundnut leaf*

3. RESULTS AND DISCUSSION

Table 2 shows the growth performance of *Clarias gariepinus* fed various levels of bambara leaf meal. The five diets were accepted and utilized for growth by the fingerlings. The control diet incorporated fishmeal but not bambara leaf meal had the highest growth performance index and this tallied with the reports of [11] where fishmeal incorporation evoked rapid growth in fish. This strongly indicates that bambara leaf cannot be utilized as a sole protein source for *C. gariepinus*. For good performance of fish, we suggest integration of bambara leaf meal (plant-based protein) at < 30 % with fishmeal (animal-based). The lowest weight gain and highest mortality rate were recorded in fish fed 30 % of the plant material. This probably suggests that ≥ 30 % bambara leaf supplementation could adversely affect growth of animals. This is in agreement with the findings of [12] that the administration of high concentration of plant powder to albino rat caused the animal weight loss, toxic and histopathological problems. Bambara leaf at high level has implications for growth of fish and insects might not be

excluded. In a recent study, [13] has demonstrated that a plant material, *Dennettia tripetala* seed which had toxic and histopathological effects on albino rat animal also had toxic effects on the insect pest, *Sitophilus zeamias* Motschulsky. So, it may not be surprising if bambara leaf is effectively used as a botanical insecticide in pest management. Hope rises for bambara for containing cysteine in particular [7]. It has been shown that cysteine proteinase inhibitor in maize grain repelled the maize weevil from attack [8] and the same may be true for bambara leaf. It is now understandable why bambara leaf included in the diet of catfish at high level affected adversely the growth of the animal.

Table2. *Growth performance of catfish fingerlings fed diets incorporated different levels of bambara leaf*

Growth parameters	0 % bambara*	7 % bambara	15 % bambara	22 % bambara	30 % bambara
Feed intake (g/ day)	86.40±15.35^{a}	68.44±4.07^{a}	70.54±4.04^{a}	59.67±4.04^{a}	66.79±3.63^{a}
Feed conversion rate	2.48±0.78^{a}	8.55±3.68^{b}	5.83±1.14^{ab}	3.37±0.50^{a}	8.01±5.89^{ab}
Weight gain (g)	29.66±11.89^{a}	8.33±3.51^{b}	13.00±2.51^{b}	17.66±2.18^{c}	8.00±2.66^{b}
Specific growth rate	0.50±0.12^{a}	0.17±0.08^{b}	0.27±0.07^{b}	0.33±0.03^{ab}	0.21±0.08^{ab}
Relative growth rate	97.30±33.48^{a}	26.06±13.76^{b}	43.00±8.52^{c}	54.60±6.30^{c}	31.68±13.20^{c}
Mortality rate (%)	6.66±13.33^{a}	13.33±13.33^{b}	26.66±13.33^{c}	26.66±13.33^{c}	33.33±24.03^{c}

**The control diet incorporated fishmeal but not bambara leaf meal.*

Data are means ± standard error of means of four replications. Means in a row followed by the same letter(s) are not significantly different by LSD at α = 0.05.

4. CONCLUSION

Although the use of bambara leaf meal is presumably a cheaper means of reducing the cost of fish feed, the current study showed that it will be best utilized when supplemented with fish meal. Recent studies have confirmed the utilization of bambara groundnut and its wastes for various applications. In the present study, it appears bambara leaf does not possess adequate nutritional requirements for *C. gariepinus* fingerlings. Therefore, investigations on proximate and anti-nutritional components of bambara leaf are suggested. The present findings in addition to seeking a plant-based material that will replace the exorbitant fishmeal have provided new insight on bambara leaf research for insecticidal activity against insect pests.

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