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Growth Performance, Nutrient Utilization, Somatic Indices and Cost Benefit Analyses of African Basil Leaf Additive Diets on *Clarias gariepinus* (Burchell, 1822) Fingerlings

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Abstract

Twelve weeks feeding experiment was carried out to evaluate the effect of *Ocimum gratissimum* as additive in the diet of *Clarias gariepinus*. 40% isoproteic diet was formulated and fermented *O. gratissimum* was included at 0%, 1%, 2%, 3% and 4%. The diets were coded T1, T2, T3, T4 and T5 150 fingerlings of mean weight 3.54 ± 0.12 g and length 5.95 ± 0.12 cm were stocked in 15 circular tanks of diameter 0.55 m at the rate of 10 fingerlings per tank in wet laboratory of the Fisheries department. They were fed 5% bodyweight for 12 weeks. Highest mean weight gain of 26.21 was recorded in T1 and lowest of 22.60 g from T2 while specific growth rate ranged between 1.03–1.12%/day. Highest Feed intake of 26.50 g was recorded in T1 and lowest of 18.92 g in T5, feed conversion ratio of 1.01 was recorded highest in T1 and lowest (0.83) in T5 which are not significantly different ($p>0.05$) and protein intake of 10.73 was recorded highest in T1 and lowest of 7.73 in T5. Highest hepatosomatic of 1.66 was recorded in T5 and lowest of 0.76 in T2 and viscerosomatic was recorded highest in T4 with value of 12.12 and lowest of 7.03 in T1. The highest cost of feed with value of ₦39.50 was recorded in T1 and T5 had the lowest value of 38.90, cost of feeding was recorded highest in T1 with value of ₦10.47 and lowest value was recorded in T5 with value of ₦7.53. the net profit of ₦45.53 was recorded as highest value in T1 and ₦41.90 which is lowest was recorded in T2, the profit index of ₦1.92 was recorded highest in T1 and ₦1.78 was recorded in T2 as the lowest value and lastly benefit cost ratio of ₦ 2.56 recorded highest in T5 and ₦2.47 which is lowest value was recorded in T2. T4 is therefore recommended for the health status, growth and cost benefit.

important method of food production and accounts for close to half of the fish consumed worldwide (FAO, 2010) [1]. For those who are raising fish, it is critical from a number of perspectives to consider the ingredients composition of the feed. For maximal growth, fish nutrition needs to be tailored towards species, sex, stages of development and nutrient requirements. Given that fish feed is one of the highest operating costs of an aquaculture system projected to be within 60-70% calls for its maximization through improve feed conversion ratio and reduction of costly feed ingredients judiciously (Sogbesan and Ekundayo, 2015) [2] Ultimately, the goal should be to optimize the nutritional composition of fish for consumption, since fish represent the main source of long-chain omega-3 fatty acids (LC ω -3 FA) in the human diet.

In general, gross malnutrition is no longer a problem, however, we are now faced with the more challenging task of determining the more subtle effects that micronutrients, and their interactions with other dietary components have on the immune system of fish. Several reviews have dealt with the subject of nutrition and their response in fish however, we lack complete information on the quantitative nutrient requirements of most fish [3-5].

O. gratissimum is an herbaceous plant which belongs to the Labiatae family. The plant is indigenous to tropical areas especially India and it is also in West Africa. In Nigeria, it is found in the Savannah and coastal areas. It is cultivated in Ceylon, South Sea Islands, and also within Nepal, Bengal, Chittagong and Deccan [6]. In the southern part of Nigeria, the plant is called "effinrin-nla" by the Yoruba speaking tribe. It is called "Ahuji" by the Igbos, while in the Northern part of Nigeria the Hausas call it "Daidoya" [7].

Feed additives are not nutrients but are edible materials added to feed for the purpose of performing specific functions which are capable of improving the texture, strength of pellets, taste, aroma, attraction, feed consumption, utilization, prevent stress from infection and disease, cure disease and promote growth and reproduction. They could be in form of drugs (antibiotics), anti-oxidant, flavors or attractants, vitamins, amino acids (synthetic), binders, preservatives, hormones and

Keywords: Growth; Feed utilization; Cost benefits; Basil leaf; Additive; *Clarias gariepinus*

Introduction

Aquaculture, the cultivation of fresh and saltwater fish, shellfish, and algae, is being increasingly recognized as an

carotenoid supplements. Antioxidants are used in feeds to prevent quality deterioration through the prevention of rancid oxidation of fats and nutrient deficiency [8]. Attempts to use the natural materials such as medicinal plants could be widely accepted as feed additives to enhance efficiency of feed utilization and aquaculture productive performance. In the last decade, some studies show the positive effects of dietary medicinal plants and feed additives on growth and feed utilization in fish [9-13].

Materials and Methods

A Completely randomized design (CRD) in which the additive was added at an equal interval to each of the diet was used. 600.0g of Fresh Africa basil leaves were purchased from Sabo Geri market washed and divided into three equal parts. This first part was packed into a transparent polythene bag, air-tighten and kept in a refrigerator for 5 days. This is to keep the freshness of the leaves. The second part was fermented by keeping it moist, kept in a white plastic bowl with cover and put in the laboratory cupboard for a darkened environment needed for a solid state fermentation according to Sogbesan. The fermentation lasted for five (5) days, and then the leaves were removed. The third portion was air-dried under laboratory

condition for five days. At the end of the fifth day, all the products were separately grinded and used for phytochemical and proximate analysis [2].

Five different groups of feed was formulated at the same 40% crude protein in which group T1 was a control feed, groups T2, T3, T4 and T5 contained 1 g, 2 g, 3 g and 4 g respectively. Other ingredients were soybean meal, fish meal, maize meal, vitamin premix, lysine, methionine, salt, palm oil, starch as presented on Table 1. One hundred and seventy healthy fishes were collected from Emmanuel fish farm and were conditioned to experimental diets for seven days before the commencement of full experiment. The experiment was set-up in wet laboratory of fisheries department, 15 bowls were used for the experiment and each treatment diet were triplicated in which each treatment has different colour of bowl and labeled to avoid mixed up and confusion. Fishes were stocked 10 per bowl and each were aerated for complete 4 weeks and covered with mosquito net. Each treatment were triplicated in three places in which they were ten fish per each replicate. The fingerlings were fed 5% of their body weight with experimental diet for the period of twelve weeks and were fed twice daily at 9 am in the morning and 4 pm in the evening.

Table 1: Percentage composition of Dry matter (g/100 g) of Experimental Diet.

Ingredients composition	Experimental Diets				
	T1	T2	T3	T4	T5
Maize	30	29	28	27	26
Fish meal	33	33	33	33	33
Soybean	32	32	32	32	32
FOGLM	0	1	2	3	4
Palm oil	1	1	1	1	1
Bone meal	0.5	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5	0.5
Iodized salt	0.5	0.5	0.5	0.5	0.5
Cassava starch	0.5	0.5	0.5	0.5	0.5
Lysine	1.00	1	1	1	1
Methionine	1	1	1	1	1
Total	100 g	100 g	100 g	100 g	100 g
Calculated protein	40.5	40.58	40.68	40.8	40.9
Feed cost	39.5	39.4	39.2	39.1	38.9
Calculated Gross energy kcal/J	410.4	409.4	408.35	407.29	406.24
Calculated Digestible energy kcal/J	365.93	365.29	364.64	364.01	363.36
Gross energy :protein	10.13	10.08	10.04	10	9.93
Digestible energy: protein	9.03	9.01	8.96	8.93	8.88

FOGLM: Fermented Ocimum gratissimum leaf meal; GE=Lipid (value) × lipid GE (value)+CP (value) × CP GE +NFE (value) × NFE GE (estimate); DE=Lipid (value) × lipid DE (value)+CP (value) × CP DE+NFE (value) × NFE DE (estimate)

The survival rate of fish was monitored during the feeding period from the beginning of the experiment to the end of experiment. According to Fasakin et al., as follows:

Bioindices

Mean Weight gain (g): This was determined by taking the initial.

$$\text{Mean Weight Gain} = W_f - W_i$$

Relative Growth Rate (RGR):

$$\text{RGR}(\%) = \frac{(W_f - W_i)}{W_i} \times 100$$

Specific Growth Rate (SGR):

$$\text{SGR}(\% \text{day}) = \frac{\text{Log}W_f - \text{Log}W_i}{t} \times 100$$

Condition factor (k):

$$k = \frac{100W}{l^3}$$

Protein Efficiency Ratio (PER):

$$\text{PER} = \frac{\text{Mean weight gains (g)}}{\text{Mean protein intake (g of protein in 100g of diet/fish)}}$$

Statistics analysis: Data collected were subjected to descriptive statistics, graph line representation and One-way ANOVA.

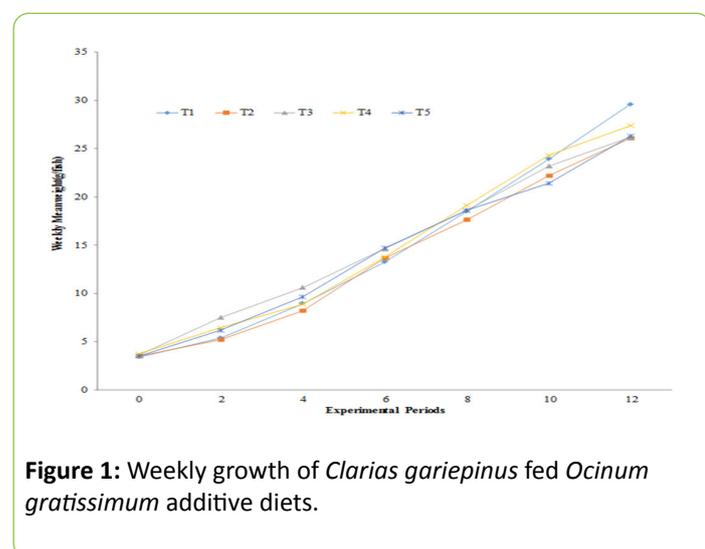
Results

The biweekly weight gain recorded for each experimental diets increases as experimental period increase as showed in Figure 1. The mean weight gain of *C. gariepinus* fingerlings fed diets contained *O. gratissimum* for the period of 12-weeks as presented in Table 2.

Table 2: Growth performance, survival and condition factors of fish fed *Ocimum gratissimum*.

Growth performance parameters	T1 (0%)	T2 (1%)	T3 (2%)	T4 (3%)	T5 (4%)
Mean initial length (cm)	5.95 ^a	5.87 ^a	6.10 ^a	6.33 ^a	5.77 ^a
Mean final length (cm)	14.30 ^a	13.33 ^a	13.35 ^a	13.42 ^a	13.45 ^a
Mean initial weight (g)	3.39	3.5	3.57	3.72	3.5
Mean final weight (g)	29.6	26.1	26.18	27.38	26.3
Mean weight gain (g)	26.21 ^c	22.60 ^a	22.61 ^a	23.66 ^b	22.80 ^b
Relative growth rate (%)	773.15	645.71	633.33	636.02	651.42
Specific growth rate (%/day)	1.12 ^b	1.04 ^a	1.03 ^a	1.03 ^a	1.04 ^a
Condition factor (K1)	1.61	1.73	1.57	1.47	1.82
Condition factor (K2)	1.01 ^b	1.10 ^a	1.10 ^a	1.13 ^b	1.08 ^{ab}
Survival Rate	95 ^c	95 ^c	80 ^b	90 ^c	70 ^a

Mean in the same row bearing different subscript are significantly different at p<0.05



In terms of nutrient utilization highest feed intake was recorded in T1 with value of 26.50 g and lowest feed intake of 18.92 g was recorded in T5, The feed conversion ratio reduces with increased level of additive in the diets in which T1 has the highest value of 1.01 and T5 has the lowest value of 0.83, the protein intake reduced with increased level of additive in which T1 has the highest value of 10.73 and the T5 has the lowest value of 7.73, the protein efficiency ratio also followed the same trend with protein intake in which T1 has highest value of 0.65 and lowest value was recorded in T3 with value of 0.55.

The Somatic indices of this research comprise of hepatosomatic index and viscerosomatic index has showed in Table 3.

The hepatosomatic index increases with increased level of additive in which T1 had the highest value of 1.40% and lowest value of 0.76% was recorded in T2 and viscerosomatic index value was highest in T4 with value of 12.12% and lowest value was recorded in T1 with value of 7.03%.

The cost benefit analysis of *O. gratissimum* as additive fed to *O. gariepinus* presented in Table 4. The following results were obtained which are cost of feed which has range between ₦38.90 to ₦39.50 in which T1 had the highest value of ₦39.50 and T5 had the lowest value of 38.90, cost of feeding was recorded highest in T1 with value of ₦10.47 and lowest value

was recorded in T5 with value of ₦7.53. the net profit of ₦45.53 was recorded as highest value in T1 and ₦41.90 which is lowest was recorded in T2, the profit index of ₦1.92 was recorded highest in T1 and ₦1.78 was recorded in T2 as the lowest value and lastly benefit cost ratio of ₦2.56 recorded highest in T5 and ₦2.47 which is lowest value was recorded in T2.

Table 3: Feed utilization and some somatic indices of *Clarias gariepinus* Fed *Ocimum gratissimum* additive diet.

Feed Utilization Parameters	T1 (0%)	T2 (1%)	T3 (2%)	T4 (3%)	T5 (4%)
Feed Intake (g)	26.50 ^a	21.69 ^b	21.03 ^b	21.53 ^b	18.92 ^c
Feed Conversion Ratio	1.01 ^a	0.96 ^a	0.93 ^{ab}	0.91 ^{ab}	0.83 ^b
Protein Intake	10.73 ^a	8.80 ^b	8.55 ^b	8.78 ^b	7.73 ^c
Protein Efficiency Ratio	0.65 ^a	0.56 ^a	0.55 ^a	0.60 ^a	0.57 ^a
Hepatosomatic (%)	1.40 ^b	0.76 ^d	1.14 ^c	1.22 ^c	1.66 ^a
Viscerosomatic (%)	7.03 ^b	7.60 ^b	10.42 ^a	12.12 ^a	9.10 ^{ab}

Mean in the same row bearing different subscript are significantly different at p<0.05

Table 4: Cost benefit analyses of experimental diets and fish.

Cost Benefit Parameters	T1 (0%)	T2 (1%)	T3 (2%)	T4 (3%)	T5 (4%)
Cost of feed	39.5	39.4	39.2	39.1	38.9
Mean cost of fingerlings stocked (₦)	20	20	20	20	20
Cost of feeding	10.47 ^a	8.55 ^b	8.25 ^b	8.42 ^b	7.53 ^c
Estimate mean investment cost	30.47 ^a	28.55 ^b	28.25 ^b	28.42 ^b	27.53 ^c
Mean yield cost (₦)	76	70.45	70.5	71.6	70.69
Net profit	45.53 ^a	41.90 ^c	42.25 ^{bc}	43.18 ^b	43.17 ^b
Profit index	1.92	1.78	1.79	1.83	1.81
Incidence of cost	1.51	1.75	1.74	1.65	1.71
Benefit cost ratio	2.50 ^b	2.47 ^c	2.49 ^c	2.52 ^b	2.56 ^a

Mean in the same row bearing different subscript are significantly different at p<0.05

Discussion

In this study, there was general increase in weight of fish fed all the experimental diets which is an indication that the fish were able to make use of the protein in feed by converting it into muscle. Although, fish fed diets with the additive recorded lowest weight gains compared to control diet. This might be an indication of an antigrowth factor though the weights were not significantly different ($p>0.05$) and this is agreed with report of Sogbesan et al. who reported lowest weight gain in the diets containing treated duckweed in comparison to the control [2]. The authors noted that this could be due to presence of anti-nutritional factors which can inhibit growth rate in fish. Dienye and Olumuji reported low growth and feed utilization by fish fed diets with increased levels of *Moringa oleifera* leaf meals [14]. Also, Richter et al. reported that low growth performance of fish could be caused by presence of anti-nutrients in *Moringa oleifera* such as tannins, phenol, phytate and saponins [15].

The specific growth rate from this study was recorded highest in control and lowest in the diets contained additive and this is in line with the report of Offor et al. in which the authors recorded highest specific growth rate in fish fed the control diet compared to those fed diets that contained 5%, 10% and 15% inclusion levels of dried basil leaf meal [16]. Similar observations have been reported by Erfanullah and Jafri for varying level of dietary carbohydrate, Alegbeleye et al. for Jackbean and Ochang et al. for palm oil. This reduction in mean weight gains and specific growth rate might due to anti-nutritional factors presence in the diet and this is supported by Oresgun and Alegbeleye that these anti-nutritional factors negate growth and other physiological activities at higher inclusion levels [17,18]

The best feed conversion ratio 0.83 recorded in diets contained 4% of additive which is evidence of an optimum utilization of fermented *O. gratissimum*, by *C. gariepinus* fingerlings and highest value of 1.01 FCR was recorded in the

control diets. This implies that the additive enhances digestion of feed [19].

Feed conversion ratio of this study agreed with report of Marroh and Ekelemu who reported higher FCR in post fingerlings fed control diet than those fed on leaf meal at varied dietary levels. Adikwu stated that the lower the FCR, the better the feed utilization by fish. According to Ilori et al. Junaid et al. and Ugwoke et al. leaf meals have been noted to support growth and nutrients utilization in *Clarias gariepinus* at limited quantities [20-23].

Condition factor is often used to determine health condition of fish, a high condition factor reflects good nutritional and environmental quality and low condition factor reflects poor nutritional and environmental quality (EPD) [24]. Ekelemu and Marroh documented that variation in condition factor might be due to abundance of food, how they adapt to their habitats and development of their gonads [25]. The overall mean of condition factor obtained in this study for K1 is 1.64 and for K2 is 1.04, in which K1 is within range of the result reported by Sogbesan et al. who recorded a mean condition factor of 1.61 for *C. gariepinus* fed treated Duckweed and Anyanwu et al. (2007) recorded condition factor of 0.654 for *C. gariepinus* reared in recirculatory system [26]. The reduction in K2 might be due to changing of environment from hatchery condition to laboratory condition, imported feed to local feed, extraneous factor and as fish grow bigger the condition factor reduces.

Hepatosomatic index and viscerosomatic index are used to determine health status of fish in which an increase in hepatosomatic index is an indication of energy reserve in fish. In a poor environment, fish usually have smaller liver (with less energy reserved in the liver) (EPD) [24]. The increase in value of hepatosomatic and viscerosomatic indices might be due to bioactive chemicals in the additive and this result agreed with Keri et al. who reported that addition of maltose (basal additive) to fish diet increases and improves fish condition in terms of hepato and visceral somatic indices which is an indication of good health status of fish in experimental diet than the control and was also supported by (EPD) On the basis of cost benefit ratio, this research has indicated that net profit and benefit cost ratio and profit index increase with increased level of additive. For cost of feed, cost of feeding, incidence of cost and estimate investment mean cost reduces with increased level of additives. This result corresponded with the report of Sogbesan et al. that highest net profit, profit index, estimate investment cost and low benefit cost ratio were recorded in control diet compared to diet contained treated duckweed fed to *Clarias gariepinus* [2,27].

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