



Effects of *Teifairia occidentalis* and *Vernonia amygdalina* Supplements on Growth Performance of *Clarias gariepinus* Fingerlings

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study examined the growth-enhancing potential of *Telfaira occidentalis* and *Vernonia amygdalina* leaf powder in *Clarias gariepinus* culture. The experiment was conducted at Tidido Fish Farm Makurdi. One thousand juvenile catfish were obtained from the farm's hatchery and allocated to five treatment groups identified as Control (0% supplement inclusion), T1 (10% fluted pumpkin leaf powder inclusion), T2 (20% fluted pumpkin leaf powder inclusion), T3 (10% bitter leaf powder inclusion) and T4 (20% bitter leaf powder inclusion). The fish were fed thrice daily for 8 weeks and water changed daily, to determine growth parameters of fish and physico-chemical parameters of water. Results obtained show that after the treatment period, Mean Weight gain and Specific Growth Rate was not significantly different ($p>0.05$). However, Specific Growth Rate and Percentage Survival rate differed significantly ($p<0.05$), highest (7.9% and 100%) in T3 respectively. Water quality parameters such as pH, Dissolve Oxygen and Temperature were within the recommended range and not significantly affected. Both plant species feed inclusions were utilized by fish, which was observed to facilitate the growth and survival of the fish species, with high percentage survival. In conclusion, T3 inclusion levels showed better growth performance.

Keywords: Supplements; treatment; feed inclusion; feed utilization; growth study.

1. INTRODUCTION

"*Vernonia amygdalina* (family *asteraceae*) is a valuable medicinal plant that is widespread in East and West Africa [1]. It is known as bitter leaf and may be used as an active anti-cancer, anti-bacteria, anti-malarial, and anti-parasitic agent" [2]. "This plant contains complex active components that are pharmacologically useful and are used in the treatment of fever, hiccups, kidney problems, and stomach discomfort. Traditional medical practitioners, herbalists, and local healers in West Africa recommend aqueous *V. amygdalina* for their patients. The beneficial use of *V. amygdalina* in animal nutrition in Nigeria has been well documented. However, the unrefined nature of the herbal preparations, coupled with the apparent lack of specificity or precision in the application of the plant in traditional medicine could lead to over dosage of the herbal medicine, which can result in accumulation of essential and non-essential plant ingredients in the human system. The accumulation can reach a toxic level, especially in the systems of people who rely heavily on unrefined products, with severe consequences on their biochemical and genetic system" [3].

"Fluted Pumpkin (*Telfaira aoccidentalis*) is a tropical vine grown in West Africa as a leaf

vegetable and for its edible seeds. *T. occidentalis* is a member of the family Cucurbitaceae and is indigenous to southern Nigerian" [3]. "The fluted gourd grows in many nations of West Africa, but is mainly cultivated in Southern eastern Nigeria and it is used primarily in soups and herbal medicines" [4]. "*Telfaira occidentalis* Is an important staple vegetable grown in Nigeria. The plant produces luxuriant edible green leaves, which are rich in iron and vitamins. Stems of the plants have branching, long twisting tendrils and the leaves are divided into three to five leaflets with the terminal leaflets up to 15 cm long, while the male plant is grown principally for leaves and seeds, which are important soup ingredients. *Telfaira occidentalis* leaf is rich in minerals (such as iron, potassium, sodium, phosphorus, calcium and magnesium), antioxidants, vitamins (such as thiamine, riboflavin, nicotinamide and ascorbic acid, phytochemicals such as phenols and the leaf extract is useful in the management of cholesterolemia, liver problems and impaired defense immune systems" [5]. "The amino acid profile of *T. occidentalis* had also been shown to be very rich and includes alanine, aspartate, glycine, glutamine, histidine, lysine, methionine, tryptophan, cystine, leucine, arginine, serine, threonine, phenylalanine, valine, tyrosine and isoleucine" [6]. Emeka and Obidoa [7] revealed that "the long term feeding of *T. occidentalis*

supplemented diet caused a significant increase in weight of animals which may be due to its content of rich nutrients". "The high protein content in leaves of plants such as *Telfairia occidentalis* could have supplementary effect for the daily protein requirement of the body. The symptoms of protein energy malnutrition such as Kwashiorkor and Marasmus were rarely observed among dwellers in region where adequate amount of protein is obtained from fruits/seeds and leaves of plants rich in proteins such as *T. occidentalis*" [8]. "Many researchers especially in the field of medical sciences have observed free radical scavenging ability and antioxidant property in *Telfairia occidentalis*. The darkish green leafy vegetable leaves of *Telfairia occidentalis* and extracts (such as aqueous and ethanol extracts) from the leaves have been found to suppress or prevent the production of free radical and scavenge already produced free radical, lower lipid preoxidation status and elevates antioxidant enzymes both in vitro and *In vivo*" [9].

"*Clarias gariepinus* fish is a perishable commodity which spoils immediately after capture. It is generally accepted that some tropical fish species can keep for longer periods in comparison to fish from temperate or colder water" [10]. This can be attributed to differences in the bacteria growth rates in tropical fish stored in ice.

Clarias gariepinus is an important aquaculture fish in Africa, but its culture is being hampered and becoming unattractive due to the high cost of feed, high cost of production and scarcity, this is because most fish feed manufactured in the country rely on imported feed ingredients. Plant based supplement included in fish feed may prove effective in supporting the growth and development of fish, thereby cutting the cost of fish farming.

1.1 Objectives of Study

1. To determine the utilization and growth rate of *C. gariepinus* to varying percentages of *Vernonia amygdalina* dietary inclusion
2. To determine the utilization and growth rate *C. gariepinus* to varying percentages of *Telfairia occidentalis* dietary inclusion
3. To determine the Feed Conversion Ratio and Survival Rate of *Clarias gariepinus* fed

with varying percentages of dietary inclusions of *V. amygdalina* and *T. occidentalis*.

1.2 Null Hypothesis

Powdered inclusion of *Vernonia amygdalina* leaf has no effect on *Clarias gariepinus* juveniles. Powdered form of *Telfairia occidentalis* leaf has no effect on *Clarias gariepinus* juveniles *C. gariepinus* did not feed or survive on the varying dietary inclusions of *V. amygdalina* and *T. occidentalis*

2. MATERIALS AND METHODS

2.1 Study Area

This experiment was conducted at Tiddo fish farm Makurdi, Benue State, situated in the Guinea Savannah agro-ecological zone and in the North Central geo-political zone of Nigeria.

2.2 Collection of the Experimental Fish

The juveniles of *C. gariepinus* was bought from the university farm and transferred to five 1000 litres plastic bowls at the fish farm and were allowed to stabilize for 48 hours before commencement of experiment. The fish were randomly distributed in the 5 treatments at stocking density of 200 fish per tank. The fish were fed thrice daily, in the morning, afternoon and Evening (8:00am, 2:00pm and 6:00pm respectively), and they were weighed once a week for 8 weeks, at daily feeding rate of 3% of the total body weight, adjusted in like manner as reported by Agarwal, [11].

2.3 Source and Preparation of *Telfairia occidentalis* and *Vernonia amygdalina* Powder

Telfairia occidentalis and *Vernonia amygdalina* leaves were harvested and the leaves were washed with clean water to remove the dust and dirt. They were subsequently air dried under room temperature and devoid of sunlight for two weeks. Upon drying and when the leaves became brittle to touch, they were blended into powdered form and sieved using a 1mm mesh size sieve as reported by Ayinla, [12].

2.4 Feed Formulation and Pellet Preparation

All dietary ingredients were ground and mixed with vitamin-mineral premix and water was

added gradually until a desirable paste-like consistency was obtained after which the mixture was pelletized through 2mm disc and sun-dried. The pelletized feeds were then stored in air tight polythene bags, until required. Diet samples were subjected to proximate analysis feed formulation [13]. Diet (1) was the control with no inclusion of *Telfaria occidentalis* (fluted pumpkin leaf) or *Vernonia amygdalina* (bitterleaf) used during formulation, Diet (2) contained 10% inclusion of *Telfaria occidentalis* (fluted pumpkin leaf) referred to as T1, Diet (3) contained 20% inclusion of *Telfaria occidentalis* (fluted pumpkin leaf) referred to as T2, Diets (4) contained 10% inclusion of *Vernonia amygdalina* (bitter leaf) referred to as T3, while Diets (5) contained 20% inclusion of *Vernonia amygdalina* (bitter leaf) referred to as T4.

2.5 Experimental Set Up

Water was pumped from the College farm borehole into over-head tanks to settle after which water was released into the experimental units. The 5 bowls were filled with 300 liters water uniformly, and 200 *Clarias gariepinus* juvenile were randomly stocked in each treatment bowl. The experiment lasted 8 weeks (56 days). The design of the experiment was completely randomized design prior to the introduction of the composition diet. Introduction of treatment diets containing different concentration of *Telfaria Occidentalis* (Fluted pumpkin leaves) and *Vernonia amygdalina*

(Bitter leaves) was carried out from the 1st to the 4th treatment bowl while the first bowl was left as the control with no inclusion of *Telfaria occidentalis* (Fluted pumpkin leaves) or *Vernonia amygdalina* (Bitter leaves).

2.6 Gross Composition of Experimental Diet

Table 1, shows the composition of the various inclusion levels of *V. amygdalina* and *T. occidentalis* treatments.

2.7 Mean Water Parameters

Mean Water Physico-chemical parameters of water used for the experiment across the treatments (Mean \pm SD) was taken during the experimental period and presented in Table 2.

2.8 Determination of Growth Performance

Data on the following performance indices were collected on a weekly basis. Initial mean weight of the fish was determined using a digital sensitive weighing balance after which regular sampling for mean weight changes were taken at two weeks intervals for 8weeks. The data collected was processed for growth assessment and nutrient utilization using the following formulae by Jobling [14], as described below.

Table 1. Gross composition of experimental diet

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Soya Beans	32	32	32	32	32
Fishmeal	10	10	10	10	10
GNC	36	36	36	36	36
Maize	7.5	7.5	7.5	7.5	7.5
Lysine	0.5	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5	0.5
Vitamin	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
Cassava Flour	5	5	5	5	5
Blood Meal	7	7	7	7	7
Bone Meal	0.5	0.5	0.5	0.5	0.5
Feed Inclusion	0%	10%	20%	10%	20%
Total	100	100	100	100	100

2.9 Mean Weight Gain (MWG)

The weight gain of fish in each treatment group were taken. All fish per treatment were individually weighed on a sensitive weighing balance and the respective means were recorded.

$$MWG (g) = W_f - W_i$$

Where:

W_f = final mean weight

W_i = initial mean weight

Percentage Mean Weight Gain (PMWG)

$$PMWG = \frac{W_f - W_i}{W_f} \times 100$$

Where:

W_f = final mean weight

W_i = initial mean weight

Specific Growth Rate:

The SGR was calculated using the formula below:

$$SGR = \frac{\ln [W_f - W_i]}{T} \times 100$$

Where:

W_f = final mean weight

W_i = initial mean weight T = culture period (day)

Feed Conversion Ratio (FCR)

This is the amount of unit weight of food that the fish were able to convert into unit muscle.

$$FCR = \text{Feed Intake} / \text{Total Weight Gain}$$

Survival Rate (SR)

$$\text{Survival Rate (\%)} = \frac{\text{No. of Fish at the end of Experiment}}{\text{Initial No. of Fish Stocked}} \times 100$$

2.10 Data Analysis

All data collected during experimental period was subjected to two-way analysis of variance (Two-Way ANOVA) using SPSS version 26. Duncan's Multiple Range Test was employed to separate the differences among treatment means.

3. RESULTS

Percentage Mean Weight Gain, Specific Growth Rate, Food Conversion Rate, and Percentage Survival Rate of *Clarias gariepinus* fed with *Telfairia Occidentalis* and *Vernonia Amygdalina* leaf Powder was determined from data obtained, recorded, and computed.

The Specific Growth Rate (SGR) was highest (7.9g) in T2 (20% Pumpkin powder) and T3 (10% Bitter Leaf) and lowest (7.3g) in T0 (Control) with significant difference (p<0.05).

The Percentage Mean Weight Gain (PMWG) was significantly different across treatments, and highest (96%) in T3 (10% Bitter Leaf) and lowest (65%) in T0 (Control). There was no significant difference (p<0.05) between T2 and T3.

The Feed Conversion Ratio showed that *Clarias gariepinus* utilized feed fed across the treatments fed with a significant difference (p<0.005) (Table 2). T0 at 1.4, and T1 to T4 at 1.0.

Table 2. Feed utilization and survival of *clarias* fingerlings in relation to varying percentages of *V. amygdalina* and *T. occidentalis* leaf powder inclusions

Parameters	Control	T1	T2	T3	T4
No.of fish Stocked	200.0	200.0	200.0	200.0	200.0
Mean Initial Weight (g)	4.0	3.9	3.9	3.9	3.9
Mean Initial Length (cm)	5.0	5.3	4.9	5.2	5.3
Mean Final Weight (g)	65.0 ^b	80.0 ^a	87.0 ^a	91.0 ^a	80.0 ^a
Mean Final Length (cm)	27.3 ^c	30.2 ^a	26.8 ^b	30.4 ^a	26.8 ^b
SGR	7.3 ^c	7.7 ^b	7.9 ^a	7.9 ^a	7.7 ^b
PMWG (%)	93.8 ^c	95.1 ^b	95.5 ^a	95.7 ^a	95.1 ^b
FCR	1.4 ^a	1.0 ^b	1.0 ^b	1.0 ^b	1.0 ^b
PSR (%)	90.0 ^c	95.0 ^b	90.0 ^c	100.0 ^a	85.0 ^d

*SGR: Specific Growth Rate, PMWG: Percentage Mean Weight Gain, FCR: Feed Conversion Ratio, and PSR: Percentage Survival Rate;

*Mean Values with the same superscript along rows are not significantly different (p>0.005);

*Mean Values with Different superscripts along rows are significantly different (P>0.005);

T1 = 10% Pumpkin Leaf; T2 = 20% Pumpkin Leaf; T3 = 10% Bitter Leaf; T4 = 20 Bitter Leaf

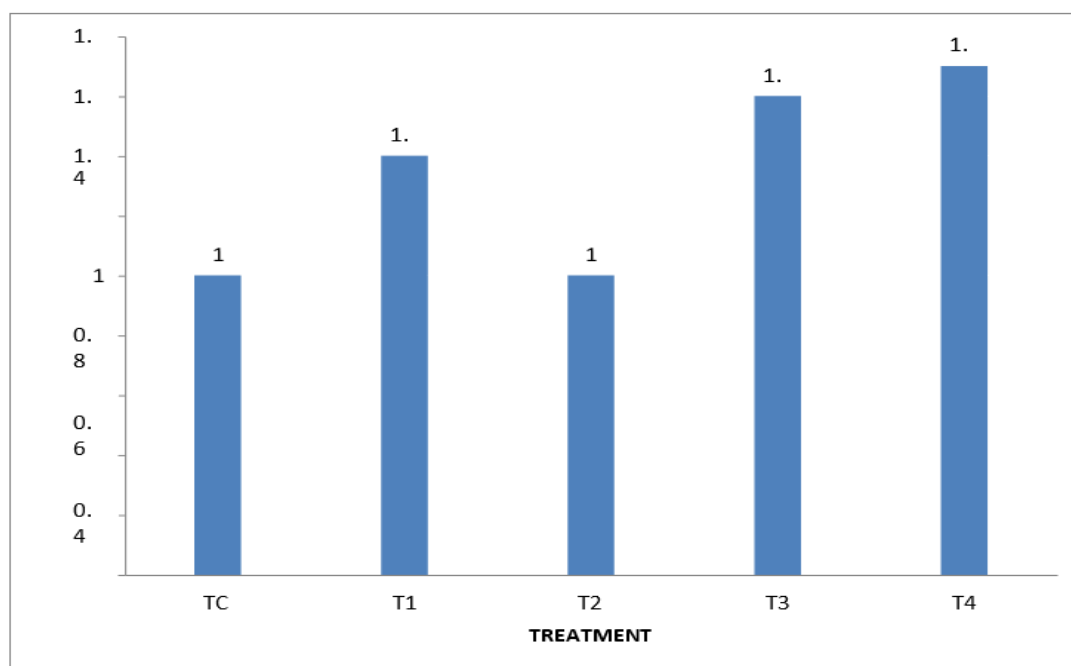


Fig. 1. Mean weight gain

T0= Control; T1 = 10% fluted pumpkin leaf; T2 = 20% fluted pumpkin leaf; T3=10% bitter leaf; T4=20% bitter leaf

Table 3. Mean water quality parameters

Parameter	Control	T1 (PL 10%)	T2 (PL 20%)	T3 (BL 10%)	T4 (BL 20%)	Normal Range
Temperature (°C)	27.20±0.10	27.00 ± 0.00	26.80±0.12	27.40±0.03	27.60±0.14	25-31
pH	7.0 ± 0.00	7.4 ± 0.03	7.6 ± 0.04	8.0 ± 0.10	7.4± 0.10	6.5-8.5
D.O(mg/L)	5.82 ± 0.20	5.6 ± 0.10	6.22 ±0.11	5.7 ±0.30	6.7± 0.10	5.00

The highest survival rate recorded was 100% for treatment3 (10%bitterleaf), 95% for treatment 1 (10% pumpkin leaf), 90% for both treatment 2 (20% pumpkin leaf) and treatment 4 (20% bitterleaf) and 85% for treatment 1 (control).

4. DISCUSSION

4.1 Growth Performance of *Clarias gariepinus* juveniles in Relation to Treatments with Pumpkin leaf and Bitter leaf Powder

There was general growth and improvement in weight of fish across the treatments. Mean Initial Weight was 3.92grams and Mean Final Weight was 7.92grams at the end of the experiment. Mean Initial Length was 5.14 cm and Mean Final Length was 9.74 cm at the end of the experiment. When fish are fed consistently, fish utilizes feed and grows. Growth can be isometric

or allometric. The growth of fish at all stages in its life history is largely regulated by a number of factors, such as food type, food intake, feeding rate, feeding frequency and its ability to absorb nutrients [15,16]. There was no weight loss across the treatments from the weight of fish from start of experiment till the final weight of fish at the end of the experiment.

The Percentage Mean Weight Gain (PMWG) was significantly different across treatments, and highest (96%) in T2 and T3 (20% *T. occidentalis* and 10% Bitter Leaf Powder) and lowest (65%) in T0 (Control). This probably indicates that the higher the percentage inclusion of *T. Occidentalis* supplements, the better the feed assimilation by the fish. *T. occidentalis* is not as toxic as *V. amygdalina* leaf in water. However, *V. amygdalina* has anti-bacterial and anti-parasitic properties Tadesse et al., [17] and Gbolade et al., 2003; has an anti-oxidant Erasto et al., [18]

and as a growth promoter enhancing the gastro intestinal enzymes thus increasing feed conversion efficiency [19]. The more the percentage inclusion of *V. amygdalina* in feed, the faster the pond water gets toxic. At 10% Pumpkin and 10% Bitter leaf (T1 and T3 respectively), Pumpkin leaf showed only a slight percentage difference (95.1% and 95.7% respectively). This indicates that both supplements (especially Pumpkin leaves) can enhance growth rates, this agrees with Yin et al [20] that said the use of plant based additives in aquaculture is one of the methods used to improve weight gain, feed efficiency, and/or disease resistance. According to Fasuyi and Nonyerem (2007), *T. occidentalis* leaf contains ingredients such as bioflavonoid, an active chemical, plant promoter, which promotes growth in birds, and may have similar effects in fish. Aqueous *T. occidentalis* is also reported to increase haematological parameters [4]. The result from this experiment had T2 (10% *T. occidentalis*) and T3 (20% *V. amygdalina*) with highest PMWG at 96%. This agrees with the findings of Adekunle [21] that showed better growth rate and weight gain with treatment with *T. occidentalis* inclusions in feed. However, the higher the concentration, the higher the tendency of leading to accumulation of toxins in fish and acute water toxicity (most liable to Bitterleaf toxin accumulation). "The unrefined nature of the herbal preparations, coupled with the apparent lack of specificity or precision in the application of the plant in traditional medicine could lead to over dosage of the herbal medicine, which can result in accumulation of essential and non-essential plant ingredients in the human system. The accumulation can reach a toxic level, especially in the systems of people who rely heavily on unrefined herbal products, with severe consequences on their biochemical and genetic systems" [22].

Most treatments with the leaf powder inclusions had a higher SGR than the Control treatment (T0). T2 at 20% *T. occidentalis* leaf powder inclusions had better SGR as well as 10% *V. amygdalina*. Recent studies that have shown that *T. occidentalis* leaf powder is rich in minerals, antioxidants, vitamins as compared to *V. amygdalina* that has more of antibiotic, antiparasitic and disease management tendencies [23]. Hence, *T. occidentalis* possesses a higher tendency to utilize feed and growth, while *V. amygdalina* inclusion had a higher disease resistant rate tendencies.

All treatments (T1 to T4) with the feed inclusions had a better FCR as compared to the Control (T0), with a significant difference ($p > 0.05$) and this agrees with the findings of Adekunle [21] that showed better FCR for treatments of feed with additive inclusions as compared with the control treatment.

Survival rate recorded showed minimal or inconsequential loss to *Clarias gariepinus* population across the treatments, and this indicates that the fish species can survive well when fed with calculated amounts of both *Vernonia amygdalina* and *Telfairia occidentalis* inclusions. The highest percentage survival rate recorded was 100% for treatment 3 (10% bitter leaf), and lowest (85%) for T4.

During the period of the experiment, Temperature and pH of experimental water fall within the normal range for aquaculture, however the data collected for Dissolved Oxygen was slightly above the normal range. This could be a factor that enhanced the survival rate of the fish as Dissolved Oxygen is a vital component required for their survival. The physico chemical parameters of the experimental water across treatments was within tolerable range for fish culture, as described by Onyia et al., [24-26].

5. CONCLUSION

V. amygdalina and *T. occidentalis* powder supplements showed improved performance. Both plant supplements can be used for growth development as they contain a healthy amount of vitamins and minerals and are not of harm to the fish species as shown by their survival rate. However, 10% Bitter leaf inclusion showed better performance.

6. RECOMMENDATION

Further research on these plant species used can be conducted to ascertain the actual amount of mineral components present. In addition, after growing to table size, proximate analysis of the fish species should be done for the control as well as the various treatment groups.

A taste survey analysis of the table size fish can be done on randomly selected individuals to ascertain if there is a difference in taste between the control and the treatment groups of the fish samples. Histological analysis can be done on the fish species to determine the effect of the supplement on the internal organs of the fish.

7. STUDY JUSTIFICATION

Aquaculture production seems to be responding to the increased fish demand and have exclusively increased the world fish production by 20 million tons. Irrespective of the achievement of aquaculture, the high cost and scarcity of desirable feeds for aquaculture enterprises in Africa has become a serious constraint in the successful operation of intensive aquaculture enterprise. Fish meal and soybean meal which are the major sources of protein are used as food, by human, it is in high demand by industries for the production of human, animal and fish feeds and this makes the products and feeds expensive. The need to reduce this cost is imperative in the aquaculture business. An inexpensive source of fish feeds will make fish farming attractive due to its profitability.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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