Use of fluted pumpkin (Telfairia occidentalis) leaf powder as feed additive in African catfish (Clarias gariepinus) fingerlings

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ABSTRACT

The effect of dietary Telfairia occidentalis leaf meal on growth, haematological profile, and body composition was investigated in African catfish Clarias gariepinus. Fingerlings of (5.12 ± 0.06 g) average weights were fed diets supplemented with four concentrations (5, 10, 15, and 20 g of T. occidentalis leaf powder/kg feed) for 56 days. Fish fed supplemented diets showed significantly improved growth performance, haematological parameters and feed utilization over the control (0 g T. occidentalis leaf meal/kg feed) treatment. The highest specific growth rate (7.33 ± 2.37% day⁻¹) and best food conversion ratio (0.86 ± 0.06) were obtained in the 5 g T. occidentalis leaf meal/kg feed treatment. Protein efficiency ratio was higher in fish fed with T. occidentalis leaf meal and lowest in the control. No differences occurred in fish carcass moisture, protein, or ash content among the treatments (p > .05). The results suggest that dietary supplementation with T. occidentalis leaf powder improved the growth, feed utilization, and survival of C. gariepinus fingerlings.

1. Introduction

The African catfish, Clarias gariepinus, is the most extensively cultured food-fish species in Nigeria. High feed costs have forced producers to examine ways to reduce production variable costs. One of the ways to reduce costs is through the use of dietary supplements that include plant-based additives.

The use of plant-based additives in aquaculture is one of the methods used to improve weight gain (WG), feed efficiency, and/or disease resistance in cultured fish. Therefore, several kinds of plant-based additives for aquafeed that are used to improve the performance of fish have been studied: plant products such as Astragalus radix and Scutellaria radix (Yin et al. 2006); Allium sativum (Sahu et al. 2007); mango (Awad & Austin 2010); and Nigella sativa (Awad et al. 2013). These plants have been examined in fish to replace antibiotic growth promoters. For example, phytogenic feed additives have been examined in African catfish (Dada & Oviawe 2011) and Tilapia (Dada 2012), and results show improvements in WG, feed conversion ratio (FCR), and blood indices.

Telfairia occidentalis (fluted pumpkin) is cultivated in various parts of southern Nigeria. The darkish green leafy vegetable is used as food and herbal medicine. The leaf is a rich source of protein, oil, vitamins, and minerals, but low in crude fibre and also a rich source of folic acid, calcium, zinc, potassium, cobalt, copper, iron, and vitamins A, C, and K (Ajitade et al. 2006).

T. occidentalis leaf contains active ingredients such as bioflavonoid, an active chemical, plant growth promoter, which promotes growth in birds (Fasuyi & Nonyerem 2007), and may have similar effects in fish. The leafy vegetables possess antimicrobial and antiviral properties (Nwozo et al. 2004; Olurunfemi et al. 2005). Aqueous extract of T. occidentalis is also reported to increase haematological parameters (Alada 2000). The objective of this study was to investigate the effects of the dietary concentration of T. occidentalis leaf meal on the growth, body composition, and haematological parameters of C. gariepinus fingerlings.

2. Materials and methods

Four diets based on a formulation of 41.3% protein, 9.08% lipid, and 5.35% ash was prepared to contain different levels of fluted pumpkin (T. occidentalis) leaf powder. Fluted pumpkin leaf powder was incorporated into the diets as follows: no Fluted pumpkin (control), 0.5 (group 1), 1.0 (group 2), 1.5 (group 3), and 2.0 g/100 g feed (group 4). Fluted pumpkin at different incorporation was added to pelleted feed and then the feed were separately dried at ambient temperature (27–30°C). The pellets (3 mm particle size) were packed and stored in tightly sealed plastic bags at 8–10°C until they were used in the feeding.

A total of 225 C. gariepinus fingerlings (mean body weight: 5.17 ± 0.06 g) were obtained from a commercial fish farm in Akure, Nigeria, and transferred to the department of fisheries and aquaculture technology hatchery at Federal University of Technology, Akure, Ondo State. Of these, 15 fish were put in each 52-litre rectangular plastic troughs. Each dietary treatment was aerated continuously using an air compressor. Water temperature (mercury-in-glass thermometer), pH (Jenway 350), and dissolved oxygen (D – 5509) concentration were monitored.
twice a week in all tanks. After 14 days adaptation, fish in each group were fed one of the four different diets at a total daily rate of 5% body weight in three equal meals, every five hours between 08:00 and 18:00 for eight weeks. All fish were weighed and counted fortnightly and feeding rates were adjusted accordingly.

At the end of the feeding trial, fish were weighed and counted to determine WG, FCR, specific growth rate (SGR), protein efficiency ratio (PER), and survival as they served as indicators for growth performance (Heidarieh et al. 2012):

\[
FCR = \frac{\text{Total feed given}}{\text{Total weight gain}},
\]

\[
SGR = 100 \times \frac{\ln W_f - \ln W_i}{\text{days}},
\]

where \(W_f\) is the mean final weight and \(W_i\) is the mean initial weight.

\[
\text{PER} = \frac{\text{Live body weight gained (g)}}{\text{Protein intake (g)}},
\]

where \(\text{Protein Intake (g)} = \text{Protein (%)} \times \text{Feed given (g)}/100\).

The diets were analysed for proximate composition, including crude protein, crude lipid, crude fibre, ash, and moisture (Table 1) using AOAC (2005) procedures.

At the beginning and end of the feeding trial, pooled samples of 15 fingerlings were analysed for carcass composition using AOAC (2005) procedures. Twelve fish (four fish per replicate) were used for blood analysis and 5 ml blood samples from each treatment were collected by cardiac puncture for blood analysis. The blood was stored at −40°C prior to analysis.

### Table 1. Ingredient composition (kg) and proximate composition (% dry matter) of basal diet.

| Ingredient          | g/kg diet |
|---------------------|-----------|
| Menhaden fish meal  | 250       |
| Corn meal           | 150       |
| Soybean meal        | 350       |
| Blood meal          | 100       |
| Cod liver oil       | 60        |
| Vegetable oil       | 40        |
| Vitamin–mineral premix | 10   |
| Corn starch         | 20        |

### Table 2. Mean growth performance and feed utilization of *C. gariepinus* fingerlings fed experimental diets for 56 days.

| Parameter             | D1 (Control) | D2 | D3 | D4 | D5 |
|-----------------------|--------------|----|----|----|----|
| Initial mean weight (g) | 5.110 (0.08) | 5.120 (0.07) | 5.21 (0.07) | 0.270 (0.06) | 5.13 (0.02) |
| Final mean weight (g)  | 6.76 (0.09)a | 9.23 (0.24)ab | 7.26 (0.51)abc | 7.04 (0.15)a | 7.55 (0.62)ab |
| WG (g)                | 1.622 (0.09)a | 4.11 (0.33)ab | 2.05 (0.33)abc | 1.78 (0.06)b | 2.42 (0.94)ab |
| PER                   | 0.03 (0.00)a | 0.07 (0.02)bc | 0.04 (0.01)abc | 0.03 (0.00)c | 0.04 (0.01)c |
| SGR (% day⁻¹)         | 2.89 (0.16)a | 7.33 (0.37)a | 3.65 (0.60)a | 3.17 (0.11)b | 4.32 (0.67)b |
| FCR (g/d)             | 1.530 (0.14)a | 0.86 (0.60)bc | 1.32 (0.40)ab | 1.44 (0.51)c | 1.33 (0.59)c |

Abbreviations: SGR, specific growth rate; PER, protein efficiency ratio; FCR, feed conversion ratio; FI, feed intake; WG, weight gain.

Notes: Values in parentheses are standard errors of means. Means in a given row with the same superscript letter were not significantly different at \(p < .05\).

### 2.1. Statistical analysis

Analysis of variance was used to test for significant differences \((p < .05)\) between the various treatment means obtained for the growth, feed utilization, carcass composition, and haematological parameters. Duncan Multiple Range Test was used to determine which pairs of the treatment means differed significantly \((Zar 1996)\).

### 3. Results

Mean water quality parameters during the experiment were dissolved oxygen \(5.20 ± 2.48 \text{ mg l}^{-1}\), pH \(7.00 ± 0.07\), and \(26.7 ± 0.85°C\). Water quality parameters were not significantly different \((p > .05)\) among treatments and were within the recommended ranges for the culture of *C. gariepinus*.

There were improvements in the growth responses of fish fed on *T. occidentalis* leaf meal. The best growth responses were obtained in the fish fed on diet D2 \((0.5 g 100^{-1}\) of *T. occidentalis* leaf powder), while the slowest growth was obtained in the fish fed the control diet D1 (Table 2). However, there were no significant differences in growth performance across the different *T. occidentalis* leaf concentrations. The results suggest that dietary *T. occidentalis* leaf at all concentrations promoted the growth of *C. gariepinus* fingerlings. This is the first report regarding the potential of fluted pumpkin leaf powder as a growth-promoting agent in *C. gariepinus*.

There were greater improvements in the FCR of fish fed on *T. occidentalis* leaf meal than the control fish. Fish fed on *T. occidentalis* meal had a significantly \((p < .05)\) higher protein content than fish fed the control diet. The body composition values are given in Table 3. These results showed that the *T. occidentalis* leaf meal treatment enhances nutrient utilization, which is reflected in improved WG, FCR, PER, and SGR. Generally, better FCR values were obtained in all treatments, but the poorest occurred in D1 \((0.5 g 100^{-1}\) of *T. occidentalis* leaf powder/kg feed) (Table 2). Although better FCR values were obtained in the *T. occidentalis* dietary treatments compared to the control, differences among the treatment means were not significant \((p > .05)\).
Table 3. Chemical composition of whole body of C. gariepinus fingerlings fed the experimental (wet basis) diets.

| Composition (%) | D1 (control) | D2 | D3 | D4 | D5 |
|----------------|--------------|----|----|----|----|
| Moisture       | 4.83 (0.42)a,b | 4.31 (0.31)b | 4.73 (0.40)a | 4.59 (0.07)ab | 4.78 (0.42)a,b |
| Crude protein  | 60.76 (0.00)a | 61.75 (0.28)a | 61.13 (0.56)a | 61.46 (0.00)a | 61.42 (0.10)a |
| Crude lipid    | 5.00 (0.20)a | 4.51 (0.07)a | 4.88 (0.03)a | 3.96 (0.69)a | 5.05 (0.06)a |
| Ash            | 13.62 (0.20)a | 13.49 (0.33)f | 11.69 (0.51)a | 13.20 (0.91)a | 12.85 (0.00)a |

Notes: Means in a given row with the same superscript letter were not significantly different at p < .05. Values in parentheses are standard errors of means.

Table 4. Some haematological characteristics of C. gariepinus fed the experimental diets.

| Blood parameter | Experimental diets |
|-----------------|---------------------|
|                 | D1 (control) | D2 | D3 | D4 | D5 |
| PCV (%)         | 37.5 (2.50)a | 37.5 (1.50)b| 29.0 (3.00)a | 30.0 (1.00)b| 32.0 (1.00)b |
| Hb (g/100 ml)   | 12.50 (0.08)c | 12.20 (0.50)b | 9.65 (0.95)a | 10.00 (0.30)b | 10.75 (0.35)b |
| WBC (× 103/µl)  | 5150 (95.0)a | 5550 (25.0)c | 8050 (12.50)e | 8050 (45.0)d | 6750 (10.50)b |
| RBC (× 106/µl)  | 1.18 (0.28)a | 1.45 (0.15)b | 3.20 (0.35)a | 3.30 (0.10)b | 3.58 (0.18)d |

Abbreviations: PCV, packed cell volume; Hb, haemoglobin estimation; WBC, white blood cell count; RBC, red blood cell count.

Notes: Means in a given row with the same letter were not significantly different at p < .05. Values in parentheses are standard errors of means.

4. Discussion

T. occidentalis leaf powder in diets promoted growth and feed conversion efficiency in birds (Fasuuyi & Nonyerem 2007). Similar results were reported by Turan (2006) who used the medical herb red clover Trifolium pratense as a growth-promoting agent for tilapia Oreochromis aureus. Diab et al. (2002) also reported that Nile tilapia Oreochromis niloticus fingerlings fed on diets supplemented with medicinal plants exhibited faster growth than those fed with the control diet. Similar results were reported for using medicinal plants as growth-promoting agents for common carp Cyprinus carpio (Yilmaz et al. 2006), guppy Poecilia reticulata (Cek et al. 2007a), the cichlid Cryptoperonos nigrofasciatus (Cek et al. 2007b), tilapia O. niloticus (Metwally 2009), and African catfish C. gariepinus (Dada & Oviawe 2011). Fallahpour et al. (2014) suggested that unknown factors in various medicinal herbs led to favourable results in fish growth trials.

The present findings may indicate that the presence of bioflavonoids in T. occidentalis stimulates growth in fish. In addition, bioflavonoids are plant chemicals with oestrogenic activity, and studies have shown that oestrogen promotes growth in common carp (Kocour et al. 2005). Therefore, the T. occidentalis leaf powder that promotes growth performance in the African catfish should be tested for its efficacy to induce efficient and economical propagation in other fish. The best feed utilization values observed with diets supplemented with T. occidentalis leaf meal suggested that the addition of T. occidentalis leaf meal improved feed utilization.

The haematological parameters of C. gariepinus (Table 4) showed no significant differences (p ≥ .05) in mean cell volume, mean corpuscular haemoglobin concentration, mean cell haemoglobin, or pack cell volume in all the treatments. However, there was a significant difference (p < .05) in the white blood cell count of fish among the treatments. Fish fed on diets supplemented with T. occidentalis leaf meal had significantly higher (p < .05) white blood cell counts.

White blood cell counts were significantly higher (p < .05) in fish fed diets including 0.5, 1.0, 1.5 and 2.0 g T. occidentalis leaf powder/100 g feed. The haematological values obtained in the present study are similar to those obtained by Dada and Oviawe (2011), who used Garcinia kola as a growth-promoting agent in C. gariepinus fingerlings. Differences in blood parameters of fish in this study could, therefore, be ascribed to differences in the dietary inclusions of T. occidentalis leaf meal in the diets.

The body composition values obtained in this study were similar to those reported by Dada and Oviawe (2011) and Dada and Sonibare (2015).

5. Conclusion

Results from the aforementioned study indicate a promising potential and reliable method for propagating fingerling production and rearing strategy. The use of medicinal plants, especially of fluted pumpkin in catfish, will be an efficient tool to achieve sustainable, economical, and safe fish production. Future research should focus on the improvement of rearing technologies for different species of fish reared using T. occidentalis leaf powder as a feed supplement.

Disclosure statement

No potential conflict of interest was reported by the author.

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