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Growth Performance and Biochemical Profile of *Clarias gariepinus* to Dietary *Allium ascalonicum* Leaf Powder

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ABSTRACT

Supplementation of spring onion (*Allium ascalonicum*) leaf powder to *Clarias gariepinus* diets influences growth, feed utilization and physiological health. Fingerlings averaging 6.93g were raised for 56 days on five diets containing varying levels of onion leaf powder (0, 0.5, 1.0, 1.5, and 2.0g per 100 g feed). The experiment was carried out in triplicate at a stocking density of 15 fish per tank. The results showed improvements in growth rate, feed efficiency and body composition when onion leaf powder was included. The diet with 1.0 g/100 g feed produced the best growth performance and feed conversion ratio while regression analysis suggested an optimal level of 0.99g to 1g/100g of feed. Based on the result obtained, *Allium ascalonicum* inclusion, particularly at 0.99%, enhanced growth and improved biochemical profile, pointing to better health and metabolic stability compared to control.

Keywords: African catfish; spring onion; dietary additive; growth response; feed utilisation

Introduction

Herbal feed additives, often called phytobiotics, are gaining recognition as natural options that can enhance growth, immunity, and feed efficiency (Citarasu, 2010). Several plants have been reported by authors to test successfully in aquaculture and these include *Telfairia occidentalis* (Dada, 2017), *Silybum marianum* (Hassaan, 2019), *Cymbopogon citratus* (Adeniyi, 2020; Adebayo *et al.*, 2020), *Apium graveolens* (Sutthi *et al.*, 2020), *Kigelia africana* (Ndour *et al.*, 2021), *Bougainvillea glabra* (Uma, 2021), and *Beta vulgaris* (Farooqi *et al.*, 2023). These studies highlight the

potential of plant-derived supplements to replace synthetic compounds.

Among medicinal plants, onion (*Allium ascalonicum*) is well-known for its wide biological activities. It contains sulfur-based compounds with antimicrobial and immune-supporting properties (Yilmaz & Acar, 2019). While onion is widely used in human medicine and livestock nutrition, its application in fish diets has received less attention compared to garlic (*Allium sativum*). This study examines the possibility of

Allium ascalonicum as growth promoter by investigating growth performance and serum biochemistry in *C. gariepinus*. The study aims to highlight *Allium*

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ascalonicum as a natural, locally accessible fish feed additive that could support aquaculture practices and reduce dependence on imported growth promoters.

Materials and Methods

Preparation of Experimental Diet and Chemical Analysis

Allium ascalonicum leaves, fishmeal, binder (starch), and other ingredients were locally sourced from Akure metropolis, Nigeria. Authentication of *Allium ascalonicum* leaves was done at the FUTA Herbarium, under voucher number FUTA 0121. The leaves were destalked, rinsed, and air-dried for 7 days. Once dried, they were ground into fine powder using a Kenwood

blender (BL440, UK) and stored in sealed containers at low temperature until required for diet formulation.

Five diets were formulated to contain equal protein levels (40%) but varying amounts of spring onion leaf powder: 0.0 (control), 0.5, 1.0, 1.5, and 2.0 g per 100 g feed (Table 1). Ingredients such as fishmeal, soybean meal, blood meal, maize meal, oils, starch, and vitamin/mineral premix were combined with the onion powder. Pellets of 3 mm size were produced, desiccated at room temperature (27–30°C), and kept at 8–10°C until use.

The formulated feeds were analyzed for their proximate composition (Table 1).

Table 1: Gross and Proximate Compositions of the Experimental Diets

Ingredients	C1 (0.0)	AA1 (0.5)	AA2 (1.0)	AA3 (1.5)	AA4 (2.0)
Fishmeal (61%)	25	25	25	25	25
Soybean meal (42%)	37	37	37	37	37
Blood meal (81%)	10	10	10	10	10
Maize meal (10%)	13	13	13	13	13
Fish Oil	6	6	6	6	6
Veg. Oil	4	4	4	4	4
Vit/Min Premix*	3	3	3	3	3
Starch	2	2	2	2	2
<i>A. ascalonicum</i>	0.0	0.5	1.0	1.5	2.0
Proximate Composition (%)					
Moisture	7.33	8.46	8.50	8.02	9.65
Lipid	20.86	21.22	21.18	20.29	19.30
Fibre	2.06	2.57	3.02	3.80	3.60
CP	40.19	40.20	40.25	40.27	40.29
Ash	6.51	5.38	5.55	6.55	6.72
Carbohydrate	23.05	22.17	21.50	21.07	20.44
Gross energy (Kcal/g) **	5.18	5.18	5.15	5.05	4.93

Proximate Composition

Some proximate composition of the formulated diets was analyzed using methods described by Association of Official Analytical Chemists, AOAC (2005) (Table 1). At both the start and end of the experiment, pooled samples of 15 fingerlings were examined for proximate composition as described by AOAC (2005).

Experimental Fish and Rearing Condition

The experiment was carried out at the Research Farm, Department of Fisheries and Aquaculture Technology, Federal University of Technology, Akure. 225 *Clarias gariepinus* fingerlings (average weight 6.93 g) were bought from a local farm in Akure metropolis and acclimated for seven days in the outdoor concrete tanks (50 × 35 × 35 cm³).

After seven days acclimation period, the fish were stocked at a density of 15 fish per tank with three replicates per treatment. The fish were fed the experimental diets of *A. ascalonicum* of 0.0 (control), 0.5, 1.0, 1.5 and 2.0 g/100 g feed denoted as, C1, AA1, AA2, AA3 and AA44 respectively, at 5% of body weight daily, divided into three meals between 08:00 and 18:00 GMT, for eight weeks. The fish were batch-weighted bi-weekly using a METLER TOLEDO PB 8001 balance. The feeding trial lasted eight weeks. Growth indices were calculated as described by Raissy *et al.* (2022):

Weight Gain (g) = Final weight- initial weight

FCR = Total feed given (g)/Total weight gain (g),

SGR (%/day) = $100 \times [(\ln W_f \pm 1 \ln W_i)/\text{days}]$,

where W_f is the mean final weight and W_i is the mean initial weight.

Daily Feed intake (g/fish) = Total feed consumed/ Number of days

FER = Weight gain (g)/Feed intake (g)

Survival (%) = Number of fish harvested/Number of fish stocked × 100

Water Quality Monitoring

Some water quality parameters such as temperature (°C), hydrogen-ion concentration (pH) and dissolved oxygen concentration (DOC) were monitored weekly using the Mercury-in-glass thermometer, pH meter (Hanna HI98106 model) and dissolved oxygen meter (JPP-607model) respectively.

Blood Sampling for Serum Biochemistry

Blood samples were collected from selected fish by cardiac puncture. Serum for biochemical tests was obtained by allowing blood to clot and centrifuging at 3,000 rpm. Parameters such as total protein, albumin, globulin, cholesterol, and glucose were analyzed following established protocols.

Statistical Analysis

The impact of *A. ascalonicum* on growth performance and serum biochemistry profiles of *C. gariepinus* were analysed using one-way analysis of variance and significant differences among treatments were compared using Duncan Multiple Range Test. Fourth degree polynomial regression analysis was used to determine *C. gariepinus* fingerlings responses to varying levels of *A. ascalonicum* in the formulated diet.

Results

Throughout the study water parameters remained within acceptable ranges for *Clarias gariepinus*. Temperature averaged 26.6°C, pH was stable around 7.6, and dissolved oxygen ranged between 4.9 and 5.7 mg/L. Spring Onion leaf supplementation did not negatively affect water quality (Table 2).

Fish fed onion leaf powder diets showed improved carcass composition compared to the control (Table 3). Crude protein levels were higher (66.9%) in fish fed 2.0 g/100 g diet. Lipid content decreased across supplemented groups, with the lowest value (9.7%) recorded in the highest inclusion level. Moisture and ash contents varied but remained within normal ranges.

Table 2: Summary of the Water Quality Parameters During the Experiment

Parameters	C1 (0.0)	AA1 (0.5)	AA2 (1.0)	AA3 (1.5)	AA4 (2.0)
Dissolved oxygen (mg/L)	4.96± 0.12 ^a	4.93±0.09 ^a	4.97±0.20 ^a	4.97±0.18 ^a	5.68±0.17 ^b
pH	7.58± 0.02 ^a	7.63±0.03 ^a	7.64±0.02 ^a	7.67±0.01 ^a	7.70±0.09 ^a
Temperature (°C)	26.57 ±0.03 ^a	26.57±0.03 ^a	26.57±0.03 ^a	26.73±0.03 ^a	26.61±0.05 ^a

Means in same horizontal row with different superscripts are significantly different (P<0.05)

Table 3: Chemical Composition of Catfish Fed Dietary *A. ascalonicum* After 56 Days

Parameters (%)	Initial	C1 (0.0)	AA1 (0.5)	AA2 (1.0)	AA3 (1.5)	AA4 (2.0)
Moisture	3.81±0.01	8.80±0.02 ^b	8.00±0.07 ^b	8.16±0.01 ^b	6.90±0.01 ^a	8.71±0.02 ^b
Ash	12.53±0.01	18.57±0.03 ^d	16.24±0.01 ^c	13.86±0.01 ^b	12.67±0.02 ^b	10.92±0.03 ^a
Lipid	23.88±0.01	11.61±0.02 ^b	13.82±0.03 ^c	12.57±0.04 ^c	10.90±0.08 ^b	9.73±0.06 ^a
Protein	54.64±0.01	57.50±0.04 ^a	58.76±0.02 ^a	62.12±0.06 ^b	65.60±0.02 ^c	66.91±0.01 ^c
NFE*	5.14±0.01	3.52±0.09 ^a	3.18±0.05 ^a	3.29±0.01 ^a	3.93±0.04 ^a	3.73±0.07 ^a

NFE*= Nitrogen free extract

Table 4: Growth Performance of *C. Gariepinus* Fed Dietary Allium Ascalonicum After 56 Days

Parameters	C1 (0.0)	AA1 (0.5)	AA2 (1.0)	AA3 (1.5)	AA4 (2.0)
Initial weight (g)	6.93±0.00	6.93±0.00	6.93±0.00	6.93±0.00	6.93±0.00
Final weight (g)	26.33±3.22 ^b	29.35±0.97 ^{bc}	33.30±1.94 ^c	27.03±3.54 ^b	22.83±1.40 ^a
Weight gain (g)	19.40±3.22 ^b	22.42±0.97 ^{bc}	26.37±1.94 ^c	20.10±3.54 ^b	15.90±1.40 ^a
SGR (%/day)	2.38±0.23 ^{ab}	2.58±0.06 ^b	2.80±0.10 ^c	2.43±0.25 ^b	2.13±0.11 ^a
DFI (g/fish)	36.45±0.54 ^b	39.72± 0.50 ^{bc}	41.59±4.80 ^c	37.23±7.07 ^b	30.58±3.57 ^a
FCR	1.88±0.48 ^b	1.77±0.19 ^{ab}	1. 58±0.06 ^a	1.85±0.21 ^b	1.92±0.24 ^c
FER	0.52±0.08 ^a	0.56±0.05 ^a	0.63±0.02 ^b	0.54±0.03 ^a	0.53±0.05 ^a
Survival (%)	37.78±5.88 ^a	53.33±6.67 ^a	62.22±8.01 ^a	62.22±5.88 ^a	42.22±4.44 ^a

Mean in the same horizontal row with different letter are significantly different (P<0.05). SGR = Specific growth rate, FCR = Feed conversion ratio, DFI = Feed intake and FER = Feed efficiency ratio

Spring Onion leaf powder supplementation enhanced growth performance (Table 4). Fish fed 1.0 g/100 g diet had the best weight gain, SGR, and feed efficiency. Regression analysis indicated that approximately 1 g/100 g was the optimal inclusion level for maximum growth (Figure 1). Survival rates were high across all treatments, showing no adverse effects of supplementation.

The impacts of dietary *Allium ascalonicum* inclusion on serum biochemical parameters of *C. gariepinus* are presented in Table 5. Variations were observed among treatments for all measured parameters. Serum glucose concentration increased progressively with dietary inclusion of *A. ascalonicum*, reaching a maximum value of 49.00 mg/dL at 2.0 g/100 g. Total protein, albumin, and globulin concentrations

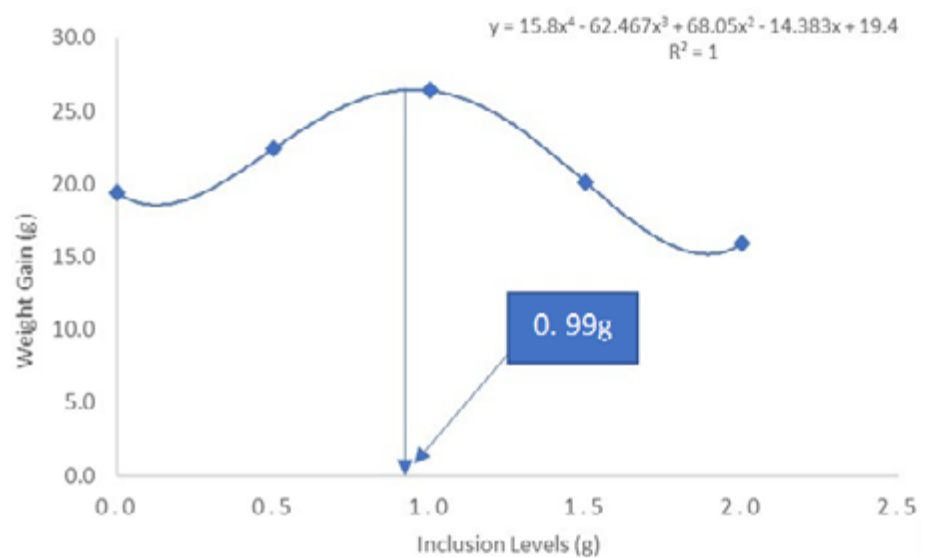


Figure 1: Fourth order degree polynomial regression analysis of weight gain to dietary *A. ascalonicum*

Table 5: Growth Performance of *C. Gariepinus* Fed Dietary Allium Ascalonicum After 56 Days

Parameters	C1 (0.0)	AA1 (0.5)	AA2 (1.0)	AA3 (1.5)	AA4 (2.0)
Glucose (mg/dl)	29.00±4.00 ^a	36.07±8.50 ^b	34.51±9.00 ^b	34.62±4.50 ^b	49.00±1.00 ^c
Total protein (g/dl)	3.22±0.20 ^a	4.59±0.80 ^c	3.46±0.70 ^b	3.45±0.10 ^b	4.61±0.15 ^c
Albumin (g/dl)	1.65±0.05 ^a	2.27±0.45 ^b	1.85±0.35 ^{ab}	1.70±0.00 ^a	2.30±0.20 ^b
Globulin (g/dl)	1.35±0.25 ^a	2.24±0.35 ^c	1.55±0.35 ^b	1.43±1.00 ^{ab}	2.26±0.05 ^c
Cholesterol (mg/dl)	55.00±2.00 ^b	48.00±1.00 ^a	47.50±6.00 ^a	54.62±7.20 ^b	64.5±1.50 ^c

Mean in the same horizontal row with different letters are significantly different (P<0.05)

were highest at 0.5 and 2.0 g/100 g inclusion levels, indicating improved protein metabolism. Cholesterol levels decreased up to 1.0 g/100 g, after which a sharp rise was observed at higher inclusion levels.

Discussion

Supplementation of *A. ascalonicum* leaf powder enhanced growth and food conversion efficiency in *Clarias gariepinus*. Comparable outcomes were

noted by Dada (2017), who reported improved growth in catfish fed *Telfairia occidentalis*. Other studies have consistently shown that medicinal plant supplementation in fish diets accelerates growth and improves feed utilization compared to control diet (Gbadamosi & Osungbemiro, 2016; Afe *et al.*, 2019; Fawole *et al.*, 2020; Adegbesan and Abdulraheem, 2020; Adeniyi, 2020). Similar positive effects have been documented in sea bass (Akrami *et al.*, 2015), and *Labeo chrysophekadion* (Sutthi *et al.*, 2020). Fallahpour *et al.* (2014) suggested that bioactive compounds in plants may explain these favorable outcomes.

The present findings point to bioflavonoids in *A. ascalonicum* as possible stimulants of growth. These compounds, known for estrogenic activity, have been linked to growth promotion in carp (Kocour *et al.*, 2005). Beyond growth, bioflavonoids and other phytochemicals also strengthen immunity and improve performance (Yilmaz *et al.*, 2006). Enhanced feed conversion in fish fed spring onion diets may be due to improved digestion and reduced diet transit time (Platel and Srinivasan, 2001). This aligns with Metwally (2009), who observed better growth in garlic-fed fish. In this experiment, the best food conversion ratio was recorded at 1.0% inclusion (AA2 treatment), contrasting with Afe *et al.* (2021), who found superior FCR in control diets compared to *Chrysophyllum albidum* supplementation. Thus, *A. ascalonicum* appears to optimize protein utilization, lowering feed requirements and production costs.

Survival rates were higher in fish fed onion-supplemented diets compared to controls, likely due to improved water quality and diet suitability. Overall, supplementation with *A. ascalonicum* improved nutrient utilization, growth rate, feed efficiency, and survival.

Polynomial regression analysis revealed that growth peaked at 0.99 g/100 g inclusion, after which weight gain declined, possibly due to reduced palatability or metabolic stress. This indicates an optimal inclusion level for maximizing growth.

Biochemical indices showed significant modulation. Moderate inclusion levels maintained glucose within normal ranges, while higher doses induced mild hyperglycemia, similar to reports in tilapia fed onion or garlic diets (Abdel-Tawwab *et al.*, 2020). Protein fractions (albumin, globulin, total protein) increased, indicating enhanced liver function and immunity (Gopalakrishnan *et al.*, 2020). Cholesterol levels declined at moderate inclusion but rose at higher doses, suggesting dose-dependent (Zeng *et al.*, 2014).

Conclusion

Supplementation of *A. ascalonicum* leaf powder in the feeds of *C. gariepinus* enhanced growth performance, nutrient utilization, proximate composition and serum biochemistry in the treated groups over the control group. The optimum inclusion level was between 0.99–1.0 g/100 g diet and given its local availability, *A. ascalonicum* represents a cost-effective dietary additive for fish farmers.

Recommendation

Results from the aforementioned study suggests that the recommended level of spring onion (*Allium ascalonicum*) in the diets of *Clarias gariepinus* should be between 0.99–1.0 g/100 g.

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