



**INTERNATIONAL JOURNAL OF SCIENCE FOR GLOBAL SUSTAINABILITY**  
**Growth Performance of *Clarias gariepinus* Fingerlings Fed with *Allium sativum* Extract as Natural Feed Additives**

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Received on: October, 2022

Revised and Accepted on: November, 2022

Published on: December, 2022

**ABSTRACT**

Fish is an important aspect of global dietary consumption and its demand makes it an important source of income and means of livelihood. 120 *Clarias gariepinus* fingerlings were sourced from Nagwamatse Farms Gusau, Zamfara State. They were acclimatized for 14 days and fed 4mm Bluecrown containing 45% crude protein diet at 3% body weight twice daily at 12hours interval and later subjected to varying concentrations of garlic extract for the period of twelve weeks. Cloves of garlic were sorted to remove the off types. Garlic dried scales were removed to allow easy air-dry in the laboratory. Dried samples were pulverized using mechanical blender. Ethanolic extraction was done using 100g of powdered samples to 500ml of ethanol. The extract was used to compound fish feed in three treatment (0.5%, 1% and 1.5%). The *C. gariepinus* samples were divided into eight groups (three treatments and a control with one replicates each). Water parameters were measured daily. The average highest mean weight gain was recorded in 1% extract treatment with 155.8±6.4 and the least mean weight was observed in the fish fed with 0.5g/kg of concentrates (140.5±8.73). *C. gariepinus* showed evidence of positive growth response however, high and very low concentrations of garlic extracts had lower positive growth response. Further research should be carried out on the physiological effects of high concentration, its durational effects and, palatability test to further ascertain its potency. The aim of this research study was to evaluate the growth performance of *Clarias gariepinus* fingerlings fed with diets containing varying concentrations of *Allium sativum* extract.

**Keywords:** *Allium sativum*, *Clarias gariepinus*, fingerlings and growth response.

**1.0 INTRODUCTION**

Fishes are major components of most aquatic habitat; there are thousands of species in streams, rivers, lakes, estuaries and oceans. They are also important aspect of global dietary consumption and its demand makes it an important source of income and means of livelihood (Rabo *et al.*, 2014). Fishery products serve as a raw materials, medicine and source of foreign exchange (Godwin and James, 1990; Rabo *et al.*, 2014). Inland aquaculture is on the increase; about 51.3 million tons of aquatic animals were farmed in inland water in 2018 which accounted for 62.5% of the total farmed (FAO, 2020). This increase also comes with several challenges which are not limited to high cost of feed production and disease outbreaks and management leading to significant loss. But to attain this intensification we have saddled lots of stress to the culture animal and environment which

leads to devastating diseases. The need to attain intensification deepens the stress and inevitable disease outbreaks (Aich *et al.*, 2018). Some farmers are leaving the business due to high loss to disease outbreak (NIOMR, 2019). Various antibiotics are widely deployed to remediate the disease outbreaks (Landers *et al.*, 2012; Marshall and Levy, 2011; Aich *et al.*, 2018). Resistant to antibiotics by disease agents have been widely reported after severe use of antibiotics in aquaculture (Heuer *et al.*, 2009), which made bacterial disease hard to control (Aich *et al.*, 2018).

Various Plants extracts have been widely used as a supplement in animal feed concentrates and have been reported to have antimicrobial, anti-helminthic, antiviral, sex reversal and growth enhancement properties. *Garcinia kola* (bitter cola) extracts (Dada and Ikuerowo, 2009), neem

(*Azadirachta indica*) extracts (Razzaghi-Abyaneh *et al.*, 2005), garlic (*Allium sativum*) extracts (Eirna-Liza *et al.*, 2016; Ndakalimwe *et al.*, 2019; Onomu, 2019), clove (*Syzygium aromaticum*) extracts (Srichana *et al.*, 2009; Reddy *et al.*, 2010) have been found to inhibit effectively the growth of fungi and production of toxins on food crops at various concentrations. Neem products have been successfully used as antifungal agents in some plant food materials (Reddy *et al.*, 2010). There has been increase in use of medicinal herbs in aquaculture as application of synthetic drugs is unsustainable due to its cost and ecological effects (Ndakalimwe *et al.*, 2019). This makes the use of natural plant extracts an ideal alternative way to improve the aquacultural output (Reddy *et al.*, 2010). The advantages of medicinal plant extracts are not limited to its ill ecological effect but also its limitation. Pharmaceutical drugs are designed for a particular purpose because of its active ingredient specificity while medicinal herbs might exhibit multi-functions, due to their combined primary and secondary metabolites (Chakraborty and Hancz, 2011; Zahran *et al.*, 2014).

Garlic has been known and put to use by human as food/ food additive as well as medicine for centuries (Afzal *et al.*, 2000; Rios and Recio, 2005). It has been reported to have various medicinal properties (Jalal *et al.*, 2007; Meriga *et al.*, 2012; Bintoro *et al.*, 2015). Garlic has high deposit of nutrients such as; vitamins, iron, Calcium, Sulfur, Zinc, Phosphorus and, metabolites such as; organo-sulfur compounds, polysaccharides and oil (Block, 1992; Dragan *et al.*, 2008; Mousa *et al.*, 2013; Chen and Huang, 2019).

In aquaculture, many researches have been carried out on the use of garlic for different purposes such as; growth enhancement (Agarwal, 1996; Lee and Gao, 2012; Büyükdeveci *et al.*, 2018) and has been found to have high percentage of polysaccharides (about 77% of dry weight) (Koch, 1996), which is used for growth of beneficial gastrointestinal microbiota (Song *et al.*, 2014). This research is aimed at determining the growth performance of *C. gariepinus* fingerlings exposed to varying treatments of *Allium sativum* extract.

## 2.0 MATERIALS AND METHODS

### 2.1 Sample Collection

The study was carried out at the Department of Biological sciences, Federal University Gusau. 120 healthy fingerlings *C. gariepinus* were sourced from Nagwamatse Farms Gusau, Zamfara State. They were transported between hours of 06:00 and 07:00am in a plastic container to the aquaria in the Biological Garden, Department of Biological Sciences, Federal University, Gusau. The fish were left to acclimatize for two weeks while being distributed evenly into aquaria (15 pieces per tank) and fed 4mm Bluecrown containing 45% crude protein diet at 3% body weight twice daily at 12hours interval (Jabbi *et al.*, 2012). Initial body weight and lengths were taken before stocking. After acclimatization, the fish were fed varying concentration of garlic fortified pellet fish feed except the control tanks. Considerable sizes of cloves of garlic were procured from reputable seller in Central market Gusau. They were sorted to remove the off-fit, followed by the removal of the dried scales. The garlic was then sliced to allow for quick air-dry in the laboratory. Furthermore, the samples were then pulverized using blending machine.

### 2.2 Experimental Diet

The powdered garlic was mixed with 95% ethanol at the ratio of 20g to 250ml, using Soxhlet apparatus. The extraction was done till the siphon tube of soxhlet apparatus becomes colourless. Vacuum evaporator was used to dry extract at 35°C until all the ethanol evaporated (Jaradat *et al.*, 2015). The dry extract was used in compounding fish feed. Qualitative analysis was done in accordance with Jaradat *et al.*, 2015 at the Biochemistry laboratory of Federal University Gusau. While qualitative analysis was done at the Multi-User-Laboratory of Ahmadu Bello University, Zaria; Proximate analysis was done following methods of AOAC (2005).

### 2.3 Experimental Procedure

The experimental setup was done at the Biological garden of Biological Sciences Department of Federal University Gusau. The extract was used to

compound fish feed in three treatment concentration (0.5%, 1% and 1.5%). The *C. gariepinus* samples were divided into 8 groups (three treatments and a control with one replicates each) experimental ponds. The fish were fed at 3% body weight twice daily at 12hours interval. The control fish were fed 4mm Bluecrown containing 45% crude protein diet at 3% body weight twice daily at 12hours interval throughout the experimentation. Physicochemical parameters were carried out using a multi-parametric meter (pocket type) while dissolved oxygen (DO) was measured using pocket DO meter (DO9100).

#### 2.4 Estimation of Growth Performance / Data Collection

- i. Mean weight gain = Final weight (mean) – Initial weight (mean)
- ii. Relative weight gain (RWG, %) =  $\frac{\text{Weight gain} \times 100}{\text{Initial weight}}$
- iii. Feed conversion ratio (FCR) =  $\frac{\text{Total feed consumed (g)}}{\text{weight gain by fish (g)}}$

$$\text{iv. Specific Growth Rate (SGR \% per day)} = \frac{\log_e(\text{wt}_2) - \log_e(\text{wt}_1)}{t_2 - t_1}$$

Where wt<sub>1</sub>: Initial weight gain, wt<sub>2</sub>: Final weight gain and t<sub>2</sub>-t<sub>1</sub>: Duration (in days) considered between wt<sub>2</sub> and wt<sub>1</sub>

$$\text{v. Mortality rate (M in \%)} = \frac{\text{total number of fish mortality} \times 100}{\text{total number of fish}}$$

#### 2.5 Statistical Analysis

Data obtained were subjected to ANOVA using IBM SPSS version 21. The mean differences were determined at P < 0.05 among treatment groups using Duncan multiple comparison.

#### 3.0 RESULTS

Mean values of nutrient compositions (Protein, fat, Ash, moisture contents, carbohydrates and fibre contents) of feed containing *Allium sativum* plant leaf extract (%), were recorded as presented in table 1.

**Table 1: Mean Nutrient Composition of Feed Containing *Allium Sativum* Extract (%)**

Treatment	Control	0.5%	1%	1.5%
Protein	34.68±.2	31.57±0.39	33.2±0.20	33.4±0.13
Fat	6.35±.06	6.23±0.03	6.5±0.00	6.8±0.00
Ash	3.4±.00	3.55±0.00	3.39±0.01	3.4±0.00
Moisture	9.03±.06	9.4±0.00	9.5±0.00	9.43±0.06
Carbohydrate	43.51	45.90	43.88	42.90
Fibre	3.03±0.07	3.33±0.06	3.53±0.06	4.07±0.06

Table 1 showed the mean nutrient composition of feed containing *Allium sativum* extract (%). The mean highest protein was recorded in the control samples. Feed containing 1.5% treatment has the highest protein value in the treated feed followed by 1% treatment. The least protein value was recorded in 0.5% treatment. While the mean fat compositions was in ascending order of the treatment concentrations, the mean Carbohydrate value was in descending order of the treatment

concentration. Ash and Moisture content follows no regular order of concentration to treatment. The highest mean Ash was recorded in 0.5% concentration followed by 1.5% and lowest in 1% treatment concentration. Moisture content was highest in feed treated with 1% concentration and lowest in 0.5% concentration.

Also the growth performance of *Clarias gariepinus* exposed to *Allium sativum* leaf extract were recorded as presented in table 3.

**Table 2: Water Physico-Chemical Parameters**

Parameter	Control	Treatment A (0.5%)	Treatment B (1%)	Treatment C (1.5%)
Temperature (°C)	25.4±0.5	25.1±0.3	24.8±0.8	26.1±0.6
DO	6.2±0.25	5.7±0.20	4.7±0.65	5.8±0.41
pH	6.00±0.43	5.85±0.18	6.01±0.17	6.00±0.35

TDS	44±0.9	67±1.9	72±1.4	70±2.3
EC	122±0.7	109±1.2	112±0.7	110±1.1

Physicochemical parameters of the water measured were Temperature, dissolved oxygen (DO), pH, total dissolved solids and electrical conductivity; these are presented in table 2. Water mean temperature ranges between 24.8 to 26.1 (°C). The

mean DO reported was between 4.7 to 6.2 mg/L. The highest mean pH and TDS were reported in 1.0% treatment B while the least were reported in treatment A. The EC reported ranges between 122 and 109

**Table 3: Growth Performance Of *Clarias Gariepinus* Exposed To *Allium Sativum* Leaf Extract**

Parameter	Control	Treatment A (0.5%)	Treatment B (1%)	Treatment C (1.5%)
Initial number of fish	30	30	30	30
Final number of fish	25	23	24	20
Mean initial fish weight(g)	9.5±0.5	9.6±0.46	9.4±0.5	9.8±0.71
Mean final fish weight(g)	145.9±8.1	150.11±7.5	175.23±7.9	160.7±5.4
Mean weight gain	136.4±9.3	140.5±8.7	155.8±6.4	150.9±10.2
Relative weight gain (RWG, %)	1435.8±13	1463.5±9.8	1763.8±17	1539.8±14.19
Feed conversion ratio (FCR)	6.28±0.3	6.63±0.8	5.4±0.02	5.7±0.6
Specific Growth Rate (SGR % per day)	0.014±0.00	0.014±0.00	0.015±0.00	0.014±0.00
Mortality rate (M in %)	16.7± 1.45	25.7±3.61	20±2.44	33.3±3.52

#### 4.0 DISCUSSIONS

The use of herbs by humans to treat various ailments has been for a very long time. Various parts of plants such as; leaves, leave extracts, root, bark, seeds and fruits are being harnessed. The use of these herbs has also been pilot in animals rearing including aquaculture. These herbs garlic inclusive have been used in aquaculture for different purposes such as disease control, growth enhancements, hormonal effect, nutritional supplements etc. In the current study, *A. sativum* extract was used to determine its growth enhancement potentials. The result showed that *A. sativum* extract improved daily specific growth rate, mean and relative weight gain. This corroborates with the findings of Irabor *et al.* (2021) who reported growth improvement in *C. gariepinus* and *Heteroclaris* respectively, fed with *A. sativum* supplemented diet.

This result could be attributed to Garlic's potential to enhance RBC and WBC and increase *C. gariepinus* resistance to infections (Thanikachalan *et al.*, 2010). Growth performances in *C. gariepinus* are dependent on many factors including; water and feed quality, feed quantity. Diab *et al.*, 2008 and Lee *et al.*, 2018 reported that, the presence of Allicin in garlic could also be attributed to its growth enhancement ability. Garlic were reported to have oxygen carrying capacity, thereby improving its intake in to the system (Houston, 1997; Fazlolahzadeh *et al.*, 2011).

Although the result showed a positive result using concentrations of 0.5%, 1.0% and 1.5% in *C. gariepinus*, however; Diab *et al.* (2012) reported higher percentage of 3.2% and 2.5% respectively with highest potential of growth enhancement on *Oreochromis niloticus*. Similarly, Irabor *et al.* (2021) reported the use of 4% and 6% garlic

inclusion in the diet of hybrid *Clarias*. Care must be taken in administering higher percentage of herbaceous supplement as they have been reported to have histopathological and hematological effects. No negative growth as a result of dietary supplementation was recorded in the study. However, Ndong and Fall (2007) reported otherwise in juvenile tilapia (*Oreochromis niloticus* x *Oreochromis aureus*) fed with supplemented garlic diet fed diets supplemented with 0.5g/kg garlic over 4 weeks.

High mortality rate was recorded in 1.5% treatment (Table 3). The cause could not be ascertained as the causes of mortality in aquaculture are multifaceted of which stress, cannibalism, water quality are inclusive. The result of physicochemical properties of the ponds (Table 2) showed there is increase in temperature of 1.5% treatment. This may be as a result of high total dissolved solid resulting from the dissolution of uneaten feed. The result of the physicochemical parameters in the treatment follows no particular order.

## 5.0 CONCLUSION

This research was conducted to determine the growth performance of *C. gariepinus* fed with varying concentration of ethanolic *A. sativum* extract. This study has shown 0.5% - 1.5% concentrate improves growth rate. 1% supplement shows a better growth rate, however, there is no significance difference between the SGR of the three treatments. Further research should be carried out on the physiological effects of high concentration, its durational effects and, palatability test to further ascertain its potency.

## ACKNOWLEDGEMENT

The team highly acknowledge and appreciate the management of Federal University Gusau, Directorate of Research and Development, Tetfund for sponsorship (TETF/DR&S/CE/UNIV/GUSAU/IBR/2020/VOL.1) and Laboratory Technologists for their supports.

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