**Effect of garlic (*Allium sativum)* as feed additives on the growth performance of African catfish (*Clarias gariepinus*)**

Kolo R.J1., Orire, A.M1., Jidelola F. B1. and Haruna, M.A2.

Department of Water Resources, Aquaculture and Fisheries Technology,

1Federal University of Technology, Minna, Niger State; [abdul.orire@futminna.edu.ng](mailto:abdul.orire@futminna.edu.ng)

Department of Fisheries and Aquaculture

Federal University Dutse, Jigawa State.

**Abstract**

A 56 days feeding trial was conducted to evaluate the effect of replacement of synthetic vitamin-mineral premix with wet and dry garlic on the performance of *Clarias gariepinus* fingerlings (2.16g±0.04). Three diets were formulated at 45% crude protein with inclusion of garlic (wet and dry forms) at 5% replacement level of the synthetic vitamin-mineral premix. There were significant differences (p<0.05) in the growth performance of the fishes. Diet containing 5% dry garlic had the best growth performance in terms of specific growth rate, mean weight gain, protein efficiency ratio and feed conversion ratio than the control diet. Therefore, the use of dry garlic at 5% inclusion level has the potential of improving on the growth performance of catfish.

**Keywords:** natural, additive, catfish

**Introduction**

Natural products of animals, plants and microbial sources have been used by man for thousands of years either in the pure forms or crude extracts to treat many diseases (Parekh and Chanda, 2007). Garlic (Allium sativum) has been used to enhance development of domesticated animals and fish (Megbowon et al., 2013). and treatment of infections (Shalaby et al., 2006).

The fresh bulb contains alliin, allicin and volatile oils. Allicin (diallyl-thiosulfinate) is the most abundant compound representing about 70% of all thiosulfinates present or formed in crushed garlic (Block, 1992; Han *et al*., 1995), it also gives garlic its distinctive pungent smell (Williamson, 2003). It also contains 33 sulfur compound, vitamins and minerals (Gruenwald, 2004) and trace elements (selenium & germanium), zinc, iron, potassium, fibre and water (Skidmore-Roth, 2003). When the garlic clove is crushed, the odorless compound alliin is converted to allicin, via the enzyme allinase. The allicin is a major antioxidant and scavenging compound, as recent studies revealed that other compounds such as polar compounds of phenolic and steroidal origin, which offer various pharmacological properties without odor and are also heat stable play stronger roles (Lanzotti, 2006).

The most abundant sulfur compound in garlic is the alliin (S-allyl-l-cysteine sulfoxide), which is present at 10 and 30 mg/g in dry and fresh respectively due to alliin loss to dehydration during drying (Mohammed, 2007 and Lawson, 1998). Garlic contains 17 amino acids: lysine, histidine, arginine, aspartic acid threonine, swine, glutamine, proline, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tryptophan and phenylalanine (Josling, 2005).

Good nutrition in animal production systems is essential to economically produce a healthy, high quality product as against synthetic products. The current study seeks to evaluate the effect of wet and dry garlic as feed additives in the diet of *Clarias gariepinus* fingerlings.

**Materials And Methods**

**Experimental site**

The research was carried out in the laboratory of Water resources, Aquaculture and Fisheries Technology at the Federal University of Technology Minna; Niger State Gidan kwano campus. **Formulation of Experimental Diets**

Maize, soya beans, fish meal, synthetic vitamin-mineral premix and fresh and dry garlic were obtained from Kure Ultra-Modern market, Bosso local government area of Niger state, Nigeria. All ingredients were ground into powdery form using a corn mill machine. The proximate chemical composition of feed ingredients and diets were estimated by the methods described by the (AOAC, 2000) for crude protein, lipid, ash, dry matter, fibre and nitrogen free extract contents (Tables 1 and 3) . Three experimental diets were formulated at 45% crude protein level and 5% garlic (wet and dry) replacement level of the synthetic vitamin-mineral premix using the Pearson square method (Table 2). The ingredients were thoroughly mixed together by hand. Warm water was added to the premixed ingredients and homogenized to a dough-like paste. The diet was sun dry for 4 days and stored in an airtight container throughout the experiment.

**TABLE 1: Proximate Analysis of Experimental feed stuff**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Feed stuffs | %  crude Protein | % Lipid | % Moisture | %  Crude fibre | % Ash |
| Maize | 12.43 | 10.09 | 9.00 | 2.00 | 1.50 |
| Soyabean | 35.50 | 21.05 | 10.60 | 30.5 | 3.50 |
| Fish meal | 67.45 | 13.04 | 11.48 | 0.95 | 11.75 |
| Dry garlic | 17.65 | 0.93 | 4.50 | 3.25 | 1.35 |
| Wet garlic | 8.56 | 0.86 | 67.98 | 0.79 | 1.44 |

**TABLE 2: Composition of experimental diets**

|  |  |  |  |
| --- | --- | --- | --- |
| Ingredients | Control diet | 5% dried garlic-based diet | 5% wet garlic-based diet |
| Maize meal | 74.65 | 74.65 | 74.65 |
| Soyabean meal | 187.7 | 187.7 | 187.7 |
| Fish meal | 187.7 | 187.7 | 187.7 |
| Dried garlic | - | 25 | - |
| Wet garlic | - | - | 25 |
| Synthetic Vitamin-mineral premix | 25 | - | - |
| Oil | 25 | 25 | 25 |
| Total | 500.05 | 500.05 | 500.05 |

**TABLE 3: Proximate Composition of experimental diets**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Diets | %  Crude protein | %  Lipid | %  Moisture | %  Ash |
| Control diet | 45.09 | 11.15 | 14.98 | 13.15 |
| Dried garlic-based diet | 44.73 | 13.28 | 9.76 | 16.15 |
| Wet garlic-based diet | 44.90 | 12.26 | 8.18 | 6.5 |

**Experimental fish and Its management**

One hundred and eighty (180) *Clarias gariepinus* fishes with an average body weight of 2.16g were used for the experiment. The fishes were transported in a plastic container and acclimatized for 5 days preceding the experiment. The experiment was carried out in 9 round plastic tanks (20cm x 10cm). Fishes were allotted at the rate of 20 fishes per tanks in triplicate of randomised design. The fishes were fed thrice daily at 3%, 5% and 7% body weight throughout the experiment for 56 days. Feacal matter and excess feed were siphoned out from the experimental tanks daily while water quality parameters were monitored.

**Data collection and analysis**

The weight of individual fish was determined with a weighing balance (citizen M300). The experimental tanks were examined on daily basis to remove dead fish and feacal matter. Data on fish growth characteristics were recorded fortnightly to generate the following growth parameters;

**Specific growth rate (SGR)** where: W2 = Weight of fish at time T2 (final), W1 = Weight of fish at time T1 (initial) and T1 and T2 are represented in days.

**Feed conversion ratio (FCR)**:

**Weight gain**: Final weight of fish ― initial weight of fish

**Protein efficiency ratio**: ; Protein fed= x feed fed

**Survival rate** = x

**Apparent net protein utilization= x ;**Where, P1 is the protein in fish carcass (g) at the beginning of the study and P2 is the protein in the fish carcass (g) at the end of the study.

**Statistical Analysis**

All data collected were subjected to one-way analysis of variance (ANOVA) using Minitab package (MINTAB release 2018). Means were separated by Duncan’s multiple range tests as outline by Steel and Torrie (1980).

**Results**

Table 4 illustrates the growth and feed consumption of *Clarias gariepinus* fingerlings fed diets containing synthetic and natural additive (dried and wet garlic). The result obtained indicated significant differences (p<0.05) in certain cases among the treatments. There were no significant differences (p>0.05) in mean initial weight for all treatments. Also, the mean feed consumed did not show significant difference (p>0.05) among treatments. However, the dried garlic-based diet (diet II) gave the best values for mean final weight, specific growth rate, protein efficiency ratio, apparent net protein utilization and lowest feed conversion ratio. The trend was shown in figue 1 where the growth pattern was higher for dried garlic-based diet followed by synthetic and then the wet garlic-based diet respectively.

**Table 5: Growth parameters for *Clarias gariepinus* fingerlings fed with synthetic and natural additives for 56 days**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Growth parameters** | **Diet I** | **Diet II** | **Diet III** | **SD±** |
| Mean initial weight (g) | 2.14±0.01a | 2.17±0.06 a | 2.17±0.01 a | 0.04 |
| Mean final weight (g) | 4.13±0.29ᵇ | 4.77±0.15 ª | 3.81±0.12ᵇ | 0.20 |
| Mean weight gain (g) | 1.99±0.27ᵇ | 2.60±0.19 ª | 1.64±0.12ᵇ | 0.20 |
| Mean feed consumed (g) | 6.72±0.34 ª | 6.80±0.28 ª | 6.34±0.22 ª | 0.28 |
| Feed conversion ratio | 3.41±0.34 ª | 2.62±0.11ᵇ | 3.87±0.17 ª | 0.22 |
| Protein efficiency ratio | 0.50±0.21ᵇ | 0.86±0.04 ª | 0.58±0.02ᵇ | 0.12 |
| Specific growth rate (%/day) | 1.17±0.11 ª | 1.41±0.10 ª | 1.00±0.06ᵇ | 0.09 |
| Apparent net protein utilization (%) | 1.67±0.57c | 2.29±0.02b | 3.03±0.68 a | 0.42 |
| Survival (%) | 50 | 50 | 67 |  |

Row means with different superscripts are significantly different at (p<0.05).

**Discussion**

When medicinal plants are used in fish diets, one of the challenges is feed acceptability by fish (Rodriguez *et al.,* 1996), this is in contrary to the finding in this research where garlic based diets were acceptable like the control diet to the fish. Garlic has been reported to promotes growth, enhances immunity, stimulates appetite, and strengthens the control of bacterial and fungal pathogens (Shubha, 2014) this is in agreement with the results obtained from fish fed garlic as it gave the best growth performance in terms of growth and survival due to its antioxidant properties (Megbowon *et al.,* 2013; Rahman, 2003). The present results were in contrast with those obtained by (Sahu *et al*., 2007) who reported that feed conversion ratio (FCR) in fish fed with 0.5%, 1% garlic powder/kg diet was not significantly different as compared with those in the control. In addition, Horton *et al*., 1991; Freitas *et al*., 2001) reported that garlic did not affect growth performance in livestock fed diet containing garlic because of the pungent smell which may lead to lower diet palatability contrary to the finding from this research where dried garlic as feed additive enhances nutrient utilization as revealed in the protein efficiency ratio (PER) than wet garlic, this could be attributed to the concentration of allicin in the additive.

**Conclusion**

The study indicated that dried garlic at 5% inclusion level can be used to improve fish growth and nutrient utilization there by reducing dependency on synthetic vitamin-mineral premix.

**Recommendation**

Fish farmers can use dried garlic as natural additive in the diet of catfish for growth enhancement.

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