International Journal of Pure and Applied Science Research, 11(2):25-31.
ISSN: 2384-5918. December, 2016

Use of Garlic (*Allium Sativum*) as Feed Additive on Growth Performance of African Catfish (*Clarias gariepinus* Burchell, 1822) Reared under Indoor Condition

Hassan, M.*, Suleiman, S.B., Ndirmbita, W.L., Mshelia, M.B., Usman, A., Mohammed, Z.B.
Department of Fisheries, University of Maiduguri, Borno State Nigeria

Abstract: *Stunted growth in pond and high costs of feed has been reported to be major factors affecting aquaculture growth in Africa including Nigeria. The effects of garlic powder Allium sativum as feed additive on growth performance and Nutrient utilization of Clarias gareipinus fingerlings were investigated. Four iso-nitrogenous diets (40% CP) containing garlic at varying levels of 0%,5%,10%,15% inclusion were formulated and allocated to triplicate groups of Clarias gareipinus at 10 fish per 50litre plastic basin for 56 days. The inclusion levels were based on previous studies on other species of fish. The result shows that although no significant differences were established among the experimental treatments and the control in terms of mean final weight, mean weight gain, specific growth rate, protein efficiency ratio and mean feed intake, these parameters showed increasing trend to level of garlic in the diet, weight gain increased from 10g to 18.31g in the control and the 15% garlic based diets respectively. However, feed conversion ratio decreased with increasing level of garlic in the experimental diets. The study indicates that garlic inclusion at these levels tends to enhance better growth and nutrient utilization by Clarias gareipinus. We recommend that higher levels of inclusions than the one used in this experiment can be tried to further investigate the increasing trends indicated by the present study.*

Keywords: *feed additive, growth promoter, inclusion levels*

*Corresponding author's email address: warodizaks@yahoo.com

INTRODUCTION

To economically produce a healthy high quality fish, good nutrition is an essential factor of consideration. In fish farming nutrition is critical because feed represents 40 – 60% of the production costs. Fish nutrition has advanced dramatically in recent years with the development of new balanced commercial diets that promote optimal fish growth and health (Sahu *et al.,* (2007). The development of new species-specific diet formulations supports the agriculture (fish farming) industry as it expands to satisfy increasing demand for affordable safe and high quality fish and sea food products (Craig and Helfrich, 2002). The success of any fish farming depends largely on the provision of suitable and economical fish feed through which optimum growth can be obtained (Eyo, 1994). The supply of qualitative animal protein in sufficient quality and at affordable cost has continued to remain a dream yet to be realized. It is a perennial problem and a major challenge to the livestock industry in most developing countries (Sahu*et al*., 2007) High cost of feed due to shortage and availability of conventional feed stuff for compounding livestock rations has been the major cause of rising cost of animal products (Sakiyay, 2010).

Efforts aimed at increasing animal protein supply must necessarily address the competition between man and livestock for feed sources which has often resulted into shortage of such conventional feed stuffs like maize, soya beans, and groundnut cake for compounding livestock feeds (Omage *et al.,* 2008). This limitation imposed by scarcity of the conventional feed stuffs and has made it necessary to source for alternative and cheaper feed materials to relatively unavailable conventional feedstuffs and this will directly reduce production cost and improve profitability. It has been studied and reported that in intensive culture of fish breeding in which the fish are fed artificial feeds, the major recurring cost is the cost of feed which is about 60 – 75% of the operating cost for every cycle (Eyo, 2002).

Recently the use of antibiotics as a growth promoter in diets of fish has been restricted by the government because of the harmful effects on human health (Botsoglu and Fletouris, 2001; Williams 2001 and McCartney, 2002). In view of this shortcoming research interest is now focused on alternatives to antibiotics that may keep fish healthy such as probiotics and plant based immune stimulants (Sahu*et al.*, 2007). In addition, the global demand for safe food has promoted the search for natural alternative growth promoters to be used in aquatic feeds. In concerning evolved of phytobiotic in aquaculture is a relatively new area of research showing promoting results (Cristea *et al.*, 2012).

Garlic is one of such ingredients showing potentials for use as growth promoter. It's a rich source of calcium, phosphorus and vitamin B_1 it has a high content of carbohydrates and as a consequence a high nutritive value. Garlic also contains iodine salts which have a positive effect on the circulatory system and rheumatism, silicate which has positive effects on the skeletal and circulatory system. Garlic also contains vitamin complex B. vitamin A, C and F (Dragan, 2008). Although it has been used as immuno-stimulants, its use as growth promoter in Clarias gariepinus feed has been understudied.

MATERIALS AND METHOD

Study Area

The study was carried out at Fish Nutrition Laboratory of the Department of Fisheries University of Maiduguri.

Source of Experimental fish and Acclimatization procedure

One hundred and twenty (120) *Clarias gariepinus* fingerlings were purchased from Mshelia fish farm in Maiduguri. The fingerlings were brought to the Laboratory in a fifty (50) litre Jerry can at about 5:00pm in the evening so as to avoid afternoon temperature peaks. As soon as we arrived the Laboratory the fingerlings were carefully transferred in to a $1m^2$ concrete pond and allowed to acclimatized for two weeks (14days), during which they were fed the control diets twice daily at 5% of their biomass.

Source and Preparation of Experimental Feed Ingredients

Feed ingredients such as Fish meal, soya bean meal, Corn, premix, table salt, Lysine and methionine, and dried Garlic powder were purchased at Maiduguri Monday market. Each of these ingredients was separately sorted to remove extraneous materials before been milled to obtain the meals following the methods of Hassan et al. (2015) respectively.

Formulation of Experimental Diets.

Each of the ingredients was measured according to the formulation (Table1). The different levels of garlic powder (0%, 5%, 10% and 15%) were then incorporated and thoroughly mixed to obtain a homogenous product. This was followed by addition of water and continues stirring until it formed dough-like consistency which was immediately pelleted using a hand operated pelleting machine. Thereafter, the pelleted feeds were sun dried and packaged in polythene bags in well ventilated room under ambient temperature.

Table 1 Ingredient Composition of Experimental diets

Ingredients	D1(control)	D2 (5%)	D3 (10%)	D4 (15%)
Maize	21.34	20.22	19.20	18.15

Fish meal	32.00	30.40	28.8	27.2
Soya Bean Meal	32.00	30.40	28.8	27.2
Methionine	0.50	0.50	0.50	0.50
Lysine	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50
Binder	1.50	1.50	1.50	1.50
Premix	2.00	2.00	2.00	2.00
Garlic	-	5.00	10.00	15.00

Experimental design and procedure

The experiment was designed to have four (4) treatment replicated three times each. The experimental treatments were labelled as T_1 (0%), T_2 (5%), T_3 (10%) and T_4 (15%) based on the levels of Garlic inclusion. The treatment containing 0% garlic served as control. One hundred and twenty (120) *Clarias gariepinus* fingerlings of mean initial weight (3.2g) were randomly stocked in these treatments at 10fish/container after which they were starved for 24hrs prior to the commencement of the feeding trial. The feeding trial was carried out in plastic containers (50 liters). Fish were fed at 5% of their body mass twice daily and adjusted based on their new weight after every two weeks, during which fish behaviour and mortality were monitored daily and recorded respectively.

Measurement of growth parameters

The following parameters were determined to express fish growth performance and nutrient utilization:

Weight gain =Final weight – initial weight

Feed intake = $\frac{\text{mean feed intake}}{\text{Number of days}}$ X Number of fish

PER = $\frac{\text{weight gain}}{\text{protienfed}}$

FCR = $\frac{\text{Feed Intake}}{\text{Weight gain}}$

SGR = $\frac{\text{log finalweight} - \text{log initialweight}}{\text{Time (days)}} \times 100$

Condition factor (K) = $\frac{W}{L^3} \times 100$

RESULTS AND DISCUSION

The result of the growth performance of the experimental fish in this experiment are presented in Table2.The mean initial weight of the experimental fish which ranged from 3.04g(T_3) to 3.45g(T_4) did not differ significantly ($p<0.05$) between the experimental treatments and the control. This ensured homogeneity of size at commencement of feeding trial. Other growth parameters such as Mean weight gain, specific growth rate, condition factor, survival rate and nutrient utilization parameters such as feed intake, feed conversion ratio, protein efficiency ratio although showed increasing trend to increasing levels of Garlic in the diets did not show significant difference ($p<0.05$) with the control diet. The mean weight gain of the experimental fish ranged from 10.0g(T_1) to 18.3g(T_4), Specific growth rate ranged from 1.05gT_1 to 1.42g(T_4), mean total feed intake ranged from 14.47g(T_1) to 19.97g (T_4), protein efficiency ratio of the experimental fish ranged from 1.80T_1 to 2.78T_2, food conversion ratio ranged from 1.54(T_1) to 1.17(T_4). Although no significant difference was in the result on growth performance, there was generally increase in growth with increasing level of garlic in the experimental diets compared with the control. This result is in line with report of Diab (2002) and Metwally (2009). It therefore shows that garlic as feed additive enhances nutrient utilization which is reflected in improved Protein efficiency ratio (PER). Protein efficiency ratio has been used as an indicative good utilization dietary protein. Protein efficiency ratio (PER) is known to be regulated by the non-protein energy input of the diet and is a good measure of the protein-sparing effect of lipid and carbohydrate (Tibbets *et al.,* 2005). Protein efficiency ratio and feed efficiency are utilized as quality indicator for fish diet and its amino acid balance. Therefore, these factors are used to evaluate protein utilization and turnover (Shalaby et al., 2006). The present results are in agreement with those obtained Sahu et al. (2007) reported that SGR and FCR in fish (Labeo rohita) fed with 0.5, 1% garlic powder/kg diet was not significantly different as compared with those of the control. Another reason for the current may due to reduced palatability as suggested by Horton et al., 1991; Freitas et al., 2001; Bampidis et al., 2005) who 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. The condition factor which ranged between (0.90 and 1.65) is an indication of the general wellbeing of the fish fed graded level of garlic (Table 2).

Table 2. Mean (±SE) Growth Performance and Nutrient Utilization of Clarias gariepinus fed experimental diets

Parameters	**Garlic (*Allium sativum*)inclusion level (%)**			
	T_1(0%)	**T_2(5%)**	**T_3(10%)**	**T_4(15%)**
Initial length	6.83 ± 0.32^{ab}	7.27 ± 0.19^{ab}	6.30 ± 0.24^{ab}	6.94 ± 0.78^{ab}
Final length	12.83 ± 0.73^{a}	13.73 ± 2.00^{a}	12.73 ± 0.59^{a}	12.38 ± 1.10^{a}
Initial weight	3.38 ± 027^{a}	3.11 ± 0.64^{a}	3.04 ± 0.30^{a}	3.45 ± 0.40^{a}
Final weight	13.39 ± 2.80^{a}	20.41 ± 13.74^{a}	$15.47 \pm 1,86^{a}$	21.58 ± 4.97^{a}
Weight gain	10.00 ± 2.83^{a}	17.10 ± 13.77^{a}	12.58 ± 1.44^{a}	18.31 ± 4.79^{a}
Specific growth rate	1.05 ± 0.18^{a}	1.35 ± 0.48^{a}	1.30 ± 0.10^{a}	1.42 ± 0.20^{a}
Food conversion ratio	1.54 ± 0.56^{a}	1.33 ± 0.93^{a}	1.28 ± 0.19^{a}	1.17 ± 0.55^{a}
Protein efficiency ratio	1.80 ± 0.82^{a}	2.78 ± 2.18^{a}	1.96 ± 0.32^{a}	2.46 ± 0.98^{a}
Feed intake	14.47 ± 2.24^{a}	15.06 ± 0.58^{a}	16.06 ± 0.73^{a}	19.97 ± 5.06^{a}
Condition factor	1.65 ± 2.10^{a}	0.90 ± 2.89^{a}	1.15 ± 1.60^{a}	0.97 ± 3.59^{a}

Means (±SE) with the same superscripts along the same row are not significantly different ($p<0.05$).

The result of this study is in agreement with the findings of Lagler (1956) who reported a range of values (0.5 to 1.0.) for healthy fish. The general welfare of fish recorded in this study may be due to the protective effect of garlic associated with its antioxidant properties as suggested by Pedraza-Chaverri*et al.* (2000) and Rahman (2003).

Carcass composition is information that relates to nutrient retention and or deposit by fish fed experimental diets. This parameter have been used to assessed nutrient digestibility and availability in experimental animals as it entails to what extent the feed consumed by the animal is retained in its tissues. In this study there was general increase in carcass crude protein of experimental fish fed garlic based diets compared to the fish fed the control diet. The highest value of 62.2% (Table3) was recorded in fish fed highest levels of garlic (T2) and lowest value of 54.32% was obtained in T4. In a related experiment Kamruzzaman, et al. (2011) reported that nitrogen (N) retention is considered as an important index of protein status in ruminants and N digestibility, N absorption and N retention were numerically higher in GS-diet with garlic stem and leaf silage than hay-diet, although N intake was similar. Probably, due to nature of the plants and plenty of bioactive components present in garlic, these parameters might have a positive impact on N balance by influencing microbial proteolytic activities of rumen fluid in sheep and fed with GS-diet. Oi et al. (2001) reported that protein anabolism occurs in rats fed the high protein diet supplemented with garlic. In the present study although there was no significant difference it is in agreement with these findings since carcass protein and protein efficiency showed increasing trend to garlic supplementation in the diet.

Table 3 Carcass Composition of C. gariepinus before and after feeding with Experimental diets

Parameters	Dry Matter	Crude Protein	Lipid	Ash	NFE
T_O	98.68±0.43[a]	50.00±0.23[a]	17.0±0.33[a]	2.0±0.44[a]	2.0±0.19[a]
T_1	96.20±0.23[a]	57.85±0.33[a]	11.0±0.32[a]	3.0±0.23[a]	2.1±0.20[a]
T_2	95.30±0.22[a]	62.20±0.30[a]	9.00±0.43[a]	1.0±0.22[a]	1.2±0.23[a]
T_3	96.90±0.26[a]	55.14±0.43[a]	18.0±0.26[a]	2.0±0.28[a]	2.2±0.18[a]
T_4	96.76±0.24[a]	54.32±0.33[a]	15.0±0.43[a]	2.0±0.26[a]	1.9±0.18[a]

Means± SE. values having the same super script along a column are not significantly different (p>0.05)
T_0= Initial Carcass Analysis; T_1= Treatment 1(0%);T_2= Treatment 2 (5%);T_3= Treatment 3 (10%);T_4= Treatment 4 (15%).

Dietary lipids are important nutrients affecting energy production in most fish and essential for growth and development. But, fish are known to utilize protein preferentially to lipid or carbohydrate as an energy source (Chang sixRa et al. 2012). In present study, lipid in whole body composition of the experimental fish was greatly increased from 11.0% in the control and 18.0% in fish fed 10% garlic based diets. Dietary garlic extract might result in excessive lipid aggregation in whole body because increase in protein utilization for fish fed GE diet could reduce role of lipid as an energy source for growth, so deposition of lipid was higher in garlic based diets group than in control similar to suggestion made by Chang sixRa et al., (2012).The mean temperature ranged between 27.17±0.33 to 28.98±0.77, The mean dissolved oxygen ranged between 6.17±0.03 to 6.30±0.20 and The pH ranged between 7.15±0.06 to 7.28±0.20 respectively. These values are within the ranges recommended for most tropical fish species.

CONCLUSIONS

From the results of this experiment garlic can be effectively used to enhance fish growth and nutrient utilization there by reducing the dependant on synthetic materials of residual consequences as growth promoter.

ACKNOWLEDGEMENT

The authors wish appreciate the Head of Department of Fisheries University of Maiduguri and the Fish Farm attendants for their valuable contribution towards this experiment.

REFERENCES

AOAC, (2000). Association of Official Analytical Chemists International (AOAC). Official methods of analysis, 17th edition AOAC International. Gaithersburg, MD, USA.*Biochemical and Biophysical Research Communications*, 277, 68-574.Blackwell Scientific publications Ltd. 575Pp.

Bampidis VA, Christodoulou V, Christaki E, Florou-Paneri P, Spais AB. (2005). Effect of dietary garlic bulb and garlic husk supplementation on performance and carcass characteristics of growing lambs. Anim Feed Sci Technol. 121:273–283.

Botsoglu, N.A., Florou-paner, P., Christoki, E., Fletouris, D.J. and Spais, A.B. (2001). Effect of dietary Oregon essential oil on performance of chickens and on iron induced lipid tissues. Br.*Poult. Sci.* 431.223-230.

Craig, C. and Helfrich, L.A. (2002). Understanding Fish Nutrition, Feeds and Feeding. Publ. No. 420-456.

Cristea, C., Anca, D. and Hummels, D.P., Larvra D. and Avetisyan, M. (2012). Trade and greenhouse Gas emissions from international freight transport (June, 2012) NBER. Working Paper No. 17117.

Diab, A.S., El-Nagar O.G., Abd-El-HadyM.Y. (2002). Evaluation of *Nigella sativa* L. (black seeds, Baraka), *Allium sativum* (garlic) and Biogen as feed additives on growth performance and immune stimulants of *Oreochromis niloticus* fingerlings. *Suez Canal Vet. Med. J*. 2: 745–753.

Eyo, A.A. (1994). The requirement for formulating standard artificial feed. Paper presented at NIFFR/FAD National Fisheries Workshop on Aquaculture Development Fish Feed Production and postharvest technology held at NIFFR Between 20th and 23rd 1994. 30P.

Eyo, A.A. (2002). Fish Processing Technology in the Tropics. National Institute for Freshwater Fisheries Research. New Bussa, Niger States. 23-35.

Freitas R, Fonseca JB, Soares RT, Rostagn HS, Soares PR. Utilization of garlic (*Allium sativum* L.) as growth promoter of broilers. Rev Bras Zootec. 2001;30:761–765.

Hassan M. Aba A. Wakil U. B. (2015) Effects of Replacing Soybean Meal with Baobab (*Adansonia digitata*) Seed Meal in the Diets of *Clarias gariepinus* (Burchell, 1822) Fingerlings. Nigerian Journal of Fisheries and Aquaculture 3(1&2): 42 – 48.

Horton GMJ, Blethen DB, Prasad BM. (1991). The effect of garlic (*Allium sativum)* on feed palatability of horses and feed consumption, selected performance, and blood parameters in sheep and swine. Can J Anim Sci. 71:607–610.

Kamruzzaman M, Torita A, Sako Y, Al-Mamun M, Sano H. (2011(. Effects of feeding garlic stem and leaf silage on rates of plasma leucine turnover, whole body protein synthesis and degradation in sheep. Small Rumin Res. 99:37–43.

LaglerK.F. (1956). Freshwater Fishery Biology. W .C. Brown Company, Dubugue, Iowa. 421Pp.

Metwally, M. A. A. (2009). Effects of garlic on some antioxidant activities in Tilapia nilotica. *World Journal of fish and marine sciences*, 1, 56-64.

Oi Y, Imafuku M, Shishido C, Kominato Y, Nishimura S, Iwai K. (2001). Garlic supplementation increases testicular testosterone and decreases plasma corticosterone in rats fed a high protein diet. J Nutr. 131:2150–2156.

Pedraza-Chaverri J., Maldonada, P.D., Medina-Campos, O.N., Olivares-Corichi, I.M.,Granados-Silvestre,M. A., Hernandez-Pando,R.and Ibarra-Rubio,M.E. (2000). Garlic ameliorates gentamicin nephrotoxicity: relation to antioxidant enzymes. *Free Radic. Biol. Med*., 29, 602–611.

Rahman K. (2003). Garlic and aging: A new insights into an old remedy. Ageing Res. Rev., 2, 39–56.

Sahu, S., Das, B. K., Mishra, B. K., Pradhan J.and Sarangi.N.(2007). Effect of *Allium sativum* on the immunity and survival of *Labeorohita* infected with *Aeromonashydrophila*. *J. Appl. Ichthyol.*, 23:80–86.

Sarkiyay, S. and Agar, T. M. (2010). Comparative Analysis on the nutritional and anti-nutritional contents of thesweet and bitter cassava varieties. *Advance journal of food science and technology*, *2*(6), 328-1084.

Tibbets S.M., Lall S.P., Milley J.E. (2005). Effect of dietary protein and lipid levels and dietary protein/dietary energy ratio on growth, feed utilization and hepatosomatic index of juvenile haddock, *Melanogram saeglefonus*. *Aquaculture Nutrition* 11: 67-78.