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Effect of garlic concentrates on performance of hybrid catfish fingerlings (*Heterobranchus longifilis* x *Clarias gariepinus*)

Irabor, A. E. [1,2*], Ekelemu, J. K. [2], Ekokotu, P. A. [2] and Nwachi, O. F.[2]

[1]Sustainable Aquaculture School of Biology University of St. Andrews, Scotland; [2]Department of Fisheries, Delta State University Abraka, Nigeria.

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Abstract The growth of hybrid catfish (Heteroclarias) subjected to varying quantity of garlic concentrate introduced into the diet was examined during a period of twelve weeks. Six hundred (600) fingerlings with average initial mean body weight 3.90 ± 0.02 indiscriminately allotted into five (5) treatments with four replicates each of thirty (30) fish sample respectively. The varying amount of garlic concentrate was at 0%, 2%, 4%, 6, and 8% per kg of feed respectively. Parameters considered in this research include feed conversion ratio (FCR), mean weight gain (MWG), total protein consumed (TPC), protein efficiency ratio (PER) and specific growth rate (SGR). All showed statistical resemblance among treatments. Means of weight gain and specific growth rate (SGR) across treatment revealed that treatment 4 were 53.63 ± 0.63 and 3.04 ± 0.06, respectively. The test ingredient showed some level of significance on the feed conversion ratio (FCR) in treatment 2 (2.57 ± 0.03) compared across treatments. Generally, the best is observed for performance in treatment 3 with 4% addition level of garlic concentrate.

Keywords: Examined, Efficiency, Parameters, Treatments

Introduction

Lately, the growing interest in herbs usage in animal feeds formulation by both researchers and feed companies have increased (Logambal and Michael, 2000). Aquaculture is not left out in this trend; most farmers now welcome the organic means of fish culture which is much healthier and economical using immune-stimulation, anti-bacterial, anti-stress and performance enhancing plant products (Sivaram *et al*., 2004; Lee *et al.,* 2012).

Garlic (*Allium sativum)* of the Alliaceae, is considered among the foremost medicinal plants harnessed globally for numerous diseases

* **Corresponding Author:** Irabor, A. E.; **Email:** iraborarnold@gmail.com

control and treatment (Rios and Recio, 2005). Interestingly, the nutritive characteristics of garlic lobes is attributable to the high deposits of Calcium (Ca), Phosphorus (P), Zinc (Zn), Iron (Fe), carbohydrates, Iodine (I), Silicon (Si), Sulfur salts, Vitamin A, F, C, B1 and B complex (Dragan *et al.*, 2008).

Since ancient times, garlic (*A. sativum)* has widely been harnessed for various purposes mainly for tackling numerous infirmities for instance heart ailments, tumors, headache, bites, and worms, enhance sexual competence and male potency (Kahn, 1996; Rivlin, 2001; Ali *et al.,* 2008; Jordan *et al.,* 2010), this is attributable to its varieties of biological roles which includes anti-thrombotic (Block *et al*., 1992), anti-microbial and anti-hypertensive (Konjufca *et al.*, 1997; Suetsuna, 1998; Sivam, 2001), anti-cancer (Mousa, 2001), hypo-lipidemic (Sumiyoshi, 1997), hepato-protective and insecticidal (Wang *et al.,* 1998), anti-oxidant (Wu *et al.,* 2001), refining immune-system (Kang *et al*., 2001), growth promoter and stimulant (Shalaby *et al.,* 2006; Ahmed *et al.*, 2008; Mesalhy *et al.,* 2008; Metwally, 2009), tower serum lipid and glucose levels (Lawson and Wang, 2001), diminish serum cholesterol intensities (Bordia *et al.*, 1975; Augusti, 1977) and BP (blood pressure) (Ali *et al.,* 2000).

Garlic also constitutes certain levels of unstable sulfur rich components which range from 0.1 to 0.36%; Allicin (which gives it the unique odor), diallyl-disulfied, diallyl-trisulfied, etc. are outstanding pharmacological qualities (Silagy and Haw, 1994; Benkeblia, 2004). The elements of garlic lobes (on DM basis) are CP; 61%, CF; 0.86%, EE; 0.65%, crude ash; 1.48% and significant level of trace mineral components such as selenium (Se), enzymes and glucosinolates (Grela and Klebaniuk, 2007), 1.7 amino acids examples are cysteine, arginine and lysine (Adetumbi *et al.*, 1986; Rees *et al.*, 1993; Corzo-Martinez *et al.*, 2007).

Numerous findings have reported various impressions of garlic inclusion on performance of some cultured fish species such as *Litopenaeus vannamei* (Javadzadeh *et al*., 2002; Zare *et al*., 2014; Gol Aghaei *et al.*, 2016), swordfish (Kalyankar *et al.*, 2013), Nile tilapia (Aly and Mohamed, 2010) , starlet sturgeon *Acipenser ruthenus* (Lee *et al*., 2014), rainbow trout (Garbor *et al.*, 2012), *Huso huso* (Tangestani *et al*., 2011; Nobahar *et al*., 2014; Akrami *et al.*, 2015), African catfish (Agbebi *et al*., 2013), *Dicentrarcus labrax* (Norhan *et al*., 2015), *Mesopotamichthys sharpeyi* (Maniat *et al*., 2014) and *Carassius auratus* (Sasmal *et al*., 2005). Also, Agarwal (1996) noted the growth enhancing characteristic of garlic which contributes to its use as food ingredient. Aside enhancing growth of

Oreochromis niloticus (Soltan and El-Laithy, 2008; Mahfouz *et al.,* 2009; Abdel – Hakim, *et al* 2010), garlic has the potential to boost immune-system (Ahmed *et al.*, 2008; Metwally, 2009) and physiological responses (Diab *et al*, 2000; Shalaby *et al.,* 2006).

Garlic extract have been revealed to lessen blood lipid levels (Bordia *et al.,* 1975; Augusti, 1977). Comparative study by Benkeblia (2004) on the microbial influence of garlic and three species of onion on the wellbeing of *Oreochromis niloticus* revealed that red onion and garlic have resilient antibacterial (inhibitory activity) on fish species.

Moreover, most members of Aliaceace, such as onion (*A. cepa*) are generally harnessed for medicinal purposes (anti-thrombotic, anti-cholestremia, anti-platelet activity and tonic effects). These pharmacological characteristics are attributed to sulfur component liable typically for the flavor, odor and flavonoids in particular quereetin which is distinguished as an anti-carcinogenic characteristic (Deschner *et al.,* 1991). Also, the peels increase male sexual performance (Junemann, 2003; Lines and Ono, 2006) due to constituents contained; small quantity of fat, sugar and A, B complex and C vitamins: increased level of potassium and copper (Dragan *et al.,* 2008). Consecutively, appetite and digestion in both higher and lower vertebrates is highly influenced by garlic.

The research findings were evaluated the growth of catfish (hybrid) fed various dietary garlic concentrate, and examined the effect of the dietary treatment on the survival rate of the sample fish species.

Materials and method

Study area

Delta State covers a land mass of roughly 18,050 Km^2 and about 60% of this land. Its location is found between longitude 5°00 and 6°45' East and latitude 5°00 and 6°30 North. The borders are Edo State to the North and Northeast and Anambra, Imo, and Rivers States, to the East, to the Southeast by Bayelsa State, on the South by Bight of Benin which in turn covers roughly 160 kilometers of the State's coastline (Ofuoku *et al.* 2006). The State is described by generally low-lying land with few hills. It also possesses a very wide coastal belt which is entwined with rivulets and streams that come together to form part of the Niger River Delta (Ofuoku *et al.* 2006)**.**

Method of sample collection, transportation and distribution

A sum total of 600 healthy fingerlings of Heteroclarias (Hybrid catfish) were purchased from a reputable farm in Delta State and transported to the laboratory of Fisheries and Aquaculture Department, Delta State University, Asaba Campus where they were kept in four receptacles filled with clean oxygenated tap water and fed twice daily with 0.8mm commercial feed for 14 days to acclimatize. After two weeks, the fingerlings were introduced randomly at 30 fingerlings each into five tanks and replicated into four labeled Treatment $1_{A, B, C, D}$ and $_{E}$, $2_{A, B, C, D}$ and $_{E}$, $3_{A, B, C, D}$ and $_{E}$, $4_{A, B, C, D}$ and $_{E}$, and $5_{A, B, C, D}$ and $_{E}$ respectively. Each tank was supplied with oxygenated tap water. The water replacement was done partially every 3 days to renew the water and to remove the wastes. The initial body weight, total length and standard length of fingerlings stocked from each treatment were measured at the inception of the experiment.

Dietary treatments

Feed materials and proportions of garlic concentrates are presented in Table 1. Garlic bulbs were cleaned and dried in oven at 60^{o}C for 72 hours, then milled into powder form and preserved in moisture free plastic container. The garlic concentrate (GC) was added in experimental diet at levels 0, 2, 4, 6 and 8%/kg, milled, mixed and pelleted to various sizes (2mm, 3mm and 4mm). Experimental fingerlings were weighed biweekly by a sensitive scale to regulate feed mass in every tank in respect to body weight changes.

Table 1. Composition of the different feed ingredients

Ingredient	**Treatment 1 (0%)**	**Treatment 2 (GC 2%)**	**Treatment 3 (GC 4%)**	**Treatment 4(GC 6%)**	**Treatment 5(GC 8%)**
Fish meal	40.0	40.0	40.0	40.0	40.0
Soya beans(toasted)	9.00	9.00	9.00	9.00	9.00
Groundnut cake	20.0	20.0	20.0	20.0	20.0
Maize	29.0	29.0	29.0	29.0	29.0
Vitamin premix	1.00	1.00	1.00	1.00	1.00
Lysin	0.20	0.20	0.20	0.20	0.20
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.20	0.20	0.20	0.20	0.20
Binder	0.50	0.50	0.50	0.50	0.50

Treatment 1: Control; GC: Garlic Concentrate

Experimental procedures

The locally formulated feed constituting the different proportion of garlic concentrate (GC) was administered to fish samples. The feeding was performed adequately (feeding based on calculated body weight) twice daily between 6:30-8am and 5:30-7pm. Proper water management practices was adhered to avoid water being polluted. Physicochemical parameters observed included temperature (via thermometer), pH (using pocket pH meter) and dissolved oxygen (using Winkler's method) measured every 7days, all tested water quality was suitable for rearing the Heteroclarias fingerlings, water temperature ranged between 24^oC - 28^oC, pH values 4.55 - 5.00 and dissolved oxygen 5.50 - 8.80 mg/l. Body weight of the samples was measured biweekly to analyze the growth parameters. The sampling was usually done by draining entirely the tanks via flushing out the water through the outlets, gently captured the fish and weighed with a sensitive weighing balance. Length was also measured with a calibrated board. Fish were promptly returned into their respective tanks after each sampling.

Determination of growth indices and food utilization

Fish weight gain, feed conversion ratio, specific growth rate and mortality were determined as follows: Weight gain = final weight of sampled fish – initial weight of sampled fish. Specific Growth Rate = (SGR): SGR = $\frac{(\text{Log } W_2 - \log W_1)}{\text{Experimental days}} \times 100$; Where, W_2 = Final Weight of fish and W_1 = Initial Weight of fish. Feed conversion ratio (FCR) is analyzed from the relationship of feed intake and diet weight gain. FCR = $\frac{\text{Total feed consumed by sampled fish (g)}}{\text{Weight gain by sampled fish}}$, Mortality; $M = (N_0 - N_1)$; Where, No = number of fish at the start of experiment and N_1 = number at the end of the experiment.

Statistical analysis

All data were statistically analyzed using the ANOVA statistical method from SPSS version 20, with Duncan's multiple range tests to separate the mean. The difference between mean were compared for the significance ($P \leq 0.05$).

Results

The results of the experiment presented in Table 2, revealed that the proximate examination of garlic concentrate added to fish feed diets. The observed parameters indicated a progressive upsurge as inclusion level appreciated, except for nitrogen free extract which indicated a decline as inclusion level increased.

Table 2. Proximate analysis of garlic as an additive to fish feed diets ± SEM

S/N	Sample	% moisture content	% ash content	% crude fibre	% ether extract	% crude protein	% Nitrogen free extract or carbohydrate
1	0%	3.96	2.48	2.00	7.84	19.49	64.00
2	2%	4.93	2.46	1.94	9.27	20.79	60.91
3	4%	5.83	2.92	2.49	10.40	21.00	57.36
4	6%	6.25	2.89	2.96	10.58	22.09	55.23
5	8%	7.96	2.99	3.00	10.73	23.08	52.24

The performance of catfish (Hybrid) fed different levels of garlic concentrate is shown in Table 3. Growth indices and feed utilization revealed significant (P> 0.05) difference across treatments. The mean WG from the experiment revealed a range of 41.73±0.63 to 59.32±0.02, where treatment 1 and treatment 4 showed the lowest and highest respectively. The test ingredient showed substantial effect on average feed consumed. The mean value for average feed consumed revealed a progressive increase but a decline at 4% inclusion level, which indicated that the test ingredient enhanced appetite up to 8% addition level of sampled fish species. The values recorded for feed utilization, indicated significant difference amongst treatments. It ranged from 2.11±0.05 to 2.51±0.01. The SGR of Heteroclarias across treatments was optimum at 6% (3.04 ± 0.06) addition level of garlic concentrate. It was observed that as inclusion level increased, there was a corresponding decline in the average protein consumed. A marginal increase across treatments was detected in the PER. High SR was observed from treatment 2 up to treatment 4, but a significant decline at 8% inclusion level. In this study, the values indicated significant increase in the growth indices of the sampled fish species fed varying dietary inclusion of garlic concentrate compared to that of control.

Table 3. Growth performance and feed utilization efficiency of Heteroclarias fingerlings fed experimental feeds ± SEM

Parameters	0% Inclusion Treatment 1	2 % Inclusion Treatment 2	4 % Inclusion Treatment 3	6% Inclusion Treatment 4	8% inclusion Treatment 5
IW(g)	3.90 ± 0.02	3.90 ± 0.04	3.90 ± 0.03	3.90 ± 0.02	3.91 ± 0.20
FW(g)	35.00 ± 2.32^{c}	79.36 ± 1.92^{b}	80.49 ± 0.29^{ab}	86.10 ± 0.39^{a}	79.10 ± 0.5^{b}
WG(g)	41.73 ± 0.63^{c}	43.96 ± 2.39^{c}	43.96 ± 0.93^{c}	53.63 ± 0.63^{b}	59.32 ± 0.02^{a}
AFC(g)	105.71 ± 0.14^{c}	155.43 ± 0.57^{b}	103.9 ± 0.71^{c}	159.58 ± 0.4^{ab}	161.10 ± 0.04^{a}
FCR	2.51 ± 0.01^{a}	2.33 ± 0.02^{b}	2.38 ± 0.02^{b}	2.11 ± 0.05^{c}	2.18. ± 0.05^{c}
SGR (%)	2.32 ± 0.04^{c}	2.79 ± 0.02^{b}	2.38 ± 0.02^{c}	3.04 ± 0.06^{a}	2.31 ± 0.08^{c}
TPC	33.19 ± 0.59^{c}	45.62 ± 1.86^{a}	37.77 ± 0.39^{b}	35.26 ±0.02^{a}	32.8 ±006^{c}
PER	0.75 ± 0.03^{c}	0.85 ± 0.01^{b}	0.91 ± 0.01^{a}	0.72 ± 0.01^{c}	0.78 ± 0.01^{c}
Survival	50.77 ± 0.33^{c}	65.94 ± 0.44^{b}	70.40 ± 0.35^{a}	72.71 ± 0.61^{a}	58.22 ± 0.06^{c}

Means along the same row with different superscripts are significantly different ($P \leq 0.05$); AFC: Average Feed Consumed; FCR: Feed Conversion Ratio; SGR: Specific Growth Rate; TPC: Total Protein Consumed; PER: Protein Efficiency Ratio.

Discussion

A number of research carried out in this area revealed laudable effects of garlic concentrate as additive on the feed utilization and performance of some fish species including; *Xiphophorus helleri* (Kalyankar *et al.*, 2013), Swordtail and *Oreochromis niloticus* (Shalaby *et al.*, 2006; Mesalhy *et al.*, 2008; Metwally, 2009; Aly and Mohamed, 2010), *Clarias gariepinus* (Agbebi *et al.*, 2013); *Oncorhynchus mykiss* (Nya and Austin, 2009; Garbor *et al*., 2012). The findings of this research regarding the feed utilization and increased performance can be explained in respect to Khalil *et al.* (2001) who stated that garlic enhance energy utilization and

digestion by increasing intestinal flora function due to its allicin content. Although, there was significant **(P> 0.05)** difference in final weight across treatments but that of control exhibited a lower final weight. However, this result does not confirm the findings of Labrador *et al.* (2016) who stated that adding garlic concentrate to fish diet at 2, 4 or 6% inclusion level, showed no reasonable effect on the weight gained (%) and final weight (g) of shrimp compared to control treatment. Likewise, Nwabueze (2012) revealed *C. gariepinus* fed garlic meal showed insignificant changes in body weight gain.

The study revealed feed conversion ratio and specific growth rate of Heteroclarias fed varying garlic concentrate as additive to be significantly superior to control. Generally, it is recorded that plant products significantly influence fish growth (Cristea *et al*., 2012), though, a study on *Labeo rohita* by Sahu *et al.* (2007) revealed slight difference in feed conversion ratio and specific growth rate at 0.5% and 1% garlic concentrate inclusion levels compared to control. The growth indices of this study confirmed that of Metwally (2009) who reported 3.2% as the best performance attained in *Oreochromis niloticus* fed experimental diet. In same vein, Diab *et al.* (2002) revealed that at 2.5% garlic concentrate/kg diet inclusion level, a positive significance is observed in growth indices of *Oreochromis niloticus*. Also, in a similar study conducted on starlet sturgeon fingerlings, Lee *et al.* (2014) observed significantly high growth at 3% garlic concentrate inclusion level. Other influencers of growth as detected in both recent and previous studies are duration of the experimentation and amount of garlic concentrate added. This agrees with the finding of Temitope (2012) who resolved that 20g of garlic concentrate added to feed optimized growth in *Tilapia zillii* as against inclusion levels 5, 10, and 15g. Another finding as recorded by Aly and Mohamed (2010) indicated an increase in performance of *Oreochromis niloticus* as feeding rate, culture period (8 months and above) and dosage (10 and 20 g/kg) of garlic concentrate increased. This was also in line with Mesalhy *et al.* (2008) who revealed that better growth is achieved with increased culture period and high amount (20g) of garlic concentrate per kg of feed compared to 10g. In addition, Shalaby *et al.* (2006) confirmed 30g of garlic concentrate /kg of feed had more significance on growth of *Oreochromis niloticus* as body weight increased with increase garlic powder inclusion level.

The level of survival expressed by Heteroclarias in this study was significantly improved among those fed experimental diets as against the control. This confirmed the outcomes of *C. gariepinus* (Thanikachalam *et*

al., 2010), *O. mykiss* (Farahi *et al.,* 2010), *Lates calcarifer* (Talpur *et al.,* 2012), *E. fuscoguttatus* (Apines-Amar *et al.,* 2012) and *X. helleri* (Kalyankar *et al*., 2013).

Results showed garlic concentrate can be conveniently introduced into complete fish diet of catfish (hybrid) at 4% and 6% inclusion. In general, the acquired results showed no adversely effect on growth of Heteroclarias suggesting that it is essentially good for growth and utilization. From the results, it is clearly demonstrated that no negative impact on the weight gain, survival rate, proficient utilization of feed, total protein consumed, feed conversion ratio and moderate feed intake are positively influenced by garlic concentrate. The significant of the research to fish farmers is concerned the growth promoters to be a fewer disadvantage as compared to artificial growth promoters which are mostly bio-accumulated to the final consumers. For suitable aquaculture practices, majorly in countries are still tilting towards development, where the level of awareness on fish drug is low, use of garlic concentrate at higher level 4% and 6% is recommended for better growth performance. Further research on the most suitable phyto-additives is needed for efficient utilization and immune activity with corresponding analysis on the tissue and blood compositions of fish. There could be trial on higher inclusion level from 10% upward to further ascertain the maximum possible derivable garlic concentrate limit in fish compounded feeds.

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