EFFECTS OF FEED FORMS AND FEEDING FREQUENCY ON GROWTH PERFORMANCE AND NUTRIENT UTILIZATION OF *CLARIAS GARIEPINUS* FINGERLINGS

AJANI F.[1] DAWODU M.O.[2]AND BELLO-OLUSOJI O.A.[3]
[1]*Dept. of Animal Science & Fisheries Management,Bowen University,Iwo,Nigeria.*
[2]*Dept. of Chemistry,Bowen University,Iwo,Nigeria*
[3]*Dept. of Wildlife & Fisheries Management,Fed.University of Technology. Akure,Nigeria*

UTICAJ OBLIKA HRANE I UČESTALOSTI HRANJENJA NA PRIRASTE I KORIŠĆENJE HRANLJIVIH MATERIJA KOD MLAĐI AFRIČKOG SOMA *CLARIAS GARIEPINUS*

Abstrakt

Eksperiment u trajanju od 12 nedelja je sproveden da bi se ustanovila optimalna učestalost hranjenja i najbolji oblik hrane za postizanje dobrog prirasta i iskorišćenje hranljivih materija kod afričkog soma Clarias gariepinus. Tri grupe riba (prosečne mase 3.05± 0.25g) su bile hranjene na nivou od 5% telesne mase plivajućim ili tonućim peletima sa različitom učestalošću (tri, dva ili jedan obrok na dan) u 2 x 3 faktorijalnom eksperimentu. Prosečni dnevni prirast i konzumiranje hrane kod riba nije bilo pod signifikantnim uticajem tipa hrane, međutim, ribe hranjene plivajućim peletima su imale nešto veći prirast u masi od onih koje su dobijale tonuće pelete. Prirast i konzumiranje hrane riba koje su hranjene dva ili tri puta na dan bili su signifikantno ($P< 0.05$) veći nego kod riba koje su hranjene samo jedan put. Učestalost hranjenja nije imala uticaj na iskorišćavanje hrane kod riba koje su dobijale tonuće pelete, ali su bile značajno ($P< 0.05$) pod uticajem kod riba koje su hranjene plivajućim peletima jednom na dan, u odnosu na češće davanje hrane. Učestalost hranjenja i oblik hrane nisu imali značajnog uticaja na udeo proteina u mesu riba. Značajne razlike ($P< 0.05$) su se ispoljile kod sadržaja lipida sa povećanjem broja hranjenja.

Zaključak je, na osnovu iznetog, da je potrebno da se bilo koja forma hrane daje dva ili tri puta na dan kako bi se ostvarili optimalni rezultati u porastu C. gariepinus.

Ključne reči*: afrički som (Clarias gariepinus), učestalost hranjenja, oblik hrane, prirast, iskorišćenje hranljivih materija.*

INTRODUCTION

As aquaculture is gaining attention all over the world as mean of improving world fish production which is currently on decline due to dwindling output from capture fishery (F A O 2009), one problem facing fish culturists is the need to obtain a balance between rapid fish growth and optimum use of the supplied feed.

The optimal frequency for feeding fish species especially African catfish is yet to be clearly defined and this has led to uncertainty in the feeding routines used by many farmers. Both over- and underfeeding can be detrimental to the health of the fish and may cause a marked deterioration in water quality, reduced weight, poor food utilization, and increased susceptibility to infection (P r i e s t l e y et. al. 2006). This may also affect the specific growth rates and the efficiency of feed conversion as these have been observed to be directly related to feed ration and frequency. Therefore, it is important to be able to predict the most favorable feeding frequency relative to the species and size of fish. When fish are fed at suitable feeding frequency, growth and survival are expected to improve because this regulates their feed intake in relation to their energy demand (S c h n a i t t a c h e r et. al. 2005). Time of feeding and feeding frequency have been reported to affect feed intake and growth performance in fishes (A l i et. al. 2005).

The culture of *C. gariepinus* is becoming increasingly popular in Africa; this is due to the facts that this fish is widely accepted as food fish and its hardy nature making culture relatively easy (A d e b a y o and F a g b e n r o, 2004). To improve on the culture of this fish (*C. gariepinus*), there is need for more information on the management method in the area of feed forms and feeding frequency in order to produce fish within the shortest possible time and at minimum cost with good quality.

MATERIALS AND METHODS

Experimental trial was conducted at the laboratory of Bowen University, Iwo, Nigeria. A total of 360 *C. gariepinus* fingerlings obtained from a reputable fish farm in Ibadan. Nigeria, weighing on average 3.05± 0.25g, was divided equally into eighteen 30L glass tanks: 20 fish were held in each tank. On the whole there were three feeding frequencies (Once meal per day- 9hour, two meals per day - 9hour & 14hour and three meal per day – 9hour, 14hour & 18hour) using two different feed forms (floating and sinking pellets), thus giving a total of 6 treatments in a 3 by 2 factorial experimental design. .

The fingerlings were acclimatized for 2 weeks in a 300 liters plastic container prior to the commencement of the experiment. The fish were starved for 24 hours before the commencement of the growth studies.

Experimental procedure

A commercial floating pellet (CHI feed®) of 50% C.P. level was used for this experimental trial while 50% C.P sinking pellet was formulated and prepared locally. The proximate analysis for these feeds is presented in Table 1.

Dechlorinated tap water was used to replace 80% of the water volume every four days before feeding. Aerator was used to aerate the glass tanks. The sample of water used was analyzed for Dissolved oxygen, temperature, ammonia level and hydrogen ion concentration (pH).

Measurement of Weight and the survival of *C.gariepinus* fingerlings /juveniles

Initially, weights of fingerlings in each treatment were determined. Subsequently on weekly basis, the weights of the test fish in each treatment were also taken in order to determine the weight gain of the experimental fish per week. Two fish samples were taken randomly per treatment and weighed using Electronic digital weighing scale (ACCULAB model meter balance 2000).

The total weight gain was determined by finding the difference between the initial weight and final weight (g) of the experimental fish at the end of the experiment.

Mean Weight Gain was estimated by dividing the total weight gain by the number of weeks of the experiment.

Specific Growth Rate(SGR)was calculated from the logarithmic difference in final and initial weight of fish according to H o g e n d o n (1980).

$$\% \text{ Survival} = \frac{\text{Number of surviving fry}}{\text{Number of fry initially stocked}} \times \frac{100}{1}$$

Statistical Design and Analysis

3 x 2 factorial experiment in complete randomized design (CRD) was used to analyze data for total weight gain, specific growth rate and survival rate of *C. gariepinus*, while all data were analyzed using the analysis of variance (ANOVA). All data were analyzed with SPSS 13.

RESULTS

Water Quality Assessment

The results of water quality parameters measured during the experimental period are summarized in table 1.

Growth Performance and Survival of *C. gariepinus* fed floating and sinking pellet at different feeding Frequencies

Table 1. Average values of water quality parameters measured during the experimental period.

Water quality parameters	Floating Pellet			Sinking pellet		
	1x	2x	3x	1x	2x	3x
Temperature (^{0}C)	27.60	28.32	27.40	29.00	30.01	32.00
Dissolved Oxygen (mg/l)	5.84	5.88	6.04	5.40	5.98	6.01
pH	7.43	7.11	7.24	7.36	7.10	7.26
NH_3(mg/l)	52.08	50.12	49.25	75.41	52.16	50.23

Key:

1x = daily feeding once
2x = daily feeding twice
3x = daily feeding thrice

Table 2 shows the parameters observed and recorded for growth performance and survival rate of *C. gariepinus* fish fed floating and sinking pellet at different feeding frequencies.

Table 2. Growth Performance and Survival of C. gariepinus fish feed floating and sinking pellet at different feeding frequencies.

	Floating Pellet			**Sinking Pellet**		
	1x	**2x**	**3x**	**1x**	**2x**	**3x**
Mean initial wt (g)	3.03±0.05	3.10±0.02	2.97±0.57	3.15±0.06	3.05±0.41	3.00±0.18
Mean final wt (g)	11.44±2.01	12.27±3.04	12.47±2.31	10.34±4.42	11.22±0.36	10.96±4.05
Mean wt. gain (g)	8.41±3.20[a]	9.17±2.32[b]	9.50±1.08[b]	7.19±2.40[c]	8.17±4.24[a]	7.96±2.09[c]
SGR (%)	0.62±0.01[c]	0.64±0.04[c]	0.68±0.21[c]	0.58±0.07[c]	0.60±0.71[c]	0.52±0.01[b]
FCR	2.88±0.02[a]	2.68±0.50[b]	2.50±0.06[b]	2.92±0.01[a]	2.85±0.12[a]	2.82±0.08[a]
Survival (%)	95.00±3.41[b]	98.0±1.81[b]	95.5±1.81[b]	85.0±3.22[a]	98.0±1.24[b]	98.0±1.41[b]

Mean values with different superscript along each row are significantly different from each other (P< 0.05)

Growth Performances of floating and sinking pellets fed at different feeding frequencies

Mean Weight Gain

No significant difference was observed from the mean weight gain obtained in fish fed floating pellet once (8.41+_3.20g), twice (9.17+_2.32g) and thrice (9.50+_1.08g). The same applied to the mean weight gain obtained in fish fed sinking pellet once (7.19+_2.40g), twice (8.17+_4.24g) and thrice (7.96+_2.09g). However, weight gain in fish fed floating pellet is higher than that of sinking pellet

Specific Growth Rate

The result for Specific Growth Rate (SGR) of *C. gariepinus* fry fed floating and sinking diets at different feeding frequency is shown in Table 2. Fry fed sinking pellet thrice had the lowest SGR (0.52+_0.01%) while fry fed floating pellet once and twice had the highest SGR. There was no significant difference in the SGR of fry fed twice with either floating (0.64+_0.04%) or sinking pellet{0.60+_0.71%}.

Percentage Survival

Fry fed sinking pellet once recorded the lowest percentage survival (85%) while there was no significant difference in the rest.

Proximate analyses of carcass fish fed the two feed types

The result of the proximate analyses of the carcass of floating and sinking pellet at different feeding frequencies is shown in Table 3.

A significant difference (P<0.05) in crude protein level was obtained in fish fed floating pellet once (16.53+_0.08%) when compared with fish fed sinking pellet once (15.77+_0.13%) while no significant difference was observed in fish fed floating/sinking pellets twice and thrice. Significant difference (P<0.05) was also recorded in the percentage fat and ash content obtained from the carcass of the fish fed floating and sinking pellets. No significant difference was observed in the percentage fibre content between the feed types.

Table 3: Proximate analysis of the fish fed floating and sinking pellets at different feeding frequencies

Parameter	Floating Pellet			Sinking Pellet		
	1x	2x	3x	1x	2x	3x
Crude Protein (%)	16.53±0.08^{b}	16.97±0.25^{b}	17.27±0.17^{b}	15.77±0.13^{b}	16.20±0.11^{b}	16.63±0.08^{b}
Crude Fat (%)	0.27±0.01^{a}	0.32±0.21^{a}	0.55±0.02^{c}	0.47±0.28^{b}	0.62±0.01^{c}	0.59±0.02^{c}
Crude Fibre (%)	0.15±0.01^{a}	0.12±0.01^{a}	0.08±0.01^{a}	0.09±0.02^{a}	0.16±0.02^{a}	0.14±0.01^{a}
Ash (%)	3.71±0.04^{b}	3.31±0.42^{a}	3.55±0.02^{b}	3.59±0.03^{b}	3.51±0.03^{b}	3.39±0.03^{b}
Dry matter (%)	11.74±0.03^{a}	11.63±0.04^{a}	11.66±0.10^{a}	11.87±0.03^{a}	11.53±0.04^{a}	11.80±0.11^{a}

Mean values with different superscript along each row are significantly different from each other (P< 0.05)

Appendix
Proximate Analysis of floating and sinking pellets
Protein 50%+_0.67; Moisture 9.08+_1.52; Fat 15%+_2.10; Fibre 0.8%+_1.82
Carbohydrate 44.46+_0.52; Ash 6.4%+_0.88; Lysine 4.1%+_0.06;P 2.9%+_0.11
Ca 2.8%+_1.00; Zn 3.04+_0.76; Fe 10.20+_1.42; Mn 7.08+_0.61.

DISCUSSION

At the end of the experiment, no significant difference was observed in weight gain in fish fed floating and sinking pellet once, twice and thrice. This shows that feeding frequency does not have any significant correlation with feed types (floating and sinking pellet). W a n g et al., (2007) noted at the end of his feeding trial that there was no significant difference in body composition among fish fed at different feeding frequencies B o o t h et al. (2008) corroborated this that different feeding regimes does not have a significant effect on weight gain.

However, the higher weight gain recorded for fish fed with floating pellet against the ones fed with sinking pellet may be attributed to the nature of the feed types. Floating pellet float on water and does not disintegrate easily like sinking pellet vis-à-vis their

availability to the fish in water. Sinking pellet does not float on water and it disintegrates easily thereby becoming unavailable to the fish. The wastage, (unavailable sinking pellet) may have resulted to the lower weight gain recorded.

Also, the lowest specific growth rate observed in fry fed sinking pellet once may be attributed to the crumbling nature of the feed types.

Fry fed sinking pellet once had the lowest percentage survival (85%). This may be attributed to the release of ammonia from unconsumed feed, thereby polluting the water since the primary nitrogenous waste produced by fish from protein digestion is ammonia (D u r b o r o w et al. 1997).

Ammonia level obtained from fry fed once with sinking pellet (75.41mg/l) was significantly higher than the recommended water quality level for warm water fishes (0.05 ppm N) which is equivalent to 50mg/l (A y o d e l e and A j a n i, 1998). This may be attributed to the disintegration of unconsumed feed since all the ration meant for the day is been given once to the fish.

S a d e k et al., (2004) also recorded a higher SGR in Sea Bream (*Sparus aurata*) fed extruded floating pellets in ponds against only inorganic fertilizer, compressed sinking pellets, and extruded semi-sinking pellets. The significant difference in crude protein level, obtained in fish fed floating/sinking pellet once could be attributed to the instability of the sinking pellet for more than an hour in water before disintegrating (C r u z and R i d h a, 2001). Sinking pellet fed once per day stands this risk thereby reducing the available nutrients to the fish.

The significant difference recorded in the percentage fat and ash content obtained from the carcass of the fish fed the different feed types may be due to losses due to volatisation or some interaction between constituents (M i c h a e l et al. 1995).

CONCLUSION

There was no significant difference in weight gain in fish fed floating and sinking pellet of the same crude protein level (50% C.P.) although fish fed floating pellet exhibited higher weight gain.

Also, no significant difference was observed among the fish fed at different feeding frequencies at 5% body weight (once, twice, thrice/day). A significance difference was obtained in fish fed floating and sinking pellet once and this is due to the crumbling nature of the sinking pellet within a short time.

It was also revealed from this experiment that floating pellet can be fed at the three feeding frequencies effectively for optimum result while the best feeding frequency for sinking pellet in order to obtain optimum result is twice and thrice per day.

REFERENCES

Adebayo, O.T. and Fagbenro, O.A. 2004. Induced ovulation and spawning of pond raised

African giant catfish, *Heterobranchus bidorsalis* by exogenous hormones.

Ali MZ, Hossain MA, Mazid MA (2005). Effect of mixed feeding schedules with varying dietary protein levels on the growth of sutchi catfish, *Pangasius hypophthalmus* (Sauvage) with silver carp, *Hypophthalmichthys molitrix* (Valenciennes) in ponds. Aquacult Res. 36:627–34

Aquaculture, 242: 229-236

Ayodele, I .A. and Ajani E .K. (1999)Essentials of fish farming(Aquaculture).Oduduwa Press,lbadan.46pp

Booth, M.A., B. J. Tucker, G.L. Allan and B. Stewart Fielder (2008). Effect of Feeding regime and fish size on weight gain, feed intake and gastric evacuation in juvenile Australian snapper Pagnis auratus. Aquaculture 282, Issues 1-4 pp. 104-110

Cruz E.M.and Ridha M.T. (2001)Growth and Survival Rates of Nile Tilapia Oreochromis niloticus L.Juveniles reared in a Recirculating system fed with Floating and Sinking pellets.Asian Fisheries Science Vol.14,No.1,pp9-16.

Durborow R.M.,Crosby D.M. and Brunson M.W. (1997)Nitrite in fish ponds.SRAC publication no 462.

Eyo, A. A. (2001) Fish Processing. Technology in the Tropics. University of Ilorin press. ISBN 9781770457, pp. 3-4

Food and Agriculture Organisation (2009): State of the World Fisheries and Aquaculture 2008. FAO Fisheries and Aquaculture Department. Food And Agriculture Organization Of The United Nations Rome, 2009

Gupta, M.V. (2006) Challenges in Sustaining and increasing fish production to combat hunger and poverty in Asia. WAGA, World fish Centre Quarterly Vol. 29, No. 1 & 2, pp. 4-10. Halver, J.E. (1972). The Vitamins in Fish nutrition Edited E. Halver Academic Press, New York.

Kaushik, S.J. and F. Meadale (1994). Energy Requirements, Utilization and Supply to Salmonids. Aquaculture, 124. pp. 81-97

Michael, B.N. Albert, G.J.T. and Imre, C. (1995) Farm made aquafeeds in Utama, G.M.C. ed. Aquafeeds and feeding strategies in Malaysia pp. 282 – 295.

Priestly, S. M.; Stevenson, E.S. and Alexander, L.G. (2006). The influence of feeding frequency on growth and body composition of the common goldfish (*Carrassius auratus*). *J. Nutr. 136:* 1979S-1981S

Sadek, S., Fathy, Osman and Adel Mansour (2004). Growth, Survival and Feed Conversation Rates of Sea bream *(Sparus aurata)* cultural in Earthen Brackish Water ponds Fed Different Feed Types. *Aquaculture International*, Vol. 12, 4 – 5 pp. 409 – 421.

Schnaittacher G, King W, Berlinsky DL (2005). The effects of feeding frequency on growth of juvenile Atlantic halibut, *Hippoglossus hippoglossus* L. *Aquacult Res.* 36:370–7.

Wang Yan, Ling – Jun Kong, Kai Li and Dominique P. Bureau (2007). Effects of Feeding frequency and ration level on growth, feed utilization and nitrogen waste output of cuneate drum (Nibea michthioides) reared in net pens. Aquaculture, 271 Issues 1-4, pp. 350-356.