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FEEDING FREQUENCIES OF *HETEROBRANCHUS LONGIFILIS* FRY AND FINGERLINGS IN STATIC AERATED REARING SYSTEM

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Abstract

Two separate experiments were carried out to determine the suitable feeding frequencies for fry and fingerlings of *H. longifilis*. In the first experiment, *H. longifilis* fry of mean weight 0.59 ± 0.02g, stocked at 10 fish/trough were fed rations of 44% crude protein at frequencies of two, four, six, eight and ten times daily for 42 days. The fry fed 4-times daily had the best growth among all frequencies. In the second experiment, *H. longifilis* fingerlings of mean weight 8.23 ± 0.22g stocked at 5fish/trough were fed rations of 45.36% crude protein at frequencies of two, three, four, five and six times daily for 56 days. Rearing was done in an aerated static system of 26.4 litres water capacity. The protein efficiency ratio was highest for fish fed 4 times and 2 times daily for the fry and fingerlings respectively. The specific growth rate (SGR) for the fry did not vary significantly ($P > 0.05$) for all frequencies while there was significant variation ($P < 0.05$) for the SGR of the fingerlings. There was significant variation ($P < 0.05$) in food conversion ratio (FCR) in the two experiments. At the end of the feeding trials the fry fed 4 - times and the fingerlings fed 2 – times daily had optimal growth. This is an indication that *H. longifilis* fry should be fed 4 – times daily while the fingerlings 2 – times daily for optimal growth, good FCR, reduction of feed wastage and low operational cost.

Keywords: Feeding, Nutrition, *Heterobranchus longifilis, Crude protein, growth rate*

Introduction

In order to augment the dwindling resources in our water bodies, the culture of the catfish, *Heterobranchus longifilis* as a model fish has great potentials to meet the high fish protein requirement of the country. Ovie (2003) reported the nutrient requirement of *H. longifilis* to be 45.36% crude protein, 23.23% crude lipid, 19.5% total carbohydrate while the protein/energy ratio was 10.43mgkcal /100g. As this information on the nutritional requirement of this fish are known, knowledge about the stocking density and the feeding frequency for optimal growth are very essential for the culture of the fish. According to Smith and Reay (1991), rearing conditions are known to influence intra-specific aggression and cannibalism in a wide range of fish species. Katavic (1989) observed that long intervals between feeding may lead to increased hunger and result in increased intra-specific aggression. Loadman *et al.* (1986) also observed that the magnitude of cannibalism might differ in conditions of light and darkness.

Feeding frequency is one of the most important factors that affect growth and the efficiency of feed utilisation (Adebayo *et al.*, 2000). Feeding at the optimum frequency for cultivable fish species helps to reduce feed wastage, maximise conversion efficiency and save feed cost. Various species of fish have been found to have different optimum feeding frequencies (Shelbourn *et al.*, 1973; Andrew and Page, 1975; Chua and Tengis, 1978; Charles *et al.*, 1984; De Silva *et al.*, 1986; Adebayo *et al.*, 2000). In the culture of rainbow trout the daily ration changed directly with the frequency of feeding (Ishiwata, 1969a, b).

Piper (1982) recommended twice daily feeding for Salmonids over 12cm. in length and 23g in weight. Piper (1982) further recommended satiation feeding with feeding decreasing as the fish grows. Twenty four hours eating regime was reported for the first few days of fry feeding on dry feed to encourage them. A frequency as high as 20 times per day was practised (Piper, 1982). For channel catfish, feeding commences 5 - 6 days after hatching and the frequency is 8 - 10 times daily at first feeding. This reduces to about 3 times per day when the fish reaches about 7cm. in length (Chiu, 1989). Omar and Gunther (1987) reported that mirror carp (a strain of *Cyprinus carpio*) improved body weight gain and feed utilisation when feeding frequency was increased from 4 to 6 times daily.

Chua and Tengis (1978) reported that there is no hard and fast rule on the feeding frequency of *Tilapia* as they feed throughout the day with minor peaks in the early hours of the morning and at dusk in the wild. New (1987) suggested manual feeding of several times per day. Teshima *et al.* (1984) showed that *Chanos chanos* fingerlings fed on various diets grew significantly faster when fed twice daily than when fed once daily. Zhou *et al.* (2003) in testing 5 feeding frequencies showed that daily food intake increased significantly ($P<0.05$) with increase in feeding frequency and there was no significant difference between daily food intakes in feeding 12 and 24 times daily. They further reported that apparent digestibility of protein and energy increased significantly at high feeding frequencies.

Twenty four times daily is the optimal feeding frequency for Gibel carp of 3.0 ± 0.2g. Dada *et al.* (2002) observed feeding twice daily for *H. bidorsalis* of 7.71g to be the optimal frequency although the mean weight gain was not significantly different from others. The macro nutrient requirements of the *H. longifilis* was recently studied (Ovie, 2003). For the commercial production of *H. longifilis* it is necessary to further determine the optimal feeding frequency of feeding for optimal growth of the fish. This study was carried out to determine the optimal feeding frequency of *H longifilis* fry and fingerlings.

Materials and Methods

H. longifilis fry, (0.59 ± 0.05g) and fingerlings (8.23 ± 0.22g) were obtained from two different commercial hatcheries. The fish was acclimated for a day. The fry were stocked 10 per 26.4 litres of water while the fingerlings were stocked 5 per 26.4 litres of water in plastic troughs. Each trough was supplied with aerators for oxygen. The fry were fed experimental diets consisting of 44% crude protein ration for 42 days. The fingerlings were fed 45.36% crude protein ration for 56 days. The experimental diets were prepared from soyabean (*Glycine max*), guinea corn (*Sorghum sp.*), fishmeal (*Pellonula afzeliusi*), groundnut cake (*Arachis hypogea*). The premix used was Biomix Premix and the details of the content is listed in Table 1.

The daily ration of 5% of their body weight were distributed at frequencies of two, three, four, six, eight and ten times. The fingerlings were fed at the same rate but at frequencies of two, four, five, and six. Each treatment was fed in triplicate groups. Remnant of feed was siphoned from the bottom of the plastic troughs and partial exchange of water was done every morning. Complete exchange of water was done on every sampling day. Water quality parameters such as dissolved oxygen (DO), pH of the water and water conductivity were determined using standard methods. (APHA, 1980).

The composition and proximate analysis of the test diets are presented in Table 1. Chemical analyses of fish carcass (initial and final) were done in duplicates according to established procedures (AOAC 1990) The feed was split into equal parts and dispensed at various times of the day as shown in Table 2. Weighing of fish and cleaning of trough was carried out weekly. Biological parameters measured were food conversion ratio (FCR), specific growth rate (SGR) and Protein efficiency ratio (PER) (Steffens, 1983).

Results of weight gain, SGR, PER were pooled for each treatment, computed and analysed using one - way analysis of variance (ANOVA). Comparison among means was done using Duncans multiple range test (Puri and Mullen, 1980). Statistical significance was determined at 5% probability level for each set of comparisons

Table 1: Formulation and proximate composition of experimental diets

Ingredients g/100g	DIETS	
	44% crude protein	45.36% crude protein
Guinea corn	21.29	17.8
Groundnut cake	21.90	19.32
Fish meal	25.90	33.95
Soyabean meal	24.90	22.91
Vitamin premix	2.00	2.00
Vegetable oil (palm Oil)	2.00	2.00
Starch (cassava)	2.00	2.00
Analysed nutrient Content(% dry matter)		
Moisture	5.20	6.71
Crude protein	44.19	45.36
Ash	5.60	6.66
Crude lipid	15.95	22.02
Crude fibre	2.60	7.34

Biomix Vitamin and Mineral Premix (mg) *Folic acid mg 800 4.00; Vitamin B12 mg 10.00 0.05; Biotin mg 160.00 0.80, Chloride mg 120 600; Inositol mg 40 200; Panthothenic acid mg 10,000.00 60.00 Betaine mg 40 200; Cobalt mg 400 2.00; Niacin mg 30,000 150.0; Vitamin C mg 4000 20,000.00 Iron mg 8000 40.00; Iodine mg 1000 40.00; Methionine mg 20,000 100.00, Manganese mg 6000 30.00 Copper mg 800 4.00; Antioxidant mg 20,000.00 100.00 Zinc mg 800 40.00; Selenium mg 40.00 0.20 . Vitamin C mg 4000 20,000.00; Vitamin D3 mg 400,000.00 2000.00, Vitamin K3 mg 16000.00 8.00, Vitamin B1 mg 4000.00 20.00, Vitamin B3 mg 6000.00 30.00; Vitamin B6 mg 2,400.00 12.00*

Table 2: Time and frequency of feeding among *H. longifilis* fry in experiments 1 and fingerlings in experiment 2

Frequency	Hours of feeding for experiment1
10	6.00,8.00, 10.00, 12.00, 14.00, 16.00, 18.00, 20.00, 22.00, 24.00
8	6.00, 8.00, 10.00, 12.00, 14.00, 16.00, 18.00, 20.00
6	8.00, 10.00, 12.00, 14.00, 16.00, 18.00,
4	8.00,12.00, 16.00, 20.00
2	8.00, 18.00
	Hours of feeding for experiment
6	8.00, 10.00, 12.00, 14.00, 16.00, 18.00
5	8.00, 10.00, 12.00, 14.00, 16.00
4	8.00, 12.00, 16.00, 20.00
3	8.00, 12.00, 16.00
2	8.00, 18.00

Results

In experiment with the fry, survival was 85 - 95 % while it was 100% in the experiment with fingerlings. In both experiments, there was positive growth of fish in all frequencies tested. Tables 3 and 4 show the daily weight gain, specific growth rate, food conversion ratio and protein efficiency ratio. In the fry, the highest weight gain was observed with a daily feeding frequency of four times which was significantly different ($P < 0.05$) from other frequencies (Fig. 1). The PER was highest with four times feeding while the food conversion ratio (FCR) was lowest with this feeding frequency. In the fingerlings the fish fed twice daily showed the best mean daily weight gain (fig. 2). There was no significant variation in the specific growth rate for the fry ($P>0.05$) whereas there was significant variation ($P < 0.05$) for -the fingerlings. There was significant variation in the FCR of the fry ($P < 0.05$) whereas there was no significant variation in the FCR of the fingerlings ($P> 0.05$). In both experiments there was significant variation in the PER ($P < 0.05$).

Table 3: Growth of *H. longifilis* fry fed at varying feeding frequencies for 42 days

Parameters	Daily feeding frequencies				
	Two	*Four*	*Six*	*Eight*	*Ten*
Mean weight gain (g)	0.56	0.60	0.56	0.57	0.61
Mean final weight(g)	1.63	2.55	1.61	1.48	1.47
Mean daily weight(g)	0.05[ab]	0.07[b]	0.05[ab]	0.04[a]	0.03[a]
SGR (%)	1.11[a]	1.37[a]	1.09[a]	0.99[a]	0.91[a]
FCR	0.37[ab]	0.32[a]	0.38[ab]	0.44[b]	0.47[bc]
PER	0.024[ab]	0.043[c]	0.024[ab]	0.021[a]	0.02[a]
PS (%)	95	85	95	85	85

Data in the same row having the same superscript are not significantly different (P >0.05)

MIW - Mean Initial Weight (Mo)
MFW - Mean Final Weight (Mt)
MWG - Mean Weight Gain = Mt - Mo
SGR - Specific Growth Rate = 100 x In Mt - In Mo/ time
FCR - Feed Conversion Ratio = Feed given (g)/ Mt - Mo
PER - Protein Efficiency Ratio = Wet weight gained / Protein fed
PS - Percentage survival = No of live fish x 100 / No of fish stocked

Table 4: Growth of *H. longifilis* fingerlings fed at varying requencies for 56 days

Parameters	Daily feeding frequencies				
	Two	Three	Four	Five	Six
Mean initial weight(g)	8.32	8.46	8.24	7.86	8.26
Mean final weight(g)	57.32	40.26	37.56	44.96	37.76
Mean daily gain(g)	0.88^{bc}	0.57^{a}	0.67^{a}	0.80^{b}	0.67^{a}
SGR(%)	3.58^{c}	2.33^{ab}	2.12^{a}	2.77^{b}	2.14^{a}
FCR	1.24^{a}	1.33^{a}	1.46^{a}	1.32^{a}	1.48^{a}
PER	1.08^{c}	0.701^{ab}	0.646^{a}	0.818^{ab}	0.65^{a}
PS	100	100	100	100	100

Figures in the same row having the same superscript are not significantly different (P >0.05)

Table 5: Body Composition of the *H. longifilis* before and after the experiment

DIETS		MOISTURE	CRUDE PROTEIN	CRUDE LIPID	ASH
EXPERIMENT I 44.17%	Initial	70.10	10.45	7.80	2.10
	Final	81.20	14.10	3.05	1.90
EXPERIMENT II 45.36%	Initial	79.10	14.02	2.30	1.55
	Final	82.20	14.56	4.10	1.80

Discussion

Good nutrition and adequate feeding while minimising waste are vital to feeding regimes of species. In the rearing of fish, several factors contribute immensely to growth. The availability of factors conducive for fish rearing are essential in determining the success or failure of the rearing exercise. Factors such as the protein requirements, energy requirement, feeding rate, feeding time, frequency of feeding, the temperature of the water, pH and other water quality parameters are very crucial to fish response to feeding. If continuous feeding was acceptable to *H. longifilis*, the feeding frequency of ten times daily in this study would have given the optimal growth.

The gradual slowing of the growth of the fish after the feeding frequency of of four times may have resulted from the non - acceptance of feed distributed beyond the optimal feeding frequency. The feed beyond the optimal frequency therefore constitutes waste and so no response in terms of utilisation.

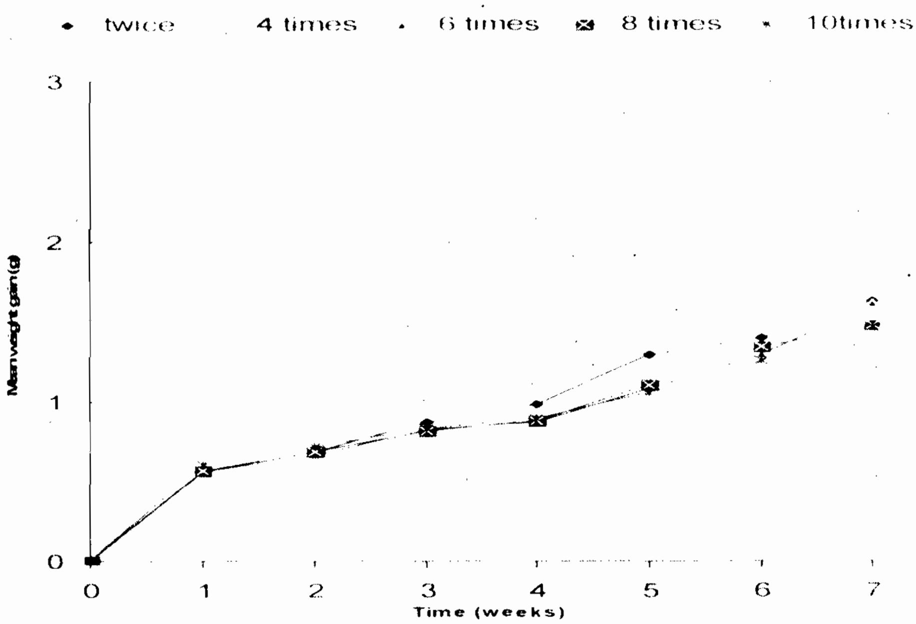

Fig. 1: Growth of H.longifilis fry fed at varying frequencies

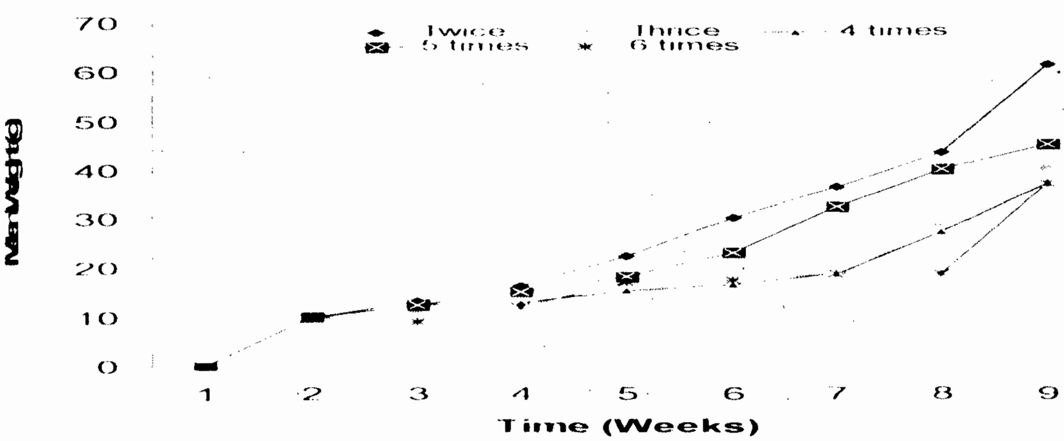

Fig 2: Growth of H. longifilis fingerlings fed at varyinying frequencies

According to the Bureau (2000), feeding of smaller sized fish (fry) should be more frequent.

In aquaculture, culturists have the goal of producing a table-sized fish at the shortest time possible. This reduces the operating cost to a large extent. The protein requirement of *H. longifilis* has been determined. Eyo (1995) reported 42.5 % crude protein while Ovie (2003) reported 45.36 % c.p. The carbohydrate, lipid, protein energy requirements for *H. longifilis* have been determined (Ovie, 2003). The study of the frequency of feeding at 5% body weight at which other requirements were determined was therefore pertinent. In this study *H. longifilis* fry of 0.59 ± 0.02g size had their optimal growth when fed four times daily. This does not compare well with Hogendoorn (1981), who reported that *Clarias lazera* of 0.50g should be fed continuously. Jobling (1983) also observed that *Chana stiatus* of 0.66g is fed once daily while *Chanos chanos* of 0.60g is fed eight times daily. Omar and Gunther (1987) reported a feeding frequency ranging from four to six times daily for mirror carp of no specific size. Zhou *et al.* (2003) observed that feeding frequency for *Carassius auratus gibelio* was 24 times daily for fish of 3.0 ± 0.2g.

Feeding twice daily was found to result in optimal growth of For the *H. longifilis* fingerlings of 8.23 ± 0.22g. This result agrees with Olarewaju (1998), Tung and Shiau (1991) and Dada *et al.* (2002) for *H. bidorsalis*; Adebayo *et al.* (2000) for hybrid *H. bidorsalis;* Marian *et al.* (1982) for *Heteropneutes fossilis* and Page and Andrew (1975) for *Icthalurus punctatus*. In this study the level of crude protein supplied (45.36%) is the requirement for *H. longifilis* (Ovie, 2003). The positive weight gain observed in all the frequencies provided is indicative of the adequacy of the protein supplied. The plateau experienced in the fish fed 5 times daily between the 6th and 7th week of experiment with fingerlings is difficult to explain as other water parameters were in the acceptable levels (Fig. 2).

The results from this study show that *H. longifilis* fry and fingerlings require feeding frequencies of four and two times daily respectively for hatchery culture of the fish. Andrew and Page (1975) reported feeding twice a day for 50g channel catfish while Murai and Andrews (1976) found channel catfish of 1.5g growing best when fed eight times per day. In this study it was observed that smaller fish (fry) grew better when fed more frequently than the larger ones (fingerlings and juveniles). In both experiments the percentage survival had no relationship with the frequency of feeding. Due to the quality of the flesh of *H. longifilis*, commercial rearing is constantly growing in Africa. The need to maximise profit while reducing operational cost is therefore imperative. This study therefore proffers an additional practical guide to hatchery farmers to maximise profit and reduce feed wastage during fry and fingerling rearing of *H. longifilis*.

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