THE EFFECT OF PHOTOPERIOD ON THE GROWTH AND SURVIVAL OF AFRICAN MUDFISH *Heterobranchus bidorsalis*

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ABSTRACT
The effect of three photoperiods on growth and survival of African mudfish, Heterobranchus bidorsalis juveniles was investigated for a period of 56 days. Forty five juveniles of initial average weight of 35g were exposed to total darkness, partial darkness and full light throughout the study period in a partial flow-through system under laboratory conditions. The juveniles were stocked in triplicate treatment and fed 45% crude protein prepared diet daily at 5% body weight. Juveniles reared in total darkness exhibited significant (P<0.01) higher feed intake, weight gain, specific growth rate, protein efficiency ratio, and lowest percentage mortality than those cultured in partial darkness. Similarly, same parameters were significantly (P<0.01) higher in juveniles reared in partial light than those in full light. Also, the juveniles cultured in total darkness had significantly (P<0.01) lowest uneaten feed and feed conversion ratio, than those reared in partial darkness and full light. Fish cultured in total darkness had darker skin colorations than those in full light. It was concluded that rearing Heterobranchus bidorsalis in totally dark culture chamber could result in reduced wastage of feed, improved growth rate and enhanced profit especially in the developing countries where fish production presents strong potential in alleviating food crisis.
Keywords: Feeding habit, light intensity, African catfish

INTRODUCTION

Protein deficiency and undernourishment in the diet is endemic in most developing countries of the world and is a reflection of the poor economic state of the people. Malnutrition constitutes problems of high magnitude even in countries, which are beginning to be self-sufficient. Fish is an excellent animal protein source, and its importance cannot be over emphasized as it constitutes over 75% of all animal protein source consumed.

The African mudfish *Heterobranchus bidorsalis* among the most important fish species currently reared both within and outside its natural range of tropical and subtropical environments. It is cherished for its growth rate, ability to breathe air and withstand poor water quality as well as its tasty flesh. There are however many constraints militating against successful aquaculture establishment in developing countries. Among these set-backs are high cost of fish feed that elicit fast growth and the challenge of evolving management options that promote profitable output within a considerable short period.

Knowledge of growth and food conversion efficiency of different fish in relation to size is important in understanding production process under natural and culture conditions (Gerking, 1972). The actual natural increase in length and weight of fish is as a result of the specific interaction of the organism and the environment. In a given period certain variables are known to influence feed utilization and growth in fish (Lovell 1998, Dupree and Hunner, 1994). The knowledge of this relationship between fish and its environment is essential in enhancing production process both in nature and in fish culture.

Feeding habit and frequency of feeding has been shown to determine the efficiency of feed utilization as well as growth performance in fishes. Photoperiod and light intensity are strong factors synchronizing the endogenous cycles of metabolism and activity (Boeuf and Bail 1999). The inherited behavior of fish is not suppressed under culture condition, but could be influenced by some factors such as feeding method, photoperiod and light intensity. Photoperiod is known to affect fish feeding activity and play a decisive role in growth and survival (Nwosu and Hozloner, 2000). It is believed that the right application of photoperiod may improve performance, profitability and sustainability of aquaculture practices. The paucity of information on the influence of photoperiod on growth and survival makes this study imperative. The study will enable the farmer to know the quantity of light required by the fish and its effect on their feeding behaviour, knowing the best time to feed the fish and utilize the knowledge to enhance production efficiency in his farm

MATERIALS AND METHOD

Forty one (41) days old *Heterobranchus bidorsalis* juveniles of initial average weight of 23g each, were obtained from Ebonyi State University fish farm complex for the study. The juveniles were acclimated for 5 days prior to the start of the experiment and were randomly distributed to nine 25 liters bowls of 0.5m depth at the stocking rate of 5 juveniles per bowl in triplicate. The water was changed regularly within the interval of 2 days throughout the 28 days study period. The juveniles were fed 45% crude protein prepared diet (Table 1) at 5% body weight twice daily at 09.00am and 04.00pm. The left over feed were collected 5 min after feeding, with the aid of scoop net. Three photoperiods, total dark, partial dark and light, were used as experimental treatments. Triplicate rearing facilities (bowl) of 25 liters of water capacity and 0.5m in depth were used for each treatment. Black cellophane polyethylene materials were used to cover off the rearing bowl to provide total darkness. The cover of the darkened bowl was perforated at the cover for easy administration of food, and the holes were covered immediately after feeding.

Table 1: Nutritional content of experimental Diet

Protein	48%
Fat	12%
Cs	2.2%
P	1.2%
Ash	8.5%
Fibre	2.5%
Mn	60ppm
Vitamin	
A	10.000µ/kg
E	200mg/kg
C	100mg/kg

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) with reference to Steel and Torrie, (1980). Significant differences in mean were evaluated using Duncan's multiple range test (Gomez and Gomez, 1984).

RESULTS

The summary of feed utilization of *Heterobranchus bidorsalis* juveniles cultured under different photoperiods is presented in Table 2. Culture of *Heterobranchus bidorsalis* juveniles under different photoperiods significantly ($P<0.01$) affected feed intake, quantity of uneaten feed, feed conversion ratio (FCR) and protein efficiency ratio (PER). The juveniles cultured under total darkness had significantly ($P<0.01$) highest feed intake, PER, best FCR and lowest quantity of uneaten feed than those cultured under partial darkness and full light.

The summary of growth performances of *Heterobranchus bidorsalis* juveniles under different photoperiod is presented in Table 3. Juveniles of *Heterobranchus bidorsalis* cultured under total darkness has significantly ($P<0.01$) higher weight gain than those cultured in partial darkness and full light. Also there was significant ($P<0.01$) increase in the SGR of juveniles of *Heterobranchus bidorsalis* cultured under total darkness. This followed the same pattern with weight gain. The weight showed highly significant ($p<0.01$) difference among treatments. This also suggests that fish under total darkness had quicker demand for feed with least uneaten feed within the five minutes of feeding followed by those in partial darkness.

The summary of weekly mortality of *Heterobranchus bidorsalis* cultured under different photoperiods is represented in table 4. There was significant ($P<0.05$) increase in the percentage survival of the juveniles cultured under full light.

The protein efficiency ratio of the fish in total darkness was 0.42 that of partial darkness was 0.33 and full light, 0.29. Therefore the protein efficiency ratio of total darkness was the highest followed by partial darkness and then full light. This may be as a result of increased protein intake by the fish in total darkness.

Table 2: Weekly Average Feed Intake (g) at Different Photoperiods

	Average Weekly Feed Intake (g)							
Photoperiod	**1**	**2**	**3**	**4**	5	6	7	8
Total Darkness	6.28[a]	8.22[a]	9.11[a]	11.60[a]	13.50[a]	16.44[a]	18.39a	19.01[a]
Partial Darkness	4.38[b]	6.58[b]	7.17[b]	9.36[b]	10.31	11.74[b]	14.33[b]	15.01[b]
Full Light	2.20[c]	4.64[c]	5.76[c]	7.53[c]	9.07[c]	10.00[c]	11.97[c]	12.84[c]
$FLSD_{(0.05)}$	0.895**	1.103**	0.970**	0.821**	1.138**	0.955**	2.065**	1.072**

Means with the same letter are not significantly different at 5% by DMRT
Levels of significance: ** = highly significant (p<0.01) and NS = non significant

Table 3: Average Weekly Weight Gain (g) at Different Photoperiod

	Average Weekly Weight Gain (Kg)							
Photoperiod	1	2	3	4	5	6	7	8
Total Darkness	3.670a	4.503a	4.233a	3.647a	3.747a	3.600a	3.173a	1.92
Partial Darkness	2.583b	3.043b	2.830b	3.010b	2.873b	2.540c	2.047b	1.97
Full Light	1.173c	2.300c	2.213c	1.133c	1.747c	3.517b	1.557c	1.72
$FLSD_{(0.05)}$	0.3262**	0.3400**	0.4314**	0.2607**	0.1025**	0.2282**	0.0979**	NS

Means with the same letter are not significantly different at 5% by DMRT
Levels of significance: ** = highly significant (p<0.01) and NS = non significant

Table 4: Average weekly Percentage Mortality

	Average Weekly Mortality							
Photoperiod	**1**	**2**	**3**	**4**	5	6	7	8
Total Darkness	1.00a	1.00a	0	0	0	0	0	0
Partial Darkness	0.67a	0.33b	0	0	0	0	0	0
Full Light	0.00b	0.00b	0	0	0	0	0	0
$FLSD_{(0.05)}$					NS	NS	NS	NS
	0.666*	0.666*	NS	NS				

Means with the same letter are not significantly different at 5% by DMRT
Levels of significance: ** = highly significant (p<0.01) and NS = non significant

DISCUSSION

The improved feed utilization in the juveniles of *Heterobranchus bidorsalis* cultured under total darkness is reflected in highest values of protein efficiency ratio, specific growth rate and lowest value of feed conversion ratio when compared with those cultured under partial darkness and full light. This suggests that *Heterobranchus bidorsalis* perform best when reared in darkness. This corresponds with Appelbaum and Kalmer, (2000) and Appelbaum and Mcgeer, (1998), who reported that African catfish are photophobic and that they eat comfortably in the dark. The less weight gain observed with the juveniles cultured under partial darkness and full light might be due to the continuous activities and stress when exposed to light. These behaviours may have affected their feed intake as their length of exposure to light increased. This corroborates the report of Britz and Piankar (1992) and similar to the observation of Almazan *et al.*, (2004) who reported that swimming and aggressive behaviours increased as the juvenile of *Clarias gariepinus* were exposed to light and that as the length of exposure to light increased the fish had less resting time. This implies that the more the energy spent on locomotion and other metabolic activities the less the energy available for growth, resulting in the reduced efficiencies observed as the length of exposure to light increased.

The juveniles cultured under different photoperiods had high survivals. Some results obtained in this work contradicts the observation of Saunders and Henderson (1970), Komourdijian *et al.* (1976), Lundqvist (1980), Brauer (1982) and Saunders *et al.* (1985) who suggested that artificially-increased day light length applied during appropriate season and during certain developmental stages may be used to enhance growth rate of fishes.

CONCLUSION

It can therefore be concluded that when *Heterobranchus bidorsalis* are cultured in total darkness, the fish spend more time resting and are not subjected to sudden fright, resulting in high feed intake, low feed wastage and better growth. A full understanding and application of photoperiod restriction may be helpful in improving productivity and sustainability of aquaculture and enhance profit especially in the developing countries where fish production presents strong potential in alleviating food crisis. However, different species of fish may have different responses to light intensity regime.

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