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Effect of feeding frequency and feeding rate on the growth and feed efficiency of catfish, *Heterobranchus bidorsalis* fry in outdoor concrete ponds

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ABSTRACT: The effect of feeding frequency on the growth and feed efficiency of *Heterobranchus bidorsalis* was investigated at two feeding rates (10% and 40% of body weight) in a 2x2 factorial experiment. The study was conducted in twelve 2x2x1m outdoor concrete ponds supplied with aeration with three replicate ponds for each treatment. Fish averaging 80 ± 4.5 mg were fed either two times or four times daily at two different feeding rates using practical diets for ten weeks. The percentage weight gain ranged from 55.25% to 95.13%. Regardless of feeding rate increasing feeding ranged from two to four times a day did not improve feed utilization and growth parameters. Based on the results, it could be concluded that in practice, when supplementary feed is provided for *Heterobranchus bidorsalis* fry under outdoor nursery/rearing (where natural food is available), feeding two times daily at 40% feeding level is optimal for attaining maximum growth and efficient feeding utilization within 10 weeks that had been the normal fry rearing period to fingerling size.

Key Words: Feeding rate; Feeding frequency; *Heterobranchus bidorsalis*; Fry; Fingerlings; Weight gain.

Introduction

As the culture of catfish (*Heterobranchus bidorsalis*) becomes more intensive, strategies for supplementary feeding will have to be assessed to reap maximum economic returns. In spite of remarkable success reported on the growth and survival of *Heterobranchus bidorsalis* larval/fry in ondoor hatchery, it is still beset with low survival during the fry-fingerling state during outdoor nursery management operations. There is paucity of information on the feeding regime of this fish during the outdoor nursety phase of fry-fingerling which is the most critical stage in the production cycle.

Feeding frequency is one important consideration as it can affect growth and the efficiency of feed utilization. Feeding at the optimum frequency and arte can result in tremendous savings in feeding costs.

According to Car *et al*. (1993) and Dada *et al*. (2001) fish growth rate is directly related to ration level. The amount of feed consumed, age, body size and temperature are the most important factors that limit maximum growth of fish (Huisman, 1976; Machiels and Henken, 1985).

Diffferent species of fish respond differently to various feeding regimes. Many studies have been conducted on the effect of feeding regimes on fish growth (Chiu *et al*., 1987; Cui *et al*., 1997; Falaye and Akinbode, 1998; Dada and Olanrewaju, 2002; Dada *et al*., 2002).

Dada *et al*. (2002) working on *Heterobranchus bidorsalis* reported that feeding frequency of two times per day produced best fish performance in terms of specific growth rate compared to feeding three or four times per day.

In view of this, there is a clear need to look at the effect of feeding frequency coupled with feeding rates for optimum survival and growth of *Heterobranchus bidorsalis* during nursery phase in outdoor ponds. The present work considers the effect of feeding frequency and feeding rates on production of *Heterobranchus bidorsalis* fry-fingerling in outdoor nursery concrete ponds.

Materials and Methods

The experiment was conducted in 2m x 2m x 1m outdoor concrete ponds supplied with aeration. Aeration was effected by electric motor connected with car air conditioner compressor and gas cylinder distributing air to the twelve experimental tanks through air hoses (Dada, 2001). The experimental fry (Mean weigth = 80 ± 4.5mg) obtained by induced spawning with hormonal injection were used for the experiment. Prior to transfer of the fry into the outdoor ponds, each tank was prepared as described by Dada *et al*. (2001).

Two feeding frequency (2 meals/d and 4 meals/d) at two feeding rates (10% and 40% of body weight) were used in a 2 x 2 factorial experiment using three replicate tanks with 500 fish per tank for each treatment. The fry density was based on the previous work on *Heterobranchus bidorsalis* (Dada, 2001). The summary of the result of the water quality parameters measured during the experiment is shown in Table 2.

The fish were fed practical diets (Table 1) containing 40% crude protein (Dada *et al*., 1999). Every week, 50% of the fish population was weighed using an electronic top-loading balance (Mettler model 200) and feeding rates were adjusted at every sampling. At the end of the trial (70 days) the fish in the tanks were counted and weighed and the total weight recorded. Water temperature, pH and dissolved oxygen concentration were monitored weekly according to the procedure described by Boyd (1981).

Moisture, crude protein (N x 6.25), crude lipids, crude fibre and ash content of the experimental diet and the fish samples were determined according to AOAC (1990).

Statistical Analysis

The data obtained were subjected to one way analysis of variance (ANOVA) and difference among means were detected with least significant difference multiple range test at the 5% probability level (Sokal and Rohlf, 1981).

Results and Discussion

Data on growth performance of the fish during the experiment are shown in Table 2. All the fish fed actively and appeared healthy. Survival of the fish during the experiment ranged from 57.0 to 58.5% and did not vary among treatments ($p > 0.05$). The best growth performance was achieved at 2 meals/day feeding frequency, coupled with 40% feeding level as shown by the results of the average final weight gain (Table 2). Average final weight gain and feed efficiency showed significant ($p < 0.05$) variations among treatments. The best efficiency of feed utilization was achieved with fish receiving rations two times daily at 40% feeding level.

Table 1: Ingredients and proximate composition of experimental diet fed *Heterobranchus bidorsalis* fry during the experimental period.

Ingredient	%
Fish meal (71.40%)	14.0
Soybean meal (46.46%)	50.3
Blood meal (87.59%)	4.60
Yellow maize (8.75%)	29.60
Vegetable oil	1.00
Vitamin pre-mix	0.50
Proximate composition	
Crude protein	40.30 ± 0.57
Crude fat	11.2 ± 0.13
Crude fibre	5.3 ± 0.10
Ash	6.7 ± 0.04
Gross energy)kcal/g)	4.3

Gross energy kcal/g was calculated using the following energy values, fish meal, 4,570 kcal/kg; Soybean meal, 4,300 kcal/kg; Blood meal, 4,824 kcal/kg; Yellow maize, 4,120 kcal/kg; Vegetable oil, 900 kcal/kg (Tacon, 1988)

Table 2: Response of *Heterobranchus bidorsalis* fry to feeding at different rates and frequencies.

Treatment No.	Feeding rate (% of body weight)	Feeding frequency (times/day)	Average weight gain	Feed efficiency (gain/feed x 100)	Survival (%)
1.	10	4	4.42^{a} ± 0.01	0.86^{a} ± 0.02	55.5^{a} ± 0.5
2.	10	2	4.63^{a} ± 0.02	0.98^{a} ± 0.01	56.5^{a} ± 0.5
3.	40	4	7.49^{b} ± 0.02	2.24^{b} ± 0.01	57.5^{a} ± 0.5
4.	40	2	7.61^{b} ± 0.02	2.09^{b} ± 0.01	58.5^{a} ± 1.0

N = 1,500 fish per treatment. Values represent the means ± SEM in each treatment. Means in the same column with the same superscript are not significantly different ($p > 0.05$).

The initial and final carcass composition of *Heterobranchus bidorsalis* are presented in Table 3. All fish exhibited an increased tissue protein concentration over the experimental feeding period. The tissue protein concentration values range between 16.19 and 20.61. Fish fed two meals daily at 40% feeding level had the highest body protein content (20.61) while those fed 4 meals daily at 10% feeding level had the lowest (16.19).

Table 3: Carcass composition (%) of *Heterobranchus bidorsalis* fed at two different frequencies and feeding levels.

Feeding Rate	Feeding frequency	Moisture	Crude Protein	Crude Lipid	Ash
10	4	3.20 ± 0.0	75.65 ± 0.07	16.19 ± 0.07	3.80 ± 0.10
10	2	2.67 ± 0.24	77.48 ± 0.02	16.80 ± 0.03	3.05 ± 0.01
40	4	2.56 ± 0.0	73.53 ± 0.01	17.46 ± 0.07	2.75 ± 0.04
40	2	2.18 ± 0.02	74.53 ± 0.0	20.61 ± 0.28	2.40 ± 0.02

Initial carcass composition: Crude protein, 10.28; Moisture, 85.73; Crude fat, 3.05; Ash, 1.25.

Based on growth performance, the best growth performance was achieved by feeding *Heterobranchus bidorsalis* fry two times daily at 40% of feeding level per day attaining a body weight of about 7.61g within ten weeks of rearing in the outdoor concrete tanks. This rate of weight development compares favourably with high values reported for other cultured species, e.g. 4.5g for carp (*Cyprinus carpio*) in 8 weeks at 23^{o}C (Huisman, 1974), 9.5g for channel catfish (*Ictalurus punctatus*) in 4 weeks at 28^{o}C (Stickney *et al*., 1972) and 4.92 for *Clarias gariepinus* in 8 weeks at 28^{o}C (Dada and Olanrewaju, 2002).

Regardless of feeding rate, increasing feeding frequency from two to four times a day did not improve feed utilization and growth parameters.

Dada *et al*. (2002) showed that *Heterobranchus bidorsalis* fry fed practical diets grew significantly faster when fed twice each day than when fed five times each day, although the rate of feeding and type of diet were more important factors affecting fry growth. The present results also show that feeding rate was the more important variable in determining weight gain.

Santiago *et al*. (1987) fed *Oreochromis niloticus* fry (initial weight, 12mg) for five weeks on crumbled pellets (35% crude protein) and fish fed 15, 30, 45 and 60% of body weight reached mean weight of 63, 198, 232 and 228mg respectively.

The dissolved oxygen, pH and temperature estimated during the experiment were within the acceptable range recommended for catfish (Viveen *et al*., 1986).

Based on the results and the foregoing, it could be concluded that in practice, when supplementary feed is provided for *Heterobranchus bidorsalis* fry under outdoor nursery/rearing (where natural food is available) feeding two times daily at 40% feeding level is optimal for attaining maximum growth and efficient feed utilization within 10 weeks, that being the normal fry rearing period.

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