

## INFLUENCE OF FEEDING TIME ON FEED UTILIZATION BY SIAMESE CATFISH, *Pangasius hypophthalmus* JUVENILE

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### ABSTRACT

Siamese catfish (*Pangasius hypophthalmus*) at juvenile stage is used as ornamental fish by fish hobbies because of their beautiful shape and movement. Feeding time is a part of feeding management to get the best and effective strategy on feed input. This study aimed to determine the growth of Siamese catfish juvenile by looking at the influence of feeding time on feed utilization. The average individual weight of juveniles used was  $\pm 3.2$  g stocked 15 fish per aquarium equipped with recirculation system. Two level factors in the factorial design consisted of 4 feeding times (at 8:00, at 12:00, at 16:00, and as control (8:00, 12:00, 16:00) and feeding level (45 g feed kg<sup>-1</sup> fish, 90 g feed kg<sup>-1</sup> fish). Interaction between feeding time and feeding level resulting eight types of treatments research, namely A (8/45), B (12/45), C (16/45), D (8:12:16/45), E (8:12:16/90), F (8/90), G (12/90), and H (16/90). The results showed that feeding time had significant effect on the specific growth rate, feed conversion, and protein efficiency ratio and were significantly different among the treatments ( $P < 0.05$ ). Besides feeding time control (treatments D and E), treatment C also showed the highest of specific growth rate (2.03%), protein efficiency ratio (1.46), and the lowest feed conversion ratio (1.85).

**KEYWORDS:** feeding time, growth, juvenile, *Pangasius hypophthalmus*

### INTRODUCTION

In several fish species, it has been demonstrated that the growth performance is strongly dependent on the time of food distribution (Hogendoorn, 1981; Noeske *et al.*, 1981; Sundararaj *et al.*, 1982; Noeske-Hallin *et al.*, 1985; Carrillo *et al.*, 1986; Boujard & Leatherland, 1992; Kerdchuen & Legendre, 1994; Baras *et al.*, 1996). In some circumstances, the difference originated from differential food intake at different times of the day (Sundararaj *et al.*, 1982). In most circumstances, however, it is admitted that for fish fed at satiation, the variable growth of fish fed at different times of the day originates from a combination

of variable food intake and variable conversion efficiency (Boujard & Leatherland, 1992).

Several mechanisms can be accounted for the variations of food conversion efficiency, in particular the variable energy expenditure of fish depending on feeding time (Gélineau *et al.*, 1998; Baras, 2000). Variable energy expenditure can originate from a variable propensity of fish to exercise dominance hierarchies and compete for food depending on time of the day and associated light level (Holm, 1989; Jorgensen & Jobling, 1993; Baras *et al.*, 1998; Baras, 2000). In other situations, the difference was attributed to hour-dependent susceptibility to stress (Boujard *et al.*, 1993), which is

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known to impact on assimilation processes. Finally, in other circumstances, the differences between the growth rates of fish fed at different times of the day were attributed to different metabolic pathways, for example, channel catfish stocking less energy into perivisceral (fat) reserves when fed during the early morning than during the late afternoon (Noeske-Hallin *et al.*, 1985).

Similarly, it has been found that the capacity for protein synthesis varies with feeding time in the rainbow trout (Gélineau *et al.*, 1998). Most research on the influence of feeding time has concerned to comparison between night-time and daytime feeding, but substantial differences have been observed for meals distributed during the same phase of the day, at a few hours of interval (e.g. Boujard *et al.*, 1993).

From a practical perspective, when experimental data indicate variable growth with different feeding schedules involving different meals shared at different times of the day (as was the case with patin Siamese, our results), it matters discriminating between differential food intake and differential food conversion efficiency. The practical consequences for fish-culturists are substantially different.

One way of solving this issue is carrying out two parallel series of experiment. In the design experiment, the first series (low feeding rate), fish receive meals that are below their maximum food intake. In these circumstances, all food distributed is consumed, and differences in growth, if any, reflect differences in food conversion efficiency. In the second series (high feeding rate), meal size exceeds the maximum food intake of fish. If differences are observed, they can reflect differences between either food intakes or conversion efficiencies, or a combination of both. However, if the results of the second series are compared with those of the first one, it is possible to deduce whether feeding time also impacts on food intake. This is precisely the type of experiment that we wish to implement with young Siamese catfish, *Pangasius hypophthalmus*. The aim of this experiment will be feed utilization according to feeding time by Siamese catfish, *P. hypophthalmus*, juvenile.

## MATERIALS AND METHODS

Based on weight gain, Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER),

Moreau *et al.* (2008) estimated the dietary protein requirement for *P. hypophthalmus* was 24 g CP kg<sup>-1</sup> fish day<sup>-1</sup>. Based on the last observation, maximum daily feeding rate was estimated at 140 g kg<sup>-1</sup> day<sup>-1</sup> for 2 g fish, with a maximum of 60 g kg<sup>-1</sup> per meal (Meilisza *et al.*, 2010, *unpublished data*).

Three meals a day was also defined as optimal feeding frequency for fish ranging 5 to 15 g (Meilisza *et al.*, 2009, *unpublished data*). Utilization of appropriate models was shown worthy for studying nutrient requirement or utilization (Shearer, 2000). Moreover, as number of parameters are reduced with a model, experimental design can be optimized by the use of appropriate statistical tools to improve experimental efficiency with lower runs than full factorial design (Ruohonen & Kettunen, 2004). For the present study, the growth was assumed first as a polynomial function according to treatment, and a uniform design was defined according to this assumption.

Growth performance and nutrient utilisation was compared between lots of fish receiving food at 8, 12, or 16 hours with four different feeding patterns and two daily feeding rates (45 and 90 g kg<sup>-1</sup> day<sup>-1</sup>). Treatments D and E served as controls for each daily feeding rate series (Table 1).

Triplicates were used for each treatment. Nutrient utilisation was studied on the basis of proximate analysis of feed and of fish at the beginning and at the end of the experiment. Local fish meal, soybean meal, corn meal, fish oil, corn oil, vitamin, and mineral were used as feed ingredients. CMC, 10 g kg<sup>-1</sup>, was used as the binder.

Each diet was formulated according to target nutrient content and proximate composition of feed ingredients, with Microsoft Excel Solver software (Table 2). Pellets were prepared using a 2 mm dye meat grinder, and slightly dried at ambient temperature. Pellets were then packed in 500-g "zip locked" plastic bags and stored at 4°C before utilisation. Dry matter was determined weekly (120°C, 4 hours) in an aliquot of each diet. Each treatment was randomly assigned to 24 lots of fish as followed (Table 3).

Fifteen fish were used for each lot with an initial fish body mass between 2 and 5 g (1.5" to 2"). At D-1 (a day before the beginning), 390 fish were randomly assigned to each of these

Table 1. Meal size (g kg<sup>-1</sup>) for different treatments according to feeding time

Treatment	Feeding time		
	8:00	12:00	16:00
A	45	-	-
B	-	45	-
C	-	-	45
D	15	15	15
E	30	30	30
F	90	-	-
G	-	90	-
H	-	-	90

Table 2. Feed formulation (g dry matter kg<sup>-1</sup> feed)

Feedstuffs	High-Lysine (50%)
Fish meal	250
Soybean meal	251
Corn	355
Fish oil	10
Corn oil	54
Vitamins	30
Mineral	10
Binder	10

Table 3. Random assignment of experimental treatments to 24 tanks

Tank	Treatment	Tank	Treatment
A1	B	B5	G
A2	B	B6	E
A3	H	B7	C
A4	E	B8	G
A5	C	C1	E
A6	D	C2	D
A7	B	C3	H
A8	A	C4	H
B1	A	C5	F
B2	A	C6	F
B3	F	C7	G
B4	C	C8	D

24 lots with a supplementary lot of 30 fishes for characterization of initial condition. At D-0, total fish mass was determined in the 24

experimental lots and control fish. In the supplementary lot, fish was weighed individually, and then froze for proximate analysis.

Every week, total fish biomass and fish number was recorded in each experimental tank. Fish was not fed on sampling days. Meal size was adjusted every week according to fish biomass in each tank. Meals were weighed individually for each tank, weekly. Fish was fed at 08:00, 12:00, and/or 16:00 according to treatment plan. Feed excess or faeces was removed by siphoning one hour after the last meal of the day for each treatment (meaning: 09:00 for treatment A & F, 13:00 for B & G, and 17:00 for C, D, E, & H).

Experiment took place in door with a natural photoperiod. Temperature (mini/maxi) was recorded daily. Water quality (dissolved oxygen, pH, ammonia, and nitrite) was controlled each week. Experiment was completed when mass gain reached as high as 200%–300% of the initial mass for the best condition and/or difference among treatments was significant. Significance test was first performed after the 4<sup>th</sup> sampling week. At the end of the experiment, fish was weighed individually, pooled per tank and froze for proximate analysis. Survival rate was calculated at the end of the experiment by counting the remaining fish in each tank.

**RESULT AND DISCUSSION**

Eight design experiments looking at the interaction between feeding time and feeding rate is shown in the Table 4. The similar performance of survival rate (100%) showed on the table has given information that no significant difference could be observed among treatments. Striped catfish juvenile on treatment E (8:12:16/90) reared during the experiment has

the highest final biomass based on feeding time/feeding rate.

Experiment results showed that interaction between feeding time and feeding rate exhibited significant difference on specific growth rate (SGR), feed conversion (FCR), and protein efficiency ratio (PER) ( $P < 0.05$ ). The data for growth rate is provided in Table 5, and data for feed conversion and protein efficiency ratio is presented in Table 6. The highest specific growth rate (SGR) was reached by treatment E (2.24%) but no significant difference among treatment G (2.18%), D (2.08%), C (2.03%), H (1.97%), and B (1.73%) were observed. Compared to the control in treatments D and E, treatment G and C gave good value on SGR.

Based on the comprehensive data obtained during the experiment, the better values of SGR, FCR, and PER was achieved by treatment C with feeding time at 16 and feeding rate of 45 g kg<sup>-1</sup> fish day<sup>-1</sup> where the value generated SGR (2.03%), FCR (1.85%), and PER (1.46%). The values of these parameters are not significantly different from that of the control (treatment D) which is feeding time at 8, 12, 16, and the feeding rate of 45 g kg<sup>-1</sup> fish day<sup>-1</sup>. This shows that the response of feed on the juvenile of Siamese’s catfish is extremely good on feeding time at 16 in the evening than in the afternoon or early morning as indicated by the values of SGR, FCR, and PER are equal to three times a day on feeding time at 8, 12, 16 (control treatment).

The supporting data on the measurement of some physical and chemical parameters of water during the experiment were as follows:

Table 4. Initial biomass, final biomass, and survival rate during the experiment

	Feeding time/feeding rate (g/kg fish/day)	Initial biomass (g)	Final biomass (g)	Number of fish (ind.)	Survival rate (%)
A	8/45	45.78	59.73	15	100
B	12/45	47.19	68.03	15	100
C	16/45	46.60	71.57	15	100
D	8;12;16/45	47.28	73.34	15	100
E	8;12;16/90	47.81	76.65	15	100
F	8/90	47.30	60.64	15	100
G	12/90	46.84	74.42	15	100
H	16/90	47.60	72.09	15	100

temperature from 28°C to 30°C; pH 6.8 to 7.3, DO 6.15 to 6.68; ammonia from 0.03 to 0.57 mg/L; nitrite from 0.030 to 0.181 mg/L; and conductivity from 256 to 300 µS. The range of physical and chemical data of water still exists within limits but is still considered optimal to support the survival and growth of fishes. This is reflected in the value of an excellent survival rate which is equal to 100% and relatively good growth in each treatment (Table 4).

From the observation, it was found that the feeding response of fish in the morning (at 8) was very low and this could be seen from the average weight of fish measured in treatments A and F each week during the experiment which were lower than the other feeding time treatments (Figure 1).

Morning is the time where suspected digestive process has not been activated after a break during the night phase. Besides, fish feeding behavior also affect the response of fish to eat, where it is estimated that there are many factors involved in these processes such as the environment and involvement of some photoreceptor organs (e.g. other parts of the brain, the skin, the eyes) and other organs acting as oscillator (Boujard & Leatherland, 1992). Ammonia excretion increased immediately after feeding the fish at midnight, and 2 hours after feeding at dawn. Ammonia excretion and energy supply from protein catabolism were higher in fish fed at midnight than in those fed at dawn, while total energy expenditure was the same in both groups.

Table 5 shows the weight gain and specific growth rate of different treatments of feeding time/feeding rate. In addition to the control (treatment D and E), treatment C and G gain the highest value of weight gain and specific growth rate among other treatments. When compared between treatments, C and G are not significantly different its mean that treatment C is better and more efficiently viewed from a given of feeding rate which is treatment C has lower feeding rate than G. Although treatment C was given feed only once in a day, its growth performance was not significantly different from the control treatment. This suggests that feeding in the evening is effective for seed of Siamese catfish.

Similar to its performance in Table 5, treatment C shows the best result in feed conversion as shown in Table 6 where it has the lowest value of 1.85 but not significantly different from the control (treatment D). The highest protein efficiency ratio was also achieved by treatment C (1.46) but again not significantly different from the control (treatment D). This further indicates that feeding in evening is better than in the afternoon or morning.

The parameters of the experiment showed that feeding in the morning increases the value of feed conversion with the result that feeding efficiency was lower which can cause increased of feed costs. The fed in the morning should not be given more in the fed on a day which viewed that occur of decreasing of feeding efficiency on this time.

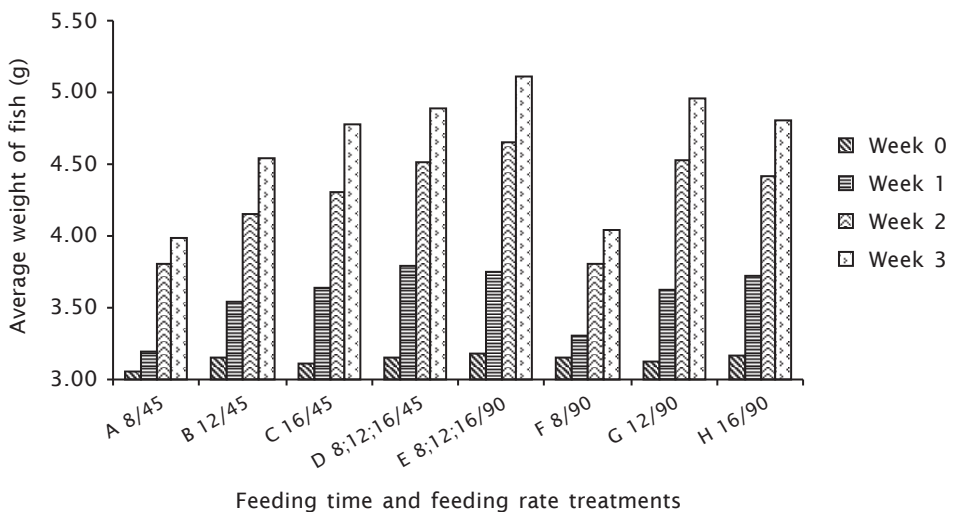


Figure 1. Average weight of fish base on feeding time/feeding rate treatments

Table 5. Weight gain (g) and specific growth rate (%/day) based on feeding time/feeding rate treatments

	Feeding time/feeding rate (g/kg fish/day)	Initial weight (g/ind.)	Final weight (g/ind.)	Weight gain (g)	Specific growth rate (%/day)
A	8/45	3.05	3.98	0.93	1.26 <sup>bc</sup>
B	12/45	3.15	4.54	1.39	1.73 <sup>abc</sup>
C	16/45	3.11	4.77	1.66	2.03 <sup>abc</sup>
D	8;12;16/45	3.15	4.89	1.74	2.08 <sup>ab</sup>
E	8;12;16/90	3.19	5.11	1.92	2.24 <sup>a</sup>
F	8/90	3.15	4.04	0.89	1.18 <sup>c</sup>
G	12/90	3.12	4.96	1.84	2.18 <sup>a</sup>
H	16/90	3.17	4.81	1.63	1.97 <sup>abc</sup>

Note: The same letter following numbers on the same row means not significantly different

Table 6. Feed conversion and protein efficiency ratio according to the feeding time/feeding rate treatments

	Feeding time/feeding rate (g/kg fish/day)	Total feed (g)	Feed/fish (g)	Feed conversion	Protein efficiency ratio
A	8/45	40.72	2.71	3.04 <sup>bc</sup>	0.90 <sup>bc</sup>
B	12/45	43.88	2.93	2.15 <sup>bc</sup>	1.25 <sup>ab</sup>
C	16/45	44.78	2.99	1.85 <sup>c</sup>	1.46 <sup>a</sup>
D	8;12;16/45	46.39	3.09	1.82 <sup>c</sup>	1.48 <sup>a</sup>
E	8;12;16/90	93.89	6.26	3.29 <sup>b</sup>	0.81 <sup>bc</sup>
F	8/90	74.50	4.97	5.60 <sup>a</sup>	0.47 <sup>c</sup>
G	12/90	87.09	5.81	3.29 <sup>b</sup>	0.82 <sup>bc</sup>
H	16/90	83.15	5.54	3.41 <sup>b</sup>	0.78 <sup>bc</sup>

Note: The same letter following numbers on the same row means not significantly different

The phenomenon of this result given assumption that the fed in the morning will make the low of growth caused by the decreasing of feeding appetite and consumption. Physiological aspects that potentially affect the feeding time (Noeske-Hallin *et al.*, 1985) have been able to be proven in this experiment.

**CONCLUSION**

The different treatments of feeding time positively affect growth performance, feed conversion, and protein efficiency ratio of tested fish. Feeding time at 16:00 with feeding rate of 45 g kg<sup>-1</sup> leads to the highest performance on growth, feed conversion, and protein efficiency ratio of fish (treatment C).

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