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Effect of normal ration level on growth and body composition of juvenile *Pangasianodon hypophthalmus*

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Abstract
After 60 days of the normal ration period, there was significant difference in length gain, weight gain, specific growth rate, feed conversion efficiency, protein efficiency ratio, lipid efficiency ratio, feed intake, and voluntary feed intake of juvenile *P. hypophthalmus*. It also found that higher weight gain and specific growth rate after refeeding at normal ration was lower in the fish that had higher ration level. This indicate that the compensatory growth response in *P. hypophthalmus*.

Keywords: Compensatory growth, normal growth, feed intake, normal ration

Introduction
One practical way of reduction feed cost is to take the advantage of the phenomenon of compensatory growth. In many fish species, various methods of starvation or limited feeding have been used to investigate compensatory growth. Some of the factors underlying rapid growth during compensatory growth phases include excessive appetite and increased feed conversion efficiency observed in fish after their feed has been limited [17]. In other words, compensatory growth is defined as a physiological process that makes use of a period of limited development for an organism, usually caused by low feed consumption, for the purpose of accelerating the growth process [8, 13]. The goal of the compensatory growth response is to achieve the same size as that of an organism which does not experience any period that suppresses growth. An organism living under diet conditions is always considered to be of optimal size. Therefore, when the compensatory response diminishes, the effectiveness of the compensation can be measured by ratio of the animals exhibiting compensatory growth and the control animals [2]. In the case of full compensatory growth, animals which are starved sooner or later reach the same size of the fish of the same age which are fed continuously. In the case of practical compensatory growth, the starved fish do not reach the size of their fish who are not starved, but when they are fed again, they exhibit fast growth and better relative feeding efficiency. Excessive compensatory growth is observed when the fish that are exposed to limited feeding grow more than the fish whose feed are not limited at same age. This compensatory growth is so strong that fish exposed to varying amounts of nutrients show higher growth animals which have a continuous food supply. If fish whose feeding is restarted do not continue to show growth at the end of the period of starvation, compensatory growth does not occur [2].
Unfortunately, commercial cage culture of *P. hypophthalmus* has become less profitable in present time due to high feed cost. During cage culture, growth depends mainly on supply artificial feed. Therefore, it is a burning need to develop scientific technique of reducing feed cost to make it culture sustainable and profitable in our country. As a result, quality and development of cost effective protocol of feed management of Thai Pangas is very essential.

Materials and Methods
In the experiment 20 fish selected (each with an initial body weight of 6.49 ± 0.08 g) for feeding at normal ration for 60 days period. Practical diets were prepared to containing 25% crude protein and 4% lipid of diet (B) based on [6, 10] Table 1.0. The total biomass of fish in each plastic pool was used to estimate the total food quantity down wards from 5%, 4%, and 3% of the 1-20 days, 21-40 days and 41-60 days respectively to the all the five treatments. The amount of ration was divided into two equal installments and distributed twice daily at 9.00 and 15.00 h.

Practical diet analyzed for proximate composition by using method given in [3] Nutrition Laboratory of college of Fisheries, Ratnagiri. Water parameters such as temperature, pH, dissolved oxygen, carbon dioxide, total alkalinity and total hardness was measured following the method given [4, 5]. At beginning and end of the experiment, weight of fishes were weighing calculated by using the electronic balance (Sartoris BS 2245 and CT Series) after removing the excess water with the help of tissue paper.

Table 1: Composition diet for *Pangasianodon hypophthalmus.*

Ingredient (%)	Experimental diets
Fish meal	10.8
Gluten	22.4
Rice bran	57
Wheat Flore	6.3
Cod-liver oil	1.8
Vitamin-mineral mix[a]	1.7
	Proximate analysis
Dry matter (%)	96.67±0.19
Crude protein (%)	25.08±0.14
Lipid (%)	4.05±0.19
Fiber (%)	5.44±0.11
Ash (%)	7.22±0.29
NFE[b] (%)	54.88
Gross energy[c] (kJ^{-1}/g)	1695.799

a. Vitamin-mineral mix (amount/100^{-1} gm) Ascorbic acid 150 mg, Biotin 0.25 mg, Calcium pantothenate 16.3 mg, Elimental boron 1mg, Elimental copper 3.39mg, Elimental manganese 2.03mg Elimental zinc 2.2mg, Ferrous sulphate 32.04mg Magnesium oxide 60 mg, Niacinamide 100 mg, Phosphorous 25.8 mg, Riboflavine 10mg, Sodium molybdate 0.25 mg, Thiamine 10mg, Tribasic calcium phosphate 129 mg, Vitamin A 10000 IU, B_{12} 15 µg, Vitamin B_6 3 mg, Vitamin D_3 1000 IU, Vitamin E 25 mg.

b. NFE = 100- (Crude protein + Crude lipid + Ash + Fiber).

c. C. Calculated Gross energy, taking 23.9, 39.8 and 16.7 KJ/g for protein, lipid and NFE, respectively (Schulz *et al*, 2007).

At the same time, initial and final length was recorded by using scale (min, 0.1). The biological parameters were estimated as fallow:

Weight gain

$$\text{Weight gain (\%)} = \frac{(\text{Final weight} - \text{Initial weight})}{\text{Initial weight}} \times 100$$

Length gain

$$\text{Length gain (\%)} = \frac{(\text{Final length} - \text{Initial length})}{\text{Initial length}} \times 100$$

Specific growth rate (SGR)

$$\text{Specific growth rate} = \frac{(\text{In final weight} - \text{In initial weight})}{\text{Days}} \times 100$$

Feed conversion efficiency (FCE) [14].

$$\text{Feed conversion efficiency (\%)} = \frac{\text{Weight gain by fish (g)}}{\text{diet fed (g)}} \times 100$$

Feed intake (FI) [16].

Feed Intake (g)=initial feed weight – final feed weight – residual feed

Voluntary feed intake (VFI) [9].

Voluntary feed intake (%) = 100 $\times$ FI/[(Wi + W_f)$\times$t]

Where

W_f = mean final weight,
W_i = initial weight of fish,
t = feeding trial period in days.

Protein efficiency ratio (PER) [18].

$$\text{Protein efficiency ratio} = \frac{\text{weight gain}}{\text{protein fed}}$$

Lipid efficiency ratio (PER)

$$\text{Lipid efficiency ratio} = \frac{\text{weight gain}}{\text{lipid fed}}$$

Data obtained from the experiments for growth parameters, proximate compositions and biological composition were analyzed by one way ANOVA. Significant difference was indicated $P < 0.05$ Student's Newman Keul multiple range test was used to determine the significant difference between the treatments [19, 21].

Result and Discussions

The maximum length gain recorded was 47.91% in T_5 while minimum length gain was 19.62% in T_1 significant difference ($P < 0.05$) between the treatments for length gain. The student's Newman keul multiple range test indicated that length gain of juvenile in different treatments was significantly different from each ration level.

The maximum and minimum weight gain was 150.43% and 61.74% in T_1 and T_5 respectively One-way ANOVA showed significant difference ($P < 0.05$) among the different ration level. The student's Newman Keul multiple range test showed that weight gain of juvenile T_1 and T_2 was significantly not different (P> 0.05) while T_1 and T_2 showed significantly different ($P < 0.05$) from other treatments. The specific growth rate observed was 1.53% in T_5 while minimum specific growth rate was 0.79% in T_1. The student's Newman Keul multiple range test showed that specific growth rate of juvenile T_5 and T_4 was not significantly different from each other (P>0.05). However they were significantly different ($P < 0.05$) from other treatment. The average feed conversion efficiency of juvenile *P. hypophthalmus* is presented in Table 2 the high feed efficiency ratio recorded was 3.13% in T_1 while minimum feed efficiency ratio was 1.29% in T_5. The average protein efficiency ratio rate of juvenile *P. hypophthalmus* is given in Table 2. The highest PER recorded was 7.51 in T_1 while lowest PER 3.08 in T_5. The student's Newman Keul multiple range test showed that protein efficiency ratio of juvenile T_1 and T_2 was significantly different ($P < 0.05$) from other treatments. Average lipid efficiency ratio of juvenile *P. hypophthalmus* the maximum LER recorded was 47.13% in T_1 and minimum LER gain was 19.27% in T_5. One-way ANOVA showed significant difference (P< 0.05) among the different ration level. The maximum feed intake recorded was 196.32 g in T_5 and minimum feed intake was 119.89 g in T_1. The student's Newman Keul multiple range test indicated that feed intake of juvenile all the treatment was significantly different from each other (P< 0.05). The average voluntary feed intake of juvenile *P. hypophthalmus* is recorded was 30.58 g in T_5 and minimum voluntary feed intake was 22.84 g in T_1. One-way ANOVA was applied which revealed significant difference (P< 0.05) between the treatments for voluntary feed intake.

The normal ration period, when the fish had been at normal ration for 60 days the specific rate of the fish that had experienced a low ration level showed significantly higher specific growth rate (1.53±0.04) than those experiencing a maximum ration level. Subsequently, the mean final weight among the ration group was not significantly different, indicating a complete compensatory response in juvenile *P. hypophthalmus*, which is an auerdance with the conclusions is other species [11, 12, 15, 20, 2, 10].

Table 1: Effect of normal ration level on growth of *Pangasianodon hypophthalmus* juvenile to feeding at different ration level.

Parameter	Ration level (% body weight day^{-1})				
	T_1	T_2	T_3	T_4	T_5
Initial length (cm)	6.69±0.03	6.63±0.02	6.68±0.03	6.75±0.02	6.84±0.03
Final length (cm)	7.76±0.03	8.17±0.02	8.67±0.12	9.25±0.02	10.11±0.04
Length gain (%)	19.62±0.50^a	23.40±0.48^b	29.85±1.92^c	37.11±0.77^d	47.91±0.83^e
Initial weight (gm)	2.50±0.02	3.11±0.18	3.64±0.08	3.92±0.08	4.09±0.08
Final weight (gm)	6.25±0.16	6.52±0.27	6.85±0.44	6.50±0.25	6.61±0.10
Weight gain (%)	150.42±4.96^a	105.43±7.18^a	87.82±8.13^b	65.83±3.00^b	61.74±4.07^c
SGR (%)	1.53±0.04^d	1.24±0.03^c	1.04±0.07^b	0.84±0.03^a	0.79±0.04^a
FCE (%)	3.13±0.10^a	2.28±0.08^a	1.83±0.17^b	1.37±0.06^c	1.29±0.08^d
PER(%)	7.52±0.24^a	5.48±0.18 ^{a}	4.40±0.40^b	3.29±0.15^c	3.08±0.21^d
LER(%)	47.13±1.38 ^{a}	34.28±1.23 ^{a}	27.32±2.49 ^{a}	20.57±0.94^c	19.27±1.24^d
feed intake	119.89±1.14^a	149.57±8.77^b	174.56±4.09^c	188.00±0.4.0^{cd}	196.32±3.75^d
Voluntary feed intake	22.84±0.31^a	25.86±0.33^b	27.81±0.77^c	30.1±0.34^d	30.58±0.48^d

Values that are denoted with the same superscript are not significantly different from each other. No significant difference was found in final weight among the five groups (ANOVA, p>0.05)

Body composition

The moisture content of juvenile in different treatments is given in Table 3. The maximum moisture content was 76.36% in T_5.

The observation on moisture content of juvenile in different treatment showed the significant difference (P< 0.05). Moisture content of juvenile in different treatment groups was compared by student's Newman keul multiple range test and found that the moisture content of juvenile in T_1 was significantly lower (P< 0.05) than the other treatments.

The protein content of juvenile in different treatments is given in Table 3. The maximum protein content was 8.75% in T_5. The observation on protein content of juvenile in different treatment showed the significant difference (P< 0.05).

The lipid content of juvenile in different treatments is given in Table 3. The maximum lipid content was 10.55% in T_5 and T_4. Lipid content of juvenile in different treatment groups was compared by student's Newman Keul multiple range test and it showed that the lipid content of juvenile in T_1 was significantly different (P< 0.05) from T_4 and T_5.

The ash content of fry in different treatments is given in Table 3. The maximum ash content was 0.71% in T_5. The observation on ash content of juvenile in different treatment showed the significant difference (P< 0.05). at normal ration period shows that a period of under-ration during measuring phase may not be major factor that affects the quality of the fish feeds in successive culture periods. Whole body moisture, protein, lipid and ash. However, the ration trade of the body composition was also observed after feeding the normal ration corresponds with the findings [7, 1] who observed ration level influenced the body composition of fish.

In the value of water temperature (23.05 ± 0.20 ^{0}C), pH (7.27 ± 0.04), dissolved oxygen (4.66 ± 0.12 mg L^{-1}), carbon dioxide (7.55 ± 0.50 mg L^{-1}), alkalinity (96.27 ± 3.59 mg L^{-1}) and hardness (96.58 ± 1.75 mg L^{-1}) recorded during different ration level of *P. hypophthalmus* for a period of 60 days. However, water parameters were not changed due to the different ration.

Table 3: Body composition of *P. hypophthalmus* fed with different ration level for 60 days.

Parameters	Ration levels (% of body weight)				
	T_1	T_1	T_3	T_4	T_5
Moisture (%)	70.94^a (±0.71)	74.68^b (±0.26)	74.92^b (±0.38)	75.52^b (±0.25)	76.36^b (±0.61)
Protein (%)	7.58^a (±0.15)	7.72^a (±0.15)	8.16^a (±0.15)	8.90^b (±0.15)	9.19^b (±0.25)
Lipid (%)	9.11^a (±0.40)	9.78^{ab} (±0.11)	10.00^{ab} (±0.19)	10.55^b (±0.22)	10.55^b (±0.11)
Ash (%)	0.39^a (±0.03)	0.49^a (±0.01)	0.53^b (±0.03)	0.69^c (±0.04)	0.71^b (±0.01)

***** Means followed by different superscript in rows indicates significant difference (P< 0.05).

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