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Research Article

EFFECT OF DIET SUBSTITUTION ON GROWTH PERFORMANCE IN *MACROBRACHIUM IDEA*

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ABSTRACT

The effect of five different diets on growth and survival were investicated for juveniles of Machrobrachium idae. The best growth was obtained with the diet containing 15% Begonia cordifolia extract. The maximum weight gain was found in prawn fed with diet III whereas the minimum weight gain was found in prawn fed with diet I during the experimental period. And also the survival rate was maximum in prawn fed with diet III and minimum in prawn fed with diet I and control.

INTRODUCTION

The progress in aquaculture directly depends upon the nutritionally balanced feed which provides superior growth within a stipulated time period(AOAC,1995). Feeding is an important function in prawns since growth development needs high amount of energy which is taken in the form of food(Majare,2016). Growth performance of prawn is not subjected to only one factor but a combination of several factors like water quality, stocking density, feeding system etc (Niu *et al*.,2003).

Use of supplementary feed has become inevitable for the success of prawn culture. Several workers have tried to develop artificial diets capable of sustaining good growth using a variety of foodstuff(Kanazawa *et al*.,1970; Das *et al*.,1996; Venkataramani *et al*.,2002; Anh *et al*.,2009). Fishmeal is the principal source of protein in commercial aquafeeds. As a result of the steep increase in price of fishmeal and the decline in fishery resources that goes into fish production, there is an interest in developing alternatives to this component. Finding and testing alternate protein and lipid sources is important to the aquatic feed industry(Kiron *et al*.,2012).

In this study, the effect of fishmeal dietary replacement with *Begonia cordifolia* on growth performance and survival of freshwater prawn *M.idae* juveniles was evaluated.

MATERIALS AND METHODS

The leaves of *Begonia cordifolia* were washed thoroughly and blotted by the blotting paper, then spreaded out at room temperature in shade to remove the excess water contents. The shade dried plant samples were ground to a fine powder using a mechanical grinder. The powdered samples were stored at 4°C for further use.

Selection of Ingredients and Preparation of diets

Experimental feed was prepared based on earlier nutritional studies carried out in crustaceans (Kanazawa *et al.,* 1970; Deshimaru and Kuroki, 1974; Conklin *et al.,* 1977; Kanazawa *et al.,* 1977; Radhakrishnan *et al*.,2016). Ingredients and formulation of the basal diets were given in the table 1. The prepared feed was air dried and stored at room temperature in air tight containers.

Physical Parameters of Diets

Moisture Content

About 5grams of powdered material was weighed in a silica crucible and was oven-dried at a temperature of 105°C overnight.The sample was placed in a desiccator, allowed to cool and weighed to a constant value. The moisture content was calculated by the following formula

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$$\text{Moisture (\%)} = \frac{\text{Water content (difference)}}{\text{Oven - dried sample}} \times 100$$

Determination of Protein

Reagents

A. 2% Na_2CO_3 in 0.1 N NaOH
B. 1% NaK Tartrate in H_2O
C. 0.5% CuSO4.5 H_2O in H_2O
D. Reagent I:48 ml of A, 1 ml of B, 1 ml C
E. Reagent II - 1 part Folin-Phenol [2 N]: 1 part water
F. BSA Standard - 1 mg/ ml

Procedure

a. 0.2 ml of BSA standard was taken in 5 test tubes and made up to 1ml using distilled water.
b. The test tube was taken with 1 ml distilled water which served as blank.
c. 4.5 ml of Reagent I was added to the test tube I and incubate for 10 minutes.
d. After incubation 0.5 ml of reagent II was added and incubated for 30 minutes.
e. The absorbance was measured at 660 nm and the standard graph was plotted.
f. The amount of protein present in the given experimental diets was estimated using the standard graph.

Estimation of Crude Fat

Reagents

1. Petroleum ether (B.P. 35-65º C) was used.
2. A labeled filter bag was placed on the balance with zero setting.
3. 2 grams of samples (Diets) were kept in a bag and this weight was recorded as W_1.
4. The filter Bag was closed with heat-seal to encapsulate the sample.
5. The samples were placed in the drying oven for 3 hours.
6. The dried samples were cooled in desiccant pouch, then weighed and was recorded as W_2.
7. Sample bags were placed a bag holder and kept in extractor for a selected period of time.
8. When the extraction process was completed, samples were placed in the oven for 15-30 minutes.
9. The Desiccant Pouch was cooled, weighed and was recorded asW_3.

Calculation

$$\text{\% of Crude Fat} = \frac{100\,(W_2 - W_3)}{W_1}$$

Where,

W1= Original weight of the sample.
W2= Weight of pre-dried sample with the Filter Bag.
W3= Weight of dried sample and Filter Bag after extraction

Ash Content (%)

Total ash was determined based on the 'Loss on Drying'' method as described by Trease and Evans, (1983). About 5grams of plant material was taken in a silica crucible, ignited, cooled and weighed.

$$\text{Totalash(\%)} = \frac{\text{Loss of oven- dried sample (difference)}}{\text{Oven- dried sample (initial)}} \times 100$$

Growth Performance

Collection and Acclimation of Test Animals

Juveniles of *M.idae,* the test animals were purchased from Azhikode hatchery, located at northern end of the Cochin estuary, Kerala and were of known nutritional history. The collected animals were transported to the laboratory without causing strain. Healthy animals were selected and sorted out according to their activity and required size. The sorted animals were stocked in fiber glass tanks and were acclimatized to laboratory conditions for two days. These animals were starved for 24 hours prior to the feeding experiments.

Grouping of Experimental Animals

To assess the suitability of the diets as prawn feeds, preliminary feeding trials were carried out on the juveniles of prawns in the laboratory. Juveniles of similar size were selected and used for the study of variability in the individual growth rate. The trials were conducted using five sets of diets. The juvenile shrimps were weighed accurately in digital electronic balance before the start of the experiment. In each experimental study, 30 animals of *M. idae* were selected and maintained in 25 liters plastic trough in the laboratory condition. The selected juvenile of *M. idae* weighing approximately 1.0±0.5grams and feeding trial was conducted for 6 month period. Each experiment was conducted in two replicates treatment. The prawns of *M. idae* were fed with twice per day at 8.00 and 18.00 hrs at 10% of the body weight. Uneaten feed and waste matters were removed separately after feeding on every experimental study. Weight of *M. idae* was recorded after removing the excess water using tissue paper.

Feeding Trials

The juvenile prawns were fed with formulated diets at the rate of 10 percentage of the body per day as suggested by Subramanyam and Oppenheimer (1970). The feeding was done at the rate of 2percentage of the body weight in the morning and in the evening in equal proportions, Viz 8 hours and 18 hours. The amount of feed given was adjusted to every month of the experiment based on changes in the body weight. Estimation of water quality was done periodically. Prawns were observed to respond readily to the pellets, which were normally ingested totally within 2-3 hours. When the prawns were small the pellets were broken into a crumble to facilitate easy acceptance of the prawns. Diets were evaluated on the basis of growth and survival rate after being fed with the control as well as experiment diets for 6 months. All surviving animals were individually weighed on a top loading balance of accuracy 0.01g. Unfed were collected one hour after feeding. Faecal strands were collected from the tanks 3 to 5 hours after the feed application.

Growth performance analysis

Growth performance parameters were evaluated using the following formula (De Silva and Anderson, 1995).

$$\text{Growth Rate (gm)} = \frac{\text{Final Wet Weight} - \text{Initial Wet Weight}}{\text{Days of experiment}}$$

Weight gain parameters were evaluated using the following formula (De Silva and Anderson, 1995).

Weight Gain (WG) = Final Wt (g) – Initial Wt (g)

Specific growth rate (SGR) was calculated after harvesting of prawns as per the expression (De Silva and Anderson, 1995).

$$\text{SGR (\%)} = \frac{\text{Final Weight - Initial Weight}}{\text{Days of experiment}} \times 100$$

Normalized Biomass Index (NBI) was calculated as per the formula (De Silva and Anderson, 1995).

$$\text{NBI} = \frac{(\text{Final Wt} \times \text{Prawn No}) - (\text{Initial Wt} \times \text{Prawn No})}{100}$$

Survival rate was calculated as per the formula (De Silva and Anderson, 1995).

$$\text{Survival rate (\%)} = \frac{\text{Final no. of prawns}}{\text{Initial no. of prawns}} \times 100$$

RESULTS

Growth Performance for 2 Month Peroid

Growth parameters of *M. idae* in relation to different composition of test diets are shown in Table 2. During the study period, *M. idae* fed with Diet III showed significantly greater growth parameter in weight gain(WG) (4.6 g), specific growth rate (SGR) (2.871) and normalized biomass index(NBI) (0.322) . While the minimum WG(2.45), SGR(2.260) and NBI(0.024) were observed in control animals.

Maximum survival rate(23.33) was observed in *M idae* fed with diet III and minimum (3.33) was observed in animals fed with control diet as well as diet V (Table 3).

Growth Performance for 4 Month Peroid

The growth performance of *M. idae* were assessed in control as well as experimental animals fed with formulated diet in different composition. During the 4th month of experimental study *M. idae* fed with diet III showed notable amount of weight gain(22.07g), specific growth rate (2.576g) and normalized biomass index (3.972) while the minimum growth parameters (WG= 7.22; SGR= 1.833; NBI 0.144) was observed in *M. idae* with control diet (Table 4).

Maximum survival rate (60.00) was observed in *M idae* fed with diet III and minimum (6.66) was observed in animals fed with control diet (Table 5).

Growth Performance for 6 Month Peroid

During the 6th month of study period also, *M. idae* fed with Diet III showed significantly greater growth in terms of weight gain (37.70 g), specific growth rate (02.088) and normalized biomass index (07.540) while the minimum WG(19.36), SGR(1.734) and NBI (1.548) were observed in control animals(Table 6).

Maximum survival rate(66.66) was observed in *M idae* fed with diet III and minimum (26.66) was observed in animals fed with control diet(Table 7).

Proximate Analysis of and Composition of Experimental Diets

Moisture content of diet ranged from 8.12 %to 8.45 % of plant extract .The fibre content was maximum in diet III(4.06%) and minimum in control diet(3.75 %) The crude protein values were increased from 45.52 % to, 46.54 %. The crude fat value of diet I is 6.019 %, diet II is 6.016 %, diet III is 6.011 % and diet IV and V is 6.018 %. The Ash content value ranged from 10.23 % to 10.49% and the results showed in Table 8.

DISCUSSION

Feed formulation is also an important criteria for best culture practices. In this study, basal diet mixed with different concentration of *Begonia cordifolia* leaf powder was tested on *Macrobrachium idae*. Diet formulation was followed by Pearson's square-method. The feeding period was scheduled and experimental animals were maintained at natural photoperiods in the laboratory condition at the room temperature.

M.idae fed with basal diet with different concentration of *B.cordifolia* leaf powder showed growth promotion when compared to control group ($P<0.05$). Similar work was done by Jamali *et al*., (2015) prepared a feed composition with six microalgae such as *Chaetoceros muelleri, C. muelleri, Isochrysis galbana, I. galbana, Tetraselmis tetrathele* and *T. tetratheie* for the culture of shrimp larvae. Similar enhancement in weight gain and specific growth rate has been reported in *M. rosenbergii* fed with *Lactobacillus cremoris*, *L. sporogenes* and *L. acidophillus* incorporated diets (Suralikar & Sahu 2001; Venkat *et al*., 2004). An increase in survival rate have also been reported in Indian white shrimp, *Fenneropenaus indicus* and in *M. rosenbergii* fed with Biogen and other probiotics incorporated diets (Ziaei Nejad *et al*. , 2006; Shinde *et al.,* 2008; Saad *et al.,* 2009). Geraldo *et al*., (2016) observed the growth and survival rates of shrimp species.

The present study also proved that the freshwater *Macrobrachium idae* require dietary protein (32-46%) for weight gain, specific growth rate and survival rate. During the study period (2 month,4 month and 6 month), *M. idae* fed with diet III showed significantly greater weight gain(WG) , specific growth rate (SGR) and normalized biomass index(NBI). While the minimum WG, SGR and NBI were recorded in control diet. The survival rate of *M. idae* was also maximium in animal fed with diet III and minimum in both control and experimental animals fed with diet V. Concentration of *B.cordifolia* in diet III was optimum. When the concentration of *B.cordifolia* exceeded or deceeded beyond the optimum level, the growth rate as well as survival rate were

reduced. Gomez *et al.,* (1988) observed the dietary energy levels improved growth and feed efficiency of the freshwater, *Macrobrachium rosenbergii.* Habashy (2009) reported the growth of juvenile freshwater prawn, *M. rosenbergii* required dietary protein level from 25-35%.

CONCLUSION

In conclusion, *B.cordifolia is a* traditional medicinal plant used in various ailments by local community. The phytochemical and pharmacognostic analysis confirm that the *Begonia cordifolia* can be used to improve the growth and survival rate of *Macrobrachium idae.* The phytochemical analysis of the plants is very important commercially and has great interest in pharmaceutical companies for the production of the new drugs for curing various diseases. Thus, this plant is used in aquaculture to improve growth of *M.idae*.

Table 1 Preparation and composition of control and experimental diets (in grams)

Composition	Control (%)	Diet I (%)	Diet II (%)	Diet III (%)	Diet IV (%)	Diet V (%)
B.cordifolia	0	25	20	15	10	05
Soybean meal	17	17	17	17	17	17
Rice bran	10	10	10	10	10	10
Wheat bran	11	11	11	11	11	11
Fish meal	15	15	15	15	15	15
Shrimp meal	14	14	14	14	14	14
Mustard oil cake	15	15	15	15	15	15
Vitamin + Mineral mixture	2	2	2	2	2	2

Table 2 Growth parameters of *Macrobrachium idae* (The date recorded at the end of 2nd month (December - January)

Parameters treatment	Initial weight(g)	Finalwt.(g)	Weight gain(g)	Specific growth rate	Normalized biomass index
Control	0.85	3.30	2.45	2.260	0.024
Diet I	0.88	4.30	3.42	2.644	0.068
Diet II	0.92	4.68	3.76	2.711	0.225
Diet III	1.00	5.60	4.60	2.871	0.322
Diet IV	0.98	5.48	4.50	2.860	0.090
Diet V	1.05	4.72	3.67	2.505	0.036

Table 3 Survival rate of *Macrobrachium idea* fed with different composition of Diet (The data recorded at the end of 2nd month (December - January)

Treatment	Initial No	Final No	Survival rate
Control	30	1	3.33
Diet I	30	2	6.66
DietII	30	6	20.00
Diet III	30	7	23.33
Diet IV	30	2	6.66
Diet V	30	1	3.33

Table 4 Growth parameters of *Macrobrachium idae* (The date recorded at the end of 4th month (December - March)

Parameters treatment	Initial Wt(g)	Final Wt.(g)	Weight gain (g)	Specific Growth Rate (%)	Normalized Biomass Index (%)
Control	0.90	8.12	7.22	1.833	0.1444
Diet I	1.00	15.02	14.02	2.257	0.841
Diet II	1.03	21.36	20.33	2.526	1.626
Diet III	1.05	23.12	22.07	2.576	3.972
Diet IV	0.98	18.15	17.17	2.432	2.747
Diet V	0.95	12.06	11.11	2.117	0.444

Table 5 Survival rate of *Macrobrachium idea* fed with different composition of Diet (Data recorded at the end of 4th month (December- March)

Treatment	Initital No	Final No	Survival rate
Control	30	2	6.66
Diet I	30	6	20.00
DietII	30	8	26.66
Diet III	30	18	60.00
Diet IV	30	16	53.33
Diet V	30	4	13.33

Table 6 Growth parameters of *Macrobrachium idae* (The data recorded at the end 6thmonth (December - May)

Parameters treatment	Initial Wt(g)	Final Wt.(g)	Weight gain (WG)	Specific Growth Rate (SGR)	Normalized Biomass Index(NBI)
Control	0.85	20.21	19.36	1.734	1.548
Diet I	1.00	28.06	27.06	1.850	3.247
Diet II	1.03	35.12	34.09	1.960	5.113
Diet III	0.90	38.60	37.70	2.088	7.540
Diet IV	0.94	32.05	31.11	1.960	5.025
Diet V	0.97	22.00	21.03	1.760	2.944

Table 7 Survival rate of *Macrobrachium idea* fed with different composition of Diet (Data recorded at the end of 6th month (December- May)

Treatment	Initital No	Final No	Survival rate
Control	30	8	26.66
Diet I	30	12	40.00
DietII	30	15	50.00
Diet III	30	20	66.66
Diet IV	30	16	53.33
Diet V	30	14	46.66

Table 8 Quantitative Estimation of Physico-chemical parameters (% dry weight basis) of experimental diets

S. No	Components and physical parameters	Experimental Diets					
		Control	Diet I	Diet II	Diet III	Diet IV	Diet V
1.	Fiber (%)	3.75	3.79	4.00	4.06	4.01	3.86
2.	Protein(%)	35.21	35.32	35.51	35.44	35.22	35.11
3.	Fat(%)	6.781	6.019	6.016	6.013	6.09	6.04
4.	Ash (%)	8.910	10.23	10.45	10.48	10.44	10.49
5.	Moisture (%)	8.98	8.12	8.23	8.34	8.43	8.45

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