International Journal of Zoology Studies
ISSN: 2455-7269
Impact Factor: RJIF 5.14
www.zoologyjournals.com
Volume 2; Issue 6; November 2017; Page No. 208-212

Effect of different diets on the growth and biochemical aspects of fresh water crab, *Himalayapotamon emphysetum*, available in the local water bodies of Jammu region of J&K state

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Abstract
One of the cultivable aqua animals in fresh water bodies are the crabs. Even though it has great potential for the employment generation, very little work has been done on the culture aspect of this crustacean. A study has therefore, been undertaken as a step towards the development of culture technology of the crab. In the present study, the effect of different feeds were studied on the growth and biochemical aspects of *Himalayapotamon emphysetum.* The feed was given daily @5% of the body weight for a duration of ninety days. It was recorded in the present study that best results in terms of growth and nutritional status were recorded for combined feed than the individual diets.

Keywords: growth, biochemical, *Himalayapotamon*

Introduction
In the intensive and semi intensive aquaculture operations feed constitutes about 60-70% of the total cost involved [1]. It is therefore, the need of the hour to incorporate unexplored unconventional locally available cheaper feed stuffs in fish feeds. An attempt has a made to find the alternatives to fish meal and determined their nutritional stability in diets.
In aquaculture, diet is often considered as the single largest cost item and can represent over 50% of the operating cost in intensive aquaculture [2]. The general approach adopted to reduce diet cost has been to develop low-cost diets by replacing the costly fish meal components with cheaper plant protein sources [3, 4]. Apart from developing low-cost diets, different feeding management strategies and/ or good husbandry methods can also lead to significant saving in diet cost. Information on the optimum feeding regimes/schedules of cultured fish is important in achieving efficient production and to ensure best FCR (feed conversion ratio) and weight gain of cultured organism. An important step in the feeding strategy is to determine the optimal frequency of feeding.

Materials and Methods
Selection and stocking of crabs
Healthy juvenile crabs were selected for the present experiment and checked for any loss of appendages. The selected crabs were then brought to the laboratory and then acclimatized. After acclimatization, the crabs were stocked at a density of 6crablets/tub (20 litres capacity) in duplicates. Higher densities were avoided as it leads to stress and competition for space and food. The duration of the experiment was 90 days.

Feeding frequency
Crabs were fed with five different feeds i.e., Trash, Poultry wastes, Artificial fish feed, Left over vegetables, and Combined feed. Feeds were provided at a rate of 5% body weight twice daily (early morning and late evening).

Water quality
During the present investigation, about 1/4th water was exchanged every alternate day. Water was well aerated with the help of air pumps. Water temperature during the present course of work varied from 26.4 to 26.8^{0}C.

Diets used
The proximate composition of the different test diets is given in Table-1

1. Diet I: Trash (offal portions of fishes i.e. gills, visceral organs of fish removed after cleaning)
2. Diet II: Poultry wastes
3. Diet III: Artificial fish feed
4. Diet IV: Left over vegetables
5. Diet V: Combined feed

Analysis of investigating species
At the end of the experiment (90 days), the experimental animals were analyzed for their nutritional status following the standard methods i.e. Total proteins [5], Lipid [6], Moisture and ash [7].

Statistical analysis
The data was analysed to the level of significance with the help of Microsoft Excel 2003 and SPSS (12.0 Version, Chicago, USA). The level of significance was tested by one way ANOVA, Duncan post multiple range comparisons.

Results and Discussion
Proximate composition
Protein
Himalayapotamon emphysetum: Perusal of table- 2 and Fig. a revealed that the highest protein content (18.60±0.73%) was recorded in the animals fed with Diet V whereas lowest value

(14.01±0.55%) was recorded in the group fed with Diet IV (vegetables). The protein content recorded for Diet I, Diet II and Diet III was 17.30±0.62%, 16.11±0.30% and 15.21±0.50% respectively. It was observed that the protein content in the investigated species differed significantly from one another.

It was also calculated that higher percentage weight gain in the present species *i.e., H. emphysetum* was attained with Diet V i.e. combined feed containing 43.89 % dietary protein content. An increasing trend in the mean weight gain and FCR was recorded in both the experimental specimens upto an increase in dietary protein content upto 43.89% (in Diet V). Further increase in dietary protein content however does not cause further enhancement in growth parameters. Such a response is obvious every species has a certain protein requirement after which excess protein levels rather than enhancing the growth parameters have an adverse effect on it. It has also been recorded by other workers that excess protein does not support additional increase in the growth performances, but rather results in economic losses and deterioration of water quality [8, 9].

Glycogen

Himalayapotamon emphysetum: Thorough study of table-2 and Fig. b revealed that the highest glycogen content (1.45±0.22%) was observed in the muscles of experimental specimens fed with (Diet V) whereas lowest value (0.99±0.16%) was recorded for the animals fed with Diet IV (vegetables). No significant variations were observed for all the diets used in terms of glycogen content in the muscles of *H. emphysetum*.

A point worth mentioning here is that the level of dietary carbohydrate had no significant impact on the growth performances of juvenile crabs. It is clearly evident that despite a wide variation in glycogen levels in various diets (1.81±0.22% to 5.50±0.09%), its incorporation in the muscles of investigated crab species, as depicted in the Table- 2.

Lipid

Himalayapotamon emphysetum: Inquisitive study of table-2 and Fig. c revealed that the highest lipid content (4.05±0.63%) was recorded in the muscles of animals fed with Diet V whereas lowest (2.75±0.30%) was recorded in animals fed with Diet IV (vegetables). The lipid content recorded for Diet I (3.72±0.76), Diet II (3.19±0.15) and Diet III (2.98±0.28) did not differ significantly from one another. Statistically significant variations were observed for Diet IV and Diet V.

All the feeds used in the present study had lipids in the range of 3 - 5.02%. The optimum dietary lipid in crustaceans has been found to be 0-10% [10-14]. It is also on record that crustaceans are not able to tolerate more than 10% of lipids in their diets and its inefficient utilization causes reduced growth [15].

Moisture Content

Himalayapotamon emphysetum: Inquisitive study of table- 2 and Fig. d revealed that the moisture content in the muscles of *H. emphysetum* fed with Diet I, Diet II, Diet III, Diet IV and Diet V was recorded to be 71.08±0.69%, 70.86±0.57%, 73.41±0.91%, 75.11±1.10% and 71.54±0.74% respectively. The values recorded for Diet I (71.08±0.81%) and Diet II (70.86±0.44%) and Diet-V (71.54±0.74) did not differ significantly from one another.

Maximum (76.81±1.58%) and minimum (70.86±1.31%) values of moisture content were obtained with Diet V and Diet II containing 39.45% and 48.83% proteins respectively. Moisture content in the muscles was therefore, observed to decrease with the increase in the dietary protein levels. Similar observations were made by other workers [15-18].

Ash Content

Himalayapotamon emphysetum: The total ash content in the muscles of *H emphysetum* fed with Diet I, Diet II, Diet III, Diet IV and Diet V was recorded to be 7.29±0.22%, 8.11±0.34%, 7.31±0.26%, 7.14±0.36% and 6.01±0.41%. The values recorded for Diet II and Diet V i.e., 8.11±0.34% and 7.14±0.36% differed significantly from each other. No significant variations recorded for Diet I, Diet III and Diet V in terms of ash content (Table-2 and Fig. e)

The ash content in the muscles of *H emphysetum* fed with five different diets did not show any significant difference among themselves. Similar results have been reported in the juveniles of *P. monodon* and in *M. malcolmsonii* wherein the dietary ash content had no effect on the nutritional status of the investigated species [19, 20].

Food conversion ratio and Food conversion efficiency

Himalayapotamon emphysetum: It was observed to be highest (1.89±0.31) for Diet IV and lowest with Diet V (1.26±0.22). The FCR values recorded were found to be 1.69±0.11, 1.65±0.19, 1.79±0.23, 1.89±0.31 and 1.26±0.22 for Diet I, Diet II, Diet III, Diet IV and Diet V respectively (Table- 31 and Figs. f & g). In the present investigation, food conversion efficiency (FCE) was higher (0.79±0.17) for diet V showing best utilization of the diet and lowest (0.53±0.16) for the diet IV.

A good FCR should be between 1.5 and 2. A feed conversion above 2 is poor and arises in the following conditions i.e. Poor quality of feed used, stressful culture conditions, overfeeding and low survival rate. Feed conversion ratio values in the present investigation ranged from 1.13-3.12 and are similar to the findings of other workers [21-25].

Growth

Himalayapotamon emphysetum: Results for the growth performance of the experimental specimens exposed to different diets (Table-2 and Fig. h) clearly depict that the maximum percental weight gain was observed in the crabs exposed to Diet V i.e. combined feed. The minimum weight gain was however recorded in the group fed with Diet IV i.e. vegetables. The final weight gain for different diets is in the order: Diet V (711.1%)> Diet II (673.1%)> Diet I (654.50%)> Diet III (620.0%)> Diet IV (588.0).

Growth is one of the most important processes that determine the recruitment success during early life history of fish [26]. It is well established fact that growth in fishes is influenced by the availability of appropriate food items[27]. The favourable temperature range for these decapods crustaceans is 28-32^{0}C and it was maintained in the present experiment. Temperature more or less than the favourable range makes the experimental species stressful [28].

Table 1: Proximate composition of test diets. The results are expressed on dry weight basis (values represent ± standard deviation)

S.NO.	Parameters Diets	Protein %	Glycogen %	Lipid %	Ash %	Moisture %
1	(Diet-I) Trash	44.43±0.54	1.81±0.22	4.11±0.13	16.90±0.26	74.64±4.53
2	(Diet-II)Poultry waste	48.83±0.71	5.31±0.06	4.49±0.25	15.73±0.19	75.08±4.04
3	(Diet-III) Artificial fish feed	42.01±0.36	4.98±0.17	4.0±0.21	12.49±0.13	72.02±3.95
4	(Diet-IV)Vegetables	39.45±0.38	4.71±0.11	3.79±0.27	15.38±0.20	75.51±5.05
5	(Diet-V)Combined feed	43.89±0.42	5.50±0.09	3.53±0.10	14.75±0.16	73.91±3.35

Table 2: Effect of diets on the proximate composition of *H. emphysetum.* The results are expressed on dry weight basis (values represent± standard deviation)

S.NO.	Diets Parameter	Diet-I (Trash)	Diet-II (Poultry waste)	Diet-III (Artificial fish feed)	Diet-IV (Vegetables)	Diet-V (Combined feed)
1	Protein %	17.30 ± 0.62^{b}	16.11 ± 0.30^{c}	15.21 ± 0.50^{cd}	14.01 ± 0.55^{d}	18.60 ± 0.73^{a}
2	Glycogen %	1.30 ± 0.19^{a}	1.38 ± 0.14^{a}	1.21 ± 0.15^{a}	0.99 ± 0.16^{a}	1.45 ± 0.22^{a}
3	Lipid %	3.72 ± 0.76^{ab}	3.19 ± 0.15^{abc}	2.98 ± 0.28^{bc}	2.75 ± 0.30^{c}	4.05 ± 0.63^{a}
4	Ash%	7.29 ± 0.22^{b}	8.11 ± 0.34^{a}	7.31 ± 0.26^{b}	7.14 ± 0.36^{b}	6.01 ± 0.41^{c}
5	Moisture %	71.08 ± 0.69^{b}	70.86 ± 0.57^{b}	73.41 ± 0.91^{a}	75.11 ± 1.10^{a}	71.54 ± 0.74^{b}

Table 3: Effect of different diets on growth, survival and weight gain of *H. emphysetum*

Diets Parameters	Diet-I (Trash)	Diet-II (Poultry waste)	Diet-III (Artificial fish feed)	Diet-IV (Vegetables)	Diet-V (Combined feed)
I.A.W. (gm)	10 ± 0.23^{a}	10 ± 0.11^{a}	10 ± 0.15^{a}	10 ± 0.54^{a}	10 ± 0.10^{a}
F.A.W (gm)	75.45 ± 3.21^{b}	77.31 ± 3.33^{ab}	72.00 ± 2.54^{bc}	68.85 ± 1.58^{c}	81.11 ± 3.68^{a}
BWG (gm)	65.45 ± 3.33^{abc}	67.31 ± 2.54^{ab}	62.00 ± 5.00^{bc}	58.8 ± 4.12^{d}	71.11 ± 3.80^{a}
% Weight gain	654.50 ± 9.55^{b}	673.1 ± 11.41^{b}	620.0 ± 10.68^{c}	$588.\pm11.11^{d}$	711.1 ± 15.35^{a}
%Survival	90.74 ± 3.58^{a}	94.44 ± 2.59^{a}	94.44 ± 3.78^{a}	92.59 ± 4.40^{a}	96.29 ± 2.90^{a}
FCR	1.69 ± 0.11^{a}	1.65 ± 0.19^{a}	1.79 ± 0.23^{a}	1.89 ± 0.31^{a}	1.26 ± 0.22^{b}
FCE	0.59 ± 0.05^{a}	0.61 ± 0.10^{a}	0.55 ± 0.09^{a}	0.53 ± 0.16^{a}	0.79 ± 0.17

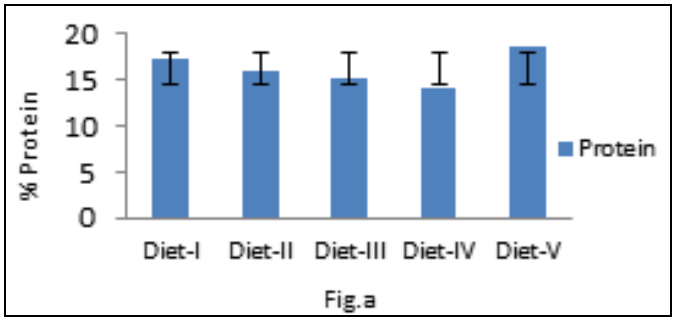

Fig 1: Effect of diets on the Protein content of *H. emphysetum*

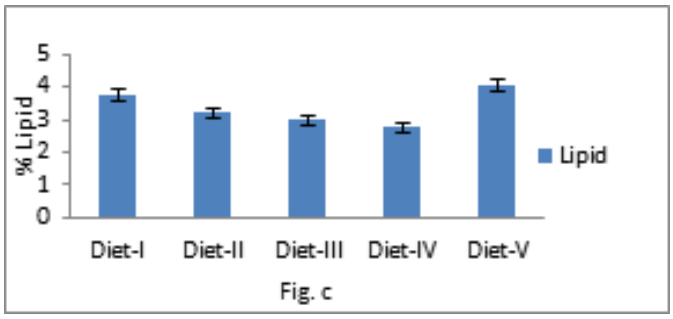

Fig 3: Effect of diets on the Lipid content of *H. emphysetum*

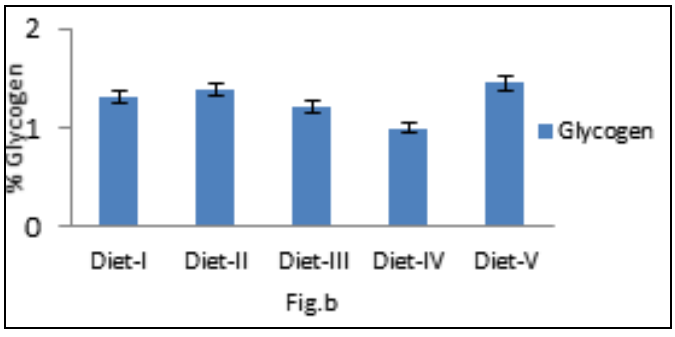

Fig 2: Effect of diets on the Glycogen content of *H. emphysetum*

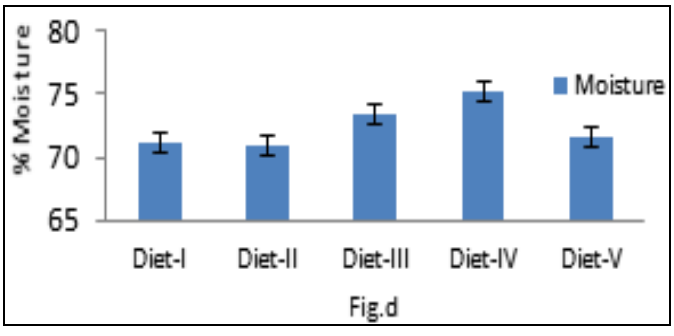

Fig 4: Effect of diets on the Moisture content of *H. emphysetum*

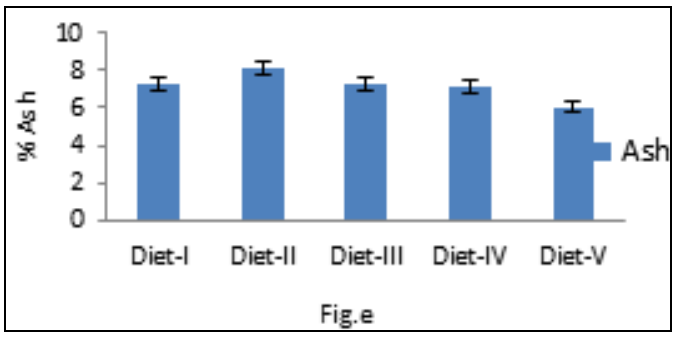

Fig 5: Effect of different diets on the Ash content of *H. emphysetum*

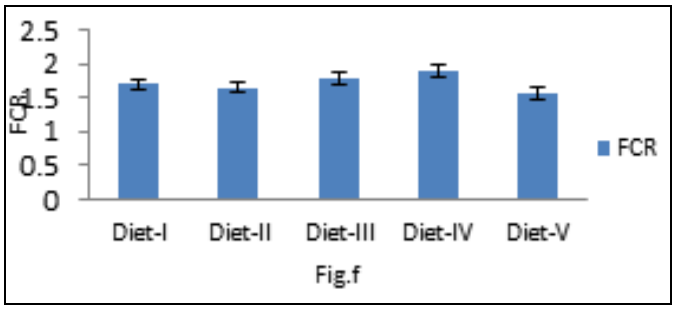

Fig 6: Effect of diets on the FCR of *H. emphysetum*

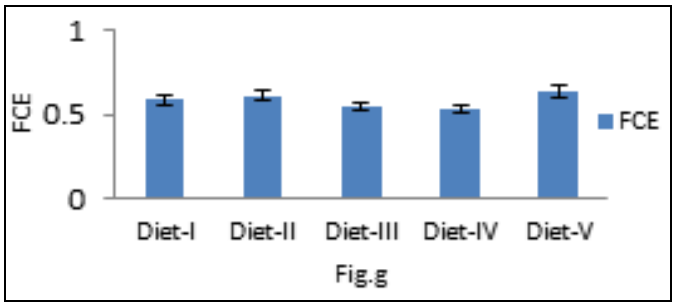

Fig 7: Effect of diets on the FCE of *H. emphysetum*

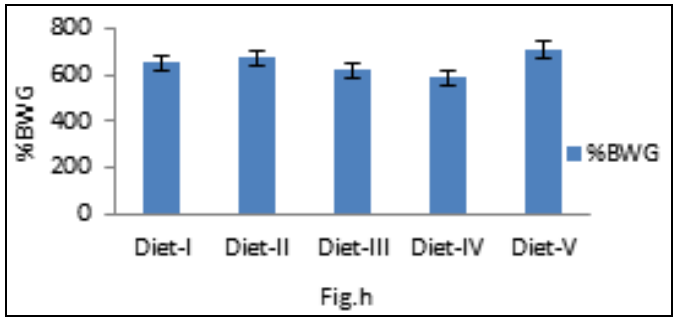

Fig 8: Effect of diets on the % BWG of *H. emphysetum*

Conclusion

From the study undertaken, it can be concluded that best results in terms of nutritional status (protein, glycogen, lipid, ash and moisture) and growth parameters (percentage weight gain, food conversion ratios, feed conversion efficiency, survival rate) were observed in the investigating species when they fed with combined feed (i.e. Diet- V) rather than individual feeds. It can therefore be concluded that combined diets prove to be better nutrient sources as compared to individual diets.

Acknowledgement

The authors are thankful to the Head of the Department of Zoology and Dr. G.D. Singh, Scientist-E IIIM, Jammu for providing the necessary laboratory facilities.

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