Effect of Different Protein Levels on the Juvenile Prawn with Special Reference to *Penaeus indicus*

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**Abstract:** *Penaeus indicus* is probably the best known species among penaeids or even among shrimps. The present study was carried out to investigate the quantitative analysis of protein, lipid, carbohydrate, food conversion ratio (FCR), net growth efficiency of *p.indicus* under the laboratory condition. Results recorded values of protein (Max-70.21 and min-68.17%), carbohydrate (Max-3.55 and min-2.82%) and lipid in (Max-17.28 and min-16.03%). Assimilation efficiency like higher in 82.67g and lower in 67.48 g. The net growth efficiency was higher in 20.83g and lower value in 19.16g. The food conversion ratio (FCR) was higher in 2.12 and lower in 1.63. This study concluded that the AM2 experiment is very good result for the proximate composition other than AM1, AM2 and AM3.

**Key words:** Assimilation efficiency %Carbohydrate %Food conversion ratio (FCR) %Lipid %*P.indicus* %Protein

**INTRODUCTION**

The overall production of a shrimp in culture system depends upon the quality of feed used and also the imprudent in nutritional formulation, water management, pond bottom management and food management etc. Protein is the principle nutrients in the diet of shrimp. Recently, aquaculturists have been showing interest in developing technologies to induce prawn growth by feeding supplementary diets enriched with various feed additives and growth promoters.

Proteins are major nutrients present in many feed ingredients of both plant and animal origin and are normally the most expensive ingredients in artificial diets for both aquatic and terrestrial animals [1]. To facilitate maximum growth and reproduction animals require an optimal level of protein in their diet [2]. The optimal level of dietary protein will vary with the dietary characteristics (digestibility and biological value of protein), animal size, age and species, as well as temperature and salinity [2]. Crustaceans and other aquatic animals generally require higher levels of proteins than do most terrestrial animals [3]. Protein functions are promotion of growth, production of metabolic and digestive enzymes and blood proteins, production of hormones, antibody and building up the body defenses against body infection. Fed the diets formulated to contain significant levels of land animal protein ingredients [4, 5]

Carbohydrates serve as an inexpensive energy source in shrimp diets. Starches, sugars and fiber are the main forms of carbohydrates. Organisms differ in their ability to use carbohydrates as an energy source. Carbohydrates are one of the major energy sources in diets besides proteins and lipids and are an important energy store in plants [6,7]. They can be found in abundance in many plant-based ingredients and have a molecular structure based upon carbon, hydrogen and oxygen [8].

Lipids, or fats, are a group of organic compounds that include free fatty acids, phospholipids, triglycerides, oils, waxes and sterols. Lipids function as an important energy source for shrimp. In addition to their value as an energy source, lipids serve as a source for essential fatty acids. Fatty acids are chain-like organic molecules with many repeating units. Each “link” in the chain contains a carbon atom. Ether or benzene and which represent a major nutrient source for crustaceans [1, 9, 10] on the balance of essential amino acid (EAA) deserves some attention since it led to the conclusion that short necked clam protein is the best protein fitting the requirements of *P. japonicus* or, in other words, the protein with best EAA profile. Formulation of well balanced diet and adequate
feeding are the most important requirement of successful farming. A well balanced diet containing diet contains all the essential nutrients in the right proportion in higher production improve recovery from diseases and strength to overcome the effects of environment stress.

The present study was carried out to investigate the quantitative analysis of protein, lipid, carbohydrate, food conversion ratio (FCR), net growth efficiency of *p.indicus* under the laboratory condition.

**MATERIALS AND METHOD**

The river Vellar estuary flowing on the southeast coast of India originates in the Shervaroyan Hills of Salem District (Tamil Nadu, South India). After meandering through a distance of 480 kms, it forms the estuarine system at Parangipettai (formerly known as Porto Novo), before it joins the Bay of Bengal. The Vellar estuary (lat. 11° 29’N and long. 79° 46’E) is always open with the Bay of Bengal and is said to be a “true estuary” as there is no complete closure of the mouth.

**Ingredients of the Test Diet:** In the present study four types of test diets with different percentage composition of protein (35, 40, 45 and 50%) were formulated in the laboratory by utilizing the cheap and indigenously available ingredients such as cephalopod meal, fish meal, prawn head meal, ground nut oil cake and rice bran. In addition, tapioca flour was also used both as binder and also as a source of carbohydrate. To fortify the diet, formulations with vitamins and minerals were added. Apart from the ingredients, in order to make up the desired protein level of the presently formulated diets, trace levels of egg albumins was also added. The percentage composition of the ingredients is given in table 1.

**Biochemical Analysis:** The biochemical constituents like protein, lipid, carbohydrate and the moisture content were estimated by the following standard method.

**Protein:** Protein was estimated spectrophotometrically following modified Burette method, using BSA (Bovine serum Albumin) as standard [11].

\[
\text{Percentage of protein} = \frac{\text{Optical density × standard value}}{\text{Weight of tissue taken}} \times 100
\]

**Carbohydrate:** Carbohydrate was estimated spectrophotometrically using phenol sulphuric acid method [12].

\[
\text{Percentage of protein} = \frac{\text{Optical density × standard value}}{\text{Weight of tissue taken}} \times 100
\]

**Lipid:** Total lipid was estimated gravimetrically, after extraction with chloroform-methanol mixture 2:1 [13].

\[
\text{Percentage of fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100
\]

**Moisture:** The moisture content was estimated gravimetrically after drying at 60 ± 2°C for 24 hours.

\[
\text{Percentage of moisture} = \frac{\text{Weight of the wet tissue} - \text{weight of the dried tissue}}{\text{Wet weight of the tissue taken}}
\]}
Physical Evaluation

Water Stability of Diets: The weight pellets of the formulated diet were kept in 1 liter trough containing filtered sea water at different salinities such as 0, 5, 10, 15, 20, 25, 30 and 35 ppt, for 12 hours and dry weight loss of the diet was calculated at the end.

Sinking Rate of Diet: The sinking rate of the diets was determined in a measuring jar of 1 liter capacity. Ten pellets of about 5mm size were gently dropped in to the water individually and the time taken by each to travel the known dept of water was noticed using a stop watch. The average time taken by each diet was calculated separately table 3.

Experiments: Juveniles of *p.indicus* were collected from the Vellar estuary and transferred to the laboratory. The most active juveniles were selected for the feeding experiment and length as well as weight was measured initially. Animals were maintain at 27 ppt salinity, 4.6 to 5.0 ml in dissolved oxygen, 27 to 28°C in temperature and 8.0 to 8.1 in pH through out period of experiment. The left over the feed and faecal matter were collected regularly to keep a record of food consumption.

Food Conversion Ratio: The food conversion is calculated using the formula

\[
FCR = \frac{\text{Food in taken (Dry wt. in gms)}}{\text{Weight gain (wet wt. in gms)}}
\]

Assimilation Efficiency: Assimilation efficiency for the formulated diets is expressed as follows.

\[
\text{Assimilation efficiency} = \frac{\text{Assimilation}}{\text{Food conversion}} \times 100
\]

Gross Growth Efficiency: Gross growth efficiency (K1) was expressed as percentage by given formula,

\[
K_1 = \frac{\text{Production}}{\text{Consumption}} \times 100
\]

Net Gross Efficiency: Net gross efficiency was expressed as a percentage by the given formula,

\[
K_2 = \frac{\text{Production}}{\text{Assimilation}} \times 100
\]

Whereas, assimilation were calculated by Consumption - Faecal output

Relative Growth Rate:

\[
P/W.20/28
\]

Whereas,

P- Production

\[W_i, \text{Initial weight}\]

20- Total number of animals

28- Number of days

Consumption Efficiency:

\[
C/W1/20/28
\]

Whereas,

C- Consumption

\[W_i, \text{Initial weight}\]

20- Total number of animals

28- Number of days

RESULTS

Results from the feeding experiments showed that all the experimental prawns accepted the diets and survived difference in growth rate was showed between the formulated diets, *ie.* AM1, AM2, AM3 and AM4. The rate of the growth in terms of both length and weight was maximum when fed with diet AM2 they added 339.1 mg to their initial wet weight of 72 mg and grown 19.25 mm more to their initial length of 23.95 mm. But in other diets only 463.75 mg, 407.22 mg and 404.03 mg of wet weight and 17.4 mm, 17.4 mm and 16.75 mm of total length was gained for the diet AM1, AM3 and AM4 respectively (Table 2).

Assimilation Efficiency: Results of assimilation efficiency was averaged 82.67% for the diet AM2, followed by be 76.62%, 71.91% and 67.48% for the prawn fed with the diet AM1,AM3 and AM4 respectively (Table 2).

Table: 1: Percentage composition of test diets

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Ingredients</th>
<th>AM1</th>
<th>AM2</th>
<th>AM3</th>
<th>AM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Octopus meal</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Prawn head meal</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Ground nut oil cake</td>
<td>10</td>
<td>10</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Fish meal</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Tapico flour</td>
<td>40</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>6</td>
<td>Rice brawn</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Egg albumin</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Vitamine and mineral</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Total 100 100 100 100

Note: AM1, AM2, AM3, AM4 is the test diets in experiment.
Table 2: Dry weight balance of *P.indicus* fed with different diets (values are expressed in gm dry wt/animal)

<table>
<thead>
<tr>
<th>Experimental diet</th>
<th>Initial wt.(w1)</th>
<th>Final wt.(W2)</th>
<th>Mean wt.(W3)</th>
<th>Production (P=W2-W1)</th>
<th>Food consumed (F)</th>
<th>Faecal output (C)</th>
<th>Assimilation (A=C-F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM1</td>
<td>0.0202</td>
<td>0.1137</td>
<td>0.0670</td>
<td>0.0935</td>
<td>0.586</td>
<td>0.137</td>
<td>0.449</td>
</tr>
<tr>
<td>AM2</td>
<td>0.0202</td>
<td>0.1151</td>
<td>0.0677</td>
<td>0.0948</td>
<td>0.554</td>
<td>0.096</td>
<td>0.458</td>
</tr>
<tr>
<td>AM3</td>
<td>0.0202</td>
<td>0.1026</td>
<td>0.0614</td>
<td>0.0824</td>
<td>0.598</td>
<td>0.168</td>
<td>0.430</td>
</tr>
<tr>
<td>AM4</td>
<td>0.0202</td>
<td>0.1019</td>
<td>0.0611</td>
<td>0.0817</td>
<td>0.618</td>
<td>0.201</td>
<td>0.417</td>
</tr>
</tbody>
</table>

Table 2 continued …

<table>
<thead>
<tr>
<th>Experimental diet</th>
<th>Metabolism (R=A-P)</th>
<th>Relative growth rate (P/W/28)</th>
<th>Assimilation efficiency (A/C)(%)</th>
<th>Gross growth efficiency (K1=P/C)(%)</th>
<th>Net growth efficiency (K2=P/A)(%)</th>
<th>Consumption efficiency (C/W/28)</th>
<th>FRC (Dry food consumed Wet weight gain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM1</td>
<td>0.3555</td>
<td>0.0498</td>
<td>76.62</td>
<td>15.96</td>
<td>20.82</td>
<td>0.312</td>
<td>1.76</td>
</tr>
<tr>
<td>AM2</td>
<td>0.3632</td>
<td>0.0500</td>
<td>82.67</td>
<td>17.11</td>
<td>20.70</td>
<td>0.292</td>
<td>1.63</td>
</tr>
<tr>
<td>AM3</td>
<td>0.3476</td>
<td>0.0479</td>
<td>71.91</td>
<td>13.78</td>
<td>19.16</td>
<td>0.348</td>
<td>2.04</td>
</tr>
<tr>
<td>AM4</td>
<td>0.3353</td>
<td>0.0477</td>
<td>67.48</td>
<td>13.22</td>
<td>19.59</td>
<td>0.361</td>
<td>2.12</td>
</tr>
</tbody>
</table>

Note: wt- weight

**Gross Growth Efficiency:** The gross growth efficiency was found to be higher in the prawns fed with the diets AM2 (17.11%), followed by 15.96%, 13.78% and 13.22% for the prawn diet AM1, AM3, AM4, respectively.

**Net Growth Efficiency:** The net growth efficiency was found to be higher for the prawn feed with the diet AM1 (20.83%) than the other diets. It was found to be 20.70% and 19.59% for the diet AM2 and AM4 respectively. The lowest value (19.16%) was recorded in the prawn fed with the diet AM3.

**Food Conversion Ratio (FCR):** The food conversion ratio was found to be level, i.e. 1.63 for the prawn fed with the diet AM2. It was found to be 1.73, 2.04 and 2.12 for the prawn feed with diet AM1, AM3, AM4, respectively.

**DISCUSSION**

In the present investigation, the test diets were formulated with locally and cheaply available various ingredients (Table 1) recommended by previous workers. Deshimaru. and Shigueno [14] reported that the squid meals is an effective protein source for prawn feeds and its amino acids composition was found to be similar to that the prawn. Venkataramiah *et al.* [15] reported that the presence of vegetable matter enhance the food conversion of the prawn *P.aztecus*. Balazs and Ross [16] used multi protein diets containing both plant and animal matter which produced good result. Qasim [17] suggested the use of oil cakes as direct manure in the polyculture pond of fish and prawns. In the present study, the maximum growth in terms of both length and weight was recorded in the diet containing 40% basal protein. Similar trend was observed by other investigators [15, 18-20] who stated that fount that *P.setiferus, P.aztecus and P.indicus* required diets containing about 40% protein for favorable growth (Table 4).

Formulated dry feeds have shown that abalone can efficiently digest highly concentrated protein and carbohydrate, but that their ability to utilize high levels of fat is limited [21-23].

In the present study, the assimilation efficiency was 82.67% in the test diet, AM 2 which containing 40% protein. This result is supported by the observation of [24] in *Metapenaeus monoceros*, which was fed with esturine detritus (89.21%-96.84%) and the observation of Raghunathan and Ajmal Khan [25] in *P.indicus* post larvae fed with pelletized diet, where the assimilation efficiency was 86.57% and also to the result of Sambasivam and Krishnamurthy [26] and Sumitra vijayaraghavan et al. [27] on prawn *P.indicus* and *Metapenaeus monoceros* feed with mangrove foliage and white fish meal. The present observation is also comparable to the findings of Sambasivam [28], who recorded a assimilation efficiencies of 80.62% in *P.indicus* fed with diet having more than 60% protein and 73.48% when fed with diet having 35% protein content.

The gross growth efficiency (k1) and the net growth efficiency (K2) of the present investigation were 13.22-17.11% and 19.16- 20.82%, respectively. Generally, in all the crustacean assimilation efficiency is high [24] and gross and net growth efficiency is close to each other. Welch [29] Postulated that carnivores and detrivores possess low assimilation efficiency and higher values. [30] obtained the ranging k1 values from 29.67% to 45.90% and K2 from 29.86 to 52.07% in *M.monoceros* fed a decapsulated brine shrimp cyst. Sambasivam and Krishnamurthy [26] also reported high gross efficiency of 9.14 - 27.42% in *P.indicus* fed with mangrove foliage. Similarly with gross efficiency in *M. monoceros* fed with decomposed mangrove leaves.
Relative growth in the present investigation was varied from 0.0477-0.0500 which are higher than the finding of Sumitra vijayaraghavan et al. [27] who reported 0.008-0.0106 for *M. monoceros* fed with whitefish meal. Sumitra vijayaraghavan et al. [27] also reported high relative growth rate (0.0102 to 0.0366) in *M. monoceros* fed with decomposed mangrove leaves. Sambasivam and Krishnamurthy [26] reported the higher relative growth rate as 0.0708 in *P. indicus* fed with mangrove foliage.

The low food conversion ratio indicates high efficiency in the present study, the lower food conversion ratio of 1.63 was recorded in the diet AM2. The present investigation is comparable to the result of Vaitheeswaran and Ahanmed Ali [31] who conducted feeding experiments in *P. japonicas* using growth promoting agents and obtained FCR values ranging from 1.61 to 4.30 and also to the findings of Raghunathan and Ajmalkhan [25] who reported in post larvae of *Penaeus indicus* fed with hormone incorporated diets; their FCR values ranging from 1.89 to 3.37.

The water stability test suggested that the present composition of the diets can be used effectively in the formulation of pellets of varying sizes depending on the need of experimental animals. This investigation is in accordance with the good water stability of the diets described by Balazs et al. [32].

In the present study the growth rate was increased upto 40% dietary protein levels. According to Lee [33], the optimal dietary protein level was 40 to 50% in *P. monodon*. Food conversion was observed in the present study the diet containing 40% protein. Colvin [19] also stated that there was a decline in weight gain with successive increase in dietary protein which supported the present result where weight gain decreased in the diet containing 45 and 50% protein. In conclusion, the results from the experiment indicate that the artificial formulated diet containing 40% protein at 45 and 50% protein. In conclusion, the results from the experiment indicate that the artificial formulated diet containing 40% protein is beneficial for the prawn *P. indicus* and that animal could be raised to the desired size with a high growth rate and less feed with high efficiency.

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REFERENCES


