CHAPTER - III

FEED UTILIZATION ON GROWTH

3.1. Introduction

In aquaculture industry, animal growth and survival rates play a vital role. Animal growth is influenced by internal nutrition and external environment factors. The freshwater prawns *M. malcolmsonii* and *M. rosenbergii* are suitable for culture as they grow to the marketable size reaching an average weight of 40 - 70 g in 6 months (Kannupandi, 1995). The prawns can receive substantial nutritional benefit from natural foods at relatively low biomass densities at higher production rates; especially large, high value individuals may be more dependent on prepared diets (Tidwell et al., 1997). Under natural condition, *M. rosenbergii* is an omnivore, feeding on various plant and animal materials (Balazs and Ross, 1976). An appropriate feeding is a major factor behind the success in aquaculture. Shang and Fujimura (1977) and FAO (1986) estimated feed cost to account for about 13 - 27% of the total annual cost of production in *M. rosenbergii*. Protein, being an important dietary constituent among animals, directly influences the formulation of diet and consequently affects the cost of production. The quality and quantity of dietary protein strongly influence growth rate in fishes (Love, 1980; Wilson and Halver, 1986). Data on the nutritional requirements of *M. rosenbergii* are scarce. Several workers have tried to develop artificial diets capable of sustaining good growth using a variety of foodstuffs (Kanazawa et al., 1970; Cowey and Forster, 1971; Deshimaru and Shegino, 1972; Sick et al., 1972; Andrews et al., 1972; Balazs et al., 1973; Venkataramiah et al., 1975; Balazs and Ross, 1976; AQUACOP, 1976; Zein-eldin and Corliss, 1976; Sedgwick, 1979; Boonyaratpalin and New, 1980; Bartlett and Enkerlin, 1983; Das et al., 1996; Venkataramani et al., 2002; Anh et al., 2009). All plant protein supplements are being used to some extent in aquaculture feeds. Of all plant protein supplements, soybean meal has been the most extensively evaluated and most
commonly used in commercial aquaculture feeds. There are limitations in our knowledge of nutrition of aquatic species. The comparison of various nutritional studies are complicated by differences in research methodology such as size and physiological state of the animal, diet composition and processing environmental conditions, and experimental facilities. The reliability of data is also dependent on growth rate, survival rate, and feed conversion ratios (Guillaume, 1997; Tacon and Akiyama, 1997; Millikin et al., 1980; Castell et al., 1989) studied the survival and metabolism by the using wide variety of locally available feedstuffs including commercial by-products as ingredients in formulated diets.

The survival rate of *M. rosenbergii* larvae and post-larvae is highly variable among facilities (Sandifer et al., 1975; Limpadanai and Tansakul, 1980). Antimicrobial and antistress effects of herbal products significantly increased the survival rate of tiger shrimp *P. monodon* larvae (Citarasu et al., 2002). Herbs as feed supplement have the characteristics of growth promoting ability, tonic to improve the immune system, anti-microbial activity, stimulating appetite and anti-stress characters due to the active principle natures, such as alkaloids, flavanoids, pigments, phenolics, terpenoids, steroids and essential oils, which are of immense use in the culture of shrimps (Citarasu, 2009). The Herbal based diet significantly increased the growth and biomass in *M. rosenbergii* and *P. monodon* (Kesavanth and Jeyaram, 1998; Citarasu et al., 2002).

Plants are the storehouses and rich sources of safer and cheaper chemical compounds. These natural plant products have been reported to have various activities like anti-stress, growth promoters, appetizer, tonic, immunostimulants and antimicrobials (Citarasu, 2002). Some studies have confirmed that the application of a diet with herbal adjuvant has a positive impact on animal health and disease resistance, and also improves their growth rate (Kim et al., 1998; Lee...
et al., 2001; Jian and Wu, 2004; Citarasu et al., 2003). It has also been determined that these can improve the metabolism of fats and their utilization (Ji et al., 2007).

In this chapter, effects of medicinal herbs (C. dactylon, M. oleifera and L. aspera) supplemented diets on growth parameters, such as survival, weight gain, length gain, specific growth rate and condition factor, feed utilization parameters, such as feed conversion ratio, conversion efficiency, protein conversion efficiency, digestibility, metabolizable energy and gross energy of M. rosenbergii PL have been studied.

3.2. Materials and Methods

Growth, Digestibility and Metabolism

A 60 days experiment was contacted in the laboratory and to assess the growth performance, feed and feed utilization of the freshwater prawn, M. rosenbergii PL. PLs were randomly divided into 10 groups with 25 PLs in each group (n = 25 prawns/group). They were assigned to three treatments (0.5%, 1.0% and 1.5% for each herbal supplement) with three replicate (n=3) per treatment. Group 1 was considered as control fed with basal diet. Group 2 to 10 was fed with basal diet supplemented with different herbal supplements, C. dactylon, M. oleifera and L. aspera. For these 25 PLs (initial weight (0.12 ± 0.02 g) and length (1.60 ± 0.22 cm) were kept in each plastic trough of 25 liter capacity.

The following parameters were analyzed: Survival Rate (SR), Weight Gain (WG), Specific Growth Rate (SGR), Condition Factor (CF) and Feed and feed utilization parameters: Feed Conversion Ratio (FCR), Conversion Efficiency (CE), Protein Conversion Efficiency (PCE), Digestibility (D), Metabolizable Energy (ME) and Gross Energy (GE) were determined at the final day of feeding schedule were measured and calculated following formula.
1. Live weight gain (g) = \(W_2 - W_1\)

2. Length gain (cm) = Final length (cm) – Initial length (cm)

3. Specific growth rate (SGR % g d\(^{-1}\)) = \(\frac{\ln W_2 - \ln W_1}{t} \times 100\)

4. Condition factor (CF) = Weight x \(10^3 / L^3\) (Weight may be given in g and length in mm)

5. Survival Rate (SR %) = Final prawn no. / initial prawn no. \times 100

6. Feed conversion ratio (FCR) = Feed given (Dry wt. g)/ body weight gain (Wet wt. g)

7. Conversion efficiency (CE)
   \[\text{CE} = \frac{\text{Body weight gain (g)/feed given (dry wt. g) \times 100}}{W_2 - W_1}/ \text{feed given} \times 100\]

8. Protein conversion efficiency (PCE) = prawn protein gain (g)/ protein intake (g) \times 100

9. Quantitative method for digestibility calculation
   \[D\% = (1 - F/R) \times 100\]

10. Gross energy GE (kJ g\(^{-1}\))
    \[= 0.2364 \times \text{protein (\%)} + 0.3954 \times \text{fat (\%)} + 0.1715 \times \text{carbohydrates (\%)}\]

11. Metabolizable energy (ME)
    \[= 0.173 \times \text{protein (\%)} + 0.356 \times \text{fat (\%)} + 0.125 \times \text{carbohydrates (\%)}\]

   Where,
   \[W_2 = \text{Final weight (g)}, \quad W_1 = \text{Initial weight (g)},\]
   \[F = \text{feces excreted}, \quad R = \text{feed ration}, \quad t = \text{Duration of experiment in days.}\]

3.3. Results and discussion

The growth gained by the *M. rosenbergii* PL after 60 days varies in herbals supplemented feeds (Table 3.1). The PL fed with herbal supplemented diets showed with *C. dactylon* (particularly at 0.5%) has gained maximum growth (final weight gain, \(2.39 \pm 0.07\) g and final length gain, \(4.68 \pm 0.06\) cm) followed by *M. oleifera* (final weight gain, \(2.20 \pm 0.08\) g and final...
length, 4.45 ± 0.12 cm) (1.0%) and *L. aspera* (final weight gain, 2.13 ± 0.04 g and final length gain, 4.35 ± 0.12 cm) (1.0%). The PL fed with control diet gained lower growth (weight, 1.62 ± 0.06 g and length 3.44 ± 0.10 cm) when compared with other diets fed PL. However other growth parameters such as specific growth rate, condition factor and survival rate were found to be better in herbal supplemented diets fed PL when compared with control. Among three herbs used, the PL fed with *C. dactylon* showed the maximum performance (3.98 ± 0.11, 39.93 ± 0.69, 72.00 ± 4.00), particularly at 0.5% followed by *M. oleifera* (3.66 ± 0.13, 38.32 ± 1.37, 68.00 ± 6.93) at 1.0% and *L. aspera* (3.54 ± 0.07, 37.76 ± 0.19, 66.67 ± 6.11) at 1.0%. The feed utilizations parameters such as FCR, CE, PCE, D, ME and GE (Table 3.3.1). These utilizations were found to be better in herbal supplemented diets fed PL when compared with control. Among three herbs used, the PL fed with *C. dactylon* (0.5%) showed the maximum performance followed by *M. oleifera* (1.0%) and *L. aspera* (1.0 %).

In this study herbal (*C. dactylon, M. oleifera and L. aspera*) supplemented feeds fed *M. rosenbergii* PL showed improved survival, growth and feed utilization. It has been reported that Nutripro-aqua, herbal based diet significantly increased the growth and biomass in *M. rosenbergii* (Kesavanth and Jeyaram, 1998). The methanolic herbal extracts (*S. trilobatum, A. paniculata* and *P. corylifolia*) were helped to increase the survival, growth and reduced the bacterial load in the shrimp, *P. monodon* post larvae. Particularly the herbal extracts of *A. paniculata* performed well in the control of bacterial load in the various bacterial pathogens inoculated *P. monodon* post larval culture media (Citarasu *et al.*, 2003). Commercially available herbal products, stressol-I- and stressol-II-enriched *Artemia* nauplii fed with *P. indicus* post larvae (PL 10–20) significantly increased the growth and reduced the osmotic stress (Chitra, 1995). Another herbal product, Tefroli contains ingredients, such as *Tephrosia purpurea,*
Eclipta alba, Phyllanthus niruri, A. paniculata, Ocimum sanctum and Terminalia chebulam has improved the survival, growth and moulting efficiencies in *P. monodon* PL when fed with enriched Artemia (Citasasu, 2009). Various herbal products such as *Hygrophila spinosa, Withania somnifera, Zingiber officinalis, Solanum trilobatum, A. paniculata, Psoralea corylifolia, Eclipta erecta, Ocimum sanctum, Picrorhiza kurooa, Phyllanthus niruri, Tinospora cordifolia, purified Silajit* and cod-liver oil have the characteristics of growth promotion, anti-stress, immune stimulation, and anti-bacterial activities in the *Penaeus* larviculture (Citasasu et al., 1998, 2002). Livol (IHF-1000) is a herbal growth promoter containing different plant ingredients, such as *Bohaevia diffusa, Solanum nigrum, Terminaelia arjuna, Colocynth* and black salt has been found to promote growth and weight gain in *P. indicus* (Sambhu and Jayapraks, 2001).

Maheshappa, (1993) studied the effect of Livol (IHF-1000) on the rohu, *Labeo rohita*, and the Livol incorporated diets stimulated digestive enzyme activity and led to increased consumption. Papaya leaf meal contains an enzyme, papain, which increases protein digestion, food conversion ratio, specific growth rate and weight gain in the 16% unsoaked papaya meal diet which was fed to *P. monodon* postlarvae (Penaflorida, 1995). The dietary ginseng herb (Ginsana G115) greatly enhanced the growth performance, diet utilization efficiency and haematological indices in the Nile tilapia, *Oreochromis niloticus*, fingerlings (Ashraf and Goda, 2008).

The survival, growth, feed utilization promoting effects of herbal incorporated feeds observed in this study clearly indicates a significant increase in total weight gain; particularly in 0.5% *C. dactylon* supplemented feed fed prawns. This was followed by *M. oleifera* (1.0%) and *L. aspera* (1.0%) supplemented feed fed prawns. This increase in specific growth rate may be due
to enzymatic breakdown of food, availability of nutrients for absorption (Das et al., 1987) and increased secretion of enzymes in the stomach and intestine (Maheshappa, 1993; Shadakshari, 1993). Moreover, it may also be due to the increase in the level of RNA/DNA ratio in the muscle and hepatopancreas which leads to protein synthesis resulting in enhanced growth (Mathers et al., 1992). Therefore, in the present study the overall performance of herbal supplemented diets on survival, growth and production of *M. rosenbergii* PL were appreciable. Hence it is suggested that *C. dactylon, M. oleifera and L. aspera* can be supplemented in artificial feed formulations.

### 3.4. Conclusion

In this chapter an interesting observation was documented in the herbal supplemented feed fed PL. Among the three plants, *C. dactylon* supplemented feed fed PL showed better results when compared to that of *M. oleifera, L. aspera* and control diet. So, this study proved that these herbs influence on the growth of *M. rosenbergii* PL.