



Nutritive evaluation in Indian white shrimp (*Fenneropenaeus indicus*) fed with different feed

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ABSTRACT

The present study was made an attempt to identify the biochemical constituents such as protein, carbohydrate and amino acids in *Fenneropenaeus indicus* tissue and hepatopancreas. The growth rate of *F. indicus* was identified with three types of feed habits *via.*, live feeds *Artemia*, algae (*Chlorella* sp.) and artificial feed (pellet) inducing the total growth rate was measured by weight biomass. The level of protein, carbohydrate and amino acids content of tissue and hepatopancreas in *F. indicus* were found maximum in *Artemia* feed. The *Artemia* (live feed) resulted better growth and high content of biochemical constituents of the shrimp *F. indicus* when compare of the other feed.

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Introduction

Good quality nutrition in animal production systems is essential to economically produce a healthy, high quality product. Aquaculture has been the fastest growing sector of global food production for more than three decades, growing at an average compound rate of approximately 8.7% since the early 1970's (Tacon, 2004). Over the same period, landings from wild capture fisheries have remained virtually static (1.2% per year) and according to some sources may in fact already be declining (Anon, 2003). Growth in the terrestrial meat production sector has only been marginally better 2.9% per year (Tacon, 2003). Over 50% of capture fisheries are now almost fully exploited and 70% are listed as in need of urgent management (Anon, 2003; Allen, 2004). For this reason capture fisheries are unlikely to make major contributions to fisheries landings in the future. As in, total world aquaculture production reached approximately 51.4 million metric tones (mmt) in 2002 or more than half the amount produced by global capture fisheries (FAO, 2004; Tacon, 2004). By region aquaculture production was highest in the developing Asian countries (especially china), which are now responsible for over 90% of total aquaculture production valued at \$49.3 billion (Tacon, 2004). Growth in world aquaculture is being driven primarily by population growth, which is predicted to reach about 8 billion by 2030 (Tacon, 2003). Fish remains one of the most important sources of protein accounts for approximately 25% of total protein intake. In contrast consumers in Europe and North America, who have access to a greater variety of protein sources through terrestrial agriculture, consume as little as 10% of their protein as fish (Allan, 2004).

A food protein with an amino acid profile similar to that of prawns is the most successful (Deshimaru and Shigueno, 1972; Akiyama *et al.*, 1992; Chen *et al.*, 1992; Millamena *et al.*, 1996; Govindasamy and Kannan, 2006). However, the carbohydrate energy associated with the protein in the diet played an important role in the survival rates. Growth also depends on the physical characteristics of feeds, attractiveness and feeding. Poor

diet performance is commonly attributed to lack of stability in water and to slow delivery of nutrients to prawns resulting in loss of nutritional value (New, 1976; Lee and Wickins, 1992; Cuzon *et al.*, 1994). The variety of live feeds namely micro algae, flagellates, yeast, rotifers, copepods, plankton, brain shrimp (*Artemia*) nauplii and fertilized oyster or mussel eggs has been used to feed shrimps during their protozoan, mysis, post larval stages (Kittaka, 1975; Liao, 1983). A number of studies on the effects of live feed (micro algae, *Artemia*) on the growth, survival and biochemical changes of cultured species, mostly relating to the commercially dominant cultured species (Adnan, 1992; Mura *et al.*, 1999; Liu, 2002; Govindasamy and Kannan, 2006; Brown *et al.*, 2007; Arulvasu and Munuswamy, 2009). Therefore this study, aimed to nutritive evaluation the food consumption of marine shrimp *F. indicus* in three feeding trials were conducted using *Artemia*, algae and commercial pellet feed and studying the effect of the biochemical profile changes and growth of marine shrimp *F. indicus*. Biochemical changes of *F. indicus* muscle and hepatopancreas by using different feed like algae (*Chlorella* sp.), *Artemia* and artificial pellet diet.

Materials and Methods

Collection and maintenance

F. indicus (Indian white shrimp) used in the experiment were collected from the mangrove forest, Tuticorin coast (Lat: 8°51'N and Long: 78°13'E) Tamilnadu in India and transported to the laboratory in polythene bags containing oxygenated water. The experiment was carried out at in our Department. The collected shrimp were transferred into aquaria tank and underwent a one month acclimatization period, fed with formulated diet (FD) at satiation level twice a day at about 8: 00am and 8: 00pm. During the experiment, shrimp was measured for body length and weight twice a week. Water quality parameters such as temperature, pH, surviving and other micronutrients were measured every day by using standard protocol through the experiment.

Experimental analysis

Sixty shrimps were transferred to a laboratory and acclimated to the basal diet for 28 days at the average weight of (0.51±0.05g). Shrimp was distributed in three experimental treatments from acclimated animals and assigned into six aquaria tank to form 3 experimental groups with different feeding diets of artificial pellet feed, algal feed and *Artemia* feed (equal combination of three diets). Water was changed partially every 3 days and entirely every week. Shrimp of all treatments were fed at a level of 3% of body weight two times a day for 28 days for regular 8.00am and periodical monitoring.

Group I: Artificial pellet feed

Commercial shrimp pellets are used this experiment, Main ingredients of this pellet: fish meal (70.00g), squid meal (2.00g), groundnut oilcake (11.50g), wheat flower (3.50g), tapioca pewter (3.50g), soya meal (4.50g), vitamin mineral mix (2.00g), cod liver oil (2.00g) and Corboxy Methyl Cellulose (1.00g) a total of 100g. For the present study, the control and experimental artificial feed were formulated following square method described by New, (1987).

Group II: Algal culture

The green algae *Chlorella sp.* were grown in semi continuous culture (Reital et al., 1994) at 24°C using 2-liter glass vessels and standard f/2 seawater medium (Guillard, 1975). The culture were kept in closed, glass bottle with stopper placed at a constant light intensity 6μ E m⁻² S⁻¹ at a temperature 23 to 25°C.

Group III: Artemia feed

Artemia have two main advantages; they are live and do not pollute the rearing environment, and they have a high energy content and well suit the nutritional requirements of larvae. Cyst of *Artemia* allowed hatching under optimum hatching conditions (35% S‰; 27°C) in the laboratory. After complete hatching (24 hours), the nauplii were separated, and then used to experiment followed procedure by Treece, (2000).

Static conditions

F. indicus shrimps were kept in aquaria tank (45cm x 30cm x 30cm, 15L volume of water), and each rearing unit was stocked with 10 individuals. The room temperature was controlled by an air conditioner, and water temperature was (25 k 0.5°C). Aeration was provided continuously and 1/2 to 213 of water was exchanged every other day. Seawater used in the experiment was filtered by composite sand filter. During the experiment, dissolved oxygen of water was maintained above 5.5mg⁻¹ pH of water was about 8.0, and the salinity of water was from 30 to 33. Photoperiod of 12 hrs light and 12 hrs darkness was followed.

Analysis of biochemical constituents

Study the biochemical constituents (carbohydrates, protein and amino acids) in tissues and hepatopancreas were estimated standard procedures followed several authors viz., Estimation of carbohydrates (Dubois et al., 1956), estimation of protein (Lowry et al., 1959) and estimation of amino acid (Anderson et al., 1995).

Results

Live feeds (*Artemia*, *Chlorella sp.*) and artificial feed was given to *F. indicus* for a period of 28 days culture and the growth and biochemical composition was estimated in shrimp tissue and hepatopancreas by using live feed (*Artemia* and *Chlorella sp.*) and artificial feed. The protein content of tissue in *F. indicus* was found maximum in the *Artemia* feed (0.173±0.0101mg g⁻¹) followed by algae feed (0.156±0.0024mg g⁻¹) and artificial feed (0.118±0.0018mg g⁻¹). Carbohydrates

content of tissue in *F. indicus* was found maximum in the *Artemia* feed (0.162±0.0017mg g⁻¹) followed by algae feed (0.133±0.0883mg g⁻¹) and artificial feed (0.071±0.0652mg g⁻¹). Further the amino acids content of the maximum in *Artemia* (0.169±0.0604mg g⁻¹) followed by algae feed (0.137±0.0031mg g⁻¹) and artificial feed (0.112±0.0026mg g⁻¹) (Tab. I). The protein, carbohydrate, amino acid content of hepatopancreas in *F. indicus* was found maximum in the *Artemia* feed (protein 0.173±0.0020mg g⁻¹; carbohydrates 0.177±0.0664mg g⁻¹; amino acids 0.162±0.0120mg g⁻¹) followed by algae feed (protein 0.147±0.0037mg g⁻¹; carbohydrate 0.131±0.0016mg g⁻¹; amino acids 0.139±0.0048mg g⁻¹) and artificial feed (protein 0.126±0.0039mg g⁻¹; carbohydrates 0.093±0.0025mg g⁻¹; amino acids 0.071±0.0013mg g⁻¹) (Tab. I). Likewise, the growth was also estimated in the cultured shrimp *F. indicus*. The growth weight was also found maximum when shrimp feed with *Artemia* (0.842±0.0034mg) then followed by algae (0.090±0.007mg) and artificial pellet feed (0.051±0.005mg) (Tab. II).

Discussion

Feeding fish larvae is the most challenging step during the culture of marine fish species. In general, marine fish larvae have reduced size, a small mouth, and incomplete or immature digestive systems. Their natural diet is composed of motile prey organisms and young larvae do not accept inert/dry diets well (Bengtson, 2003). Attempts at replacement of live feed by formulated inert diets during the first feeding of all larvae (those that, when the yolk sac is exhausted, remain in a relatively undeveloped state) has resulted in poor growth performance and high mortality, making the use of live-food organisms practically obligatory for successful culture of early life stages of most marine larvae (Bengtson, 2003). The successes of larval rearing is greatly influenced by first-feeding regimes and the nutritional quality of the diets used, with dietary lipids being recognized as one of the most important nutritional factors that affect larval growth and survival (Izquierdo et al., 2000; Govindasamy and Kannan, 2006). In shrimp larval culture, a variety of live feeds namely micro algae, flagellates, yeast, rotifers, copepods, plankton, brine shrimp nauplii and fertilized oyster or mussel eggs has been used to feed shrimps during their protozoal, mysis, post larval stages (Kittaka, 1975; Liao, 1983). Govindasamy and Kannan (2006) reported the maximum growth rate of brine shrimp with (*Isochrysis galbana* + *tetraeselmis gracilaria*) feeded animals *Artemia parthenogenetica*. Similarly, Sivakumar et al. (2011) reported the maximum growth rate of shrimp with Microalgae (*Chlorella sp.*, *Tetraselmis sp.* and *Isochrysis sp.*) and Cyanobacteria (*Synechococcus sp.* and *Phormidium sp.*) feeded *Penaeus monodon*. Syama Dayal et al. (2011) reported the maximum count level of tiger shrimp with sunflower cake feeded *P. monodon*.

Seenivasan et al. (2011) reported the effect of probiotics, Binifit-TM on survival, growth, biochemical constituents and energy budget of the freshwater prawn *Macrobrachium rosenbergii* post larvae (PL). Therefore, incorporation of this probiotics in aqua feed is stressed for promoting sustainable culture of *Macrobrachium sp.* In addition shrimp larval culture is made more convenient but with variable success through the use of preferred and artificial feeds such as suspensions of fish crustaceans and mollusks (Tacon, 1990; Alikunhi et al., 1990) and microencapsulated or flaked artificial feeds (Kanazawa et al., 1982; Bautista et al., 1989) compared with artificial pellet feed. The shrimp was cultured for one month period. The growth

and biochemical's (protein, carbohydrate, amino acid) increasing with days of culture period. The use of manufactured feeds is not yet possible in the larval and juvenile phases of most marine finfish and crustacean aquaculture (Storrupp, 2003), because poor development of the digestive system in young fish. The biochemical studies of protein, carbohydrates and lipid in to the muscle and hepatopancreas of experimental shrimp *P. monodon* reported on Palani Kumar *et al.* (2011). Biochemical changes and growth performance of black tiger shrimp larvae after using richness communes extract as feed chemical addition reported by Sankar *et al.* (2011). Izquierdo *et al.* (2008) reported effect of green and clear water and lipid source on survival, growth and biochemical composition of Pacific white shrimp *Litopenaeus vannamei*. In similarly, Moss *et al.* (2006) to determine whether shrimp pond water has sparing effect on Vitamines, trace minerals and protein levels in diets fed to juvenile Pacific white shrimp *L. vannamei*. Suryavanshi *et al.* (2009) reported on biochemical changes in penned shrimp, *M. monoceros*.

Live food organisms consumed by the larvae are thought to assist digestion by donating their digestive enzymes. Live food organisms contain a package of enzymes, gut neuropathies, and nutritional growth factors that enhance digestion. These substances are frequently omitted in commercial diets. Moreover, particulate diets for larvae contain protein and other ingredients that are difficult to digest (especially since formulated diets contain 60- 90% dry matter while live feed has only 10%). Use of live algae and *Artemia* nauplii as shrimp larval feed was introduced (Liao *et al.*, 1983). Micro algae play a crucial nutritional role for marine animals in open ocean and consequently in marine aquaculture. Most of the marine invertebrates depend on micro algae as a food for their whole life cycle. The main consumers of micro algae in aquaculture are filter feeders (mainly larvae, juveniles and bloodstock of mollusk), and reared for fish or crustacean larvae (Androne Bastien, 2006). A major review published by Robert and Trintignac (1997) concluded that non-living diets generally give lower growth and higher mortalities when compared to controls fed with live microalgae. These fatty acids are considered to be growth stimulants (Kanazawa *et al.*, 1977). The proportion of these fatty acids in greater quantities in *Artemia* (Leger, 1986) is probably helping shrimps to attain the faster growth and give rich protein source. This statement is now supported by the study *Artemia* adults provide additional benefits as they have been used for induction, reinforcement of sexual maturation and for increasing of fertilization rates (Naessens *et al.*, 1997). *Artemia* have two main advantages; they are live and do not pollute the rearing environment, and they have a high energy content and well suit the nutritional requirements of larvae. Present study is clarify indicated that the unutilized rich source of *Artemia* as a best food in salt pans and lakes in India can be harvested and used as an important ingredient in the preparation of high quality shrimp feeds in aquaculture aspects.

Conclusion

The effects of live feed (*Chlorella* sp. and *Artemia*) on the growth, survival and biochemical changes of cultured shrimp *F. indicus* compared with commercial pellet feed. The growth and biochemical contents such as protein, carbohydrate and amino acid were found maximum in *F. indicus* when fed with *Artemia* feed. *Chlorella* sp. also gives better growth, because vitamin content rich in algae. Live feed is better for growth of shrimp larval culture. Hence, the *Artemia* feed strongly recommended for the better growth of the Indian white shrimp *Fenneropenaeus*

indicus

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Table I. Mean concentration (mg g⁻¹) of protein, carbohydrate and amino acids content in *F. indicus* tissue and hepatopancreas fed with different feed.

Biochemical	Artificial Feed (± SD)	Algae(<i>Chlorella</i> sp.) (± SD)	<i>Artemia</i> (± SD)
Tissue Protein	0.118 ± 0.0018	0.156 ± 0.0024	0.173 ± 0.0101
Carbohydrate	0.071 ± 0.0652	0.133 ± 0.0883	0.162 ± 0.0017
Amino acids	0.112 ± 0.0026	0.137 ± 0.0031	0.169 ± 0.0604
Hepatopancreas Protein	0.126 ± 0.0039	0.147 ± 0.0037	0.173 ± 0.0020
Carbohydrate	0.093 ± 0.0025	0.131 ± 0.0016	0.177 ± 0.0664
Amino acids	0.071 ± 0.0013	0.139 ± 0.0048	0.162 ± 0.0120

Table II. Mean value of growth in weight (mg g⁻¹) of *F. indicus* using different feeds

<i>Diets (feed)</i>	<i>Initial Weight (mg) (W1) (± SD)</i>	<i>Final Weight (mg) (W2) (± SD)</i>	<i>Production P=W2-W1 (± SD)</i>
Artificial (pellet)	0.951 ± 0.029	1.002 ± 0.014	0.051 ± 0.005
(<i>Chlorella</i> sp.)	1.302 ± 0.009	1.392 ± 0.003	0.090 ± 0.007
<i>Artemia</i> feed	1.052 ± 0.0030	1.210 ± 0.0020	0.842 ± 0.0034