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Effect of formulated feed on the biochemical composition of cultured shrimp, *Penaeus monodon* (Fabricius, 1798)

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Abstract
Experimental feed were formulated using locally available ingredients and commercial feeds were bought from market and the quality were studied. An experiment was conducted using both the feeds later these were fed to *P. monodon* and finally compared whole body biochemical composition of shrimp fed by different feeds to assess the quality of the feeds on biochemical cultured shrimp composition. The biochemical composition of the experimental feed fed shrimp showed higher protein, lipid, carbohydrate, fiber, ash and less moisture than commercial feeds. Amino acids composition of shrimps showed higher amount of essential amino acids and fewer amounts of non-essential amino acids and it was high in laboratory made feed. Shrimp meat had significantly higher proportion of unsaturated fatty acids, lower proportion of saturated fatty acids and their content were in the following trend that shrimps fed with laboratory made feed > control feed. It was evident from this study that the crustacean nutritive profiles are influenced by the changes in the nutritional composition of the diet and by changes in the dietary sources.

Keywords: Feed, shrimp, nutritive profile

1. Introduction

Crustacean's meat gained global reception and they are extensively fished and marketed in all the maritime states of India and abroad (Manivannan *et al*., 2010) [57] and apart from their delicacy of shrimp meat it is a major source of nutritious food for human consumption and also has got high biological value compared to protein from many other sources due to easy digestibility (85%) (Dong, 2001) [37]. The worthiness of the seafood to the human beings is to maintain a state of positive health and optimal performance by providing all essential nutrients in adequate quantities to prevent deficiency diseases and also prevent diet related chronic disorders. The deficiency may be minimized for some extent by making available cheaper nutrient rich ingredients which are available to local communities to produce the nutritionally enriched crustaceans (Dinakaran *et al.*, 2009) [37]. There are much studies encouraging crustacean consumption (Barrento Marques *et al*., 2008; Wardiatno and Mashar, 2010) [18, 90].

The nutritive values of crustaceans depend upon their biochemical composition, such as protein, amino acids, lipid, fatty acids, carbohydrate, fibre and ash (Bhavan *et al*., 2010) [22]. The proximate compositions of shrimp muscles are dependent on factors such as species, growth stage, feed, and season (Sikorski *et al*., 1990; Karakoltsidis *et al*., 1995) [78, 47]. Studies on the biochemical composition of edible organisms are important from the nutritional point of view. No much published works are available on the influence of feeds on the biochemical composition of commercial crustaceans in general and shrimps in particular. Hence, the present study was aimed to know the effect of formulated feeds on the organic constituents of commercially valuable shrimp *Penaeus monodon.*

2. Materials and methods

The feed was formulated in the laboratory using trash fishes (50 g) as a major ingredient, 10 g wheat powder, 20 g soybean meal, broken rice 20 g were finely ground with similar particle size. All ingredients were thoroughly mixed and 45 ml of water was added to 100g of dry mixture and mixed well to form dough. Then the dough was steam cooked at 60 -70 °C for 5 minutes to gelatinize the starch. After steaming it was cooled and pressed through a hand pelletizer 1.8 - 2.0 mm, diameter dies and pellets were collected as long strands in trays. The strands were cut into pellets of 3 to 4 mm length. The trays with moist pellets were dried in a hot air oven at 45 °C for 8 hours to reduce the moisture below 10%. After drying, uniform pellets were stored in airtight containers at room temperature as stock feed. Commercially manufactured feeds were bought from the market for comparative analysis.

The feeds were analyzed for their proximate composition as follows: Moisture (AOAC, 1990) [2], protein (Tecator, 1987) [85], lipid (Tecator, 1983 using diethyl ether) [86], total ash content, acid insoluble ash (AOAC, 1990) [2], and fibre (AOAC, 1990) [2]. Carbohydrates (as nitrogen free extract NFE) were calculated by difference. The non-saponifiable lipids of cholesterol were analyzed spectrometrically according to the method of Zlatkis *et al*., (1953) [65]. Caloric content was calculated by multiplying the concentration of various nutrients with conversion factors such as 4.15, 9.4 and 5.65 of carbohydrate, lipid and protein respectively (Phillips, 1969). The caloric values were expressed in calories per gram (cal/ gm) on dry weight basis.

Ten number of PL 20's of *P. monodon* were transferred in to grow out tanks with 500 L capacity with filtered sea water at the level of 100 L at the stocking density of 1 individual for 10 liters maintained at laboratory condition at 28^{o}C prior to the commencement of the experiment for 10 days which was continuously aerated by an air stone connected to an air pump. From 30th day of the culture, the shrimps were fed continuously and growth parameters and feed efficiency were measured throughout the experimental period.

After termination of 140 days feeding trails with two different feeds, the proximate composition of experimental shrimps were determined - Protein (Lowry *et al.*, 1951) [55], carbohydrate (AOAC, 2000) [1], lipid (Folch *et al*., 1957) [41], ash and moisture (AOAC, 2005) [11]. Each analysis was determined with three replicates. The values were expressed as % dry weight basis. The experimental shrimp samples were dried at 60ºC for 24 hours in an oven and the dried samples were finely ground for the estimation of amino acids in HPLC system with a fluorescent detector (FLD-6A) with amino acid standard as described by the method of Baker and Han (1994) [15]. For fatty acid analysis, samples were homogenized with chloroform: methanol (2:1 v/v) mixture and the fat were extracted, it was esterifies with 1% H_2So4 and fatty acid methyl ester were prepared. The fatty acid methyl esters of the samples were injected into the gas chromatography (GC - 6890) (Berner and Berner, 1994) [21]. The fatty acid peaks were detected by flame ionization detection and individual methyl esters were identified by comparison to known standards.

3. Results

The proximate compositions of the feeds were shown in Table.1. Significant difference was observed in all the parameters between feeds because all the nutrient parameters were higher in experimental feed compared to the control feeds. Other than the proximate composition special additives responsible for the attractants, high lipid class and total available energy were also observed in the experimental feeds.

Whole body proximate composition, amino acid composition and fatty acid composition of shrimp *Penaeus monodon* fed with different types of feed expressed in percentage dry weight basis illustrated in Table.2, 3 and 4.

Moisture content ranged lesser (72.44%) in shrimps fed with experimental feed where as it was (74.1%) in shrimps fed with commercial control feed. Proximate compositions such as protein content significantly different among shrimps receiving two dietary treatments ranged between 24.58 – 23.1%. Lipid content of shrimp fed with experimental feed was different from shrimps fed with the control commercial feed. The carbohydrate content differed significantly among shrimps receiving different diets and it ranged between 1.36 - 3.0%. Higher percentage of protein, lipid, carbohydrate and ash content were 24.58, 8.32, 3.0 3.65 and 3.04 was noticed in shrimp fed with experimental feed.

Essential and non-essential amino acid profiles of the shrimps fed with different feeds and the obtained result from this study indicated the presence of 9 essential amino acids (arginine, histidine, lysine, threonine, methionine, leucine, isoleucine, valine and phenyl alanine). The highest average concentration of lysine 6.54 mg/100g was recorded in shrimps fed with experimental feed. Shrimps fed with experimental feed and commercial feed had low level of threonine (2.75 mg/100g). Control feed fed shrimps had high level of alanine (1.15 mg/100g) and cystine (1.68 mg/100g). Furthermore EAA recorded data showed that, experimental feed fed shrimp had higher contents of all essential amino acids than control feed fed shrimps. The whole body compositon of *P. monodon* had 8 non essential amino acids (Aspartic acid, glutamic acid, cysteine, tyrosine, alanine, glycine, proline, and serine) and among these Glutamic acid (5.42 mg/100g) and aspartic acid (4.93 mg/100g) had the highest concentration in all the shrimps (Table 2) while alanine had lowest level than other non essential amino acids.

Fatty acid profiles of the shrimps fed with different feeds and the results shown better fatty acid composition was observed in experimental feed fed shrimps than commercial feed fed shrimps. Shrimp meat had significantly higher proportion of unsaturated fatty acids, significantly lower proportion of saturated fatty acids and their content were in the following trend that shrimps fed with experimental feed fed shrimps > control feed.

Table 1: Biochemical composition of experimental and control feed

Parameters	experimental feed	Control feed
Moisture (%)	8.7 ± 0.7^a	11.0 ± 0.6^c
Protein (%)	47.6 ± 1.8^c	43.8 ± 0.9^b
Lipid (%)	$9.8 \pm .0.2^c$	7.7 ± 0.4^b
Fibre (%)	2.6 ± 0.5^a	2.3 ± 0.2^a
Ash (%)	14.8 ± 0.6^a	21.8 ± 1.2^c
AIA (%)	0.7 ± 0.05^b	1.1 ± 0.1^c
NFE (%)	16.9 ± 0.9^c	14.1 ± 0.7^b
Phospho lipid (%)	2.02 ± 0.01^b	1.7 ± 0.2^b
Cholesterol (%)	2.0 ± 1.0^b	0.6 ± 0.1^a
GE (kCal/100g)	433.8 ± 1.6^d	368.7 ± 1.2^b
ME (Kcal/100g -1)	360.9 ± 1.5^d	303.8 ± 1.0^b
Carotenoid (mg/100g)	13.4 ± 1.4^c	1.7 ± 0.5^a

Table 2: Whole body biochemical composition of shrimp fed with different feeds

Parameters	experimental feed fed shrimps	Commercial feed fed shrimps
Protein	24.58±1.39	23.1±0.9
Lipid	8.32±0.58	7.77±0.43
Carbohydrate	3.0±0.08	1.36±0.29
Fibre	3.65±0.49	3.13±0.04
Ash	3.04±0.05	2.90±0.13
Moisture	72.44±0.51	74.1±0.9

Table 3: Amino acid composition of different feeds

Essential Amino acids		
Aminoacids	**Experimental feed**	**Commercial feed**
Threonine	2.75±0.25	2.07±0.04
Valine	3.78±0.40	2.30±0.60
Arginine	6.49±0.98	4.97±0.06
Methionine	5.04±0.07	4.26±0.53
Isoleucine	6.21±0.73	5.12±0.68
Leucine	2.57±0.47	2.52±0.50
Lysine	6.54±0.54	5.34±0.57
Phenylalanine	5.58±0.44	5.33±0.58
Histidine	3.31±0.54	3.13±0.05
Non Essential Amino acids		
Aspartic acid	4.93±0.39	4.45±0.55
Glutamic acid	5.42±0.52	4.71±0.29
Cystine	1.49±0.44	1.68±0.55
Tyrosine	2.44±0.49	2.50±0.48
Alanine	1.09 ± 0.08^c	1.15±0.76
Glycine	2.73±0.50	2.41±0.53
Proline	2.97±0.23	2.81±0.27
Serine	3.73±0.30	3.12±0.12

Table 4: Fatty acid composition of experimental feeds

Fatty acids	Farm made feed	Commercial feed
Leuric acid	2.5±0.55	2.45±0.56
Myristic acid	0.95±0.15	0.85±0.25
Palmitic acid	2.7±0.43	1.8±0.34
Stearic acid	0.78±0.05	0.68±0.08
Behenic acid	1.67±0.57	1.33±0.58
Palmitoleic acid	2.28±0.57	2.0±1
Oleic acid	6.10±0.13	5.88±0.49
Nervonic acid	4.71±0.13	0.64±0.26
Linoleic acid	11.64±0.69	11.15±0.90
Linolenic acid	2.85±0.13	2.36±0.55
Arachidonic acid	3.38±0.54	2.85±0.28
Eicosapentaenoic acid	11.13±1.02	7.65±0.6
Docosahexaenoic acid	8.85±0.31	8.52±0.42

4. Discussion

The declared moisture content of feed is 10 - 12% (Tangendjaja, 2000) [83] and it was acceptable in the experimental and control feed in this study. Increase of moisture content of the feed can affect the stability of the feeds in water (Ravishankar, 1983 ; Shyama, 1987) [70, 76] and leads to low shelf life (Jain, 1998) [46] and susceptible to growth of microbes (Raghavan, 2003). Proteins are continuously use by the animals to build new tissues and repair tissues if reduction in protein results in loss of weight (Sargent *et al.*, 2002) [73]. The quantity and quality of protein in the feed is very important (Alava and Lim, 1983). Shrimp fed with higher quality protein showed higher protein digest ability, better growth and less susceptibility to disease (Venkataramiah *et al.*, 1975) [88]. In the present study protein level in diets varied from 43.8 to 47.6%. Several authors reported better growth of *P. monodon* fed with feeds with different protein contents such as 42% (Bages and Sloane, 1981; Ponraj *et al.*, 1990) [14, 67], 45% (Annie and Jeyaprakas, 1990), 45.8% (Lee, 1971) [51], 40% (Balazs *et al.,* 1973; Venkataramiah *et al.*, 1975) [17, 88], 48% (Deshimaru and Yone, 1978C) [34]. Lipids are water insoluble biomolecules and are a source of fatty acids and attractants and the quality and quantity is important and levels do not exceed 10% in feed (Sivanandavel *et al.,* 2007) [77] and it substantiate with the present study in the value range of 7 – 9%. The percentage of lipid content for the best growth, efficient feed conversion and optimum survival rate of *P. monodon* was less than 10.

Fibre content is a mixture of cellulose, hemicelluloses, lignin and other indigestible fractions in the feed gave better binding property and influence the feed passage through the alimentary canal and are very limited content of 8 -15%. In the present study both the feeds showed the presence of fibre content and it was within the acceptable limit. Akiyama and Dominy (1989) [6] reported feed contain 20% fibre decrease the protein digestibility. Shiau and Suen (1994) [74] reported that feed with 6% fibre provides physical bulk to the feeds and better feed conversion.

Ash is a group of soluble nature of mixed minerals and the acceptable limit in feed was10 - 25%. Acid insoluble ash is a insoluble nature of materials found in feeds indicates the presence of silica, dirt sand and the acceptable limit in feed is 2% and above this cause difficult to digest by prawn (Deering *et al.,* 1996). In this study both were acceptable limit in all feeds except traditional feed and AIA was high in traditional feed and this was agreed with the results of Hossain *et al.*, (2003) [44]. Carbohydrates or NFE are low cost non protein energy source which can spare more expensive protein for growth (Rosas *et al*., 2000) [71]. Kavitha *et al*., (2004) [48] reported carbohydrate requirement of fish from feed was 20% and the shrimp was 35 - 45% and also reported younger prawns require less carbohydrate than compared to that growing prawn because younger prawn require high protein for energy and growth. Present study results coincide with the above statements in the quantity of carbohydrate in feed.

The lipid classes such as cholesterol and phospholipids are essential components of bio membranes systems in shrimp, together with the proteins important role in the absorption of fatty acids from the intestine transport to the blood and give good skeletal molting, act as good attractants, improving the physical properties of feeds and to promote growth and survival (Kontara and Sorgeloos, 2000) [49]. Shrimps are incapable of synthesizing these two compounds because of the absence of CDP-choline and hydroxy 3 methylglutaryl CoA reductase so it must be need to supply through feed. Teshima *et al.*, (1986) [84] found rich source of cholesterol and phospholipids in fish meal. The dietary requirement of cholesterol is 0.5 - 2.0% (Wu, 1986) and coincide with our statement. Chen (1993) [26] reported the requirement of phospholipids for *P. monodon* as 2.5% for juveniles, 2.0% for post larvae and 2.0% for brood stock.

Carotenoid is a pigment of carotenoproteins and its role in aquaculture feed is giving colour to the aquatic animal because exoskeleton of crustaceans having good colour ranking first than lighter-coloured prawns (Chien and Jeng, 1992) [25]. Synthetic carotenoid is too expensive and crustacean and mollusk meals are a natural sources of carotenoid and also economical and this was agreed with the results of present study because trash fish meal contain carotenoid pigment. Gross energy (GE) is known as the total energy of feed and not all the energy available to animal some are excreted via urine and faeces and remaining energy that is totally available to the animal known as metabolizable energy (Noblet *et al.,* 1994) and calculated from the proximate composition with standard value provided by ADCP (1983). Basudha and Vishwanath (2001) [19] reported higher protein content yield highest gross energy (474.52 k cal) compared to lower protein (417 k cal) and non protein diets (386 k cal) and the present study results coincide with the above statement because the gross energy content was high in higher inclusion of fishmeal in experimental feed and it was lower in control feed.

Muscle portion was collected from experimental and control shrimps and were subjected to biochemical analysis which is important in nutritional experiments. The biochemical constituents of the animals vary with season, size of the animal, stage of maturity, temperature, food availability etc. The feeds have positive influence on carbohydrate, protein, nitrogen and lipid metabolism in crustaceans (Highman and Hill, 1979) [45] which were found to vary with times and species (Vernberg and Vernberg, 1974; Madyasthan and Rengnekhar, 1976) [89, 56]. In the present study, all the biochemical constituents of the shrimp *P. monodon* were altered significantly by the quality of feeds during the experimental study and it was agreed by Karakoltsidis *et al*., (1995) [47]; Soundarpandian and Ananthan (2008) [80] they reports feeds play an important role in the proximate composition of the finfish and crustaceans.

The whole body moisture content of the shrimps varied when they fed with two different feeds in the present study. Nor Faadila *et al*., (2013) [61] reported majority of shrimp usually consists of about moisture within the range of 70 - 80% and it was agreed with our results. Manivanan *et al.,* (2010) [57] reported that moisture content of crab *S. serrata* was affected by quality of feed. Maynard and Loosli (1969) [58] reported moisture tends to decrease with increasing nutrient content and it was agreed with the current observation. O'Connor and Gilbert (1969) [62] reported that deficiency of nutrients uptake leads to longer inter molt period cause very soft nature of shells and increase the moisture in crustaceans is due to water uptake and this was supported with our results.

Protein is the major constituent in the muscle of shrimps (Dabrowski *et al*., 1969) [30]. In the present study, protein content was higher in experimental feed fed *P. monodon* (24.58%) when compared to other control feeds fed shrimps. Mona *et al.,* (2000) [59] reported that high protein content in crustaceans' species can be attributed to be its feeding habit of animal and the average body protein of the shrimp directly related to the level of the protein in the diet up to 75% and it was agreed with our results. In the present study experimental feed fed shrimps had more or less similar protein content of other peaneid species such as *P. indicus* (Ravichandran *et al.,* 2009) [69] wild *P. monodon* (Kumaraguru *et al.,* 2005) [50]. Manivannan *et al*., (2010) [57] reported the average body protein of the crab was directly related to the level of protein in the diet. Rosas *et al.,* (2007) [72] reported ingredients in the feed have some negative effect on the body protein levels. In the current study protein content of the experimental feed had influenced the body protein content of *P. monodon*. Similar pattern of protein changes depends upon the feeds was reported in *P. monodon* (Alva and Lim, 1983) [9] and *Macrobrachium malcolmsonii* (Soundarapandian and Ananthan, 2008) [80].

Lim and Dominy (1990) [53] reported that there was no significant difference in the whole body composition of lipid, ash, calcium or potassium of *Peaneus vannamei* fed with different diets incorporated with a major ingredient of soya bean meal. Lipids are highly efficient source of energy and they contain twice the energy of carbohydrates and proteins and act as a major food reserves along with protein and the content were fluctuated depends upon the external factors such as temperature and internal factor of diet (Gopakumar and Nair, 1975) [42]. In the present study, lipid content of the experimental feed fed shrimps were higher (8.32%) than other feeds fed shrimps. Abulude *et al*., (2006) [3] reported the lipid content varied from one shrimp to another, but the values were between 5.0 and 9.0% and it was accepted in this study prove that culture species are very susceptible to feed quality. Catacutan (1991) [24] noticed increased level of carcass lipid in *P. monodon* fed a diet containing high lipid supplement. Croos *et al*., (2005) [27] reported lipid content of *P. monodon* was 6.6 – 7.7%. Oleary and Mathews (1990) reported lipid level of the wild and farmed *P. monodon* were dissimilar and was 4.35% and 8.66%. However, the findings of this study shows that's the average lipid content of the experimental shrimps were more or less similar with the previous studies of above authors. The lipid content of *P. monodon* in the present study was influenced by diets. Similar types of changes were reported by in *Macrobrachium malcolmsonii* (Soundrapandian and Ananthan, 2008) [80] and in *Scylla tranquebarica* (Manivannan *et al.,* 2010) [57].

The whole body ash content of P. *monodon* in the present study was affected by diets because the contents varied with different feeds and similar result has been reported earlier in *P. monodon* (Sriraman and Reddy, 1977) [81]. USDA (2005) [87] reported higher moisture, protein, lipid and lower ash contents for wild and cultured *P. monodon* and it was agreed with our results. Adeyeye (2002a) [7] reported high ash content is of significance in measuring the mineral content of the species as the amount of ash shows the richness of the food in terms of element composition. In the present study ash content of 3.04 and 2.90% for experimental and control feed fed *P. monodon*. Sriraman and Reddy (1977) [81] observed slight increase in ash content with increase in the size of *P. monodon*. In the present study also gradual rise in ash content of muscle varies with size of animal. Similar marginal increases in ash during growth were also reported by Achuthan kutty and Parulekar, (1984) [4] in *P. stylifera* and *M. affinis*, Ajith kumar (1990) [8] in *Macrobrachium idella*.

In the present study the whole body fibre content of the shrimps was affected by diet quality. The body fiber content is lesser than feeds and similar results have been reported for *P. monodon* (Babu *et al*., 2010) [13]. High fibre content has got a nutritional advantage in that it will assist in reducing constipation and other attendant problems in the human consumers (Abulude *et al*., 2006) [3]. The fibre content of the fish was low (0.40-0.54%) and the content was high in crustacean (4.21- 4.34%) and that recorded by Bukola *et al.,* (2006) [23]. In this study the fibre content was above 2- 3% in two feed fed shrimp species.

Carbohydrates are non-protein compounds are also important constituents but are present in small amounts and are usually ignored during analysis (Love, 1980; Cui and Wootton, 1988) [54, 28]. The shrimp species fed with two different feed has a carbohydrate content varied that ranged from 1.36 - 3.0% and this was similar to that recorded by Sudhakar *et al.,* (2011) [82] the carbohydrate content of 1.57% for *Podopthalmus vigil* and Ravichandran *et al.,* (2009) [69] reported 1.4-2.4% for *P. monodon*. Okuzumi and Fujii (2000) [63] which stated that faecal carbohydrate increased with decreased muscle carbohydrate. As with protein the carbohydrate content of the feeds in this study influenced the body carbohydrate content of *P. monodon*. The results of Alava and Pascaul (1987) and Diaz and Nakagawa (1990) indicated that dietary carbohydrate can influence the proximate composition of prawn. Manivannan *et al*., (2010) [57] reported dietary carbohydrate level can affect the proximate composition of crab *S. tranquebarica*. Soundarapandian and Ananthan (2008) [80] indicated that dietary carbohydrate has no effect on body carbohydrate of *M. malcolmsonii*. The previous study suggested that the carbohydrate content of crustaceans in *Podophyhalam usvigil was 0.63*% (Radhakrishnan and Natarajan, 1979) [68]; 0.73% in *P. sanguinolentus* (Radhakrishnan and Natarajan, 1979) [68]; 0.17% in *Scylla serrrata* (Prasad and Neelakantan, 1989) [66]; 0.55% in *P. pelagicus;* 3.4% in *Charybdis smithii* (Balasubramanian and Suseelan, 2001) [16] and 1.1% in *Fenneropenaeus penicillatus* (Fatima *et al.,* 2013) [40] were very close with the present investigation. Ajith kumar (1990) [8] reported raise in carbohydrate content was gradual among the size groups and the peak value was observed in the bigger size group, which may be due to more synthesis and accumulation of carbohydrates in the higher size groups than in younger ones and it was agreed with our results because carbohydrate fluctuation was noticed among the size groups of experimental shrimps and higher was observed in experimental feed fed animals.

Amino acids are the building blocks of proteins and serve as body builders. They are utilized to form various cell structures, of which they are key components and they serve as a source of energy (Bhavan *et al*., 2010) [22]. The recorded data in the present study indicate the presence of 9 essential amino acids (arginine, histidine, lysine, theronine, methionine, leucine, isoleucine, valine and phenylalanine) and 8 non-essential aminoacids (aspartic acid, glutamic acid, cystine, tyrosine, alanine, glycine, proline, and serine). O'Leary and Matthews (1990) [64] reported in aqua cultured shrimp *P. monodon*, sixteen amino acids were detected, among these 9 essential and seven were non-essential amino acids. Bhavan *et al.,* (2010) [22] reported in *Macrobrachium rosenbergii*, nineteen amino acids were detected, among these eleven are essential and eight are non-essential amino acids, while nine essential amino acids and nine non-essential were detected by Hamdi (2011) [43] in edible muscle of *Procambarus clarkii* and *Erugosquilla massavensis*. The different amino acids in flesh of crustacean species might be associated with the varying tastes as well as textural properties of meat of the crustacean's species (Ehigiator and Oterai, 2012) [49]. According to Sikorski *et al.,* (1990) [78] glycine, alanine, serine and threonine give tasty sweet and in this study also considerable amount of those amino acids were noted in *P. monodon* and it give and it give good nutritive value with taste. Simpson *et al*., (1998) [79] have found that there is a high level of glycine, proline, arginine and valine amino acid in fresh *P. monodon* shrimp meat and in this study high level of lysine, arginine, phenyl alanine, methionine found in meat of experimental shrimp *P. monodon*. In the present study, the amino acids show considerable variation in proportion from different feeds fed animals. To be precise, trash fish experimental feed fed *P. monodon* tend to have high essential amino acid contents in muscles than control feed fed *P. monodon* results are agreement with the results of Bassey *et al.,* (2011) [20]; Devanathan *et al*., (2011) [33]; Sudhakar *et al*., (2011) [82] and Babu *et al.,* (2010) [13]. Prasad and Neelekandan (1989) [66] reported the essential amino acid composition were higher in *P. monodon* and the total contribution was 36.82% but in this study the essential amino acids in the contribution of 42.27% in shrimp fed with experimental feed and 35.04% control feed fed animal. This suggests quality of feed differences affect the amino acid composition of edible shrimp. The recorded data indicated that feed with good protein source with lots of essential amino acids were good for edible shrimp than the nutritionally imbalanced feed.

Shrimp lipid contains fatty acids which provide various health benefits to humans (Dayal *et al*., 2013a) [31]. Saturated fatty acids contributes to major proportion of fatty acid profiles of many species of fish (Edirisinghe *et al.,* 1998) [38], wild caught *P. monodon* (Croos *et al*., 2005) [27], *S. serrata* (Prasad and Neelakantan, 1989) [66] and S. *transquebarica* (Manivannan *et al*., 2010) [57]. In contrast this study reveals only a minor proportion of fatty acid profile represented by saturated fatty acids in cultured *P. monodon*. Also the percentages of MUFA and PUFA recorded from the *P. monodon* were considerably high compared to those of some other sea foods (Edirisinghe *et al.,* 1998) [38] and wild caught *P. monodon* (Croos *et al.,* 2005) [27]. The most biologically active PUFA viz, Eicosapentaenoic acid (EPA), and Docosahexaenoic acid (DHA) are reported to contribute to highest proportion of total n-3 PUFA in most species (Edirisinghe *et al*., 1998) [38]. The same was evident from the present study and high was noted for experimental feed fed animals. Also EPA and DHA contents recorded in the present study showed that content of EPA > the content of DHA which is a distinguish feature of crustaceans and mollusks (Ackman, 2000) [5]. The Present investigation shows that the fatty acid profile of the intensive cultured shrimp was distinct between the qualities. The reason might be the differences in quality of feed used in the culturing practices. It was evident from the previous study that the crustacean fatty acid profiles are influenced by the changes in the nutritional composition of the diet and by changes in the dietary sources (D'Abramo and Sheen, 1993; Deering *et al.,* 1997; Lim *et al.*, 1997; Sheen and WU, 1999) [29, 32, 52, 75].

5. Conclusion

The results of the present study have shown that on-laboratory made diet is cost effective and can boost growth of aquaculture. It also agrees with other studies, which indicate that local production of shrimp feed is very crucial to the development and sustainability of aquaculture. In conclusion, the results of the present study revealed; on-laboratory made experimental feeds are economically sustainable and suitable for production of *P. monodon* and apart from the feed ingredients preparation method need to be good to obtain the fruitful results.

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