Effect of Dietary Nutrient Sources on Nitrogen and Phosphorus Loading from Culture of Tiger Shrimp (Penaeus monodon)

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Abstract

Effect of dietary nutrient source like, fishmeal (F1), soymeal (F2), casin (F3) and groundnut oilcake (F4) on nitrogen and phosphorus loading during culture of tiger shrimp, Penaeus monodon was assessed. Healthy shrimps (PL 25) with average body weight of 20.3 ± 0.3 mg were reared in 200 litre capacity FRP tanks containing 150 litre filtered seawater (20 ppt salinity) at the stocking density of 15 individuals/tank with well aeration in triplicate. Shrimps were fed with the experimental diets four times per day at ad libitum and the uneaten remains were collected daily in the early hours and dried in an oven at 80°C. The growth of P. monodon was found to be greater (2.43 ± 0.07 g) with better FCR (1.71 ± 0.03) and SGR (5.33 ± 0.18%) on F1 diet. Total nitrogen losses were high in shrimps reared in F3 diet (73.34 ± 0.78 mg) whereas total phosphorus losses were high in F1 diet (37.279 ± 0.590 mg). Nitrogen loss per gram of shrimp produced and per gram of feed consumed showed maximum value (48.51 ± 0.49 and 23.21 ± 0.41 mg/g) in F3 diet fed group followed by other diets groups. Phosphorus loss per gram of shrimp produced and feed consumed were high in F1 diet fed shrimp. Total phosphorus loading (kg/t) based on shrimp production showed high value (15.34 kg/t shrimp produced) in F1 diet fed group, whereas it was low (1.087 kg/t shrimp produced) in F3 diet group. Total nitrogen loading based upon shrimp production showed maximum loading (48.8 kg shrimp produced) in F3 diet group and minimum value (20.2 kg shrimp produced) in F2 diet group. Therefore, in shrimp farming there is a need for consideration of availability of proper meal proportionate, nutritionally complete, cost-effective and aquaculture friendly green formulated feeds in order to achieve better productivity and aquaculture sustainability.

Keywords: Aquaculture; Dietary source; Nitrogen loading; Phosphorus loading; Tiger shrimp

Abbreviations: ANOVA: Analysis of variance; FCR: Feed Conversion Ratio; SGR: Specific growth rate; PL: Post larvae; FRP tanks: Fibreglass Reinforced Plastics; SNK: Student-Newman-Keuls multiple range test; CMC: Carboxy Methyl Cellulose; P:E: Protein : Energy ratio; SD: Standard Deviation

Introduction

Shrimp farming is one of the most outstanding commercial success stories in the history of Asian aquaculture, which produced more than 80% of the global cultured shrimp [1]. Out of 46.9 million tons of World inland aquaculture production, shrimp alone contribute 5% [2]. In most of the developing Asian countries, cultured shrimp production earning valuable foreign exchange and hence more and more areas are coming under shrimp farming including India. Success in shrimp farming is highly dependent in the availability of well balanced, nutritionally complete and cost-effective formulated feeds [3].

Along with the rapidly expanding shrimp farming, artificial feeds of different forms and composition have also been developed and widely used in every phase of culture from larval rearing to brood stock maturation and spawning [4]. The release of nitrogen and phosphorus from these artificial feeds to their habitat is of greater concern, because accumulation of these elements causes excessive algal bloom and eutrophication in that habitat [5-7]. Shrimp diets are prepared with higher level of protein and hence fish meal is added as the major ingredient like as the source of most dietary phosphorus. Fish meal, a main protein component in aquatic feeds, usually contains 2-4% phosphorus in the form of hydroxyl apatitate, which is almost unavailability to many cultivable species which lacks a stomach and devoid of gastric juice secretion [8-10]. Considering the limited supply of fish meal and also the need to reduce nitrogen and phosphorus excretion through retention in the dietary nitrogen and phosphorus, plant derived ingredients are increasingly substituted for fish meal as protein source in salmon and trout diets [11,12].

In shrimp farming the tendency of over use of fish meal, rather than including both animal and plant protein ingredients, resulting in higher nitrogen and phosphorus excretion into the water system. That is why; one of the fundamental challenges facing the shrimp industry is to improve both environmental and economic performance by developing and implementing an integrated approach to reducing nitrogen and phosphorus wastes [5,6,13]. Hence this study was conducted to examine the effect of different dietary protein sources on nitrogen and phosphorus retention and loss in an outdoor shrimp culture system. In addition, the effect of different dietary treatments on growth performance, Carcass biochemical composition, FCR and SGR were investigated.

Materials and Methods

Collection of shrimp

For this study, post larvae (PL20) of tiger shrimp (Penaeus monodon) were fed with the experimental diets four times per day at ad libitum and the unfed remains were collected daily in the early hours and dried in an oven at 80°C. The growth of P. monodon was found to be greater (2.43 ± 0.07 g) with better FCR (1.71 ± 0.03) and SGR (5.33 ± 0.18%) on F1 diet. Total nitrogen losses were high in shrimps reared in F3 diet (73.34 ± 0.78 mg) whereas total phosphorus losses were high in F1 diet (37.279 ± 0.590 mg). Nitrogen loss per gram of shrimp produced and per gram of feed consumed showed maximum value (48.51 ± 0.49 and 23.21 ± 0.41 mg/g) in F3 diet fed group followed by other diets groups. Phosphorus loss per gram of shrimp produced and feed consumed were high in F1 diet fed shrimp. Total phosphorus loading (kg/t) based on shrimp production showed high value (15.34 kg/t shrimp produced) in F1 diet fed group, whereas it was low (1.087 kg/t shrimp produced) in F3 diet group. Total nitrogen loading based upon shrimp production showed maximum loading (48.8 kg shrimp produced) in F3 diet group and minimum value (20.2 kg shrimp produced) in F2 diet group. Therefore, in shrimp farming there is a need for consideration of availability of proper meal proportionate, nutritionally complete, cost-effective and aquaculture friendly green formulated feeds in order to achieve better productivity and aquaculture sustainability. *Corresponding authors: Preetha VV, College of Natural & Computational Science, Haramaya University, P.O. Box 282, Ethiopia; Tel: 251-915137322; E-mail: preethakani@gmail.com

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**Experimental diets**

Four experimental diets were prepared with varying protein source i.e. fish meal (F1), soya meal (F2), casein (F3) and groundnut oil cake (F4). In addition, other ingredients such as wheat flour, rice bran and cod liver oil were supplemented to maintain similar dietary contents. The additives like, vitamin and mineral mix and NaH2PO4 were also used. The proportions of various feed ingredients used for the preparation of experimental diets (F1, F2, F3 and F4) are shown in Table 1. The biochemical composition such as protein, carbohydrate, lipid and total phosphorus contents of all experimental diets were measured.

**Estimation of protein:** The protein reacts with copper sulphate to form a protein – copper complex. In the second step, this complex was allowed to reduce by the phosphomolybdic-phosphotungstic acid complex. The reduced complex was blue in colour and measured colorimetrically at 660 nm [14].

**Estimation of carbohydrates:** The carbohydrates are first hydrolyzed into simple sugars using dilute hydrochloric acid. In hot acidic medium, glucose is dehydrated to hydroxy methyl furfural. This compound forms green colored products with anthrone reagent which can be measured at 630 nm [15].

**Estimation of lipid:** The quantitative determination of lipid by sulphophosphovanilin method depends on the reaction of total lipid extracted from the sample using chloroform methanol mixture with sulphuric acid. Phosphoric acid and vanillin to give a red colour complex. The intensity of red colour is directly proportional to the concentration of total lipid in the sample [16].

A solution of 0.5 m sodium carbonate buffer at pH 8.5 was used for the extraction of the total available phosphorus in tissue samples. The extracted phosphorus in the solution was estimated colorimetrically through spectrophotometer by developing blue colour of the chlorostannous indicator reduced to molybdic phosphoric acid [17].

The energy content of the experimental diets was also estimated in a Parr 1421 semi microbomb calorimeter (Parr instrument Co., Moline, USA). Energy content in the test diets was estimated indirectly by relating the level of macronutrients i.e. protein, carbohydrate and lipid contents of the diets with the energy equivalent of the respective nutrients i.e. 5.65 kJ for 1.0 g protein, 4.15 kJ for 1.0 g carbohydrate and 9.40 kJ for 1.0 g lipid [18]. The calorics values were expressed as calories per gram (cal/gm) on dry weight basis. All the estimations were done in triplicate and mean values were calculated. Considering the protein and energy content of the particular diet, P:E ratio was calculated.

**Feeding experiment**

Healthy shrimps (PL 25) with average body weight of 20.3 ± 0.3 mg were reared in 200 litre capacity FRP tanks containing 150 litre filtered seawater (20 ppt salinity) at the stocking density of 15 individuals/tank with well aeration in triplicate, three tanks for each feed (a total of twelve tanks). Then one shrimp from each replicate were collected and the mean value was taken for each feed type. There were triplicate samples - The water temperature recorded was 28 ± 1°C and pH recorded was 8.0 ± 0.2. During experimentation, the shrimps were fed with the experimental diets four times per day at ad libitum and the unfed remains were collected daily in the early hours and dried in an oven at 80°C. Fifty percentage of the tank water was changed daily so as to maintain proper water quality in all the system. The feeding experiment was conducted for 90 days. The growth of the shrimp was assessed by gravimetric method once in 10 days. At the end of the experiment, the animals were collected and weighed individually, sacrificed following the method of Maynard and Loosli [19] and stored at -20°C for further biochemical analysis.

**Growth responses**

The growth performance, biomass (g), Specific Growth Rate (SGR - %) and Feed Conversion Ratio (FCR) were estimated using the formula described by Mohanty [20,21]. Diet performance was evaluated by calculation of:

- Percent weight gain = final weight - initial weight/initial weight x 100
- Specific growth rate = 100 (ln average of final weight - ln average of initial weight)/number of culture days
- Feed conversion ratio (FCR) = total dry feed intake (g)/wet weight gain (g)
- Percent survival = final number of shrimp/initial number of shrimp x 100

**Nitrogen and phosphorus estimation**

The amount of nitrogen and phosphorus in the diets (fishmeal (F1), soymeal (F2), casin (F3) and groundnut oilcake (F4)) and in the shrimp carcass; nitrogen and phosphorus consumption, gain, retention and loss rates were estimated following the formula described by [22-24].

**Estimation of tissue phosphorus:** A solution of 0.5 m sodium carbonate buffer at pH 8.5 was used for the extraction of the total available phosphorus in tissue samples. The extracted phosphorus in the solution was estimated colorimetrically through spectrophotometer by developing blue colour of the chlorostannous indicator reduced to molybdic phosphoric acid [17].

Nitrogen gain/retention = Tissue nitrogen x Total biomass production (mg wet weight)

Nitrogen consumption = Feed nitrogen x Total feed consumed (mg dry weight)

Total nitrogen loss = Nitrogen in feed – Nitrogen gain/retention (mg wet weight)

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**Table 1:** Proportion of feed ingredients of prepared experimental diets (F1 to F4).

<table>
<thead>
<tr>
<th>Constituents in grams</th>
<th>Experimental diets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1</td>
</tr>
<tr>
<td>Fish meal</td>
<td>74</td>
</tr>
<tr>
<td>Soya meal</td>
<td>-</td>
</tr>
<tr>
<td>Casein</td>
<td>-</td>
</tr>
<tr>
<td>Groundnut oil cake</td>
<td>-</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>8</td>
</tr>
<tr>
<td>Rice bran</td>
<td>3</td>
</tr>
<tr>
<td>CMC</td>
<td>3</td>
</tr>
<tr>
<td>Tapioca powder</td>
<td>5</td>
</tr>
<tr>
<td>NaH2PO4</td>
<td>1</td>
</tr>
<tr>
<td>Oil</td>
<td>4</td>
</tr>
<tr>
<td>Vitamin</td>
<td>2</td>
</tr>
<tr>
<td>Cellulose</td>
<td>-</td>
</tr>
</tbody>
</table>

Nitrogen gain in fish (mg) = (Final wet wt x final nitrogen) – (Initial wet wt x initial nitrogen)

Nitrogen loss per g of shrimp produced (mg/g) = Total nitrogen loss/Total biomass

Nitrogen loss per g of feed consumed (mg/g) = Total nitrogen loss/Total feed consumed

Phosphorus gain / retention = Tissue Phosphorus x Total biomass production (mg wet weight)

Phosphorus consumption = Feed Phosphorus x Total feed consumed (mg dry weight)

Total Phosphorus loss = Phosphorus in feed – Phosphorus gain/retention (mg wet weight)

Phosphorus gain in fish (mg) = (final wet wt x final Phosphorus) – (Initial wet wt x initial Phosphorus)

Phosphorus loss per g of shrimp produced (mg/g) = Total Phosphorus loss/Total biomass

Phosphorus loss per g of feed consumed = Total Phosphorus loss/Total feed consumed

Data analysis

The data obtained in this study were subjected to relevant statistical analysis following the method described by [25]. Individual weight was analyzed using one-way ANOVA and Student-Newman-Keuls multiple range test (SNK). The parameters like, growth performance, biomass, SGR (%), FCR, Retention and loading of nitrogen and phosphorus were analysed in one-way ANOVA to determine if significant difference exist among the different diets fed groups. Results were considered statistically significant at the level of P < 0.05.

Results and Discussion

Biochemical composition of diets

The proximate compositions of the experimental diets are provided in Table 2. The protein content varied from 29.68 ± 0.356 to 34.06 ± 0.545%. The carbohydrate and lipid contents ranged from 15.06 ± 0.27 to 22.03 ± 0.446% and from 13.02 ± 0.078 to 13.20 ± 0.211% respectively. High phosphorus content was recorded in fish meal (1.284 ± 0.017%) diet and low phosphorus value was measured in casein added diet (0.0942 ± 0.001%).

Growth performance of shrimps

The growth performance of Penaeus monodon (Fabricius, 1998) (Family Penaeidae) fed with four test diets (i.e. fish meal, soya meal, casein and groundnut oil cake) for a period of 90 days showed marked variation (Table 3). The final weight of P. monodon fed on F1 diet was maximum (2.43 ± 0.073 g), but in the other diets (F2 – F4) fed groups ranged between 1.49 ± 0.04 and 1.81 ± 0.06 g. The food consumption was positively correlated with the final weight gain. Better feed conversion ratio (1.71 ± 0.03) was observed in fish meal (F1) supplemented diet fed P. monodon. The result is in consistence with the fact that to ensure better performance in black tiger shrimp, animal matter is essential [26]. The variation in FCR value of P. monodon which were fed on various experimental diets was statistically significant (P < 0.05) except between F1 and F2 diets fed groups. The trend noticed for the SGR of P. monodon was more or less similar to that of FCR values. The variation in SGR of P. monodon fed on test diets was statistically significant (P < 0.05) except between F1 and F2 diets fed groups. This variation in growth response of P. monodon fed on F1 to F4 diets may be attributed by the variation in source of nutrient in the test diets.

Various studies revealed that variation in growth response of shrimp could be attributed by the variation in source of nutrient in the test diets [4, 27]. Of course there are many studies indicating that the replacement of one meal with the other didn’t show significance difference on various experimental diets was statistically significant (P < 0.05) except between F1 and F2 diets fed groups. This variation in growth response of P. monodon fed on test diets was statistically significant (P < 0.05) except between F1 and F2 diets fed groups. This variation in growth response of P. monodon fed on F1 to F4 diets may be attributed by the variation in source of nutrient in the test diets.

Carass biochemical composition

The percentage biochemical composition of a shrimp carcass fed with F1 to F4 diets are shown in Figure 1. Protein content of shrimps fed with F1 and F2 diets showed more or less similar values (9.61 ± 0.15 and 9.53 ± 0.17%) and a low value was noticed in F4 diet fed group. Carass carbohydrate content showed no marked variation between dietary groups and it ranged from 2.24 ± 0.03 to 2.46 ± 0.04%. Maximum lipid content was noticed in F4 diet fed group and in other groups

![Figure 1: Variation in carcass biochemical constituents of P. monodon fed with experimental diets (F1 to F4).](image-url)
(F1 to F3) the values showed no variations. But phosphorus content varied much from F1 to F4 diet fed groups. Maximum phosphorus content was recorded in F1 diet fed group (0.664 ± 0.008) and a minimum value in F3 diet fed group (0.089 ± 0.001).

The factors which affect the growth performance of fishes also exert their influence on carcass biochemical composition. The little variation noticed in the carcass biochemical composition of *P. monodon* may be attributed to the variation in source of nutrient in the test diets. Erfanullah and Jafri [29] reported that the effect of different carbohydrate sources on fingerlings of *L. rohita*, a higher amount of carcass carbohydrate content was recorded, when fed on diet containing 30% sucrose and 40% protein. Changes in whole body composition in tilapia *Oreochromis mossambicus* with respect to variation in dietary protein was also reported by Al Hafedh [30]. Nematipour et al. [31] also reported the marked variation in whole body dry matter, lipid and protein content.

The source and composition of feed stuffs also bring about significant variation in digestibility as reported in *Oreochromis aureus* and *O. niloticus* [32]. The variation noticed in carcass biochemical composition of *P. monodon* may be due to the difference in the digestibility co-efficient of the given nutrient sources which are compatible with the result reported by [33].

### Retention and loading nitrogen and phosphorus

Nitrogen and phosphorus consumption, gain and retention of *P. monodon* showed a decreasing trend with respect to the addition of alternative dietary protein ingredients in the diets and it ranged between 226.56 ± 7.15 to 135.87 ± 3.65 mg. The higher nitrogen consumption (226.56 ± 7.15 mg) was noticed in F1 diet fed *P. monodon* (Table 4). Nitrogen gain of *P. monodon* was also showed a similar trend with that of nitrogen consumption and it ranged between 173.82 ± 2.78 mg in F1 diet fed group to 75.10 ± 1.27 mg in F4 diet fed shrimps (Table 4). The variation in nitrogen gain of *P. monodon* fed test diets was statistically significant (P < 0.05). Nitrogen retention of *P. monodon* as percentage of feed nitrogen was varied from 53.03 ± 0.85% in F3 diet fed group to 77.07 ± 1.37% in F2 diet fed group and the variation between F1 and F2, F3 and F4 diets fed groups was not statistically significant (P > 0.05). A similar report was also made earlier by [16,17].

The results on phosphorus consumption of *P. monodon* was high in fish meal protein diet (F1) fed group (53.41 ± 1.178 mg) and low in casein protein diet (F3) fed group (2.98 ± 0.089 mg) (Table 5). The phosphorus gain/retention of *P. monodon* was high in F1 diet fed group and low in (1.33 ± 0.032 mg) F3 diet received shrimps and the variation between the test diets was statistically significant (P <0.05). Phosphorus retention as percent of feed phosphorus was high (45.05 ± 0.41%) in *P. monodon* received diet with casin (F3) (Table 7). SNK test indicated that the variation in phosphorus retention as percentage of feed phosphorus was statistically significant except between F2 and F4 diet fed group.

The total nitrogen loss was also established a marked variation and it was higher in F3 and F4 diets. Maximum nitrogen loss (73.34 ± 0.78 mg) was measured in F3 diet fed group against the minimum of 36.54 ± 0.67 mg obtained in F2 diet fed group and the variation between them was statistically significant (P < 0.05). The nitrogen loss per gram of shrimp produced was the highest (48.51 ± 0.49 mg/g) in F3 diet fed group and lowest (20.20 ± 0.38 mg/g) in F2 diet fed shrimps (Table 6). Multiple comparison of mean total nitrogen loss per gram of shrimp produced indicated that the variation between them was statistically significant (P < 0.05). But nitrogen loss per gram of feed consumed showed much variation and it ranged between 11.04 ± 0.17 and 23.21 ± 0.41 mg/g (Table 6). In this respect the use of F2 diet (soyameal) along with the F1 diet (fishmeal) is more encouraged for high shrimp production and sustainable aquaculture.

The total phosphorus loss was high in F1 (37.28 ± 0.590 mg) and low in F3 (1.641 ± 0.042 mg) diets fed groups and the variation was statistically significant (P < 0.05) (Table 6). Phosphorus loss per gram of shrimp produced (mg/g) was also high in F1 diet fed group and low in F3 and F4 diets fed groups. Phosphorus loss per gram of feed produced showed a similar trend with that of total phosphorus loss. Phosphorus loss/g of shrimp produced ranged between 8.961 (F1) to 0.519 (F3) mg/g (Table 7). Multiple comparison of mean total phosphorus loss per

### Table 4: Nitrogen metabolism of *P. monodon* fed on experimental diets (F1 to F4).

<table>
<thead>
<tr>
<th>Feed</th>
<th>Biomass nitrogen / retent. (mg)</th>
<th>Nitrogen gain / retent. (mg)</th>
<th>Nitrogen consumption (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial (mg)</td>
<td>Final (mg)</td>
<td>Amount of feed (mg)</td>
</tr>
<tr>
<td>1</td>
<td>20.0 ± 0.45</td>
<td>2430 ± 0.073</td>
<td>7.15 ± 0.164</td>
</tr>
<tr>
<td>2</td>
<td>20.5 ± 0.40</td>
<td>1810 ± 0.062</td>
<td>7.09 ± 0.167</td>
</tr>
<tr>
<td>3</td>
<td>20.6 ± 0.50</td>
<td>1510 ± 0.051</td>
<td>5.57 ± 0.460</td>
</tr>
<tr>
<td>4</td>
<td>20.0 ± 0.46</td>
<td>1490 ± 0.042</td>
<td>5.04 ± 0.580</td>
</tr>
</tbody>
</table>

Each value is a mean (X ± SD) of triplicate samples

Note: Values in a row with different alphabets are statistically significant

(P < 0.05; SNK test)

### Table 5: Phosphate metabolism of *P. monodon* fed on experimental diets (F1 to F4).

<table>
<thead>
<tr>
<th>Feed</th>
<th>Biomass phosphorus / retent. (mg)</th>
<th>Phosphorus gain / retention (mg)</th>
<th>Phosphorus retention (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial (mg)</td>
<td>Final (mg)</td>
<td>Amount of feed (mg)</td>
</tr>
<tr>
<td>1</td>
<td>20.0 ± 0.45</td>
<td>2430 ± 0.073</td>
<td>0.664 ± 0.021</td>
</tr>
<tr>
<td>2</td>
<td>20.5 ± 0.40</td>
<td>1810 ± 0.062</td>
<td>0.2473 ± 0.008</td>
</tr>
<tr>
<td>3</td>
<td>20.6 ± 0.50</td>
<td>1510 ± 0.051</td>
<td>0.089 ± 0.002</td>
</tr>
<tr>
<td>4</td>
<td>20.0 ± 0.46</td>
<td>1490 ± 0.042</td>
<td>0.195 ± 0.005</td>
</tr>
</tbody>
</table>

Each value is a mean (X ± SD) of triplicate samples

Note: Values in a row with different alphabets are statistically significant

(P < 0.05; SNK test)
considering the nitrogen and phosphorus retention, the total nitrogen and phosphorus loading was calculated in *P. monodon* fed on F1 to F4 diets. Total nitrogen loading was high in F1 (15.34 kg/t) diet and low in F3 and F4 (1.09 kg/t) each diets and the variation between was statistically significant (P < 0.05) (Figure 2). On the other hand, the total nitrogen loading showed a significant difference (P < 0.05), and maximum loading was noticed in F3 (48.5 kg/t shrimp produced) and F4 (40.79 kg/t shrimp produced) diets fed groups and minimum loading in F1 (21.69 kg/t shrimp produced) and F2 (20.2 kg/t shrimp produced) diets fed groups (Figure 2). It was also revealed that a large portion of input nitrogen and phosphorus into shrimp ponds as feed is not converted to shrimp biomass, but is released into the environment [34-36] that could results in algal blooming and eutrophication. On the other hand, with respect to variation in source of protein, the phosphorus loading varied much being the maximum in F1 diet fed shrimps and it was comparatively high (P<0.05) when compared to F2 – F4 diets fed groups. This result indicated that the inclusion of fish meal as the major protein substitute in F1 diet resulted in increased accumulation of total phosphorus. A similar observation was also made by Jahan et al. [37] in carp culture as the result of increase in concentration of dietary fish meal. Hence even at low dietary protein level of 30 to 34% inclusion of fish meal as the major protein source could result in accumulation of more amount of phosphorus in shrimp culture system. As stated by [13] of the feed input at a food conversion ration of 20 only 24% of the nitrogen and 13% of the phosphorus was incorporated into the shrimp harvested, whilst the remainder was retained in the pond and ultimately exported to the surrounding environment.

**Conclusion**

In shrimp farming there is a need for consideration of appropriate meal proportionate in order to achieve better productivity and habitat management. For example, an inclusion of fish meal as the major protein substitute in F1 diet resulted in high growth with better FCR and FGR, high nitrogen gain and consumption and increased accumulation of total phosphorus whereas resulted in high phosphorus loading to the aquaculture. The F3 meal also resulted in minimum phosphorus loading, whereas maximum loss per gram of shrimp produced and high nitrogen loading based upon shrimp production to the shrimp culture system. Therefore, there is a need to minimize F3 meal from the shrimp meal proportion. The results showed that the need for using different meals such as, soymeal, casin and groundnut oilcake relatively having less environmental impact rather than focusing only on fish meal, with proper proportion by considering the degree of nitrogen and phosphorus retention and loss in shrimp culture. By doing so, one can achieve better productivity and maintain sustainability of the aquaculture. In general, in shrimp farming there is a need for consideration of availability of proper meal proportionate, nutritionally complete, cost-effective and aquaculture friendly green formulated feeds in order to achieve better productivity and aquaculture sustainability.

**References**