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# Purge lecithin for less-expensive diet formulation for black tiger prawn *Penaeus monodon*

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**Abstract**. The knowledge of the nutrient requirements and practical diet formulations for *Penaeus monodon* is fully known. In the production cost, the cost of diet alone comes around 50 to70%. This is mainly because of the addition of lecithin which is a relatively expensive dietary ingredient. It is important to determine the usefulness of lecithin in the growth of *P. monodon*. In order to keep the diet cost as low as possible this experiment was designed with and without lecithin. The objective of the present study was to assess the growth of shrimp with varying lecithin doses. To study the water quality parameters and to study the growth and survival of animals feed containing different percentage of lecithin. Trials conducted indicated the soybean lecithin did not have any effect on shrimp's growth. The shrimp weight varied from 3.15 to 8g in Control, 2.58 to 6g in Treatment A, 2.87 to 6.62g in Treatment B**,** 3.1 to 6.75g in Treatment C. These confirm that under a controlled clear water culture system, partial or complete replacement of soybean lecithin in a commercial diet for *P. monodon* resulted in no detriment in growth. Purge lecithin in the diet may allow for less-expensive diet formulations for *P. monodon* and may reduce the diet cost for producers, who are supplying feed. As diet cost represents the largest variable cost in a commercial aquaculture operation, increased knowledge of specific dietary requirements is essential for formulating a cost-effective commercial *P. monodon* diet.
**Key Words**: *P. monodon,* nutrients, lecithin, dietary requirements culture system and Aquaculture.

**Introduction**. The significance of aquaculture in the context of global food production sector, the management of aquatic resources and the socio-economic development of coastal rural areas is now fully appreciated world-wide. Shrimp is one of the most popular types of seafood in the world. Approximately 5 million metric tons are consumed annually. Brackish-water aquaculture in India is synonymous with penaeid shrimp aquaculture. Black tiger shrimp (*Penaeus monodon* (Fabricius, 1798), Decapoda, Fam. Penaeidae) is the most popular species for aquaculture, In accordance with the expected growth of the aquaculture industry, Global aqua feed requirements are projected to grow from 15 MMT in 2000 to 27 MMT by 2010. This will result in an increased demand for and possibly shortage of a number of raw materials which are derived from finite natural resources. Severe increases of formulation cost of aqua feeds can only be avoided by increasing the power of least cost formulation, i.e. by offering a wider range of ingredients for which the selection is based on a comprehensive knowledge of nutritional requirements, raw material characteristics and cost. As ingredient and energy costs have spiraled upwards to unprecedented highs, nutritionists and formulators in the feed manufacturing sector are under pressure to manage the cost of feeds without compromising performance. It is well documented that shrimp have unique requirements of phospholipids for development, growth, reproduction and survival. Phospholipids are important nutrients to fish and shrimp at all stages of growth and they are routinely included in aquaculture diets in the form of crude lecithin. Lecithin, a lipid material composed of choline and inositol, is found in all living cells as a major component of cell membranes, which regulate the nutrients entering and exiting the cell.

The knowledge of the nutrient requirements and practical diet formulations for P. *monodon* is fully known. In the production cost, the cost of diet alone comes around 50 to70%. This is mainly because of the addition of lecithin which is a relatively expensive dietary ingredient. It is important to determine the usefulness lecithin in the growth of P.

*monodon*. In order to keep the diet cost as low as possible this experiment was designed with and without lecithin. The objective of the present study was to assess the growth of shrimp with varying lecithin.

To study the water quality parameters and to study the growth and survival of animals feed containing different percentage of lecithin.

## Material and Methods

**Experimental design**. The study was conducted CAS in Marine Biology, Annamalai University. The work consists of two growth trials with *Penaeus monodon*. The shrimps were captured on May 10, 2008 from grow out pond of a commercial shrimp farm at Parangipettai. A total of 500 juveniles of *P. monodon* with 2.6±0.87g were transported in 30-L volume plastics bags containing seawater at 28 ‰ salinity.

**Shrimp stocking and management**. Immediately after the transportation, shrimps were stocked in 24 rectangular tanks of 50 liters capacity. Shrimps were stocked at the rate of 10 shrimps/ tank and provided with continuous aeration by 2.5hp blowers (Figs. 1, 2). Feeding was done twice daily one in the morning and the other in the evening. After completion of every 10 days of rearing, the shrimps per were captured, weighed and immediately released in the respective tanks. During the culture period dead shrimps were removed and the weight of the dead ones was subtracted from the initial total weight. Feeding was adjusted once in 10 days, depending on the biomass in each tank. One hour after feeding, the uneaten feed was immediately after the transportation, shrimps were stocked in 24 rectangular tanks of 50 liters capacity. Shrimps were stocked at the rate of 10 shrimps/ tank and provided with continuous aeration by 2.5hp blowers. Feeding was done twice daily one in the morning and the other in the evening. After completion of every 10days of rearing, the shrimps per were captured, weighed and immediately released in the respective tanks. During the culture period dead shrimps were removed and the weight of the dead ones siphoned from the bottom of the tank. The water quality parameters like Salinity, pH, dissolved oxygen and ammonia nitrogen concentration in the tanks were measured once in a week following methods of Strickland & Parsons (1972).

**Feeds and experimental design**. The work was carried out as one control and three replicates. The feeds were formulated with similar ingredients and nutritional composition. The ingredients were similar in all experimental feeds but the only variation was only with regard to the inclusion of soybean lecithin. Feeds were prepared in the laboratory itself. The control feed (**C**) consisted of 0% soybean lecithin, while in the experimental feeds: **T-A**, consisted lecithin of10%, **T-B**, consisted lecithin of 15%. **T-C**, consisted lecithin of 20%.10 kg of each feed was prepared in the laboratory (Table 1). The culture experiment was carried out in 24 tanks. Six replicate tanks were designated for each experiment and control.

**Growth performance indices**. In trials, shrimps were reared for a period of 80 days. At the end, all shrimps were individually weighed to determine biomass (*i.e*., number of shrimps x average body weight).

**Water quality**. Water quality parameters were kept within optimum levels for rearing *P. monodon*. Mean obtained values were 30.0±2 ppt salinity, 7.4±0.1 pH and 26.7± 1.2$^{o}$C temperature. No statistical difference could be detected in water quality parameters between tanks (P>0.05; ANOVA).

## Results and Discussion

**Shrimp growth** (Figs 3-7). Trials conducted indicated the soybean lecithin did not have any effect on shrimp's growth. The shrimp weight varied from 3.15 to 8g in Control, 2.58 to 6g in Treatment A, 2.87 to 6.62g in Treatment B, 3.1 to 6.75g in Treatment C. These

confirm that under a controlled clear water culture system, partial or complete replacement of soybean lecithin in a commercial diet for *P. monodon* resulted in no detriment in growth (Fig. 3, 4, 5, 6 and 7).

Table 1

Diet and treatments for *P. monodon*

| *Ingredients* | *Control Diet* | *Treatment 1* | *Treatment 2* | *Treatment 3* |
|---|---|---|---|---|
| | | *g/Kg feed* | | |
| Fish Meal | 400 | 400 | 400 | 400 |
| Shrimp head meal | 100 | 100 | 100 | 100 |
| Squid meal | 155 | 155 | 155 | 155 |
| Soybean meal | 75 | 75 | 75 | 75 |
| Wheat flour | 125.2 | 125.2 | 125.2 | 125.2 |
| Lecithin | 0 | 10 | 15 | 20 |
| Dried Yeast | 20 | 20 | 20 | 20 |
| Broken rice | 25 | 25 | 25 | 25 |
| Fish Oil | 25 | 25 | 25 | 25 |
| Tapioca powder | 50 | 50 | 50 | 50 |
| Dicalcium phosphate | 0.5 | 0.5 | 0.5 | 0.5 |
| Choline chloride | 0.1 | 0.1 | 0.1 | 0.1 |
| Vitamin mix | 2 | 2 | 2 | 2 |
| Mineral mix | 2 | 2 | 2 | 2 |
| Antioxidant (Endox) | 0.1 | 0.1 | 0.1 | 0.1 |
| Mould inhibitor (Mycocurb) | 0.1 | 0.1 | 0.1 | 0.1 |
| Bentonite | 1 | 10 | 0 | 20 |

**Shrimp survival** (Fig. 8). In this experiment, shrimp survival rate was decreased from after 20$^{th}$ day in all feeding treatments. The cause of mortality was not confirmed, but clinical and behavioral signs and growth patterns suggested an outbreak of *Vibrio sp*. On Day 80, average survival had dropped to 74.47%. Final shrimp survival was 78%for control, 70%, 65% and 80% for treatments **T-A**, **T-B** and **T-C** respectively (Fig. 8).

In the present study, the lipid level in experimental diets averaged 75g kg$^{-1}$ and that too not only by the lecithin but also by other basal ingredients. Kumarguru Vasagam et al (2005) reported that the lipid levels in experimental diet average 86.4 g kg$^{-1}$ and that too was constituted not only by the oils but also by other basal ingredients.

The dietary lecithin is an essential nutrient for some crustaceans, our study indicates that *P. monodon* fed with a diet containing up to 2%, 1% and 0% of a commercial lecithin did not improve growth and survival compared with the basal diet lacking supplemental lecithin. Thompson et al (2003) found the same kind of the result in red claw juveniles fed a semi-purified diet containing up to 2% of a commercial lecithin did not improve growth or survival compared with the basal diet lacking supplemental lecithin. In the present study, growth rates and survival of *P. monodon* fed all diets were almost similar, but survival percentage was little higher in T-C fed animals.

It has been reported that *P. monodon* (average initial weight 2.92 g), grown in individual containers for 80days fed with four different percentage level of lecithin Control, T-A, T-B and T-C (0%, 10%, 15% and 20%), survival percentages were 78% for control, 70%, 65% and 80% T-A, T-B and T-C respectively.

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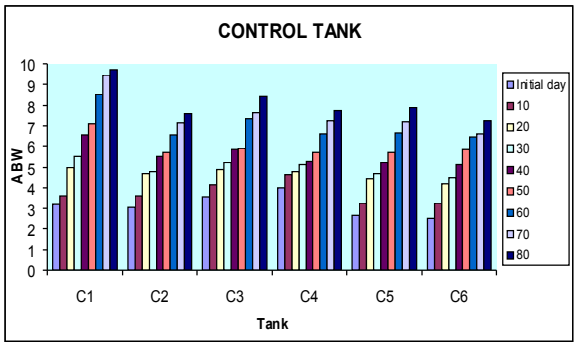


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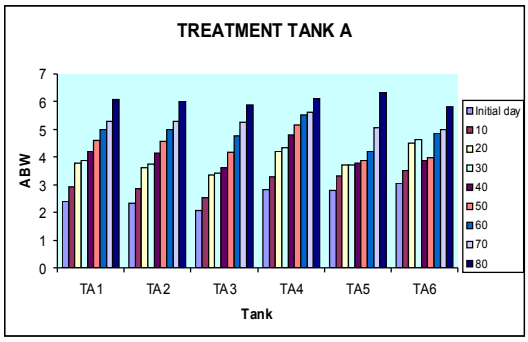


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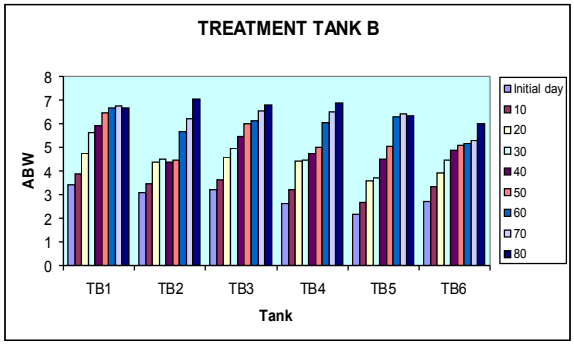


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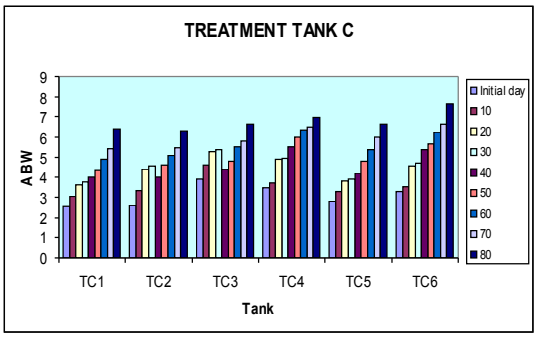


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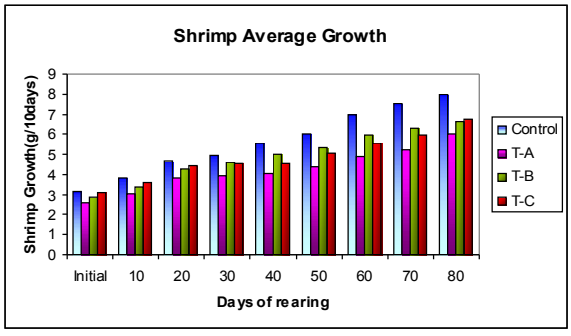


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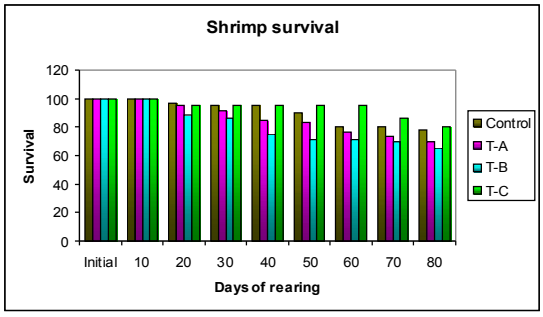


Figs. 1-8. The experimental setup and growth performance**:** 1 - specimens of *P. monodon*in a tank; 2 – experimental tanks in the laboratory facility; 3, 4, 5, 6, 7, 8 - growth performance in different tanks, shrimp average growth and survival (original).

Gong et al (2001) reported that growth-enhancing effects of juvenile shrimp *L. vannamei* fed three different types of commercial lecithin with various percentages of PC levels (21.7, 12.5 and 7.5) were not different, and suggested that PL other than PC may also affect shrimp growth.

Briggs et al (1988) stated that supplementary lecithin was not essential in semi-purified diets, and phospholipid levels should be readily achievable in practical dietary formulations which could result in cost savings in future diet formulated for juvenile freshwater prawn. Kanazawa (1993) reported that adding 1 and 2% soya bean lecithin to diets containing either casein-based or crab protein based diets did not improve growth or survival of the freshwater prawn.

Kean et al (1985) suggested that the American lobster may have a limited capacity for PC synthesis, but that supplemental lecithin was not necessary if the diet had crab protein, instead of casein, as the protein source. Conflicting reports for a need of supplemental lecithin in some crustacean diets, both fresh and saltwater, may have several possible explanations. Based upon previous reports (Kean et al 1985; Briggs et al 1988; Chen & Jenn 1991; Gong et al 2001), it appears that addition of cholesterol to diets should have had little effect on lecithin requirement for juvenile red claw. Thompson et al (2003) suggested, red claw fed diets 1 (0% lecithin), 2 (0.5% lecithin) and 3 (inclusion of 2.0% lecithin) had no significant difference ($P > 0.05$) in final weight, percentage weight gain. However in many studies, supplementing PL to the diet of shrimp showed increased growth regardless of the lipid source tested.

Kanazawa et al 1985, proposed that PL may possibly improve the utilization efficacy of EFA supplied in the diet as neutral lipid, mostly triacylglycerol, and thus reduce the quantitative requirements for n-3 HUFA in shrimp diets. Glencross (1998) demonstrated the digestibility enhancing potential of PL in *P. monodon* through both in vivo and in vitro experiments. Meyers (1993) observed that PL also plays a functional role in improving the physical properties of manufactured feeds. Soybean lecithin has been widely used for dietary supplementation of PL in shrimp diet.

**Conclusions**. The discrepancy between the present study and some other reports may arise from the difference in species, developmental state, or experimental conditions. Eliminating lecithin in the diet may allow for less-expensive diet formulations for *P. monodon* and may reduce the diet cost for producers, who are supplying feed. As diet cost represents the largest variable cost in a commercial aquaculture operation, increased knowledge of specific dietary requirements is essential for formulating a cost-effective commercial *P. monodon* diet.

## References


Briggs M. R. P., Jauncey K., Brown J. H., 1988 The cholesterol and lecithin requirements of juvenile prawn (*Macrobrachium rosenbergii*) fed semi-purified diets. Aquaculture **70**:121–129.

Chen H. Y., Jenn J. S., 1991 Combined effects of dietary phosphatidylcholine and cholesterol on the growth, survival and body lipid composition of marine shrimp, *Penaeus penicillatus*. Aquaculture **96**:167–178.

Glencross B. D., 1998 Effect of dietary phospholipids on digestion of neutral lipid by prawn *Penaeus monodon*. J World Aquacult Soc **29**:365– 369.

Gong H., Lawrence A. L., Gatlin D. M., III Jiang D. H., Zhang F., 2001 Comparison of different types and levels of commercial soybean lecithin supplemented in semi-purified diets for juvenile *Litopenaeus vannamei* Boone. Aquacult Nutr **7**:11–17.

Kanazawa A., 1993 Essential phospholipids of fish and crustaceans. In: Kaushik S. J., Luquet P. (eds.), Fish Nutrition in Practices, Biarritz (France), 24-27 June. Les colloques **61**:519-530.

Kanazawa A., Teshima S., Sakamsto M., 1985 Effects of dietary lipids, fatty acids and phospholipids on growth and survival of prawn (*Penaeus japonicus*) larvae. Aquaculture **50**:39–49.

Kean J. C., Castell J. D., Boghen A. G., D'Abramo L. R., Conklin D. E., 1985 A re-evaluation of the lecithin and cholesterol requirements of juvenile lobster *Homarus americanus* using crab protein-based diets. Aquaculture **47**:143–149.

Kumaraguru-Vasagam K. P., Ramesh S., Balasubramanian T., 2005 Dietary value of different vegetable oil in black tiger shrimp *Penaeus monodon* in the presence and

absence of soy lecithin supplementation: effect on growth, nutrient digestibility and body composition. Aquaculture **250**:317–327.
Meyers S. P., 1993 Soy lecithin and phospholipids in aquatic diets. In: Lim C. E., Sessa D. J. (eds.), Nutrition and Utilization Technology in Aquaculture. AOCS press, Champaign, Illinosis, pp. 105–113.
Strickland J. D. H., Parsons T. R., 1972 A practical handbook of seawater analysis. 2nd edition. Fisheries Research Board of Canada Bull **167**. Alger Press, 310pp.
Thompson K. R., Muzinic L. A., Christian T. D., Webster C. D., Manomaitis L., Rouse D. B., 2003 Lecithin requirements of juvenile Australian red claw crayfish *Cherax quadricarinatus*. Aquaculture Nutrition **9**:223-230.

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