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Effects of dietary supplementation of fish and vegetable oils on the growth performance and muscle compositions of the freshwater prawn *Macrobrachium rosenbergii*

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Abstract The present investigation was conducted to assess the suitability of three vegetable oils (sunflower oil, coconut oil and castor oil) as an alternative dietary lipid source for cod liver oil to culture *Macrobrachium rosenbergii* post larvae (PLs). The experimental feeds contained 40% protein with separately incorporated three vegetable oils and cod liver oil. The feeding trial was conducted on *M. rosenbergii* PL for 60 days. In the final day of the experimental period, the survival rate, weight gain, length gain, specific growth rate and protein efficiency ratio of prawns showed no significance ($P > 0.05$) between sunflower oil and cod liver oil incorporated feed fed groups. The coconut oil and castor oil showed lower performance when compared with cod liver oil. The present result showed biochemical accumulation of total protein, amino acids, carbohydrate and lipid in experimental groups. Also there is no significant difference in ash and mineral (Na^+ and K^+) contents. Among the tested diets, the recorded growth rate and biochemical constituents of sunflower oil and cod liver oil incorporated feed fed groups were similar. The present results revealed that the sunflower oil was on par with cod liver oil. Hence, the sunflower oil can be incorporated in feed formulation for *M. rosenbergii* PL culture. It can be concluded that the coconut oil and castor oil are not ideal vegetable lipid source with these concentrations which produced lower performance in survival, growth and biochemical compositions of *M. rosenbergii* PL.

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Introduction

The blue revelation of aquaculture is a major part of the food production sector in the world. The cultivable crustaceans, such as prawns, shrimps, lobsters and crabs have a vital role in aquaculture due to their nutritious delicacy for human consumption. The giant river prawn, *Macrobrachium rosenbergii* is dominating in India, and it is one of the major contributors to national economy. It represents a good source of protein, essential amino acids and polyunsaturated fatty acids, and very low in fat. Therefore, it can be used as a delicious healthy choice of food for human consumption. In the culture of this species, artificial feed constitutes a major operating cost (D'Abramo and Sheen, 1994). Animal and plant byproducts are important contributors to the growth and extension of the world aquaculture food production. They supply the chief source of proteins, essential amino acids, carbohydrate, fats, minerals and vitamins. Fishmeal, chicken waste meal and soybean meal are excellent protein sources for *M. rosenbergii* (Hasanuzzaman et al., 2009; Muralisankar and Bhavan, 2013).

Dietary lipids serve as energy source and provide essential fatty acids for freshwater prawn. They also serve as a source of sterols and phospholipids necessary for survival, growth, maintenance and proper physiological functions (Corbin et al., 1983). The *de novo* synthesis of polyunsaturated fatty acids (PUFA) from either linoleic (ω 6) or linolenic (ω 3) series is non-existent in freshwater and marine shrimps (Fenucci et al., 1981; Mukhopadhyay et al., 2003). Hence, the prawns are in need for these fatty acids from their dietary sources. Fish oils are excellent sources of *n*-6 and *n*-3 fatty acids and are better utilized by farmed species. In recent years, the production of fish oil may not be enough to cover the increasing demand for animal feed but the production of vegetable oils has increased and their prices are more stable and even less expensive than fish oil. Some vegetable oils, such as soybean and linseed oils are considerably good alternative lipid sources for salmonids, freshwater fish and prawns (Caballero et al., 2002; Kim et al., 2012). Similarly, the replacement of dietary fish oil by vegetable oils had better survival and growth of the freshwater prawn *M. rosenbergii* (Kim et al., 2012). Also, the replacement of 50–100% of fish oil by vegetable oils showed better survival, growth and health status in *Macculochella peelii*, *Tor tambroides*, *Dicentrarchus labrax*, *Diplodus puntazzo*, *Carassius auratus* and *Salmo salar* (Parameshwaran et al., 2002; Bransden et al., 2003; Richard et al., 2006; Piedecausa et al., 2007; Miller et al., 2007; Turchini et al., 2011; Kamarudin et al., 2011). The present study was conducted to assess the effects of three vegetable oils (sunflower oil, coconut oil and castor oil) on the survival, growth performance and body composition of PL of *M. rosenbergii*.

Materials and methods

Experimental animals

The PLs of *M. rosenbergii* were collected from Happy Bay Aqua Nova Hatchery, Mugaiyur, Kancheepuram, Tamilnadu, India. The PLs were acclimatized to laboratory conditions for 2 weeks before the commencement of experiments. During the acclimatization period the PLs were fed with boiled egg albumin (custard), live *Artemia* nauplii and commercially available crumple feed (Rosen fisheries, Marathakkara). The water medium was renewed on daily basis and provided mild aeration for maintaining optimum oxygen level.

Ingredients and feed preparation

The feed ingredients (green gram, soya bean meal, ground nut oil cake, tapioca flour and eggs), the vegetable oils (sunflower oil, coconut oil and castor oil), vitamin capsule and codliver oil were purchased from the local market at Coimbatore. The formulated feed basal ingredients and oils percentage are provided in Table 1. The dried basal ingredients were ground separately with electric pulvalizer and sieved with 60 μ mesh. The concerned quantity of ingredients was blended 15 min for equal mixing and steam cooked for 15 min at 90–100 °C, and allowed to cool at room temperature. The lipid source oils such as, cod liver oil, sunflower oil, coconut oil and castor oil were separately incorporated with the cooked blends. Finally, vitamin tablets, egg albumen and tapioca were incorporated with blends. The blends were again blended 15 min for thorough mixing for the binding. The final blends were mixed with water and pelletized (3 mm diameter). The pellets were dried at thermostatic oven, until reaching less than 10% moisture. The physical appearance, texture and fragrance of feed pellets were checked and kept in a plastic container. For feeding trial, three vegetable oils (sunflower oil, coconut oil and castor oil) and codliver oil incorporated feed were prepared.

Experimental procedure

M. rosenbergii post larvae ranging from 1.00 ± 0.12 cm in length and 0.15 ± 0.02 g in weight were divided into four

Table 1 Ingredients and composition of experimental diets.

Ingredients	Composition (g kg^{-1})
Soya bean meal	400
Green gram	240
Ground nut oil cake	240
Tapioca flour	60
Egg albumen	30
Vitamin mix[b]	10
Cod liver oil[a], Sunflower oil[a], Coconut oil[a] and Castor oil[a]	20
Total	1000
Proximate composition (%)	
Protein	41.74 ± 0.10
Carbohydrate	25.18 ± 0.12
Lipid	7.08 ± 0.15
Moisture	8.94 ± 0.22
Ash	11.82 ± 0.06

Each capsule contains, Total mg = 438.5 mg; Thiamine Mononitrate IP, 10 mg; Riboflavin IP, 10 mg; Pyridoxine Hydrochloride IP, 3 mg; Vitamin B_{12} (as tablets 1:100) IP, 15 mcg; Niacinamide IP, 100 mg; Calcium pantothenate IP, 50 mg; Folic acid IP, 1.5 mg; Biotin USP, 100 mcg; Ascorbic acid IP, 150 mg.

[a] Each vegetable oil was individually added to the prepared diet.

[b] Becosules capsules (manufactured by Pfizer).