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Effect of Unilateral Eyestalk Ablation and Diets on the Growth of Freshwater Prawn Juveniles of *Macrobrachium malcolmsonii* (H. Milne Edwards)

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Abstract: Effect of unilateral eyestalk ablation and diets on the growth of the juveniles of *Macrobrachium malcolmsonii* was studied. Weight gain of the eyestalk ablated juveniles fed with live foods, adult *Artemia* (8.41 g), earthworm (6.90 g) and oyster (6.54 g) was better than those fed with artificial feed I (5.18 g). Both in eyestalk ablated and intact control animals, adult *Artemia* induced higher weight gain; whereas the animals fed with artificial feed I showed the lowest weight gain. Feed consumption was higher when eyestalk ablated animals were fed with earthworm (13.92 g) and artificial feed II (13.73 g) than those fed with artificial feed I (11.63 g) and adult *Artemia* (12.12 g). However, feed consumption did not show significant difference when eyestalk ablated animal fed with earthworm, feed II and oyster. The intact control animals consumed more earthworm (11.68 g) than oyster (10.51 g), adult *Artemia* (10.32 g) and artificial feed I (9.28 g). The eyestalk ablated prawns which were fed with adult *Artemia* showed the best FCR value (1.48) followed by oyster (2.02), earthworm (2.05) and artificial feeds I (2.38) and II (2.42). Similar pattern was evident in intact control prawns. The eyestalk-ablated animals fed with adult *Artemia* showed higher survival (75.6%) than those fed with earthworm (73.6%), oyster (72.8%), artificial feeds II (69.6%) and I (68.6%). Similar pattern was also observed in intact control juveniles. The present study clearly indicates that unilateral eyestalk ablation can be adapted in aquaculture practices of *M. malcolmsonii* juveniles as it yields high weight gain within a short period when compared to intact controls.

Key words: *Macrobrachium malcolmsonii*, juveniles, FCR, Adult *Artemia*, eyestalk ablation, artificial feed

INTRODUCTION

The freshwater prawns, *M. malcolmsonii* (H. Milne Edwards) and *M. rosenbergii* (De Man) are suitable for culture, as they grow to the marketable size reaching an average weight of 40.70 g in 6 months (Kannupandi, 1995). Of the two species, *M. malcolmsonii* is quite suitable for both mono and polyculture with carps in Tamil Nadu (Anonymous, 1985; Nalluchinnappan, 1985). Eyestalk ablation is a common technique used to increase moulting frequency and growth (Rao *et al.*, 1973; Mauviot and Castell, 1976). Although eyestalk ablation has been associated with high mortality, the administration of high quality feed improved the survival of the prawns. *Tubifex* supported maximum growth in *M. lamarrei* (Marian *et al.*, 1986), *M. lanchesteri* (Ponnuchamy *et al.*, 1983) and *M. malcolmsonii* (Murugadass *et al.*, 1988). Koshio *et al.* (1992) reported a crab-protein based diet was found to be suitable for eyestalk ablated juveniles of *M. rosenbergii*. Chakravarty (1992) observed eyestalk ablation induces precocious moulting and accelerated growth in males of prawn *M. rosenbergii* when offered with bits of earthworm, coconut oil cake and mussel meat. Hence, the present study was carried out to know the effect of unilateral eyestalk ablation and diets on the weight gain of *M. malcolmsonii* juveniles fed with live and artificial feeds and to find the usefulness of this technique in producing marketable size of prawns in a short period.

MATERIALS AND METHODS

The feeding experiment was conducted in the juveniles of *M. malcolmsonii* for a period of 60 days. The ovigerous females of *M. malcolmsonii* were collected from the freshwater areas of Manampadi near Parangipettai (Lat. 11°29' N and Long 79°46' E) in Tamil Nadu. The larvae were reared in the laboratory upto juvenile stage. Healthy juveniles of *M. malcolmsonii* weighing 0.90-0.92 g and 3.5±0.5 cm lengths were selected. The experimental animals were divided into two groups. One group served as the control (intact control) and another group was used for eyestalk ablation experiment. Unilateral eyestalk at its base with a fine and clean scissors and the wound was cauterized immediately with a hot blunt needle in order to prevent the loss of haemolymph and mortality (Caillouet, 1973). Five juveniles were introduced in to each plastic trough (35 cm diameter × 13 cm height) filled with 10 L of freshwater. Each experiment had eight replicates and the juvenile were fed once a day in the morning with live and artificial feeds at 10% of the body weight. The experimental set-up was kept under the following conditions: dissolved oxygen 6.2±1 mg L⁻¹, pH 8.2±0.5, light dark regime 12/12 and temperature 28±2°C. Both unutilized feed and faeces were collected every day during water exchange and were dried in a hot air oven at 60°C for 24 h. At the termination of the experiment, wet weight of surviving individuals in each treatment was recorded.

In the present study three types of live foods (adult *Artemia*, earthworm and oyster) and two types of artificial feeds (Feed I and II) were used. Adults of *Artemia* were cultured in the laboratory using the cysts of Sunshine Brand, India. Earthworm (*Lambito mauritii*) was collected from nearby fields and oyster (*Crassostrea madrasensis*) from the Vellar estuary. The proportion of different ingredients of artificial feeds is given in Table 1. The ingredients were dried and powdered separately. The pellets were prepared by mixing together, the required quantities of the finely powdered materials and the mixture was kneaded well by adding minimum quantity of water to form dough. This dough was cooked in a pressure cooker for 30 min and the cooked material was extruded through a hand pelletizer with 2 mm perforation in the form of noodles on a filter paper and oven dried at 60°C. The dried pellets were broken into pieces of 2 to 3 mm length and stored in polythene bags for future use. Proximate analysis of live and artificial feeds was also carried out. The protein, carbohydrate and lipid contents were estimated by adopting the standard methods of Raymont *et al.* (1964), Dubois *et al.* (1956) and Folch *et al.* (1956), respectively.

Moisture

One gram of both live and artificial feeds was dried in hot air oven at 60°C for 48 h and reweighed. The difference in weight gave the moisture content.

Table 1: Composition of test diets

Ingredients	(%)	Ingredients	(%)
Feed I		Feed II	
Fish meal	35.0	Prawn head waste	30.0
Ground nut oil cake	24.0	Ground nut oil cake	15.0
Soya flour	15.0	Wheat flour	10.0
Milk powder	05.0	Tapioca powder	05.0
Yeast	01.0	Rice bran	10.0
Cholesterol	02.0	Clam meat	10.0
Tapioca powder	01.0	Squid meat	05.0
Cod liver oil	01.0	Beaf liver	05.0
Vitamin mix	01.0	Milk powder	06.0
Mineral mix		Cholesterol	05.0
		Cod liver oil	01.0
		Vitamin mix	01.0
		Mineral mix	01.0

Ash

Ash content was estimated by incinerating the test material in a muffle furnace at 560°C for a period of 5 h and weighing the residue as recommended by Paine (1964).

Gross Energy

The gross energy of the feed was calculated from the biochemical constituents by using the conversion factors that is 4.18 kcal g⁻¹ for carbohydrate, 9.46 kcal g⁻¹ for lipid and 4.32 kcal g⁻¹ for protein (Bages and Sloane, 1981).

Statistical Analysis

To know the statistical significance, t-test was applied for the growth parameters between eyestalk ablated and intact control juveniles fed with different feeds. Finally, the data were analyzed by one-way analysis of variance. Differences in treatment means were determined by Duncan's multiple range test (p<0.05) using SPSS/PC⁺ package.

RESULTS

Growth

The results of proximate composition are displayed in Table 2 and the results of 60 days growth trial are presented in Table 3 and 4. Eyestalk ablation had a significant effect on weight gain in *M. malcolmsonii* juveniles fed with different feeds. Weight gain of the eyestalk ablated juveniles fed with live foods, adult *Artemia* (8.41 g) was significantly better than those fed with artificial feeds I (5.18 g) and II (5.86 g). The weight gain of eyestalk ablated animal fed earthworm and oyster was significantly greater than those fed with feed I but not feed II. Both eyestalk ablated and intact control animals fed with artificial feed I showed the lowest weight gain whereas adult *Artemia* fed animals showed the highest weight gain.

Table 2: Proximate composition of test diets

Feed	Protein (%)	Carbohydrate (%)	Lipid (%)	Ash (%)	Moisture (%)	Gross energy (Kcal g ⁻¹)
Adult <i>Artemia</i>	56.00	0.889	12.50	29.02	74.10	3.97
Earthworm	35.15	11.84	03.80	13.09	72.82	2.37
Oyster	48.71	06.08	04.01	15.06	73.61	2.75
Feed I	45.01	11.05	09.00	13.08	07.01	3.28
Feed II	48.20	12.02	07.02	17.60	08.04	3.27

Table 3: Weight gain, feed consumed, feed conversion ratio and survival of unilaterally eyestalk-ablated juveniles of *M. malcolmsonii* fed with different feeds after 60 days feeding trail

Feed	Weight gain (g)	Feed consumed	Feed conversion ratio (FCR)	Survival (%)
Adult <i>Artemia</i>	8.41±1.18 ^a	12.12±1.39 ^a	1.48±0.34 ^a	75.6±1.60 ^c
Earthworm	6.90±1.19 ^b	13.92±1.26 ^b	2.05±0.26 ^b	73.6±0.92 ^b
Oyster	6.54±1.24 ^b	12.77±1.32 ^{ab}	2.02±0.46 ^b	72.8±1.58 ^b
Feed I	5.18±1.19 ^a	11.63±1.24 ^a	2.38±0.70 ^b	68.6±0.92 ^a
Feed II	5.86±1.05 ^{ab}	13.73±1.30 ^b	2.42±0.56 ^b	69.6±1.69 ^a

Means with different superscripts are statistically different, p<0.05; Duncan's multiple range test

Table 4: Weight gain, feed consumed, feed conversion ratio and survival of intact control juveniles of *M. malcolmsonii* fed with different feeds after 60 days feeding trail

Feed	Weight gain (g)	Feed consumed	Feed conversion ratio (FCR)	Survival (%)
Adult <i>Artemia</i>	5.61±0.76 ^b	10.32±1.11 ^b	1.87±0.33 ^a	97.6±0.92 ^c
Earthworm	4.65±0.88 ^a	11.68±0.94 ^c	2.59±0.58 ^b	96.8±0.71 ^{bc}
Oyster	3.81±0.95 ^a	10.51±0.92 ^b	2.88±0.60 ^b	96.1±0.83 ^b
Feed I	3.71±0.92 ^a	09.28±0.95 ^a	2.66±0.84 ^b	94.1±0.64 ^a
Feed II	3.82±0.89 ^a	10.91±0.71 ^{bc}	2.99±0.78 ^c	94.2±1.36 ^a

Means with different superscripts are statistically different, p<0.05; Duncan's multiple range test

Feed Consumption

Eyestalk ablation significantly altered the feed consumption of the juveniles of *M. malcolmsonii* (Table 3). Food consumption was significantly higher in the eyestalk-ablated animals offered earthworm (13.92 g) and artificial feed II (13.73 g) than those fed artificial feed I (11.63 g) and adult *Artemia* (12.12 g). However, the food consumption of oyster feed did not differ significantly from that of earthworm and artificial feed II. Intact control animals consumed significantly more earthworm (11.68 g) than artificial feed II and earthworm. Animals consumed the least amount of artificial feed I (9.28 g).

Feed Conversion Ratio (FCR)

Eyestalk ablation had a significant effect on the Feed Conversion Ratio (FCR) in *M. malcolmsonii* juveniles (Table 3 and 4). The adult *Artemia* fed eyestalk ablated prawns showed the best FCR value (1.48) than those fed with other feeds. Artificial feeds I and II showed poorer FCR than the live foods. In the intact control prawn again feeding adult *Artemia* resulted in the lowest FCR. There was no significant difference among the remaining dietary treatments.

Survival

The survival rate was significantly influenced by unilateral eyestalk ablation (Table 3 and 4), as the survival rate was lower in eyestalk-ablated animals than that in intact control animals. The ablated animals fed with adult *Artemia* (75.6%) had significantly higher survival rate than those fed with other feeds. Survival was minimum in the prawns fed with artificial feed I. Similar pattern was also noticed in the intact control juveniles.

DISCUSSION

The present study demonstrated that unilateral eyestalk ablation accelerated the growth of juvenile, *M. malcolmsonii* and also improved its feed utilization efficiency. Growth and feed efficiency were already reported to be improved in many ablated animals, *M. lancesterii* (Ponnuchamy *et al.*, 1981), American lobster, *Homarus americanus* (Koshio, 1985), *M. lamarrei* (Marian *et al.*, 1986), *M. rosenbergii* (Chakravarty, 1992; Koshio *et al.*, 1992) and *M. malcolmsonii* (Murugadass *et al.*, 1998; Soundarapandian *et al.*, 1995). But the growth of the mud crab *Rhithropanopeus harrisii* and the red king crab *Paralithodes camtchatica* was not enhanced due to eyestalk ablation (Costlow, 1966; Molyneaux and Shirley, 1988). In most of the studies mentioned above, the ablated animals showed a reduction in the intermoult period and tissue growth after post-ablated moult was mainly dependent on the nutritional quality of feeds (Koshio *et al.*, 1990). Hence the growth was assumed to be improved by offering high quality foods to the ablated animals. The present study confirms the influence of diet on the growth of eyestalk ablated animals fed with live foods was significantly higher than those of artificial feeds I and II.

The greater weight gains of eyestalk ablated juveniles fed with live foods compared with those fed with artificial feeds is in agreement with the findings of Molyneaux and Shirley (1988). The fact that feeding *Artemia* resulted in highest growth both for ablated and control animals could possibly be related to feed attractants present in the *Artemia*. Trider *et al.* (1979) observed a high survival in eyestalk-ablated lobsters (*H. americanus*) fed with frozen *Artemia*. Feeding with live food-*Artemia salina* and other synthetic diets having high protein content could improve the survival and growth of *H. americanus* (Mauviot and Castell, 1976). It was reported that a diet of adult *Artemia* induced maturation in prawn without eyestalk ablation (Camara and Rocha, 1985; Flores, 1985).

Earthworm fed ablated prawn grows larger than those fed feed I only. This growth was not significantly different from ablated animals fed oyster or feed II. Zayapragassarazan *et al.* (1995)

reported that earthworm was a highly nutritious feed for *M. malcolmsonii*. The growth was relatively poor in artificial feed I fed ablated animals may be due to the incorporation of fish meal as a major ingredient of the prawn feed which was already reported to give poor results (Deshimaru and Shigeno, 1972; Colvin, 1976; Mohiuddin and Swain, 1990).

The weight gain of unilaterally eyestalk-ablated prawn in this study is attributed to the reduced production of MIH (moult inhibiting hormone) factors from the eyestalk. Higher weight gain which was observed at moult was presumed to be due to elimination of hormone that regulates water uptake during ecdysis (Carlisle, 1955; Koch, 1952) ascribed the size increase to the increased water uptake and not to the development of tissue and this was supported by Passano (1960), Charmantier *et al.*, (1984) and Jackson *et al.* (1987). However, weight gain does not appear to be due to mere accumulation of water but subsequent tissue synthesis, which replaces the water, absorbed during ecdysis (Vijayakumaran and Radhakrishnan, 1984).

In the present study, eyestalk ablated animal consumed more food than intact control animals. Food consumption was not always related to the weight gain. The increased weight gain in ablated lobster (Vijayakumaran and Radhakrishnan, 1984) and prawn, *M. malcolmsonii* (Murugadass *et al.*, 1988; Soundarapandian *et al.*, 1995) had resulted from higher feed consumption, higher feed conversion efficiency and lower loss of converted food as exuvia. However, such variations were not observed in eyestalk ablated *M. lamarrei* (Ponnuchamy *et al.*, 1983). The high food requirements of the ablated decapods are attributed to the accelerated digestion and faster stomach evacuation with animals getting the appetite quickly. Hence the ablated prawns require more food than intact control prawns. The FCR of the present study was similar to that obtained by Ali (1982), Mathew and Jayaprakas (1990) and Ponraj *et al.* (1990).

The stress of eyestalk ablation cannot account for the high mortality. The X-organ sinus gland complex constitutes the secretory site of many neurohormones (Fingerman, 1987) and the endocrine imbalance in eyestalk-ablated animals might reduce their survival. For instance, the absence of hormone, which controls salt deposition in the exoskeleton, would result in difficulties and thus mortality incurred during ecdysis (Chu and Chow, 1992). Further it has been suggested that diet plays a significant role in the survival of eyestalk-ablated crustaceans (Castell *et al.*, 1976).

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