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Growth Response of the Freshwater Prawn *Macrobrachium malcolmsonii* (Juveniles) to Isocaloric Diets with Variable Protein Levels

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ABSTRACT

Indoor culture of freshwater prawn is considered to be an alternative and sustainable approach in order to meet the market demand. Culture potential of freshwater prawn (*Macrobrachium malcolmsonii*) under laboratory conditions was determined by growth trials performed in glass aquaria. The dietary protein requirement of *M. malcolmsonii* juveniles was analyzed using rations based on fish meal and shrimp meal as the main sources of protein. Five protein levels T1 (30%), T2 (32.5%), T3 (35%), T4 (37.5%) and T5 (40%) were tested to assess the best growth. Overall maximum growth was observed in T_3 while minimum growth was observed in T_4. Significantly higher ($p<0.05$) average weight, % weight gain and SGR was observed in T_2 and T_3 diets as compared to T_1, T_4 and T_5 diets. Feed conversion ratio was significantly lower ($p<0.05$) in T_2 and $T_3$and but significantly higher ($p<0.05$) in T_1, T_4 and T_5. Water quality parameters like dissolved oxygen, ammonia, nitrate, and nitrite were recorded to be within the permissible limits while temperature, pH, alkalinity and hardness were found to be slightly higher than the permissible limits.

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Authors' Contributions
ABT designed and supervised the study. RA executed the experimental work. ABT, AY and GR wrote the article.

Key words
Protein requirements, juvenile prawn, feed conversion ratio, *Macrobrachium malcolmsonii.*

INTRODUCTION

Aquaculture is the fastest growing food sector (Kutty, 2005). An immense potential is present for the development of this sector in Pakistan but still efforts for the promotion of this sector are very limited (FAO, 2005).

Pakistan has a large number of fresh, salt and marine water resources but fish culture is most commonly going on in inland waters. Prawn culture is practiced only on a limited scale, and extensive farming practices with little inputs of carps are cultured in earthen ponds (FAO, 2005). Freshwater prawn culture is sustainable and environment friendly (Radheysham, 2009). Prawns have high nutritive value and there is worldwide stress on the need for prawn culture (Bhavan *et al.*, 2010).

Freshwater prawn *M. malcolmsonii* is the next species for farming after *M. rosenbergii* and having a good growth potential (Kutty *et al*., 2000; Radheysham, 2009). Both of these species are suitable for culture because they grow to a marketable size in 6 months. *M. malcolmsonii* is suitable for both mono and poly- culture with carps (Edwards, 2008). Due to non-availability of adequate amounts of seeds of this species and useful culture technology, its commercial farming is not commonly practiced (Radheysham, 2009). In addition for successful and extensive culture of prawn, it is important to investigate the nutritional requirement of prawns (Tendulkar and Kulkarni, 2011). Present study evaluates the optimum protein requirement of *M. malcolmsonii* by its culture at varying protein levels.

MATERIALS AND METHODS

Experimental setup

The experiment was conducted in 10 glass aquaria (3'×1.5'×1') of 90 L capacity containing 60L of tap water. *M. malcolmsonii* juveniles were transported to aquaculture laboratory of Sustainable Development Study Center, Government College University, from natural waters at Taunsa Barrage and transported in polythene bags partially filled with oxygen. These juveniles were stocked in glass aquaria, after giving a bath into $KMnO_4$ solution with concentration of 2mg/l for 30 seconds only (Marecaux, 2006) and acclimatized for two weeks. Air pumps were used to maintain dissolved oxygen above 5mg/l. Ten juveniles of *M. malcolmsonii* (1.5±0.01g) were stocked in each experimental aquarium and each treatment was comprised of 3 replicates.

Experimental diets of prawns

Fish meal, soybean meal, wheat bran, rice bran, fish oil, egg albumin, vitamins and minerals premix were used for the preparation of prawn feed (FAO, 2002). Five different feed with varying protein levels as T_1 (30%), T_2 (32.5%), T_3 (35%), T_4 (37.5%), and T_5 (40%) were prepared (Table I). Feed was prepared in the form of pellets and air dried. After drying the pellets were cut into granules of small millimeters in size and stored in plastic

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bags. Feed were stored in plastic bags and kept in dry place (Hasanuzzaman *et al.*, 2009).

Table I.- Composition of different experimental diets for *M. malcolmsonii* juveniles.

Ingredients	Diet-1	Diet-2	Diet-3	Diet-4	Diet-5
Rice polish	25	22	19	16	13
Fishmeal	22	25	28	31	34
Wheat flour	25	22	19	16	13
Soybean meal	22	25	28	31	34
Vitamin mineral premix	1	1	1	1	1
Ascorbic acid	2	2	2	2	2
Cod liver oil	2	2	2	2	2
Egg albumen	1	1	1	1	1
Total	100	100	100	100	100

All the five feeds were analyzed for proximate composition *i.e.* protein, fat, moisture, ash, fiber in percentage and energy in Kcal/100g (AOAC, 2005). Percentage crude protein was analyzed by protein analyzer (Inkjel M Behr Labor-Technik), lipids by solvent extraction unit (KB 8 Gerhardt Bonn), ash by using muffle furnace (Carbolite CWF 1200), moisture by oven (memmert GmbH + Co. KG D-91126 Schwabach FRG),fiber contents by crude fiber apparatus (OSK 1352OA, Ogawa Seiki Co), and energy was determined by bomb calorimeter (K-C2000 basic IKAR WERKE).Each analysis was done in triplicate(Ghazala *et al*., 2011) (Table II).

Feed trials

The juveniles were fed thrice a day with prepared feed at a feeding rate of approximately 15% body weight per feeding per day (Radheyshyam, 2009). Juvenile prawns were weighed every fortnight and weight gain was used to adjust the feed for the following fortnight. To remove uneaten food and feces each aquarium was siphoned out regularly after 1 and 3 hours respectively (Tabinda and Butt, 2012).

Nutritional indices analysis

During acclimatization period, juveniles of freshwater prawn were fed with standard feed (32.5%) @10% of body weight for two times a day. Evaluation of biological parameters *viz.*, average weight gain, percent weight gain (%WG), specific growth rate (SGR), and feed conversion ratio (FCR) was done following the procedures of Manivannan and Saravanan (2012).

Physico-chemical parameters monitoring

Water temperature, dissolved oxygen (DO) and pH were recorded daily using mercury thermometer (IR Thermometer Smart Sensor), DO meter (HANNA-HI 9145) and pH meter (WTW D82362 Wellheium, Germany) respectively. Alkalinity, hardness, nutrients (nitrite, nitrate, ammonia and phosphate), were measured fortnightly using standard methods (APHA, 2005).

Statistical analysis

Significance of variations in the recorded values of growth parameters and physico-chemical parameters of water were analyzed by using one way analysis of variance, ANOVA using SPSS 18 software.

RESULTS AND DISCUSSION

In the present study, differences were investigated with respect to performance of five different protein level diets on growth parameters of *M. malcolmsonii*. Overall weight gain ranged between 3.45 and 4.45g throughout the experimental period in different dietary treatments. Growth response of juvenile *M. malcolmsonii* in terms of AWG, was significantly higher ($p<0.05$) in T_3 (4.45±0.71) as compared to T_1 (3.75±1.43), T_4 (3.45±2.03) and T_5 (3.5±1.72) but insignificantly higher ($p>0.05$) to T_2 (3.95±1.05). Similarly significantly higher ($p<0.05$) %WG was observed in T_3 (196.66%) as compared to T_1 (141.93%), T_4 (109.09%) and T_5 (133.33%) but insignificantly higher ($p>0.05$) to T_2 (192.59%) (Table III).

The growth trend for different treatments was in the order of $T_3>T_2>T_1>T_5>T_4$. Similar to present study New (1980) reported 27 to 35% as best protein level for growth of shrimp and prawns Mitra *et al.* (2005) and CIBA (2003) reported that 35% protein is required for the growth of juveniles *M. rosenbergii*. Similar to current study, Radheyshyam (2009) also reported 35% protein feed for optimal growth and survival of *M. malcolmsonii*. Findings of Wurst *et al.* (2009) are also in agreement with present studies and achieved best growth in feed containing 35.5% crude protein. Similarly Teshema *et al.* (2006) also achieved comparatively better growth in *M. rosenbergii* for 35.5% protein diet than other test diets.

Overall range of SGR was between 0.60 and 1.10. Maximum SGR was observed in T_3 (1.10±0.33) but minimum in T_4 (0.60±0.21). Significant difference ($p<0.05$) was determined among SGR of T_2 (0.96±0.71) and T_3 (1.10±0.33), as compared to SGR of T_1 (0.80±0.09), T_4 (0.60±0.21) and T_5 (0.71±0.39) (Table III). Similar results for highest SGR were reported by the Teshema *et al.* (2006) and Wurst *et al.* (2009) for 35% protein diet.

FCR during the experiment ranged between 1.70 and 2.75. Significantly lower FCR ($p<0.05$) was observed in T_3 (1.70±0.19) and T_2 (2.05±0.23) as compared to T_1 (2.53±0.04), T_4 (2.75±0.04) and T_5 (2.61±0.27). FCR of

Table II.- Proximate composition (Mean±SD) of feed ingredients used in preparation of different diets for *M. malcolmsonii* juveniles.

Ingredients	Protein (%)	Fiber (%)	Fat (%)	Ash (%)	Moisture (%)	Energy (Kcal/100g)
Fish meal	57.00±0.001	11.78±0.001	2.40±0.002	21.3±0.002	9.78±0.001	453.80±0.02
Soya bean	46.00±0.001	14.44±0.002	11.24±0.001	7.43±0.001	9.80±0.002	429.20±0.01
Rice polish	16.00±0.001	11.37±0.002	1.92±0.001	9.42±0.002	8.76±0.002	444.60±0.02
Wheat flour	6.00±0.002	2.76±0.001	1.10±0.002	1.08±0.002	7.98±0.001	419.00±0.02
Egg Albumin	14.6±0.007	4.02±0.001	0.2±0.004	0.76±0.01	85.40±0.006	420.30±0.03

+ Values are expressed as mean± SD of triplicate samples

Table III.- Growth performance (Mean±SD) of *M. malcolmsonii* Juveniles fed with different level of protein diets.

Treatment	Diet-1	Diet-2	Diet-3	Diet-4	Diet-5
Protein level (%)	30	32.5	35	37.5	40
Average initial weight (g)	1.55±0.09*	1.35±0.02*	1.50±0.02*	1.65±0.13*	1.50±0.07*
Average final weight (g)	3.75±1.43*	3.95±1.05**	4.45±0.71**	3.45±2.03*	3.50±1.72*
Weight gain (g)	2.20±1.77*	2.60±10.07**	2.95±0.65**	1.80±2.70*	2.00±1.88*
% weight gain	141.93±26.46*	192.59±10.61**	196.66±9.73**	109.10±31.43*	133.33±23.42*
SGR	0.80±0.09*	0.96±0.71**	1.10±0.33**	0.60±0.21*	0.71±0.39*
FCR	2.53±0.04*	2.05±0.23**	1.70±0.19**	2.75±0.26*	2.61±0.27*
Survival (%)	95	100	100	95	96

+Values are expressed as mean of triplicate groups of ten juvenile prawns.
-Means with different asterisk within a row are significantly different (P<0.05)

Table IV.- Physico-chemical parameters of aquarium water during the feeding trial of *M. malcolmsonii* juveniles with different levels of protein diets.

Parameters	Diet-1	Diet-2	Diet-3	Diet-4	Diet-5
Temperature (°C)	26.28±4.07	26.43±4.42	26.60±4.38	26.70±4.17	26.48±3.92
pH	8.38±0.33	8.25±0.16	8.46±0.28	8.33±0.37	8.17±0.13
Dissolved oxygen (mg/L)	6.37±0.21	6.44±0.24	6.46±0.35	6.62±0.41	6.62±0.35
Alkalinity (mg/L)	350.68±25.28	359.65±22.84	346.85±19.52	363.06±13.87	335.98±19.27
Hardness (mg/L)	315.01±26.74	335.68±4.84	335.38±49.61	343.30±13.15	355.48±22.80
Nitrite (mg/L)	0.03±0.08	0.02±0.17	0.04±0.09	0.06±0.10	0.05±0.21
Nitrate (mg/L)	3.39±0.37	3.54±0.26	5.18±0.39	5.40±0.33	4.46±0.29
Ammonia (mg/L)	0.03±0.02	0.07±0.02	0.07±0.01	0.06±0.01	0.06±0.02
Phosphate (mg/L)	0.05±0.02	0.06±0.05	0.06±0.10	0.07±0.02	0.09±0.04

Mean ± SD of two replicates.

T_1, T_4 and T_5 did not significantly differ ($p>0.05$) from each other (Table III). Differences in FCR, SGR and % weight gain between the treatments may be attributed to differences in the component and proportions of protein ingredients. Wurst *et al.* (2009) also observed lowest FCR for 30 and 35% protein diets. The decrease in FCR itself indicates the better quality of feed.

Average temperature, pH and DO recorded in the present study were 26.3-26.7°C, 8.17-8.38, 6.37-6.62mg/L, respectively (Table IV). These values were within the permissible limits as described by Boyd and Zimmerman (2000). Similar ranges of water quality parameters were observed by Hasanuzzaman *et al.* (2009) and Bhavan *et al.* (2011) during their feeding experiment on *M. malcolmsonii*. Alkalinity and hardness values ranged as 346.85-359.65, 315.01-355.68 mg/L, respectively (Table IV). These values were higher than the standards prescribed by Boyd (2001) and Bhavan (2011) for *M. malcolsonii* culture. Similarly average value of nitrite, nitrate, ammonia and phosphate for this experiment were 0.02-0.06, 3.39-5.54, 0.03-0.07and 0.05-0.09 mg/L, respectively (Table IV). Burford and Lorenzen (2004) also observed same values for these water parameters.

CONCLUSION

In this study, among the five different levels of protein, the diet containing 35% protein the best growth performance and survival rate in *M. malcolmsonii* juveniles.

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