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Effect of dietary vitamin E on growth and survival rate of the giant freshwater prawn *Macrobrachium rosenbergii*

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Abstract. The experiment was carried out to evaluate the effect of dietary vitamin E on the growth and survival rate of freshwater prawn (*Macrobrachium rosenbergii*) for a period of 10 weeks. PL of initial weight of 0.18±0.03g were released at stocking density of 265/m^3. Four different treatments (T1, T2, T3 and T4) having different amount of vitamin E such as 1000 mg vitamin E/kg feed (T2), 2000 mg vitamin E/kg feed (T3), and 3000 mg vitamin E/kg feed (T4) where 0 mg vitamin E/kg feed (T1) was considered as control. Final weight (g), weight gain (g), specific growth rate (%/day) and protein efficiency ratio (PER) varied from 1.0 ± 0.02 to 1.20 ±0.01, 0.86±0.02 to 1.02±0.01, 476.38±11.81 to 564.21±5.54, 2.50±0.03 to 2.70±0.01 and 1.75±0.15 to 1.86±0.23, respectively. The highest survival rate (95.53 ± 1.03) was found in T4 and lowest was (88.87±1.98) in T1. Best growth performance and survival rate was found in T4 followed by T3, T2 and T1. The study suggests that the best growth performance and survival rate of prawn can be obtained from supplementation of 3000 mg vitamin E/kg feed containing diet.
Keywords: *Macrobrachium rosenbergii,* Vitamin E

Introduction

The giant freshwater prawn (*Macrobrachium rosenbergii*) farming is currently one of the most important sectors of the national economy of Bangladesh and during the last two decades, its development has attracted considerable attention because of its export potential. Shrimp is one of the major export items of Bangladesh, generating 3682.26 core taka annually and total shrimp and prawn production including capture has been increased from 0.16 m MT in 2002-03 to 0.245 m MT in 2016-17 and its growth rate was 4.67 (DoF 2017). The migration of poor communities from the coastal region to the urban areas has reduced because of improved livelihood opportunities brought by prawn and shrimp culture.

Vitamin E supplementation has been reported to enhance non-specific immune responses in fish and maintain flesh quality, normal resistance of red blood corpuscles to haemolysis and permeability of capillaries, even though its exact mechanism has not been demonstrated (Halver 2002). A number of studies reported improved immune responses, growth performance, reproductive performance, nutrient digestibility, meat quality and disease resistance in many fish species as well as terrestrial animals by feeding higher levels of dietary vitamin E than required (Lee *et al.* 2003, Samanta *et al.* 2006). It has been well known that nutrients, such as proteins, lipids, vitamins and minerals could affect phagocyte function (Landolt 1989). Vitamin C and E are considered as activators of the phagocyte population and immunostimulants (Eo and Lee 2008). Kanazawa (1985) found that Vitamin E played a significant role in shrimp nutrition; preventing polyunsaturated fatty acid oxidation in shrimp tissues and addition of vitamin E to

diets resulted in improvement of survival of larval *Marsupenaeus japonicus*. *Penaeus vannamei* showed significantly lower survival and weight gain when fed a vitamin E-free diet (He *et al.,* 1992). Tocopherol is known to be one of the components affecting the quality of penaeid eggs, in terms of hatching rate and larval viability (Cahu *et al.* 1991). For prawn, the optimum amounts of vitamin E in formulated feeds are important because either low or high levels of vitamin may lead to poor growth. Moreover, excess vitamin E in diet may be wasteful and cause the diets to be unnecessarily expensive. Therefore, the present study was designed to determine the effect of different levels of vitamin E on the growth performances and survival rate of *M. rosenbergii*.

Materials and Methods

***Experimental design*:** The research work was undertaken in 12 glass aquaria (each contained 60L) at the wet laboratory, Faculty of Fisheries, Bangladesh Agriculture University, Mymensingh. The size of each aquarium was $61 \times 30.50 \times 39.59 cm^3$. Stored ground water was used for rearing the prawn. The glass aquaria were divided into four treatments T1, T2, T3 and T4 with three replications of each. An adequate level of dissolved oxygen in each aquarium was maintained through artificial aeration. Partial change of water from each aquarium was done daily during the removal of uneaten feed and faces.

***Sample collection and acclimatization*:** PL of *M. rosenbergii* was collected from Fish Seed Multiplication Farm, Shambhuganj, Mymensingh. Transportation of PL was done in oxygen bag to avoid stress and injury. During three days of acclimatization period, adequate oxygen supply was maintained through artificial aeration and PL were fed formulated pelleted feed. The PL were randomly distributed at a rate of 15 per aquarium.

***Feed formulation*:** The ingredients used for preparation of basal experimental diets along with their proximate composition are shown in Table I. Four levels of vitamin E (α-tocopherol acetate) were tested in this study. Diets of T1, T2, T3 and T4 contained 0 mg, 1000 mg, 2000 mg and 3000 mg vitamin E/kg respectively. α-tocopherol acetate was supplemented separately to the basal diet at the expense of wheat bran. The ingredients were ground, milled, weighed, mixed, dough of feed ingredients made and pelleted with meat mincer through a 0.5 mm diameter. After pelleting, the feed were air dried and put in an air-tight container. All diets were stored at -20°C until fed.

Table I. Proximate composition analysis and inclusion level of different feed ingredients (dry basis)

Feed Ingredients	Crude Protein (%)	Crude Lipid (%)	Moisture (%)	Ash (%)	Crude Fibre (%)	NFE	Inclusion level (%)
Fish meal	58.74	10.60	8.51	16.60	2.80	2.75	60
Rice bran	13.61	11.40	12.01	13.60	6.80	42.58	15
Wheat bran	16.13	5.60	13.14	13.40	6.95	44.78	15
Molasses	-	-	-	-	-	-	5
Carboxy methyl cellulose	-	-	-	-	-	-	3
Mineral Premix	-	-	-	-	-	-	1
Vitamin Premix (Vitamin E free)	-	-	-	-	-	-	1

***Proximate composition of formulated feed*:** Proximate composition of prepared feeds, individual ingredients and initial and final carcass composition of prawn were analyzed in the Fish Nutrition Laboratory, Department of Aquaculture, BAU following Association of Officials Analytical Chemists (AOAC 2000) methods. Proximate composition of the four formulated feed is shown in Table II.

Table II. Proximate composition analysis of formulated feed (dry basis)

Diet	Moisture (%)	Crude Lipid (%)	Crude Protein (%)	Ash (%)	Crude Fibre (%)	NFE
Control	14.38	6.65	33.30	13.81	4.98	26.88
Diet 2	13.81	5.98	34.48	14.68	4.40	26.65
Diet 3	13.06	6.20	32.92	13.62	6.56	27.64
Diet 4	13.54	6.38	33.71	13.97	5.36	27.04

Experimental procedure: The experiment was conducted for 10 weeks (from 03 August to 12 October, 2018). Initial weight of *M. rosenbergii* was 0.18g. Feeding was done once daily at 6.30 pmat the rate of 15% for first two weeks, 10% for following two weeks, 5% of the body weight for rest of the experimental period. About 50% water was changed daily at 9.00 am. Initial and final weight of prawn in each aquarium was recorded. The weight was measured biweekly to keep the record.

***Estimation of growth performance*:** The growth performances of *M. rosenbergii* in terms of final weight (g), weight gain (g), specific growth rate (%/day), feed conversion ratio (FCR), feed conversion efficiency (FCE) and protein efficiency ratio (PER) were calculated at the end of the experiment.

***Water quality parameters*:** The water quality parameters such as water temperature, dissolved oxygen (DO), pH were monitored biweekly throughout the experimental period to evaluate the environmental quality of aquaria.

***Data analysis*:** The collected data were analyzed by Microsoft Excel and XL-Stat (version 2013) analytical tool which was used to perform statistical analysis as one way ANOVA. The means of different treatment were compared by Duncan Multiple Range Test (Duncan, 1955) to test the significance of variation between the treatment means at $p < 0.05$.

Result and Discussion

***Weight gain (g)*:** The effect of vitamin E on the growth and survival rate of prawn in aquarium was investigated. Compared with other treatments, growth performance of prawn were significantly ($p < 0.05$) higher (1.02 ± 0.01g) in T4 which was provided with higher levels of vitamin E (3000 mg/kg) whereas lower in T1 (0.86 ± 0.02 g) (Table III). Murthy *et al.* (2016) recorded that the weight gain of *M. rosenbergii* was higher where carotenoid was used at a dose of 180 mg/kg whereas lower growth was observed in the control group (0 mg/kg). The result of the above study more or less agreed with the present study. In the present study, the maximum mean final weight was 1.20 ± 0.01g in T4, whereas, the minimum was 1.04 ± 0.02g in T1.

Murthy *et al*. (2016) showed that maximum mean final weight in *M. rosenbergii* was 1.585± 0.08g and the minimum was 1.225±0.07g.

Specific growth rate (SGR%/day): SGR varied from 2.50 ± 0.03 to 2.70 ± 0.01% (Table III). SGR was significantly ($p<0.05$) higher in T4 than T3 followed by T2 and T1. Amlashi *et al*. (2012) found the highest value of SGR of *Husohuso* in treatment with vitamin E at 50 mg/kg feed and lowest without vitamin E. Murthy *et al*. (2016) reported the highest SGR value was 2.53±0.05% and the lowest was 2.09±0.07%. The SGR values obtained in the present study are more or less similar to the above studies.

Table III. The effect of different treatments on growth performance, feed utilization and survival of prawn (*M. rosenbergii*) reared in aquarium (Mean±SE) during the study period

Variable parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Level of sign.
Initial weight (g)	0.18 ± 0.03	0.18 ± 0.03	0.18 ± 0.03	0.18 ± 0.03	NS
Final weight (g)	1.04 (± 0.02)^{d}	1.10 (± 0.01)^{c}	1.14 (± 0.02)^{b}	1.20 (± 0.01)^{a}	*
Weight gain (g)	0.86 (± 0.02)^{d}	0.92 (± 0.01)^{c}	0.96 (± 0.02)^{b}	1.02 (± 0.01)^{a}	*
SGR (%/day)	2.50 (±0.03)^{d}	2.58 (±0.01)^{c}	2.63 (±0.03)^{b}	2.70 (±0.01)^{a}	*
FCR	1.63 (±0.10)	1.66 (±0.08)	1.65 (±0.10)	1.68 (±0.08)	NS
FCE	0.61 (±0.04)	0.60 (±0.03)	0.61 (±0.04)	0.60 (±0.03)	NS
PER	1.85 (±0.18)	1.75 (±0.15)	1.86 (±0.23)	1.77 (±0.02)	NS
Survival rate (%)	88.87 (±1.98)^{c}	91.13 (±1.13)^{b}	91.13(±1.13)^{b}	95.53 (±1.03)^{a}	*

The values in the same row having different alphabets differ significantly ($p<0.05$) as per Duncan MultipleRangeTest (DMRT).

***Food conversion ratio (FCR)*:** In the present study, the FCR ranged from 1.63±0.10 to 1.68±0.08. No significant difference was observed in FCR among the treatments (Table III). Ouraji *et al*. (2011) reported the FCR of *Fenneropenaeus indicus* in T1 (100 mg/kg vitamin E) and T2 (300 mg/kg vitamin E) was 3.76±0.16 and 3.85±0.11, respectively. Murthy *et al.,* (2016) reported the highest FCR value was 2.73±0.16 and the lowest was 2.26±0.01. The FCR values in the present study were lower than the above studies. This may be due to good quality and high energy value of feed ingredients used in this experiment, quality of PLs and overall good environmental condition during the experimental period.

***Protein efficiency ratio (PER)*:** PER ranged from 1.75±0.15 to 1.86±0.23 but no significant difference was observed among the (Table III). Amlashi *et al.,* (2012) found the value of PER of *Husohuso* in different treatment ranged from 2.06±0.05 to 2.36±0.02. Murthy *et al.,* (2016) reported the highest PER value was 1.259±0.00 and the lowest was 1.043±0.05. The PER in the present study were higher than (1.043 to 1.259) reported by Murthy *et al*. (2016) but lower than (2.06 to 2.36) stated by Amlashi *et al.,* (2012).

Survival rate (%): In the present study, the survival rate varied from 88.87±1.98 to 95.53±1.03% (Table III). Survival rate was higher in T4with the highest vitamin E level (3000 mg/kg feed) and lower in T1 (control) where prawn reared without vitamin E. Gimenez *et al*. (2004) observed highest 64.00±0.00% survival in T4where vitamin E level was 1500 mg/kg feed and lowest 43±0.00% in T2where vitamin E level was 100 mg/kg feed. In another trial, Gimenez *et al*. (2004) found that highest survival rate 90.00±0.00% was at T5 where vitamin E

level was 1750 mg/kg feed and lowest 62.00±0.00% in T1 where no vitamin E was supplemented. In the present study, survival rate was higher than the above studies, which might be due to good quality and high energy value of feed ingredients, aeration used in the experimental aquaria and water exchanged at regular intervals. The better water quality might have positively contributed to the higher survival (%) of prawn PLs.

***Water quality parameters*:** The maintenance of good water quality is essential for both survival, growth and production of commercial aquaculture species. In the present study, water temperature varied from 27.60 to 30.20°C (Table IV). Boyd (1982) reported that the range of water temperature from 26.06 to 31.97°C is suitable for fish culture. Zafar *et al.* (2015) observed that water temperature ranged from 30.00±0.00 to 32.67±0.88°C which is very similar to the present study.

Table IV. Summary of water quality parameters observed during the experimental period

Parameters	Value range
Temperature (°C)	27.60 – 30.20
pH	7.98 – 8.20
Dissolved Oxygen (DO) (mg/l)	8.3 – 9.4

The dissolved oxygen content from present experiment ranged from 8.3 to 9.4 mg/l (Table IV). Zafar *et al.* (2015) observed that the dissolved oxygen level ranged from 7.67±0.33 to 9.67±1.68 mg/L is suitable for prawn and shrimp culture. Other studies reported that the optimum range of dissolved oxygen for shrimp and prawn is >4 ppm which is very similar to the finding of the present study (DoF 2009). During the study period, the pH value was 7.98 to 8.20 (Table IV). Zafar *et al.* (2015) observed that the pH level ranged from 8.17±0.17 to 8.37±0.08 is suitable for prawn and shrimp culture. The pH values recorded in the present study were within suitable range for prawn culture. So, all the water quality parameters measured were suitable for prawn culture and did not have any negative effect on growth of prawn.

The result of the present study revealed that the best growth performance and survival rate of *M. rosenbergii* were obtained with supplementation of 3000 mg/kg feed that could be recommended for prawn PLs rearing. Further research should be carried out in pond system to observe growth, survival rate and histological parameters of prawn to find out the optimum level of vitamin E per kg feed which could be chosen by the fish farmers and feed manufacturers.

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