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GROWTH PERFORMANCE OF THE GIANT FRESHWATER PRAWN, *Macrobrachium rosenbergii* JUVENILE FED ON A BASAL DIET CONTAINING DIFFERENT ZINC CONCENTRATIONS

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SUMMARY

The main objectives of this study were to evaluate the effects of zinc on growth performance, survival, feed utilization and body composition of the giant freshwater prawn, Macrobrachium rosenbergii juvenile. Eight diets were formulated with 0 (control), 10, 30, 50, 70, 90, 110 and 130 mg Zn kg^{-1} of diet as Zinc sulphate ($ZnSo_4$. $7H_2O$). Fish meal, soybean meal, bread flour and wheat meddling were used as an ingredient of the basal diet which contained 36.7 % crude protein and used as control diet without zinc supplementation. Twenty post-larvae of Macrobrachium rosenbergii of mean length of 1.45 ± 0.01cm and weight of 0.022 ± 0.001g were stocked in each aquarium, set in triplicate groups. The experiment continued for 12 weeks.

The results revealed that, the best growth performance and survival rate were obtained with groups of prawn fed diet supplemented with 70 mg Zn kg^{-1} diet. Best feed conversion ratio (FCR), feed efficiency ratio (FER), protein efficiency ratio (PER) and feed intake were obtained with diet supplemented with 70 mg Zn kg^{-1} and 90 mg Zn kg^{-1} of diet as compared to 0 control, 10, 30, 50,110, and130 mg Zn kg^{-1} diet. Whole body composition of moisture and protein did not differ significantly among treatments. The highest lipid content was obtained with the groups of prawn fed 30 mg Zn kg^{-1} diet compared with the others. Whole body ash increased significantly with the increasing of zinc level.

It could be concluded that diet supplemented with 70 mg Zn kg^{-1} of diet is the best Zn level for feeding of the giant freshwater prawn, Macrobrachium rosenbergii under the experimental condition.

Keywords: Growth, survival, feed utilization, body composition, zinc levels, Macrobrachium rosenbergii

INTRODUCTION

Historically, freshwater prawns of the genus *Macrobrachium* have been esteemed as food in many parts of the world. Of this group, the giant prawn of the Indo-Pacific, *M. rosenbergii*, has become so popular and has received a great deal of attention as a preferred crustacean. It grows fastest among all freshwater prawn **(**Mukhopadhyay *et al.,* 2003**).** Like most animals, crustaceans require small amounts of minerals, to support a number of key metabolic processes (DeSilva and Anderson, 1995). Minerals act as biocatalysts for enzymes, hormones, and proteins or form components for hard-tissues matrices (exoskeleton), soft-tissues, and as cofactors or activators of enzymes. Minerals are also involved in maintenance of osmo-regulation, pH balance and membrane potential (Davis and Lawrence, 1997).

Complete dietary mineral requirement for *M. rosenbergii* is not yet elucidated and knowledge of qualitative and quantitative requirements is scantly (Kanazawa *et al.,* 1984). Some authors suggested that prawn may obtain minerals from ambient water, however, the importance of dietary minerals has been supported by the demonstrated ability of prawn to absorb inorganic minerals from diets and levels of some minerals such as calcium and magnesium in the carapace peaked at inter-molt and declined during pre-molt of prawn. The minerals content in the carapace can be affected by the levels of minerals in the diet (Mukhopadhyay *et al.,* 2003).

Trace elements are not only the basic units of the skeletal structures of animals but also important co-factors for enzymes and other biological chemicals involved in life processes. The importance of zinc as a diet component has gained considerable attention in the past few years. Zinc has an important role in numerous biological processes in avian, mammalian and aquatic species. For instance, zinc is an essential component of many enzymes (Vallee and Auld, 1990), and it has both structural and catalytic functions system and is a component of a large number of metallo enzymes. Furthermore, dietary zinc is required for normal immune response and an adequate dietary Zn concentration for non-specific immune responses in *Penaeus monodon* is about 35- 48 mg Zn/kg diet (Shiau and Jiang, 2006). It is an essential element required for normal growth and is indispensable in the diet (Yamaguchi, 1998**).** Rath and Dube (1994) stated that zinc has a significant role on growth promotion and survivability of the freshwater prawn. However, studies regarding nutritional requirement of zinc are confined to rainbow trout (Ogino and Yang 1978 and Kenox *et al.,* 1984) and *Nile tilapia* (Magouz, 2002).

In the present study an attempt has been made to study the effect of the trace element zinc in promoting growth, survival, feed utilization and body composition of *M. rosenbergii* larvae.

MATERIALS AND METHODS

Diet preparation:

Experimental practical basal diet formulation and proximate analysis is tabulated in Table (1) to be adequate for *M. rosenbergii* (36.7 % crude protein). The basal diet was divided to eight portions and Zinc sulphate ($ZnSo_4$. $7H_2O$) was added to the diets at levels of 0 (control) , 10, 30, 50, 70, 90, 110, 130 mg Zn Kg^{-1} diet. Zinc sulphate was dissolved in 400 ml distilled water and subsequently was well mixed with the dry components, until stiff dough resulted. This was then passed through a mincer with die and the resulting "Spaghetti-like" strings were dried using an electrical fan at 22 ºC. After drying, the diets were broken up and sieved into convenient pellet sizes and stored at -20ºC.

Experimental system and animals:

The feeding trial was conducted in 24 glass aquaria each containing 80-liter of dechlorinated tap water. About one third of water volume in each aquarium was daily replaced by aerated fresh water after cleaning and removing the accumulated excreta. All aquaria were supplied with compressed air for oxygen requirements. A photoperiod of 12-h light, 12-h dark (08.00 to 20.00 h) was used. Fluorescent ceiling lights supplied the illumination.

Water temperature and dissolved oxygen were measured every other day using a YSI Model 58 oxygen meter. Total ammonia and nitrite were measured twice weekly using a DREL, 2000 spectrophotometer. Total alkalinity and chloride were monitored twice weekly using the titration method; pH was monitored twice weekly using an electronic pH meter (pH pen; Fisher Scientific, Cincinnati, OH). During the 12-weeks feeding trial, the water-quality parameters averaged (± SD): water temperature, 26.8 ± 0.9 ºC: dissolved oxygen, 5.6 ± 0.7 mg l^{-1}: total ammonia, 0.19 ± 0.12 mg l^{-1}: nitrite, 0.07 ± 0.03 mg l^{-1}: total alkalinity, 178 ± 42 mg l^{-1}: chlorides, 570 ± 152 mg l^{-1}: pH, 8.4 ± 0.3.

A set of 480 juvenile *M. rosenbergii* average initial length of 1.45±0.01cm and weight of 0.022±0.001g were collected from the stock at Fish Research Laboratory in Shebin El-Kom, Faculty of Agriculture, Minufiya University and were used for the feeding trial. Twenty juvenile were randomly stocked into each aquarium with triplicate per treatment. After stocking, to minimize stress of handling, 10 prawns from each aquarium were measured and weighed every two weeks and at the end of the feeding trial. All prawns were fed at 5 % of the total body weight daily. Prawns were fed twice a day (0800 and 1600 h) six days per week for 12 weeks.

Growth performance and feed conversion were measured in terms of final individual weight (g), survival rate (%), specific growth rate (SGR, % day^{-1}), feed conversion ratio (FCR), protein efficiency ratio (PER), and feed intake (% body weight). Growth response parameters were calculated as follows: SGR (% day^{-1}) = ({In W_t - In W_i}/ T) x 100, where W_t is the weight at time t, W_i is the weight at time 0, and T is the rearing period in days: FCR = total dry feed fed (g) / total wet weight gain (g): PER = wet weight gain (g) / amount of protein fed (g): Feed intake = total dry feed fed (g $fish^{-1}$) (Richardson *et al.,* 1985).

Chemical analysis:

At the end of the experiment a random sample of five individual prawns were collected from each aquaria. They were pooled, ground, stored in polyethylene bags and freeze for subsequent body crude protein, lipid, moisture and ash contents determined according to AOAC (1995).

The Zn concentrations of the eight diets and prawn carcasses were also analyzed according to AOAC (1995). Proximate composition of test diets and prawn carcasses were determined in triplicate according to the following procedures: Moisture after drying at 105ºC for 24 h., Protein (N×6.25) by Kjeldahl method after acid digestion, ash by incineration at 550 ºC for 16 h. Crude lipid was determined by the ether-extraction method using a Soxtec System HT (Soxtec System HT6, Tecator, Sweden). Metabolizable energy (ME) was estimated from the diet ingredient according to NRC (1993).

Statistical analysis:

Data were analyzed using the SAS ANOVA procedure (1988). Duncan's multiple range test (Duncan, 1955) was used to compare differences among treatments. Treatment effects were considered significant at P ≤ 0.05.

All percentage and ratio were transformed to arc sin values prior to analysis (Zar, 1984).

RESULTS

During the 12 weeks exposure period of *M. rosenbergii* larvae to different dietary zinc levels, the highest significant (P<0.01) final length (4.45cm), weight (0.616g) and condition factor (K) (0.90) were found for prawn fed 70 mg Zn kg^{-1} diet, followed by those fed on 90 mg Zn kg^{-1} diet. While the lowest values for length and weight were recorded for prawn fed on 130 mg Zn kg^{-1} diet, being 2.85 cm for length and 0.166 g for weight (Table 2 and Figures 1 and 2).

The results indicated that the highest gain in length, weight and specific growth rate was recorded for prawn larvae fed on 70 mg Zn kg^{-1} diet. The lowest value was listed for those fed on diet containing 130 mg Zn kg^{-1} diet (Table 3). The maximum significant (P≤0.01) survival rate (77.5%) was achieved by prawn larvae fed on 70 mg Zn kg^{-1} diet followed by those fed on 90 mg Zn kg^{-1} diet. However, the lowest value of survival (17.5%) was obtained with prawn fed on the highest dietary zinc level 130 mg Zn kg^{-1} diet (Table 3).

The results revealed the highest values (P≤0.01) of feed intake, feed efficiency ratio (FER) and protein utilization measured as protein efficiency ratio (PER) were recorded for prawn fed on diet supplemented with 70 and 90 mg Zn kg^{-1} diet. However, the best values of feed conversion ratio (FCR) were recorded for groups of prawn fed the same two diets (Table 4).

It is obvious from the data that there were no significant differences for both of protein and moisture contents. While, lipid showed a slightly differences the highest significant value (14.9%) for larvae fed on diet supplemented with 30 mg Zn kg^{-1}diet. For ash content it was found that as zinc level increase ash increase so, the highest significant (P<0.01) values were observed for those fed on diets containing 110 and 130 mg Zn kg^{-1}diet (Table 5).

DISCUSSION

It has been known that zinc is essential to life as an integral part of more than 200 enzymes isolated from different species (Vallee, 1988). Meanwhile, critical functions of zinc in DNA metabolism have been confirmed and numerous findings have greatly amplified the general significance of zinc in cell biology (Hao and Maret, 2006). It is generally considered that a dietary source of some minerals for growth is necessary because of the repeated losses of certain minerals during molting (Niu *et al*., 2008). The essentiality of dietary zinc for normal growth of *M. rosenbergii* larvae was clearly demonstrated in the present study. It was found that weight and length gain were recorded for prawn larvae fed on diet supplemented with 70 mg Zn kg^{-1} diet. Specific growth rate (SGR % day^{-1}), best FCR, feed intake, FER, PER and survival rate % were also for larvae fed on the same diet followed by those fed on 90 mg Zn kg^{-1} diet. Zinc supplemented diet on the other hand, resulted in an improvement and enhancing growth performance and feed utilization of prawn larvae. There was a linear increase of these parameters with increasing levels of zinc supplementation to the diet up to optimum level 70 mg Zn kg^{-1} diet. A further increase in zinc supplementation does not improve growth performance or feed utilization of the prawn. These results are in confirm with that obtained by Shiau and Jiang (2006) who stated that weight gain was reduced for the shrimp (*Penaeus monodon*) fed the unsupplemented basal diet and increased with increase in dietary Zn up to the requirement level. In this respect, Rath and Dube (1994) recorded that deletion of Zinc from the diet of *M. rosenbergii* stunted the growth and led to poor FCR, SGR and survival rate in comparison to the other diets supplemented with zinc. Zinc accumulation in the body tissue differs with concentration of zinc supplemented in diet. For other trace elements such as iron, El- Serafy *et al.* (2007) suggested that final body weight, SGR and best FCR were the highest in fish (*Oreochromis niloticus*) fed on the diet supplemented with 1200 mg Fe kg^{-1} diet. On the contrary, low concentration of dietary cadmium caused a decrease in food utilization and reduced growth of tilapia (*Oreochromis urolepis*). Cadmium in the diet probably inhibits intestinal absorption and transport of food and essential minerals thought the gut wall (Pratap, 1999).

In contrast, the study with *Litopenaeus vannamei* showed that weight gain of the shrimp did not respond to the dietary Zn supplementation (Davis and Lawrence, 1993). On the other hand, Wu and Chen (2005) demonstrated that significant growth retardation was observed in shrimp exposed to 0.6 mg Zn l^{-1}, the average body weight and length of shrimp exposed to 0.2 and 0.6 mg Zn l^{-1} were generally lower than those of control group, which might be related to the decrease in their food consumption rates as well as changes in nutritional conditions. Moza *et al*. (1995) recorded that gold fish, *Cararssius auratus* fed cadmium food have retained the feed in the gut for a longer duration than the controls and a decrease in feed intake and protein digestibility has been reported in gold fish exposed to water-borne cadmium. A similar decrease in the absorption and feeding was observed in catfish reared in ambient mercury (Sivakami *et al.,* 1995). In this respect, Farmer *et al*. (1979) found a reduced feeed intake have been reported in Atlantic salmon exposed to zinc.

For other fishes, it has observed that dietary zinc affects not only appetite, growth and mortality, but also the level of zinc, iron and copper in the tissue of rainbow trout (Satoh *et al*., 1983). Deficiency of zinc is found to cause poor growth performance, high mortality, erosion of fins and skin, dwarfism and cataract in rainbow trout (Wekell *et al*., 1983) and in Nile tilapia (Magouz, 2002). However, Ketola (1979) demonstrated that zinc availability in white fish meal is insufficient for good fish performance to protect rainbow trout from cataract formation, and an external Zn source was essential to eliminate the pathologies.

Diet is considered the major source of zinc for prawn larvae, and the increase of FBW and SGR are associated with increasing levels of zinc in the diet up to optimum level after which they were reduced. These results are in harmony with the findings of Davis and Lawrence (1993), Rath and Dube (1994) and Shiau and Jiang (2006) who demonstrated that zinc may have positive effect on metabolism, growth and food consumption of organisms. Gomez *et al*. (1999) recorded that zinc can influence bone mineralization either directly, as divalent action acting on nucleation and mineral accumulation, or indirectly, as a cofactor of enzymes or other metalloenzymes involved in the processes. The reported study here in showed that the highest gain in both length and weight of prawn was observed for prawn larvae fed on 70 mg Zn kg^{-1} diet followed by those fed on 90 mg Zn kg^{-1} diet. Hence, lower and excess zinc supplementation gives lower results.

The lowest values of survival rate were recorded for larvae fed on diets having excess element (110 and 130 mg Zn kg^{-1} diet), indicates that excess of element in the diet increases mortality rate and this results in accordance with that obtained by Rath and Dube (1994) who observed that the best survival rate was for prawn fed on diet supplemented with 90 mg Zn kg^{-1} diet. Element increase in diet decreased the survival rate.

Study on the effect of cadmium and zinc on the growth, food consumption of white shrimp, *Litopenaeus vannamei* revealed that Zn showed milder effects on growth of shrimp compared to Cd and body weight and length of shrimp exposed to 0.6 mg Zn/l and 0.2 mg Zn/l were generally lower than those of control group (free from Zn). Scope for growth is a measure of the energy budget that is the difference between the energy absorbed from food intake and energy metabolized, and gives an indication of the metabolic condition of an organism (Rinderhagen *et al.,* 2000). Moore and Farrar (1996) reported that growth rates significantly decreased with reduced food rations in the amphipod *Hyalella azteca.* It is reasonable that growth retardation may result from a decrease in feed intake.

The proximate composition of the final prawn carcass showed no significant differences in both of moisture and protein contents between different dietary treatments. Ash content increased significantly ($P<0.01$) with increasing zinc level in the diet. The highest values were recorded for prawn fed on 110 and 130 mg Zn kg^{-1} diet. Slightly lipid content differences between treatments were observed the highest value was found for prawn fed on 30 mg Zn kg^{-1}diet. These results are in agreement with that obtained by Cheng *et al*. (2005) who reported that there were no significant differences in crude protein, lipid and moisture of abdomen muscle of shrimp, *Litopenaeus vannamei* fed different levels of dietary magnesium, while ash content increase with increasing magnesium supplementation in the diet.

CONCLUSION

The best growth performance, feed intake, FCR, FER, PER and survival were obtained for prawn larvae fed on diet supplemented with 70 mg Zn kg^{-1}diet in comparison with the control group and the other dietary treatments. Whole body composition of moisture and protein did not differ significantly among treatments. The highest lipid content was observed for those fed on 30 mg Zn kg^{-1}diet. While, whole body ash content increased significantly with increasing zinc level in the diet. Diet supplemented with 70 mg Zn kg^{-1}diet is the best for feeding of *M. rosenbergii* larvae compared with other diets under the experimental conditions.

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Table 1. Composition and proximate analysis of the practical basal diet used.

Ingredients	%
Fish meal (60% CP)	40
Soybean meal (44% CP)	20
Bread flour	20
Wheat meddling	10
Soybean oil	2.5
Fish oil	2.5
Vit-mixture[1]	2.0
Min-mixture[2]	1.0
Ca-sulphate	2.0
Total	100
Proximate composition (%)	
Moisture	5.3
Crude protein	36.7
Crude Lipid	11.9
Crude ash	13.6
Crude fiber	4.10
Nitrogen free extract (NFE)	28.4
Met. Energy (kcal kg^{-1}diet)[3]	3675

[1]Vitamin mixture(mg g^{-1}): para-aminobenzoic acid,10; inositol, 100; pyridoxine-hydrochloride, 1.5; riboflavin 0.833; nicotinic acid o.2667; thiamine-hydrochloride, 0.5185; retinol acetate, 0.6444; menadione, 1.4815; Alpha-tocopherol acetate,10; cyanocobalamine, 0.0074; cholecalciferol, 0.0037; Folicacid 0.0777; L-ascorbyle-2monophosphate Mg, 1.4815; cholinechloride 229.6296; d-biotin 0.0889; calcium pantothenate, 5.1481.

[2]Mineral mixture zinc free (mg g^{-1}) NaH_2PO_4, 215; Ca (H_2PO_4). H_2O, 265; $CaCO_3$, 105; $Ca(CH_3CHOHCOO)_2$, $5H_2O$, 165; KCl, 139.53; KI, 0.23; $MgSO_4$ $7H_2O$, 100; FeC_6 $H_5O_7.nH_2O$,10; $CuCl.2H_2O$, 0.15; $AlCl_3.6H_2O$, 0.24; $MnSO_4.H_2O$, 1.07; $CoCl_2.6H_2O$, 1.4.

Table 2. Average (X ± SE) length weight and condition factor of *Macrobrachium rosenbergii* post-larvae fed with practical basal diet with graded level of zinc (n=3)

Zinc conc. (mg kg^{-1} diet)	Initial Length (cm)	Initial Weight (g)	Condition Factor (K)	Final Length (cm)	Final Weight (g)	Condition Factor (K)
Control	1.45±0.01	0.022±0.001	0.72±0.01	2.82±0.02^{fg}	0.201±0.01^{ef}	0.70±0.01^{cd}
10	1.45±0.01	0.022±0.001	0.72±0.01	3.14±0.01^{e}	0.235±0.01^{e}	0.76±0.01^{bc}
30	1.45±0.01	0.022±0.001	0.72±0.01	3.71±0.02^{d}	0.306±0.01^{d}	0.60±0.00^{e}
50	1.45±0.01	0.022±0.001	0.72±0.01	3.88±0.03^{c}	0.365±0.02^{c}	0.63±0.03^{de}
70	1.45±0.01	0.022±0.001	0.72±0.01	4.45±0.06^{a}	0.616±0.01^{a}	0.90±0.04^{a}
90	1.45±0.01	0.022±0.001	0.72±0.01	4.19±0.02^{b}	0.500±0.02^{b}	0.69±0.02^{cde}
110	1.45±0.01	0.022±0.001	0.72±0.01	2.96±0.06^{f}	0.207±0.01^{e}	0.80±0.01^{b}
130	1.45±0.01	0.022±0.001	0.72±0.01	2.85±0.05^{g}	0.166±0.01^{f}	0.72±0.05^{b}

Means in the same column bearing different superscript letters differ significantly at $P \leq 0.01$

Table 3. Average (X ± SE) gain in length, average gain in weight, specific growth rate and survival rate (%) of *Macrobrachium rosenbergii* post-larvae fed with practical basal diet with graded level of zinc (n=3)

Zinc conc. (mg kg^{-1} diet)	Average gain in length (cm)	Average gain in weight (g)	Average gain in length (%)	Average gain in weight (%)	Specific growth rate (%day^{-1})	Average survival rate (%)
control	1.37±0.02^{g}	0.175±0.01^{ef}	94.1±1.04^{g}	811.4±25.0^{ef}	3.1±0.04^{f}	70.0±5.0^{ab}
10	1.69±0.01^{e}	0.215±0.01^{e}	116.2±0.35^{e}	966.0±20.5^{e}	3.3±0.03^{e}	57.5±7.5^{ab}
30	2.26±0.02^{d}	0.285±0.01^{d}	155.9±1.38^{d}	1290.9±31.8^{d}	3.7±0.04^{d}	55.0±5.0^{b}
50	2.43±0.04^{c}	0.340±0.02^{c}	167.2±1.72^{c}	1556.9±88.7^{c}	3.9±0.08^{c}	60.0±5.0^{ab}
70	3.00±0.06^{a}	0.595±0.02^{a}	206.6±3.79^{a}	2700.0±54.5^{a}	4.6±0.03^{a}	77.5±7.5^{a}
90	2.74±0.02^{b}	0.475±0.02^{b}	188.6±1.04^{b}	2170.5±75.0^{b}	4.3±0.05^{b}	75.0±10.0^{ab}
110	1.51±0.06^{f}	0.185±0.02^{ef}	104.1±4.14^{f}	838.7±61.4^{e}	3.1±0.09^{f}	22.5±2.5^{c}
130	1.40±0.05^{fg}	0.145±0.01^{f}	96.6±3.45^{fg}	652.3±11.4^{f}	2.8±0.02^{g}	17.5±2.5^{c}

Means in the same column bearing different superscript letters differ significantly at P≤0.01

Table 4. Average (X ± SE) feed intake(g larvae^{-1}), feed conversion ratio, feed efficiency ratio and protein efficiency ratio of *Macrobrachium rosenbergii* post-larvae fed with practical basal diet with graded level of zinc (n= 3)

Zinc conc. (mg kg^{-1} diet)	Average feed intake (g larvae^{-1})	Average feed conversion ratio (FCR)	Average feed efficiency ratio (FER)	Average Protein efficiency ratio (PER)
control	0.29±0.00^{d}	1.62±0.04^{bcd}	0.62±0.02^{cd}	1.75±0.05^{bcd}
10	0.35±0.00^{c}	1.66±0.03^{bcd}	0.60±0.01^{cd}	1.65±0.05^{cd}
30	0.43±0.01^{bc}	1.50±0.06^{bc}	0.67±0.03^{bcd}	1.85±0.05^{bcd}
50	0.48±0.01^{b}	1.41±0.10^{abc}	0.72±0.05^{bc}	2.00±0.10^{bc}
70	0.71±0.08^{a}	1.20±0.16^{ab}	0.84±0.10^{a}	2.30±0.25^{ab}
90	0.52±0.01^{b}	1.09±0.03^{a}	0.92±0.02^{a}	2.55±0.05^{a}
110	0.35±0.01^{c}	1.87±0.12^{d}	0.54±0.04^{d}	1.50±0.10^{cd}
130	0.24±0.03^{d}	1.67±0.18^{cd}	0.61±0.07^{cd}	1.70±0.20^{bcd}

Means in the same column bearing different superscript letters differ significantly at P≤0.01

Table 5. Proximate body composition analysis (X ± SE) of moisture, protein lipid and ash of *Macrobrachium rosenbergii* post-larvae fed with practical basal diet with graded level of zinc. Values are mean ± SE of three replicates (n=3)

Zinc conc. (mg kg^{-1} diet)	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
control	72.7±1.14	52.2±0.49	11.2±0.35^{b}	6.03±0.12^{b}
10	73.2±1.30	55.7±1.73	11.8±0.66^{b}	5.93±0.41^{b}
30	76.6±0.52	53.5±2.47	14.9±0.70^{a}	6.53±0.22^{ab}
50	75.4±0.78	52.8±3.11	12.4±0.46^{b}	5.93±0.27^{b}
70	74.9±0.81	54.5±1.90	10.9±0.49^{b}	6.57±0.19^{ab}
90	73.6±1.32	48.9±0.80	11.6±0.46^{b}	6.70±0.12^{ab}
110	75.0±0.80	52.7±2.00	12.0±0.40^{b}	6.93±0.22^{a}
130	76.2±0.50	51.7±0.44	12.6±0.40^{b}	7.13±0.20^{a}

Means in the same column bearing different superscript letters differ significantly at P≤0.01

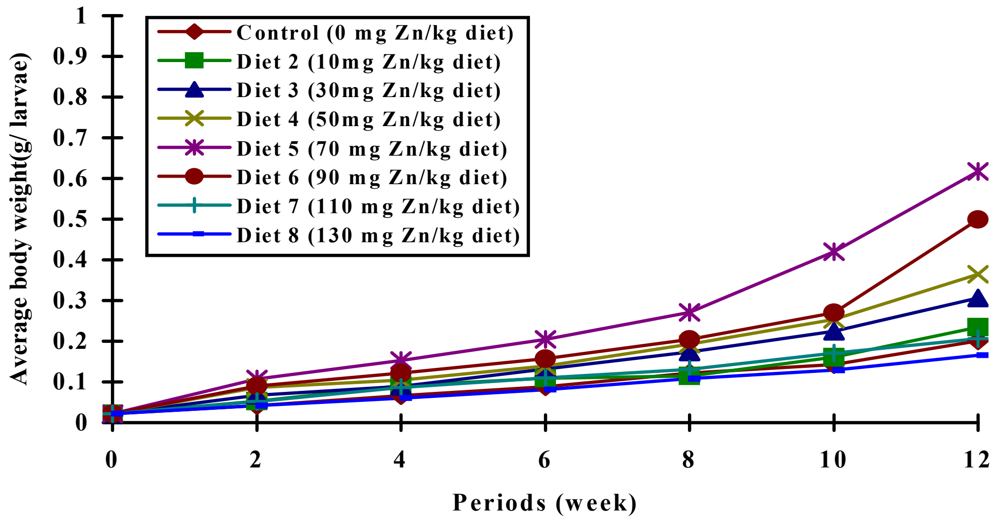

Figure 1. Changes in average body weight of *Macrobrachium rosenbergii* post-larvae fed with practical basal diet with graded level of zinc for a period of 12 week

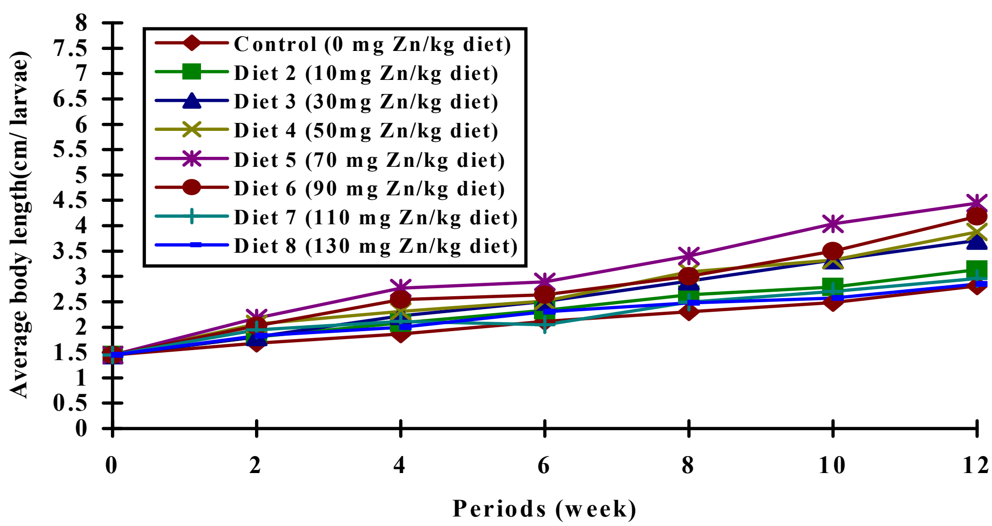

Figure 2. Changes in average body length of *Macrobrachium rosenbergii* post-larvae fed with practical basal diet with graded level of zinc for a period of 12 week

الآداء الإنتاجى ليرقات جمبرى المياة العذبة التى تتغذى على عليقة أساسية تحتوى مستويات مختلفة من الزنك.

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تهدف هذة الدراسة الى تقييم تأثير إضافة عنصر الزنك الى العلائق على النمو والاداء ومعدل الحيوية والاستفادة الغذائية ومكونات الجسم ليرقات جمبرى المياة العذبة. تم تكوين عليقة اساسية من مسحوق السمك وكسب فول الصويا ودقيق الخبز والردة الناعمة تحتوى على ٣٦.٧% بروتين خام. قسمت العليقة الى ٨ اقسام متساوية وتم اضافة الزنك فى صورة كبريتات الزنك الى العلائق بمستويات مختلفة وهى صفر (كنترول) , ١٠ , ٣٠ , ٥٠ , ٧٠, ٩٠ , ١١٠ , ١٣٠ ملجم زنك/كجم عليقة. تم تسكين عدد ٢٠ يرقة جمبرى/حوض بمتوسط وزن ابتدائى ٠.٠٢٢ جم/ حيوان ومتوسط طول ابتدائى ١.٤٥سم/ حيوان فى ثلاث مكررات لكل عليقة واستمرت التجربة لمدة ١٢اسبوع. أوضحت النتائج ان افضل اداء للنمو ومعدل الحيوية كان فى مجاميع جمبرى المياة العذبة التى غذيت على العليقة المضاف اليها عنصرالزنك بمعدل ٧٠ ملجم/كجم عليقة. وجد ايضا أن أفضل معدل استهلاك للغذاء ومعامل التحويل الغذائى وكفاءة الاستفادة من الغذاء وكفاءة الاستفادة من البروتين كانت فى مجاميع الجمبرى المغذاه على العليقة المضاف اليها الزنك بمعدل ٧٠ملجم/كجم عليقة و ٩٠ ملجم/كجم عليقة وذلك مقارنة بمجاميع الجمبرى المغذاه على العليقة الكنترول وباقى العلائق. وجد ان تحليل مكونات جسم الجمبرى من البروتين الخام والرطوبة لم تختلف معنويا بين العلائق. بينما وجد ان اعلى محتوى من الدهن الخام كان فى مجاميع الجمبرى المغذاه على العليقة المضاف اليها الزنك بمعدل ٣٠ملجم/كجم عليقة وذلك بالمقارنة بالكنترول وباقى العلائق. وجد ايضا ان محتوى الجسم من الرماد الخام لجمبرى المياة العذبة يزداد بزيادة مستوى الزنك بالعلائق. نستنتج من نتائج التجربة أن اضافة الزنك الى مكونات علائق يرقات جمبرى المياة العذبة بمعدل ٧٠ملجم/كجم عليقة يعتبر هوالمعدل الافضل للزنك حيث انة لم تحدث اى تاثيرات معنوية سلبية على النمو والاداء ومعدل الحيوية والاستفادة الغذائية ومكونات الجسم وذلك تحت ظروف التجربة.