Egypt. J. Aquat. Biol. & Fish., Vol. 17, No. 1: 81-90 (2013) ISSN 1110 –1131

Effect of stocking density and probiotic dietary supplementation on growth performance, feed conversion and survival of postlarvae of the freshwater prawn (*Macrobrachium rosenbergii*)

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ABSTRACT

The present study was conducted at the Fish Hatchery Saft Khalid, Behera Governorate, Egypt, for two months in order to investigate the effect of stocking density and probiotic (Ecobiol Aqua) dietary supplementation on growth performance, feed utilization, survival rate and whole body chemical composition of postlarvae of the freshwater prawn (*Macrobrachium rosenbergii*) of an initial weight 0.161g. reared in indoor nursery concrete tanks. A total number of 1350 postlarvae freshwater prawns were divided randomly into 18 concrete tanks (1 m^2 area each) to represent three stocking densities (50; 75 and 100 PL/m^2) with or without probiotic supplementation in three replicates each treatment. The experimental prawns were fed during the experimental period (8 weeks) on a diet contained 37.5% crude protein 5times/day at a rate related to the development stage. The treatments applied were D_1A; D_2A; D_3A; D_1B; D_2B and D_3B i.e. densities 50; 75 and 100 animals/m^2 without probiotic and densities 50; 75 and 100 animals/m^2 with supplemental probiotics, respectively. Results obtained are summarized in the following:

1- Water quality parameters tested were within the permissible levels recommended for optimum growth and development of freshwater prawn.
2- Both densities D_1 and D_2 (50 and 75animals/m^2) recorded significantly ($p<0.05$) higher final weights; total weight gains; specific and relative growth rates compared to the highest density, regardless of the probiotic effect.
3- Probiotic supplementation had insignificant effects on final weight; total weight gain; specific and relative growth rates, regardless of stocking density.
4- Within each stocking density supplementing the diets of freshwater prawn with probiotic improved the survival rate and the improvements were more pronounced at the lower stocking densities.
5- The best feed conversion ratio (FCR) (the lowest) was recorded by D_1A group ($p<0.05$) followed by D_2B; D_1B; D_2A; D_3B and D_3A, respectively.
6- Neither stocking density nor probiotic supplementation released any significant effects on whole body chemical composition of freshwater prawn.

Based on the obtained results, the optimum stocking density of postlarvae *M. rosenbergii* laid between 50 to 75animals/m^2 and increasing the stocking density more than75/m^2 had negative effects on growth performance parameters. Also the results obtained may lead us to recommend the supplementation of probiotic (Ecobiol Aqua) to postlarvae *M. rosenbergii* diets in order to improve the survival rate during the nursery period.

Key words: Freshwater prawn, stocking density, probiotic.

INTRODUCTION

Macrobrachium rosenbergii, the giant freshwater prawn is known to be the most important commercial prawn species in temperate climates. In Egypt the culture of such prawn has great economic interest due to the availability of wide brackish water surfaces, the suitability of the climatic conditions and the high market prices.

In Egypt, many farmers are devoted to freshwater prawn monoculture; however others practice polyculture of prawn with other fish species. Prawns have been successfully cultured with tilapia (Rouse *et al*., 1980), channel catfish (Huner *et al*., 1981) and Chinese carp (Malecha *et al*., 1981). The world production of freshwater prawn (*M. rosenbergii*) increased from < 50.000 MT (metric tons) in 1995 to more than 280.000 MT in 2003 as reported by FAO(2005) and has become an important part of rice-fish or small scale carp polyculture system in many developing countries (Giap *et al*., 2005).

In view of *M. rosenbergii* faster growth rate, excellent demand in internal as well as export markets and higher prices, it is commanding in recent years, a growing interest has been noticed in farming of this species in Egypt and worldwide. Two of the main difficulties for communal culture of this species are cannibalism and social suppression of growth (Karplus *et al*., 1987). According to New *et al*. (2000), high stocking densities of prawns are less profitable due to the agonistic behavior of male prawns, this results in low stocking densities and less environmental impacts.

Development of bacterial resistance to antibiotics has been well documented and the fear of the spread of this resistance to human pathogens (Amabile-Cuevas *et al*., 1995) has recently led to the banning of several antibiotics as so-called growth promoters in animal husbandry within the European Union. This concern has also been raised in the aquaculture industry and has led to suggestions for other disease control measures, including the use of live nonpathogenic bacteria as probiotics (Westerdahl *et al*., 1991; Smith and Davey, 1993; Gatesoupe, 1994; Austin *et al*., 1995; Bly *et al*., 1997; Graam *et al*., 1999).

The main objective of the present study is to high light the optimal space requirement, the optimal stocking density as well as the effects of supplementing the diet of post larval stages of *M. rosenbergii* with probiotic (Ecobiol Aqua which contains spores of a strain of *Bacillus amyloliquefaciens*) on growth and survival during nursery period under Egyptian conditions.

MATERIALS AND METHODS

The present study was carried out at the Fish Hatchery in Saft-Khalid Behera Governorate. A total number of 1350 postlarvae of the freshwater prawn *(Macrobrachium rosenbergii)* of an initial weight 0.161g were divided randomly into 6 experimental groups, representing three stocking densities (50; 75 and 100 PL/m^2) each fed on a diet without probiotic and with the tested probiotic (Ecobiol-aqua which contains spores of a strain of *Bacillus amyloliquefaciens*) supplemented to the diet at 0.01% level.

The treatments were applied in 18 concrete tanks divided with fine mesh nets to 1m^2 area, where the experimental prawns were stocked. The tanks were supplied with ground fresh water and to a depth of 50cm. level during the whole experimental period that lasted 8 weeks after start.

The prawn postlarvae were fed on commercial diet containing 37.5% crude protein and 4180k cal gross energy/kg diet with or without the tested probiotic. The diet was fed at 30; 20; 15; 12; 10; 10; 10; and 7 % rates of biomass in 5 equal portions daily. The treatments applied were D_1A; D_2A; D_3A; D_1B; D_2B and D_3B i.e. densities 50; 75 and 100 animal/m^2 without probiotic and densities 50; 75 and 100 animal/m^2 with supplemental probiotics, respectively. The experimental tanks were supplied with aeration through an air blower for 24 hours.

Physicochemical analysis of experimental tanks water:

Water quality parameters were adjusted every two weeks during the experimental period. Water temperature (^{o}c) in the experimental ponds was measured two times daily (at 6 am. and 6 O'clock pm.), dissolved oxygen (DO) (mg/l) was measured two times daily (at 6 am. and 6 O'clock pm.) using oxygen thermometer apparatus (YSI model 58, Yellow Spring Instrument, Ohio, USA.), water pH was measured by using a pH meter (Digital Mini-pH Meter, model 55, Fisher Scientific, Denver, USA), water turbidity NTU (nephlometric turbidity unit) was measured by using a Turbidity meter model HACH 2100 N., total ammonia (mg/l) and nitrite (mg/l) ware determined by using a spectrophotometer model Cecil 3021 series 3000 according to APHA (1992) and total dissolved salts (TDS) (mg/l) was determined using a conductivity meter (*m* sec/cm) model Orion star 3 and the factor 0.67 was used to calculate the TDS from the reading of the conductivity meter.

Analytical methods:

The proximate chemical analysis of diet and prawn were carried out according to the methods described by A.O.A.C. (1990) for moisture, crude protein (CP), ether extract(EE), crud fiber (CF) and total ash contents (Table 1) while nitrogen free extract (NFE) was calculated by difference. Gross energy contents of the commercial diet used were calculated from their chemical composition, using the factors 5.64, 9.44, 4.00 and 4.00 (k cal /g) for protein, fat, fiber and NFE, respectively (Jobling, 1983).

Table 1: The proximate analysis of experimental diet.

	Moisture	Ash	CF	CP	EE
Fish meal	9.48	26.69	5.75	60.08	1.88
Shrimp meal	6.13	52.51	2.60	23.26	3.96
Soybean meal	13.61	7.19	2.34	39.21	4.90
Corn gluten meal	10.95	2.51	0.84	63.17	0.96
Rice bran	14.92	4.42	3.77	13.69	0.62
Diet *	7.70	22.62	8.55	37.50	2.10

*NFE contents of the diet was calculated by differences

NFE = 100 - (CP + Ash + EE + CF)
= 100 – (37.5 + 22.62 + 8.55 + 2.10)
= 100 – 70.77 = 29.23

Gross Energy = C.P. * 85.65 + E.E. * 9.45 + C.F. * 4.00 + N.F.E. * 4.00
= (37.5 * 85.65) + (8.55 * 9.45) + (2.10 * 4.00) + (29.23 * 4.00)
= 211.88 + 80.80 + 8.40 + 116.92
= 418 *10 = 4180 k Cal / kg diet According to (Jobling, 1983)

Growth performance parameters:

Bodyweight: was measured every week in a sample of 30 postlarvae to adjust the feeding rate for the following period.

The following growth performance parameters were recorded:

Total weight gain (TWG) = W1 – W0

Specific growth rate (SGR) (%/day) = (Ln. W1 – Ln. W0) / T * 100

Average daily gain (ADG) (g/day) = (W1 - W0)/ T
Relative growth rate (RGR) (%) = (TWG / W0) *100
Where: W0 Initial body weight (g)
W1 Final body weight (g)
Ln Natural logarithm
T Experimental period (days)

Feed Intake (FI) (g) = $\frac{\text{Total feed offered (g)}}{\text{(Initial number of prawns + final number of prawns) / 2}}$

Feed conversion ratio (FCR) (g) = Feed intake (g) / Weight gain (g)

Survival rate (SR) (%) = $\frac{\text{Number of prawns survived at the end of the experiment}}{\text{Number of prawns stocked at the start of the experiment}}$ *100

Statistical analysis:

Data of the present study were statistically evaluated using the SAS version 9 (SAS Institute, 2002) statistical package. Data were statistically analyzed in a Factorial design procedure according to Snedecor and Coahran (1982). Means of treatments were compared by Duncan (1955) multiple range test. Duncan test ($p<0.05$) was used to compare means and ($F<0.05$) was considered for the variance analyses.

RESULTS AND DISCUSSION

Results presented in Table (2) show that average water quality parameters during the experimental period including water temperature (^{o}c); pH; turbidity (NTU); total ammonia (mg/l); nitrite (mg/l); dissolved Oxygen (mg/l) and total dissolved salts (mg/l) were within the permissible ranges for growth and development of *M. rosenbergii* postlarvae. They agree with the ranges suggested by Armstrong *et al.* (1976); Hsieh *et al.* (1990); New (1990) and Saxena (2003).

Table 2: Ranges of water quality parameters during the experimental period.

Treatments	**D_1(A,B)**	**D_2(A,B)**	**D_3(A,B)**
Temperature (°C)	27-29	27-29	27-29
pH	7.9-8.2	7.7-8.0	7.5-7.8
Turbidity (NTU)	0.4-0.6	1.1-1.3	1.8-2.0
Total ammonia (mg/l)	0.02-0.08	0.06-0.10	0.10-0.12
Nitrite (mg/l)	0.02-0.04	0.03-0.05	0.03-0.05
Dissolved Oxygen (mg/l)	4.5-5.5	4.5-5.5	4.5-5.5
Total dissolved salinity (mg/l)	705-715	705-715	755-715

Where:
D_1 → 50 pl/m^2 (A) → without probiotic
D_2 → 75 pl/m^2 (B) → with probiotic
D_3 → 100 pl/m^2

Growth performance parameters:

As presented in Table (3), group D_1A recorded significantly ($P<0.05$) the highest final weight (FW); total weight gain (TWG); average daily gain (ADG); specific growth rate (SGR) and relative growth rate (RGR) compared to D_1B; D_3A and D_3B groups, however differences among D_1A; D_2A and D_2B groups in the growth traits cited above were insignificant ($P>0.05$). Also differences in growth performance parameters among D_1B; D_3A and D_3B groups were insignificant ($P>0.05$). Concerning survival rate (SR), results in Table (3) show that groups D_1A; D_1B; D_2A and D_3B had significantly ($p<0.05$) higher survival rate compared to D_3A and D_3B groups however differences among D_1A; D_1B; D_2A and D_2B groups were insignificant (P>0.05). In general, results in Table (3) indicate (except the group D_1B) that supplementing freshwater prawn with the tested probiotic improved growth parameters within each stocking density tested.

As presented in the same Table, results revealed that regardless of probiotic effect, increasing the prawns stocking density from 50 to75 animal/m^2 resulted in insignificant (P>0.05) differences in FW; TWG; ADG; SGR; RGR and SR, however increasing the stocking density to 100 animal/m^2 decreased all tested growth parameters and survival rate significantly(P<0.05). These results are in accordance with the findings of Phuong *et al.* (2003), Bays and Wahngchai (2007), El-Sherif and Ali Mervat (2009) and Langer *et al.* (2011).

Table 3: Growth performance parameters of *M. rosenbergii* as affected with stocking density and probiotic.

	IW (g)	FW (g)	TWG (g)	ADG (g/prawn/day)	SGR (%)	RGR (%)	SR (%)
Interaction:							
D_1(A)	0.161 ± 0.00	1.216 ± 0.37 ^{a}	1.056 ± 0.04 ^{a}	0.019 ± 0.00 ^{a}	3.610 ± 0.53 ^{a}	655.69 ± 22.70 ^{a}	72.67 ± 3.33 ^{a}
D_1(B)	0.161 ± 0.00	0.847 ± 0.24 ^{bc}	0.686 ± 0.02 ^{bc}	0.012 ± 0.00 ^{bc}	2.964 ± 0.50 ^{bc}	426.29 ± 14.73 ^{bc}	82.67 ± 2.40^a
D_2(A)	0.161 ± 0.00	1.065 ± 0.16 ^{ab}	0.904 ± 0.16 ^{ab}	0.016 ± 0.00 ^{ab}	3.337 ± 0.26 ^{ab}	561.70 ± 96.33 ^{ab}	74.00 ± 6.51 ^{a}
D_2(B)	0.161 ± 0.00	1.093 ± 0.08 ^{ab}	0.932 ± 0.08 ^{ab}	0.017 ± 0.00 ^{ab}	3.410 ± 0.13 ^{ab}	578.88 ± 50.58 ^{ab}	76.33 ± 6.44 ^{a}
D_3(A)	0.161 ± 0.00	0.734 ± 0.36 ^{c}	0.573 ± 0.04 ^{c}	0.010 ± 0.00 ^{c}	2.704 ± 0.09 ^{c}	355.69 ± 22.57 ^{c}	57.00 ± 3.46 ^{b}
D_3(B)	0.161 ± 0.00	0.787 ± 0.10 ^{c}	0.626 ± 0.10 ^{c}	0.011 ± 0.00 ^{c}	2.802 ± 0.24 ^{c}	388.82 ± 63.88 ^{c}	58.00 ± 0.58 ^{b}
Stocking density:							
D_1	0.161 ± 0.00	1.032 ± 0.08 ^{a}	0.871 ± 0.08 ^{a}	0.0156 ± 0.002^a	3.287 ± 0.15 ^{a}	540.99 ± 52.70 ^{a}	77.67 ± 2.89 ^{a}
D_2	0.161 ± 0.00	1.079 ± 0.08 ^{a}	0.918 ± 0.08 ^{a}	0.0164 ± 0.001^a	3.374 ± 0.13 ^{a}	570.29 ± 48.81 ^{a}	75.17 ± 4.19 ^{a}
D_3	0.161 ± 0.00	0.760 ± 0.05 ^{b}	0.599 ± 0.05 ^{b}	0.0107 ± 0.00 ^{b}	2.753 ± 0.12 ^{b}	372.26 ± 31.19 ^{b}	57.50 ± 1.59 ^{b}
Probiotic:							
(A)	0.161 ± 0.00	1.005 ± 0.09	0.844 ± 0.09	0.015 ± 0.002	3.217 ± 0.06	524.36 ± 53.11	67.89 ± 3.59 ^{b}
(B)	0.161 ± 0.00	0.909 ± 0.06	0.748 ± 0.06	0.013 ± 0.001	3.059 ± 0.12	464.67 ± 37.63	72.33 ± 4.23 ^{a}

a, b,…. Average within the same column bearing the same letters are not significantly (P>0.05) different otherwise they do.

Where:

D_1 → 50 pl/m^2
D_2 → 75 pl/m^2
D_3 → 100 pl/m^2
(A) → without probiotic
(B) → with probiotic

IW → Initial weight (g)
FW → Final weight (g)
TWG → Total weight gain (g)
ADG → Average daily gain (g/prawn/day)
SGR → Specific growth rate (%)
RGR → Relative growth rate (%)
SR → Survival rate (%)

Regardless of stocking density, results in Table (3) show that probiotic tested in the present study released insignificant effects on FW; TWG; ADG; SGR and RGR, however probiotic supplementation increased significantly ($p<0.05$) survival rate compared to the unsupplemented groups indicating that the tested probiotic increased the immune response and reduced stress effects in freshwater prawns.

Results for the insignificant effects of the tested probiotic on growth performance parameters are contradictory to that reported by Deeseenthum *et al.* (2007) and Keysami *et al.* (2012) which may be due to the fact that these authors used isolated *Bacillus* strains from the gut of the prawns as probiotic which influenced the growth parameters of the tested *Macrobrachium rosenbergii* positively.

Feed conversion ratio:

Results in Table (4) show that group D_1A showed significantly ($P<0.05$) the best feed conversion ratio (the lowest) (3.160g. diet required for each g. gain in weight) followed in a significant ($P<0.05$) increasing order by both D_1B; D_2A, then by both D_3A and D_3B, respectively. Differences in feed conversion ratio among D_1A and D_2B groups were insignificant.

Table 4: Effect of stocking density and dietary probiotic supplementation on feed intake and feed conversion ratio of *M. rosenbergii* postlarvae.

	FI (g)	TWG (g)	FCR (g)
Interaction:			
D_1(A)	3.799 ± 0.01 ^{a}	1.056 ± 0.04 ^{a}	3.610 ± 0.12 ^{c}
D_1(B)	3.368 ± 0.15 ^{abc}	0.686 ± 0.02 ^{bc}	4.910 ± 0.27 ^{b}
D_2(A)	3.654 ± 0.24 ^{ab}	0.904 ± 0.16 ^{ab}	4.042 ± 0.48 ^{b}
D_2(B)	3.575 ± 0.12 ^{abc}	0.932 ± 0.08 ^{ab}	3.840 ± 0.21b ^{c}
D_3(A)	3.074 ± 0.16 ^{c}	0.573 ± 0.04 ^{c}	5.364 ± 0.36 ^{a}
D_3(B)	3.147± 0.20 ^{bc}	0.626 ± 0.10 ^{c}	5.030 ± 0.56 ^{a}
Stocking density:			
D_1	3.584 ± 0.12 ^{a}	0.871 ± 0.08 ^{a}	4.115 ± 0.32 ^{b}
D_2	3.615 ± 0.12 ^{a}	0.918 ± 0.08 ^{a}	3.938 ± 0.25 ^{b}
D_3	3.111 ± 0.12 ^{b}	0.599 ± 0.05 ^{b}	5.194 ± 0.30 ^{a}
Probiotic:			
(A)	3.509 ± 0.14	0.844 ± 0.09	4.158 ± 0.32
(B)	3.363 ± 0.10	0.748 ± 0.06	4.496 ± 0.28

a, b,… Average within the same column bearing the same letters are not significantly ($P>0.05$) different otherwise they do.

Where:

D_1 → 50 pl/m^2
D_2 → 75 pl/m^2
D_3 → 100 pl/m^2
(A) → without probiotic
(B) → with probiotic

FI → Feed intake (g)
TWG → Total weight gain (g)
FCR → Feed conversion ratio (g)

As presented in Table (4) averages of feed conversion ratio for stocking densities D_1; D_2 and D_3 regardless of probiotic effect were found to be 4.115; 3.938 and 5.194(g. diet required for each g. gain in weight), respectively. Statistical analysis of the results indicate that D_1 and D_2 groups had significantly ($P<0.05$) better (lower) feed conversion ratio compared to the group with the highest stoking density (D_3). These results are in agreement with the findings of Whangchai *et al.* (2007); Baysa and Whangchai (2007); El-Sherif and Ali Mervat (2009); Langer *et al.* (2011) and Ibrahem (2011).

Results in Table (4) show that averages of feed conversion ratio of prawn postlarvae as affected with the probiotic tested, regardless of stocking density, were 4.158 and 4.496 (g. diet required for each g. gain in weight)for the group fed on diet unsupplemented and that supplemented with the tested probiotic , respectively and differences among the groups were insignificant.

In this connection, Keysami *et al.* (2012) tested the potential effects of probiotic of *Bacillus subtilis* isolated from juvenile *M. rosenbergii* and the suitable methods of administration (mixing, soaking, spraying and bathing) on feed conversion ratio of prawn. They reported that supplementing the prepared probiotic by the methods tested improved FCR significantly and the improvement was more pronounced in soaking method of administration.

Proximate whole body chemical composition:

Average of ash; ether extract and protein contents calculated as percent on dry matter basis of *M. rosenbergii* postlarvae as affected with stocking density and dietary probiotic are presented in Table (5). Results of this Table reveal that neither stocking density nor probiotic supplementation released significant effects on dry matter; ash; ether extract and protein contents in prawn whole bodies.

Table 5: Effect of stocking and dietary probiotic on proximate whole body chemical composition of *M. rosenbergii* postlarvae.

	DM %	CP %	EE %	ASH %
Interaction:				
D_1(A)	71.28 ±0.38	48.78 ± 0.19	4.99 ± 0.22	11.16 ± 0.11
D_1(B)	70.09 ± 0.18	48.38 ± 0.18	4.37 ± 0.10	11.13 ± 0.12
D_2(A)	71.44 ± 0.43	48.72 ± 0.33	4.82 ± 0.23	11.10 ± 0.14
D_2(B)	70.11 ±0.16	48.61 ± 0.29	4.90 ± 0.28	11.15 ± 0.13
D_3(A)	71.46 ± 0.16	49.15 ± 0.23	4.42 ± 0.19	11.29 ± 0.06
D_3(B)	70.17 ± 0.27	48.44 ± 0.41	4.41 ± 0.19	11.26 ± 014
Stocking density:				
D_1	70.68 ± 0.25	48.58 ± 0.13	4.67 ± 0.14	11.15 ± 0.08
D_2	70.77 ± 0.27	48.67 ± 0.21	4.86 ± 0.17	11.13 ± 0.09
D_3	70.81 ± 0.22	48.79 ± 0.24	4.42 ± 0.13	11.28 ± 0.07
Probiotic:				
(A)	71.39 ± 0.19	48.89 ± 0.15	4.47 ± 0.13	11.19 ± 0.06
(B)	70.12 ± 012	48.48 ± 0.17	4.56 ± 0.12	11.18 ± 0.08

Where:

D_1 → 50 pl/m^2 (A) → without probiotic

D_2 → 75 pl/m^2 (B) → with probiotic

D_3 → 100 pl/m^2

Regardless of probiotic effect, results in Table (5) reveal that stocking density had no significant effects on dry matter; crude protein; ether extract and ash contents in prawn whole bodies.

Regarding the effect of probiotic irrespective of the stocking density, results in Table (5) show that the probiotic supplementation had no significant effects on dry matter; crude protein; ether extract and ash contents in prawn whole bodies. These results are in accordance with the findings of Keysami *et al.* (2012) who reported that supplementing the diets of *M. rosenbergii* with probiotic containing *B. subtilis* isolated from juveniles *M. rosenbergii* by different methods of application had no significant effects on whole body crude protein, crude lipids and ash contents.

CONCLUSION

Based on the present results, it is recommended that the optimal stocking density of postlarvae *M. rosenbergii* lied between 50 to 75animals/m^2 for the maximum growth performance parameters and survival rates of prawn postlarvae reared in indoor nursery. Also the supplementation of probiotic (Ecobiol-Aqua) is recommended for its positive effect on improving the survival rate during the nursery period.

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ARABIC SUMMARY

أثر معدلات التسكين والبروبايوتك على أداء النمو وكفاءة تحويل الغذاء ومعدلات الإعاشة لمرحلة ما بعد اليرقة فى جمبرى المياه العذبة

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أجريت هذه الدراسة فى المفرخ السمكى بصفط خالد بمحافظة البحيرة بمصر لمدة شهرين. هدفت هذه الدراسة الى تقييم أثر كل من معدلات التسكين واضافة البروبايوتك اكوبيول أكوا (حافز نمو حيوى) على اداء النمو ومعدلات الإعاشة فى مراحل مابعد اليرقة لجمبرى المياه العذبة المربى فى تنكات حضانة خرسانية تحت النظام المغلق.

تم تقسيم عدد 1350 من يرقات جمبرى المياه العذبة اليافعة بمتوسط وزن ابتدائى 0.161جم عشوائيا في 18 حوض حيث تم اجراء المعاملة فى مساحة متر مربع فقط من الحوض مثلت فى ثلاثة معدلات تسكين (50,75,100 يرقة يافعة للمتر المربع) باستخدام علائق مضافا اليها البروبايوتك وعلائق غير مضافا اليها البروبايوتك حيث تم تمثيل كل معاملة فى ثلاثة مكررات. تم تغذية جمبرى المياه العذبة موضع الدراسة أثناء مدة التجربة (8 أسابيع) على عليقة (تحتوى على 37.5% بروتين خام) بمعدلات تغذيه حسب وزن الكتلة الحية للحوض خمسة مرات يوميا وتتلخص النتائج المتحصل عليها فى الآتى:

1- خواص المياه المختبرة كانت جميعها فى الحدود المسموح بها للنمو والتطور الأمثل لمراحل مابعد اليرقة لجمبرى المياه العذبة.
2- سجلت معنويا كلا من كثافة 50حيوان/م^2 وكثافة 75حيوان/م^2 أعلى الأوزان النهائية والأوزان الكلية ومعدلات النمو النسبى والنوعى مقارنة بالكثافة الأعلى بغض النظر عن تأثير البروبايوتك.
3- إضافة البروبايوتك لم تؤثر إحصائيا على الأوزان النهائية والأوزان الكلية ومعدلات النمو النسبى والنوعى بغض النظر عن تأثير الكثافة.
4- إضافة البروبايوتك موضع الدراسة الى العلائق داخل كل معدل تسكين حسن إحصائيا معدل الإعاشة واتضح هذا التحسن خاصة فى الكثافات المنخفضة.
5- أفضل معدل تحويل غذائى (الأقل) سجل بواسطة المجاميع 50 حيوان/م^2 بدون إضافة البروبايوتك ثم المجاميع 50,75 حيوان/م^2 بإضافة البروبايوتك و 75 حيوان/م^2 بدون البروبايوتك ثم الكثافة 100 حيوان/م^2 بإضافة البروبايوتك وبدون البروبايوتك وذلك على الترتيب.
6- أوضحت المعاملات المدروسة أنها لم تظهر أى تأثير ملحوظ على التركيب الكيميائى للأجسام الكاملة لجمبرى المياه العذبة.

بناء على النتائج المتحصل عليها إتضح أن معدل التسكين الأمثل ليرقات جمبرى المياه العذبة اليافعة يقع مابين 75,50 حيوان/م^2 فى نظم الحضانة المغلقة وأن زيادة معدل التسكين أعلى من 75 حيوان /م^2 كان له آثار سلبية على مقاييس أداء النمو. وهذه النتائج أيضا تجعلنا نوصى بإضافة البروبايوتك (إكوبيول أكوا) إلى علائق جمبرى المياه العذبة لتحسين معدلات الاعاشة خلال فترة الحضانة.