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OPTIMUM DIETARY PROTEIN LEVEL AND STOCKING DENSITY FOR FRESH-WATER PRAWN *(Macrobrachium rosenbergii)* JUVENILES REARING IN CONCRETE BASINS

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SUMMARY

Five dietary crude protein levels (15, 20, 25, 30 and 35% CP of dry weight) with two stocking densities (5 and 10 prawn/m3) were investigated in concrete basins for 84 days. The results showed that growth performance, feed and nutrient utilization of prawn Macrobrachium rosenbergii juveniles were significantly (P<0.05) increased by increasing the dietary crude protein level up to 30%. Increasing the stocking density from 5 to 10 prawn/m3 led to increase growth performance and feed & nutrient utilization, significantly (P<0.05).

It could be concluded that 30% CP and 5 prawn/m3 were the optimum levels for dietary protein and stocking density, respectively which improved growth of Macrobrachium rosenbergii.

Keywords: Freshwater prawn, protein, stocking density, survival, growth, feed and nutrient utilization

INTRODUCTION

Freshwater prawn *Macrobrachium rosenbergii* is generally classified as having abenthophagic omnivorous feeding habits, reported stomach contents including organic detritus, mollusks, adult insects and larvae, crustaceans, fish, algae, grain, aquatic macrophytes and vegetable matter (Tacon,1993). Jauncy and Ross (1982), Balazes and Ross (1976), Millikin *et al.*(1980), Watanabe (1975), Tidwell *et al.*(1993 a and b), EL-Kholy (1995) and New (1976) were estimated the requirement of freshwater prawns *(Macrobrachium rosenbergii)* from 27 to 38% for juveniles. At the other side, the optimum protein to energy ratio for best growth of freshwater prawn was reported by El-Kholy (1995) to be 81-82 mg crude protein to kcalgross energy, while Alava and Lim (1983) reported an optimum average protein to energy ratio for *Macrobrachium rosenbergii* growth of about 98 mg protein/ kcal gross energy.

Malecha *et al.* (1981), Zaki and Abdel-Halim (1997) were suggested that the growth performance and survival rate of freshwater prawn were decreased by increasing the stocking density. However, total production increased with increasing stocking density within certain limits (Bjornsson, 1994) due to the fixed carrying capacity of the ecosystem under certain conditions.

The study presented here aimed to investigate the optimum dietary protein level and stocking density of freshwater prawns juveniles grown in concrete basins.

MATERIALS AND METHODS

The present work was carried out at the experimental fish farm of the Faculty of Agriculture, Alexandria University. Freshwater prawn *(Macrobrachium rosenbergii)* juveniles averaged in a factorial design of 2 stocking densities x 5 protein levels. Investigated stocking densities were 5 and 10 prawn/m3 and the experimental diets (Table 1) contained 15,20,25,30 and 35% CP respectively.

The energy level of the experimental diets was approximately 436.41 kcal/100g. Ten treatments were assigned in duplicates and twenty (2m3) concrete basins (1x2x1m) were used, each basin was supplied with fresh water from independent fossil and had a separated spill in order to facilitate filling and draining separately. Water in each basin was removed by draining out the spill. Water from the city water system was collected in a reserve tank and transported by gravity to the experimental concrete basins at a renewal rate of 10% /h. Water was obtained from the irrigation canal (a branch of El-Mahmodeia canal).

The water was analyzed weekly for pH and chlorine levels, which were kept within acceptable standard levels. Water temperature was ranged from 19-35C, dissolved oxygen ranged between 5.5-10.7 ppm, total alkalinity 283- 294 and chlorosity 1.5-2.0 g/l.

Freshwater prawn were acclimated in one concrete basin (10x5x1.5m) for 7 days, during which time they were fed on diet 3 (25% CP), as indicated in Table (1). At the end of the acclimation period, healthy individuals were selected, weighed and a group of forty prawn was immediately killed and frozen at -20C for initial chemical body composition analysis. Investigated prawns were fed at a rate of 10% of their estimated body weight, twice daily (at 8.00 a.m. and 3.00 p.m.), 6 days a week for 84 day.

The average initial fresh-water prawn weights in the present study were approximately equal in all basins with an average of (0.200.0 g / juvenile). Estimates of freshwater prawns weight were based on biweekly weighing of prawns in each basin. At the end of the experiment, experimental prawns were netted and weighed (collectively), counted and immediately killed and frozen to be used for the final chemical body composition analysis. Proximate composition (crude protein, ether extract, ash, crude fiber and moisture) of the experimental diets and whole freshwater prawns bodies were determined according to AOAC (1984) methods.

Gross energy (GE) of the diets , as well as, freshwater prawns body energy contents were indirectly estimated from the mean values of heat combustion of protein , lipid and carbohydrate being 5.64, 9.44, 4.1/Kcal/g DM, respectively (NRC,1993).

Experimental results were statistically analyzed as described by Snedecor and Cochran

(1971). ANOVA and multiple-range methods given by Duncan (1955) were followed.

Table 1. Ingredient and nutrient composition of the experimental diets containing different levels of dietary protein.

Item	Dietary protein levels %				
	15	20	25	30	35
Ingredient					
Fishmeal	3	8	14	20	26.0
Shrimp meal	10	10	10	10	10.0
Soybean meal	2	7	13	19	25.0
Wheat bran	10	10	10	10	10.0
Wheat middling by-products	35	30	24	18	12.0
Yellow corn	35	30	24	18	12.0
Fish oil	3	3	3	3	3.0
Vitamin mixture [1]	1	1	1	1	1.0
Mineral mixture [2]	1	1	1	1	1.0
Nutrients (%on dry matter basis					
Dry matter	89.82	90.13	90.51	90.80	90.99
Crude protein(CP%)	15.57	20.36	25.15	30.19	35.22
Ether extract(EE%)	6.12	6.79	7.46	8.21	8.95
Crude fiber	4.47	4.91	5.35	5.84	6.33
Ash	5.04	6.29	7.53	8.89	10.26
Nitrogen-free extract (NFE%)	68.80	61.65	54.51	46.87	39.24
Gross energy (Kcal/100g)[3]	428.36	432.31	436.30	440.41	444.41
Protein/GE ratio [4]	36.35	47.11	57.64	68.55	79.25

[1] Vitamin mixture/kg premix containing the following: 3300IU vitamin A, vitamin D3, 410 IU vitamin E,2660mg vitamin B1,133mg vitamin B2,580 mg vitamin B6 ,410 mg vitamin B12 ,50mg biotin 9330 mg Colin chloride, 4000mg vitamin C, 2660 mg Inositol, 330 mg para-amino benzoic acid,9330 mg niacin, 26.60 mg pantothenic acid.

[2] Mineral mixture/kg premix containing the following 325 mg Manganese, 200mg Iron, 25mg Copper, 5 mg Iodine, 5mg Cobalt.

[3] Gross energy (GE kcal/100 g diet) calculated according to NCR (1993) using the following calorific values: 5.64 , 9.44 ,and 4.11 kcal/g diet protein ,fat and carbohydrate, respectively.

[4] P/E ratio = mg protein / 100 kcal

RESULTS AND DISCUSSION

Proximate chemical analysis % (Table 1) showed that the experimental diets were approximately isoenergetic and contain different crude protein levels (15,20,25,30 and 35% CP, respectively).

The experimental diets differed in protein to energy ratios (P/E ratio) and ranged between (36.35 to 79.25 mg CP /kcal GE) .

Results concerning final body weight, gain, average daily gain (ADG mg/juvenile/day) and specific growth rate (SGR%) showed a significant ($P<0.05$) increase with increasing the dietary protein level up to 30% followed by 25% and 35% CP, respectively in both investigated stocking densities (5 and 10 prawn/m3). Values of final weight for fresh-water prawn, weight gain, average daily gain and SGR% were significantly ($P<0.05$) decreased by increasing stocking density over 5 prawn/m3. In agreement, Rao *et al.* (1986) found that growth performance of fresh-water prawn and total production improved with stocking density of 6 individuals/m3. Also Perry and Tarver (1981) found that prawns stocked at 1.2, 2.5 or 3.7/m2 and given no supplemental feed produced 124,224 and 292 kg/ha, of mean final body weight 18,15 and 12 g inversely related to stocking density. D,Abramo *et al.* (1989) found that mean prawn weight at harvest ranged 15.0 to 44.3 g and decreased with increasing stocking density. Mulyanti and Suharto (1990) found that increasing stocking density (10,20,30 and 40 prawn / m2) of *Macrobrachium rosenbergii* were followed by decreasing weight gain (25.9 g, 18.3 g, 14.7 g, and 14.0 g / prawn) while survival (75%, 75%, 38.9% and 75%, respectively) and production (97.125 kg, 137..25 kg, 85.892 kg and 210 kg / 500 m2, respectively) were fluctuated up to 20 prawn / m2 and down to 30 prawn / m2 and then up again at 40 prawn / m2.

New and Singholka (1982) found that commercial diet containing around 40% crude protein was described as higher than is required for fresh-water prawn. On the other side Balazes and Ross (1976) found that 35% crude protein level provided better growth of fresh-water prawn than 15 or 25% crude protein, and New (1976) suggested that an optimal protein range for prawn from 27 to 35%.

Feed intake and feed conversion ratio was significantly ($P<0.05$) increased with increasing the dietary protein level up to 30% CP, respectively under different stocking rates.

Values of protein utilization (PER and PPV%) were significantly ($P<0.05$) decreased with increasing the dietary protein level under different stocking rates. However, energy utilization (energy retention) reached its maximum level with diet containing 30% followed by 35% CP, respectively. A negative significant ($P<0.05$) relationship was found between dietary protein level under stocking rate of 5 prawn/m3, however, it was significant between dietary protein levels under stocking rate of 10 prawn/m3.

Chemical body composition (%) of fresh-water prawn at the beginning and at the end of the present study (Table 3) show a significant increase ($P<0.05$) in DM, CP, NFE, and energy content (kcal/100g), however, EE and ash content decreased under different stocking rates.

Table 2. Effect of different dietary protein levels and stocking density on growth performance of fresh-water prawn (*Macrobrachium rosenbergii*) juveniles reared in concrete basins

Diet No[1]	Weight (g/prawn)		ADG*	SGR%[2]
	Final	Gain	(mg/prawn/day)	
Stocking density (5 prawn/m^3):				
1	5.68 ^{cd}	5.48 ^{cd}	65.24 ^{f}	3.98 ^{h}
2	7.39 ^{cd}	7.19 ^{cd}	85.54 ^{de}	4.30 ^{e}
3	10.58 ^{b}	10.38 ^{b}	123.52 ^{b}	4.73 ^{b}
4	13.80 ^{a}	13.60 ^{a}	161.91 ^{a}	5.04 ^{a}
5	9.78 ^{b}	9.58 ^{b}	114.05 ^{bc}	4.63 ^{c}
Stocking density (10 prawn/m^3):				
1	3.57 ^{f}	3.37 ^{j}	40.12 ^{g}	3.41 ^{j}
2	4.81 ^{e}	4.61 ^{i}	54.88 ^{f}	3.79 ^{i}
3	6.30 ^{cd}	6.10 ^{e}	71.67 ^{ef}	4.11 ^{f}
4	8.93 ^{bc}	8.73 ^{d}	103.63 ^{cd}	4.53 ^{d}
5	6.05 ^{de}	5.85 ^{g}	69.65 ^{ef}	4.06 ^{g}
$LSD_{0.05}$	1.132	0.1523	18.261	0.026

[1] Diets 1,2,3,4 and 5 containing 15,20,25,30 and 35% dietary protein levels, respectively. [2] SGR%=Specific growth rate

Table 3. Effect of different dietary protein levels and stocking density on feed and nutrient utilization of fresh-water prawn (*Macrobrachium rosenbergii*) juveniles reared in concrete basins

Diet No[1]	Feed utilization		Protein utilization		EU%[6]
	FI (g/prawn)[2]	FCR[3]	PER[4]	PPV%[5]	
Stocking density (5 prawn/m^3):					
1	17.86 ^{g}	3.26 ^{e}	1.98 ^{a}	27.8 ^{a}	6.70 ^{a}
2	22.72 ^{d}	3.16 ^{d}	1.56 ^{b}	22.15 ^{ab}	6.91 ^{a}
3	30.52 ^{b}	2.94 ^{f}	1.36 ^{b}	20.39 ^{ab}	7.71 ^{a}
4	38.49 ^{a}	2.83 ^{g}	1.17 ^{b}	18.15 ^{ab}	8.02 ^{a}
5	30.75 ^{b}	3.21 ^{cd}	0.86 ^{c}	13.02 ^{b}	6.78 ^{a}
Stocking density (10 prawn/m^3):					
1	11.63 ^{i}	3.45 ^{a}	1.86 ^{a}	25.07 ^{a}	6.05 ^{b}
2	15.40 ^{h}	3.34 ^{b}	1.47 ^{b}	20.42 ^{ab}	6.40 ^{a}
3	19.64 ^{f}	3.22 ^{c}	1.24 ^{b}	17.80 ^{ab}	6.72 ^{a}
4	26.45 ^{c}	3.03 ^{e}	1.09 ^{b}	15.91 ^{b}	7.19 ^{a}
5	20.42 ^{e}	3.49 ^{a}	0.82 ^{c}	11.48 ^{b}	6.00 ^{ab}
$LSD_{0.05}$	0.507	0.052	1.535	10.941	2.143

[1] Diets 1,2,3,4 and 5 containing 15,20,25,30 and 35% dietary protein levels, respectively. [2] FI=Feed intake [3] FCR=Feed conversion ratio [4] PER=Protein efficiency ratio [5] PPV%=Protein productive value [6] EU%=Energy utilization

Table 4. Effect of different dietary protein levels and stocking density on body composition of fresh-water prawn (*Macrobrachium rosenbergii*) juveniles reared in concrete basins.

Diet No[1]	Dry matter (DM%)	% on dry matter basis[2]				
		CP	EE	Ash	NFE	EC
At start:	23.19	51.53	8.19	23.54	16.38	435.86
1	25.18 ^{e}	53.83 ^{h}	6.72 ^{b}	20.56 ^{d}	18.90 ^{a}	445.02 ^{a}
2	25.29 ^{e}	54.78 ^{f}	6.47 ^{c}	19.89 ^{f}	18.87 ^{a}	449.93 ^{a}
3	26.16 ^{b}	56.67 ^{b}	5.83 ^{g}	19.70 ^{g}	17.82 ^{de}	466.91 ^{b}
4	26.47 ^{a}	57.54 ^{a}	5.36 ^{h}	18.69 ^{h}	18.41 ^{b}	450.79 ^{a}
5	25.82 ^{c}	55.77 ^{c}	6.09 ^{f}	19.87 ^{f}	18.28 ^{bc}	418.31 ^{ab}
1	24.18 ^{g}	53.13 ^{c}	6.92 ^{a}	22.12 ^{a}	17.84 ^{de}	396.45 ^{ab}
2	24.60 ^{f}	53.79 ^{h}	6.74 ^{b}	21.81 ^{b}	17.67 ^{ef}	407.83 ^{ab}
3	25.28 ^{e}	55.01 ^{e}	6.29 ^{d}	21.22 ^{c}	17.53 ^{f}	433.10 ^{a}
4	25.56 ^{d}	55.58 ^{d}	6.21 ^{e}	20.21 ^{e}	18.01 ^{cd}	446.07 ^{a}
5	25.16 ^{e}	54.14 ^{g}	6.53 ^{c}	21.75 ^{b}	17.58 ^{ef}	439.45 ^{a}
$LSD_{0.05}$	0.148	0.194	0.065	0.103	0.279	0.641

[1] Diets 1,2,3,4 and 5 containing 15,20,25,30 and 35% dietary protein levels, respectively.

[2]CP= Crude protein , EE= Ether extract , NFE= Nitrogen free extract , and EC= Energy content. (kcal/100g)

Increasing the dietary protein level from 15 to 30% followed by 35% resulted in a significant ($P<0.05$) increase in fresh-water prawn body DM,CP,NFE and energy content, however ether extract and ash content decreased, which is in agreement with El-Kholy (1995). Increasing the stocking density significantly ($P<0.05$) decreased body DM, CP,NFE and energy content, however, ether extract and ash content increased. Similar results have been obtained in fresh-water prawn (Zaki and Abdel-Halim, 1997).

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مستوى البروتين الأمثل فى العليقة ومستويات التخزين ليرقات جمبري المياه العذبة المرباة فى أحواض خرسانية

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أجريت هذه التجربة بهدف دراسة أثر مستويات البروتين في العليقة (١٥، ٢٠، ٢٥، ٣٠، ٣٥%) ومستويات التخزين في المتر المكعب (٥ ، ١٠ يرقه /م^3) على كفاءة النمو وكفاءة الاستفادة من الغذاء (بروتين وطاقة) ليرقات جمبري المياه العذبة المرباة في أحواض خرسانية لمدة ٨٤ يوماً . تم استخدام عشرون حوضاً خرسانياً (٢م^3/ حوض) لتمثل عشرة معاملات (خمسة مستويات من البروتين ومستويين للتخزين . وأشارت النتائج التي تم التحصل عليها إلي ما يلي:

١- بغض النظر عن مستويات التخزين فإن رفع مستوى البروتين في العليقة من ١٥% إلى ٣٠% أدى إلى زيادة معنوية في وزن جسم يرقات الجمبري طوال مدة التجربة ومن ناحية أخرى فقد أظهرت النتائج أن زيادة مستويات التخزين تحت كل مستوى من مستويات البروتين التى تم استخدامها قد أدى إلى نقص معنوي في أوزان الجسم.

٢- أوضحت النتائج أيضا أن زيادة مستويات البروتين في العليقة أدت إلى تحسين في معدلات النمو النوعي بغض النظر عن مستويات التخزين . في حين أن زيادة مستويات التخزين أدت إلى نقص معدل النمو النوعي ليرقات جمبري المياه العذبة.

٣- تحسنت كفاءة تحويل الغذاء والاستفادة من الغذاء (بروتين وطاقة) بزيادة مستوى البروتين في العليقة حتى نسبة ٣٠% بروتين بغض النظر عن مستويات التخزين. كما أوضحت النتائج أن يرقات الجمبري المرباة على مستوي تخزين منخفضة (٥ يرقة/ م^3) تحسنت كفاءة تحويل العليقة وكذلك الاستفادة من العناصر الغذائية (بروتين وطاقة) مقارنة بكثافة التخزين المرتفعة (١٠ يرقة /م^3)