Egyptian J. Anim. Prod., 33, Suppl. Issue, Nov. (1996): 521-533

FRESHWATER PRAWN *(MACROBRACHIUM ROSENBERGII)* NUTRITION IN AQUACULTURE. 1- INFLUENCE OF DIETARY PROTEIN LEVELS WITH OR WITHOUT 5.0% CORN OIL

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SUMMARY

Two experiments were conducted in order to evaluate the influence of different dietary protein levels with or without addition of 5% corn oil on survival, growth performance,body gain of nutrients, feed and nutrient (protein and energy) utilization of freshwater prawn (*Macrobrachium rosenbergii*) post larvae reared in indoor circular Fiberglass tanks (1.5 m diameter and 1000 liter of water per tank). In the 1*st* experiment six diets containing 25, 30 and 35% dietary crude protein levels with or without addition of 5% corn oil were prepared . Each diet was fed to two replicates of prawns (average weight 0.20 ± 0.01 g/animal) stocked at rate of 20 prawn/m^3 tank and fed at decreasing feeding rates (20, 15 and 10% of the live body weight for 28 day's each)for 84 days . The results of the 1*st* experiment showed that survival, growth performance and body gain of nutrients were significantly ($P< 0.05$) improved with increasing the dietary protein level from 25% CP to 35% CP. However, addition of 5% corn oil significantly ($P < 0.05$) decreased the above mentioned criteria's. Values of feed intake were significantly ($P< 0.05$) increased with increasing the protein level to 35%, however, it significantly ($P<0.05$)decreased with addition of corn oil. Feed utilization improved with increasing of dietary protein level to 35% CP while it reduced by the addition of 5% corn oil. Protein utilization values were significantly ($P<0.05$) decreased with increasing the dietary protein level or with addition of 5% corn oil. However, energy utilization was significantly ($P<0.05$) increased with increasing the dietary protein content to 35% CP and decreased with addition of 5% corn oil as compared with the control diets (without corn oil) .

In the 2*nd* experiment a larger post larvae (average weight 0.53 ± 0.01 g/animal) were stocked at a rate of 10 prawns/m^3 tank and fed on six diets containing higher levels of dietary protein (35, 40 and 45% CP) with or without addition of 5% corn oil in two replicate per treatment, for 84 days and similar rearing and feeding procedures as mentained in experiment 1 were applied. The results showed that increasing the dietary protein level more than 35% or addition of 5% corn oil significantly ($P<0.05$) decreased survival, growth performance, and body gain of nutrients of prawns. Also the values of feed intake, feed and nutrient utilization (protein and energy) were

significantly ($P<0.05$) decreased with increasing the dietary protein level more than 35% or with addition of corn oil.

Therefore, it could be concluded that 35% CP level and 81-82 mg CP/Kcal gross energy (P/E ratio) was the optimum dietary protein and protein/energy ratio for fresh-water prawns post larvae reared under the experimental conditions.

Keywords : Prawn, protein , oil, growth, feed and nutrient utilization.

INTRODUCTION

Fresh water prawn *Macrobrachium rosenbergii* is generally classified as having a benthophagic omnivorous feeding habit. Tacon (1993) reported those stomach contents of prawns including organic detritus, molluscas, adult insects and larvae, crustaceans (including other prawns of the same species), fish, algae, grain, aquatic macrophytes and vegetable matter. Weidenback (1982) showed that artificial diets were readily consumed by *M. rosenbergii* reared in pond with detritus, macrofauna and limited amounts of macrophytes, but that macrophytes dominated the prawns diet when no formulated feeds were provided. With applying the artificial feeds there are three topics on which aquaculture nutritionists and fish farmers often disagree. These are (1) the proper number of post larvae per square meter (of water surface), (2) the performance of the feed ,and (3) the quality of shrimp at harvest. In the present paper, we will study partially the second of these topics. Cuzon *et al.*, 1994 noted that feeds for Crustacean, specially those for shrimp, are used extensively and represent a key factor in the success of any farming activity whether it is run under semi-intensive, intensive or super-intensive conditions according to the stocking density of postlarvae or juveniles. Compositions of the feeds differ according to the stage of development of the prawns. Currently three types of feeds are available; (1) micorbound or microencapsulated, for post larvae (2) starter and grower feed provided under different granulometries; and (3) broodstock feeds.

Protein requirements for fresh water prawns have been studied by many authors such as Jauncey and Ross (1982), Balazes and Ross (1976); Millikin *et al.*, (1980), Watanabe (1975) and Tidwell *et al.* (1993 a and b) with reported values ranging among 30 and 38 % CP. On the other hand, information about carbohydrates, the cheapest source of energy in prawn nutrition is very little (New, 1976 and 1988; Kanazawa, 1984 and Forther *et al.*, 1980).

In order to maintain a good balance among feed ingredients, ratios between carbohydrates and fats (Clifford and Brick, 1979), protein and starch (Bages and Sloane, 1981) and the overall energy to protein ratio (Halver, 1976) should be adjusted. A major difference from fish feeds is that the pellet must be very water stable, this has led to a larger amount of research on the use of proper binders. For prawn larvae, alginate has been used extensively, providing an excellent water-stable and attractive, well-sized feed particle (Aquacop, 1976). Alginate even at 15% level of the diet did not appear to effect nutrient digestibility in prawn as has been reported for European sea-bass (Spyridakis *et al.*, 1987).

In Egypt, *Macrobrachium rosenbergii* was very recent introduced to fish farming, however, no nutritional studies were conducted on its feed requirements till now, therefore the present work was conducted to study the influence of different dietary protein levels with or without addition of 5.% corn oil on survival, growth

performance, nutrient gain and feed and nutrient utilization of fresh water prawn (*Macrobrachium rosenbergii*) post larvae reared in fiberglass tanks.

MATERIALS AND METHODS

Twelve circular fiberglass tanks (each 1.5 m diameter and 1 m^3 water volume) were used for housing the prawns in each experiment representing six nutritional treatments with their replicates. . Each tank was filled with 1000 liters of previously dechlorinated tap water, in an open circuit with a renewal rate of 10% per hour. The water was continuously aerated (oxygen concentration in the tanks was always over 5.8 ppm) and thermoregulated (27.0 ± 1 ^{o}C) with a light/dark period of 12/12 h(light period from 7.00 to 19:00).

Fresh-water prawns (*M. rosenbergii*) post larvae used in these experiments were purchased from Mariut Fish Farming Project, Mariut, Alexandria, Egypt in May 1993. They came from a single culture unit. Healthy prawns were acclimated and adapted for 15 days on a basal diet (25% CP, table 1) before being distributed randomly in the experimental groups. Prawns with an average weight of 0.20 g ± 0.01 g/ animal were stocked at a rate of 20 animal per tank in the first experiment, however, individuals with an average weight of 0.53 ± 0.01 g/ animals were stocked at a rate of 10 per tank for the second experiment. Fifty prawns from each weight (0.20 g and 0.53 g/ animal in experiments 1 and 2 respectively) were retained frozen at -20 ^{o}C for chemical analysis (initial chemical body composition).

Six experimental diets were formulated and tested in each experiment. In the 1*st* experiment, three dietary protein levels (25, 30 and 35% CP) with or without addition of 5.0% corn oil were prepared diets (1-6) (Table 1) and the results indicated with 35% CP diet, still there were an improvement in the tested criteria. Therefore in the 2*nd* experiment, higher protein levels (35, 40 and 45% CP) were used with or without addition of 5.0% corn oil (diets 7-12) (Table 1). Table 1 shows the composition and proximate chemical analysis of the experimental diets (1-6, 7-12) used in experiments 1 and 2 respectively.

Preparation of experimental diets were conducted as described by Zein-Eldin and Meyers, (1973) by utilizing the same operations as the preparation of fish feeds, *i.e.* grinding of the ingredients, mixing, wetting at room temperature (more than 50% moisture) and performed with meat mincer after using of 2.0 % sodium alginate as a binder (Aquacop, 1976). The resulted "strings" of each diet were then dried at room temperature and mechanically broken to small granules by hand and stored at 4 ^{o}C In a cold room. The mineral mixture and vitamin premix were prepared as described by Kanazawa *et al.* (1970).

Prawns in experiments 1 and 2 were fed for 84 days three times daily (10.00, 16.00 and 20.00 h) at decreasing rates (20, 15 and 10% for four weeks per each feeding rate, respectively) of their body weight. Prawns were weighed every two week on the 14*th* day, before the feeding time. After weighing the prawns in each tank, the daily feed allowance was corrected according to body weight of prawns.

Proximate compositions (crude protein, fat, crude fiber, ash and moisture) of the tested diets and prawns were determined according to AOAC methods (1980).

Chemical body composition of prawns was determined at the beginning of the experiments (in about 50 prawns) and at the end of the experimental period after sacrifice of all the prawns of each tank and pooling them by mincing.

Table 1. Composition (%) and proximate analysis (%) of the experimental diet (DM)

Item	Diet*											
Ingredient	1	2	3	4	5	6	7	8	9	10	11	12
White fish meal	--	--	10	10	20	20	25	25	35	35	45	45
Shrimp meal	15	15	15	15	15	15	17	17	17	17	17	17
Squid meal	--	--	--	--	--	--	4	4	4	4	4	4
Meat meal	5	5	5	5	5	5	5	5	5	5	5	5
Blood meal	5	5	5	5	5	5	5	5	5	5	5	5
Soybean meal	15	15	15	15	15	15	10	10	10	10	10	10
Sodium alginate	2	2	2	2	2	2	2	2	2	2	2	2
Yellow corn	51	51	41	41	31	31	26	26	16	16	6	6
Starch	5	--	5	--	5	--	5	--	5	--	5	--
Corn oil	--	5	--	5	--	5	--	5	--	5	--	5
Vit. premix **	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5
Min.premix **	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5
Proximate analysis												
Moisture	10.8	9.5	11.3	10.6	12.0	12.0	12.8	11.9	12.1	11.5	10.3	11.2
% on dry matter (DM) basis:												
Crude protein	25.9	25.3	30.7	30.2	35.4	35.2	35.9	35.1	40.1	40.1	45.0	44.4
Ether extract	3.4	8.8	4.6	9.1	5.5	10.4	5.5	10.8	5.7	10.2	5.3	10.2
Ash	8.8	9.3	10.0	10.6	11.1	11.8	11.9	11.6	12.7	12.7	13.2	13.5
Crude fibre (CF)	3.9	3.1	3.7	2.8	3.3	2.8	2.6	2.5	2.3	2.3	1.9	2.0
NFE	58.0	53.5	51.0	47.3	44.7	39.8	44.1	40.0	39.2	34.7	34.6	29.9
Energy (kcal gross** energy, GE/ 100 g d.w.)												
	417	446	426	451	435	460	436	464	441	465	446	470
Potein/energy ratio(mgCP/kcal GE)												
	62	57	72	67	81	77	82	76	91	86	101	95

*Diets 1-6 and 7-12 were used in the 1 *st* and 2 *nd* experiments respectively.

** According to Kanazawa *et al* ., ((1970) .

** Gross energy **(Kcal/g DM) was calculated according to NRC, 1983 using the calorific values: 5.65, 9.44 and 4.11 Kcal /g diet DM for protein, fat and carbohydrate, respectively.

The following indices were determined:
gain= final weight - initial weight,
Feed efficiency (FE) = weight gain/feed intake,
Protein efficiency ratio (PER) = weight gain/protein intake,
Specific growth rate SGR = 100 [(Ln final weight - Ln initial weight)]/number of days
Protein productive value (PPV%) = percentage of nitrogen retained from nitrogen ingested as protein ; nitrogen retained was calculated by difference between body nitrogen content at the beginning and at the end of the experiment.
Energy utilization (EU %) = percentage of energy retained from energy ingested.

Statistical Analysis

All data were subjected to one-way analysis of variance (Snedecor and Cochran, 1967). The Duncan's Multiple Range Test was used to test significant differences between group means ($P < 0.05$).

RESULTS

Proximate chemical analysis of the tested diets as shown in Table 1 indicates different protein to energy ratios (P/E), these are 62, 57 , 72 , 67, 81 and 77 mg CP/kcal gross energy (GE) in diets (1-6) of experiment 1 and 82 , 76 , 91 , 86 , 101 and 95 mg CP / kcal GE in diets (7-12) of experiment 2, respectively .

Survival, growth performance and body gain of nutrients (protein, fat and energy) per tank in the 1*st* experiment (Table 2) significantly ($P < 0.05$) increased with increasing the dietary protein level to 35% CP. However, the addition of 5.0% corn oil was significantly ($P<0.05$) decreased above mentioned criteria's as compared with the control (without 5% corn oil) .

Table 2. Influence of dietary protein levels with or without 5% corn oil on survival, growth performance and body gain of nutrients of fresh water prawns *

Item	Corn oil %	Protein level % 25	30	35	Mean
Survival rate %	0	92.50	90.00	95.50	92.67^{A}
	5	82.50	87.50	87.50	85.83^{B}
	av.	87.50^{c}	88.75^{b}	91.50^{a}	---
Initial weight (g/ prawn)	0	0.20	0.20	0.20	0.20
	5	0.18	0.20	0.20	0.19
	av.	0.19	0.20	0.20	--
Final weight (g/prawn)	0	2.03	2.32	3.18	2.50^{A}
	5	1.51	2.10	2.45	2.02^{B}
	av.	1.77^{c}	2.21^{b}	2.82^{a}	---
Gain (g /prawn)	0	1.83	2.12	2.98	2.30^{A}
	5	1.33	1.90	2.25	1.80^{B}
	av.	1.58^{c}	2.01^{b}	2.62^{a}	--
Specific growth rate (SGR%)	0	2.76	2.92	3.29	2.99^{A}
	5	2.55	2.80	2.98	2.77^{B}
	av.	2.66^{c}	2.86^{b}	3.15^{a}	--
ADG (mg/prawn/day)	0	21.79	25.24	35.48	27.42^{A}
	5	15.83	22.62	26.89	24.65^{B}
	av.	18.81^{c}	23.93^{b}	31.19^{a}	--
Body gain of nutrients:- Protein gain (g/tank)	0	4.72	5.65	8.86	6.41^{A}
	5	3.12	5.09	6.58	4.93^{B}
	av.	3.92^{c}	5.37^{b}	7.72^{a}	---
Fat gain (g/tank)	0	0.48	0.54	0.86	0.63^{B}
	5	0.64	1.05	1.33	1.01^{A}
	av.	0.56^{c}	0.80^{b}	1.10^{a}	--
Energy gain (kcal/ tank)	0	31.16	36.97	58.10	42.08^{A}
	5	23.66	38.62	49.67	37.32^{B}
	av.	27.41^{c}	37.80^{b}	53.89^{a}	--

Means followed by the same lettter are not significantly different ($P<0.05$)

* Each tank was stocked with 20 prawns.

	Survival	Final weight	Total gain	ADG%	SGR	Protein gain	Fat gain	Energy gain
LSD 0.05 protein	5.750	0.064	0.064	0.064	10.48	0.211	0.087	0.570
LSD 0.05 corn oil	4.690	0.050	0.050	0.050	8.55	0.167	0.056	0.460

Values of feed intake, feed and nutrient (protein and energy) utilization (Table 3) of prawns were significantly (P< 0.05) increased with increasing the dietary protein level from 25 to 35%. However, addition of 5.0% corn oil was significantly (P<0.05) reduced the values of feed intake and feed and nutrient utilization as compared with the control diet (without 5% corn oil). The results of the *1st* experiment clearly indicated that diet containing 35% CP and 81 mg CP / kcal gross energy (P/E) were the optimum dietary protein level and protein (mg CP)/energy (Kcal gross energy) ratio respectively for *M. rosenbergii* post larvae.

Table3. Influence of dietary protein levels with or without 5% corn oil on feed intake,feed and nutrient utilization of fresh water prawns *

Item	Corn oil	Protein level %			Mean
		25	30	35	
Feed intake (g DM/animal)	0	8.16	9.57	11.56	9.76^{A}
	5	6.80	8.48	9.87	8.38^{B}
	average	7.48^{c}	9.03^{b}	10.72^{a}	---
Feed conversion ratio	0	4.46	4.51	3.88	4.28^{B}
	5	5.11	4.46	4.39	4.67^{A}
	average	4.79^{a}	4.49^{b}	4.14^{c}	---
Protein efficiency ratio	0	0.87	0.79	0.77	0.81
	5	0.77	0.82	0.71	0.77
	average	0.82	0.80	0.74	---
Protein productive value	0	12.07	10.69	11.27	11.34^{A}
	5	10.99	11.36	10.82	11.06^{B}
	average	11.53^{a}	11.03^{b}	11.05^{b}	---
Energy utilization (EU%)	0	4.95	5.04	6.05	5.34^{A}
	5	4.73	6.00	6.25	5.65^{B}
	average	4.84^{c}	5.50^{b}	6.15^{a}	---

Means followed by the same letter are not signiicantly diferent (P<0.05)
*Each tank was stocked with 20 prawns

	Feed intake	FCR	PER	PPV %	EU%
LSD 0.05 protein	0.259	0.309	0.028	0.078	0.185
LSD 0.05 corn oil	0.212	0.252	0.023	0.064	0.185

In the 2*nd* experiment, the results in Table (4) show that increasing the dietary protein level over 35% CP was significantly (P < 0.05) decreased the survival, growth performance and body gain of nutrients (protein, fat and energy). Also addition of 5.0% corn oil decreased the survival rate, growth performance , body protein and energy gain as compared to control diets (without 5% corn oil),however, body fat gain was significantly (P < 0.05) increased with addition of corn oil to prawn diets.

Table 5 shows the influence of dietary protein levels (35, 40 and 45% CP) with or without 5.0% corn oil on feed intake, feed and nutrient (protein and energy) utilization of prawn post larvae. The results showed that increasing the dietary protein level over 35% CP significantly (P < 0.05) decrease the feed intake, feed utilization and nutrient utilization (PER, PPV % and EU %) of prawns. The addition of corn oil slightly decreased feed intake, feed utilization and nutrient utilization as compared

with the control diets (without fat). The results of the 2*nd* experiment clearly showed that 35% CP and 82 mg CP/ kcal gross energy (P/E) were the optimum dietary protein level and P/E ratio. The addition of 5.0% corn resulted in a significient ($P<0.05$) decrease in growth performance, feed and nutrients utilization of prawns.

Table 4. Influence of dietary protein levels with or without 5% corn oil on growth performance, survival and body gain of nutrients of freswater prawns *

Item	Corn oil %	Protein level % 35	40	45	Mean
Survival rate %	0	95.50	87.50	82.50	88.50^{A}
	5	92.50	85.00	72.50	83.33^{B}
	av.	94.00^{a}	86.25^{b}	77.50^{c}	---
Initial weight (g/ prawn	0	0.53	0.51	0.52	0.52
	5	0.53	0.52	0.53	0.53
	av.	0.53	0.52	0.53	---
Final weight (g/ prawn)	0	3.09	2.70	2.39	2.73^{A}
	5	2.86	2.49	2.22	2.19^{B}
	av.	2.98^{a}	2.60^{b}	2.31^{c}	---
Gain (g/ prawn)	0	2.56	2.19	1.82	2.21^{A}
	5	2.33	1.97	1.69	1.99^{B}
	av.	2.45^{a}	2.08^{b}	1.75^{c}	---
Specific growth rate SGR%)	0	2.10	1.98	1.82	1.97^{A}
	5	2.01	1.87	1.71	1.86^{B}
	av.	2.06^{a}	1.93^{b}	1.75^{c}	---
ADG (mg/prawn/day)	0	30.48	26.07	21.67	26.07^{A}
	5	27.74	23.45	20.36	23.85^{B}
	av.	29.11^{a}	24.76^{b}	20.83^{c}	---
Protein gain (g/ tank)	0	4.09	3.58	2.53	3.40^{A}
	5	3.66	2.53	1.94	2.71^{B}
	av.	3.88^{a}	3.05^{b}	2.23^{c}	---
Fat gain (g/ tank)	0	0.31	0.32	0.28	0.30^{B}
	5	0.66	0.54	0.39	0.53^{A}
	av.	0.48^{a}	0.43^{b}	0.34^{c}	---
Energy gain (kcal/ tank)	0	25.89	23.15	16.89	21.98^{A}
	5	26.83	19.37	14.65	20.28
	av.	26.36^{a}	21.26^{b}	15.77^{c}	---

abc Means followed by the same letter are not significantlydifferent ($P<0.05$).

* Each tank was stocked with 10 prawns.

	Survival %	Final weight	Total gain	ADG%	SGR	Protein gain	Fat gain	Energy gain
LSD 0.05 protein	2.860	10.410	10.42	0.860	10.41	0.155	0.005	0..890
LSD 0.05 Corn oil	2.340	8.500	8.51	0.050	8.50	0.127	0.004	0.730

DISCUSSION

Successful commercial farming of freshwater prawns may involve the use of supplementary feeding. Commercial diets containing around 40% crude protein were described higher than required for fresh water prawns (New and Singholka, 1982)

and are therefore too expensive for prawn production. Balazes and Ross (1976) found that 35% crude protein level provided better growth of *M. rosenbergii* than 15 or 25% crude protein. These findings were supported by New (1976) who suggested an optional protein range for prawn ranging from 27 to 35%. In the present study, prawn performed better by feeding on diets containing 35% crude protein. Diets that contained lower or higher protein levels resulted in lower survival, lower gain and specific growth rates. However, diets with the same protein level (35% CP) with varying protein to energy ratios (P/E ratios) gave different results depending upon the presence or absence of additional fats. When 5% corn oil was added to these diets, it resulted in lower P/E ratios (57, 67 and 77 ; 76, 86 and 95mg CP / kcal gross energy in the first and second experiments, respectively) and resulted in lower survival and growth performance of prawns. Higher survival of (95 and 95.5%) was obtained with diets without 5% corn oil than with diets containing corn oil (87.5 and 92.5%) in the first and second experiments, respectively. This may be due to adjusting protein to energy ratios. The apparently optimum P/E ratios were 81 and 82 mg protein/Kcal gross energy of the experimental diets. The low growth rates of the prawn fed with energy values and P/E ratios in the desired ranges 446-470 Kcal gross energy /100 g DM and 57-95 mg CP/Kcal gross energies, respectively, were attributed to high lipid intake since these diets contained 5% corn oil. Many workers have shown that when prawns are fed lipids higher than the normal amount they can tolerate, lipids may accumulate rapidly and cause an imbalance in the protein/energy ratio. This could adversity affect normal metabolic functions and resulted in decreased growth or death of the prawn (D'Abramo *et al.*, 1980). The significant ($P<0.05$) increase in growth of prawns with the decrease in the dietary protein level from 45 to 35% while maintaining an energy level of 446-436 Kcal gross energy /100 g DM suggests that protein may be spared by carbohydrates or lipids as long as caloric requirements are met. Therefore, protein was utilized more efficiently in 35% CP diets as compared with diets containing 40 or 45% protein. Sedgwick (1979) found that the optimal utilization of protein by *Penaeus merquiensis* was closely related to the energetic values of the diet and that CHO and lipid can increase growth efficiency at sub-optimal levels of protein. Sheen and D'Abramo (1991) had found that the optimal amount of dietary lipid depends upon both the amount and quality of dietary protein and the level of available dietary energy. They obtained the best final weight with diets containing 6% dietary lipid level that coincides with the results of the present work where the best growth was obtained with 5.5% lipid level in both experiments. The reduced growth response to high levels of dietary lipids is propably due to inefficient utilization. It may also indicate that fats are not an effective energy source for juvenile prawns.

The detrimental influence of deficient or excessive nutrients (CHO or lipids) in the diet may be, in part, explained by imbalance in the ratio with other nutrients. An optimum supply therefore, is necessary to assure a metabolic pool of energy that will allow the prawn to utilize efficiently the protein in the diet. Koshio *et al.* (1992) have found that the minimum dietary protein content for maximum growth of prawns could be reduced when dietary energy content is increased.

The survival of prawns in the present work was higher than that obtained by Bautista (1986). The low survival of prawns in Bautista (1986) experiments were attributed to an imbalance of protein and energy in some diets tested.

Table 5. Influence of dietary protein levels with or without 5% corn oil feed intake, feed and nutrient utilization of fresh water prawns *

Item	Corn oil %	Protein level % 35	40	45	Mean
Feed intake (gDM/animal)	0	13.25	11.64	11.44	12.11
	5	12.41	11.44	11.36	11.74
	av.	12.83^{a}	11.54^{b}	11.40^{b}	-----
Feed conversion ratio (FCR)	0	5.18	5.32	6.29	5.60
	5	5.33	5.81	6.72	5.95
	av.	5.26^{b}	5.57^{b}	6.51^{a}	---
Protein efficiency ratio (PER)	0	0.75	0.61	0.45	0.60
	5	0.74	0.57	0.42	0.58
	av.	0.75^{a}	0.59^{b}	0.44^{c}	-----
Protein productive value (PPV%)	0	12.48	11..46	7.56	10.5^{A}
	5	12.61	8.61	7.59	9.60^{B}
	av.	12.55^{a}	10.04^{b}	7.58^{c}	-----
Energy utilization (EU%)	0	4.91	5.34	4.11	4.79
	5	5.24	4.42	3.87	4.51
	av.	5.08^{a}	4.88^{a}	3.99^{b}	---

abc Means followed by the same letter are not significanly different (P<0.05).

* Each tank was stocked 10 prawns.

	Feed intake	FCR	PER	PPV %	EU%
LSD 0.05 protein	0.780	0.508	0.041	0.623	0.344
LSD 0.05 corn oil	1.000	0.415	0.033	0.509	0.281

Similar results were obtained by Alava and Lim (1983). The authors reported that 30-45% protein with energy levels ranging from 3570 to 3750 Kcal gross energy /kg diet can maintain satisfactory resistance against molting stress. The higher levels of protein and energy in the diet could have provided enough resistance to this kind of stress.

A diet containing 35% CP was 81.2 mg protein/Kcal gross energy resulted in 94% survival rate which considered as a higher survival rate among the other tested diets. The result of the present study is in agreement with those of Alava and Lim (1983), who reported an optimum average protein to energy ratio of about 98 mg protein/Kcal gross energy. The comparatively higher survival obtained from diets containing no oil as compared with diets containing 5% corn oil could have been due to the right proportion of protein and non protein calories in the diet.

Prawns fed on 35% CP diet in experiment 1 (diet 5) grew faster and utilized their feeds better than in the *2nd* experiment (diet 7). Although diet 7 contains more animal protein from fish meal and shrimp meal, it also contains 4% squid meal and less soybean meal and yellow corn as compared with diet 5, however, the performance of prawns fed on diet 5 (Exp. 1) was much better than diet 7 (Exp. 2). The reasons for these results could be attributed to the differences in prawns size (0.20 versus 0.53 g/prawn). However, the survival on the same diets was higher in the *2nd* experiment as compared with the first experiment (92.5% versus 95.5%). These higher survival in the *2nd* experiment could be attributed to the presence of squid meal. Squid meal

is often used because of its growth promoting effect on shrimp (Cruz-Ricque *et al.*, 1987).

In the present study, balanced diets with 35% crude protein in which P/E ratios were 81.2 and 82.3 mg protein/Kcal gross energy resulted in efficient utilization of protein since PPV % values were higher at 81.2 and 82.3 mg crude protein/Kcal gross energy . Taking into consideration that the protein is the most expensive fraction in the formulated diets, it appears that this P/E ratio may be the best for commercial prawn diets.

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تغذية جمبرى المياه العذبة (*Macrobrachium rosenbergii*) فى المزارع المائية. ١- تأثير مستوى بروتين العليقة مع أو بدون ٥٪ زيت الاذره

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أشتملت الدراسة على تجربتين بهدف تقييم أثر تغذية اليرقات اليافعة من جمبرى المياه العذبة على مستويات مختلفة من البروتين مع أو بدون إضافة ٥٪ من زيت الأذره على معدل الإعاشة والنمو والزيادة فى وزن الجسم من العناصر الغذائية وكفاءة الاستفادة من الغذاء والعناصر الغذائية (بروتين وطاقة) ٠ وتم رعاية الجمبرى داخليا فى تنكات مستديرة (قطر ٥و١ م وحجم الماء فى التنك ١٠٠٠ لتر) مصنعة من الألياف الزجاجية٠

فى التجربة الأولى تم أعداد ٦ علائق تجريبية تحتوى على ٢٥، ٣٠ ، ٣٥٪ بروتين خام مع أو بدون إضافة ٥٪ من زيت الأذره وغذيت كل عليقه لمكررتين من جمبرى المياه العذبة (متوسط وزن مبدئى ٢و ± ١٠, جرام/ حيوان) وبكثافة ٢٠ حيوان /م٣ تنك وغذيت بمعدلات متناقصة (٢٠،١٥،١٠٪ من الوزن الحى لمدة ٢٨ يوم لكل معدل غذائى) ولمدة ٨٤ يوم٠ وتشير نتائج التجربة الأولى إلى أن معدلات البقاء والنمو والزيادة فى العناصر الغذائية فى الجسم كانت تتحسن جوهريا (معدل معنوية أعلى من ٥٪) بزيادة نسب البروتين الخام من ٢٥٪ إلى ٣٥٪ فى حين أن إضافة ٥٪ من زيت الأذره قد خفض جوهريا (معدل معنوية أعلى من ٥٪) من المعايير السابقة ٠ ووجد أن قيم استهلاك الغذاء كانت تزيد جوهريا بزيادة البروتين الخام فى العليقة إلى ٣٥ ٪ فى حين كان هناك انخفاض جوهرى فى استهلاك الغذاء مع أضافة زيت الأذرة بنسبة ٥٪ ٠ وقد تحسنت قيم الاستفادة الغذائية بزيادة نسبة البروتين الخام فى العليقة إلى ٣٥٪ فى حين انخفضت بإضافة ٥٪ من زيت الأذرة٠قيم الاستفادة من البروتين الخام فى جسم جمبرى المياه العذبة انخفضت بزيادة نسب البروتين فى العليقة أو بإضافة زيت الأذرة فى حين زادت قيم الاستفادة من الطاقة ٠

فى التجربة الثانية تم تخزين يرقات من جمبرى المياه العذبة بوزن اكبرمن التجربة الاولى (متوسط وزن ٥٣, ± ٠١, جرام/ حيوان) بمعدلات ١٠ جمبرى / متر مكعب /تنك ٠وغذيت على مستويات أعلى من البروتين الخام فى العليقة (٣٥ ، ٤٠ ، ٤٥٪ بروتين خام) مع أو بدون إضافة ٥٪ من زيت الأذره فى مكررتين لكل مجموعة لمدة ٨٤ يوم مع استخدام نفس أسلوب الرعاية فى التجربة الاولى٠ وتشير النتائج إلى أن زيادة نسبة البروتين الخام فى العليقة عن ٣٥٪ أو إضافة زيت الذرة بنسبة ٥٪ أدت إلى خفض جوهرى فى معدلات الإعاشة والنمو والزيادة فى العناصر الغذائية فى جسم الجمبرى٠ أيضا وجد أن قيم استهلاك الغذاء والاستفادة من الغذاء والعناصر الغذائية كانت تنخفض جوهريا مع زيادة بروتين العليقة عن ٣٥٪ أو إضافة زيت الأذرة ٠ولهذا يمكن استنتاج أن ٣٥٪ بروتين خام و ٨١-٨٢ مجم بروتين خام/ كيلو كالورى طاقة كلية (بروتين/ للطاقة) كانت هى النسبة المثلى للبروتين ، البروتين للطاقة فى علائق اليرقات اليافعة لجمبرى المياه العذبة تحت ظروف التجربة٠