

Effect of Different Protein Sources and Levels on Growth and feed Utilization of Common Carp (*Cyprinus carpio* L.) Fingerlings.

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TWELVE experimental diets containing 18, 25, 33 and 40% crude protein from a) plant protein, b) animal protein and c) a mixture of animal and plant proteins were fed to common carp (*Cyprinus carpio* L) fingerlings in 24 circular plastic tanks (35 L) for 98 days. Each dietary treatment was randomly assigned to two tanks, each stocked with 10 fish. The fish were fed 6 days a week at a rate of 3% of fish body weight and their daily feed allowances were increased weekly on the basis of weight gain. Growth performance and feed utilization for each diet were compared. The results showed that :

1. the diet containing, 33% crude protein from animal source produced optimum growth performance and feed utilization than the other tested diets.
2. animal protein was better utilized than the plant protein source in improving the growth of fish and feed utilization.
3. The mixture of animal and plant protein in the diets increased the growth performance and feed utilization mor than the plant protein alone in the diets.

Key wards : Fish, Carp, Feeds proteis sources levels, Growth.

Protein is the main constituent of fish body, thus sufficient dietary supply is needed for rapid growth . As protein is more expensive than carbohydrates and fat; therefore, the amount of protein in the diet should be just enough for growth and tissue repair (Lovell, 1980).

For fish, the optimum amount of protein in formulated feeds is important because either low or high levels of protein may lead to poor growth. As well, excess protein in fish diets may be wasteful and cause the diets to be unnecessarily expensive.

In contrast dietary protein requirements for optimum growth of fish seem to be affected by some environmental factors such as temperature, salinity and also fish size (Cowey, 1976). Ogino and Chen (1973a) reported that the biological value of animal protein sources were higher than those of plant protein ones.

The biological value of dietary proteins have remarkable influence upon the mode of utilization of absorbed nitrogen for maintenance, growth and waste energy. The higher biological value resulted in higher growth and lower waste energy. however the lower biological value resulted in a lower growth and higher waste energy (Ogino and Chen, 1973b).

This study, therefore, was designed to provide information on the level of dietary protein needed by common carp (*Cyprinus carpio* L) fingerlings for optimum growth in a laboratory type culture where natural food is limited. Specific objectives included determining growth and feed conversion and feed utilization for grown fish using nutritionally complete diets containing varying levels and sources of protein.

Material and Methods

Twenty four circular plastic tanks, each, measuring 38.5 cm in diameter and 37 cm in height, at the Department of Animal Production, Fac. Agric. Alexandria Univ. were used in the experiment. The 24 tanks each was filled with 35 L of tap water that was stored for at least two nights before being used. On July, 18, 1987, the tanks were stocked with 10 fingerlings of common carp (*Cyprinus carpio* L) fingerlings 5-6 gm body weight. Fifty fingerlings were immediately killed and frozen at -20°C for analytical purposes. The tanks were randomly arranged into twelve feeding treatments with two replications for each treatment.

Twelve diets containing 16, 25, 30 and 40% crude protein were used in the experiment. Under each level of protein, three diets were tested, the first diet contain plant protein, the second diet contain animal protein and the third diet contain a mixture of animal and plant protein. The composition of the twelve tested diets is given in table (1). Diets were mixed mechanically by horizontal mixture. The feed mixture was processed into califonia pellet meal (CPM) machine. The pellets were soft enough for

fish to take and retain. Particle size was 0.6 mm diameter, 2mm length.

The fishes were fed three times daily (09.00, 12.00 and 15.00 hours) 6 days a week at rate of 3.0% of fish body weight (Percentage moisture) throughout the experimental period. All fishes were removed using a net from each tank and weighed to determine their average weights of the fish in each treatment.

After weighing the fish, each tanks was cleaned to prevent accumulation of fecal materials and reduce algal growth to a minimum. The same source and amount of water were than used to refill the tanks before the weighed and amount of water were then used to refill the tanks before the weighed fish were returned to their respective tanks.

At the end of the experiment (October, 24, 1987) all fish in each tanks were killed after 14 weeks of the application of the feeding regime and frozen.

Fish samples were pulverized, autoclaved and afterwards homogenised with Ultra Turrax. The homogonized samples were oven dried (60°C-80°C for 48 hrs).

Chemical analysis of feeds and fishes were carried according to the method described by Naumann and Basslor (1976).

Statistical analysis of the experimental results were conducted according to Snedecor and Cochran, (1967).

Results and Discussion

Chemical analysis (%) of the twelve tested diets containing 18, 25, 33 and 40% CP and mixture of plant and animal proteins (1 : 1) are shown in Table 2. Increasing the level of protein in the diet, increased ash content however, nitrogen free extract was decreased.

Growth performance of carp fingerlings fer on different levels and sources of protein are showed in table (3). The results showed that increasing protein level more than 18% resulted in an increase in the final weight, gain and specific growth rate (SGR %/day). The maximum gains and SGR %/day were obtained when fish were fed on 33% crude protein from fish meal or

= 1

TABLE 1 : Composition (%) of the experimental diets.

Feed Ingredients	1	2	3	4	5
Yellow corn	73	81	76	50	67
Fish meal	—	15	7	—	29
Soybean meal	23	—	19	46	—
Corn oil	2	2	2	2	2
Vitamin mixture	1	1	1	1	1
Mineral mixture	1	1	1	1	1

TABLE 2 : Chemical analysis % of the tested diets.

	Protein level %				
	18			25	
	A	B	C	A	B
DRY MATTER %	83.68	85.25	84.15	85.70	85.41
% on DM basis :					
Ash	3.54	3.35	3.55	6.47	4.61
CP	17.30	17.90	18.0	25.80	25.50
EE	4.3	4.14	4.84	4.34	4.70
CF	2.12	2.07	2.98	2.28	1.53
NFE	72.74	72.54	70.63	61.11	63.66
Energy Kj/gDM)	18.72	18.50	18.58	18.64	18.71

A — Plant protein

B — Animal protein

fish meal respectively. The differences were significant at ($P < 0.05$ level).

Chemical analysis (%) of fish carcasses fed on different levels and sources of protein are showed in table 4, Generally, feeding of carp increased dry matter and ether extract. however, crude protein content and ash were decreased. The protein content in fish carcasses fed on fish meal containing diets was higher than in the diets containing a mixture of plant and animal proteins or plant protein respectively. The diets containing the lower protein level (18%) increased fat deposition in the fish carcasses. Ash content in fish carcasses did not affected with the level and sources of protein.

Data in table (5 and 6) show the effect of level and source

6	7	8	9	10	11	12
58	37	58	40	6	39	20
15	—	43	21	—	57	26
23	58	—	35	90	—	50
2	2	2	2	2	2	2
1	1	1	1	1	1	1
1	1	1	1	1	1	1

C	33			40		
	A	B	C	A	B	C
85.64	86.19	86.29	86.01	85.24	85.50	85.70
4.85	5.07	6.75	6.18	4.97	6.67	6.45
25.08	33.09	32.98	33.0	39.8	39.19	40.2
5.10	5.45	4.96	5.72	4.67	4.83	5.34
4.27	2.91	2.51	2.73	4.78	1.64	4.70
60.75	53.48	52.80	52.37	45.78	46.95	43.31
18.77	19.29	19.08	19.06	19.94	19.31	18.73

C — Mixture of animal and plant proteins

of protein in the diets on feed and nutrient utilization in common carp fingerlings. Feed intake was greatly increased by increasing protein level to 33% from a mixture of fish meal and soybean meal or fish meal. Feed utilization (FGR) was significantly increased ($P < 0.05$) by increasing the level of crude protein to 33% from a mixture of animal and plant protein or fish meal respectively. Increasing the level of crude protein in the diet more than 33% did not improve the feed utilization from different protein sources.

The protein efficiency ratio (PER) on the low level of protein (18%) was higher in plant protein containing diet than fish meal or the mixture of animal and plant proteins diets, however, the differences were not significant.

Protein utilization was improved by increasing the protein

TABLE 3 : Effect of different levels and sources of protein on the growth

	Protein level %					
	18			25		
	A	B	C	A	B	
Initial weight (g/10 fish)	59.55	58.05	60.80	57.85	61.50	
	± 1.20	± 1.91	± 3.96	± 1.2	± 4.95	
Final weight (g/10 fish)	91.65	87.55	84.90	105.85	115.1	
	± 5.16	± 5.3	± 1.56	± 1.34	± 19.44	
Gain (g/10 fish)	34.10	29.5	24.0	48	45.6	
	± 3.96	± 7.21	± 2.55	± 2.59	± 14.99	
SGR%/day	0.48	0.56	0.43	0.63	0.64	
	± 0.04	± 0.02	± 0.16	± 0.02	± 0.09	

A : Plant protein, B : animal protein and C : mixture of animal and plant protein

TABLE 4 : Chemical analysis (%) of common carp carcasses fed on different level

	Protein level %					
	At the start	18			25	
		A	B	C	A	
Dry matter %	15.16	25.1	25.3	25.05	22.91	23.86
% on DM basis :						
Ash	20.66	15.29	14.95	15.34	11.61	12.11
CP	65.83	49.72	54.26	52.71	51.72	65.12
EE	12.57	32.17	31.06	29.46	31.66	25.56

A) Plant protein

B) Animal protein

level from 18% to 33% and then decreased. Fish meal protein was better utilized when protein content was ranged between 25 and 33%. Mixing of plant protein with animal protein improved the protein utilization than plant protein only (Table 5 and 6). The differences were significant at ($P < 0.05$) level.

Results in table (5 and 6) shows that the protein productive values (PPV%) were significantly ($P < 0.05$) higher when carp was fed on 25% CP containing fish meal diet than any other tested levels and sources (except the diet contained 33% CP from a

performance of common (*Cyprinus carpio* L) fingerlings.

33			40			
C	A	B	C	A	B	C
58.1	59.5	55.0	62.8	55.95	55.90	59.70
+ 2.97	± 0.71	± 2.83	± 1.13	± 1.34	± 3.11	± 3.7
103.2	94.5	127.55	133.8	98.85	102.3	95.25
+ 7.91	± 0.89	± 2.33	± 2.2	± 16.48	± .42	± 15.2
45.1	35.0	72.55	71.0	43.05	46.2	35.55
+ 4.95	± 5.28	± 0.49	± 4.24	± 17.6	± 17.6	± 11.53
0.59	0.50	0.86	0.77	0.58	0.62	0.47
+ 0.02	± 0.04	± 0.03	± 0.4	± 1.19	± 0.06	± 0.01

N : Not tested.

and sources of protein.

33			40			
C	A	B	C	A	P	C
25.63	22.87	22.47	25.43	21.37	21.92	22.55
13.74	12.72	12.92	14.17	12.83	13.02	14.37
55.21	57.05	67.35	62.15	63.86	67.76	64.76
29.07	28.84	30.56	23.23	21.24	19.22	21.65

C) Mixture of animal and Plant protein (A : 1).

mixture of fish meal and soybean meal. The values are 22, 20, 19 and 14% for the diets containing 25, 33, 18 and 40% CP respectively. On the other hand it was found that fish meal improved the PPV% than soybean meal and a mixture of both increased the PPV% than soybean meal alone.

Ogino and Satio (1970) reported that the made of weight gain and protein accumulation by carp fed on casein as the main source of protein is considerably different a higher levels of protein in the diet. The protein accumulation rate (Protein accumulated/protein consumed) showed its highest value at near 21% of

TABLE 5 : Feed utilization of common carp fingerling fed different levels and sources of protein.

	Protein level %				
	18% CP			25% CP	
	A	B	C	A	B
Feed intake (g/group ± SD)	179.4 ± 10.2	172.5 ± 10.1	171.4 ± 12.1	156.9 ± 8.0	167.9 ± 18.3
Feed/gain (g feed/g gain ± SD).	5.28 ± 0.31	5.99 ± 1.12	7.21 ± 1.27	3.28 ± .36	3.21 ± 0.55
PER (g/gain /g protein. intake ± SD)	1.1 ± 0.07	0.95 ± 0.18	0.79 ± 0.13	1.19 ± 0.13	1.24 ± 0.21
PPV% ± SD	19.0 ± 0.7	20.0 ± 1.0	17.0 ± 2.0	17.0 ± 1.0	28.0 ± 4.0
Energy utili- zation.	11.0 ± 0.22	11.0 ± 0.45	9.9 ± 0.83	13.8 ± 1.25	14.8 ± 1.66

N. Not tested A : plant protein B. Animal protein

protein level, while the protein utilization value (protein accumulation rate × protein content of the diet) attained its highest value at 38% of protein level. The present results showed that the protein accumulation rate was differ with the different protein source and it was highest at 18% CP from soybean meal and 25% CP from fish meal. The protein requirements for optimum growth of fish seem to be affected by some environmental factors such as temperature, salinity and also fish size (Cowey, 1976).

The protein productive value (PPV%) in the present experiment was ranged between 14 and 22% and differed with the source of protein. A similar results were obtained by several others and ranged between 7.5 and 27.1% (Koch 1984, Eckhardt *et al.*, 1981. Peffer and Meske 1978 and Omar. 1984).

Energy utilization (%) showed that diets contained 33% CP increased its value than any other tested levels. The energy utilization (%) values were 15.13, 14.00, 11.07 and 10.63% for diets contain 33, 25, 40 and 16% crude protein respectively (Table 5 and 6).

C	33% CP			40% CP			L.S.D.0.05
	A	B	C	A	B	C	
165.5 ± 29.3	159.1 ± 8.6	183.1 ± 8.8	185.4 ± 2.3	149.8 ± 5.2	154.4 ± 1.0	166.4 ± 13.2	N
3.66 ± 0.25	4.52 ± 0.21	2.53 ± 0.11	2.62 ± 0.19	3.77 ± 1.41	3.34 ± 0.22	4.87 ± 1.20	0.96
1.10 ± 0.08	0.67 ± 0.03	1.20 ± 0.05	1.17 ± 0.8	0.72 ± 0.2	0.781 ± 0.05	0.52 ± 0.3	0.2978
22.0 ± 2.0	13.0 ± 0.7	23.0 ± 1.0	25.0 ± 0.0	14.0 ± 4.0	16.0 ± 0.0	12.0 ± 0.2	4.242
13.4 ± .24	11.7 ± 0.4	15.7 ± .77	18.0 ± .94	10.9 ± 2.86	12.1 ± .4	10.2 ± 1.6	2.786

C. Mixture of animal and plant protein

Energy utilization was also affected by the protein source which is higher with the fish meal containing diets than with soybean meal diets. Mixing of fish meal protein with plant protein increased the energy utilization than soybean meal alone. The energy utilization values were 15.65, 12.88 and 11.85% for fish meal, mixture of fish meal and soybean meal, and soybean meal respectively.

The optimum energy utilization was obtained in the diet contained 33% CP from a mixture of plant and animal protein sources and significantly higher ($P < 0.05$) than the other tested diets except the diet contained the same level of CP from animal source.

The present results showed that the values of energy utilization % were ranged between 9.9 and 18.0% which is similar to the results of Eckhard et al., (1981). Meske and Peffer (1977) and Peffer and Meske (1978) and Koch (1984) which is ranged between (12.6% and 26.7%) and less than that obtained by Omar 1984 (19.2 — 26.1%).

TABLE 6 : Summary of the results on the effect of levels and sources of protein on growth performance and feed utilization by common carp fingerlings.

A. Effect of protein level %				
	18	25	33	40
SGR %	0.49	0.62	0.71	0.26
	± 0.07	± 0.03	± 0.19	± 0.02
FGR	6.16	3.38	3.23	3.99
	± 0.99	± 0.24	± 1.12	± 0.79
PER	0.95	1.18	1.01	0.67
	± 0.16	± 0.07	± 0.30	± 0.14
PPV%	18.70	22.33	20.33	14
	± 1.52	± 5.50	± 6.43	± 2.0
Energy utilization	%10.63	14.00	15.13	11.07
	± 0.64	± 0.72	± 3.19	± 0.98

B. Effect of protein source			
	Fish meal (1)	Soybean meal	Mixture of (1) and (2) (1:1)
SGR %	0.67	0.55	0.57
	± 0.13	± 0.07	± 0.15
FGR	3.77	4.21	4.29
	± 1.52	± 0.88	± 1.97
PER	7.04	0.92	0.90
	± 0.22	± 0.26	± 0.30
PPV %	21.75	15.75	19.00
	± 5.06	± 2.75	± 2.72
Energy utilization %	13.4	11.85	12.88
	± 2.21	± 1.35	± 3.77

These difference in protein and energy utilization could be attributed to the differences in :

- (1) period of growth,
- (2) feeding level,
- (3) protein level and quality
- (4) energy level and
- (5) rearing facilities.

It could be concluded from the present results that :

(1) fish meal is better utilized by carp fingerlings than soybean meal and a mixture of both improved growth performance and feed utilization.

(2) the optimum utilization of protein could be achieved with 18 and 25% CP level when soybean meal and fish meal were used respectively.

(3) a mixture of protein sources from soybean meal and fish meal (1 : 1) is utilized better than plant protein alone.

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تأثير مصادر البروتينات المختلفة ومستوياتها على النمو وكفاءة تحويل الغذاء في اصبيغيات البروك العسادي

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استخدمت اثنى عشرة عليقة تحتوى على 18 ، 25 ، 33 ، 40 ٪ بروتين خام من كل من (1) البروتين النباتى ، (2) البروتين الحيوانى ، (3) مخلوط من البروتين النباتى والحيوانى في تفضية اصبيغيات البروك العسادي (*Cyprinus Carpio L.*) وذلك في 24 من الاحواض البلاستيكية المستديرة (35 لتر) لمدة 98 يوم . ووزعت المعاملات على الاحواض عشوائيا ووضع عشرة اصبيغيات في الحوض . وغذى السبك ستة ايام في الاسبوع بمعدل 2 ٪ من وزن الجسم الطارح وكانت كمية الغذاء المسموح بها تزداد على اساس زيادة وزن الجسم وتم مقارنة كفاءة النمو وكفاءة الاستفادة من الغذاء واظهرت النتائج ما يلى : -

- 1 - العليقة المحتوية على 33 ٪ بروتين خام من مصادر حيوانية اعطت نمو مئالى وأعلى كفاءة للاستفادة من الغذاء عن الملائق الاخرى التى تم اختبارها .
- 2 - الاستفادة من البروتين الحيوانى كانت أعلى من الاستفادة من البروتين النباتى في حفظ النمو وكفاءة الاستفادة من الغذاء .
- 3 - مخلوط البروتينات النباتية والحيوانية في الملائق زودت من معدلات النمو وكفاءة الاستفادة من الغذاء على البروتين النباتى فقط .