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EFFECT OF SUBSTITUTION OF PROTEIN CONCENTRATE BY SHRIMP MEAL ON SOME GROWTH TRAITS OF COMMON CARP (*CYPRINUS CARPIO* L.)

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ABSTRACT

This study was conducted for a period of 90 days to investigate the effect of using different levels of shrimp meals as a partial substitute for the protein concentrate in the diets of common carp (*Cyprinus carpio*) on growth performance. Eight glass tanks were used, and 48 fish were randomly distributed, with an average weight of 23.0 ± 0.5 g, for individual, which were divided into four experimental treatments, with two replicates for each treatment (6 fish / replicate). Fish were fed at 4% of body weight on laboratory formulated diets with a diameter of 2 mm, and shrimp meal was used in proportions of 0, 16, 32 and 48% for T1, T2, T3 and T4 treatments, respectively. Results of the study showed that treatment T3 was significantly superior to ($P < 0.01$) in the total weight gain rate, daily growth rate, and the feed conversion rate and efficiency, as it recorded 10.90 g / fish, 0.77 g / day / fish, 3.35 and 29.66% for the above characteristics, respectively. The study concluded that there is a positive role in the use of shrimp meal added to the diet by 32% in increasing the essential and non-essential amino acids and its effect on improving growth parameters, which was reflected in the productive characteristics of common carp.

Keywords : Common carp, shrimp meal, feed conversion rate, feed conversion efficiency

Introduction

Fish meat is a healthy food with high nutritional value, as the protein in it contains essential amino acids, as well as the availability of unsaturated fatty acids, vitamins and mineral elements (Hassan and Hashem, 2016). Thus, in recent decades, attention has turned towards fish farming due to the increasing demand for its meat consumption due to its great advantages when compared with animals.

The cultivation of the common carp *Cyprinus carpio* has received great attention because of its advantages in achieving a high production rate, its speed of growth, its resistance to environmental conditions and diseases, the ease of its cultivation and the availability of all its requirements, as well as the possibility of its reproduction under conditions of families, which are ideal characteristics of fish to be cultured on a commercial scale (Gupta *et al.*, 2005).

The great development in fish farming has led to an increase in production inputs, specifically the feeding process, which accounts for a large proportion of the costs of farming. Therefore, other alternatives must be sought to replace the important components of the feed such as fish meal, protein concentrate and soybean meal (Sajid *et al.*, 2016). The costs of feeding fish and providing fodder in fish breeding projects constitute 40-60% of the production costs (Hertrampf and Piedad-Pascual, 2000). It is possible to use alternatives to protein that are less expensive and more economical, thus obtaining the lowest cost of feed, as a result of the rapid expansion and development of the breeding sector. Fish In recent years, efforts have focused on developing better quality and low-cost fish feed industry, which led to an increase in fish production by 50-80% while boosting the value of protein in the feed between 30-40% through the use of other low-cost protein sources (EI-Sayed *Et al.*, 2003). As a result of high costs, increased demand, and the limited availability of fish meal as a source of animal protein, researchers have been conducting several studies on nutrition to provide reliable alternative sources to form diets Freshwater and marine fishes to be reared (Nyirenda *et al.*, 2000), these alternatives will undoubtedly have an important role on a large scale in the aquaculture industry in the future (Miles and Chapman, 2006).

Given the availability of freshwater shrimp *Metapenaeus affinis* in large quantities in Iraqi fish farms and inland waters, and because it competes with growing fish in ground ponds for food and place, and because there is no study on its use in forming fish diets, the current study aimed to benefit from it by partially replacing it with proportions. Different substitutes for the imported protein concentrate used in fish diets and to note its effect on some growth characteristics of common carp.

Materials and Methods

Freshwater shrimp *Metapenaeus affinis* was brought from a fish farm and preserved by freezing at first and was classified to determine its species. Three samples of shrimp were taken as follows: the first sample is a whole shrimp, the second is the head and shells of the shrimp (chitinous shell) and the third is the muscle part (meat) without Chitinine cover and head. Samples were dried by exposing them to sunlight and milled with a grain grinder and turned into a powder. The chemical analyzes of the body composition

were carried out and the protein, moisture, fat, carbohydrates, fiber and ash were estimated (Table 1) based on the standard methods mentioned in AOAC (2003), and the energy of the feed materials was estimated. Especially in the ratio of protein between the whole shrimp, the chitinine cover and the meat, so the shrimp was completely dried under the sun for a week and stirred continuously, then grinded well and turned into a powder for the purpose of using it according to the proportions required in the manufacture of diets.

Table 1 : Chemical analysis of freshwater shrimp meal *Metapenaeu affinis*

Proportions	Content
Crude protein	17.5
Fat	6.6
Raw fiber	7.1
Ash	14.0
Moisture	5.57
Carbohydrates	49.23
*Energy (Kcal / Kg)	3244.0

Manufacture of feeds

Four experimental diets were made of approximately equal energy and protein content, with different usage ratios for shrimp meal, depending on the calculations of (Table 2).The ingredients included in the composition of the diets and according to the theoretically calculated proportions (Table 3) were mixed by hand for the purpose of homogenizing the mixture for all the components of one bay and separately, 350 - 400 ml of warm water per kilogram of the mixture were added to the components of one bean. Four diets were formed into a homogeneous dry dough that was easy to pass through the meat grinder. Putting the dough for each feed into a meat mincing machine with a thickness of 2.5 mm holes, and re-chopping the feed twice to increase its consistency. The granules resulting from the mincing process were dried in the open air for two days, and placed in the shade at a temperature of 43 °C, with continuous stirring to ensure complete disposal of the excess moisture and to avoid preventing the growth of fungi on them. After drying, the filaments resulting from the mincing process were cut into small granules that fit the size of the mouth of the fish used in the experiment. The feeds made with nylon bags were kept, as each feed was placed inside a bag with the transaction number affixed and the bags were placed in the refrigerator at a temperature of 4 °C until the feeds were presented to the experiment fish.

Table 2 : Chemical analysis of the materials used in forming diets of the experiment

Feed Material	Chemical components				
	Crude protein (%)	Ether extract (%)	Ash (%)	Fiber (%)	Soluble carbohydrates (%)
*Jordanian fishmeal powder	50	14	9	1.20	25.80
**Soybean cake	43.20	2.72	7.61	6.90	36.87
**Wheat bran	15.72	4.47	5.52	11.82	62.47
**yellow corn	10.12	4.87	2.61	2.25	80.15
**Lizard	12.90	16.00	8.80	7.00	55.30
**Barley	12	3.00	13.80	9.40	61.80
**Millet grains	10.80	3.00	13.80	9.40	63.00

*The label installed from the manufacturer on the product
**According to N.R.C. (2011).

Table 3 : Components of experimental relationships (on dry matter basis %)

N	Feed ingredients for diets Experimental	T1 Control rennet free from shrimp meal	T2 Addition of shrimp meal at 16% is a partial substitute for fishmeal	T3 Addition of shrimp meal at 32% is a partial substitute for fishmeal	T4 Addition of shrimp meal at 48% is a partial substitute for fishmeal
1	Fishmeal	28	23.52	19.04	14.56
2	Soybean cake	35	35	35	35
3	Shrimp meal	0	4.48	8.96	13.44
4	yellow corn	8	8	8	8
5	Barley	6	6	6	6
6	Millet grains	5	5	5	5
7	Flour bran	5	5	5	5
8	Scourer	10	10	10	10
9	Fish fat	1	1	1	1
10	*Vitamins and Minerals	1	1	1	1
11	Salt	1	1	1	1
	Total	100%	100%	100%	100%

*Coli-Vita Ar of Jordanian origin contains group vitamins A, D3, E, K3, B1, B2, B6, B12, Niacin, Folic Acid, Calcium-D-pantothenate, Manganese Sulphate, Zinc Sulphate, FerrousSulphate, Copper Sulphate, Cobalt Sulphate, Potassium lodide, DL-methionine, L-Lysine.

Acclimatization of fish

100 fish of similar weights were placed in a brine solution at a concentration of 0.5% until signs of stress appeared on the fish in order to get rid of external parasites on the skin, if any (Mohaisen, 1983). 48 fish were selected from them and distributed randomly and evenly over eight glass ponds with an average initial weight of 23 ± 0.5 with a live mass rate of 138 ± 1 g per pond, the ponds for the experiment were divided into four treatments, with two repetitions for each treatment, and six fish for each replicate. For 4% of the weight of fish living mass in each pond, at a rate of three meals per day at 7 am, 11 noon and 5 pm the fish were acclimatized to laboratory conditions for a period of 21 days, not counted within the experiment period, which lasted for 90 days. Weighed the fish every 15 days and adjusted the amount of feed provided to the fish after each weighing process. The absence of fish ponds was used when performing the weighing process in order to clean them well from the excrement accumulated on the bottom and sides of the pond. Fish were fed on four experimental feeds under We applied shrimp meal to partially substitute fishmeal with ratios 0, 16, 32 and 48 for T1, T2, T3 and T4 treatments, respectively, to study some growth characteristics of the experimental fish.

Studied growth traits

The values of the studied traits were calculated according to the following mathematical equations :

Total Weight Gain (T.W.G).

Total weight gain (g / fish) = average final weight g/fish-average initial weight g / fish

Daily Growth Rate (D.G.R).

Calculated according to Uten's equation (1978).

$$\text{Daily growth rate}\left(\text{g/day}\right)=\frac{\text{Weight gain}\left(\text{g/fish}\right)}{\text{Duration of experiment}\left(\text{day}\right)}$$

Feed Conversion Ratio (F.C.R)

It is calculated according to the equation referred to by Hepher (1988).

$$\text{Feed conversion rate}=\frac{\text{Amount of feed}\left(\text{g/fish}\right)}{\text{Fish wet weight gain}\left(\text{g/fish}\right)}$$

Feed Conversion Efficiency % (F.C.E): Feed Conversion Efficiency

Calculated according to Uten's equation (1978).

$$\text{Fish wet weight gain (g / fish)}=\frac{\text{Food Transfer Efficiency}}{\text{Amount of feed}\left(\text{g/fish}\right)}\times 100$$

Statistical analysis

The Statistical Analysis System -SAS (2012) program was used in analyzing the data to study the effect of different parameters on the studied traits according to the fully randomized design (CRD). The significant differences between the averages were compared with the Duncan (1955) polynomial test.

Mathematical model of design:

$$Yij = \mu + Ti + eij$$

As:

Yij: the view value j of transaction i.

μ: the general average of the studied trait.

Ti: effect of i-treatment.

eij: the normally distributed random error with mean equal to zero and variance of $\sigma^2 e$.

Results and Discussion

The water temperature ranged between 20-27 °C during the duration of the experiment and the dissolved oxygen concentration ranged between 3-7.4 mg/liter and the pH between 7.3-8.1 (Table 4). The aforementioned ranges of environmental factors fall within the natural rates appropriate for the livelihood, survival and growth of common carp (Al-Khshali and Al –Hilalli, 2019). Vandeputte (2003) stated that the best growth temperature ranges between 23-28 °C, and Linhart *et al.* (2003) indicated that the optimal concentration of O_2 ranges between 4-8 mg/L While the best pH for water ranges between 5-9. Therefore, the aforementioned results fall within the safe standards for the livelihood and growth of common carp (Kohlman *et al*., 2003).

Table 4 : Temperature averages, dissolved oxygen concentrations and pH values in common carp pond waters

T	October			November			December		
Treatments	Temperature (C°)	Dissolved oxygen(O2) (mg/L)	pH	Temperature (C°)	Dissolved oxygen(O2) (mg/L)	pH	Temperature (C°)	Dissolved oxygen(O2) (mg/L)	pH
T1	23 – 27	5 – 7.3	8.1 - 7.5	22 – 24	5.5 – 7.3	7.3 – 8.1	20 – 22	6- 7.3	8.1 – 7.5
T2	23 – 27	5 – 7.3	8.1 - 7.6	22 – 24	5.5 – 7.3	7.6 – 8.0	20 – 22	6.2 – 7.3	8.1 – 7.5
T3	23 – 27	5 – 7.3	8.1 - 7.4	22 – 24	3 – 5	7.3 – 8.1	20 – 22	6 – 7.4	8.1 – 7.5
T4	23 – 27	5 – 7.3	8.1 - 7.3	22 – 24	5.5- 7.3	7.4 – 8.1	20 – 22	6 – 7.3	8.1 – 7.5

The average initial weight of the common carp was clearly close in all the experiment treatments (22.95 g), and clear differences appeared between the average weights of the experimental fish, as after 90 days the final weights reached 76.15, 60.15, 51.33 and 45.25 g, respectively. The results of the statistical analysis and the existence of significant differences ($P < 0.01$) in the total weight increase between the various treatments, as the third treatment (32% shrimp meal) showed a clear superiority in the total weight increase of 53.29 g/fish over the fourth treatment 37.40 g/fish, followed by the second treatment. That was 28.23 g/fish, then the first treatment, which was 22.24 g/fish. The

results of the statistical analysis of the daily growth rates during the period of the experiment took a similar trend to the results of the weight gain rates in the significant outperformance of the third treatment fish (P <0.01) (32% of shrimp meal) over the parameters T4, T2 and T1 throughout the experiment times, and were recorded at 0.77, 0.33, 0.32 and 0. 24 transactions in a row. With regard to the feed conversion rate, the third treatment outperformed the rest of the trial treatments, and it recorded 3.35, 5.80, 6.75 and 6.91 for the treatments T3, T2, T4 and T1, respectively. As for the efficiency of food conversion, the results showed the same pace in the results of the food conversion rate from the superiority of treatment T3 over The rest of the transactions were recorded as 29.66, 17.17, 14.66 and 14.37 for T3, T2, T4 and T1 transactions, respectively (Table 5).

Table 5 : Weight gain, daily growth rate, rate and feed conversion efficiency of common carp fish fed with different proportions of shrimp.

Treatments	Initial weight g/fish	Final weight g/fish	Weight gain g/fish	Daily growth rate g/day/fish	Food conversion rate	Food conversion efficiency
T1 (0% Shrimp meal)	23.01±0.009 a	45.25±0.197 d	22.24±0.206 d	0.24 ±0.007 c	6.91 ±0.180 c	14.37 ± 0.11 c
T2 (16%Shrimp meal)	23.10 ± 0.094 a	51.33±0.055 c	28.23±0.016**c**	0.32 ±0.005 b	5.80 ± 0.125 b	17.17 ± 0.07b
T3 (32%Shrimp meal)	22.86 ± 0.009 a	76.15 ±0.229 a	53.29 ± 0.238 a	0.77 ± 0.002 a	3.35 ± 0.000 a	29.66 ± 0.21 a
T4 (48%Shrimp meal)	22.85 ± 0.001 a	60.15 ± 0.133 b	37.30 ± 0.131 b	0.33 ± 0.005 b	6.75 ± 0.090 c	14.66 ± 0.17 c

It is noted from the results of the rates of weight gain and the daily rate of growth that the diets that contained different percentages of shrimp, namely T2, T3 and T4, significantly outperformed the control treatment T1 that was devoid of shrimp. From (Table 5) the treatment of T3 is superior to the rest of the treatments, which indicates that the diet is balanced in its protein content, especially of the essential amino acids important for growth, and that the proportion of 32% of shrimp used in the formation of the diet in the third treatment (T3) appears to be the ratio The ideal in terms of utilizing the components of the diet and the balance of its components of essential and non-essential amino acids and fatty acids, which was positively reflected in the achievement of high weight gain. The reason that the treatment T4 did not exceed the treatment T3 during the experiment period, with its higher percentage of shrimp meal (48%), may be attributed to the fact that using shrimp completely with insights The presence of the chitinous shell that contains chitin, which can only be digested by the enzyme chitinase, because common carp fish may not be able to fully digest it and resort to throwing it out with the waste, and thus it depletes energy from the body to get rid of it. While it may spend energy to get it out and get rid of it, this is what might happen in the 48%. Abdul Hamid (2017) indicated that the enzyme chitinase is secreted from the pancreas and stomach of fish fed on crustaceans or insects, and it is an important and necessary enzyme to break down chitin. However, treatment T3 is the best treatment due to its significant superiority in overall weight gain of 53.29 g, compared with weight increments of 37.30, 28.23, and 22.24 g for transactions T4, T2 and T1 respectively. Weight gain is the final result that depends upon in assessing forage sources and their quality (Al-Amili, 2003). Shrimp meal is a good food for nutrition. Ginson and Bindu (2017) stated that Shrimp is one of the best sources of animal protein due to its abundance and cheapness, because it this a healthy food and contains very little fat and a high-quality source of protein. The World Health Organization (WHO) recommends the use of shrimp residues in feeding young common carp because of its importance in improving growth and stimulating immunity in aquaculture (Kandra *et al.*, 2011). Dincer and Aydin (2014) confirm that shrimp meat consists of unsaturated fatty acids such as eicosapentaenoic EPA and docosahexaenoic. DHA, which is essential in the diet, and common carp fish need of omega-3 and 6 fatty acids, at a ratio of 1% each, which achieve the highest rates of weight gain and daily growth. The results of the present study agreed with the results of Mahida *et al.* (2015) who introduced the powder of shrimp heads without shells into the diets at rates of 10%, 20%, 30%, 40% and 50% in the feeding of *mossambicus oreochromis* with an initial weight rate of 16.18 g for a period of 60 days, so he concluded that the best Weight gain was using the ratio of 30% because it gave the best weight gain, and the final weight of the fish was 94.64 g. The present results are in agreement with the results of Nwanna (2003) who used the silage of fermented shrimp heads as a partial substitute for fish meal in the rations at rates of 5%, 10%, 20%, 30% and 40% in feeding African runaway fish *Clarias gariepinus* with an average initial weight of 12.04 g for a period of 84 days. The results showed superior treatment. Which contained 30% of shrimp, as it gave the best weight gain, and the final weight of the fish was 53.98 g. The results were inconsistent with the study of Santos *et al.* (2012) that used shrimp residues at 0, 15, 30 and 60% as a partial substitute for fishmeal in liquid form in the diets used to feed young Nile tilapia fish with an initial weight of 1.7 g. The final weights of the first treatment were 27.18 g, the second 29.46 g, and the third. 26.02 gm and the fourth 25.19 gm, the results showed that the second treatment was superior to using 15% of shrimpmeal residue and the least weight gain was when using the ratio 60%. The superiority of the third treatment in the current study throughout the period of the experiment for the rate and efficiency of the feed conversion may be attributed to the increased palatability of the feed or to the balance in the content of the diet mixture of essential amino acids important to the requirements of growth, as well as the use of the appropriate ratio of the combination of shrimp and fishmeal, which works to complete One of them to the other by contributing to the completion of the required proportions of essential amino acids and fatty acids necessary for the requirements of growth, which increases the rate of

consumption of this diet without the other and thus works to increase growth and raise the rates and efficiency of food conversion of fish. This result is in agreement with Cahu and Zambonino-Infante (2001) pointing out that the growth of fish and the efficiency of converting feed into meat are closely related to the quality of the feed and the composition of its components, especially the protein concentration, since it is the quality of the feed and its nutritional value that determine the amount of what is converted into meat. The results of the current study agree with the results of Raja Nandini (2014) regarding the effect of using levels of shrimp residues on the rate of dietary conversion of Koi Carp *Cyprinus carpio haematopterus*, as levels 0, 25, 50, 75 and 100% were used for the treatments T1, T2, T3, T4 and T5, and the results showed superiority. T3 and T2 were recorded for the rest of the transactions, which recorded 1.30 and 1.45, respectively, while it recorded 1.70, 1.74 and 1.82 for the transactions T1, T4 and T5, respectively.

The superiority of the third treatment over the rest of the treatments in the characteristic of the feed conversion rate may be attributed to the efficiency of the feed used and the possibility of processing the fish of the treatment with the necessary and required requirements, the most important of which are amino acids, especially the basic ones, because of their essential and effective role in growth, and the quality of the feed conversion rate may also return when using Shrimp powder with a ratio of 32% to a balanced content of proteins and fats and the integration of the components of the diet. As the rate of food conversion is the ability of the animal to convert food to an actual increase in weight while maintaining the health status (Al-Qoud, 2003).

The superiority of treatment T3 in terms of the rate and efficiency of food conversion over the rest of the treatments throughout the period of the experiment may be due to enhancing the necessary requirements for fish in performing its vital activities and thus increasing feed consumption, which raises the rate and efficiency of feed conversion, as Abou-Zeid (2002) indicated that the efficiency of feed conversion is expressed On the efficiency of the organism to take advantage of the food intake to form a weight gain expressed as a percentage, Hardy and Halver (2002) stated that fish are among the most efficient farm animals in their ability to benefit from food. The high rate and efficiency of nutritional conversion in experimental diets containing different proportions of shrimp meal When compared to the control treatment free of shrimp meal , it may be evidence of the effectiveness of shrimp meal in metabolizing fats, improving the digestibility and utilization of the food, and this indicates the quality of the feed. Al-Amili (2003) indicated that the efficiency of the feed conversion is one of the criteria used to measure the quality of the feed provided to fish. Or any other animal.

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