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Effect of Different Feeding Rates on Growth Performance Some Biochemical Traits of Common Carp (*Cyprinus Carpio*) and its Economical Efficiency.

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ABSTRACT

This study was carried out during summer 2009 for 150 days in twoelve earthen ponds. (1000 m^2 each). Each pond was stocked with 2500 of fish, common carp (*Cyprinus carpio*) fingerlings, (12 ±0.1 g/ fish). Four treatments were conducted with supplementary feed (25% protein) at different rates (1.5, 3, 4.5 and 0.0 % of fish weight for T1, T2, T3 and T4, respectively). Ponds were fertilized with organic and inorganic fertilizers. The present study aimed to determine the effect of different feeding rates on some water quality parameters, enzyme activites, approximate analyses of fish body, growth performance and economical evaluation.The obtained results showed that; Aspartate aminotransferase (AST) and Alinine aminotransferase ALT activities in liver were, increased gradually with increasing feeding rates. Plasma and tissue cholesterol contents of the studied fish, increased gradually with increasing feeding rates. Dry matter and crude protein content in whole fish body were increased gradually, while crude fat and ash decreased, with increasing feeding rates. Final body weights of common carp significantly decreased ($p < 0.05$) with decreasing feeding rates. They were 390.2, 469.9, 475.4 and 190.6 g/ fish for T1, T2, T3 and T4 respectively.The weight gain, specific growth rate (SGR) and total production were significantly decreased with decreasing of feeding rate. Treatment (T2) 3% feeding rate had the best economical efficiency.

Keywords:

INTRODUCTION

In fish culture, many factors affecting growth performance and physiological characteristics of fish. Feeding period and rate of feeding were main factors strongly affect growth and physiological status of the cultured fish. It is a common practice in traditional pond fish culture in Egypt to apply both artificial feeding with

pond manuring to increase the abundance of natural food. Best Feed Conversion ratio of 1.6 had been achieved by Common carp using pellets containing 25% Protein in demand feeders at stocking rates of 5000 fingerlings per hectare under conditions of improved feeding (Kruger , 1978) Lam and Shepherd (1988) found that common carp growth in tanks supplied with both natural feeds and a high protein supplement was very variable , and detected that fish growth was influenced by the presence of natural feed . Green *et al*, (1990) reported that , feeding rate of 3% of body weight appeared more economically viable and produced the greatest gross fish tilapia yields and net returns. Zonneveled and Fadholi (1991) found that the relation between growth and feeding rate is linear. The maximum weight gain is reached at or near satiation level, in other words, when feed intake is maximum. Feeding rates for tilapia are affected by species, size, temperature, feeding frequency, and the availability of natural foods. Excess feeding can result in an increase in organic material, a decrease in dissolved oxygen due to oxidation by bacteria and an increase in metabolic wastes (Boyd, 1992). Analyses of plasma constituent have been proved to be useful in the detection and diagnosis of metabolic disturbances and disease incidences. (Balarin and Haller, 1982).Cowey *et al.* (1974) found that cultured plaice (*Pleuronectes platessa*) fed on 50% protein diets had a significant increase in hepatie (AST and ALT) activities than those fed on 20% protein diets regardless of the response to the quality of protein. Rezkalla and Tanios (1994) found in hibition of AST and ALT in liver of tilapia after fed naturally when compared to that offered intermittent feed. Tokud and takeuchi (1995) found that the AST and ALT activities in serum of rainbow trout were in the normal range regardless of feeding with alphatocopherol. This result indicated that excess of alphatocopherol did not influence fish liver functions.

MATERIALS AND METHODS

This experiment was conducted in twoelve earthen ponds 1000 m^2 each and water depth of one meter during the experimental period. The ponds were located at the Riyadh Center, Kafr ElSheikh, Egypt (private fish farm). The experiment was undertaken during summer 2009 for 150 days (from 10 June to 6 November). Each pond was fertilized biweekly, with 7.5 kg super-phosphate and 2.5 kg urea plus 7.5 chicken manure. The experiment was designed to study the effect of different artificial feeding rates on growth performance and the activity of liver enzymes in common

carp. Economic efficiency of the applied feeding regimes also was studied. therefore, four treatments were applied each treatment was carried out in three ponds replicates. Common carp fish (*Cyprinus carpio*) of an average initial body weight of 12 ± 0.1 g were stocked at density of 2500 fish per 1000 m^2 in monoculture system. Commercial pelleted fish feed (25% protein) was provided to fish in the experimental treatments according to following regimes:-

The first group (T1): was received artificial feeding rate at 1.5 % of fish weight.

The second group (T2): was received artificial feeding rate at 3 % of fish weight.

The third group (T3): was received artificial feeding rate at 4.5 % of fish weight.

The fourth group (T4): was not received artificial feed during the whole experimental period (150 days) and kept as control. The chemical analysis of the pelleted fish feed used in the present experiment is presented in Table (1). Pelleted feed was submitted once daily and readjusted biweekly according to fish biomass as estimated by sampling the fish ponds. Water samples were taken biweekly in the early morning and the physico-chemical properties (temperature, oxygen, pH, Total hardness, Orthophosphate and Total alkalinity) of pond water were determined according to Boyd (1992). The phytoplanktons were counted with Sedgwick Rafter (SR) counting cell by the strip counting method according to Boyd (1992).

Table (1): ***Chemical analysis of complete feed* used in the present experiment (on dry matter basis).***

Analyzed components	Percent
Moisture	**5.50**
Dry matter	**94.50**
Crude protein	**25.10**
Crude fat	**8.23**
Crude fiber	**6.58**
Ash	**6.72**
NFE**	**53.37**
GE (Kcal / Kg diet)	**4688.1**

**** Comercial diet from local market.***

***** NFE (nitrogen free extract) = 100 – (protein + Lipid + ash + crude fiber).***

The number of zooplankton per liter was determined also according to Boyd (1992). At the end of the experiment, ponds were drained and harvested. Fish yield was weighted and total production of fish was determined. Proximate analysis of fish was carried according to Association of Official Analytical Chemists (AOAC), (1990). Plasma and tissue cholesterol were determined according to Watson (1960). Liver enzymes activity Aspartate amino transferrase (AST) and Alanine aminotransferase (ALT) were measured colorimetrically according to Reitman and Frankel (1957), using diamond diagnostic kits.

Weight gain was calculated as: final mean weight - initial mean weight.

Relative Growth Rate (RGR%) was calculated as

$$\text{RGR \%} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

Specific Growth Rate (SGR%) was calculated as:

$$\text{SGR \%} = \frac{(\ln \text{wt} - \ln \text{wo})\ 100}{\text{t}}$$

Where:

In is the natural logarithm.

t = experimental period in days.

wt = final weight.

wo = initial weight.

Statistical analysis of date collected through the experiment period was analyzed according to SAS (1985).

RESULTS AND DISCUSSION

1) Water quality:

1-1) Physico-chemical characters :

Results of physical chemical analyses of water quality are presented in Table (2). The average of recorded temperature (26˚ C) was suitable for common carp. In the present study the highest dissolved oxygen (DO) (3.65 mg/ L) was obtained in control ponds of (T4), with natural feed, while the lowest (DO) was recorded in ponds of (T1, T2 and T3), supplemented with feed. Boyd (1992) postulated that excess feeding can result in an increase in organic material with increases in oxidation through metabolic processes by bacteria producing a decrease in DO. pH values were almost in alkaline side (8.40 – 8.85) which are in the tolerable range for fish and for primary productivity to flourish (Boyd, 1992). Total alkalinity and total hardness values are commonly encountered in natural waters Boyd (1992). Orthophosphate concentrations (0.50 – 0.90 mg/ L) were relatively higher in comparison with the values obtained by Boyd (1992) in fertilized ponds (0.03 mg/ L) due to excess feeding.

Table (2): ***Average of physical and chemical properties of water in the experimental ponds (means ± S.E.).***

pameter / treatment	Temperature C)(	Dissolved oxygen (mg/l)	pH	Total Alkalinity (mg/l)	Total hardness (mg/l)	Orthophosphate (mg/l)
T1	26.35^{a}± 0.45	3.57^{a}±0.20	8.70^{a}±0.11	320.52^{C}±14.10	200.65^{C}± 25.01	0.60^{C}±0.10
T2	26.60^{a}±0.35	3.50^{a}±0.21	8.75^{a}±0.25	360.70^{b}±20.11	210.50^{b}±20.11	0.75^{b}±0.05
T3	26.80^{a}±0.70	3.35^{a}±0.35	8.85^{a}±0.22	410.76^{a}±15.15	300.25^{a}±22.10	0.90^{a}±0.09
T4	26.30^{a}±0.85	3.65^{a}±0.38	8.40^{a}±0.21	220.42^{d}±13.11	160.10^{d}±10.11	0.50^{d}±0.12

Means within each column with different subscripts differ significantly ($p < 0.05$).

1-2) Biological characters :

Effect of artificial feeding rates on phytoplankton is shown in Table (3). The average number and the total average of phytoplankton organisms per litre in ponds water is lowest in the control pond (T4) its total average of phytoplankton density is (990×10^4 cell/liter). This supposed to be due to grazing of phytoplankton by zooplankton and fish as suggested by Fogg (1965). The highest total average of phytoplankton organisms (3265×10^4 cell/ litre) was found in ponds of treatment of (T3) which received commercial pelleted feeding rate of 4.5% fish weight. Table (3) shows also the total average of zooplankton organisms per litre in ponds water, since the lowest average of total density (210 unit/ litre) was found in the control ponds (T4) that with non artificial feeding, due to grazing zooplankton by fish. The highest total average (265 unit/ litre) was determined in ponds of treatment (T3) that received commercial feeding rate at 4.5% of fish weight.

2) Activity of transaminase enzymes:

The aspartate transaminase (AST) and Alanine transaminase (ALT) enzymes activities in liver of common carp were illustrated in Table (4). Results indicate that these enzymes activity increased gradually with increasing feeding rates. The highest AST and ALT was found in the treatment received feeding rate of 4.5% of fish weight (T3), while the lowest value was recorded in the control (T4), with no artificial feeding. This indicates that increasing feeding rate, may be related to liver function elevated to meet the more protein intake. These results are in agreement with those reported by Cowey *et al.* (1974) and Khadiga, *et al.* (2002) In this conection, transamination represents one of the prinicipal pathways for the synthesis and deamination of the mino acids, by allowing in terplay between

Table (3): ***Average standing crop of phytoplankton and zooplankton organisms of ponds water during the experimental period.***

Organisms	Treatment											
	T1			T2			T3			T4		
Phytoplankton (10^4 organisms/ l)	Cyano	Chloro	Euglino	Cyano	Chloro	Euglino	Cyano	Chloro	Euglino	Cyano	Chloro	Euglino
Sp. Average	450	830	700	1119	1168	703	1335	1200	730	338	335	317
Total Average		1980			2990			3265			990	
Zooplankton (organisms/ l)	Copepods	Rotifera	Cladosrea	Copepods	Rotifera	Cladosrea	Copepods	Rotifera	Cladosrea	Copepods	Rotifera	Cladosrea
Sp. Average	90	63	78	68	58	130	67	45	153	65	55	90
Total Average		231			256			265			210	

carbohydrate, fat and protein metabolism during fluctuating energy demands of the organism in various adaptive relations. Therefore attention has been focused on the changes in the aminotransferases (AST and ALT), which promote gluconeogenesis from amino acids and relate changes in their activities to the liver condition (Marie, 1994).

3) Plasma and tissue cholesterol:

Plasma and tissue cholesterol contents of common carp are illustrated in Table (4). Results indicate that the cholesterol contant was significantly increased in common carp after they had fed at the highest feeding rate. The highest plasma and tissue cholesterol was found in fish received artificial feed at rate of 4.5% of fish weight (T3), while the lowest values were recorded in the control treatment (T4) without any artificial feeding. These results agree with that obtained by Omoregie, (2002).

Table (4): ***Biochemical characteristics of common carp as affected by the different feeding rate at the end of the experimental period (Means ± S.E.).***

Type of analysis	Treatments			
	T1	T2	T3	T4
Liver AST (u/100g tissue)	125.15^{c}± 7.15	143.45^{b}± 9.11	175.15^{a}± 5.10	105.30^{d}± 6.20
Liver ALT (u/100g tissue)	80.70^{c}± 3.10	90.19^{b}± 4.25	100.70^{a}± 4.20	65.45^{d}± 3.15
Tissue cholesterol (mg/gweet)	29.80^{c}± 0.55	32.52^{b}± 0.33	34.65^{a}± 0.66	26.78^{d}± 0.78
Plasma cholesterol (mg/ dl)	485.66^{c}± 20.10	520.10^{b}± 19.20	575.70^{a}± 15.21	400.30^{d}± 15.10

Means in the same row followed by different superscripts are significantly different ($p < 0.05$).

Table (5): ***percentage of chemical components (on DM basis) of common carp whole body as affected by the different feeding treatments (means ± S.E.)***

Components	Treatments			
	T1	T2	T3	T4
Dry Matter (DM)	26.10^{c}± 0.22	26.50^{b}± 0.15	27.10^{a}± 0.13	25.30^{d}± 0.14
Protein	66.12^{c}± 0.55	68.45^{b}± 0.35	69.60^{a}± 0.70	64.70^{d}± 0.55
Fat	22.30^{a}± 0.31	20.90^{b}± 0.19	20.19^{c}± 0.20	22.95^{a}± 0.17
Ash	11.60^{b}± 0.20	10.82^{c}± 0.17	10.18^{d}± 0.16	12.40^{a}± 0.10

Between treatments the means followed by different superscript letters are significantly different (p < 0.05).

The proximate chemical analyses:

Average of chemical component of whole common carp bodies at the end of the experiment are presented in Table (5). The mean value of dry matter and protein content in whole body of common carp were significantly increased in all treatment when compared to the control group. The highest values of dry matter and protein contents were obtained in the treatment received feeding rate at 4.5% of fish weight (T3) while the lowest values were found that the control group (T4). Fat and Ash contents showed opposite trend to that of crud protein content. These results agree with that obtained by Ghousia and Shantha (2001) who found that protein increased with increasing feeding rate, while the fat increased with decreasing feeding rate.

4) Growth performance and total production:

The highest final body weight (FBW) and total production values of common carp (475.4 g/ fish and 1091 kg/pond) were obtained in the treatment (T3) that received pelleted feed at feeding rate of 4.5% of fish weight, while the lowest value was obtained with (T4) no artificial feeding (190.6g/fish and 423.1kg/pond) Table (6). It is evident that common carp production and growth increased in almost a linear manner with each increase in the feeding rate. This is in agreement with Prather and Lovell (1973) who found that maximum production of catfish of about 312.5kg/ 1000 m^2 may be achieved in ponds by feeding. Zonneveld and Fadholi (1991) found that the relation between production and feed intake is linear. These results are in agreement with those of Abdel- Fattah (2002) who found that (RGR%) and (SGR%) of tilapia increased with increasing feeding rates. The effect of different

Table (6): ***Growth performance and total production of common carp as affected by the different feeding treatments.***

Treatments Items	T1	T2	T3	T4
Initial weight (g/ fish)	12.30^{a}± 0.12	12.10^{a}± 0.10	11.90^{a}± 0.05	12.50^{a}± 0.11
Final weight (g/ fish)	390.2^{b}± 15.5	469.9^{a}± 17.2	475.4^{a}± 20.1	190.6^{c}± 14.3
Weight gain (g/ fish)	377.9^{b}± 18.4	457.8^{a}± 19.1	463.5^{a}± 12.5	178.1^{c}± 12.2
RGR (%)	3072.4^{c}± 18.4	3764.8^{b}± 20.9	3894.9^{a}± 30.2	1424.8^{d}± 18.6
SGR (%)	2.31^{b}± 0.21	2.44^{a}± 0.22	2.45^{a}± 0.30	1.81^{c}± 0.18
No; of stocked fish at start of the experiment (fish)	2500	2500	2500	2500
No; of livability (fish)	2285	2300	2295	2220
Survival (%)	91.4	92	91.8	88.8
Total production/ pond (kg)	891.6^{b}	1080.8^{a}	1091.1^{a}	423.1^{c}

feeding rate on fish survival (%) fish, are presented in Table (6). The highest number of fish and survival (%) was obtained in the treatment received feeding rate at 3% of fish body weight (T2), while the lowest number was found in (T4), control, with no commercial feeding. Relative growth rate and specific growth rate of common carp increased also with increasing feeding rates (Table 6).

5) Economic Efficiency:

As presented in Table (7), the total costs including variable costs and fixed costs for treatment applied in L.E. were 3025, 3825, 4475 and 825 for the treatment T1, T2, T3 and T4, respectively. These results show that the total costs of T4 were the lowest, due to the fact that this treatment was not provided with artificial food as the other groups. On the other hand, the total costs of T3 were the highest due to the costs of artificial feed. Net returns in L.E. per pond were 2324.6, 2659.8, 2071.6 and 1713.6 L.E. for the treatments T1, T2, T3 and T4, respectively (Table 7). Under the present conditions T2 net return (2659.8 L.E.) resulted in the best economic efficiency. Such result accords with that of Green *et al.* (1990).

Table (7): ***The effect of different feeding rates on economic efficiency of growing common carp.***

Items \ Treatments	T1	T2	T3	T4
1- Variable costs*(L.E./ pond)	**2600**	**3400**	**4050**	**400**
2- Fixed costs (L.E./ pond)**	**425**	**425**	**425**	**425**
Total operating costs (variable & fixed): (L.E./ pond)	**3025**	**3825**	**4475**	**825**
Total return*(L.E./ pond)**	**5349.6**	**6484.8**	**6546.6**	**2538.6**
Net return**(L.E./ pond)**	**2324.6**	**2659.8**	**2071.6**	**1713.6**

**** Variable costs include: Feed cost, fertilizer cost, fingerlings cost and labor cost.***
*****Fixed costs include: land rent, taxes and others.***
******Total return = market value of common carp.***
*******Net return = total return – total costs.***

CONCLUSION

Based on the obtained results, it could be concluded that treatment (T2) that received feeding rate at 3% of fish body weight revealed the best economic efficiency, compared to other treatments.

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تأثير اختلاف معدلات التغذية على النمو وبعض الصفات البيوكميائية لأسماك المبروك العادي وكفاءتها الاقتصادية

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تم إجراء هذه الدراسة خلال موسم صيف عام ٢٠٠٩ ولمدة ١٥٠ يوم في اثني عشر حوض ترابي مساحة الحوض الواحد ١٠٠٠ متر مربع وتم تخزين عدد ٢٥٠٠ من أصبعيات أسماك المبروك العادي في كل حوض بمتوسط وزن ١٢ جم/ سمكة. وصممت التجربة على ٤ معاملات تم تغذية الأحواض بعلف ٢٥٪ بروتين بمعدلات تغذية هي (١,٥، ٣، ٤,٥، ٠٪) من وزن السمك للمعاملات (١، ٢، ٣، ٤ على التوالي) كما تم تسميد جميع الأحواض بسماد عضوي وغير عضوي، إستهدفت الدراسة قياس تأثير معدلات التغذية المختلفة على نمو البلانكتون (الغذاء الطبيعي) في الأحواض وعلى التغيرات في النشاط الأنزيمي وعلى تركيب جسم الأسماك وكولسترول الأنسجة والبلازما وأيضاً حجم الإنتاج الكلي بالإضافة إلى التقييم الاقتصادي للتجربة وكانت النتائج كالآتي:

١ ـ زاد نشاط إنزيمات الكبد (ALT, AST) تدريجياً كلما زادت معدلات التغذية.

٢ ـ حدثت زيادة تدريجية في كلا من محتوى كولسترول البلازما والأنسجة كلما زادت معدلات التغذية.

٣ ـ زادت نسبة كلا من المادة الجافة والبروتين بأنسجة المبروك بينما انخفضت نسبة الدهن الخام والرماد مع زيادة معدلات التغذية.

٤ ـ ظهر تناسب طردي بين المتوسط العام لوزن الجسم النهائي وزيادة معدل التغذية وكان ٣٩٠,٢ ، ٤٦٩,٩ ، ٤٧٥,٤ ، ١٩٠,٦ جرام/ سمكة للمعاملات ١، ٢، ٣، ٤ على التوالي وظهر ذات التناسب مع الإنتاج الكلي للأحواض.

أظهرت المعاملة الثانية والتي تم تغذيتها بمعدل ٣٪ من وزن الجسم أفضل كفاءة اقتصادية.