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Effect of some food additives on growth performance of koi fish, *Cyprinus carpio* (Linnaeus, 1758)

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ABSTRACT

The present study was carried out to investigate the effect of some food additives (leaf and root of Turnip, leaf Grape and root Carrot) on growth performance of koi fish, *Cyprinus carpio.* In an experiment, fish were divided into 8 groups in 16 glass aquaria (100 x 30 x 40 cm) with stocking density of 10 fish / aquarium (2 replicate aquaria were assigned for each experimental group). Fish were fed on plain food as a control (C), plain diet+ 5% Turnip (T_1), plain diet+ 5% Grape (T_2), plain diet+ 5% Carrot (T_3), plain diet+ 5% Grape + Carrot (T_4), plain diet+ 5% Grape + Turnip (T_5), plain diet+ 5% Carrot + Turnip (T_6) and plain diet+ 5% Turnip + Grape + Carrot (T_7) over 6 months.

Results showed that, the highest values of growth in length, length gain, body weight, weight gain, average daily gain, growth in weight, specific growth rate, feed intake and food conversion ratio of koi fish, *C. carpio*, was recorded in T_1 (Turnip). But, the lowest value was recorded in T_7 (Turnip + Grape + Carrot). The koi fish, *C. carpio*, fed on different feed rations exhibited the lowest (best) feed conversion ratio (3.45) was recorded in T_1 (Turnip), while, the highest (bad) feed conversion ratio (4.51) occurred in T_7 (Turnip + Grape + Carrot).

1. INTRODUCTION

Ornamental fish are those small sized, live and colourful fish kept in home or public aquaria or in garden pools for recreation. Mills (1990) viewed aquarium fish as visually exciting objects. This is why; they are also termed as 'live jewels'. In fact, next to birds, aquarium fish are probably the most cheerful living creatures, and in terms of popularity, aquarium keeping has emerged as the second most popular hobby next to photography (Chapman & Reiss, 1997).

Koi carp, *Cyprinus carpio* is a member of the Cyprinidae family and order Cypriniformes. It is an ornamental mutation of the common carp (*C. carpio*), native to Asia, especially China and Japan. It is one of the most popular and favourite ornamental fish and it has high market value for its excellent colour.

The colour and scale pattern (squamation) of the species is highly variable. A variety of colours and colour patterns have since been developed; common colours include white, black, red, yellow, blue, and cream. They grow up to 100 cm total length with an elongate body measuring 3 to 4 times less in height than total length. In their natural habitat, koi carp lives up to 15-24 years. Males are known to live longer than females (Kalilola *et al*., 1993).

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These plant products have also been associated with beneficial health effects based on the presence of bioactive compounds, with antioxidant capacity, such as vitamins C and E (Wu *et al*., 2004), carotenoids, phenolics, flavonoids (Podsedek, 2007 ; Powers *et al*., 2004). Grape leaves with antioxidant activity have been reported to treat chronic venous in sufficiency in human and nephrotoxicosis induced by citrine (Bilgrami & Jeswal, 1993 ; Kiesewetter *et al*., 2000). Carotenoid has a positive rule related to metabolism of fishes (Segner *et al*., 1989).

The present study aimed to investigate the effect of some food additives (leaf and root of Turnip, leaf Grape and root Carrot) on growth performance of koi fish, *Cyprinus carpio*.

2. MATERIAL AND METHODS

2.1 Experimental fish:

A total of 160 specimens of Koi fish, *Cyprinus carpio* (Fig. 1), with a good condition were obtained from a private farm at Kafr El-Shaikh Governorate. All fish samples were pre-adults, and they greatly similar in weight (5.07±1 g). Fish were transported to the fish laboratory at Animal House of Zoology Department, Faculty of Science, Al-Azhar University; in large plastic bags, each containing approximately 20 L of water and a lot of oxygen. In the laboratory, fish were acclimatized for one week in well aerated large glass tanks (100x 50x 50 cm). Fish were fed daily on a commercial fish diet.

Fig. 1. A photograph of a Koi fish, *Cyprinus carpio.*

All fish specimens were kept in the laboratory conditions (temperature: 20±2ºC); and fed on the main experimental diet for 2 months, before the beginning of the experiment.

2.2 Experimental diets:

The main experimental fish diet 30% protein was bought from fish diet factory at October City. This fish diet is sinking pellets. It was used for all fish during the preparatory period (the first 2 months). Also, it was used as a control diet for control fish group. Then, it has been used as a plain for all the treatment diets. Seven treatment diets were prepared by adding 50 grams (5%) of testing additive to 950 grams (95%) of basic diet. The basic diet was grinded and milled.

The experimental additives are carrot (root), Grape (leaf) and turnip (leaf and root). These additives were hot air dried in electric oven at 40-50ºC for 3 hours; then they were grinded and milled. The ingredients of basic diet and the proper additives were weighed and mixed. Then, they were pelleted with meat mincer through a 0.8 mm diameter. After cold pelleting, the feeds were hot air dried in electric oven at 40ºC for 4 hours. All prepared diets were put in air tight containers, and stored in dry-weathered place until it used in fish feeding. Feed preparation was carried out monthly to prevent long storage. The experimental eight diets were prepared as diagrammatically shown in Fig. (2).

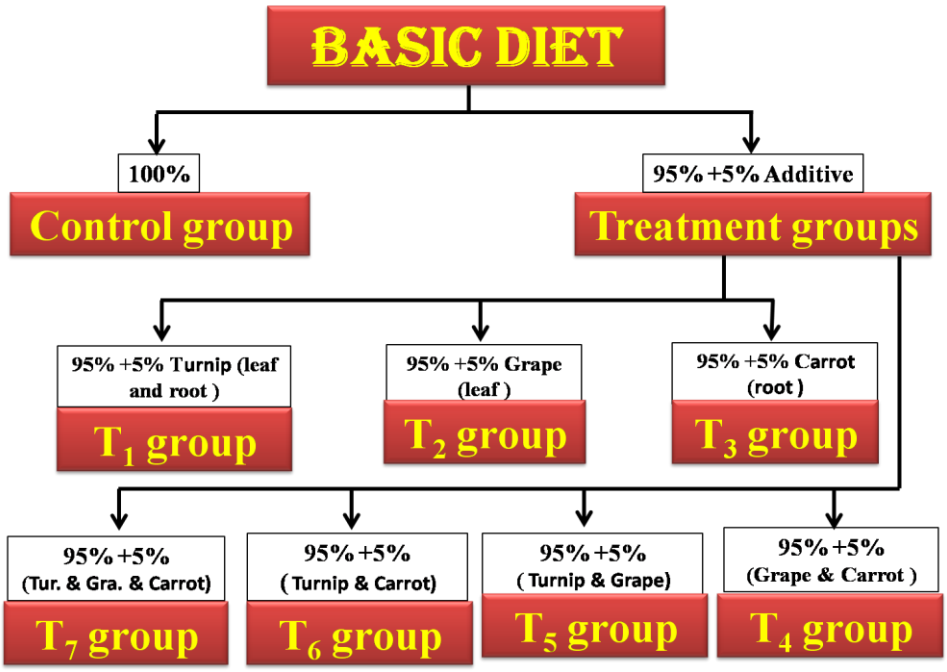

Fig. 2: A diagram showing the preparation of different experimental diets.

2.3 Fish grouping and experiment:

After acclimatization and preparatory periods, fish were divided into 8 groups in 16 glass aquaria (100 x 30 x 40 cm) with stocking density of 10 fish / aquarium (2 replicate aquaria were assigned for each experimental group). Fish groups were fed with different fed rations (C, T1, T2, T3, T4, T5, T6 and T7) respectively. Fish were feeding on plain food as a control (C), diet contains 5% Turnip (leaf and root) (T1), diet contains 5% Grape (leaf) (T2), diet contains 5% Carrot (root) (T3), diet contains 5% Grape(leaf) + Carrot (root) (T4), diet contains 5% Grape (leaf) + Turnip (leaf and root) (T5), diet contains 5% Carrot (root) + Turnip (leaf and root) (T6) and diet contains 5% Turnip (leaf and root) + Grape (leaf) + Carrot (root) (T7). Fish were fed twice daily, six days a week at a fixed feeding rate of 2% of body fish weight (dry feed/ day).

The feeding rate was adjusted at monthly intervals; where 32 fish were randomly selected from all group (2 fish from each aquarium), weighted and the average fish weight was recorded and the monthly feed intake (g feed / fish /month) was calculated for each group. Half of the water volume, for all aquaria, was replaced once every week with de-chlorinated fresh tap water after removing the wastes (diet and excreta).

2.4 Biometric studies:

The experiment was conducted for 6 months (October, 2014 – March, 2015). Weights of 32 randomly sampled fish from treatments were recorded each 30 days as well as their initial lengths and weights and survival rate were recorded.

2.4.1 Measurements of growth performance:

Growth in length, length gain, growth in weight, total weight gain, average daily weight gain, specific growth rate, feed intake (FI) and feed conversion ratio in *Cyprinus carpio* were determined according to Recker, (1975) and Castell & Tiews, (1980) as following:

A- Growth in length (cm):

The fish length (standard length) of each fish, from control and treatment groups, was recorded at the end of the experiment.

B-Length gain (cm/fish):

The length gain was calculated from the following equation:

Length gain= L_T-L_I

Where:

L_T = final average length of fish in cm.

L_I= initial average length of fish in cm.

C- Growth in weight (g):

The total fish weight of 32 randomly sampled fish from the both control and treatment groups was recorded each 30 days.

D-Total weight gain (mg/fish):

The total weight gain was calculated from the following equation:

Total Weight Gain= W_T-W_I

Where: W_T = final means weight of fish in grams.

W_I = initial means weight of fish in grams.

E- Average daily weight gain (mg /fish/day):

The average daily weight gain was calculated from the following equation:

ADG = total gain/ duration period

F-Specific growth rate (% / day):

The specific growth rate was calculated from the following equation:

SGR= 100 × (Ln W_T- Ln W_I)/days

Where:

Ln= Natural log.

W_T = final means weight of fish in grams.

W_I = initial means weight of fish in (g)

E- Total Feed intake:

The total fish intake was calculated from the following equation:

TFI = ∑monthly average fish weight *(daily feeding rate *30)

G- Feed conversion ratio:

The feed conversion ratio was calculated from the following equation:

FCR = feed intake (g)/ total weight gain

3. RESULTS

The results in Tables (1-4) and Figs. (3-11) showed the variations in growth performance, length weight relationship and condition factors of fantail fish, *Cyprinus carpio*, reared for 120 days in the experimental glass aquaria and fed on different feed rations {plain food as a control (C), diet contains 5% Turnip (leaf and root) (T_1), diet contains 5% Grape (leaf) (T_2), diet contains 5% Carrot (root) (T_3), diet contains 5% Grape (leaf) + Carrot (root) (T_4), diet contains 5% Grape (leaf) + Turnip (leaf and root) (T_5), diet contains 5% Carrot (root) + Turnip (leaf and root) (T_6) and diet contains 5% Turnip (leaf and root) + Grape (leaf) + Carrot (root) (T_7)}.

Table 1: Total fish length (Mean ± SD g) of koi fish, *Cyprinus carpio*, fed on different feed rations, at different treatment periods.

Time (days)	Control (C)	Treatments (Mean±SD)						
		T_1	T_2	T_3	T_4	T_5	T_6	T_7
0 (Initial time)	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67
30	7.17± 0.79	7.16± 0.68	7.24± 0.67	7.09± 0.61	7.21± 0.65	7.21± 0.67	7.12± 0.72	7.10± 0.71
60	8.11± 0.61	8.29± 0.61	8.41± 1.01	8.31± 0.69	8.42± 0.77	8.43± 0.61	8.40± 0.71	8.56± 0.86
90	9.66± 1.16	10.28± 1.73	10.20± 1.53	10.18± 1.38	10.03± 1.12	10.19± 1.35	10.13± 1.27	10.05± 1.50
120 (Final time)	11.28± 2.50	12.67± 2.67	11.16± 2.66	11.56± 2.92	10.45± 1.90	10.42± 2.09	10.48± 2.00	10.04± 1.05

Table 2: Growth in length (cm) of koi fish, *Cyprinus carpio* (total fish), fed on different feed rations, for 120 days.

Growth items		Control (C)	Feed rations (Treatments)						
			T_1	T_2	T_3	T_4	T_5	T_6	T_7
Initial length (cm)	mean ± SD	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67	6.1± 0.67
Final length range (cm)	Min - max	9 - 16	9 - 17	9 – 16.5	9 - 16	9 – 15.5	8.7 – 16.1	9 – 15.9	8.7 – 12.5
Final length average (cm)	mean ± SD	11.28± 2.50	12.67± 2.67	11.16± 2.66	11.56± 2.92	10.45± 1.90	10.42± 2.09	10.48± 2.00	10.04± 1.05
Length gain (cm/fish)	mean ± SD	5.18± 2.5	6.57± 2.67	5.06± 2.66	5.46± 2.92	4.35± 1.90	4.32± 2.09	4.38± 2.00	3.94± 1.05
Daily length gain (mm/day)	mean ± SD	0.43± 0.21	0.55± 0.22	0.42± 0.22	0.46± 0.24	0.36± 0.16	0.36± 0.17	0.37± 0.17	0.33± 0.9
Growth in length (%)	mean ± SD	84.92± 40.92	107.70± 43.81	82.95± 43.66	89.51± 47.91	71.31± 31.09	70.82± 34.19	71.80± 32.85	64.59± 17.14

3.1 Growth in length:

Results in Tables (1&2) and Figs.(3 & 4) showed that, the koi fish, *C. carpio*, fed on different feed rations exhibited great variation in body length. The highest average body length (12.67±2.67 cm) was recorded in T_1 (Turnip), representing the highest growth in length (106.70±43.81 %). While, the lowest average body length (10.04±1.05cm) was recorded in T_7 (Turnip+ Grape+ Carrot), also representing the lowest growth in length (64.59±17.14 %).

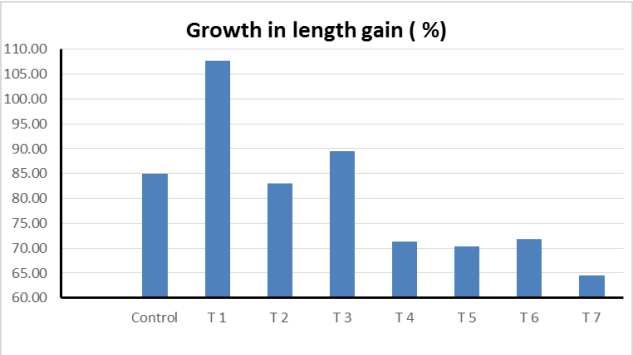

Fig. 3: Growth in standard length (cm) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

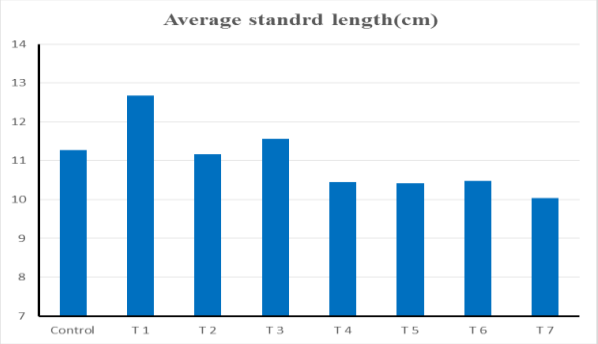

Fig. 4: Growth in length (%) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

Moreover, the average growth in length over the rearing period of 120 days in T_1 (Turnip) (84.92±40.92) and T_3 (Carrot) (89.51±47.91) were higher, while, T_2 (Grape) (82.95±43.66), T_4 (Grape + Carrot) (71.31±31.09), T_5 (Grape + Turnip) (70.82±34.19), T_6 (Turnip + Carrot) (71.80±32.85) and T_7 (Turnip+ Grape+ Carrot) (64.59±17.14) were lower compared with the control (84.92±40.92).

3.2 Length gain (cm/fish):

Results in Table (2) and Fig. (5) showed that, the koi fish, *C. carpio*, fed on different feed rations, exhibited greatly variation in length gain. The greatest length gain (6.57±2.67) was recorded in T_1 (Turnip) and the lowest occurred in T_7 (Turnip + Grape + Carrot) (3.94±1.05) compared with the control group (5.18±2.5).

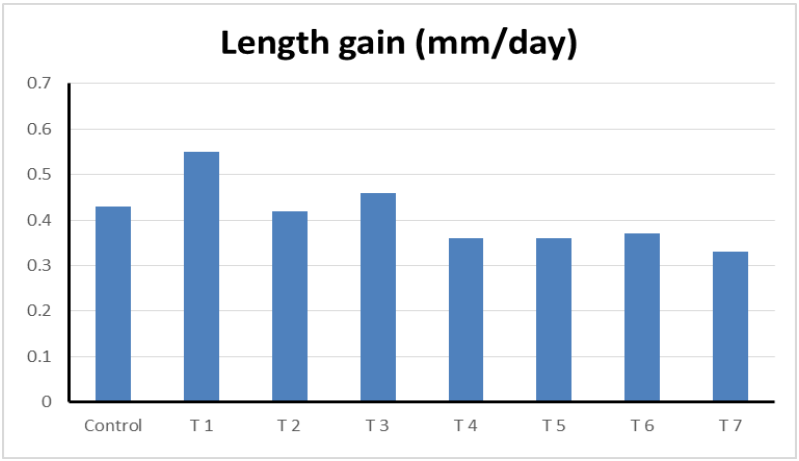

Fig. 5: Length gain (mm/ day) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

3.3 Total body weight:

Results in Table (3) and Figs. (6&7) showed that, koi fish, *C.carpio*, fed on different feed rations, exhibited greatest total weight gain (33.48±22.81) was recorded in T_1 (Turnip) and the lowest occurred in T_7

(Turnip + Grape + Carrot) (14.35±6.20) compared with the control group (23.21±14.53).

The total weight gain in T_1 (Turnip) (33.48±22.81) and T_3 (Carrot) (25.07±19.43) were higher, while in T_2 (Grape) (21.49±16.99), T_4, (Grape+ Carrot) (19.49±1.90), T_5 (Grape+ Turnip) (17.67±14.18), T_6 (Carrot +Turnip) (17.59±13.86) and T_7 (Turnip + Grape + Carrot) (14.35±6.20) were lower compared with the control group (23.21±14.53).

Table 3: Total fish weight (Mean ± SD g) of koi fish, *Cyprinus carpio*, fed on different feed rations, at different treatment periods.

Time (days)	Control (C)	Treatments (Mean±SD) T_1	T_2	T_3	T_4	T_5	T_6	T_7
0 (Initial time)	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21
30	5.86± 1.12	6.81± 1.25	6.47± 1.39	6.24± 1.66	5.56± 1.00	6.18± 1.21	6.19± 0.97	5.68± 0.80
60	6.72± 1.76	9.31± 2.56	7.32± 1.45	8.24± 1.10	8.68± 2.88	7.83± 1.43	7.91± 2.35	8.08± 2.59
90	11.25± 3.21	16.06± 8.87	12.51± 5.06	12.12± 4.22	12.32± 5.13	13.33± 7.10	13.88± 4.50	12.19± 4.58
120 (Final time)	23.21± 14.53	33.48± 22.81	21.49± 16.99	25.07± 19.43	19.49± 1.90	17.67± 14.18	17.59± 13.86	14.35± 6.20

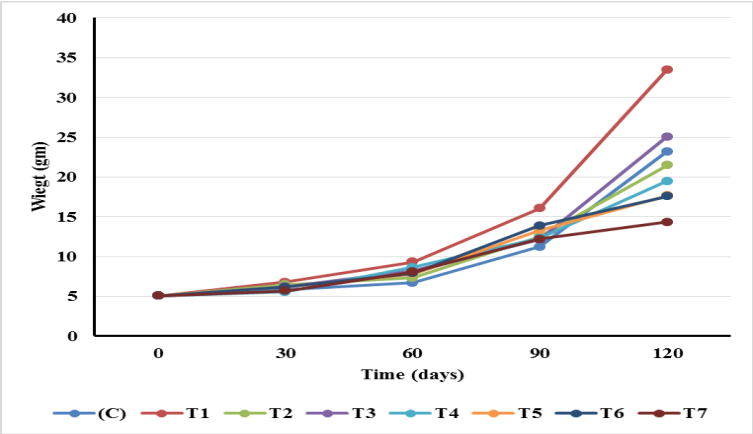

Fig. 6: Growth in total body weight (g) of *Cyprinus carpio*, fed on different feed rations, at different treatment periods (days).

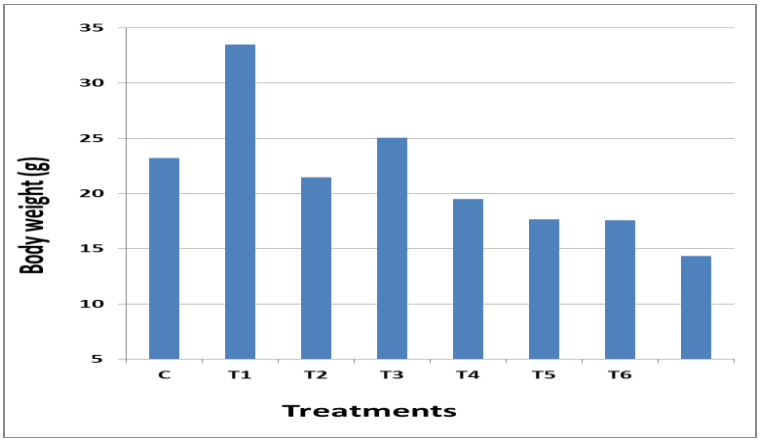

Fig. 7: Growth in total body weight (g) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

3.4 Total weight gain (g/fish):

Results in Table (4) and Fig. (8) showed that, the fish of koi fish, *C. carpio*, fed on different feed rations for the rearing period of 120 days exhibited greatest variation in weight gain. The highest average weight gain (28.41±21.64) was recorded in T_1 (Turnip) and the lowest average weight gain (9.28±5.88) was recorded in T_7 (Turnip + Grape + Carrot).

Table 4: Growth performance items of koi fish, *Cyprinus carpio*(total fish), fed on different feed rations, at the end of experiment period.

Growth items	Control (C)	Treatments						
		T_1	T_2	T_3	T_4	T_5	T_6	T_7
0 (Initial time)	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21	5.07± 1.21
120 (Final time)	23.21± 14.53	33.48 ±22.81	21.49± 16.99	25.07± 19.43	19.49± 1.90	17.67± 14.18	17.59± 13.86	14.53± 6.20
Weight gain (g/fish)	18.14± 13.78	28.41± 21.64	16.42 ±16.12	20.00± 18.44	11.42± 10.46	12.60± 13.46	12.52± 13.15	9.28± 5.88
Average daily weight gain (mg/day)	151.16± 114.8	236.74± 180.36	136.79± 134.34	166.69± 153.65	95.2± 87.15	105.03± 112.14	104.33± 109.57	77.33± 48.98
Growth in weight (%)	357.77± 271.8	560.34± 449.99	323.69± 335.17	394.46± 383.33	225.19± 217.42	248.50± 279.78	246.86± 273.36	182.98± 122.19
Specific growth rate (%day)	1.13± 0.50	0.93± 0.38	0.68± 0.36	0.75± 0.41	0.59± 0.26	0.60± 0.30	0.61± 0.28	0.54± 0.21
Feed intake (g/fish)	39.090	49.247	35.834	38.757	32.288	33.761	34.176	30.220
Feed conversion ratio	3.90± 3.05	3.45± 3.37	4.29± 2.89	4.31± 3.03	4.13± 1.88	4.69± 3.09	4.22± 1.90	4.51± 2.67

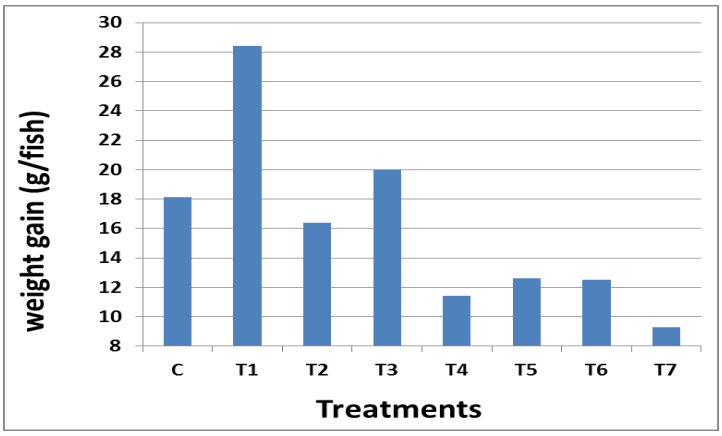

Fig. 8: Weight gain (g/fish) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

The average weight gain in T_1 (28.41±21.64) (Turnip) and T_3 (Carrot) (20.00±18.44 g) were higher, while in T_2 (Grape) (16.42±16.12), T_4, (Grape+ Carrot) (11.42±10.46), T_5 (Grape+ Turnip) (12.60±13.46), T_6 (Carrot +Turnip) (12.52±13.15) and T_7 (Turnip + Grape + Carrot) (9.28±5.88) were lower compared with the control group (18.14±13.78).

3.5 Average daily weight gain (mg /fish/day):

Results in Table (4) and Fig. (9) showed that, the koi fish, *C. carpio*, fed on different feed rations, exhibited the highest average daily weight gain (236.74±180.36) was recorded in T_1 (Turnip) and the lowest (77.33±48.98) occurred in T_7 (Turnip + Grape + Carrot).

The average daily weight gain in T_1 (236.74±180.36) (Turnip) and T_3 (Carrot) (166.69±153.65) were higher, while in T_2 (Grape) (136.79±134.34), T_4, (Grape+ Carrot) (95.2±87.15), T_5 (Grape+ Turnip) (105.03±112.14), T_6 (Carrot +Turnip) (104.33±109.57) and T_7 (Turnip + Grape +

Carrot) (77.33±48.98) were lower compared with the control group (151.16±114.85).

3.6 Growth in weight:

Results in Table (4) and Fig. (10) showed that, the koi fish, *C. carpio*, fed on different feed rations exhibited great variation in the growth in weight. The highest average growth in weight (560.34±449.99%) was recorded in T_1 (Turnip). While, the lowest (182.98 ± 122.19%) occurred in T_7 (Turnip + Grape + Carrot).

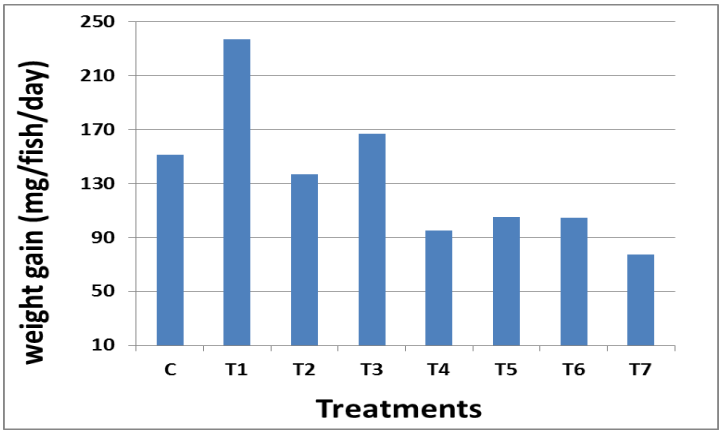

Fig. 9: Daily weight gain (g/fish/day) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

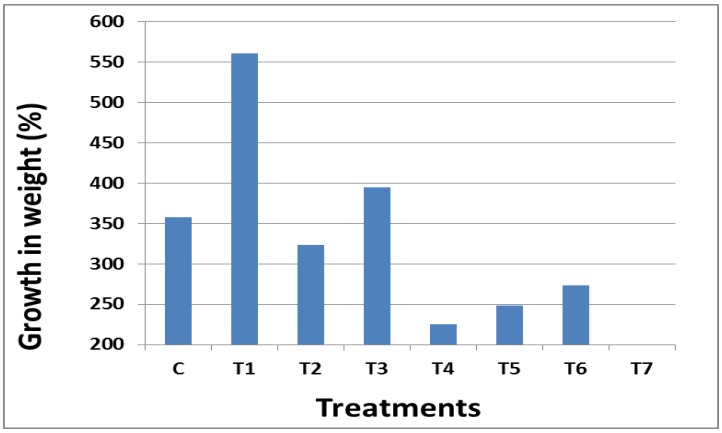

Fig. 10: Growth in weight (%) of *Cyprinus carpio*, fed on different feed rations, for 120 days.

Moreover, the average growth in weight in T_1 (560.34±449.99) (Turnip) and T_3 (Carrot) (394.46±383.33) were higher, while in T_2 (Grape) (323.69±335.17), T_4, (Grape+ Carrot) (225.19± 217.42), T_5 (Grape+ Turnip) (248.50±279.78), T_6 (Carrot +Turnip) (246.86±273.36) and T_7 (Turnip + Grape + Carrot) (182.98±122.19) were lower compared with the control group (357.77±271.84%).

3.7 Specific growth rate (% / day):

Results in Table (4) showed that, the specific growth rate of koi fish, *C. carpio*, fed on different feed rations were lower in all treatments (0.93±0.38 in T_1 (Turnip), 0.68±0.36 T_2 (Grape), 0.75±0.41in T_3 (Carrot), 0.59±0.26 in T_4, (Grape+ Carrot),0.60±0.30 in T_5 (Grape+ Turnip), 0.61±0.28 in T_6 (Carrot +Turnip), 0.54±0.21 in T_7 (Turnip + Grape + Carrot)) compared with the control group (1.13±0.50).

3.8 Total feed intake (g/fish):

Results in Table (4) showed that, the maximum feed intake of koi fish, *C. carpio*, fed on different feed rations (49.247) was recorded in T_1 (Turnip) and the minimum

(30.220) occurred in T_7 (Turnip + Grape + Carrot).

Moreover, the feed intake value in T_1 (49.247) (Turnip) was higher and in T_2 (Grape) (35.834), T_3 (Carrot) (38.757), T_4, (Grape+ Carrot) (32.288), T_5 (Grape+ Turnip) (33.761), T_6 (Carrot +Turnip) (34.176) and T_7 (Turnip + Grape + Carrot) (30.220) were lower compared with the control group (39.090).

3.9 Feed conversion ratio:

Results in Table (4) and Fig. (11) showed that, the koi fish, *C. carpio*, fed on different feed rations exhibited the lowest (best) feed conversion ratio (3.45) was recorded in T_1 (Turnip), while, the highest (bad) feed conversion ratio (4.51) was recorded in T_7 (Turnip + Grape + Carrot).

Moreover, the mean value of feed conversion ratio in T_1 (3.45±3.37) (Turnip) was lower and in T_2 (Grape) (4.29±2.89), T_3 (Carrot) (4.31±3.03), T_4, (Grape+ Carrot) (4.13±1.88), T_5 (Grape+ Turnip) (4.69±3.09), T_6 (Carrot +Turnip) (4.22±1.90) and T_7 (Turnip + Grape + Carrot) (4.51±2.67) were higher compared with the control group (3.90±3.05).

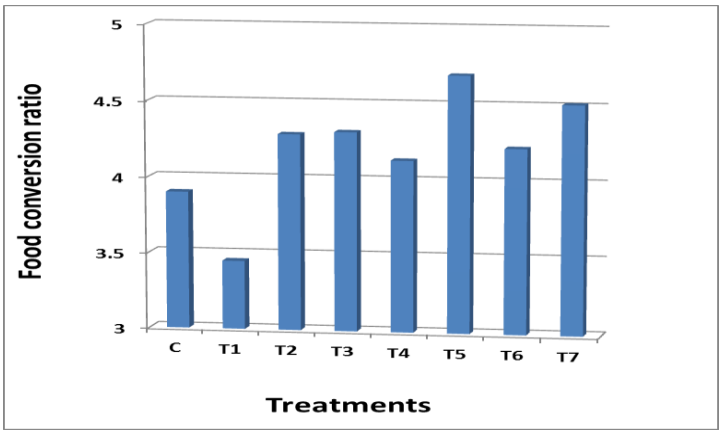

Fig. 11: Food conversion ratio of *Cyprinus carpio*, fed on different feed rations, for 120 days.

4. DISCUSSION

Ornamental fish culture is an increasingly growing aquaculture activity in developing countries. This market has been increasing since the 1980's with annual profits around U$ 900 million with fish marketing and three billion dollars with related equipment and feed. The Asian countries are responsible for more than half of worldwide production in this activity while the main consumers are the USA, Japan and Europe particularly Germany, France and United Kingdom (FAO, 1999).

Ornamental fish keeping is one of the most popular hobbies in the world today. With the expansion of global ornamental fish trade, increased attention is being paid to the nutritional requirements of ornamental fish. Nutrition is one of the key factors of improving production efficiency of ornamental fish (Jagtap and Kulkarni, 2013).

In the present study, the highest values of growth in length, length gain, body weight, weight gain, average daily gain, growth in weight, specific growth rate, feed intake and food conversion ratio of koi fish, *C. carpio*, was recorded in T_1 (Turnip). But, the lowest values were occurred in T_7 (Turnip + Grape + Carrot). This is may be due to active ingredients in Turnip. These compounds convert the food energy into increase in growth performance..

Turnip is important source of bioactive compounds and nutrients like Vitamin E and C, soluble fibre, enzymes owing antioxidant activity for example peroxidase, superoxide dismutase (SOD) and catalase and carotenoids which have persuasive antiviral, antibacterial and anticancer activity (Sharma and Kapoor, 2015). Some studies showed increases in length and weight of koi fish, *C. carpio*, when feed on mixed of zooplankton

instead of pellet diet (Janakiraman and Altaff, 2014) and feed on biosilage (Al-Noor *et al*., 2014).

The inhibition in growth of koi fish, *C. carpio* fed on T_7 (Turnip + Grape + Carrot), may be due to carotenoids in carrot useful in skin and flesh pigmentation. This interpretation was coinciding with Cynthia Montoya *et al.* (2014). They mentioned that, carotenoids do not play an important role in the growth of fish. Moreover, the traditional parameters used in aquaculture to evaluate diet formulation such growth performance and reproduction, is required to consider diets containing carotenoids to enhance the skin and flesh pigmentation (Velasco-Santamaría & Corredor-Santamaría, 2011).

Carotenoids were found in the body animals are either a result of the direct accumulation of carotenoids from food or they are partly modified through metabolic reactions (Britton *et al.,* 1995). Thus, the carotenoid patterns in animals provide a key to tracing the food chain as well as metabolic pathways (Matsuno, 2001). In many countries, there is a restriction of antibiotic usage as feed additives in fish diets. Use of dietary supplements that can promote immune system function is one of the strategies in which not only provide essential nutrients to support growth and development of the cultured organisms, but also may be one of the most promising means to influence the culture organisms health and resistance to stress and disease causing agents (Sheikholeslami Amiri *et al*., 2012).

In the present study, the koi fish, *C. carpio*, fed on different feed ratios exhibited the lowest (best) feed conversion ratio (3.45) was recorded in T_1 (Turnip), while, the highest (bad) feed conversion ratio (4.51) occurred in T_7 (Turnip + Grape + Carrot). The growth promoters improve the immunity, productivity and economic efficiency of the fish via its improvement the fish body weight (Carnevali *et al*., 2006), weight gain (Venkat *et al*., 2004), food conversion ratio and feed efficiency (Abdel-Hamid & Mohamed, 2008).

So, it is well recommended to use Turnip as an additive for enhancing growth performance of the koi fish.

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