Journal of
Fisheries and Aquatic Science

ISSN 1816-4927

Academic
Journals Inc.

www.academicjournals.com

Journal of Fisheries and Aquatic Science 7 (1): 65-71, 2012
ISSN 1816-4927 / DOI: 10.3923/jfas.2012.65.71

Dietary Requirement of Vitamin A and Biochemical Composition of Common Carp *Cyprinus carpio* var. communis

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ABSTRACT

The Common carp (*Cyprinus carpio* var. communis) is a potential culture species in fresh water ponds in India. However, growth of an industry around this species is constrained by poor survival during weaning from artificial diets. Hence, the present study was conducted to determine the dietary vitamin A requirement of Common carp (*Cyprinus carpio* var. communis) by formulating five different diets containing 0 (Control) 100, 200, 300 and 400 vitamin A. Each experimental diet was fed to triplicate groups of 10 fingerlings each with initial average weights of (1.48±0.26 g) maintained at 28±2°C for 30 days. The results revealed that feed consumption, protein consumption, feed conversion efficiency, protein efficiency ratio, growth, percentage growth, relative growth rate, Assimilation and metabolism was higher in feed IV containing 400 mg of vitamin A. Whereas higher gross growth efficiency and net growth efficiency recorded in feed II and feed I, respectively. The biochemical composition (%) such as moisture, protein and lipid of the fish significantly increased when the concentrations of vitamin A increased in the feeds. Interestingly, carbohydrate and ash content decreased with increasing concentrations vitamin A. Based on these results, it is recommended that the diet for fingerling *Cyprinus carpio* var. communis should contain vitamin A at a level of 400 mg for optimum growth, efficient feed utilization and profitability to farmers.

Key words: Vitamin A, feeding and nutrition, biochemical composition, feed utilization, common carp

INTRODUCTION

The goals of the aquaculture industry are to optimize growth and to produce high-quality fish. As in all farming, the outbreak of diseases in fish farming can be a major concern. Nutritional requirements of an animal are a fundamental aspect that depends on species, habitat and live cycle stages (Sargent *et al*., 1989; Singh *et al*., 2006; Chowdhury *et al*., 2008). Preparation of a balanced diet and their adequate feeding is known as a key step for both restocking program and aquaculture (Ramezani, 2009). Nowadays, vitamins are important essential nutrients for most animal species which plays on important role such as vision, immune defenses, maintenance of body linings and skin, bone and body growth, normal cell development and reproduction. The dietary requirement vitamin A for land animals has been studied extensively (Hidiroglou *et al*., 1992). The quantitative requirement for growth has been studied in only a few species of fish.

Vitamin A can be found in the body of animals as retinol, retinal and retinyl esters (NRC, 1993) and retinoic acid (Combs, 1998). And also it can plays a vital role in several biological processes, including vision, reproduction, embryonic development, growth, differentiation, bone development and maintenance of general health of fishes (Combs, 1998; Halver, 2002). Unfortunately fish lack the capacity for Vitamin A synthesis and require a dietary source of Vitamin A for their normal growth (Halver, 2002). Therefore urgent to need to detect optimum dietary requirement of Vitamin A. The quantitative requirement of vitamin A was studied extensively fishes like rainbow trout *Oncorhynchus mykiss* (Kitamura *et al*., 1967), guppy *Poecilia reticulata* (Shim and Tan, 1990), yellow tail *Seriola quinqueradiata* (Shimeno, 1991), catfish *Ictalurus punctatus* (NRC, 1993), tilapia *Oreochromis niloticus* (Saleh *et al*., 1995), red sea bream *Chrysophrys major* (Hernandez *et al*., 2003), greasy grouper *Epinephelus tauvina* (Mohamed *et al*., 2003) and Sterlet *Acipenser ruthenus* (Tatina *et al*., 2010). However, none of them addressed the vitamin A requirements of *Cyprinus carpio*. Therefore, present study to determine the optimum dietary vitamin A requirement of common carp *Cyprinus carpio*.

MATERIALS AND METHODS

Materials: For the present study *Cyprinus carpio* var. communis fingerlings (1.48±0.26 g) were collected from Pandian fish farm near Dindigul, Tamil Nadu, India and transported to the laboratory in polythene bags filled with oxygenated water in the year of March 2007. Fishes were acclimated in plastic round troughs (60 cm dia.) for 15 days at 28±2°C. During acclimation, fishes were fed with trainee feed containing fish meal, ground nut oil cake, wheat flour and rice bran in the form of dry pellets. The raw materials used in this study are fish meal, ground nut oil cake, wheat flour, tapioca powder, sunflower oil, NaCl, supple-vite mix and sodium benzoate. To increase the growth and disease resistance vitamin A added to different concentrations.

Methods: Different ingredients used in the feed preparation were tested for its protein content by Lowry *et al*. (1951). After knowing their protein contents, feeds were prepared according to square method (Ali, 1980) with varying concentrations of vitamin A such as 0, 100, 200, 300, 400 mg for control, experimental feeds 1, 2, 3 and 4, respectively (Table 1). The components used for feed preparation were dried, powdered and sieved through 425 micron sieve. The ingredients were weighed and mixed thoroughly with 130-150 mL of distilled water. The mixed stuff was put

Table 1: Ingredients used in the control and experimental feeds (No. 1, 2, 3 and 4) (wt in gm)

Ingredients	Control	Feed I	Feed II	Feed III	Feed IV
Fish meal	34.15	34.15	34.15	34.15	34.15
Groundnut oil cake	34.15	34.15	34.15	34.15	34.15
Wheat flour	10.85	10.85	10.85	10.85	10.85
Tapioca	10.85	10.85	10.85	10.85	10.85
Fish oil	2	2	2	2	2
Sunflower oil	4	4	4	4	4
Supplevite- mix	2.5	2.5	2.5	2.5	2.5
Sodium chloride	0.5	0.5	0.5	0.5	0.5
Sodium benzoate	1.0	1.0	1.0	1.0	1.0
Vitamin A (mg)	-	100.0	200.0	300.0	400.0

in autoclave for 15 min. at 100°C. Then it was extruded with the help of pelletizer. The pellets were dried in room temperature. These pellets were tested for its stability by placing it in the water for 1 h. Uniform size of *Cyprinus carpio* var. communis fingerlings was selected. The length and weight of fishes were taken. Then the fishes were introduced in the rectangular through (45 cm L×30 cm B×15 cm H). Then water in the trough was maintained as 10 liters. Each trough 10 fingerlings were distributed and triplicates were maintained. During rearing the fishes were fed on *ad-libitum* feed on prepared feed twice a day for 1 h. each from 8-9 am and 4-5 pm. The unfed was dried to constant weight. The faecal matter was collected daily before changing the water with least disturbance to the fishes and dried at 90°C. Approximately 75% of water in the through was replaced with tap water. The experiment was continued for 30 days and on the final day the fishes were weighed in live condition. At the end of the experiment, all of the *Cyprinus carpio* were chill-killed and stored frozen at-20°C for subsequent determination of whole body composition. Earlier samples of *Cyprinus carpio* from the initial population were collected and stored frozen for a similar evaluation. The condition factor (K) was calculated (Weatherly *et al*., 1987) for individual fish before and after the experiments.

Biochemical composition: A known quantity of sample was taken and the excess moisture was removed using a filter paper (Rajendran, 1973). Then the sample was dried in a hot air oven at a constant temperature of 60°C until the wet sample was dried completely. The dried samples were used for estimation of protein (Lowry *et al*., 1951), carbohydrate (Dubois *et al*., 1956), lipid (Folch *et al*., 1957) and the ash content was determined by burning oven-dried sample in a muffle furnace at 550°C (AOAC, 1995).

Statistical analysis: The feed utilization parameters were calculated Statistical analysis Dietary treatments were compared by one way ANOVA all the above mentioned statistical analysis were performed using SPSS statistical software (Ver. 11.5 for Windows, SPSS, Chicago, IL., USA.). Limits of significance for all critical ranges were set at $p<0.05$.

RESULTS AND DISCUSSION

Condition factor (K) was estimated only for comparative purposes to assess the feed. The condition factor increased in all the fishes after rearing for a period of 30 days in different level of vit. A. The condition factor was best in feed III (2.60±0.015) containing 300 mg vitamin A when compared to other feeds (Fig. 1). Similar increase in condition factor was reported by

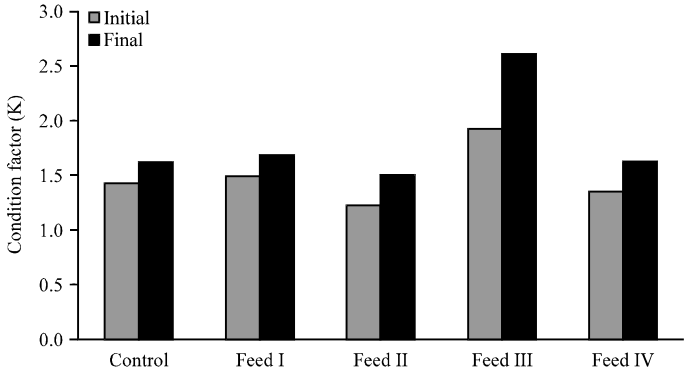

Fig. 1: Condition factor (K) of common crap

Karpagam (2000) when ornamental fish *Xiphophorous helleri* reared in different concentration of vit C.

The feed utilization parameters were presented in Table 2. Parameters like Feed consumption, protein consumption, feed conversion ratio and feed conversion efficiency were significant ($p<0.05$) among the dietary treatments. Feed consumption of *Cyprinus carpio* was higher in feed IV containing 400 mg. In feed IV the feed consumption was increased when the level of vit. A in the feed was increased. Protein consumption of *Cyprinus carpio* reared in different concentrations of vit. A feeds were significantly increased from 100 to 400 mg. In the present study the maximum protein consumption, feed conversion ratio and feed conversion efficiency was higher in 400 mg of vit. A. Similar study was reported when common carp *Cyprinus carpio* was fed with 400 mg of vitamin E (Ramachandran *et al*., 2009). Protein consumption and protein efficiency ratio was higher when the vitamin level in the feed was 100 to 400 mg. Growth percentage growth and relative growth rate was increased in feed IV containing 400 mg vit. A. Similar result was reported when red sward tail and common carp was fed with vitamin C and E in the feed (Karpagam, 2000; Vinothini, 1999; Ramachandran *et al*., 2009). In the present study both assimilation and metabolism was higher when the level of vitamin A was increased. The gross growth efficiency was higher in feed II containing lower quantity of vit A (200 mg) when compared to other feeds. The gross growth efficiency was significantly varied in different feeds. The net growth efficiency was higher in feed I containing minor quantity of vit A (100 mg).

Table 2: Feed utilization parameters of common carp (*Cyprinus carpio var communis*) in relation to different feed (different Vitamin A concentrations)

Parameters	Control	Feed I	Feed II	Feed III	Feed IV
Feed Consumption (FC) g g^{-1} live wt. 30 days	1.79±0.01^{a}	2.13±0.11^{b}	2.46±0.05^{c}	3.193±0.01^{d}	3.61±0.01^{e}
Feed Conversion Efficiency (FCE)	14.09±0.09	10.40±0.43	14.54±0.05	11.45±0.05	15.77±0.24
Feed Conversion Ratio (FCR)	10.18±0.01	11.09±0.09	11.55±0.08	11.78±0.03	12.38±0.44
Protein Consumption (PC) g g^{-1} live wt. 30 days	0.46±0.02	0.45±0.01	0.48±0.005	0.50±0.02	0.58±0.005
Protein Efficiency Ratio (PER)	0.22±0.01	0.24±0.01	0.28±0.01	0.31±0.02	0.44±0.01
Growth (G) g g^{-1} live wt. 30 days	0.26±0.01^{a}	0.30±0.01^{b}	0.35±0.01^{c}	0.40±0.01^{d}	0.44±0.005^{e}
Percentage Growth (PG) %	18.13±0.29	20.13±0.13	22.94±0.06	27.03±0.03	30.40±0.01
Relative Growth Rate (RGR)	0.13±0.005	0.15±0.004	0.17±0.003	0.20±0.006	0.26±0.036
Assimilation (A)	1.63±0.63	2.14±0.04	2.81±0.03	3.08±0.076	3.39±0.01
Metabolism (M)	1.73±0.040	1.78±0.028	2.46±0.1	2.60±00.02	2.97±0.020
Gross Growth Efficiency (GGE %)	12.25±0.015 ^{a}	13.57±0.02^{b}	14.37±0.459^{c}	12.48±.032^{d}	12.46±0.032^{e}
Net Growth Efficiency (NGE %)	13.49±0.015^{a}	14.28±0.02^{b}	12.16±0.030^{c}	13.31±0.02^{d}	11.72±0.057^{e}

Each value is the average (±SD) performance of 10 individuals in triplicate observed for 30 days. Value in the same row sharing different superscript are significantly different

Table 3: Biochemical composition of fish at beginning and end of the experiment (% dry matter basis)

Parameters (%)	Initial	Control	Feed I	Feed II	Feed III	Feed IV
Moisture*	80.30±0.2^{a}	81.80±0.435^{a}	82.40±1.153^{a}	81.80±0.264^{a}	80.08±0.076^{a}	82.96±0.404^{a}
Protein	63.00±0.5^{a}	60.00±0.5^{a}	60.66±1.04^{a}	61.50±0.5^{a}	62.87±0.99^{a}	63.50±1.5^{ab}
Carbohydrate	12.43±0.115^{a}	12.93±0.115^{a}	12.10±0.360^{a}	11.63±0.20^{a}	10.80±0.1^{ab}	10.03±0.057^{ab}
Lipid	13.30±0.264^{a}	13.46±0.305^{a}	13.96±.208^{a}	14.60±0.173^{a}	15.46±0.115^{a}	16.13±0.115^{a}
Ash	10.26±0.208^{a}	9.90±0.173^{a}	9.30±0.264^{a}	8.23±0.251^{a}	7.60±0.173^{a}	7.10±0.1^{a}

*Wet matter basis. Means of triplicates in the same row sharing different superscripts are significantly different ($p<0.05$).

The effects of various levels of vitamin A on the body composition of fish differed. Thompson *et al.* (1995) reported that the dietary vitamin A level did not influence the body composition of rainbow trout. Mohamed *et al.* (2003) indicated a significant decrease in body fat along with the increase in the dietary vitamin A level however, Abbass (2007) declared that lipids level increased in *Cyprinus carpio* with the increase of oil sources level in the diet similarly El-Marakby (2006) also confirmed total lipids increased in *Oreochromis niloticus* with the increase in dietary lipid. Furthermore, Hu *et al.* (2006) reported that dietary vitamin A had some influence on the body moisture and protein of hybrid tilapia. In the present study, supplemental dietary vit A affect moisture, carbohydrate and ash contents of whole body among groups moisture, carbohydrate and ash contents gradually decrease when concentration of vit A increase (Table 3). Biochemical constituents like protein, lipid and carbohydrates varied significantly ($p<0.05$).

Several authors also reported that dietary vit. A did not affect the moisture, carbohydrate and ash contents when increasing concentration. This phenomenon has been reported in Brook trout *Salvelinus fontinalis* (Poston, 1971), guppy (Shim and Tan, 1990), greasy grouper (Mohamed *et al.*, 2003) and Japanese flounder (Hernandez *et al.*, 2005). In the present study Crude protein and lipid content was significantly increased from 100 to 400 mg of vit. A. Interestingly higher protein and lipid content was observed in fish fed with 400 mg of vit. A than other feeds.

CONCLUSION

Present study has clearly indicated fingerlings species of *Cyprinus carpio* var. communis have different growth performance and different feed utilization efficiency under the different concentration of vit. A examined in this study. Optimum dietary vit A level was necessary for higher net growth efficiency of the fish and approximately 400 mg vit A are needed for the feed consumption, fast growth, protein and lipid content of Common carp. This new information on quantitative dietary vit. A requirement of *Cyprinus carpio* var. communis is useful in designing practical cost-effective diets for the intensive culture of this species.

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