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Effects of Vitamin E and Riboflavin (B_2) and their Combination on Growth and Survival of Common Carp, *Cyprinus carpio* Fingerlings

[1]S.A. Sharifzadeh, [2]H. Khara and [3]Sh. Ghobadi
[1]Young Researchers and Elite Club, Lahijan Branch, Islamic Azad University, Lahijan, P.O. Box 1616, Iran
[2]Department of Fisheries, Lahijan Branch, Islamic Azad University, Lahijan, P.O. Box 1616, Iran
[3]Department of Fisheries, Babol Branch, Islamic Azad University, Babol, P.O. Box 755, Iran

Corresponding Author: H. Khara, Department of Fisheries, Lahijan Branch, Islamic Azad University, Lahijan, P.O. Box 1616, Iran Tel: +989112320270 Fax: +981412222602

ABSTRACT

This study was carried out to evaluate the effects of vitamins E, B_2 and their combination on growth and survival parameters of Common carp, *Cyprinus carpio* fingerlings during a period of 56 days. In this respect, the various dietary levels of vitamins E, B_2 and E+B_2 were used as experimental treatments as follow: T_1: Vit E (80 mg), T_2: Vit E (160 mg kg^{-1} diet), T_3: Vit E (240 mg kg^{-1} diet), T_4: Vit B_2 (7 mg kg^{-1} diet), T_5: Vit B_2 (15 mg kg^{-1} diet), T_6: Vit B_2 (20 mg kg^{-1} diet), T_7: Vit E (80 mg kg^{-1} diet)+Vit B_2 (7 mg kg^{-1} diet), T_8: Vit E (160 mg kg^{-1} diet)+Vit B_2 (15 mg kg^{-1} diet) and T_9: Vit E (240 mg kg^{-1} diet)+Vit B_2 (20 mg kg^{-1} diet). Also, one control group without vitamin supplement was considered as control group. According to results, the highest and lowest levels of Specific Growth Rate (SGR), daily Growth Rate (GR), Weight Gain percent (WG) and Condition Factor (CF) were observed in T_7 and T_5, respectively. The minimum and maximum values of Feed Conversion Ratio (FCR) were found in T_7 and control group, respectively. T_5 showed the lowest value of FCR. Also, there were no significant differences between experimental treatments and control group in terms of survival rate of fingerlings. In conclusion, our results showed that combination of 80 mg kg^{-1} diet Vit E and 7 mg kg^{-1} diet Vit B_2 has best influence on growth parameters of common carp fingerlings.

Key words: Vitamin E, riboflavin, special growth rate, condition factor, common carp

INTRODUCTION

Several studies showed that the vitamins improve immunity system, meat quality, survival, growth rates, resistance against diseases and stressors, fecundity and reproductive efficiency (Conklin, 1989; Gapasin *et al.*, 1998; Samocha *et al.*, 1998; Racotta *et al.*, 2004). Vitamin E (α-Tocopherol) is important micronutrient that affects the reproductive performance of fishes. Increasing vitamin E in the diet increases spawning success, egg survival, hatchability and larval survival, increase the gonado-somatic index and vitellogenesis in many fish species (Watanabe and Takashima, 1977; Kanazawa, 1985; Santiago and Gonzal, 2000). Vitamin E is to prevent peroxidation of polyunsaturated fatty acids of phospholipids and cholesterol in cellular and subcellular membranes. Most of the deficiency signs observed in fish, such as nutritional muscular dystrophy, fatty liver degeneration, anemia, erythrocyte hemolysis, hemorrhage, depigmentation and reduction of fertility are related to peroxidative damage to cellular membranes (NRC., 1993). As a membrane-bound antioxidant, vitamin E appears to scavenge free radicals at the site of their formation. Riboflavin is an essential nutrient for all animals including fishes. A number of riboflavin deficiency signs have been reported for various species of fish but the only clinical indicators that are common among species are anorexia, poor growth and high mortality (Murai and Andrews, 1974). Established requirements for riboflavin are 4-10 mg kg^{-1} diet for common carp (Aoe *et al*., 1967). Common carp is one of the most important fish species in aquaculture industry in many countries specially Iran. Therefore, any study about enhancing of carp production would be valuable. In the present study, we investigated the effects of dietary levels of vitamin E, B_2 and their combination on growth, survival of Common carp and *Cyprinus carpio* fingerlings. Such study may help to enhance the efficiency of common carp aquaculture.

MATERIAL AND METHODS

The experiment was conducted in 30 experimental tanks containing 1000 L of dechlorinated and gentle aerated water. A number of 10 (fish weight: 10-15 g) common carp fingerlings were distributed to each experimental tank. Fish were fed by commercial diet (SFC) containing various dietary levels of vitamins E, B_2 and their combinations during 56 days. In this respect, 9 experimental treatments including: T_1: Vit E (80 mg), T_2: Vit E (160 mg kg^{-1} diet), T_3: Vit E (240 mg kg^{-1} diet), T_4: Vit B_2 (7 mg kg^{-1} diet), T_5: Vit B_2 (15 mg kg^{-1} diet), T_6: Vit B_2 (20 mg kg^{-1} diet), T_7: Vit E (80 mg kg^{-1} diet)+Vit B_2 (7 mg kg^{-1} diet), T_8: Vit E (160 mg kg^{-1} diet)+ Vit B_2 (15 mg kg^{-1} diet), T_9: Vit E (240 mg kg^{-1} diet)+Vit B_2 (20 mg kg^{-1} diet) and one control group without vitamin supplement were established. Before adding of vitamins E and B_2 to SFC, the E and B_2 content of SFC were measured by HPLC. Then, the values of experimental vitamin supplements were regulated on the basis of their values in SFC. Vitamin E (5500 IU α-Tocopherol acetate kg^{-1}) and B_2 (4 g Riboflavin kg^{-1}) premix were provided from RSHT-DANEH company, Gorgan, Iran. The general composition of experimental diet was presented in Table 1. The feeding frequency and rate during experiment period was carried out according to standard feeding schedule. The growth and survival parameters of fish including growth rate (SGR), Weight Gain Percent (WG), Condition Factor (CF) and Feed Conversion Ratio (FCR) were measured after experiment as follow (Helland *et al*., 1996):

$$SGR = \ln BW_F - \ln BW_I / t \times 100$$

where, BW_F refers to the final weight of rainbow trout and BW_I refer to the initial weight of rainbow trout (Ghosh *et al*., 2003):

$$WG = BW_F - BW_I / BW_I \times 100$$

Table 1: Composition of experimental diet (SFC)

Ingredients (%)	Dry weight (g kg^{-1})
Total protein	82.0
Total lipid	10.5
Ash	11.2
Moisture	8.7

$$CF = BW/TL^3 \times 100$$

where, BW refers to the weight of rainbow trout and TL refer to the total length of rainbow trout (Lagler *et al*., 1962):

$$FCR = F/W_F\text{-}W_I$$

where, F refers to the value of consumed food (Helland *et al*., 1996):

$$SR = \frac{\text{Total no. of alive fish}}{\text{Total no. of fish}} \times 100$$

Statistical analysis: All data were analyzed by SPSS software. Because of percentage data did not have a normal distribution, proportional data were converted by angular transformation (arcsin vp). One-way analysis of variance (ANOVA) was employed to compare the means. When significant F-ratios were calculated by ANOVA, the Tukey test was applied to identify which means were different.

RESULTS

According to results, the highest and lowest levels of Specific Growth Rate (SGR) (Fig. 1a-c, $p<0.05$), daily Growth Rate (GR) (Fig. 1b, $p<0.05$), Weight Gain percent (WG) (Fig. 1c, $p<0.05$) and Condition Factor (CF) (Fig. 2a-b, $p<0.05$) were observed in T_7 and T_5, respectively. WG, GR and SGR values in fish fed by combination of vitamins E and B_2 were significantly higher than those fed only by E and B_2 ($p<0.05$). The lowest and highest values of Feed Conversion Ratio (FCR)

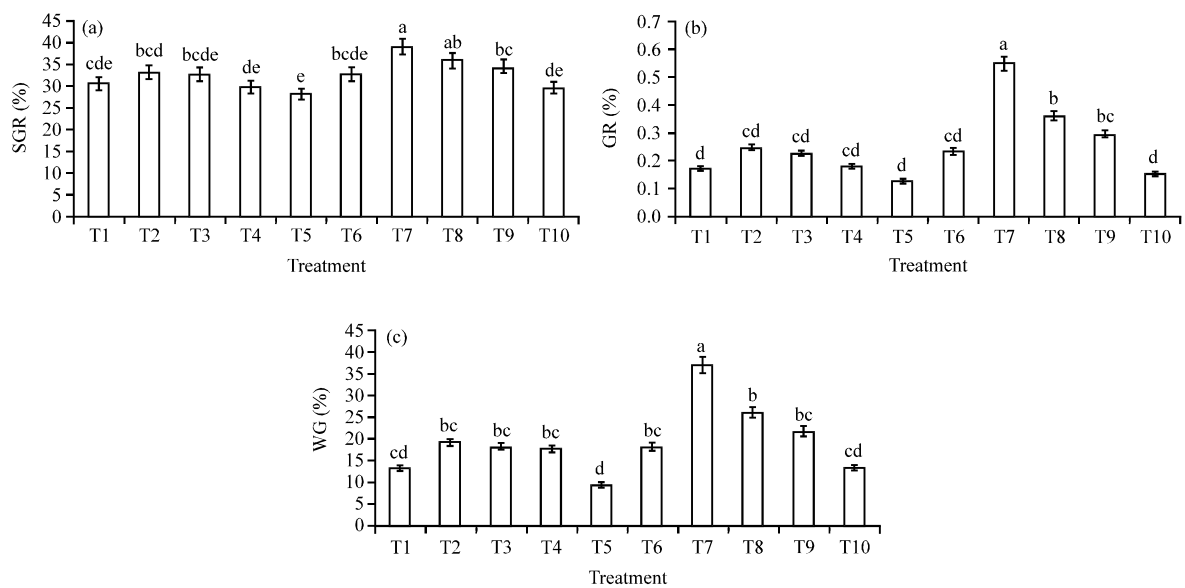

Fig. 1(a-c): Mean values of (a) SGR, (b) GR and (c) WG (%) in response to dietary levels of Vitamin E and B_2 in the Common carp, *Cyprinus carpio* fingerlings. The means with same letters on error bars are not statistically different ($p>0.05$)

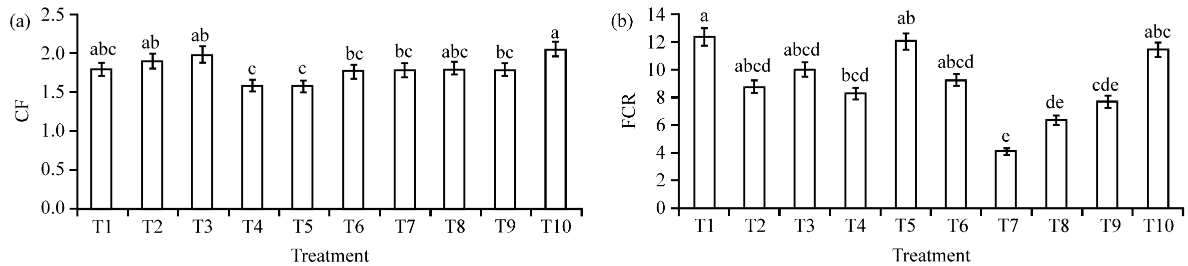

Fig. 2(a-b): Mean values of (a) CF and (b) FCR in response to dietary levels of Vitamins E and B_2 in the Common carp, *Cyprinus carpio* fingerlings. The means with same letters on error bars are not statistically different (p>0.05)

(Fig. 2b, p<0.05) were found in T_7 and control group, respectively. T_5 showed the lowest value of FCR. Also, there were no significant differences between experimental treatments and control group in terms of survival rate of fingerlings (p>0.05).

DISCUSSION

Vitamin E and Riboflavin (B_2) have important roles in biological systems of animals especially in fish. The riboflavin as a part of coenzymes NADH and NADPH function in cell respiration process. Riboflavin is involved with pyridoxine in the conversion of tryptophan to nicotinic acid and is most important in the respiration of poorly vascularized tissues such as the cornea of the eye. Also, riboflavin is involved in the retinal pigment during light adaptation. Vitamin E acts as inter-and intracellular antioxidants to maintain homeostasis of labile metabolites in the cell and tissue plasma. As physiological antioxidants, these usually protect oxidizable vitamins and labile unsaturated fatty acids. As well as, vitamin improves considerably the efficiency of reproduction in fish. Our results showed that vitamins E and B_2 had enhancing effect on growth parameters of common carp fingerlings during 56 days experiment, although they had no effect on survival rate. In this regard, combination use of E and B_2 had more impact on enhancing of growth parameters especially WG, GR and SGR. Many studies showed that dietary requirements to vitamin E depends on some factors such as lipid level, source and other antioxidants or antioxidant enzymes presented in the diet or body system (Baker and Davies, 1996). Dietary levels of vitamin E improve the growth performance of fish and shrimps (Kocabas and Gatlin III, 1999; Liu *et al.*, 2007; Lin and Shiau, 2005), although some researchers did not observe significant effects on growth (Forster *et al.*, 1988; Mourente *et al.*, 2002). The impaired survival, growth and feed utilization induced by oxidized oil ingestion in relation to Vit E deficiency have been well documented in many fish species (Fontagne *et al.*, 2006; Peng *et al.*, 2009; Gao *et al.*, 2012; Dong *et al.*, 2011). In our study, enhancing of growth parameters of common carp with increasing of dietary levels of Vit E may be in relation to the antioxidant role of Vit E, although the best results were observed when combination of Vit E and B_2 were used. It seems that dietary supply of 80 mg kg^{-1} diet+7 mg kg^{-1} diet Vit B_2 in this study may have met the requirements of common carp. Similar to Vit E, the Vit B_2 increases also the growth parameters of fish. The Hemorrhages, dermatitis, lens cataracts, fin erosion and loss of normal body color are of clinical signs of B_2 deficiency in fish (Amezaga and Knox, 1990; Soliman and Wilson, 1992). In the present study, the absence of clinical signs of B_2 deficiency likely returns to short period of the experiment. The best FCR was observed when combination of Vit E (80 mg kg^{-1} diet)+Vit B_2 (7 mg kg^{-1} diet) was used. This likely show that Vit E and Vit B_2 have effective roles in efficient consumption of the feed.

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