Assiut University web-site: www.aun.edu.eg

EFFECT OF VITAMIN A AND D_3 SUPPLEMENTAION ON THE GROWTH PERFORMANCE OF NILE TILAPIA (OREOCHROMIS NILOTICUS)

S.Y. HUSSEIN [1]; METWALLY M.A [2] AND ASMAA, A.M. [3]
[1] Prof. of Fish Physiology –Dept. of Poultry Production –Fac. of Agri. Assiut University
[2] Prof. of Poultry Nutrition–Dept. of Poultry Production –Fac. of Agri. Assiut University
[3] Demonstrator. of Poultry Production Dept. –Fac. of Agri. Assiut University

Received: 13 March 2021; **Accepted:** 30 April 2021

ABSTRACT

This study was conducted to evaluate the effect of supplemental levels of vitamin A (0; 20,000 and 40,000 IU/kg/diet) and 10 mg vitamin D_3/kg diet on the growth performance of Nile tilapia, (*Oreochromis niloticus*). The180 fish were randomly divided into four treated groups each of 45 fish and each group was divided into 3 subgroups (15 fish / unit). The fish groups fed twice daily at 3% of body weight for 10 weeks. The body weight and total length were recorded biweekly all over the experimental period. At the end of experiment ten fish were scarified to determine hepatosmatic index (HSI), spleen somatic index (SSI), and gonadosomatic index (GSI). The results at the end of the experiment indicated that there was insignificant (P> 0.05) increase in body weight, body weight gain and total length. The specific growth rate (SGR %) increased insignificantly (P> 0.05) in fish group fed 10 mg vitamin D3/kg as compared to the control ones. While, the condition factor (K-value) decrease insignificantly (P> 0.05) in the fish group fed 20,000 IU vitamin A/kg than the control ones. Feed conversion ratio was insignificant (P > 0.05) decrease in treated fish with 10 mg vitamin D_3 /kg as compared with other fish groups and control ones. Contrary, the hepatosomatic index (HSI) increase insignificantly (P > 0.05) as compared to the other fish groups and control. Moreover, all the doses of vitamin A and vitamin D_3 had no effect on spleensomatic index (SSI) and gonadosomatic index (GSI). Results of the current study concluded that the studied levels of vitamin A and D_3 had insignificant (P>0.05) effect on growth parameters of Nile tilapia, *Oreochromis niloticus*.

Keywords: Growth, Nile tilapia, Vitamin A, Vitamin D3, feed supplements

INTRODUCTION

The shortage of human dietary protein can be provided by fish protein, particularly in developing countries, where protein shortage is serious (FAO, 1983 and Watanabe, 2002). Aquaculture is the fastest growing food production sector in the world and produces a variety of products where nowadays it contributes >50% of global seafood production thus reducing the pressure on the capture fisheries industry which has been on a plateau for many decades. (Wing-Keong and Nicholas Romano, 2013 and FAO, 2018).

Tilapia is the second most farmed fish where it is one of the most widely and successfully cultured species worldwide over the past decade. So, it is one of the

Corresponding author: Asmaa, A.M.
E-mail address: asmaa_bakr57@yahoo.com
Present address: Demonstrator. of Poultry Production Dept. –Fac. of Agri. Assiut University

most widely cultivated fish worldwide (Delphino *et al.,* 2019; Machimbirike *et al.,* 2019) which is farmed in >100 countries owing to its rapid growth, adaptiveness, and high market value (Prabu *et al.,* 2019). Therefore, currently, almost 6 million metric tons (MT) of tilapia are grown annually worldwide (Fernando Kubitza., 2019a). Nile tilapia (Oreochromis niloticus) has future prospects due to favorable biological properties, such as easy to breed, grow fast, thick and compact meat also tolerant to various environmental conditions and has a broad response to different food sources and high marketability and relatively stable market prices (Wing-Keong and Nicholas Romano, 2013 and Mohamad *et al.*, 2021).

It is noteworthy to mention that currently, Egypt is one of the countries where aquaculture is growing fastest with Nile tilapia (Oreochromis niloticus) as the most widely farmed species.

Unfortunately, intensive aqua-farming is accompanied with several problems where dietary costs, infectious diseases and oxygen deficiency come in limiting the production with consequent negative impact on growth, fecundity and productivity (Cavalcantea *et al.,* 2020, Ahmed and Doaa 2021 and Tolba, 2021).

Adequate nutrition is critical for tilapia growth, feed efficiency, health and immune status, and quality of farmed tilapia (Fernando Kubitza, 2019). Vitamins are organic compounds found in the diet in relatively small quantities for growth, health, and function in fish. Minerals and vitamins are essential for the formation of tilapia bones and act as cofactors of enzymes in several metabolic processes, play specific roles in the acid-base balance of the blood, in the transmission of nerve impulses, and in the formation of metalloproteins like hemoglobin (Fernando Kubitza, 2019b).

Vitamin A is an essential nutrient for the normal growth of fish since it plays an important role in a range of physiological processes including vision, reproduction, embryogenesis, growth and differentiation and maintenance of epithelial cells (Luis and Ronald 2020). So, many studies indicated that vitamin A deficiency decrease weight gain, specific growth rate and feed utilization of fish (Yang and Kallio 2002). Other studies have showed that adequate levels of vitamin A could increase body weight, body weight gain, specific growth rate and feed intake of fish (Zhang *et al.,* 2017). Moreover, vitamin A deficiency symptoms reported for various fish species include hemorrhages, retarded growth, poor feed efficiency, anorexia, abnormal coloration, bone deformity, fin erosion, exophthalmia, eyes lesions and hemorrhages, increased erythrocyte osmotic fragility, anemia, lethargy and high mortality (Blazer, 1992; NRC, 1993; 2011 and Mohamed *et al.,* 2003).

Indeed, most of vitamins are not synthesized by animals so, they are taken from diet to meet their needs. So, Saleh *et al.* (1995) reported that the fat soluble vitamins include vitamin A, D, E and K. are well known to be important for vision, metabolic processes, condition factor and growth in fish, and therefore dietary supplementation in the diets of tilapia is essential.

Tilapia is one of the most widely and successfully cultured species worldwide. However, limited information is available with respect to the effects of dietary vitamin A and D_3 on growth of tilapia but new information continues to be published. Thus, this study was conducted to evaluate the influence of various dietary levels of vitamin A and D_3 on growth performance (weight and length), K-value, feed conversion ratio (FCR) and body indices (HSI, SSI and GSI) of Nile tilapia *Oreochromis niloticus.*

MATERIALS AND METHODS

The present study was carried out at the experimental fish farm belonging to the Poultry Production Department, Faculty of Agriculture, Assiut University. The experimental tilapia fish (O. niloticus) were collected from this experimental fish farm. All the fish were clinically normal and in a good health at the start of the experiment.

1- Management of experimental fish:
The experimental fish were adapted for two weeks in floating cages in a water pond. At the start of the experiment, a total number of one hundred and eighty healthy fish were chosen and weighed and measured the total length. The average body weight and body length were 50.32 ± 1.72 g and 14.11±0.20 cm, respectively. The fish groups (45 fish each, 15 /subgroup) distributed randomly into four experimental groups as follow:

1- **The first group** was fed on the basal diet and considered as a control (C),
2- **The second group** was fed on the basal diet supplemented with 20000 IU vitamin A/kg diet (T1),
3 - The third group was fed on the basal diet supplemented with 40000 IU vitamin A/kg diet (T2) and
4 - **The fourth group** was fed on the basal diet supplemented with 10 mg vitamin D_3/kg diet (T3).

2- Diet preparation:
The dry ingredients of the experimental diets were thoroughly grinded, mixed and pelletized. The ingredient composition and calculated analysis of the experimental diet is shown in Table (1). Fish were adapted to the experimental conditions for two weeks on the diet formulated according to Eid and El-Gamal (1996). All the experimental groups were fed the experimental diet twice daily at a rate of 3% of the live body weight of the fish. The feed quantity was readjusted biweekly on the basis of the actual average biomass of the fish in each treatment. The water temperature and pH were measured daily all over the experimental period.

Table 1: Ingredient composition and calculated chemical analysis of the basal diet.

Ingredients	%
Yellow corn ground	**52**
Soybean meal	**22**
Fish meal	**25**
Premix	**1**
Total	**100**
Calculated analyses.	
ME (Kcal/kg)	**3005**
Crude protein	**30.41**
Fat	**4.5**
Fiber	**2.1**
Ca	**1.3**
P avails.	**0.8**

Water quality:
The water temperature was 29.80±1.31 and pH was 7.65± 0.52 all over the experimental period. These values are suitable for rearing the Nile tilapia (*Oreochromis niloticus*) according to Abd-elhamid (2000).

3- Growth parameters:
The individual body weight (g) and total body length (cm) for all fishes per treatment were recorded biweekly. The average body weight gain (ABWG) was estimated according to the following equation:

Average body weight gain = Average final weight (g) –Average initial weight (g)
Average body length increment (cm) was estimated according to the following equation

Average length increment (cm)=Average final length(cm)-Average initial length (cm).
Specific growth rate in each treatment over the experimental period was calculated using the formula:

Specific growth rate (SGR) =

$$\frac{In(W_f) - In(W_i)}{t} X100$$

Where: SGR is the specific growth rate (% body weight gain per day), *ln (Wf)* is the natural log of the mean final weight, *ln* (W_I) is the natural log of the mean initial weight and it is the time in days.

Condition factor (K- Value) was calculated for individual fish according to the following equation:

Condition factor (K-value)

$$= \frac{Body\ weight\ (g)}{Body\ length\ (cm^3)} X100$$ (Schreek and Moyle, 1990).

Feed conversions were calculated as following equation:

Feed conversion ratio (FCR) =

$$\frac{Feed\ consumption\ (g)}{Live\ body\ weight\ gain\ (g)}$$

The gonad, liver and spleen indices were calculated as follow:

Spleenosomatic index (SSI) =

$$\frac{Spleen\ weight\ (g)}{Body\ weight\ (g)} X100$$

Gonadosomatic index (GSI) =

$$\frac{Gonad\ weight\ (g)}{Body\ weight\ (g)} X100$$

Hepatosomatic index (HSI) =

$$\frac{Liver\ weight\ (g)}{Body\ weight\ (g)} X100$$

4- Statistical analysis:

Analysis of variance was conducted using the general linear models (GLM) procedure of SAS (SAS Institute, 1998 Licensed to University of Maryland, USA. Proprietary Software Release 6.12 TS020). Duncan's multiple range tests was used to compare between means of the control and treated groups (Steel and Terrie, 1980). The model of analysis was as follows:

$$Yij = \mu + Ti + Eij$$

μ = The overall mean.
Ti = The effect of treatment.
Eij = The random error.

RESULTS AND DISSCUSSION

A- Growth parameters

1- Body weight (BW) and body weight gain (BWG)

The illustrated data in Table (2) showed that there were no significant differences (P>0.05) in average body weight fish at the beginning of the experiment (initial weight) and at the second and fourth weeks of experimental period among all experiment groups and control.

Table 2: Average body weight (g) of *O. niloticus* fed different experimental diets.

Period week	Treatment			
		Vitamin A		$VitaminD_3$
	Control	T1 (20,000IU)	T2 (40,000IU)	T3 (10 mg)
0-0	50.00±1.36	49.66±1.62	50.55±1.96	51.51±1.23
2	56.82±1.67	54.31±1.91	54.71±2.22	51.46±2.03
4	68.81±2.00	62.14±2.39	63.24±2.86	63.65±2.09
6	82.13±2.45[a]	70.61±2.32[b]	77.43±2.93[ab]	72.50±2.47[b]
8	92.41±2.79[a]	79.19±2.72[b]	87.52±3.47[ab]	87.50±3.19[ab]
10	106.53±3.51[a]	89.97±3.48[b]	95.34±3.86[ab]	105.51±3.61[a]
Overall mean	76.11	67.64	71.46	72.02

At the sixth week of the experiment, the average body weight of fish group fed 40.000 IU vitamin A (T2) had a superior body weight (*P<0.05*) as compared with the other groups but less than the control ones. While, at the eighth week there were insignificant (P>0.05) increase in the average body weight for T2 and T3 as compared with T1.At the tenth week, the average body weight of T3 had insignificant (P>0.05) increase comparing with T1 and T2 and no significant (P>0.05) differences between T3 and control ones.

The obtained data concerning average body weight gain of *Oreochromis niloticus* fed diet supplemented with vitamin A and D_3 are presented in Table (3) showed that the averages body weight gain were 6.82,3.75, 4.26 and -0.53 for C, T1, T2 and T3 at the second week. On the fourth week, the average body weight gain of T3 increased insignificantly (P>0.05) as compared other treated groups and control group. Also, at the sixth and eighth week of the experiment, the average body weight gain of fish group fed 10 mg vitamin D_3/Kg diet (T3) increased insignificantly (P>0.05) as comparing with the other treated fish groups and control ones.

At the tenth week, the average body weight gain of T3 group had a significant (*P<0.05*) higher value as compared to the other treated groups but insignificant (P>0.05) increase comparing with control ones.

Table 3: Average body weight gain(g) of *O. niloticus* fed different experimental diets.

Period week	**Treatment**			
		Vitamin A		**VitaminD3**
	Control	**T1 20,000IU**	**T2 40,000IU**	**T3 10 mg**
2	**6.82±1.42[a]**	**3.75±0.86[ab]**	**4.26±1.80[ab]**	**-0.53±1.87[b]**
4	**11.94±0.16[ab]**	**7.17±0.95[b]**	**8.45±2.88[ab]**	**12.56±2.72[ab]**
6	**13.54±0.36**	**10.12±1.67**	**14.12±2.34**	**9.20±1.21**
8	**10.09±0.42**	**7.33±1.30**	**10.74±3.17**	**9.87±2.34**
10	**15.22±94[ab]**	**3.75±0.86[c]**	**9.45±2.91[bc]**	**17.99±1.06[a]**
Overall mean	**11.52**	**6.42**	**9.40**	**10.03**

2- Body length (BL) and length increment (L I)

The differences in body length among the experimental groups at the start of the experiment were insignificant [(P> 0.05), Table (4)] which indicate that experimental groups were homogenous at the beginning of the experiment. After two weeks, average body length increased insignificantly (P>0.05) in fish groups fed 40000 IU vitamin A/Kg diet (T2) and fish group fed 10 mg vitamin D_3 (T3) as compared with T2 and control group (Table 4). While, on the fourth and sixth week of the experiment, the average body length had no significant (*P>0.05*) differences between all the treated fish groups and control ones.

Contrary on the eighth week of the experiment, the average body length of the fish group fed 40000IU vitamin A/Kg diet (T2) increased significantly (P<0.05) as compared with T1 but there were insignificant differences between T2 and T3 and control ones. At the tenth week, the average body length of T3 increased significantly (P<0.05) as compared with fish groups of T1 and T2. While, there were no significant (P>0.05) differences between fish group of T3 and control group.

Table 4: Average body length (cm) of *O. niloticus* fed different experimental diets.

Period week	Treatment			
		Vitamin A		VitaminD_3
	Control	T1 (20,000IU)	T2 (40,000IU)	T3 (10 mg)
0-0	14.52±0.17	14.35±0.18	14.40±0.22	14.72±0.19
2	14.61±0.15^{ab}	14.35±0.17^{b}	14.96±0.23^{ab}	14.78±0.22^{ab}
4	15.85±0.18	15.32±0.20	15.65±0.26	15.86±0.21
6	16.30±0.16	15.78±0.15	15.98±0.24	15.90±0.19
8	17.70±0.19^{a}	16.45±0.21^{c}	17.13±0.25^{ab}	17.00±0.19^{bc}
10	17.93±0.19^{ab}	17.39±0.23^{b}	17.35±0.24^{b}	18.13±0.21^{a}
Overall Mean	16.15	15.60	15.91	16.06

Data are presented in Table (5) showed that the length increment at the second, fourth, sixth, eighth and tenth week of the experiment in the fish groups C, T1, T2 and T3, respectively. Analysis of variance for the length increment (LI) showed that there are no significant (*P>0.05*) differences in body length increment for all groups.

3-specific growth rate (SGR%/day):

The illustrated data in Table (6) show that at the specific growth rate (SGR %) of *O. niloticus* decreased significantly (P<0.05) in fish group fed 10 mg D_3 / Kg diet as compared with the other treated groups and control ones at the second week. While there were no significant (P>0.05) differences between all the treated fish groups and control ones at the fourth, sixth and eighth week. Meanwhile, at the tenth week, the average specific growth rate of T3 increased significantly (P<0.05) as compared with fish group of T2.While, there were no significant (P>0.05) differences in SGR% between fish groups of T3 and T1 and control group.

Table 5: Average body length increment (cm) of *O. niloticus* fed different experimental diets.

Period (week)	Treatment			
		Vitamin A		VitaminD_3
	Control	T1 20,000IU	T2 40,000IU	T3 10 mg
2	0.06±0.13	0.00±0.25	0.06±0.33	0.03±0.44
4	1.40±0.15	0.90±0.20	0.46±0.13	0.70±2.06
6	0.46±0.03	0.70±0.10	0.73±0.32	1.96±1.81
8	0.16±0.76	0.96±0.63	1.16±0.38	1.10±0.15
10	1.33±0.23	0.33±1.18	0.23±0.46	1.13±0.03
Overall mean	0.68	0.57	0.52	0.98

Table 6: Average specific growth rate (SGR %) of *O. niloticus* fed different experimental diets.

Period(week)	Treatment			
		Vitamin A		VitaminD_3
	Control	T1 20,000IU	T2 40,000IU	T3 10 mg
2	0.39^{a}	0.22^{ab}	0.24^{ab}	0.10^{b}
4	0.59	0.49	0.44	0.54
6	0.55	0.47	0.62	0.41
8	0.40	0.30	0.39	0.60
10	0.44^{ab}	0.44^{ab}	0.26^{bc}	0.54^{a}
Overall mean	0.47	0.38	0.39	0.43

4- Condition factor (K- value):

The obtained results in Table (7) showed that there were significant (P<0.05) variations in K-value between T2 and T3 and T1 and control ones at the second week. Otherwise, there were significant (P<0.05) differences in condition factor values between treated fish groups and control at the fourth week of the experiment. At the sixth and eighth week there were no significant (P>0.05) variations in K-value of treated fish groups and control ones. While, the condition factor decreased insignificantly (P>0.05) in fish group of T2 but there were no significant (P>0.05) in K-value between T3 and T1 and control group at the tenth week.

Table 7: Average condition factor of *O. niloticus* fed different experimental diets.

Period week	Treatment			
		Vitamin A		VitaminD3
	Control	T1 20,000IU	T2 40,000IU	T3 10 mg
0.0	1.63±0.03	1.62±0.06	1.67±0.03	1.60±0.05
2	1.81±0.05[a]	1.81±0.00[a]	1.60±0.02[b]	1.57±0.07[b]
4	1.72±0.01[a]	1.70±0.04[b]	1.61±0.01[bc]	1.59±0.02[c]
6	1.88±0.03[ab]	1.77±0.01[b]	1.92±0.08[a]	1.79±0.01[b]
8	1.64±0.02	1.76±0.07	1.72±0.06	1.76±0.03
10	1.82±0.02[a]	1.67±0.04[b]	1.80±0.06[a]	1.75±0.01[ab]
Overall mean	1.75	1.72	1.72	1.67

The obtained results in the present study on growth parameters showed that the tested levels of 20000 and 40000 IU vitamin A (T1 and T2) and 10 mg D3/kg diet (T3) had insignificant (P > 0.05) effects on growth parameters (body weight, body weight gain, total length, length increment and condition factor) of Nile tilapia (*Oreochromis niloticus*) throughout the experimental periods. Mainly weight gain is the most common response variable used to assess dietary requirements for vitamin A.

Some previous studies showed beneficial effects of *vitamin A and* D_3 on growth parameters of *O. niloticus*. NRC, (1993, 2011) had been earlier reported that vitamin A and D_3 is dietary essential for Nile tilapia and several other fish species. Similar results were obtained by Saleh *et al.* (1995) and Guimarães et.al. (2014) on *O. niloticus* who reported that after two weeks of feeding, fish fed the vitamin A unsupplemented diet exhibited significantly lowest weight gain than those of other treatments. Also, they showed that these parameters were not observed in fish fed diets supplemented with 2500 to 20,000 IU/kg diet vitamin A. Mohamed *et al.* (2003) observed that diets supplemented with 3,764 mg vitamin A kg^{-1} for greasy grouper led to a better weight gain.

Moreover, dietary vitamin A levels up to 5.400 IU kg^{-1} influenced final weight and weight gain of fish (P < 0.05) but did not influence feed consumption (Daniela *et al.*, 2009). Saleh *et al.* (1995) also observed that Nile tilapia juveniles fed diets supplemented with 5,000 IU vitamin A kg^{-1} presented better weight gain than fish fed diets containing 0, 10,000 or 40,000 IU vitamin A kg^{-1}. Also, Hu *et al.* (2006) recorded that the dietary vitamin A requirement for juvenile hybrid tilapia was 5850–5670 IU kg^{-1}.

On contrary, Saleh *et al.* (1995) showed that an addition of 5000, 10 000 and 40 000 IU vitamin A for O. niloticus resulted in a body weight gain of 23.9, 21.6 and 13.2 g. while 10000 IU already show signs of metabolic distortion and even higher dosages cause hypervitaminosis. Therefore, they concluded that 5000 IU vitamin A kg^{-1} diet covers the requirement of *Tilapia nilotica* fingerlings, while 10 000 IU already show signs of metabolic distortion and even higher dosages cause hypervitaminosis. In the same trend, Campeche *et al.* (2009) recorded that dietary levels of vitamin A up to 5.400 IU kg^{-1} influenced final weight and weight gain of Tilapia fish (p <0.05).

As commonly observed, requirement estimates differ in the same species depending on the response variable used, as reported in tilapia, *Oreochromis niloticus* (Luis and Ronald 2020). So, when Hu *et al.* (2006) fed hybrid tilapia fed diets supplemented with 50,000 IU vitamin A kg^{-1} present better weight gain. Therefore, the fluctuation in K-value may reflect the health condition of the fish attributed to feeding rate and protein and lipid contents.

The lower requirement of Tilapia to vitamin A may be due to its ability to utilize β-carotene to fulfill the dietary vitamin A requirements. The conversion ratio by weights of β-carotene to vitamin A was approximately 19:1 (Hu *et al.*, 2006).

Taking in consideration other fish species, sunshine bass fed diets supplemented with 509 – 40,516 μg vit A kg^{-1} had no difference in weight gain (Hemre *et al.*, 2004). Also, Atlantic halibut fed diets supplemented with 0-250 mg of retinal kg–1 had no differences in final weight (Moren *et al.*, 2004).

5-Feed conversion (FCR):

Data concerning feed conversion of the experimental fish was illustrated in Table (8). At the second week, there was significant (P<0.05) difference in feed conversion between the fish group of T3 and control ones. Contrary, there were insignificant (P>0.05) variations in FCR between the fish group of T1 and T2 as compared with control group. While there were no significant (P>0.05) differences in FCR for all the fish groups and control ones at the fourth, sixth and eighth week. Meanwhile, the FCR of fish group fed 10 mg D_3/Kg diet (T3) decreased insignificantly (P>0.05) i.e. it is improved as compared with control group at the tenth week. But there were no significant differences in FCR between fish groups of T1 and T2 and control ones.

The obtained results concerning the effects of dietary supplementation of vitamin A and D_3 on feed conversion (FCR) of Nile tilapia are shown in Table (8).

The FCR value is closely related to the growth of tilapia. A low FCR value indicates better feed efficiency. The high and low feed conversion ratio is influenced by several factors, especially the quality, and amount of feed, fish species, fish size and water quality. Feed efficiency describes the ability of fish to utilize feed optimally (Winfree and Stickney 1981; Omasaki *et al.*, 2017). Moreover, Kushayadi *et al.* (2020) found that the FCR values for O. niloticus ranged among 1.15 to 1.39 less than the range of 1.2 to 1.8 reported in O. niloticus.

Table 8: Average feed conversion (FCR) of *O. niloticus* fed different experimental diets.

Period (week)	Treatment			
		Vitamin A		Vitamin D_3
	Control	T1 (20,000IU)	T2 (40,000IU)	T3 (10 mg)
2	3.62 ± 0.80^{b}	6.55 ± 1.35^{ab}	8.81 ± 4.87^{ab}	16.05 ± 3.98^{a}
4	2.14±0.02	3.52±0.65	3.91±1.56	2.35±0.33
6	2.14±0.10	2.78±0.63	1.93±0.28	2.77±0.62
8	3.43±0.09	4.42±1.11	3.44±1.51	1.97±0.51
10	2.68 ± 0.13^{b}	2.88 ± 0.28^{b}	4.97 ± 0.87^{ab}	1.97 ± 0.18^{b}
Overall Mean	2.80	4.03	4.61	5.02

Based on the obtained results in this study, the FCR value did not show significant differences (P>0.05) between fish group fed 20000 IU vitamin A (T1) and 40000 IU vitamin A (T2), but it decreased in fish group fed 10mgD3/kg (T3) as compared to T1,T2 and control ones.

Some studies showed that dietary levels of vitamin A up to 5.400 IU kg^{-1} did not influence feed consumption (Daniela *et al.*, 2009). Saleh *et al.* (1995) also observed that Nile tilapia juveniles fed diets supplemented with 5,000 IU vitamin A kg^{-1} presented better feed consumption rate and better feed conversion ratio than fish fed diets containing 0, 10,000 or 40,000 IU vitamin A kg–1. Moreover, Dawood and Koshio (2016) reported that the FCR value for tilapia did not affected significantly (P>0.05) with the usage of vitamin A. In the same trend, Guimarães *et al.* (2014) reported that after two weeks of feeding, fish fed the vitamin A unsupplemented diet exhibited significantly lowest feed intake and feed efficiency ratio than those of other treatments. Mohamed *et al.* (2003) observed that Sunshine bass fed diets supplemented with 509 – 40,516 μg vit A kg^{-1} had no difference in feed efficiency.

Contrary, Hu *et al.* (2006) reported that hybrid tilapia fed diets supplemented with 50,000 IU vitamin A kg^{-1} present better feed conversion ratio (1.00). Also, Mohamed *et al.* (2003) observed that diets supplemented with 3,764 mg vitamin A kg^{-1} for greasy grouper led to a better feed conversion ratio.

It is remarkably that increasing vitamin A supplementation higher than requirement level enhanced some nonspecific effects.

6- Hepato, gonado and spleeno – somatic indices:

The data of hepato, gonado and spleeno–somatic indices presented in Table (9). The HSI of the fish group fed 10 mg vitamin $D_{3/}$ Kg diet(T3) increased significantly (P<0.05) as compared with control group. While, there were no significant (P>0.05) variations in HSI between the fish groups of T1 and T2 and control group. For spleenosomatic index, the SSI of the treated fish groups (T1, T2 and T3) decreased insignificantly (P>0.05) comparing to the control group. Otherwise, there were no significant differences in GSI between all treated fish groups and control ones.

The results presented in Table (9) revealed that the diet supplementation with 20000 IU vitamin A or 40000IU vitamin A had insignificant(P>0.05) effect on HSI. While, the dietary incorporation of 10mg D_3/kg led to significant (P<0.05) increase in HSI.

The liver plays a major role in the metabolism, uptake, storage and release of vitamin A (Batres and Olson, 1987). Guimarães *et al.* (2014) reported that dietary deficiency of vitamin A has been shown to cause liver damage and reduced liver size in the fish. So, they showed that *O. niloticus* fed vitamin A un supplemented diet had significantly lower hepatosomatic index (HSI) relative to the groups fed vitamin A supplemented diets. Hu *et al.* (2006) referred these results to increasing of liver vitamin A retention with increasing dietary vitamin A. Also, a significant reduction of HSI was also demonstrated in common carp fed the vitamin A-deficient diet (Yang *et al.*, 2008).

Table 9: Average hepato, spleeno and gonadosomatic indices of *O. niloticus* fed different experimental diets.

Item	Treatment			
		Vitamin A		VitaminD3
	Control	T1 20,000IU	T2 40,000IU	T3 10 mg
HIS	2.27±0.14[bc]	2.12±0.15[c]	2.21±0.27[bc]	2.87±0.19[a]
SSI	0.20±0.02[ab]	0.13±0.01[b]	0.18±0.02[ab]	0.19±0.02[ab]
GSI	0.31±0.05	0.35±0.08	0.77±0.36	0.47±0.10

While, In Japanese flounder, Hernandez *et al.* (2007), observed no significant differences in HSI among fish fed different levels of dietary vitamin A, but lower values were recorded in fish fed the diet without supplemental vitamin A.

Saleh *et al.* (1995) showed that in tilapia fish enlargement of liver and spleen coincided with vitamin A levels. Therefore, hemorrhagic, amorphous, granulomatous spleen; necrotic, granulomatous, amorphous liver were conspicuously found in fish receiving less than 1,200 IU vitamin A kg^{-1} diet. Spleen severe conditions were also registered to a lesser extent in fish fed diets containing 1,800 - 2,400 IU vitamin A kg–1 diet.

Additionally, the gonado-somatic index increased insignificantly ($P > 0.05$) in T1, T2 and T3 as compared with that of the control group.

These results coincided with Saleh *et al.* (1995) findings which showed the role of vitamin A on fish organs.

CONCLUSION

The results of this study indicated that the high levels (20000 and 40000) IU vitamin A and 10mgD$_3$ had insignificant effects on growth parameters (body weight, body weight gain, total length, length increment, condition factor), and food conversion (FCR) and body indices (HSI, SSI and GSI) of Nile tilapia (*O. niloticus).* In view of the results of the present study, the potential of using high levels of supplemental vitamin A and D$_3$ to improve growth parameters of Nile tilapia is not warranted. However, for future research it could be recommended more researches are needed to test lower levels of vitamin A and D $_3$ in Nile tilapia (*O. niloticus)* feeds.

REFERNCES

Abdelhamid, A.M. (2000): Scientific Fundamentals of Fish Production and Husbandry. 2nd Ed., Mansors Faculty of Agriculture.

Ahmed, Doaa Y. (2021): Effect of Black Seeds and Rosemary Seeds on Productivity of Nile Tilapia "*Oreochromis niloticus*. M.Sc. Faculty of Agriculture, Assiut University. Aquaculture, 262 (2007), pp. 444-450
Article Download PDF View Record in Scopus Google Scholar

Blazer, V.S. (1992): Nutrition and disease resistance in fish. Annu. Rev. FishDis. 2,309–323.

Hu, C.J.; Chen, S.M.; Pan, C.H. and Huang C.H. (2006): Effects of dietary vitamin A or β-carotene concentrations on growth of juvenile hybrid tilapia, Oreochromis niloticus × Oreochromis aureus Aquaculture, 253 (2006), pp. 602-607. Article Download PDF View Record in Scopus Google Scholar

Campeche, D.F.B.; Catharino, R.R.; Godoy, H.T.; and Cyrino, J.E.P. (2009): Vitamin a in diets for Nile tilapia. Scientia Agricola Volume 66, Issue 6,.: 751-756.

Cavalcantea, Raissa Bertoncello, Guilherme Silveira Tellib, Leonardo Tachibanac, Cross Ref View Record in Scopus Google Scholar

Daniela Ferraz Bacconi Campeche; Rodrigo Ramos Catharino; Helena Teixeira Godoy and José Eurico Possebon Cyrino (2009): Vitamin A in diets for NILE TILAPIA Sci. Agric. (Piracicaba, Braz.). Vol. 66, No.6, 751-756.

Danielle de Carla Diasc; Eliana Oshirob; Mariene MiyokoNatoric; Wemeson Ferreira da Silvad and Maria José Ranzani-Paivac (2020): Probiotics, Prebiotics and Synbiotics for Nile tilapia: Growth performance and protection against *Aeromonas hydrophila* infection. Aquaculture Reports 17 – 100343.

Dawood, M.A. and Koshio, S. (2016): Recent advances in the role of probiotics and prebiotics in carp aquaculture: a review. *Aquaculture, 454*, 243-251.

Delphino, M.K.V.C.; Leal, C.A.G.; Gardner, I.A.; Assis, G.B.N.; Roriz, G.D.; Ferreira, F.; Figueiredo, H.C.P. and Gonçalves, V.S.P. (2019): Seasonal dynamics of bacterial pathogens of Nile tilapia farmed in a Brazilian reservoir. Aquaculture 498, 100–108.

Effects of vitamin A on growth, serum anti-bacterial activity and transaminase activities in the juvenile Japanese flounder, Paralichthys olivaceus

Eid, A. and El-Gamal, A.A. (1996): Effect of stocking density on growth performance of Nile tilapia (*0rochromis niloticus*) reared in three different culture systems. Egyptian J. Anim. Prod., Suppl. Issue, 485-498.

FAO (1983): Fish feeds and feeding in developing countries – UNDPL FAO. ADCP REP, 83 (13), pp 97.

FAO (2018): The State of World Fisheries and Aquaculture 2018-Meeting the Sustainable Development Goals. FAO, Rome, Italy.

Fernando Kubitza (2019) a: Advances in tilapia nutrition, part 1. Advances in tilapia nutrition, part 1 Global Aquaculture Advocate: 1-9.

Fernando Kubitza (2019) b: Mineral supplementation and feeding strategy. Advances in tilapia nutrition, part 2. Advances in tilapia nutrition, part 2 « Global Aquaculture Advocate: 1-12.

Guimarãesa, I.G.; Limb, C.; Yildirim-Aksoyb, M. and Lic, M.H. (2014): Effects of dietary levels of vitamin A on growth, hematology, immune response and resistance of Nile tilapia (*Oreochromis niloticus*) to Streptococcus iniae. Animal Feed Science and Technology journal 188: 126– 136.

Hemre, G.I.; DENG, D.F.; WILSON, R.P. and BERNTSSEN, M.H.G. (2004): Vitamin A metabolism and earlier biological responses in juvenile sunshine bass (*Morone chrysops* x *M. saxatilis*) fed graded levels of vitamin A. Aquaculture, Vol.235,:645-658. J. Nutr., 117 (1987), pp. 77-82.

Kushayadi, A.G.; Suprayudi, M.A.; Jusadi, D. and Fauzi, I.A. (2020): Evaluation of rubber seed oil as lipid source in red tilapia (Oreochromis sp.) diet. Aquaculture Research 51:114–123.

Hernandez, L.H.H.; Teshima, S.; Koshio, S.; Ishikawa, M.; Tanaka, Y.; Alam Luis Hector Hernandez, S. and Ronald W. Hardy (2020): REVIEW ARTICLE Vitamin A functions and requirements in fish. Aquaculture Research; 51:3061–3071.

Machimbirike, V.I.; Jansen, M.D.; Senapin, S.; Khunrae, P.; Rattanarojpong, T. and Dong, H.T. (2019): Viral infections in tilapines: more than just tilapia lake virus. Aquaculture503, 508–518.

Mohamed, J.S.; Sivaram, V.; Roy, T.S.C.; Mariam, M.P.; Murugadass, S. and Hussain, M.F (2003): Dietary vitamin A requirement of juvenile greasy grouper (*Epinephelus tauvina*). Aquaculture, Vol.219,: 693-701.

Moren, M.; Opstad, I.; Berntssen, M.H.G.; Infante, J.L.Z. and Hamre, K. (2004): An optimum level of vitamin A supplements for Atlantic halibout (*Hippoglossus hippoglossus*, L.) juveniles. Aquaculture, Vol.235,:587-599.

NRC National Research Council (1993): Nutrient requirement of fish and shrimp. National Academy Press, Washington.

NRC National Research Council (2011): Nutrient requirement of fish and shrimp. National Academy Press, Washington.

Omasaki, S.K.; Janssen, K.; Besson, M. and Komen, H. (2017): Economic values of growth rate, feed intake, feed conversion ratio, mortality and uniformity for Nile tilapia. Aquaculture 481: 124-132.

Prabu, E.; Rajagopalsamy, C.; Ahilan, B.; Jeevagan, I.J.M.A. and Renuhadevi, M. (2019): Tilapia–an excellent candidate species for world aquaculture: a review. Ann. Res. Rev. Biol. 1–14.

Rozik, M. and Rochman, A. (2021): Non-specific immune response development of Aeromonas hydrophila-infected Nile tilapia Oreochromis niloticus with application of immunostimulant of saluang belum (Luvunga sarmentosa) extract. *Aquaculture, Aquarium, Conservation & Legislation*, 14(1), 536-545.

R.O. Batres, and Olson, J.A. (1987): Relative amount and ester composition of vitamin A in rat hepatocytes as a function of the method of cell preparation and of total liver stores J. Nutr., 117 (1987), pp. 77-82.

Cross Ref View Record in Scopus Google Scholar.

Saleh, G.; Eleraky, W. and Gropp, J.M. (1995): A short note on the effects of vitamin A hypervitaminosis and hypovitaminosis on health and growth of *Tilapia nilotica* (*Oreochromis niloticus*). *Journal of Applied Ichthyology*, *11*, 382–385. https://doi.org/10.1111/j.1439-0426.1995.tb000 46.x.

SAS Institute (1998): Licensed to UNIVERSTIY OF MARYLAND SAS institute, 1998 licensed to UNIVERSTIY OF MARYLAND USA. proprietary software release 6.12 tso20.

Schreek, C.B. and Moyle, P.B. (1990): Method of fish Biology. American Fisheries Society, Bethesda, Maryland, USA.

Steel, R.G.D. and Torrie, J.H. (1980): Principles and procedures of statistics. McGraw-Hill, NewYork.

Tolba, A.G. (2021): Impact of Growth Promoter on Productive Performance, Physiological Status, and Immune Response of Nile Tilapia, *Oreochromis niloticus*. M.Sc. Faculty of Agriculture, Assiut University.

Watanabe, T. (2002): Strategies for further development of aquatic feeds. Fish. Sci. 68, 242–252.

Winfree, R.A. and Stickney, R.R. (1981): Effects of dietary protein and energy on growth, feed conversion efficiency and body composition of Tilapia aurea. The Journal of Nutrition 111(6): 1001-1012.

Wing-Keong Ng and Nicholas Romano (2013): A review of the nutrition and feeding management of farmed tilapia throughout the culture cycle. Wiley Publishing Asia Pty Ltd5, 220–254 doi: 10.1111/raq.12014. www.elsevier.com/locate/anifeedsci

Yang, B. and Kallio, H. (2002): Composition and physiological effects of sea buckthorn (Hippophae) lipids. Trends in Food Science & Technology, 13(5), 160-167.

Yang, Q.H.; Zhou, X.Q.; Jiang, J. and Liu, Y. (2008): Effect of dietary vitamin A deficiency on growth performance, feed utilization an dimmuneresponses of juvenile Jiancarp

(Cyprinuscarpiovar. Jian). Aquac.Res.39, 902–906.

Zhang, L.; Feng, L.; Jiang, W.D.; Liu, Y.; Wu, P.; Kuang, S.Y. and Zhou, X.Q. (2017): Vitamin A deficiency suppresses fish immune function with differences in different intestinal segments: the role of transcriptional factor NF-κB and p38 mitogen-activated protein kinase signalling pathways. *British Journal of Nutrition*, *117*(1), 67-82.

تأثير فيتا مين أ ، د٣ على الأداء الانتاجى للبلطى النيلى (ايروكروموس نيلوتيكس)

سمير يوسف حسين ، محمد متولى أحمد ، أسماء أحمد محمود

E-mail: asmaa_bakr57@yahoo.com Assiut University web-site: www.aun.edu.eg

اجريت هذه الدراسة بالمزرعة السمكية التابعة لقسم انتاج الدواجن– كلية الزراعة جامعة أسيوط لدراسة تأثير فيتامين أ ، د٣ على أسماك البلطى النيلى حيث استخدم فى هذه الدراسة عدد ١٨٠ سمكه من أسماك البلطى النيلى بمتوسط وزن١,٧٢ ±٥٠,٣٢ جم ومتوسط طول كلى ٠,٢٠ ± ١١,١٤سم . تم اقلمة هذه الاسماك لمدة أسبوعين فى الأقفاص العائمة.وكان يتم تغذية الاسماك فى فترة الاقلمة على عليقة واحدة لكل المجموعات وهى العليقة الاساسية بدون اضافات .

فى بداية الدراسة تم تقسيم الاسماك الى اربع مجموعات بكل مجموعة ٤٥ سمكة وتم تقسيم كل مجموعة الى ثلاثة مكررات بكل مكررة ١٥ سمكة وتم تربية الاسماك فى قفصين عائمين وتم تقسيم كل قفص إلى ثلاثة أجزاء بالشباك ليتم تربية ١٥ سمكة فى كل مكررة. وقسمت الاسماك الى اربع مجموعات : **المجموعة الاولى** وتم تغذيتها على العليقة الاساسية بدون اضافات وتعتبر المجموعة الضابطة **(الكونترول) والمجموعة الثانية** تم تغذيتها على العليقة الاساسية بالاضافة الى ٢٠٠٠٠ وحد دولية من فيتامين أ/ كجم علف **(T1) ,والمجموعة الثالثة** تم تغذيتها على العليقة الاساسية بالاضافة الى ٤٠٠٠٠ وحد دولية من فيتامين أ/ كجم علف **(T 2)** بينما تم تغذية **المجموعة الرابعه** على العليقة الاساسية بالاضافة الى ١٠جم فيتامين د٣ / كجم علف **(T 3)**.

استمرت الدراسة لمدة ١٠ أسابيع وكان يتم حساب قياسات الوزن والطول كل أسبوعين، وكان يتم تعديل كمية الغذاء طبقا للتغيير فى أوزان الأسماك كل أسبوعين، وكان معدل تغذية الأسماك 3 % من وزن الأسماك الحية.

وفى نهاية الدراسة تم أخذ عشرة أسماك من كل معاملة لتعقدير كل من وزن الجسم وطول الجسم وكذلك وزن كل من الكبد والطحال والأعضاء التناسلية وتم نسبتها الى وزن الجسم الكلى لحساب ادلة الجسم وهى معامل الكبد (HSI) ومعامل الطحال (SSI) ومعامل الغدة الغدة الجنسية (GSI).

وكانت اهم النتائج المتحصل عليها الأتى:

وجود فروق غير معنوية (P>0.05) فى متوسط وزن الجسم ومتوسط الزيادة فى وزن الجسم ومتوسط طول الجسم وكذلك الزيادة فى طول الجسم بين المعاملات بالمقارنة بالكنترول وايضا لم توجد فروق معنوية (P>0.05) فى متوسط معامل الحالة الجسمية (K-value) بين المعاملات بالمقارنة بالكنترول كذلك كانت هناك فروق غير معنوية فى قيمة معدل الكفاءة التحويلية للغذاء بين المعاملات ومجموعة الكونترول.

أدت المعاملة بمستوى 10جم فيتامين د٣ الى زيادة معنوية (P <0.05) فى معامل الكبد (HSI) بالمقارنة بالمعاملات الأخرى بينما لم توجد فروق معنوية (P>o.o5) فى كلا من معامل الطحال (SSI) ومعامل الغدة الجنسية (GSI) بين كل المعاملات ومجموعة الكونترول.

من هذه النتائج السابقة يمكن الاستنتاج بان الجرعات المستخدمة من فيتامين أ (٢٠٠٠٠ & ٤٠٠٠٠) وحدة دولية لكل كيلوجرام علف وكذلك مستوى ١٠ جم فيتامين د٣ / كيلو جرام علف لها تأثير غير معنوى على أداء النمو لاسماك البلطى بنما كان للمستوى ١٠ جم فيتامين د٣ / كيلو جرام علف تأثيرا على معامل الكبد بينما كان هناك تأثير غير معنوى لتلك المعاملات على معامل الطحال ومعامل الغدة الجنسية.