*Egyptian J. Nutrition and Feeds (2010)13(3):577-588*

# EFFECT OF DIETARY PANTOTHENIC ACID SUPPLEMENTATION AND WATER TEMPERATURE ON GROWTH PERFORMANCE AND BLOOD COMPONENTS OF NILE TILAPIA FISH (*OREOCHROMIS NILOTICUS*).

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*(Received 18/9/2010, Accepted 21/12/2010)*

## SUMMARY

The experimental fish *Oreochromis niloticus* weighing 14 ± 0.29 g were distributed into 18 glass aquaria 20 fish per each, representing to 6 treatments (3 replicates per treatment). All fish were divided into two main groups, within each group the fish were divided into three sup-groups. Fish of the first three sub-groups were reared during the summer season (27.4 °C), while the other three sub-groups were reared during the winter season (17.4 °C). Within each season, the first sub-group was fed a diet without supplementation; the second and third sub-groups were fed on diets supplemented with 10 and 20 mg $kg^{-1}$ pantothenic acid diet (Vitamin B5), respectively. The best final live body weight and daily gain were obtained in fish group reared during summer season and fed diet supplemented with 10 mg vitamin B5. Fish fed diet supplemented with 10 mg vitamin B5 recorded the best feed conversion ratio. The interaction between season and dietary vitamin supplementation recorded the significant ($P<0.001$) effect on feed conversion. Blood total protein, albumin and $T_3$ significantly increased in fish group reared during summer season, while createnine concentration in blood significantly ($P<0.05$) decreased. The concentration of nitrite and nitrate in water increased with increasing vitamin level in fish diets.

***Keywords:*** *Oreochromis niloticus, Pantothenic acid, water temperature, growth rate.*

## INTRODUCTION

Pantothenic acid (Vitamin B5) is one of the water-soluble vitamins. All B vitamins help the body to convert carbohydrates into glucose, which is burned to produce energy. These B vitamins are essential in the breakdown of fats and protein, and also play an important role in maintaining muscle tone in the gastrointestinal tract and promoting the health of the nervous system, skin, hair, eyes, mouth, and liver (Kimura *et al.*, 1980; Somer, 1995). Pantothenic acid is converted by the body into a compound called coenzyme A, which the body needs to change food into energy (Moiseenok *et al.*, 1988; Medline Plus, 2007). A deficiency of Pantothenic acid impairs the metabolism of mitochondria rich cells that undergo rapid mitosis and high energy expenditure. Thus deficiency signs have been found to appear within 10-14 days in rapidly growing fish (Hosokawa, 1989). Clubbed gills, anemia and high mortality have been observed in salmonids (Poston & Page, 1982; Karges & Woodward, 1984), Channel catfish (Murai & Andrews, 1979; Brunson *et al.* 1983; Wilson *at al.* 1983). Slow growth, anorexia, lethargy, hemorrhage, skin lesion and anemia were observed in common carp and Japanese eel (Ogino, 1967; Arai *et al.* 1972). In addition to playing a role in the breakdown of fats and carbohydrates for energy, Vitamin B5 is critical to the manufacture of red blood cells as well as sex and stress-related hormones produced in the adrenal glands. Vitamin B5 is also important in maintaining a healthy digestive tract and it helps the body use other vitamins (particularly riboflavin) more effectively. It is sometimes referred to as the anti-stress vitamin because it is believed to enhance the activity of the immune system and improve the body's ability to withstand stressful conditions (Lieberman & Bruning, 1997).

Ayyat, *et al.* (2007) reported that Nile tilapia fish growth performance was improved with decreasing each of dietary energy level and stocking density and supplemented with 10 mg vitamin $B_5$/kg diet, under the summer Egyptian conditions.

Temperature has a vital role in various processes that help determine whether a watershed is suitable for fish. These include aquatic plant photosynthesis and respiration, chemical reaction rates, gas solubility and microbial mediated processes. Temperature also is important in controlling almost all processes in fish (Jensen *et al.* 1993), both physiological and behavioral. Wedemeyer and McLeay (1981) define a stressor as an environmental change severe enough to require a physiological response on the part of a fish, population, or ecosystem. The optimum temperature range provides for feeding activity, normal physiological response, and normal behavior. Thermal stress is any temperature change producing a significant alteration to biological functions of an organism and which lower probability of survival (Elliott, 1981).

The objective of the present study was to investigate the effects of water temperature (year season) and dietary supplementation of vitamin B5 (Pantothenic acid) on growth performance, feed efficiency, blood components and body composition of *Oreochromis niloticus.*

## MATERIALS AND METHODS

The present study was carried out at the wet Laboratory of the Animal Production Department, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. The experimental period lasted 84 day after start during the period from July, to October, 2006 (as hot period) and during the period from December to February 2006-2007 (as cold period).

The fingerlings *Oreochromis niloticus* were obtained from Central Laboratory for Aquaculture Research at Abbassa, Zagazig, Egypt. De-chlorinated tap water was used throughout the study. In order to avoid accumulation of the metabolites, the water of the aquarium was partially changed daily. The experimental fish (weighing 14± 0.29 g after adaptation period for three weeks under normal laboratory conditions) were randomly distributed into 18 glass aquaria (70 X 40 X 35 cm), 20 fish per each, representing to 6 treatments (3 replicates per treatment). In a 2 x 3 factorial design, all fish were divided into two main groups, within each group the fish were divided into three sup-groups. The fish of the first three groups were reared during the summer season (water temperature was averaged 27.4 °C; 24.5-29.5 °C), while the other three groups were reared during the winter season (water temperature was averaged 17.4 °C; 15.3-20.1 °C). Within each season, the first group was fed a diet without supplementation; the second and third groups were fed diets supplemented with 10 and 20 mg $kg^{-1}$ pantothenic acid diet, respectively. Fish wastes were siphoned out and 30% of the water in each aquarium was removed daily and replaced with fresh new water.

All fish groups were fed basal pelleted diet consistent of fish meal 16.0%, soybean meal (44% protein) 10.0%, corn 25.8%, corn gluten meal 15.0%, wheat bran 15.0%, wheat flour 14.0%, fish oil 2.0%, sun flower oil 1.0%, minerals mixture 0.2% and vitamin mixture 1.0% (Each one kg of Minerals mixture contained: Zinc 1.23 g, Manganese 930 mg, iron 630 mg , Copper 105 mg , Iodin 10.5 mg, Selnium 2.1mg). Afterwards, the mixture (ingredients and water) were blended using kitchen blender to make a paste from each diet. Pelleting of each diet was carried out by passing the blended mixture through laboratory pelleting machine with a (1mm) diameter matrix. The pellets were dried in a drying oven model (Fisher oven 13–261–28A) Denver, CO, USA, for 24 hours on 65 °C and stored in plastic bags which were kept in a refrigerator at 8-10 °C during the experimental period to avoid rancidity. Experimental diets were formulated to meet the nutritional requirement of fish (*NRC, 1993*). The Pantothenic acid is added to ingredients as calcium dl-pantothenate (46 percent activity) as a dry powder in a multivitamin premix.

The chemical composition of the diet was crude protein 29.85%, ether extract 6.15%, crude fiber 8.06%, gross energy 18920 kJ/kg and 11.63 mg/kg diet pantothenic acid (calculated according to NRC, 1993).

Fish were individually weighed to the nearest 0.1 g at the beginning of the experiment and biweekly intervals throughout the experimental period. Feed conversion was calculated as the quantity of feed required to obtain one unit growth during the experimental period, according to Berger & Halver (1987). Blood samples were collected from randomly selected three fish in each group and samples were taken from the caudal vein by using heparinized disposable syringes and the plasma was separated by centrifugation at 3000 rpm for 20 min and stored at –20°C until further biochemical analysis.

Total protein, albumin (according to Sundeman, 1964), urea-N, creatinine (according to Henery, 1974), plasma transaminase enzymes (AST; aspartate amino transferase and ALT; alanine amino transferase; according to Reitman & Fankel, 1957) and thyroxin ($T_3$) were measured in blood plasma by colorimetric methods using commercial kits. Triiodothyronine hormone ($T_3$) was estimated using $T_3$ antibody coated tubes kit using radioimmunoassay technique, purchased from Diagnostic Production Corporation, Los-Angeles, California, USA. Proximate chemical compositions of experimental diets and fish body were determined according to AOAC (1980) for moisture, protein, fat and ash. Gross energy was calculated according to NRC (1993).

Water samples were collected biweekly from each aquarium at 8.00 am pefore replacing the water. Water temperature and dissolved oxygen were measured with a YSI model 58 oxygen meter (Yellow Spring Instrument Co., Yellow Spring, Ohio, USA). While the pH degree was measured using a pH–meter (Digital Mini-pH Meter, model 55, Fisher Scientific Denver, CO, USA). Unionized ammonia was measured using DREL/2 HACH kits (HACH Co., Loveland, Colorado, USA).

The obtained data were statistically analyzed by 2 X 3 factorial experiment (Sendecor and Cochran, 1982) as the following model:

$$Y_{ijk} = \mu + T_i + V_j + TV_{ij} + e_{ijk}$$

Where, $\mu$ is the overall mean, T is the fixed effect of water temperature (i= 1 ...2), V is the fixed effect of supplementation of vitamin B5 (k=1...3), $TV_{ik}$ is the interaction effect of water temperature and supplementation of vitamin B5 $e_{ijk}$ is random error. Differences between treatments were statistical tested by Duncan''s multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSION

### *Growth performance:*

Live body weight and daily gain of Nile tilapia (*Oreochromis niloticus*) decreased significantly ($P<0.001$) as decreasing in water temperature (Table 1). Live body weight and daily gain of fish increased significantly ($P<0.001$) as increasing in dietary pantothenic acid level. Results of Table (1) revealed a significant interaction among water temperature and vitamin supplementation on body weight and daily gain. The best final body weight and daily gain were obtained in fish group reared during summer season and fed diet supplemented with 10 mg vitamin B5.

### *Feed efficiency:*

Daily feed intake increased with the same ratio of increasing body weight. Increasing water temperature and dietary vitamin supplementation improved ($P<0.001$) the feed conversion during the whole experimental period (Table 1). The fish fed diet supplemented with 10 mg vitamin B5 recorded the best feed conversion ratio during the whole experimental period (0 – 12 weeks). The interaction between season and dietary vitamin supplementation recorded the significant ($P<0.001$) effect on feed conversion (Table 1).

Within each season, increasing dietary vitamin supplementation improved the feed conversion. Fish group reared during summer and fed diet supplemented with 10 mg $kg^{-1}$ vitamin B5 diet consumed lower feed to produce one unite of body gain (Table 1).

### *Blood components:*

Blood total protein, albumin and $T_3$ significantly ($P<0.001$, 0.01 or 0.05) increased in fish group reared during summer season, while createnine concentration in blood significantly ($P<0.05$) decreased (Tables 2 and 3). Blood total protein, albumin, urea, createnine, ALT and $T_3$ significantly (P<0.001 or 0.01) affected by vitamin supplementation in fish diets.

**Table (1): Growth performance and feed efficiency of Nile tilapia (*Oreochromis niloticus*) as affected by dietary vitamin B5 supplementation, water temperature and their interactions.**

| Item | Initial body weight | Final body weight | Daily gain | Daily feed intake | Feed conversion |
|---|---|---|---|---|---|
| Water temperature effect | | | | | |
| 17.39 °C | 14.09±0.03 | 30.29±2.79 | 0.19±0.03 | 0.58±0.03 | 3.00±0.83 |
| 27.35 °C | 14.02±0.02 | 36.29±2.24 | 0.27±0.03 | 0.67±0.03 | 2.53±0.21 |
| Significance | NS | *** | *** | *** | *** |
| Vitamin B5 supplementation | | | | | |
| 0.0 mg | 14.30±0.03 | 23.45±1.83[c] | 0.11±0.02[c] | 0.52±0.02[c] | 4.77±0.89[a] |
| 10.0 mg | 14.00±0.03 | 40.04±0.94[a] | 0.31±0.01[a] | 0.71±0.02[a] | 2.29±0.03[c] |
| 20.0 mg | 14.07±0.03 | 36.32±1.32[b] | 0.26±0.02[b] | 0.66±0.02[b] | 2.49±0.03[b] |
| Significance | NS | *** | *** | *** | *** |
| Interaction effect of water temperature and vitamin supplementation | | | | | |
| 17.39 °C | | | | | |
| 0.0 mg | 14.13±0.03 | 19.39±0.17[f] | 0.06±0.01[f] | 0.47±0.01[f] | 2.50±0.22[a] |
| 10.0 mg | 14.03±0.03 | 37.97±0.27[c] | 0.29±0.01[c] | 0.68±0.01[c] | 2.38±0.02[d] |
| 20.0 mg | 14.10±0.06 | 33.38±0.19[d] | 0.230±0.01[d] | 0.62±0.01[d] | 2.70±0.01[c] |
| 27.35 °C | | | | | |
| 0.0 mg | 14.07±0.03 | 27.51±0.41[e] | 0.16±0.01[e] | 0.56±0.01[e] | 3.50±0.09[b] |
| 10.0 mg | 13.97±0.03 | 42.11±0.22[a] | 0.34±0.01[a] | 0.75±0.01[a] | 2.24±0.01[d] |
| 20.0 mg | 14.03±0.03 | 39.26±0.23[b] | 0.30±0.01[b] | 0.71±0.01[b] | 2.36±0.04[d] |
| Significance | NS | *** | *** | *** | *** |

*** *P< 0.001 and N.S = Not significant.*

*Means in the same column within each classification bearing different letters are significantly (P<0.05) different.*

Results of Tables (2 and 3) revealed a significant interaction among water temperature and dietary vitamin supplementation on blood components.

***Body composition*:**

Water temperature significantly affected body composition, while the vitamin supplementation in fish diets insignificantly affected body composition (Table 4). Fish group reared during summer season (hot climate) recorded higher crude protein and ether extract, while dry matter decreased than those reared during winter season. The interaction among season and dietary vitamin supplementation insignificantly affected body composition.

The optimum temperature range provides for feeding activity, normal physiological response, and normal behavior (i.e., without thermal stress symptoms). The optimum range is slightly wider than the growth range. Preferred temperature range is that which the fish most frequently inhabits when allowed to freely select temperatures in a thermal gradient (Elliott 1981). Temperature has a vital role in various processes that help determine whether a watershed is suitable for fish. Temperature also is important in controlling almost all processes in fish (Jensen *et al.* 1993), both physiological and behavioral.

The present results indicated that the live body weight and daily gain of Nile tilapia fish decreased significantly ($P<0.001$) as decreasing in water temperature. Also, blood total protein, albumin and $T_3$ significantly decreased in fish group reared during winter season, while createnine concentration in blood significantly increased. Field studies of fish growth under increasing or decreasing seasonal temperature trends have been documented by several authors. Jensen (1990) noted that a decreasing autumn temperature trend caused growth to be less at a given temperature than at the same temperature under a generally increasing temperature trend in spring. He also added that such a seasonal effect on growth rates has been observed in brown trout and Atlantic salmon by various authors, but others have not detected any seasonal difference at comparable temperatures. The physiological optimum is the temperature under which a number of physiological functions, including growth, swimming, spawning, and heart performance, are optimized (Armour, 1990). The optimum temperature range provides for feeding activity, normal physiological response, and normal behavior. The optimum range is slightly wider than the growth range (Elliott 1981).

The obtained results indicated that the live body weight and daily gain of fish increased significantly as increasing in pantothenic acid level in diets, also the feed conversion ratio improved. The fish group fed diet supplemented with 10 mg vitamin B5 recorded the higher body gain and the best feed conversion ratio. Blood total protein and albumin increased as increasing of pantothenic acid level in fish diets, while concentration of $T_3$ significantly decreased. Soliman & Wilson (1992); Sayed (2002) recommended that the dietary pantothenic acid requirement for growth performance of *Oreochrormis aureus* was determined to be 10 mg $kg^{-1}$ calcium *d*-pantothenate diet (92% Pantothenic acid activity). Sayed (2002) determined the requirements of pantothenic acid of Nile tilapia for maximum growth and observed that tilapia need 13.8 mg $kg^{-1}$ pantothenic acid diet for optimum performance; increasing the level of supplementation will not result in any significant benefit and the author mentioned that pantothenic acid level of 9.2 mg $kg^{-1}$ diet is sufficient. Pantothenic acid is involved in a number of biological reactions, including the production of energy, the catabolism of fatty acids and amino acids, the synthesis of fatty acids, phospholipids, sphingolipids, cholesterol and steroid hormones, and the synthesis of heme and the neurotransmitter acetylcholine. It also appears to be involved in the regulation of gene expression and in signal transduction (Webster, 1998).

Obtained results revealed a significantly interactions among water temperature and dietary vitamin supplementation on growth performance, feed efficiency and blood components. The best final live body weight and gain were obtained in fish group reared during summer season, fed diet supplemented with 10 mg vitamin B5. During winter season (low water temperature) supplemented tilapia fish diet with 10 mg $kg^{-1}$ vitamin B5 diet protect fish against the decreasing water temperature, while during summer season we can supplement fish diet with 10 mg vitamin B5 to improve growth rate and feed efficiency.

***Water quality*:**

Water temperature (year season) significantly (P>0.001 or 0.01) affected dissolved oxygen, pH, Nitrite and nitrate (Table 5). The concentration of dissolved oxygen, nitrite and nitrate in water decreased with increasing water temperature.

**Table (2): Plasma total protein, albumin, urea-N and createnine of Nile tilapia as affected by dietary vitamin B5 supplementation, water temperature and their interactions.**

| Item | Total Protein g/100 ml | Albumin g/100 ml | Urea-N mg/100 ml | Createnine mg/100 ml |
|---|---|---|---|---|
| Water temperature effect | | | | |
| 17.39 °C | 4.37±0.14 | 2.75±0.16 | 10.63±0.35 | 1.31±0.07 |
| 27.35 °C | 5.03±0.16 | 3.12±0.22 | 9.88±0.51 | 1.21±0.04 |
| Significance | *** | *** | * | * |
| Vitamin B5 supplementation | | | | |
| 0.0 mg | 4.89±0.22 [a] | 3.13±0.09 [b] | 9.83±0.09 [b] | 1.16±0.02 [b] |
| 10.0 mg | 4.99±0.15 [a] | 3.46±0.13 [a] | 9.41±0.80 [b] | 1.19±0.04 [b] |
| 20.0 mg | 4.21±0.17 [b] | 2.21±0.060 [c] | 11.54±0.34 [a] | 1.44±0.07 [a] |
| Significance | *** | *** | *** | *** |
| Interaction effect of water temperature and vitamin supplementation | | | | |
| 17.39 °C | | | | |
| 0.0 mg | 4.43±0.13 | 2.93±0.02 [c] | 9.85±0.16 [b] | 1.13±0.02 |
| 10.0 mg | 4.75±0.15 | 3.18±0.03 [b] | 10.63±0.59 [ab] | 1.25±0.04 |
| 20.0 mg | 3.93±0.18 | 2.14±0.07 [d] | 11.42±0.68 [a] | 1.56±0.10 |
| 27.35 °C | | | | |
| 0.0 mg | 5.36±0.12 | 3.34±0.06 [b] | 9.80±0.14 [b] | 1.18±0.04 |
| 10.0 mg | 5.24±0.16 | 3.74±0.06 [a] | 8.20±0.05 [c] | 1.13±0.05 |
| 20.0 mg | 4.98±0.19 | 2.28±0.09 [d] | 11.65±0.31 [a] | 1.33±0.05 |
| Significance | NS | ** | ** | NS |

**** P< 0.001, ** P<0.01, * P<0.05 and N.S = Not significant.*

*Means in the same column within each classification bearing different letters are significantly (P<0.05) different.*

Vitamin B5 supplementation significantly (P>0.01 and 0.05) affected on dissolved oxygen, nitrite and nitrate (Table 5). The interaction between water temperature and dietary vitamin B5 supplementation affected significantly (P<0.01) on nitrite and nitrate in water. Fish culturists are more concerned with those aspects of water quality, which indicate the suitability of water for rearing fish. This is because failure to maintain adequate water quality in ponds may critically influence the growth rate, physiological and biochemical status of fish (kheir *et al.*, 1998; Salah El-Deen *et al.*, 1999). The concentration of nitrite and nitrate in water decreased with increasing water temperature. The concentration of dissolved oxygen, nitrite and nitrate in water decreased with increasing vitamin level in fish diets.

**Table (3): Plasma aspartate amino transferase (AST), alanine transferase (ALT) and thyroxin ($T_3$) of Nile tilapia as affected by dietary vitamin B5 supplementation, water temperature and their interactions.**

| Item | AST (U/L) | ALT (U/L) | $T_3$ (ng/ml) |
|---|---|---|---|
| Water temperature effect | | | |
| 17.39 °C | 24.49±0.77 | 12.85±0.73 | 2.29±0.06 |
| 27.35 °C | 22.19±0.49 | 11.83±0.43 | 2.76±0.18 |
| Significance | ** | ** | *** |
| Vitamin B5 supplementation | | | |
| 0.0 mg | 22.99±0.52 $^{ab}$ | 12.77±0.49 $^{a}$ | 2.81±0.28 $^{a}$ |
| 10.0 mg | 24.478±1.22 $^{a}$ | 13.18±1.05 $^{a}$ | 2.36±0.09 $^{b}$ |
| 20.0 mg | 22.58±0.79 $^{b}$ | 11.08±0.22 $^{b}$ | 2.42±0.08 $^{b}$ |
| Significance | * | ** | ** |
| Interaction effect of water temperature and vitamin supplementation | | | |
| 17.39 °C | | | |
| 0.0 mg | 22.42±0.72 $^{bc}$ | 12.17±0.78 $^{bc}$ | 2.19±0.08 $^{b}$ |
| 10.0 mg | 26.96±0.78 $^{a}$ | 15.48±0.33 $^{a}$ | 2.19±0.03 $^{b}$ |
| 20.0 mg | 24.12±0.81 $^{b}$ | 10.91±0.41 $^{c}$ | 2.48±0.10 $^{b}$ |
| 27.35 °C | | | |
| 0.0 mg | 23.56±0.71 $^{b}$ | 13.37±0.47 $^{b}$ | 3.42±0.19 $^{a}$ |
| 10.0 mg | 21.98±0.79 $^{bc}$ | 10.87±0.32 $^{c}$ | 2.53±0.14 $^{b}$ |
| 20.0 mg | 21.04±0.35 $^{c}$ | 11.26±0.19 $^{c}$ | 2.35±0.12 $^{b}$ |
| Significance | ** | *** | *** |

*** $P< 0.001$, **$P<0.01$ and * $P<0.05$.

*Means in the same column within each classification bearing different letters are significantly (P<0.05) different.*

**Table (4): Whole body composition of Nile tilapia as affected by dietary vitamin B5 supplementation, water temperature and their interactions.**

| Item | Dry matter (%) | Protein[1] (%) | Ether extract[1] (%) | Ash[1] (%) |
|---|---|---|---|---|
| Water temperature effect | | | | |
| 17.39 °C | 25.75±0.16 | 64.09±0.06 | 19.11±0.06 | 16.80±0.10 |
| 27.35 °C | 22.84±0.37 | 65.35±0.11 | 17.76±0.24 | 16.89±0.12 |
| Significance | *** | *** | *** | NS |
| Vitamin B5 supplementation | | | | |
| 0.0 mg | 24.61±0.65 | 63.19±0.95 | 14.89±0.38 | 17.06±0.07 |
| 10.0 mg | 24.12±0.86 | 63.354.94 | 14.66±0.27 | 16.83±0.14 |
| 20.0 mg | 24.161±0.695 | 63.230±0.932 | 14.71±0.41 | 16.65±0.14 |
| Significance | NS | NS | NS | NS |
| Interaction effect of water temperature and vitamin supplementation | | | | |
| 17.39 °C | | | | |
| 0.0 mg | 25.98±0.21 | 61.08±0.11 | 14.11±0.09 | 16.98±0.13 |
| 10.0 mg | 25.62±0.42 | 61.29±0.06 | 14.27±0.04 | 16.70±0.20 |
| 20.0 mg | 25.66±0.21 | 61.15±0.13 | 13.964±0.09 | 16.73±0.22 |
| 27.35 °C | | | | |
| 0.0 mg | 23.24±0.43 | 65.31±0.22 | 15.68±0.29 | 17.15±0.05 |
| 10.0 mg | 22.61±1.10 | 65.42±0.31 | 15.049±0.45 | 16.96±0.21 |
| 20.0 mg | 22.66±0.35 | 65.31±0.06 | 15.45±0.52 | 16.57±0.21 |
| Significance | NS | NS | NS | NS |

*1 = On dry matter basis, *** P< 0.001 and N.S = Not significant.*

**Table (5): Water quality as affected by dietary vitamin B5 supplementation, water temperature and their interactions.**

| Item | Dissolved Oxygen (mg/L) | pH (degree of acidity) | Ammonia (NH4) (mg/L) | Nitrite (NO2) (mg/L) | Nitrate (NO3) (mg/L) |
|---|---|---|---|---|---|
| Water temperature effect | | | | | |
| 17.39 °C | 6.26±0.06 | 8.00±0.02 | 0.94±0.02 | 0.49±0.01 | 0.45±0.08 |
| 27.35 °C | 6.04±0.03 | 7.12±0.06 | 1.02±0.04 | 0.09±0.01 | 0.16±0.01 |
| Significance | ** | *** | NS | *** | *** |
| Vitamin B5 supplementation | | | | | |
| 0.0 mg | 6.23±0.09 a | 7.62±0.19 | 1.03±0.04 | 0.29±0.08 | 0.29±0.06 b |
| 10.0 mg | 6.17±0.06 ab | 7.57±0.21 | 0.96±0.04 | 0.30±0.10 | 0.32±0.07 a |
| 20.0 mg | 6.05±0.04 b | 7.50±0.21 | 0.94±0.04 | 0.29±0.08 | 0.29±0.07 b |
| Significance | * | NS | NS | NS | ** |
| Interaction effect of water temperature and vitamin supplementation | | | | | |
| 17.39 °C | | | | | |
| 0.0 mg | 6.40±0.06 | 8.03±0.03 | 0.97±0.01 | 0.48±0.01 b | 0.42±0.01 c |
| 10.0 mg | 6.27±0.09 | 8.00±0.06 | 0.97±0.01 | 0.53±0.02 a | 0.48±0.01 a |
| 20.0 mg | 6.10±0.06 | 7.97±0.03 | 0.87±0.01 | 0.48±0.02 b | 0.46±0.01 b |
| 27.35 °C | | | | | |
| 0.0 mg | 6.07±0.09 | 7.20±0.06 | 1.09±0.06 | 0.11±0.01 c | 0.16±0.01 d |
| 10.0 mg | 6.07±0.03 | 7.13±0.19 | 0.95±0.08 | 0.08±0.01 c | 0.16±0.01 d |
| 20.0 mg | 6.00±0.06 | 7.03±0.03 | 1.01±0.05 | 0.11±0.01 c | 0.15±0.01 d |
| Significance | NS | NS | NS | ** | ** |

*** *P< 0.001, **P<0.01, * P<0.05 and N.S = Not significant.*

*Means in the same column within each classification bearing different letters are significantly (P<0.05) different.*

From this study it could be concluded that supplemented of Nile tilapia diets with 10 mg $kg^{-1}$ vitamin B5 diet improve growth rate and feed conversion during summer and winter seasons in Egypt.

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# تأثير إضافة حمض البانتوثينيك فى الغذاء ودرجة حرارة المياه على آداء النمو ومكونات الدم لأسماك البلطى النيلى

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استخدم فى هذه التجربة أسماك البلطى النيلى التى تزن حوالى 14 جرام وتم توزيعها على 18 حوض زجاجى فى كل منها 20 سمكة، وهى تمثل ثلاث مجموعات تجريبية فى كل منها 3 مكررات. تم تقسيم جميع الأسماك إلى مجموعتين رئيسيتين، وداخل كل مجموعة من الأسماك قسمت الى ثلاث مجموعات فرعية. الأسماك فى أول ثلاث مجموعات فرعية تم تربيتها خلال موسم الصيف (27.4 درجة مئوية)، في حين تم تربية الثلاثة مجاميع الفرعية الأخرى خلال فصل الشتاء (17.4 درجة مئوية). في كل موسم، تم تغذية المجموعة الأولى على عليقة من دون أى إضافات، وغذيت المجموعة الثانية والثالثة على ذات العليقة السابقة مع إضافة 10 و 20 ملجرام / كجم من العليقة فيتامين B5 ، على التوالي. سجلت النتائج أفضل وزن نهائي ومعدل نمو يومي فى مجموعات الأسماك التى تم تربيتها خلال موسم الصيف والنظام الغذائي الذى استخدم فيه 10 ملجرام فيتامين B5. الأسماك التى تم تغذيتها على عليقة مضاف إليها 10 ملجرام فيتامين B5 سجلت أعلى نسبة تحويل غذائي. وسجل التفاعل بين موسم التربية وإضافة فيتامين B5 تأثير معنوى (0.001) على التحويل الغذائي. بروتين الدم الكلي والألبيومين و $T_3$ سجلت زيادة كبيرة في مجموعات الأسماك التى تم تربيتها خلال موسم الصيف، في حين أن تركيز الكرياتينين في الدم انخفض بشكل ملحوظ. تركيز النتريت والنترات فى مياة تربيه الاسماك يزداد بزياده مستوي البانتوثينك في العليقه