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Influence of some feed additives on growth rates and physiological measurements of blue tilapia (*Oreochromis aureus*)

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Abstract

An experiment was conducted to evaluate the effect of two different commercial feed additives on growth performance, feed utilization and some blood parameters of *Oreochromis aureus* fingerlings. Seven treatments were applied, two forms of *Allium sativum* (powder and oil extract), *Thymus vulgari*s (dried powder and oil extract), and their combination (1:1) of each form, in addition to control group diet free from any additives. The experiment was completed using fourteen glass aquaria (80×45×40 cm, each,). Each was stocked with 40 fingerlings with an average initial body weight 2.8 ± 0.3 g. and body length 6.0 ± 0.3 cm. The experiment lasted for 10 weeks. Generally, growth performance, feed conversion ratio, protein efficiency ratio, survival and apparent protein digestibility were improved for blue tilapia (O. *aureus*) fed on diets with commercial feed additives compared to fish fed the control diet. In terms of blood measurements, alkaline phosphatase (ALP), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities in plasma decreased significantly ($P<0.05$) for fish fed all treated groups. Plasma total protein, albumin and globulins of fish fed on additives significantly increased ($P<0.05$) for those fed on additives, while blood glucose, triglycerides and cholesterol values were significantly decreased ($P<0.05$), as compared to the control group. These results revealed that feeding (*O. aureus*) with a mixture of thyme and garlic powders or oil extracts, can promote growth rate, decrease mortality rate and improve the physiological activities.

Keywords: Blue tilapia, growth, blood measurements, feed additives, Garlic, Thymus.

1. Introduction

The global aquaculture industry currently accounts for over 45% of all seafood consumed. That figure has been projected to increase to 75% over the next 20 years (FTU, 2007). In Egypt, the production of fish from aquaculture represented about 60% of total fish production sources (GAFRD, 2007). This activity requires high-quality feeds, which should contain not only necessary nutrients but also complementary feed additives to keep organism healthy, favor growth and environment-friendly aquaculture. An improper or incomplete fish diet can result in nutrient and vitamin deficiencies and the onset of serious conditions such as stunted or improper growth, a weakened immune system, or death.

Garlic (*Allium sativum*) is probably one of the earliest known medicinal plants (Lewis and Elvin-Lewis, 2003), and thyme (*Thymus vulgaris*) locally known "zaatar" a member of the family Lamiaceae, is widely used in all global folk medicine (Zambonelli *et al*., 2004). The aromatic and medicinal properties of thyme and garlic have been used all over the world for thousands of years for a wide range of conditions. Garlic has been prized since the first records of civilization for its uses in treating wounds, infections, tumors, and intestinal parasites. It is necessary to investigate those plants scientifically, which have been used as traditional additives in fish diets to improve the quality of fish

Modern day research helps explain the broad applications of this "miracle" herbs garlic and thyme since garlic bulbs contain the amino acid allicin. When crushed, allicin is released. This chemical Element is the component that gives garlic its strong odor and is responsible for the powerful pharmacological properties of the plant (Williamson, 2003). One medium clove of garlic has the antibacterial action equivalent to 1% penicillin. Modern scientists in numerous clinical trials have concluded that garlic lowers cholesterol (lipid-lowering effects) and sugar, have antihypertensive effects, (Schulz, *et al.,* 2004) and fights bacteria like an antibiotic (Wichtl, 2004).

Garlic contains about 0.5% of a volatile oil that is composed of sulfur-containing compounds. Garlic's sulfur compounds, in addition to (selenium and germanium) and vitamins A and C containing compounds (Skidmore-Roth, 2003) make it a potent antioxidant, protecting cell membranes and DNA from damage and disease (Gruenwald, 2004). Garlic extract exerts antioxidant action by scavenging reactive oxygen species, enhancing the cellular antioxidant enzymes, and increasing glutathione in the cells. Garlic inhibits lipid peroxidation, reducing ischemic/reperfusion damage and inhibiting oxidative modification of LDL. Garlic protects DNA against free radical-mediated damage and mutations (Carmia, 2001).

Although garlic directly attacks bacteria and viruses, it also stimulates the body's natural defenses

against foreign invaders. The composition of the garlic fresh bulbs is approximately 84.09% water, 13.38% organic matter, and 1.53% inorganic matter, while the leaves have 87.14% water, 11.27% organic matter, and 1.59% inorganic matter. Carmia (2001) concluded the vitamins and minerals content as thiamine 0.2 mg. riboflavin 0.11 mg. niacin 0.7 mg., pantothenic acid 0.596 mg., vitamin B6 1.235 mg., vitamin. B9 3µg., vitamin C 31.2 mg., calcium 181 mg., iron 1.7 mg., magnesium 25 mg., phosphorus 153 mg., potassium 401 mg., sodium 17 mg., zinc 1.16 mg and selenium 14.2 mcg.

On the other hand, the flowered stem of *Thymus vulgaris* contains essentially flavonoids (derived of apigenol and luteolol), acids, phenols, tannins, resin and especially essential oil rich in chemical compounds which are responsible for the majority of its pharmacological effects (Hmamouchi, 2001, and Brandão *et al*., 2006). It was also have a tonic and stimulant properties which contain, sodium and niacin derived from tryptophan or protein.

Phenolics are found in every part of the powdered thyme including the fruit, seeds and leaves. The major constituent of *Thymus vulgaris* is Luteolin, to which are attributed many of the antioxidant properties (Tepe *et al*., 2005). The antioxidant activity occurs via various mechanisms such as the inhibitory effect on lipid peroxidation and by scavenging the radicals.

The essential oils of thyme were obtained by (Zambonelli *et al*., 2004, and Rota *et al.,* 2007), the main components identified were: p-cymene: (9.1-18.5%), γ-terpinene (6.9-18.9%), thymol (22-38%), carvacrol (2.4-4.2%) and β-caryophyllene (1.64-6.07%).

Recent studies have shown that *Thymus* species have strong antibacterial, antifungal, antiviral, antiparasitic, spasmolytic and antioxidant activities (Prabuseenivasan *et al*., 2006). They are reported to possess some biological effects such as antispasmodic (Meister *et al.,* 1999), antifungal (Soliman and Badeaa, 2002), antibacterial (Dob *et al*., 2006 and Rota *et al.,* 2007), antioxidant activities (Tepe *et al*., 2005), anti-tabagism (Carlini *et al.,* 2006), giardicidal (Amaral *et al.,* 2006) and effect opposite to cancer by the means of antioxidant properties of its components (Lee and Shibamoto, 2002).

In the present study it was aimed to evaluate two forms of thyme and garlic (powder and oil) extracts. These results will allow to improve general growth conditions (growth performance, feed utilization, body composition), also biological and physiological conditions in order to obtain the optimal fish health and production.

2. Materials and methods

2.1. Experimental system and fish

Garlic powder and oil extract produced by ATOS pharma, Cairo, Egypt. Powder and oil extract of thyme (*Thymus vulgari*s L.) were acquired from the local market produced by Cap Pharm for extracting oils, herbs and Cosmetics, El Obour City, Cairo, Egypt.

The present study, was established on 20, August, 2007 to 12, November, 2007 using six hundred and fifty fingerlings *Oreochromis aureus* which were purchased from the local fishermen who fishing from Damietta Nile Branch, with mean fish body weight 2.8 (g), and body length 0.3 (cm.). They were apparently healthy and free from any abrasions or external parasites. Fish were acclimated to laboratory conditions of the Barrage Fish Farm (30 Km-north of Cairo), which belongs to National Institute of Oceanography and Fisheries, Cairo, Egypt,) for 14 days before being randomly divided into seven equal experimental groups (40 fish / each treatment at two replicates (glass aquarium). Each aquarium was 80×45×40 cm, with a total volume 120 liters of water, and supplied with dechlorinated (aerated) tap water representing seven nutritional groups. One group served as control and six groups represented the feed additives tested. The experimental fish were weighed biweekly in order to adjust the amounts of daily feed given, which was 3 % of the total live biomass at two times/day (10.0 am, and 1.30, pm) for 10 weeks. The glass aquaria were cleaned daily, and about 10% of their water was replaced by new fresh water. Dissolved oxygen was maintained at an acceptable levels (5.6-6.8 mg/l), measured by oxygen meter, water temperature ranged from 25-28°C under a photoperiod of 12 h light: 12 h dark, and water pH was adjusted at 7.4, using pH meter. At the end of the experiment, fish in each aquarium were weighed and counted.

2.2. Experimental diets

Seven isonitrogenous diets were formulated from practical ingredients (Table 1) where the control basal diet was without feed additives and the other diets were supplemented by 3.0% garlic powder, 3.0, % thyme powder and 3.0% of their combination in powder form (1:1) for diets 1, 2 and 3 respectively and 0.3% garlic oil, 0.3% thyme oil and 0.3 % of their combination in oil form (1:1) for diets 4, 5 and 6, respectively. The experimental diets were formulated to contain almost 28% crude protein. The experimental diets were prepared by individually weighing of each component and by thoroughly mixing the minerals, vitamins and additives with corn. This mixture was added to the components together with oil. The wet mixture was passed through pellet machine with 2 mm diameter. The produced pellets were dried at room temperature and kept frozen until experimental start.

2.3. Growth response was calculated as a follows

Gain in weight (g $fish^{-1}$)= mean final body weight – mean initial body weight.

Average daily weight gain (DWG) = weight gain (g fish $^{-1}$) ÷ time (days).
Specific growth rate (SGR) = [(Ln final weight (g) -Ln initial weight (g)/time (days)] x100.
Percent weight gain (PWG) = (total weight gain ÷ initial average weight gain) x 100
Condition factor (k) =100 (Wt/L^3), where Wt is fish body weight (g), L is total length (cm)
Feed conversion ratio (FCR) = Total dry feed consumed (g) ÷ total wet weight gained (g).
Feed efficiency ratio (FER) = Live weight gained (g) ÷ dry feed given (g) X 100.
Protein efficiency ratio (PER) = Wet weight gained (g) ÷ amount of protein consumed (g).
Protein productive value (PPV) = [Final fish body protein (g)-initial fish body protein (g)/crude protein intake (g)] x 100
Survival rate (%) = No. of surviving fish/total No. of fish at the beginning X 100.

Apparent protein digestibility, (APD) was determined using the method of (Furukawa and Tasukahara, 1966). The diets and feces were collected during the last 15 days of the experimental period. Any uneaten feed or feces from each aquarium was carefully removed by siphoning about 30 min after the last feeding. Feces were also collected by siphoning separately from each aquarium before feeding in the morning. Collected feces were then filtered, dried in an oven at 60^{o}C and kept in airtight containers for subsequent chemical analysis.

2.4. Biochemical analysis

Chemical composition of feed ingredients and fish body were recorded in Tables (1& 3 respectively), the tested diets were analyzed for crude protein (CP); ether extract (EE %); crude fiber (CF %); ash (%); and moisture, according to standard AOAC methods (1995). The nitrogen free-extract (NFE %) was calculated by differences. An initial sample of 5 fish per aquarium were killed prior to the start of the experiment and a final sample of 10 fish per aquarium were treated similarly and subjected to proximate analysis, except crude fiber (AOAC, 1995).

Blood was collected using heparinized syringes from caudal vein of the experimental fish at the end of the experiment. Blood was centrifuged at 3000rpm for 5 minutes. Samples were subjected to measuring plasma total protein (PTP) (Armstrong and Carr, 1964) and plasma albumin (PA) (Doumas, *et al*., 1977). Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined according to (Reitman and Frankel,1957).Triglycerides (STG) and cholesterol (Chol) were estimated according to the method described by (Stein, 1986). Alkaline phosphatase. (ALP) activity was determined by using the method of (Williamson, 2003) while glucose concentration was measured according to (Trinder, 1969).

2.5. Statistical analysis

All data were analyzed by one-way analysis of variance (ANOVA) using the general linear models procedure of statistical analysis system (SAS,2002) version 8.0 Duncan's multiple range test (Duncan, 1955) was used to resolve differences among treatment means at 5% significant level.

3. Results and discussion

3.1. Growth performance

The highest growth performance was observed in fish fed on garlic and thyme (Table 2) the total body weight gain of the fish groups fed on supplemented diets had significantly ($P<0.05$) higher than the rest of the experimental groups. However, the lowest total body weight gain (15.35g) was achieved by the group of fish fed the (control diet). Analysis of variance for final body weight, percentage weight gain and average daily weight gain (g/fish/day) values followed the same trend as in total body weight gain.

The condition factor, (K) showed significant better ($P<0.05$) results (2.06;1.97; 2.10;1.93; 1.96 and 2.09 respectively) in *O. aureus* fed on diets containing different forms of *Allium sativum and Thymus vulgari*s than that of fish fed on diet without additives (1.75).

Moreover the all fish groups fed on the garlic and thyme had significantly ($P<0.05$) higher SGR than the rest of experimental groups. However at the end of the trial, SGR values were 2.67 (control diet), 2.92; 2.83; 2.94; 2.84;2.86 and 2.94% / day for fish groups fed on diets containing different forms of garlic and thyme. These results in agreement with those mentioned by Diab *et al*. (2002) who obtained the highest growth performance in *O. niloticus* with 2.5% garlic/kg diet. They recorded that using garlic in fish farming has become popular for enhancing the activity of non-specific defense systems and conferring protection against diseases and it was used as a growth promoter in *O. niloticus* culture. Moreover, Khattab *et al*. (2004) and Mohamed *et al*. (2007) reported that Nile tilapia fingerlings fed on diets supplemented with probiotics exhibited greater growth than those fed with the control diet. Also, Abou-Zeid (2002) recorded that *Allium sativum* supplementation positively affected *O. niloticus* biomass and SGR. Azemipour *et al.* (2006) came to similar findings for common carp. Similar results were reported using bacteria as a probiotics by Kozasa (1986) for yellowtail (*Seriola lalandei*) by Gatesoupe (1991) for turbot (*Psetta maxima*) and Japanese flounder (*Paralichthys olivaceus*). In addition to Carnevali *et al.* (2006) for sea bass *Dicentrarchus labrax*. The present data are agreed with the findings by Bogut *et al.* (1998) who studied the effect of supplementing common carp feeds with different additives, including antibiotics. They observed better

growth with probiotic-supplemented diets. On the other hand the present results disagreed with the results of Abdelhamid *et al*. (2002) who found that Biogen supplementation did not significantly improve growth performance in tilapia fish.

3.2. Feed utilization and body composition

Feed efficiency ratio (FER) and protein efficiency ratio (PER) are used as quality indicators for fish diet and amino acid balance. So, these parameters are used to assess protein utilization and turnover. Results of feed utilization in terms of (FCR), (PER), (FER), protein productive value, (PPV) and daily feed intake (DFI) are presented in Table 2. These results indicated that the best ($P<0.05$) (FCR), (PER), (FER) and (PPV) values observed with the mixture containing (garlic and thyme 1:1) powder or oil extract followed by garlic powder supplemented diets suggested that addition of mixture from the two additives or garlic powder alone improved

Table 1: Constituents and proximate chemical composition of experimental diets (dry matter basis).

	Experimental Diets						
Feed Ingredients:	Control	1	2	3	4	5	6
Fish meal (62% CP)	15	15	15	15	15	15	15
Corn gluten (60% CP)	15	15	15	15	15	15	15
Soy bean meal (44%CP)	18	18	18	18	18	18	18
Wheat bran	16	16	16	16	16	16	16
Yellow corn	32.5	29.5	29.5	29.5	32.2	32.2	32.2
Soy oil	2	2	2	2	2	2	2
Vit. & Min. Mix [1]	1	1	1	1	1	1	1
Garlic powder	-	3.0	-	-	-	-	-
Thyme powder	-	-	3.0	-	-	-	-
Mixture[2]	-	-	-	3.0	-	-	-
Garlic oil (mg/kg)	-	-	-	-	0.3	-	-
Thyme oil (mg/kg)	-	-	-	-	-	0.3	-
Mixture[3] (mg/kg).	-	-	-	-	-	-	0.3
Cr_2O_3[4]	0.5	0.5	0.5	0.5	0.5	0.5	0.5
TOTAL	100	100	100	100	100	100	100
Chemical composition:							
Moisture	9.7	9.7	9.7	9.6	9.8	9.7	9.5
Crude protein	28.30	28.31	28.28	28.32	28.32	28.33	28.35
Lipid (Ether extract)	6.9	6.7	6.7	6.6	6.9	6.9	6.8
Crude fiber	5.2	5.1	5..2	5.2	5.1	5.1	5.1
Ash	7	6.8	6.7	6.8	6.6	6.7	6.7
Nitrogen free extract(NFE)	42.90	43.39	43.42	43.48	43.28	43.27	43.55
Gross energy (Kcal/ 100g)[5]	422.3	422.1	422.5	422.0	423.6	423.6	423.9
Protein /Energy ratio[6]	67.01	67.06	66.94	67.11	66.86	66.87	66.87

1- Each Kg vitamins & minerals mixture contained Vitamin A, 4.8 million IU, D_3, 0.8 million IU; E, 4 g; K, 0.8 g; B_1, 0.4 g; Riboflavin, 1.6 g; B_6, 0.6 g, B_{12}, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin,20 mg , Mn, 22 g; Zn, 22 g; Fe, 12 g; Cu, 4 g; I, 0.4 g, Selenium, 0.4 g and Co, 4.8 mg.
2-Mixture of garlic and thyme powder (1:1).
3-Mixture of garlic and thyme oils (1:1).
4- Cr_2O_3: Chromic Oxide.
5- Gross energy content of the diets was calculated by using the factors of 5.65 Kcal/g proteins, 9.45 kcal/g lipids and 4.10 kcal/g Carbohydrates (NRC, 1993)
6- Protein / Energy ratio = mg protein / Kcal.

feed utilization (Table 2). These results may be attributed to the improvement of the digestibility and have an appetizing effect for tilapia fed the two additives. These results are also in agreement with those obtained by Khattab *et al*. (2004) and Mohamed *et al*. (2007), who found that the dietary of Biogen increased feed intake, FCR and PER, in tilapia fingerling.

Analysis of variance for daily feed intake DFI (g/fish/day) values followed the same trend as in the PER. These results indicate that supplementing diets with garlic and thyme significantly ($P<0.05$) improved protein utilization parameters in commercial diets of tilapia, and they are considered as growth promoters. Prabuseenivasan *et al*. (2006) stated that the consumption of traditional diets prepared with spices, medicinal and aromatic herbs have gained increasing interest among consumers and the scientific community because they contain chemical compounds exhibiting antioxidant properties. These properties are attributed to a variety of active phytochemicals including phenolics, vitamins, carotenoids and terpenoids (Soliman and Badeaa, 2002 and Rota *et al.,* 2007). They concluded that the major constituents in the chemical composition of the essential oil of *Thymus vulgaris* were thymol, 67.8 %, carvacrol 17%, γ-Terpinene 15.9 %, and p-cymene, 13% as a dietary antioxidant. The present findings are also in agreement with Shelby *et al*. (2006) and El-Dakar *et al*. (2007) who added that dietary supplements have beneficial effects on fish growth and that translates into financial benefits for farmers by decreasing feed cost per unit growth of *Siganus rivulatus*.

Results of apparent protein digestibility (APD) (Table 2) was improved with garlic and thyme diets, this may in turn explain the better growth and feed efficiency noticed with the supplemented diets. Similar results were obtained by Gomes *et al*. (1993) in rainbow trout, Degani *et al*. (1997) in hybrid tilapia, Goddard and Mclean (2001) in *O. aureus* and Khattab *et al.* (2004) in Nile tilapia. On the other hand, the present findings are in conformity with Lara-Flores *et al.* (2003) for *O. niloticus* and De-Schrijver and Ollevier (2006) for juvenile turbot.

Better survival rate was recorded for the fish fed the six supplemented diets (97.5; 90; 97.5; 90; 92.5; and 100%) and were significantly higher in comparison with the control diet (80%). These findings are in agreement with Abdelhamid *et al*. (2002) and El-Dakar *et al*. (2007) who found that the supplementation of Biogen led to 100 % survival rate.

In this study, Table 3, the results showed that protein content in the body of *O. aureus* was significantly ($P<0.05$) higher in the groups fed on diet containing garlic and thyme alone or combination than in control group (13.76 %) but no significant difference were found among the treatment groups . Contrarily, total lipids content in fish groups fed the six diets supplemented by *Allium sativum* and *Thymus vulgaris* decreased significantly in comparison with the control diet. These results agree with those obtained by Abdelhamid *et al.* (2002) and Khattab *et al.* (2004), who found that inclusion of Biogen in the diet increased fish protein content and decreased whole body fat. These results are also in agreement with the findings of Mohamed *et al*. (2007) on tilapia and El-Dakar *et al.* (2007) who tested the effects of a commercial probiotic (Biogen) containing allicin, high unit hydrolytic enzyme, and they found that the dietary Biogen increased feed intake, FCR, PER and body composition (crude protein, ether extract and ash) in rabbit fish (*Siganus rivulatus*). On the other hand, Diab *et al.* (2002) reported that there were no significant changes in fish body composition caused by different garlic levels.

3.3. Blood measurements

In the present study, plasma glucose concentration reduced significantly in fish fed on diets containing garlic and thyme, (84.0, 96.0, 91.0, 79.0, 88.0, and 85.0 mg/dl) compared to the highest values obtained in the control group (106.0 mg/dl). These findings were attributed to improvement of the antioxidant system of pancreas to produce insulin. Lower levels of plasma glucose in fish have also been reported in the assessment of physiological effects of *Allium sativum* (Sheela and Augusti, 1992). Garlic decreases both total cholesterol and low-density lipoprotein (Adler, and Holub, 1997). Results of plasma total protein (PTP), plasma albumin (PA) and plasma globulins (PTG) showed significant differences for fish groups fed on the additives in comparison with the control diet. These findings are in agreement with Mohamed *et al*. (2007) who noted that increasing the plasma total protein indicates the improvement of the nutritional value of the diet. Blood serum protein is a fairly labile biochemical system, precisely reflecting the condition of the organism and the changes happening to it under influence of internal and external factors (Shalaby *et al*. ,2006).In present work, mean values of (PTP) were increased significantly in fish fed on garlic and thyme diets (4.78; 4.36; 4.50; 4.42; 4.50 and 4.6 g/dl, respectively) than that fish fed on diet without additives (3.40 g /dl), which agrees with the results of Hussein (1996) and Shelby *et al.*(2006) who stated that probiotics can help in improving immune response of Nile tilapia fry and the increasing of plasma protein levels have been reported due to improve in liver and other organs functions which synthesized plasma protein.

Table 2: Growth performance, feed utilization and biological measurements of *O. aureus* fingerlings fed the experimental diets (Means ±SE).

Experimental groups	Control Additives Free	Diet 1 Garlic powder	Diet 2 Thyme powder	Diet 3 Mixture (Garlic,Thyme) powder	Diet 4 Garlic oil	Diet 5 Thyme oil	Diet 6 Mixture (Garlic,Thyme) oil
Initial body weight (g)	2.8 ±0.35	2.8 ± 0.30	2.8 ±0.50	2.8 ±0.29	2.8 ±0.26	2.8 ±0.32	2.8 ±0.30
Final body weight (g)	18.15 ± 0.23^{d}	21.53 ±0.20^{ab}	20.32 ± 0.17^{b}	21.95 ±0.17^{a}	20.45 ±0.13^{b}	20.74 ± 0.16^{b}	21.94 ±0.16^{a}
Final body length (cm)	10.10 ± 0.2^{a}	10.14 ± 0.2^{a}	10.09 ± 0.3^{a}	10.14 ± 0.1^{a}	10.20 ± 0.1^{a}	10.19 ± 0.2^{a}	10.16 ± 0.2^{a}
Mean weight gain (g)	15.35 ± 0.23^{cd}	18.73 ± 0.21^{a}	17.52 ± 0.20^{b}	19.15 ± 0.29^{a}	17.65 ± 0.30^{b}	17.94 ± 0.17^{b}	19.14 ± 0.30^{a}
C.F (K).	1.75^{c}	2.06^{a}	1.97^{ab}	2.10^{a}	1.93^{ab}	1.96^{ab}	2.09^{a}
DFI(g/fish/day)	0.52^{b}	0.53^{ab}	0.54^{a}	0.53^{ab}	0.55^{a}	0.54^{a}	0.54^{a}
SGR (% /d)	2.67 ±0.13^{cd}	2.92 ± 0.12^{a}	2.83 ± 0.04^{ab}	2.94 ± 0.10^{a}	2.84 ± 0.05^{ab}	2.86 ±0.05^{ab}	2.94 ± 0.07^{a}
PWG (%)	548 ±3.96^{cd}	669 ±2.78^{a}	626 ±2.06^{bc}	684 ±2.02^{a}	630 ±1.76^{b}	641 ±3.98^{ab}	684 ±2.10^{a}
DWG (g/fish)	0.219 ± 0.05^{cd}	0.268 ±0.02^{a}	0.250 ± 0.05^{ab}	0.273 ± 0.14^{a}	0.252 ± 0.03^{a}	0.256 ± 0.10^{a}	0.273 ± 0.02^{a}
APD (%)	74.2 ±0.73^{c}	78.8 ±0.29^{a}	76.7 ±1.01^{b}	79.5 ±0.90^{a}	76.9 ±0.42^{b}	77.5 ±0.37^{ab}	79.2 ±0.70^{a}
FCR.	2.06 ±0.28^{c}	1.74 ±0.17^{a}	1.88 ±0.21^{b}	1.70 ±0.10^{a}	1.89 ±0.08^{b}	1.86 ±0.06^{ab}	1.71 ±0.11^{a}
PER.	1.72 ± 0.15^{c}	2.03 ± 0.06^{a}	1.88 ± 0.10^{b}	2.08 ± 0.11^{a}	1.87 ± 0.07^{b}	1.93 ± 0.09^{b}	2.06 ± 0.12^{a}
FER (%)	48.5 ±1.10^{c}	57.5 ±1.25^{a}	53.2 ±1.59^{b}	58.8 ±1.14^{a}	52.9 ±2.16^{b}	54.6 ±1.32^{b}	58.5 ±1.84^{a}
PPV (%)	12.18 ±0.83^{d}	17.05 ±1.10^{a}	15.13 ±0.90^{cd}	17.68 ±0.87^{a}	15.87 ±0.60^{c}	16.34 ±0.68^{b}	17.24 ±1.04^{a}
Survival rate (%)	80 ±0.00^{cd}	97.5 ±0.00^{a}	90 ±0.00^{b}	97.5 ±0.00^{a}	90 ±0.00^{b}	92.5 ±0.00^{b}	100 ±0.00^{a}

Note: a, b, c…Means in the same row have different superscripts are significantly different (P≤ 0.05)

Table 3: Chemical composition of whole body of *O. aureus* fingerlings fed the experimental diets (on wet weight basis).

Chemical composition	Experimental diets							
	Initial	Control	1	2	3	4	5	6
Moisture (%)	73.34	72.00^{a}	70.92^{b}	71.28^{b}	70.88^{b}	71.17^{b}	71.0^{b}	70.90^{b}
Crude protein (%)	13.76	14.85^{b}	15.33^{a}	15.17^{a}	15.39^{a}	15.26^{a}	15.3^{a}	15.36^{a}
Ether extract (%)	6.57	6.27^{a}	6.02^{b}	6.07^{b}	5.99^{b}	6.11^{a}	6.12^{a}	6.00^{b}
Ash (%)	6.33	6.88^{c}	7.73^{a}	7.48^{b}	7.74^{a}	7.46^{b}	7.60^{a}	7.74^{a}
Lipid/Protein ratio	0.48	0.42^{b}	0.39^{a}	0.40^{a}	0.39^{a}	0.40^{a}	0.40^{a}	0.39^{a}

Note: a,b,c…Means in the same row have different superscripts are significantly different (P≤ 0.05)

The mean value of triglycerides (STG) and cholesterol (Chol.) levels in blood of fish showed decreases ($P<0.05$) in fish fed on the six treated diets containing additives compared with the control (Table 4). Reduction of total lipid in plasma of *O. niloticus* fed on diets containing *Allium sativum* is in agreement with the study by Adler and Holub (1997), who verified that total lipid and total cholesterol decreased significantly in men treated with garlic and fish oil alone or combined. The sulfur containing compound of garlic and thyme (Tepe *et al.,* 2005), may increase the oxidation of plasma and cell lipids by improving fish health.

Transamination Plasma alkaline phosphatase. (ALP) represents one of the main pathways for synthesis and domination of amino acid, thereby allowing interplay between carbohydrate and protein metabolism during the fluctuating energy demands of the organism in various adaptive situations. It is also considered to be important in assessing the state of the liver and some other organs (Schram *et al*., 2008). Furthermore, Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities might be altered by a variety of chemical, biological, and physiological factors or by a disturbance in the Kreb's cycle. Decreased activity of the Kreb's cycle cause a decrease in its intermediates, thereby, ALT and AST compensate by providing a-ketoglutarate (Salah El-Deen and Rogerswa, 1993). Results of this study showed that AST and ALT activities decreased significantly in the fish group fed on garlic and thyme. These data agree with those reported by Faisal (2003) who mentioned reduced AST of catfish after ampicillin administration. These results can be attributed to the combination of *Allium sativum and Thymus vulgari*s which may cause stabilized cell membrane and protect the liver against deleterious agents and free radical-mediated toxic damages to the liver cells. This is reflected in the reduction of liver enzymes. Garlic and thyme may help the liver to maintain its normal function by accelerating the regenerative capacity of its cells.

ALP values (Table 4) decreased significantly with adding *Allium sativum and Thymus vulgari*s to diets (32.08; 37.66; 34.9; 34.37; 35.0 and 33.0 U/l) compared to the highest values in the control group (45.0 U/l). ALP results indicate that adding *Allium sativum or Thymus vulgari*s significantly ($P<0.05$) improved ALP activity in blood of the blue tilapia improving fish health, with optimal fish flesh condition. These results are similar to results of Metwally *et al*. (2001) for Nile tilapia fed on garlic additive, who noted that ALP activity in Nile tilapia and catfish fed on antioxidant vitamin C and selenium was significantly decreased after exposure to copper toxicity. Garlic and thyme extraction helps the liver to maintain its normal function by accelerating the regenerative capacity of its cells. Allicin treatment seems to be an enhancing effect for antibody activity (Colorni *et al.,* 1998).

Table 4: Physiological parameters of *Oreochromis aureus* fingerlings fed on Garlic and Thyme supplemented diets (Mean + SE).

Parameters	Experimental diets						
	Control	1	2	3	4	5	6
Gluc. (mg/dl)	106.0 ±3.24 ^{a}	84.0 ±1.12 ^{bc}	96.0 ±1.90 ^{b}	91.0 ±1.64 ^{b}	79.0 ±1.36 ^{c}	88.0 ±2.33 ^{b}	85.0 ±1.08 ^{bc}
PTP (g/dl)	3.40 ±0.27 ^{c}	4.78 ±0.33 ^{a}	4.36 ±0.25 ^{b}	4.50 ±0.28 ^{a}	4.42 ±0.35 ^{ab}	4.50 ±0.32 ^{a}	4.60 ±0.40 ^{a}
PA (g/dl)	1.42 ±0.09 ^{cd}	2.10 ±0.10 ^{a}	1.93 ±0.13 ^{ab}	1.90 ±0.10 ^{ab}	1.8 ±0.12 ^{b}	1.88 ±0.16 ^{b}	1.93 ±0.08 ^{ab}
PTG * (g/dl)	1.98 ±0.24 ^{c}	2.68 ±0.15 ^{a}	2.43 ±0.27 ^{b}	2.60 ±0.21 ^{a}	2.58 ±0.25 ^{a}	2.62 ±0.23 ^{a}	2.67 ±0.19 ^{a}
STG (mg/dl)	69.0 ±3.13 ^{a}	59.0 ±1.54 ^{c}	68.0 ±3.17 ^{a}	66.0 ±1.19 ^{b}	55.0 ±1.07 ^{d}	65.0 ±1.14 ^{b}	60.0 ±2.7 ^{c}
Chol (mg/dl)	137.0 ±3.16 ^{a}	118.0 ±1.64 ^{bc}	121.0 ±1.17 ^{bc}	120.0 ±1.04 ^{bc}	116.0 ±0.84 ^{c}	119.0 ±1.10 ^{bc}	117.0 ±1.16 ^{bc}
ALP (U/L)	45.0 ±2.12 ^{a}	32.08 1.16 ^{d}	37.66 ±1.42 ^{b}	34.9 ±1.05 ^{c}	34.37 ±1.19 ^{c}	35.0 ±1.00 ^{c}	33.0 ±1.22 ^{c}
AST (U/L)	118.0 ±2.29 ^{a}	86.5 ±0.99 ^{d}	112.0 ±1.14 ^{b}	106.0 ±1.15 ^{c}	96.0 ±0.81 ^{c}	107.0 ±1.06 ^{c}	104.0 ±1.43 ^{c}
ALT (U/L)	43.0 ±1.60 ^{a}	36.0 ±1.07 ^{b}	29.5 ±0.66 ^{cd}	32.9 ±1.05 ^{c}	33.4 ±1.08 ^{bc}	35.5 ±1.12 ^{b}	33.9 ±1.30 ^{bc}

a,b,c…Means in the same row have different superscripts are significantly different ($P \leq 0.05$)

* Plasma total globulins (PTG) (g/dl) = plasma total protein- plasma albumin.

4. Conclusion

Finally, From the previous results it could be concluded that garlic and thyme may be used as a growth promoter, decrease mortality rate and improve the physiological activities in (*Oreochromis aureus*) and the prevention of the diseases and for enhancing fish tolerance to environmental stress therefore combination of *(Allium sativum* and *Thymus vulgaris*) should be added to the diets of freshwater fish which could result in reductions of production cost .

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تأثير بعض الاضافات الغذائيه على النمو والقياسات الفسيولوجية لاصبعيات البلطي الازرق

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أجريت تجربة لتقييم تأثير نوعين مختلفين من الإضافات الغذائية التجارية هما الثوم والزعتر *Allium sativum* and *Thymus vulgaris*) على آداء النمووالقياسات الفسيولوجية فى إصبعيات أسماك البلطي الازرق تم تطبيق سبع معاملات (مسحوق أومستخلص زيت أعشاب الزعترونبات الثوم والخليط بينهما بنسبة 1:1) بالإضافة الى معاملة الكنترول بدون المواد المضافة. تم تطبيق العلائق المختبرة فى 14 حوضا زجاجيا بسعة(80 × 45 × 40 سم) لكل، حيث تم التخزين بمعدل 40 من أصبعيات البلطي الاوريا موزعه عشوائياً بمتوسط وزن (8,2 ± 0.3 جرام) ومتوسط طول (0,6 ± 0.3 سم). استمرت التجربة لمدة 12 أسبوعا، اسبوعان للاقلمه و عشرة اسابيع لاجراء المعاملات.

وقد كان أفضل أداء للنمو و معدل تحويل الغذائي وكفاءة تمثيل البروتين و كفاءة معامل هضم البروتين مع أعلى معدل البقاء على قيد الحياة لكل الاسماك التى غذيت على العلائق المضاف اليها الإضافات الغذائية التجارية بالمقارنة بمجموعة الأسماك التى غذيت على عليقة الكنترول.

أيضآ فقد حدث انخفاضا معنوياً فى قياسات الدم مثل انزيم جلوتاميك أوكسالو أسيتيك ترانس أمينيز و انزيم جلوتاميك بيروفيك ترانس أمينييز. وأيضا نسبة الجلوكوز و الدهون الثلاثيه وقِيَم الكوليستيرول في دم الاسماك المرباه في تلك المجموعاتِ المُعَالَجةِ بالمقارنة مع مثيلاتها بمجموعة الكونترول.

وعلي النقيض فقد ارتفعت قيم بروتين البلازما والالبومين وكذلك الجلوبيولين بطريقه ملحوظه بالاسماك التي تغذت علي الاضافات بمقارنتها بمثيلاتها التي تغذت علي العليقه الخاليه من الاضافات (العليقه الكونترول).مما يظهر الارتفاع في محفزات المناعة بتلك الاسماك.

وخلص البحث الي أن اضافة مزيج من(مسحوق الزعتر والثوم الجاف) أو من الزيوت المستخلصه من كل منهما بنسب متساويه الي علائق أصبعيات البلطي الازرق ، يمكن أن ترفع من معدلات النمو وتعطي أعلى معدل بقاء وذلك بدوره أدي الي تحسن النشاط الفسبولوجي في الاسماك، مما يؤدي بالضروره الي ارتفاع مقومات المناعه للاسماك المرباه التي تناولت الوجبات المحتويه علي هذه الاضافات.