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EFFECT OF OCHRATOXIN-A WITH OR WITHOUT BIOGEN® ON GROWTH PERFORMANCE, FEED UTILIZATION AND CARCASS COMPOSITION OF NILE TILAPIA (*Oreochromis niloticus*) FINGERLINGS.

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ABSTRACT

Eight experimental diets containing different levels of ochratoxin-A (OCTA) being 0, 4.8, 9.6 and 14.4 mg / kg diet with (3 g biogen/Kg diet) or without biogen were fed to Nile tilapia (*Oreochromis niloticus*) fingerlings to determine their effects on growth performance, feed utilization and carcass composition. These diets containing 30 % crude protein were fed to duplicate groups of tilapia (3.6 g/fish) at a daily feeding rate of 3%of the body weight. The results showed that increasing OCTA levels in the diet resulted in decreasing growth performance and feed utilization parameters. However, addition of biogen to the diets enhanced the growth performance, feed utilization and reduced the negative effects of OCTA on the same parameters. Carcass dry matter, protein and ash contents were negatively correlated with OCTA levels however, carcass lipids and gross energy content had positively correlated with OCTA levels. Supplementation of diets with biogen reduced carcass lipid content than without biogen. Finally, it could be concluded that OCTA reduced growth performance and feed utilization of tilapia, however, biogen improved the above mentioned criteria.
Keywords: *Tilapia, Ochratoxin, Biogen and Growth.*

INTRODUCTION

Mycotoxins are toxic metabolites produced by a large number of fungi under a wide range of environmental conditions. Many of these fungi are commonly to invade cereals, nuts and grains, which used in the manufacture of animal feeds (Ottinger and Doerr, 1982). One of the main factors affecting fish production and efficiency is the fish diseases that result from mycotoxins and mainly ochratoxins especially ochratoxin A (OCTA), which produced by fungi of the *Aspergillus ochraceous* and some *Penicillium* species that commonly contaminated the human, animal and fish feeds (Wood, 1992; Abdelhamid, 1983a & b & 1990; Braunberg, *et al.*, 1994; Abdelhamid and Saleh, 1996; Abdelhamid *et al.*, 1996 & 1998; El-Shaboury, 1998; Belmadani *et al.*, 1999, McMasters and Vedani, 1999 and Palli *et al.*, 1999). Ochratoxins cause severe economic losses to fish industry (Bauer, 1988 and Jonsyn and Lahai, 1992) through decreasing fish weight and increasing feed conversion ratio and resulted in severe mortality among fish (Fuchs *et al.*, 1986 and El-Shaboury, 1998).

Using immunostimulants is very important for fish, these immunostimulants mainly facilitate the function of phagocytic cells and increase their bactericidal activities. Several immunostimulants also, stimulate the natural killer cells, complement, lysozyme and antibody responses of fish. These immunostimulants including glucan, chitin, lactoferrin and leavmisole besides some nutritional factors such as vitamins B complex and C, growth hormone and prolactin (Sakai, 1999). Garlic was reported to produce increasing effect on hemoglobin concentration, red cell

count and leucocytosis in animals, also an anticoagulant effect was demonstrated to be produced by garlic juice (Satoh, 1952; Sang *et al.*, 1963 and Kamel, 1966).

Therefore, the present work aims to evaluate the effect of dietary ochratoxin-A on growth performance, feed and energy utilization and carcass composition of tilapia (*Oreochromis niloticus*) and to test biogen as imunostimulant to overcome the drastic effects of the ochratoxin.

MATERIALS AND METHODS

The experimental work of the present study was carried out in the Fish Nutrition Laboratory, Faculty of Agriculture (Saba basha), Alexandria University to evaluate the effect of dietary levels of ochratoxin with or without biogen on growth performance, feed and energy utilization and carcass composition of tilapia (*Oreochromis niloticus*) fingerlings.

Fish and Culture Facilities

Nile tilapia *O. niloticus* (average initial weight of 3.6 g/fish) obtained from Maryout Company for Fish Farms were used in the present study. Glass aquaria (each of 30 x 40 x 100 cm and 100 L capacity of water) were used in the experiment. Fish were randomly stoked into all treatments at a rate of 15 fish in each aquarium, with two replicats per treatment. The experimental glass aquaria were cleaned every morning before the first feeding and about half of the water was replaced by fresh dechlorinated tap water. Water temperature was checked daily, and ranged between 25 and 27° C. Supplemented aeration was provided through air stones by using air pumps (Rina), which permitted a suitable level of dissolved oxygen for fish. Fish from each replicate were weighed every 2 weeks and the daily amounts of feeds were readjusted as percentage of live body weight. The experimental period lasted for 14 weeks. About 20 fish were frozen for initial proximate body chemical analysis.

Experimental Diets

Crystalline ochratoxin A (OCTA) obtained from Sigma Chemical Co. USA was used in the present study. Crystalline OCTA was dissolved in 95 % ethanol and mixed with a small portion of the experimental diet (Table 1) which was air dried and mixed with the rest of the diet to provide the desired concentrations of OCTA. According to the (OCTA) LD_{50}, which determined before by Saad (2001), OCTA was incorporated at the concentrations of 0, 4.8, 9.6 and 14.4 mg/Kg diet. Hence, the OCTA concentrations added in the diets were 0, half of LD_{50}, LD_{50} and one and half of LD_{50} , respectively. Each OCTA treatment was supplemented with or without biogen at a level of 3 g/Kg diet. Biogen is a natural non-antibiotic feed supplement comprised of: Allicin (aged garlic extract) not less than 0.247 mole/g, *Bacillus subtilis nato* (6 x 10 7 –cells/g), high unit hydrolytic enzymes not less than 3690 units/g (proteolytic, amylolytic, lipolytic and cell separating enzymes), germanium (ginseng 41.98 ppm of Ge. Element) and organic selenium (China way Corporation). Feed ingredients used for preparation of the experimental diets were thoroughly mixed in a plastic container. The oil was added, drop wise

during mixing, then warm water (45° C) was slowly added under continuous mixing until the diets began to clump. The diets were formulated in small diameter (3.0 mm) pellets using a commercial meat mincer 3 times, and oven dried at 80° C for 24 hrs in a drying oven. Dried diets were stored at 4° C in refrigerator and certain amounts were taken weekly as required for feeding. The experimental diets were fed twice daily (08,00 am and 16,00 pm) at a rate of 3 % of the live body weight on dry matter basis/day for 14 weeks (6 days a week).

Samples Collection and Analysis

At the termination of the experiment, fish were collected, weighed and counted per each replicate in each treatment for whole body composition analysis. Fish samples were pulverized, autoclaved and afterwards homogenized with ultra-tunax. The homogenized samples were oven dried at 60 – 80° C for 48 hrs. Carcass composition and chemical analysis of the basic experimental diet were performed using standard AOAC, (1990) methods. All data were analyzed for statistical significance by using analysis of variance (SPSS/PC program). Multiple comparisons among means were made with the Duncan's Multiple range test (Puri and Mullen, 1980).

RESULTS AND DISCUSSIONS

The proximate analysis (%) of the basic experimental diet used in the present experiment is shown in Table 1. The diet contained 466.01 Kcal gross energy /100 g dry matter and about 30 % crude protein. The value of protein to energy (P:E) ratio was 65.93 mg protein/Kcal gross energy.

Table (1): Feed ingredient (%) and nutrient composition of the basic experimental diet used in the present experiment.

Ingredient	%
Fish meal	28.5
Soybean meal	14.0
Yellow corn	41.1
Wheat bran	14.0
Corn oil	2.0
Vit. & Min mixture[1]	0.4
Chemical composition %:	
Dry matter (DM)	92
Nutrient (%) on dry matter basis:	
Crude protein	30.66
Ether extract	7.80
Ash	10.58
Crude fiber	6.10
Nitrogen free extract	44.86
Gross energy (Kcal/100g DM)[2]	430.93
Protein : Energy Ratio (mg CP : Kcal)	65.79

[1]Meveco premix Co. (Abou Sultan, El-Esmaaelia), Vit. & Min., every 2.5 kg contain Vit. A 12000000 IU, D_3 2000000 IU, E 10g, K 2g, B_1 1000 mg, B_2 4g, B_6 1.5g, Pantothanic acid 10g, B_{12} 10mg, Niacin 20g, Folic acid 1000 mg, Biotin 56 mg, Choline chloride 500 g. Fe 30g, Mn 40g, Cu 3g, I 300 mg, Cobalt 200 mg, Se 100 mg and Zn 45g.

[2]Gross energy, calculated on the basis of 5.64, 4.11 and 9.44 Kcal GE/g protein, NFE and lipid, respectively (NRC, 1993).

The results of OCTA and biogen effects on growth performance and survival rate of tilapia are illustrated in Table 2. From the obtained data it was

clear that fish fed diets incorporated with different levels of OCTA suffered from a sever decrease in final weight, weight gain, average daily gain (ADG), specific growth rate (SGR%) and survival rate compared to fish fed the control diet (free from OCTA). However, the addition of dietary biogen with OCTA causes an increase in the above tested parameters than without biogen. The higher values of final weight, weight gain, ADG, SGR % and survival rate were recorded in favour of control group supplemented with biogen, and the lower values of these parameters were recorded in favour of fish fed the higher level of OCTA (treatment 7) without biogen. Biogen contained allicin and ginseng in its contents, allicin can activate(coordinate) the function of various endocrine glands in the body and thus enable them to secrete hormone normally. Also allicin is used for treatment of bacterial, fugal and parasitic infections (Lun, *et al.*, 1994). So, from the obtained results biogen may success to overcome the negative effect of OCTA on nutritional and metabolizable functions. Since Nile tilapia fed dietary OCTA with biogen (3 g/Kg diet) had higher body weight and body gain than the group of fish fed diet free from biogen (Saad, 2001). Mehrim (2001) found that the addition of biogen (0.3 %) to the diet, proved to be effective to overcome the direct and indirect drastic effect of phenol on growth performance. Yet, Abdelhamid *et al.* (2002) found that biogen addition (2 & 4 g/kg diet) was not useful in overcoming aflatoxicosis by Nile tilapia fish.

The effects of OCTA or biogen on growth performance of Nile tilapia *O. niloticus* are summarized in Table 2. The results revealed that with increasing the levels of OCTA, final weight, weight gain, ADG, SGR and survival rate were significantly ($P < 0.05$) decreased. Fish fed diets containing different levels of OCTA had significant ($P < 0.05$) reduction in growth performance and survival rate comparing with the fish group received the control diet (free from OCTA). However, there was insignificant ($P > 0.05$) difference between the control diet and the diet contained 4.8 mg OCTA/kg diet in survival rate. The present data are in harmony with the findings of Prior and Sisodia (1978) who found that feeding OCTA contaminated feed to lying hens decreased body weight gain. Also, Prior *et al.* (1980) and Huff and Doerr (1981) observed that chicks fed diets containing OCTA had reduced performance. Moreover, a reduction in growth rate of turkey was recorded by Chang *et al.* (1981), when OCTA was incorporated into the diet with different concentrations. The graded concentration of OCTA resulted in a depression in growth rate of broiler chicks. The degree of depression was dependent on the concentrations of dietary OCTA (Huff *et al.*, 1974 and Kubena *et al.*, 1983). Saad (2001) demonstrated that incorporated OCTA into the diet of Nile tilapia causes a decrease in body weight and body weight gain of fish compared with the control group.

Regarding to the survival rates, Choudhury *et al.* (1971) noted that the mortality rate was high after six weeks from toxicity with OCTA to hens at dose of 2 and 4 ppm. Additionally, a reduction was recorded in the survival of turkey and Japanese quail received oral dose of OCTA (Prior, *et al.*, 1976). Kubena *et al.* (1983) found a decrease in survival for broiler chicks fed diet contained 3

Table (2): Effect of different levels of dietary ochratoxin (OCTA) with or without biogen (B) on the growth performance of tilapia *O. niloticus* fingerlings.

Treatment	Final weight (g/fish)	Gain (g/fish)	ADG[1] (g/fish /day)	SGR[2] (%/day)	Surviv- -al rate (%)
1 0 OCTA without B	18.65[b]	15.05[b]	0.15[b]	1.68[b]	93.3[a]
2 0 OCTA with B	19.60[a]	16.00[a]	0.16[a]	1.73[a]	93.3[a]
3 4.8 mg OCTA without B	16.85[d]	13.25[d]	0.14[d]	1.58[d]	90.0[a]
4 4.8 mg OCTA with B	18.65[b]	15.05[b]	0.15[b]	1.68[b]	93.3[a]
5 9.6 mg OCTA without B	14.60[f]	11.00[f]	0.11[f]	1.43[f]	70.0[b]
6 9.6 mg OCTA with B	17.75[c]	14.15[c]	0.14[c]	1.63[c]	70.0[b]
7 14.4 mg OCTA without B	11.80[g]	8.20[g]	0.08[g]	1.21[g]	30.0[d]
8 14.4 mg OCTA with B	15.65[e]	12.05[e]	0.12[e]	1.50[e]	53.3[c]
Ochratoxin effect:-					
0 mg/kg	19.13[a]	15.53[a]	0.16[a]	1.705[a]	93.33[a]
4.8 mg/kg	17.75[b]	14.15[b]	0.14[b]	1.628[b]	91.67[a]
9.6 mg/kg	16.18[c]	12.58[c]	0.12[c]	1.530[c]	70.00[b]
14.4 mg/kg	13.73[d]	10.13[d]	0.10[d]	1.353[d]	41.67[c]
Biogen effect:-					
Without B	123.8[b]	95.00[b]	0.12[b]	1.474[b]	70.83[b]
With B	143.3[a]	114.50[a]	0.14[a]	1.634[a]	77.50[a]

Means in each column not sharing the same superscript are significantly different *(P<* 0.05).

[1]ADG = Average daily gain (g/fish/day): gain/experimental period.

[2]SGR = Specific growth rate (%/day): *(ln wt-ln wi/T) x 100*, where *wt* is weight of fish at time *t*, *wi* is weight of fish at time 0, and *T* is the experimental period in days.

Concerning the biogen effect, the results in Table 2 showed that, the group of fish fed biogen had higher values of growth performance and survival rate than that fed biogen free diet. El- Saidy and Gaber, (1997) indicated that Nile tilapia fed the diet supplemented with 4 % dry garlic meal were heavier than the fish fed on the control diet (without garlic). Zaki and El-Ebiary (2003) reported that fish fed dry garlic meal (5 g/Kg diet) and dry onion (3 g/ Kg diet) had higher growth performance than that without garlic or onion. Furthermore, Osman (2003) demonstrated that addition of biogen (3 g/Kg diet) to the diet contained 45 % poultry by-products meal, resulted in improving growth performance of eels (*Anguilla anguilla*) compared with fish fed diet free from biogen. On the other hand, Abdelhamid *et al.* (2002) found that dietary biogen addition did not improve growth performance of tilapia but increased its survival rate significantly.

Results in Table 3 showed the effects of OCTA and biogen on feed and energy utilization of Nile tilapia *O. niloticus* fingerlings. The best values of feed conversion ratio (FCR), protein efficiency ratio (PER) and energy utilization (EU%) were recorded by groups 1 and 2 fed the control diet supplemented with or without biogen followed by groups 4, 6 and 8 with biogen, comparing with the other tested treatments. Thus, the addition of biogen with OCTA in the same diet caused a decrease in the drastic effects of OCTA on feed and energy utilization compared with the groups fed on diets free from biogen. Yang and Yu (1990) reported that ginseng promotes phagocytic activity and enhances the mitogenesis of lymphocytes. Ginseng may reduce cell damage and acts directly on body cells promoting DNA and

protein synthesis, it also enhances the body resistance (Kim *et al.*, 1993). Nile tilapia fed diet contained OCTA and biogen (3 g/Kg diet) achieved good feed conversion and feed efficiency ratios than without biogen (Saad, 2001). Mehrim (2001) found that addition of biogen (0.3 %) to the diet of fish exposed to phenol enhanced feed and nutrient utilization of tilapia compared with the fish fed diet free from biogen. But, Abdelhamid *et al.* (2002) reported that biogen lowered significantly the feed efficiency without markable effect on the nutrients utilization.

Table (3): Effect of different levels of dietary ochratoxin (OCTA) with or without biogen (B) on the feed and nutrient utilization of tilapia *O. niloticus* fingerlings.

Treatment	Feed intake (g/fish)	FCR[1]	Protein utilization		EU[4] %
			PER[2]	PPV[3] %	
1 0 OCTA without B	25.74^{a}	1.71^{ab}	1.91^{ab}	31.17^{a}	20.46^{ab}
2 0 OCTA with B	26.89^{a}	1.68^{a}	1.94^{a}	31.84^{a}	20.66^{a}
3 4.8 mg OCTA without B	25.89^{a}	1.96^{c}	1.66^{c}	26.35^{a}	18.11^{bc}
4 4.8 mg OCTA with B	25.98^{a}	1.73^{ab}	1.88^{ab}	28.97^{a}	19.33^{ab}
5 9.6 mg OCTA without B	24.23^{a}	2.21^{d}	1.47^{d}	21.95^{a}	16.03^{d}
6 9.6 mg OCTA with B	25.67^{a}	1.82^{b}	1.77^{b}	26.69^{a}	18.85^{bc}
7 14.4 mg OCTA without B	22.32^{a}	2.73^{e}	1.19^{e}	16.19^{a}	12.49^{e}
8 14.4 mg OCTA with B	23.54^{a}	1.96^{c}	1.65^{c}	23.42^{a}	17.50^{cd}
Ochratoxin effect:-					
0 mg/kg	26.32^{a}	1.70^{a}	1.92^{a}	31.50^{a}	20.56^{a}
4.8 mg/kg	25.93^{ab}	1.84^{b}	1.77^{b}	27.66^{b}	18.72^{b}
9.6 mg/kg	24.95^{b}	2.01^{c}	1.62^{c}	24.32^{c}	17.44^{c}
14.4 mg/kg	22.93^{c}	2.34^{d}	1.42^{d}	19.80^{d}	15.01^{d}
Biogen effect:-					
Without B	24.54^{b}	2.15^{b}	1.56^{b}	23.91^{b}	16.77^{b}
With B	25.52^{a}	1.79^{a}	1.81^{a}	27.73^{a}	19.09^{a}

Means in each column not sharing the same superscript are significantly different ($P < 0.05$).

[1]FCR = Feed conversion ratio: total dry diet fed (g)/total wet weight gain (g).

[2]PER = Protein efficiency ratio: wet weight gain (g)/amount of protein fed (g).

[3]PPV = Protein productive value (%): $(P-P_o)\ 100/P_i$ where P is protein content in fish carcass at the end of the experiment, P_o is the protein content in fish carcass at start of the experiment and P_i is the protein in feed intake.

[4]EU = Energy utilization (%): $(E-E_o)\ 100/E_i$ where E is the energy in fish carcass (Kcal) at the end of the experiment, E_o is the energy in fish carcass (Kcal) at the start of the experiment , and E_i is the energy in feed intake (Kcal).

The result of the effect of different levels of dietary OCTA with or without biogen on feed and energy utilization of Nile tilapia *O. niloticus* fingerlings are presented in Table 3. There was insignificant difference ($P > 0.05$) in feed intake between fish group fed diet contained 4.8 g OCTA and fish group fed the control diet. Meanwhile, there was a significant difference ($P < 0.05$) among fish fed these diets and fish fed diets contained 9.6 or 14.4 mg OCTA/kg diet. Regarding FCR, PER, protein productive value (PPV) and EU %, these values followed the same general pattern as growth performance parameters. Where, with increasing OCTA level, values of these parameters significantly ($P < 0.05$) decreased. Incorporated OCTA into the diet (1 µg/g) of broiler chicks resulted in a reduction in protein metabolism

(Huff *et al.*, 1974). Also dietary OCTA caused a significant reduction in the intestinal glucose absorption rate, pancreatic and plasma amylase activity of pigeon, the decrease in the enzyme activity was dependent on OCTA levels (Suzuki *et al.*, 1977 and Ali, *et al.*, 1984). These findings may explain the low utilization of tilapia from feed and energy with increasing the dietary OCTA levels. Furthermore, dietary OCTA resulted in a depression in feed intake of hens (Choudhury, *et al.*, (1971),an increased feed conversion ratio of turkey (Chang, *et al.*, 1981) and a reduced feed efficiency ratio of Nile tilapia (Saad, 2001).

An over look to the biogen effect, a significantly ($P < 0.05$) increase was obtained in feed intake, FCR, PER, PPV and EU % for fish fed diet supplemented with biogen than without biogen. Jones and Mann (1963) reported that the antibacterial effect of garlic may contribute indirectly towards improved nutrient utilization. El-Saidy and Gaber (1997) showed that feed consumption of tilapia fed diet containing 4 % garlic meal was higher than that of fish fed diet without garlic. Moreover, feed and nutrient utilization values of fish fed diet contained 4 % garlic meal were enhanced. Addition of biogen to the diet improved feed intake, feed conversion ratio, feed and energy utilization of tilapia and eels (Mehrim, 2001 and Osman, 2003).

Data of OCTA and biogen effects on carcass composition of tilapia are presented in Table 4. The obtained results revealed insignificant effects ($P > 0.05$) of OCTA with or without biogen on all carcass composition parameters. These results are in partial agreement with the findings of Osman (2003) who found a significant ($P < 0.05$) difference between fish fed diet supplemented with biogen and the control group, in ether extract and gross energy. The other carcass composition parameters (dry matter, crude protein and ash) were not significantly affected. But, Abdelhamid *et al.* (2002) mentioned that crude protein of tilapia fish significantly increased and its ether extract and ash contents significantly decreased by dietary inclusion of biogen.

There was an insignificant ($P > 0.05$) difference in dry matter content between fish fed diets contained 4.8 and 9.6 mg OCTA/kg . Meanwhile, there was an insignificant difference in carcass crude protein between fish fed the control diet and those fed the diet contained 4.8 mg OCTA/kg as well as between the fish fed diets contained 9.6 and 14.4 mg OCTA/kg diet. Carcass ether extract increased significantly ($P < 0.05$) with increasing OCTA level in the diet. There was insignificant differences ($P > 0.05$) in ash content among fish fed the control diet and the diets contained 4.8 and 9.6 mg OCTA/kg. Whereas, there was a significant difference between this group and the fish fed diet contained 14.4 mg OCTA/kg. Relative weights of the liver, kidney, pancreas and gizzard of broiler chicken were all greater than those of controls for birds receiving OCTA dose of 4 µg/g feed (Huff, *et al.*, 1988). This means that OCTA caused an increase in body moisture and thus caused a decreased in dry matter. Belmadani *et al.* (1999) indicated that OCTA induced neurotoxic effect via inhibition of protein synthesis. Moreover, OCTA enhanced lipid peroxidation (Ethane Exhalation) in vivo in rates (Chang and Rahimtula, 1992). Abdelhamid *et al.* (1999) reported that OCTA increased significantly relative weight of liver and heart but decreased carcass

percentage of rabbits. They mentioned too that OCTA significantly increased serum values of creatinine, urea, uric acid, cholesterol and transaminases activity and reduced significantly serum proteins.

Regarding the biogen effect, there was an insignificant difference ($P > 0.05$) between the fish had diets with biogen and the fish had diets free from biogen in dry matter, crude protein, ash and gross energy. However, the fish fed diet with biogen had significantly ($P < 0.05$) lower body lipid than the fish fed diet without biogen.

Table (4). Effect of different levels of dietary ochratoxin (OCTA) with or without biogen (B) on carcass composition and gross energy of tilapia *O. niloticus* fingerlings.

Treatment	Dry matter %	% on dry matter basis			Gross energy (Kcal /100g)*
		Crude protein	Ether extract	Ash	
Initial body composition	23.86	52.95	21.23	25.82	499.05
Final carcass composition:-					
1 0 OCTA without B	28.12 [a]	55.61 [a]	24.84 [a]	19.55 [a]	548.13 [a]
2 0 OCTA with B	28.32 [a]	55.50 [a]	24.27 [a]	20.23 [a]	542.13 [a]
3 4.8 mg OCTA without B	27.33 [a]	54.06 [a]	26.80 [a]	18.64 [a]	557.89 [a]
4 4.8 mg OCTA with B	27.01 [a]	55.12 [a]	25.21 [a]	19.67 [a]	548.86 [a]
5 9.6 mg OCTA without B	27.17 [a]	52.81 [a]	28.35 [a]	18.84 [a]	565.47 [a]
6 9.6 mg OCTA with B	27.11 [a]	53.31 [a]	27.34 [a]	19.35 [a]	558.76 [a]
7 14.4 mg OCTA without B	25.53 [a]	52.26 [a]	29.69 [a]	18.05 [a]	575.02 [a]
8 14.4 mg OCTA with B	26.23 [a]	52.74 [a]	29.39 [a]	17.87 [a]	575.00 [a]
Ochratoxin effect:-					
0 mg/kg	28.22 [a]	55.56 [a]	24.56 [d]	19.89 [a]	545.21 [c]
4.8 mg/kg	27.17 [b]	54.59 [a]	26.01 [c]	19.16 [a]	553.42 [c]
9.6 mg/kg	27.14 [b]	53.06 [b]	27.85 [b]	19.10 [a]	562.16 [b]
14.4 mg/kg	25.88 [c]	52.50 [b]	29.54 [a]	17.96 [b]	574.96 [a]
Biogen effect:-					
Without B	27.04 [a]	53.69 [a]	27.42 [a]	18.77 [a]	561.66 [a]
With B	27.17 [a]	54.17 [a]	26.56 [b]	19.28 [a]	556.25 [a]

Means in each column not sharing the same superscript are significantly different ($P < 0.05$).

***Gross energy, calculated on the basis of 5.64 and 9.44 Kcal GE/g protein and lipid, respectively (NRC, 1993).**

Finally, it could be concluded from the present study that the dietary treatment of OCTA caused drastic effects on growth performance, feed utilization and carcass composition of Nile tilapia (*O. niloticus*) fingerlings. However, addition of biogen (3 g/Kg diet) minimized the above mentioned effects of OCTA on fish.

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أثر الأوكراتوكسين (أ) فى وجود أو عدم وجود البيوجين على كفاءة النمو والاستفادة من الغذاء وتركيب جسم إصبعيات البلطى النيلى.

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تم إجراء ثمانية معاملات غذائية على عليقه واحدة تحتوى ٣٠ % بروتين، حيث أضيف إلى هذه العليقة صفر او٤,٨ او٩,٦ او١٤,٤ مجم أوكراتوكسين أ /كجم عليقة (مقارنة بدون أوكراتوكسين ونصف التركيز المميت لنصف عدد أسماك البلطى و التركيز المميت لنصف عدد الأسماك ثم مرة ونصف التركيز المميت لنصف عدد الأسماك على التوالى) مع إضافة بيوجين (٣ جم/كجم عليقة) أو عدم إضافة البيوجين، وتمت التغذية اليومية بمعدل ٣ % من وزن الجسم فى مكررتين، وذلك لتقدير أثر هذه المعاملات على كفاءة النمو ومعدل الاستفادة من الغذاء والتركيب الكيماوى لجسم الأسماك البلطى (٣,٦ جم/سمكة). وقد أظهرت النتائج أنه كلما زاد تركيز الأوكراتوكسين فى العليقة كلما قلت كفاءة النمو ومعدل الاستفادة من الغذاء، وأنه بإضافة البيوجين قد تحسن معدل النمو والاستفادة من الغذاء مع تقليل التأثير السلبى للأوكراتوكسين على نفس المقاييس السابق ذكرها وذلك فى العلائق التى احتوت على البيوجين. كانت هناك علاقة سالبة بين محتوى جسم الأسماك من المادة الجافة والبروتين والرماد من ناحية وبين تركيزات الأوكراتوكسين من ناحية أخرى ولكن كانت هناك علاقة موجبة بين المحتوى من الدهون والطاقة من ناحية وهذه التركيزات للسم من ناحية أخرى، والأسماك التى غذيت على علائق تحتوى على البيوجين كان محتواها من الدهون أقل مما هو فى الأسماك التى غذيت على علائق خالية من البيوجين. وعليه تظهر هذه الدراسة أن تلوث علائق الأسماك بالأوكراتوكسين يعمل على خفض كفاءة النمو والاستفادة من الغذاء وأن إضافة البيوجين إلى هذه العلائق يقلل من هذه التأثيرات السلبية.