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EFFECT OF MANNAN OLIGOSACCHARIDE AND VITAMIN E SUPPLEMENTATION ON PRODUCTIVE PERFORMANCE OF LOCAL STRAIN OFLAYING HENS SUBJECTED TO OCHRATOXIN-A CONTAMINATION

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ABSTRACT

In this study, mannan-oligosaccharide (MOS) and vitamin E (Dl-α-tocopheryl acetate) were used as feed supplements to ameliorate the deleterious effect of Ochratoxin-A (OTA) on laying hens productive performance, some blood constituents and egg quality. A total of 180 Inshas hens, 28 weeks of age were randomly distributed according to diet supplementation into six groups (30 hens each) as follow. T1: fed a hen diet without any supplementation (control) ; T2: fed the control diet supplemented with 1 g MOS / kg diet; T3: fed the control diet supplemented with 150 mg Vit.E / kg diet; T4: was fed the control diet contaminated with 1000 ppb of OTA. While, T5: fed the control diet contaminated with 1000 ppb OTA and supplemented with 1 g MOS / kg diet; T6: fed the control diet contaminated with 1000 ppb OTA and supplemented with 150 mg Vit.E / kg diet. Results showed that feeding OTA at 1000 ppb (T4) significantly decreased egg production percentage and feed consumption. Moreover, a significant increase in relative weights of kidney and liver, in addition to high mortality percent and worse feed conversion ratio were observed in OTA-fed birds. On the other hand, addition of either MOS or Vit E ameliorate the toxic effects of OTA.

Keywords: Ochratoxin-A, Mannan-oligosaccharide, vitamin E and local chickens

INTRODUCTION

Ochratoxin-A is an important mycotoxin produced by different *Aspergillus* and *Penicillium* species. The presence of ochratoxin-A (OTA) in animal feeds raises concerns in poultry and livestock industry due to subclinical intoxications and poor growth in animals (Gentles *et al*., 1999 and Zia *et al.,* 2010). The OTA presence in the poultry feeds in low to moderate levels induces immunosuppression, decreased body weight gains and increased susceptibility to infectious diseases (Saleemi *et al.,* 2010 and Mukhtar *et al.,* 2010). Ochratoxin-A has gained considerable attention due to its intrinsic toxicity and its frequent occurrence in feed commodities used in livestock feeds (Abddlhamid, 1993 and 1996). The main target organ of OTA in poultry, as in other species, appears to be the kidney, although liver, gastrointestinal tract, lymphoid organs, skeletal system, hematopoietic tissues and the reproductive organs can also be affected (Abddlhamid and Salh, 1996; Abddlhamid, 2000 and Paterson and Lima, 2010). Ochratoxin-A not only induces disease in chicken but also it may accumulate in the eggs and meat of the poultry and thus enters in human food chain (Abddlhamid *et al.,* 1999) . Therefore, all the efforts should be made to protect the

commercial poultry birds from the toxic effects of ochratoxin. Its levels in the feeds are kept minimum by different methods including use of ingredients having low levels of OTA, proper storage and use of toxin binders to bind the preformed mycotoxins and rendering them unabsorbable from the gut (Abddlhamid, 2000) .

Lately, the more promising and practical approaches to counteract mycotoxins are the use of organic and inorganic adsorptives and vitamin supplements to livestock feeds (Abddlhamid *et al.,* 2002) .

Some previous researches proved that the Bio-Mos® prebiotic product, which contains mannan-oligosaccharides issued from the cell wall of the *Sacharomyces cerevisiae* yeast, could generate beneficial effects, such as combat against intestinal pathogen germs in birds and mammals, through the immune response modulation and through the improvement of the intestinal mucosae structural integrity (Spring, 1999 and Spring *et al.,* 2000). Prebiotics also improve the absorbtion of the nutrients, including macro and microelements, through the intestinal wall (Pop, 2002 and Chen and Chen 2004), increasing meantime the degree of their availability to be used for organism's maintenance and regeneration, as good as for production.

Vitamin E is an essential vitamin possessing an antioxidant activity. Vitamin E given at higher level than recommended doses increase the number of antibody producing cells and raises antibody titers in chickens and mice (Hossain *et al.,* 1998).

In this respect, the present study was aimed to determine if the addition of MOS and vitamin E would ameliorate the deleterious effects of Ochratoxin-A on laying hens performance.

MATERIALS AND METHODS

The present study was carried out at Sakha Animal Research Station, Animal Production Research Institute, Ministry of Agriculture, Egypt. The chemical analyses were carried out at Laboratories of the Animal Production Research Institute, Ministry of Agriculture, Egypt. The present study aimed to evaluate the effect of mannan-oligosaccharide (MOS) [commercially available as Bio Mos®, a nutritional supplement manufactured by Alltech, Inc. (Nicholasville, KY)] and vitamin E (Vit.E) supplementation on performance of laying hens subjected to Ochratoxin-A (OTA) contamination. A total number of 180 Inshas hens, 28 weeks of age were randomly distributed into 6 groups with 3 replicates each (10 hens). Birds fed on the experimental diets, as follows; (1) control, basal diet; (2) basal diet plus 1g MOS /kg diet; (3) basal diet plus 150 mg vitamin E /kg diet; (4) basal diet plus 1000 ppb OTA /kg diet; (5) basal diet plus 1000 ppb OTA plus 1 gm of MOS /kg diet; (6) basal diet plus 1000 ppb OTA /kg diet plus 150 mg vit. E /kg diet.

The experimental period lasted 16 weeks. The experimental diets were formulated on the basis of a basal diet (Table 1) to be isonitrogenous (16% CP) and isocaloric (2700 Kcal ME/Kg diet) and to satisfy the nutrient requirements according to Agriculture Ministry Decree (1996) The basal diet did not contain detectable levels of ochratoxin or aflatoxin (<1 µg/kg diet).

The birds were reared under the same managerial conditions in open-sided house on floor. Photoperiod was 17 hours daily. Feed and water were offered *ad libitum* during the experimental period.

Ochratoxin production:

The OTA was produced from *Aspergillus ochraceus*, strain NRRL 3174 available at the Institute of Animal Health, Dokki, Cairo, Egypt. A flasks, each containing 100 gm of finely ground corn and 40-50 ml of distilled water was mixed and autoclaved at 121°C for one hour. The flask was shaken to prevent cooking of yellow corn. It was inoculated with corresponding fungus for required mycotoxins and incubated for 4 weeks at 25-28°C. After end of incubation period , the corn was removed from flasks, dried, finely ground and 50 g of each was subjected to toxin extraction as recommended by **(Wyllie and Morehous, 1978 and Hansen (1993)).**

Mycotoxin standard solution for TLC :

Mycotoxin standard of Ochratoxin-A, was purchased from (Sigma Chemical Company, St. Louis U.S.A).

Measurements:

Birds were individually weighed at the beginning and at the end of the experimental period. Feed Intake (FI), egg production (EP %) and egg weight (EW) were recorded. Thirty representative eggs from each treatment (10 from each replicate) were collected monthly throughout the experimental period in order to determine egg quality. Shape index and yolk index were determined according to **Romanoff and Romanoff (1949)** as follows:

Shape index (%) = (width/length) × 100

Yolk index (%) = (height / diameter) × 100

Egg shell thickness, including shell membranes, was measured using a micrometer at the equator. The egg yolk visual color score was determined by matching the yolk with one of the 15 bands of the “1961, Roche Improved Yolk Color Fan”.

Serum Biochemistry and Organ Weight:

At the end of experimental period , the chickens were held 12 hours prior to slaughter without feed. Then 3 chicken from each treatment were randomly selected weighed and slaughtered to obtain organs weight after bleeding, Scalding, feather picking by hand and evisceration, different organs (liver, kidney, spleen, hart, gizzard and ovarian), data expressed as a percentage of live body weight.

While birds were sacrificed, 3 ml blood sample was taken and stored frozen at (-20°C) for serum chemical analysis to determine effects of consumption of diets on blood chemistry of total protein, albumin, globulin, uric acid, cholesterol, calcium, phosphorus, lipids, and activities of alkaline phosphatase (ALP), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured by using available commercial kits purchased from Diamond Diagnostics Company, Egypt.

Analysis of OTA Residue in the kidney, Liver and eggs:

Tissue samples (muscles, liver and kidney) were collected from a total 3 chickens in each treatment. Tissues were pooled and then homogenized for OTA extraction and determination. OTA extraction from different tissues was performed according to Aoudia *et al.* (2008). Briefly

thawed kidney, liver or muscle samples were pooled and homogenized. 5 g were transferred into a 100 ml round-bottom plastic tube and triturated for 3 min after the addition of 10 ml H3P04 (0.5 M) and 50 ml chloroform. The chloroform phase was then isolated by centrifugation for 20 min at 830 g, and the remaining phase was extracted a second time with 50 ml chloroform. The chloroform extracts were evaporated at (35±5°C). The residue was dissolved in 50 ml of 0.5M sodium bicarbonate. Six egg samples per treatment consisting of the pool of the last 3 eggs produced by the hen at the end of the study were analyzed for OTA residues. The procedure followed was a modification of the method developed by Monaci *et al.* (2005). Standards were prepared by adding an appropriate volume of methanol solution of the toxin to the homogenized egg .

Detection of ochratoxin in organs, eggs and feeds:

Measurement of ochratoxin in organs, eggs and feeds was applied according to the fluorometeric method reported by Hansen (1993). The recommended amount of samples subjected for extraction of toxins by addition of methanol and water and passed over immunoaffinity column. The obtained extract was measured by fluorometer or T.L.C.

Statistical analysis:

Data from all the response variables were subjected to one way analysis of variance **(SAS, 2000).** Variables having a significant F-test ($P \leq 0.05$) were compared using Duncan's Multiple Range Test **(Duncan, 1955).**

Model:

$X_{ij} = \mu + T_i + e_{ij}$

Where: X_{ij} = Any observation

μ = Overall mean

T_i = Treatments (i = 1, 2,…and 6)

e_{ij} = Experimental error

RESULTS

Results of feed consumption (FI), body weight (BW) changes, egg production, and feed conversion ratio are shown in Table 2. Ochratoxin-A decreased daily feed consumption compared with the control group, while supplementing hen diets with MOS or Vit E in absence of OTA recorded significantly a higher body weight change, egg weight, egg production and feed intake ($P \leq 0.05$) than all experimental groups. The lower feed intake with diet contaminated with OTA decreased egg mass production and average egg weight. However, there were no differences among treatments regarding feed-to-gain ratio. Incorporating MOS and vit. E into the OTA-contaminated diets partially ameliorated the adverse effects of OTA on daily feed consumption and egg production (%/hen). The OTA treatment showed the least egg production. Egg quality parameters are shown in Table 3. There were no effects due to treatments on albumin % and yolk color. The effects of dietary treatments on serum biochemistry are summarized in Table 4. Ochratoxin-A in the diet significantly increased the serum activities of alanine aminotransferase and aspartate aminotransferase, serum activity of ALP and the concentration of uric acid, whereas it decreased the serum concentration

of total protein, globulin, calcium and phosphorus (Table 4). In contrast, feeding MOS or vit. E in absence of OTA recorded insignificant effect of serum biochemistry. A significant interaction between OTA and MOS or vit.E was observed in the serum concentrations of uric acid, cholesterol, and triglycerides as a consequence of the change observed on the OTA treatment.

The relative weights of the kidney, liver and spleen are shown in Table 5. The contaminated diets increased the relative weight of the kidney, liver, heart and spleen but did not affect the relative weight of the gizzard. Supplementing the contaminated diets with MOS or vit. E significantly reduced adverse effects of ochratoxin-A (Table 5). Samples analyzed at the end of the experiment for residual OTA showed that OTA was mostly accumulated in the kidney, liver and meat; while, eggs gave negative results of residual OTA (Table 6). Generally, it could be seen that the OTA-detoxifying agents applied and their combination significantly decreased accumulation of OTA in kidney, liver and meat.

DISCUSSION

Effects of OTA on laying hens birds from the OTA group presented clinical signs of toxicosis. Differences were observed between toxicosis hens (OTA) and the control group in daily feed consumption, egg production and egg quality, liver function, and serum uric acid levels. The production results are in agreement with those reported by Haazele *et al.* (1993), who observed decreased feed consumption in laying hens fed 1.7 mg of OTA/kg of feed for 2 wk, and by Verma *et al.* (2003), who reported reductions in the egg mass production of laying hens fed contaminated diet with 1, 2, and 4 mg OTA/kg diet. However, OTA cause significant decreased in changes in BW. The reduction in body weight due to ochratoxicosis in laying hens in the present study is in agreement with the previous reports of Kubena *et al.,* (1997); Raju and Devegowda (2000), Stoev *et al.* (2002), and Verma *et al.* (2004). Also, Garcia *et al.* (2003) pointed out that broiler chicks fed OTA-contaminated diet at level of 567 ppb had a lower body weight than the control birds. Furthermore, Elaroussi *et al.* (2006) reported a significant decrease in body weight of broiler chicks fed a contaminated diet with OTA at level of 400 and 800 ppb.

The depression in productive performance occurred during ochratoxicosis in this study may be attributed to many factors. OTA affects protein synthesis through competitive inhibition of phenylalanine-t-RNA-synthesis by phenylalanine moiety of the toxin (Konrad and Roschenthaler , 1998 and Bung *et al.,* 1999) . Moreover, ochratoxin-A interferes with DNA , RNA and protein synthesis and affects carbohydrate metabolism, particularly glucogenolysis. Changes such as the serum concentrations of several proteins and metabolites and the activity of certain enzymes can be used as sensitive indicators of ochratoxicosis (Ali *et al.,* 1984 and Marquardt and Frohlich, 1992). Biochemical signs of ochratoxicosis reported in the literature in poultry include decreases in total protein, albumin, globulin, potassium, and

triglyceride levels, and increases in uric acid and creatine levels and in the activities of serum ALP and GGT (Huff *et al.,* 1988).

Increase in ALT values in birds fed with ochratoxin could be attributed to the hepatic damage caused by ochratoxin. The increased level of ALT might be attributed to the liver damage observed in the present study. In the present investigation, the AST levels in mycotoxin treated birds increased significantly than the control birds. The increase in AST level in the present study could be due attributed to leakage of enzyme due to liver damage. The present study revealed that mycotoxin treated birds showed an increase in serum ALP level as compared to control birds. The increased level of this enzyme could be correlated to the degenerative changes noticed in the liver leading to seepage of enzyme into serum (Manafi, 2011).

In our study, significant ($P \leq 0.05$) increases were observed in serum creatine and uric acid concentration in birds exposed to OTA in the diet. Similar observations attributable to ochratoxicosis have been reported by Kalorey *et al.* (2005) within these parameters. The observed increase in ALP activity is known to be indicative of hepatobiliary disease (Gentles *et al.,* 1999). In fact, the reductions in serum cholesterol and triglyceride concentrations during ochratoxicosis may confirm impaired liver metabolism (Kalorey *et al.,* 2005). Ochratoxin A is known to be primarily nephrotoxin in poultry species and the kidney is a target organ for the toxic action of OTA. In addition to that, it was found also in this investigation that OTA caused detrimental effects in layers liver that lead to the conclusion that OTA had also hepatotoxic properties. This hepatotoxic action was manifested by the significant increase in the relative liver weight in layers that were subjected to OTA toxicity in their diets compared to the control group. Similar increases in relative kidney and liver weights have also been observed in chickens exposed to OTA came in agreement with several previous reports using dietary 2 mg OTA / kg (Santin *et al.,* 2002 and Denli *et al.,* 2008); 130, 300 and 800 µg OTA / kg OTA and 1000-5000 µg penicillic acid (PA) / kg (Stoev *et al.,* 2000 and 2004), while, other investigators using OTA at 2 mg / kg diet (Raju and Devegowda, 2000) or 4 mg / kg diet (Verma *et al .,* 2004) reported an increase only in kidney weight. The reported enlargement in the liver and kidney in OTA groups is probably due to the fact that these organs are involved in detoxification and elimination of OTA. Ochratoxin-A is known to have direct toxic action (Stoev *et al.,* 2000) and high rate of accumulation in these two organs (Biro *et al .,* 2002), and an increase in the concentration of serum uric acid has been observed in chickens fed OTA-contaminated diets (Hoehler and Marquardt, 1996 and Denli *et al.,* 2008). Feeding OTA-contaminated diets significantly decreased serum calcium and phosphorus levels. Similar results were reported previously by Bailey *et al.* (1989) and Gupta *et al.* (2005). Huff *et al*. (1980) reported that feeding 2 mg OTA /kg diet to broiler chicks decreased bone breaking strength. Kidney dysfunction has been hypothesized as the cause of the decrease in phosphorus concentration. However, the most critical aspect of mycotoxins in animal production is the likely presence of mycotoxins in animal products. Ochratoxin A has been described as showing potential teratogenic (Fukui *et al.,* 1987) and genotoxic (Creppy *et al.,* 1985) effects, and has been classified

by the International Agency for Cancer Research (1993) as a possible carcinogen agent (group 2B) to humans. There is a correlation between OTA concentration in feed and its residues in animal tissues (Krogh, 1976). In pigs, ochratoxin is accumulated mostly in the kidneys, followed by the liver and muscle (Malagutti *et al.,* 2005). In our study, we observed significant amounts of OTA in the kidney and liver of all birds fed the contaminated diets. We did not observe OTA residues in eggs when considering detection limits of 0.05 ng/g. Similarly, Krogh (1987) and Denli *et al.* (2008) reported no detection of OTA in eggs of laying hens fed diets containing 1 and 2 mg of OTA/kg diet, respectively. In contrast, Piskorska-Pliszczyńka and Juszkiewicz (1990) reported that OTA was detected in the eggs of laying hens fed diets containing a greater level of OTA (10 mg/kg diet). The differences between studies may have been due to the concentrations of OTA in the diet.

Residues of OTA have been also detected in the muscle of hens and chickens, and in eggs (Piskorska-Pliszczyńka and Juszkiewicz 1990). In an experiment in which the toxic effects of OTA (OTA, 2 mg/kg of feed) was evaluated in laying hen diets, OTA exposure promoted an increase in the content of OTA in the liver (15.1 µg/kg) as compared to control animals (Denli *et al.,* 2008). However, OTA residue was not detected within the detection limit (0.05 µg/kg) in any of the analyzed eggs. Moreover, Niemiec *et al*. (1994) observed a range from 0.7 to 1.3 µg OTA/kg of eggs when animals were fed a diet contaminated with OTA at 10.0 mg/kg diet. In contrast, no OTA was detected in eggs of Japanese quails given 1 mg OTA/kg BW (Piskorska-Pliszczyńka and Juszkiewicz ,1990).

Efficacy of MOS and/or vit E:

The most promising and economical approach for reducing mycotoxicosis in animal feeding is the use of adsorbents, which bind mycotoxins efficiently in the gastrointestinal tract and prevent their adsorption (Dakovic *et al.,* 2005). The *in vitro* biosorption of OTA by vinasse containing yeast cell walls, purified yeast β-glucan and dried yeast cell wall fractions was studied (Ringot *et al.,* 2005). Dried yeast cell wall fractions were reported to be the most efficient at adsorbing OTA. Several reports explained this phenomena by relating it to yeast β-D-glucans (Yiannikouris *et al.,* 2006), glucomannans (Raju, and Devegowda 2002) and mannanoligosaccharide (Oguz, and Parlat 2004). At the same time, Santin *et al.*(2001, 2003 and 2006) reported that cell wall of *Saccharomyces cerevisiae* improved the intestinal mucosa aspects and it might be the explanation for the improve in productive performance of layers. The cell wall of yeast is normally constituted of mannan oligosaccharides and the use of theses compost have been shown to improve feed conversion of birds (Savage and Zakrzewska, 1997 and Fritts and Waldroup, 2003). Furthermore, Cooney (1980) explained the ability of active yeast to alleviate the aflatoxicosis effects, via chelating aflatoxins, which is transported to and eliminated via intestinal tract. Live yeast (*Saccharomyces cerevisiae*) at level of 0.1% was found to alleviate the adverse effects of aflatoxicosis on body weight (Stanley *et al.,* 1993). Glucomannans extracted from the external parts of *Saccharomyces cerevisiae* are able to bind certain mycotoxins. This great binding capacity results from the large area available for exchange, thus 500 g of

glucomannan have the same capacity adsorption as 8 kg of clay (Ahokas *et al.,* 1998).

In respect to vitamin E, Abd El-Maksoud (2006) reported that vitamin E supplementation increased egg production (%) by alleviating the adverse effects of high ambient temperature on laying hens during summer months. Hassan *et al.* (2009) reported that vitamin E supplementation from 125 to 250 mg/kg in Matrouh laying hens diets improved ($P<0.05$) body weight, feed intake and egg weight.

Some other substances, such as antioxidants, have also been evaluated to decrease OTA toxicity in several species. Özçelik *et al.* (2004) and Abdel-Wahhap *et al*. (2005) found that melatonin exhibits a preventive effect against OTA-induced oxidative stress and structural damage in the kidney through its role in the scavenging of free radicals and/or the prevention of lipid peroxidation. Grosse *et al.* (1997) also demonstrated that the incorporation of alpha-tocopherol in the diet decreased by 58% the total DNA adduct provoked in kidney by a single administration of OTA in mouse and rat kidney.

However, MOS or vit. E increased shell thickness and the serum calcium concentration, which suggest likely effects of the product on the absorption of minerals and carotene. Moreover, when MOS or vit. E were incorporated into the OTA-contaminated diets, they increased egg production to values not significantly different from the control, and it ameliorated the negative effects on some of the serum variables altered by OTA, such as the serum concentrations of T. protein, cholesterol, uric acid, and creatinine . These results and the lower content of OTA in the kidney and liver of birds fed the OTA + MOS or vit. E diets appear to support the suggestion that MOS or vit. E may provide protection against the toxic effects of OTA.

In conclusion, results of this study confirmed the toxic effects in laying hens of a prolonged dietary intake of OTA and the inclusion of MOS or vit. E, can significantly ameliorate many of its adverse effects.

Birds fed MOS or VE along with 1000 µg/OTA showed productive performance and biochemical responses, almost similar to those of control birds suggesting a protective effect of MOS or VE against OTA. These agents (substances) may be used as protective agents in poultry to meliorate the adverse effects of Ochratoxin-A.

Table (1): Chemical composition and calculated analysis of the basal experimental diet.

Ingredients	%
Yellow corn	66.00
Soybean meal (44%)	24.00
Limestone	7.59
Di-calcium phosphate	1.71
Sodium chloride	0.30
Vit.& Min. Mixture*	0.30
DL.Methionine	0.10
Total	100
Calculated analysis**	
Metabolizable energy (kcal/kg)	2750
Crude Protein, %	16.43
Crude fiber, %	3.20
Ether extract, %	2.70
Calcium, %	3.33
Available phosphate, %	0.45
Total phosphorus, %	0.66
Lysine, %	0.86
Methionine, %	0.39

***Supplied per kg of diet: vit.A, 10000 IU; D_3, 2000 IU; Vit.E, 10mg; Vit.K_3,1mg; vit.B_1, 1mg; vit. B_2, 5mg;**
vit.B_6, 1.5mg; vit. B_{12}, 10mcg; Niacin, 30mg; Pantothenic acid, 10mg; Folic acid, 1mg; Biotin, 50µg; Choline,
260mg; Copper, 4mg; Iron; 30mg; Manganese, 60mg; Zinc, 50mg; Iodine, 1.3mg; Selenium, 0.1mg and
Cobalt, 0.1mg.
**** Calculated according to NRC. (1994)**

Table (2): Efficacy of Mannan-Oligosaccharides (MOS) and vitamin E for detoxification of ochratoxin contaminated diets on productive performance of local laying hens during the experimental period.

Treatment	Initial body weight,(g)	Final body weight, (g)	Body weight gain,(g)	Body weight change, %	Total Egg number	Avrage egg weight, g	Egg mass (g/hen/day)	Egg production %	Feed intake (g/hen/day)	Feed conversion (feed/egg mass)
Control (C)	1487.33	1686.33^{a}	199.00^{ab}	11.79^{ab}	648.33^{a}	50.57^{ab}	29.27^{a}	57.88^{a}	94.08^{a}	3.21
MOS	1474.83	1680.33^{ab}	205.50^{a}	12.22^{a}	654.00^{a}	50.67^{a}	29.59^{a}	58.39^{a}	92.47^{ab}	3.12
Vitamin E	1484.16	1683.16^{ab}	199.00^{ab}	11.82^{ab}	653.66^{a}	50.53^{ab}	29.49^{a}	58.36^{a}	92.23^{ab}	3.12
OTA	1482.83	1585.33^{c}	102.50^{d}	6.45^{d}	617.00^{b}	49.23^{d}	27.12^{b}	55.08^{b}	85.68^{d}	3.15
OTA+MOS	1480.16	1673.83^{ab}	193.66^{b}	11.57^{b}	646.66^{a}	50.27^{c}	29.02^{a}	57.73^{a}	90.11^{bc}	3.10
OTA+ VE	1486.00	1668.83^{b}	182.83^{c}	10.95^{c}	642.33^{a}	50.49^{b}	28.95^{a}	57.35^{a}	89.18^{c}	3.05
SEM	1.93	3.24	2.91	0.165	3.35	0.120	0.211	0.299	0.729	0.016
P-value.	0.474	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.244

$^{a-d}$Means in the same column with different letters, differ significantly (P≤0.05).

Table (3): Efficacy of Mannan-Oligosaccharides (MOS) and vitamin E for detoxification of Ochratoxin-A contaminated diets on egg quality of local laying hens at the end of the experimental period.

	Egg weight (g)	Yolk weight %	Albumin weight %	Shell weight %	Shape index %	Yolk index %	Shell thickness (mm)	Yolk color score
Control (C)	50.58^{a}	32.68^{b}	55.84	11.46^{ab}	76.43^{a}	46.86^{a}	0.362^{a}	5.60
Bio-Mos	50.32^{a}	32.81^{b}	55.88	11.30^{bc}	76.01^{a}	46.19^{ab}	0.365^{a}	5.63
Vitamin E	50.47^{a}	32.61^{b}	55.83	11.55^{a}	76.80^{a}	46.35^{ab}	0.369^{a}	5.66
OTA	48.68^{c}	33.93^{a}	55.82	11.06^{d}	72.81^{c}	44.58^{c}	0.340^{c}	5.66
OTA+MOS	49.71^{b}	32.^{70b}	56.16	11.13^{cd}	74.24^{b}	45.48^{bc}	0.344^{bc}	5.53
OTA+ Vit.E	48.98^{c}	33.93^{a}	55.59	11.32^{b}	75.46^{ab}	45.81^{abc}	0.352^{ab}	5.60
SEM	0.091	0.089	0.072	0.030	0.241	0.188	0.002	0.054
P-value.	0.0001	0.0001	0.396	0.0001	0.0001	0.009	0.001	0.965

$^{a-d}$Means in the same column with different letters, differ significantly (P≤0.05).

Table (4): Efficacy of Mannan-Oligosaccharides (MOS) and vitamin E for detoxification of Ochratoxin-A contaminated diets on some blood constituents of local laying hens at the end of the experimental period.

Itemies	Control (C)	MOS	Vit. E	OTA	OTA +MOS	OTA+ Vit.E	SEM	P-value.
T. protein (g/dl)	5.40^{ab}	5.63^{a}	5.60^{a}	5.06^{b}	5.36^{ab}	5.36^{ab}	0.057	0.026
Albumin (g/dl)	2.56^{abc}	2.76^{ab}	2.80^{a}	2.60^{abc}	2.50^{c}	2.53^{bc}	0.038	0.083
Globulin (g/dl)	2.83	2.86	2.80	2.46	2.86	2.83	0.056	0.299
Cholesterol (mg/dl)	127.66^{ab}	123.00^{b}	125.00^{b}	140.33^{a}	131.66^{ab}	138.00^{a}	2.04	0.040
Lipids (mg/dl)	14.33	15.00	13.33	17.00	15.00	15.00	0.383	0.119
AST(U/L)	42.66^{c}	40.00^{c}	40.00^{c}	57.00^{a}	47.33^{b}	48.66^{b}	1.500	0.0001
ALT(U/L)	10.66^{c}	11.00^{c}	11.66b^{c}	15.33^{a}	14.66^{ab}	13.66^{abc}	0.549	0.018
ALP(U/L)	24.5^{c}	24.3^{c}	24.7^{c}	28.6^{a}	26.4^{b}	26.7^{b}	1.20	0.0001
Uric acid (mg/dl)	4.60^{bc}	4.43^{c}	4.63^{bc}	5.86^{a}	4.80^{bc}	4.90^{b}	0.120	0.0001
Creatinine (mg/dl)	0.453^{b}	0.450^{b}	0.466^{b}	0.556^{a}	0.486^{b}	0.486^{b}	0.010	0.004
Ca (mg/dl)	11.66^{a}	11.93^{a}	11.83^{a}	10.00^{c}	11.16^{b}	10.93^{b}	0.167	0.0001
P(mg/dl)	4.40^{ab}	4.50^{a}	4.46^{ab}	3.36^{d}	4.23^{b}	3.93^{c}	0.100	0.0001

$^{a-d}$Means in the same row with different letters, differ significantly (P≤0.05).

Table (5): Efficacy of Mannan-Oligosaccharides (MOS) and vitamin E for detoxification of Ochratoxin-A contaminated diets on some organs weight % of local laying hens at the end of the experimental period.

Treatment	Liver %	Spleen %	Ovarian%	Gizzard %	Heart %	Kidney %
Control (C)	2.10^{c}	0.075^{c}	1.133^{a}	1.310	0.350^{c}	0.936^{c}
Bio-Mos	2.09^{c}	0.082^{c}	1.123^{a}	1.131	0.363^{c}	0.976^{c}
Vitamin E	2.04^{c}	0.079^{c}	1.170^{a}	1.293	0.340^{c}	0.973^{c}
OTA	2.70^{a}	0.176^{a}	0.777^{c}	1.513	0.556^{a}	1.150^{a}
OTA+MOS	2.50^{b}	0.143^{b}	0.926^{b}	1.370	0.476^{b}	1.030^{b}
OTA+ Vit. E	2.50^{b}	0.143^{b}	0.890^{bc}	1.346	0.490^{b}	1.040^{b}
SEM	0.706	0.010	0.038	0.031	0.020	0.017
P-value.	0.003	0.0001	0.0001	0.379	0.0001	0.0001

$^{a-d}$Means in the same column with different letters, differ significantly (p≤0.05).

Table (6): Ochratoxin-A residue (ng / g.) in kidney, liver and meat tissues of hens at the end of the experimental period as affected by ochratoxin diets without and with Mannan-Oligosaccharides (MOS) and vitamin E .

Treatment	Kidney	Liver	Meat
Control	0.00*	0.00	0.00
OTA	12.83^{a}	8.50^{a}	2.80^{a}
OTA+MOS	5.23^{b}	3.46^{b}	1.20^{b}
OTA+Vit. E	5.40^{b}	4.00^{b}	1.22^{b}
SEM	1.390	0.868	0.258
P-value	0.004	0.03	0.003

$^{a-b}$Means in the same column with different letters, differ significantly (P≤0.05).
***No detecting of Ochratoxin-A**

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تأثير اضافة المنان أوليجوسكريد وفيتامين هـ على الأداء الانتاجى لسلالة الدجاج المحلى البياض المعرض للتلوث بالأوكراتوكسين أ

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***قسم أنتاج الدواجن – كلية الزراعة جامعة المنصورة**

****معهد بحوث الأنتاج الحيوانى – مركز البحوث الزراعية - وزارة الزراعة**

فى هذه الدراسة تم أستخدام المنان أوليجوسكريد (بيوموس) وفيتامين هـ كأضافات للأعلاف لتقليل التأثيرات الضارة للأوكراتوكسين على أنتاجية الدجاج البياض وبعض مكونات الدم وجودة البيضة . تم توزيع عدد 180 دجاجة أنشاص عمر 30 أسبوعا الى 6 مجاميع (كل مجموعة 30 دجاجة) كالأتى : المعاملة الأولى: عليقة بدون أضافات (كنترول)، المعاملة الثانية: عليقة الكنترول مضاف اليها 1 جرام بيوموس /كجم علف، المعاملة الثالثة : عليقة الكنترول مضافا إليها 150 مليجرام فيتامين هـ ،المعاملة الرابعة : عليقة الكنترول ملوثة بـ 1000 جزء فى البليون /كجم علف ، المعاملة الخامسة : عليقة الكنترول الملوثة مضافا إليها 1 جرام بيوموس /كجم علف ، المعاملة السادسة : عليقة الكنترول الملوثة مضاف اليها 150 مليجرام فيتامين هـ /كجم علف . أوضحت النتائج أن التغذية على الأوكراتوكسين قللت معنوية أنتاج البيض والعلف المستهلك فى حين زاد الوزن النسبى للكلية والكبد بالأضافة الى أرتفاع نسبة النافق وتدهور الكفاءة الأنتاجية وعلى الجانب الأخر أدت أضافة البيوموس وفيتامين هـ الى تقليل التأثيرات الضارة للأوكراتوكسين .

قام بتحكيم البحث

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