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EFFECT OF SOME NATURAL FEED ADDITIVES ON INTERNAL ORGANS AND BIOCHEMICAL ANALYSIS OF BIRDS FED AFLATOXIC DIETS.

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SUMMARY

A total number of eight hundred and ten unsexed Inshas day old chicks were divided into nine experimental groups of 90 chicks each (three replicates per each group) including control and 8 dietary treatments as follows; (T1) Basal diet + AF(1.0mg total AF/kg diet), (T2) Basal diet + AF+ Mannan-oligosaccharide (Bio-mos at1.0g/kg diet), (T3) Basal diet +AF+ Radish extract (RE at 10g/kg diet) , (T4) Basal diet +AF+Hydrated sodium calcium aluminosilicate (HSCAS at 0.5%) , (T5) Basal diet + AF+ Bio-mos + RE , (T6) Basal diet +AF+Bio-mos +HSCAS, (T7) Basal diet +AF+RE + HSCAS , (T8) Basal diet +AF+Bio-mos +RE + HSCAS, and (T9) Basal diet (control).

Characteristics investigated included : Relative weight of internal organs (bursa of Fabricius, the thymus glands, spleen , liver, ovary and testes); serum biochemical estimates (serum AST and ALT activities, total lipids, total protein and albumin); age at sexual maturity ; egg production traits (egg number / hen / first 4 wks of laying , average egg weight, egg mass / hen / first 4 wk of laying).

Results obtained could be summarized as follows;

1. Relative weights of liver and spleen significantly increased. While, bursa of fabricius and thymus gland weight,ovarian relative weight and testes relative weight decreased in AF groups.
2. Chicks fed AF-diet recorded lower values of blood total protein, albumin, total lipids and higher values of aspratate aminotranseferase (AST) and alanine aminotranseferase (ALT) enzymatic activities.
3. Chicks fed-diet without additives recorded the lowest values of (egg production traits) egg number, egg weight and egg mass.
4. The three anti – AF agents studied showed significant beneficial effects in ameliorating the adverse effects resulting from AF administration.

Thus, on the basis of the achieved results in the present study MOS, if available, could be recommended as an efficient protective substance in cases of aflatoxicosis followed by HSCAS or their combination. In locations where radish is available in sufficient amounts, it could be chopped off and introduced fresh to birds as a protective feed additive.

***Keywords**: poultry, aflatoxin, Bio mos, HSCS, radish extract, chemical analysis.*

INTRODUCTION

Aflatoxin (AF) are a group of structurally similar polysubstituted coumarins that are produced by the common molds Aspergillus flavus link and A. parasiticus speare. AFB1 is the most potent of the naturally occurring mycotoxins; it is extremely toxic and powerful carcinogen and, therefore represents a serious risk to health in human populations (International agency for research on cancer, 1993). The effects of AF on broiler and local chicks have been well documented (Smith and Hamillton, 1970; Tunge *et al.*, 1975; Campble *et al.*, 1983; Qota, 1999). Hegazy *et al.*, (1991) reported that 30.7% of 1175 poultry feed samples collected from Egyption farms were contaminated with aflatoxins. The concentration of aflatoxin in the positive samples ranged from 1 to 2000ppb. It has been shown that the inclusion of Hydrated sodium calcium aluminosilicate clay (HSCAS) in the diet of sensitive animals significantly reduces the symptoms of aflatoxicosis (Phillips, 1999), as well as with local chickens and turkey (Qota, 2003). Doyle and Marth (1978) found that lactoperoxidase degraded aflatoxin In Vitro in the presence of NaCl and H2O2 at 28 degrees C. Chistrangade and Mishra (2000) found that AFB1 in groundnut meal was detoxified invitro up to 53% with treatment with horseradish peroxidase enzyme in presence of hydrogen peroxide. The effect of peroxidase on aflatoxin invivo is lack.. On the other hand, Ali (2002) found that addition of radish extract to commercial enzyme improved performance of broiler fed diet contained 30% wheat bran compared to broiler fed enzyme alone and indicated that radish peroxidases may play role in detoxification of phenolic compounds present in wheat bran. The beneficial effects of Saccharomyces cerevisiae(SCE) have been attributed to Mannan oligosaccharide(Bio-Mos) dried from cells wall of SCE. The researchers discovered and extracted MOS also showed considerably high binding ability(80-97%)with Af (Mahesh and Devegowda, 1996) and it has been preferred for detoxification of AF in poultry species. The studies performed by Bio- MOS (0.5 and 1g/kg) with different concentration of Af (0.05 to 1 mg/ kg) in broiler (Raju and Devegowda, 2000, and Santin *et al.*, 2003) showed that Bio-MOS partially and / or completely reversed the adverse effect of AF on performance, biochemistry, hematology and immune response of birds.

Studies have never stopped to evaluate the efficacy of the available detoxification methods and to develop recent innovations in this field to reduce the bioavailability of mycotoxins to poultry and farm animals.

This research was designed to investigate the response of a local Egyptian chicken strain (Inshas) to aflatoxicosis and the effectiveness of using three anti-aflatoxic agents with different mode of actions, when added to AF-contaminated diets singly or in combination. The three agents investigated are Hydrated sodium calcium aluminosilicate (HSAS), Mannan oligosaccharide (Bio-Mos®) and Radish extract.

MATERIALS AND METHODS

The current study was carried out at the Poultry Research Station and the laboratories belonging to the Animal and Poultry Research Institute, Agricultural Research Center, Ministry of Agriculture during the period from 1st of June to the last of November 2005.

A total number of 810 unsexed vaccinated Inshas day-old-chicks were weighed , wing banded and randomly divided into nine experimental groups of 90 chicks each (three replicates/ each group) .The chicks were housed in floor pens with an evenly decreasing day length from 24 hours in the first week to 11 hours at growing period (12-20 wk) then 17 hours at laying period (20-28 wk) . Composition and calculated analysis of the

experimental diets are shown in Table (1). The experimental period was lasted for (4-28 wks) of age. The birds were placed in a room maintained at a constant temperature of 28±3 °C and a relative humidity of 70±3% .Food and water were always available *ad libtum* . At 4^{th},8^{th}, 12^{th} ,16^{th} and 20^{th} wk of age, internal organs (liver, ovary , testes , spleen, bursa of fabricious and thymus gland) were collected carefully, weighed and calculated as a percentage of body weight. In the same time, blood samples were collected for biochemical analysis. The results obtained were statistically analyzed using the general linear model procedure of the SPSS (1988) programme, while difference among treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955). Statements of statistical significance are based on $P<0.05$.

Experimental design:

The experimental design consisted of nine dietary treatments as follows:

Treatment	Type of treatment
T1	Basal diet + AF(1.0mg total AF/kg diet)
T2	Basal diet + AF+ Bio-mos (1.0g/kg diet)
T3	Basal diet +AF+ RE(10g/kg diet)
T4	Basal diet +AF+ HSCAS(0.5%)
T5	Basal diet + AF+ Bio-mos + RE
T6	Basal diet +AF+Bio-mos +HSCAS
T7	Basal diet +AF+RE + HSCAS
T8	Basal diet +AF+Bio-mos +RE + HSCAS
Control	Basal diet (control)

AF (aflatoxin) ; Bio-mos (mannan oligosaccharide) ; RE (radish extract); HSCAS (hydrated sodium calcium aluminosilicate). The chicks were maintained on these treatments from 4 weeks to 28 week of age.

Available culture of Aspergillus parasiticus NRRL 2999 (Poultry Science Dept. Maryland Univ., USA) was used for the production of aflatoxin on rice by the method of Shotwell *et al.* (1966) and as modified by West *et al.* (1973).

The MOS preparation used in these studies was the commercial product Bio-Mos ® produced by Alltech, Nichola Siville, Kentucky ,USA .

Radish extract (RE) was prepared by cutting the root of radish into chips and then processed in a blender , Braun multipress MP32, Germany . The juice was collected into glass cups and then mixed with the experimental diet at the rate of 10g/kg diet.

HSCAS is a commercial product of the Integrated World Enterprises Co. USA.

Table (1):Composition and calculated analysis of experimental diets.

Ingredients %	Starter 4-12 wk	Grower 13-20 wk	Laying 21-28 wk
Yellow corn	62.3	63.7	63.00
Soybean meal (44%)	32.1	17.6	27.1
Wheat bran	---	15.1	---
Dicalcium phosphate	1.9	1.0	1.8
Limestone	1.8	0.74	6.7
Premix*	0.3	0.3	0.3
NaCl	0.3	0.3	0.3
DL-Methionine	0.1	0.07	0.14
Sand	1.2	1.19	0.66
Total	**100**	**100**	**100**
Calculated analysis**			
Crude protein, %	19.66	15.76	17.52
ME (kcal/kg)	2806	2725	27181
Calcium, %	1.20	0.58	3.02
Available phosphorus, %	0.45	0.40	0.40
Methionine ,%	0.44	0.34	0.44
Lysine,%	1.09	0.76	0.95
CF,%	3.71	4.34	3.36

**Vitamin and mineral premix was added as 3 kg/ton of diet and supply 1 kg of diet with: Vitamin A 12000 IU;Vit. D 2200 IU; Vit.E 10 mg; Vit k3 2mg; Vit B1 1mg; Vit B2 5mg; Vit B6 1.5 mg Vit B12 10 Mcg; Nicotinic acid 30 mg; Folic acid 1 mg; Pantothenic acid 10 mg; Biotin 50 Mcg; Choline chloride 500 mg; Copper 10 mg; Iron 30 mg; Manganese 60 mg; Zinc 50mg; Iodine 1mg; Selenium 0.1mg and Cobalt 0.1mg.*

***Calculated according to NRC (1994).*

RESULTS AND DISCUSSION

Relative weight of internal organs:

Results (Table 2) indicated that feeding birds AF- contaminated diet lead to a significant atrophy of bursa of Fabricius and thymus glands throughout the whole experiment. The three anti-aflatoxin agents applied caused variable levels of protection against the toxin. After 4 and 8 wk of treatment, the highest protection rate was obtained with MOS and its combinations, However, the least values were seen in groups received the AF- contaminated diet provided with RE and / or RE+HSCAS. As birds advanced in age and entered the phase of sexual maturation, bursa of Fabricius and thymus relative weight declined following the normal curve of the glands. However, after 12 wk of treatments they generally showed the same responses to AF-treatments applied with some deviations.

The spleen was found to be significantly enlarged in groups fed AF – contaminated diet (Table 3). All the additives studied completely or partially ameliorated this negative effect of AF on the spleen, but in general the best results were observed in groups given MOS alone or together with the other two agents. During the rest of the experiment, the same trends were conserved with some deviations from the values recorded formerly.

Diets contaminated with AF caused a significant atrophy of bursa of Fabricius and thymus glands and enlargement of the spleen . The atrophy of bursa of Fabricius has also

been reported by (Peroz and Rivera, (2003). Reduced thymus relative weight was previously observed by Raju *et al.* (2005). It has been postulated that the loss of weight and regression of bursa of Fabricius and the thymus could be the result of loss of lymphoid tissue and infolding of epithelium, and in the thymus there is a loss of cortex (Riddell, 1987).

The gross enlargement of the spleen may indicate the incidence of destruction of lymphocytes followed by edema within and around follicles and in some cases by associated hemorrhage. In addition an increase in germinal centers and pyroninophilic cells in the spleen is observed. (Riddell, 1987).

The relative weight of the liver in birds fed AF-contaminated diet ranged between 134.2% (after 4wks) and 187.6% (after 16 wks) of control values Table (3). The beneficial effects of the 3 agents studied to overcome the negative effects of AF were clear since the first weeks of the experimental period.

Results obtained herein confirm those reported by Ortatatli and Oguz (2001) and Verma *et al.* (2004) who concluded that AFB1 increased liver relative weight .

The increase in the relative weight of livers induced by AF has been attributed to the increase in accumulation of liver fat contents as a result of interference of aflatoxin with lipid metabolism (Qota, 2003), which produces the characteristic, enlarged, friable, fatty livers associated with aflatoxicosis in broiler (Ibrahim *et al.*, 1998).

Reprductive system:

The testes and the Ovary:

Results (Table 4) indicated that the male gonads nearly followed the same trends obtained with those of the female gonads . It is clearly evident that the testes and the ovary underwent a marked atrophy in response to dietary AF since its relative weight was lower than the normal values of control birds. All the anti-AF agents incorporated completely ameliorated the negative effect of AF on the testes and ovarian relative weight . Generally, the best results were observed in combinations including MOS.

In the present study dietary AF significantly reduced testes relative weight . These results agreed with that reported by (Clarke *et al.*, 1987).

Moreover, Ottinger and Doerr (1980) suggested that AFB1 reduced testes weight through suppressing circular testosterone concentration in Japanese quails.

Ovarian regression due to dietary AF observed in our experiment has been reported by Truckesess *et al.*, (1983). It could be attributed to an alteration of yolk synthesis by liver.

Serum biochemical estimates :

Serum AST and ALT activities :

Results in Table (5) proved that AF significantly increased the activities of both AST and ALT enzymes and that all the dietary additives applied partially or completely ameliorated these increases over the 20 wks of the study. This confirm the previous report of Abou-El-Soud and El-Lakany (2001).However, results reported herein are in disagreement with previous reports who mentioned that the activity of different anabolic and catabolic enzymes as lactate dehydrogenase, alanino aminotransferase (ALT), sorbitol dehydrogenase and glutamic dehydrogenase were decreased in cases of aflatoxicosis (Fernandez *et al.*, 1994).

The effect of increasing AST and ALT by AFB1 may suggest hepatic alteration. However, the values obtained are within the normal ranges of these enzymes in chicken.

From the biological point of view all records obtained were still within the normal range of these enzymes which are known to have a wide range.

Serum total lipids and proteins:

Results obtained (Tables 6 and 7) indicated that due to consuming AF-contaminated diet, serum total lipids content was significantly reduced being more or less equal half the normal values of control birds (48.41-56.1%).

Over all periods of sampling, it has been observed that the three agents applied significantly counteracted the effect of AF as the values of serum total lipids in the seven groups (T2-T8) were insignificantly different from that of control group. Similar results were also reported by Ortatatli and Oguz (2001). This may be due to the interference of AF with lipid metabolism as those reported by Hamilton and Garlich, (1972) who explained that lipid transport is inhibited somehow by aflatoxicosis which could account for the accumulation of lipid in the liver and their decreases in the serum.

Response of serum total protein , albumin and globulin to AF treatment followed the same trend observed with total lipids as it was significantly reduced compared to the control values. All deviations in total protein, albumin and globulin records were corrected through the three agents applied or their combinations. It could be generally stated that the best protective action was observed with MOS and its combinations. Similar results were reported by Eraslan *et al.* (2004)

It has been suggested that AF inhibits DNA-dependent RNA polymerase and causes impairment of nuclear DNA template function, resulting in general inhibition of protein synthesis (Yu, 1977). As a result, hypoproteinaemia is a common effect of aflatoxicosis (Huff *et al.*, 1986). Also, Thaxton *et al.* (1974) suggested that the decrease in albumin and globulin by aflatoxin B1 could be the result of inhibition of synthesis of specific immunoglobulins.

Age at sexual maturity and egg production traits :

Data presented in Table (8) show the effect of the different dietary treatments on age at sexual maturity and egg production traits for the first four weeks of laying.

It is clearly evident that feeding birds the AF-contaminated diet significantly delayed the onset of sexual maturity. Hens of T1 laid their first egg about 17 days later than control hens. Inclusion of MOS, RE, HSCAS or their combinations significantly counteracted the negative effect of AF on age at sexual maturity. The best results were obtained with T4, T6 and T8 followed by T2,T5, T3 and T7, consequently.

Egg number: It is generally observed that rate of laying of this strain is relatively low during the first month. The average record for the control group was less than two eggs/hen/period in spite of the relatively early sexual maturity. Besides, results of egg number in the different groups seemed to be dependent on the results of age at sexual maturity, since the four weeks of recording started the moment of laying the first egg for whole experimental groups together. Results also clearly indicated that dietary AF adversely affected ovarian development and onset of laying. The average egg number / hen for T1 was nearly half that for T9(=54%). The use of MOS(T2) significantly counteracted the adverse effect of eggs produced/ hen. It is interesting to note that the number of eggs/hen in MOS treatment (T2) significantly exceeded that of control although the latter started laying about nine days earlier. In this respect, T4 (HSCAS) and T6 (MOS+HSCAS) showed the highest record of egg number correlated with the youngest age at sexual maturity(nearly the same age of the controls).It was also observed that RE(T3) partially

ameliorated the adverse effect of AF producing about 174% of number recorded for T1. It seems that RE antagonized the action of each of MOS and HSACS .T4 (HSCAS alone) showed the best results, but when was accompanied with RE (T7) the least records were obtained. The same conclusion could be noticed if the records of T6 (MOS+ HSCAS) are compared with T8 those (MOS+ HSCAS+ RE) which significantly differed from each other although both reached maturity almost at the same age . It seems that the records mainly depend on the degree of ovarian maturity and the number of large yellow follicles and the hierarchy of ovarian follicles and not on the age at first ovulation and onset of laying.

Egg weight: results of average egg weight seemed to be negatively correlated to those of egg number being greatest for AF- treatment(T1) and significantly smaller for the other groups. However, average egg weight in case of including MOS (T2, T5, T6, T8) reached about 98% of those in T1.

Egg mass :It is known that egg mass is the product of multiplying egg number by average egg weight. Since variations in average egg weight were not as great as those of egg number, so it was logic to find egg mass results are closely related to the records of egg number. The least values were observed with T7 which was even significantly less than T1 (AF- treatment). The highest values were those of T4, T6 and T8 followed by T2 and T5. Effect of RE (T3) followed the same trend of egg number records.

Egg production was negatively influenced by AFB1 treatments. These results are in general agreement with (Rizzi *et al*., 2003). Garlish *et al* . (1973) suggested that the decrease in egg production observed in cases of aflatoxicosis in laying hens could be probably due to fatty liver syndrome caused by AF. The liver syndrome caused by aflatoxin would appear to be characterized by the following sequence of events. Aflatoxin rapidly causes a liver lesion which is indicated by rapid increase in serum alkaline phosphatase which is an indicator of liver disorders (Karl, 1968). The liver malfunction results are an increase of liver lipid and decrease of plasma lipids and proteins which are produced in the liver and are precursors of the yolk lipids and proteins (McIndoe, 1971). These suppositions and observations were supported by prior findings of greatly impaired lipid transport, there would appear to be preferential channeling of the reduced amounts of yolk precursors to ova already committed to maturation. This could account for the delayed effect of aflatoxin on egg production. This explanation seems plausible in view of the established time period of 7 to 11 days from the time the follicle enters the "rapid growth" stage to ovulation, and the subsequent rate and manner of follicular growth along with the reduction in egg size due to aflatoxin (Hamilton and Garlich, 1972).

Economic efficiency:

Data presented in Table (9) show the effect of the different dietary treatments on economic efficiency. It is clearly evident that feeding birds the AF-supplemented diet dramatically suppressed economic efficiency. Generaly, it could be seen that the three AF-detoxifying agents singly applied significantly ameliorated the deleterious effect of AF on economic efficiency, however their combinations gave worse values compared to the control.

CONCLUSION

The addition of HSCAS, HSCAS+RE, RE+ MOS, HSCAS+MOS or their mixture (HRM) decreased the negative effects of toxicity due to aflatoxicosis in chicken diets for all studied criteria and effectiveness. The combination of HSCAS and MOS was the most successful additive in this study .Further studies must be carried out to study the possibility of using these additives in detoxification of other mycotoxins like ocratoxin, T2-toxin...etc.

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Table (2): Relative weight of bursa of Fabricius and thymus glands at different ages as influenced by dietary AF and the treatment with each of Bio-mos, RE, HSCAS as well as their combinations.

Treatment	Age of birds (wk)							
	Bursa of Fabricius				Thymus glands			
	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)
T1 (AF)	0.36 ± 0.04^{D}	0.10 ± 0.15^{C}	0.09 ± 0.01^{C}	0000	0.46 ± 0.07^{C}	0.17 ± 0.02^{C}	0.22 ± 0.02^{C}	0000
T2 (AF+MOS)	0.85 ± 0.05^{A}	0.25 ± 0.11^{AB}	0.17 ± 0.03^{AB}	0.06 ± 0.05	$0.87\pm0.06_{A}$	0.40 ± 0.04^{AB}	0.43 ± 0.05^{A}	0.14 ± 0.08
T3 (AF+RE)	0.48 ± 0.05^{BC}	0.20 ± 0.05^{ABC}	0.13 ± 0.02^{BC}	0.04 ± 0.02	0.68 ± 0.07^{AB}	0.38 ± 0.07^{AB}	0.28 ± 0.05^{BC}	0.05 ± 0.04
T4 (AF+HSCAS)	0.41 ± 0.07^{C}	0.18 ± 0.11^{ABC}	0.14 ± 0.01^{ABC}	0.03 ± 0.03	0.63 ± 0.06^{BC}	0.33 ± 0.04^{BC}	0.36 ± 0.04^{ABC}	0.04 ± 0.04
T5 (AF+MOS+RE)	0.55 ± 0.06^{BC}	0.22 ± 0.06^{ABC}	0.16 ± 0.01^{AB}	0.04 ± 0.04	0.71 ± 0.06^{AB}	0.39 ± 0.09^{AB}	0.38 ± 0.04^{AB}	0.06 ± 0.06
T6 (AF+MOS+HSCAS)	0.59 ± 0.07^{B}	0.26 ± 0.08^{AB}	0.16 ± 0.03^{AB}	0.05 ± 0.04	0.79 ± 0.10^{AB}	0.40 ± 0.04^{AB}	0.38 ± 0.03^{AB}	0.06 ± 0.04
T7 (AF+RE+HSCAS)	0.39 ± 0.03^{C}	0.14 ± 0.06^{BC}	0.13 ± 0.02^{BC}	0000	0.67 ± 0.03^{AB}	0.32 ± 0.04^{BC}	0.27 ± 0.03^{BC}	0.03 ± 0.03
T8 (AF+MOS+RE+HSCAS)	0.62 ± 0.04^{B}	0.23 ± 0.05^{AB}	0.20 ± 0.02^{A}	0.06 ± 0.04	0.72 ± 0.04^{AB}	0.49 ± 0.04^{AB}	0.37 ± 0.02^{ABC}	0.10 ± 0.10
Control	0.64 ± 0.05^{B}	0.25 ± 0.09^{AB}	0.19 ± 0.03^{AB}	0.11 ± 0.05	0.82 ± 0.08^{AB}	0.52 ± 0.08^{A}	0.50 ± 0.05^{A}	0.10 ± 0.07

A,B,...: Means in the same column followed by different letters are significantly different at $P\leq0.05$.

Table (3): Relative weight of spleen and liver at different ages as influenced by dietary AF and the treatment with each of Biomos, RE, HSCAS as well as their combinations.

Treatment	Age of birds (wk)							
	Spleen				Liver			
	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)	8 (after 4 wk of treatment)	12 (after 8 wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)
T1 (AF)	0.37 ± 0.03^{A}	0.34 ± 0.02^{A}	0.29 ± 0.01^{A}	0.27 ± 0.02^{A}	3.49 ± 0.12^{A}	3.37 ± 0.13^{A}	2.9 ± 0.12^{A}	3.19 ± 0.27^{A}
T2 (AF+MOS)	0.33 ± 0.02^{AB}	0.28 ± 0.02^{AB}	0.20 ± 0.04^{BC}	0.18 ± 0.02^{B}	2.9 ± 0.17^{BC}	2.7 ± 0.29^{BC}	1.8 ± 0.08^{C}	1.8 ± 0.11^{CD}
T3 (AF+RE)	0.30 ± 0.07^{AB}	0.27 ± 0.02^{AB}	0.23 ± 0.01^{AB}	0.21 ± 0.02^{B}	3.1 ± 0.10^{AB}	3.0 ± 0.14^{AB}	2.3 ± 0.13^{B}	2.4 ± 0.27^{B}
T4 (AF+HSCAS)	0.28 ± 0.03^{AB}	0.25 ± 0.01^{AB}	0.20 ± 0.02^{BC}	0.18 ± 0.02^{B}	2.95 ± 0.11^{BC}	3.0 ± 0.17^{AB}	2.1 ± 0.13^{BC}	2.1 ± 0.14^{BCD}
T5 (AF+MOS+RE)	0.25 ± 0.02^{AB}	0.28 ± 0.03^{AB}	0.19 ± 0.01^{BC}	0.16 ± 0.02^{B}	2.6 ± 0.14^{C}	2.5 ± 0.14^{BC}	2.0 ± 0.11^{BC}	2.0 ± 0.05^{BCD}
T6 (AF+MOS+HSCAS)	0.22 ± 0.05^{B}	0.30 ± 0.04^{AB}	0.19 ± 0.02^{BC}	0.20 ± 0.02^{B}	2.9 ± 0.14^{BC}	2.6 ± 0.21^{BC}	1.8 ± 0.21^{C}	1.7 ± 0.22^{D}
T7 (AF+RE+HSCAS)	0.26 ± 0.03^{AB}	0.28 ± 0.02^{B}	0.15 ± 0.02^{C}	0.21 ± 0.02^{B}	3.0 ± 0.06^{BC}	3.0 ± 0.15^{AB}	2.2 ± 0.17^{BC}	2.3 ± 0.17^{BC}
T8 (AF+MOS+RE+HSCAS)	0.23 ± 0.03^{B}	0.29 ± 0.02^{AB}	0.19 ± 0.03^{BC}	0.19 ± 0.01^{B}	2.7 ± 0.18^{C}	2.9 ± 0.17^{AB}	1.8 ± 0.08^{BC}	1.7 ± 0.09^{D}
Control	0.29 ± 0.03^{AB}	0.23 ± 0.02^{AB}	0.22 ± 0.02^{BC}	0.18 ± 0.01^{B}	2.6 ± 0.14^{C}	2.3 ± 0.22^{C}	1.9 ± 0.16^{BC}	1.7 ± 0.017^{D}

A,B,...: Means in the same column followed by different letters are significantly different at $P\leq0.05$.

Table (4): Relative weight of ovary and testes at different age as influenced by dietary AF and the treatment with each of Bio-mos, RE, HSCAS as well as their combinations.

Treatment	Age of birds (wk)					
	Ovary			Testes		
	12 (after 8wk of treatment)	16 (after 12wk of treatment)	20 (after 16wk of treatment)	12 (after 8wk of treatment)	16 (after 12wk of treatment)	20 (after 16wk of treatment)
T1 (AF)	0.05 ± 0.02^{B}	0.001 ± 0.01^{D}	0.08 ± 0.03^{C}	0.10 ± 0.03^{C}	0.09 ± 0.07^{D}	0.47 ± 0.24^{C}
T2 (AF+MOS)	0.17 ± 0.04^{AB}	0.11 ± 0.01^{AB}	1.48 ± 0.25^{AB}	0.67 ± 0.06^{AB}	0.80 ± 0.24^{ABC}	1.99 ± 0.27^{AB}
T3 (AF+RE)	0.04 ± 0.01^{B}	0.04 ± 0.01^{CD}	1.06 ± 0.50^{ABC}	0.31 ± 0.17^{BC}	$0.44\pm0.18^{BC}{}_{D}$	097 ± 0.31^{BC}
T4 (AF+HSCAS)	0.13 ± 0.11^{AB}	0.11 ± 0.03^{AB}	1.69 ± 0.19^{AB}	0.39 ± 0.35^{BC}	0.80 ± 0.18^{ABC}	1.19 ± 0.34^{ABC}
T5 (AF+MOS+RE)	0.27 ± 0.05^{A}	0.05 ± 0.01^{BCD}	1.83 ± 0.52^{AB}	0.43 ± 0.11^{BC}	0.94 ± 0.12^{AB}	2.15 ± 0.50^{A}
T6 (AF+MOS+HSCAS)	0.22 ± 0.05^{A}	0.14 ± 0.03^{A}	2.13 ± 0.31^{A}	1.02 ± 0.02^{A}	0.83 ± 0.05^{AB}	1.30 ± 0.19^{ABC}
T7 (AF+RE+HSCAS)	0.03 ± 0.01^{B}	0.03 ± 0.01^{D}	0.90 ± 0.39^{BC}	0.28 ± 0.21^{BC}	0.25 ± 0.16^{CD}	1.07 ± 0.26^{ABC}
T8 (AF+MOS+RE+HSCAS)	0.17 ± 0.03^{AB}	0.09 ± 0.03^{ABC}	1.22 ± 0.21^{AB}	0.47 ± 0.07^{BC}	0.86 ± 0.30^{AB}	1.81 ± 0.46^{AB}
Control	0.28 ± 0.03^{A}	0.12 ± 0.01^{A}	1.86 ± 0.30^{AB}	1.12 ± 0.11^{A}	1.16 ± 0.12^{A}	1.59 ± 0.14^{AB}

A,B,...: Means in the same column followed by different letters are significantly different at $P\leq0.05$.

Table (5): Serum AST and ALT (IU/L) activity at different age as influenced by dietary AF and the treatment with each of Biomos, RE, HSCAS as well as their combinations.

Treatment	Age of birds (wk)							
	AST (IU/L)				ALT (IU/L)			
	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)
T1 (AF)	133.6±0.38^{A}	133.9±0.92^{A}	134.1±0.78^{A}	135.2±0.54^{A}	11.3±0.42^{A}	10.97±0.14^{A}	12.2±0.61^{A}	12.3±0.57^{A}
T2 (AF+MOS)	114.2±1.33^{FG}	121.9±1.25^{CD}	120.3±0.32^{E}	120.5±4.07^{D}	8.7±0.25^{C}	9.06±0.09^{CD}	10.2±0.15^{BC}	10.3±0.03^{CD}
T3 (AF+RE)	125.7±0.43^{C}	126.4±0.76^{B}	127.7±0.51^{B}	129.5±0.34^{B}	10.1±0.11^{C}	10.73±0.41^{A}	10.7±0.21^{BC}	10.9±0.16^{BC}
T4 (AF+HSCAS)	119.8±0.40^{D}	125.8±0.64^{B}	124.7±0.71^{CD}	128.3±0.91^{B}	8.9±0.13^{B}	9.61±0.15^{BC}	10.7±0.13^{BC}	10.6±0.15^{BCD}
T5 (AF+MOS+RE)	116.4±0.67^{EF}	120.3±0.51^{D}	123.3±0.54^{D}	123.4±0.49^{CD}	8.9±0.19^{C}	8.85±0.38^{CD}	10.6±0.15^{BC}	10.2±0.08^{CD}
T6 (AF+MOS+HSCAS)	113.3±1.59^{G}	121.9±0.85^{D}	123.2±0.55^{D}	123.2±1.08^{CD}	8.9±0.13^{C}	8.64±0.20^{D}	10.7±0.17^{BC}	9.8±0.40^{D}
T7 (AF+RE+HSCAS)	128.9±0.48^{B}	128.0±1.13^{B}	126.1±0.25^{C}	129.9±0.83^{B}	10.5±0.40^{AB}	10.22±0.49^{AB}	11.0±0.98^{B}	11.2±0.21^{B}
T8 (AF+MOS+RE+HSCAS)	117.5±0.81^{DE}	123.2±0.50^{C}	123.3±0.54^{D}	125.7±0.57^{BC}	9.1±0.43^{C}	8.99±0.20^{CD}	10.6±0.22^{BC}	10.7±0.16^{BCD}
Control	110.5±083^{H}	119.5±0.64^{D}	119.9±0.08^{E}	120.9±0.87^{CD}	8.6±0.18^{C}	8.64±0.23^{D}	9.9±0.39^{BC}	9.8±0.37^{D}

A,B,...: Means in the same column followed by different letters are significantly different at P≤0.05.

Table (6): Serum total lipids and total protein, g/dl as influenced by dietary AF and the treatment with each of Bio-mos, RE, HSCAS as well as their combinations.

Treatment	Age of birds (wk)							
	Total lipids (g/dl)				Total protein (g/dl)			
	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)
T1 (AF)	6.7±1.02^{C}	6.2±0.97^{B}	7.0±0.19^{C}	8.2±1.35^{E}	2.5±0.16^{E}	2.8±0.25^{E}	2.5±0.16^{C}	2.7±0.02^{C}
T2 (AF+MOS)	11.2±0.89^{AB}	11.8±1.35^{A}	12.2±0.29^{AB}	14.7±2.52^{ABC}	5.3±0.12^{B}	5.9±0.08^{AB}	5.3±0.08^{A}	5.5±0.15^{A}
T3 (AF+RE)	9.1±2.76^{ABC}	8.6±1.83^{AB}	9.9±0.62^{B}	10.7±1.00^{D}	3.7±0.16^{D}	4.71±0.23^{C}	4.1±0.12^{B}	4.5±0.29^{B}
T4 (AF+HSCAS)	8.2±1.06^{BC}	9.9±1.55^{AB}	10.0±0.19^{B}	12.2±0.55^{CD}	4.4±0.20^{C}	5.6±0.15^{B}	5.3±0.08^{A}	5.2±0.27^{A}
T5 (AF+MOS+RE)	12.3±1.17^{AB}	12.9±0.95^{A}	13.1±0.80^{A}	13.0±0.67^{ABC}	5.3±0.20^{B}	5.8±0.12^{AB}	5.6±0.20^{A}	5.2±0.16^{A}
T6 (AF+MOS+HSCAS)	13.0±0.96^{A}	11.8±1.44^{A}	12.8±0.73^{A}	13.00±0.69^{BCD}	5.7±0.12^{AB}	5.9±0.08^{AB}	5.6±0.25^{A}	5.5±0.33^{A}
T7 (AF+RE+HSCAS)	6.9±0.80^{C}	8.6±2.25^{AB}	10.8±1.07^{AB}	9.7±0.19^{D}	3.3±0.08^{D}	4.0±0.13^{D}	3.8±0.29^{B}	4.0±0.04^{B}
T8 (AF+MOS+RE+HSCAS)	11.3±0.96^{AB}	11.7±1.45^{A}	11.9±0.95^{AB}	16.1±0.29^{AB}	5.6±0.19^{AB}	5.9±0.08^{AB}	5.6±0.19^{A}	5.3±0.08^{A}
Control	11.9±0.4^{AB}	12.6±0.59^{A}	12.6±1.13^{A}	17.0±1.17^{A}	5.8±0.08^{A}	6.1±0.04^{A}	5.6±0.12^{A}	5.7±0.11^{A}

A,B,...: Means in the same column followed by different letters are significantly different at P≤0.05.

Table (7): Serum albumin and globulin, g/dl as influenced by dietary AF and the treatment with each of Bio-mos, RE, HSCAS as well as their combinations.

Treatment	Age of birds (wk)							
	Albumin (g/dl)				Globulin (g/dl)			
	8(after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)	8 (after 4 wk of treatment)	12 (after 8wk of treatment)	16 (after 12 wk of treatment)	20 (after 16 wk of treatment)
T1 (AF)	1.3 ± 0.18^{E}	1.6±0.18E	1.8 ± 0.07^{D}	1.3 ± 0.01^{E}	1.2 ± 0.25^{D}	1.2 ± 0.22^{D}	0.7 ± 0.23^{C}	0.7 ± 0.23^{C}
T2 (AF+MOS)	1.90 ± 0.02^{ABC}	2.3 ± 0.09^{AB}	2.4 ± 0.09^{AB}	2.1 ± 0.02^{BC}	3.4 ± 0.13^{A}	3.6 ± 0.13^{A}	2.9 ± 0.10^{A}	2.9 ± 0.10^{A}
T3 (AF+RE)	1.7 ± 0.04^{CD}	1.8 ± 0.06^{C}	1.8 ± 0.04^{D}	1.9 ± 0.04^{CD}	2.0 ± 0.16^{C}	2.9 ± 0.23^{B}	2.2 ± 0.08^{B}	2.2 ± 0.08^{B}
T4 (AF+HSCAS)	1.8 ± 0.06^{BCD}	2.1 ± 0.02^{BC}	2.2 ± 0.05^{BC}	2.2 ± 0.07^{AB}	2.6 ± 0.23^{B}	3.5 ± 0.17^{A}	3.1 ± 0.13^{A}	3.1 ± 0.13^{A}
T5 (AF+MOS+RE)	2.0 ± 0.03^{AB}	2.3 ± 0.03^{A}	2.3 ± 0.06^{ABC}	2.2 ± 0.13^{AB}	3.4 ± 0.21^{A}	3.4 ± 0.14^{A}	3.3 ± 0.22^{A}	3.3 ± 0.22^{A}
T6 (AF+MOS+HSCAS)	1.9 ± 0.12^{ABC}	2.4 ± 0.03^{A}	2.2 ± 0.08^{BC}	2.2 ± 0.12^{AB}	3.80 ± 0.03^{A}	3.5 ± 0.07^{A}	3.3 ± 0.32^{A}	3.3 ± 0.32^{A}
T7 (AF+RE+HSCAS)	1.6 ± 0.03^{D}	1.9 ± 0.09^{C}	1.8 ± 0.07^{D}	1.8 ± 0.09^{D}	1.7 ± 0.11^{C}	2.5 ± 0.22^{C}	2.0 ± 0.22^{B}	2.0 ± 0.22^{B}
T8 (AF+MOS+RE+HSCAS)	2.0 ± 0.05^{AB}	2.2 ± 0.06^{AB}	2.1 ± 0.1^{C}	2.2 ± 0.07^{BC}	3.5 ± 0.15^{A}	3.7 ± 0.02^{A}	3.4 ± 0.11^{A}	3.4 ± 0.11^{A}
Control	2.1 ± 0.05^{A}	2.42 ± 0.06^{A}	2.5 ± 0.02^{A}	2.4 ± 0.03^{A}	3.7 ± 0.13^{A}	3.68 ± 0.02^{A}	3.2 ± 0.13^{A}	3.2 ± 0.13^{A}

A,B,.. Means in the same column followed by different letters are significantly different at P≤0.05.

Table (8): Effect of mannanoligosaccharide (MOS), radish extract (RE) and hydrated sodium calcium aluminosilicat (HACAS) and their combinations on age at sexual maturity (average at 1st egg) and egg production of birds fed diets containing 1mg total aflatoxin (AF)/ kg diet.

Treatment	Age at sexual maturity	Egg production traits during the first 4 wks of laying		
		No.of egg/hen	Av.egg wt(g)	Eggs(g/hen)
T1 (AF)	165.0±015^{A}	0.92±0.01^{F}	34.1±0.09^{A}	31.4±0.45^{F}
T2 (AF+MOS)	157.0±0.30^{C}	2.10±0.08^{C}	33.4±0.04^{B}	68.5±2.60^{C}
T3 (AF+RE)	156.0±0.15^{D}	1.60±0.06^{E}	32.8±0.26^{C}	51.2±1.50^{E}
T4 (AF+HSCAS)	147.9±0.28^{E}	3.10±0.08^{A}	31.6±0.25^{D}	97.3±3.40^{A}
T5 (AF+MOS+RE)	157.0±0.15^{C}	1.80±0.03^{D}	33.4±0.02^{B}	60.8±0.93^{D}
T6 (AF+MOS+HSCAS)	148.0±0.29^{E}	3.00±0.08^{A}	33.3±0.04^{B}	98.9±2.60^{A}
T7 (AF+RE+HSCAS)	160.3±0.15^{B}	0.80±0.02^{F}	31.0±0.19^{E}	25.4±0.62^{G}
T8 (AF+MOS+RE+HSCAS)	147.9±0.30^{E}	2.60±0.09^{B}	33.5±0.03^{B}	85.4±2.90^{B}
Control	148.2±0.30^{E}	1.70±0.06^{E}	32.7±0.18^{C}	55.3±2.20^{DE}

A,B,..: Means in the same column followed by different letters are significantly different at p≤0.05.

Table (9): Economic efficiency as influenced by dietary AF and the treatment with each of Bio-mos, RE, FSCAS as well as their combinations.

Treatment	Items					
	Total feed consumption (g/bird/ period)	Cost of feeding/hen /period LE (a)	total body weight gain (g/bird/ period)	No.of egg/ hen/ period	Selling income L.E (b)	Economic efficiency a-b *100 a
T1 (AF)	5024	6.28	834.4	0.92	7.99	27.23
T2 (AF+MOS)	5723	10.87	1616.6	2.10	15.58	43.33
T3 (AF+RE)	5470	7.93	1374.0	1.60	13.19	66.33
T4 (AF+HSCAS)	5467	9.57	1417.5	3.10	14.04	46.70
T5 (AF+MOS+RE)	5581	11.72	1510.5	1.80	14.51	23.81
T6 (AF+MOS+HSCAS)	5654	13.57	1408.6	3.00	13.93	2.65
T7 (AF+RE+HSCAS)	5589	10.90	1250.6	0.80	11.81	8.35
T8 AF+MOS+RE+HSCAS)	6019	15.65	1484.1	2.60	15.43	1.40
Control	6285	7.86	1664.2	1.70	15.90	102.29

A,B,..: Means in the same column followed by different letters are significantly different at P≤0.05.

تأثير بعض الإضافات الغذائية الطبيعية على بعض الأعضاء الداخلية وبعض التحليلات الكيميائية للدجاج النامي المغذى على علائق تحتوى على سموم فطرية

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تم استخدام عدد ٨١٠ كتكوت عمر يوم من سلالة أنشاص قسمت الى ٩ معاملات تجريبية فى كل منها ٩٠ كتكوت و كل معاملة مقسمة الى ٣ مكررات لدراسة تاثير بعض الاضافات الغذائية الطبيعية على بعض الاعضاء الداخلية و مكونات الدم للدجاج النامى المغذى على علائق تحتوى على سموم فطرية. الاضافاتالغذئية التي شملتها الدراسة هي :

أ- سليكات الصوديوم والكالسيوم والألمونيوم (HSCAS) كمادة إدمصاص ثبت فاعليتها الكبيرة مع السموم الفطرية .

ب- مانان عديد التسكر (Bio – Mos $^{(R)}$) كمادة ذات اصل بيولوجي

جـ- عصارة درنات الفجل (RE) كمادة مضادة للأكسدة غنية فى محتواها من إنزيم البيروكسيديز.

وقد اشتملت التجربة على(٩) معاملات غذائية هي كما يلي:

المعاملة الأولى: أعطيت العليقة الأساسية + الأفلاتوكسين (١.٠ مللجم/كجم عليقه).

المعاملة الثانية: أعطيت العليقة الأساسية + الأفلاتوكسين + Bio-Mos (١.٠جم/كجم عليقه).

المعاملة الثالثة: أعطيت العليقة الأساسية + الأفلاتوكسين + RE (١٠.٠ جم/كجم عليقه)

المعاملة الرابعة : أعطيت العليقة الأساسية + الأفلاتوكسين + HSCAS (٠.٥٪)

المعاملة الخامسة: أعطيت العليقة الأساسية + الأفلاتوكسين + RE + Bio –Mos.

المعاملة السادسة : أعطيت العليقة الأساسية + الأفلاتوكسين + HSCAS.

المعاملة السابعة : أعطيت العليقة الأساسية + الأفلاتوكسين + HSCAS + RE.

المعاملة الثامنة : أعطيت العليقة الأساسية + الأفلاتوكسين + HSCAS +RE + Bio-Mos

المعاملة التاسعة : وهى المجموعة المقارنة حيث أعطيت العليقة الأساسية فقط دون أى إضافات .

وقد تم خلال التجربة دراسة الصفات التالية : الوزن النسبي لبعض الأعضاء الداخلية (كيس فابر يشيوس ، غدة الثيموس ، الطحال ، الكبد ، ، المبيض ، الخصية ، بعض التقديرات البيوكيمانية في السيرم مثل نشاط إنزيمات AST ، ALT ، الليبيدات الكلية ، البروتين كلى ، اللبيومين ، الجلوبيولينن وكذا عمر النضج الجنسى وأنتاج البيض خلال شهر.

ويمكن تلخيص أهم النتائج المتحصل عليها في النقاط التالية :

١. **زادت الأوزان النسبية لكل من الكبد والطحال بنسبة معنوية فى المجاميع التى تناولت علائق ملوثة بالأفلاتوكسين بينما قلت الأوزان النسبية لكل من البرسا و غدة التيموسية والمبيض والخصيتين.**

٢. **سجلت الكتاكيت التى تناولت علائق ملوثة بالأفلاتوكسين قيم منخفضة لكل من البرتينات الكلية والليبيدات الكليةو الألبيومين والجلوبيولين فى سيرم الدم بينما سجلت ارتفاع فى قيم أنزيمات وظائف الكبد.**

٣. **سجلت الكتاكيت التى تغذت على علائق ملوثة بالأفلاتوكسين بدون اضافات اقل قيم لأنتاج البيض.**

٤. **أدى استخدام المواد الثلاثة المدروسة معنويا إلى تخفيف هذه الآثار السلبية لدرجة كبيرة.**

و بناءاً على النتائج التى حصلت اليها هذه الدراسة يمكن التوصية باستخدام Bio-Mos **إذا ما كان متاحاً كمادة وقائية و فعالة فى حالات تلوث العلائق بالأفلاتوكسينات ويليه فى الفاعلية** HSCAS **زهذا ولم يكن هناك ميزة إضافية لإستخدام المركبين معاً فى معظم الصفات و ذلك عند الأخذ فى الإعتبار الجانب الإقتصادى كذلك اوصى الباحث بأنة فى المناطق التى يتوافر بها الفجل بكميات كبيرة وبتكلفة محدودة يمكن تقطيع وفرم جزورة وتقديمه طازجا للطيور كإضافة غذائية وقائية لما يحتوية من إنزيمات متعدده الفوائد.**