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NOVEL METHODS OF DETOXIFICATION OF AFLATOXIN B1 IN CONTAMINATED LOCAL LAYING HEN DIETS

By

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Abstract: *A total number of 224 hens plus 49 cocks from El-Salam strain of 30 weeks old were divided into 7 groups with 4 replicates each (8 hens + 1 cock). The remaining 21 cocks were also divided into 7 groups of 3 cocks each and housed separately for semen evaluation . Hens of treatment 1 received a basal layer diet (as a control diet). Hens of treatment 2 received the basal diet plus 1000 ppb aflatoxin B_1 (AF-diet). Hens of treatments 3,4,5,6 and 7 were received the AF-diet supplemented with 0.5% hydrated sodium calcium alumino silicate (HSCAS), 0.5% HSCAS+1% radish extract (RE), 1% RE+ 1% sodium sulphate (SS), 0.5% HSCAS+1% SS or 2.5%mixture of HRS (0.5% HSCAS +1%RE+1%SS), respectively. The experimental groups were fed on the experimental diets from 30 to 34 weeks (treatment period), then they were fed the control diet from 34 to 38 weeks (recovery period).Main results obtained can be summarized as follow :*

1- *Hens fed AF-diet without additives recorded the lowest values of body weight gain, egg number, egg weight, egg mass, feed intake and the worst feed conversion. Also, AF-diet alter egg quality parameters.*

2- *Relative weight of liver, spleen, and heart significantly increased while ovarian relative weight decreased in groups fed AF-diet.*

3- *Liver lipid and serum alkaline phosphatase significantly increased while yolk cholesterol and serum calcium, phosphorus and triglycrides decreased in hens fed AF-diet. Also, AF-diet decreased semen volume, concentration and mass motility while sperm abnormality and percentage of dead sperms increased.*

4- *AF-diet decreased fertility, hatchability of eggs, chick weight at hatch and increasing chick abnormality. Also, hens fed AF-diet recorded the highest value of AFB_1 residue in egg yolk.*

5- *All feed additive used in this study decreased the negative effects of toxicity due to aflatoxicosis for all studied criteria. The combination of HSCAS and SS was the most successful additive in this study, compared to the others.*

INTRODUCTION

Aflatoxins (AF) are a group of closely related, extremely toxic chemicals produced by *Aspergillus flavus* and *Aspergillus parasiticus* and can occur as natural contaminants of poultry foods (Oguz *et al.*,2000). The incidence of AF contamination in agricultural commodities depends on several factors, such as the type and quality, growing regions, and seasonal conditions under which the crops are grown, harvested, and stored. Among birds, aflatoxicosis may affect turkeys, quail, ducklings, goslings and chickens (Arafa *et al.* 1981). Aflatoxicosis in chickens is characterized by mortality, listlessness, anorexia, decreased growth rates, negative feed conversions, fatty liver, decreased egg production, poor pigmentation, and increased susceptibility to other diseases (Arafa *et al*., 1981 Doerr *et al.*,1983).Also, maternally transferred AFB_1 has been reported to affect embryo viability and hatchability (Qureshi *et al.* 1998). For these reasons, intensive research has been focused on the addition to feedstuffs the nonnutritive sorbents, such as bentonite or hydrated sodium aluminosilicate (Phillips *et al.,* 1988;Oguz and Kurtoglu, 2000; Rosa et al.,2000). Also, dietary alterations have received considerable attention, such as increased dietary concentration of protein (Smith *et al.,* 1971), supplemental dietary vegetable oil (Raju *et al* 2005), alfa-tocopherol and ascorbic acid (Hoehler and Marquardt, 1996), pyridoxine, folic acid, riboflavin , and choline (Johri *et al.,* 1990) and selenium (Burguera *et al.* 1983). Plant peroxidases such as lignin peroxidase from white rot fungi, *Phanerochaete chrysosporium*, has been reported to oxidize a wide range of toxins, including polycyclic aromatics and polychlorinated phenols (Geargiou, 1987). Das and Mishra (2000) indicated that horseradish peroxidase can successfully detoxify authentic aflatoxin B_1 in a liquid culture up to 60%. Recently, Qota *et al*. (2005) found that addition of 1% radish extract (RE) to AF-diet gave protection by 27.8% compared to chicks fed AF-diet alone. Aflatoxin B1 is biotransformed in the liver by monoxygenases and then transformed by cytochrome P450 into aflatoxin 8,9 epoxide (Emerole *et al.*, 1979), a highly

active electrophilic compound that is inactivated by conjugation with glutathione and excreted through urine and bile (Essigmann *et al*.,1982).Cysteine is the rate-limiting amino acid for reduced glutatione (GSH) biosynthesis, which is catalyzed by gama- glutamylcysteine synthesis (Meister, 1984). Deficiency of dietary liptropic factors (choline and methionine) may increase or decrease the resistance of rats to the acute toxicity and hepatocarcinogenic effects of aflatoxin (Campbell *et al.,* 1978). Veltmann *et al*.(1983) found with chicks fed 1.25 PPM AFB_1 that the diets with 66%,100% and 134% of the NRC requirement for sulphur amino acids resulted in body weights that were 82%,87% and 96% of the control group fed no mycotoxin. Earlier, Miller (1974) suggested that the sulphate may be a partial substitute for methionine when the latter was present at inadequate dietary levels. Beside that sulphate can spare action of the sulphur amino acids, the sulphate may be conjugates with AFB_1. Wei and Hsieh (1985) found with rat that the AFB_1 conjugate with glucuronide and sulphate and these aflatoxin conjugates were not mutagenic to *Salmonella typhimurium* strain. With chicken there were no evidence in the literature that AFB_1 conjugate with sulphate but Chipley *et al.* (1974) stated that conjugation might be accomplished by the combination of the AFB_1 metabolite to a variety of compounds including amino acid, glucuronic acid, active sulphate and acetate. Bartelt and Kirinya (1976) found that liver slices from geese, ducks and chickens contained low uridine diphosphate-glucuronylransferase and high sulphate conjugation enzyme activities. Qota *et al.* (2005) found that the addition of 1 % sodium sulphate (SS) to AF-diet (500 ppb) increased BW by 13.33% compared with chicks fed AF-diet alone and gave protection by 40.6%.

The aim of this study that evaluate the efficacy of commercial products of hydrated sodium calcium aluminosilicate (HSCAS), HSCAS + RE, SS+RE, HSCAS+SS, or HSCAS+RE+SS on alleviating the toxic effects of aflatoxin in contaminated laying hen diets.

MATERIALS AND METHODS

This study was conducted at Sakha Animal Production Research station, Animal Production Research Institute, Agricultural Research Center. A total number of 224 hens plus 49 cocks from El-Salam strain of 30 weeks old were divided into 7 groups of 4 replicates each (8 hens+ 1 cock) and housed in floor pens (280 cm long x 220 cm wide). The remaining 21 cocks were also divided into 7 groups of 3 cocks each and

housed separately for semen evaluation. Seven experimental diets were prepared from a hen basal diet (Table1). Laying hens were allotted on the following treatments:

1- The basal diet without any supplement serves as a control diet.

2- Basal diet supplemented with aflatoxin B_1 (AFB_1) with rate 1000 ppb (AF-diet).

3- AF-diet +0.5%HSCAS.

4- AF-diet+0.5%HSCAS+1%RE.

5- AF-diet+1.0%RE+1% SS.

6- AF-diet+ 0.5% HSCAS+1%SS.

7- AF-diet+2.5% HRS (0.5% HSCAS +1%RE+1%SS),.

Experimental diets were fed for 4 weeks (treatment period) followed by another 4 weeks as a recovery period during which birds were offered the control diet. Characteristics investigated included body weight (BW), weight gain (WG) egg number (EN), egg weight (EW), egg mass (EM), AFB_1 residue in yolk egg, some reproductive performance and semen characteristics. At the 4^{th} and 8^{th} weeks of the experiment a total number of 35 egg yolks (5 from each treatment) were taken to determine AFB_1 residue in egg yolk according to A.O.A.C (2000). At the same time (4^{th} and 8^{th} week) a total number of 280 eggs (40 egg from each treatment) were taken to determine egg quality. After measuring the egg quality, yolk samples from each treatment were separated from the broken eggs, and extracted to determine cholesterol according to Folch *et al.* (1957). During the 4^{th} and 8^{th} week of the experiment, a total number of 1120 eggs (40 egg from each replicate) were incubated to evaluate the reproductive traits.

Three cocks from each treatment were used for collecting semen samples at the 4^{th} and 8^{th} week of the experiment. Sperm concentration, mass motility, sperm abnormality and dead were measured according to Kamar (1959 and 1960). Aflatoxin was produced via fermentation of rice by *Aspergillus parasiticus* NRRL 2999 as described by Shotwell *et al.*, (1966) and modified by west *et al.*, (1973). Fermented rice was autoclaved, dried and ground to fine powder which was analyzed spectrophotometrically for its aflatoxins content by method of Nabney and Nesbitt (1965) which modified by Wiseman *et al.*, (1967). Aflatoxins in the rice powder were

extracted by chloroform, then incorporated into the basal diet and confirmed by HPLC to provide the desired level 1000 ppb aflatoxin B_1 . Hydrated sodium calcium aluminosilicate clay (HSCAS) is a chemical compound that contains Silicon oxide (64.7%), aluminum oxide (15.5%), oxides of iron, magnesium, calcium, sodium, potassium (8.9%) and moisture (10.9%). Anhydrous Sodium sulphate (SS) was supplied by the Egyptian Salt and Mineral Company. Radish extract (RE) was prepared by cutting the root of radish into chips and put the chips Into carrot press and the juice was collected into glass cups and then mixed with diet. All feed additives were added on the expense of sand. At the end of treatment period and recovery period, 3 hens from each treatment were randomly selected, weighed and sacrificed to obtain relative organs weight and tissues analysis. Meat protein was analyzed according to official methods of A.O.A.C (1990). Liver lipids of fresh tissues were estimated by method of Folch *et al.,* (1957). Blood constituents including ca, p, triglycerides and alkaline phosphatase were determined by colorimetric methods using commercial kits. Moreover, a sample of radish extract was taken to measure peroxidase activity according to method of Amako *et al.*, (1994). The peroxidase activity of radish extract is expressed in a unit / milligram protein. Peroxidase activity = 9.73 U/mg protein. Data were statistically analyzed using the General Linear Model for analysis of variance (SAS, 1990). Duncan's multiple range test (Duncan 1955) was used to test the significance ($P<0.05$) of differences among means.

RESULTS AND DISCUSSION

Body weight:

The effect of feed additives on alleviation of the toxic severity of aflatoxin diets on body weight (BW) and weight gain (WG) during treatment and recovery periods are shown in Table (2). The results showed that the group of hens fed AF-diet recorded significantly the lowest BW values during treatment and recovery periods compared with the control and other treatments. The addition of HSCAS alone or in combination with RE or SS increased BW and WG during treatment period compared with hens fed AF-diet alone. Also, the combination of SS and RE or mixture HRS to some extent succeeded in alleviation the toxic effect of aflatoxin diets on BW and WG during treatment period.

However, Qota *et al.* (2005) found with growing local chicks fed 500 ppb AFB_1 that HSCAS, RE, SS or mixture of them gave protection of BW by 51.4, 27.8, 40.6 and 44.2% at 6 weeks. During recovery period, hens fed AF-diet elevate a compensatory growth and hens fed mixture HRS reached to weight of the control group (1694 g).

Laying hen performance:

As shown in Table (3) there were significant differences between treatments in EN,EW and EM. The hen fed AF-diet recorded EN, EW and EM values which were lower by 27.67,4.85 and 31.15 %,respectively compared with those fed the control diet. The addition of HSCAS to

AF-diet significantly increased the EN, EW and EM by 20.7, 1.34 and 22.34%, respectively compared to hens fed AF-diet alone. The addition of RE to HSCAS increased numerically but not significant EN, EW and EM compared to hens fed AF-diet + HSCAS alone. The RE contain factors other than peroxidase that may alter the toxicity of AFB_1. Rojanapo and Tepsuwan (1993) found that hexane and chloroform extracts of fresh Chinese radish inhibit mutagenicities of aflatoxin B_1. Also, radish contains significant amount of anthocyanins which have radical scavenging (Matsufuji *et al* 2003). The role of antioxidants in decreasing the severity of AFB_1 have been studied by many authors, Fukayama *et al.* (1984) found with rats that exposure to BHT may protect the lacting animal from the carcinogenic effect of AFB_1. In this respect, Nahm (1995) found that a combination of HSCAS and antioxidants gave effective protection against the toxic effects of AFB_1 3.0 mg/kg in the diet compared with HSCAS or any antioxidants. A combination of 1% SS and 1% RE to AF-diet increased EN,EW and EM by 24.25, 1.42 and 26.01 %, respectively compared to those fed on AF-diet. To our knowledge the work was done by our lab (Qota *et al.,*2005 or this study) is the first time to use SS or RE in detoxification AFB1 *in vivo* .The AFB_1 degradation was demonstrated *In vitro* by lactoperoxidase (Doyle and Marth, 1978) and horseradish peroxidase (Das and Mishra ,2000).The SS may be conjugate with degradation compound produced by RE. Jakoby (1980) showed that xenobiotics conjugation with sulphate is an important route for conversion of lipophilic xenobiotics to more readily excreted polar metabolites. The addition of SS+HSCAS to AF-diet significantly increased EN, EW and EM by 36.82,4.97 and 43.67%, respectively compared to hens fed AF-diet alone. The present study showed clearly that the addition of SS is the best additive to HSCAS to alleviate the

toxic effect of aflatoxin. The HSCAS is a large molecules and cannot be carried across the intestinal wall and theoretically some of AF compounds escape from HSCAS and across the intestinal wall. The SS may be play role in detoxification of these compounds (AFB_1 or its metabolites) in liver and intestine. Chipley *et al.* (1974) stated that conjugation might be accomplished by the combination of the AFB1 metabolite to a variety of compounds including amino acid, glucuronic acid, active sulphate and acetate. Bartelt and Kirinya (1976) found that liver slices from geese, ducks and chickens contained low uridine diphosphate-glucuronylransferase and high sulphate conjugation enzyme activities .They also found that the activities of uridine diphosphate-glucuronylransferase and sulphate conjugation enzymes were higher in the duodenum than the remainder of the alimentary tract and the activities of these enzymes in pieces of duodenum were as high as those in slices of liver. The addition of mixture HRS to AF-diet numerically decreased EN, EW and EM compared to hens fed a combination of HSCAS and SS. The RE may degrade the AF compounds and change the chemical structure and consequently the new structure can not be attached to HSCAS. Further research is needed to elucidate the mechanisms of work of RE. There were significant differences between experimental treatments in FI and FC. The feed additive used in this study significantly increased FI compared to hens fed AF-diet alone. The hens fed AF-diet recorded the worst FC compared with other treatment. The feed additives used in this study significantly improved feed conversion compared to hens fed AF-diet alone. It was surprising that the addition of HSCAS+ SS to AF-diet gave protection for FC by 112.5% and we can not explain this result. In the recovery period, the hens fed AF-diet recorded the lowest values of all performance parameters,while the hens fed the control diet recorded the highest values.

Egg quality parameters:

There was a significant difference between treatments in yolk weight for different treatments (Table 4). The hens fed AF-diet significantly recorded the higher value compared to other treatments, while the hens fed the control diet recorded the lowest value. These results disagree with those obtained by Washburn *et al.* (1985) who found a reduction in yolk weight for groups of hens fed a diet supplemented with 5 ppm of AFB_1. Also, Huff *et al* (1975) found that the graded levels from 1.25 to 10 ppm reduced yolk weight and the yolk as percent of total egg. There was a significant difference between treatments in albumin weigh. The hens fed AF-diet recorded the lowest value of albumin weight and this may be a result of total

protein decrease in serum (Harvey *et al*.1993). However, The feed additives significantly increased albumin weight percent compared to hens fed AF-diet alone. There was a significant difference between values of shell weight for different treatments. The hens fed AF-diet recorded the shell weight value, which was found to be significantly lower than those fed control diet. These result disagree with those obtained by Hamilton and Garlish (1972) and Washburn *et al* (1985) who reported an increase in percent shell of hens receiving aflatoxin. The same trend had been found in shell thickness and these results agree with those obtained by Verm *et al.* (2003) who found that the shell thickness significantly reduced by higher level of AF (2ppm) and disagree with Huff *et al* (1975) who found no significant effect of aflatoxin on shell thickness. There was a significant differences between different treatments in yolk color and hens fed AF-diet recorded the lowest value. The variation in color parameters might be connected to the AFB1 interference with lipid metabolism (Tung *et al*. 1972), carotenoid absorption or deposition in yolk (Genedy *et al*., 1999). These results disagree with those obtained by Huff *et al*. (1975) who observed a greater degree of yellowness in egg yolk of hens fed a diet containing 10 ppm of AFB_1. The hens fed AF-diet recorded significantly lower value of Haugh unit and yolk index compared to other treatments. These results disagree with those obtained by Verm *et al* (2003) who found Haugh unit and yolk index remained unchanged when the hens fed AF-diet (2ppm). The difference between these authors cited above and present results may be due to different dose level, age and strain of birds. After 4 weeks of recovery period (Table 5), egg quality and its components have been recovered to some extent by groups fed AF-diet. The hens fed AF-diet recorded the lowest values in yolk height, shell thicknes, Haugh unit, and yolk index.

Relative weights of organs and glands:

The relative weight of liver, spleen, ovarian, gizzard and heart for different treatments in treatment and recovery periods are summarized in Table (6). Hens fed AF-diet recorded the highest values of relative weight of liver, spleen and heart, while recorded the lowest value of relative weight of ovarian. Increasing liver weight may be due to the increase in accumulation of liver fat contents as a result either of interference of aflatoxin with lipid metabolism (Smith and Hamilton,1970) or probably related to its important role in elimination of xenobiotics (Klaassen, 1980). Adding the studied additives decreased the severity of aflatoxin diets effects for all organ weights. Also, the feed additive significantly increased ovarian weight compared to hens fed AF-diet alone. However, Trucksess *et al*. (1983)

found that the relative ovary weights decreased in the AF treated hens. After 4 weeks recovery period, organs for hens fed AF-diet with additives were recovered, while hens fed the AF-diet alone still have a severity of AF.

Meat protein, liver lipid, yolk cholesterol and some blood constituents.

There were insignificant differences between treatments in meat protein, while there were significant differences in liver lipid and yolk cholesterol. Nesheim and lvy (1971) reported that liver fat in layers markedly increased in hens fed 8 ppm aflatoxin compared with control. These results agree with those obtained by Genedy *et al.* (1999) who found that AF-diet significantly increased liver fat of laying hens. The feed additives in this study significantly decreased liver lipid compared to hens fed AF-diet alone. The hens fed AF-diet recorded value of yolk cholesterol which was found to be lower than the other treatments and these may be as a result to the inhibition of cholesterol biosynthesis. In this respect, Kato *et al.* (1969) demonstrated for AF inhibitor of cholesterol biosynthesis in rats. All feed additive used in this study significantly increased yolk cholesterol. There were significant differences between treatments in calcium and phosphorus level in serum. The hens fed AF-diet alone recorded the lowest value of calcium and these results agree with those obtained by Kubena *et al.* (1998) who found that AF-diet reduced calcium in broiler serum. All feed additives significantly increased level of calcium in serum compared to hens fed AF-diet alone. There were significant differences between AF-treatment and control diet in serum phosphorus. Kim *et al.* (2003) found that addition of 500 ppb aflatoxin reduced serum phosphorus. There was a significant difference between experimental treatments values of alkaline phosphatase (ALP). The hens fed AF-diet alone recorded the highest value, while the control diet recorded the lowest value. In this study, treated hens fed diet with AF significantly decreased serum triglycerides compared to those fed control diet. These result agree with those obtained by Stanely *et al.* (1993) who found with broiler that addition of 5 ppm of aflatoxin significantly decreased serum triglycerides.

All feed additives used in this study significantly increased serum triglecride compared to hens fed the AF-diet alone. After 4 weeks of recovery period, the hens in AF treatments recovered in all parameters except hens fed AF-diet alone which still recorded the highest value of liver lipid and the lowest value of yolk cholesterol (Table 8).

Semen characteristics:

As illustrated in Table (9), AF-diet caused a significant decrease in semen volume, sperm concentration and mass motility, while increased the percentage of sperm abnormalities. Sharlin *et al* (1980) and Mohiddin (1982) have implied that AF caused degeneration and a decrease in germinal epithelial cells, disruption in spermatogenesis. Also, Ortatatli *et al* (2002) showed that AF might totally or partially (dose related) suppress spermatogenesis, cause abnormality in spermatozoa and atrophy in testes. On the other hand, Muthiah *et al.* (1997) found that graded levels of aflatoxin from 0.5 to 1.5 mg/kg AFB_1 did not affect the semen volume, sperm motility and concentration but the incidence of abnormal spermatozoa increased with the aflatoxin content of the diet. The severity of AF effects on semen characteristics was decreased by adding the studied additives to AF-diets. After 4 weeks recovery period, alterations caused by AF-diets were negated for semen characteristics except males fed AF-diet alone which still recorded significantly lower values of semen volume and sperm concentration compared with other treatments.

Reproductive performance:

There was a significant effect for decreasing fertility, hatchability and increasing chick abnormalities by AF-diet. These results agree with those obtained by Qureshi *et al.* (1998) who found that AF dietary exposure resulted in embryonic mortality and reduction in hatchability compared to controls. Also, Sur and Celik (2003) indicated that low concentration of AFB_1 transferred into the fertilized eggs might be the cause of serious problems. The data in Table (10) showed that response to addition of SS+RE to AF-diet was lower than that was expected. Fukayama *et al* (1984) suggested that exposure to BHT may protect the lacting animal from carcinogenic effect of AFB_1 but may increase the risk of exposure of newborn infant to carcinogenic metabolite AFM_1. The RE may increase metabolites of AFB_1 by its antioxidant activity and sulphate increased its deposition in egg. Chipley *et al.* (1974) stated that conjugation might be accomplished by the combination of the metabolites of AFB_1 to a variety of compounds including amino acid, glucuronic acid, active sulphate and acetate. However, All feed additives used in this study decreased the severity of AF compared to hens fed AF-diet alone. After 4 weeks of recovery period, the hens in AF treatments recovered in all parameters except hens fed AF-diet alone which still recorded the lowest value of fertility and hatchability.

Aflatoxin B1 residue in egg yolk:

Aflatoxin B_1 residue was found in egg yolk of hens fed AF-diets without or with studied additives are presented in Table (11). There was significant differences between experimental treatments and the hens fed AF-diet recorded the highest value (1.22 micro g/kg), while there were no residues in egg yolk of hens fed the control diet . In this respect, Oliveira *et al.* (2000) found that residues of aflatoxin B_1 were detected only in the eggs of hens given 500 micro g/kg feed, at levels that ranged from 0.05 to 0.16 micro g/ kg and indicated that the feed : egg AFB_1 transmission ratio was approximately equals to 5000: 1. With laying Japanese quail, Oliveira *et al* (2003) found that the previous ratio was 3333: 1 for diet containing 100 micro g AFB_1 /kg feed. In this study the hens fed AF-diet recorded value which was found to be higher compared to those found in the literature and this may be due to lower egg production in the local hens and consequently increased the level of AFB_1 excreted in the egg. However, Rizk *et al* (1993) found with local hen (Matrouh) fed AF-diet containing 200 ppb that AFB_1 residue being 1.98 ppb in the egg. The feed additives used in this study significantly decreased the level of AFB_1 residues in egg yolk compared to those fed AF-diet alone. Regarding to hen performance (Table 3), the hens fed AF-diet+ SS+ HSCAS recorded the highest values of EN, EW and EM compared to the other feed additives and also recorded the lowest value of AF-residue indicating that SS+HSCAS was the successful combination additives in this study. After 4 weeks of recovery period, there were no residues in egg yolk. These results are in agree with those obtained by Wolzak *et al* (1985) who found that no residues were detected in the albumen or yolk after 5 and 7 days of withdrawal, respectively.

CONCLUSION

The addition of HSCAS, HSCAS+RE, RE+SS, HSCAS +SS or mixture of them (HRS) decreased the negative effects of toxicity due to aflatoxicosis in hen diets for all studied criteria and effectiveness. The combination of HSCAS and SS 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.

Table (1): Composition of the hen basal diet from 30 to 38 weeks of age (experimental diet).

Ingredients	%
Yellow corn	64.45
Soybean meal (44%)	23.25
Di calcium phosphate	1.50
Limestone ground	7.60
Sodium chloride	0.30
Vit. & Min. mix*	0.30
DL-methionine	0.10
Clean sand	2.50
Total	100
Calculated Values**	
Crude protein%	16
ME. Kcal/kg	2700
Methionine %	0.36
Methionine+cystine	0.620
Lysine	0.80
Calcium %	3.3
Available phophorus %	0.40

* Premix contain per 3kg vit A 12 000 000, vit D3 2000 000 IU, vit E 10000mg, Vit K3 2000mg , vit B1 1000mg, vit B2 5000mg, vit B6 1500mg, vit B12 10mg, pantothenic acid 10000mg, Niacin 30000mg, Biotin 50mg, Folic acid 1000mg, Choline 250gm, Selenium 100mg, Copper 4000mg, Iron 30000mg, Manganese 60000mg, Zinc 55000mg, Iodine 1000mg, Cobalt 100mg and $CaCO_3$ to 3000g.

**Calculated according to NRC(1994

Table (2): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on (BW) and (WG) during treatment (30-34 wks) and recovery period (34-38 wks).

Parameters	Treatment Period			Recovery Period		
	BW2(g)	BW4(g)	WG04	BW6(g)	BW8(g)	WG48
Control	1660 ±1.66	1673^{a} ±1.14	23.12^{a} ±0.98	1679^{a} ±1.84	1694^{a} ±2.21	21.71^{c} ±1.66
AF-diet	1655 ±1.32	1659^{d} ±1.24	4.68^{d} ±1.20	1668^{b} ±2.00	1685^{c} ±1.75	25.43^{abc} ±1.31
AF-diet +0.5% HSCAS	1655 ±1.42	1663^{cd} ±1.35	11.40^{c} ±1.55	1672^{b} ±1.47	1687^{bc} ±1.77	24.28^{bc} ±1.25
AF-diet +0.5%HSCAS +1%RE	1658 ±1.13	1666^{bc} ±1.33	15.81^{b} ±1.11	1677^{a} ±1.28	1691^{ab} ±1.42	24.46^{bc} ±1.32
AF-diet +0.5%SS +1%RE	1658 ±1.37	1665^{bc} ±1.24	14.25^{bc} ±1.03	1677^{a} ±1.29	1692^{ab} ±1.37	26.40^{ab} ±1.31
AF-diet +1%SS +0.5%HSCAS	1657 ±1.35	1663^{cd} ±1.39	11.93^{c} ±0.94	1677^{a} ±1.39	1692^{a} ±1.19	29.00^{a} ±1.28
AF-diet +2.5%HRS	1660 ±1.67	1668^{b} ±1.49	12.18^{c} ±0.91	1680^{a} ±1.42	1694^{a} ±1.64	26.28^{ab} ±1.32

$^{a-c}$ Means in the same column with different letters, differ significantly ($P \leq 0.05$).
Means ± standard error.

Table (3): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on EN, EW, EM, FI and FC during treatment (30-34 wks) and recovery periods (34-38 wks).

Parameters	Treatment Period					Recovery Period				
	EN	EW(g)	EM*(g)	FI(g)	FC**	EN	EW(g)	EM*(g)	FI(g)	FC**
Control	17.27^{a} ±0.12	49.27^{a} ±0.06	851.26^{a} ±6.96	100.0^{a} ±0.79	3.29^{a} ±0.05	18.68^{a} ±0.15	49.55^{a} ±0.03	925.7^{a} ±6.91	100.00^{a} ±0.45	3.02^{a} ±0.03
AF-diet	12.49^{d} ±0.15	46.88^{d} ±0.05	586.03^{d} ±7.79	87.25^{d} ±0.59	4.17^{d} ±0.04	16.59^{c} ±0.17	48.34^{f} ±0.03	802.5^{e} ±8.51	96.50^{b} ±0.67	3.36^{d} ±0.05
AF-diet +0.5% HSCAS	15.08^{c} ±0.12	47.51^{cd} ±0.03	716.97^{c} ±6.45	95.87^{b} ±0.62	3.74^{c} ±0.05	17.33^{b} ±0.11	48.76^{e} ±0.01	845.56^{d} ±5.81	98.50^{ab} ±0.79	3.26^{cd} ±0.04
AF-diet +0.5%HSCAS +1%RE	15.55^{c} ±0.23	47.98^{bc} ±0.02	746.51^{c} ±10.90	95.25^{b} ±0.43	3.57^{b} ±0.05	17.40^{b} ±0.05	48.88^{d} ±0.02	850.7^{cd} ±3.18	98.75^{ab} ±0.66	3.25^{cd} ±0.02
AF-diet +1%SS +1%RE	15.52^{c} ±0.10	47.55^{cd} ±0.01	738.40^{c} ±5.22	92.37^{c} ±0.42	3.50^{b} ±0.01	17.30^{b} ±0.26	49.13^{c} ±0.03	850.40^{cd} ±12.84	100.0^{a} ±0.91	3.29^{cd} ±0.05
AF-diet +1%SS +0.5%HSCAS	17.09^{ab} ±0.17	49.21^{a} ±0.76	841.96^{ab} ±21.02	95.62^{b} ±1.21	3.18^{a} ±0.06	17.74^{b} ±0.15	49.21^{c} ±0.07	873.20^{c} ±6.61	100.0^{a} ±1.20	3.20^{bc} ±0.04
AF-diet +2.5%HRS	16.68^{b} ±0.13	48.66^{ab} ±0.06	811.95^{b} ±5.99	96.37^{b} ±0.55	3.32^{a} ±0.03	18.24^{a} ±0.05	49.41^{b} ±0.01	901.60^{b} ±2.72	100.0^{a} ±0.40	3.10^{ab} ±0.003

[a-b] Means in the same column with different letters, differ significantly ($P \leq 0.05$). Means ± standard error

EN: egg number

EW: egg weight

EM: egg mass

FI : feed intake/hen/day

*EM = average egg weight X egg number

**Feed conversion (FC) = feed intake (g)/egg mass (g)

Table (4): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on egg quality at the end of treatment period (34 wks old).

Item	Yolk weight (g)	Albumin weight (g)	Shell weight (g)	Yolk Height (mm)	Shell Thickness (mm)	Yolk width (mm)	Yolk color	Haugh unit	Yolk index
Control	31.60^{d} ±0.12	58.34^{a} ±0.11	10.10^{a} ±0.03	15.60^{a} ±0.06	0.383^{a} ±0.0006	31.00 ±0.23	7.25^{a} ±0.07	96.12^{ab} ±0.22	50.4^{a} ±0.46
AF-diet	33.42^{a} ±0.16	56.91^{d} ±0.14	9.54^{d} ±0.07	14.80^{e} ±0.05	0.331^{f} ±0.003	33.00 ±0.28	4.32^{e} ±0.16	88.52^{e} ±0.49	44.9^{c} ±0.37
AF-diet +0.5% HSCAS	32.53^{bc} ±0.16	57.66^{bc} ±0.14	9.70^{cd} ±0.05	15.0^{d} ±0.04	0.362^{d} ±0.008	32.00 ±0.30	6.37^{c} ±0.09	94.97^{c} ±0.20	47.0^{b} ±0.46
AF-diet +0.5% HSCAS +1%RE	32.91^{b} ±0.23	57.48^{c} ±0.13	9.72^{c} ±0.06	15.0^{d} ±0.05	0.368^{c} ±0.008	32.00 ±0.32	6.47^{c} ±0.09	95.37^{bc} ±0.25	47.0^{b} ±0.52
AF-diet +1%SS +1%RE	32.40^{bc} ±0.17	57.82^{bc} ±0.15	9.77^{bc} ±0.06	15.20^{c} ±0.05	0.355^{e} ±0.001	32.00 ±0.32	5.87^{d} ±0.11	93.75^{d} ±0.22	47.6^{b} ±0.48
AF-diet +1%SS +0.5%HSCAS	32.17^{c} ±0.14	57.99^{ab} ±0.12	9.83^{bc} ±0.05	15.10^{cd} ±0.04	0.375^{b} ±0.0009	32.00 ±0.27	7.10^{ab} ±0.12	95.80^{abc} ±0.22	47.3^{b} ±0.46
AF-diet +2.5%HRS	32.11^{c} ±0.18	57.94^{ab} ±0.15	9.94^{ab} ±0.05	15.40^{b} ±0.05	0.376^{b} ±0.0011	32.00 ±0.26	6.92^{b} ±0.10	96.30^{a} ±0.19	48.2^{b} ±0.43

[a-f] Means in the same column with different letters, differ significantly ($P \leq 0.05$).
Means ± standard error.

Table (5): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on egg quality at the end of recovery period (38 wks old).

Item	Yolk weight(g)	Albumin weight(g)	Shell weight(g)	Yolk Height(mm)	Shell Thickness(mm)	Yolk width(mm)	Yolk color	Haugh unit	Yolk index
Control	31.75 ±0.12	58.25 ±0.10	10.04 ±0.04	15.70^{b} ±0.03	0.380^{a} ±0.0002	31.00 ±0.208	7.20 ±0.07	95.70^{a} ±0.21	50.72^{a} ±0.32
AF-diet	31.94 ±0.21	58.41 ±0.09	9.89 ±0.07	15.20^{d} ±0.03	0.376^{e} ±0.0004	31.00 ±0.21	7.00 ±0.09	94.17^{d} ±0.16	49.12^{b} ±0.35
AF-diet 0.5% HSCAS	31.61 ±0.10	58.42 ±0.09	9.96 ±0.04	15.60^{bc} ±0.03	0.378^{d} ±0.0003	31.02 ±0.18	7.07 ±0.07	94.75^{c} ±0.20	50.34^{a} ±0.30
AF-diet 0.5%HSCAS +1%RE	31.38 ±0.11	58.49 ±0.11	10.12 ±0.03	15.50^{c} ±0.03	0.379^{d} ±0.0003	31.00 ±0.23	7.12 ±0.09	94.97^{bc} ±0.19	50.10^{a} ±0.37
AF-diet +1%SS +1%RE	31.67 ±0.10	58.33 ±0.08	9.98 ±0.07	15.61^{bc} ±0.03	0.380^{c} ±0.0002	31.00 ±0.205	7.12 ±0.08	95.47^{ab} ±0.18	50.40^{a} ±0.32
AF-diet +1%SS 0.5%HSCAS	31.67 ±0.11	58.27 ±0.09	9.94 ±0.06	15.60^{bc} ±0.02	0.380^{c} ±0.0003	31.00 ±0.18	7.20 ±0.10	95.47^{ab} ±0.18	50.39^{a} ±0.33
AF-diet +2.5%HRS	31.62 ±0.09	58.45 ±0.09	9.93 ±0.05	15.80^{a} ±0.02	0.381^{b} ±0.0002	31.00 ±0.20	7.00 ±0.06	95.80^{a} ±0.19	51.05^{a} ±0.34.

[a-c] Means in the same column with different letters, differ significantly ($P \leq 0.05$).
Means ± standard error

Table (6): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on relative organs and glands weight of body weight at end of treatment (34 wks)and recovery periods(38 wks) .

Parameters	Treatment Period					Recovery Period				
	Liver%	Spleen%	Ovarian %	Gizzard %	Heart%	Liver%	Spleen%	Ovarian%	Gizzard%	Heart%
Control	2.10^{b} ±0.03	0.07^{d} ±0.005	1.05^{a} ±0.002	1.29 ±0.05	0.35^{c} ±0.011	2.17^{abc} ±0.02	0.08 ±0.004	1.03^{ab} ±0.01	1.35 ±0.02	0.363^{b} ±0.01
AF-diet	2.53^{a} ±0.08	0.15^{a} ±0.009	0.732^{c} ±0.05	1.41 ±0.10	0.53^{a} ±0.03	2.21^{a} ±0.01	0.10 ±0.007	0.930^{c} ±0.011	1.36 ±0.004	0.448^{a} ±0.02
AF-diet +0.5% HSCAS	2.18^{b} ±0.02	0.10^{bc} ±0.004	0.966^{ab} ±0.02	1.32 ±0.04	0.46^{b} ±0.01	2.19^{ab} ±0.01	0.08 ±0.01	1.004^{b} ±0.009	1.38 ±0.01	0.395^{b} ±0.01
AF-diet +0.5%HSCAS +1%RE	2.19^{b} ±0.05	0.11^{bc} ±0.005	0.982^{ab} ±0.02	1.42 ±0.03	0.457^{b} ±0.01	2.16^{bc} ±0.007	0.08 ±0.005	1.009^{b} ±0.01	1.35 ±0.03	0.392^{b} ±0.003
AF-diet +1%SS +1%RE	2.29^{b} ±0.06	0.11^{b} ±0.01	0.917^{b} ±0.05	1.36 ±0.09	0.46^{b} ±0.01	2.14^{bc} ±0.003	0.08 ±0.012	1.018^{ab} ±0.010	1.37 ±0.014	0.394^{b} ±0.008
AF-diet +1%SS +0.5%HSCAS	2.20^{b} ±0.06	0.08^{cd} ±0.008	1.00^{ab} ±0.018	1.43 ±0.07	0.429^{b} ±0.006	2.16^{abc} ±0.018	0.08 ±0.015	1.02^{ab} ±0.004	1.38 ±0.007	0.381^{b} ±0.013
AF-diet +2.5%HRS	2.15^{b} ±0.02	0.09^{bcd} ±0.007	1.01^{ab} ±0.01	1.36 ±0.08	0.425^{b} ±0.018	2.14^{c} ±0.008	0.09 ±0.006	1.04^{a} ±0.01	1.37 ±0.01	0.384^{b} ±0.006

[a-d] Means in the same column with different letters, differ significantly ($P \leq 0.05$). Means ± standard error.

Table (7): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on meat protein, liver lipid and some blood constituents at the end of treatment period (34 wks).

Parameters	Meat Protein g/100gDM	Liver lipid mg/g fresh tissue	Yolk Cholesterol mg/g fresh	Ca mg/DL	P mg/DL	ALP U/L	Triglycrides mg/100ml
Control	72.77 ±1.32	70.56^{c} ±1.25	14.15^{a} ±0.25	12.22^{a} ±0.54	6.18^{a} ±0.20	24.34^{d} ±0.42	169.37^{a} ±0.96
AF-diet	70.76 ±1.00	97.97^{a} ±1.47	10.90^{c} ±0.14	8.75^{c} ±0.23	4.38^{b} ±0.21	29.53^{a} ±0.29	136.77^{d} ±2.48
AF-diet +0.5% HSCAS	72.15 ±1.90	78.65^{b} ±0.87	12.28^{b} ±0.25	10.03^{b} ±0.24	4.79^{b} ±0.19	26.59^{bc} ±0.26	155.02^{bc} ±4.07
AF-diet +0.5%HSCAS +1%RE	72.25 ±1.57	78.99^{b} ±2.11	12.43^{b} ±0.24	9.98^{b} ±0.27	5.06^{b} ±0.17	26.60^{bc} ±0.26	156.40^{bc} ±3.42
AF-diet +1%SS +1%RE	71.94 ±1.46	83.62^{b} ±4.49	11.71^{b} ±0.29	9.74^{b} ±0.17	4.61^{b} ±0.20	27.58^{b} ±0.17	149.22^{c} ±1.88
AF-diet +1%SS +0.5%HSCAS	71.16 ±1.70	81.34^{b} ±3.56	12.09^{b} ±0.32	9.86^{b} ±0.21	4.90^{b} ±0.10	26.97^{bc} ±0.42	158.66^{b} ±2.73
AF-diet +2.5%HRS	74.13 ±1.46	80.79^{b} ±1.55	12.49^{b} ±0.26	9.98^{b} ±0.42	4.70^{b} ±0.33	26.37^{c} ±0.37	161.30^{b} ±2.39

$^{a-c}$ Means in the same column with different letters, differ significantly ($P \leq 0.05$).
Means ± standard error.

Table (8): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on meat protein, liver lipid and some blood constituents at the end of recovery period (38 wks).

Parameters	Meat Protein g/100gDM	Liver lipid mg/g fresh tissue	Yolk Cholesterol mg/g fresh	Ca mg/DL	P mg/DL	ALP U/L	Triglycrides mg/100ml
Control	72.69 ±1.41	70.66^{b} ±0.90	14.20^{a} ±0.41	12.1 ±0.54	6.04^{a} ±0.26	24.55 ±0.65	169.77 ±1.47
AF-diet	71.76 +1.50	83.15^{a} +3.51	11.92^{d} +0.16	9.50 +0.29	4.68^{b} +0.12	26.94 +0.26	159.55 +2.29
AF-diet +0.5% HSCAS	72.80 ±1.94	71.01^{b} ±0.90	13.30^{bc} ±0.26	11.54 ±0.35	5.71^{a} ±0.18	25.19 ±0.36	165.32 ±2.31
AF-diet +0.5%HSCAS +1%RE	72.76 ±1.35	72.98^{b} ±1.62	12.99^{bc} ±0.25	11.07 ±0.70	5.45^{ab} ±0.35	25.84 ±0.42	167.30 ±3.46
AF-diet +1%SS +1%RE	72.52 ±1.68	76.43^{b} ±2.15	12.65^{cd} ±0.17	10.63 ±0.65	5.23^{ab} ±0.31	25.80 ±0.50	162.22 ±3.14
AF-diet +1%SS +0.5%HSCAS	73.26 ±1.22	76.10^{b} ±2.75	12.79^{bc} ±0.17	10.57 ±0.44	5.20^{ab} ±0.22	25.84 ±0.57	161.22 ±2.33
AF-diet +2.5%HRS	72.29 ±1.82	70.95^{b} ±1.35	13.50^{ab} ±0.29	11.11 ±0.57	5.45^{ab} ±0.29	25.19 ±0.60	168.42 ±2.76

$^{a-d}$ Means in the same column with different letters, differ significantly ($P \leq 0.05$). Means ± standard error.

Table (9): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on semen characteristics at the end of treatment (34 wks) and recovery periods (38 wks).

Parameters	Treatment Period					Recovery Period				
	Volume (ml)	**Concentration billion/ml**	**Mass motility%**	**Abnormality %**	**Dead%**	**Volume (ml)**	**Concentration billion/ml**	**Mass motility**	**Abnormality %**	**Dead%**
Control	0.640^{a} ±0.01	3.89^{a} ±0.02	85.60^{a} ±0.87	7.23^{c} ±0.66	4.36^{b} ±0.43	0.614^{a} ±0.002	3.73^{a} ±0.10	85.50 ±1.28	6.00 ±0.57	4.33 ±0.33
AF-diet	0.443^{b} ±0.01	2.36^{c} ±0.12	72.69^{c} ±1.73	10.13^{a} ±0.24	7.00^{a} ±0.60	0.573^{b} ±0.006	3.16^{b} ±0.14	80.27 ±1.55	8.33 ±0.33	5.66 ±0.33
AF-diet +0.5% HSCAS	0.558^{bc} ±0.02	2.92^{bc} ±0.24	81.96^{ab} ±1.36	8.00^{bc} ±0.05	4.83^{b} ±0.14	0.610^{a} ±0.001	3.53^{a} ±0.16	84.81 ±0.21	6.00 ±0.57	4.33 ±0.33
AF-diet +0.5%HSCAS +1%RE	0.594^{ab} ±0.001	3.31^{ab} ±0.21	81.13^{ab} ±1.39	8.23^{bc} ±0.23	4.56^{b} ±0.39	0.611^{a} ±0.0001	3.33^{a} ±0.22	84.69 ±1.20	5.33 ±0.88	3.66 ±0.33
AF-diet +1%SS +1%RE	0.509^{c} ±0.001	2.95^{bc} ±0.19	78.76^{b} ±1.85	8.70^{b} ±0.28	5.56^{b} ±0.38	0.612^{a} ±0.001	3.29^{a} ±0.10	84.71 ±1.02	6.00 ±0.57	4.33 ±0.33
AF-diet +1%SS +0.5%HSCAS	0.583^{b} ±0.01	3.28^{ab} ±0.27	81.92^{ab} ±1.14	8.16^{bc} ±0.28	5.13^{b} ±0.23	0.612^{a} ±0.001	3.44^{a} ±0.17	85.17 ±0.48	6.33 ±0.66	4.00 ±0.57
AF-diet +2.5%HRS	0.577^{b} ±0.01	3.41^{ab} ±0.16	81.56^{ab} ±1.63	7.90^{bc} ±0.15	4.93^{b} ±0.18	0.612^{a} ±0.001	3.54^{a} ±0.26	84.88 ±0.39	5.66 ±0.88	4.00 ±0.57

$^{a-c}$ Means in the same column with different letters, differ significantly ($P \leq 0.05$). Means ± standard error.

Table (10): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on some reproductive performance during treatment (30-34 wks) and recovery periods (34-38 wks).

Parameters	Treatment Period				Recovery Period			
	Fertility %	Hatchability %	Abnormality %	Chick weight at hatch (g)	Fertility %	Hatchability %	Abnormality %	Chick weight
Control	96.87^{a} ±0.91	91.87^{a} ±0.91	2.50^{b} ±0.94	34.98^{a} ±0.02	96.25^{a} ±0.81	91.87^{a} ±0.91	1.25 ±0.81	35.58 ±0.62
AF-diet	84.37^{d} ±1.13	66.87^{d} ±0.92	7.50^{a} ±0.94	34.09^{e} ±0.06	93.12^{b} ±0.91	84.37^{b} ±1.13	3.12 ±0.91	34.63 ±0.02
AF-diet +0.5% HSCAS	92.50^{bc} ±0.94	85.00^{b} ±1.63	3.12^{b} ±0.91	34.26^{d} ±0.05	96.87^{a} ±0.91	93.12^{a} ±0.91	1.25 ±0.81	35.20 ±0.36
AF-diet +0.5% HSCAS +1%RE	93.12^{b} ±0.91	85.00^{b} ±1.33	3.12^{b} ±0.80	34.49^{c} ±0.02	96.87^{a} ±0.91	91.87^{a} ±1.61	1.87 ±0.91	34.85 ±0.01
AF-diet +0.5%SS +1%RE	90.00^{c} ±0.94	78.75^{c} ±1.25	5.00^{ab} ±0.94	34.51^{c} ±0.02	96.87^{a} ±0.91	92.50^{a} ±1.33	1.87 ±0.91	34.90 ±0.01
AF-diet +1%SS +0.5% HSCAS	92.50^{bc} ±0.94	83.75^{b} ±1.56	3.12^{b} ±0.91	34.60^{bc} ±0.02	96.87^{a} ±0.91	93.12^{a} ±0.91	1.25 ±0.81	34.97 ±0.03
AF-diet +2.5%HRS	93.12^{b} ±0.91	85.00^{b} ±1.33	3.12^{b} ±0.98	34.70^{b} ±0.03	97.50^{a} ±0.94	93.75^{a} ±0.81	1.25 ±0.81	35.01 ±0.03

[a-d] Means in the same column with different letters, differ significantly ($P \leq 0.05$).
Means ± standard error.

Table (11): Efficacy of feed additives for detoxification of AFB_1 in contaminated El-Salam hens diets on AFB_1 residue in egg yolk (micro g/kg) at the end of treatment period (34 wks old).

Control	AF-diet	AF-diet +0.5% HSCAS	AF-diet +0.5%HSCAS +1%RE	AF-diet +0.5%SS +1%RE	AF-diet +1%SS +0.5% HSCAS	AF-diet +2.5%HRS
0.0	1.22^{a}	1.00^{b}	0.90^{c}	0.850^{d}	0.423^{f}	0.616^{e}
0.0	$\pm$0.01	$\pm$0.003	$\pm$0.006	$\pm$0.02	$\pm$0.014	$\pm$0.008

[a-f] Means in the same raw with different letters, differ significantly ($P \leq 0.05$).
Means $\pm$ standard error.

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الملخص العربي

طرق جديدة لازالة الافلاتوكسين ب1 في علائق الدجاج البياض المحلي

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- تم استخدام 224 دجاجة بالاضافة الى 49 ديك من سلالة السلام على عمر 30 اسبوع في هذه الدراسة و تم تقسيمهم الى 7 مجموعات و كل مجموعة 4 مكررات و كل مكرر 8 دجاجات و ديكا . الديوك المتبقية (21 ديك) فتم ابقائهم في اقفاص منعزلة لتقدير جودة السائل المنوي . غذيت الدجاجات في المعاملة 1 على عليقة قاعدية (عليقة قياسية) . غذيت الدجاجات في المعاملة الثانية على عليقة قياسية ملونة بسموم الافلاتوكسين ب1 بمعدل 1000 جزء في البليون (عليقة الافلاتوكسين). الدجاجات في المعاملات 3،4،5،6،7 غذيت على عليقة الافلاتوكسين +0.5% صوديوم الامونيوم سليكات ، عليقة الافلاتوكسين + 0.5% صوديوم الامونيوم سليكات+ 1% مستخلص الفجل – عليقة الافلاتوكسين + 1% مستخلص فجل + 1% كبريتات الصوديوم،

عليقة الافلاتوكسين + 0.5% صوديوم الومنيوم سليكات +1% كبريتات الصوديوم ، عليقة الافلاتوكسين + المخلوط الثلاثي منهم .

- و استمرت التجربة لمدة 4 اسابيع (فترة معاملة) يليها 4 اسابيع اخرى تم فيها رفع السموم والاضافات من العليقة كفترة استشفاء .

و يمكن تلخيص نتائج التجربة كما يلي :

1- سجلت الدجاجات المغذاة على عليقة الافلاتوكسين بدون اضافات اقل القيم لكل من الوزن

المكتسب، عدد البيض، وزن البيض، كتلة البيض، الغذاء المستهلك و أسوأ كفاءة غذائية- ايضا تأثرت جودة البيض بعليقة الافلاتوكسين .

2- زاد الوزن النسبي لكل من الكبد – الطحال – القلب بينما انخفض الوزن النسبي لمبيض الدجاجات المغذاة على عليقة الافلاتوكسين .

3- زاد مستوى الدهن في الكبد و كذلك انزيم ALP معنويا بينما انخفض كوليسترول البيضة ومستوى الكالسيوم و الفوسفور و الجلسريدات الثلاثية في سيرم الدم و ذلك في الدجاجات المغذاة على عليقة الافلاتوكسين – كذلك ادت عليقة الافلاتوكسين الى قلة حجم السائل المنوي وتركيز الحيوانات المنوية و الحركة الكلية لها كما ادت الى زيادة السيرمات المشوهة و الميتة .

4- ادت عليقة الافلاتوكسين الى قلة الخصوبة ونسبة الفقس ووزن الكتكوت عند الفقس وزيادة نسبة الكتاكيت المشوهة – ايضا سجلت الدجاجات المغذاة على عليقة الافلاتوكسين اعلى نسبة متبقيات من الافلاتوكسين ب1 في صفار البيض .

5- ادت جميع الاضافات الغذائية المستخدمة في هذه الدراسة الى تقليل الاثار السلبية الناتجة عن السمية وذلك في كل الضفات المدروسة – ويعتبر المخلوط بين الالومنيوم سليكات و كبريتات الصوديوم انجح المخاليط تحت ظروف هذه الدراسة .