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Emeliorative Efficiency of Mixed Adsorbents on Performance and Hematobiochemical Alterations of T-2 Toxin Challenged Broilers

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Abstract

In Al-sulaumania college of Agriculture, through 2005, an experiment was conducted on eighty-one-day-old Ross 308-strain broiler chickens, that were fed diets containing 0 or 4 ppm T-2 toxin from 1 to 42 days of age. Mixture of 0.125% Sodium bentonite , 0.125% hydrated sodium calcium aluminosilicate (HSCAS) and 0.125% mycofix (∑ 0.375%), were added to the basal diet, as fed basis to determine the effects of these additives against T-2 toxicosis. Broiler chickens were divided into 4 groups of 10 with similar initial weights. Each experimental diet was replicated 2 times during 42 days. Body weight gain, , feed conversion ratio, weekly feed intake, relative weight of organs (liver, , heart, Kidney, proventriculus and gizzard, thymus, bursa of Fabricius and spleen); blood picture ;stress factor; total serum protein ; lactate dehydrogenase, Alanin aminotransferase, aspartate aminotransferase were recorded. The results showed that body weight gain, , feed consumption and feed conversion ratio, were significantly lesser ($P<0.05$) with diet containing T-2 alone. Relative weight of pancrease, liver and kidney in chickens fed diet containing T-2 alone were significantly greater ,while the relative weights of thymus, bursa of Fabricius and spleen were significantly lesser with diet containing T-2 alone. Red blood cells, white blood cells, haemoglobin, packed cell volume, lymphocytes, heterophils were significantly lesser , while stress factor was significantly greater with diet containing T-2 alone . Blood enzymes show significant , increase in LDH level, but reduction in both ALT and AST in T-2 fed chicks , compared with other groups. On the other hand, chickens receiving mixture additives to the T-2 toxin contaminated diet showed an increase in body weight gain, feed consumption and improving feed conversion ratio; restore relative weights of internal organs; improve blood picture and stress factor; return serum total protein concentration and serum enzymes to control values, when compared to birds fed diet containing T-2 alone. From above it is evident that the addition of the above compounds made an improvement against all negative effects of T-2 toxin in broiler chickens.

كفاءة خليط من الممتزات في تخفيف التغيرات الحاصلة في النمو والاداء الانتاجي وكيموحيوية الدم لافراخ فروج اللحم المعرضة لسم T-2

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الخلاصة

في جامعة السليمانية / كلية الزراعة وخلال 2005 تمت تربية ثمانون من افراخ فروج اللحم نوع روس 308 بعمر يوم واحد، على علائق خالية او حاوية على سم T-2 بمستوى 4 جزء بالمليون وحتى عمر 42 يوما. استخدم خليط الممتزات المتكون من 0.125% بنتونايت الصوديوم، 0.125% سيليكات الالمنيوم و0.125% مايكوفكس (وبمجموع 0.375%) . اضيف مزيج الممتزات لتقييم قابليته في تخفيف تاثير سم T-2 في افراخ فروج اللحم. اعتبرت كلتا المجموعتين الخالية والحاوية على سم T-2 مجموعتا سيطرة للمقارنة. قسمت الافراخ الى اربعة مجاميع (10 افراخ لكل مجموعة) وباوزان بداية متساوية. واعد طيلة فترة التجربة مكررين لكل مجموعة. تم خلال التجربة قياس المعايير التالية: الزيادة الوزنية،استهلاك العليقة، معامل التحويل الغذائي،الاوزان النسبية للاعضاء الداخلية(الكبد، الكلى،القلب، المعدة الغدية،القانصة،البنكرياس ،غدة التوثة، غدة فابريشيا والطحال)، صورة الدم ،معامل الكرب، بروتين مصل الدم،انزيمات مصل الدم (LDH, AST ,ALT) . اوضحت النتائج ان كل من الزيادة الوزنية واستهلاك العليقة ومعامل التحويل الغذائي كانت اقل معنويا($P<0.05$) في المجموعة المستهلكة لسم T-2 بمفرده مقارنة مع المجاميع الأخرى. وأوضحت النتائج ايضا ان الوزن النسبي للكبد والبنكرياس والكلية قد ازداد معنويا في الافراخ المستهلكة لسم T-2 بمفرده مقارنة مع المجاميع الأخرى، في حين انخفض الوزن النسبي لكل من غدة فابريشيا وغدة التوثة والطحال بصورة معنوية مقارنة مع المجاميع الاخرى. وسجل ايضا انخفاض في اعداد كريات الدم الحمراء والبيضاء وهيموكلوبين الدم وحجم الخلايا المرصوصة وكذلك الخلايا اللمفية والعدلة ومؤشر الكرب بصورة معنوية في الافراخ المستهلكة لسم T-2 بمفرده مقارنة مع المجاميع الاخرى . اضافة الى ذلك فقد سجل انخفاض معنوي بمستوى بروتين الدم وانزيم LDH بينما ارتفع مستوى كل من الانزيمين AST و ALT في الافراخ المستهلة لسم T-2 بمفرده مقارنة مع المجاميع الاخرى. في مقابل ذلك فان إضافة مزيج الممتزات الى العليقة الملوثة بسمT-2 قد ادى وبصورة معنوية في تعديل جميع المعايير المتاثرة سلبا بسم T-2 واعادة قيمها ومستوياتها الى تلك في مجموعة السيطرة. يتضح من النتائج ان ان خليط الممتزات كان كفيلا بازالة كل التأثيرات السلبية التي سببها استهلاك سم T-2 في افراخ فروج اللحم مما يعطيه دورا واعدا في علاج حالات التسمم الفطري في افراخ فروج اللحم.

الكلمات الدالة :
سم T-2 ، افراخ فروج اللحم، خليط الممتزات

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البحث مستل من رسالة الماجستير للباحث الثاني

Introduction

Poultry are usually exposed to non macrocyclic trichothecenes, which includes type A trichothecenes (T-2 toxin, neosolanial, DAS, and others) and type B (Nivalenol, DON, fusarenone-X, and others) (Leeson *et al*., 1995). One of the major mycotoxin group affecting poultry production worldwide is T-2 toxin produced by *Fusarium tricinctum* and *Fusarium sporotrichoides*,(Atroshi *et al.*, 2002). T-2 toxin occur in feedstuffs worldwide, including corn, wheat, barley, oats, rice, rye, sorghum. safflower seed, mixed feed (Yoshizawa et al., 1991). Feeding T-2 toxin to broilers lead to growth reduction ; ulceration and crusting of the oral mucosa ; digestive; nervous signs as abnormal wing positioning, seizures, and loss of righting response; affecting brain neurotransmitters; rickets; abnormal feathering; pigmentation defects; anemia associated with marked hematopoietic depletion in the bone marrow with red or yellow bone marrow ; impaired blood coagulation ; Lymphoid organs atrophy; pale, yellows liver; changes in serum biochemical tests reflected by lesions in the liver, intestine, muscle, and kidney, (Leeson *et al*., 1995). Various commercial products are designed and marketed to protect poultry health and production by inactivation of mycotoxins (secondary metabolites of fungi) in feeds for poultry and livestock. Currently, there is no universally effective inactivating agent for the 6 to 10 most common mycotoxins known to cause economic damage or health threats (Devegowda *et al.*, 1998).

Increased efforts are being undertaken in the areas of developing cost-effective procedures and products to effectively deal with the decontamination and remediation of feedstuffs contaminated withT-2toxin. Extensive research has been conducted to prevent T-2 toxicosis that mainly include physical, chemical, nutritional or biological approaches. The use of adsorbing agents, which can trap the mycotoxin molecule by means of ion exchange and thereby hindering their absorption into blood from the gastrointestinal tract, has gained much attention in prevention of mycotoxins. Hydrated sodium calcium aluminosilicate (HSCAS) (Jindal *et al.*, 1993), bentonite (Santurio et al., 1999), zeolite ore compounds (Harvey et al., 1993), spent canola oil bleaching clays (Smith ,1984), activated charcoal (Edrington *et al.*, 1997), inorganic sorbents (Bailey *et al.*, 1998) and a blend of organic acids and aluminosilicates (Mahesh and Devegowda, 1996). The feasibility of utilizing organic adsorbents is also examined, particularly esterified glucomanane which is isolated from the inner layer of yeast cell wall and which possesses significant capability of mycotoxin adsorption (Devegowda ,1996). Recently a new type of additive, containing microorganisms with the ability to inactivate mycotoxins by enzyme modification of their structure (Fuchs et al., 2002), has been developed .Minazel-plus (Modified clinoptilolite, ITNMS Beograd), Mycosorb (Esterified glucomanane, Altech, USA) and Mycofix-plus (Biomin, Austria) were added to the feed in the amount of 0,2%. (Vladimir et al., 2009) . These adsorbents bind to T-2 toxin in the gastrointestinal tract and preventing its absorption

The objective of this research was to determine the efficacy of mixed adsorbents (Hydrated sodium calcium aluminosilicate (HSCAS), Activated charcoal (AC), and Mycofix) for broiler protection against dietary T-2 toxin challenge on growth, performance and blood profile.

Materials and Methods

Birds and housing:

This study carried out on eighty -1-d -old male broiler chicks (Ross X Ross 308), procured from commercial hatchery, during 2005 year. Birds were weighed, wing banded, and randomly distributed into 4 groups with two replicates each of 10 birds each at the Poultry farm at Al-Sulaimani University. They reared in a battery brooder with a random distribution of individuals among the dietary experimental groups. The temperature degree and humidity percentages daily measured and recorded approximately 35 ± 2.0 C^o and 65-±3.0percentage as averages at the first week, then the temperature degree gradually decreased with age until the end of the experiment. Continuous lighting program (24hr) used during the completely experimental period. The study lasted 6 weeks. Birds vaccinated against Newcastle disease and infectious bronchitis by spray method at one day of age, Newcastle disease at 8 days and infectious bursal disease at 14 days of age. Recording Individual body weight was at 1, 2, 3, 4, 5, and 6 weeks of age. Feed was weighed initially when added to each feeder and at each 7-d interval. Feed added to the feeders between the weekly weights was included in the total weekly feed intake value.

Experimental Diets:

The basal diet was a commercial-type corn-soybean meal diet formulated to meet nutritional requirements of growing chicks as recommended by (Leeson and Summers, 1997) and contained 23.99% crude protein and 3188 Kcal metabolizable energy. For preparation of experimental diets, Production of purified crystalline T-2 toxin was by culturing *Fusarium tricinctum* 3299 according to the method reported by (Burmeister , 1971). The crystalline toxin was calculated using Neogen ELISA kit (Neogen Corporation) with XL800 reader. The toxin dissolved in acetone, added to experimental diets, and mixed to homogeneity by means of a twin –shell blender.

Checking the experimental ration to contain no detectable levels of aflatoxins, Ochratoxins, Zearalenone, and T-2 toxin was by the method reported by (Coker *et al.*, 1984). Offering feeds and water were ad libitum for chicks along the experimental period The ingredients and calculated composition of the basal diet used to prepare the dietary treatments are shown in Table 1. Experimental diets were stored in individual labeled (25kg) bags and held in a climate-controlled feed room for use in the feeding study.

Experimental Design:

This study carried out on eighty -1-d -old male broiler chicks (Ross X Ross 308),and randomly distributed into 4 groups with two replicates each of 10 birds each .The experimental treatments were consisted of four groups. Group 1 has no toxin or mycofix (negative control, NC). Group 2 contains 4ppm T-2 toxin (positive control, PC); Group 3 contain 0.375% a mixture of adsorbents is consisted of activated charcoal (0.125%); hydrated sodium calcium aluminosilicate (0.125%) and mycofix plus 3® (0.125%, (AM,); Group 4 contains both 4ppm T-2 toxin and 0.375% (AM).Cumulative feed intake and BW were measured weekly. The weekly feed:gain ratio was calculated for each treatment group.

On d 42, birds were. All birds were evaluated by gross necropsy examination. Total carcass weight and weight of liver, kidney, spleen, proventriclus, gizzard, pancrease, thymus, heart and bursa were recorded and expressed as a percentage of total carcass weight. Calculation of oral lesion score was according to (Huff et al., 1988). Collection of individual blood sample from the right jugular vein using EDTA containing tubes was practiced Calculation of the total leukocyte and erythrocyte count , Packed cell volume and hemoglobin, differential and absolute leukocyte count using the two-slide wedge method were determined according to (Campbell, 1995). Blood protein, SGOT, SGPT, and LDH were calculated using kits supplied by Biomeurix Company.

The statistical analysis of obtained data was performed by SPSS ® Computer Software 10.00 (SPSS, ®1999) based on multi factorial ANOVA was performed to test the significant differences among means at ($P<0.05$) level of significance (Bruning and Kintz, 1977).

Results and Discussion

Body weight gain:

The effect of T-2 toxin and the three adsorbents on the weekly body weight gain is presented in Fig. 1. Body weight gain from the 1^{st},2^{nd},3^{rd},4^{th},5^{th},6^{th} and 7^{th} weeks were affected by treatment with 4 ppm T-2 toxin (PC) ($p<0.05$). There were 16.86,36.62,43.58,25.68,68.26,197.81% reduction in body weight gain respectively as compared with the (NC) group .By the addition of mixed additives to the T-2 contaminated diet (TMA), there was a significant improvement in the body weight gain by12.67,15.18,22.52,8.26,29.49,37.59% increase through the 1^{st},2^{nd},3^{rd},4^{th},5^{th},6^{th} and 7^{th} weeks respectively. There was no negative effect by addition of the three adsorbents on the body weight gain (MA)when compared with the negative control group (NC).

The effect of T-2 toxin and the three adsorbents on the total body weight gain, feed consumption, feed conversion and oral score gross lesions were presented in table 1. Total body weight gain was significantly reduced by 35.40% in chicks fed T-2 toxin (PC), compared with that in (NC) group. After addition of the three adsorbents to the T-2 toxin contaminated diet (TMA) , there was ameliorating effect on the body weight gain through a significant 22.70% increase, compared with (PC) group. The addition of the adsorbents alone (NC), had a slight beneficial effect on the total body weight gain through 3.11% increase, compared with (NC).

Feed consumption :

The effect of T-2 toxin and the three adsorbents on the total feed consumption is presented in table 1. Total feed consumption was significantly 11.26% reduced in group (PC), which fed T-2 toxin, compared with (NC) group. On the opposite side , nearly equal 12.10% increase in total feed consumption after addition of the adsorbents to the T-2 contaminated diet (TMA). Addition of the adsorbents alone (MA) group, had a positive effect on the feed consumption by 1.73% increase, compared with (NC) group.

Feed conversion ratio:

The effect of T-2 toxin and the three adsorbents on the total feed conversion ratio is presented in table 1. Feed contaminated with T-2 toxin (PC), had a negative statistical effect on the feed conversion ratio by 33.41% increase, compared with (NC) group. Amending T-2 toxin contaminated diet with three adsorbents (TMA), was responsible for counteracting the negative toxin effect on the feed conversion ratio by 8.63% improvement, compared with (PC) group. Another improvement was noticed by 1.43% , when the adsorbents were added alone in (MA) group, compared with (NC) group.

Relative organs weight:

The effect of T-2 toxin and the mixed adsorbents on the relative weights of internal organs are presented in table 2. T-2 toxin inclusion in the diet of (PC) group had a statistical significant reduction effect on the relative weights of the lymphoid organs, (thymus,

bursa of fabricious and spleen) and pancreas with a reduction of 32.43, 50, 60, and 36.66% respectively, compared with (NC) group. Addition of the three adsorbents to the T-2 contaminated diet (TMA), gave a total protection against the negative T-2 toxin effect on these organs, by 36, 50, 55, and 31.57% increase in the relative weights when compared with

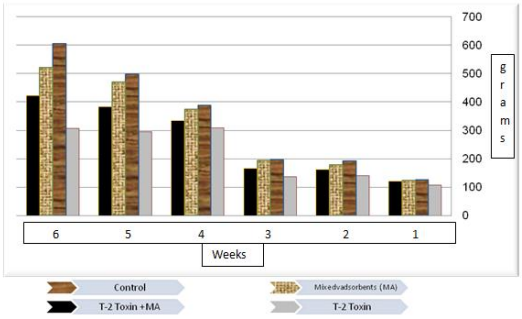

Figure 1: Effect of T-2 toxin and mixed additives on body weight gain of broilers through 42 days of rearing period.

Table 1: Effect of T-2 toxin and mixed additives on body weight, feed consumption, feed conversion ratio and oral gross lesions of broilers through 42 days of rearing period.

Groups	Treatments	Body weight gain (g)1-42 days	Feed consumption (g)	Feed conversion (g)	Oral lesion score
NC**	**0 (Toxin or CA)**	***2005.7±12.4a*****	**5584ab**	**2.78a**	0.0±0.0a
PC	**T-2 4 ppm**	**1295.5±17.2c**	**4955b**	**3.82d**	0.37±2.6c
MA	**0.375% MA**	**2068.2±13.1a**	**5681a**	**2.74a**	0.0±0.0a
TMA	**T-2 4ppm+ 0.375% MA**	**1589.6±12.9ab**	**5555ab**	**3.49abc**	0.27±0.5b

*Mean ±SE for 10 birds
**NC (0 ppm T-2 & no MA); PC (4 ppm T-2 & no MA); MA (0 ppm T-2 & 0.375 %MA); TMA (4 ppm T-2 &0.375 %MA)
***Means with same superscripts within a column do not differ from each other

(PC) group. On the other side, T-2 toxin (PC group), had a significant effect on the relative weights of the gizzard, liver and kidneys, by 13.21, 14.13and 12.30% increase respectively, compared with (NC) group. Amending the T-2 toxin contaminated diet (TMA), with the adsorbents was responsible for counteracting the negative effect, by 6.59, 8.88 and 17.80% reduction in the relative weights of these organs, compared with (PC) group. No significant effect of T-2 toxin (PC group) was recorded on the relative weights of proventriculus and heart, compared with (NC) and (TMA) groups. Addition of the adsorbents (MA) group had no negative effect on the relative weights of all examined internal organs, compared with all groups (NC,PC and TMA).

Table 1: Effect of T-2 toxin and mixed additives on the relative organs weight (g/100g) body weight of broilers through 42 days of rearing period

Group	Relative organs weight (g/100g) body weight								
	Thymus	**Bursa of Fabricius**	**Spleen**	**Pro-ventriculus**	**Gizzard**	**Pancreas**	**Liver**	**Heart**	**Kidney**
NC**	***0.37±0.11 a**	**0.80±0.006 a*** **	**0.22±0.01 a**	**0.53±0.02 a**	**1.74±0.07 a**	**0.30±0.30 a**	**2.76±0.07 bc**	**0.50±0.01 a**	**0.65±0.03 bc**
PC	**0.25±0.16 c**	**0.40±0.007 b**	**0.09±0.01 c**	**0.53±0.11 a**	**1.97±0.15 b**	**0.19±0.03 c**	**3.15±0.11 a**	**0.53±0.04 a**	**0.73±0.02 a**
MA	**0.38±0.1 a**	**0.60±0.007 ab**	**0.20±0.007 a**	**0.44±0.05 a**	**1.65±0.03 a**	**0.27±0.03 a**	**2.51±0.07 c**	**0.53±0.02 a**	**0.73±0.03 a**
TMA	**0.34±0.16 ab**	**0.60±0.007 ab**	**0.140±0.007 b**	**0.42±0.01 a**	**1.84±0.07 a**	**0.25±0.03 b**	**2.87±0.17 b**	**0.51±0.01 a**	**0.60±0.02 c**

*Mean ±SE for 10 birds
**NC (0 ppm T-2 & no MA); PC (4 ppm T-2 & no MA); MA (0 ppm T-2 & 0.375 %MA); TMA (4 ppm T-2 &0.375 %MA)
***Means with same superscripts within a column do not differ from each other (P>0.05)

Blood parameters and stress factor:

The effect of T-2 toxin and the mixed adsorbents on the blood prophile and stress factor are presented in table 3. Contamination of the diet in group (PC) with T-2 toxin had a statistical significant detrimental effect on the blood picture of red blood cells, white blood cells, haemoglobin and packed cell volume, through 23.01,28.63, 54.86, 31.57% reduction respectively, compared with (NC) group. Using mixed adsorbents in the T-2 toxin contaminated diet (TMA),were intermediately effective in counteracting the reduction effect of T-2 toxin on the blood parameters by 15.46, 28.30, 88.56 and 34.61 increase respectively, compared with (PC) group. The absolute lymphocytes and heterophils were statistically affected by inclusion T-2 toxin in group (PC) diet by 32.66 and 18.92% reduction respectively, compared with (NC) group. Ameliorating effect was approached by the addition of protective adsorbents (TMA group) against the negative T-2 toxin effect on these cells by 33.33 and 14.98% increase in their absolute numbers, compared with (PC) group. Stress factor (lymphocytes/heterophils) was also negatively affected by feeding T-2 toxin to the birds in (PC) group through an increase in a percentage of 20.56%, while the addition of the adsorbents to the contaminated diet with T-2 toxin (TMA) group, they were responsible for a significant reduction of stress factor by 13.82% when , with (PC) group. No significant effect was noticed through the addition of the three adsorbents to the diet of (MA) group in all blood parameters and stress factor, when compared with (NC) group.

Table 2: Effect of T-2 toxin and mixed additives on Blood parameters and stress factor of broilers through 42 days of rearing period.

Group	Blood parameters				Absolute WBCs 103/mm3		Stress factor
	Red blood cells10^6/mm3	WBCs 10^3/mm3	Hemoglobin g/100ml	Packed cell volume%	Lymphocytes	Heterophils	
NC**	*2.52±0.04 a***	17.18±2.86 a	8.33±0.7 a	30.40±0.80 a	12.52±1.50 a	3.54±1.00 a	0.282 a
PC	1.94±0.06 c	12.26±4.87 b	3.76±0.8 c	20.80±0.48 c	8.43±1.40 b	2.87±1.01 b	0.340 b
MA	2.49±0.09 a	15.96±2.18 a	8.26±0.9 a	30.40±0.42 a	11.71±1.75 a	3.35±1.30 a	0.286 a
TMA	2.24±0.04 ab	15.73±2.20 a	7.09±0.50 b	28.00±0.97 b	11.24±1.38 a	3.30±1.84 a	0.293 a

*Mean ±SE for 10 birds
**NC (0 ppm T-2 & no MA); PC (4 ppm T-2 & no MA); MA (0 ppm T-2 & 0.375 %MA); TMA (4 ppm T-2 &0.375 %MA)
***Means with same superscripts within a column do not differ from each other (P>0.05)

Serum biochemical:

The effect of T-2 toxin and the mixed adsorbents on serum biochemical's are presented in table 3.Serum protein was significantly ($p<0.05$) affected by feeding T-2 toxin to birds in (PC) group, through its reduction by a percentage of 38.83%, compared with (NC) group. Intermediate restoration of serum protein level was approached by addition of the adsorbents to the diet of (TMA) group through an increase in the serum level by 64.82%, compared with (PC) group. Of the tested serum enzymes, LDH, was significantly reduced, while both SGOT, and SGPT were increased by the addition of T-2 toxin to the bird diets (PC) group. The reduction was significant ($p<0.05$) in serum LDH by 47.48% , compared with (NC) group. Counteracting T-2 toxin effect on serum LDH level was achieved by addition of the adsorbents through intermediate returning its level by 59.86%, compared with (PC) group. The liver function indicator enzymes , ALT and AST, were statistically affected by T-2 toxin inclusion to the birds diet (PC) group. They were increased by a rate of 91.17 and 42.30% respectively, compared with (NC) group. Scavenching the levels of these enzymes to that level of the control (NC) group was approached through 16.92 and 5.40 redction in the level of these enzymes , compared with (PC) group. No observed negative effects were notised when the adsorbents were used alone (MA) adsorbents, compared with other group (NC),

Table 7: Effect of T-2 toxin and mixed additives on serum protein and enzymes of broilers through 42 days of rearing period.

Groups	Treatments	Serum biochemicals			
		Serum protein g/100 ml	**LDH IU**	**ALT IU**	AST IU
NC	**0(Toxin or CA)**	**6.180± 0.446a**	**617-05± 18.53a**	**34± 2.915c**	**26± 0.707c**
PC	**T-2 4ppm**	**3.78± 0.740b**	**324.02± 25.495c**	**65± 6.723a**	**37± 1.140a**
MA	**0.375% CA**	**5.390± 0.583ab**	**514.80± 25.320b**	**44.20± 5.505bc**	**34.00± 0.907abc**
TMA	**T-2 4PPM± CA0.375**	**5.55± 0.607ab**	**518± 19.697b**	**54.10± 6.581ab**	**35± 1.410ab**

*Mean ±SE for 10 birds
**NC (0 ppm T-2 & no MA); PC (4 ppm T-2 & no MA); MA (0 ppm T-2 & 0.375 %MA); TMA (4 ppm T-2 &0.375 %MA)
***Means with same superscripts within a column do not differ from each other (P>0.05)

T-2 toxin is important to the poultry industry because of its toxicity and frequency of occurrence in food stuffs . The toxicity with T-2toxin in poultry has been well documented in Mosul governorate (Shareef ,2010), and elsewhere (Wijdnans and Van leucden, 2006). In this experiment, The lower feed intake, daily weight gain and higher food conversion ratio observed in chicks fed with T-2 alone (the positive control group,PC) as compared with other treatments were consistent with previous reports on the performance depressing effects of T-2 (Pande *et al.,* 2006).

The reduction in feed consumption is largely due to oral gross lesions induced by feeding T-2 toxin in birds of (PC) groupcompared with other treatments. Experimentally ,T-2 toxin has cytotoxicity on cultured cells (Bouaziz *et al.,* 2006). Oral lesions were reported to decrease feed consumption and to depress body weight gain (Sklan *et al.,* 2001). The toxin itself is a potent protein synthesis inhibitor through the inactivation of initiation , translation and termination process of protein synthesis, possibly through its binding to ribosomes (Kalantari and Hematti, 2001) Recently, T-2 toxin was found to induce apoptosis (Bouaziz *et al.,* 2008) and affects almost all tissues and organs. Labile cells are mostly attacked by structural changes due to T-2 toxin cytotoxic effects. The cytotoxic effect of T-2 toxin resulted in our experiment in a significant reduction in the relative weights of thymus , bursa of Fabricius and spleen, which were affected by dietary treatment of T-2 toxin (PC), compared with other groups (NC,MA,TMA). Atrophy of the lymphoid organs was also reported earlier during mycotoxicoses (Venkatesh *et al.,* 2005) and are in line with results of the present trial. This mycotoxin causes pathomorphological alterations and generalized lymphoid depletion; Lymphocytolysis and atrophy invariably in all lymphoid organs of toxin fed birds indicated the immunosuppressive potential of this toxin due to its cytotoxic effect on the lymphoid cells. ((Jakic-Dimic *et al.,* 2009). T-2 toxin strongly induces apoptosis in the thymus and spleen and bursa of Fabricius (Conkova *et al.,* 2003). The reductions in size of these organs might have been due to necrosis and cellular depletion by the mycotoxins. (Hoerr *et al.,* 1982). Other internal organs , liver (WHO , 2002), on the other side, and by the effect of T-2 toxin were increased in their relative weights (PC) group, compared with other groups .These finding are in the line of (Grizzle *et al.,* 2004) T-2 toxin strongly induces apoptosis particularly quickly in the liver, compared with other organs (Conkova *et al.,* 2003)T-2 toxin caused lesion in lymphocytic and haematopoietic tissues, alimentary tract(oral, croup, provenriculus and gizzard);the hepatobiliary tract,and kidney (Conkova *et al.,* 2003).

T-2 toxin was associated with a significant reduction in the number of red and white blood cells, haemoglobin concentration and haemtocrit,compared with negative controlgroup., and does so particularly quickly in the liver, compared with other organs (Conkova *et al.,* 2003) In our results T-2 toxin had a detrimental effect on the blood picture, loweringblood cell, HB, and PCV in birds of group (PC), compared with negative control group. These findings were in line of other investigators (Kamalavenkatesh , 2003), who found a dramatic alteration in the red cell morphology (Gongyossy-Issa *et al.,* 1986) leading to anaemia; alukea (reduction in white blood cells), due to irreversible damage to the bone marrow (Moss , 2002); reduction in HB, PCV, hypoproteinaemia (Raju and Devegowda,2004) . Toxin treated birds revealed reduction in PCV and Hb values indicating anaemia. Anaemic changes have been reported in broilers fed 1 ppm of T-2 toxin onwards (Huff *et al.,* 1988); Decreased seum protein, observed in T-2 group (PC) could be attributed to the reduction in feed consumption and hepatic damage as observed in this study, since liver is the major organ of. Protein synthesis (Kaneko *et al.,* 1997). Significant reduction in total protein value was observed in T-2 fed birds, which agreed with the findings of earlier workers (Kamalavenkatesh , 2003).

Feeding broiler chicken with 4 ppm of T-2 toxin from 0 to 6 weeks of age also caused significant decreased LDH and increased ALT and AST (Kamalavenkatesh , 2003).

Increase of AST and ALT levels with reduction in LDH in T-2 feeding group(PC) were also founded with earlier reports (Yadav *et al.,* 2003). The increased AST, ALT and ALP values might be attributed to the liver damage in the toxin fed birds.

The mixture of adsorbents used in this experiment were hydrated sodium calcium aluminosilicate, activated charcoal and mycofix (TMA) in a percentage of o.375% were effective in ameliorating the effect of T-2 toxin on the 24 parameters examined ($p<0.05$), compared with the (PC) group. Aziz (2005), studied the effect of these adsorbents each alone with or without T-2 toxin on 20 parameters in broiler chicks and found that 14, 15 and 18 parameters were alleviated by using HSCAS, activated charcoal and mycofix respectively.

The beneficial effect of Mycofix- plus on the negative effect of T-2 toxin is based on the enzymatic inactivation of the 12,13-epoxide ring of the trichothecenes and flavonoligands which are some of the components of Mycofix-plus and have the role to protect liver by blocking receptors in cell membrane of hepatocytes. Besides the biological constituent, Mycofix-plus contains inorganic binder with the adsorption based on the production of hidrating connection between the mycotoxin and the adsorbent, as well as flavonoligands, terpenoid complexes and fycofite components which reduce inflammation, stimulate immune response and accelerate metabolic processes. (Garcia *et al.,* 2003)

Activated charcoal significantly antagonized the lethal effects of T-2 toxin by adsorbing the ingested toxin, thereby preventing absorption and removing toxin from the GI tract, preventing further cellular damage (Vladimir et al., 2009; Vesna *et al.,* 2007). Although HSCAS was reported to be ineffective with T-2 toxin **(**Girish and Devegowda , 2006), it may still in our study the least adsorbents in counteracting T-2 toxin in broiler chicks. It seems logic to use more than one adsorbent in an attempt to counteract the effect of the naturally occurring cocktail of mycotoxins present at any time especially in bad managed feed production. Since, an efficient mycotoxin adsorption does not depend only on the physical properties of the adsorbent itself (total charges and their distribution, polarity, solubility, surface area, and its molecular properties), but also one the toxin being adsorbed (polarity, pore size solubility, size, type and distribution of its charges and molecules) (Huwing et al., 2001). So, it is likely that one adsorbent could not fulfil by its own characteristics the full adsorption capacity of particular mycotoxin, and the advisement in the recent years to use more than adsorbent to treat feed mycotoxicosis in poultry production is a matter of concern .

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