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Effects of different levels of date pits in broilers' feed contaminated with aflatoxin B_1 on broilers' performance and carcass characteristic

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The aim of this study was to evaluate the ability of date pits (DP) to reduce the deleterious effects of aflatoxin B_1 (AFB_1) in broiler chicks. A total of 216 one-day-old male broiler chicks (Ross 308) were distributed randomly for nine treatments (with four replicates and six birds in each) for 35 days. The experiment included a 3×3 factorial arrangement of treatments involving three levels of DP (0, 2 and 4%) and three levels of AFB1 (0, 150 and 300 ppb) based on a completely randomized design. There was a significant reduction of feed intake with treatment of 300 ppb during fourth and fifth weeks. DP levels were effective in diminishing the adverse effect caused by aflatoxin on feed intake of broilers (P< 0.05). However, 4% date pits had better effect. Mean body weights were not affected weekly, but the main effect of aflatoxin was significantly (P< 0.05) low by feeding 300 ppb aflatoxin in fourth and fifth weeks. Treatments with DP levels did not show any significant change with control group in case of feed conversion ratio; however the main effect of aflatoxin diets containing 300 ppb showed significant reduction in feed conversion ratio only in fourth week (P<0.05). Carcass weight decreased significantly in the main levels of AFB_1 while the relative weight of the liver, intestine, gizzard and thigh increased significantly (P≥0.05). Other carcass parts were not affected. It is suggested that DP might be used for reducing the adverse effects of aflatoxin in the broiler diets.

Key words: Aflatoxin, broiler, date pits, performance, carcass characteristic.

INTRODUCTION

A European Union report implies that, 30% of food and agricultural products infected by 90% mycotoxins are related to aflatoxins (Moss, 1996). In order to eliminate or reduce mycotoxin in animal diets, different physical, chemical and biological methods are used (Santin et al., 2003). Aflatoxins in humidity over 15%, minimum ambient temperature of 25°C, having enough air (Ruston, 1997) growing particularly in warm, humid climate damage the liver, kidney (Hoerr, 1997), trachea, subcutaneous tissues, glands and stomach (Yang et al 2012; Magnoli et al 2011; Bommakanti and Waliyar, 2006). Aflatoxin B1 is the most toxic and carcinogenic. The carcinogenic effect of aflatoxins in humans and animals has been demonstrated (Shames, 2005). Low doses of mycotoxin that may be unrecognizable reduce production and increase susceptibility to infections and can lead to low profit of the producers. The amount of aflatoxin in poultry rations is normally not more than 20 mg (Whiaker et al., 1996).

Aflatoxicosis or illness resulting from the consumption of aflatoxin in broilers is primarily a chronic occurrence and the main symptoms are: reduced body weight, increased feed conversion, low productivity, high losses and ultimately low unit efficiency (McKean, 2006). The date palm (*Phoenix dactylifera L.*) is well adapted to the dry and semi-dry regions of the world (FAO, 2007). Based on the theory of the Dawson, the main home of

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date trees is Iraq and western and southern regions of Iran (Dowson, 1982). Iran is considered to be the fourth date-producer country with an annual production of approximately 880,000 metric tons (FAO, 2007). But, little information about the use of this by-product in poultry diets is available (El Hag and Khanjari, 1992). Date pits consist of approximately 8 to 15% of the total weight of the date and high frequency components, which can play an important role in providing nutritious food used in livestock and poultry. Unfortunately, in Iran little research on the use of date byproducts in feed for livestock and poultry has been implemented. Research results indicate that date pits have nutritional value for livestock and poultry (Aldhaheri et al., 2004). The other names for date pit are: pits, stones, kernels or seeds. Some fruits of dates are completely worthless despite their abundant nutrients (approximately 7 to 5% crude protein; 10 to 7% fat; 20 to 10% fiber; 65 to 55% crude carbohydrate), which can be grinded and mixed with other livestock and poultry feed (Barreld, 1993). Subsequently, due to the high level of mannan in date pits mannan enzymes improve the nutritive value of this product (Hoerr, 1997).

With the development of biotechnology in the past decades, new methods for solving the problem of Mycotoxins are opened to researchers. Glucomannan commonly has the ability to connect with multiple mycotoxin (Zhao et al 2010; Navid Shad 2007). Some yeasts have been identified to reduce impacts of aflatoxicosis in poultry. These beneficial effects are related to Glucomannan in their cell wall. Mannan is polymers; the menus are available in the cell walls of plants. A type of glycomannan is the main component of the cell walls of palm kernels, which in this case acts as a food reserve and disappears during germination (Navid Shad, 2007). According to the above experiment, the effective use of date pits due to mannans and their role in reducing the effects of aflatoxicosis in poultry have been investigated.

MATERIALS AND METHODS

A total of 216 day-old broiler chicks (Ross 308) were housed in the poultry research station and randomly allocated to 9 groups with 4 replicates (n=6). This trial was conducted as a factorial experiment (3 × 3) consisting of three levels of DP (0, 2 and 4%) and three levels of AFB1 (0, 150, and 300 ppb) based on completely randomized design. While the first group was kept as a control, the other groups received the feed for 35 days: 2) 150 ppb of AFB_1, 3) 300 ppb of AFB_1, 4) 2% DP, 5) 2% DP with 150 ppb AFB_1, 6) 2% DP with 300 ppb of AFB_1, 7) 4% DP, 8) 4% DP with 150 ppb AFB_1, 9) 4% DP with 300 ppb AFB_1. Ration was adjusted according to the requirements recommended by ROSS companies and set by using software UFFDA (Tables 1, 2 and 3).

In this study, aflatoxin was produced via fermentation of milled rice by *Aspergillus flavus* IR 111 as described by Shotwell et al. (1966). AF was extracted according to the study of Romer (1975) and was quantified by TLC as outlined by AOAC (1995). The AFB_1 content in the milled rice was 60 ppm. The contaminated rice was milled and changed to fine powder which was added to the diet according to the desired aflatoxin levels needed for treatments. The experimental period was 35 days. The feeding programs consisted of starter diets fed from 1 to 14 days of age, grower diet fed from 14 to 28 days of age and finisher diet fed from 28 to 35 days of age. Date pits were prepared from the pulp mill dates factory; and then to separate foreign materials, they were washed, dried and finely milled.

Feed intake (FI) and body weight gain (BWG) were determined weekly for each replicate and feed conversion ratio (FCR) was calculated, accordingly. Two birds from each treatment group were randomly selected at the end of the trial and slaughtered to estimate weights of carcass components (%). Data were analyzed by the statistical software SAS (1991) as a completely randomized design based on factorial experiment (repeated measurement for repeated data) with the mixed procedure. Differences were considered significant at (P<0.05). Also, the Tukey-Kramer test was adopted to compare mean values.

RESULTS

Results of feed intake in different weeks of experiments are presented in Table 4. Results indicate that in the first three weeks of the experiment, there were no significant changes observed in feed intake among the treatments but at the end of the fourth and fifth weeks, a significant decrease in feed intake in the treatment containing 300 ppb aflatoxin was observed with other groups. Treatments with date pits and aflatoxin increased feed intake which were not significant with the control group (P <0.05). In the main level of aflatoxin, levels of 300 ppb were significant (P <0.05) with other levels during the fifth week. Also, 4% of date pits on average feed intake in the 4th and 5th weeks of the trial was statistically significant (P<0.05) with 0 level.

Mean body weights were not affected weekly (Table 5), but the main effect of aflatoxin was significantly (*P*<0.05) low by feeding 300 ppb aflatoxin in fourth and fifth weeks (P<0.05). A significant increase in the main level of 0 with 2% date pits and 0 with 4% on body weight gain was seen (P<0.05) in the fourth week. The results also indicate that supplementation of 4% date pits in poultry diets has no negative impact on the average weight gain. In addition, no significant change in average weight gain of chickens that received the control diet was observed. Supplementary diet of 4% date pits improved reduction in an average weight gain caused by the consumption of feed contaminated with 300ppb aflatoxin levels. Thus, the weight gain of chickens that received diets contaminated with aflatoxin and supplement of 4% date pits had no significant difference in mean weight gain compared to chickens that received the control diet.

At weeks 4 and 5 of the experiment, FCR increased significantly between treatments containing 300 ppb aflatoxin alone or 2% date pits containing 150 ppb of date pits (P <0.05) (Table 6). In the 5th week of the experiment, treatment with 300 ppb Aflatoxin with 150 ppb aflatoxin treated with 2% date pits was significant (P<0.05). The statistical difference between the main level of 300 ppb and 0 ppb aflatoxin was observed in the average feed conversion (P<0.05) at the fourth week.

Table 1. Different combinations of diets in starter phase (1-14 days) percent.

Ingredient (%)	Treatment								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Corn	56.12	56.12	56.12	52.77	52.77	52.77	49.42	49.42	49.42
Soybean meal	34.05	34.05	34.05	34.42	34.42	34.42	34.79	34.79	34.79
Fish meal	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Soybean oil	2.44	2.44	2.44	3.44	3.44	3.44	4.44	4.44	4.44
DCP	1.54	1.54	1.54	1.54	1.54	1.54	1.53	1.53	1.53
Shell	1.1	1.1	1.1	1.08	1.08	1.08	1.07	1.07	1.07
Mineral supplements*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin supplements**	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DL - methionine	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35
L - lysine	0.18	0.18	0.18	0.17	0.17	0.17	-	-	-
Date pits	-	-	-	2	2	2	4	4	4
Contamination levels of aflatoxin B1 (ppb)	-	150	300	-	150	300	-	150	300
Calculated nutrient composition (%)									
Energy ME (Kcal/Kg)	2950	2950	2950	2950	2950	2950	2950	2950	2950
Crude Protein (%)	22	22	22	22	22	22	22	22	22
Calcium (%)	1	1	1	1	1	1	1	1	1
Phosphorus (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

The amount of feed contaminated with aflatoxin B1 is expressed in ppb. *Each kg contains 64.5 g manganese, 33.8 g zinc, 8 g copper, 640 mg iodine, 190 mg cobalt, and 8 g selenium. **Each kg contains 4400000 unit per kg contain vitamin A, 72000 IU of vitamin D, 14400 mg of vitamin E, 2000 mg of vitamin K, 640 mg of cobalamin, 612 mg vitamin C, 3000 mg riboflavin, 4896 mg pantothenic acid, 12160 mg niacin, 612 mg pyridoxine

Table 2. Different combinations of diets in grower phase (14-28 days) percent.

Ingredient (%)	Treatment								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Corn	62.09	62.09	62.09	58.95	58.95	58.95	55.6	55.6	55.6
Soybean meal	29.81	29.81	29.81	30.14	30.14	30.14	30.51	30.51	30.51
Fish meal	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Soybean oil	2	2	2	2.82	2.82	2.82	3.82	3.82	3.82
DCP	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Shell	1.02	1.02	1.02	1.01	1.01	1.01	1	1	1
Mineral supplements*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin supplements**	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DL - methionine	0.28	0.28	0.28	0.28	0.28	0.28	0.29	0.29	0.29
L - lysine	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.12	0.12
Date pits	-	-	-	2	2	2	4	4	4
Contamination levels of aflatoxin B1 (ppb)	-	150	300	-	150	300	-	150	300
Calculated nutrient composition (%)									
Energy ME (Kcal/Kg)	3000	3000	3000	3000	3000	3000	3000	3000	3000
Crude Protein (%)	20	22	22	22	22	22	22	22	22
Calcium (%)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Phosphorus (%)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45

The amount of feed contaminated with aflatoxin B1 is expressed in ppb. *Each kg contains 64.5 g manganese, 33.8 g zinc, 8 g copper, 640 mg iodine, 190 mg cobalt, and 8 g selenium. **Each kg contains 4400000 unit per kg contain vitamin A, 72000 IU of vitamin D, 14400 mg of vitamin E, 2000 mg of vitamin K, 640 mg of cobalamin, 612 mg vitamin C, 3000 mg riboflavin, 4896 mg pantothenic acid, 12160 mg niacin, 612 mg pyridoxine.

Table 3. Different combinations of diets in finisher phase (28-35 days) percent.

Ingredient (%)	Treatment								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Corn	66.93	66.93	66.93	63.58	63.58	63.58	60.23	60.23	60.23
Soybean meal	25.78	25.78	25.78	26.16	26.16	26.16	26.53	26.53	26.53
Fish meal	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Soybean oil	2.15	2.15	2.15	3.15	3.15	3.15	4.15	4.15	4.15
DCP	1.47	1.47	1.47	1.47	1.47	1.47	1.46	1.46	1.46
Shell	1	1	1	0.9	0.9	0.9	0.97	0.97	0.97
Mineral supplements*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin Supplements**	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DL - methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26
L - lysine	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.17
Date pits	-	-	-	2	2	2	4	4	4
Contamination levels of aflatoxin B1 (ppb)	-	150	300	-	150	300	-	150	300
Calculated nutrient composition (%)									
Energy ME (Kcal/Kg)	3050	3050	3050	3050	3050	3050	3050	3050	3050
Crude Protein (%)	18	18	18	18	18	18	18	18	18
Calcium (%)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Phosphorus (%)	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42

The amount of feed contaminated with aflatoxin B1 is expressed in ppb. *Each kg contains 64.5 g manganese, 33.8 g zinc, 8 g copper, 640 mg iodine, 190 mg cobalt, and 8 g selenium. **Each kg contains 4400000 units per kg contain vitamin A, 72000 IU of vitamin D, 14400 mg of vitamin E, 2000 mg of vitamin K, 640 mg of cobalamin, 612 mg vitamin C, 3000 mg riboflavin, 4896 mg pantothenic acid, 12160 mg niacin, 612 mg pyridoxine.

Table 4. Average feed intake of chicken per week (chicken. g).

Parameter		Week 1	Week 2	Week 3	Week 4	Week 5
Treatment	1- Control without AFB1 and DP	128.58	329.04	577	798.42^{ab}	1034.54^{ab}
	2- 150 ppb AFB1	124.24	326.54	573.66	789.33^{ab}	1032.12^{ab}
	3- 300 ppb AFB1	124.91	223.96	540.49	732.66^{c}	990.09^{c}
	4- 2% DP	126.99	325.41	572.37	791.66^{ab}	1039.87^{a}
	5- 2% DP and 150 ppb AFB1	125.25	324	576.21	795.58^{ab}	1037.25^{ab}
	6- 2% DP and 300 ppb AFB1	125.87	324.87	564.37	788.83^{ab}	1000.24b^{c}
	7- 4% DP	124.45	327.37	578.37	798.50^{ab}	1042.20^{a}
	8- 4% DP and 150 ppb AFB1	127.83	328.37	578.83	806.33^{a}	1044.50a
	9- 4% DP and 300 ppb AFB1	126.26	329.74	576.58	786.79^{ab}	1034.37^{ab}
	SEM					6.72
AFB1	0	126.68	327.27	575.91	769.19^{b}	1038.87^{a}
	150 ppb	125.77	326.3	576.23	797.08^{a}	1038.29^{a}
	300 ppb	125.82	326.19	560.48	769.43^{b}	1008.22^{b}
	SEM					3.88
DP	0	125.91	326.51	563.72	773.47^{b}	1019.23^{b}
	2%	126.04	324.76	570.98	792.02^{ab}	1025.79^{ab}
	4%	126.31	328.5	577.93	798.21^{a}	1040.36^{a}
	SEM					3.88
Level of significant	AFB1					0.0008
	DP					0.0156
	AFB1*DP					0.0722

$^{a-c}$Each column with different letters are statistically significant ($p < 0.05$).

Table 5. Increase in mean body weight at different weeks (chicken. g)

Parameter		Week 1	Week 2	Week 3	Week 4	Week 5
Treatment	1- Control without AFB1 and DP	110.48	186.33	333.26	397.04	514.67
	2- 150 ppb AFB1	94.04	197.94	329.96	410	489.34
	3- 300 ppb AFB1	104.11	195.5	312.42	332.96	448.63
	4- 2% DP	107.37	191.96	357.08	401.46	483.83
	5- 2% DP and 150 ppb AFB1	107.24	201.09	381.21	418.46	562.21
	6- 2% DP and 300 ppb AFB1	105.12	199.13	327.58	406.55	431.08
	7- 4% DP	102.4	201.21	354.34	416.5	498.54
	8- 4% DP and 150 ppb AFB1	107.85	189.65	327.44	459.08	498.88
	9- 4% DP and 300 ppb AFB1	103.24	208.31	323	393.96	489.5
	SEM					16.48
AFB1	0	106.75	193.16	348.23	405.00[ab]	499.02[ab]
	150 ppb	103.04	196.22	346.2	429.18[a]	516.81[a]
	300 ppb	104.16	200.61	321	377.82[b]	456.40[b]
	SEM					9.51
DP	0	102.88	193.25	325.21	380.00[b]	484.21
	2%	106.58	197.39	355.29	408.82[a]	492.37
	4%	104.5	199.36	334.92	423.18[a]	495.64
	SEM					9.51
Level of significant	AFB1					0.0004
	DP					0.0245
	AFB1*DP					0.1718

[a-c]Each column with different letters are statistically significant (p <0.05).

Significant changes in the relative weight of the legs, back and neck, wings, spleen, pancreas, bursa of Fabricius, abdominal fat, proventriculus and heart were not seen (Tables 7 and 8). Carcass weight decreased significantly ($p<0.05$) in high levels of AFB_1 while the relative weight of the liver increased. Supplementation diets with 4% date pits and 300 ppb aflatoxin decreased liver weight. The relative weight of intestine increased significantly ($P<0.05$). Significant increase in the relative weight of the thigh and gizzard with increasing levels of date pits was seen in the main level of date pits.

DISCUSSION

Reduction in feed intake observed in this experiment matches with the results reported by Tedesco et al. (2004) and Ledux et al. (1998) but conflicts with the results of Edrington et al. (1997). Our results on weekly mean body weight match with the results of the research of Rajendra (1993) where he used different levels of aflatoxin in broiler chickens diets. Hussein et al. (1998) used different levels of date pits in broiler chicks, and concluded that chicks fed with diets containing date pits significantly ($P<0.05$) increase in body weight compared to chicks fed with the control diet (containing no date pits). The findings of this study showed that levels of aflatoxin in the diet have significant impact on the increase of the average feed conversion in poultry; this is consistent with the work of Celik et al. (2005) but contrary to the study of Miazzo et al. (2005). Growth depression due to aflatoxicosis includes reduction in feed intake, altered protein metabolism, altered enzyme activity, decreased nutrient utilization and absorption. As the levels of aflatoxin were low the chronic effect was seen at the last weeks. Consumption of contaminated feed with low levels of aflatoxin resulted in significant depression in the performance of broilers.

Addition of date pits to contaminated feed effectively impressed the performance of broilers as date pits contain mannanoligosaccharides. This effect of date pits might be attributed to mycotoxin adsorption (Devegowda, 1997) ability to prevent coloni-zation of pathogens in the gastrointestinal tract (Olsen, 1995) and its inhibitory effect on liver antioxidant depletion (Dvorska and Surai, 2001). Increased liver weight matched with the results of the investigation of Huff et al. (1986) and Miazzo et al. (2005), where they used various levels of aflatoxin in broiler chickens diets, and all their reports on the effects of aflatoxin in increasing the liver weight were approved. There was increased weight of the small intestine, due to decreased activity in the intestines of chickens that

Table 6. Average feed conversion of chickens a week (chicken. g).

Parameter		Week 1	Week 2	Week 3	Week 4	Week 5
Treatment	1- Control without AFB1 and DP	1.16	1.76	1.72	2.00[ab]	2.02[ab]
	2- 150 ppb AFB1	1.34	1.65	1.73	1.92[ab]	2.10[ab]
	3- 300 ppb AFB1	1.21	1.66	1.72	2.26[b]	2.20[ab]
	4- 2% DP	1.17	1.7	1.61	1.99[ab]	2.15[ab]
	5- 2% DP and 150 ppb AFB1	1.16	1.6	1.52	1.93[ab]	1.88[a]
	6- 2% DP and 300 ppb AFB1	1.19	1.62	1.72	1.94[ab]	2.34[b]
	7- 4% DP	1.21	1.62	1.63	1.89[ab]	2.09[ab]
	8- 4% DP and 150 ppb AFB1	1.18	1.73	1.77	1.76[a]	2.08[ab]
	9- 4% DP and 300 ppb AFB1	1.22	1.58	1.78	1.99[ab]	2.15[ab]
	SEM					0.082
AFB1	0	1.18	1.69	1.65	1.96[a]	2.08
	150 ppb	1.23	1.66	1.67	1.87[ab]	2.02
	300 ppb	1.21	1.62	1.74	2.06b	2.23
	SEM					0.047
DP	0	1.24	1.69	1.72	2.06	2.11
	2%	1.17	1.64	1.61	1.95	2.12
	4%	1.2	1.64	1.73	1.88	2.11
	SEM					0.047
Level of significant	AFB1					0.0305
	DP					0.1036
	AFB1*DP					0.4253

[a-c]Each column with different letters are statistically significant ($p<0.05$).

Table 7. Average relative weights of carcass components (%).

Parameter		Carcass	Breast	Thigh	Back and neck	Wing	Foot
Treatment	1- Control without AFB1 and DP	62.38[ab]	21.76	18.47[b]	16.43	5.71	4.53
	2- 150 ppb AFB1	63.53[ab]	22.62	19.10[ab]	16.36	5.44	4.41
	3- 300 ppb AFB1	60.85[b]	21.06	18.28[b]	15.89	5.53	4.42
	4- 2% DP	62.11[ab]	21.08	19.16[ab]	15.93	5.93	4.50
	5- 2% DP and 150 ppb AFB1	64.29[a]	22.87	19.71[ab]	16.06	5.64	4.34
	6- 2% DP and 300 ppb AFB1	62.87[ab]	21.41	19.59[ab]	16.17	5.59	4.56
	7- 4% DP	62.84[ab]	22.70	19.47[ab]	15.29	5.36	4.54
	8- 4% DP and 150 ppb AFB1	62.88[ab]	21.98	19.71[ab]	16.07	5.10	4.67
	9- 4% DP and 300 ppb AFB1	62.57[ab]	21.85	20.90[a]	14.66	5.14	4.36
	SEM	0.7233	0.6744	0.4805	0.6442	0.1798	0.1211
AFB1	0	62.44[ab]	21.85	19.03	15.89	5.67	4.52
	150 ppb	63.57[a]	22.49	19.51	16.16	5.39	4.47
	300 ppb	62.06[b]	21.44	19.59	15.57	5.42	4.44
	SEM	0.4176	0.3894	0.2774	0.3719	0.1038	0.0699
DP	0	62.25	21.81	18.61[b]	16.22	5.56[ab]	4.45
	2%	63.06	21.79	19.49[ab]	16.05	5.72[a]	4.47
	4%	62.76	22.18	20.03[a]	15.34	5.20[b]	4.53
	SEM	0.4176	0.3894	0.2774	0.3719	0.1038	0.0699

Table 7. Contd.

Level of significant	AFB1	0.0364	0.1644	0.3133	0.5394	0.1306	0.7166
	DP	0.3897	0.7313	0.0025	0.2117	0.0027	0.7324
	AFB1*DP	0.3209	0.4299	0.2967	0.8033	0.9934	0.3009

[a-c]Each column with different letters are statistically significant (p <0.05).

Table 8. Average relative weight sensitive organs (%).

Parameter		Proventriculus	Gizzard	Liver	Spleen
Treatment	1- Control without AFB1 and DP	0.36	1.71[c]	2.16[ab]	0.107
	2- 150 ppb AFB1	0.40	1.85[bc]	2.04[b]	0.111
	3- 300 ppb AFB1	0.42	1.89[bc]	2.86[a]	0.105
	4- 2% DP	0.38	2.22[a]	2.17[b]	0.0945
	5- 2% DP and 150 ppb AFB1	0.35	1.87[bc]	2.00[ab]	0.110
	6- 2% DP and 300 ppb AFB1	0.43	2.14[ab]	2.45[ab]	0.107
	7- 4% DP	0.36	2.47[a]	2.07[b]	0.119
	8- 4% DP and 150 ppb AFB1	0.37	2.35[a]	2.00[b]	0.126
	9- 4% DP and 300 ppb AFB1	0.44	2.24[a]	2.34[ab]	0.108
	SEM	0.022	0.076	0.137	0.013
AFB1	0	0.37[b]	2.13	2.14[ab]	0.197
	150 ppb	0.37[b]	2.02	2.01[b]	0.115
	300 ppb	0.43[a]	2.09	2.55[a]	0.107
	SEM	0.012	0.044	0.079	0.007
DP	0	0.392	1.82[c]	2.35	0.198
	2%	0.392	2.07[b]	2.21	0.104
	4%	0.392	2.35[a]	2.14	0.118
	SEM	0.012	0.044	0.079	0.007
Level of significant	AFB1	0.0013	0.2177	<0.0001	0.6611
	DP	0.9816	<0.0001	0.1607	0.4320
	AFB1*DP	0.5141	0.0054	0.3760	0.9250

[a-c]Each column with different letters are statistically significant (p <0.05).

received diets containing aflatoxin levels and supplementation diets with 4% date pits and 300 ppb aflatoxin improved weight of small intestine in broilers that received these diets. Significant increase in the relative weight of the gizzard with increasing levels of date pits could be as a result of the hard tissue of date pits.

Zangiabadi and Torki (2009) reported that adding complete waste of 30% dates only significantly affected the relative gizzard weight but had no significant effect on the other body parts that may be caused by hard tissue of date pits in experimental diets. Increase in the relative weights of liver in birds fed with contaminated feed as observed in the present study has been reported also by Kubena et al. (1997). This result may be due to the heaptotoxic effect of AF, resulting in appreciable changes in the functioning and gross appearance of liver (Tung et al., 1975). The relative increase in gizzard weight is in accordance with earlier studies (Kubena et al., 1990), which may be due to the result of severe inflammation and thickening of the mucosal layer. Based on the results of this experiment, the level of 300ppb aflatoxin has more significant effect on broilers' performance and carcass characteristic of broilers compared to 150 ppb aflatoxin B_1. Four percent (4%) of date pits had better effect on broilers' performance than 2% in reducing the detrimental effects of aflatoxin B_1. Therefore, it can be concluded that 4% of date pits can prevent the toxic effects of aflatoxin B_1 on broilers' performance and carcass characteristic.

Based on the findings of this study, it can be stated that mannanoligosaccharides in date pits can prevent the

Table 8. Contd.

Parameter		Abdominal fat	Bursa of Fabricius	Pancreas	Back and neck	Heart
Treatment	1- Control without AFB1 and DP	1.55	0.196^{ab}	4.34^{ab}	0.219	0.487
	2- 150 ppb AFB1	1.45	0.174^{ab}	4.14^{b}	0.246	0.484
	3- 300 ppb AFB1	1.37	0.181^{ab}	5.12^{a}	0.246	0.463
	4- 2% DP	1.32	0.188^{ab}	4.79^{ab}	0.242	0.442
	5- 2% DP and 150 ppb AFB1	1.44	0.149^{b}	3.98^{b}	0.223	0.432
	6- 2% DP and 300 ppb AFB1	1.16	0.223^{ab}	4.64^{ab}	0.241	0.461
	7- 4% DP	1.51	0.301^{a}	4.15^{b}	0.216	0.504
	8- 4% DP and 150 ppb AFB1	1.36	0.206^{ab}	4.000^{b}	0.200	0.440
	9- 4% DP and 300 ppb AFB1	1.64	0.180^{ab}	4.24^{b}	0.239	0.459
	SEM	0.127	0.029	0.186	0.014	0.019
AFB1	0	1.46	0.229	4.43^{ab}	0.226	0.478
	150 ppb	1.42	0.176	4.04^{b}	0.223	0.452
	300 ppb	1.39	0.195	4.67^{a}	0.242	0.461
	SEM	0.073	0.017	0.107	0.008	0.0113
DP	0	1.46	0.184	4.53^{a}	0.237	0.478
	2%	1.31	0.187	4.46^{ab}	0.235	0.445
	4%	1.50	0.229	4.13^{b}	0.218	0.468
	SEM	0.073	0.017	0.107	0.008	0.0113
Level of significant	AFB1	0.8085	0.098	0.0005	0.2212	0.2680
	DP	0.1637	0.1190	0.0218	0.2117	0.1235
	AFB1*DP	0.2627	0.1059	0.0587	0.3838	0.2966

[a-c]Each column with different letters are statistically significant ($p < 0.05$).

negative effects of aflatoxin B_1 on broilers' performance and their carcass characteristics. Supplementation diets contaminated with 300ppb aflatoxin B_1 by 4% date pits show the ability of this product to reduce weight loss, feed intake, feed conversion and improve the destruction of its effect on carcass characteristic.

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