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EFFECT OF AFLATOXIN B_1 ON PRODUCTIVE PERFORMANCE IN JAPANESE QUAIL RAISED UNDER EGYPTIAN CONDITIONS

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ABSTRACT: A total number of 480 unsexed one week old Japanese quail chicks for growing period and 96 layers (64 females plus 32 males) were used in the 1st generation. While, in the 2nd generation 416 unsexed one week old chicks for growing period and 96 layers (64 females plus 32 males) were used. This work was conducted to study the effect of dietary aflatoxin B_1 (AFB_1) at levels (0.0, 1.5, 3.0 and 4.5 ppm) on Japanese quail performance, during growing and laying periods for two generations.

The live body weight (LBW), egg number (EN), egg weight (EW), some external and internal traits for egg quality were significantly ($P \leq 0.01$) lower and delayed sexual maturity with 4.5 ppm than 3.0, 1.5 and 0.0 ppm levels, respectively in both generations. Heritability estimates based on sire component of variance (h^2_s) for LBW at different ages ranged between moderated (0.209) to high (0.825). While, h^2_s for age, LBW and egg weight at sexual maturity were 1.05, 0.951 and 0.792, respectively. h^2_s for EN and EW at different ages were ranged between 0.386-1.333, while egg quality traits were ranged between 0.065-0.755.

Key words: Aflatoxin B_1, productive traits, heritability and Japanese quail.

INTRODUCTION

Aflatoxins, natural contaminates of foodstuffs, are hepatotoxic metabolites produced by storage fungi of the genus *Aspergillus,* particularly types *A. flavus* and *A. parasiticus*, during growth on a number of food and feed materials (Coulombe, 1991). Eighteen different aflatoxins have been identified, and the major ones are B_1, B_2, C_1, and G_2, with aflatoxin B_1 (AFB_1) being the most common and toxic compound (Hsieh and Atkinson, 1991). Effects of aflatoxins are dose- and time-dependent, and two distinct forms of aflatoxicosis, namely acute and chronic, can be distinguished depending on the dose and length of time of exposure (Leeson *et al.*, 1995). Acute toxicity is clinically characterized by depression, anorexia, icterus, hemorrhages, and death (Pier, 1992). Chronic aflatoxicosis is generally associated with poor performance and usually results from regular low-level dietary intake of aflatoxins. In poultry, AFB_1 causes immunosuppression and decreased body weight gain and feed utilization. Reduced egg production and egg weight are the most reported manifestations of aflatoxicosis in quail layers (Leeson *et al.*, 1995), hepatotoxicosis (Nowar *et al.*, 1992 ; Oguz, 1997 and Kiran *et al.*, 1998) mutagensis, teratogensis, carcinagensis and haemorrhage (Edds and Bortell, 1983; Schull, 1985 and Nowar *et al.*, 1992).

In this study, it has been aimed to study the effects of AFB_1 on quail performance such as LBW, sexual maturity traits, egg production and quality traits and estimates of heritability values for the same traits studied.

MATERIALS AND METHODS

This study was carried out at the poultry farm, Department of Poultry Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt, during the period from 2003 to 2005.

Materials

A total number of 480 unsexed one week old Japanese quail chicks for growing period and 96 layers (64 females plus 32 males) were used in the 1^{st} generation. While, in the 2^{nd} generation 416 unsexed one week old chicks for growing period and 96 layers (64 females plus 32 males) were used. The quails were randomly assigned to one of four dietary AFB_1 (0.0, 1.5, 3.0 and 4.5 ppm) treatment groups. During growing period (1-6 weeks), each treatment consists of four replicates, each containing 30 birds for the 1^{st} generation and eight replicates, each containing 13 birds for the 2^{nd} generation. During laying period, (8-20 weeks), each treatment consists of eight replicates, each containing one male and two females for two generations studied (sex ratio 1:2).

The quails were given diet *ad libitum* containing 24.05% protein and 2901 kcl ME/kg in the growing period, and 20.03% protein and 2922 kcl ME/kg in laying period accordance to NRC 1994. A lighting schedule of 18 h light/day was applied. During the study, 0.01 gm sensitive electronic scale was used for weighing birds and eggs; however, a sensitive compass (0.01 mm) was used for measuring the length, width, yolk diameter of the eggs; a Table with a flat glass was used for eggs quality. A 3-legged sensitive micrometer (0.01 mm) was used for measuring the height of yolk and albumen; a sensitive micrometer (0.01 mm) was used for measuring the shell thickness.

Methods

All birds were individually weighed at 1, 3, 6, 8, 12, 16 and 20 weeks of age. Sexual maturity was assessed by average age (days), LBW (gm) and egg weight (EW) at the first 5 eggs were recorded. All eggs were recorded and individually weighed daily per sire in each pen from sexual maturity up to the end of the experiment. The width and length of the eggs were measured by a compose, (Romanoff and Romanoff, 1949). After this process, the eggs were broken on a Table with a glass cover in order to measure the yolk (height, diameter and weight), albumen height and shell weight. Weight of albumen was taken by subtracting weight of yolk plus shell weight from the whole egg weight (Amer, 1972). Shell thickness was measured with micrometer to the nearest 0.01 mm using the average of three points (narrow, broad and waist). Some internal and external quality traits of the eggs were estimated using formula on the bases of the aforementioned measures, (Selim and Ibrahim, 2004), as the following equation:

Egg surface area (cm^2) = $3.9782W^{0.75056}$

W = Egg weight (mg).

Unit surface shell weight (mg/cm^2) = Egg weight (mg) / Egg surface area (cm^2).

Egg shape index (%) = [Width (cm) / Length (cm)] X 100.

Shell (%) = [Shell weight / Egg weight] X 100.

Yolk (%) = [Yolk weight / Egg weight] X 100.

Albumen (%) = [Albumen weight / Egg weight] X 100.

Haugh unit (HU) = 100 log ($H + 7.57 - 1.7W^{0.37}$).

H = Albumen height (mm).

W = Egg weight (gm).

Statistical Analysis

Analysis of variance for data for the two generations studied was accomplished using the SAS General Liner Models Procedure (SAS Institute, 1996). The model was assessed for different traits according to Snedecor and Cochran (1982). The statistical model used was:

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

Where:

Y_{ij} = An observation, μ = Overall mean, T_i = Effect of aflatoxin treatment (i = 1, ... and 4) and e_{ij} = Random error.

Duncan's new multiple range test (Duncan, 1955) was used to test the differences among the means. All percentages were converted to the corresponding arcsine prior to statistical analysis.

Heritability Estimates

After adjusting the data, the statistical analysis was performed using least squares analysis of data as described by Harvey (1990). Heritability, standard errors and expected mean squares (E.M.S.) of equal and unequal numbers of progeny per sire, analysis of variance were estimated according to the following formula (Becker, 1985).

Equal and unequal numbers of progeny per sire group (balanced and unbalanced design)

S.O.V.	D.F.	S.S.	M.S.	E.M.S.
B. sires	S-1	SS_S	MS_S	$\sigma^2_W + (k \text{ or } k_1)\sigma^2_S$
B. progeny within sires	N-S	SS_W	MS_W	σ^2_W
Total	N-1	SS_T		

Where,

N = Total number of progenies, S = Number of sires, K = Number of progeny per sire (balanced design) and K_1 = Number of progeny per sire (unbalanced design), where

$$K_1 = \frac{1}{S-1}\left(n. - \frac{\sum n_i^2}{n.}\right)$$

n. = Total number of progenies and n_i = number of progeny with the i-th sire.

The heritability values based on parental half-sibs (h^2_S) was estimated as follows

$$h^2_S = \frac{4\sigma^2_s}{\sigma^2_s + \sigma^2_w}$$

Standard error (S.E.) of the heritability was estimated by using the following formula.

1. Balanced design

$$S.E.(h_S^2) \cong 4\sqrt{\frac{2(1-t)^2\left[1+(k-1)t\right]^2}{k(k-1)(S-1)}}$$

2. Unbalanced design

$$S.E.(h_S^2) \cong 4\sqrt{\frac{2(n-1)(1-t)^2\left[1+(k_1-1)t\right]^2}{k_1^2(n-S)(S-1)}}$$

Where, t = The interclass correlation, was estimated by using the following formula. $t = \sigma_s^2 / \sigma_s^2 + \sigma_w^2$

RESULTS AND DISCUSSION

Live Body Weight (LBW)

In growing period, birds received a dietary AFB_1 (4.5 ppm) were significantly ($P \leq 0.01$) lower in LBW than those received 3.0, 1.5 and 0.0 ppm, respectively at 3 and 6 weeks of age for both generations studied (Table 1). The results obtained agreed with those reported by Ruff *et al.*, (1992), Jakhar and Sadana (2000), Matari (2001) and Oguz and Parlat (2004). They showed that AFB_1 significantly ($P \leq 0.05$) decreased LBW during growing period.

In laying period, the LBW for treated quails with 4.5 ppm AFB_1 were significantly ($P \leq 0.01$) lower than those received 3.0, 1.5 and 0.0 ppm, respectively at 12, 16 and 20 weeks of age for both generations studied (Table 1). These results are in accordance with the findings showed by Johri *et al.*, (1990), Abd El-Hamid and Mahmoud (1996), Matari (2001). They mentioned that feeding on a dietary AFB_1 resulted significant ($P \leq 0.05$) decrease in LBW in laying quail. But, disagreement with Oliveira *et al.*, (2002) who showed that average LBW was not affected by AFB_1 levels (25, 50, or 100 µg AFB_1 / kg feed for 168 days.

Sexual Maturity

The results tabulated in Table (2) show that, the level 4.5 ppm AFB_1 was significantly ($P \leq 0.01$) delayed age (days) and significantly ($P \leq 0.01$) decreased EW at sexual maturity than 3.0, 1.5 and 0.0 ppm AFB_1 respectively, for two generations studied. Whereas, the percentages of increasing in age with 4.5 ppm AFB_1 level were 33.6 and 31.7, while the percentages of decrease in EW was 16.2 and 15.4 comparing with the control birds for two generations studied, respectively. The averages of LBW were significantly ($P \leq 0.01$) lower with 3.0 ppm AFB_1 than 4.5, 1.5 and 0.0 ppm respectively, for two generations studied. But, there

Table 1. Means ± S.E of live body weight (gm) as affected by different levels of AFB_1 during the growing and laying periods for two generations studied in Japanese quails

AFB_1 levels (kg. diet)	Growing period			Laying period			
	1[st] week	3[rd] weeks	6[th] weeks	At 8 weeks	At 12 weeks	At 16 weeks	At 20 weeks
	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$
First generation							
	N.S	**	**	N.S	**	**	**
0.0 ppm (Control)	19.88 ± 0.14^a	83.34 ± 0.48^a	171.81 ± 1.14^a	178.90 ± 0.11^a	197.61 ± 0.42^a	209.00 ± 0.60^a	221.66 ± 1.03^a
1.5 ppm	19.95 ± 0.14^a	79.63 ± 0.48^b	160.65 ± 0.97^b	178.93 ± 0.10^a	194.70 ± 0.44^b	203.84 ± 0.75^b	212.96 ± 1.22^b
3.0 ppm	19.84 ± 0.12^a	75.40 ± 0.56^c	154.30 ± 0.80^c	179.13 ± 0.12^a	192.67 ± 0.41^c	200.65 ± 0.78^c	207.92 ± 1.07^c
4.5 ppm	19.72 ± 0.10^a	71.87 ± 0.56	149.56 ± 0.86^d	179.20 ± 0.14^a	189.76 ± 0.40^d	196.67 ± 0.91^d	204.27 ± 1.07^d
Second generation							
	N.S	**	**	N.S	**	**	**
0.0 ppm (Control)	19.72 ± 0.15^a	84.07 ± 0.38^a	173.62 ± 0.43^a	178.35 ± 0.13^a	199.31 ± 0.64^a	209.00 ± 0.60^a	222.36 ± 1.07^a
1.5 ppm	19.62 ± 0.11^a	79.49 ± 0.26^b	163.90 ± 0.33^b	178.23 ± 0.12^a	194.69 ± 0.62^b	204.05 ± 0.80^b	214.27 ± 0.92^b
3.0 ppm	19.51 ± 0.11^a	76.36 ± 0.25^c	156.25 ± 0.42^c	178.20 ± 0.12^a	192.45 ± 0.56^c	199.10 ± 0.80^c	209.55 ± 0.94^c
4.5 ppm	19.42 ± 0.12^a	72.16 ± 0.32^d	150.33 ± 0.41^d	178.37 ± 0.11^a	190.41 ± 0.61^d	196.25 ± 0.74^d	204.61 ± 0.95^d

Means in the same column within each classification bearing different letters are different significantly at ($P < 0.05$), N.S=Not significant and **= Significant at 0.01 level.

Table 2. Means ± S.E for age, live body weight and egg weight at sexual maturity of Japanese quails as affected by different levels of AFB_1 for two generations studied

AFB_1 levels (kg. diet)	Age (day)		Live body weight (gm)		Egg weight (gm)	
	$\bar{X} \pm SE$	% from control	$\bar{X} \pm SE$	% from control	$\bar{X} \pm SE$	% from control
<u>First generation</u>	**		**		**	
0.0 ppm (Control)	42.06 ± 0.24^{d}	100.0	170.68 ± 0.30^{a}	100.0	10.22 ± 0.04^{a}	100.0
1.5 ppm	46.29 ± 0.32^{c}	110.1	166.95 ± 0.20^{b}	97.8	9.44 ± 0.05^{b}	92.4
3.0 ppm	49.17 ± 0.19^{b}	116.9	161.63 ± 0.20^{d}	94.7	9.16 ± 0.06^{c}	89.6
4.5 ppm	56.19 ± 0.35^{a}	133.6	163.40 ± 0.18^{c}	95.7	8.56 ± 0.07^{d}	83.8
<u>Second generation</u>	**		**		**	
0.0 ppm (Control)	41.67 ± 0.24^{d}	100.0	170.97 ± 0.32^{a}	100.0	10.11 ± 0.06^{a}	100.0
1.5 ppm	45.21 ± 0.28^{c}	108.5	167.35 ± 0.20^{b}	97.9	9.68 ± 0.04^{b}	95.7
3.0 ppm	47.81 ± 0.21^{b}	114.7	163.00 ± 0.21^{c}	95.3	9.12 ± 0.10^{c}	90.2
4.5 ppm	54.86 ± 0.30^{a}	131.7	163.62 ± 0.08^{c}	95.7	8.55 ± 0.08^{d}	84.6

Means in the same column within each classification bearing different letters are different significantly at ($P < 0.05$) and **= Significant at 0.01 level.

was no significant differences in LBW between the levels (3.0 and 4.5 ppm) in the second generation. Whereas, the percentages of decrease with 3.0 ppm AFB_1 level was 5.3 and 4.7 comparing with the control birds for two generations studied, respectively (Table 2). The results obtained agreed with those reported by Kosutzka *et al.*, (1988) and Jakhar and Sadana (2004). They found that AFB_1 delayed sexual maturity.

Egg Production Traits

The results presented in Table (3) show that, EN was significantly ($P \leq 0.01$) lower in birds received 4.5 and 3.0 ppm AFB_1 than those received 1.5 and 0.0 ppm, during all periods for two generations, while there were no significant differences between levels (0.0, 1.5) and (3.0, 4.5) whereas, the level 1.5 ppm decreased EN during 16-20 weeks of age in the 1st generation only. EN was decreased by 36%, 36.9%, 38.3% and 37% in the 1st generation and 24.7%, 25.5%, 31.5% and 27% in the 2nd generation during 8-12, 12-16, 16-20 and 8-20 weeks of age, respectively with 4.5 ppm AFB_1 level comparing with the control birds. EW was significantly ($P \leq 0.01$) lower with 4.5 ppm AFB_1 than 3.0, 1.5 and 0.0 ppm AFB_1, respectively, during all periods for two generations, except the period from 8-12 weeks of age in the 1st generation whereas, there were no significant differences between levels 1.5 and 3.0 ppm AFB_1. Whereas, the percentages of decrease in EW with level 4.5 ppm AFB_1 were (7.1, 7.4, 6.8 and 7) in the 1st generation and (7.8, 6.4, 6.7 and 6.1) in the 2nd generation during 8-12, 12-16, 16-20 and 8-20 weeks of age, respectively comparing with the control birds (Table 3). The results obtained agreed with those cited by Johri *et al.*, (1990), Matari (2001), Ogido *et al.*, (2004) and Yldz *et al.*, (2004). They showed that AFB_1 significantly ($P \leq 0.05$) decreased EN and EW in Japanese quail.

Egg Quality Traits

Exterior traits

The results presented in Table (4) show that, egg weight and unit surface shell weight were significantly ($P \leq 0.01$) lower with AFB_1 treatment (4.5 ppm) than 3.0, 1.5 and 0.0 ppm, respectively at most periods for two generations. While, Shell percent was significantly ($P \leq 0.01$) higher with 4.5 ppm than 3.0, 1.5 and 0.0 ppm at most periods in two generations. Shell thickness was significantly ($P \leq 0.01$) decreased with 1.5, 3.0 and 4.5 ppm at all periods in the 1st generation and 8-12, 8-20 weeks in

Table 3. **Means ± S.E for egg number and egg weight traits as affected by different levels of AFB_1 during the laying periods for two generations studied in Japanese quails**

AFB_1 levels (kg. diet)	8 – 12 weeks		12 – 16 weeks		16 – 20 weeks		8 – 20 weeks	
	$\bar{X} \pm SE$	% from control	$\bar{X} \pm SE$	% from control	$\bar{X} \pm SE$	% from control	$\bar{X} \pm SE$	% from control
Egg number								
First generation	**		**		**		**	
0.0 ppm (Control)	20.13 ± 0.28^{a}	100.0	23.56 ± 0.35^{a}	100.0	17.13 ± 0.43^{a}	100.0	60.81 ± 0.73^{a}	100.0
1.5 ppm	17.56 ± 1.16^{ab}	87.3	20.56 ± 1.25^{ab}	78.3	13.69 ± 1.26^{b}	79.9	51.81 ± 3.33^{ab}	85.2
3.0 ppm	15.44 ± 1.31^{bc}	76.7	17.50 ± 1.54^{bc}	74.3	12.56 ± 1.17^{b}	73.4	45.50 ± 3.99^{bc}	74.8
4.5 ppm	12.88 ± 1.48^{c}	64.0	14.88 ± 1.63^{c}	63.1	10.56 ± 1.05^{b}	61.7	38.31 ± 4.14^{c}	63.0
Second generation	**		**		**		**	
0.0 ppm (Control)	20.25 ± 0.23^{a}	100.0	23.50 ± 0.21^{a}	100.0	17.88 ± 0.42^{a}	100.0	61.63 ± 0.64^{a}	100.0
1.5 ppm	18.25 ± 1.19^{ab}	90.1	21.13 ± 1.41^{ab}	89.9	15.50 ± 1.10^{ab}	86.7	54.88 ± 3.66^{ab}	89.0
3.0 ppm	17.19 ± 1.11^{bc}	84.9	18.00 ± 1.76^{b}	76.6	13.44 ± 1.20^{bc}	75.2	48.63 ± 3.73^{bc}	78.9
4.5 ppm	15.25 ± 0.98^{c}	75.3	17.50 ± 1.16^{b}	74.5	12.25 ± 1.21^{c}	68.5	45.00 ± 3.01^{c}	73.0
Egg weight								
First generation	**		**		**		**	
0.0 ppm (Control)	11.18 ± 0.08^{a}	100.0	11.67 ± 0.03^{a}	100.0	11.87 ± 0.05^{a}	100.0	11.55 ± 0.03^{a}	100.0
1.5 ppm	10.93 ± 0.08^{b}	97.8	11.37 ± 0.03^{b}	97.4	11.52 ± 0.03^{b}	97.1	11.26 ± 0.03^{b}	97.5
3.0 ppm	10.73 ± 0.06^{b}	96.0	11.10 ± 0.02^{c}	95.1	11.25 ± 0.02^{c}	94.8	11.01 ± 0.02^{c}	95.3
4.5 ppm	10.39 ± 0.05^{c}	92.9	10.81 ± 0.04^{d}	92.6	11.06 ± 0.01^{d}	93.2	10.74 ± 0.02^{d}	93.0
Second generation	**		**		**		**	
0.0 ppm (Control)	11.36 ± 0.07^{a}	100.0	11.71 ± 0.03^{a}	100.0	11.95 ± 0.04^{a}	100.0	11.66 ± 0.02^{a}	100.0
1.5 ppm	11.16 ± 0.06^{b}	98.0	11.49 ± 0.03^{b}	98.1	11.60 ± 0.03^{b}	97.1	11.41 ± 0.01^{b}	97.8
3.0 ppm	10.86 ± 0.04^{c}	95.6	11.17 ± 0.03^{c}	95.4	11.32 ± 0.02^{c}	94.7	11.10 ± 0.01^{c}	95.2
4.5 ppm	10.47 ± 0.06^{d}	92.2	10.96 ± 0.05^{d}	93.6	11.15 ± 0.03^{d}	93.3	10.84 ± 0.02^{d}	93.9

Means in the same column within each classification bearing different letters are different significantly at ($P < 0.05$) and **= Significant at 0.01 level.

Table 4. Exterior traits for egg quality of Japanese quails ($\bar{X} \pm SE$) as affected by different levels of AFB_1 for two generations studied

AFB_1 levels (kg. diet)	Egg weight (gm)		Shell percent		Shell thickness (mm)		Egg shape index		USSW (mg/cm^2)	
	$\bar{X} \pm SE$	% from control	%	% from control	$\bar{X} \pm SE$	% from control	%	% from control	$\bar{X} \pm SE$	% from control
First generation at:										
8-12 weeks										
	**		**		**		N.S		**	
0.0 ppm (Control)	12.48 ± 0.06^{a}	100.0	19.13^{c}	100.0	0.24 ± 0.001^{a}	100.0	71.62^{a}	100.0	47.18^{a}	100.0
1.5 ppm	10.62 ± 0.09^{b}	85.1	20.76^{b}	108.5	0.23 ± 0.001^{b}	95.8	70.18^{a}	98.0	45.31^{b}	96.0
3.0 ppm	10.50 ± 0.07^{b}	84.1	23.66^{a}	123.7	0.23 ± 0.001^{b}	95.8	70.78^{a}	98.8	45.17^{b}	95.7
4.5 ppm	10.14 ± 0.08^{c}	81.3	24.39^{a}	127.5	0.23 ± 0.001^{b}	95.8	70.91^{a}	99.0	44.79^{c}	94.9
12-16 weeks										
	**		**		**		**		**	
0.0 ppm (Control)	12.55 ± 0.08^{a}	100.0	19.33^{c}	100.0	0.24 ± 0.001^{a}	100.0	71.46^{a}	100.0	47.24^{a}	100.0
1.5 ppm	11.42 ± 0.09^{b}	91.0	20.40^{bc}	105.5	0.23 ± 0.001^{b}	95.8	69.63^{b}	97.4	46.14^{b}	97.7
3.0 ppm	11.14 ± 0.04^{c}	88.8	21.24^{b}	109.9	0.23 ± 0.001^{b}	95.8	69.67^{b}	97.5	45.86^{c}	97.0
4.5 ppm	10.86 ± 0.06^{d}	86.5	22.80^{a}	118.0	0.23 ± 0.001^{b}	95.8	69.71^{b}	97.6	45.57^{d}	96.5
16-20 weeks										
	**		**		*		*		**	
0.0 ppm (Control)	12.41 ± 0.07^{a}	100.0	18.82^{d}	100.0	0.24 ± 0.001^{a}	100.0	70.81^{a}	100.0	47.11^{a}	100.0
1.5 ppm	11.55 ± 0.07^{b}	93.1	20.03^{c}	106.4	0.23 ± 0.001^{b}	95.8	70.06^{ab}	98.9	46.28^{b}	98.2
3.0 ppm	11.31 ± 0.04^{c}	91.1	21.43^{b}	113.9	0.23 ± 0.001^{b}	95.8	69.77^{b}	98.5	46.04^{c}	97.7
4.5 ppm	11.11 ± 0.03^{d}	89.5	23.02^{a}	122.3	0.23 ± 0.001^{b}	95.8	69.62^{b}	98.3	45.83^{d}	97.3
8-20 weeks										
	**		**		**		**		**	
0.0 ppm (Control)	12.48 ± 0.05^{a}	100.0	19.10^{d}	100.0	0.24 ± 0.001^{a}	100.0	71.30^{a}	100.0	47.18^{a}	100.0
1.5 ppm	11.20 ± 0.04^{b}	89.7	20.36^{c}	106.6	0.23 ± 0.001^{b}	95.8	69.95^{b}	98.1	45.91^{b}	97.3
3.0 ppm	10.99 ± 0.04^{c}	88.1	22.08^{b}	115.6	0.23 ± 0.001^{b}	95.8	70.07^{b}	98.3	45.69^{c}	96.8
4.5 ppm	10.70 ± 0.05^{d}	85.7	23.38^{a}	122.4	0.23 ± 0.001^{b}	95.8	70.08^{b}	98.3	45.40^{d}	96.2

Table 4. Continued

AFB$_1$ levels (kg. diet)	Egg weight (gm)		Shell percent		Shell thickness (mm)		Egg shape index		USSW (mg/cm^2)	
	$\overline{X} \pm SE$	% from control	%	% from control	$\overline{X} \pm SE$	% from control	%	% from control	$\overline{X} \pm SE$	% from control
Second generation at:										
8-12 weeks	**		**		**		N.S		**	
0.0 ppm (Control)	11.27 ± 0.17 [a]	100.0	17.31 [d]	100.0	0.24 ± 0.001 [a]	100.0	71.33 [a]	100.0	45.94 [a]	100.0
1.5 ppm	10.75 ± 0.07 [b]	95.4	22.85 [c]	132.0	0.23 ± 0.001 [b]	95.8	70.59 [a]	99.0	45.44 [b]	98.9
3.0 ppm	10.50 ± 0.07 [b]	93.2	23.88 [b]	138.0	0.23 ± 0.001 [b]	95.8	70.91 [a]	99.4	45.17 [b]	98.3
4.5 ppm	10.18 ± 0.06 [c]	90.3	25.52 [a]	147.4	0.23 ± 0.001 [b]	95.8	71.08 [a]	99.6	44.83 [c]	97.6
12-16 weeks	**		**		N.S		N.S		**	
0.0 ppm (Control)	12.23 ± 0.07 [a]	100.0	19.01 [d]	100.0	0.24 ± 0.001 [a]	100.0	70.95 [a]	100.0	46.93 [a]	100.0
1.5 ppm	11.53 ± 0.07 [b]	94.3	20.49 [c]	107.8	0.23 ± 0.001 [a]	95.8	69.85 [a]	98.4	46.25 [b]	98.6
3.0 ppm	11.32 ± 0.04 [b]	92.6	22.00 [b]	115.7	0.23 ± 0.010 [a]	95.8	69.94 [a]	98.6	46.05 [b]	98.1
4.5 ppm	10.94 ± 0.10 [c]	89.5	23.58 [a]	124.0	0.23 ± 0.001 [a]	95.8	70.84 [a]	99.8	45.65 [c]	97.3
16-20 weeks	**		**		N.S		**		**	
0.0 ppm (Control)	12.38 ± 0.08 [a]	100.0	19.15 [c]	100.0	0.24 ± 0.001 [a]	100.0	70.98 [a]	100.0	47.08 [a]	100.0
1.5 ppm	11.72 ± 0.06 [b]	94.7	21.09 [b]	110.1	0.23 ± 0.001 [a]	95.8	70.26 [b]	99.0	46.44 [b]	98.6
3.0 ppm	11.39 ± 0.04 [c]	92.0	22.55 [a]	117.8	0.23 ± 0.001 [a]	95.8	69.90 [b]	98.5	46.12 [c]	98.0
4.5 ppm	11.15 ± 0.02 [d]	90.1	22.41 [a]	117.0	0.23 ± 0.002 [a]	95.8	69.75 [b]	98.3	45.87 [d]	97.4
8-20 weeks	**		**		**		N.S		**	
0.0 ppm (Control)	11.96 ± 0.07 [a]	100.0	18.53 [d]	100.0	0.24 ± 0.001 [a]	100.0	71.09 [a]	100.0	46.65 [a]	100.0
1.5 ppm	11.33 ± 0.04 [b]	94.7	21.44 [c]	115.7	0.23 ± 0.001 [b]	95.8	70.23 [a]	98.8	46.04 [b]	98.7
3.0 ppm	11.07 ± 0.03 [c]	92.6	22.78 [b]	123.0	0.23 ± 0.002 [b]	95.8	70.25 [a]	98.8	45.78 [c]	98.1
4.5 ppm	10.75 ± 0.05 [d]	89.9	23.79 [a]	128.4	0.23 ± 0.001 [b]	95.8	70.56 [a]	99.3	45.45 [d]	97.4

Means in the same column within each classification bearing different letters are different significantly at ($P < 0.05$), USSW=Unit surface shell weight (mg/cm^2), **= Significant at 0.01level, *=Significant at 0.05 level and N.S=Not significant.

the 2nd generation, except at 16-20 weeks in the 1st generation, it was significantly ($P \leq 0.05$) decreased. Egg shape index was significantly ($P \leq 0.01$) decreased with levels 1.5, 3.0 and 4.5 ppm at 12-16, 8-20 weeks in the 1st generation, while at 16-20 weeks, it was significantly ($P \leq 0.05$) decreased in the 1st generation and significantly ($P \leq 0.01$) decreased in the 2nd generation. The obtained results are in agreement with those obtained by Matari (2001) who found that egg shape index and shell thickness traits were significantly ($P \leq 0.05$) decreased with feeding laying Japanese quails on a diet containing 1 ppm AFB_1. While, the results of Oliveira *et al.*, (2002) showed that average shell thickness was not affected by the low levels of dietary AFB_1 on laying Japanese quail.. Percentage of egg shell was higher ($P \leq 0.05$) in the group fed the ration containing 100 μg AFB_1 / kg diet.

Interior traits

The results presented in Table (5) show that, yolk percent was significantly ($P \leq 0.01$) lower with AFB_1 treatment (4.5 ppm) than 3.0, 1.5 and 0.0 ppm, respectively at most periods for two generations. Albumen percent was significantly ($P \leq 0.01$) lower with 4.5 ppm than 3.0 ppm at most periods for the 1st generation, while in the 2nd generation, it was significantly ($P \leq 0.01$) lower with 3.0 and 4.5 ppm than 1.5 ppm at 8-12 weeks and significantly ($P \leq 0.01$) increased with 1.5, 3.0 ppm at (12-16, 8-20) weeks and 1.5, 4.5 ppm at 16-20 weeks of age. Albumen height was significantly ($P \leq 0.01$) decreased with 1.5, 3.0 and 4.5 ppm at all periods in the 1st generation. While, in the 2nd generation it was decreased with 3.0, 4.5 ppm at 8-12, 16-20 and 8-20 weeks only. Yolk index was significantly ($P \leq 0.01$) decreased with 1.5, 3.0 and 4.5 ppm at 8-12 and 8-20 weeks for two generations. While, haugh units significantly ($P \leq 0.01$) decreased with 4.5 ppm only at 8-12 weeks in the 1st generation. These results are in accordance with the findings showed by Washburn *et al.*, (1985) who showed that yolk weight was significantly ($P \leq 0.05$) decreased in layer hen when fed on a diet containing AFB_1 (5 mg / kg diet). also Matari (2001) showed that albumen weight was significant ($P \leq 0.05$) decreased with feeding on a dietary AFB_1 (1 ppm) in laying Japanese quail while, there were no significant differences in yolk weight and yolk index between the birds received 0, 1 and 2 ppm

Table 5. Interior traits for egg quality of Japanese quails ($\bar{X} \pm SE$) as affected by different levels of AFB_1 for two generations studied

AFB_1 levels (kg. diet)	Yolk percent		Albumen percent		Albumen height (mm)		Yolk index		Haugh unit	
	%	% from control	%	% from control	$\bar{X} \pm SE$	% from control	%	% from control	$\bar{X} \pm SE$	% from control
First generation at:										
8-12 weeks	**		**		**		**		N.S	
0.0 ppm (Control)	29.05^{a}	100.0	51.82^{a}	100.0	5.57 ± 0.06^{a}	100.0	51.97^{a}	100.0	94.52 ± 0.27^{a}	100.0
1.5 ppm	28.05^{b}	96.7	51.19^{ab}	98.8	5.32 ± 0.03^{b}	95.5	49.60^{b}	95.4	94.53 ± 0.16^{a}	100.0
3.0 ppm	25.49^{c}	87.7	50.86^{b}	98.1	5.23 ± 0.04^{bc}	93.9	49.31^{b}	94.9	94.16 ± 0.19^{a}	99.6
4.5 ppm	25.78^{c}	88.7	49.84^{c}	96.2	5.18 ± 0.03^{c}	93.0	49.01^{b}	94.3	94.19 ± 0.20^{a}	99.7
12-16 weeks	**		**		**		N.S		N.S	
0.0 ppm (Control)	28.40^{a}	100.0	52.27^{a}	100.0	5.48 ± 0.06^{a}	100.0	51.98^{a}	100.0	94.01 ± 0.31^{a}	100.0
1.5 ppm	28.16^{a}	99.2	51.54^{a}	98.6	5.30 ± 0.05^{b}	96.7	51.40^{a}	98.9	93.88 ± 0.29^{a}	99.9
3.0 ppm	27.10^{b}	95.4	51.66^{a}	98.8	5.25 ± 0.04^{b}	95.8	51.43^{a}	98.9	93.81 ± 0.19^{a}	99.8
4.5 ppm	26.80^{b}	94.4	50.40^{b}	96.4	5.18 ± 0.03^{b}	94.5	51.33^{a}	98.7	93.64 ± 0.16^{a}	99.6
16-20 weeks	**		**		**		N.S		N.S	
0.0 ppm (Control)	28.73^{a}	100.0	52.45^{a}	100.0	5.49 ± 0.04^{a}	100.0	52.24^{a}	100.0	94.14 ± 0.17^{a}	100.0
1.5 ppm	27.48^{b}	95.6	52.49^{a}	100.1	5.35 ± 0.03^{b}	97.4	52.27^{a}	100.1	94.04 ± 0.20^{a}	99.9
3.0 ppm	27.42^{b}	95.4	51.15^{b}	97.5	5.28 ± 0.03^{bc}	96.2	52.19^{a}	99.9	93.86 ± 0.15^{a}	99.7
4.5 ppm	26.39^{c}	91.9	50.59^{b}	96.5	5.21 ± 0.02^{c}	94.9	52.11^{a}	99.8	93.61 ± 0.08^{a}	99.4
8-20 weeks	**		**		**		**		*	
0.0 ppm (Control)	28.72^{a}	100.0	52.18^{a}	100.0	5.51 ± 0.02^{a}	100.0	52.06^{a}	100.0	94.22 ± 0.11^{a}	100.0
1.5 ppm	27.89^{b}	97.1	51.76^{a}	99.2	5.33 ± 0.02^{b}	96.7	51.09^{b}	98.1	94.15 ± 0.10^{a}	99.9
3.0 ppm	26.70^{c}	93.0	51.23^{b}	98.2	5.25 ± 0.02^{c}	95.3	50.98^{b}	97.9	93.94 ± 0.10^{ab}	99.7
4.5 ppm	26.33^{c}	91.7	50.29^{c}	96.4	5.19 ± 0.02^{d}	94.2	50.83^{b}	97.6	93.81 ± 0.11^{b}	99.6

Table 5. Continued

AFB$_1$ levels (kg. diet)	Yolk percent		Albumen percent		Albumen height (mm)		Yolk index		Haugh unit	
	%	% from control	%	% from control	$\overline{X} \pm SE$	% from control	%	% from control	$\overline{X} \pm SE$	% from control
Second generation at:										
8-12 weeks										
	**		**		**		**		N.S	
0.0 ppm (Control)	29.80^{a}	100.0	52.89^{a}	100.0	5.48 ± 0.03^{a}	100.0	52.22^{a}	100.0	94.86 ± 0.18^{a}	100.0
1.5 ppm	25.87^{b}	86.8	51.28^{b}	97.0	5.41 ± 0.02^{ab}	98.7	50.06^{b}	95.9	94.88 ± 0.10^{a}	100.0
3.0 ppm	23.76^{c}	79.7	52.36^{c}	99.0	5.37 ± 0.03^{bc}	98.0	49.51^{b}	94.8	94.85 ± 0.15^{a}	100.0
4.5 ppm	23.06^{d}	77.4	51.41^{c}	97.2	5.29 ± 0.03^{c}	96.5	49.84^{b}	95.4	94.70 ± 0.17^{a}	99.8
12-16 weeks										
	**		**		N.S		N.S		N.S	
0.0 ppm (Control)	29.60^{a}	100.0	51.39^{b}	100.0	5.42 ± 0.06^{a}	100.0	52.02^{a}	100.0	93.90 ± 0.03^{a}	100.0
1.5 ppm	26.76^{b}	90.4	52.75^{a}	102.6	5.43 ± 0.04^{a}	100.2	51.72^{a}	99.4	94.42 ± 0.21^{a}	100.6
3.0 ppm	25.42^{c}	85.9	52.58^{a}	102.3	5.38 ± 0.04^{a}	99.3	51.96^{a}	99.9	94.32 ± 0.19^{a}	100.4
4.5 ppm	24.73^{d}	83.5	51.69^{b}	100.6	5.27 ± 0.03^{a}	97.2	52.27^{a}	100.5	94.06 ± 0.18^{a}	100.2
16-20 weeks										
	**		**		**		N.S		N.S	
0.0 ppm (Control)	29.15^{a}	100.0	51.71^{b}	100.0	5.47 ± 0.03^{a}	100.0	52.34^{a}	100.0	94.09 ± 0.18^{a}	100.0
1.5 ppm	25.98^{b}	89.1	52.93^{a}	102.4	5.46 ± 0.03^{ab}	99.8	52.54^{a}	100.4	94.40 ± 0.19^{a}	100.3
3.0 ppm	25.30^{c}	86.8	52.15^{b}	100.9	5.39 ± 0.03^{b}	98.5	52.89^{a}	101.1	94.35 ± 0.39^{a}	100.3
4.5 ppm	24.68^{d}	84.7	51.91^{a}	102.3	5.29 ± 0.01^{c}	96.7	52.73^{a}	100.7	93.99 ± 0.07^{a}	99.9
8-20 weeks										
	**		**		**		**		N.S	
0.0 ppm (Control)	29.50^{a}	100.0	51.97^{b}	100.0	5.45 ± 0.02^{a}	100.0	52.19^{a}	100.0	94.28 ± 0.13^{a}	100.0
1.5 ppm	26.21^{b}	88.8	52.35^{a}	100.7	5.43 ± 0.01^{a}	99.6	51.44^{b}	98.6	94.57 ± 0.07^{a}	100.3
3.0 ppm	24.85^{c}	84.2	52.36^{a}	100.8	5.38 ± 0.01^{b}	98.7	51.45^{b}	98.6	94.51 ± 0.07^{a}	100.2
4.5 ppm	24.19^{d}	82.0	52.02^{b}	100.1	5.28 ± 0.02^{c}	96.9	51.61^{b}	98.9	94.25 ± 0.11^{a}	100.0

Means in the same column within each classification bearing different letters are different significantly at ($P < 0.05$),
**= Significant at 0.01 level, *=Significant at 0.05 level and N.S=Not significant.

AFB_1. Oliveira *et al.*, (2002) showed that average haugh units was not affected by AFB_1 treatment (0, 25, 50 and 100 µg AFB_1 / kg diet) on laying Japanese quail.

Heritability Estimates

Heritability estimates (h_s^2) based on sire components of variance and their standard errors for live body weight at different ages during growing and laying periods, for sexual maturity, egg production and egg quality traits are presented in Table (6).

Heritability values for LBW at 1, 3, 6, 16 and 20 weeks of age were 0.213, 0.209, 0.206, 0.786 and 0.825, respectively. Similar trends were in harmony with the results of the present study reported by Bahi El-Deen (1991 and 1994), El-Fiky (1991), Samuel and Kimberly (1994), Kosba *et al.*, (1996) and El-Full *et al.*, (2001).

Heritability values for age at sexual maturity was estimated in this study was nearly similar to that obtained by Bahi El-Deen (1991) and El-Fiky (1991) in quail. While, heritability values for LBW and EW at sexual maturity were 0.951 and 0.792 (Table 6). This results are in accordance with the results found by Bahi El-Deen (1991) and Harfoush (2004).

Heritability estimates (h_s^2) showed high fluctuation through periods (8-12, 12-16, 16-20 and 8-20) weeks of age, with the general mean ranged from 0.386 to 0.6 and from 0.567 to 1.333 for EN and EW, respectively. The heritability values in this study were around the values found by Strong *et al.*, (1978), Bahi El-Deen (1991, 1994 and 2002), El-Fiky (1991), Sharaf (1992), Yehia (1992), Helal (1994) and Harfoush (2004).

Heritability estimates (h_s^2) based on sire component of variance for egg quality traits ranged between low (0.065) to high values (0.755).

In conclusion, the present study show that, although, dietary AFB_1 with higher than 1.5 ppm level had negative effects on Japanese quail performance which caused the lower heritability values for live body weight at most ages studied, because AFB_1 caused increasing in sire component variance, but, there were some improvement in the second generation comparing with the first one which may be due to transferred the genetic resistance from the parents to their offspring's. So, it is important to keeping the diets free from harmful contaminations such as AFB_1.

Table 6. Heritability estimates (h^2_s ± SE) for some productive and reproductive traits in Japanese quails

Traits	h^2_s ± SE
Live body weight:	
Growing period at:	
One week	0.213 ± 0.085
3 weeks	0.209 ± 0.089
6 weeks	0.206 ± 0.091
Laying period at:	
8 weeks	1.416 ± 0.321
12 weeks	1.893 ± 0.308
16 weeks	0.786 ± 0.346
20 weeks	0.825 ± 0.351
Sexual maturity at first five eggs:	
Age	1.050 ± 0.308
Live body weight	0.951 ± 0.307
Egg weight	0.792 ± 0.305
Egg production traits:	
Egg number at 8-12 week	0.436 ± 0.096
Egg number at 12-16 week	1.087 ± 0.160
Egg number at 16-20 week	0.386 ± 0.092
Egg number at 8-20 week	0.600 ± 0.099
Egg weight at 8-12 week	0.567 ± 0.112
Egg weight at 12-16 week	1.333 ± 0.175
Egg weight at 16-20 week	0.580 ± 0.116
Egg weight at 8-20 week	0.779 ± 0.119
Egg quality traits:	
Egg weight	1.776 ± 0.203
Yolk weight	0.755 ± 0.154
Albumen weight	0.682 ± 0.148
Shell weight	0.631 ± 0.143
Egg shape index	0.281 ± 0.102
Albumen height	1.088 ± 0.180
Haugh unit	0.266 ± 0.100
Yolk index	0.065 ± 0.072
Shell thickness	0.275 ± 0.099
Unit shell surface weight (USSW)	1.684 ± 0.202

h^2_s = Heritability estimates based on sire component (from paternal).

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تأثير الأفلاتوكسين B_1 على الأداء الانتاجى في السمان اليابانى المربى تحت الظروف المصرية

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أجريت هذه الدراسة بمزرعة الدواجن التابعة لقسم الدواجن – كلية الزراعة- جامعة الزقازيق – الزقازيق – مصر – خلال الفترة من ٢٠٠٣-٢٠٠٥. وقد استهدفت الدراسة معرفة تأثير الأفلاتوكسين B_1 على الأداء الانتاجى للسمان اليابانى مع حساب المكافئ الوراثى لبعض الصفات الإنتاجية و التناسلية للسمان.

وقد تم استخدام ٤ تركيزات من الأفلاتوكسين B_1 (صفر، ١,٥، ٣، ٤,٥ جزء في المليون) خلال مرحلتي النمو وإنتاج البيض لجيلين متتاليين. حيث تم استخدام ٤٨٠ كتكوت سمان عمر يوم غير مجنس لمرحلة النمو و ٩٦ طائر (٦٤ أنثى+ ٣٢ ذكر) في مرحلة إنتاج البيض في الجيل الأول. بينما تم استخدام ٤١٦ كتكوت غير مجنس عمر أسبوع لمرحلة النمو و ٩٦ طائر (٦٤ أنثى+ ٣٢ ذكر) في مرحلة إنتاج البيض للجيل الثاني.

و كانت أهم النتائج المتحصل عليها:

١- سجلت الطيور المعاملة بالمستوى ٤,٥ جزء في المليون أفلاتوكسين B_1 أقل وزن جسم حي $(P < 0.01)$ يليها المستويات (٣، ١,٥، صفر) على الترتيب عند عمر ٣، ٦ ، ١٢ ، ١٦ ، ٢٠ أسبوع من العمر في الجيلين.

٢- تأخر عمر النضج الجنسي و انخفض وزن البيض معنوياً $(P \le 0.01)$ في الطيور المعاملة بالمستوى ٤,٥ جزء في المليون عن المستويات ٣، ١,٥، صفر على الترتيب. بينما سجلت الطيور المعاملة بالمستوى ٣ جزء في المليون أقل $(P \le 0.01)$ وزن حي يليها المستويات ٤,٥، ١,٥، صفر على الترتيب للجيلين.

٣- انخفض عدد البيض معنوياً $(P \le 0.01)$ في الطيور المعاملة بالمستويين ٣، ٤,٥ جزء في المليون عن تلك المعاملة بالمستويين ١,٥ ، صفر في كل الفترات للجيلين ولا توجد اختلافات معنوية بين المستويين صفر، ١,٥ و المستويين ٣ ، ٤,٥ حيث انخفض عدد البيض مع المستوى ١,٥ في الفترة ١٦-٢٠أسبوع في الجيل الأول فقط. سجلت الطيور المعاملة بالمستوى ٤,٥ جزء في المليون أقل وزن بيضة $(P \le 0.01)$ يليه المستوى ٣ ، ١,٥ ،صفر على الترتيب في كل فترات الإنتاج في الجيلين ما عدا الفترة ٨-١٢ أسبوع من الجيل الأول حيث لا توجد اختلافات معنوية بين المستويين ١,٥، ٣ جزء في المليون.

٤- أنخفض كلاً من وزن البيض و النسبة المئوية للصفار ووزن وحدة المساحة من القشرة معنوياً $(P \le 0.01)$ مع المستوى ٤,٥جزء في المليون عن المستويات ٣,٥، ١,٥، صفر على الترتيب للجيلين. انخفضت النسبة المئوية للبياض معنويا ($P \le$

0.01) مع المستوى ٤,٥ جزء في المليون عن المستوي ٣ جزء في المليون في معظم فترات الجيل الأول، بينما انخفضت معنويا (P ≤ 0.01) في الجيل الثاني مع المستويين (٣، ٤,٥) عن المستوى ١,٥ خلال الفترة ٨-١٢ أسبوع ثم زادت معنويا مع المستويين (١,٥، ٣,٠) خلال الفترة ١٢-١٦ و الفترة ٨-٢٠ أسبوع و المستويين (١,٥، ٤,٥) في ١٦-٢٠ أسبوع. أنخفض ارتفاع البياض معنويا (P ≤ 0.01) بالمستويات ١,٥، ٣,٠، ٤,٥ جزء في المليون في كل فترات الجيل الأول بينما انخفضت معنويا (P ≤ 0.01) بالمستويين (٣،٤,٥) خلال ٨-١٢، ١٢-٢٠، ٨-٢٠ أسبوع في الجيل الثاني. أنخفض دليل الصفار معنويا (P ≤ 0.01) مع المستويات ١,٥، ٣,٠، ٤,٥ جزء في المليون خلال ٨-١٢، ٨-٢٠ أسبوع في الجيلين و لكن وحدات هاف انخفضت معنويا (P ≤ 0.01) بالمستوى ٤,٥ جزء في المليون في الفترة ٨-٢٠ أسبوع في الجيل الأول فقط. زادت النسبة المئوية للقشرة معنويا (P ≤ 0.01) بالمستوى ٤,٥ جزء في المليون عن المستويات ٣، ١,٥، صفر على الترتيب في معظم فترات الجيلين. أنخفض سمك القشرة معنويا (P ≤ 0.01) مع المستويات ١,٥، ٣,٠، ٤,٥ خلال كل الفترات في الجيل الأول و الفترتين ٨-١٢، ٨-٢٠ أسبوع في الجيل الثاني ما عدا الفترة ١٦-٢٠ أسبوع في الجيل الأول حيث انخفضت (P ≤ 0.05) مقارنة بالكنترول. أنخفض دليل البيضة (P ≤ 0.01) بالمستويات ١,٥، ٣، ٤,٥خلال الفترتين ١٢-١٦، ٨-٢٠ أسبوع في الجيل الأول أما الفترة ١٦-٢٠ أسبوع فقد انخفضت (P ≤ 0.05) للجيل الأول و (P ≤ 0.01) للجيل الثاني.

٥- كانت قيم المكافئ الوراثى لوزن الجسم الحي عند أعمار ١، ٣، ٦، ١٦، ٢٠ أسبوع (٠,٢١٣، ٠,٢٠٩، ٠,٢٠٦، ٠,٧٨٦، ٠,٨٢٥) على الترتيب. المكافئ الوراثى للعمر ووزن الجسم ووزن البيضة عند النضج الجنسي (١,٠٥، ٠,٩٥، ٠,٧٩) على الترتيب، المكافئ الوراثى لعدد البيض خلال كل فترات الإنتاج يتراوح من ٠,٣٨٦- ٠,٦ بينما يتراوح بين ٠,٥٦٧ - ١,٣٣٣ لوزن البيضة. المتوسط العام للمكافئ الوراثى لصفات جودة البيضة هو ٠,٧٥ .

الخلاصة:

تبين نتائج هذه الدراسة أنة على الرغم من أن تلوث الأعلاف بالأفلاتوكسين B_1 بمستوى أعلى من ١,٥ جزء في المليون ذات تأثير سلبي على الأداء الانتاجي للسمان الياباني، حيث أدى إلى انخفاض قيم المكافئ الوراثى لوزن الجسم بسبب زيادة تباين الآباء ولكنة وجد بعض التحسين في أداء الجيل الثاني عن الجيل الأول والذي ربما يرجع إلى انتقال المقاومة الوراثية من الآباء إلى النسل الناتج. لذلك فانه من الضروري حفظ الأعلاف بعيدا عن مصادر التلوث مثل الأفلاتوكسين B_1.