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PHYSIOLOGICAL RESPONSES AND PRODUCTIVE EFFICIENCY OF CHICKENS REARED UNDER SIWA OASIS CONDITIONS

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Abstract: *The present study was carried out in Siwa Oasis Research Station, Desert Research Center. The experiment started in July 2004 up to June 2005. The aim of this work was to evaluate the physiological responses and productive efficiency of Siwa Oasis (SO) and Fayoumi (F) chickens under Siwa Oasis conditions. Two hundred- one day old of SO and F chicks (100 chicks of each) were reared in open system from one day old to up 6 months of egg production. Blood samples were taken at 18 weeks (pre-laying), 21 weeks (sexual maturity) and 34 weeks (peak of egg production).*

Higher plasma glucose and cholesterol levels were determined (P<0.05) in the blood of SO than that of F chickens. While, there is no significant difference between SO and F chickens in the concentration of plasma total protein and total lipids. On the other hand, plasma glucose, total protein and total lipids concentrations increased (P<0.05) at sexual maturity and at the peak of production status than that of pre-laying status. While, plasma cholesterol did not significantly changed as a result of productive status.

Total white blood cells significantly increased in F than that of SO chickens, it's significantly increased at sexual maturity than that of pre-laying status then significantly decreased at the peak of production. Heterophils and lymphocytes ratio significantly lower in F than that of SO chickens, it's significantly higher at sexual maturity and at peak of production than that of pre-laying status.

There were insignificant differences between SO and F chickens in age at sexual maturity, egg number and feed conversion. Body weight at sexual maturity and peak of production, first egg weight, average egg weight, egg mass and feed consumption values of SO were significantly higher than that of F chickens.

Results of this study declared that, there was a similarity in the most of physiological responses and productive efficiency of Fayoumi and Siwa Oasis chickens under Siwa Oasis conditions.

INTRODUCTION

Siwa Oasis is one of the most important areas in the Western desert, located in the Western South of Marsa Matrouh Governorate about 305 km away.

Air temperature in Siwa Oasis is high all over the year, with an average of 21^0 C during winter months and 40^0 C during summer months. This attributed to the high rate of sun shine being to 83% in winter and raises during summer months to 91%. The relative humidity decrease especially in the summer months, the yearly average is about 41-49%. The rainfall is so scarce in Siwa Oasis region (Soliman, 1999).

Chickens in Siwa Oasis produce about 95 eggs/ year (Soliman, 1999). Local breeds adapted to adverse environmental conditions, consume less amount of feed, their nutrition and housing requirements are relatively cheap, more resistant to disease and more palatability than commercial breeds. On the other hand, performance of the local breeds should be evaluated at Siwa Oasis region before considering their ability as a good breed for this region (Hossari *et al*., 1992). Many investigations indicated that Fayoumi breed has been a popular bird in Egyptian villages, as well as its superiority over than other breeds, particularly in disease resistance (Kader *et al.,* 1986).

El-Bogdady *et al.*, 1993a suggested that, to achieve high productivity, the birds have to possess physiological efficient makeup, which could be determined to a great certainly through the study of the physical and biochemical parameters of the blood and physiological characteristics of the birds. Therefore, this study was carried out to evaluate the productive performance and physiological responses of Siwa Oasis and Fayoumi chickens under Siwa Oasis conditions.

MATERIALS AND METHODS

The present study was carried out at Siwa Oasis Research Station, Desert Research Center, Egypt. The experiment started in July 2004 up to June 2005.

Two hundred- one day old of Siwa Oasis (SO) and Fayoumi (F) chicks (100 chicks of each) were housed on floor in open system until they reached 14 weeks old. Then, birds were transferred to wire cage and housed

individually until the end of experiment (48 weeks). Birds were provided with clean fresh water and fed *ad-libitum* on recommended standard rations for each age (from One day to 10 weeks, crude protein was 18% and metabolizable energy was 2800 Kcal /Kg; from 11 to 20 weeks, crude protein was 15% and metabolizable energy was 2600 Kcal /Kg and at age of 21 weeks to end of experiment, crude protein was 17% and metabolizable energy was 2800 Kcal /Kg) according to NRC (1984).

Birds were exposed to natural day- light until reaching 18 weeks of age. Natural day-light was provided with artificial light to increase the day light up to 14 hr at 18 weeks of age. Then increased 30 minutes every other week until fixed at 17 hrs daily from 30 weeks of age to the end of experimental period. Birds were healthy by vaccinated against diseases and treated with antibiotics and vaccines. Indoor maximum and minimum ambient temperature (AT, ^{0}C) and relative humidity (RH, %) were recorded daily at the early morning and afternoon during the experimental period using thermometer and hygrometer (Figures 1and 2).

Age at sexual maturity was recorded. Body weight at sexual maturity, body weight at peak of production and first egg weight were individually recorded using digital balance. Feed consumption was recorded and feed conversion was calculated weekly for each hen throughout egg production period (6 months). Egg production and egg weight were recorded for SO and F hens. Egg mass was calculated by multiplying average egg weight by egg number.

Blood samples were withdrawn from the wing vein in tube containing EDTA at 18 weeks (Pre-laying), 21 weeks (sexual maturity) and 34 weeks (peak of production). Plasma was collected by using centrifugation at 3000 r.p.m for 15 minutes and it stored at –20^0 C until determination of blood metabolites (glucose, total protein, total lipids and cholesterol) by calorimetric methods (Diamond Diagnostics Company).

Immunological measurements were taken at Pre-laying, sexual maturity and peak of egg production. White blood cells counts were recorded by using 1. ml of Brilliant Crystal Blue stain add to 50 µl blood for 1: 20 dilution rate then components were mixed well and white cells were counted (cells/ mm^3) in each blood sample by Hemocytometer technique.

Heterophils /Lymphocytes ratio (H/L ratio) was calculated according to (Gross and Siegel, 1983). Hundred different white cells were counted and differentiated in to lymphocytes and heterophils and the ratio of H/L was calculated. The blood smears were stained by Wrigts stain for 2 minutes.

Drops of distilled water was added on the blood smear for 4-5 minutes and then washed by tap water until pink color appeared in the smear.

Statistical analysis

Productive performance was analyzed by the least square analysis of variance using the general linear model procedure (SAS, 1998).

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

Y_{ij} = any observations of i^{th} bird within j^{th} genotype, μ = mean,

B_i = Effect of i^{th} genotype, i, 1-2 (1=Siwa oasis and 2= Fayoumi genotype),

e_{ij} = Experimental error

Blood traits were analyzed by the least square analysis of variance using the general linear model procedure (SAS, 1998)

$Yijk = \mu + B_i + A_j + BA_{ij} + e_{ijk}$

Yijk = any observations of k^{th} bird within j^{th} age within i^{th} genotype, μ = mean

B_i = effect of i^{th} genotype, i,1-2 (1=Siwa Oasis and 2= Fayoumi genotype)

A_j = effect of j^{th} productive status, j, 1-3 (1=pre-laying, 2=sexual maturity, 3=peak of production), BA_{ij}= the interactions between genotype and productive status, e_{ijk} = experimental error

Significant differences among means were tested using Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Environmental conditions

Monthly fluctuations of the maximum, minimum and average indoor ambient temperature and relative humidity during the experimental period are present in Figures 1and 2, Figure (1) showed that average ambient temperature was high all over the year, with an average from 14.8 ^{o} C during December month to 31.9 ^{o}C during July month. The highest ambient temperature was recorded at July (38.7 ^{o} C), while, the lowest ambient temperature recorded at January (10.7 ^{o} C). Figure (2) showed that average relative humidity was low all over the year, with an average of 53.0 % to 65.6 %. The highest relative humidity was recorded at January (81.3 %) and the low relative humidity recorded at August (35.1 %).

2. Physiological responses

2.1. Blood metabolites

2.1.1. Glucose level

Higher average plasma glucose level was determined ($P<0.05$) in the blood of SO than that of F chickens (Figure 3). However, these values are in the normal range (200 to 450 mg/dl) for most birds (Emberth, 1986). This result may be related to body weight. Similar results were found by Houska (1969) which demonstrated that chickens with heavy body weight have higher blood glucose concentration than those of light body weight.

The highest plasma glucose level was determined at the peak of egg production. The differences between different productive states were significant (Figure 3). This result was in agreement with the work of Mady *et al*. (1990) who reported that level of blood glucose was at highest level when egg production was maximum.

2.1.2. Total protein level

There is no significant difference between SO and F chickens in average plasma total protein level (Figure 4). This result may owing to the non significant difference between SO and F chickens in egg number (Table 3) especially these components participated in egg formation and correlated with egg production and age at sexual maturity (Obeidah *et al*., 1978 and El-Bahy, 1994).

Plasma total protein associated with significant change with advancement of egg laying (Figure 4). It was 6.5 g/dl at pre-laying, 8.1 g/dl at age sexual maturity and 8.6 g/dl at peak of production. This result was in agreement with Amin (1998) and Mady *et al*. (1990) they reported that the mean of total protein increased gradually from the growing period to the peak of production and attributed the increase in plasma total protein during the laying period to the indigenous activity of estrogen hormone. A considerable increase of plasma total protein concentration occurs just prior to egg laying, which could be attributed to the estrogen-induced increase in globulins. The proteins were the yolk precursors (vitellogenin and lipoproteins), which were synthesized in the liver and transported *via* the plasma to the ovary where they were incorporated in the oocytes (Ritchie *et al.*, 1994).

2.1.3. Total lipids level

There is no significant difference between SO and F chickens in the level of average plasma total lipids (Figure 5). Plasma total lipids

significantly increased from sexual maturity to the peak of egg production (Figure 5). It was 6.8 g /l at sexual maturity and 8.1 g/l at peak of production. This result was in agreement with the work of Harris and Wilcox, (1958) and Wills *et al.* (1972) they reported that total lipids increased with change in productive status.

2.1.4. Cholesterol level

Average plasma cholesterol level was significantly higher in SO than that of F chickens (Figure 6).These values are in the normal range (100 to 200 mg/dl) for most birds (Emberth, 1986). This result may be due to SO are crosses (chicken were found resulted in randomly mating between different local chickens in Siwa Oasis). This result was in agreement with the work of Shafey *et al.* (1998). They reported that significant effect ($p<=0.01$) of genotype on plasma cholesterol. They added that plasma cholesterol increased in crosses compared with pure breeds.

Average plasma cholesterol level increased at sexual maturity by 12.1% than that of pre-laying then decreased at the peak of egg production by 3.4 % than that of sexual maturity age. However, the differences due to productive status were not significant (Figure 6). These results are in agreement with the work of Shafey *et al.* (1998) and Bhatti *et al*. (2002) they reported that insignificantly difference in plasma cholesterol level before and after egg production. They added that there was no relation between egg production and plasma cholesterol level.

No significant genotype × productive status interactions with blood metabolites were observed (Table 1). However, there was a trend that Siwa Oasis chickens, in general, have higher levels of plasma glucose, total protein, total lipids and cholesterol at different productive status (Table 1).

2. 2. Hematological parameters

2.2.1. Total white blood cells (TWBCs)

Total white blood cells significantly increased in F than that of SO chickens (Figure 6). This result is in agreement with the work of Mohammed (1999) who found significant differences between local breeds in TWBCs.

Fluctuated trend was detected in TWBCs with changes in different productive status. TWBCs significantly increased at sexual maturity by about (+6 %) than pre-laying, then it significantly reduced by about (-10.2 %) at the peak of egg production than that at the age of sexual maturity (Figure 7). This trend may be due to stress of egg formation and different

physiological changes at sexual maturity, Ibraheem (2003) found that TWBCs decreased with advance of age in mature chickens.

2.2.2. Heterophils and lymphocytes ratio (H/ L ratio)

Heterophils and lymphocytes ratio is a good indicator for ability of chickens to resist stress, H/ L significantly decreased in F than that of SO chickens (Figure 8), this result may be due to that F chicken is less affect by stress. This result was in agreement with Spinu *et al.* (1992) who found that H/L ratio for Bedouin hens was lower than white leghorn hens and concluded that Bedouin hens are less affected by stress than leghorn hens.

Heterophils and lymphocytes ratio significantly increased at sexual maturity age and peak of production as compared with pre- laying age (Figure 8).

No significant genotype × productive status interactions with hematological parameters were observed (Table 2). However, there was a trend that Fayoumi chickens, in general, have higher count of TWBCs cells and less than Siwa Oasis chickens in H/L ratio at different productive status (Table 2).

2.3. Productive performance

There were insignificant differences between Siwa Oasis chickens (SO) and Fayoumi chickens (F) in age at sexual maturity, egg numbers and feed conversion (Table 3), body weight at sexual maturity, first egg weight, average egg weight, egg mass and feed consumption of SO was significantly increased than that of F chickens. The increase in egg mass, average egg weight and first egg weight of SO might be due to their heavy body weight at sexual maturity. (Abd El-Ghani (1996); Nofal (2001) and Zaky (2005) found similar trend in local breeds. Also, results agree with finding of El- Bogdady *et al.* (1993), they found that age at sexual maturity, first egg weight, feed intake and feed conversion were 154.8 days, 33.6 g,106.2 g/hen/day and 4.1 g feed/ g for Fayoumi chickens, respectively.

On the other hand, similar results were found by Soliman (1999); Mehaisen (1997) and El-Hossari *et al*. (1992) for age at sexual maturity in SO, body weight at sexual maturity and first egg weight for Fayoumi, respectively.

Results of this study declared that, there was a similarity in the most of physiological responses and productive efficiency of Fayoumi and Siwa Oasis chickens under Siwa Oasis conditions.

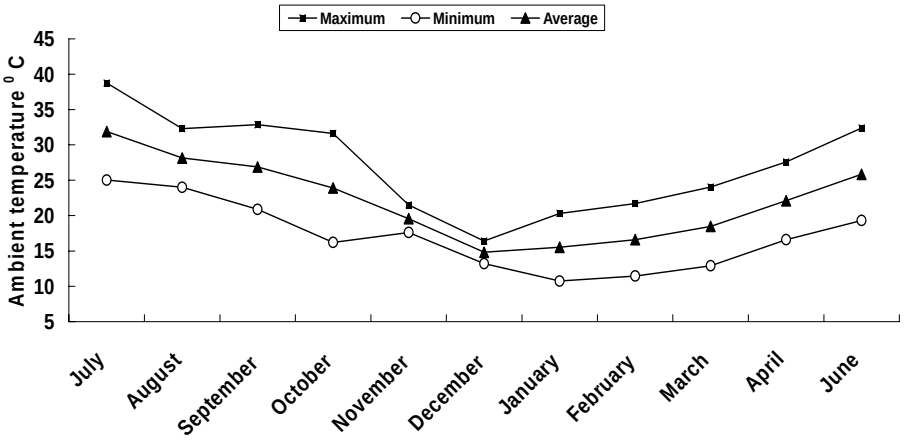


Figure (1): Indoor ambient temperture(0 C) during experimental period.

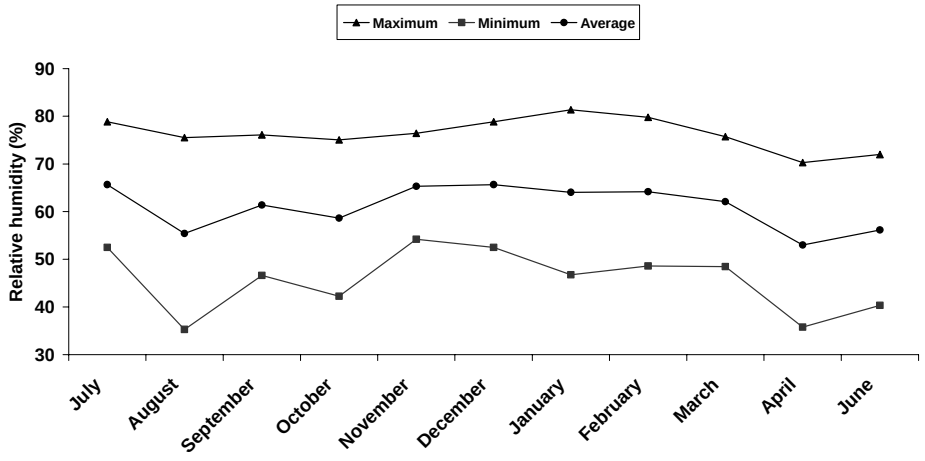
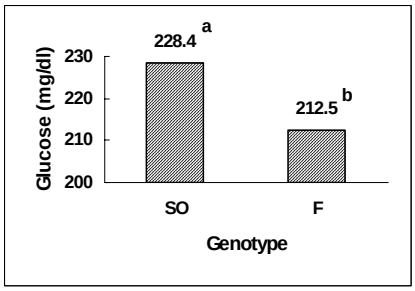
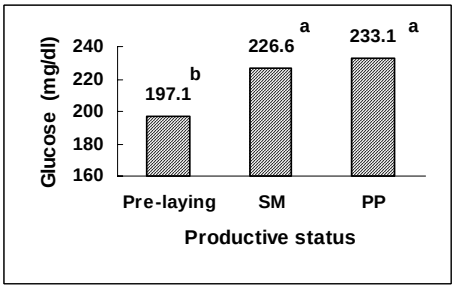


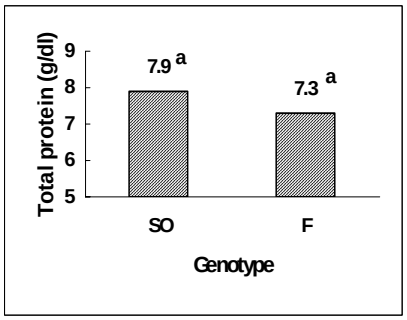
Figure (2):Indoor relative humidity (%) during experimental period.

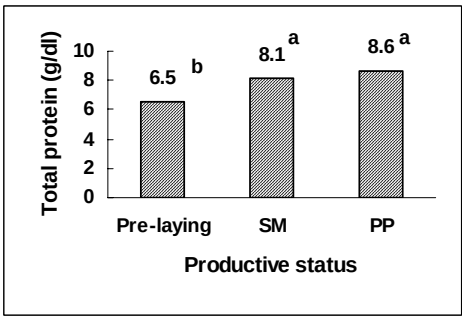




SO=Siwa Oasis chickens F=Fayoumi chickens SM=Sexual maturity PP=Peak of production

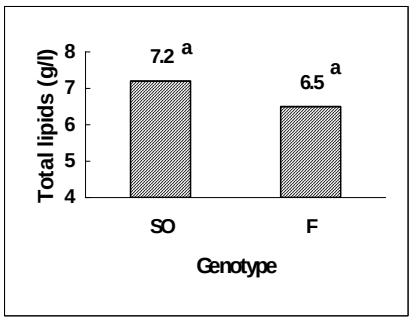
Figure (3): Effect of genotype and productive status on average plasma glucose level.

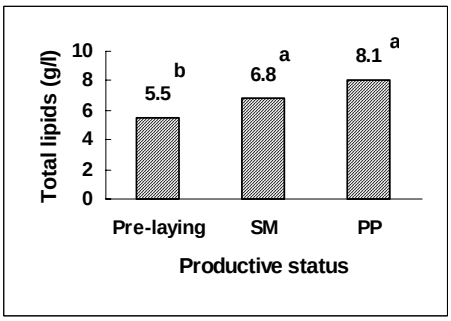




SO=Siwa Oasis chickens F=Fayoumi chickens SM=Sexual maturity PP=Peak of production

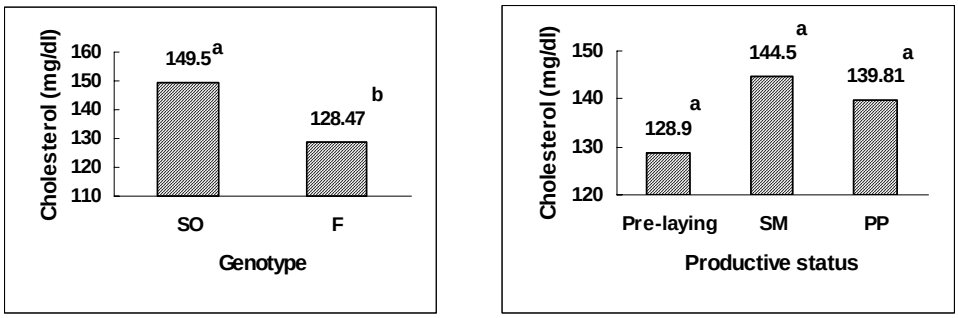
Figure (4): Effect of genotype and productive status on average plasma total protein level.





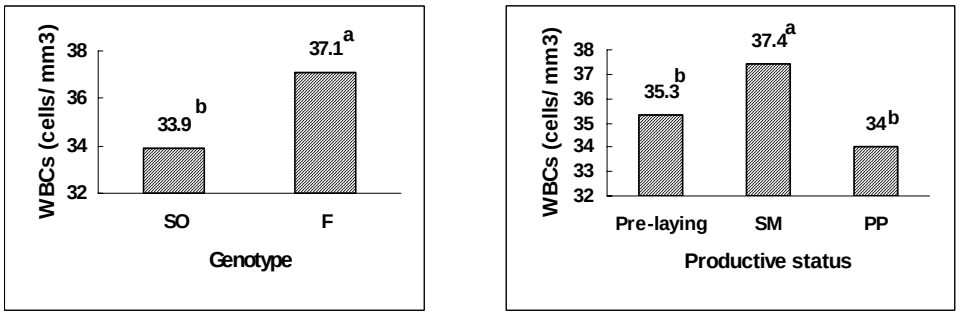
SO=Siwa Oasis chickens F=Fayoumi chickens SM=Sexual maturity PP=Peak of production

Figure (5): Effect of genotype and productive status on average plasma total lipids level.



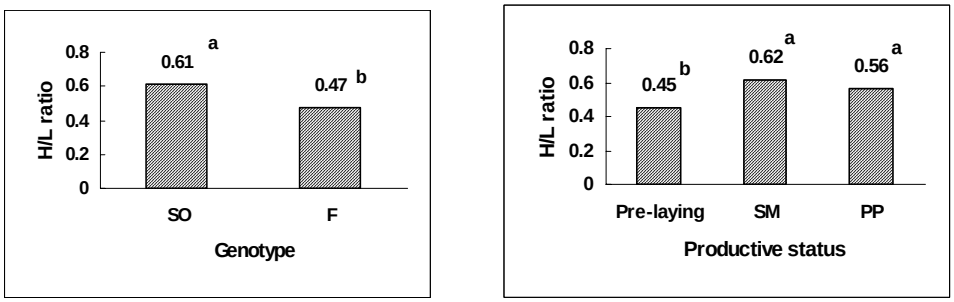
SO=Siwa Oasis chickens F=Fayoumi chickens SM=Sexual maturity PP=Peak of production

Figure (6): Effect of genotype and productive status on average plasma cholesterol level.



SO=Siwa Oasis chickens F=Fayoumi chickens SM=Sexual maturity PP=Peak of production

Figure (7): Effect of genotype and productive status on average white blood cells.



SO=Siwa Oasis chickens F=Fayoumi chickens SM=Sexual maturity PP=Peak of production

Figure (8): Showed that effect of genotype and productive status on average H/L ratio.

Table (1): Blood metabolites of Siwa Oasis (SO) and Fayoumi (F) chickens as affected by different genotypes at different productive status

Items	Genotype	Productive status		
		Pre-laying	SM	PP
Glucose (mg/dl)	SO	200.4±7.29	234.3±3.10	246.1±6.15
	F	194.6±6.35	219.2±6.77	220.4±5.49
Total protein (g/dl)	SO	5.5±0.27	8.5±0.96	9.1±0.46
	F	5.6±0.19	7.7±0.06	8.0±0.53
Total lipids (g/l)	SO	5.7±0.41	7.1±0.55	8.6±0.95
	F	5.3±0.28	6.4±1.05	7.6±0.85
Cholesterol (mg/dl)	SO	137.8±18.02	151.9±10.89	153.8±10.41
	F	120.1±7.13	137.0±9.57	125.0±9.66

SM=Sexual Maturity PP=Peak of production

Table (2): Hematological parameters of Siwa Oasis (SO) and Fayoumi (F) chickens as affected by different genotypes at different productive status

Items	Genotype	Productive status		
		Pre-laying	SM	PP
Total white blood cells (10^3/mm^3)	SO	34.4±0.75	35.4±0.94	31.7±0.97
	F	36.1±0.82	39.5±0.14	35.8±0.94
H/L ratio	SO	0.52±0.04	0.66±0.02	0.67±0.04
	F	0.38±0.02	0.58±0.04	0.45±0.03

SM=Sexual Maturity PP=Peak of production

Table (3): Productive performance of Siwa Oasis (SO) and Fayoumi (F) chickens throughout 6 months of egg production

Items	Level of Production	
	SO	F
Age at sexual maturity (day)	151.3^{a}±1.27	154.7^{a}±1.50
B.W. at sexual maturity (g)	1459.6^{a}±75.68	1224.6^{b}±20.52
B.W. at peak of production (g)	1633.3^{a}±59.40	1406.1^{b}±32.76
The first egg weight (g)	33.9^{a}±1.63	30.1^{b}±1.17
Average egg weight (g)	43.0^{a}±1.06	39.0^{b}±0.61
Egg number	126.6^{a}±2.72	122.5^{a}±3.43
Egg mass (g)	5426.3^{a}±143.78	4769.5^{b}±116.05
Feed consumption (g/hen/day)	112.1^{a}±2.10	102.9^{b}±1.71
Feed conversion (g feed/ g egg)	3.6^{a}±0.15	3.9^{a}±0.05

B.W. =body weight a, b…Means with different superscript in the same row are significant different ($P<0.05$).

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الإستجابة الفسيولوجية والكفاءة الإنتاجية للدجاج المربى تحت ظروف واحة سيوة

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أجريت هذه الدراسة بمحطة بحوث سيوة التابعة لمركز بحوث الصحراء خلال الفترة من يوليو ٢٠٠٤ وحتى يونيو ٢٠٠٥ م. كان الهدف من الدراسة تقييم الأداء الإنتاجى والإستجابة الفسيولوجية للدجاج المتواجد بواحة سيوة (دجاج سيوة) والدجاج الفيومى. أستخدم فى هذه الدراسة ٢٠٠ كتكوت عمر يوم من دجاج سيوة و الدجاج الفيومى (١٠٠ لكل نوع) تم تربيتها من عمر يوم وحتى عمر ستة أشهر من الانتاج. تم أخذ عينات الدم من الدجاج خلال عمر ١٨ اسبوع (مرحلة ما قبل الانتاج) و ٢١ اسبوع (النضج الجنسى) و ٣٤ اسبوع (قمة الانتاج).

أوضحت النتائج وجود زيادة معنوية فى كلا من مستوى جلوكوز و كوليستيرول الدم فى دجاج سيوة عن الدجاج الفيومى. بينما لم يكن هناك اختلافا معنوياً فى مستوى البروتين الكلى والدهون الكلية بالدم. صاحب مرحلة النضج الجنسى و قمة الانتاج ارتفاع معنوى فى كل من مستوى الجلوكوز و البروتين الكلى والدهون الكلية عن مرحلة ما قبل الانتاج. بينما لم يكن هناك اختلاف معنوي خلال المراحل المختلفة من العمر على مستوى كوليسترول الدم.

إزداد عدد كرات الدم البيضاء الكلية معنوياً فى الدجاج الفيومى عن دجاج سيوة، كما إزداد عدد كرات الدم البيضاء الكلية معنويا فى مرحلة النضج الجنسى عن مرحلة ما قبل الانتاج وقمة الانتاج. سجلت نسبة كرات الدم المتعادلة/ كرات الدم الليمفاوية ارتفاعا معنويا بدم دجاج سيوة عن الدجاج الفيومى. كما إرتفعت نسبة كرات الدم المتعادلة/ كرات الدم الليمفاوية معنويا فى مرحلة النضج الجنسى وقمة الانتاج عن مرحلة ما قبل الانتاج.

وزن الجسم عند النضج الجنسى وقمة الانتاج و وزن أول بيضة وكتلة البيض المنتج ومتوسط وزن البيض وكمية الغذاء المستهلك فى دجاج سيوة أعلى معنوياً عن الدجاج الفيومى. بينما لم يكن هناك اختلافات معنوية بينهما فىالعمر عند النضج الجنسى وعدد البيض المنتج وكفاءة التحويل الغذائي.

أوضحت نتائج هذه الدراسة التشابة بين دجاج سيوة و الدجاج الفيومى فى معظم الإستجابات الفسيولوجية و الإداء الإنتاجى تحت ظروف واحة سيوة.