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THE EFFECT OF HEAT STRESS ON PRODUCTIVE TRAITS FOR THREE EGYPTIAN BREEDS

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ABSTRACT

The objective of the present study the effects of heat stress on the productive traits are Play an important role in the poultry industry. The experiment was carried out in the farm of the Faculty of Agriculture-Ain Shams University, reared 600 chick of three breeds (Sinai - Fayoumi - Dandrawi) were divided into equal two groups (the treatment was exposed to heat stress on different periods of 3 days - 8 weeks - 16 weeks on temperature of 40^0c for 4 hours / 3 days. While, the control under environmental conditions. Then, take the body weight in 8, 10,12,14,16 weeks of ages, and body measurements (shank length, tibia length, body depth, keel length, comb and wattle) in three local breeds. The most important results obtained that It could be observed that the effect was high significantly ($p<0.0001$) heavier in Fayoumi compared to Dandarawi and Sinai in weight body and The results in the body measurements of the parent stock showed The effect on the Fayoumi breed was higher followed by Dandarawi and Sinai, The effect of the rectal temperature and rate respiratory are significant on the breed and the treatment. Concluded that study the effect on productive traits for three local breeds.

INTRODUCTION

Heat stress is one of the most challenging environmental conditions affecting poultry production. Recent years have seen Global climate change, elevated temperatures and the increased occurrence of heat waves will cause stress in poultry, resulting in reduced productivity and increase mortality rate **(Turnpenny et al 2001).** According to recent surveys, the heat stress is a major problem of poultry production due to of poultry does not contain sweat glands and containing layer fatty subcutaneous resulting difficulty in getting rid of high temperatures and as a result, lead to a huge loss of both laying and broiler **stocks (Obike et al 2016).** The heat stress reflected a negative balance between the net amount of energy flowing from the animal's body of its surrounding environment and the amount of heat energy produced by the animal. This imbalance may be caused by variations on a combination of environmental factors (sunlight, thermal irradiation, air temperature, humidity, and movement), and characteristics of the animal (species, metabolism rate, and thermoregulatory mechanisms). Environmental stressors, such as heat stress, are particularly detrimental to animal agriculture. The issue of environmental stress has quickly become a great point of interest in animal agriculture, particularly due to public awareness and concerns. The importance of animal responses to environmental challenges applies to all species. However, poultry seems to be particularly sensitive to temperature-associated environmental challenges, especially heat stress. It has been suggested that modern poultry genotypes produce more body temperature, due to their greater metabolic activity. Understanding and controlling environmental conditions is successful poultry production and welfare. The topic of heat stress in poultry production can be described as 'acute' or 'chronic'; acute heat stress refers to short and sudden periods of extremely high temperature, whereas chronic heat stress refers to extended periods of elevated temperature **(Emery, 2004).** It has been shown that heat stress has detrimental effects on the performance of 4-8 wk old broiler birds reared in the open-sided poultry houses; principally through reducing feed intake, growth rate, negatively affect feed efficiency and carcass quality as well as health (**Carmen et al 1991; Yahav & Hurwitz, 1996 and Younis et al 2003).** Moreover, chronic

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heat stress increases the time to reach market weight and increase mortality rate (**Howlider & Rose, 1989 and Ozbey & Ozceilik, 2004)**. Poultry production of hot climates is increasing in response to multiple factors. As climate changes, the weather affecting the major centers of chicken production is expected to become warmer **(Meehl and Tebaldi, 2004)**. Breeding of birds that are genetically more resistant to heat stress will lessen these effects**(Renaudeau et al 2012)**. The objective of the present study effect heat stress on productive traits for local breeds.

MATERIALS AND METHODS

Experimental design

The experiment was designed reared 600 chick of three strains (Sinai - Fayoumi - Dandrawi) were divided into equal two groups the first group called to treatment group, the treatment group was exposed to heat stress on different periods of 3 days - 8 weeks - 16 weeks on temperature of 400c for 4 hours / 3 days. While, the second groups control group was reared ideal environmental conditions.

Heat tolerance test

Heat tolerance test included (respiratory rate, rectal temperature) were measured at 3 days, 8 and 16 weeks of age. The respiratory rate was measured by counting the panting breaths of the birds for 1 min. While, the rectal temperature was obtained by introducing a digital thermometer into the cloaca of each bird until the reading stabilized

Productive traits

Body weight

Individual body weight (in gram) was recorded for each sex separately within each breed at 8,10,12,14 and 16 weeks of age.

Body measurement

Body measurements included (shank length, tibia length, keel length, body depth and length both comb and wattle) were measured for each sex separately within each breed at 8,12 and16 weeks of age by a digital caliber and measured comb and wattle length by using Ruler.

Statistical analysis

Data were subjected to three -way analysis of variance between breed, treatment and age factors. Their interaction using the General Linear Models (GLM) procedure of SAS User's Guide, Ver.8.2, 2001. Duncan's multiple range tests were used to test differences among means according to **Duncun (1955)** separate means when separation was relevant.

The three-way analysis of variance model interaction:

$$Y_{ijk}= \mu+T_i+B_j+ A_k+ (TB)_{ij} +(BA)_{jk} +(TA)_{ik} +(TBA)_{ijk} +e_{ijk}$$

μ= Ovellall mean, B_j=Breed effect, A_k= Age effect, T_i= Treatment effect, TBA_{ijk}= Interaction between Breed and Treatment and age , e_{ijk}= Experimental error.

RESULTS AND DISCUSSION

Productive traits

Body weight

Figures (1, 2) show the heat tolerance measurement (Rectal temperature and respiratory rate responses) for Sinai, Dandarawi and Fayoumi for parent stock. As shown **Fig. (1)** respiratory rate of Sinai, Dandarawi and Fayoumi under heat at different age for parent stock. The results showed that the male Fayoumi breed was high significant at different age compared to Sinai and Dandarwi ones. But, the female showed that Sinai breed was significant compared to Fayoumi and Dandarwi ones. As shown .fig (2) rectal temperature of Sinai, Dandarawi and Fayoumi for parent stock was not a significant effect of breeds and treatment. **Arjona et al (1990) and Elbashir et al (2001)** found no significant differences in the body temperature of acclimated and non-acclimated birds. **Arad and Marder (1982)** reported that acclimation to heat stress led to decrease rectal temperature and respiration rate. **Blagojevic (2007)** founded that exposure to low-temperature provokes physiological responses related to oxygen consumption and induces changes in energy production and subsequent reactive oxygen species (ROS) production. **Walsh et al (1971**) reported that heat stress led to increase rectal temperature and respiration rate.

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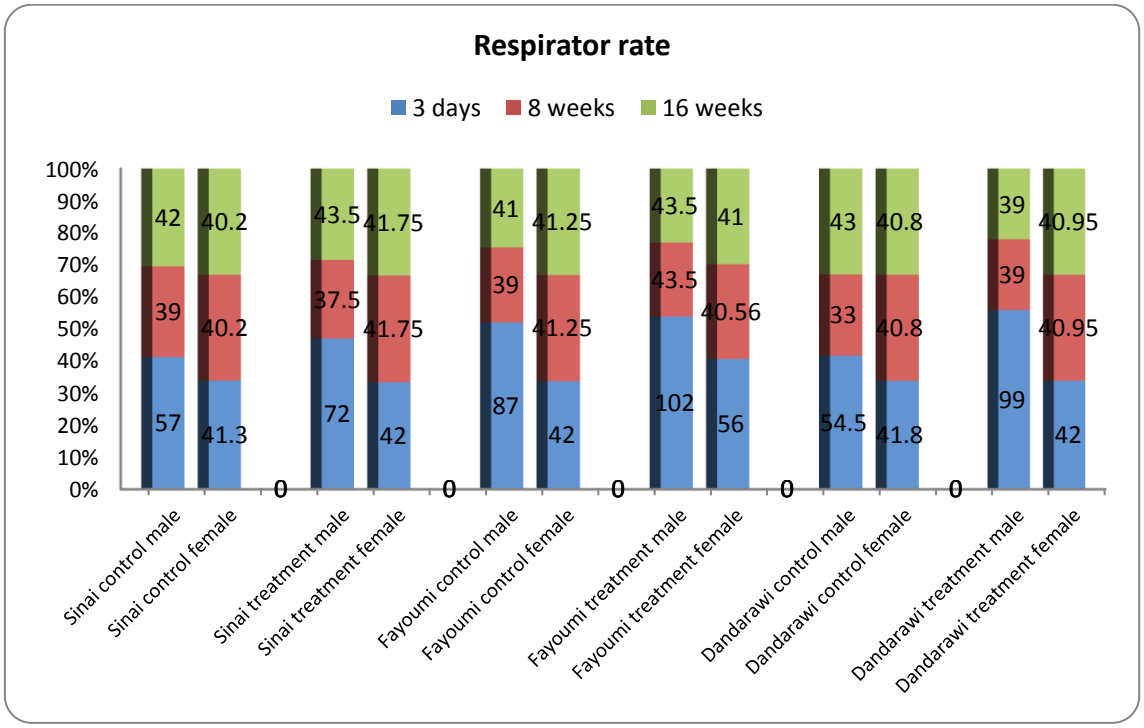

Fig. 1. Respiratory rate of Sinai, Dandarawi and Fayoumi under heat at different age for parent stock

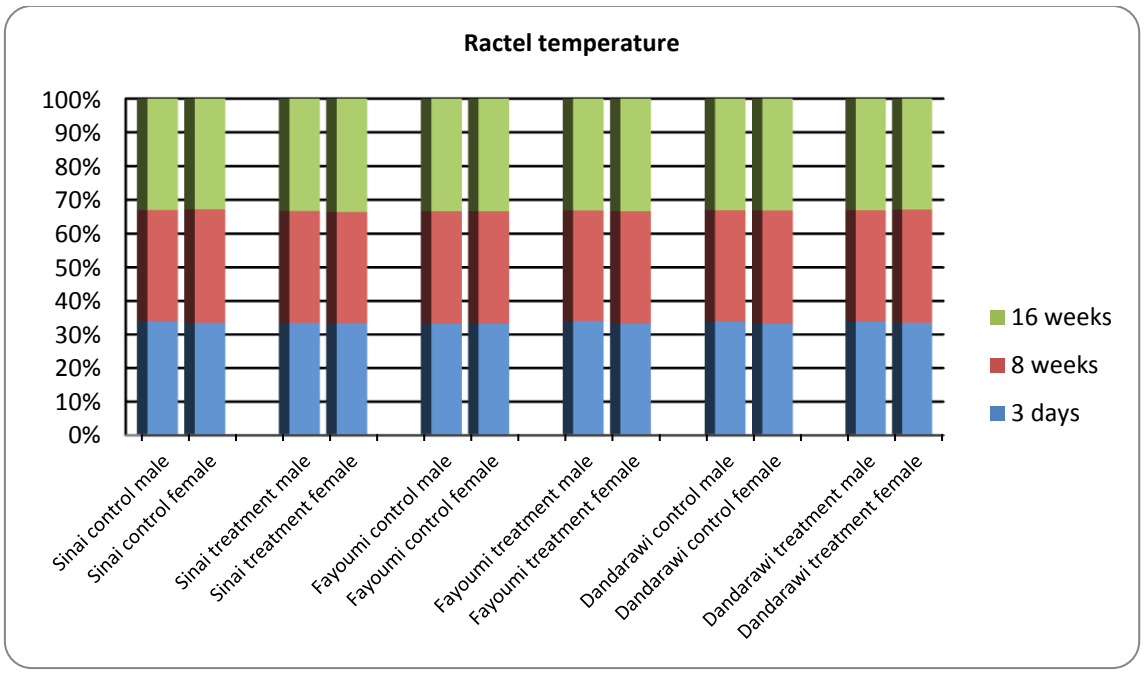

Fig. 2. Rectal temperature of Sinai, Dandarawi and Fayoumi for parent stock

Productive traits

Body weight (BW)

Body weights of local breeds in Table (1, 2)

Males

Effect of breeds, treatment, age and their interaction on of body weight for Fayoumi and Sinai and Dandarawi breed's parents (male) are summarized in **Table (1).** It could observed that Fayoumi breed males were significantly heavier body Weight at different of age in this study compared to Sinai and Dandarawi ones. However, the heat treatment was a significant decrease body weight at different age from these studies. This result agreement with **Aljuobori et al (2016).** They observed that the high ambient temperature was depressed the growth performance of birds duo to increase feed conversion ratio.

Females

Effects of breeds, treatment,age and their interaction on of body weight for Fayoumi and Sinai and Dandarawi breed's parents (female) data presented in **Table (2).** The same trend was observed in female sex compared to the male counterparts. Also, the heat treatment was a significant decrease body weight at different age from these studies. This result agrees **Aljuobori et al (2016)**; that the high ambient temperature was depressed growth performance of birds.

Table 1. Means±SE of effect of breeds, age , treatment and their interaction on of body weight for Fayoumi and Sinai and Dandarawi breed's parents (male).

Breeds (B)	**Treatment(T)**		**Overall**	**Prob.**						
	Control	**Heat**		**A**	**T**	**B**	**A*T**	**A*B**	**T*B**	**A*T*B**
8 weeks										
Fayoumi	509.78±25.55	504.18±37.69	**506.98^{AA}**	**0.001**	**0.001**	**0.001**	**0.0001**	**0.001**	**NS**	**0.0001**
Dandarawi	469.12±17.2	440.40±10.9	**454.76^{C}**							
Sinai	468.63±13.54	490.56±14.56	**479.59^{B}**							
Overall	**482.51^{A}**	**478.38^{B}**								
10 weeks										
Fayoumi	647.80±28.93	767.50±42.63	**707.65^{A}**							
Dandarawi	579.00±20.08	565.61±21.1	**572.305^{C}**							
Sinai	597.61±23.69	626.84±15.27	**612.22^{B}**							
Overall	**608.136^{B}**	**653.31^{A}**								
12 weeks										
Fayoumi	914.30±42.43	853.36±60.14	**883.83^{AA}**							
Dandarawi	708.90±25.50	693.21±30.7	**701.055^{C}**							
Sinai	736.33±23.73	720.42±23.89	**728.375^{B}**							
Overall	**786.51^{A}**	**755.66^{B}**								
14 weeks										
Fayoumi	1107.8±58.10	942.50±84.53	**1025.15^{AA}**							
Dandarawi	902.93±30.01	631.26±35.15	**767.095^{C}**							
Sinai	887.00±33.90	798.21±48.04	**842.605^{B}**							
Overall	965.91^{AA}	790.65^{B}								
16 weeks										
Fayoumi	1155.1±128.3	1116.6±61.95	**1135.85^{AA}**							
Dandarawi	946.69±61.7	818.18±58.29	**882.435^{C}**							
Sinai	987.00±40.04	912.26±40.00	**949.63^{B}**							
Overall	**1029.59^{A}**	949.01^{B}								

A=Age, T=Treatment, B=Breeds. a, b, c values in the same row for each parameter with different letters are significantly different (P < 0.05). NS, not significant

Table 2. Means±SE of effect of breeds, age, treatment and their interaction on of body weight for Fayoumi and Sinai and Dandarawi breed's parents (female).

Breeds (B)	Treatment(T)		Overall	Prob.						
	Control	Heat		A	T	B	A*T	A*B	T*B	A*T*B
8 weeks										
Fayoumi	422.57±11.42	466.07±9.38	**444.32^{A}**	**0.001**	**0.001**	**0.001**	**0.001**	**NS**	**NS**	**0.0001**
Dandarawi	419.53±8.39	436.50±10.8	**428.01^{BB}**							
Sinai	400.50±7.1	441.87±10.8	**411. 85^{B}**							
Overall	**414.2^{B}**	**448.14^{A}**								
10 weeks										
Fayoumi	522.03±16.56	613.66±11.77	**567.89^{A}**							
Dandarawi	477.12±11.6	541.11±10.38	**509.11^{C}**							
Sinai	472.55±12.7	554.65±16.07	**513.6^{B}**							
Overall	**490.56^{A}**	**569.80^{B}**								
12 weeks										
Fayoumi	703.93±24.32	688.69±19.88	**696.31^{A}**							
Dandarawi	608.40±20.5	604.58±16.14	**606.49^{C}**							
Sinai	622.19±15.63	634.27±24.5	**628.23^{B}**							
Overall	**644.84^{A}**	**642.51^{B}**								
14 weeks										
Fayoumi	810.80±27.75	687.94±19.01	**749.37^{A}**							
Dandarawi	731.84±20.6	596.69±21.1	**664.265^{C}**							
Sinai	695.41±19.98	691.77±25.7	**693.59^{B}**							
Overall	**746.01^{A}**	**658.8^{B}**								
16 weeks										
Fayoumi	859.41±29.6	809.22±20.08	**834.31^{A}**							
Dandarawi	774.90±29.6	695.58±19.3	**735.24^{C}**							
Sinai	778.00±21.8	784.40±22.50	**781.2^{B}**							
Overall	**804.10^{A}**	**763.06^{B}**								

Body measurements

Effect of breeds, age, treatment and their interaction on of body measurements during growth period for Fayoumi and Sinai and Dandarawi breeds for parents. (Male and female) are summarized in **Tables (3 and 4).**

Males and females

Shank length

The Fayoumi had significantly longer shank bone compared to Sinai and Dandarawi breeds at different ages. Also, males had significantly longer shank length compared to female. While, the heat treatment was no significant effect compared to control groups. Also, the interaction between (breeds * ages) and (treatment *breeds) were no significant. This result confirmed by **Yakoub (2006)** observed that Fayoumi breed had significantly longer shank length compared to both Dandarawi (crested or non-crested) at 4, 12 and 16 weeks of age.

Tibiai length

The results showed that the effect of tibia length of the breed was greater in Fayoumi, followed by Sinai and Dandrawi ones.Showed the effect Tibia length has a significant between breeds, ages and treatments. Results showed that the effect of Tibia length of sex was greater males than females.

Keel length

The Fayoumi had significantly longer keel length compared to Sinai and Dandarawi breeds at different ages. Also, males had significantly longer keel length compared to females. While, the heat treatment effect not significant.But, the interaction between breeds, ages and treatment were significant.

Table 3. Means±SE of effect of breeds,age, treatment and their interaction on of body measurements during growth period for Fayoumi and Sinai and Dandarawi breeds parents. (Male)

Age (A)	Breeds(B)	Treatment(T)		Overall	Prob.						
		Control	Heat		A	T	B	A*T	A*B	T*B	A*T*B
	Shank length, cm										
8 weeks	Fayoumi	78.93±1.72	83.89±0.78	**81.41^{A}**							
	Dandarawi	74.54±0.91	75.13±1.15	**74.83^{B}**							
	Sinai	75.47±1.05	79.13±79.1	**77.3^{B}**							
	Overall	**76.31^{A}**	**79.38^{A}**								
12 weeks	Fayoumi	96.02±1.82	98.23±1.69	**97.125^{A}**							
	Dandarawi	87.50±1.17	91.28±1.35	**89.39^{B}**	**0.0001**	**NS**	**0.0001**	**0.001**	**NS**	**0.001**	**NS**
	Sinai	90.18±1.33	93.33±0.86	**91.75^{B}**							
	Overall	**91.23^{A}**	**94.28^{A}**								
16 week	Fayoumi	104.35±2.9	110.31±2.3	**107.33^{A}**							
	Dandarawi	99.16±2.23	97.26±2.46	**98.21^{B}**							
	Sinai	99.69±1.3	100.90±1.34	**100.29^{B}**							
	Overall	**101.06^{A}**	**102.82^{A}**								
	Tibia length,cm										
8 weeks	Fayoumi	101.21±1.9	103.97±0.94	**102.59^{A}**							
	Dandarawi	92.37±1.1	93.78±0.83	**93.07^{B}**							
	Sinai	94.50±1.1	98.38±1.13	**96.44^{B}**							
	Overall	**96.02^{A}**	**98.71^{A}**								
12 weeks	Fayoumi	123.10±2.2	126.04±1.79	**124.57^{A}**							
	Dandarawi	112.8±1.5	120.10±3.1	**116.45^{B}**							
	Sinai	116.28±1.6	118.28±1.05	**117.28^{B}**	**0.0001**	**NS**	**0.0001**	**NS**	**NS**	**0.001**	**NS**
	Overall	**117.39^{B}**	**121.47^{A}**								
16 week	Fayoumi	141.62±4.6	143.21±2.45	**142.41^{A}**							
	Dandarawi	135.02±3.4	129.38±2.87	**132.2^{B}**							
	Sinai	136.30±2.0	133.58±1.67	**134.94^{B}**							
	Overall	**137.64^{A}**	**135.39^{A}**								
	Keel length,cm										
8 weeks	Fayoumi	73.78±1.60	74.80±1.60	**74.29^{A}**							
	Dandarawi	67.39±1.0	69.11±1.09	**68.25^{B}**							
	Sinai	68.65±0.9	71.21±0.58	**69.93^{B}**							
	Overall	**69.94^{A}**	**71.70^{A}**								
12 weeks	Fayoumi	87.20±1.63	97.01±8.96	**92.10^{A}**							
	Dandarawi	78.89±1.05	81.90±1.22	**80.39^{B}**	**0.0001**	**0.01**	**0.0001**	**NS**	**0.001**	**0.001**	**NS**
	Sinai	80.66±1.62	83.12±0.72	**81.89^{B}**							
	Overall	**82.25^{B}**	**87.34^{A}**								
16 week	Fayoumi	99.39±3.17	97.41±3.96	**98.4^{AA}**							
	Dandarawi	93.18±2.39	90.27±2.10	**91.72^{B}**							
	Sinai	91.79±2.35	89.17±2.76	**90.48^{B}**							
	Overall	**94.78^{A}**	**92.28^{A}**								
	Body depth,cm										
8 weeks	Fayoumi	55.53±1.48	58.61±1.22	**57.07^{A}**							
	Dandarawi	49.83±1.15	53.32±1.32	**51.575^{B}**							
	Sinai	50.62±1.09	54.69±1.26	**52.655^{B}**							
	Overall	**51.99^{B}**	**55.54^{A}**								
12 weeks	Fayoumi	67.25±1.60	72.10±1.71	**69.67^{A}**							
	Dandarawi	61.84±1.44	64.99±1.34	**63.41^{B}**	**0.0001**	**0.0001**	**0.0001**	**0.001**	**0.001**	**NS**	**NS**
	Sinai	61.96±1.12	66.08±0.91	**64.02^{B}**							
	Overall	**63.68^{B}**	**67.72^{A}**								
16 week	Fayoumi	79.57±3.56	84.57±2.59	**82.07^{A}**							
	Dandarawi	73.89±2.44	78.72±2.4	**76.30^{B}**							
	Sinai	75.01±2.12	78.52±2.7	**76.76^{B}**							
	Overall	**76.156^{B}**	**80.603^{A}**								

Table 4. Means±SE of effect of breeds, age , treatment and their interaction on of body measurements during growth period for Fayoumi and Sinai and Dandarawi breeds parents. (Female)

Age (A)	Breeds (B)	Treatment(T)		Overall	Prob.						
		Control	Heat		A	T	B	A*T	A*B	T*B	A*T*B
	Shank length, cm										
	Fayoumi	71.4±0.89	76.9±0.73	**74.15^{A}**							
8 weeks	Dandarawi	69.84±0.5	75.03±0.5	**72.43^{B}**	**0.0001**	**0.0001**	**0.0001**	**0.001**	**NS**	**0.001**	**NS**
	Sinai	69.07±0.4	76.26±0.92	**72.66^{B}**							
	Overall	**70.103^{B}**	**76.063^{A}**								
	Fayoumi	83.48±1.1	88.7±0.73	**86.09^{A}**							
12 weeks	Dandarawi	79.17±1.8	83.88±1.1	**81.525^{B}**							
	Sinai	79.07±0.67	86.51±0.82	**82.79^{B}**							
	Overall	**80.57^{B}**	**86.36^{A}**								
	Fayoumi	90.6±1.48	91.2±0.73	**90.9^{A}**							
16 week	Dandarawi	87.31±1.1	87.48±0.9	**87.39^{B}**							
	Sinai	84.57±0.58	89.99±0.95	**87.28^{B}**							
	Overall	**87.49^{A}**	**89.55^{A}**								
	Tibia length,cm										
	Fayoumi	91.34±1.09	96.63±0.7	**93.98^{A}**							
8 weeks	Dandarawi	89.34±0.6	94.29±0.7	**91.81^{A}**							
	Sinai	88.88±0.63	96.17±0.77	**92.525^{A}**	**0.0001**	**NS**	**0.0001**	**NS**	**NS**	**0.001**	**NS**
	Overall	**89.853^{B}**	**95.696^{A}**								
	Fayoumi	109.76±1.7	118.12±1.3	**113.94^{A}**							
12 weeks	Dandarawi	106.40±2.39	112.96±1.6	**109.68^{B}**							
	Sinai	105.55±0.87	113.88±1.13	**109.71^{B}**							
	Overall	**107.23^{B}**	**114.98^{A}**								
	Fayoumi	125.30±1.7	124.97±0.8	**125.13^{A}**							
16 week	Dandarawi	121.13±1.46	119.79±1.20	**120.46^{B}**							
	Sinai	118.59±1.0	122.67±1.0	**120.63^{B}**							
	Overall	**121.67^{A}**	**122.47^{A}**								
	Keel length,cm										
	Fayoumi	66.95±0.81	71.75±0.56	**69.35^{A}**							
8 weeks	Dandarawi	63.94±0.67	67.02±0.71	**65.48^{A}**							
	Sinai	64.93±0.54	69.66±0.65	**67.29^{A}**	**0.0001**	**0.01**	**0.0001**	**NS**	**0.001**	**0.001**	**NS**
	Overall	**65.27^{A}**	**69.47^{A}**								
	Fayoumi	78.23±1.22	82.95±0.86	**80.59^{A}**							
12 weeks	Dandarawi	74.47±1.79	77.13±1.18	**75.8^{A}**							
	Sinai	75.07±0.85	78.71±1.56	**76.89^{A}**							
	Overall	**75.92^{A}**	**79.59^{A}**								
	Fayoumi	91.20±1.54	88.97±1.06	**90.08^{A}**							
16 week	Dandarawi	87.69±1.12	85.95±0.96	**86.82^{A}**							
	Sinai	87.02±0.89	90.61±1.03	**88.81^{A}**							
	Overall	**88.63^{A}**	**88.51^{A}**								
	Body depth,cm										
	Fayoumi	51.35±0.79	54.35±0.63	**52.85^{A}**							
8 weeks	Dandarawi	48.19±0.56	51.81±0.86	**50^{A}**							
	Sinai	48.56±0.68	54.85±0.83	**51.70^{A}**							
	Overall	**49.36^{A}**	**53.67^{AA}**								
	Fayoumi	61.61±0.95	68.20±0.84	**64.90^{A}**							
12 weeks	Dandarawi	66.66±8.07	62.87±0.83	**64.76^{A}**	**0.0001**	**0.0001**	**0.0001**	**0.001**	**0.001**	**NS**	**NS**
	Sinai	59.53±0.84	64.78±0.93	**62.15^{A}**							
	Overall	**62.6^{A}**	65.28^{AA}								
	Fayoumi	74.81±1.42	80.31±1.17	**77.56^{A}**							
16 week	Dandarawi	71.76±2.15	75.48±1.3	**73.62^{A}**							
	Sinai	72.25±1.11	77.85±1.30	**75.05^{A}**							
	Overall	**72.94^{A}**	**77.88^{A}**								

This result was agreement with **Hussen et al (2000**) shows that, Fayoumi breed birds had the longest keel bone at 8,12and 16 weeks of age compared with Dandarawi breed.

Body depth

The Fayoumi breed had high significantly deeper body depth than Sinai and Dandrawi at different ages in both sexes. The males were significant deeper body depth than female. Also, the heat treatment effect was significant decrease body depth than control groups. While, all type interactions were highly significant. This result sustained by **Hussen et al (2000)** found that there was a significant difference between Fayoumi and Dandarawi breed for body depth character at different ages, also the interaction between strain and sex was not significant, that Fayoumi breed was significantly deeper body depth compared to Dandarawi one at 4,8,12and 16 weeks of age.

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