EFFECTS OF HIGH FAT DIET ON SOME PHYSIOLOGICAL PARAMETERS IN BROILER CHICKEN UNDER HIGH ENVIRONMENTAL TEMPERATURE

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ABSTRACT

The objectives of this study were to investigate the effects of increasing the level of soybean oil in the diet of broiler chicken on some physiological parameters including growth performance, some blood parameters, some blood metabolites and hormonal changes during the exposure to stress of high environmental temperature. A total of 60 one -day- old chicks were divided into three groups with each group containing 20 chicks of both sexes. One group served as a control group whereas the other two groups served as experimental groups. At day 21 of age, the control group; Normal Temperature Low Fat (NTLF) was transferred to a separate room and remained under ideal temperature (25oC) and the same fat level (3%) in the diet. In the other two experimental groups in which temperature was not adjusted and depended on the outdoor climatic condition of the summer season, one group remained under the same fat level (3%) (High Temperature Low Fat group (HTLF)) and fat level was increased in the diet of the other group (6%) (High Temperature High Fat group (HTHF). No significant differences between the groups regarding body weight, body weight gain, feed conversion ratio and feed intake were found. A significant decrease in the total red blood cells count (RBCs) was observed in the HTLF group at 42 day of age and in the total leucocytic count (WBCs) at both 35 and 42 days of age. Heterophile/Lymphocyte ratio (H/L) was significantly higher in HTLF and HTHF group at 28 days of age. Serum total cholesterol (Tcol), triacylglycerol (TG), total lipids and high density lipoprotein cholesterol (HDL-c) were significantly higher in HTHF and HTLF group while there was a significant decrease in low density lipoprotein cholesterol (LDL-c) in these groups. Serum total protein was significantly decreased in HTHF and HTLF group. Serum triiodothyronin (T3) was significantly decreased in HTHF and HTLF group at 28 days of age. These results suggest that the addition of soybean oil to broiler diets at a level of 3 and 6 % during the period of heat stress can improve growth performance parameters without affecting serum TCOL, TG, total lipids and T3. Increase serum HDL-c and reduce LDL-c.

INTRODUCTION

Broiler industry is increasing dramatically throughout the developing countries. It has been developed very fast in the last two dec-

ades to become one of the most important sectors in animal production industry. Fat is frequently included in poultry diets to increase the energy density **(Pinchasov and Nir, 1992; Sanz et al., 1999)**. As no special problems are associated with feeding fats to poultry, the use of different vegetable oils allows the enrichment of poultry meat with poly-unsaturated fatty acids **(Lopez-Ferrer et al., 1999). Alao and Balnave, (1985)** investigated the nutritional significance of different dietary fat level (sunflower oil, maize oil, poultry fat and animal tallow) for the growing broilers and concluded that increasing the dietary supplementation of fats and oils from 3 to 9% improved the growth rate of broilers. Also, optimum growth responses were obtained with vegetable oils. It was found that diets contained saturated fat had poorer feed conversion ratio than those contained polyunsaturated fats **(Pinchasov and Nir, 1992; Zollitsch et al., 1997)**. **Nitsan et al., (1997)** observed that the addition of 3% soybean oil in the diet of broilers improved the live weight gain significantly than the diet containing 0% soybean oil. They also observed higher (but not significant) live weight gain of 3.4% in group of broiler fed on 6% soybean oil than 3% soybean oil added diet during heat exposure.

Tony (1997) investigated the effect of dietary fat sources (rich in essential fatty acids) on some blood constituents of broiler chickens. The effects of feeding high energy diets containing supplemented fat on some blood constituents in broilers were investigated by **Wafaa and El-Sadawy, (1997)**. No significant changes in serum total protein, albumin and globulin among different treatments were reported while serum total lipids and cholesterol significantly decreased in the broilers fed low fat supplemented diets. High content of HDL-c was found in broilers fed 6% corn oil and soybean oil respectively. Cholesterol level was also lower in groups fed 6% sunflower oil and soybean oil respectively (Özdo_an and Aksit, 2003). Dietary supplementation with 3 or 6% soybean oil did not significantly affect serum total lipid in the experimental broiler chicks **(Mansour, 2006). In addition, El-Katcha and Walaa, (1996)** reported that blood metabolites in broilers did not significantly affected by dietary fat level. **Bartha (1993)** showed that adding fat to isocaloric diet decreased T3 and increased T4 levels in the serum of broiler chicken. **Kahl et al., (1998) and Rosenbrough et al., (1999)** reported no differences in plasma thyroid hormone in broiler chickens fed diets with different dietary fat levels. These findings indicate that there is a close relationship between thyroid hormone metabolism and fat metabolism but the effect of dietary fat type needs more investigation.

In Egypt high ambient temperature during the summer generates a status of stress and evokes a combination of behavioural, biochemical, immunological and physiological changes **(Abd-Elsamee, 2005 and Abdel-Fattah, 2006)**. The expression 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)**. High environmental temperature have deleterious effects such as reducing rate of growth, feed intake, live

weight gain, feeding efficiency and digestibility of nutrients **(Donkoh, 1989 and Mills et al, 1999)**. Chronic heat stress has detrimental effects on the performance of broiler birds reared in open sided poultry houses, principally through reducing feed intake and growth rate, negatively affect feed efficiency as well as health **(Carmen et al., 1991 and Har et al., 2000)**.

Heat stress may shorten the RBC's life span, resulting in a decrease total numbers of RBCS **(Sturkie, 1986; Sahota et al., 1994 and Rautela et al., 1994)**. **Mashaly et al., (2004)** found that birds exposed to chronic heat stress had a lower WBCs count compared to those exposed to chronic cycle or controlled temperature. They also reported that the total WBCs counts were significantly inhibited in hens (31 weeks old) exposed to heat stress (constant heat stress and humidity for 5 weeks). The heterophile/ lymphocyte ratio has been shown to be a highly heritable **(Al-Murrani et al, 1997 and Zulkifi et al., 2003)** and a reliable index for determining stress in poultry **(Gross and siegel, 1983). Borges et al., (2004)** showed that heat stress altered the proportion of heterophile (increased) to lymphocyte (decreased) in blood. **Puvadolpirod and Thaxton, (2000)** reported that stress increased serum cholesterol levels in chickens. **Sosnowka-Czajka et al., (2005)** exposed chicks to elevated ambient temperature from the 21st day of age to the 28th day of age and found that the highest level of cholesterol was found in these chickens on last day of rearing (day 42). They also reported a high level of triacylglycerol in these birds.

Gursu et al., (2004) investigated the effects of high environmental temperature, vitamin C, and folic acid supplementation on serum metabolites in Japanese quails and found an increase in the level of cholesterol, high density lipoprotein cholesters (HDL-c) and triglyceride in the blood of the heat stressed birds. **Sahin et al., (2001)** recorded a reduction in the concentration of total protein, albumin and globulin in broilers as a result of the exposure to chronic heat stress from 21 to 42 days of age. It is generally accepted that neuron- endocrine factors act as an interface between input factors such as genotype, sex, environmental conditions and nutrition **(Buyse et al., 2001)**. Heat stress caused a series of physiological and metabolic changes in broiler chicken **(Deyhim and Teeter, 1991)** such as a reduced metabolic status which was reported to occur due to decreased levels of plasma triiodothyronine (T3). Similarly, **Sinurate et al., (1987)** indicated that the plasma T3 concentration decreased, but the T4 concentration increased during exposure to high temperature. On contrary to that, **Geraert et al., (1996)** reported a significant reduction in plasma T3 concentration whereas T4 concentration did not decrease as much or even remained unchanged under chronic heat exposure. Blood corticosterone concentration has been widely used as a measure of environmental stress in broilers **(Zulkifli et al., 2003 and McFarlane and Curtis, 1989)**. **Lin et al., (2006)** reported that corticosterone concentration in broilers that had been exposed to acute heat stress (32^{o}C and 40% relative humidity) for 6 hours varied from 3.17 to 4.28 ng/ml on day 42. This experiment was therefore carried out to investigate the effects of increasing the level of soybean oil in the diet of broiler chicken on some physiological

parameters including growth performance, some blood parameters, some blood metabolites and hormonal changes during the exposure to stress of high environmental temperature.

MATERIALS AND METHODS

A total number of 60 one -day- old chicks (Cobb breed) were divided into three groups with each group containing 20 chicks of both sexes. During the first 3 days of age, the brooding temperature was maintained at 35 to 32^{o}C with a constant lighting (24 hours / day). The room temperature was decreased by 1^{o}C every 2 days reaching 22-25^{o}C by the beginning of the third week of age. At day 21 of age, the control group was transferred to a separate room and remained under ideal temperature (25^{o}C) and the same fat level in the diet till the end of the experiment. In the other two experimental groups the temperature was not adjusted and depended on the outdoor climatic condition of the season, one group remained under the same fat level (Low fat group) whereas the fat level was increased in the diet of the other group (High fat group) (table 1). Corn-Soybean based broiler diet (starter-grower and finisher diet) was used with two levels of soybean oil (3% and 6%) in isonitrogenous and isocaloric diet. The diet was formulated according to **NRC (1994)** recommendation (Table 2).

Body weight, body weight gain, feed efficiency and feed intake were calculated for each group at 21, 28, 35 and 42 days of age. Blood samples were collected from the birds at these ages. Five birds from each group were bled from the wing vein. Each collection was divided into two samples. The first one was taken with sodium citrate 3.8% freshly prepared as anticoagulant **(Shum and Griminer, 1972)** and was used immediately for the determination of the total erythrocytic count, total leucocytic count **(Feldman et al., 2000)** and differential leucocytic count **(Gross and Siegel, 1983)**. The second sample was collected without anticoagulant and was left to clot at room temperature. It was then centrifuged at 3000 rpm for 15 minutes to separate clear serum sample which was stored frozen at -20^{o}C for later determination of serum total cholesrerol **(Allain et al., 1974)**, triacylglycerol **(Fassati and Prencipe, 1982)**, HDL-c **(Lopez-Virella et al., 1977)**, LDL-c **(Fraidwald et al., 1972)**, Total lipids **(Zollner and Kirsch, 1962)**, serum total protein **(Gornal et al., 1949)**, albumin **(Doumas et al., 1971)** using commercial available kits and T3 **(Klee, 1996)**, T4 (Albertini and Eknis, 1982) and corticosterone hormone **(Donia, 1987)** using ELISA kit Statistical analysis was done using **SPSS (1994)**. Mean and standard errors were calculated for the obtained data and the level of significance for all means was determined using general linear model (GLM) of Univariate analysis (full factorial design).

RESULTS AND DISCUSSION

Growth performance parameters: There were no significant differences between the two experimental groups (High temperature-low fat (HTLF) and high temperature-high fat (HTHF) and between the two experimental groups and the control one (normal temperature- low fat (NTLF)) during the last three weeks at which the experimental conditions were applied in respect to body weight (table 3), body weight gain (table 4), feed conversion

ratio (table 5) and amount of feed consumed (table 6). These results agree with those of **Whitehead and Keller, (2003) and Ghazalah et al., (2007)** who reported that nutrient modification affects productivity, health and physiological processes occurring in the body of broilers reared in elevated ambient temperature. On the other hand, the performance of broiler chicks was improved with using fat in broiler chick diet. The improvement seen in the birds of the two experimental groups that were exposed to the chronic heat stress for the last three weeks of age can be explained by **Ferket (1995)** who found that fat could improve energetic efficiency of a diet fed during hot weather in 3 ways. First, dietary fat gives 2.25 times more energy per unit of weight than carbohydrate or protein so, it can be used to increase the flexibility of feed formulation by allowing more inclusion possibilities for another crucial nutrients. Second, digestion and metabolism of dietary fat generates less body heat per gram when absorbed and used for growth than dietary carbohydrate and protein. Third, the rate of food passage is reduced by dietary fat which may increase the digestibility of other ingredients **(Mateos et al., 1982)**. Higher, but not significant, live weight gain was seen in heat exposed chicken fed diet contain 6% soy bean oil than heat exposed chickens fed diet contain 3% soybean oil and this finding agrees with the result obtained by **Nitsan et al., (1997)**.

Blood parameters: The results shown in table (7) revealed a significant decrease in RBCs count in the HTLF and HTHF group at the 42nd day of age. Reduced numbers of red blood cells in heat stressed birds was observed by **Sahota et al., (1994) and Rautela et al., (1994)**. A higher RBCs count was seen in HTHF than HTLF group due to increasing the fat level from 3 to 6% which is supported by the finding of **Mateos et al., (1982)** who found that the digestibility of other nutrient including protein might increase which it needed in the RBCs building. The reduction in the RBCs count might be due to demodulation due to increased water consumption during heat stress period. Furthermore, **Sturkie, (1986)** stated that the numbers of RBCs are dependent on both the numbers of newly produced RBCs and the average life span of the old cells, hence heat stress may shorten the RBCs life span, resulting in a reduction in the total numbers of RBCs. The significant reduction in the WBCs count that is seen in the current experiment in table (8) is in hand with the finding of **Mashaly et al., (2004)** who reported that birds exposed to chronic heat stress had a lower WBCs count compared with birds exposed to chronic or controlled temperature. The results in table (8) revealed a significant increase in heterophile (H %), H/L ratio and a decrease in lymphocyte (L %) in both the HTLF and the HTHF groups during the period of the last 3 weeks of age. Broiler exposed to heat stress in summer showed an increase in heterophiles and a decrease in lymphocytes, which led to an increase in the H:L ratio. These results are in an agreement with those of **Borges et al., (2004) and Turkyilmaz,, (2008)** who reported that increased circulating (H/L) ratio is one of the most accepted indicators of the stress condition in birds as heat stress altered (increased) the proportion of heterophile to lymphocyte (decreased) in the blood and there was also a significant

increase in H/L ratio in birds after the application of heat stress.

Serum metabolites: Results presented in table (8) showed significant increases in the level of serum total cholesterol and triacylglycerol in the HTLF and HTHF than NTLF group. These results are in harmony with those of **Siegel, (1968) and Özbey et al., (2004)**. High temperature increased levels of serum total cholesterol and triglyceride. It could be said that as a consequence of increased serum total cholesterol and triglyceride levels, levels of total lipids were subsequently increased in the two heat stresses groups. From the results recorded in table (8) it can be observed that increasing fat level in the diet from 3 to 6% in the HTHF group did not increase cholesterol and triglyceride levels in this group compared to the HTLF group. The Significant increases in the levels of HDL-c in heat stressed groups observed in this study are in an agreement with the findings of **Gursu et al., (2004)**. Increasing fat level from 3 to 6% in the HTHF group increased the level of HDL-C in the HTHF group compared to the HTLF group at the 28^{th} and the 35^{th} days of age. It also decreased levels of LDL-c in the HTHF in comparison to the LTLF group at the 28^{th}, 35^{th} and the 42^{nd} days of age. This is in an agreement with the results of **Kinsella et al., (1990)** who stated that dietary PUFA of vegetables oils containing mostly linoleic acid are effective in counter- acting the effects of dietary saturated FAs. Thus n-3 PUFAs may reduce plasma lipids and alter the cell and tissue PUFAs. In respect of serum total protien the results shown in table (9) revealed that serum total protein levels were reduced in the two heat stressed groups (HTLF and HTHF) compare to the control group (NTLF). This finding is in an agreement with that of **Makind and Fatunmbi (1985); Faltas et al., (1987); Kutlu and Forber, (1993) and Berrong and Washburn, (1998)** who reported that concentrations of blood protein were decreased significantly when birds were exposed to heat stress. These results may be due to the reduction in the amount of protein consumed and the reduced protein digestibility with the exposure of broiler chickens to high temperatures **(Bonnet et al., 1997; Ozbey and Ozcelik, 2004; Abu-Dieyeh, 2006a,b)**. The non significant decreases in the levels of serum albumin in HTLF and HTHF group and the non significant changes in the levels of globulin in comparison with the control group as shown in table (9) disagree with the results of **Faisal et al., (2008) and Sahin et al., (2001)**. This might be due to differences in the condition of heat stress application.

Serum hormonal parameters: Data illustrated in table (10) revealed decreased levels of T3 in both HTLF and HTHF group at the 28^{th} days of age and levels are non significantly changed than the control group at the 35^{th} and the 42^{nd} days of age. These results are supported by those reported by **Geraert et al., (1996)** who found a significant reduction in plasma T3 concentration under chronic heat stress. It is well known that thyroid hormones play a crucial role in thermoregulation in avian species and that plasma T3 levels are positively correlated with heat production **(Decuypere and Kuhn, 1984, 1988)**. T4 concentrations remained significantly unchanged throughout the 3 weeks of applying the heat stress condition. These findings are

in harmony with those of **Gereart et al., (1996)**. The finding that T3 levels returned to a level similar to that of the control group at the 35^{th} and the 42^{nd} days of age might be due to various factors impact on T3 and T4 levels including species **(Scanes et al., 1983, Gonzales et al., 1999)**, age **(Newcomer, 1978; Decuypere and Buyse, 1988; Rendon et al., 1994)** and energy intake and dietary composition **(He et al., 2000)**.

Blood CORT concentration has been widely used as a measure of environmental stress in broilers **(Mcfarlance and Curtis, 1989 and Zulkiflie et al., 2003)**. **Lin et al., (2006)** reported that CORT concentration in broilers that had been exposed to acute heat stress (32^{o}c and 40% relative humidity) for 6 hours varied from 3.17 to 4.28 ng/ml on day 42. It was also reported that heat stress caused the blood CORT level to increase in cockerels. The results shown in table (10) disagree with those of **Lin et al., (2006)**. This difference might be due that in the current work broiler chickens were exposed to chronic heat stress from the 21^{st} day to the 42^{nd} days of age. So, if serum CORT levels were increased as a result of heat exposure this would have been in the first days after heat exposure but after 1, 2 and 3 weeks (28, 35, 42 days of age) serum CORT levels in the heat stresses groups would have been the same as the control group. This finding is in harmony with that of **Edens, (1978)** who stated that in heat stressed broilers, a sharp increase was followed by a rapid decline in plasma CORT levels as involvement of corticosteroids has been investigated under thermal conditions, but not in chronically heat-exposed chickens **(Geraert et al., 1996)**.

Table 1: ***The experimental design***

Group	*Name*	*Number of chicks*	*Fat level*	*Temperature*
NTLF (control)	Normal Temperature-Low Fat	20	3%	Ideal (22-25 ^{o}C)
HTLF	High Temperature-Low Fat	20	3%	Natural temperature of Summer season from 21 day of age till 42 day of age. (25 ^{o}C -37 ^{o}C)
HTHF	High Temperature-High Fat	20	6%	Natural temperature of Summer season from 21 day of age till 42 day of age. (25^{o}C -37 ^{o}C)

Table 2: The ***Physical and chemical composition o f the experimental diet***

	Starter –grower diet		*finisher diet*	
	0-4 weeks		*4-6 weeks*	
	Soy bean oil level %			
Ingredient	**3**	**6**	**3**	**6**
Yellow corn	59.54	53.52	69.50	62.54
Soybean meal	22.38	29.98	17.90	25.62
Corn gluten	4.6	--	3.43	--
Say bean oil	3.00	6.00	3.00	6.00
Fish meal	7.25	7.5	2.90	2.00
Lime stone	1.38	1.01	1.08	1.30
Di Calcium phosphate	1.20	1.59	1.51	1.93
Sodium chloride	0.30	0.30	0.30	0.30
Sodium vit. premix*	0.25	0.25	0.25	0.25
Methionine	0.1	0.1	0.03	0.06
Crude protein %	23	22.96	18	18.02
ME (Kcal / kg)	3130	3160	3182	3200
Ether extract %	6.07	9.16	6.02	8.76
Calcium %	1.03	1.00	0.91	1.06
Total phosphorus %	0.71	0.73	0.68	0.77

Table (3): ***Effect of fat level and high environmental temperature on body weight (gm) of broiler chickens. (Means ± SE)***

Age/day	NTLF	HTLF	HTHF
21st	788.5^{a}±16.53	787.5^{a}±13.72	745.5^{a}±25.64
28th	1329^{a}±28.83	1294^{a}±26.85	1295^{a}±40.31
35th	1787^{a}±40.31	1713^{a}±39.32	1762^{a}±57.86
42th	2103^{a}±48.41	2051.4^{a}±47.41	2145.7^{a}±29.26

Table (4): ***Effect of fat level and high environmental temperature on body weight gain (gm) of broiler chickens. (Means ± SE).***

Age/day	NTLF	HTLF	HTHF
21st	412[a]±16.5	412.5[a]±7.15	384.5[a]±15.66
28th	540.5[a]±128.46	507[a]±14.74	550 [a] ±16.81
35th	458[a]±16.29	418.5[a]±15	466.6[a]±21.79
42th	309.86[a]±26.2	290.71[a]±12.97	372[a]±34.72

Table (4): ***Effect of fat level and high environmental temperature on body weight gain (gm) of broiler chickens. (Means ± SE).***

Age/day	NTLF	HTLF	HTHF
21st	1.4429[a]±0.08	1.4432[a]±0.02	1.4884[a]±0.06
28th	1.6361[a]±0.07	1.8192[a]±0.05	1.8243[a]±0.09
35th	2.1953[a]±0.07	2.2117[a]±0.07	2.0411[a]±0.09
42th	3.5943[a]±0.2	3.4112[a]±0.14	2.8473[a]±0.33

NTLF (control) (normal temperature-low fat) **HTLF** (high temperature low fat) **HTHF** (high temperature high fat)

Table (4): ***Effect of fat level and high environmental temperature on body weight gain (gm) of broiler chickens. (Means ± SE).***

Age/day	NTLF	HTLF	HTHF
21st	583.25	593.75	563
28th	865	855	815
35th	995	915.5	934.5
42th	1100	980.56	990

NTLF (control) (normal temperature-low fat) **HTLF** (high temperature low fat) **HTHF** (high temperature high fat)

Table (7): ***Effect of fat level and environmental temperature on blood cells count and differential leucocytic count (Means ± SE).***

Parameter	Age/day	NTLF	HTLF	HTHF
RBCs x10^6	28	2.452^{def}±0.19	2.486^{def}±0.27	2.88^{cde}±0.23
	35	2.762^{def}±0.22	2.46^{def}±0.03	2.756^{de}±0.13
	42	2.998^{cde}±0.21	1.784^{f}±0.16	2.324^{ef}±0.27
WBCs x10^3	28	18.470^{c}±0.35	15.640^{de}±1.6	16.300^{d}±0.89
	35	18.520^{c}±0.17	13.590^{f}±1	18.560^{c}±1.4
	42	18.720^{c}±0.18	14.480^{ef}±1.9	16.480^{d}±1.4
H%	28	39^{g}±0.89	48.8^{a}±2.22	49.4^{a}±2.37
	35	36.4^{h}±1.07	48.8^{a}±1.74	46.8^{c}±0.91
	42	32.4^{i}±1.07	41.6^{e}±1.2	43.6^{d}±0.67
L %	28	58.8^{c}±0.96	41.6^{k}±2.24	44.4^{j}±2.73
	35	62.8^{d}±0.66	48.4^{g}±1.63	48^{gh}±2.48
	42	65.4^{a}±1.66	55.2^{e}±1.31	51.2^{f}±2.08
H/L ratio	28	0.664^{bcd}±0.02	1.197^{a}±0.12	1.179^{a}±0.12
	35	0.58^{cd}±0.02	1.017^{abc}±0.06	1.029^{abc}±0.08
	42	0.498^{d}±0.02	0.757^{abcd}±0.03	0.853^{abcd}±0.03

Table (8): ***Effect of fat level and high environmental temperature on serum lipid metabolites (Means ± SE).***

Parameter	Age/day	NTLF	HTLF	HTHF
Tcol (mg/dl)	28	131.718^{cdef}±2.9	135.917^{ab}±3.29	136.917^{a}±3.61
	35	131.472^{cdef}±2.26	133.864^{abc}±3.43	133.864^{abc}±3.34
	42	131.865^{cdef}±2.26	132.613^{bcde}±3	132.372^{bcde}±3.89
TG (mg/dl)	28	86.516^{ab}±4.07	88.087^{a}±4.27	88.965^{a}±4.2
	35	85.835^{ab}±4.72	87.12^{ab}±4.51	87.589^{a}±4
	42	86.604^{ab}±5.05	86.211^{ab}±4.87	86.264^{ab}±4.44
Tot. Lipids (mg/dl)	28	866.568^{bc}±93.67	890.573^{a}±82.28	890.129^{a}±81.34
	35	832.155^{de}±93.36	862.763^{bc}±108.3	873.498^{ab}±76.54
	42	865.342^{bc}±92.93	875.006^{ab}±105.4	893.401^{a}±88.62
HDL (mg/dl)	28	83.134^{e}±5.97	84.11^{de}±5.77	89.368^{abc}±5.51
	35	83.56^{de}±8.18	85.748^{bcd}±7.19	90.456^{ab}±3.92
	42	84.39^{cde}±8.17	93.337^{a}±3.62	93.251^{a}±3.98
LDL (mg/dl)	28	31.282^{abcd}±5.73	34.314^{a}±4.86	29.081^{abcd}±3.35
	35	31.655^{abcd}±6.23	30.411^{abcd}±4.39	25.890^{cde}±1.55
	42	26.633^{bcde}±6.23	22.034^{e}±1.69	21.868^{e}±1.76

- Tcol= Total cholesterol, TG= Triacylglycerol, Tot.Lipid= Total lipids
- Means carrying different small letters in the same row are significantly different at the level of p<0.05.
- **NTLF** (control) (normal temperature-low fat) **HTLF** (high temperature low fat) **HTHF** (high temperature high fat).
- Means carrying different small letters in the same row are significantly different at the level of p<0.05
- **NTLF** (control) (normal temperature-low fat) **HTLF**(high temperature low fat) **HTHF** (high temperature high fat)**.**

Table (9): ***Effect of fat level and high environmental temperature on serum total protein, albumin and globulin (Means ± SE).***

Parameter	Age/day	NTLF	HTLF	HTHF
Protein (g/L)	28	2.804^{abc}±0.3	2.52^{bc}±0.28	2.531^{bc}±0.23
	35	3.148^{ab}±0.31	2.516^{bc}±0.19	2.704^{bc}±0.22
	42	3.006^{abc}±0.11	2.688^{bc}±0.17	2.705^{bc}±0.11
Albumin (g/L)	28	1.52^{a}±0.17	1.27^{a}±0.06	1.215^{a}±0.06
	35	1.698^{a}±0.15	1.329^{a}±0.14	1.293^{a}±0.11
	42	1.645^{a}±0.17	1.375^{a}±0.14	1.386^{a}±0.12
Globulin (g/L)	28	1.285^{a}±0.2	1.226^{a}±0.3	1.316^{a}±0.25
	35	1.408^{a}±0.22	1.187^{a}±0.19	1.411^{a}±0.18
	42	1.361^{a}±0.08	1.313^{a}±0.14	1.316^{a}±0.12

- Means carrying different small letters in the same row are significantly different at the level of p<0.05
- **NTLF** (control) (normal temperature-low fat) **HTLF** (high temperature low fat) **HTHF** (high temperature high fat)

Table (10): ***Effect of fat level and environmental temperature on serum hormones (Means ± SE).***

Parameter	Age/day	NTLF	HTLF	HTHF
T3 ng/ml	28	1.068^{abc}±0.07	0.838^{c}±0.02	0.832^{c}±0.02
	35	1.128^{abc}±0.09	1.006^{abc}±0.06	0.892^{bc}±0.03
	42	1.134^{abc}±0.08	1.11^{abc}±0.08	1.092^{abc}±0.11
T4 ng/ml	28	5.934^{a}±0.87	5.99^{a}±0.98	6.06^{a}±0.89
	35	5.906^{a}±1.25	6^{a}±0.82	5.716^{a}±1.08
	42	5.940^{a}±1.05	5.88^{a}±0.84	5.886^{a}±0.84
CORT ng/ml	28	1.508^{a}±0.15	2.066^{a}±0.35	2.132^{a}±0.23
	35	1.534^{a}±0.16	1.892^{a}±0.38	1.918^{a}±0.2
	42	1.63^{a}±0.08	1.752^{a}±0.2	1.756^{a}±0.3

Means carrying different small letters in the same row are significantly different at the level of p<0.05
NTLF(control) (normal temperature-low fat) **HTLF** (high temperature low fat) **HTHF** (high temperature high fat)

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الملخص العربى

تـأثيـرات العليقـة عاليـة الدهـون على بعض السـمات الفسيولوچية فى بدارى التسـمين تحت درجات الحـرارة العاليـة

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أجريت الدراسة الحالية لاستبيان تأثير زيادة مستوى زيت الصويا فى علائق بدارى التسمين على بعض السمات الفسيولوچية لهذه الطيور تحت درجات الحرارة العالية فى فصل الصيف وقد تم إستخدام ستين كتكوت عمر يوم من سلالة (كوب) وتقسيمهم عشوائياً إلى ثلاث مجموعات متساوية كل مجموعة تحتوى على عشرين كتكوتاً، المجموعة الضابطة (درجة حرارة عادية ومستوى دهن منخفض) والتى تم ترتبيتها (درجة حرارة عالية ومستوى دهن منخفض) والتى تم تربيتها تحت درجة حرارة عالية فى فصل الصيف وتم تغذيتها على عليقة تحتوى على ٣٪ زيت صويا وذلك من عمر ٢١ حتى ٤٢ يوم والمجموعة الثالثة (درجة حرارة عالية ومستوى دهن عالى) والتى تم تربيتها تحت درجة حرارة عالية فى فصل الصيف وتم زيادة نسبة زيت الصويا فى العليقة من ٣٪ إلى ٦٪ وذلك من عمر ٢١ حتى ٤٢ يوم، تم حساب متوسط الأوزان وكمية العليقة المستهلكة إسبوعياً وأيضاً تسجيل معدل الزيادة وكفاءة التحويل لكل مجموعة وتم تجميع عينات الدم من أوردة الجناح عن عمر ٢٨ و ٣٥ و ٤٢ يوم وتم تقسيم العينات لعينات دم وعليها موانع تجلط لعد خلايا الدم الحمراء وخلايا الدم البيضاء وعمل مسحات لتسجيل كلاً من إعداد الهيتروفيل والليمفوسيت ونسبة الهيتروفيل إلى الليمفوسيت (H/L ratio) كما تم فصل مصل الدم لقياس مستويات الكوليسترول الكلى والجليسريدات الثلاثية والدهون الكلية والبروتينات الدهنية (الليبوبروتينات) عالية وقليلة الكثافة والبروتينات الكلية والألبومينات والجلوبيولينات والتراى أيودوثيرونين (T3) والثيروكسين (T4) والكورتيكوستيرون (CORT) وكانت النتائج كالتالى :

- **معدلات النمو :** لوحظ عدم وجود فروق معنوية بين المجموعات فى وزن الجسم، معدل الزيادة فى وزن الجسم، كفاءة التحويل الغذائى وكمية العليقة المستهلكة.

- **مكونات الدم :** كان هناك إنخفاض معنوى فى متوسط عدد كرات الدم الحمراء فى عينة الدم فى المجموعة عالية الحرارة قليلة الدهون عند عمر ٤٢ يوم مقارنة بالمجموعة عالية الحرارة عالية الدهون والمجموعة الضابطة عند نفس العمر، بالنسبة لمتوسط عدد خلايا الدم البيضاء فى الدم كان هناك انخفاض معنوى فى المجموعة عالية الحرارة قليلة الدهون عن عمر ٣٥، ٤٢ يوم والمجموعة عالية الحرارة عالية الدهون عند

عمر ٤٢ يوم مقارنة بالمجموعة الضابطة عن عمر ٢٨، ٣٥، ٤٢ يوم، بالنسبة لمتوسط نسبة الهيتيروفيل إلى الليمفوسيت كان عناك زيادة معنوية فى المجموعة عالية الحرارة منخفضة الدهون والمجموعة عالية الدهون عند عمر ٢٨ يوم وكان هناك انخفاض معنوى فى المجموعة الضابطة عند عمر ٤٢ يوم.

- نواتج أيض الدهون فى الدم : الصيف كان متوسط الكوليسترول فى مصل الدم ليدارى تسمين المجموعة عالية الحرارة عالية الدهون عند عمر ٢٨ يوم أعلى معنوياً منه فى المجموعة الضابطة والمجموعة عالية الحرارة منخفضة الدهون عند عمر ٢٨ يوم وافى المجموعة عالية الحرارة عالية الدهون عند عمر ٢٨ و ٣٥ يوم مقارنة بالمجموعة الضابطة.

بالنسبة لمستوى الدهون الكلية فى مصل الدم كان هناك زيادة معنوية فى المجموعة عالية الحرارة منخفضة الدهون عند عمر ٢٨ يوم وفى المجموعة عالية الحرارة عالية الدهون عن عمر ٢٨ و ٣٥ يوم مقارنة بالمجموعة الضابطة عند عمر ٢٨ و ٣٥ و ٤٢ يوم.

كانت متوسطات الليبوبروتينات عالية الكثافة فى مصل الدم لبدارى التسمين أعلى معنوياً فى المجموعة عالية الحرارة قليلة الدهون والمجموعة عالية الحرارة عالية الدهون عند عمر ٤٢ يوم وكانت متوسطات المجموعة الضابطة أقل معنوياً من المجاميع الأخرى عند عمر ٢٨، ٣٥، ٤٢ يوم، بالنسبة لليبوبروتينات منخفضة الكثافة كانت المتوسطات منخفضة معنوياً فى المجموعة عالية الحرارة قليلة الدهون والمجموعة عالية الحرارة عالية الدهون عند عمر ٤٢ يوم مقارنة بالمجموعة الضابطة.

البروتينات الكلية والالبومين والجلوبيولين : كان هناك انخفاض معنوى فى قيمة البروتينات الكلية فى المجموعة عالية الحرارة قليلة الدهون والمجموعة عالية الحرارة عالية الدهون عند عمر ٢٨، ٣٥، ٤٢ يوم مقارنة بالمجموعة الضابطة عند نفس الأعمار، لم تكن عناك فروق معنوية فى متوسطات الألبومين والجلوبيولين فى مصل الدم بين المجموعات.

- الهرمونات :

(تراى أيودوثيرونين (T3)، الثيروكسين (T4) والكورتيكوستيرون (CORT) كان متوسط هرمون (T3) فى مصل الدم أقل معنوياً فى المجموعة عالية الحرارة قليلة الدهون والمجموعة عالية الحرارة عالية الدهون عند عمر ٢٨ يوم مقارنة بالمجموعة الضابطة عند نفس العمر وعند عمر ٣٥ و ٤٢ يوم لوحظ عدم وجود فروق معنوية بين المجاميع، بالنسبة لمتوسط هرمون(T4) فى السيروم لم تكن هناك فروق معنوية عند عمر ٢٨، ٣٥ و ٤٢ يوم بين المجاميع، بالنسبة لمتوسط هرمون (CORT) فى مصل الدم كانت هناك زيادة غير معنوية عند عمر ٢٨ يوم فى كلاً من المجموعة عالية الحرارة قليلة الدهون والمجموعة عالية الحرارة عالية الدهون مقارنة بالمجموعة الضابطة وعند عمر ٣٥ و٤٢ يوم لوحظ عدم وجود فروق معنوية بين المجموعات.