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EFFECTS OF LATE HEAT STRESS ON SOME PHYSIOLOGICAL AND IMMUNOLOGICAL PARAMETERS IN TWO LOCAL STRAINS OF CHICKENS

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ABSTRACT

A total number of 500 two-weeks old sexed chicks from each strain "Inshas and Matrouh" was used to study the effect of late heat stress on some physiological and immunological traits. The chicks were divided randomly into five equal groups "100 chicks for each group, 50 male and 50 female". The first group didn't receive any treatment and served as control, the second group was exposed to both early (at 4 weeks of age) and late (at 18 weeks of age) heat stress without anti-stress, the third group received the same treatment as second group with anti-stress, the fourth was exposed to late heat stress without anti-stress, the last group (fifth) was received the same treatment as the fourth group with anti-stress. The heat stress was for 4 hours / day for 5 consecutive days at 38-39 °C inside the house and the anti-stress was vitamin C, where it was added at level of 3 gm (20% concentration)/liter drinking water from 1 day before heat exposure until the end of the treatment. The obtained results could be summarized as follows:

- Body temperature (°C) in treated chicks was higher significantly (P≤ 0.05) than control and female chicks were higher significantly (P≤ 0.05) than males.
- Heat exposure increased respiration rate (RR) significantly (P≤ 0.05) in treated chicks than control and in "Inshas" females than males. In general, no significant differences were found between the two strains or between two sexes for respiration rate.
- Plasma total protein, albumin and globulin didn't affected by strain or sex or their interaction (strain x sex). Late heat exposure with vitamin C increased plasma total protein and albumin concentration significantly (P≤ 0.05) than other treatments. Globulin concentration had no trend with treatments. No differences were found between strains or sexes or treatments in glucose concentration.
- Treatment with heat stress (either with anti-stress or without anti-stress) had no effect on Ab's production (humoral immune response) against SRBC's. Also no significant differences were found between strains or sexes.
- With regard to Ab's production against Newcastle disease (ND), no significant differences were found between strains or sexes. The treated groups were significantly lower in Ab's production (P≤ 0.05) than control.
  The treatment with heat stress decreased significantly (P≤ 0.05) the humoral immune response against Newcastle disease (ND).

Keywords: Local chickens, humoral immune response, cell mediated immune response, blood, heat stress, PHA response).

INTRODUCTION

Rearing chickens during summer in open houses resulted in serious economic losses in productive performance. Low growth rate; lower feed intake and decrease in feed efficiency are associated with exposing broilers

to high ambient temperature (Bonnet *et al.*1997). Ambient temperature is the most environmental factor, which affects all physiological processes and productive performance of animals. (El-Sagheer and Makled 2005). Raising rectal temperature as a result of exposure to elevated ambient temperature is known to influence body temperature regulation center in the brain (Glue and Hardy, 1970). The increase in rectal temperature may be due to the ability of animals to prevent the rise in core temperature at high ambient temperature and/or to the failure of the physiological mechanisms of animals to balance the excessive heat load caused by exposure to high ambient temperature. (Habeeb, *et al.*, 1993).

Panting is one of the visible responses of poultry during exposure to heat. This specialized form of respiration dissipates heat by evaporative cooling at the surface of the mouth and respiratory passageways. Sandercock, *et al.* (2001) found that, exposure to acute heat stress (AHS) significantly increased deep body temperatures, panting-induced acid/base disturbances and plasma creatine kinase (CK) activities. Kotze *et al.*, (1977) reported that an oral dose of 250 and 500 mg of ascorbic acid (AA) decreased rectal temperatures in men exposed to 33.9 °C for 4 h /day for 10 consecutive days. McKee et *al.*, (1997) found that, a temperature by ascorbic acid (AA) interaction was detected in which heat exposed birds expressed lower ($p < 0.10$) respiratory quotients when consuming the AA- supplemented diet.

Deyhim et *al.* (1995) found that, heat stress (35°C for 6 h/ day) reduced serum total protein, albumin, but it raised ($p < 0.05$) blood sugar. Liu *et al.* (1998) reported that, heat stress survival time was positively correlated with glucose, cholesterol and albumin and negatively correlated with T3. Metwally (2005) concluded that vitamin C (200 mg/kg diet) during heat stress improved total protein, calcium and phosphorus concentrations while decreased levels of glucose, albumin and cholesterol in plasma. High ambient temperature could result in numerous physiological and metabolic disturbances in broiler chickens, which would negatively impact performance and immune response (Borges *et al.*2003). Anwar *et al.* (2004) concluded that, subjected broiler chicks to heat stress (93-97 degrees F) decreased the immune response and ratio of bursa, thymus and spleen to body weight of the birds. Ascorbic acid (AA) synthesized in avian kidneys has been demonstrated to protect the birds from heat stress and improve disease resistance in chicken by optimizing the function of the immune system (Amakye-Anim *et al.*, 2000).

The aim of this work (experiment) was to study the effect of heat stress on productive performance, some physiological and immunological characteristics in two local strains of chickens (Inshas and Matrouh strains).

MATERIALS AND METHODS

Genetic stock and management

A total number of 500 two-week old sexed chicks from each strain "Inshas and Matrouh" were used in this experiment. The chicks were reared on ground pens with deep litter under natural day light. All chicks received

feed and water "ad libitum". The chicks received layer starter ration from"1-6 " weeks of age (crude protein 19.1% and 2850 Kcal/ ME), layer grower ration from "7-12" weeks of age (16% crude protein and 2800 Kcal/ME) and layer pre-production ration from "13-19" weeks of age (17.1% crude protein and 2760 Kcal/ME) as shown in Table (1). The rations were formulated according to NRC, (1994). The chicks were vaccinated according the recommended vaccination program in local area.

Experimental design "treatments"

The chicks of each strain were distributed randomly into five equal groups "100 chick for each group, 50 male chicks and 50 female chicks". Each group was reared in ground (floor) pens; the feed and water were available for free consumption (*ad.libitum*).

The first group didn't have any treatment and served as control, the second group was exposed to both early (at 4 weeks of age) and late (at 18 weeks of age) heat stress without any anti-stress (ascorbic acid, AA), the third group received the same treatment as second group with (AA), the fourth group was exposed to late heat stress without (AA) and the last (fifth) group was received the same treatment as the fourth group with anti-stress.

The heat stress was for 4 hours/day for 5 consecutive days at 38-39°C and the anti stress was vitamin C (AA), where it was added at level of 3gm (with concentrate of 20%) / liter of drinking water from 1 day before heat exposure until the end of the treatment.

Studied traits

(a) Growth performance

Monthly body weight (BW), body weight gain (BWG), growth rate (GR) and mortality rate (MR) were recorded.

(b) Body temperature (°C)

Body temperature was measured by digital thermometer by inserting the hand-held thermometer into the cloaca at "18" weeks of age during the treatment.

(c) Respiration Rate (RR)

The respiration rate was counted by observing the abdominal movements for one minute at "18" weeks of age during the treatment.

(d) Blood picture

At "18" weeks of age, three blood samples were withdrawn from each sex within each treatment within each strain for measuring hematocrite percent Ht % (PCV %) and hemoglobin concentration (Hb) g /dL according to Merck (1974).

(e) Plasma constituents

At "18" weeks of age, three blood samples from each sex /treatment/strain were taken from brachial vein in hepranized tubes and centrifuged at 3000 rpm for 10 minutes to obtain the plasma and stored at -20 °C until the analysis. The plasma samples were used in the analysis to measure Total protein (T.P.) according to Gornall *et al.*, (1949), Albumin (Alb) according to Doumas,*et al.*,(1971),Glucose (GLu) according to Trinder (1969) and liver function (AST, ALT) according to Reitman and Frankel (1957).

Immunological Parameters

Hurmolal immune response (antibody titer)

In this experiment, two indicators were used to measure the humoral immunity (antibody production) by both ND vaccine and SRBC's injection as shown below:

(a)Against Newcastle disease (ND) vaccine

We used the procedures reported by Bread *et al.*, (1975).

(b)Against Sheep red blood cells (SRBC's)

We used the procedure that reported by El-Kaiaty (1993), Bachman and Mashaly (1986) and Isakov *et al.*, (1982).

Cell-mediated immunity (CMI):

The response to phytohemagglutinin (PHA) injection as indicator of cell mediated immunity was measured by injecting 50 µl of PHA (dissolved in 0.1 ml of saline) subcutaneously into a defined area on the right wattle of 3 chicks of each sex /strain / and treatment. A similar amount of saline was injected in the opposite (left) wattle and served as control. The thickness of both wattle were measured before and after PHA injection 24hours by using a caliper (Cotter and Weinner, 1997) and (El-Kaiaty, 1993).

The response to PHA injection was calculated as a ratio as described by (Bachman and Mashaly, 1987).

Statistical analysis

Data that were collected during this study were statistically analyzed using the two way analysis of variance (GLM) statistical analysis (SAS) software package (1999). The significance of differences between means was tested by Duncan's Multiple range test (1955).

Table(1): composition and calculated analysis of experimental diets:

Ingredients	Layer diets		
	Starter	Grower	Pre-Production
Yellow corn	62.20	65.50	65.50
Soy bean meal (44 %)	18.00	8.00	15.50
Layer concentrate (50 %) *	10.00	10.00	10.00
Whate bran	9.00	16.00	1.00
Bone meal	0.40	----	0.50
Limestone	0.40	0.50	7.50
Total	100.00	100.00	100.00
Calculated analysis:			
CP %	19.60	16.50	17.70
ME Kcal/Kg	2850	2840	2800
Ca %	1.04	0.95	3.75
Avi. P %	0.44	0.40	0.42
Lys. %	0.98	0.74	0..87
Meth. %	0.41	0.37	0.38
TSAA %	0.83	0.74	0.77

Layer concentrates analysis: 50 % CP, 2500 ME; 7 % Ca, 2.5 % Avi.P; 2.5 % Lys., 1.5 % Meth and 1.8 % TSAA.

RESULTS AND DISCUSSION

The body temperature after exposure to heat stress was significantly higher ($p< 0.05$) in treated chicks (averaged 42.33) than control (37.96). Female chicks (40.56) were significantly higher ($p< 0.05$) than males (40.08) in their body temperature, also, It can be noticed that, "Matrouh" females were significantly higher (40.69) than "Matrouh" males (39.97) in their body temperature, but the differences between "Inshas" males (40.19) and "Inshas" females (40.44) were not significant, also, the differences between the two strains "Matrouh" (40.33) and "Inshas" (40.31) were not significant, on the other hand, It can be noticed that, the supplementation of ascorbic acid "AA" (vitamin C) as anti stress decreased body temperature of the treatment (early+late heat stress+ "AA") (42.25) than the treatment (early+late heat stress only) (42.33), the differences between these two treatments were not significant. But, ascorbic acid supplementation decreased body temperature of the treatment (late heat stress+"AA") (41.80) significantly than the treatment (late heat stress only) (42.95), these results is shown in (Table 2).Chicken like all birds, is a homothermia, it keeps its body temperature at a relatively constant level by thermoregulation, the body temperature of chicken depending on bird size, environmental temperature, age and sex (Sturkie, 1986).Exposing chickens to high environmental temperature produces an initial increase in the temperature of peripheral tissues and subsequently increase body temperature (Wang *et al.*, 1989). The increase in rectal temperature may be due to either ability of animals to prevent the rise in core temperature at high ambient temperature and/or to the failure of the physiological mechanisms of animals to balance the excessive heat load caused by exposure to high ambient temperature, Habeeb, *et al.*, (1993). These results agree with Sandercock, *et al.* (2001) and El-Tantawy, *et al.* (2003). On the other hand, the effect of ascorbic acid supplementation in this experiment agrees with Pardue *et al.* (1985) and Atta (2002).

(Table 3) showed that, heat exposure caused a significant increase ($p< 0.05$) in respiration rate (RR) in treated chicks (averaged 151.74) than control (74.16), the (RR) in Inshas female (146.00) was significantly higher ($p< 0.05$) than Inshas males (133.40).However, and in general, no significant differences were found between the two strains or between sexes for respiration rate. It can be noticed from this table that, (RR) in the treatment (early+late heat stress+"AA") was (155.00) while (RR) in treatment (early+late heat stress only) was (130.83), these differences were significant, also, (RR)in the treatment (late heat stress+"AA") was (167.75), while (RR)in treatment (late heat stress only) was (153.41), also these differences were significant. these results may be due to that, Birds have no sweat gland as mammals, so birds uses a process of evaporative cooling by the vaporization of moisture from the damp lining of the respiratory tract. Heat loss in this manner is named latent or insensible heat loss and is considered a major method of heat elimination from the body of the birds when the ambient temperature is high (Mohamed, 1985).

Table (2): Effect of heat stress (μ ± SE) on Body temperature at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	40.65± 0.39 ^{gh} (1)	40.20 ± 0.39 ^{hj}	40.60 ± 0.39 ^{gh}	40.41 ± 0.39 ^{hj}	40.96±0.19 ^{C} (2)
Early +Late	42.43 ± 0.39 ^{abcd}	42.16 ± 0.39 ^{abcd}	42.06± 0.39 ^{abcd}	42.66 ± 0.39 ^{abc}	42.33 ± 0.19 ^{B}
Early +Late+ Anti	42.35±0.39 ^{abcd}	42.30±0.39 ^{abcd}	41.61 ± 0.39 ^{cd}	42.76 ± 0.39 ^{abc}	42.25 ± 0.19 ^{B}
Late	42.85 ± 0.39 ^{abc}	43.15 ± 0.39 ^{a}	42.81 ± 0.39 ^{abc}	43.00 ± 0.39 ^{ab}	42.95 ± 0.19 ^{A}
Late +Anti	42.00±0.39 ^{abcd}	42.26±0.39 ^{abcd}	41.13 ± 0.39 ^{de}	41.80± 0.39 ^{bcd}	41.80 ± 0.19 ^{B}
Sex * Strain	40.19 ±0.14 ^{BC} (3)	40.44 ± 0.14 ^{AB}	40.97 ± 0.14 ^{C}	40.69 ± 0.14 ^{A}	
Strain overall mean	Inshas		Matrouh		
	40.31 ± 0.10 A		40.33 ± 0.10 ^{A}		
Sex overall mean	Male		Female		
	40.08 ± 0.10 ^{B} (4)		40.56 ± 0.10 ^{A}		

(1) a,b,c,d,e,f,g,h means within the same row and column with different superscripts are differ significantly (P≤0.05) from each other.
(2) A, B, C means within the same column with different superscripts are differ significantly (P≤0.05) from each other.
(3) A, B, C means within the same row with different superscripts are differ significantly (P≤0.05) from each other.
(4) A, B means within the same row with different superscripts are differ significantly (P≤0.05) from each other.

Table (3): Effect of heat stress (μ± SE) on Respiration rate at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	88.00 ± 8.07 ^{g} (1)	71.66 ± 8.07 ^{g}	69.00 ± 8.07 ^{g}	68.00 ± 8.07 ^{g}	74.16± 4.03 ^{D} (2)
Early +Late	135.00 ± 8.07 ^{def}	130.66 ± 8.07 ^{ef}	129.33 ± 8.07 ^{f}	128.33 ± 8.07 ^{f}	130.83 ± 4.03 ^{C}
Early +Late+Anti	133.33 ± 8.07 ^{ef}	177.66 ± 8.07 ^{ab}	161.33 ± 8.07 ^{abcd}	147.66 ± 8.07 ^{cdef}	155.00 ± 4.03 ^{B}
Late	149.33 ± 8.07 ^{cdef}	178.66 ± 8.07 ^{a}	133.66 ± 8.07 ^{ef}	152.00 ± 8.07 ^{bcdef}	153.41 ± 4.03 ^{B}
Late +Anti	161.33 ± 8.07 ^{abcd}	171.33 ±8.07 ^{abc}	181.66 ± 8.07 ^{a}	156.66 ± 8.07 ^{abcde}	167.75 ± 4.03 ^{A}
Sex * Strain	133.40 ± 3.61 ^{B} (3)	146.00 ± 3.61 ^{A}	135.00 ± 3.61 ^{B}	130.53 ±3.61 ^{B}	
Strain overall mean	Inshas		Matrouh		
	139.70 ± 2.55 ^{A}		132.76 ± 2.55 ^{A}		
Sex overall mean	Male		Female		
	134.20 ± 2.55 ^{A}		138.26 ± 2.55 ^{A}		

(1) a,b,c,d,e,f ,g means within the same row and column with different superscripts are differ significantly (P≤0.05) from each other.
(2) A,B,C,D,means within the same column with different superscripts are differ significantly (P≤0.05) from each other.
(3) A, B, means within the same row with different superscripts are differ significantly (P≤0.05) from each other.

Birds can balance their body energy by reducing heat production, or increasing evaporative heat loss (panting), by increasing sensible heat loss (convection and radiation), or by a combination of all of these (Hillman *et al.*, (1985) .Heat- distressed birds exhibit increased respiration rate and respiratory alkalosis (Bottje and Harrison, 1985).These results are in agreement with Zhou, *et al.* (1997) and El-Tantawy, *et al.* (2003). The effect of supplemented vitamin C as anti stress in the present experiment agrees with McKee *et al.*, (1997) and Atta, (2002).

(Tables 4) showed that, plasma total protein concentration after exposure to heat stress was significantly lower (averaged 6.06) in treated chicks than control (6.88), also, "Inshas" females were significantly higher (6.97) than "Inshas" males (5.76). The differences between "Matrouh" females and "Matrouh" males were not significant. Plasma total protein concentration did't affected by strain or sex but affected by treatment. Late heat exposure with vitamin C increased plasma total protein significantly (6.64) than the treatment with late heat stress only (5.91), but, the plasma total protein concentration of the treatment (early+late heat stress+ anti "AA") reduced significantly (5.33) than in the treatment subjected to (early+late heat stress without "AA") (6.37).The highest value was found in control. Table (5) showed that, albumin concentration after exposure to heat stress was significantly higher (averaged 3.01) in treated chicks than control (2.69), also, It can be noticed that, the concentration of albumin in the treatment with (late heat stress+"AA" was significantly higher (4.04) than the same treatment without ascorbic acid (2.72), but the differences were not significantly between the treatments (early+late heat stress) and (early+late heat stress+"AA"), also, there were not any significant differences between breeds or sexes or in the interaction between (strain and sex)in the albumin concentration. Table (6) showed that, globulin concentration after exposure to heat stress was significantly lower (averaged 3.02) in treated chicks than control (4.19), this table showed that, there were not any significant differences between strains or sexes or in the interaction between them. The concentration of globulin was significantly higher (3.92) in the treatment (late heat stress) than the treatment (late heat stress+"AA" (2.56), but there were not significant differences between (early+late) or (early+late+"AA"). Table (7) showed that, there was not any significant differences between treatment or sexes or strains or the interaction between (strain and sex) on the concentration of glucose, also, the supplemented with ascorbic acid had not any significant effect, but the differences were statistical. These results are in agreement with Metwally (2005) and Khan, *et al.* (2002). The beneficial effects of supplementation of vitamin C on plasma constituents which are presented in this study are similar to the studies by Gursu, *et al.* (2004) and Metwally (2005).Total plasma protein may be used as useful criterion for heat stress in birds (Eberhart and Washburn, 1993), however, Yahav *et al.*, (1997) found as opposite trend, where the differences among the results of such investigators may be due to differences in poultry species and /or duration of heat stress exposure.

Table (4): Effect of heat stress (μ± SE) on Plasma Total Protein concentration at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	6.09 ±0.73 abcde (1)	8.43 ± 0.73 a	6.67 ± 0.73 abcde	6.35 ± 0.73 abcde	6.88 ± 0.41 A (2)
Early +Late	4.77 ± 0.73 de	5.64 ± 0.73 bcde	8.10 ± 0.73 ab	6.97 ± 0.73 abcde	6.37 ± 0.41 AB
Early +Late+Anti	5.79 ± 0.73 bcde	No sample	4.53 ± 0.51 e	5.93 ± 0.73 bcde	5.33 ± 0.43 B
Late	6.05 ± 0.73 abcde	6.02 ± 0.73 abcde	6.42 ± 0.73 abcde	5.17 ± 0.73 de	5.91 ± 0.41 AB
Late +Anti	6.11 ± 0.73 abcde	7.82 ± 0.73 abc	5.58 ± 0.73 cde	7.05 ± 0.73 abcd	6.64 ± 0.41 A
Sex * Strain	5.76 ± 0.38 B (3)	6.97 ± 0.42 A	5.97 ± 0.34 AB	6.29 ± 0.38 AB	
Strain overall mean	Inshas		Matrouh		
	6.23 ± 0.28 A		6.22 ± 0.25 A		
Sex overall mean	Male		Female		
	5.96 ± 0.25 A		6.50 ± 0.28 A		

(1) a.b,c,d,e means within the same row and column with different superscripts are differ significantly (P≤0.05) from each other.
(2) A, B, means within the same column with different superscripts are differ significantly (P≤0.05) from each other.
(3) A, B, means within the same row with different superscripts are differ significantly (P≤0.05) from each other.

Table (5): Effect of heat stress (μ ± SE) on Albumin concentration in blood 'mg/dl' at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	3.34 ± 0.47 abcde (1)	2.71 ± 0.47 abcde	2.41 ± 0.47 cde	2.30 ± 0.47 cde	2.69 ±0.25 B (2)
Early +Late	1.88 ± 0.47 e	1.85 ± 0.47 e	3.72 ± 0.47 abc	2.89 ± 0.47 abcde	2.58 ± 0.25 B
Early +Late+Anti	3.49 ± 0.47 abcd	No sample	2.49 ± 0.33 bcde	2.95 ± 0.47 abcde	2.72 ± 0.26 B
Late	2.60 ± 0.47 abcde	2.12 ± 0.47 de	3.52 ± 0.47 abcd	2.63 ± 0.47 abcde	2.72 ± 0.25 B
Late +Anti	4.13 ± 0.47 a	4.00 ± 0.47 ab	4.15 ± 0.47 a	3.88 ± 0.47 abc	4.04 ± 0.25 A
Sex * Strain	3.09 ± 0.26 A	2.67 ± 0.29 A	3.13 ± 0.23 A	2.93 ± 0.26 A	
Strain overall mean	Inshas		Matrouh		
	2.85 ± 0.16 A		3.04 ± 0.15 A		
Sex overall mean	Male		Female		
	3.12 ± 0.15 A		2.78 ± 0.16 A		

(1) a.b,c,d,e means within the same row and column with different superscripts are differ significantly (P≤0.05) From each other.
(2) A, B, means within the same column with different superscripts are differ significantly (P≤0.05) from each other.

Table (6): Effect of heat stress (μ ± SE) on Globulin concentration 'mg/dl' at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	2.91 ± 0.88 ^{abc} (1)	3.98 ± 0.88 ^{abc}	5.77 ± 0.88 ^{a}	4.11 ± 0.88 ^{abc}	4.19± 0.43 ^{A} (2)
Early +Late	2.34 ± 0.88 ^{bc}	1.71 ± 0.88 ^{c}	2.44 ± 0.88 ^{bc}	3.02 ± 0.88 ^{abc}	2.38 ± 0.43 ^{B}
Early +Late+Anti	3.48 ± 0.88 ^{abc}	No sample	3.44 ± 0.62 ^{abc}	2.56 ± 0.88 ^{bc}	3.24 ± 0.46 ^{AB}
Late	3.15 ± 0.88 ^{abc}	4.82 ± 0.88 ^{ab}	3.69 ± 0.88 ^{abc}	4.02 ± 0.88 ^{abc}	3.92 ± 0.43 ^{A}
Late +Anti	2.03 ± 0.88 ^{bc}	3.51 ± 0.88 ^{abc}	1.48 ± 0.88 ^{c}	3.22 ± 0.88 ^{abc}	2.56 ± 0.43 ^{B}
Sex * Strain	2.78 ± 0.42 ^{A}	3.50 ± 0.47 ^{A}	3.37 ± 0.38 ^{A}	3.38 ± 0.42 ^{A}	
Strain overall mean	Inshas		Matrouh		
	3.12 ± 0.29 ^{A}		3.39 ± 0.26 ^{A}		
Sex overall mean	Male		Female		
	3.09 ± 0.26 ^{A}		3.42 ± 0.29 ^{A}		

(1) a,b,c means within the same row and column with different superscripts are differ significantly (P≤0.05) from each other.
(2) A, B, means within the same column with different superscripts are differ significantly (P≤0.05) from each other.

Table (7): Effect of heat stress (μ± SE) on Glucose concentration 'mg/dl' at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	282.89 ± 29.63 ^{a}	273.76 ± 29.63 ^{a}	302.23 ± 29.63 ^{a}	316.32 ± 29.63 ^{a}	293.80 ± 13.52 ^{A}
Early +Late	318.95 ± 29.63 ^{a}	284.06 ± 29.63 ^{a}	300.09 ± 29.63 ^{a}	306.41 ± 29.63 ^{a}	302.38 ± 13.52 ^{A}
Early +Late+Anti	297.47 ± 29.63 ^{a}	No sample	281.34 ± 20.95 ^{a}	279.30 ± 29.63 ^{a}	280.45 ± 14.28 ^{A}
Late	280.56 ± 29.63 ^{a}	289.11 ± 29.63 ^{a}	311.51 ± 36.29 ^{a}	303.88 ± 29.63 ^{a}	295.68 ± 14.15 ^{A}
Late +Anti	266.18 ± 29.63 ^{a}	298.15 ± 29.63 ^{a}	320.01 ± 29.63 ^{a}	307.77 ± 29.63 ^{a}	298.03 ± 13.52 ^{A}
Sex * Strain	289.21 ± 11.90 ^{A}	286.27 ± 13.31 ^{A}	298.71 ± 11.18 ^{A}	302.74 ± 11.90 ^{A}	
Strain overall mean	Inshas		Matrouh		
	286.27 ± 9.17 ^{A}		301.86 ± 8.38 ^{A}		
Sex overall mean	Male		Female		
	295.09 ± 8.38 ^{A}		293.04 ± 9.17 ^{A}		

(Tables 8) showed that, there was not significant effect of heat stress (either with anti-stress "AA" or without anti-stress) on antibodies (Ab's) production (in humoral immune response) against sheep red blood cells (SRBC's). But in Table (9) It can be noticed that, Ab's production (in humoral immune response) against Newcastle disease (ND) after exposure to heat stress was significantly lower (averaged 5.92) in treated chicks than control (7.42), also It can be noticed that, there were not any significant differences on humoral immune response against (ND) between strains or sexes, also, the ascorbic acid had not any significant effects. Results by Atta (2002) and Thaxton and Siegel, (1970), showed that acute heat stress resulted in decreased antibody titer to SRBC's antigen. This immune suppression has been attributed to an increase in the incorporation of endogenously produced ACTH and corticosteroids into lymphoid cells, which in turn causes the suppression of cell proliferation factors or interlukin II (Farrar *et al.*, 1980 ; Atta, 1996).Previous studies showed that in vivo heat stress suppress the activity of T- and B-lymphocytes and macrophages (Atta, 1996). High antibody titer against SRBC's at 6 day post immunization in ascorbic acid (AA) supplementated chicks may explain the benefits of (AA) supplementation on humoral immune response, especially during heat stress. Dietary supplementation of (AA) at 1000 ppm increased antibody response to SRBC's that were suppressed by heat stress (Pardue *et al.*, 1985). Tuekana *et al.*, (1994) showed that chicks supplemented with (AA) at 500 ppm had higher antibody titer to infection bronchitis. Also, the results of El-Housseiny *et al.*, (2001) demonstrated that, chicks supplemented with (AA) had superior antibody titer against Newcastle disease virus compared to those without (AA) supplementation. The enhancement of immune response via (AA) supplementation may be due to their antioxidant property. It may protect immature lymphocytes from damage by free radicals due to oxidation (Amakye- Anim *et al.*, 2000), inhibit biosynthesis and release of corticosterone (Gross, 1988), increase synthesizing cells (plasma cells) (Franchini *et al.*, 1994).

(AA) supplementation also enhance mononuclear cells to produce interleukins and enhance IL-2 receptor (IL-2R) expression on immune cells which their growth and proliferative are IL-2R dependent (Puthpongsiriporn *et al.*, 2001).Excessive environmental temperatures can alter immune function by reducing antibody production (Thaxton and Siegel, 1970). Also, phagocytic potential of chicken macrophages is decreased during heat-stress condition in vitro (Miller and Qureshi, 1991). It is possible that vitamin supplementation is probably improved helper T cell function, which is required to provide help during the induction and synthesis phase of antibody response for T-dependent antigens; such as SRBC's. This response is probably not due to nonspecific activation of macrophage function, such as phagocytosis, because no significant differences between phagocytosis of opsonized and unopsonized SRBC's were observed in macrophages among any of the treatment groups. The phagocytic potential of broiler macrophages was similar to that observed for White Leghorn chickens by Qureshi *et al.* (1986). These findings were in agreement with Anwar *et al.* (2004).

Table (8): Effect of heat stress (μ ± SE) on antibody production against sheep red blood cells (SRBC´S) at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	6.00 ± 1.15 ^{a}	7.00 ± 1.63 ^{a}	7.60 ± 0.73 ^{a}	7.25 ± 0.81 ^{a}	6.96 ± 0.57 ^{A}
Early +Late	7.71 ± 0.61 ^{a}	7.42 ± 0.61 ^{a}	8.50 ± 0.66 ^{a}	7.71 ± 0.61 ^{a}	7.83 ± 0.31 ^{A}
Early +Late+ Anti	8.00 ± 0.61 ^{a}	6.66 ± 0.66 ^{a}	8.00 ± 0.61 ^{a}	8.50 ± 0.66 ^{a}	7.79 ± 0.32 ^{A}
Late	7.12 ± 0.57 ^{a}	7.71 ± 0.61 ^{a}	8.14 ± 0.61 ^{a}	7.40 ± 0.73 ^{a}	7.59 ± 0.32 ^{A}
Late +Anti	6.71 ± 0.61 ^{a}	7.33 ± 0.66 ^{a}	7.50 ± 0.66 ^{a}	7.00 ± 0.61 ^{a}	7.13 ± 0.32 ^{A}
Sex * Strain	7.11 ± 0.33 ^{A}	7.22 ± 0.41 ^{A}	7.94 ± 0.29 ^{A}	7.57 ± 0.31 ^{A}	
Strain overall mean	Inshas		Matrouh		
	7.16 ± 0.26 ^{A}		7.76 ± 0.21 ^{A}		
Sex overall mean	Male		Female		
	7.52 ± 0.22 ^{A}		7.40 ± 0.26 ^{A}		

Table (9): Effect of heat stress (μ ± SE) on antibody production against Newcastle disease (ND) at 18 weeks of age in "Inshas" and "Matrouh" strains

Treatments	Strain				Treatments overall mean
	Inshas		Matrouh		
	Sex		Sex		
	Male	Female	Male	Female	
Control	7.14 ± 0.54 ^{ab} (1)	7.40 ± 0.64 ^{ab}	7.28 ± 0.54 ^{ab}	7.85 ± 0.54 ^{a}	7.42 ± 0.28 ^{A} (2)
Early +Late	6.28 ± 0.54 ^{abc}	6.28 ± 0.54 ^{abc}	6.42 ± 0.54 ^{abc}	4.14 ± 0.54 ^{d}	5.78 ± 0.27 ^{B}
Early +Late+Anti	5.57 ± 0.54 ^{bcd}	5.85 ± 0.54 ^{bcd}	6.00 ± 0.54 ^{abcd}	5.83 ± 0.58 ^{bcd}	5.81 ± 0.27 ^{B}
Late	5.12 ± 0.50 ^{cd}	7.42 ± 0.54 ^{ab}	5.66 ± 0.58 ^{bcd}	5.83 ± 0.58 ^{bcd}	6.01 ± 0.27 ^{B}
Late +Anti	5.85 ± 0.54 ^{bcd}	6.00 ± 0.58 ^{abcd}	5.71 ± 0.54 ^{bcd}	6.85 ± 0.54 ^{abc}	6.10 ± 0.27 ^{B}
Sex * Strain	5.99 ± 0.24 ^{A}	6.59 ± 0.25 ^{A}	6.21 ± 0.24 ^{A}	6.10 ± 0.25 ^{A}	
Strain overall mean	Inshas		Matrouh		
	6.29 ± 0.17 ^{A}		6.16 ± 0.17 ^{A}		
Sex overall mean	Male		Female		
	6.10 ± 0.17 ^{a}		6.34 ± 0.17 ^{a}		

(1) a,b,c,d, means within the same row and column with different superscripts are differ significantly (P≤0.05) from each other.
(2) A, B, means within the same column with different superscripts are differ significantly (P≤0.05) from each other.

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تأثير الإجهاد الحراري المتأخر على بعض الصفات الفسيولوجية و المناعية في نوعين من السلالات المحلية

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إستخدم عدد (٥٠٠ كتكوت) عمر أسبوعين مجنس من كل من سلالتي أنشاص و مطروح لدراسة تأثير الإجهاد الحراري المتأخر على بعض الصفات الفسيولوجية و المناعية، و لقد تمت التربية على فرشة أرضية تحت نظام الإضاءة الطبيعي كما تم تقديم الماء و العلف بصورة حرة، كما تم التحصين وفق برنامج التحصين المطبق في السلالات المحلية، ولقد تم تقسيم الكتاكيت عشوائيا إلى (٥) مجموعات متساوية (١٠٠ كتكوت في كل مجموعة " ٥٠ ذكور+٥٠ إناث")، حيث تم إعتبار المجموعة الأولى هي الكنترول (لم تتعرض للمعاملة الحرارية)، المجموعة الثانية تم تعريضها لإجهاد حراري مبكر (عند عمر ٤ أسابيع) و إجهاد حرارة متأخر (عند عمر ١٨ أسبوع)، أما المجموعة الثالثة فتم تعريضها لنفس المعاملة الحرارية التي تعرضت لها المجموعة الثانية مع إضافة حمض الاسكوربيك كمضاد للإجهاد، أما بالنسبة للمجموعة الرابعة فتعرضت للإجهاد الحراري المتأخر فقط (١٨ أسبوع)، أيضا المجموعة الخامسة (الأخيرة) تعرضت للإجهاد الحراري المتأخر و لكن مع إضافة حمض الاسكوربيك.

مع العلم أن الإجهاد الحراري الذي تعرضت له الطيور كان على درجة حرارة ٣٨-٣٩° م لمدة ٤ ساعات في اليوم و ذلك لمدة ٥ أيام متتالية، كما أن حمض الاسكوربيك (فيتامين ج) تم إضافتة بمعدل ٣ جم (بتركيز ٢٠%) / لتر ماء شرب و ذلك قبل تعريض الطيور للإجهاد الحراري بـ ٢٤ ساعة و طوال مدة الإجهاد الحراري. و لقد تم الحصول على النتائج الاتية:-

١- تسببت المعاملة الحرارية في إرتفاع درجة حرارة جسم الطيور الداخلية و ذلك بصورة معنوية بالمقارنة بالكونترول، و لقد لوحظ أن الإناث كانت أعلى معنويا في درجة حرارة جسمها عن الذكور، كذلك تمت ملاحظة تأثير إضافة حمض الاسكوربيك في خفض درجة حرارة الجسم الداخلية.

٢- إرتفع معدل التنفس بطريقة واضحة في الطيور المعرضة للإجهاد الحراري بالمقارنة بالكنترول، كما لوحظ أيضا التأثير الايجابي لإضافة حمض الاسكوربيك على خفض معدل التنفس.

٣- كانت للمعاملة تأثير معنوي على خفض نسبة الالبيومين، البروتين الكلى و الجلوبيولين، بينما لم يكن للسلالة أو الجنس تأثير معنوي عليهم، كما لوحظ أن إضافة حمض الاسكوربيك تسبب في زيادة هذه النسب، أما بالنسبة للجلوكوز فان المعاملة الحرارية لم يكن لها تأثير معنوي عليه بينما كانت هناك فروق إحصائية بين المعاملات.

٤- المعاملة بالإجهاد الحراري المتأخر قللت من الاستجابة المناعية لمرض النيوكاسيل في المجاميع المعاملة بالمقارنة بالكنترول و لكن الفروق كانت غير معنوية أي إحصائية فقط.