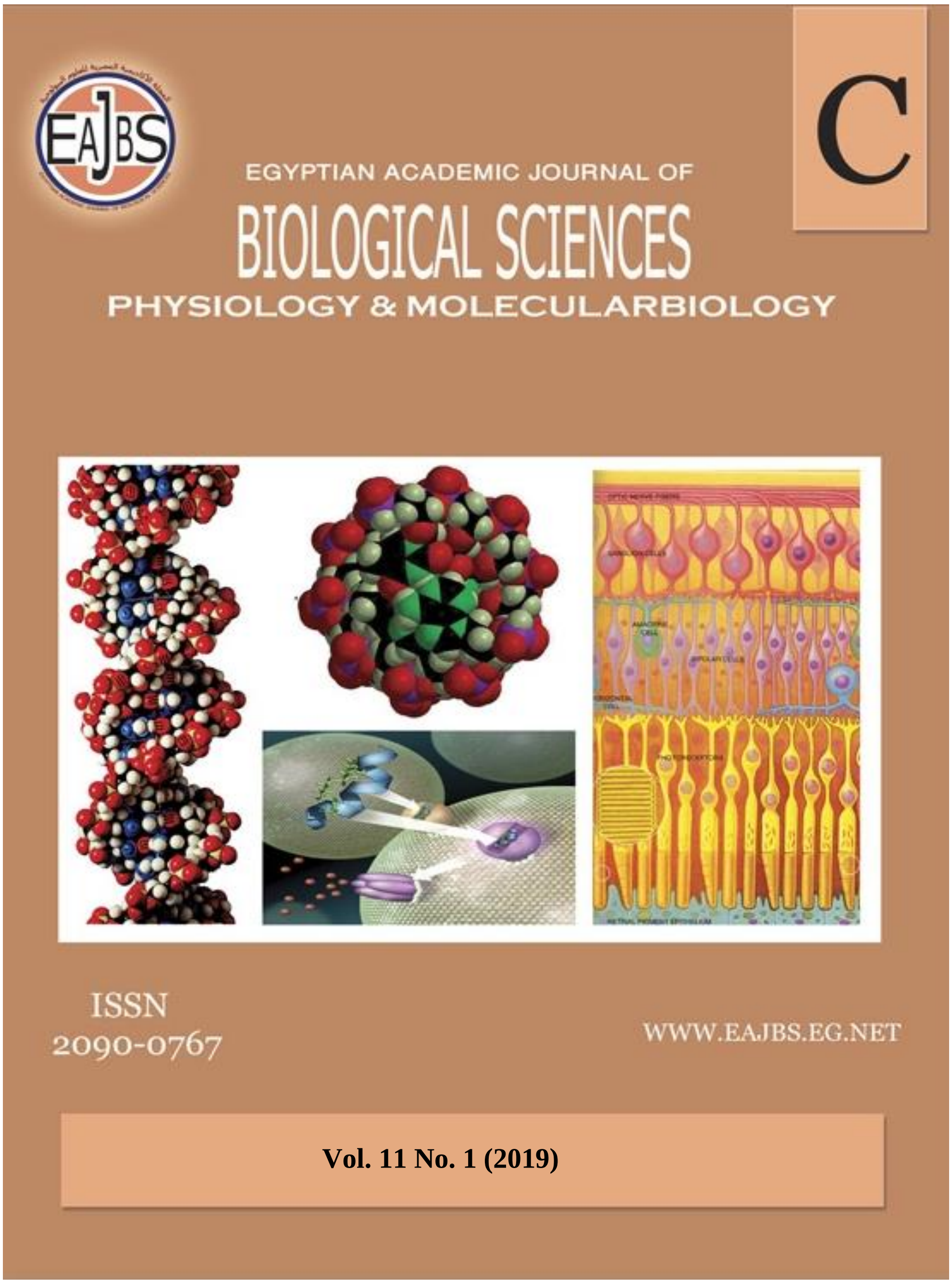

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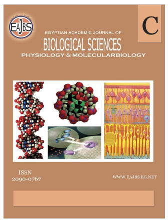

Broiler Productive and Physiological Performance under Different Heat Combating Practices during Acute Heat Stress

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ABSTRACT

An experiment was designed to study the effect of different heat combating practices during acute heat stress on productive and physiological performances of Cobb500 chicks. Total of 540 one-day old of Cobb500 chicks was randomly divided into six equal groups with three replicates (30 birds in each). The first group was subjected to neutral temperature (NT), the second group was under chronic heat stress as a control (CHS), the third group was exposed to early heat acclimation (EHA), the fourth group was exposed to feed restriction (FR), the fifth group was supplemented with 1 g vitamin C/Kg diet (Vit.C), and the six group was treated with a combination of the last three treatments (EFC). It was observed that, CHS group recorded the highest value in respiratory, mortality rate, serum liver enzymes activities (ALT and AST), serum glucose concentrations and the lowest body weight, feed intake, feed conversion ratio, serum concentrations of triiodothyronine (T3) and thyroxine (T4) hormones, serum immunoglobulin concentration, serum lipid profile levels, livability among groups, while, exposed chicks to different heat combating practices: NT, EFC, Vit.C, FR and EHA, respectively, decreased significantly chicks mortality, serum corticosterone concentration hormone and improved the livability percentages, body weight, feed intake, feed conversion ratio, serum immunoglobulin concentrations and had better results for serum ALT and AST activities. Furthermore, NT and EFC groups recorded the highest significant EPEI values (378.17 and 357.96) respectively, and serum concentrations of triiodothyronine (T3) and thyroxine (T4) hormones compared to the other groups. It can be concluded that EFC treatment showed the best practical method compared to the other groups to enhance the production performance and immunity status followed by T5, T4 and T3.

Therefore, these methods can be applied in broilers farms to increase the economic return

INTRODUCTION

Heat stress is known to be one of the major problems affecting broiler production in hot climate areas (Charles 2002). Hence, under acute heat stress (AHS) conditions, there is an increased demand for different heat combating practices to reduce the deleterious effects of AHS on health and performance of birds. Early heat acclimation, feed restriction and Vit.C during the periods of heat stress have become a common heat combating practices in many broiler-producing areas. In this respect, Yahav *et al.,* (1996) showed the important role of early heat acclimation in alleviating the adverse effects of heat stress in susceptible chickens. Moreover, Lin *et al.,* 2006b and Renaudeau *et al.,* 2012 showed the positive impact of feed restriction during the periods of heat stress on improving the feed efficiency and increasing heat stress resistance of broiler chickens. In addition, Vit.C under heat stress is a multi-functional biological agent and can improve the tolerance to heat exposure (Liew *et al.,* 2003 and Abu-Dleyeh, 2006). The physiological importance of Vit.C under stressful conditions led several researchers to supply poultry diets with Vit.C in order to improve humeral and cellular immune responses, productivity, survivability and to reduce body temperature and respiratory rate in broiler chickens (Wu *et al.,* 2000; Shoukry, 2001; Sahin *et al.,* 2003;Celik and Ozturkcan, 2003; Ciftci*et al.,* 2005). Therefore, the present study was planned to study the effect of applying different heat combating practices on Cobb500 chicks under acute heat stress on their productive and physiological performance.

MATERIALS AND METHODS

Birds and Husbandry:

Five hundred and forty, day-old Cobb 500 strain broilers maintained at the Poultry Research Station, Animal Production Department, Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo, Egypt.The chicks were randomly allocated to 6 experimental treatments for 6 wks (experimental period). Each treatment had 3 replicates of 30 chicks and chicks were numbered and housed on the floor. Birds were provided with 24hrs light and fed a standard mash diet formulated to fulfill the nutrient requirements of broiler chicks according to strain guide. The ingredients' composition and calculated chemical analysis of the basal diet are given in Table (1). The diet and water were available *ad libitum* throughout the experimental period.

Table (1): Shows the composition and calculated analysis of diets.

Ingredients	Diets of broiler chicks		
	Starter (1-10 day)	Grower (11-22 day)	Finisher (23-42 day)
Ground yellow corn 8.8%	62.05	62.6	64.55
Soybean meal 44%	24.15	26.01	23.28
Corn gluten meal 60%	9.1	4.58	4.58
Sunflower oil	0.15	2.5	3.5
Dicalcium phosphate	2.14	2.1	2
Limestone	1.4	1.24	1.11
Premix*	0.3	0.3	0.3
Sodium Chloride (NaCl)	0.3	0.3	0.3
DL-methionine	0.12	0.17	0.17
L-lysine-HCl	0.29	0.2	0.21
Total (Kg)	**100**	**100**	**100**
Calculated analysis**			
Crude protein%	21.29	19.24	18.24
ME. cal/Kg feed	2986.70	3082.96	3176.00
C/P ratio	142.16	162.18	176.35
Calcium%	1.04	0.98	0.90
Available P.%	0.50	0.49	0.47
Lysine%	1.20	1.11	1.06
Methionine%	0.52	0.51	0.50
Methionine + Cystine %	0.89	0.85	0.82

***Composition of vitamins and minerals premix. Each 3Kg of vitamin and minerals mixture contain:** Vit. A 10.000.000 IU, Vit. D3 2.000.000 IU, Vit. E 10.000 mg, Vit. K3 1.000 mg Vit. B1 1.000 mg, Vit. B2 5.000 mg, Vit. B6 1.500 mg, Vit B12 10 mg, Niacine 20.000 mg, PantothenicAcid 10.000 mg, Folic Acid 1.000 mg, Biotin 50 mg, Choline chloride 500.000 mg, Copper 4.000 mg, Iodine 300 mg, Iron 30.000 mg, Manganese 60.000 mg, Zinc 50.000 mg, Cobalt 100 mg and Selenium 100 mg.

**According to NRC (1994)

Experimental Treatments:

At the beginning of the experiment, the birds were randomly distributed into 6 experimental groups with three replicates (30 birds each) as follows:

T1: Chicks exposed to neutral temperature (NT).

T2: Chicks exposed to heat stress and served as a control (CHS).

T3: Chicks exposed chicks from day 3 to day 5 of age to early heat acclimation (EHA), 39 to 42°C for 4 hrs daily.

T4: Chicks exposed to feed restriction (FR) for 6 hrs daily from 10am to 4pm. up to 35 days of age

T5: Chicks supplemented with Vit.C 1g/kg diet (Vit.C) during the experimental period.

T6: Chicks treated with combination among EHA, FR and Vit.C (EFC).

Growth Performance Traits:

Livability and mortality were monitored daily during the whole experimental period. Body weight gain, feed consumption and feed conversion ratio were recorded weekly during the experimental period. Feed conversion ratio (FCR) was calculated as the ratio between feed intake and body weight gain at the end of each week and European Production Efficiency Index (EPEI) were calculated guide (1999).

EPEI = BW (kg) x LA x 100/PP x FCR.

B.W: Body weight (kg).

LA: Livability (100% mortality).

PP: Production period (days), FCR: Feed conversion ratio (kg feed / kg gain).

All measurements were performed on a pen basis using a high precision electronic scale. At the end of the growing period (42 days), 10 birds from each group were selected randomly and exposed to acute heat stress (42°C) until 50% of the control group died.

Blood Sampling and Analysis:

At the end of the experimental

period, 6 birds from each group have fasted overnight then blood samples were collected into non-heparinized tubes via jugular vein, then centrifuged at (3000 rpm) for 10 minutes, and the resulting serum was kept at -20ºC until analyzed. Serum total lipids, cholesterol and triglycerides were measured using commercially available kits from Sigma Diagnostics Company, (Taufkirchen, Germany) on an auto-analyzer apparatus. In addition, serum triiodothyronine (T3) and Thyroxine (T4) concentrations were measured by Radioimmunoassay (RIA) method using RIA kits (Amersham International Ltd., Amersham, United Kingdom). While, serum corticosterone levels were measured using the kits (Gamma-$B^{125}I$ Corticosterone) for IDS double antibody RIA technique, with a Berthold LB211 gamma counter. Finally, serum immunoglobulin G (IgG and IgM) concentrations were measured using single radial immuno diffusion technique, as described by Fahey and Mckelvey, (1965).

Statistical Analysis:

Data analysis was performed using SPSS software program package **(SPSS, 2005; version 16.0).** All data were analyzed based on a completely randomized design using one way ANOVA. All percentages were first transformed to arcsine to approximate normal distribution before ANOVA. Data were presented as means ± standard error.

RESULTS AND DISCUSSION

The Effect of Applying Different Heat Combating Practices on Some Blood Biochemical Components of Broiler During Acute Heat Stress:

Serum Liver Enzymes and Lipids Profile:

Effect of applying different heat combating practices on Cobb500 chicks under acute heat stress on serum liver enzymes activities [alanine aminotransferase (ALT) and aspartate aminotransferase (AST)] and lipids profile (total lipids, triglycerides and cholesterol) are present in the Table (2). It was observed that chicks group which exposed to neutral temperature T1 (NT), and chicks group T6 (EFC) treated with combination among EHA, FR and Vit.C had better results for serum liver enzymes activities (ALT and AST). While the chicks exposed to chronic heat stress T2 (CHS) showed the highest values among the experimental groups.

The obtained results indicated that treated chicks with EHA, FR and Vit.C had no negative effects on liver functions and body health. Hence, the increase in the activity of hepatic enzymes is a symptom of liver injury or damage in birds. The activity of these enzymes in chicks group which exposed to neutral temperature (NT), and chicks group (EFC) treated with combination among EHA, FR and Vit.C indicative of better efficiency of the liver. Borges *et al.,* 2003a; Tolba *et al.*, (2005) and Zulkifili *et al.*, (2009) found significant increase in the activity of liver enzymes in serum of broilers chickens exposed to prolonged heat stress (32°C) in the broiler for 5 wks. However, many studies reported that hyperthermia caused a significant decrease in serum AST, (El-Menhali 2002; and Eldessoki, 2004).

Results in Table (2) suggested that serum lipid profile levels were significantly higher in the chicks group which exposed to neutral temperature (NT), than other groups. Moreover, the exposed group chicks to heat stress (CHS) showed the lowest values among the groups. The obtained results illustrated the impact of heat stress on reducing levels of serum lipid profile. In this subject, Santoso *et al*., (1995a) reported that exposed broiler chicks to a feed restriction cause a considerable reduction in lipid fractions Also, Santoso *et al.*, (1995b) and Santoso *et al.*, (1995a) showed that a decrease in serum cholesterol was accompanied by a decrease in liver cholesterol.

Table (2): Shows serum liver enzymes and lipids profile (Mean ±SE) of broiler chicks as affected by different heat combating practices during acute heat stress

Treatments	Serum liver enzymes		Serum lipids profile		
	ALT Iu/ml	AST Iu/ml	Total lipids (mg/dl)	Triglyceride (mg/dl)	cholesterol (mg/dl)
T1: (NT)	9.75b±0.06	41.00c±1.08	561.75a±8.38	61.00a±1.63	135.00a±2.55
T2: (CHS)	10.50a±0.2	58.50a±3.54	514.50b±2.10	41.50b±2.40	105.50c±2.66
T3: (EHA)	10.14b±0.2	54.50ab±2.50	515.75b±4.44	47.50b±1.32	112.50b±5.63
T4: (FR)	10.13b±0.2	50.25b±3.32	525.50b±3.59	44.75b±2.43	117.75b±6.47
T5: (Vit. C)	10.0b±0.1	50.27b±6.38	521.00b±2.68	44.75b±2.21	109.50b±3.03
T6: (EFC)	9.90b±0.09	42.25c±2.00	520.50b±6.28	43.75b±1.75	115.75b±2.81

a, b, c and d = Means within the same column with different superscripts are significantly different (P≤0.05).

ALT: alanine aminotransferase

AST: aspartate aminotransferase

Serum Glucose:

Table 3 showed significant elevation (P≤0.05) in serum concentrations of glucose in the exposed group (control) to heat stress (CHS) compared to other groups. Moreover, the exposed group to neutral temperature (NT) showed the lowest values among the groups. This result may be attributed to CHS group has reduced feed intake and as a result, led to increasing the plasma concentrations of glucose. This finding is in agreement with (Chowdhury *et al.*, 2012 and Habibian *et al.*, 2014), who found significant increase in serum glucose level of broilers reared under heat stress conditions, on the other hand, the results of using different heat combating practices in this experiment as well as EHA, FR, Vit.C and EFC as presented in Table 3 showed their positive role in improving feed intake and reaching normal range of serum glucose concentration under acute heat stress.

Serum T_3 and T_4 hormones:

Results in Table (3) displayed that serum concentrations of triiodothyronine (T3) and thyroxine (T4) hormones were significantly higher in NT (T1) and EFC (T6) groups compared to other groups. Furthermore, the exposed group to CHS offered the lowest values among the groups. It is well known that thyroid hormones play important role in the adaptation to heat stress and the regulation of the metabolic rate of the body birds (Rezaei and Hajati, 2010). These findings agree with those reported by Uni *et al.*, (2001) and Yahav and McMurty, (2001) found a significant decrease in plasma thyroid hormones concentrations following exposure of chickens to high environmental temperature.

Serum Corticosterone Hormone:

Serum concentration of corticosterone hormone was significantly higher in CHS, FR and EHA groups respectively, compared to other groups. There were no significant differences between the group of T1 and T6. The obtained results illustrated the impact of HS, FR and EHA on elevating plasma corticosterone levels as an indicator of stress in avian species (Siegel, 1995). In this subject, Edens, (1978) reported the impact of various stresses in stimulation the release of corticosterone from the adrenal glands.

Serum Immunoglobulin During Acute Heat Stress:

Comparison of plasma immunoglobulin (IgG and IgM) concentrations among experimental groups are shown in Table 3. Serum immunoglobulin concentrations were significantly higher in NT (T1) group compared to the other groups. While the lowest serum immunoglobulin concentration was noticed in the exposed group to CHS (T2). Likewise, there was gradual improvement in serum immunoglobulin concentrations in EFC, Vit.C, FR and EHA, groups, respectively. However, there were no significant differences between groups of T6,T5,T4 and T3.The obtained results indicated the adverse effect of HS on antibodies reduction. In addition, using different heat combating practices in this experiment as well as EFC, Vit.C, FR and EHA, respectively, as presented in Table 3 demonstrated a positive role in enhancing antibodies concentrations under acute heat stress.

The results were agreement with Bartlett and Smith, (2003) who observed a significant decrease in total levels of circulating antibodies, as well as IgM and IgG in broilers subjected to heat stress.

Table (3): Exhibits some serum biochemical components (Mean ±SE) of broiler chicks as affected by different heat combating practices among acute heat stress.

Treatments	Glucose (mg/dl)	T3 (ng/ml)	T4 (ng/ml)	Corticosterone (ng/ml)	IgG (mg/dl)	IgM (mg/dl)
T1: (NT)	229.25b±1.3	3.83a±0.05	7.93a±0.06	6.23c±0.13	15.75a±0.85	3.28a±0.11
T2: (HS)	290.0a±6.53	2.68d±0.09	5.65d±0.10	9.00a±0.35	7.50c±0.65	1.35c±0.36
T3: (EHA)	246.7b±2.1	3.50b±0.04	6.83b±0.05	8.85a±0.37	11.50b±0.65	1.95bc±0.21
T4: (FR)	239.7b±2.7	3.25c±0.03	6.08c±0.14	8.88a±0.37	11.26b±0.48	1.96bc±0.27
T5: (Vit.C)	241.3b±1.9	3.35c±0.03	6.20c±0.11	7.38b±0.17	12.01b±0.41	2.10bc±0.06
T6: (EFC)	248.0b±5.1	3.63b±0.05	7.83a±0.05	6.75bc±0.21	12.51b±0.65	2.18b±0.24

a, b, c and d = Means within the same column with different superscripts are significantly different ($P \leq 0.05$)
T3: Triiodothyronine T4: Thyroxine IgG: immunoglobulin g IgM: immunoglobulin M

The Effect of Applying Different Heat Combating Practices on Broiler Thermoregulation Changes During Acute Heat Stress

The results clarified in Table (4) indicated the effect of applying different heat combating practices before and after acute heat stress on cloacal and skin temperature and respiratory rate of broiler chicks. The results appeared that after exposed the birds to acute heat stress, there were higher cloacal and skin temperatures and respiratory rate than before acute heat stress in all groups. Moreover, CHS group before and after acute heat stress recorded the highest value in respiratory rate (57 and 72) breath/min, respectively than all other groups.

The significant increase in the respiratory rate during exposure to acute heat stress reflects the performance of birds to dissipate the excess body heat by evaporative cooling at the surface of the mouth and respiratory passage ways, which accounts for about 80% of the total heat dissipation, (Al-Fataftah and Abu-Dieyeh, 2006). Furthermore, increase the cloacal temperature during the AHS episode in the heat-acclimated birds might be associated with the process of reducing water loss in order to prevent dehydration (Guerreiro *et al.*, 2004). Moreover, Lott, (1991) found that acclimated broilers at 35°C had significantly lower cloacal temperature than unacclimated birds received feed 1 hour prior to exposure at 24 - 41°C

Table(4): Shows thermoregulation changes in Cloacal and skin temperatures and respiration rate of broiler chicks as affected by different heat combating practices among exposed to acute heat stress (Mean±SE).

Treatments	Before Acute Heat Stress			After Acute Heat Stress		
	Cloacal Temp.	Skin Temp.	Resp. Rate	Cloacal Temp	Skin Temp.	Resp. Rate
T1: NT	$41.80^{cB}\pm 0.24$	$36.48^{cB}\pm 0.44$	$49.83^{bcB}\pm 2.65$	$43.52^{aA}\pm 0.32$	$40.15^{aA}\pm 0.34$	$63.17^{bA}\pm 2.52$
T2: CHS	$42.72^{aB}\pm 0.20$	$37.80^{aB}\pm 0.40$	$57.67^{aB}\pm 1.95$	$43.42^{aA}\pm 0.15$	$39.43^{abA}\pm 0.37$	$72.50^{aA}\pm 3.20$
T3: EHA	42.18bc± 0.14	$37.6^{abB}\pm 0.19$	$46.33^{cB}\pm 2.86$	$42.42^{b}\pm 0.27$	$38.87^{bA}\pm 0.28$	$64.17^{cA}\pm 2.63$
T4: FR	$42.12^{bcB}\pm 0.12$	$36.70^{bcB}\pm 0.32$	$54.33^{abB}\pm 1.60$	$43.52^{aA}\pm 0.11$	$39.73^{abA}\pm 0.33$	$70.33^{bcA}\pm 0.47$
T5: Vit.C	$42.35^{abB}\pm 0.11$	$37.40^{abcB}\pm 0.43$	$54.33^{abB}\pm 1.54$	$43.47^{aA}\pm 0.28$	$39.73^{abA}\pm 0.15$	$67.50^{bcA}\pm 3.08$
T6: EFC	$42.38^{abB}\pm 0.10$	$36.43^{cB}\pm 0.26$	$48.33^{bcB}\pm 2.26$	$43.40^{aA}\pm 0.13$	$38.55^{bA}\pm 0.63$	$64.83^{bcA}\pm 2.79$

a, b, c and d = Means within the same column with different superscripts are significantly different (P≤0.05).

A, B and C = Means within the same raw (treatment) with different superscripts are significantly different (P≤0.05).

The Effect of Applying Different Heat Combating Practices on Broiler Livability % and Mortality % During Exposure to Acute Heat Stress

Table (5) show the effect of applying different heat combating practices on livability and mortality percentages of broiler chicks exposure to acute heat stress. The results indicated that CHS group recorded the highest chicks mortality 50% and the lowest livability 50 % among groups. Exposed chicks to different heat combating practices: EFC, Vit.C, FR and EHA, respectively, significantly decreased chicks mortality and improved the livability percentages. The obtained results confirmed the significant effect of EFC as the best heat combating practice on enhancing the economic efficiency measurements of broiler chicks exposed to AHS followed by Vit C. and FR groups. On the other hand, the main reason for the high mortality of broilers under heat stress might be due to inefficient evaporative cooling which lead to continuous accumulation of heat inside the body "hyperthermy" until it reached the lethal level, where birds die (Yahav and Hurwitz, 1996 and Yahav *et al.*, 1997a; Al-Fataftah and Abu-Dieyeh, 2007).

As a result using different heat combating practices: EHA, FR, Vit.C and EFC, respectively enable the chicks to moderate changes in physiological processes, hence, the exposure to acute temperature changes demands rapid and extensive response of the blood system of broilers to control body temperature.

Table (5): Presents mortality rate (%) of broiler chickens as affected by different heat combating practices exposed to acute heat stress (Mean±SE).

Treatments	Total birds	Total dead birds	Mortality %	Livability %
T_1: NT	10.00	0.00	0.00	100.00
T_2: CHS	10.00	5.00	50.00	50.00
T_3: EHA	10.00	3.00	30.00	70.00
T_4: FR	10.00	1.00	10.00	90.00
T_5: Vit.C	10.00	1.00	10.00	90.00
T_6: EFC	10.00	0.00	00.00	100.00

The Effect of Applying Different Heat Combating Practices of Broiler on Production Performance and Economic Efficiency During Exposure to Acute Heat Stress:

The impact of NT, CHS, EHA, FR, Vit.C and EFC on production performance and economic considerations of broiler chicks exposed to acute heat stress is offered in Table (6). The technical evaluation expressed as European Production Efficiency Index (EPEI) in the present study, cleared that NT and EFC groups recorded the highest significant EPEI values (378.17 and 357.96), respectively, compared to the other groups.. These results may be due to the increase in body weight gain and the best feed conversion ratio. In contrast, the CHS group recorded the lowest EPEI value 9.16 among the groups. The results indicated that using different heat combating practices were effective on improving feed conversion ratio, body weight gain, net revenue of broiler production and European Production Efficiency Index (EPEI) better than CHS group. Moreover, EFC and NT groups, respectively, showed the best practical methods to enhance the production performance and reflect a better economic efficiency of broilers among the other groups.

Table (6): Appears the economic efficiency of broiler chickens as affected by different heat combating practices during exposure to acute heat stress (Mean±SE).

Treatments	T1 (NT)	T2 (CHS)	T3 (EHA)	T4 (FR)	T5 (Vit.C)	T6 (EFC)
Total feed intake (kg) /bird	4.03^{a} ±0.03	3.84^{b} ±0.01	3.87^{b} ±0.02	3.86^{b} ±0.02	3.85^{b} ±0.01	3.96^{a} ±0.03
Price /kg diet (LE)	4.80					
Cost of feed intake/bird (LE)	19.34	18.43	18.58	18.53	18.48	19.01
Marketing age (day)	42.00					
Cost of chick + management (LE)	9.00					
Total production cost/bird (LE)	28.34	27.43	27.58	27.53	27.48	28.01
Feed conversion ratio	1.59^{c} ±0.01	1.79^{a} ±0.02	1.71^{b} ±0.02	1.69^{b} ±0.02	1.73^{b} ±0.01	1.62^{c} ±0.01
Body weight gain / bird (kg)	2.53^{a} ±0.03	2.15^{c} ±0.02	2.26^{b} ±0.02	2.29^{b} ±0.01	2.23^{b} ±0.02	2.44^{a} ±0.03
Price /kg meat (LE)	18.00					
Livability %	100.00	50.00	70.00	90.00	90.00	100.00
Total cost/100 bird (LE)	2834	2743	2758	2753	2748	2801
Total price of market birds (LE)	4554.00	1935.00	2847.60	3709.80	3612.60	4392.00
Net revenue	1719.60	-808.20	90.00	957.00	864.60	1591.20
EPEI	378.17^{a} ±3.65	143.31^{d} ±1.91	219.97^{c} ±2.65	291.12^{b} ±2.64	276.78^{b} ±3.48	357.96^{a} ±3.48

a,b,c, and d= Means within the same column with different superscripts are significantly different (P≤0.05)

EPEI: European Production Efficiency Index

LE: Egyptian pound

Conclusion and Recommendations:

It can be concluded that using different heat combating practices were effective in reducing the harmful effects of heat stress and consequently, improving feed conversion ratio, body weight gain, physiological situation, immunoglobulin status, mortality rate, livability percentage, net revenue of broiler production and European Production Efficiency Index (EPEI) better than CHS group. Moreover, EFC group, showed the best practical methods among the others groups, it has the ability to enhance the production performance which reflect on a better economic efficiency of broilers chicks exposed to AHS and as a result, it can be applied in broiler farms to reduce the total cost and increase the economic return.

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ARABIC SUMMERY

الأداء الإنتاجي والفسيولوجي لدجاج اللحم تحت ممارسات مختلفة لتقليل الحرارة خلال الاجهاد الحراري الحاد

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تم استخدام عدد 540 كتكوت تسمين من سلالة (كب500) عمر يوم تم تجنيسها وتم توزيعهم عشوائيًا إلى 6مجموعات تحتوى كل منها على ثلاثة مكرارات (30 كتكوت فى كل مكررة) بهدف دراسة تأثير الاجهاد الحراري المفاجئ الحاد على الأداء الإنتاجي، الفسيولوجي والاقتصادي لدجاج اللحم وذلك باستخدام بعض وسائل تقليل تأثير الآجهاد الحراري. وكانت المعاملات كالتالي :-

المعاملة الأولى وهى معاملة تحت التبريد (الحرارة المثلى).

المعاملة الثانية وهى معاملة الاجهاد الحراري (الكنترول).

المعاملة الثالثة وهى معاملة التأقلم المبكر على درجة الحرارة المرتفعة.

المعاملة الرابعة وهى معاملة تحديد الغذاء.

المعاملة الخامسة تم إضافة فيتامين جـ إلى العليقة بمعدل 1جم لكل كجم عليقة .

المعاملة السادسة وهى اشتملت على التأقلم المبكر على درجة الحرارة المرتفعة وتحديد الغذاء وفيتامين جـ.

عند عمر 42 يوما تم إختيار 10 طيورعشوائيا من كل مجموعة (5 ذكور + 5 إناث) وتم تعريض الطيور لدرجة حرارة 42^{o}م لمدة 4 ساعات أو حتى نفوق 50 % من المجموعة المقارنة. تم قياس درجة حرارة المجمع والجلد ومعدل التنفس قبل وبعد التعريض للإجهاد الحراري الحاد وكذلك تسجيل نسبة النفوق بعد التعرض للإجهاد الحراري الحاد في كل مجموعة، كما تم عمل تقييم إقتصادي وإنتاجي لتأثير الإجهاد الحراري الحاد على كل المعاملات المختلفة ونتج عن ذلك الآتي

1- قبل التعريض للإجهاد الحراري لم توجد إختلافات بين المعاملات فى معدل التنفس أو درجة حرارة المجمع.
2- أدى التعريض الفجائي للإجهاد الحراري الحاد إلى زيادة معنوية فى معدل التنفس ودرجة حرارة المجمع فى جميع المعاملات أثناء التعريض للحرارة ثم نقص معنوي بعد إنتهاء التعريض للإجهاد الحراري.
3- أدى أسلوب الأقلمة المبكرة للجو الحار وفيتامين ج إلى نقص معنوي فى معدل التنفس ودرجة حرارة المجمع عن الكنترول أثناء التعريض للإجهاد الحراري الحاد وبعده.
4- أدى التعريض الفجائي للحرارة المرتفعة (الإجهاد الحراري الحاد) إلى زيادة نسبة النفوق بشدة فى المجموعة الأولى (الكنترول الموجب) تبعتها المجموعة الثانية (الكنترول السالب) ثم انخفضت نسبة النفوق معنويا فى المعاملات الرابعة (التصويم) و الخامسة (فيتامين ج) ، بينما لا يوجد نفوق في المعاملات التى تعرضت للأقلمة المبكرة والمعاملة السادسة.
5- أما بالنسبة للنفوق فقد كانت هناك زيادة فى نسبة النفوق بشدة فى المعاملتين الأولى والثانية (تبريد وتغذية حرة) وبالتالى انخفضت نسبة الحيوية وحدث نقصا معنويا فى معدل كفاءة الإنتاج الأوروبي وعدد الطيور الحية المعدة للتسويق مما أدى إلى نقص فى الإيرادات عن التكاليف ونتج عن ذلك حدوث خسائر إقتصادية مرتفعة عند مقارنتهما بالمعاملات الثالثة والرابعة والسادسة والتى حققت أرباحا إقتصادية و كفاءة إنتاج أوروبي أعلى من غيرها.