THE IMPACT THERMAL STRESS ON SOME PHYSIOLOGICAL, ENDOCRINE PROFILES AND HSP IN LOCAL MALE CALVES

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ABSTRACT

This study was conducted in the field cattle in Al-Qurna, north of Basra Governorate, in the period between July 2018 to February 2019 and included the following seasons, the monthly summer season(July and August of 2018), the monthly autumn season (October and November of 2018) and the winter season is monthly (January and February of 2019) .This experiment was designed to reveal the effect of the THI value on some physiological and hormonal values on the local male Holstein. The studied group include 20 calves and with age between (one year to one year and eight months), twenty blood samples were collected per month from male Holstein calves subjected to a different value of temperature and humidity in different months and seasons.The results of the first experiment showed: A significant($P\leq0.05$) increase in the values of THI, respiratory rate, and heart rate, where a significant($P\leq0.05$) increase was noted in months and the summer season except for the rectal temperature, which showed no significant difference ($P>0.05$) among different seasons. The antioxidants CAT, MDA, SOD, and GPX also showed a significant increase ($P\leq0.05$) during the summer months and seasons compared to the autumn and winter months and seasons. Also significant increase ($P\leq0.05$) in cortisol and HSP70 during the summer and season months.The levels of testosterone and thyroid hormone (T_4) and triiodothyronine (T_3) decreased significantly ($P\leq0.05$) during summer and season compared to other months and seasons, but the level of insulin in the blood showed a significant decrease ($P\leq0.05$) during the summer season than the other seasons.

INTRODUCTION

Large domestic animals are exposed to various kinds of stress such as physical, nutritional, chemical, psychological and thermal stress. Changes in natural environmental factors are seen as main affecting in live stock animal's health and production(1). Which lead to huge economic losses is about 60% of the dairy farms production around the world (2). Elevated the global warming, air humidity and sunlight based radiation are condition focusing on factors that potential hazard on the animal's biological systems (3).

On the among the normal variables impacting trained the domesticated animals, ecological temperature is one of the most interesting components has an unfavorable effect on cattle's health (4). Augmentation in air temperature during summer season is one of the standards of the natural change which is risking the conceptive capacities, production and wellbeing of the domesticated animals through all the world, specifically in tropical and subtropical countries (5). Along these lines, the normal occasional changes are perceived as a physiological stressors which impact in the creature's natural frameworks (behavioral, biochemical, immunological and physiological changes)(6).

Hence, the importance of these climatic changes becomes clear if we know that by the end of the 21^{th} century it is expected that the numbers of hot and dry summer days will increase and the temperature and climate changes will affect the tropical and sub-tropical regions more like the geographic region in which Iraq is located(7). The temperature degree increases and the number of dry days, as well as the decrease in the intensity of rain (8). Over hundreds of years, natural selection acted on local breeds, resulting in animals obtained unique adaptive traits such as disease resistance and tolerance to heat and cold(9).

The importance of selecting the most resilient and adaptive animals to climatic changes and different stress conditions arises through the selection of some molecular mechanisms in protecting the cells that protect them from the effects of heat stress and different stress conditions(10), and the most important of these molecular mechanisms that body possesses are a family of heat shock proteins(HSP), especially heat shock proteins 70 (HSP70),which activation when animals exposure to heat or cold stress that have the ability to protect and keep the cells alive when exposed to different stress conditions, by act as molecular chaperones in regulating the cellular homeostasis and folding and unfolding of damaged proteins during the stress(11). This study aimed to evaluate the effect of natural change in temperature humidity index (THI) value at different months and seasons on most physiological parameters and ability Holstein calves for adaptive to this conditions and also evaluate the level of serum heat shock protein 70 (HS70) adaptive Holstein calves.

MATERIALS AND METHODS

A total twenty male calves (1-1.8) years old was used in this study which exposed to different value of temperature humidity index (THI) during different months and season of years from cattle filed of the private sector in the area of Al-Quranh, north of Basrah Governorate, Iraq and all tests has been done in the laboratories of the college of Veterinary Medicine at the University of Basrah, including the physiological laboratory, medicinal laboratory, central research unit and Bayan Group For Advance Laboratories Diagnostic. The animals were supplied with a standardized food as well as green fodder free once a week. Salts and drinking water were constantly present in front of the animals. According to Minimum and maximum temperatures and humidity percentage values were obtained from the reports of Basrah Metrological service in Basrah, Governorate, the temperature humidity index (THI) value was calculated by (12).

The pulse rate, respiratory rate and rectal temperature was measured once time monthly according to (13), About 20ml of blood samples were collected from Jagular vein calves in the morning at (8-10)by using disposable syringe (20ml). Some of blood samples were collected in gel tube for serum samples for biochemical analysis were separated by centrifuge at (3000 rpm for 15 minutes) to obtained the serum, and these samples separated in many eppendorf tubes to avoid repeated thawing and stored at (-4ºC) until they were analyzed.

Biochemical parameters : the determination of superoxide dismutase (SOD) activities, is based on SOD ability to inhibit of pyrogallol autoxidation. By(14), The colorimetric method by (15) used to detect the serum value of MDA, √while the effectiveness of serum catalase enzyme was measured by modified manner by (16), and the sandwich-ELISA kit was used to detect the GPx activities by (17).

Bovine heat shock protein70 serum levels was detected by using enzyme linked immunosorbent assay (ELISA) kit manufactured by Shanghai Korain Biotech Company,China. Hormonal Profile: The thyroxin (T_4), total triiodothyronine hormone (T_3), cortisol, testosterone, and insulin hormones were estimated in Bayan Group For Advance Laboratories Diagnostic .

Statistical Analysis

Data was analyzed by using SPSS (Statistical Program for Social Sciences) program version 22.0 and presented as mean ±standard deviation(18). One way ANOVA was used to compare mean different among more variable.

RESULTS

1-The Maximum, Minimum Temperature, Relative Humidity and Average THI Value During Months and Seasons of Study Period

The maximum and minimum climate temperature and relative humidity percentage are obtained from the Basrah Meteorological Center is clarified in the Table (1), and revealed that high value of maximum and minimum climate temperature was obtained during July and August months(47.63±1.44, 47.46±1.43 and 28.40±1.13 , 27.16±1.01), while the lowest values were recorded during January month (19.90±1.39, 6.90±2.13) respectively than others months.The high and low value of maximum of relative humidity percentage was recorded during January and July (72.09±5.17, 26.03±3.14) respectively, but a highest and lowest value of minimum relative humidity percentage was recorded during February and July months (26.71±1.86, 7.26±2.25) respectively than the others months.

The mean ±SD value of monthly average of temperature and relative humidity percentage during different months were reveled in the Table (2). In the present study, a highest and lowest values of average climate temperature was obtained from July and January months (38.166±0.79 and 12.82±0.92) respectively, while a highest and lowest values of the relative humidity percentage was obtaind during February and July months (48.96±1.77 and 16.90±2.13) respectively.

The average value of temperature humidity index(THI) during different months and seasons of experimental study period are present in Table (3). The average THI value varied among different months and seasons. The average THI value was recorded high significant (p≤0.05) with summer season, where recorded highest value (**85.22±0.41**) in August months compared to the rest months, while the lowest significant (P≤0.05) was recorded in January month (**55.19±0.00**) during winter season as compared to other months and seasons.

Table (1): Mean±SD Values of Maximum and Minimum Temperature and Relative Humidity During Study Months Period**.**

Months	Max.Temp (ºC)	Min.Temp (ºC)	Max. RH (%)	Min.RH (%)
July	47.63±1.44a	28.40±1.13a	26.03±3.14e	7.26±2.25f
August	47.46±1.43a	27.16±1.01a	38.40±1.79d	16.93±3.90d
October	35.87±1.38b	19. 00±1.48b	44.06±2.48c	11.12±2.01e
November	27.53±0.86c	12.50±0.62 c	69.33±4.64b	21.30±1.64c
January	19.90±1.39e	5.74± 0.85e	72.09±5.17a	24.29±1.67b
February	21.75±1.87d	10.28±1.38d	71.21±2.79a	26.71±1.86a
LSD	1.84	1.23	1.88	2.42

Mean THI value with different superscripts (a, b,c,d,e and f) in the column differ significantly (P≤0.05). (Basrah Meteorological Center 2018-219)

Table (2): Mean±SD Values of Monthly Average Temperature and Relative Humidity During Study Months Period.

Months	Average. Temp (ºC)	Average . RH (%)
July	38.16±0.79a	16.90±2.13d
August	37.31±0.94b	27.66±2.22c
October	27.43±1.03c	27. 59±1.68c
November	20.01±0.51d	45.33±2.32 b
January	12.82±0.92f	48.32± 3.23a
February	16.01±1.15e	48.96±1.77a
LSD	0.85	2.98

Mean THI value with different superscripts (a, b, c, d, e and f) in the column differ significantly (P≤0.05). (Basrah Meteorological Center 2018-219)

Table(3): Mean ±SD Values of Average Temperature Humidity Index (THI) During the Study Months and Seasons Period.

Months	Average THI	Season	Average THI
July	83.66±0.27b	Summer	84.44±0.86a
August	85.22±0.41a		
October	77.87±0.00c	Autumn	69.17±8.92b
November	60.48±0.00d		
January	55.19±0.00f	Winter	55.85±0.68c
February	56.52±0.00e		
LSD	1.33	LSD	13.32

Mean THI value with different superscripts (a, b, c, d, e and f)in the column differ significantly (P≤0.05).

2-Effect The Thermal Stress on Respiratory Rate, Heart Rate and Rectal Temperatures Values In Holstein Calves During Months and Seasons of Study Period.

The effect of variation weather (ambient temperature value and humidity percentage) during different months and seasons on heart rate, respiratory rate and rectal temperature explained in a Table (4and5). There was significant increase (P≤0.05) in heart rate in both months August and July as summer seasons than the October, November months (Autumn season) and January and February months (winter season). Significant (p≤0.05) increase of respiratory rate was recorded during August months and summer season as compared to the rest months and season. While, during January month and winter season the respiratory rate was significantly (p≤0.05) decrease. During August month, the rectal temperature value was significantly(p≤0.05) increase than others months but did not recorded any varied among the different seasons.

Table(4): Effect the Thermal Stress on Respiratory Rate, Heart Rate and Rectal Temperature Values in Holstein Calves During Months of Study Period, (Mean ±SD., n=20).

Months	**H.R(Beat/min)**	**R.R(Breath/min)**	**R.T(ºC)**
July	83.60±1.26a	46.60±6.67b	38.52±0.07b
August	86.20±2.04a	49.90±6.67a	38.64±0.07a
October	73.50±2.91b	39.30±2.90c	38.36±0.08c
November	67.80±2.14c	27.80±2.61d	38.34±0.06cd
January	60.60±0.84d	17.30±0.94e	38.25±0.05d
February	64.80±2.52c	18.70±0.82e	38.27±0.04cd
LSD	5.00	2,20	0.11

Values express as mean ± SD., n = 20 calves. with different superscripts (a , b,c,d,e) in the column differ significantly (P≤0.05).

Table(5): Effect The Thermal Stress on Respiratory Rate, Heart Rate and Rectal Temperature Values in Holstein Calves During Seasonal Period, (Mean ±SD., n=20)

Season	**H.R(Beat/min)**	**R.R(Breath/min)**	**R.T(ºC)**
Summer	84.90±2.12a	48.25±6.71a	40.83±10.11
Autumn	70.65±3.84 b	33.55±6.48b	38.35±0.76
Winter	62.70±2.83c	18.00±1.12c	38.26±0.50
LSD	7.95	14.70	NS

Values express as mean ± SD., n = 20 calves. with different superscripts (a,b and c) in the column differ significantly (P≤0.05).

3-Effect The Thermal Stress on Oxidant and Antioxidant Statute Value in Serum Holstein Calves During Months and Seasons of Study Period

Table (6 and 7) Show the effect of thermal stress on antioxidant statute in serum Holstein calves during different months and seasons. The results revealed a significant increase ($p \leq 0.05$) in MDA , SOD, GPX and CAT in July and August summer months as compared to other months and seasons.

Table (6): Effect of Thermal Stress on Value of MDA, SOD, GPX and CAT in Holstein Calves During Months of Study Period, (Mean ±SD., n=20).

Months	MDA(U/L)	SOD (U/L)	GPX (U/L)	CAT (IU/ml)
July	3.94±0.56a	60.65±1.28a	331.40±17.80a	2.77±0.43a
August	3.94±0.60a	60.65±1.28a	333.06±19.97a	2.97±0.51a
October	3.15±0.54b	55.63±0.66b	290.57±22.05b	2.53±0.30b
November	3.05±0.13b	44.7±6.50c	290.57±22.04b	2.29±0.27b
January	2.34±0.34c	36.90±3.51d	273.62±12.17c	1.99±0.36c
February	2.43±0.36c	36.89±11.3d	274.45±3.31c	1.98±0.42c
LSD	0.62	5.02	16.94	0.43

Values express as mean ± SD., n = 20 calves, with different superscripts (a, b,c and d) in the column differ significantly ($P \leq 0.05$).

Table (7): Effect of Thermal Stress on Value of MDA, SOD, GPX and CAT in Holstein Calves During Seasonal Period, (Mean ±SD., n=20).

Season	MDA (U/L)	SOD (U/L)	GPX (U/L)	CAT (IU/ml)
Summer	3.94±0.57a	60.41±1.34a	332.23±18.43a	2.87±0.47a
Autumn	3.10±0.38b	50.17±7.18b	290.04±21.46b	2.41±0.30b
Winter	2.39±0.34c	36.89±8.18c	274.57±8.69c	1.98±0.38c
LSD	0.71	10.24	16.53	0.42

Values express as mean ± SD., n = 20 calves ,with different superscripts (a,b and c) in the column differ significantly ($P \leq 0.05$).

4-Effect The Thermal Stress on Hormones Profiles in Serum Holstein Calves During Months and Seasons of Study Period

On the basis on the results that clarified in Table (8 and 9), revealed a significant decrease ($P \leq 0.05$) in serum Testosterone, T_4 and T_3 levels during July and August month of summer season than the other months and season, where its recorded high significant in January and February months of winter season. While serum cortisol level recorded high significant ($P \leq 0.05$)in both months and summer season as compared to other months and seasons.

The serum Insulin concentration was not recoded any significant (P>0.05) changing among different months of the experimental in Table(8). During winter season, the serum Insulin level was significantly (p≤0.05) higher than the autumn and summer season in Table (9).

Table(8): Effect The Thermal Stress on Testosterone, Cortisol, Insulin, Thyroxin(T_4), and Triiodothyronin(T_3) Hormones level in Holstein Calves During Months of Study Period, (Mean ±SD., n=20).

Months	Testosterone (ng/ml)	Insuline (µIU/ml)	Cortisol (nmol/l)	T_4 (ng/ml)	T_3 (ng/ml)
July	11.02±3.16c	17.88±0.73	17.21±1.20a	3.66±0.33c	0.74±0.10c
August	10.12±0.55c	17.89±0.72	18.58±0.56a	3.43±0.27c	0.71±0.08c
October	10.65±0.40c	18.06±0.81	16.18±1.45b	3.41±0.34c	0.71±0.09c
November	11.97±0.55b	18.14±0.85	13.47±1.77c	5.56±0.54b	0.87±0.13b
January	13.71±0.79a	20.00±0.60	12.45±1.56c	6.69±0.52a	1.07±0.18a
February	13.57±0.72a	19.92±0.62	11.82±1.43c	6.70±0.49a	1.17±0.15a
LSD	0.92	NS	2.84	1.12	0.12

Values express as mean ± SD., n = 20 calves ,with different superscripts (a,b and c) in the column differ significantly (P≤0.05), NS: non- significant.

Table (9): Effect of Thermal Stress on Testosterone, Cortisol, Insulin, Thyroxin and Triiodothyronin Hormones level in Holstein Calves During Seasonal Period, (Mean ±SD., n=20).

Seasons	Testosterone (ng/ml)	Insuline (µIU/ml)	Cortisol (nmol/l)	T4 (ng/ml)	T3 (ng/ml)
Summer	10.18±0.81b	17.89±0.70c	17.89±1.15a	3.54±0.32c	0.73±0.09c
Autumn	11.31±0.82b	18.10±0.81 b	14.82±2.10 b	4.48±1.18b	0.79±0.14b
Winter	13.64±0.74a	19.96±0.6a	12.14±1.49c	6.69±0.49a	1.12±0.17a
LSD	2.33	0.37	2.68	0.94	0.33

Values express as mean ± SD., n = 20 calves ,with different superscripts (a, b and c) in the column differ significantly (P≤0.05).

5-Effect of Thermal Stress on Serum Hsp70 level in Holstein Calves During Months and Seasons of Study period

On the basis on the results that clarified in Table (10), revealed a the serum HSP70 level varied between different months and seasons. Which recorded highest significant (P≤0.05) in July and August months of summer season while recoded lowest significant in both January and February months of winter season than the rest months and seasons.

Table(10): Effect of Thermal Stress on Value of Serum Hsp70(ng/dl) In Holstein Calves During Months and Seasons of Study Period,(Mean ±SD., n=20).

Months	HSP70 (ng/dl)	Season	Hsp70 (ng/dl)
July	3.14±0.50a	Summer	3.21±0.51a
August	3.27±0.53a		
October	2.83±0.57b	Autumn	2.66±0.53a
November	2.49±0.46b		
January	1.51±0.45c	Winter	1.52±0.42b
February	1.53±0.41c		
LSD	0.44	LSD	1.14

Values express as mean ± SD., n = 20 calves ,with different superscripts (a , b and c) in the column differ significantly (P≤0.05)

DISCUSSION

It's clear that the THI value recorded significant (P≤0.05) increase at August month than others month and during summer season and autumn season compared to cold season which present in the Tables(3), might be due to the elevated the global temperature and humidity in this month and these season in Basrah governorate. Our results agreed with (19) who revealed a significant increase of THI value at hot season than other years season.(20) showed that THI value75 to 80 was moderate to high power of heat stress, while THI value73-77were considered mild thermal stress and THI value 72 and underneath was considered as no warmth stress. But, (21) considered that THI value 78 to 89 as moderate and above 90 as extreme thermal stress. In this manner, in the current examination the average THI of during the cold season (winter) demonstrated that the creatures were under no warmth stress. While, the average THI value throughout the autumn and hot (summer) seasons respectively showed that the creatures were under moderate to high power of warm pressure at Basrah governorate.

The weather change has increased significantly, which will significantly affect animal neuroendocrinlogy, hematology parameter, and different physiological process (22). The respiratory rate, heart rate rectal temperature recorded greatly significant (P<0.05) during August month but rectal temperature did not recorded any significant among different months. While all values recorded high significant in summer season than autumn and winter seasons, these data like to that reported by (13) in cow. Heat stress causes many physiological changes in farm animals (23,24). The variation in number of breath/mint from (2.8 into 3.3) was recorder when ambient temperature increased one degree only(25). (26) showed an improved in breathing value as result of stimulation breathing receptors which transfer signs into respiratory center in hypothalamus in order to remain acid-base homeostasis. In stressor cattle the respiratory acidosis was noticed due to decrease the pH of blood and insufficiency of arterial carbon dioxide (27). Therefore, enhanced the mean of breathing per minute as increases expiration of C_{O2} through the lung to decline carbonic acid concentration to critical balance then causes respiratory alkalosis(28).

Breath/minute is impact by many factors include, age, sex, morphology, phenotype, nutrition, management and other environment factor(25).Usually, enhanced the respiration and sweating process were determined once animals were exposed to harsh climate temperature, in order to eliminate the additional heat load by cutaneal cooling system (29, 30)

. Historically, circulation of cortisol levels have been direct relation with rectal temperature and heart beat value in beef calves(31). Other studied referred to the correlation between rectal temperature value and respiratory rate which considered a lead to assess in health of function and vital activity (32). So when the rectal temperature a get higher one degree was accompanied by diminish in animals appetite and production. Rectal temperature as greater than before in heated stressor cattle (33).

Calves differs from others animals in the tolerance of harsh heat according to their anatomical structure, when its rectal temperature increased at stress period accompanied with set of physiological change(34). Others authors showed that the Creole goats breed tend to adapt on the region factors which selected in throughout keep its rectal temperature closely into the normal degree with little variation in pulse and respiratory rate value(35) while, thick of skin surface and decrease sweat gland mad buffalo more affected by hostile factors (36).

In different heat stressful buffalo breed their rectal temperature and respiratory rate were affected at high THI value in Mediterranean breed as compared to crossbred breed(37) . Furthermore, (38) recorded lower value in respiratory rate, rectal temperature and pulse rate in silk haired Holstein cow at hot condition than the normal haired cows. Other research investigated that the elevated levels of thyroid hormones increment cell breath, ATP generation, cell development, cardiovascular and respiratory rates and catabolic pathways (39).

Physiologically, in the present study the Holstein calves might be adapted to dry and humidity heat condition by enhanced metabolic rate, respiratory rate and cutaneal cooling mechanism. The pulse rate value in the present study was agreed with studied by (40), these rise as a result of the relationship within respiratory rate as the latter promotes blood circulation leading to increase heart beat and thus an increase in the elimination of heat through the skin surface(41). Increased pumping of blood from the heart to word the peripheral of blood vessels was investigated to maintain homoeothermic by(42). A rise in heart rate has been conjointly reported in heat stressful goat during summer season (43). But (44) showed that the heart beat decrease when animal enhanced water intake and excreted it throughout their body at hot period.

In ours study the calves has been exposed to different environmental condition, the metabolic process and physiological parameters were realized adjustment only when the calves exposed to hot condition.The our results were obtained in the current experimental showed that the serum levels of (MDA, SOD, CAT, GPx) in calves have been affected by variation of THI value during different season. Serum oxidative agent is higher than in the demand at high value of THI than the low value of it. MDA has been recorded highest value in August month, thus agreement with (45) indicated that the combination changes of climate temperature degree and relative humidity are stimulate peroxidation process of poly unsaturated fatty acid, successively thus the MDA is taken a main signs for oxidative stress. High and low value of THI had been negatively affect with imbalance of oxidative and anti oxidative status, previous rumored by(46).

This result agreement with the study of (47) in calving cows showed significant decline in blood MDA level at high global temperature during summer season than the winter season. Hence, MDA plasma level reduced significant in winter than summer season(48) While, other investigators showed that the plasma oxidative had been recorded high value in cow at low ambient temperature(49).

The conducted research showed that activity of enzymatic antioxidant superoxide dismutase (SOD), catalase (CAT), and glutathione peroxides (GPx) were significantly higher at winter period in comparison with other period. This obtained uncorroborated with (50,51). Also, (52,53) indicated to direct relation between high value of THI within plasma superoxide dismutase (SOD) and catalase (CAT) levels in buffaloes and cattle respectively. Furthermore, low significant in erythrocyte catalaes (CAT) and superoxide dismutase (SOD) enzymes were noticed in Halliklar cows during winter season compared to rainy and summer seasons (54).

Catabolism hormones had been negatively effect on SOD and GPx in hottest cow and goat (55) respectively. Metabolic process in cattle are affected at high ambient temperatures due to increased production of free radicals and decrease in the secretion of thyroid hormone, subsequently this explained the association between blood level of hydrogen peroxides and the low secretion of thyroid hormones with hot weather(56). Reduced feed intake at hot condition in addition to increase discharge of catabolism hormone (cortisol) assume a significant job in raised the generation of free radicals and ROS and exhaustion of anti oxidants status through expanded lipolysis process (45).

In Holstein calves during experimental study month of the years were recorded decrease significantly ($P<0.05$) in summer months and season contrasted with other months and seasons. This result may be because of brought down body metabolic rate during summer months which is required to keep up balance between heat generation and heat dispersal during summer pressure. In the animal exposed to excessive ambient temperature (57) had a look at that have an influence of high ambient temperature on the lowering discharge of thyroid hormones because of the impact of excessive temperature on pituitary thyroid peripheral tissue axis (PTA) which in flip is prompted reduction in the basal metabolism rate as compared to the animal covered to low ambient temperature.

While, (58)explained the reason for the decline of hormones during the summer season, especially thyroxin, due to decline synthesized of this hormone by thyroid follicle cell which lead to decreased accessibility of thyro-peroxidase protein which required for oxidation of iodide particles to frame iodine molecules as a great part of the chemical movement is associated with catalyzing H_2O_2 created summer pressure.

The thyroid gland activity is reduced even as the animal is uncovered to hot conditions and multiplied while exposed to cold, well-adapted animals reply quickly to environmental modifications and as a consequence could make the vital physiological adjustments. While, (39) investigated that the discharge of tropic hormones is influenced at the point when a creature is exposed to high encompassing temperatures, emission of those hormones is repressed so as to keep away from thermogenesis.

The serum cortisol concentration in our study recorded high significant in August month as compared to others month its recorded high significant ($P<0.05$) during summer season as compared to autumn season and winter season. This study conducted with studied by (54) in Hallikar cattle. In our study, an enhanced the level of COR mitigated the damage of the safe organs and the confusion of protein metabolism in calves at heat pressure.

Our study is un concurrence with different investigations that have announced cortisol decline a few days after heat pressure(59). Other result was described that elevated air temperature caused enhanced in plasma cortisol level and in rectal temperature value in beef cattle, which initiate the activity of heat shock protein (HSPs) to control cell suitability against heat(60).

The serum insulin concentration in our study change value in January to July months of year and did not recorded any significant among different months. This study agreement with study by (61) observed there was no significant in plasma insulin level in dairy cows when exposure to cold and heat stress. But, disagreement with result by (62) who recorded high significant in insulin value at both dry hot weather and humid hot weather in buffalo as compared to cooling one.

The concentration of testosterone hormone in Holestin calves during experimental study different months and different season of the year in(Table (8 and 9). The concentration of testosterone hormone our study change in July and August, in October and November to January and February months respectively and its recorded decrease significant ($p<0.05$) during summer season as compared to autumn season and winter season. The our data agreement with results obtained by other research such as (63) in their study on decline level of testosterone hormone under heat factor, and (64) explained the reason of its decline might be due to decline synthesis of it or enhanced metabolism of it by liver.

(65) investigated that the decline in the level of testosterone hormone, furthermore affected of testicular function is inverse related with high concentration of serum glucocorticod. This study disagreement with result related by other researchers such as (66)in their study on effect the high and moderate temperature in lamb.

In Table (10), there was a significant effect of months, seasons and variation value of THI on serum Hsp70 level in Holstein calves during experimental study months and different seasons of the years. This result has been recorded high significantly ($P<0.05$) on Hsp70 level in August month compared to others month and high significant in summer season contrasted with other season because the dynamic of Hsp70 with an expansion in stress factor demonstrated that the first security to the cells/body against the heat pressure for protecting any basic and useful harm to the cell, and this study consistent with previous study by many authors such as (67).

The elevated level of Hsp70 could be used as a main indicator for change in body temperature when it is more than 38.6ºC (68), Therefore, the high level of Hsp70 in summer season than other season in our study was agreed with studied by (33) in Buffalo. Wherever, (69) detailed higher articulation of Hsp70 during summer than winter season in goat breeds.

Plasma concentration of Hsp70 is strongly associated with ambient temperature but not with body temperature of animals owing to intermediate messengers that respond to changes in ambient temperature leading to increased transcription of HSP (69).Under heat condition, HSP are activated and save the cell by minimizing accumulation of the denatured or abnormal proteins in the cell. In this way, they enhance the cell. Cellular proteins are adversely affected by heat stress except HSP, which are activated by heat shock.

تأثير الإجهاد الحراري على بعض الصور الفسيولوجية و الصمية و HSP في ذكور العجول المحلية

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الخلاصة

أجريت هذه الدراسة في حقل لتربية الأبقار في القطاع الخاص بمنطقة القرنة شمال محافظة البصرة حيث أجريت في الفترة ما بين تموز ٢٠١٨ إلى شباط ٢٠١٩ وتضمنت المواسم التالية ، موسم الصيف شهري (تموز وأغسطس من عام ٢٠١٨) ،موسم الخريف شهري(أكتوبر ونوفمبر من عام ٢٠١٨) وموسم الشتاء شهري(يناير وفبراير من عام ٢٠١٩).صممت هذه التجربة للكشف عن تأثير قيمة THI على بعض القيم الفسيولوجية والهرمونية على الذكور لعجول هولشتاين المحلية عدد ٢٠ حيث تراوحت اعمارهم مابين (سنة الى سنة وثمانية اشهر) حيث تم جمع عشرين عينة دم شهريًا من الذكور لعجول هولشتاين المتعرضة الى درجات الحرارة والرطوبة في الأشهر والمواسم المختلفة. اظهرت النتائج ارتفاع معنوي($P\leq0.05$) في كل من قيمة THI ، معدل التنفس ، ومعدل ضربات القلب اذ سجلت ارتفاع معنوي في شهور وموسم الصيف باستثناء درجة حرارة المستقيم والتي لم تظهر أي فرق معنوي ($P>0.05$) بين المواسم المختلفة. كما سجلت مضادات الاكسدة SOD, CAT, MDA و GPX زيادة معنوية ملحوظة ($P\leq0.05$) خلال أشهر وموسم الصيف مقارنة بأشهر وموسمي الخريف والشتاء.لوحظ ايضا ارتفاع كبير ($P\leq0.05$) في مستوى هرمون الكورتيزول و في مستوى بروتين الصدمة الحرارية HSP70 خلال أشهر الصيف والموسم. كما لوحظ انخفاض في مستويات هرمون التستوستيرون وهرمون الغدة الدرقية (T_4) وثلاثي يودوثيرونين (T_3) بشكل ملحوظ ($P\leq0.05$) خلال أشهر وموسم الصيف مقارنة بالأشهر والمواسم الاخرى ، لكن مستوى هرمون الأنسولين في الدم أظهر انخفاضًا ملحوظًا ($P\leq0.05$) خلال موسم الصيف مقارنة بالمواسم الاخرى.

References

1-**Hahn, G. L., Mader, T. L., & Eigenberg, R. A. (2003).** Perspective on development of thermal indices for animal studies and management. *EAAP Technic Ser*, *7*, 31-44.

2-**Behl,R.; Behl,J. and Joshi,B.K.(2010).** Heat tolerance mechanism in cattle- status in zebu cattle: A review. *J Anim Sci*., 80(9): 891-897.

3-**Krishnan, G., Bagath, M., Pragna, P., Vidya, M. K., Aleena, J., Archana, P. R., ... & Bhatta, R.** (2017). Mitigation of the heat stress impact in livestock reproduction. Theriogenology, 8, 8-9.

4-**Ravagnolo, O., & Misztal, I.** (2002). Effect of heat stress on nonreturn rate in Holsteins: fixed-model analyses. Journal of dairy science, 85(11), 3101-3106.

5-**Seguin, B. (2008**). The consequences of global warming for agriculture and food production. Livestock and global change, 9-11.

6- **Alberghina, D., Piccione, G., Casella, S., Panzera, M., Morgante, M., & Gianesella, M. (2013).** The effect of the season on some blood metabolites and haptoglobin in dairy cows during postpartum period. Archives Animal Breeding, 56(1), 354-359.

7-**Intergovernmental Panel on Climate Change (IPCC). (2014).** Synthesis report. Summary for policymakers. 2015. Fifth assessment report on consistent treatment of uncertainties, intergovernmental panel on climate change (IPCC). Geneva, Switzerland.

8-**Polade,S.D.; Pierce,D.W.; Cayan,D.R.; Gershunov,A. and Dettinger,M.D. (2014).** The key role of dry days in changing regional climate and precipitation regimes. *Scientific Reports*.,4 : 4364.

9-**Silanikove,N.(2000).** The physiological basis of adaptation in goats to harsh environments. *Small Rumin Res*., 35:181–193.

10-**Hassan,F.U.; Nawaz,A.; Rehman,M.S.; Ali,M.A., Dilshad,S. and Yang,C. (2019).** Prospects of HSP70 as a genetic marker for thermo-tolerance and immuno-modulation in animals under climate change scenario. *Animal nutrition (Zhongguo xu mu shou yi xue hui)*., *5*(4):340–350.

11-**Kapila,N.; Kishore,A.; Sodhi, M.; Sharma,A.; Mohanty,A.K.; Kumar,P. and Mukesh, M. (2013).** Temporal changes in mRNA expression of heat shock protein genes in mammary epithelial cells of reverine buffalo in response to heat stress in vitro. *Int. J Anim. Biotech*., 3: 3-9.

12-Mader,T.L.; Davis,S.M. and Brown-Brandl,T.(2006). Environ mental factors influencing heat stress in feedlot cattle. *J Anim. Sci*., 84:712–719.

13-Ayied,Y.A. and AL-Fayad,A.M.(2015). Relationship between temperature and relative humidity, pulsing rate, respiration rate and rectum temperature in cross cow. *Thi-Qar Unvi. J. for Agric. Res*., 4(2).

14-Magnani,L.; Gaydou,M. and Jean,C.H.(2000). Spectrophoto metric measurement of antioxidant properties of flavones and flavonols against superoxide anion. *Anal Chim Acta*.,411(1-2) : 209-216.

15-Yiğit,S.; Yurdakök,M.; Kilinc,K.; Oran,O.; Erdem,G. and Tekinalp, G. (1998). Serum malondialdehyde concentration as a measure of oxygen free radical damage in preterm infants. *The Turk J pediat*., 40(2): 177-183.

16- Aebi,H.(1984). Catalase in vitro. Methods in Enzymology., 105:121-126.

17-Zhao,J.; Xu,S.; Song,F.; Nian,L.; Zhou,X. and Wang,S. (2014). 2,3,5,4′-tetrahydroxystilbene-2-O-β-d-glucoside protects human umbilical vein endothelial cells against lysophosphatidyl -choline-induced apoptosis by up regulating superoxide dismutase and glutathione peroxidase. *IUBMB Life*., 66(10): 711-722.

18-Abo-Allam,R.M.(2003). Data statistical analysis using SPSS program. 1st ed. Cairo Publication for Universities.

19-Trana,A.D.; Celi,P.; Claps,S.; Fedele,V. and Rubino,R. (2006). The effect of hot season and nutrition on the oxidative status and metabolic profile in dairy goats during mid lactation. *Anim Sci*., 82: 717-722.

20-Cincovic,M.R.; Belic,B.; Toholj, B.; Potkonjak,A.; Stevancevic, M.; Lako,B. and Radovic,I. (2011). Metabolic acclimation to heat stress in farm housed Holstein cows with different body condition scores. *African J. Biotech*., 10(50): 10293-10303.

21-Srikandakumar,A.; Johnson,E.H. and Mahgoub,O.(2003). Effect of heat stress on respiratory rate, rectal temperature and blood chemistry in Omani and Australian Merino sheep. *Small Ruminant Res*., 49: 193-198.

22-Hu,L.; Kang,L.; Wang,S.H.; Li,W.; YanX.Y.; Luo,H.P.; Dong, G.H.; Wang,Y.X.; Wang,Y.C. and Xu,Q.(2018). Effects of cold and heat stress on milk production Traits and blood biochemical parameters of Holstein cows. *Sci Agri Sci*.,51(19): 3791-3799.

23-Gaworsk,I.M. and Rocha,A.G.F.(2016). Effect of management practices on time spent by cows in waiting area before milking. In: Engineering for Rural Development, Malinovska L., Osadcuks V. (eds). *Latvia Univ Agric*, Latvia.,Pp:1300-1304.

24-Pilatti,J.; Vieira,F.; Rankrape,F. and Vismara,E.(2018). Diurnal behaviors and herd characteristics of dairy cows housed in a compost-bedded pack barn system under hot and humid conditions. *Anim*.,13:399-406.

25-Gaughan,J.B.; Hotl,M.S.; Hahn,L.G.; Mader,L.T. and Eigeberg.R.(2000). Respiration Rate – Is It a Good Measure of Heat Stress in Cattle? *J. B. Asian-Aus. J. Anim. Sci*.,13:329-332.

26-Haidary,A.l. and Ahmed,A.(2004). Physiological of Naimey sheep to heat stress challenge under semiarid environments. *Int J Agri Biol*., 2:307-309.

27-Maurya,V.P.; Naqvi,S.M.K.; Joshi,A. and Mittal,J.P.(2007). Effect of high temperature stress on physiological responses of Malpura Sheep. *Indian J Anim Sci*., 77: 1244-1247.

28-Das,R.; Sailo,L.N.; Bharti,P.; Saikia,J.; Imtiwati, and Kumar,R.(2016). Impact of stress on health and performance of dairy animals: A review. *Vet Word* ., 9(3):260-268.

29-Kadzere,C.T.; Murphy,M.R.; Silanikove,N. and Maltz,E. (2002). Heat stress in lactating dairy cows: a review. *Livest Sci*., 77:59–91.

30-Berman,A.(2006). Extending the potential of evaporative cooling for heat-stress relief. *J Dairy Sci*.,89: 3817–3825.

31-Kim,S.W.; Jae-Sung, L.; Jeon, W.S.; Peng,Q.D.; Kim,S.Y.; Bae,H.M.; Jo,H.Y. and Lee,G.H.(2018). Correlation between blood, physiological and behavioral parameters in beef calves under heat stress. *Asian-Australas J Anim Sci*., 31(6):919-925.

32-Keim,S.M.; Guisto,J.A.; SullivanJ.B.J.(2002). Environmental thermal stress. *Ann. Agric. Environ. Med*. 9: 1-15.

33-Manish,K.; Jindal,R.; Nayyar,S. and Singla,M.(2010). Physiological and biochemical responses in Beetle goats during summer season. *Ind J Small Rum*.,16: 255-257.

34-Kadokawa,H.; Sakatani,M. and Hansen,P.J.(2012). Perspectiv -es on improvement of reproduction in cattle during heat stress in future Japan. *Anim Sci J*.,83(6):439-445.

35-Ribeiro,N.L; Costa, R.G.; Pimenta Filho,E.C.; Ribeiro,M.N. and Bozzi, R. (2018). Effects of the dry and the rainy season on endocrine and physiologic profiles of goats in the Brazilian semi-arid region. *Ital J Anim Sci*., 17:454–461.

36-Gudev,D.; Popova-Ralcheval,S.; Moeval,P.; Aleksiev,Y.; Peeva ,T.; Ilieva,Y.; Penchev,P.(2007). Effect of heat stress on some physiological and biochemical parameters in buffaloes. *Ital J Anim Sci*., 6 (2):1325-1328.

37-Shenhe,L.; Jun,L.; Zipeng,L.; Tingxian,D.; Rehman,Z.; Zichao,Z. and Liguo,Y.(2018). Effect of season and breed on physiological and blood parameters in buffaloes. *J Dairy Res*., 85:181-184.

38-Dikmen,S.; Khan,F.A.; Huson,H.J; Sonstegard,T.S; Moss,J.I.; Dahl,G.E. and Hansen,P.J.(2014). The slick hair locus derived from Senepol cattle confers thermotolerance to lactating Holstein cows. *J Dairy Sci*.,97: 5508–5520.

39-Nadol'Nik,L.I.(2010). Stress and the thyroid gland. *Biomed Khim*., 56(4):443-56.

40-Naik,B.R.; Kumar,V.N.S.; Bramhaiah,K.V. and Chakravathi, V.P. (2013). Effect of seasons on physiological and hematological values in punganur cattle. *Int J Pharm Bio Sci*., 4(4): 40-49.

41-Al-Tamimi,H.J.(2007). Thermoregulatory response of goat kids subjected to heat stress. *Small Rumin Res*., 71:280–285.

42-Marai,I.F.M.; El-Darawany,A.A.; Fadiel, A. and Abdel-Hafez, M.A.M. (2007). Physiological traits as affected by heat stress in sheep: a review. *Small Rumin Res*.,71:1-12.

43-Shaji,S.; Sejian,V.; Bagath,M.; Mech,A.; David,I.C.G.; Kurien,E.K.; Varma, G. and Bhatta,R.(2016). Adaptive capabili -ty as indicated by behavioral and physiological responses, plasma HSP70 level and PBMC HSP70 mRNA expression in Osmanabadi goats subjected to combined (heat and nutritional) stressors. *Int J Biometeorol*., 60(9):1311–1323.

44-Alexiev,J.; Gudev,D.; Popova-Ralcheva,S. and Moneva,P. (2004). Thermo- regulation in sheep. IV. Effect of heat stress on heart rate dynamics in shorn and in shorn ewes from three breeds. *Zhivotnovdni-Nauki*., 41 (1): 16-21.

45-Hady,M.M.; Melegy,M.T. and Anwar,R.S.(2018). Impact of the Egyptian summer season on oxidative stress biomarkers and some physiological parameters in crossbred cows and Egyptian buffaloes. *Vet World*., 11(6): 771-777.

46-Kumar,J.; Madan,A.M.; Kumar,M.; Sirohi,R.; Yadav,B.; Reddy,A.V. and Swain,D.K.(2017). Impact of season on antioxidants, nuritional metabolic status, cortisol and heat shock proteins in Hariana and Sahiwal cattle. *Biol Rhythm Res*.,

47-Colakoglu,E.H.; Yazlik,O,M.; Kaya,U.; Colakoglu,C.E.; Kurt,S.; Bayramoglu,R.; Vural,M.R. and Kuplulu,S. (2017). MDA and GSH-Px activity in transition dairy cows under seasonal variations and their relationship with reproductive performance. *J Vet Res*., 61:497-502.

48-Kumar,A.; Singh,G.; Kumar,S.B.V. and Meur,S.K.(2011). Modulation of antioxidant status and lipid peroxidation in erythrocyte by dietary supplementation during heat stress in buffaloes. *Livestock Sci*., 138: 299-303.

49-Sakatani,M.; Balboula,A.Z.; Yamanaka,K. and Takahashi,M. (2012). Effect of summer heat environment on body temperature, estrous cycles and blood antioxidant levels in Japanese Black cow. *Anim Sci J*., 83(5): 394-402**.**

50-Chetia,M.; Sarma, S.; Tamuly, S.; Nath, R.; Goswami,J.; Mili,D.C. and Das,P. K.(2017). Hormonal, antioxidant and Enzymatic Profiling in cross-breed cattle (*Bos tauraus*). *J Cell Tissue Res*.,17(1): 5997-6001.

51-Simonov,M.; Petruch,I. and Vlizlo,V.(2015). Processes of lipid peroxidation and antioxidant defense in dairy cows depending on lactation period and season. *Rocz. Nauk. Zoot*., 42(2) :107-115.

52-Yatoo, M.I.; Dimri, M. and Sharma, M.C.(2014). Seasonal changes in certain blood antioxidants in cattle and buffaloes. *Indian J. Dairy Sci*., 84(2): 173-176.

53-Allaam,A.M.; Tamer, S.A. and Elkhatam, A.O.(2014). Biochem -ical and circulating oxidative stress biomarkers in Egyptian buffaloes (*Bubalus bubalis*) infested by sarcoptic mange. *Glob. Vet*., 13(4): 656-661.

54-Kalmath,P.G.(2015).Studies on heat shock protein 70, antioxidant status, biochemical, and hormonal profiles during summer stress in Hallikar cattle. Ph.D. Thesis. Veterinary Physiology, Animal and Fisheries Sciences University, Bidar.

55-Megahed,G.A.; Anwar, M.M.; Wasfy, S.I. and Hammadeh, M.E.(2008). Influence of heat stress on the cortisol and oxidant-antioxidants balance during oestrous phase in buffalo-cows (Bubalus bubalis): Thermo-protective role of antioxidant treatment. *Reprod Dom Anim*., 43: 672–677.

56-Deshpande,U.R.; Joseph,L.J.; Patwardhan,U.N. and Samuel,A.M.(2002). *Indian J Exp Biol*., 40: 735-738.

57-Kahl,S.; Elsasser,T.H.; Rhoads,R.P.; Collier,R.J. and Baumgard,L.H.(2015). Environmental heat stress modulates thyroid status and its response to repeated endotoxin challenge in steers. *Domest Anim Endocrinol*., 52: 43-50.

58-Sivakumar,A.V.N.; Singh,G. and Varshney,V.P.(2010). Antioxidant supplementation on acid base balance during heat stress in goats. *Asian-Australian J Anim Sci* .,23(11):1462-1468.

59-Boonkum,W.; Misztal,I.; Duangjinda,M.; Pattarajinda,V.; Tumwasorn,S. and Sanpote,J.(2011). Genetic effects of heat stress on milk of Thai Holstein crossbreds. *J Dairy Sci*., 94:487–492.

60-Pires,V.B.; Stafuzza,N.B.; Lima,P.N.P.G.B.S.; Negrão,A.J. and Paz,P.C.C. (2019). Differential expression of heat shock protein genes associated with heat stress in Nelore and Caracu beef cattle. *Livestock Sci* .,230.

61-Min,L.; Cheng,J.; Shi, B.; Yang,H.; Zheng,N. and Wang,J. (2015). Effects of heat stress on serum insulin, adipokines, AMP-activated protein kinase, and heat shock signal molecules in dairy cows. *J Zhejiang Univ- Sci B* (*Biomed Biotechnol*)., 16(6):541-548.

62-Aggarwal,A. and Singh,M.(2010). Hormonal changes in heat stressed Murrah buffaloes under two different cooling systems. *Buffalo Bulletin*., 29(1): 1-6 .

63- Deviche,P.J.; Hurley,L.L.; Fokidis,H.B.; Lerbour,B.; Silverin,B.; Silverin,B.; Sabo,J. and Sharp,P.J.(2010). Acute stress rapidly decreases plasma testosterone in a freeranging male songbird: potential site of action and mechanism. *Gen Comp Endocrinol*., 169, 82–90.

64-Lynn,S.E.; Perfito,N.; Guardado, D. and Bentley,G.E.(2015). Food, stress, and circulating testosterone: Cue integration by the testes, not the brain, in male zebra finches.

65-Palma,B.D.; Suchecki,D. and Tufik,S.(2000). Differential effects f acute cold and footshock on the sleep of rats. *Brain Res*., 861:97-104.

66-Rasooli,A.; Jalali,T.M.; Nouri,M.; Mohammadian,B. and Barati,F.(2010). Effect of chronic heat stress on testicular structures , serum testosterone and cortisol concentrations in developing lambs. Animal Reproduction Sciences., 117(1-2):55-59.

67-Mishra,S.R. and Palai,T.K.(2014). Importance of heat shock protein 70 in livestock- at cellular level. *J Mol Pathophysiol*., 3 (2):30–32.

68-Gaughan,J.B.; Bonner,S.L.; Loxton,I. and Mader,T.L.(2013). Effects of chronic heat stress on plasma concentration of secreted heat shock protein 70 in growing feedlot cattle. *J Anim Sci*., 91(1): 120–129.

69-Banerjee,D.; Upadhyay,R.C.; Chaudhary,U.B.; Kumar,R.; Singh,S.; Das,A.T. K. and De,S.(2015.) Seasonal variations in physio-biochemical profiles of Indian goats in the paradigm of hot and cold climate. *Biol Rhythm Res*., 46: 221-236.