PHYSIOLOGIC RESPONSE, RUMEN AND BLOOD PARAMETERS, AND MILK PRODUCTION OF FRIESIAN COWS TREATED WITH VARIOUS DOSES OF ASCORBIC ACID DURING SUMMER MONTHS IN EGYPT.

BY

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ABSTRACT

A total of 24 Friesian cows averaging 472.9±12.5 kg LBW and ranging between 27 - 52 months of age and 1- 4 parities was used in this study. All cows were at early post-partum (10 days) period. Cows were divided into four similar groups, sex in each group, according to their LBW, parity and milk production. During the experimental period, cows in a 1st group were fed the basal diet without treatment and were considered as the control group (G1), while cows in 2nd (G2), 3rd (G3) and 4th (G4) groups were received a daily oral dose from ascorbic acid (AA), being 0.25, 0.500 and 1.0 g/cow, respectively. Results revealed that cows in all groups were exposed to heat stress during the experimental period, being moderate (THI = 72 – 74) during June and July and very sever (THI over 76) during August. Rectal, skin white and skin black temperatures as well as respiration rate during heat stress period in summer months (June, July and August) decreased ($P<0.05$) for all groups treated with AA, in particular by increasing AA dose from 0.25 up to 1.0 g/h/d as compared to the control group. The highest dose from AA showed the lowest ($P<0.05$) pH value and the highest concentration from TVFA and NH_3-N in rumen liquor. Concentration of total proteins and albumin as well as activity of AST and ALT in blood plasma did not differ significantly between treated and control groups. However, concentrations of globulin increased ($P<0.05$) and of glucose decreased ($P<0.05$) only by increasing daily AA dose up to one gram/h. All milk production parameters as daily actual and 4% FCM milk yields, fat and protein yields were higher ($P<0.05$) in cows of G4 than the control group

(G1). However, these parameters in G2 and G3 tended to be insignificantly higher than the controls and insignificantly lower than G4. Milk composition was not affected by AA treatment, especially percentage of fat and protein.

The current study concluded that heat stress could be eliminated and milk production could be improved for Friesian cows kept under heat stress during summer months in Egypt by receiving a daily oral dose (one g/h/d) from ascorbic acid.

INTRODUCTION

Ascorbic acid promotes antioxidant function, immune function, normal interferon levels, adrenal function and thyroid function **(McCorkel *et al.*, 1980; Andreson, 1981; Beisel, 1982 and Bendich, 1987)**. During heat stress ascorbic acid is secreted into the peripheral circulation by the adrenal **(Frankal, 1970).** Ascorbic acid has been mentioned as one of the anti heat stress substance **(Afify and Makled, 1995).**

Heat stress which induces hyperthermia in cattle is deleterious to any form of productivity and occurs regardless of breed and stage of adaptation **(Finch, 1984).**

The general homeostatic responses to thermal stress in mammals include augmentation of respiration rate **(Yousef, 1982 & 1985),** panting, drooling, reduced heart rates, profuse sweating **(Brody, 1956),** and decreased feed intake **(McDowell, 1972).** The rate at which these heat exchanges occur is depending on the individual resistance of each entity (the cattle and the environment). The resistances to heat exchange that affect the ability of an animal to regulate its body temperature are tissue, coat, and air resistance, as well as evaporative resistance **(Finch, 1986).**

Effective temperature affects the level of heat stress to which animals are exposed (**Fuquay, 1981**). Five environmental factors influence effective temperature: air temperature, humidity, air movement, solar radiation, and precipitation (**Igono, *et al.* 1992**). There are many approaches to quantify heat stress, from complex formulas (**Igono *et al.*, 1992 and Linville and Pardue, 1992**) to simpler methods such as the temperature humidity index

(THI). THI can be used to estimate the effect of heat stress on production **(Ravagnolo *et al.*, 2000).**

The aim of this study was to determine effects of different levels of ascorbic acid (0.25, 0.50 and 1.0 g/h/d) on physiological response, rumen and blood parameters and milk production of Friesian cows during summer months (June, July and August) under Egyptian condition.

MATERIALS AND METHODS

The present study was carried out at Sakha Animal Production Research Station, belonging to the Animal Production Research Institute, Agricultural Research center, Ministry of Agriculture, during the period from June to October 2006.

Animals:

A total of 24 Friesian cows averaging 472.9±12.5 kg LBW and ranging between 27 - 52 months of age and 1- 4 parities was used in this study. All cows were at early post-partum (10 days post calving) period. At the beginning of the experimental period (the 1st week of June), cows were divided into four similar groups, sex in each group, according to their LBW, parity and milk production. Cows in the 1st group were fed a basal diet without treatment and were considered as a control group (G1), while cows in 2nd (G2), 3rd (G3) and 4th (G4) groups were received a daily oral dose from ascorbic acid (AA), being 0.25, 0.500 and 1.0 g/cow, respectively, during the experimental period. All cows were free of any diseases with healthy appearance and housed in separated groups under semi-open sheds, partially roofed with asbestos.

Feeding system and management:

Throughout the experimental period, cows in all groups were fed concentrate feed mixture (CFM), which composed of 37.5% yellow corn, 20% soybean meal, 15% corn gluten, 22.5% wheat bran, 3% molasses, 0.5% and 1.5% common salt. Cows in all groups were fed on equal amounts of a diet containing CFM, rice straw (RS) and berseem hay (BH) according to the recommendation of the **NRC (2001)** allowances for dairy cows based on live body weight and milk yield.

Chemical analysis of representative monthly samples of foodstuffs was analyzed for CP, CF, EE, NFE and ash on DM basis according to the official methods of the **A.O.A.C. (1984).** Chemical composition of CFM, RS and BH as well as calculated chemical composition of the basal diet used in feeding cows in all groups is shown in table (1).

Table (1): Chemical analysis of different feed stuffs (on dry matter basis) used in feeding cows in all groups.

Item	Chemical composition (%)			Calculated composition of the diet
	CFM	RS	BH	
DM	90.42	88.74	88.52	89.57
OM	89.54	82.83	88.28	87.41
CP	15.34	1.61	14.57	11.32
CF	11.46	37.36	24.62	21.54
EE	5.02	1.51	6.12	4.2
NFE	57.72	42.35	42.97	50.36
Ash	10.46	17.18	11.72	12.59

Experimental procedures:

Temperature humidity index (THI):

Daily maximum and minimum values of ambient temperature (AT, °C) and relative humidity (RH%) during the entire length of the experimental period are shown in table (2). The temperature-humidity index (THI, table 2) was estimated according to Livestock and Poultry Heat Stress Indices, suggested by Agricultural Engineering Technology Guide, Clemson University, Clemson, Sc. 29634, USA, using the following formula:

$$THI = db\,^{o}F - (0.55 - 0.55\,RH)\,(db - 58)$$

Where:

db °F = dry bulb temperature in Fahrenheit.

RH = relative humidity (RH / 100).

The obtained values of THI were classified as follows:

Less than 72 = absence of heat stress. 72 to 74 = moderate heat stress.

74 to < 76 = severe heat stress. Over 76 = very severe heat stress.

Body temperatures and respiration rate:

Throughout the experimental period from July up to October, body temperatures including rectal (RT) as well as skin temperatures at white (STW) and black (STB) sites were recorded twice weekly at 13;00 h using digital precision thermometer (TRD, Ellab Cropcopen Hagen, Denmark). At the same time, respiration rate (RR) was measured by counting the flank movements for one minute using stop watch.

Rumen sampling:

Rumen fluid samples were collected 4 h post-feeding using stomach tube attached to vacuum pump at the end of the experimental period. Ruminal pH was immediately measured by the pH meter (Model HI 8424) after filtering the rumen liquor samples through two layers of surgical gauze. Total volatile fatty acids (TVFA) concentration was determined by steam distillation as mentioned by **Eadie *et al.*, (1967)**. Ammonia-N concentration was determined using micro diffusion technique of **Conway (1978)**.

Milk yield and composition:

According to the managerial practices applied in the farm, cows were milked twice daily at 6:00 and 17:00 h by milking machine. Milk yield was individually recorded for morning and evening milkings. Individual milk samples were monthly collected for determining milk composition using milko-scan (Model 133B) and somatic cell count using a Fossomatic 360 (Foss Electronic, Slangerupgade, Denmark).

Blood sampling:

At the end of the experimental period, blood samples were biweekly collected in clean test tubes via the jugular vein from all cows in each group. Blood plasma was separated by centrifugation of the collected blood at 15 *g* for 10 min, then plasma was kept frozen at –20 ^{0}C until chemical analyses. Concentration of total proteins **(Gornall *et al.*, 1949)**, albumin **(Weichselaum, 1946)** and glucose **(Trinder, 1969)** as well as activity of aspartate (AST) and alanine (ALT) aminotransferases **(Reitman and Frankal, 1957)** in blood plasma were determined using commercial kits (Diagnostic

System Laboratories, Inc USA). Plasma globulin was calculated by subtracting concentration of albumin from total proteins.

Statistical analysis:

The obtained data were statistically analyzed according to **Snedecor and Cochran (1980)** using model procedures of **SAS (1990)**. The significant differences among treatment groups were tested using Duncan's Multiple Range Test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Temperature humidity index:

Data in table (2) revealed that cows in all groups were exposed to heat stress during the experimental period, being moderate (THI = 72 – 74) during June and July and very sever (THI over 76) during August (Table 2).

Table (2): Average values of ambient temperature (^oC) and relative humidity (RH%) during different months of the experimental period.

Item	Experimental period during:		
	June	July	August
Ambient temperature (^oC):			
Maximum	32.9±2.2	32.2±1.3	34.8±1.4
Minimum.	19.1±1.3	17.0±2.3	19.6±2.4
Relative humidity (RH%):			
Maximum	89.5±12.4	90.5±6.5	93.0±8.4
Minimum.	53.0±8.5	60.4±7.4	58.0±6.4
Temperature humidity index (THI):			
THI	72.05±9.5	73.23±7.4	79.81±4.6

This indicated that Friesian cows exposed to heat stress through summer months, in particular during August months as found for a previous study of **Abdel-Khalek (2000)** on Friesian bulls kept at the same station.

Thermoregulatoy responses:

Data in table (3) show that body temperatures including RT, WST and BST as well as RR during heat stress period in summer months (June, July and August) significantly (P<0.05) decreased for all groups treated with AA, in particular by increasing dose from 0.25 up to 1.0 g/h/d as compared to the control group.

It is of interest to note that the observed increase in THI values in August reflected in tendency of higher response of cows in all groups in term of higher RT, WST, BST and RR than in June and July, but the response was the lowest in cows of G4 (Table 3).

Table (3): Rectal and skin temperatures and respiration rate during postpartum of Friesian cows treated with different levels of ascorbic acid.

Item	Control (G1)	Treatment group		
		G2	G3	G4
Rectal temperature (°C):				
June	40.33 ± 0.20^{a}	39.58 ± 0.12^{b}	39.10 ± 0.20^{bc}	38.85 ± 0.10^{c}
July	39.92 ± 0.08^{a}	39.40 ± 0.10^{b}	39.19 ± 0.10^{b}	38.94 ± 0.07^{c}
August	40.51 ± 0.20^{a}	39.56 ± 0.14^{b}	39.43 ± 0.10^{b}	39.08 ± 0.10^{c}
Skin temperature (°C) for white site:				
June	34.79 ± 0.1^{a}	33.01 ± 0.10^{b}	33.28 ± 0.20^{b}	33.08 ± 0.08^{b}
July	34.28 ± 0.12^{a}	33.48 ± 0.11^{b}	33.68 ± 0.13^{b}	33.08 ± 0.12^{b}
August	35.18 ± 0.2^{a}	34.72 ± 0.16^{a}	34.08 ± 0.20^{b}	34.08 ± 0.20^{b}
Skin temperature (°C) for black site:				
June	34.69 ± 0.14^{a}	33.98 ± 0.13^{b}	34.51 ± 0.11^{a}	33.69 ± 0.12^{b}
July	35.07 ± 0.21^{a}	34.61 ± 0.16^{ab}	34.74 ± 0.20^{ab}	33.97 ± 0.23^{b}
August	36.22 ± 0.20^{a}	35.61 ± 0.17^{ab}	35.75 ± 0.12^{ab}	35.37 ± 0.17^{b}
Respiration rate (times/min)				
June	66.72 ± 4.1^{a}	53.03 ± 3.7^{b}	52.17 ± 3.5^{b}	49.25 ± 3.4^{b}
July	58.33 ± 3.4^{a}	49.51 ± 3.6^{ab}	48.25 ± 3.1^{b}	41.33 ± 3.1^{b}
August	67.33 ± 4.2^{a}	52.08 ± 4.1^{b}	53.17 ± 3.6^{b}	50.42 ± 3.8^{b}

a, b and c: Means having different superscripts within the same row are significantly different at P<0.05.

Similar trends of changes in body temperatures were reported on Friesian calves (**Fawzy *et al.*, 1998 and Abu El-Hamd, 2000**) and on Friesian bulls (**Fawzy and Rabie, 1996 and Abdel-Khalek, 2000**). Generally, exposing cows to heat stress during summer months caused disturbances in animal body thermoregulation, resulting in marked increase ($P<0.05$) in RT and RR **(Abdel-Samee, 1995 & 1997)** and **Marai *et al.* (1997).** The observed trend of decrease in WST and BST in treatment groups than in the control group was similar to that obtained by **Darwish *et al.* (1972) and Salem *et al.* (1984)** in cattle and **Abu El-Hamd (2000)** in Friesian calves.

It is worthy noting that AA treatment resulted in significantly ($P<0.05$) lower RT rather than those observed in WST, BST and RR (Table 3). This may be a strong reaction of control cows to store heat in their bodies more than treated cows **(Abdel-Samee, 1998).**

The relatively low RR in AA treated cows may be due to higher respiration efficiency in treated cows by increasing the depth of air changing rather than increasing their number (**Kobeisy, 1992 and Yousef *et al.*, 1997**) and in Friesian calves **(Abu El-Hamd, 2000).**

Generally, physiological response in terms of RT, WST, BST and RR in June, July and August (Table 3) was in relation to THI values during these months (Table 2). In cows exposed to heat stress, respiratory rate decreased and both peripheral blood flow and sweating increased. These responses have a deleterious effect on physiologic status of the cow **(West, 2003).**

Rumen parameters:

Data in table (4) show a significant ($P<0.05$) effect of AA treatment on pH value and concentration of TVFA and NH_3-N in rumen liquor (RL) of cows. Such effect was maximized by the highest dose from AA (one gram/h/d), which showed significantly ($P<0.05$) the lowest pH value and the highest concentration from TVFA and NH_3-N in RL.

The differences in pH value as affected by treatment was mainly attributed to the production rate of VFA via fermentation process of carbohydrates **(Abdel-Gadir *et al.*, 1996 and Ahmed, 1996)**, which is almost in negative relation with TVFA concentration in RL. The pattern of VFA concentrations showed reversible trends to those of pH values in rumen liquor of each group **(Shafie and Ashour, 1997 and El-Reweny, 1999).**

Generally, the present values of ruminal pH are within the optimal range (6-7) reported by **Abou-Akkada and Blackburn (1963)** for maximal activity of ruminal microorganisms. Improvement of TVFA concentration with the highest dose from AA may indicate beneficial effects of AA treatment on activity of ruminal microorganism and in turn increasing ruminal fermentation and/or on decreasing ruminal temperature of cows. In this respect, **Abdel-Khalek (2000)** found a tendency of higher values in rumen temperature of heat stressed bulls. Moreover, **Salem (1990)** and **Murad *et al.* (1994)** found a tendency of higher rumen temperature in sheep kept at 35°C than 18°C. The obtained concentrations of NH_3-N for all groups are nearly similar to the optimal concentration of NH_3-N necessary for maximal rate of rumen fermentation (23.5 mg/100 ml) as reported by **Mehrez *et al.* (1977). Cappa (1958)** reported that adult cattle are prone to AA deficiency when AA synthesis is impaired because exogenous supplies of this vitamin are rapidly destroyed by ruminal microflora.

Table (4): Effect of ascorbic acid treatment on rumen parameters of Friesian cows.

Item	Control (G1)	Treatment group		
		G2	G3	G4
pH value	6.17 ± 0.10^{a}	6.07 ± 0.07^{a}	5.73 ± 0.10^{b}	5.43 ± 0.15^{b}
TVFA (m Eq/100 ml)	11.38 ± 1.1^{b}	12.52 ± 1.2^{ab}	13.40 ± 0.9^{ab}	15.32 ± 1.1^{a}
NH_3-N (mg/100 ml)	15.13 ± 1.10^{b}	16.28 ± 1.30^{ab}	17.16 ± 1.20^{ab}	19.78 ± 0.94^{a}

a and b: Means having different superscripts within the same row are significantly different at $P<0.05$.

Blood parameters:

As affected by AA treatment, concentration of total proteins and albumin as well as activity of AST and ALT in blood plasma did not differ significantly between treated and control groups (table 5). Similar trends were obtained by **Kobeisy and Abd El-All (1993)** and **Kobeisy (1994)** in buffalo and Jersey calves fed diet supplemented with AA, respectively, and **Abu El-Hamd (2000)** on Frisians calves fed milk supplemented with different levels of AA.

Table (5): Effect of ascorbic acid treatment on some biochemical parameters and enzyme activity in blood plasma of Friesian cows.

Item	Control (G1)	Treatment group		
		G2	G3	G4
Concentration of:				
Proteins(g/dl)	7.24±0.22	7.46±0.24	7.65±0.18	7.86±0.24
Albumin (g/dl)	3.58±0.10	3.64±0.07	3.72±0.08	3.74±0.90
Globulin (g/dl)	3.66±0.09[b]	3.80±0.10[b]	3.93±0.07[ab]	4.14±0.08[a]
Glucose (mg/dl)	67.95±4.5[a]	61.50±7.2[ab]	62.74±5.6[ab]	52.42±4.2[b]
Activity (IU/dl) of:				
AST	43.78±2.6	42.16±2.8	46.24±3.1	43.18±2.4
ALT	21.45±1.2	20.75±0.9	22.04±1.3	20.45±0.9

a and b: Means having different superscripts within the same row are significantly different at $P<0.05$.

However, concentration of globulin significantly ($P<0.05$) increased and of glucose significantly ($P<0.05$) decreased only by increasing daily AA dose up to one gram/h (Table 6). Exposing Friesian bulls to solar radiation was accompanied by marked decline ($P<0.01$) in plasma concentration of total protein and globulin. While, albumin concentration was not affected **(Abdel-Khalek, 2000).** Such trend may indicate that AA prevent the effect of heat stress on metabolism of protein in treated cows. Heat stress may related to direct effect on liver function of animal **(Abdel-Samee, 1997, Marai and Habeeb, 1997 and Habeeb *et al.*, 1997)** or indirectly on the metabolic hormones **(Abdel-Samee and Diel, 1998).**

As response of cows to AA treatment, the significant decrease in concentration of glucose in blood plasma of cows in G4 may be in relation to increasing milk production of cows in this group (Table 7). This may indicate the beneficial effect of AA treatment on alleviation of the heat-stressed cows.

Feed intake:

Data presented in table (6) show that average daily feed intake (CFM, RC and BH) and total intake as DM, TDN and DCP were not differ significantly among dietary groups, although cows in G4 showed slight tendency of higher total intake as DM, TDN and DCP than the other groups.

Table (6): Effect of ascorbic acid treatment on feed intake of Friesian cows.

Item	Control	Treatment group		
	(G1)	G2	G3	G4
Average daily feed intake (kg/h/day):				
CFM	7.10	7.35	7.20	7.75
RC	4.00	4.00	4.00	4.00
BH	3.00	3.20	3.20	3.25
Total	14.10	14.55	14.40	15.00
Average feed intake (kg/h/day):				
Total DM	12.63	13.03	12.89	13.43
TDN	8.06	8.50	8.28	8.85
DCP	1.03	1.10	1.06	1.14

Milk production:

The effect of AA treatment on daily milk production as actual milk yield. fat corrected milk (FCM) as well as fat and protein yields was significant ($P<0.05$) (Table 7). All milk production parameters were significantly higher in cows of G4 than the control group (G1). However, these parameters in G2 and G3 tended to be insignificantly higher than the control and insignificantly lower than G4. Interestingly to observe that milk composition was not affected by AA treatment, especially percentage of fat and protein, which indicate superiority of cows in G4 in their daily production from 4% FCM, fat and protein yields.

In comparing 90 day-milk yield as actual or 4% FCM, also cows in G4 showed significantly ($P<0.05$) the highest yields as compared to the control group. In addition to increasing milk production, cows in G4 showed significantly ($P<0.05$) the lowest somatic cell count (SCC) in milk as compared to the control and other treated groups (Table 7).

It is worthy noting that the significant ($P<0.05$) increase in milk production parameters of cows in G4 was mainly associated with marked reduction ($P<0.05$) in estimated body temperatures and RR of cows in this group as compared to the control and other treated groups (Table 3).

Table (7): Effect of ascorbic acid treatment on milk production, milk composition and somatic cell count in milk of Friesian cows.

Item	Control (G1)	Treatment group		
		G2	G3	G4
Daily milk production:				
Actual MY (kg)	11.63±1.4^{b}	13.38±1.4^{ab}	12.85±2.1^{ab}	16.46±1.3^{a}
4% FCM (kg)	11.35±1.3^{b}	13.22±1.5^{ab}	12.18±1.7^{ab}	15.17±1.2^{a}
Fat yield (g)	447±29^{b}	524±36^{ab}	469±32^{b}	573±23^{a}
Protein yield (g)	270±24^{b}	314±28^{ab}	298±26^{ab}	377±30^{a}
Chemical composition (%):				
Fat	3.84±0.10	3.92±0.20	3.65±0.20	3.48±0.09
Protein	2.32±0.09	2.35±0.08	2.32±0.10	2.29±0.10
Lactose	4.25±0.20	4.18±0.20	4.19±0.30	4.24±0.30
TS	11.15±0.70	11.20±0.6	10.98±0.70	10.79±0.80
SNF	7.29±0.40	7.28±0.50	7.26±0.50	7.29±0.6
Milk production through 90 days lactation period (kg):				
Actual MY	1046.7±76^{b}	1204.8±90^{ab}	1156.5±60^{b}	1481.4±85^{a}
4% FCM	1021.5±67^{b}	1189.8±86^{ab}	1096.2±62^{b}	1365.5±65^{a}
Somatic cell count (1000/ml):				
SCC	681.43±40^{a}	727.5±58^{a}	740.2±60^{a}	485.42±30^{b}

MY: Milk yield FCM: Fat corrected milk TS: Total solids
SNF: Solids not fat
a and b: Means having different superscripts within the same row are significantly different at $P<0.05$.

Fuquay (1981) reported that lactating dairy cows are susceptible to heat stress during summer because of elevated internal heat production associated with lactation. During periods of heat stress, milk production, feed intake, and physical activity decreased. **West *et al.* (2003)** found that changes in cow body temperature (measured as milk temperature) were most sensitive to same day climatic factors. Cow DM intake and milk yield were most affected by climatic variables, not cow body temperature.

McDowell (1972) stated that the most comfortable and productive environmental temperature of dairy cows ranged between -5 and 25°C. This is the thermal comfort zone. When environmental temperatures exceed 26°C, milk production declines. This is mainly because of a decrease in DM intake. Reduced DM intake is an adaptation strategy to maintain a normal body temperature (i.e. in the range 38.5 - 39.3°C). It was estimated that milk yield reduced by 0.32 kg per unit increase in THI (**Ingraham *et al.*, 1979**), or was declined by 0.2 kg per unit increase in THI when THI exceeded 72 (**Ravagnolo *et al.*, 2000**) due to a decline in milk yield and TDN intake by 1.8 and 1.4 kg for each 0.55°C increase in RT (**Johnson *et al.*, 1963**). **Umphrey *et al.* (2001)** reported that the partial correlation between milk yield and RT for cows was negative ($r = -0.135$).

Johnson *et al.* (1963) reported that milk yield and DM intake exhibited significant declines when maximum THI reached 77. **Igono *et al.* (1992)** determined that the critical values for minimum, mean and maximum THI were 64, 72, and 76, respectively. Studies established that there is a significant negative correlation between THI and DM intake for cows (**Holter *et al.*, 1996 and Holter *et al.*, 1997**), and the effect of THI is probably mediated through the effects of increasing body temperature on cow performance.

Along with reduction in body temperatures and RR of cows in G4, rumen parameters, particularly concentration of TVFA significantly ($P<0.05$) improved, which may indicate increasing their efficiency in milk production (Table 5). In addition to the role of AA as one of the anti-heat stress substance (**Afify and Makled, 1995**), it promotes antioxidant function, immune function, normal interferon levels, adrenal function and thyroid function (**Mc Corkel *et al.*, 1980; Andreson, 1981; Beisel, 1982 and Bendich, 1987**). Ascorbic acid play to epoch improved heat stress tolerance (**Kobeisy, 1994**). **Frankal (1970)** found that ascorbic acid is secreted into the peripheral circulation by the adrenal during heat stress.

Economic efficiency:

Data in table (8) revealed that feed cost per kg from 4% FCM was lower for G4 and G2 (0.72 and 0.79) than that for G3 and control (0.85 and 0.89), respectively. Its worth noting from the economical point of view that economic feed efficiency was the highest in G4 than the other groups (Table 8).

Table (8): Effect of ascorbic acid treatment on economic efficiency of Friesian cows.

Item	Control (G1)	Treatment group		
		G2	G3	G4
Total feed cost (L.E.)	10.09	10.48	10.30	10.96
Return of milk (L.E.)	15.70	18.06	17.35	22.22
Feed cost/kg 4% FCM	0.89	0.79	0.85	0.72
Economic efficiency (%)	156	172	168	203

CONCLUSION

The current study concluded that heat stress could be eliminated and milk production could be improved for Friesian cows kept under heat stress during summer months in Egypt by receiving a daily oral dose (one gram/h/d) from ascorbic acid.

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الاستجابة الفسيولوجية، خصائص الكرش والدم وإنتاج اللبن لأبقار الفريزيان المعاملة بجرعات مختلفة من حمض الأسكوربيك خلال أشهر الصيف في مصر.

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أستخدم في هذه الدراسة ٢٤ بقرة فريزيان متوسّط أوزانها ٤٧٢,٩ ±١٢,٥ كجم وتتراوح أعمارها بين ٢٧ – ٥٢ شهر من العمر وفي موسم ما بين ١-٤. كلّ الأبقار كانت في الفترة المبكرة بعد الولادة. قسّمت الأبقار إلى أربع مجموعات متماثلة في الوزن والعمر وموسم الحليب وإنتاج اللبن. كانت الأبقار في المجموعة الأولى بدون معاملة (كنترول) بينما تم تجريع المجموعة الثانية والثالثة و الرابعة بحمض

الأسكوربيك ٠,٢٥، و٠,٥٠ و١,٠ جم/رأس/يوم، علي الترتيب أثناء الفترة التجريبية. ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

١- الأبقـــار في كلّ المجموعات تعرّضت لإجهاد حراري بمعدل معتدل أثـــناء يونيو ويوليو (THI= ٧٢ – ٧٤) وإجهاد حراري عالي جدا (THI= ٧٦) أثناء أغسطس.

٢- انخفـــضت درجـــة حرارة المستقيم وجلد المناطق البيضاء و الجلد المـــناطق الـــسوداء ومعدل التنفس في كل المجاميع المعاملة معنويا مقارنـــا بالكنتـــرول وكان النقص ملحوظ بزيادة الجرعة من حمض الأسكوربيك من ٠,٢٥، إلي ١,٠ جم/رأس/يوم خلال المفترة التجريبية (يونيو ويوليو وأغسطس).

٣- أظهرت الجرعات العالية من حمض الأسكوربيك نقص في رقم الأس النتروجيني وزيادة في الأحماض الدهنية الطيارة والأمونيا في سائل الكرش مقارنة بالكنترول.

٤- لـــم يختلف تركيز البروتين الكلي والألبيومين ونشاط إنزيمات الكبد (AST & ALT) معـــنويا في المجموعات المعاملة والكنترول. أما الجلوبيولين فقد زاد معنويا في المجموعات المعاملة مقارنة بالكنترول بينما نقص الجلوكوز معنويا في المجموعة الرابعة.

٥- زاد إنـــتاج اللبن الفعلي والمعدل لنسبة دهن (٤%) كما زاد محصول البـــروتين والـــدهن اليومـــي فـــي أبقـــار المجموعة الرابعة مقارنة بالكنترول. بينما لم يتأثر تركيب اللبن معنويا وخصوصا نسبة الدهن والبروتين.

اســـتنتجت هـــذه الدراسة بأنه يمكن تلافي أثارّ الإجهاد الحراري وزيـــادة إنتاج اللبن لأبقار الفريزيان تحت ظروف الإجهاد الحراري أثناء شـــهور الـــصيف في مصر باستخدام الجرعة ١جم /رأس/يوم من حمض الأسكوربيك.