تأثير درجة الحرارة والرطوبة النسبية للاسطبلات على كمية الهيموجلوبين وعد كريات الدم فى الأبقار والجاموس

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الملخص العربى

قام الباحثون بدراسة تأثير درجة حرارة الجو والرطوبة النسبية داخل اسطبلات الحيوانات خلال فصول السنة ـ على كمية هيموجلوبين وعدد كريات الدم فى الأبقار والجاموس ولاحظوا :

١ ـ ارتفاع كمية الهيموجلوبين فى الدم صيفا عندما تصل درجة حرارة الاسطبل الى ٢٩درجة مئوية والرطوبة النسبية الى ٥ر٥٥٪ ٠

٢ ـ انخفاض عدد كريات الدم الحمراء صيفا كنتيجة لتخفيف الدم بسبب شرب الحيوانات لكميات كبيرة من الماء فى هذا الوقت ٠

٣ ـ ارتفاع عدد كريات الدم البيضاء خلال فصلى الخريف والشتاء ربما كعامل مساعد فى حماية جسم الحيوانات من التعرض للعدوى بالميكروبات فى الأجواء ذات درجة الحرارة المنخفضة

٤ ـ زيادة عدد كريات الدم المتعادلة والقلوية مع انخفاض درجة حرارة الاسطبل ٠

٥ ـ زيادة نسبة الخلايا الحمضية خلال فصلى الصيف والخريف ٠

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THE EFFECT OF CLIMATIC CHANGES ON HAEMOGLOBIN CONTENT AND CORPUSCULAR CONSTITUENTS OF BLOOD IN CATTLE AND BUFFALOES

(With 6 Tables)

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SUMMARY

The variations in blood constituents of dairy cattle, bovine and buffalo calves as a result of exposure to varying environmental climatic conditions during the different seasons have been studied. Highly significant seasonal variations were noticed :

1.—Haemoglobin content was definitely increased during summer months, when the enviromental temperature increased in this part of Upper Egypt to 29°C and the air was comparatively dry (relative humidity 55.5%). Its content in buffalo-calves remained higher throughout the four seasons when compared with its value in other animals investigated, which may explain the increased adaptability of these animals to hot weathers.

2. A reduction in circulating erythrocytes was observed during summer, which may be probably a haemodilution effect brought about by the consumption of large amounts of water every day during exposure to high environmental temperatures.

3. The highest leucocytic count was observed during autumn and winter in all farms ivestigated, which by virtue of their phagocytic properties, they may assist in arresting the invasion of pathogenic micro-organisms during exposure to cold and windy weather.

4. Polymorphs, monocytes and basophils were found to be much higher during cold season.

5. The percentage of eosinophils was much increased during summer an autumn, indicating that the animals were not under heat-stress during rise of environmental temperature.

INTRODUCTION

The climatic environment. consisting primarily of temperature, humidity and wind velosity significantly influences the vitality and productivity of livestock. Seasonal variations in the haematologic constituents were observed by many workers. CANHAM (1930) noticed an increase in the total leucocytic count during hot season, while McCAY (1931) reported an increase in haemoglobin levels during summer months. However, MANRESA *et al*

(1940) stated that haemoglobin levels were lowerduring summer than in winter. Other workers (AKOPJAN, 1941 and DAUBNEY, 942) have found that haemoglobin levels were highest during the warmer months of the year.

RUSOFF *et al.* (1954) determined by monthly analysis of blood of mature bulls over a period of one year, a significant increase of haemoglobin values and leucocytic counts during summer months when environmental temperature increased over 80°F. However, erthrocytic counts were not affected by environmental conditions. They concluded that there was a relationship between high environmental temperatures and haemoglobin and leucocytic count.

Seasonal variations in the total leucocyte count and in the number of circulating lymphocytes, eosinophils and polymorphonuclear leucocytes have been studied by VRZGULOVA (1961). She reported that leucocytic count was highest during autumn and winter ; that the percentages of lymphocytes were greater during summer and autumn months; that the percentages of eosnophils were lowest during summer and highest in autumn; that the percentages of polymorphonuclear leucocytes were lowest during autumn and highest during winter and spring, and that the percentages of monocytes were lowest in spring and highest in winter.

RAGHAVAN and MULLICK (1962) noted a negative correlation of total leucocytic count with atmospheric changes.

BHATTACHARYA *et al.* (1965) noticed significant seasonal variations in body temperature and blood haemoglobin. They concluded that maximum haemoglobin value was observed during summer, while maximum value of body temperature was recorded in winter time.

PATEL *et al.* (1965) reported high total erythrocytic count during summer.

The maximum leucocytic count was observed by ABT *et al.* (1966) in June. (11,600 per mm^3), followed by a drop to 10, 500 per mm^3 during August. However, during October the leucocytic count rose again to reach 11,200 per mm^3 and began to decrease during December and January to reach the minimum count in February (8,200 per mm^3). After this cold season, the leucocytic count rose steadily again during April (9,700 per mm^3) and June where the count reached its maximum. On the other hand, the maximum haemoglobin content (11.5 gm%) was observed during February, while the least was recorded during October and June (10.4 and 10.0 gm%, respectively).

In Egypt, RAGAB (1968) found that the mean values of haemoglobin of normal cow's blood was 10.32 gm%, erythrocytic count 6.91 mill. per mm^3 and leucocytic count 11.15 thousands per $mm.^3$ However. the average value of haemoglobin of normal buffalo's blood was 12.73 gm%, erythrocytic count 6.68 mill. per mm^3, and leucocytic count 10.81 thousands per mm^3.

A significant depression in circulating leucocytes with increasing environmental temperature was reported by ROUSSEL *et al.* (1969) and PATEL *et al.* (1971). Moreover, PATEL *et al.* (1971) found that the haemoglobin

concentration was higher in summer than in winter, while the highest haemoglobin content was noticed in buffalo bulls during all seasons of the year.

Because of the wide variations in the environmental temperatures and relative humidity percentages between seasons in the region of Upper Egypt, Assiut province in particular, this study was undertaken to establish detailed comparative data dealing with factors environmentally influencing blood haemoglobin content, erythrocytic count, leucocytic count and differential count.

MATERIAL AND METHODS

A representative sample of lactating cow, bovine and buffalo calves were selected. Equal numbers of animals from the respective breeding farms, situated at Mankabad and El-Hawatka in Assiut Province, as well as from Faculy of Agriculture farm in Al-Minia Governorate were chosen (Table 1)

TABE 1

Farm	Breeding tracts	Site	Species	Age	Sex	No.of selected animals	No.of samples examined
I	Project for fattening calves	Mankabad	Bovine calves	1—1½ y	Male	10	7
II	Buffalo breeding station	El Hawatka	Buffalo calves	3—6 m	Male	10	5
III	Faculty of Agriculture-Farm	Al Minia	Dairy cows	3—7 y	Females	10	5
	Total					30	17

The animals used in obtaining the following data were apparently normal in all aspects, The animals in each farm were kept under uniform managerial conditions throughout the course of this investigation, which was extended over the four seasons of the year. The aimals of Farm I were enclosed in a dirty floor housing system without partitions and the walls were build from red bricks with thatchy roof.

In Farm II, the calves were housed in pens with concrete floor and roof, while the walls and partitions were build from red bricks and cement. The dairy cows in Farm III were stabled in a milking house system.

Seventeen blood samples from 30 animals were taken for this study during the four seaseons of the year (Summer "June-August"; autumn "September-Novemder, winter, "December-Februry" and spring "March-May"). Normal environmental data prevailing at these different localities were recorded in order to enable assessment of the difference in such conditions. Environmental temperature was determined four times daily at 8 A.M., 12 Noon, 4 P.M. and 8 P.M., with the aid of an ordinary thermometer constantly hanged in the middle of the stable. Relative humidity was recorded directly by means of hair hygrometer similarly situated.

Haemoglobin content, erythrocytic, leucocytic and differential counts were carried out according to COLES (1967).

RESULTS AND DISCUSSION

The mean climatological data of environmental air temperature and relative humidity during the investigation period in different seasons are presented in Tables II A and IIB. The season-wise distribution of the haematological attributes was given in Tables III and IV.

Haemoglobin concentration of blood has been claimed as an index of animal's adaptability (COLES, 1967). In the present investigation, haemoglobin values were definitely found to increase during summer months when the environmental temperature reached its maximum, and the air was comparatively dry (Tables II A, TI B and III). The minumum haemoglobin concentration was observed during winter, while in autumn it was higher than in spring. Similar results were previously observed by many investigators(Mc CAY,1931; AKOPJAN, 1941; DAUBNEY, 1942 ; RUSOFF *et al.*, 1954; BHATTACHARYA *et al.*, 1965., and PATEL *et al.*, 1971). However, MANRESA *et al.*, (1940) and ABT *et al.*, 1966) recorded the reverse.

It has been noticed in this study that haemoglobin concentration was highest in buffalo calves (Farm II) when compared with its value in other animals examined (Table III), which may explain the highest adaptability of buffaloes to hot weathers. This is in acord with the results found by RAGHAVAN and MULLICK (1962) and PATEL *et al.* (1971).

The yearly mean concentrations of haemoglo bin different animals studied are shown in Table V, which were within the normal range expected from healthy animals (RAGAB, 1968).

During summer, a reduction in circulating erythrocytes was observed, while the highest count recorded during winter months (Table III). The low erythrocytic count during summer time, may be probably a haemodilution effect brought about by the consumption of large amount of water by the animals every day during the exposure to high environmental temperatures. This effect is consistant with an increase in bllod volume during the initial stages of heat stressDDALE *et al.*, 1956).Consequently an increase in plasmavolume preceded changes in cells resulting in a reduction in the concentration of circulating

TABLE II (A). Seasonal mean values of environmental variables during the investigation period (Environmental temp. °C)

Farm/Month	Farm I				Mean	Farm II				Mean	Farm III				Mean
	8 A.M.	12 N.	4 P.M.	8 P.M.		8 A.M.	12 N.	4 P.M.	8 P.M.		8 A.M.	12 N.	4 P.M.	8 P.M.	
August	23.0	31.4	32.1	27.8	28.5	25.6	29.8	32.0	30.7	29.7	—	—	—	—	—
September	23.0	32.1	33.3	22.0	27.6	—	—	—	—	—	—	—	—	—	—
October	—	—	—	—	—	24.3	28.0	30.4	—	27.5	20.7	25.0	24.4	22.1	23.0
November	16.6	23.7	25.4	19.1	20.7	—	—	—	—	—	14.3	18.2	19.2	15.8	16.9
December	12.8	16.4	17.5	13.1	14.9	11.5	13.4	17.2	—	14.0	—	—	—	—	—
February	14.3	19.3	23.2	22.1	19.7	14.5	16.7	19.2	—	16.8	12.6	18.9	18.9	13.0	15.8
March	14.9	24.1	23.3	—	20.7	—	—	—	—	—	—	—	—	—	—
April	—	—	—	—	—	21.7	32.7	29.1	22.2	26.4	—	—	—	—	—
May	25.1	30.2	32.5	—	29.2	—	—	—	—	—	20.0	27.1	26.0	25.2	24.5
June	—	—	—	—	—	—	—	—	—	—	22.6	29.2	27.3	26.1	26.3
Total	18.5	25.3	26.7	20.8	23.0	19.5	24.1	25.5	26.4	22.8	18.0	23.6	23.2	20.4	21.3

TABLE II (B). Seasonal mean values of environmental variables during the investigation period (Relative humidity %)

Farm/Month	Farm I				Mean	Farm II				ean	Farm III				Mean
	8 A.M.	12 N.	4 P.M.	8 P.M.		8 A.M.	12 N.	4 P.M.	8 P.M.		8 A.M.	12 N.	4 P.M.	8 P.M.	
August	70.5	41.6	31.9	42.0	46.5	78.5	57.4	45.7	41.0	55.6	—	—	—	—	—
September	92.5	59.6	56.5	41.8	62.6	—	—	—	—	—	—	—	—	—	—
October	—	—	—	—	—	69.0	61.8	50.7	—	60.5	85.6	64.1	58.4	74.5	70.6
November	97.5	60.3	52.1	57.5	66.8	—	—	—	—	—	84.1	68.4	64.0	79.3	73.9
December	86.4	54.1	47.7	69.4	64.4	82.0	68.3	63.3	—	71.2	—	—	—	—	—
February	93.2	62.8	43.0	81.0	70.0	76.8	64.6	58.4	—	66.6	75.9	69.9	64.8	75.0	71.4
March	85.7	32.8	35.4	—	51.3	—	—	—	—	—	—	—	—	—	—
April	—	—	—	—	—	71.1	42.0	26.7	31.5	42.8	—	—	—	—	—
May	56.6	40.5	36.7	—	44.6	—	—	—	—	—	69.8	41.6	30.5	42.9	46.2
June	—	—	—	—	—	—	—	—	—	—	68.0	39.1	28.4	30.5	41.5
Total	83.2	50.2	43.3	58.3	58.0	75.4	58.8	48.9	36.2	59.3	76.7	56.6	49.2	60.4	60.7

TABLE III. Seasonal variations of haemoglobin content, erythrocytic and leucocytic counts in respect to varying climatic conditions

Season	Farm I					Farm II					Farm III				
	Env. temp °C	R.H. %	R.B.C. mill./ mm³.	Hb. mg %	W.B.C. thous/ mm³.	Env. temp °C	R.H %	R.B.C. mill./ mm³.	Hb mg %	W.B.C. thous/ mm³.	Env. temp °C	R.H. %	R.B.C mill/ mm³.	Hb mg %	W.B.C. thous/ mm³.
SUMMER	28.5	46.5	5.46	11.60	8.266	29.7	55.6	7.22	12.60	9.870	26.3	41.5	6.11	11.3	7.610
AMTUMN	24.1	64.7	6.30	9.20	10.350	27.5	60.5	7.70	11.30	10.020	19.9	72.2	6.20	10.2	9.230
WINTER	17.3	67.2	7.46	9.05	12.190	15.4	68.9	9.42	10.30	10.650	15.8	71.4	7.31	9.1	9.500
SPRING	24.9	47.9	6.13	9.10	7.240	26.4	42.8	8.10	10.90	9.840	24.5	46.2	5.60	9.8	6.300
Overall	means		6.33	9.73	9.511	—	—	8.11	11.27	10.096	—	—	6.30	10.1	8.640

erythrocytes. Similar results were previously recorded by PATEL *et al.* (1971) and PAAPE *et al.* (1973).

The total erythrocytic count in buffalo calves (Farm II) remained higher throughout the year when compared with other animals (Table III). It was lower in summer and autumn than winter and spring. However, in calves (Farm I) and dairy cows (Farm III), the erythrocytic counts were lowest during spring and autumn. These observations support the results recorded by PATEL *et al* (1965). and PATEL *et al.* (1971).

The overall mean values of erythrocytic counts in bovine calves and lactating cows were found to be 6.33 and 6.30 mill. per mm^3 respectively (Table V); which are within the normal range expected from healthy cattle (RAGAB, 1968). However, a relatively higher mean value was obtained in buffalo calves (8.11 mill./mm^3) than that previously recorded by RAGAB (1968).

It is clear therefore, that the erythrocytic count of the blood is significantly affected by climatic variations.

Seasonal variations in the total leucocytic count and in the percentages of circulating myelocytes, band cells, lymphocytes, eosinophils, basophils, monocytes and polymorphonuclear leucocytes are presented in Tables III and IV. It is clear that the total leucocytic counts were invariably highest during autumn and winter months than summer, which may be responsible for arresting the invasion of pathogenic micro-organisms by virtue of their phagocytic properties (CASTLE, 1961), during exposure to cold windy weather in winter and autumn. The least counts were recorded during spring in all farms investigated. These results are consistent with those recorded by VRZGULOVA (1961) RAGHAVAN and MULLICK (1962), ABT *et al.* (1966), ROUSSEL *et al.* (1969). PATEL *et al.* (1971) and PAAPE *et al.* (1973).

The over all mean values of leucocytes (Table V) in baffalo calves were found to be similar to the values recorded by RAGAB (1968), while comparatively lower values were observed in bovine calves and dairy cows.

Each of the morphological types of leucocytes probably plays a distinct role in body deffense mechanism. Therefore, the blood concentration of the specific types of leucocytes, is much more meaningfull than totoal leucocytic concentration during exposure to varying seasonal climatic conditions.

As shown from Table V, the percentage of polymorphs was lowest during summer and spring and highest during winter and autumn. The number of polymorphs was found to be higher in buffalo calves during all the seasons than in other animals. The eosinophils were much reduced during spring but increased again in summer and autumn. Eosinophils have been found to be efficient phagocytes for antigen antibody complexes (SABESIN, 1963). The lymphocytic count increased significantly during summer and spring in buffalo calves and dairy cattle. These results are consistent with those found by PATEL *et al.* (1971). However, the percentage of lymphocytes in bovine calves (Farm 1) was greater during summer and autumn months. The percentages of monocytes and basophils were found to be highest in winter, while those of

TABLE IV. Effect of seasonal environmental conditions on the differential leucocytic counts

Season	Farm I							Farm II							Farm III						
	My %	Ba %	S. %	L. %	E. %	B. %	M. %	My %	Ba. %	S. %	L. %	E. %	B. %	M. %	My %	Ba %	S %	L. %	E. %	B. %	M %
Summer .	2.0	6.6	17.4	71.5	2.50	0	0	0	6.0	11.0	81.5	1.50	0	0	1	7.4	14.8	78.2	3.9	0	0
Autumn .	0.1	5.6	20.0	72.3	1.92	0	0.05	0	8.6	27.5	61.1	2.60	0	0	0	5.9	22.2	67.1	4.6	0.2	0
Winter. .	0	5.5	23.6	69.9	0.70	0	0.20	0	5.8	25.4	67.7	0.75	0.06	0.06	0	5.1	24.9	65.9	3.3	0.3	0.0.5
Spring .	0	0	16.8	70.4	0.62	0	0	0	0	24.6	75.0	0.40	0	0	0	0	21.3	75.7	3.0	0	0
Mean .	0.52	4.42	19.45	71.02	1.43	0	0.06	0	5.10	22.12	71.32	1.31	0.015	0.015	0.25	4.60	20.8	71.72	3.7	0.125	0.125

My = Myelocyte s Ba = Band cells E = Eosinophils S = Segmented (Polymorphoneuclear leucocytes) L = Lymphocytes B = Basophils M = Monocytes

TABLE V.— The mean values of certain constituents of blood

Variable	Unit	Farm I			Farm II			Farm III		
		Min	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
Haemoglobin	mg %	6.00	14.50	9.730	8.50	14.50	11.270	7.50	12.50	10.100
Total erythrocytic count	mill./mm³	4.06	12.78	6.330	3.86	12.59	8.110	4.34	9.00	6.300
Total leucocytic count.	thous/mm³	3.40	16.40	9.511	6.00	14.40	10.096	5.00	20.40	8.640
Myelocytes	%	0	14.00	0.520	0	0	0	0	0	0.250
Band cells	%	0	18.00	4.420	0	19.00	5.100	0	10.00	4.600
Segmented	%	8.0	48.00	19.450	5.00	47.00	22.120	13.0	35.00	20.800
Lymphocytes . . .	%	45.0	90.00	71.020	50.0	93.00	71.320	55.0	81.00	71.720
Eosinophils	%	0	6.00	1.430	0	8.00	1.310	0	12.00	3.700
Basophils	%	0	0	0	0	1.00	0.015	0	1.00	0.125
Monocytes	%	0	1.00	0.062	0	1.00	0.015	0	3.00	0.125

myelocytes and band cells were higher during summer and autumn, and lower during winter and spring months. Similar findings were obtained by VRZGULOVA (1961).

From the results obtained during the course of this investigation, it is clear therefore that there were significant monthly and seasonal variations for all of the different haematological values studied, which suggest that temperature season significantly alters pattern of certain physiological blood constituents which are of diagnostic interest.

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