3

Egypt. J. Amin. Prod., 26. No. 1 pp 35-46 (1986)

Seasonal Differences in Some Blood Components of Egyptian Sheep and Goats.*

M.A. Samak, G.A. Hassan, F.D. El-Nouty, Zahraa abo Elezz and A. Badawy.

Department of Animal Production, Faculty of Agriculture, University of Alexandria, Alexandria, Egypt.

Changes in the blood levels of Hb, RBC, PCV, WBC, gloucose and serum proteins were determined in spring, summer and winter in 16 ewes (8 Barki and 8 Rahmani) and in 8 Baladi goats. The results indicated that the seasonal variation had significant effect on the Hb, RBC, PCV, glucose, total serum proteins and serum albumin Also, there are a significant differences between breeds in RBC, WBC, PCV and albumin concentration. Accordingly significant interactions between breeds and season were recorded in Hb and RBC. Minimum variations in the main hematological parameters due to season of year were shown in goats indicating its tolerance capacity under subtropical conditions.

Key Words : (Seasonal, blood, Sheep, goats)

In the newly reclaimed desert areas, the most important problems limiting expansion of animal production are shortage in both water and green fodders sources and high environmental temperature. Some common domestic species such as sheep and goats, as well as certain domestic animals indigenous to arid regions such as the camel and donkey, have acquired adaptations enabling them to withstand severe lack of water.

Previous studies on sheep, goats and cattle have indicated that many of blood hematological and biochemical components were greatly affected by genetical and environmental conditions (El-Nouty *et al.*, 1986; Samak *et al.*, 1983; Shaffer *et al.*, 1981 and Jindal, 1980). It is known that the hematolo-

* Partial support of this research by the International Atomic Energy Agency in Vienna is gratefully acknowledged (Contract No. 3158).

gical changes which occur in the animals may have an important role in adjusting the different functions of animal's body to existing environmental conditions especially under stressful conditions. Accordingly, the physiologists in the tropics are searching for blood index or combination of indices which might measure the effects of hyperthermia on animals, where hyperthermia condition are common and constant for 6 months of the year. The present study was thus designed to evaluate the seasonal effects on certain blood parameters in two main breeds of sheep (Barki and Rahmani) and in Egyptian Baladi goats.

Material and Methods

Sixteen ewes (8 Barki & Rahmani) and 8 Baladi goats belonging to the Alexandria University Experimental Station were used to study the effect of seasons of the year and breed on their hematological characteristics. The experiments were started in April 1983 (spring) and were terminated in February 1984 (winter). All animals were dry, non pregnant and were 1 to 2 years old at the beginning of the experiment. The animals were individually confined in semi-opened barns which provided enough shade and ventillation in summer and protection from rain in winter. Water was offered *ad libitum* to animals throughout the experimental period. Animals were given their nutritional requirements (roughage and concentrates) according to Morrison (1959). The concentrate mixture contained at least 61% total digestible nutrients and 11.5% digestible protein. Animals were also provided with wheat straw during summer and with Berseem *(Trifolium alexandrinum)* during winter and spring as sources of roughages. All animals were free from diseases and any behavioral abnormalities throughout the experimental period.

All animals were used during the 3 seasons of the year as specified consecutively starting with spring to study the effect of season of the year and breed of animals on some hematological parameters. During every season, the experimental period included a preliminary period of 2 weeks, that was followed by an 6 day period during which 3 blood samples were collected every other day. Blood samples were obtained from the Jugular vein of each animal in the morning before feeding and drinking. Ethylene diamine tetra-acetic acid (EDTA) was used as anticoagulant, a part of each sample was left without the anticoagulant to obtain serum. Blood samples were blaced immediately on ice until used. Plasma or serum was obtained by centrifuga-

tion of blood at 860 xg for 20 minutes, and were stored at -20°C until used for further analyses.

Whole blood was analyzed shortly after collect for hemoglobin (Hb), packed cell volume (PCV), red blood cell counts (RBC) and white blood cell counts (WBC) by the conventional methods (Hepler, 1966). Blood glucose concentration was measured according to Hyvarinen and Nikklla (1962). Total serum proteins were determined using the method of Armestrong and Carr (1964) and albumin concentration was determined by the method of Doumas *et al.*, 1971. Globulin concentration was calculated by difference between the total protein and the albumin concentration, then A/G ratio was calculated. Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated using the formules proposed by Schalm (1965).

The average maximum and minimum ambient temperature were 29.9 and 7.6°C in spring, 29.1 and 20.7°C in summer and 19.7 and 5.1°C in winter. The average maximum and minimum relative humidity were 78.0 and 39.9% in spring, 77.4 and 52.1 in summer and 77.1 and 42.0% in winter.

Data obtained were subjected to statistical analyses according to Snedecor and Cochran (1973). Split-plot design were used to test the effects of season, breed and their interactions on each parameter.

Results and Discussion

Results of the present study indicate that Hb concentrations in the blood of sheep and goats were significantly ($P < 0.01$) affected by season of the year. During spring there was a lower concentration than during summer and winter (Tables 1 and 3). These findings are in accordance with that reported by Samak *et al.*, (1983) on sheep and with Rowlands *et al.*, (1979) working on cows. They attributed these changes to an increase in the oxygen carrying capacity of the blood during summer accompanied with an increase in the respiratory rate due to the high ambient temperature. This was confirmed by the increase in transferrin or total iron binding capacity (TIBC) in the sheep during summer (Sykes and Field, 1973). Erythrocyte counts also were significantly ($P < 0.01$) affected by season of year, but contrary to Hb the lower values were recorded during summer and winter. Also PCV values were significantly affected ($P < 0.01$) by season and the lower values

were recorded during summer. These results agree with those of Singh (1983), Samak *et al.*, (1983) and Shaffer *et al.*, (1981) who found significant decreases in PCV with increase in environmental temperature. Lee *et al.* (1981) reported that PCV depression during the hot season was partially attributed to a decrease in circulating erythrocytes which has been suggested to be due to an increased rate of erythrocyte destruction. Heat strers measurements associated with depression of PCV and RBC's suggest that the depression is related to reduction in cellular oxygen requirement to reduce metabolic heat load to compensate for elevated environmental heat load.

Calculated MCV, MCH and MCHC are considered more reliable hematological measurements as induces of heat stress. As shown in Table 1, it is clear that MCV and MCH values were lower in spring followed by summer then winter. Lower cell volume or higher plasma volume helps in the increase of the peripheral evaporative cold mechanism in order to relief the subject from greater internal heat load under climatic stress. Gutierrez *et al.*, (1971) and Raghavan and Mullick (1962) recorded similar observations in cows. In the present study it is clear that there are significant ($P < 0.01$) decreases in the MCHC during spring and winter than in summer, which are due to reduction of RBC counts with the presence of high Hb concentration (Table 1).

No breed differences were observed in Hb values (Tables 1 and 3). However, it has been found that goats had lower Hb values than sheep (11.47 vs. 11.94 gm%). On the other hand RBC counts were obviously higher in goats than in both breeds of sheep (10.0 vs. 8.78 $\times$ 10^6 Cu mm), although PCV values were obviously lower (28.69 vs. 32.47%). Accordingly, MCV and MCH were lower in goats than in both breeds of sheep. More *et al.*, (1980a) reported similar differences in PCV value for sheep and goats. The relatively lower hematocrit values in goats could be due to their larger extracellular or plasma volume, a characteristic which has been considered advantageous for living under hot desert conditions (MacFarlane, 1975). It is of interest to notice that there are a significant ($P < 0.01$) breed $\times$ season interaction in Hb concentration. Barki ewes were less affected by summer stress than Rahmani ewes, indicating the adaptability of Barki sheep to hot condition. The animals showing minimum changes in Hb concentration during stressful temperature are considered more adaptable to hot environment (Pandy and Roy, 1969). Total leucocyte counts did not show significant differences due to the season of the year. However higher counts were recorded during spring and winter than summer. Breed effect on leucocyte counts was found

TABLE 1 : Means and overall means ± S.E. of blood hemoglobin (Hb), red blood cell (RBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and white blood cell (WBC) in Barki and Rahmani Sheep asd in goats during different seasons of the year.

Seasons	Breeds	Hb (g%)	RBC ($\times 10^6$)	PCV (%)	MCV (cu.u)	MCH (u.ug)	MCHC (%)	WBC ($\times 10^3$)
Spring	Barki	12.25±0.39	9.33±0.42	33.66±0.74	35.89±2.01	13.05±0.79	36.47±1.25	7.18±0.18
	Rahmani	10.65±0.25	9.37±0.24	32.02±0.62	34.26±1.04	11.29±0.23	33.11±1.15	10.92±0.73
	Goats	9.70±0.40	11.36±1.03	27.87±0.65	26.09±2.63	9.09±0.99	34.86±1.42	10.56±0.52
Summer	Barki	12.33±0.66	8.87±0.24	29.34±0.56	33.32±1.34	14.03±1.01	41.90±1.79	8.13±0.48
	Rahmani	13.10±0.53	8.85±0.54	30.58±0.63	35.65±2.35	15.27±1.19	42.73±1.66	9.01±1.21
	Goats	11.88±0.51	9.12±0.31	27.31±1.15	30.18±1.48	13.15±0.75	43.49±0.79	9.47±1.24
Winter	Barki	12.13±0.44	7.19±0.42	34.03±0.88	48.51±3.18	17.28±1.29	35.60±0.77	8.51±0.31
	Rahmani	11.28±0.32	8.87±0.26	35.16±0.73	39.79±0.90	12.75±0.29	32.15±1.03	9.81±0.47
	Goats	12.84±0.33	9.54±0.40	30.88±1.49	32.79±2.32	13.54±0.33	42.38±2.37	9.91±0.43
Overall means								
Breeds'	Barki	12.23±0.28a	8.53±0.29b	32.35±0.60a	39.24±1.88a	14.78±0.69a	37.99±0.94ab	8.15±0.20b
	Rahmani	11.65±0.31a	9.03±0.21ab	32.59±0.54a	36.56±0.99a	13.10±0.52ab	35.99±1.23b	9.91±0.50a
	Goats	11.47±0.36a	10.00±0.42a	28.69±0.71b	29.69±1.34b	11.93±0.58b	40.24±1.21a	9.98±0.46a
Seasons	Spring	10.83±0.29b	10.09±0.45a	31.19±0.63b	32.08±1.42c	11.14±0.53b	34.81±0.76c	9.76±0.41a
	Summer	12.43±0.33a	8.95±0.21bc	29.08±0.53c	33.05±1.09bc	14.15±0.58a	42.70±0.83a	8.87±0.58a
	Winter	12.08±0.24a	8.53±0.29c	33.36±0.71a	40.36±1.86a	14.52±0.60a	36.71±1.23bc	9.41±0.26a

to be significant ($P < 0.05$). Goats have higher counts than both breeds of sheep (9.98 vs. 9.05 $\times$ 10^3 mm^3), and Rahmani ewes have higher counts ($P < 0.05$) than Barki ewes. Amariki (1981) and Thomas and Chiboka (1981) did not find significant breed differences in leucocyte counts between Nigirian goats or sheep. The existing breed difference in leucocyte counts in the present study could be attributed mainly to the wide difference in the genetic make-up of sheep and goats and between the two breeds of sheep.

The overall mean of blood glucose level was significantly ($P < 0.01$) influenced by season of year. During spring and summer there was a marked higher glucose concentration than during winter. The difference between breeds in blood sugar was negligible (Tables 2 and 3). The seasonal changes in glucose concentration may be due to the change in environmental temperature on glucose metabolism which may be considered special importance for productivity of ruminant livestock with their reliance upon gluconeogenesis. Sano *et al.*, (1983) showed that both pool size and turnover rate of blood glucose tended to decrease on the *4th*- and *10th* days of heat exposure (30°C) in sheep. However, the proportion of glucose that was oxidized relatively unchanged. Heat production decreeased almost parallel to the blood glucose turnover rate. In addition, a strong positive correlation was found between production of propionate, a major precursor of blood glucose, in the rumen and entry rate of blood glucose (Elliot, 1980). Production of propionate may be increased with increasing concentrate/roughage ratio in the ration, a situation which occurs in the summer feeding under our present experimental condition. Accordingly, it was expected that the blood glucose level tended to increase during summer season. The present study also showed that the serum contained significantly ($P < 0.05$) high protein levels during spring and winter than during summer, and such increases are mainly due to the increase in albumin since globulin level remained unchanged (Tables 2 and 3). Some workers reported a decrease in serum protein during hot season (Samak *et al.*, 1983; Hassan *et al.*, 1983), while others reported the opposite (Guerrini *et al.*, 1982; More *et al.*, 1980a). Such contradicting results may be attributed to the variation in availability of green fodder in different localities. In Egypt, winter season is characterized by the abundance of Berseem, a green fodder with a high protein content, while in summer the main source of roughage is wheat straw which is poor in protein. In other countries, the situation is reversed since summer is the season in which there is abundance of green fodder rich in protein. The decline in total protein during summer may be also due to the hemodilution effect as water retention increease dur-

TABLE 2. Means and overall means ± S.E. of blood glucose, total proteins, albumin (A), globulin (G) and A/G ratio in Barki and Rahmani sheep and in goats during different seasons of the year

Season	Breed	Glucose (mg/100 ml)	Total protein (gm/100 ml)	Albumin (A) (gm/ml	Globulin (G) (gm/100 ml)	A/G ratio
Spring	Barki	62.02 ± 2.878	6.56 ± 0.096	3.12 ± 0.115	3.42 ± 0.092	0.93 ± 0.048
	Rahmani	62.98 ± 2.235	6.89 ± 0.168	3.17 ± 0.093	3.72 ± 0.182	0.87 ± 0.059
	Goats	64.52 ± 2.370	7.90 ± 0.175	3.80 ± 0.111	4.11 ± 0.262	0.96 ± 0.088
Summer	Barki	63.69 ± 3.452	6.53 ± 0.176	2.89 ± 0.115	3.65 ± 0.225	0.83 ± 0.083
	Rahmani	60.18 ± 3.381	6.87 ± 0.083	2.97 ± 0.144	3.90 ± 0.103	0.77 ± 0.054
	Goats	58.00 ± 3.808	6.63 ± 0.124	3.28 ± 0.134	3.35 ± 0.197	0.01 ± 0.093
Winter	Barki	51.88 ± 3.363	7.20 ± 0.420	3.29 ± 0.151	3.90 ± 0.327	0.88 ± 0.077
	Rahmani	47.37 ± 2.244	7.26 ± 0.414	3.48 ± 0.119	3.79 ± 0.321	0.95 ± 0.051
	Goats	49.96 ± 0.946	7.64 ± 0.478	3.68 ± 0.188	3.68 ± 0.188	0.99 ± 0.105
Overall means						
Breeds	Barki	59.19 ± 2.093a	6.76 ± 0.158	3.10 ± 0.079c	3.66 ± 0.136	0.88 ± 0.040
	Rahmani	56.84 ± 2.046a	7.01 ± 0.150	3.20 ± 0.080b	3.80 ± 0.123	0.86 ± 0.035
	Goats	57.51 ± 1.963a	7.39 ± 0.198	3.58 ± 0.551a	3.80 ± 0.171	0.98 ± 0.053
Season	Spring	63.17 ± 1.401a	7.12 ± 0.143a	3.37 ± 0.087a	3.75 ± 0.121	0.92 ± 0.038
	Summer	60.64 ± 2.018a	6.68 ± 0.079b	3.04 ± 0.081b	3.63 ± 0.111	0.87 ± 0.048
	Winter	49.73 ± 1.378b	7.37 ± 0.240a	3.48 ± 0.356a	3.88 ± 0.188	0.91 ± 0.045

In each column, no significant between means with same letter.

TABLE 3, Mean squares for the effect of breeed and season and their interaction on Hb, RBC, PCV, MCV, MCH, MCHC, WBC, glucose total proteins albumin and A/G ratio in Barki and Rahmani sheep and in goats during different seasons of the year.

S.O.V.	d.f.	Hb	RBC	PCV	MCV	MCH	MCHC	WBC	Glucose	T. Prot.	A	G	A/G
Breed	2	3.83	13.52*	114.68**	582 72**	49.56*	108.55*	25.88*	35.28	2.38	1.55**	0.17	0 11
Animal/breed (Error b)	21	2.37	3 03	11.18	86.26	8.85	26.68	6.24	61.98	0.70	0.22	0.49	0 51
Season	2	16.90**	15.59**	109.81**	491.83**	82 45**	407.64**	4.89	1224.04**	2.91**	1 22**	0.37	0.28
B × S	4	8.79**	4.09	8.94	96.95	18.93	68.03	2.96	41 51	1.11	0.11	0.72	0.28
Error (S)	42	1.20	1.39	3.72	7 54	4.31	11.79	3.06	67.69	0.55	0.101	0.49	0.43

* **($P < 0.05$)**

** **($P < 0.01$)**

ing summer resulting in a higher total body water (Taher, 1985). In addition, blood proteins have a relatively fast turnover rate during summer and seem to be in dynamic equilibrium with the amino acids pool. Significant breed differences were observed in albumin concentration, but not in total serum protein, globulin and albumin/globulin ratio. Overall serum albumin was highest in goats followed by Rahmani ewes by Barki ewes (Table 2). Hassan *et al.*, (1982) reported higher serum protein in Rahman than Barki sheep. Other workers, however found insignificant differences in total serum protein between several breeds of sheep (Singh *et al.*, 1982; More *et al.*, 1980a).

It was clear from the present work that goats responded to changes in environmental condition differently from sheep. Since the magnitude of hematological changes, mainly in Hb, PCV and WBC, in goats were less with the rise of air temperature in comparison to sheep. Additionally the total leucocyte counts was relatively higher in goats than in sheep which may reflect the adaptability of goats to the adverse conditions of the subtropical areas.

References

Armstrong, W.D. and Carr, C.W. (1964). «*Physiological Chemistry, Laboratory Directions.*» 3rd ed., Minneapolis, Minnesota.

Amariki, S.F. (1981). Haematological studies of various indigenous and exotic breeds of goats and their F_1 crosses in Nigeria. *Bull. Anim. Hlth. Prod. Afr.*, *29*, 377.

Doumas, B.I.; Watson, W.A. and Biggs, H.G. (1971). Albumin standards and the measurement of serum albumin with bromocresol green. *Clin. Chem. Acta*, *31*, 87.

Elliot, J.M (1980). «*Propionate Metabolism and Vitamin* B_{12}. Digestive *Physiology and Metabolism in Ruminants.*» Y. RUCKEBUSCH and P. THIVEND, ed. MTP Press, Ltd., Lancaster, England 485.

El-Noutty, F.D.; Hassan, G.A. and Salem, M.H. (1986). Effect of season and level of production on haematological values in Holstein cows. *Indian J. Animal Sci.*, *56*, 346.

Guerrini, V.H.; Bertchinger, H. and Coster, N. (1982). The effects on sheep urinary

and plasma electrolytes of 4 week's exposure to different ambient temperatures and humidities. *Aust. J. Agric. Res., 33,* 347.

Gutierrez, J.H.R.; Warnick, A.C.; Cowley, J J. and Hentges, J.F. (1971): Environmental physiology in the subtropics. I. Effect of continuous environmental stress on some hematological values of beef cattle. *J. Anim. Sci., 32,* 968.

Hassan, A.; Samak, M.A. Yassin, A. El-Komy, A. and Zaki, A. (1983). Seasonal effects on physiological performance of goats under hot-arid conditions. *Alex. Sci. Exch., 4,* 207.

Hassan, A.; Samak, M.A. and Badawy, A. (1982). Haematological characteristics of lactating and non lactating ewes. II. Erythrocyte number and size, haemoglobin concentration and some chemical constituents. *Alex. J. Agric. Res., 30,* 161.

Hepler, O.E. (1966). «*Manual of Clinical Laboratory Methods.*» Springfield, Illinois.

Hyvarinen, A. and Nikkla, E. (1962). Specific determination of blood glucose by O-toludine. *Clin. Chem. Acta., 7,* 140.

Jindal, S.K. (1980). Effect of climate on goats, A review. *Indian J. Dairy Sci.,33,* 285;

Lee, J.A.; Roussel, J.D. and Beatty, J.F. (1976). Effect of temperature season on bovine adrenal cortical function, blood cell profile and milk production. *J. Dairy Sci., 59,* 104.

Macfarlane, W.V. (1975). «*In the Blood of Sheep : Composition and Function*», pp. 1-27 (ed.). Blunt, M.H. Berlin, Heidelberg, Germany.

More, T.; Singh, A. and Ray, A.K. (1980a). Note on the effect of thermal exposure on body fluid composition of different breeds and breed crosses of sheep. *Indian J. Anim. Sci., 50,* 207.

Morrison, F.B. (1959). «*Feeds and Feeding.*» The Morrison Publishing Co. In. Clinton, Iowa, U.S.A.

Pandy, M.D.; and Roy, A. (1969). Studies on the adaptability of buffaloes to tropical climate. *J. Anim. Sci., 39,* 378.

Raghavan, G.V. and Mullick, D.N. (1962). Effects of air temperature and humidity on the blood composition in buffalo bulls. *Indian J. Dairy Sci., 15,* 61.

Rowlands, G.L.; Little, W.; Stark, A.J. and Manston, R. (1979). The blood composition of cows in commercial dairy herds and relationships with season and lactation *Britsih Vet. J. 135*, 65.

Samak, M.A.; Hassan, A.; Zaki, A. and El-Komy, A. (1983). Response of the adult male and female Barki sheep to the semi-arid, subtropical environmental conditions of the north western desert of Egypt. *Alex. Sci. Exch., 4*, 361.

Sano, H.; Takahashi, K.; Ambo, A. and Tsuda, T. (1983). Turnover and oxidation rates and blood glucose and heat production in sheep exposed to heat. *J. Dairy Sci., 66*, 856.

Schalm, O.W. (1965). «*Veterinary Hematology.*» 2*nd* Ed. Lea and Febiger. Philadelphia.

Shaffer, D.; Rossel, J.D. and Koonce, K.L. (1981). Effects of age, temperature-season and breed on blood characteristics of dairy cattle. *J. Dairy Sci., 64*, 62.

Singh, K. (1983) Effect of heaet stress on blood constituents in crossbred heifers. *Indian J. Anim. Sci., 53*, 355.

Singh, K.; More, T.; Ral, A.K. and Karim, S.A. (1982) A note on the adaptability of native and crossbred sheep to hot summer conditions of smi-arid and arid areas. *J. Agric. Sci. Camb., 99*, 525.

Snedecor, G.W. and Cochran, W.G. (1973). «*Statistical Methods.*» 6*th* ed., Iowa State Univ. Pres. Ames. Iowa, U.S.A.

Sykes, A.R. and Field, A.C. (1973). Effects of dietary deficiencies of energy, protein and calcium on the pregnant ewe, serum total protein, albumin, transferrine and plasma urea levels. *J. Agric. Sci., 80*, 29.

Taher, H.H. (1985). Effect of season of the year and breed on some blood components. Water requirements and metabolism in sheep and goats. *M.Sc. Thesis, Fac. Agric.*, Alex. Univ.

Thomas, K.D. and Chiboka, O. (1981). Haematological of west African dwarf rams and their crosses with permer. *Bull. Anim. Hlth. Prod. Afr., 29*, 325

الاختلافات الموسمية فى بعض مكونات الدم للأغنام والماعز المصرية

ممدوح عبد الله سمك ، جمال الدين عبد الرحيم حسن ، نرجات الدسوقى التونى ، زهراء أبو العز ، احمد محمود بدوى

قسم الانتاج الحيوانى ـ كلية الزراعة ـ جامعة الاسكندرية

أجرى هذا البحث على عدد ١٦ من النعاج الرحمانى والبرقى وكذلك على عدد ٨ من الماعز البلدى وكان الهدف هو تقدير الاختلافات الموسمية فى تركيز الهيموجلوبين عدد كرات الدم الحمراء والبيضاء ، قيمة الهيماتوكريت ، تركيز البروتين الكلى فى السيرم ، تركيز كل من الالبيومين، الجلوبيولين وأيضا قدر حجم الكرات الدموية الحمراء وما تحتويه كل كرة من الهيموجلوبين وكذلك ما يشغله الهيموجلوبين من مساحة الكرة ٠

وقد أظهر البحث أن هناك اختلافات معنوية نتيجة فصول السنة على كل من تركيز الهيموجلوبين وعدد الكرات الدموية الحمراء وقيمة الهيماتوكريت وتركيز الجلوكوز فى الدم ٠ وكذلك تركيز البروتين الكلى فى السيرم وأيضا هناك اختلافات جوهرية بالنسبة لتركيز الالبيومين فى سيرم الدم ٠ كما دلت النتائج أن هناك اختلافات معنوية بين مجاميع الحيوانات فى عدد الكرات الدموية الحمراء والبيضاء وكذلك فى قيمة الهيماتوكريت وتركيز الالبيومين ٠ أما بالنسبة للتداخل بين الفصول المختلفة للسنة والأنواع المختلفة كان له تأثير معنوى على كل من تركيز الهيموجلوبين وعدد كرات الدم الحمراء ٠

وقد أظهر البحث أيضا أن الاختلافات فى مكونات الدم نتيجة لتأثير الموسم من السنة كانت أقل ما يمكن فى الماعز عن سلالتى الأغنام وهذا يرجع الى مقدرة الماعز التأقلمية على الأجواء التحت استوائية كما هو الحال فى جمهورية مصر العربية ٠