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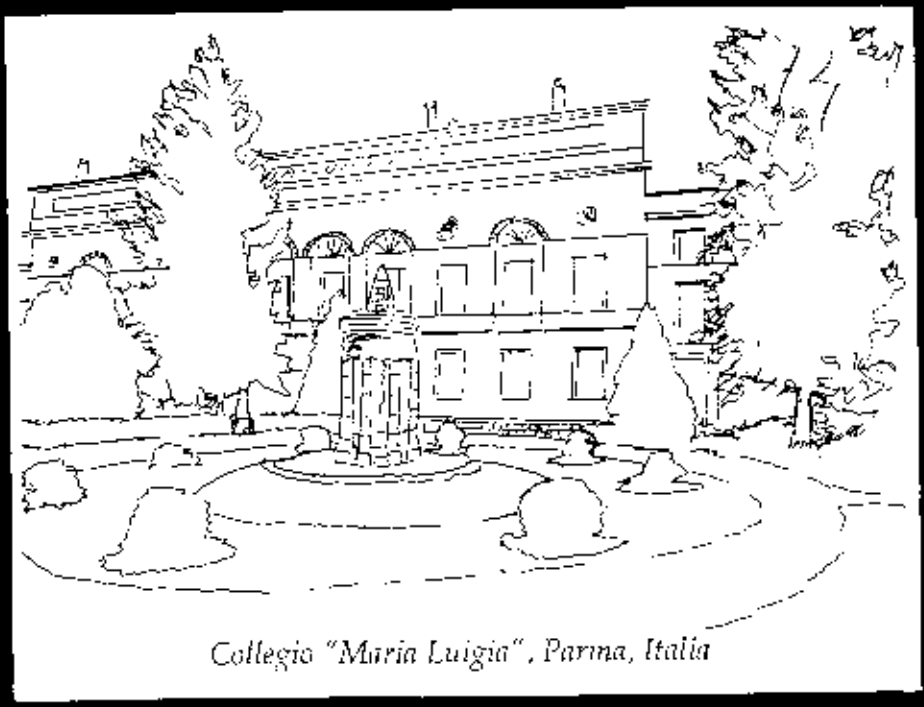

Collegio "Maria Luigia", Parma, Italia

Proceedings

Vth CONGRESS OF INTERNATIONAL SOCIETY OF ANIMAL CLINICAL BIOCHEMISTRY

September 2 - 6, 1992. Parma, Italy

INFLUENCE OF PHYSIOLOGICAL STATUS AND SEASONAL PERIOD ON HAEMATIC PARAMETERS IN SAANEN GOATS.

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SUMMARY

Serum electrolyte levels (Ca, P, Mg, Na, K, Cl, Zn, Cu, Fe), serum concentrations of total lipids, triglycerides, phospholipids, total and free cholesterol, ß-lipoproteins, glucose, total proteins, albumin, urea, creatinine, uric acid and electrophoretic protein patterns were determined in a Saanen goat herd. The data were analysed by the model: $parameter_{ijkl} = \mu_l + period_i + status_j + \varepsilon_{ijkl}$, were "parameter" was the l^{th} blood constituent in consideration, "period" the period of the year where the sample was collected (1, 2, 3 = May-June, October-November, January-February, respectively) and "status" is the physiological status of the goats: 1, 2, 3 is for the order of lactation, 4 is for dry goats. The results show that the serum concentration of the examined parameters were influenced both by the physiological status and by the seasonal period.

Key words: goat, electrolytes, lipide profile, protein profile.

INTRODUCTION

In the last years goat breeding is developing very quickly in Italy, as well as in other countries and the number of intensively-bred goat herd is also increasing. There is a need of investigations to determine reference values for several variables of physiological interest in the intensively bred goats since informations in such field are limited. The knowledge of metabolic parameters is useful to check the healthy of the herds and to prevent metabolic disorders which may be induced by unappropriate alimentation.

Following our precedent studies (1-6,10), in the present investigation we want to study how much the metabolic profile can predict the belonging of an animal to a certain group only by considering the blood parameters, and which variables are more important in discriminating the groups.

MATERIALS AND METHODS

Blood samples were drawn from a herd of Saanen goats reared exclusively in a goat house located in a typical area of Tuscany (Italy) near the sea. One hundred twenty goats were randomly selected. Breeding and feeding techniques were described in a previous work (3).

The parameters were analysed on serum by the following methods:

1) by colorimetric methods were analysed calcium, phosphorus, magnesium, cloride, total proteins, albumin, creatinine, glucose, total lipids and ß-lipoproteins;
2) by enzymatic - colorimetric methods were analysed blood urea nitrogen, uric acid, triglycerids, phospholipids and total and free cholesterol;
3) by measuring of the potential of ionic-selective membrane (Electrolyte Analyzer (NOVA 6) were determined sodium and potassium;
4) by atomic absorption spectrophtotometry (Perkin-Elmer mod. 305B) were determined zinc, copper and iron.

Data were subjected to preliminary analysis of the variance to check the distribution of the residuals (10). All the haematic levels were verified to be normally distributed and no conversion was carried out.

Multivariate least square analysis was employed by utilising SAS package (8). The data were analysed by the model:

$$parameter_{ijkl} = \mu_l + period_i + status_j + \varepsilon_{ijkl}$$

where "parameter" is the I^{th} blood constituent in consideration, "period" the period of the year when the sample was collected (1, 2, 3 = May-June, October-November, January-February, respectively) and "status" is the physiological status of the goats: 1, 2, 3 is for the order of lactation, 4 is for dry goats. After computing the least square means, we used a stepwise regression analysis (BMDP) to ascertain i) how much the metabolic profile can predict the belonging of an animal to a certain group only by considering the blood parameters, ii) which variables are more important in discriminating the groups. After computing the standardized distances of the predicted groups, a cluster analysis was carried out to evidentiate which groups are nearer to each other.

The generalized distance between estimated groups was calculated according to Mahalanobis (7) and showed by dendrogram.

RESULTS AND DISCUSSION

The period of the year noticeably affects the concentration of the blood parameters. Practically only P, K and Cu remain constant thrugh the year.

Table 1. Least square means and standard deviations for the main effect period of the year.

Parameters	May-June		October-November		January-February	
uric ac. mg/dl	.15^{a}	.09	.32^{b}	.18	.08^{c}	.07
creat. mol/l	75.62^{a}	16.98	58.87^{b}	9.45	87.56^{c}	20.94
urea mmol/l	6.95^{a}	1.54	6.90^{a}	1.85	7.76^{b}	1.19
tot.prot. g/l	75.76^{a}	7.69	78.34^{b}	9.93	70.51^{c}	7.38
albumine g/l	30.68^{a}	3.81	26.39^{b}	3.71	30.19^{a}	5.42
tot.lip. mg/dl	461.10^{a}	101.01	316.25^{b}	57.99	394.75^{c}	83.79
triglyc. mmol/l	.47^{a}	.13	.55^{b}	.26	0.46^{a}	.17
phospholip. mg/dl	137.48^{a}	30.35	127.49^{b}	24.87	143.42^{c}	26.30
tot.chol. mmol/l	2.33^{a}	.63	2.07^{b}	.42	2.14^{b}	.65
free chol. mmol/l	0.51^{a}	.17	0.65^{b}	.22	0.66^{b}	.17
S-lipoprot. mg/dl	96.64^{a}	40.42	74.35^{b}	31.71	89.70^{a}	40.31
glucose mmol/l	3.21^{a}	.27	3.54^{b}	.71	3.05^{a}	.31
Ca mmol/l	2.29^{a}	.25	2.16^{b}	.24	1.93^{c}	.25
P mmol/l	2.53^{ns}	.53	2.47^{ns}	.54	2.42^{ns}	.34
Mg mmol/l	1.01^{a}	.20	0.90^{b}	.16	0.78^{c}	.16
Na mEq/l	153.15^{a}	9.34	149.74^{b}	3.46	150.32^{b}	3.79
K mEq/l	4.77^{ns}	1.09	4.65^{ns}	1.00	4.56^{ns}	0.84
Zn mol/l	10.74^{a}	2.05	8.83^{b}	1.98	10.08^{c}	1.49
Cu mol/l	20.05^{ns}	5.11	19.51^{ns}	5.10	20.16^{ns}	5.12
Fe mol/l	29.53^{a}	7.21	28.59^{a}	7.34	32.87^{b}	6.90
Cl- mEq/l	109.61^{a}	9.87	98.37^{b}	5.78	102.60^{c}	5.74

Note: means with different superscripts on the same row differ per P<.05.

Table 2. Distance metric is standardized euclidean distance single linkage method between period of the year (nearest Neighbor) (1=May-June; 2=October-November; 3=January-February).

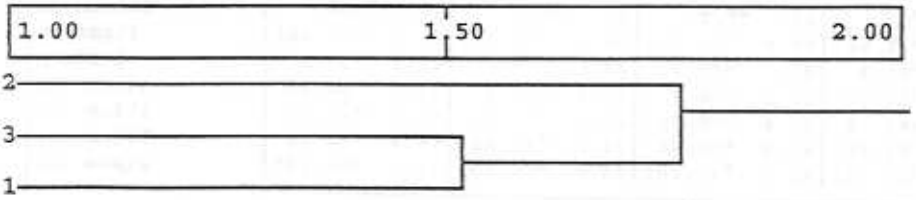

Table 3. Classification Matrix (1=May-June 2=October-November; 3=January-February).

SEASON	PERCENT CORRECT	NUMBER OF CASES CLASSIFIED INTO GROUP		
		1	2	3
1	93.8	271	3	15
2	97.2	1	175	4
3	95.4	10	3	272
TOTAL	95.2	282	181	291

The physiological status also modifies the metabolic profile and particularly dry goats show a very distinct pattern compared to lactating goats. Dry goats show a reduced level of total lipids as well as of other lipids such as phospholipids, cholesterol and ß-lipoproteins. Triglycerides and free cholesterol levels, on the contrary, do not differ from those of lactating goats. The creatinine levels are higher in dry goats than in lactating goats and urea levels in dry goats are lower than in lactating goats. The first lactating goats show for some parameters similar levels to that one found in dry goats, for example total proteins, Na, K, Zn and Cu.

Table 4. Least square means and standard deviations for the main effect physio- logical status.

Parameters	1st Lact.		2nd Lact.		3rd Lact.		Dry goats	
uric ac. mg/dl	.18^{ns}	.07	.19^{ns}	.10	.19^{ns}	.10	.16^{ns}	.17
creat. mol/l	71.90^{a}	19.51	71.93^{a}	18.52	76.48^{a}	19.00	77.08^{b}	18.95
urea mmol/l	7.62^{a}	1.25	7.37^{a}	1.32	7.39^{a}	1.26	6.44^{b}	1.84
tot.prot. g/l	73.16^{a}	7.40	75.65^{b}	8.14	76.76^{b}	7.67	73.94^{a}	9.77
albumine g/l	29.67^{a}	3.63	29.17^{a}	5.60	28.40^{b}	4.08	29.11^{a}	4.72
tot.lip. mg/dl	412.90^{a}	103.3	401.14^{a}	96.02	400.37^{a}	103.2	348.40^{b}	82.49
triglyc. mmol/l	.48^{ns}	.14	.48^{ns}	.13	.49^{ns}	.17	.53^{ns}	.24
phospholip. mg/dl	138.08^{a}	25.72	145.96^{a}	28.80	145.96^{a}	30.27	122.17^{b}	25.12
tot.chol. mmol/l	2.23^{a}	.67	2.25^{a}	.62	2.20^{a}	.71	2.05^{b}	.47
free chol. mmol/l	0.55^{a}	.15	.63^{b}	.18	.64^{b}	.21	.61^{b}	.21
ß-lipoprot. mg/dl	86.28^{a}	37.79	86.89^{a}	44.99	91.48^{b}	38.88	82.94^{a}	35.76
glucose mmol/l	3.21^{ns}	.30	3.21^{ns}	.27	3.21^{ns}	.24	3.27^{ns}	.64
Ca mmol/l	2.08^{a}	.31	2.12^{a}	.32	2.07^{a}	.30	2.24^{b}	.26
P mmol/l	2.45^{ns}	.45	2.51^{ns}	.47	2.50^{ns}	.49	2.44^{ns}	.48
Mg mmol/l	.88^{ns}	.21	.91^{ns}	.22	.91^{ns}	.22	.88^{ns}	.17
Na mEq/l	150.83^{a}	2.10	151.08^{a}	8.50	152.66^{b}	6.89	149.71^{a}	4.07
K mEq/l	4.74^{a}	1.11	4.63^{a}	.89	4.53^{b}	.95	4.74^{a}	.97
Zn mol/l	10.28^{a}	1.67	9.39^{b}	1.79	9.66^{b}	1.92	10.22^{a}	2.04
Cu mol/l	21.39^{a}	4.67	18.97^{b}	4.54	17.89^{b}	4.26	21.38a	5.63
Fe mol/l	30.06^{a}	6.89	28.59^{a}	7.41	28.99^{a}	6.49	33.68^{b}	7.49
Cl- mEq/l	101.65^{a}	6.61	103.27^{a}	8.68	103.36^{a}	9.29	105.82^{b}	8.67

Note: means with different superscripts on the same row differ per P<.05.

The period of the year presents a very distinct metabolic profile as the discriminant analysis shows. In fact very few subjects are incorrectly classified and many variables concur to the discrimination.

Table 5. Distance metric is standardized euclidean distance single linkage method between physiological moment (nearest Neighbor) (1=1st lact.; 2=2nd lact.; 3=3rd lact.; 4=Dry goats).

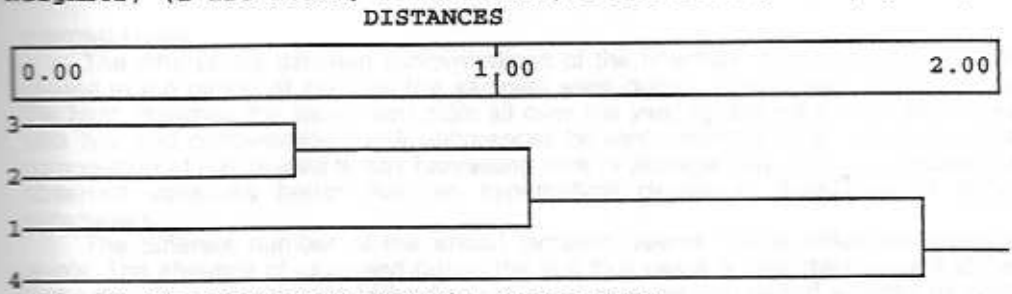

Table 6. Classification Matrix (1=1st Lact. 2=2nd Lact.; 3=3rd Lact.; 4=Dry goats).

MOMENT	PERCENT CORRECT	NUMBER OF CASES CLASSIFIED INTO MOMENT			
		1	2	3	4
1	66.9	105	21	23	8
2	28.1	37	45	62	16
3	58.0	25	33	91	8
4	80.7	33	13	8	226
TOTAL	61.9	200	112	184	258

Table 7. Summary of Stepwise Discriminant analysis. The Table shows the order and the F-ratio the variables were entered with. Variables with an F value below 5 did not entered for the discrimination.

	VARIABLE FOR PERIOD	F
1	total lipid	276.687
2	Ca	178.782
3	uric acid	143.075
4	creatinine	90.955
5	free chol.	91.887
6	Cl-	59.631
7	Na	43.646
8	Fe	35.759
9	Mg	24.568
10	albumine	30.688
11	total proteins	36.239
12	urea (BUN)	24.260
13	triglycerides	26.571
14	K	19.585
15	glucose	13.653
16	ß-lipoproteins	12.295
17	Zn	9.117
18	total chol.	5.455
19	Cu	6.061

	VARIABLE FOR PHYS.STATUS	F
1	total lipid	108.961
2	urea (BUN)	32.912
3	triglycerides	25.649
4	Na	17.573
5	Cu	16.513
6	Ca	16.168
7	K	16.063
8	Fe	11.854
9	free chol.	11.398
10	phospholip.	15.398
11	Mg	5.763
12	albumine	5.720
13	total proteins	7.209
14	creatinine	5.113

The physiological status presents a satisfactory discrimination only for the dry goats and a fairly acceptable one for the goats at first lactation. It is very difficult to differentiate the subjects at further lactations. In both discriminations the total lipid level is the most important variable for classifying the subjects.

CONCLUSIONS

The differences between concentrations of the haematic parameters are mainly related to the period of the year the samples were drawn. Even if the organization of the farm assumed the same food plain all over the year (goats were feed exclusively with hay and concentrated food), differences between storage time and/or chemical composition of hay related to hay harvesting time or storage may concur to explain the observed variations better than an hypothetical circannual fluctuation of serum parameters.

The different number of the ended lactation seems not to influence haematic levels. The absence of any trend during the first four years is important since it shows that probable momentary underfeeding or unbalanced feeding period suffered by goats did not cause any metabolic problems in the following lactations.

The explanation of the observed differences between dry and lactating goats may also be explained by the nutrition. The necessity to reconstitute the reserves consumed during the lactation and the physiological status both determine different nutrient requirement which are translated in different feeding regimes and consequently different haematic levels.

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Work supported by M.P.I. 40% and 60%.