Hystrix, (n.s.) 9 (1-2) (1997): 39-44

PATHOPHYSIOLOGICAL SIGNIFICANCE OF HEMATOCHEMICAL PARAMETERS OF *CAPRA IBEX*

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ABSTRACT - Reference values for hcmatochemical parameters in wild animals are difficult to obtain. because of the effects of capture stress or of the drugs used for chemical restraint. To establish rcfcrcncc values for *Capra ibex*, we examined 30 females culled monthly from January to May 1991 in the Grisons (CH). The following serum variables were studied: cortisol, non esterified fatty acids (NEFA), glucose, triglycerides, cholesterol, total protein. calcium, inorganic phosphate. Values were compared with those of animals culled in the same period of 1990. The only significant differences were in serum cortisol and triglycerides, which were higher in 1991, when climatic conditions were less favourable. Serum NEFA were positively correlated with the animal's level of alertness.

Most of the values of the serum parameters wcrc within the range of those of the domestic goat.

Key words: Capra ibex, Hematochernical parameters, Winter season. Stress.

INTRODUCTION

Reference values for hematochemical parameters of wild animals are needed to characterize the metabolic changes in nutritional or infectious diseases. However, it is very difficult to obtain values for wild animals, because of thc effect of capture stress or of the drugs employed for chemical restraint (Chao et al., 1984; Kock et al., 1987). In addition, hematochemical parameters probably change during the year because of the differences in feeding, social or environmental stress, or in pregnancy and lactation in females. To establish reference values for *Capra ibex*, in a previous study wc examined blood samples from 60 ibex culled monthly in Grisons (CH) by the game keepers during 1990 (Sartorelli et al., 1994). An additional thirty ibex from the same colony were examined from January to May 1991 and their hematochemical parameters were compared with those obtained during the same period in 1990. Indeed, these months are the most difficult for the animals because of the severity of the alpine habitat before the vegetation regrows.

MATERIALS AND METHODS

As part of a multidisciplinary study on *Capra ibex* in the Grisons (CH) (Ratti. 1994). thirty female aged from 2 to 17 years (8±3; mean±S.D.), culled monthly from January to May 1991 at an altitude between 1900 and 2700 m, were examined.

Blood samples were taken from hearts. recording the times after death (20±14 min). Thc times before serum collection and freezing (6±1,9 hours). environmental temperature. depth of snow. time of the day. animal weight and age, prcgnancy, level of alertness (1=quiet; 2=vigilant; 3=walking; 4=running away) were also recorded.

Serum cortisol levels were measured by RIA (Sorin Biomedica). serum glucose by the UV enzymatic method (Boehringer Mannheim). scrum NEFA (Boehringer Mannheim). serum cholesterol (Boehringer Mannheim), triglycerides (Boehringer Mannheim), total protein (Abbott), cal-

cium (Abhott). and inorganic phosphate (Pi) (Bcckman) by the colorimetric enzymatic methods.

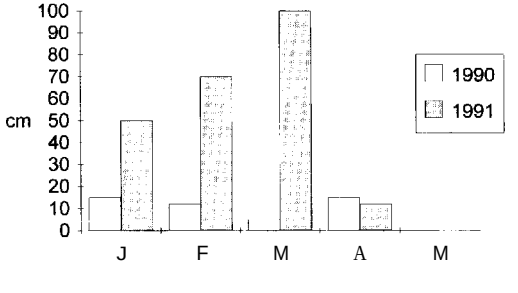
Results were analyzed using the ANOVA and Tukey test. Significance in differences between mean values of the same month of 90 and 91 were tested using the t-test. The correlation coefficient (r) and the coefficient of determination (R^2) were calculated from the regression analysis.

RESULTS

Mean hematochemical values from January to May 1991 and 1990 are reported in Tables 1 and 2.

The environmental temperature was lower in 1991 and the snow was deeper. especially during March (Fig.1). The mean body weight was lower in 1991 than in 1990 (19.2 Kg vs. 21.1). The other variables recorded were similar in both years.

The only hematochemical parameter to show any change relatcd to these variables was NEFA. significantly correlated with the level of alertness (P=0.011) (Fig.2). Even though the mean cortisol values showed similar changes (Fig. 3), their increase was not significant (P=0.065). Cortisol levels were the highest in March 1991, and significantly higher than in March 1990 (P<0.01) (Fig.4). Serum NEFA were high in February and March, but not significantly higher than in 1990. Serum cholesterol values were very similar in the two years, and decreased significantly from January to May. Serum triglycerides did not change during 1991. In 1990 triglyceride values were lower than in 1991 until April, and only in May rose to those of 1991. Total protein, glucose, Ca and Pi did not show any significant change. It was observed that age had no influence on hematochemical parameters.



Figurc 1 - Depth of snow from January to May 1990 and 1991

DISCUSSION

The ibex examined in the two years were comparable in number, age and number of pregnant females. apart from in February 1990 where only 3 animals were collected. In a previous study (Sartorelli et al., 1994), covering an entire year, Serum NEFA. glucose and triglycerides were significantly affcctcd by environmental temperature. time between death and blood taken, and time before serum freezing. These were probably "in vitro" effects. In this study none of these effects were evident.

"Preanalytical errors" are, therefore, less important when winter and early spring blood samples are examined. This is probably because none of the field operations lasted too long. because the animals were concentrated in a small area and the day was shorter; the time at which the animals were shot was also more uniform (h 13±1.7) and the temperature always low ($\leq$10°C).

When preanalytical errors are negligible, the effects of other factors can be observed, for example the level of alertness on serum NEFA, which are considered a stress marker in Ruminants as they are regulated by adrenaline (Locatelli et al., 1989). However. NEFA changes are related only partially with stress, because other factors, such as fasting or pregnancy, are also important. In addition, the level of alertness was calculated arbitrarily, but by thc same two gamekeepers in both years.

The relationship between serum cortisol, another stress marker, and alertness is not significant. Sometimes high levels werc found

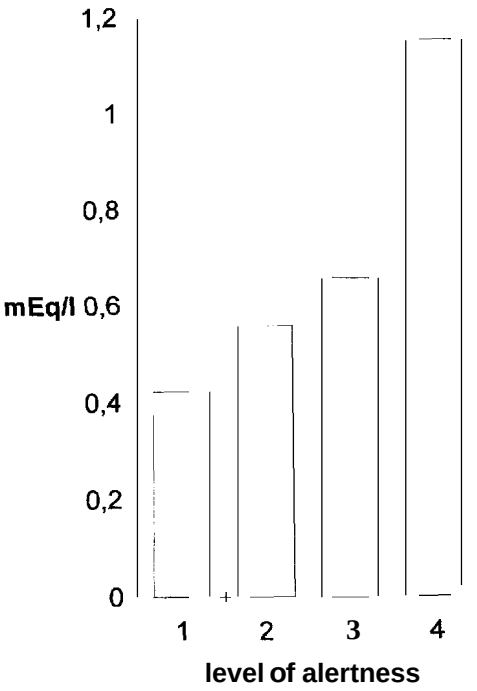


Figure 2 - Mean serum **NEFA** concentration in ibex of different levels of alertness (from 1=quiet to 4=running away).

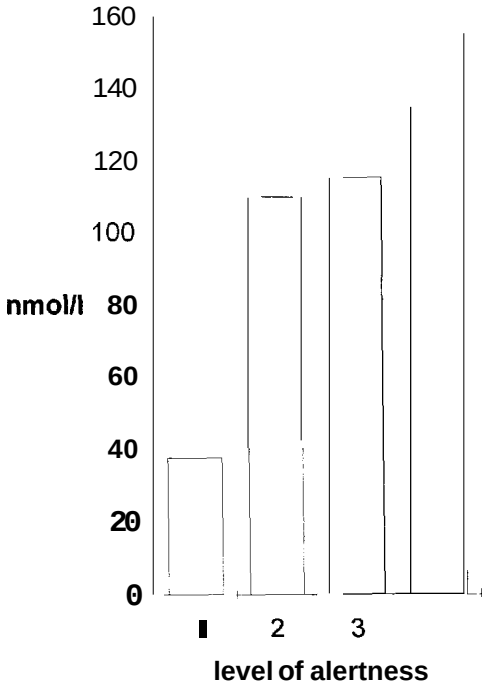


Figure 3 - Mean serum cortisol concentration in ibex of different level of alertness (from 1=quiet to 4=running away).

in "quiet" animals. perhaps because of some other "chronic" stressor such as an environmental factor. The cortisol levels in March 1991 were significantly higher than in March 1990. This seem not to depend only on different levels of alertness (2.6 vs 3.1), but also on different snow depht (Fig.4). It is obvious that serum cortisol can bc used as an environmental stress marker only when acute stress determined by capture and blood taking has been minimized. Moreover, it must be emphasised that individual conditions of health can also influence serum cortisol levels (Selye. 1976). Mean cortisol values reported in literature for the ibex are higher than most of those we found (De Meneghi et al., 1990a; De Meneghi et al., 1990b; Sartorelli et al.,1989; Sartorelli et al.. 1991), and also higher than those in the domestic goat (Saccon ct al.,1992), probably because they are always affected by the stress of capture or by anesthetic. However. the values of anesthetized animals can be used to study the stress status of a population if the animals are not alerted before chemical restraint and if thc time of blood taking are strictly standardized. Using this method, it was possible to find similar, although not "basal", serum cortisol values for three successive years in the same area (De Meneghi et al., 1990a; De Meneghi et al., 1990b; Sartorelli et al., 1991).

Serum glucose levels of somc individuals were high, and this could be due to long-lasting adrenocortical stimulation, but it is not correlated with cortisol values or with alertness, thus confirming that glucose is not a good stress indicator in Ruminants,

Table 1 - Hematochemical parameters (mean ± SD) in ibex culled from January to May 1991

	cortisol nmol/l	glucose mmol/l	NEFA mEq/l	cholesterol mmol/l	triglycerides mmol/l	total protein g/l	calcium mmol/l	in. phosphate mmol/l
January	57.52	6.63	0.50	1.75	1.06	63.94	2.52	2.22
(5)	f48.51	±7.10	f0.21	±0.18	20.20	±4.2	±0.03	f0.66
February	94.63	3.70	0.98	1.39	1.07	64.40	2.81	2.36
(7)	f67.45	f1.82	f0.42	±0.36	f0.35	±8.9	±0.47	M.63
March	248.41	6.05	0.74	1.67	1.18	78.03	2.88	2.21
(6)	k161.01	f4.44	f0.28	f0.23	f0.62	±15.1	±0.45	k0.44
April	44.I7	4.04	0.46	1.49	I.40	64.55	2.78	2.48
(6)	f39.05	f1.89	f0.20	±0.27	M.41	k8.9	f0.51	f0.46
May	58.26	3.34	0.46	1.39	1.37	68.02	2.50	2.58
(6)	fJ9.65	f1.36	±0.36	f0.28	f0.60	k4.7	±0.27	f0.73

Table 2 - Hematochemical parameters (mean± SD) in ibex culled from January to May 1990

	cortisol nmol/l	glucose mmol/l	NEFA mEq/l	cholesterol mmol/l	triglycerides mmol/l	total protein g/l	calcium mmol/l	in. phosphate mmol/l
January	28.96	3.07	0.98	**1.83**	0.62	67.02	2.65	3.72
(5)	±14.43	f0.24	±0.59	f0.48	fO.10	f10.47	±0.15	±1.02
February	28.05	6.45	0.71	1.45	0.78	68.07	2.66	3.10
(3)	i16.43	±5.16	f0.37	±0.16	±0.04	kJ.15	±0.16	20.59
March	27.89	6.45	0.61	1.58	0.61	67.71	2.37	2.27
(8)	k32.15	f4.25	±0.30	k0.29	±0.10	±5.64	±0.21	f0.73
April	78.46	8.42	0.66	**1.31**	0.66	64.48	2.80	2.35
(6)	f99.90	f3.81	±0.20	f0.28	±0.08	k7.05	±0.55	±0.84
May	82.06	4.90	0.63	1.24	1.44	62.95	2.29	3.37
(6)	±46.08	f2.10	±0.25	±0.25	±0.57	f6.66	±0.11	k1.34

unlike in monogastrics (Locatelli et al., 1989).

Among lipid metabolism indicators, serum cholesterol levels are very constant. The decrease from January to May, observed in both years in spite of different climatic conditions, is possibly due to advancing pregnancy, as suggested by similar changes reported in domestic ruminants (Baglioni et al..1987: Kaneko, 1989). However, no statistical analysis between pregnant and non-pregnant animals is possible because of the small number of animals studied per month. The higher values of serum triglycerides recorded in 1991 are difficult to explain. They are usually considered as indicators of good nutrition, and, in fact, high values were recorded in Summer and Autumn 1990 in the same population (Sartorelli et al., 1994). However, serum triglycerides increase in sheep after repeated ACTH treatment (Paltrinieri et al.. 1994) and in goats under difficult environmental conditions (low temperature and snow) (Saccon et al.,1992). This increase is due probably to increased hepatic synthesis of lipoprotein because of lipolysis from chronic stress as observed in other species (Soveri et al., 1992). Animal body weights were, indeed, lower in 1991 than **in** 1990.

Unlike lipid metabolism, protein metabolism is not influenced by different environmental conditions. Total protein were similar for the two years and the values are within the range for the domestic goat (Kaneko, 1989). Calcium and phosphorus levels were also not affected.

The number of animals used was too low to produce reliable data to evaluate the effects of age, diet, reproductive status, etc. However, in wild species it is very difficult to study a larger number of animals during the same period. The results emphasize the need, when considering blood parameters from field studies, to take into consideration the animal's stress level, due to both acute and chronic stress factors, and the possible intluence of preanalytical errors. Correct basal values are necessary both for a greater knowledge of ibex biology and for a basis for pathological conditions and/or management evaluation.

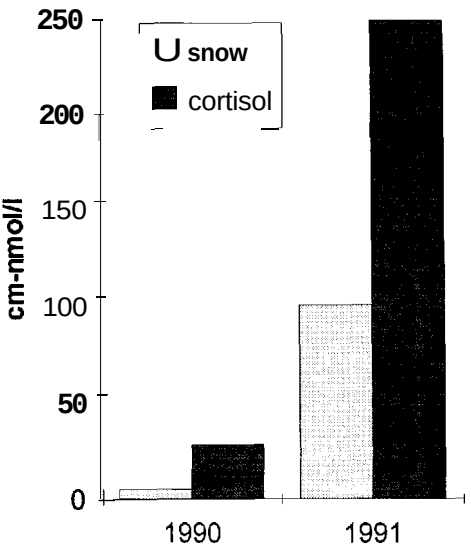


Figure 4 - Depth of snow and mean serum cortisol concentration in March 1990 and March 1991

ACKNOWLEDGEMENT

The authors wish to express their gratitude to the Direction and to the Game keepers of the Jagd- und Fischereininspektorat dcs Kantons Graubünden (CH) for their generous help in the field, which made this investigation possible, and to Mrs Sonia Dominoni for her laboratory assistance.

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