

HEMATOLOGICAL PROFILE VARIATION IN THE EUROPEAN BISON (*BISON BONASUS* L., 1758) AS A FUNCTION OF AGE, SEX AND HEALTH CONDITION

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Keywords: European bison, hematological indices, various ages, sex, pathology

Abstract: The paper analyzes some new hematological data on the European bison from the Natural Park of Vanatori Neamt, a comparison being made both between the values recorded in animals of different ages (2-8 years) and sexes, and between the values of the European bison and those registered in some kindred ruminant mammals, such as the deer and the cow. More than that, a comparison is made between the data taken over from healthy bisons and from an animal affected by severe anemia and multiple parasitary indices. Hematological prosperity increases with the age in female bisons, while a decrease is reported in males, especially in the case of suffering animals, *versus* the healthy ones. Comparatively with other big mammals, the hematological profile of the bison is much more similar to that of domestic ruminants, being wholly different from that of the wild deer.

INTRODUCTION

The Vanatori Neamt Natural Park is a protected area established in 1999, as a site of the Nature 2000 ecological network, with both communitary and avi-faunistic protection importance, one of its main destinations being the release of the bison in its natural milieu.

The bison, symbol of the Carpathians, the most impressive herbivorous animal of Europe (800-1000 kg/ex. the male and 500-700 kg/ex. the female), is now living in Romania only in captivity. Nowadays, In Romania, about 73% of the total number of bisons live in two main reservations; thus, the Bucșani Neagra Reservation, administered by the Forestry Department of Dambovită has 41 animals, within an area of 160 ha, while the Vanatori Neamt Natural Park shelters 22 animals, in a space of 180 ha.

One of the main directions of the conservation and protection of the bison flocks is the permanent monitorization of their healthy condition, some diseases – such as tuberculosis, aphta fever, the malady of the blue tongue, brucellosis or leucosis, etc. – being extremely dangerous for these animals. To avoid this, the captive animals are periodically examined for the identification and combat of ecto- and endo-parasites, the intestinal contents and their excrements are analyzed, as well as the composition of some biological fluids, of blood firstly.

Previous investigations (Deju *et al.*, 2010) discussed some preliminary hematological and biochemical data on the bisons from the Vanatori Neamt Natural Park. The limited number of individuals available for the study restricted our investigations to 2 and 3 year-old bisons, the conclusion reached being that the 3 year-old females evidence an additional hematological prosperity, comparatively with the 2 year-old ones (+31.8% for hemoglobin concentration, +7.5% for the hematocyte and +17.5%, respectively, for the number of red cells).

The present paper provides new hematological data on the bison from the Vanatori Neamt Natural Park, a comparison being made – on one side - between the values of hematological indices of young, 2 and 3 year-old bisons and those of mature, both male and female, 7 and 8 year-old animals and – on the other – between the values of the European Bison and those recorded in some kindred ruminant mammals, such as the deer and the cow. Besides this, the indices of healthy bisons are compared with the results of the blood analyzes of an ill, 5 years-old female, diagnosed with severe anemia and multiple parasitary indices.

MATERIALS AND METHOD

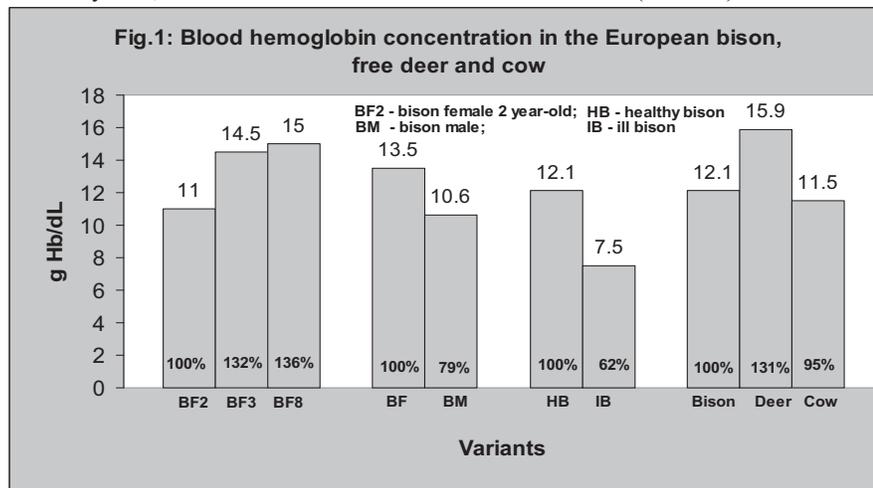
The blood samples have been taken over through puncture of the jugular vein, after animals' tranquilization, 2 mL Vacutainer – type tubes being employed. The laboratory investigations were performed with a ABX Micros VET ABC–type automated hematological analyzer, the following 6 hematological parameters being determined: Hb – hemoglobin (g/dL blood), Ht – hematocyte (%), E - number of erythrocytes ($\times 10^6/\mu\text{L}$), MCV - mean cell volume ($\mu\text{m}^3/\text{erythrocyte}$), calculated with relation: $\text{MCV} = \text{Ht} \times 10/\text{E}$, MCH - mean cell hemoglobin (pg hemoglobin/erythrocyte): $\text{MCH} = \text{Hb} \times 10/\text{E}$ and MCHC – mean cell hemoglobin concentration (g Hb/dL erythrocytic mass): $\text{MCHC} = \text{Hb} \times 100/\text{Ht}$.

The comparative analyzes and interpretations were made both on the values previously obtained from 4 female bisons, 2 of them 2 year-old and the other two - 3 year-old (Deju *et al.*, 2010), and on the results of some previous

samples taken over from 2 adult bisons, an 8 year-old female and a 7 year-old male, the last one imported from Germany. All these values were also compared with the existing literature data on some kindred ruminant mammals, such as the deer and the cow.

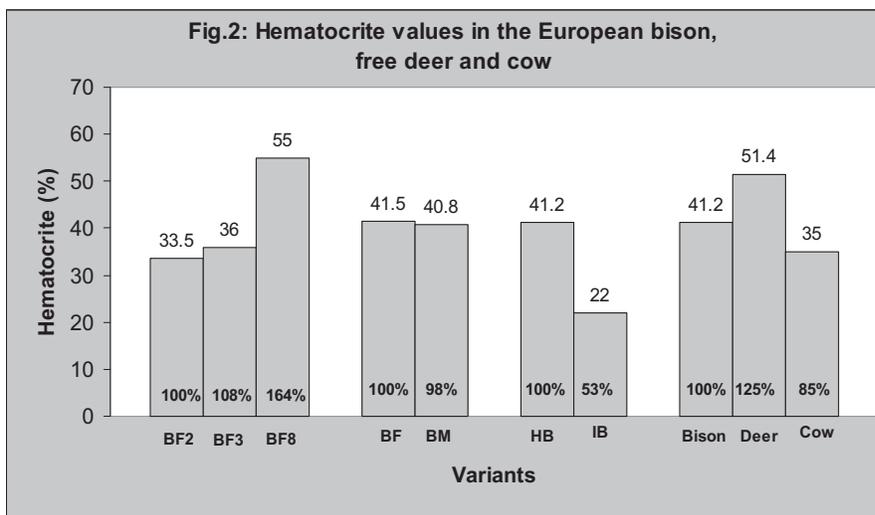
RESULTS AND DISCUSSION

Laboratory analyzes were performed on 2-3 repetitions from each sample, the results synthesized in Table 1 representing the arithmetic mean of the partial values obtained. Analysis of these results shows an intense variability of the hematological profile of the bison living in the Vanatori Neamt Natural Park, regarding both the comparative values as a function of age and sex, and the health condition of the individuals under investigations. Worth mentioning are the sometimes significant differences between the values of the hematological indices in the bison grown relatively free, in the wild deer and in a domestic ruminant (the cow).

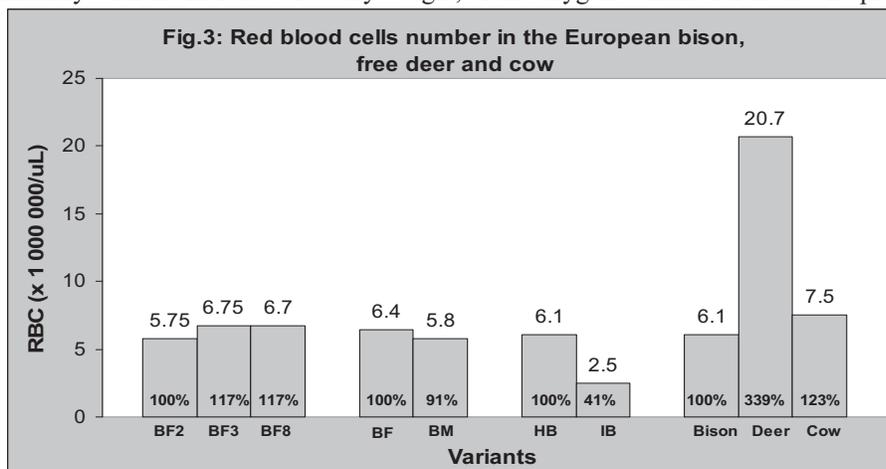


a). Modifications of the hematological profile in female bisons as a function of age.

A number of 5 female bisons, with ages of 2 and 3 years (two pairs each) and one with an age of 8 years, was investigated. The values of the analyzed indices express a clear-cut growing tendency, with age, in the extent of hematological prosperity. Thus, if taking as reference the age of 2 years (Fig. 1), the level of hemoglobin in blood increases with 32% in 3 year-old females (Deju *et al.*, 2010) and with 36%, respectively, at an age of 8 years. Also, the hematocyte (Fig. 2) is 8% higher in 3 year-old females and 64% higher, respectively, in the 8 year-old ones, comparatively with the reference values, while the number of red cells (Fig. 3) is 17% higher in the older ones, comparatively with the reference.

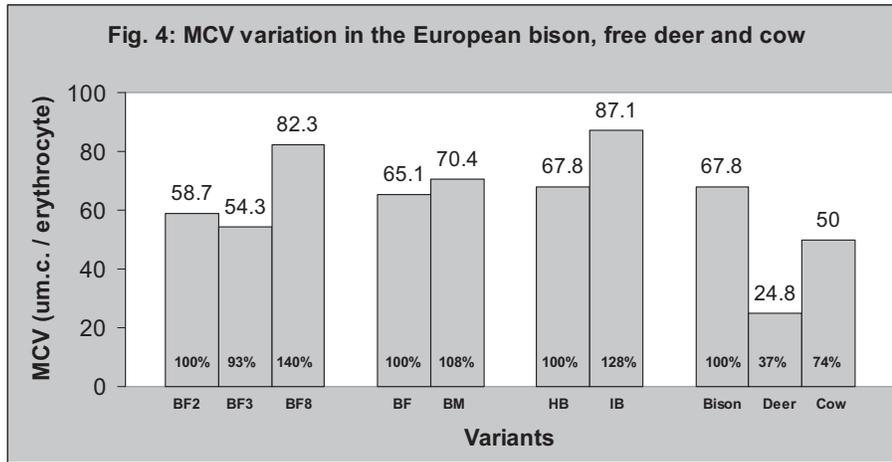


This parallel increase, with age, of the level of hematological prosperity, especially in the number and volume of hemoglobin-bearing cells, may be explained through the increase, concomitantly with the increase of bodily weight, of the oxygen demand for metabolic processes.



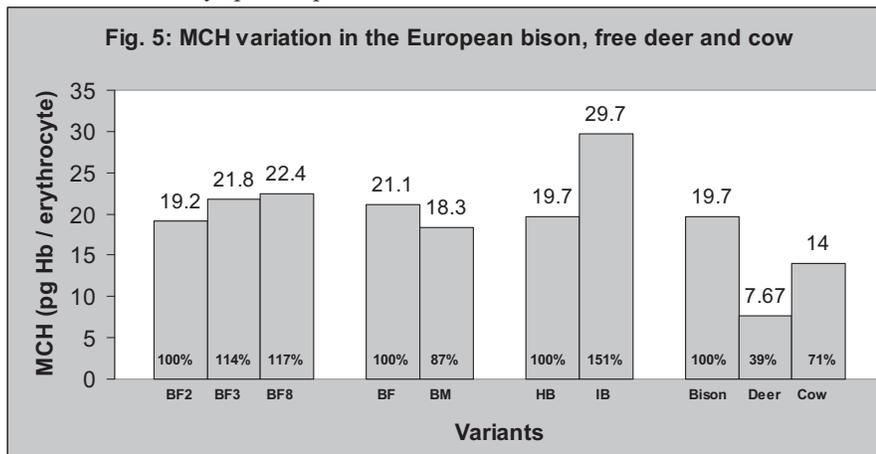
The data presented in Figures 4 and 5 evidence a more than 40% increase of the mean cell volume (MCV) at an age of 8 years, comparatively with the values registered for 2 year-old females, along with an important increase in the hemoglobin charge of each erythrocyte, the MCH values being 14% higher for BF3 and 17% higher for BF8, respectively, comparatively with the reference.

b). Modifications of the hematological profile as a function of sex. The investigations devoted to such aspects are based on the analysis of the samples taken over from 6 bisons – 5 females of different ages and a 7 year-old male.



A general observation to be made is that the mean values of the main hematological indices in the male are comparable, yet constantly lower than those registered in females. Consequently, the differences in the hematological profile of bisons of both sexes are not significant, being more eloquent, that is 10% higher as to hemoglobin concentration, which is 21% lower in males, while MCH (-13%) and MCHC (-22%), and less eloquent, respectively, that is 10% lower in the case of hematocyte (-2%), number of red cells (-9%) and MCV (+8%).

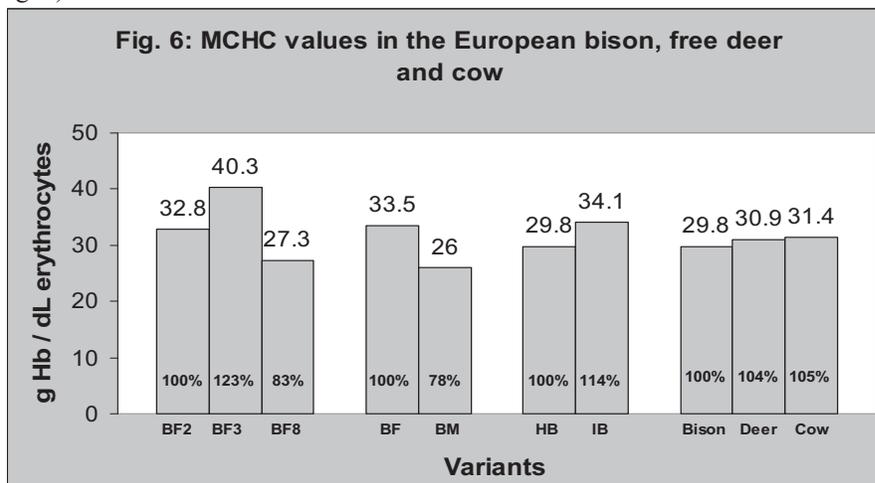
e). Modifications of the hematological profile of bisons as a function of health condition. Evaluation of this aspect is based on data collected from 7 bisons, 6 of which considered as healthy individuals, and also from a 5 year-old female showing anemia symptoms and disfunctions caused by specific parasites.



These results, as well as those on the hematological profile of healthy males, should be considered only as preliminary data, to be further completed with information provided by subsequent investigations.

The values of the parameters determined in the blood of the ill bison indicate a severe hematological insufficiency, with significant depletions comparatively with the healthy ones, of

38% for hemoglobin concentration, 47% for the hematocyte and 59%, respectively, for the erythrocyte number (Fig. 3). The results obtained confirm the fact that, apart from affecting the hemoglobin synthesis function, illness also influences, in a decisive manner, erythropoiesis, while adaptation of the respiratory function of animals, under conditions of drastic decrease in the number of red cells occurs at the expense of a 28% increase of the mean cell volume (Fig. 4) and, especially, of the degree of hemoglobin charge of each erythrocyte (MCH) with more than 51% (Fig. 5).



d). Comparative analysis on the hematological profile of the partially free bison, wild deer and domestic cow. A comparative analysis between the data obtained by our investigations on the bison from the Vanatori Neamt Natural Park and the existing literature data on the wild deer (Gupta *et al.*, 2007) and domestic ruminants (Duncan and Prase, 1986) shows first that, as to the level of hemoglobin and hematocyte, as well as to the average number of erythrocytes, the values registered for the bison are close to those of the domestic ruminants, the deer evidencing an additional hematological prosperity. Consequently, in the deer, the average hemoglobin level is 31% higher than that of the bison, the hematocyte is 25% higher, while the number of red cells / μL blood is 239% higher than that of the bison. To assure the efficiency of its respiratory exchanges, the deer, recognized as much more dynamic than the bison, adapted its respiratory functions by increasing the surface of gaseous exchange, an action involving a much higher number of red cells, which are much smaller than those of the bison, the mean cell volume being 63% lower in the deer, comparatively with the bison (Fig. 4), each red cells having – in its turn – a 61% lower hematological charge than in the bison (Fig. 5).

The differences between the values of the hematological indices determined by the authors for the bison and the literature data on domestic ruminants are fewer than in the case of the deer. Thus, the mean values of hemoglobin concentration in the cow are only 5% lower than in the bison, the hematocyte values are 15% lower, while the erythrocyte number of the cow is 23% higher than in the bison. The explanation for such a hematological behavior between the two species may be also correlated with the mobility and rapidity of movements, more restricted in the case of bison and of domestic ruminants, comparatively with the wild deer.

CONCLUSIONS

The hematological prosperity of female bisons increases with their age, over the 2-8 year interval of age, hemoglobin concentration being 1.36 times multiplied, while the hematocyte is 1.64 times multiplied and the erythrocytes number, respectively, is 1.17 times multiplied.

The sexual dimorphism of the bison is identified, too, at hematological level, especially as to hemoglobin concentration, which is 21% lower in males than in females; MCH (-13%) and MCHC (-22%).

Blood homeostasis is severely affected in cases of illness of the bison, when hematological insufficiency gets installed, being manifested – according to our own data – by a 38% decrease of hemoglobin level, comparatively with that of healthy animals, a 47% decrease of the hematocyte and a 59% decrease of the erythrocyte number, respectively.

The hematological profile of the bison is much more similar to that of domestic ruminants, characterized by a lymphatic temper and lower requirements of respiratory oxygen, the situation being wholly different for the wild deer, known as running fast and, consequently, developing more intense muscular activities, reflected, at sanguine level, by a higher number of small-sized red cells, which will assure a more extended area of respiratory space.

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APPENDIX

Table 1 - Results of hematological analyses in the bison, comparatively with some ruminant mammals

Determined hematological indices	VANATORI NEAMT BISON										FRE DEE R ⁽²⁾	DOMESTIC COW ⁽³⁾
	Healthy											
	Females							7 year-old male v.m.	Average value healthy bison	Ill, 5 year-old female		
	2 year-old ⁽¹⁾		3 year-old ⁽¹⁾		8 year-old		Mean value females					
v.m.	%	v.m.	%	v.m.	%							
Hb (g/dL)	11.0	100	14.5	131.8	15.0	136.4	13.5	10.6	12.05	7.50	15.90	11.5
Ht (%)	33.5	100	36.0	107.5	55.0	164.2	41.5	40.8	41.15	22.0	51.44	35.0
RBC (x 10 ⁶ /μL)	5.75	100	6.75	117.4	6.7	116.5	6.4	5.8	6.10	2.525	20.70	7.50
VEM (μm ³ /erythrocyte)	58.7	100	54.3	92.5	82.3	141.2	65.1	70.4	67.75	87.13	24.78	50.0
HEM (pg Hb/eritrocit)	19.2	100	21.8	113.5	22.4	116.7	21.1	18.3	19.70	29.7	7.67	14.0
CHEM (g Hb/dL erythrocytes)	32.8	100	40.3	122.9	27.3	83.2	33.5	26.0	29.75	34.1	30.91	31.4

v.m. – mean value;
 (1) – Deju *et al.*, 2010;
 (2) – Gupta *et al.*, 2007;
 (3) – Duncan and Prase, 1986.