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# ABSTRACT

## OF PhD DISSERTATION

## „*RESEARCHES CONCERNING THE FEEDING IMPROVEMENT POSIBILITIES OF THE BISON RAISED IN CAPTIVITY*”

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The need for a doctoral thesis on "Research on Improving the Nutrition of European Bison Bred in Captivity" arises from analyzing the research needs defined in the paper "European bison – Current state of the species and an action plan for its conservation" (Pucek, Belousova, Krasinski, Krasinska and Olech, 2002) presented to the working committee for the European Convention on the Conservaton of Biological Diversity and Natural Habitats of the Council of Europe (Strasbourg, December 2-5, 2002). A major research direction refers to the rational feeding of the European bison living in captivity or in the wild, with an emphasis on analyzing the additional feeding in various conditions.

While there is an extensive and comprehensive local literature on ruminants, the specialized bibliography on the European bison is rather scarce. This thesis has two major sections: the first is a bibliographic study that presents up-to-date information concerning the particular features of the European bison nutrition and feeding (physiological characteristics of feeding, evaluation of food needs, practical considerations related to the feeding of European bison), while the second is based on my own research aimed at offering solutions to improve the feeding of the European bison bred in captivity. The final result of this doctoral thesis can be applied in providing additional feeding for the European bison living in Romania (Vanatori Neamt, Targoviste, Hateg) or in developing a feeding pattern for the individuals proposed for repopulating certain unexplored areas, as the mountain regions (national or natural parks), which are potential ecosystems for this endangered species.

The Vanatori Neamt Reserve ("Dragos Voda" European bison reserve of Tg. Neamt) is managed by the Vanatori Neamt Natural Park Administration, which is part of the Tg. Neamt Forests District subordinated to the Piatra Neamt Forests Department of the National Forests Corporation. There are 6 European bison (brought here from other Romanian reserves, mostly from Hateg Silvut, Hunedoara County) living in a fenced area of 4 hectares. This reserve has been chosen for research because it plays a key role in the process of acclimatization and increasing the number of European bison for release to wild or semi-wild life in Eastern Carpathians.

This doctoral thesis starts from identifying and describing, from a chemical and nutritional point of view, the specific food resources available in the forest district (Tg. Neamt Forest District) and in the reserve concerned ("Dragos Voda" European bison reserve of Tg. Neamt) with the aim of drawing conclusions and proposing some recommendations that could contribute to improving the nutrition and feeding of the European bison living in captivity.

In order to achieve this goal, the ***initial phase*** consisted in research aimed at:

- identifying and describing, from a geobotanical viewpoint, the food resources existing in the studied area;
- assessing the quality of grazing lands;
- establishing the rough chemical structure of the fodder used for feeding the European bison;
- calculating the nutritional value of each ingredient used in the food rations.

The biologic material considered in the initial phase included the food types eaten by the European bison living in the Vanatori-Neamt reserve, classified according to their share in the diet of the animals in the reserve:

a) *primary food resources:* two types of permanent grazing lands: *Agrostis tenuis – Festuca rubra* (prevailing in the Vanatori-Neamt Park) *and Festuca rubra-Nardus stricta (mainly in the European bison reserve)*;

b) *secondary food resources*: beech, birch and oak seedlings and young shoots, acorns;

c) *additional food resources:* mountain grassland hay, whole corn stems, apples, wild cabbage, fodder carrots, corncobs, barley, oat.

The quality of food was assessed in point of grazing value (exclusively for the grazing lands) (Anghel *et al.*, 1980, 1981), chemical composition and nutritional value.

The *second phase* consisted in describing the feeding pattern applied during one year, differentiated for two seasons: summer and winter. The research on the feeding of European bison in captivity and on its possibilities of improvement was conducted on the population in the "Dragos Voda" Reserve of Vanatori Neamt (6 individuals – 3 ♂ + 3♀), which had the following structure:

- ♂ Rarău, aged 10, 800 kg;
- ♀ Rodia, aged 17, 450 kg;
- ♀ Romsilva, aged 7, 400 kg;
- ♂ Rozvan, aged 4, 350 kg;
- ♀ Roana, aged 2, 200 kg;
- ♂ Robastian, aged 2, 200 kg.

The food consumed by the European bison in the Dragos Voda – Vanatori Neamt Reserve has seasonal differences and includes a wide range of fodders specific to ruminants. The food rations differ, depending on the fodders available, and there are usually 4 versions for each season. For instance, the main food source during the warm period of the year is the

grazing land of the reserve (*Festuca rubra-Nardus stricta*), supplemented with: grass harvested from the park, (*Agrostis tenuis-Festuca rubra*), corn kernels or various plant parts (e.g. birch shoots).

Although the European bison are not fed individually in the reserve studied, as the animals graze freely or receive additional food in common mangers, the food rations have been customized for each individual, considering the actual ingestion capacity calculated based on the body weight.

The evaluation of the fodder resources used for feeding the European bison in the Dragos Voda – Vanatori Neamt reserve led to the following conclusions:

- the following fodder categories are fed to the European bison during a year:

  a) *primary food resources:* permanent grazing lands consisting of gramineous plants;

  b) *secondary food resources*: tree species – beech, birch and oak seedlings and young shoots, acorns;

  c) *additional food resources:* mountain grassland hay, whole corn stems, apples, wild cabbage, fodder carrots, corncobs, barley, oat;
- in point of grazing value, the mountain grazing lands analyzed were rated as "good quality" (*Agrostis tenuis-Festuca rubra*) and „medium quality" (*Festuca rubra – Nardus stricta*) grazing lands;
- from a chemical and nutritional point of view, the grazing land with *Agrostis tenuis-Festuca rubra* has the parameters of a good grazing land, while the one in the reserve (*Festuca rubra – Nardus stricta*) was rated as low-quality;
- due to the specific adaptation of the European bison and to their preference for feeding on forest tree species, the shoots and fruits of certain trees in the Vanatori-Neamt park have been successfully used to respond to the needs generated by this type of eating behavior.
- the chemical composition of the deciduous tree shoots included high concentrations of soluble carbohydrates (NES = 45-54%), while protein concentration ranged from 10 to 17% of DS, with a raw cellulose content of 16-26% of DS;
- in spite of containing certain acids that give it a bitter taste, acorn is enjoyed by the European bison and its chemical structure includes NES 67% and RC 15% of DS and proteins below 10% DS;

- the hay harvested from the grazing land of the Vanatori Neamt Park (*Agrostis tenuis – Festuca rubra*) is a quality food source and is used as basic forage for the European bison during the winter;
- the measured humidity was below 10%, which makes it very suitable for preservation; in addition to that, the percentage of proteins in dry substance reached 11.6%, while the concentration of cellulose was relatively high – 37.4% of DS – which can be explained by the vegetation stage of the grazing land at the time of harvesting;
- the analyzed natural hay had a rather low energy level (0.53 UFC-0.63 UFL), while the level of IDP was approx. 73 g/kg of DS;
- although the nutritional value calculated for the corncob samples is good (1.1 UFL and 74 g PDIN-110 g PDIE), there is a shortcoming: the contamination of forage with mold as a result of harvesting and storing it in high humidity conditions;
- the corn stem samples had high concentrations of parietal carbohydrates (CB = 368.20 g/kg DS, ADF = 451 g/kg DS) and low levels of proteins (60 g PB/ kg DS), fats (15.6 g GB/ kg DS), and minerals, resulting in poor nutritional value;
- barley and oat have a high concentration of raw cellulose, i.e. of non-digestible components (cellulose + lignin), resulting in low digestibility for monogastric animals, but they have been used with good results as food for the European bison, to the extent required to cover the energy needs;
- apples are not part of the basic diet of the European bison in the reserve, but are occasionally included, during the cold period of the year, as a source of vitamins and soluble sugars (over 80% of DS);
- the root vegetables analyzed (fodder carrots and wild cabbage) are fed in limited quantities to the European bison in this reserve;

Particular attention should be paid to the optimal moments for using the grazing lands for grazing or for hay harvesting, correlating the phonological phase of vegetation with the raw chemical structure and the nutritional value. For instance, for good quality mountain grassland, the best harvesting moment is before earing up, when the concentration of raw proteins is high and the cellulose content is low.

The grazing value of the studied grazing lands could be improved by maintenance and oversowing works in order to reduce the percentage of species with no nutritional value (e.g.

*Nardus stricta*) and to stimulate the growth of valuable species (gramineous plants with specific quality ratings above 4 and leguminous species).

There are some fluctuations in the nutrition of the European bison in the Dagos-Voda – Neamt reserve, due to the seasonal availability of some of the existing food sources and a more stable feeding pattern is recommended in order to avoid nutritional deficiencies.

The institutes specializing in establishing feeding standards for domesticated animals have not conducted any particular research on the nutrition of European bison so far. As a result, the information available on the nutritional needs of the species is scarce. This is why we believe that this thesis is a contribution to improving the knowledge in this field.

In estimating the nutritional standards for the studied animals, we applied certain methods used in the calculations for large ruminants, starting from data concerning the chemical structure and nutritional value of the forage resources available in the Dragos Voda – Vanatori Neamt reserve.

The investigation conducted on the organization of feeding in the studied reserve revealed certain discontinuities in the access to forage resources adapted to the particular nutritional needs of the species during the year. Four types of rations were used in the summer: $R_1V$ (grazing land – *F. rubra-N. stricta*), $R_2V$ (grazing land – *F. rubra-N. stricta* + grazing land – *A. tenuis-F. rubra*), $R_3V$ (grazing land – *F. rubra-N. stricta* + corn kernels) and $R_4V$ (grazing land – *F. rubra-N. stricta* + birch shoots). Four types of rations were used in winter, too: $R_1I$ (natural hay + cornstalks), $R_2I$ (natural hay + fodder beet), $R_3I$ (natural hay + corn kernels) şi $R_4I$ (natural hay + barley grains + oat grains).

The feeding is not customized for each individual, by based on standards that take into account body weight, ingestion capacity, age and reproductive status.

The analysis of the food rations frequently fed to the European bison in the Dragos Voda reserve revealed certain discrepancies between the nutritional value of the forage and the estimated standards:

- for adults, in the summer, of the 4 ration versions used, $R_2V$ responded the best to the nutritional needs and balanced the energy/protein ratio, as it included the two gramineous species in the forest area grazing lands (*F. rubra-N. stricta* and *A. tenuis-F. rubra*). Unfortunately, the other three food ration versions ($R_1V$, $R_3V$ and $R_4V$) provided an excess energy level (EM MCal) of 2-27%, while the protein deficit ranged from 1% to 15%, compared to the nutritional standards;
- none of the food ration versions applied during the summer responded to the minimum protein needs for the two younger bison, due to the lower ingestion

capacity; the deficit ranged from 8% ($R_2V$) to 32% ($R_1V$). Only the ration included mass fodder supplemented with corn kernels ($R_3V$) provided the necessary energy levels. The minimum phosphorus levels also failed to be reached by the 4 ration versions and an additional source of phosphorus is required (dicalcium phosphate);

- the rations fed to the adult animals during the winter met the nutritional needs, with one exception – Rarau (male, aged 10, 800 kg), whose energy needs were not properly covered (-2% to -13%). All animals received excess proteins (+11% to +45%), compared to the standards;
- for the young individuals, the rations exclusively made of mass fodder ($R_1I$ and $R_2I$) were deficient in point of energy (-5% to - 7%) and phosphorus (-25% to -28%); the added concentrated fodder (corn kernels – $R_3I$ or barley and oat – $R_4I$) solved the energy deficit, but reduced the level of proteins (-16 %) and calcium (-40% to -50%).

New proposals were made for the structure of food rations in order to improve the use of food resources readily available throughout the year, in addition to certain seasonal fodders, while trying to fully meet the nutritional standards estimated for each individual. As a possible alternative to a sole diet in the summer, a ration including grazing (*F. rubra-N. stricta*), natural hay and oat is proposed. The same combination can be used during the cold period of the year, too, replacing the grass with beet.

The type of intensively replenished collective manger used in the Dragos Voda - Neamt reserve often causes hay loss, as the hay tends to mold in the manger. This is why it would be recommendable to introduce roofed vertical mangers for better preservation of the hay by improved ventilation and molding prevention.

It would be also appropriate to introduce troughs for feeding the additional ration individually to each of the 6 animals, in order to prevent competition for food and to customize the feeding depending on the individual needs.