

## The Digestibility of Nutrients of Natural Diet by European Bison in Different Seasons

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Experiments were carried out with two 3 and 4 years old European bison. The digestibility of nutrients and energy was estimated of diets composed of plants eaten by free-living bison at different time of the year. The diet contained: in spring — willow, hornbeam and aspen browse and blueberry bushes; in summer — fresh grass and herbs and willow bark; in autumn — dried grass and browse. Values for digestibility coefficients in spring, summer and autumn were, respectively: dry matter — 55.6, 60.6, 51.6, crude protein — 59.4, 56.0, 38.9, crude fibre — 35.4, 56.4, 46.8, cellulose — 52.6, 66.5, 56.2, lignin — 30.1, 32.0, 27.4 and energy — 56.5, 61.6, 49.5. Soluble sugars were completely digested.

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### 1. INTRODUCTION

Numerous studies were conducted recently on the hoofed animals (European bison, roe deer, red deer) of the virgin forest of Białowieża to provide information on the role of these animals in the forest ecosystem. The kinds and quantities of ingested feeds were estimated in studies on the feeding habits of the European bison (Baškirov, 1939; Zablockaja, 1957; Koročkina, 1966, 1969 a, b; Borowski *et al.*, 1967; Borowski & Kossak, 1972, 1975; Gębczyńska & Krasińska, 1972). In some experiments the digestibility of nutrients were estimated but the feeds given differed considerably from the natural diet of free-living bison (Szaniawski, 1959; Gębczyńska *et al.*, 1974; Peden *et al.*, 1974).

The purpose of the present experiment was to estimate the digestibility of nutrients and energy of the natural diet of free-living bison.

### 2. MATERIAL AND METHOD

The experiment was conducted in three different seasons: in May, in June—July and in October with two bison captured in the forest: Kalif (Pedigree No. 2753, live weight 290 kg) 3 years old, and Karat (Pedigree No. 2752, live weight 385 kg)

4 years old. The bisons were placed in a 10 ha large, enclosed forest reserve of the Mammals Research Institute in Białowieża. During the experiment the animals were kept in individual pens, 135 m<sup>2</sup> large, with concrete floor.

In successive digestibility trials diets were given composed of natural feeds derived from the forest. The diet composition differed depending on the season and was based on the studies of Borowski & Kossak (1972). It consisted of plants readily accessible and eaten by the animals under natural conditions: in spring — willow, hornbeam and aspen browse and blueberry bushes; in summer — fresh grasses and herbs and willow bark, and in autumn grasses and browse in proportion shown in Table 1. In spring and summer the feed was gathered daily early in the morning and given on the same day. In autumn the feed was harvested in September, air-dried and stored for subsequent use.

Table 1  
Average composition of rations (%) and daily intake (kg).

	Seasons		
	I — spring	II — summer	III — autumn
<i>Carpinus betulus</i> (twigs with leaves)	20.6	—	9.9
<i>Salix caprea</i> (twigs with leaves)	25.9	—	16.4
<i>Salix caprea</i> (bark)	13.8	9.6	—
<i>Vaccinium myrtillus</i>	13.8	—	9.8
<i>Populus tremula</i> (twigs with leaves)	25.9	—	9.8
<i>Urtica dioica</i>	—	11.3	9.8
<i>Impatiens noli-tangere</i>	—	11.3	—
<i>Cirsium oleraceum</i>	—	22.6	9.8
<i>Ranunculus lanuginosus</i>	—	11.3	—
<i>Cirsium</i> sp.	—	11.3	—
Gramineae	—	11.3	—
<i>Aegopodium podagraria</i>	—	11.3	—
Gramineae (hay)	—	—	24.6
<i>Rubus idaeus</i>	—	—	9.9
Intake per day, kg (in brackets — dry matter intake)			
Kalif	12.0 (3.8)	27.0 (4.4)	8.4 (6.4)
Karat	17.0 (5.4)	35.0 (5.7)	9.9 (7.3)

The diet was given in two equal meals per day: at 08<sup>00</sup> and 16<sup>00</sup> h. The amount given depended on the liveweight of the animal and was chosen so that the feed was eaten completely (Table 1). The animals had free access to water.

In each trial a 10 day preliminary period, during which the amount of feed was established, was followed by a 6 day collection period. The faeces were collected quantitatively after each excretion and representative samples were analysed. The proximate composition of feeds and faeces was estimated by conventional methods. Apart from that, soluble sugars, readily hydrolysable carbohydrates, cellulose and lignin were determined as described by Hoffman *et al.* (1969) and the content of hemicellulose was assessed from the difference between total carbohydrates and estimated fractions. The digestible energy of the diet was calculated from the difference between the gross energy of feeds and faeces, their energy contents being calculated from the chemical composition, using the equations of Nehring *et al.* (1970).



## 3. RESULTS

In spite of the widely different botanical composition of the diets given at different time of the year (Table 1) the contents of nutrients in the dry matter were similar (Table 2).

Table 2  
Chemical composition of rations, %

	Seasons		
	I — spring	II — summer	III — autumn
Dry matter	31.82	16.36	74.02
In dry matter:			
Ash	5.42	10.25	9.43
Organic matter	94.58	89.75	90.57
Crude protein	14.31	11.63	12.05
Ether extract	4.28	2.99	3.11
Crude fibre	22.19	25.92	26.05
N-free extractives	53.80	49.21	49.36
Carbohydrates:			
Soluble sugars	3.33	4.03	5.23
Readily hydrolysable carbohydrates	1.73	1.59	1.45
Cellulose	26.12	28.79	26.86
Lignin	24.67	19.25	19.87
Hemicellulose	20.14	21.46	22.00
Gross energy per 1 kg of DM, kcal	3175	4249	4291

Table 3  
Apparent digestibility coefficients of nutrients  
of the rations (averages and mean deviations).

	Seasons		
	I — spring	II — summer	III — autumn
Dry matter	55.6±0.4	60.6±1.3	51.6±1.1
Ash	37.4±2.9	35.1±0.7	31.1±2.7
Organic matter	59.1±0.5	63.5±1.5	53.8±1.5
Crude protein	59.4±0.1	56.0±0.8	38.9±1.9
Ether extract	21.7±0.6	28.1±2.9	17.0±4.2
Crude fibre	35.4±1.0	56.4±1.9	46.8±1.2
N-free extractives	71.4±0.7	71.1±1.5	63.4±1.3
Soluble sugars	100	100	100
Readily hydrolysable carbohydrates	72.3±0.3	73.9±1.3	73.5±5.7
Cellulose	52.6±0.2	66.5±1.9	56.2±1.2
Lignin	30.1±0.1	32.0±3.9	27.4±6.7
Hemicellulose	99.8±0.2	88.9±0.4	75.1±3.6
Gross energy	56.5±0.5	61.6±1.3	49.5±1.5

Digestibility coefficients of nutrients and energy are presented in Table 3. The digestibility of crude protein was highest in spring, of dry matter, crude fibre and cellulose in summer. The digestibility of energy was highest with the summer diet.

## 4. DISCUSSION

The results have shown differences in the utilization of nutrients and energy of the diet by bisons, depending of the season. The spring and summer diet consisted largely of young twigs and grasses with a high content of soluble nitrogenous constituents, amides and free amino acids and, consequently, the digestibility of crude protein in these seasons was higher than in autumn. The situation was similar with regard to the digestibility of crude fibre, cellulose and N-free extractives. Seasonal changes in the digestibility of these constituents affected indirectly the digestibility values of dry matter and organic matter. Seasonal changes in dry matter digestibility of the rations offered to bisons were observed also in the experiment of P e d e n *et al.* (1974).

The soluble sugars were completely digested, in accord with the results of previous experiments (K o w a l c z y k *et al.*, 1969; P r i n s & G e e l n, 1971; G ę b c z y ń s k a *et al.*, 1974). On the other hand, the digestibility of readily hydrolysable carbohydrates was rather low, 74<sup>0</sup>%, irrespective of season. A possible explanation is that certain amounts of undigested bacterial cells and endogenous glycoproteins are being excreted in the faeces and the sugars, forming part of this material, are released in the course of the estimation of readily hydrolysable carbohydrates. If, as was the case with our experiment, the diet contains little readily hydrolysable carbohydrates (about 1.5<sup>0</sup>%) then the sugars contained in the bacteria and glycoproteins excreted in faeces are likely to reduce the apparent digestibility of this carbohydrate fraction, in spite of the fact that the readily hydrolysable carbohydrates of the diet are completely metabolised in the rumen.

The high digestibility of lignin observed in all seasons is consistent with the results of previous experiments on bisons (G ę b c z y ń s k a *et al.*, 1974). The problem of lignin digestibility is still controversial but numerous studies seem to suggest that it can be digested by cattle to a certain extent, depending on the kind and stage of maturity of the plants, composition of the diet *etc.* but the digestibility in cattle is less than in European bisons (M a y n a r d & L o o s l i, 1967; J o h n s o n, 1972; V e r m e & U l l r e y, 1972; G ę b c z y ń s k a *et al.*, 1974). The technique of lignin estimation may also influence the digestibility values (V a n S o e s t, 1964).

The utilization of energy of the diet differed depending on the season and was least in autumn (Table 3). This is not surprising, as at this time of the year the feed contained a considerable proportion of undigestible constituents and the intake of dry matter was greater than in the other seasons (Table 1). The natural diet was well utilised by the bisons as



indicated by relatively high digestibility values, in spite of the fact that the diet consisted largely of browse and bark of trees and shrubs. The ability to digest lignin suggest specific adaptation of the bison to its natural environment, the woodland, and the lignin-rich material it feeds on. This adaptation has not been affected by long years of breeding in the reserve, where the bison are fed largely on feeds similar to those used for domestic cattle.

A practical suggestion for bison breeders in reserves and zoological gardens is evident from this study: the natural feeds for late autumn and wintertime should be harvested during late spring and summer. The digestibility of these feeds is better than when gathered at a later time. This applies primarily to browse *i.e.* well leafed twigs of no more than 1 cm diameter which are then air-dried.

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#### STRAWNOŚĆ SKŁADNIKÓW POKARMOWYCH PASZ NATURALNYCH POBIERANYCH PRZEZ ŻUBRY W RÓŻNYCH PORACH ROKU

##### Streszczenie

W doświadczeniach przeprowadzonych w Puszczy Białowieskiej na dwóch 3—4 letnich żubrach określono współczynniki strawności składników pokarmowych oraz energii dawek złożonych z roślin pobieranych przez żubry żyjące na wolności w trzech sezonach roku. W skład dawek wchodziły: wiosną — świeżo zebrane pędy iwy, grabu, osiki oraz czarna jagoda; latem — świeże trawy i zioła oraz kora z iwy; jesienią — suche rośliny trawiaste oraz gałązki drzew i krzewów.

Współczynniki strawności w sezonie wiosennym, letnim i jesiennym wynosiły odpowiednio: sucha masa — 55.6; 60.6; 51.6; białko — 59.4; 56.0; 38.9; włókno — 35.4; 56.4; 46.8; celuloza — 52.6; 66.5; 56.2; lignina — 30.1; 32.0; 27.4; energia — 56.5; 61.6; 49.5. Węglowodany rozpuszczalne były całkowicie trawione przez żubry.