

BISONIANA LV

Zofia GĘBCZYŃSKA, Jan KOWALCZYK,
Małgorzata KRASIŃSKA & Aleksandra ZIOŁECKA

A Comparison of the Digestibility of Nutrients by European Bison and Cattle*

[With 2 Tables]

Apparent digestibility coefficients of nutrients and energy of the ration were determined in 2 European bisons deriving from a free ranging herd in the Białowieża Forest, and in 2 Black and White Lowland bulls. The diet consisted of meadow hay (70%) and ground barley (30%) with the addition of Cr_2O_3 as the indicator of digestibility. The experiment was continued for 30 days, faeces being collected for 10 days in this period. The content of crude protein and crude fibre in the dry matter of the feed amounted to 11.9 and 22.3%, respectively. The energy value of 1 kg of the dry matter was 4347 kcal of gross energy. The apparent digestibility coefficients of the nutrients for bisons were higher than for cattle, except cellulose, soluble and readily hydrolysed carbohydrates. The higher coefficients include crude protein (37%), ether extract (45%), lignin (198%) and ash (76%). These results indicate a better feed utilization as expressed by the digestibility of nutrients and energy, by European bisons than by cattle.

1. INTRODUCTION

In relation to the investigations on the role of the European bison in forest ecosystems of the Białowieża Forest it is essential to determine not only the specific composition and amount of consumed food but also the extent of its utilization by the animal organism.

Studies on the species composition and food preference of free ranging herd of European bisons have been hitherto carried out by Baškirov, 1939; Zablockaja, 1957; Borowski, Krasiński & Miłkowski, 1967; Koročkina, 1966; 1969a, b; Borowski & Kossak, 1972. The selectivity and food requirements of the bison were described

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in an earlier paper (Gębczyńska & Krasieńska, 1972). On the other hand, data concerning digestibility and food utilization in this species are almost totally lacking. The only available report is that published by Szaniawski (1959). Elucidation of this problem is an essential link in further studies on the estimation of the energy balance of bisons living in the Białowieża Forest.

The aim of present study was to compare the digestibility of nutrients and energy of a ration in European bisons and in domestic cattle.

2. MATERIAL AND METHOD

The experiment on 2 European bisons was carried out in the Mammals Research Institute at Białowieża. The animals deriving from a free ranging herd were: Kalif (Pedegree No. 2753, live weight 200 kg, 2 years old) and Karat (Pedegree No. 2752, live weight 300 kg, 3 years old). Parallel comparative experiments on two Black and White Lowland bulls weighing 240 kg, aged approximately 8 months, were carried out in the Institute of Animal Physiology and Nutrition at Jabłonna.

Specific conditions of life of European bisons make difficult the employment of classical methods of determination of nutritive value and utilization of consumed feedstuff. For this reason the indicator method was employed in the experiment.

The food ration of all animals consisted of meadow hay (70%) and ground barley (30%) with the addition of Cr_2O_3 . The ground barley was thoroughly mixed with the indicator to ensure a uniform distribution of chromic oxide in the feed, and pelleted.

The captured European bisons were placed in an experimental forest reserve, 10 ha in area. For the period of the proper experiment they were transferred to enclosures, 135 m² in area, with the run covered with concrete. The daily ration was supplied in two equal portions at 8⁰⁰ and 16⁰⁰, but on account of body weight differences Kalif obtained jointly 6 kg of feed and Karat 7 kg. After a twenty-day initial period, in which the final daily ration was established, the collection of faeces was carried out for 10 days.

Samples of faeces were taken from each defaction. Also samples of feed were taken for chemical analysis during the whole collection period. Water was given always *ad libitum*.

The bulls were given the experimental ration for 29 days before the collection period. Similarly to bisons they obtained feed twice daily in the amount of 7 kg. Before and during faeces collection the ration was reduced to 5 kg in order to ensure complete consumption. Drinking water was always available. During the collection period the animals were maintained in metabolic cages and faeces were collected for 4 consecutive days.

The content of nutrients in the feed and faeces was estimated by conventional methods. In addition, the following components were determined: soluble carbohydrate, readily hydrolysed carbohydrates, cellulose and lignin according to the methods recommended by the Oskar Kellner Institute in Rostock (Hoffmann & Nehring, 1969), pentosans and hemicellulose from the difference between the sum of carbohydrate components and determined fractions, and chromium oxide according to Struszyński (1954).

The apparent digestibility coefficients were estimated by means of the indicator method with Cr_2O_3 . The digestible energy of the ration was calculated from the difference between the gross energy of the feed and faeces using the coefficients given by Nehring *et al.* (1970). The amount of faeces excreted by bisons was calculated from the amount of the indicator assuming 100% recovery of chromium oxide given with the feed.

3. RESULTS

The results of chemical analyses of feed and faeces are given in Table 1. The contents of crude protein and fibre in the dry matter of feed amounted to 11.9 and 22.3%, respectively, and the energy value of 1 kg of feed corresponded to 4347 kcal gross energy.

The animals readily consumed all supplied feed leaving no remnants.

The digestibility coefficients of all nutrients, except cellulose, soluble carbohydrate and readily hydrolysed carbohydrates, were higher in bisons than in cattle (Table 2). The differences were greatest for crude protein (37%), ether extract (45%), lignin (198%) and ash (76%).

4. DISCUSSION

The results obtained seem to indicate a better utilization of feed, in terms of the digestibility of nutrients and energy, by bisons than by cattle. The considerable difference in the digestion of lignin between the two compared species of ruminants indicates a better ability to digest this component in bisons. In their natural environment bisons consume feed rich in lignin and thus their digestive system may be better adapted than that of domestic cattle. However, taking into consideration the limited number of animals in the experiment, their individual variation and the relatively large error involved in lignin determination it is difficult to establish the real degree of better utilization of this component by bisons. The problem requires further studies. The differences in the digestibility of ash may be due to the fact that bisons staying in the enclosures could, apart from feed, take up some additional mineral components by licking them up from the concrete floor of the run.

Most of the studies concerning digestibility of nutrients in free living ruminants were carried out on *Cervidae* (deer, elk, reindeer, roe-deer). From the investigations carried out on European bisons only the results of Szaniawski (1959) are known. The author compared a half-year-old bison calf and a domestic young bull of the same age. In contrast to our results Szaniawski (1965) found that the digestibility of crude and true protein, fibre and nitrogen-free extractives in the bull was higher than in the bison. It is possible that in the young bison the digestive system was not yet properly developed since it is known that bisons

Table 1
Chemical composition of feeds and faeces of European bison and bulls.

	Dry matter	Ash	Organic matter	Crude protein	Ether extract	Crude fibre	N-free extractives	Monosaccharides	Readily hydrolysed carbohydrates	Cellulose	Lignin	Pentosans + hemicellulose
Meadow hay	89.12	6.47	82.65	10.19	2.25	25.56	43.64	6.37	2.47	29.58	11.01	20.77
Ground barley	87.99	5.63	82.36	11.37	2.12	3.98	64.89	5.33	45.44	2.86	4.73	10.51
Faeces of bison	16.47	2.18	14.25	2.12	0.66	4.61	6.86	0.03	0.27	4.49	3.63	3.05
Faeces of bull	15.72	2.02	13.70	2.30	0.69	4.04	6.67	0.03	0.35	4.17	3.57	2.59

Table 2
Apparent digestibility coefficients of nutrients of the ration for European bison and bulls.

	Dry matter	Ash	Organic matter	Crude protein	Ether extract	Crude fibre	N-free extractives	Monosaccharides	Readily hydrolysed carbohydrates	Cellulose	Lignin	Pentosans + hemicellulose	Gross energy
Bisons	65.57 ±1.32	34.46 ±0.48	66.89 ±2.46	62.65 ±1.66	44.61 ±2.33	56.60 ±2.37	74.49 ±1.01	99.09 ±0.21	96.70 ±0.45	61.06 ±4.46	25.95 ±2.90	68.09 ±1.85	79.68 ±1.32
Bulls	58.46 ±0.46	19.53 ±0.23	61.22 ±0.47	45.74 ±1.14	30.71 ±3.23	52.18 ±1.32	69.18 ±0.34	98.92 ±0.21	95.62 ±0.35	61.39 ±1.98	8.18 ±3.04	66.83 ±1.03	64.71 ±1.98

at this age still suckle their dams (Wróblewski, 1927), while a half-year-old bull utilizes feed as well as adult cattle (Ziołocka, 1969; Church, 1971).

The coefficients of digestibility of the dry matter (65.4) and organic matter (66.7) obtained in our experiments for European bisons are similar to those reported by Rice & Church (1971) for the deer. On the other hand, the digestibility of individual components was in the experiments of these authors either higher (protein, ether extract), or lower (lignin, hemicellulose, cellulose) in comparison with European bison. The coefficients of digestibility of dry matter, protein and cellulose in deer in the experiments of Maloy & Key (1971), varied depending on the quality of feed in the range of 53—62, 42—61 and 52—64, respectively.

However, it is difficult to compare and generalize these data since the experiments were carried out on different ruminant species, under different conditions and using different feed.

Soluble carbohydrate and readily hydrolysed carbohydrates are almost completely fermented already in the rumen (Hobson, 1969; Kowalczyk, Ramirez & Geerken, 1969) hence no difference in their digestibility was observed between cattle and bisons. The small amount of soluble carbohydrate and readily hydrolysed carbohydrates excreted with faeces might come from undigested microorganisms and glycoproteins.

The results obtained in our experiments confirm a widespread opinion that free living animals digest and utilize feed more efficiently than do domestic animals (Church *et al.*, 1972). The differences may be caused by different anatomical structure and physiological properties of the intestinal tract in various ruminant species (Tomme *et al.*, 1953; Sablina, 1970; Prins & Geelen, 1971; Szaniawski 1973).

In the light of our experiment the problem of digestibility of feed in the European bison seems to be interesting and should be continued with the use of natural feed consumed by bisons in the Białowieża Forest in various seasons of the year.

A better understanding of this problem may have practical application in proper breeding of this species as free ranging herds, as well as in a more rational economy of feeding fields.

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Mammals Research Institute,
Polish Academy of Sciences,
17-230 Białowieża, Poland.

Institute of Animal Physiology and Nutrition,
and Polish Academy of Sciences,
05-110, Jabłonna n. Warszawa.

Zofia GĘBCZYŃSKA, Jan KOWALCZYK, Małgorzata KRASIŃSKA i Aleksandra ZIOŁECKA

STRAWNOŚĆ SKŁADNIKÓW POKARMOWYCH W PASZY U ŻUBRÓW I BYDŁA

Streszczenie

Określono współczynniki strawności składników pokarmowych oraz energię dawki pokarmowej stosowanej u 2 żubrów w wieku 2 i 3 lata odpowiednio, pochodzących z wolnego stada z Puszczy Białowieskiej oraz u 2 buhajów rasy nizinnej czarno-białej, w wieku 8 miesięcy.

Dawka pokarmowa składała się z siana łąkowego (70%) i śruty jęczmiennej (30%) z dodatkiem Cr_2O_3 użytego jako wskaźnik do oznaczenia strawności. Doświadczenie trwało 30 dni, w tym okres kolekcji kału 10 dni. Wyniki analiz chemicznych paszy i kału zawarte są w Tabeli 1. Zawartość białka ogólnego i włókna w suchej masie paszy wynosiła 11,9 i 22,3% odpowiednio, a wartość energetyczna 1 kg suchej masy odpowiadała 4347 kcal energii brutto.

Współczynniki strawności składników pokarmowych z wyjątkiem celulozy oraz cukrów prostych i węglowodanów łatwo hydrolizujących były wyższe u żubrów niż u bydła domowego (Tabela 2). Największe różnice wystąpiły w strawności białka ogólnego (37%), ekstraktu eterowego (45%), ligniny (198%) oraz popiołu (76%). Uzyskane wyniki wskazują na lepsze wykorzystanie pasz wyrażone strawnością jej składników i energii przez żubry niż przez bydło domowe.