Influence of lucerne and meadow hay quality on the digestibility of nutrients in the roe deer

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ABSTRACT: It was confirmed in metabolic experiments with 4 individuals of roe deer (2 males and 2 females with the live weight of 20.8 and 17.9 kg, respectively) that due to the animals' selective choice of a part of feeds there was no significant difference in the intake of lucerne hay of different quality and high-quality meadow hay (515.86 ± 66.97 and 597.82 ± 94.87 g, respectively). However, different quality of lucerne hay influenced the animals' intake of crude protein and crude fibre. When the animals were fed meadow hay, they took in significantly less crude protein and fibre and significantly more nitrogen-free extract, fat and ash. Digestibility of crude protein was observed to be significantly decreased in hay of lower quality (by 10.1%). Digestibility coefficients for crude protein, crude fibre, organic matter and fat were significantly lower in grass hay compared to lucerne hay. Based on the coefficients of nutrient digestibility it can be stated that meadow hay, even if of excellent quality, is not a suitable supplement for the roe deer.

Keywords: roe deer; lucerne and meadow hay; feed intake; apparent digestibility of nutrients

The roe deer belong to the markedly selective type of free-living ruminants and thus it is important to know the intake of individual feeds mainly in relation to the their quality. Little is known about the neurohumoral regulation of feed intake as well as about the passage of digesta in the guts. In the red deer the mean passage speed of digesta is twice as fast as that observed in domestic ruminants and it can only be supposed that this process is even faster in the red deer. Lochman (1975) stated the digestibility of organic matter, crude protein, fibre and nitrogen-free extract in meadow hay to be 56 and 38%, 37 and 31%, 57 and 31% and 57and 35% in roe does and bucks, respectively.

At a body weight of 20 kg the daily dry matter consumption in the roe deer ranges from 0.4 to 0.8 kg. Dittrich and Groppel (1980) reported the weight of the rumen contents to be 8.71% of the body weight.

Based on the analysis of the rumen contents Onderscheka (1976) found the nutrition of roe deer to be particularly rich in crude protein, with the proportion of sugar and starch being lower. According to Eisfeld (1974) the intake of 5 363 KJ of digestible energy was sufficient for a roe doe with the live weight of 20 kg.

As for the available scientific literature it can be stated that very few experimental papers deal with the need and digestion of nutrients and exact experiments are missing at all. We can agree with Ellenberg (1978) that data on the need of nutrients so far obtained are very diverse and seem to be influenced by several known as well as unknown factors. The aim of our study was to determine apparent digestibility of nutrients in lucerne hay of different quality and in meadow hay from different high-quality sites.

MATERIAL AND METHODS

Metabolic experiments were carried out with 4 individuals of roe deer (*Capreolus capreolus* L.; 2 bucks and 2 does) in each group; the animals had a mean live weight of 19.4 kg (bucks = 20.8 kg, does 17.9 kg). The animals were weighed prior to the morning feeding at the start of the preparatory period and at the start and end of the experimental period.

The metabolic experiments consisted of a 21-day preparatory period and a 10-day experimental period. In both periods feeds and feed leftovers were weighed to the nearest 0.01 kg. Lucerne and meadow hay were the only feeds and were given to the animals at 6:30 in the morning at an amount of 1 kg per animal/day. Night and day, the animals were provided free access to the feeds and water. Aliquot parts of both lucerne and meadow hay were taken daily, mixed, and Weenden analysis (Order of the Ministry of Agriculture of the Slovak Republic 1492/97) was carried out twice to determine the nutrient levels in the mean sample. Feed leftovers were weighed daily prior to the morning feeding; at the end of the experimental period they were mixed to make a mean sample that was analysed similarly like lucerne and meadow hay (Table 1). In addition, mineral levels (Ca, Mg, Na, K) in lucerne and meadow hay were measured using an AAS UNICAM 939. Phosphorus levels were determined by spectrophotometry.

During the main experimental period the amounts of excreta were weighed daily (always at 6:30 in the morning). Preliminary dry matter levels were determined and from each animal an adequate fraction was stored in sealed containers in a cooling box. At the end of the experiment a mean sample was prepared by the thorough mixing of daily amounts. The mean sample was subjected to analysis similarly like the feeds.

Based on the ingested and excreted amounts of nutrients their digestibility was determined both in each animal individually and in the groups. The results of the experiments were statistically processed by multifactorial analysis of variance (Duncan's test); dry matter and nutrient intake and the coefficients of apparent digestibility in lucerne hay (experiments A and B) and meadow hay (experiments C and D) were compared by the *F*-test. For all comparisons three levels of significance were determined: *** = $\alpha < 0.001$; ** = $0.001 < \alpha < 0.01$; * = $0.01 < \alpha < 0.05$; "–" = insignificant difference.

RESULTS AND DISCUSSION

Intake of feeds, nutrients and water

Each animal in groups A, B, C and D was provided 1 kg of original hay mass daily. The real consumption was as follows:

Group	Real consumption of dry matter (g/animal/day)
A lucerne hay (2nd harvest prior to anthesis)	562.29 ± 110.11
B lucerne hay (1st harvest after anthesis)	597.82 ± 94.87
C meadow hay (full anthesis)	515.86 ± 66.97
D meadow hay (full anthesis)	583.39 ± 99.24

The above data on hay consumption do not reveal any significant differences in the consumption of dry matter between the animals or the experimental groups. The consumption was not even influenced by differences in the quality of lucerne hay. Based on our further observations it can be stated that this was mainly caused by the selective choice of mainly lucerne leaves and more tender stalks. The choice of tender parts is much more limited with low-quality meadow hay in consequence of which its consumption decreases to less than 300 g per day (Vodňanský and Sommer, 2001). The obtained results are consistent with those in literature according to which mean dry matter consumption in the roe deer ranges from 400 to 800 g per day. No significant differences could be observed between does and bucks. The intake of water ranged from1.95 ± 0.46 l to 1.54 ± 0.56 l per animal/day.

Different quality of lucerne hay caused significant differences in the intake of particular nutrients by the animals of the experimental groups (Tables 2, 2a, 2b).

Recalculation to dry matter revealed that in comparison with the animals of group B those of group A (high quality lucerne) took in by 35.5 g more crude protein (insignificant difference "–") and by 95.6 g less crude fibre (***), which became evident in a decrease of ADF and NDF consumption by 107.0 g (–) and 92.3 g (–), respectively. With meadow hay (groups C and D) no significant differences were observed in the consumption of dry matter (–67.5 g), organic matter (–51.6 g) or fat (1.2 g). The animals were given high-quality meadow hay from grassland plants in full anthesis (Table 1). In comparison with the lucerne groups these animals ingested on average by 48.9 g less crude protein (***) and by 51.0 g less crude fibre (*) but by 48.4 g more nitrogen-free extract (**), by 5.5 g more fat (***) and by 15.5 g more ash (***) when recalcu-

Table 1. Levels of nutrients in lucerne and meadow hay

Experiment	Hay quality	Dry matter (g/kg)	Nutrient levels (g per kg dry matter)											
			crude protein	crude fibre	ADF	NDF	crude fat	ash	nitro-gen-free extract	Ca	P	Mg	Na	K
A	Lucerne hay 2nd harvest prior to anthesis	908.31	233.87	271.48	316.87	390.44	16.94	99.15	378.57	19.01	3.50	3.66	1.16	18.55
B	Lucerne hay 1st harvest after anthesis	893.24	135.49	430.56	486.17	554.38	15.54	64.56	353.86	9.31	2.11	1.91	0.44	15.48
C	Meadow hay full anthesis	897.96	117.81	269.55	339.04	476.08	28.35	111.19	473.10	11.77	2.05	3.07	0.24	18.08
D	Meadow hay full anthesis	909.84	119.19	275.93	345.94	454.12	23.93	126.88	454.08	11.06	1.89	2.94	0.19	18.29

lated per 1 kg of dry matter per animal/day. As to the intake of dry matter, organic matter, ADF and NDF, no significant differences were observed between the lucerne groups (A, B) and the meadow hay groups (C, D) (Table 2a). Referring to the opinion of Onderscheka (1976), according to whom the nutrition of roe deer is particularly rich in crude protein, then grassland hay is a less suitable feed

Table 2. Intake of dry matter and nutrients

Nutrient	Intake of dry matter and nutrients (g per animal/day)							
	Group A		Group B		Group C		Group D	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Dry matter	562.29	110.11	597.82	94.87	515.86	66.97	583.39	99.24
OM	510.37	96.87	556.30	91.53	461.66	59.90	513.22	91.99
Crude protein	141.65	26.49	87.74	9.32	57.81	6.19	73.86	8.81
Fibre	143.40	27.29	239.05	57.31	131.67	24.02	148.86	38.21
ADF	165.21	34.38	272.17	61.77	172.39	28.33	187.32	41.15
NDF	218.03	63.64	310.30	70.18	240.24	38.79	243.84	65.03
Fat	9.77	1.78	9.70	1.57	15.85	1.35	14.66	2.09
Ash	51.92	13.38	41.51	4.60	54.20	7.63	70.16	8.83
Nitrogen-free extract	215.76	41.72	219.81	30.15	256.33	28.42	275.83	43.51
Ca	11.42	2.13	6.19	0.71	6.82	0.44	7.35	0.87
P	2.04	0.40	1.35	0.17	0.87	0.11	1.09	0.22
Mg	2.16	0.39	1.18	0.15	1.71	0.12	1.81	0.22
Na	0.71	0.14	0.26	0.06	0.05	0.01	0.06	0.07
K	10.77	2.16	9.66	1.60	8.13	1.02	10.67	2.24
BE (MJ)	9.87	1.99	9.88	1.67	9.96	2.23	10.47	2.14
ME (MJ)	4.37	0.88	4.37	0.74	4.41	0.99	4.63	0.95

Table 2a. Statistically significant differences in the of dry matter and nutrients (Duncan's test)

Indicator	Difference					
	A – B	A – C	A – D	B – C	B – D	C – D
Dry matter	–	–	–	–	–	–
OM	***	***	***	**	–	–
Crude protein	–	***	–	***	–	***
Fibre	***	–	***	***	–	***
ADF	–	*	**	*	**	***
NDF	–	–	**	–	–	*
Fat	–	–	–	–	–	–
Ash	–	***	–	***	–	**
Nitrogen-free extract	–	*	–	*	–	*
Ca	***	***	***	–	–	–
P	***	***	***	**	–	–
Mg	**	***	*	***	–	***
Na	***	***	***	***	–	***
K	*	–	–	–	*	–
BE	–	–	–	–	–	–
ME	–	–	–	–	–	–

*** = α < 0.001, ** = 0.001 < α < 0.01, * = 0.01 < α < 0.05

Table 2b. Intake of dry matter and nutrients from lucerne and meadow hay

Nutrient	Intake of nutrients in g/animal/day				Difference $X - Y$	F-test
	lucerne X (A + B)		grass Y (C + D)			
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$		
Dry matter	580.05	107.72	549.62	94.13	30.43	–
OM	533.34	100.18	487.44	84.48	45.90	–
Crude protein	114.69	34.58	65.84	11.43	48.86	***
Fibre	191.22	67.74	140.27	34.14	50.96	*
ADF	218.69	75.61	179.85	37.29	38.83	–
NDF	264.17	84.01	242.04	55.33	22.13	–
Fat	9.74	1.73	15.25	1.92	–5.52	***
Ash	46.72	11.65	62.18	11.85	–15.46	***
Nitrogen-free extract	217.78	37.65	266.08	39.27	–48.30	**
Ca	8.80	3.16	7.09	0.76	1.72	*
P	1.69	0.48	0.98	0.21	0.72	***
Mg	1.67	0.59	1.76	0.19	–0.09	–
Na	0.48	0.26	0.07	0.02	0.41	***
K	10.21	2.05	9.40	2.23	0.82	–
BE	9.87	1.66	10.21	2.13	–0.34	–
ME	4.37	0.73	4.52	0.94	–0.15	–

*** = α < 0.001, ** = 0.001 < α < 0.01, * = 0.01 < α < 0.05

which the animals do not prefer mainly because grassland plants do not enable them to make selective choice of suitable parts.

Digestion of nutrients

The coefficients of apparent digestibility of the particular nutrients (Table 3) in the experimental groups were influenced by the ingested amounts but mainly by the different nutrient contents of the feeds. Different quality of lucerne hay did not show the anticipated effect on the course of the digestive processes. With lucerne hay of lower quality significant differences could be stated only in the digestion of crude protein (–10.1% ***) – Tables 3a, 3b. This could be caused by increased selection of feed parts by the animals and by the speed of digesta passage in the digestive tract of the animals. Although they excreted more crude fibre through faeces (443.1 g vs. 343.4 g daily), the total digestibility of crude fibre increased due to the ingestion of higher amounts of fine stalks. The amount of ingested fibre fractions (ADF and NDF) is of great influence as well. In ruminants ADF that comprises fractions of lignin and cellulose shows a negative correlation with nutrient digestibility whereas NDF (fractions of lignin, cellulose and hemicellulose) negatively correlates with the intake of feed dry matter.

Significant differences were observed in the coefficients of dry matter and nutrient digestibility (crude protein, crude fibre, fractions of ADF, NDF, organic matter and fat) between lucerne and meadow hay (Table 3b). In spite of the high quality of meadow hay the coefficients of digestibility of dry matter, crude protein, crude fibre, ADF, NDF and organic matter significantly decreased on average by 14.2% (***), 25.7% (***), 15.8% (***), 20.1% (***), 16.8% and 14.9% (***), respectively (Table 3b). With meadow hay, increased digestibility was observed in crude fat only (by 16.6%; ***). As to the digestibility of ash and nitrogen-free extract, no significant difference could be stated between meadow and lucerne hay. The digestibility of Ca, P and Mg was rather low with both types of hay (Table 3a) so that supplementation with a suitable mineral supplement might be necessary. The coefficients of digestibility determined in our experiments were higher than those reported by Lochman (1975), however, no differences were

Table 3. Coefficients of apparent digestibility

Percentage	Coefficients of apparent digestibility							
	Experiment A		Experiment B		Experiment C		Experiment D	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Dry matter	65.43	1.08	63.85	4.33	48.37	4.09	52.52	4.96
Crude protein	79.96	1.28	69.86	3.88	43.87	6.65	54.54	3.64
Fibre	53.47	2.57	59.09	8.20	37.88	4.76	43.16	7.11
ADF	56.01	3.63	60.91	7.51	40.03	5.17	36.67	9.22
NDF	58.39	4.71	61.06	8.55	43.39	4.77	42.54	5.33
Fat	19.26	9.05	20.62	6.30	38.34	7.97	34.67	8.81
Ash	32.21	4.49	32.42	5.54	23.90	7.18	42.55	7.67
Ca	12.88	7.77			11.53	3.24		
P	32.23	8.65			11.11	0.43		
Mg	35.50	3.16			24.14	8.18		
Na	94.18	0.88			15.64	0.58		
K	97.95	0.49			89.66	2.72		
OM	68.74	1.05	66.24	5.10	51.21	3.98	53.87	4.75
Nitrogen-free extract	79.45	4.72	84.54	5.28	81.49	3.39	81.63	5.01

Table 3a. Statistically significant differences between the coefficients of apparent digestibility (Duncan's test)

Indicator	Difference					
	A – B	A – C	A – D	B – C	B – D	C – D
Dry matter	–	***	***	***	***	*
Crude protein	***	***	***	***	***	***
Fibre	–	***	**	***	***	–
ADF	–	***	***	***	***	–
NDF	–	***	***	***	***	–
Fat	–	***	**	***	**	–
Ash	–	*	**	*	**	***
Ca		–				
P		*				
Mg		**				
Na		***				
K		***				
OM	–	***	***	***	***	–
Nitrogen-free extract	–	–	–	–	–	–

*** = α < 0.001, ** = 0.001 < α < 0.01, * = 0.01 < α < 0.05

Table 3b. Coefficients of apparent digestibility of lucerne and meadow hay

Nutrient	Coefficients of apparent digestibility (%)				Difference $X - Y$	F-test
	lucerne X (A + B)		grass Y (C + D)			
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$		
Dry matter	64.6	3.16	50.4	4.89	14.2	***
Crude protein	74.9	5.92	49.2	7.56	25.7	***
Fibre	56.3	6.55	40.5	6.45	15.8	***
ADF	58.5	6.23	38.3	7.43	20.1	***
NDF	59.7	6.81	43.0	4.90	16.8	***
Fat	19.9	7.57	36.5	8.33	–16.6	***
Ash	32.3	4.87	33.2	12.01	-0.9	–
OM	67.5	3.78	52.5	4.45	14.9	***
Nitrogen-free extract	82.0	5.51	81.6	4.13	0.4	–

*** = α < 0.001, ** = 0.001 < α < 0.01, * = 0.01 < α < 0.05

observed between bucks and does. This fact might be caused by different quality of hay and its botanical composition as well as the selected methods.

Following Ehlenberger (1978) it can be concluded that the need and digestibility of feed nutrients in the roe deer is influenced by several known as well as unknown factors. However, based on our results it can be stated that meadow hay, even of excellent quality, is not a suitable supplementary feed for the roe deer.

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