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ALIMENTARY VALUE OF FODDER CONSTITUTING FEEDING GROUND FOR DEER, LEVEL OF METABOLITES OF PROTEIN-ENERGY CHANGES IN THE CONTENTS OF RUMEN AND SELECTED BLOOD PARAMETERS

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ABSTRACT

Three-year studies were conducted in the area of the Centre of Forest Environment Studies and Chase Game Breeding of Agricultural University of Wrocław. The subject of the investigation was the alimentary base for the deer family in the existing and newly established green crops in this area. The crop yield, botanical composition and alimentary value of the ground flora were determined. The hematological and biochemical indexes were determined in blood and serum of roe deer, deer and fallow deer during a hunting season within deer-hunting periods. Besides, pH, N-NH_3 and LKT sum were determined in rumen content samples taken from the animals shot during hunting.

The alimentary value of fodder coming from green crops depended on the brand composition of ground flora, particularly with regard to protein; fibre and its fractions (ADF, NDF). The level of protein-energy metabolism metabolites in the animals' rumen depended on the species. The hematological and biochemical indexes of blood and blood serum were considerably diversified depending on the species and showed great divergence within species.

Key words: feeding ground, deer, rumen contents, blood.

INTRODUCTION

Human interference into natural environment through changes of cultivation structure, fertilisation, use of pesticides, contamination, urbanisation and fast development of motorization have a negative influence on the population and health of wild animals.

The introduction of vaccination against rabies in foxes and lack of interest in products of red fox fur has significantly increased its population. A highly significant decrease in the number of small animals, mainly hares and partridges – which also constituted natural food for foxes – has resulted in the fact that the fox has become a threat for young roes and fallows, which could be confirmed by our own observations as well as hunters' reports published in hunting periodicals.

In the breeding activities concerning warrantable animals one should aim at the improvement of living conditions also through improving the feeding base and biological shield.

Considering the above factors, efforts have been taken to protect a good feeding base in the area of the Centre of Forest Environment Studies and Chase Game Breeding of Agricultural University in Wrocław.

MATERIAL AND METHODS

Three-year long investigation was conducted at the area of the Centre of Forest Environment Studies and Chase Game Breeding of Agricultural University in Wrocław of 7.655 ha area, including 5.299 ha of forests. The general area of green crops approx. amounted to 15 ha. Three areas were selected for the development by means of a full cultivation method after inventory taking of green crops constituting aa basic feeding base for deer family.

In the spring of 2001, old turf was destroyed chemically, ploughing was carried out, and grass mix and papilionaceous plants were sowed. The crop yield, the botanical composition of ground flora as well as the alimentary value of fodder were determined in subsequent years. The studies were conducted simultaneously in the existing green crops and in the newly established ones.

Basic chemical composition was of the collected fodder samples was determined with standard chemical methods [1], while mineral components (Ca, Mg, Na, K, Zn, Cu and Mn) after prior wet mineralisation, with atomic absorption method [1] by means of AAS-3 apparatus manufactured by Zeiss, and phosphorus with vanadinite-molybdenous method, spectrophotometrically [3].

Neutral-detergent fibre (NDF) and acid-detergent fibre (ADF) were determined with the method described by Goering and Van Soest [6].

Hematological and biochemical blood tests of deer in 40 roes, 24 deers and 22 fallows were conducted during hunting seasons of 2003/2004 and 2004/2005 over the periods for deer hunting.

Blood for testing was taken from the hearts of healthy animals (basing on observation and examination after the shooting of animals) into two test tubes, with heparin and without heparin for biochemical tests.

Serum separation was conducted within 6 hours from blood drawing.

Erythrocyte number (RBC), leukocyte (WBC), hemoglobin level (Hb), hematocrit value (Ht), mean cell volume (MCV), mean concentration of hemoglobin (MCHC) as well as mean hemoglobin mass (MCH) were determined in hematological tests.

Urea level, γ-glumatylotransferase activity (GGT), cholesterol and triglyceride content (TG), sodium, potassium, chloride, calcium, inorganic phosphor and magnesium concentrations were considered in biochemical blood serum tests. The obtained numeric values concerning the indexes in blood and blood serum were prepared with the use of statistical methods usual for such tests [20].

The tests were conducted in the biochemical laboratory of the Department of Internal and Parasitic Diseases with Horse, Dog and Cat Disease Clinic, Agricultural University of Wrocław with the use of generally known and applied methods.

Besides, rumen content samples were collected from the animals shot during hunting and frozen; after defrosting, Ph, $N\text{-}NH_3$ and LKT sum were determined in the rumen liquid. Ph value was determined potentiometrically (Polymetron pH-meter), LKT sum in Margham's apparatus, while $N\text{-}NH_3$ with Conway method [2, 4].

RESULTS AND DISCUSSION

The alimentary value of fodder coming from green crops depended on ground flora species composition, and fluctuated within broad limits (table 1). Total protein content amounted to 9.21% on average in dry matter (s.m. = d.m.). Pasture green crops were distinctly differentiated with regard to the amount of this component. The highest amount of total protein was found in the fodder coming from permanent turf, over 15% in dry matter, and the smallest amount, i.e. only 5.8% of dry matter, in sedge community.

The mean fibre content amounted to 33.40% in dry matter. The ground flora with common cocksfoot included over 40% of this component, while fodder of permanent turf – only about 29% of fibre in dry matter.

The content of neutral-detergent fibre (NDF) including hemicelluloses, celluloses and lignins converted into dry matter of fodder ranged from 63 up to 77%. These values are characteristic of green forage of lower quality or harvested during later vegetation stages [12, 18, 19]. The level of acid-detergent fibre (ADF) in the examined material ranged from 34 up to 53%. The acid-detergent fibre fraction (ADF) including cellulose-lignin complex in plants is usually well digested by all ruminating animals.

The level of protein-energy metabolism metabolites in deer family rumen depended to a certain degree on the animal species [17]. Considering the mean values obtained in tests for individual species (table 2), the highest pH was characteristic of adult fallow deer (6.63), while the lowest – of deer-bulls (5.53). Hydrogen ion concentration in roe deer rumen content remained at a medium level and amounted to 6.25.

$N\text{-}NH_3$ mg% concentration in fallow and roe was similar, and its range in these animals amounted to: from 17.6 up to 30.8, and from 14 up to 33.4%, respectively.

A very high level – 44 and 53.5mg% – of this metabolite was found in two deers. Perhaps the animals fed on young of papilionaceous plants, e.g. lucerne, shortly before being shot (12, 19). A high content of protein in rumen combined with good solubility might have caused a sudden increase of this metabolite level in the rumen content. Generally, high $N\text{-}NH_3$ concentration in the rumen contents was found in all deer family animals. It is probably related to a higher, than in domestic ruminants, secondary circulation of nitrogen in the organism. The level of volatile fatty acids (LKT) sum depended, to a minimal degree, on the species of the evaluated animals. The mean levels for individual species ranged from 11.6 mM/dl in case of deer up to 13.5 mM/dl for adult fallow (table 2). Scant and incomplete information in the available literature does not allow a broader discussion on the course of fermentation processes in the deer family rumen, particularly in case of a different quality of feeding grounds.

The results of hematological and biochemical tests of full blood and serum are presented in tables 3 and 4.

The biggest differences were found in electrolyte levels, in the contents of K^{+}, P-inorg., Mg^{++} and Ca^{++} in deer blood serum (table 4) and in the concentration level of Ca^{++}, P-inorg. and Na^{+} in roe deer.

Table 1. Chemical and mineral composition of ground flora

Details	Components in % of dry matter						Macroelements in g/kg					Microelements in mg/kg		
	ash	protein	fibre	fat	NDF	ADF	Ca	P	Mg	Na	K	Zn	Cu	Mn
1. Type of meadow of common cocksfoot	3.94	8.24	34.88	1.32	65.63	36.93	2.80	1.29	0.92	1.40	2.25	15.84	6.52	264.05
2. Type of meadow of Festuca pratensis	3.71	7.38	31.19	2.91	63.71	34.58	2.37	2.13	0.95	1.86	3.50	24.54	7.01	292.71
3. Type of meadow of Yorkshire fog	3.85	8.20	35.87	1.46	69.92	35.21	2.51	1.50	0.71	1.60	2.33	18.81	6.52	241.32
4. Type of meadow of Carex species	3.58	10.37	28.99	2.34	68.71	36.71	4.11	2.41	1.52	1.12	2.09	33.14	7.24	292.71
5. Meadow by tarmac New turf	3.15	7.31	43.09	2.45	77.08	52.80	2.19	2.29	1.19	2.30	2.62	6.74	6.34	252.43
6. Meadow by tarmac Permanent turf	5.41	10.95	3135	2.93	64.95	35.92	3.27	1.98	1.39	1.51	3.52	14.40	8.53	292.71
7. Meadow by the barn New turf	4.74	9.56	30.18	2.73	62.95	3996	3.47	3.22	0.95	1.98	2.58	6.69	6.63	98.00
8. Meadow by the barn Permanent turf	4.98	15.14	29.56	2.95	63.67	34.18	3.85	2.80	2.34	2.01	3.70	13.13	6.37	151.48
9. Type of meadow of Dactylis glomerata	3.47	5.77	35.57	2.29	71.20	42.44	2.59	1.30	0.92	0.97	1.63	8.21	6.90	63.64
Mean	**4.09**	**9.21**	**33.41**	**2.26**	**67.53**	**38.75**	**3.01**	**2.10**	**1.21**	**1.64**	**2.69**	**15.72**	**6.90**	**216.56**

Table 2. Content of volatile fatty acids and N-NH_3 in the content of deer family rumen

No	Shooting date	Species and individual structure	Body weight in kg	pH	LKT	N-NH_3	
					ml.0.1n NaOH	ml 0.01n H_2SO_4	mg/%
1	19.09.04	Deer-bull	119.0	5.30	13.40	1.52	53.50
2	19.09.04	Deer-bull	111.0	5.76	12.40	0.57	20.05
3	29.09.04	Deer-bull	119.0	5.81	7.00	0.50	17.60
4	3.10.04	Deer-bull	159.0	7.28	2.00	1.25	44.00
5	5.10.04	Deer-bull	141.0	5.27	14.30	0.80	28.15
6	29.09.04	Deer-hind	73.0	5.42	8.20	0.44	33.07
7	18.11.04	Deer-calf	40.0	7.06	9.75	0.77	27.28
mean				**5.99**	**1.85 (excl. 4)**	**0.91**	**31.95**
1	19.11.04	Fallow-bull	34.0	7.12	15.00	0.70	24.64
2	25.11.04	Fallow-bull	45.0	6.42	9.00	0.50	17.60
3	19.11.04	Fallow-hind	35.0	6.32	14.75	0.62	22.00
4	19.11.04	Fallow-hind	31.0	6.76	13.25	0.87	30.80
5	19.11.04	Fallow-hind	33.0	6.52	15.50	0.62	22.00
6	20.10.04	Fallow-calf	20.0	5.16	12.20	1.00	35.20
7	19.11.04	Fallow-calf	18.0	6.97	11.50	0.70	24.64
8	19.11.04	Fallow-calf	22.0	6.52	13.50	0.90	31.68
9	24.11.04	Fallow-calf	17.0	6.42	10.50	0.90	31.68
mean				**6.47**	**12.77**	**0.76**	**26.69**
1	18.09.04	Roe-goat(male)	15.0	6.03	6.20	0.70	24.64
2	19.11.04	Roe-goat(female)	17.0	6.76	10.50	0.90	31.68
3	25.11.04	Roe-goat(female)	18.5	6.07	11.25	0.95	33.44
4	26.11.04	Roe-goat(female)	16.5	6.21	12.50	0.40	14.08
5	26.11.04	Roe-goat(female)	17.5	6.41	11.00	0.60	21.12
6	27.11.04	Roe-goat(female)	18.5	6.33	12.00	0.70	24.64
7	21.10.04	Roe-goating	8.0	6.06	6.40	1.20	42.22
8	26.11.04	Roe-goating	7.5	6.43	8.75	0.50	17.60
mean				**6.28**	**9.82**	**0.74**	**26.17**

Table 3. Hematological indexes of deer blood (mean and limit values)

Species	WBC 10^9/L	RBC 10^{12}/L	HB mmol/L	HT L/L	MCV F/l	MCH pq	MCHC q/dl
Roe	6.35 ± 6.95 (3.8–13.8)	9.47 ± 3.08 (4.95–12.55)	9.52 ± 4.82 (4.7–10.79)	0.39 ± 0.18 (0.27–0.58)	41.18 ± 4.2	16.19 ± 2.1	393.21 ± 21.3
Deer	8.26 ± 6.6 (5.0–15.2)	9.21 ± 6.29 (5.06–15.51)	9.04 ± 6.16 (6.1–15.2)	O.41 ± 0.33 (0.254–0.704)	44.51 ± 3.8	15.81 ± 2.8	355.2 ± 18.4
Fallow	9.10 ± 4.20 (6.0–14.72)	9.35 ± 4.20 (5.20–15.30)	11.80 ± 5.84 (7.20–16.40)	0.42 ± 0.19 (0.28–0.58)	44.91 ± 5.1	20.33 ± 3.4	452.61 ± 23.8

Table 4. Biochemical indexes of deer blood (mean and limit values)

Species	Ureas mmol/l	GGT U/L	Cholesterol mmol/l	TG mmol/l	Ca++ mmol/l	Mg++ mmol/l	P-inorg. mmol/l	Na+ mmol/l	K+ mmol/l	Cl^- mmol/l
Roe	7.05 (2.4–21.6)	244 (125–810)	1.03 (0.61–1.37)	0.81 (0.26–4.15)	2.61 (2.5–3.8)	1.24 (1.18–1.82)	3.71 (2.24–5.81)	141.8 (115–144.1)	9.1 (8.47–115)	98.75 (85.0–108.0)
Deer	6.62 (5.03–22.5)	136.5 (63–138)	0.76 (0.68–1.04)	0.74 (0.46–0.98)	2.55 (2.4–4.0)	1.276 (1.1–2.13)	3.05 (2.31–9.23)	142.5 (136–146)	9.37 (8.75–18.65)	98.05 (84–103)
Fallow	3.0 (2.4–3.8)	170 (140–190)	1.14 (0.80–2.40)	0.70 (0.40–1.10)	2.20 (1.8–2.4)	1.18 (0.92–1.30)	2.41 (1.75–3.20)	145 (137–153)	5.3 (4.8–7.1)	101 (84–109)

Very high differences of hematological indexes were found in all animals of a given species (table 3). As for the tested biochemical indexes of blood, the biggest differences were found in urea levels and GGT activity in roe and deer as well as in cholesterol level in fallow, and triglycerides in roe (table 4).

The obtained values were close to the results obtained by other authors [5, 7, 8, 10, 11, 13, 16, 22, 23]. However, it is necessary to stress that some authors [15, 21] obtained slight differences in limit values contrary to our results, but these studies were conducted in closed animal breeding and considered age and physiological condition related mainly to the mating season.

SUMMARY

The results obtained during the three-year investigation, conducted in the area of the Centre of Forest Environment Studies and Chase Game Breeding of Agricultural University of Wrocław, indicate that the alimentary base constituting the feeding grounds for deer was diversified with regard to the brand composition and alimentary value, and depended on the composition of the ground flora type.

The level of protein-energy metabolites in the rumen of the deer family depended on the animal species.

The hematological and biochemical indexes in the blood and serum of the deer family were characteristic of individual species and showed broad differentiation within species.

The course of fermentation processes in the deer family rumen does not allow complete determination of the alimentary component changes in rumen due to the diversification of the feeding ground quality. The obtained results may constitute a basis for further studies on deer, which should take into consideration the period of animal gaining for tests (seasons of the year) as well as their age.

It seems that the obtained results will allow planning proper forest-pasture management so that deer will use mid-forest areas more effectively.

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