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THE NUTRITIONAL QUALITY OF FEEDSTUFFS USED IN DAIRY GOAT NUTRITION IN VOJVODINA

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Abstract: The study was to conduct to evaluate the chemical composition and nutritive values of feedstuffs (forages and concentrate mixtures) used for dairy goats nutrition in Vojvodina. Samples were collected from six farms, including one organic farm. The results showed that the relative feed values of analyzed forages were in the range of good, medium to lower quality. Average protein content from lowest to highest for investigated forages was: corn silage (*Zea Mays*) (65.37-82.57g kg^{-1}DM), alfalfa haylage (*Medicago sativa L.)* (159.99-184.17g kg^{-1}DM), pasture (185.30g kg^{-1} DM), and alfalfa hay (*Medicago sativa L.*) (167.48-203.60g kg^{-1}DM). The non-fibre carbohydrates and protein content most varied in organic hay samples (cv: 29.25% and 19.09%, respectively). Generally, feedstuffs used in organic nutrition, including organic concentrate, were of lower nutritional quality and moreover contained higher amounts of crude fibre and lignin. Especially, a high source of variation was observed in investigated concentrate mixtures for the crude protein content ($p<0.0001$), ranged from 135.32 to 209.87g kg^{-1}DM. Corn silages also varied substantially in their chemical composition and significant difference ($p<0.05$) was observed in regard to acid detergent fibre (ADF) and lignin content (ranged: ADF: 242.20-319.24g kg^{-1}DM; ADL: 27.98-52.54g kg^{-1}DM, respectively). Furthermore, pasture contained the most soluble materials during May and June and their content was related inversely to crude fibre amount. This survey highlights that investigated farms still pay insufficient attention to the quality of the feedstuff. For the development of intensive goat farming, greater emphasis should be placed on using higher quality feedstuffs, as well, standards for feed quality must be considered and established.

Key words: feedstuffs, chemical composition, nutritional value**,** carbohydrate fractions

Introduction

Goats are often associated with vitality, inquisitiveness and high physical activity. At the same time, they are considered as easily herded animals and nowadays they are reared in various breeding systems, from extensive to highly intensive. Besides that, different feeding management systems are applied, from grazing diets to the total mixed rations (*Cannas et al., 2008*). Proper nutrition is the basis of the successful production systems and with increasing milk yield, producers require technology inputs in nutrition and feeding to improve production efficiency (*Lee et al., 2007*). Furthermore, *Rahmann (2009)* highlighted the importance of feedstuffs quality for highly productive goats and indicated that under these conditions a highly productive organic dairy milk production is possible. Similarly to other domestic ruminants, goats are usually fed *ad libitum,* whether they are reared intensively or extensively but the nutrient quality of forages, herbage from pasture and foliage from bushes fluctuate depending on geographic and climatic conditions (*Pulina et al., 2013*). Goats prefer to consume a wide variety of feedstuffs but in their diet is mostly used hay, silage, or pasture. However, forage quality varies tremendously and its nutritive value can be determined by their chemical composition (*Van Soest, 1965; Van Soest, 1996*). The chemical composition of the feedstuffs can be obtained through chemical or NIR analysis or from published tables of feed composition. The nutritive value of the feedstuffs can be calculated from the chemical composition in accordance with the feed evaluation systems (Institut National de la Recherche Agronomique, INRA; Agricultural and Food Research Council, AFRC; National Research Council, NRC; etc.) (in *Martinez-Marin et al., 2010*). Among the forages, the utilization of alfalfa as hay or pellets is very common. This forage is characterized by higher protein content (more than 16% CP on a DM basis) and lower neutral-detergent fibre (NDF) concentration than permanent pasture hay (*Rapetti and Bava, 2008*). The quality of forages is especially important in intensive systems and should be carefully evaluated (*Rapetti and Bava, 2008*). Moreover, *Oliveira et al. (2014)* added that in contrast to grains and other concentrate supplements, roughages possessed widely variable digestibility values, and thus affected the feed efficiency. The various factors can interact to influence alfalfa chemical composition and as a result, hay from the same farm and field can vary significantly within a year (*Martin et al., 2004*). If forage quality is poor, a large amount of concentrate needs to be supplied in the diet which increases not only feeding costs but also the risk of metabolic disorders (*Rapetti and Bava, 2008*). On the other hand, in order to fulfil the nutrient requirements of high yield and early lactation goats, it is required additional dietary protein sources because microbial protein can only fulfil the requirements in low production in late lactation stages (*Lee et al., 2001*).

In Vojvodina, Province of Serbia, the goat sector has increased significantly during the last two decades. Goat’s milk production in Serbia exhibit a great diversity of systems: from extensive to intensive management and the milk yield of goat in our systems of production depends largely on feeding condition (*Petrović et al., 2017*). Rations containing alfalfa hay and different concentrate mixtures are the most practised feeding strategies in goat husbandry in Vojvodina. Generally, in Serbia, there is a lack of protein in herbage. Therefore, low production and high prices of milk and meat are mostly a consequence of low herbage quality and a high share of concentrated feeds in the diet for ruminants (*Sokolović et al., 2013*). However, studies in quality of feedstuffs used in goat nutrition in Vojvodina are sparse and limited.

The aim of the paper was to determine the chemical composition and nutritional quality of the feedstuffs used in the nutrition of dairy goats in Vojvodina. The present study was therefore undertaken with the special emphasis on providing information on the nutrient components, especially those related to carbohydrate fractions.

Material and methods

Samples collection

The research was carried out in Vojvodina, Province of Serbia. Feedstuffs used in goat nutrition were sampled from 6 farms, in regards to the main breed French Alpine. The goat farms were different in the number of lactating goats (LG) and systems (Table 1).

Table 1. Characteristics of investigated farms

Farms/Parameters	Number of lactating goats (LG)	Farm systems	Feeding management
Farm A (FA)	900	organic	indoors
Farm B (FB)	420	conventional	indoors
Farm C (FC)	250	conventional	indoors
Farm D (FD)	130	conventional	outdoors
Farm E (FE)	48	conventional	indoors
Farm F (FF)	22	conventional	indoors

The feeding strategy was substantially similar in terms that alfalfa hay and water were offered *ad libitum*, and concentrate mixture twice daily at the milking time (in amount: FA: 300g-400g/day/goat, FB, FC, FD: 600-700g/day/goat and FE, FF: 500g/day/goat. Goats received both, the farm produced and commercial feedstuffs. During spring, summer and autumn the nutrition of goats on FD was based primarily on pasture (kept them indoors at night time). Samples of pasture were collected for five months. Supplementary nutrition of concentrated diets was based mostly on cereals grains with the addition of commercial mineral-vitamin mixtures, chalk and NaCl. Furthermore, Farm B used commercial pellets concentrate mixtures. Farms A, E and D occasionally used corn silage while farms E and F alfalfa haylage (ensiling forage into big bales wrapped with plastic).

Feed chemical analyses

In total, samples of alfalfa hay (*Medicago sativa L.*) (n=18), concentrate mixtures (n=15), pasture (n=5), corn silage (*Zea Mays*) (n=9) and alfalfa silage (n=6) were analysed for chemical composition. The analysis of dry matter (DM) content, moisture, crude protein (CP), ether extract (EE) and crude ash (CA) were carried out according to the standards methods (*Official Gazette of SFRJ, 15/87*). The content of nitrogen-free extracts (NFE) was calculated. The examination of crude fibre was done as per AOCS (2005) procedure. The content of acid and neutral detergent fibre was determined using the procedures of Van Soest et al. (1991). Non-fibre carbohydrates (NFC) derived by the equations given by *Van Soest et al. (1991),* total carbohydrates (TC) were estimated from *Sniffen et al. (1992*) and relative feed values (RFV) according to the equation proposed by *Lacefield (1988).* The fractioning of carbohydrates of the feedstuffs was made according to methodologies proposed by *Sniffen et al. (1992)* being the carbohydrates divided into A and B1 fractions (non-fibre carbohydrates, rapidly degradable), B2 fraction (fibre carbohydrates, potentially degradable) and C fraction (fibre carbohydrates, non-degradable).

Statistical analysis

Depending on the values of coefficients of variation (cv), an appropriate method was chosen to test the difference between the groups. For homogenous datasets (cv<30%) the groups were compared using one-way ANOVA followed by Tukey`s multiple comparison test and for heterogeneous datasets (cv>30%) the groups were compared using Kruskal-Wallis ANOVA followed by Dunn`s multiple comparison test. Numerical data for homogenous datasets are presented as mean±standard deviation (Mean±SD) and for heterogeneous datasets as median values with corresponding interquartile range (IQR). Statistical analysis of the chemical feedstuff`s results obtained in the investigation was carried out using statistical software GraphPad Prism version 6 (GraphPad, San Diego, CA, USA). In addition, a significant difference between samples of alfalfa haylage was tested using the t-test.

Results and discussion

Alfalfa hay

The chemical composition of alfalfa hay samples is summarized in Table 2. The content of DM, CP and EE were similar and non-significant variation in these parameters occurs between investigated farms. Contrary, CF and CA content showed a significant difference ($p<0.05$, $p<0.01$, respectively). Generally, alfalfa hay contains DM in approximate 820-900g kg^{-1} and our results were in this range (863.30 (FE) to 908.50g kg^{-1}DM (FC). Although the EE is an excellent source of energy, it is generally low in forages and roughages. By looking at the protein content it can be observed that our samples varied from 167.48 (FD) to 203.60g kg^{-1}DM (FB), with the highest coefficient of variation for organic hay (cv: 19.09%). *Blair (2011)* reported that value of alfalfa hay lies in its relatively high content of crude protein, which may be as high as 200g kg^{-1}DM if it is made from a crop cut in the early bloom stage. During the maturation of the alfalfa, the proportion of fibres and lignin increases while NFC and protein content decreases (*Martin et al., 2004*). The average high CF content was obtained for almost all farms with the exception of samples collected at FB. Moreover, it was significantly different ($p<0.05$) from FC, FD and FE. Feeds high in crude cellulose can furnish most of the ruminant`s maintenance energy needs. The content of fibre is needed to maintain a normal milk-fat test and a certain minimum fibre level is required for a healthy rumen function. However, too much poor quality fibre will lead to lowered levels of milk production (*Van Soest, 1994*). According to, *Morand-Fehr and Sauvant (1980)* hay of medium quality could reduce milk production by 15 to 25%. For dairy goats, the maximum and minimum fibre contents in the diet to maximize intake and production efficiency are not yet well defined (Oliveira et al., 2014). However, *Lacefield (1988)* pointed out that hay must be low in fibre and palatable for the animal to consume enough of it. Furthermore, the research of Oliveira et al. (2014) confirmed the negative effect of increasing the dietary fibre and NDF content on feed efficiency in lactating goats.

Table 2. The chemical composition of Alfalfa hay (g kg⁻¹DM)

Farms/Parametres		FA	FB	FC	FD	FE	FF	P
DM g kg $^{-1}$	M	881.30	894.43	908.50	895.47	863.30	875.60	ns
	±Sd	±13.00	±16.80	±9.68	±11.98	±53.62	±17.80	
	cv(%)	1.47	1.88	1.06	1.34	6.21	2.03	
CP	M	173.77	2036.0	168.42	167.48	179.40	201.16	ns
	±Sd	±33.17	±5.67	±22.51	±22.40	±33.55	±9.71	
	cv (%)	19.09	2.78	13.36	13.37	18.70	4.83	
EE	M	14.45	12.97	12.41	13.73	12.48	13.55	ns
	±Sd	±2.34	±0.75	±0.68	±0.62	±2.19	±0.34	
	cv (%)	16.19	5.78	5.48	4.52	17.55	2.51	
CF	M	353.84	289.05	367.24	364.84	364.86	345.49	*
	±Sd	±7.43	±29.23	±16.60	±11.76	±44.00	±13.93	
	cv (%)	2.10	10.14	4.52	3.22	12.06	4.03	
CA	M	73.41	97.76	77.94	74.25	95.51	86.77	**
	±Sd	±3.03	±6.73	±1.89	±12.18	±9.66	±2.25	
	cv (%)	4.13	6.88	2.42	16.40	10.11	2.59	
NFE	M	384.43	396.61	373.99	379.69	345.36	353.36	ns
	±Sd	±30.19	±22.12	±11.99	±24.58	±54.32	±9.27	
	cv (%)	7.85	5.58	3.21	6.47	15.73	2.62	
NDF	M	549.89	436.12	513.79	541.04	505.16	502.08	*
	±Sd	±50.95	±28.05	±23.67	±29.94	±34.91	±15.25	
	cv (%)	9.26	6.43	4.61	5.53	6.91	3.04	
ADF	M	429.15	372.24	440.14	438.35	404.78	412.90	ns
	±Sd	±17.94	±28.15	±5.88	±11.53	±52.25	±28.91	
	cv (%)	4.18	7.56	1.34	2.63	12.91	7.00	
ADL	M	89.42	76.15±	107.10	91.54	82.98	86.98	ns
	±Sd	±12.08	4.29	±5.94	±4.74	±17.67	±12.54	
	cv (%)	13.51	5.63	5.55	5.18	21.29	14.42	
NFC	M	188.19	249.56	227.44	203.49	210.79	196.44	ns
	±Sd	±55.05	±26.87	±3.30	±11.54	±31.79	±10.34	
	cv (%)	29.25	10.77	1.45	5.67	15.08	5.26	
RFV	M	114.62	150.92	115..35	111.99	131.66	123.01	*
	±Sd	±7.98	±18.40	±6.38	±7.48	±7.57	±17.30	
	cv (%)	6.96	12.19	5.53	6.68	5.75	14.06	

DM-Dry matter; CP-Crude protein; EE-Ether extract; CF-Crude fibre; CA-Crude ash; NFE-Nitrogen-free extract; NDF-Neutral detergent fibre; ADF-Acid detergent fibre; ADL-Acid detergent lignin; NFC-Non-fibre carbohydrates; RFV-Relative feed value; M±Sd: Mean±Standard deviation; cv (%)-coefficient of variation; P-Statistic probability; *: $p<0.05$; **: $p<0.01$; ns-not-significant

Our results showed that the proportion of non-degradable carbohydrates fractions were the highest in samples collected from farms C, F, D and A (Table 5.) as well indicated lower hay feeding value for dairy goats. This is confirmed by RFV which showed that hay collected from investigated farms were ranged of good (FB), medium (FE) to less quality (FA, FC, FD and FF) (Table 2).

b) Concentrate mixtures

Table 3 shows the results of the analysed concentrate mixtures. Significant interactions were observed for most investigated parameters. Especially, a highly significant source of variation (p<0.001) was found for the content of dietary CP. Thus, it was varied in the range from 135.32 (FD) to 209.87g kg^{-1}DM (FE).

Table 3. The chemical composition of concentrate mixtures (g kg^{-1}DM)

Farms/Parametres		FA	FB	FC	FD	FE	P
DM g kg^{-1}	M	886.23	885.57	870.93	862.93	891.97	ns
	±Sd	±113.19	±20.85	±5.80	±14.37	±1.90	
	cv (%)	1.49	2.35	0.67	1.66	0.21	
CP	M	191.67	187.15	190.70	135.32	209.87	****
	±Sd	±5.38	±4.96	±4.02	±6.38	±4.51	
	cv (%)	2.81	2.65	2.11	4.71	2.15	
EE	M	41.46	62.82	29.9	43.09	44.36	*
	±Sd	±4.81	±4.96	±2.57	±18.75	±0.45	
	cv (%)	11.60	7.89	8.59	43.51	1.01	
CF	M	103.47	62.79	94.71	63.93	101.59	****
	±Sd	±4.90	±2.20	±2.36	±3.33	±9.44	
	cv (%)	4.74	3.50	2.49	5.21	9.29	
CA	M	73.16	66.33	59.24	61.31	69.56	*
	±Sd	±3.31	±2.12	±2.62	±0.91	±10.53	
	cv (%)	4.52	3.20	4.42	1.48	15.14	
NFE	M	590.23	620.91	625.45	696.35	611.84	**
	±Sd	±6.63	±5.66	±6.35	±15.03	±44.05	
	cv (%)	1.12	0.91	1.01	2.16	7.20	
NDF	M	267.28	159.99	274.97	184.53	231.86	****
	±Sd	±27.87	±1.16	±15.46	±4.02	±11.23	
	cv (%)	10.43	0.72	5.62	2.18	4.84	
ADF	M	109.35	80.18	122.51	90.91	104.54	***
	±Sd	±9.96	±2.68	±7.50	±1.54	±13.04	
	cv (%)	9.11	3.34	6.12	1.69	12.47	
ADL	M	33.87	15.86	25.19	22.36	21.11	***
	±Sd	±1.95	±1.57	±0.87	±2.21	±5.57	
	cv (%)	5.76	9.90	3.45	9.88	26.38	
NFC	M	426.43	523.71	445.20	575.36	463.73	***
	±Sd	±18.43	±8.55	±19.24	±18.71	±57.83	
	cv (%)	4.32	1.63	4.32	3.25	12.47	

DM-Dry Matter; CP-Crude protein; CF-Crude fibre; EE-Ether extract; CA-Crude ash; NFE-Nitrogen-free extract; ADF-Acid detergent fibre; NDF-Neutral detergent fibre; ADL-Acid detergent lignin; NFC-Non-fibre carbohydrates; M±Sd: Mean±Standard deviation; cv (%)-coefficient of variation;
P- Statistic probability; *: p<0.05; **: p<0.01; ***: p<0.001; ****: p<0.0001; ns-not-significant

Concentrates mixtures in ruminant nutrition, could be either, rich in energy or protein and the occurred difference reflected different goat feeding practices in Vojvodina. The animal feed industry offers different types of concentrate, especially with different CP contents. Therefore, the current Serbian legislation does not recognize limits for quality and compositional parameters of dairy goats concentrate. The concentrates fed on dairy goat farms often determine the majority of the cost of milk production, yet little guidance is given to farmers in ration balancing (*Delaney et al., 2008*). Most commercially prepared goat concentrates contained 12-17% of crude protein but it is of major importance that the dairy goats have a balanced diet. Different carbohydrates intake as a source of energy is important for better efficiency of nitrogen utilization. Particularly, it is important for having a balance between the amounts and availabilities of N and energy to the rumen microbial population (*Waldo, 1967*). In research done by *Schmidely et al. (1999)* goats fed with the rapidly degraded diet compared with goats fed the slowly degraded diet possessed a greater amount of N in urine and at the same, the efficiency of N use for milk output was better but N balance was lower.

Concentrate feedstuffs have a high content of rich-carbohydrate components in the form of various sugars and starch (fractions A+B_1, Table 5.). NFC possessed high soluble digestibility and highest amount, as expected, was determined in low-protein concentrate (FD) but also in pelleted concentrate mixtures (Tables 3 and 5.). In addition, pelleted concentrate mixtures contained the lowest values of dietary CF, NDF, ADF and ADL, which contributes to its higher digestibility. It is advisable to use concentrates as pellets, in order to avoid feed selection and pulmonary disease caused by dust inhalation which can occur when the particle size of the feedstuff is too small (*Rapetti and Bava, 2008*).
Organic concentrate compared to other concentrate mixtures contained higher amounts of dietary CF and ADL and according to this lower nutritional quality.

Considering the fat content, it is most varied in samples collected from FD (cv: 43.51%). Fat energy density should be an advantage when formulating rations for high producing dairy goats. Higher levels of fat will limit consumption and can result in gastrointestinal discomfort, but goats, unlike other ruminants, can tolerate more than 6% of dietary fat (*Kouakou et al., 2008*). In many cases, it is possible that the nutrient composition of concentrate does not complement properly hay. As a consequence, the final ration does not fully satisfy the nutrient requirements of goats (*Rapetti and Bava, 2008). Pulina et al. (2008)* recommended that forage/concentrate ratio should be higher than 45–55 to maintain milk fat content above 3%. If the quantity of concentrate in the diet is increased milk fat content will slightly decrease (*Morand-Fehr et al., 2007; Pulina et al., 2008*) but results of *Morand-Fehr and Sauvant (1980)* showed that milk production was improved by almost 20% with the diet high in concentrate.

c) Corn silage and alfalfa haylage

The proximate composition of corn silage and alfalfa haylage has been presented in Table 4. Significant differences ($p<0.05$) were observed for the parameters of dietary CP, ADF and ADL for corn silage samples. Furthermore, analysis of this feedstuff quality showed variability in NDF and ADL cell wall content, and particularly in organic silage for EE content (cv: 34.08%).

Table 4. The chemical composition of corn silage and alfalfa haylage (g kg $^{-1}$DM)

Farms/Parameters		Corn silage			Alfalfa haylage	
		FA	FD	FE	FE	FF
DM g kg^{-1}	M	289.57	375.98	353.30	416.27	366.87
	±Sd	±34.67	±7.20	±22.93	±46.55	±45.97
	cv(%)	11.97	1.91	6.49	11.18	12.53
CP	M	74.47*	65.37*	82.50*	159.99	184.17
	±Sd	±5.81	±1.86	±5.18	±38.32	±13.30
	cv (%)	7.80	2.84	6.27	23.95	7.22
EE	M	21.54	23.82	28.30	26.14	28.78
	±Sd	±7.34	±1.10	±4.11	±8.48	±4.09
	cv (%)	34.08	4.62	14.48	32.44	14.21
CF	M	241.22	217.04	227.40	317.44*	280.51*
	±Sd	±35.59	±21.57	±67.42	±16.18	±12.93
	cv (%)	14.75	9.94	29.65	5.10	4.61
CA	M	47.23	42.17	39.70	120.41	160.95
	±Sd	±12.98	±1.08	±4.17	±27.20	±72.93
	cv (%)	27.48	2.56	10.49	22.59	45.31
NFE	M	613.13	651.60	621.80	376.90	345.59
	±Sd	±35.88	±21.72	±69.74	±25.39	±78.97
	cv (%)	5.85	3.33	11.21	6.74	22.85
NDF	M	480.08	423.44	414.00	510.32	456.65
	±Sd	±32.19	±63.54	±49.94	±93.61	±48.21
	cv (%)	6.71	15.01	12.06	18.34	10.56
ADF	M	319.24*	261.02*	242.20*	381.14	363.89
	±Sd	±23.51	±19.08	±30.66	±46.28	±21.93
	cv (%)	7.36	7.31	12.65	12.14	6.03
ADL	M	52.54*	36.24*	27.98*	75.60	82.71
	±Sd	±11.45	±0.62	±8.61	±11.50	±16.43
	cv (%)	21.79	1.71	30.77	15.21	19.86
NFC	M	376.69	445.47	435.20	183.15	190.65
	±Sd	±33.51	±63.32	±50.45	±92.85	±44.50
	cv (%)	14.68	14.21	11.59	50.70	23.34
RFV	M	121.98	153.44	159.28	110.91*	130.73*
	±Sd	±6.35	±28.52	±24.72	±24.63	±18.45
	cv (%)	5.21	18.59	15.52	22.21	14.11

DM-Dry Matter; CP-Crude protein; CF-Crude fibre; EE-Ether extract; CA-Crude ash; NFE-Nitrogen-free extract; ADF-Acid detergent fibre; NDF-Neutral detergent fibre; ADL-Acid detergent lignin; NFC-Non-fibre carbohydrates; ; M±Sd: Mean±Standard deviation; cv (%)-coefficient of variation; *:p<0.0

According to *Van Soest (1982),* high NDF values above 480-500g kg^{-1}DM reduce the silage quality and consequently decrease consumption rates. In our study, organic corn silage possessed high levels of NDF (480.08g kg $^{-1}$DM) and lower nutrient value (RFV, 121.98). Silage production could be an alternative to haymaking but its nutritional value can be also quite variable (*Martin et al., 2004; Blair, 2011*). In comparison to alfalfa hay, corn silage contains much less protein and ash content (30-50%), but significantly more NFC. The difference in protein, fibre and NFC between these two feedstuffs suggests that they might complement one another in dairy rations (*Martin et al., 2004*). Furthermore, *Canizares et al. (2008)* recorded that high moisture corn silage can total or partially replace corn grain without affecting milk production in Alpine goats. It must also be noted that in the presence of certain feeds, such as hay and silage goats showed selective feeding behaviour and more aggressive competition for hay than silage which confirmed their higher preference for hay (*Jorgensen et al., 2007*).

The alfalfa haylage samples showed a significant difference ($p<0.05$) in regard to the content of TC and RFV value (Tables 4 and 5). Comparing our results with values obtained by *Vranić et al. (2011)* our samples contain markedly higher values of average crude protein (141.6g kg^{-1}DM) while the content of NDF was in a similar range (447.0-527.0 g kg^{-1}DM).

Table 5. Carbohydrate fractions of the feeds in the proportion of total carbohydrates

	TC g kg^{-1}DM, M±Sd	Fraction A+B1,%	Fraction B2, %	Fraction C, %
Alfalfa hay				
FA	738.37±35.17	25.49	62.36	12.11
FB	685.68±12.33	36.39	52.50	11.11
FC	741.23±24.99	30.68	54.87	14.45
FD	744.53±34.70	27.33	60.37	12.30
FE	712.61±43.80	29.58	59.02	11.40
FF	698.52±7.42	28.13	59.42	12.45
Concentrate mixtures				
FA	693.70±9.52****	61.47	33.65	4.88
FB	683.70±7.71****	76.60	21.02	2.38
FC	720.20±3.99****	61.82	34.68	3.50
FD	760.30±15.67****	75.68	21.33	2.99
FE	676.20±14.99****	67.02	30.01	2.97
Corn silage				
FA	856.76**	43.97	49.90	6.13
FD	868.64**	51.28	44.55	4.17
FE	849.28**	51.25	45.46	3.29
Lucerne silage				
FE	693.46*	26.41	62.69	10.90
FF	626.11*	30.45	59.72	13.21
Pasture				
May	710.80	26.83	67.00	6.16
June	702.00	25.71	59.87	7.51
July	677.65	14.36	78.46	7.20
August	635.86	20.22	70.87	8.91
September	718.37	21.93	71.70	6.37

TC-total carbohydrates; fractions A+B1-rapidly degradable carbohydrates; fraction B2-potentially degradable carbohydrates; fraction C-non-degradable carbohydrate; *: $p<0.05$; **: $p<0.01$; ****: $p<0.0001$

d) Pasture

The average chemical composition of natural pasture in the five-month period is reported in Figure 1. The quality of pasture depends on many factors: grass species, nutrient composition, stage of maturity, soil and climatic conditions etc. Generally, stage of maturity and nutrient contents of these feed resources often is not correlated and protein content decreased as the season advanced and fibre fractions increased. *Leng (1990)* reported that pasture can be considered to be of low to intermediate nutritional quality if they contain less than 55% organic matter and 8% CP. According to this, investigated pasture could be categorised of lower quality forages due to the average percent of CP was below the stated value. In further, the highest content of NDF and at the same, the lowest values in RFV were registered during the summer and autumn months. The different fractions of carbohydrates vary considerably during the season. The highest values of A+B1 carbohydrate fraction were recorded in the first two months of investigation. Similar results have been published by *Tudisco et al. (2010).* They recorded the worst chemical composition of pasture in July. On the other hand, the highest protein content and low NDF was registered during May and September. This is in general means that, in summer, the marked decrease in fermentable compounds, especially sugars, is followed by an increase in fibre fractions which greatly reduce the nutritive value of the grass (*Bonanno et al., 2008*). Mature forage will have high lignin content and be of limited use to grazing animals (*Pulina et al., 2008*).

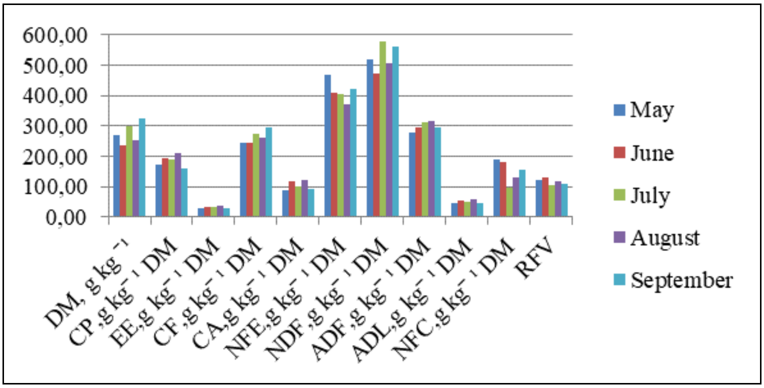

Figure1. Chemical composition of pasture in five months period

Conclusion

Investigated farms used different concentrate mixtures (energy or protein-rich concentrate) and present different supplementary feeding strategies. The obtained results showed that the nutritional quality of feedstuffs used in the goat's nutrition

in Vojvodina was widely variable. Results also indicated that in particular, organic and small conventional farms used feedstuffs of less quality and therefore of lower nutritional quality. Moreover, relative feed value for alfalfa hay, haylage and corn sillage, showed different values, in the range from the highest, medium to lowest quality forage. This was probably caused by a different productivity strategy and still insufficiently developed goat and especially, organic livestock management system. Even though considerable advances have been made in goat dairy production, and progress is being made relative to feedstuffs quality, the development of feeding systems for goats is even more challenging. It requires not only the optimization of natural and local resources but the efforts, together with government considerations should be intensified to improve and established standards for goat's feed quality. An intensive feeding system based on pelleted concentrate mixtures and quality hay showed that it could be an alternative promising feeding system to rear goats more effectively.

Nutritivni kvalitet hraniva koja se koriste u ishrani mlečnih koza u Vojvodini

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Rezime

Istraživanje je bilo sprovedeno sa ciljem procene hemijskog sastava i nutritivne vrednosti kabastih hraniva i smeša koncentrata koja se koriste u ishrani mlečnih koza u Vojvodini. Ispitivano je ukupno šest farmi,uključujući i organsku farmu. Dobijeni rezultati su pokazali da se relativna hranibena vrednost analiziranih kabastih hraniva kretala od dobrog, srednjeg do slabijeg kvaliteta. Prosečan sadržaj proteina od najmanjih do najviših vrednosti se kretao u opsegu: kukuruzna silaža (*Zea Mays*) (65.37-82.50g kg^{-1}DM), senaža lucerke (*Medigao sativa L.)* (159.99-184.17g kg^{-1}DM), pašnjak (185.30g kg^{-1}DM) i seno lucerke (*Medigao sativa L.*) (167.48-203.60g kg^{-1}DM). Sadržaj nestrukturnih ugljenih hidrata i proteina pokazao je najveće varijacije u uzorcima organskog sena (cv: 29.25% и 19.09%, pojedinačno). Generalno, hraniva koja su bila ispitivana na organskoj farmi, uključujući organske smeše koncentrata, su pokazale lošiji nutritivni kvalitet usled većeg sadržaja sirovih vlakana i lignina. Posebno su utvrdjene velike varijacije u ispitivanim smešama koncentrata u pogledu sadržaja proteina ($p<0.0001$), koji je bio rangiran od 135.32 do 209.87g kg^{-1}DM. Kukuruzne silaže su takodje značajno varirale u njihovom hemijskom sastavu i signifikantna razlika ($p<0.05$) je utvrdjena u pogledu sadržaja kiselih deteržent vlakana (ADF) i lignina (u opsegu: ADF:

242.20-319.24g kg^{-1}DM; ADL: 27.98-52.54g kg^{-1}DM, pojedinačno). Osim toga, utvrdjeno je da je pašnjak posedovao najviše rastvorljivih materija tokom Maja i Juna meseca a njihov sadržaj je bio obrnuto povezan sa sadržajem sirovih vlakana. Ovo istraživanje je pokazalo da ispitivane farme još uvek ne posvećuju dovoljno pažnje kvalitetu hraniva. Za razvoj intenzivnog uzgoja koza, veći naglasak treba staviti na upotrebu kvalitetnijih hraniva i istovremeno standardi kvaliteta hrane moraju biti razmotreni i utvrđeni.

Ključne reči: hraniva, hemijski sastav, nutritivna vrednost, frakcije ugljenih hidrata

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