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DEGRADABILITY OF DRY MATTER AND OF CRUDE PROTEIN IN FEEDSTUFFS AND IN RATIONS FOR COWS BY IN SACCO METHOD

RAZGRADLJIVOST SUHE TVARI I SIROVIH BJELANČEVINA U HRANI I OBROCIMA KRAVA POSTUPKOM "IN SACCO"

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SUMMARY

The degradability of dry matter and crude protein in two summer feeding rations for cows was studied. The degradability of two feeding mixtures (K1 and K2) which were fed within the first and the second ration, respectively, and of two types of oil seed meal which were included in K1 and in K2 were also studied. The basic ration was the same in both cases: pasture 40 kg, 4.5 kg hay and 4.2 kg mixture. After 48 hours, the degradability of dry matter (DDM) and crude protein (DCP) and effective protein degradability (EPD) for the ration with K1 was 86,15%, 89,41% and 65,71% and 84,50%, 86,99% and 65,14%, respectively, for the ration with K2; 92,30%, 80,52% and 50,94% for K1, 87,25%, 62.81% and 44.66%, respectively, for K2; 97,90%, 100,00% and 74.92% for soybean meal, and 71.09%, 73.42%, 43.38% for rape seed meal. The differences in DDM, DCP and EPD between oil seed meals and K1 and K2 were statistically highly significant.

Introduction

The protein value of some feedstuffs for ruminants depends on the solubility of crude protein and on their degradability in the rumen, on the amino-acid composition and digestibility of degraded part in the small intestines.

The protein degradability is effected by various factors such as the structure and composition of protein.

Orskov (1982) reports that the size of degradability of crude protein of a certain feedstuff depends on the feedstuff itself and on the conditions in the rumen. A significant difference exists among feedstuffs in degradability of protein. Therefore, it is necessary to know the degradability of crude protein and other nitrogen compounds in feedstuffs with the view of better and rational supply with protein in ruminants, especially if voluminous feeds are included into rations as supplements to feed mixtures or if some concentrates are comprised. A suitable combination of feedstuffs in rations for ruminants depends also on dynamics of protein and dry matter degradability in a certain feedstuff. A regular supply with protein contributes to a lower loss of nitrogen from the rumen which means lower secretion of nitrogen with urine. In greater herds the latter represents a danger for the environment.

In sacco method has already been proved as successful for the study of crude protein degradability in a rumen. In the last few years a lot of researches on feedstuff evaluation have been carried out by this method. The method is especially useful for evaluation of crude protein content in feedstuffs and for evaluation of protein

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needs in cattle. Weisbjerg and Hvelplund (1993) report that this method is more reliable for prediction of protein degradability than in vitro method.

A lot of studies investigating can be found the protein degradability in concentrates and in voluminous feed in literature (Varvikko et al.; 1988, Seghal et al., 1988; Tompson et al., 1988; Sekine et al., 1988; Ćeresnakova et al., 1988; Ramazin et al., 1989; Michalet-Doreau, 1990; Fritz et al., 1990; Amrane et al., 1991; Arruda et al., 1992; Mayombo et al., 1992; Grbeša et al., 1992; Khazaal and Orskov, 1993). Data on protein degradation in concentrates do not differ while the data on the voluminous feed do.

In Slovenia degradability of crude protein has been determined by in sacco method only for some voluminous feedstuffs, i.e. red clover and maize (Verbič, 1987, 1992), cock's foot and crimson (Babnik, 1989, 1992), lucerne (Brus, 1989), grazing grass and hay (Kac, 1990). Orskov (cit. by Brown, 1989) reports that degradability of protein is not a constant value and that it depends on the way of feeding.

The aim of the present research is to evaluate the protein value of two summer rations by in sacco method. Two herds of dairy cows received two different feed mixtures which were included into rations.

Material and methods

The degradation of dry matter and crude protein of feedstuffs in rations was determined in rumen of two fistulated cows of Holstein-Friesian breed. Cows were fastened. Cows were fastened. During the trial they were fed on hay, total 9 kg dry matter a day, and water ad libitum. The cows were dried during the trial.

We used in sacco method (by Mehrez and Orskov, 1977 and Orskov et al., 1989).

Samples at 10 g dry matter were incubated in bags at 14 x 26 cm in two repetitions and in two paralles in the following periods: 1,5; 3; 24 and 48 hours. The effective degradability of crude protein was calculated by Kristensen et al. (1982). Results were processed by SAS.

The experimental ration consisted of a whole-day grazing - 40 kg, 4,5 kg hay and 4,2 kg feed mixture K1 or K2. Feed mixture K1: maize (55,9%), tapioca (30%), soybean meal (9,0%) and mineral- vitamin mixture (5,1%). Feeding mixture K2: maize (85,8%), soybean meal (4,1%), rape seed meal (5,9%) and mineral-vitamin mixture (5,2%).

Chemical analyses were accomplished for hay for the experimental animals, for experimental rations, feed mixture and oil meals and for samples after the incubation.

Results and discussion

In Table 1, chemical composition of included feedstuffs is given.

Table 1: Chemical composition of feeds (g/kg dry matter)
Tablica 1. Kemijski sastav hrane (g/kg suhe tvari)

Composition Hranjive tvari	Pasture Paša	Hay Sijeno	Feeding mixture Mješavine		Oilseed meals Sačme	
			K1	K2	Soya Soje	Rape Repice
Dry matter,g/kg suha tvar,g/kg	195,0	888,0	880,0	870,0	898,9	916,3
Crude protein Sirove bjelančevine	185,0	128,0	115,0	116,0	481,2	389,5
Crude fibre Sirova vlaknina	205,0	293,0	49,0	41,0	72,7	130,5
Ether exract. Sirova mast	46,1	27,0	27,0	33,0	16,3	13,8
Crude ash. Pepeo	133,0	82,0	62,0	61,0	68,1	72,7
N-free extractives Nedušične ekstraktivne tvari	446,0	470,0	746,0	748,0	361,7	393,5

Feed mixtures K1 and K2 differed in the content of crude fibres. Besides the high portion of tapioca (39%) in K1, it also contained 8 g crude fibres in a kg of dry matter more than K2, where maize prevailed (85.8%). Lignin nad crude protein in feedstuffs could not effect the use of feedstuff in a rumen neither could they effect the degradability of dry matter (Arruda et al., 1992) and crude protein (Lindberg, 1985). Regarding the content of crude protein the feed mixtures K1 with 115 g and K2 with 116 g in a kg of dry matter were nearly equal.

The calculated nutritive value of an average consumed ration is as follows: 15.6 kg dry matter, 2951 g crude fibre, 2377 g crude protein and 105.8 MJ NEL per a cow. The ration corresponds to the production of 22,2 kg milk with 4% fat if consumed energy is considered (DLG standards for ruminants, 1982) and to the production of 23,6 kg milk if digestible protein is considered.

Cows which were given the experimental ration produced 25,35 kg FCM a day.

Table 2: In sacco degradability of dry matter in incubation period (%)
Tablica 2. In sacco razgradljivost suhe tvari u inkubacionoj periodi (%)

Feeds Hrana		Hours - Sati					
		1,5	3	6	12	24	48
Ration with K1 Obrok s K1	$\bar{x}$	35,94	38,67	48,69	62,78	77,91	86,15
	SD	0,68	1,52	2,76	4,74	1,42	0,79
Ration with K2 Obrok s K2	$\bar{x}$	32,63	35,66	47,20	59,37	77,06	84,50
	SD	0,59	1,05	3,12	3,81	2,53	1,99
Feeding mixture K1 Krmna smjesa K1	$\bar{x}$	46,27	48,13	56,45	66,40	82,96	92,30
	SD	1,47	2,26	4,12	4,68	7,12	1,96
Feeding mixture K2 Krmna smjesa K2	$\bar{x}$	34,77	37,19	41,18	52,35	67,96	87,25
	SD	1,69	2,17	2,54	3,92	2,34	3,13
Soybean meal Sojina sačma	$\bar{x}$	41,00	45,63	59,71	83,02	94,71	97,90
	SD	2,87	2,52	5,58	5,59	3,32	0,43
Rape seed meal Repičina sačma	$\bar{x}$	29,00	29,88	32,53	40,77	56,12	71,09
	SD	0,42	0,90	0,94	4,81	5,04	2,88

Table 2 shows that the degradation of dry matter in rations has been practically equal after 48 hours of incubation and is not statistically significant (F=1,18). The difference between the mixtures is statistically highly significant (F=7,78) as well as the difference between the oil seed meals (F=110,76).

The difference in degradability of dry matter between soybean meal and rape seed meal is high. The starting difference for 1.5 hour of incubation increases till 12 hours of incubation and it decreases slowly till 48 hours of incubation. After 48 hours of incubation, the degradability of dry matter in soybean meal is 97.90%, and only 71.09% for rape seed meal. The differences between the incubation periods of feed mixtures and oil meals are statistically significant, first on the lower and later on the higher level.

Table 3: In sacco degradability of crude protein (%)
Tablica 3. In sacco razgradljivost sirovih bjelančevina (%)

Feeds Hrana		Hours - Sati					
		1,5	3	6	12	24	48
Ration with K1 Obrok s K1	$\bar{x}$	35,01	37,9	48,82	68,30	83,41	89,41
	SD	0,89	1,63	3,87	6,27	1,42	1,21
Ration with K2 Obrok s K2	$\bar{x}$	34,75	39,04	51,29	65,93	82,37	86,99
	SD	0,76	5,08	4,34	5,29	1,52	3,36
Feeding mixture K1 Krmna smjesa K1	$\bar{x}$	27,63	29,74	36,29	43,64	62,81	80,52
	SD	2,27	2,80	3,01	7,75	8,46	9,36
Feeding mixture K2 Krmna smjesa K2	$\bar{x}$	31,28	33,49	37,63	42,04	47,71	62,81
	SD	3,12	2,31	3,74	4,54	3,55	4,23
Soybean meal Sojina sačma	$\bar{x}$	31,00	38,85	54,14	81,71	100,00	100,00
	SD	4,58	3,98	7,90	9,17	0	0
Rape seed meal Repičina sačma	$\bar{x}$	23,52	25,52	28,76	36,35	51,66	73,42
	SD	1,21	1,37	1,55	5,85	6,17	5,07

Table 3 shows in sacco degradability of crude protein of rations, feed mixtures and oil seed meals.

Nearly all proteins consumed from ration degrade in

the rumen. In our trial both rations are highly degraded after 12 hours of incubation, i. e. 68.30% and 65.93%, and 89.41% and 86.99% after 48 hours of incubation. The degradability of protein in voluminous feedstuffs is affected by the voluminous feedstuff and concentrate ratio (Ramanzin et al., 1989). In our experimental rations, the proportion of protein from voluminous feedstuffs is 82% and 18% from concentrates. Voight and Piatkowski (1987) report that there exists a connection between degradability of crude protein and dry matter and even more, by increase in degradability of dry matter the protein degradability increases as well. In both rations the degradability of dry matter is high after 48 hours of incubation. The difference in degradability of crude protein between the rations is significant on the level p=0.05 (F=2,71) and the difference in incubation periods for the ration with K1 between 1,5 and 3 hours of incubation is significant on the level p=0,05, and among other periods on the level p=0,001. The periods of incubation in the ration with K2 have the same degradability of crude protein except the periods of 24 and 48 hours when the difference is significant on the level p= 0,05.

In our trial, the degradability od crude protein was 80.52% for feed mixture K1 at 48 hours of incubation and 62.81% for K2; the difference between the mixtures K1 and K2 statistically very highly significant (F=217,16). Differences in degradability of crude protein for incubation periods are significant in K1 for incubation periods between 3 and 6 hours on the level p=0,001.

The degradability of crude protein in soybean meal after 12 hours of incubation was 81.71% and 100% after 48 hours of incubation. The degradability of crude protein in rape seed meal was lower; after 24 hours of incubation it was only 51.66% and after 48 hours 73.42%. Differences could be the consequence of chemical composition. Soybean meal contained 481 g crude protein and 72.7 g crude fibre in a kg of dry metter, and rape seed meal 389.5 g crude protein and 130.5 g crude fibre. The difference in degradability of crude protein in oil seed meals is statistically very highly significant (F=186,28). Differences in degradability of crude protein of oil seed meals for various incubation periods are significant for the incubation periods 1,5 and 3 hours on the level p=0,02, while for 3 and 6 hours and 6 and 12 hours they are significant on the level p=0.001.

Regarding rape seed meal, the difference in degradability of crude protein for incubation period 3 and 6 hours is significant on the level 0,05, and for the other periods on the level p=0,001.

Table 4 shows the effective degradability of crude protein in rations, feed mixtures and oil meals.

Table 4 shows that the effective degradability of crude protein in rations is nearly equal after 48 hours of incubation and 5% passage rate per hour, in ration with K1 65.7% and in ration with K2 65.14%. The difference among rations is not statistically significant but the difference in effective degradability of crude protein between the incubation periods for individual ration is (p=0,001).

A higher difference in effective degradability of crude protein exists between the feed mixtures; K1 has 50.94% and K2 44.66%. The diference between the soybean meal and rape seed meal is even higher. For soybean meal the effective degradability is 74.62% and 43.38% for rape seed meal. The difference in effective degradability of crude protein between the feed mixtures is statistically highly significant (F=47,79) as well as between both oil meals (F=245,78). Differences in degradability between incubation periods for a feed mixture and an oil meal are highly significant (p=0,001).

Table 4: Effective degradability of crude protein (k=0,05)
Tablica 4. Djelotvornost razgradnje sirovih bjelančevina (k=0,05)

Feeds Hrana	Hours - Sati					
	1,5	3	6	12	24	48
Ration with K1 Obrok s K1	35,01	37,59	46,32	58,01	64,50	65,71
Ration with K2 Obrok s K2	34,75	38,57	48,36	57,15	64,22	65,14
Feeding mixture K1 Krmna smjesa K1	27,63	29,51	34,75	39,16	47,40	50,94
Feeding mixture K2 Krmna smjesa K2	31,28	33,25	36,56	39,20	41,64	44,66
Soybean meal Sojina sačma	31,00	37,99	50,22	66,75	74,62	74,62
Rape seed meal Repičina sačma	23,52	25,30	27,89	32,45	39,03	43,38

Conclusion

1. A high degree of degradability was determined for both experimental rations, feed mixtures K1 and K2, soybean meal and rape seed meal. After 48 hours of incubation, the lowest degradability was determined for rape sead meal (71.09%) and the highest for soybean meal (97.90%).

Lower degradability of dry matter in rape oil is expressed in the degradability of dry matter in feed mixture

K2 and less in ration with mixture K2. Difference in degradability of dry matter in oil meals and feed mixtures is statistically highly significant. The difference between both rations is not statistically significant.

2. The degradability of crude protein in rape seed meal after 48 hours of incubation was 73.42%, in soybean meal 100%, so the difference was statistically highly significant. The degradability of crude protein in feed mixture K1 was 80.52% and in K2 62.81%. The effect of lower degradability of crude protein in the rape seed meal was evident. The difference in degradability of crude protein between K1 and K2 is statistically highly significant. The degradability of crude protein in the ration with K1 was 89,41% and 86,99% with K2. The effect of the rape seed meal on degradability of crude protein in the ration with K2 was lower than in feed mixture K2, but the difference in degradability of crude protein between both rations was statistically significant.

3. The effective degradability of crude protein in rape seed meal was 43.38% after 48 hours of incubation and 74.62% n soybean meal. Degradability of crude protein in feed mixture K2 where the effect of rape seed meal was evident, was low (44,66%). The effective degradability of crude protein in K1 was 50.94%. The effective degradability of crude protein in the ration with K2 was not influenced by the rape seed meal. The ration with K1 had an effective degradation of crude protein 65.71% and the ration with K2 65.14%. The difference in the effective degradation of crude protein between the rape seed meal and soybean meal was statistically very highly significant. The difference in the effective degradability between the both rations was not significant.

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SAŽETAK

Proučavana je razgradljivost suhe tvari i sirovih bjelančevina u dva ljetna obroka hrane krava. Isto tako je proučavana razgradljivost dviju krmnih smjesa /K1 i K2/ što su davane u prvom odnosno drugom obroku, te dvije vrste uljne sačme umiješane u K1 i K2. Osnovni obrok bio je isti u oba slučaja: paša 40 kg, sijeno 4,5 kg i krmna smjesa 4,2 kg. Nakon 48 sati razgradljivost suhe tvari /RST/ i sirovih bjelančevina /RSB/ te djelotvorna razgradljivost bjelančevina /DRB/ za obrok s K1 bila je 86,15%, 89,41 i 65,71% odnosno 84,50%, 86,99% i 65,14% za obrok s K2; 92,30%, 80,52% i 50,94% za K1 odnosno 87,25%, 62,81% i 44,66% za K2; 97,90%, 100,00% i 74,92% za sačmu soje i 71,09%, 73,42%, 43,38% za sačmu repice. Razlike u RST, RSB i DRB između sačme uljane repice i K1 i K2 bile su statistički vrlo značajne.

IZVLEČEK

RAZGRADLJIVOST SUHE SNOVI IN SUROVIH BELJAKOVIN V KRMILIH IN OBROKIH ZA MOLZNICE PO METODI IN SACCO

Proučena je razgradljivost suhe snovi in surovih beljakovin dveh poletnih krmnih obrokov za krave. Ugotovljena je tudi razgradljivost dveh krmnih mešanic (K1 in K2), pokladnih pri enem oziroma drugem obroku in tudi dveh vrst oljnih tropin, ki so bile vključene v K1 oziroma K2. Osnovni obrok je v obeh primerih enak, paša 40 kg, 4,5 kg sena in 4,2 kg mešanice. Po 48 urah inkubacije je bila razgradljivost suhe snovi (RSS), surovih beljakovin (RSB) in efektivna razgradljivost beljakovin (ERB) za obrok s K1 86,15%, 89,41% in 65,71% oziroma 84,50%, 86,99% in 65,14% za obrok s K2. RSS, RSB in ERB za K1 je 92,30%, 80,52% in 50,94% oziroma K2 87,25%, 62,81% in 44,66%; za sojine tropine 97,90%, 100,00% in 74,62% ter ogrščične tropine 71,09%, 73,42% in 43,38%. Razlike v RSS, RSB in ERB med tropinama ter K1 in K2 so statistično visoko značilne.