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PROTEIN DEGRADABILITY OF SOME CONCENTRATE FEEDS USED IN DAIRY COW NUTRITION

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Protein degradibility in concentrates and by-products commonly used was determined by the in situ method on two ruminally cannulated lactating cows. The investigated feeds and their effective protein degradability at a rumen outtlow rate od 5% per hour were: wheat bran - 44,6%; maize meal - 37.1% oat meal - 40.6%; soybean meal - 42.1%; sunflower meal - 68.8%; dried sugar beet pulp - 21.2%; pea grain - 62.4%; faba bean grain - 47.1%. The results for maize and sunflover meals are in agreement with those of other authors but most feeds had a somewhat lower protein degradability than expected.

Key words: Concentrates, cow feeding, protein degradabillity, in situ,

INTRODUCTION

New methods for feed evauation in ruminant nutrition take intro account the degradability of their protein in the numen. Utilization of feeds in ruminants largely depends on degradability processes in the forestomachs. Protein supply is one of the most important components of feeding schemes for dairy cows (NRC, 1988, Madsen and Hvelplund, 1990). The main purpose of balancing protein in diets for dairy cows is to enable adequate amino acid supply to the animal This is a very complex problem in ruminants, because the microbial population in the rumen has a significant influence on protein supply (Van Straalen and Tamminga, 1990, Grubić et al., 1996).

To enable the application of new systems of feed evauation, protein degradability was investigated by the in situ method for eight feeds commonly used for cows.

MATERIALS AND METHODS

Bags were made from synthetic material of dimensions 140 x 90 mm, with an average pore size of 40 μm. Samples were ground in a hammer mill

with a sieve size of 1 mm. Each feed was placed in five bags in each of two ruminally cannulated cows. Sample incubations in the rumen lasted for 2, 8, 16, 24 and 48 hours. The cows were in lactation and received a diet of meadow hay that met their nutritive needs.

Dry matter (DM) was determined by heating first at 60^{0}C and later at 100+5 ^{0}C. The crude protein (CP) content was analyzed by the standard Kjeldahl procedure.

Degradability parameters were derived as constants in a function that made the best fit to in situ data. The function that best matched the experimental data was calculated by an iterative nonlinear least squares procedure based on Marquardt's algorithm. The protein degradability (PD) in the rumen was expressed by the exponential model of McDonald (1981):

$$P = a + b\,[1 - e^{-c(t-t_o)}]$$

where 'a' is the soluble fraction extrapolated fromm the exponential portion of the curve at zero time ('t'), 'b' is the degradable fraction 'c' is a rate constant for 'b' expressed in % per hour and 't' is the lag phase (in hours), or the time at which degradation starts.

Effective degradability (ED) was calculated by the equation of McDonald (1981):

$$ED = a + \frac{bc}{c + k}\, e^{[-(c+k)t_o]}$$

where 'k' represents the theoretical out flow rate from the rumen (0.05) and the other parameters were as above. To enable comparison between feeds and with the findings of other authors all results were calculated with the same 'k' value.

RESULTS AND DISCUSSION

The content of dry matter and crude protein in the investigated feeds is given in Table 1.

Table 1. Dry matter and crude protein content in the investigated feeds, %

Feed	Dry matter	Crude protein
Wheat bran	89.59	15.23
Maize meal	87.00	9.80
Oat meal	87.00	10.00
Soybean meal	89.51	44.62
Sunflower meal	89.03	33.09
Dried sugar beet pulp	90.97	10.65
Pea grain	87.00	18.30
Faba bean grain	90.00	23.31

Protein degradability of the investigated feeds was shown in Table 2. It is noticeable that some feeds had lower degradability than expected from data present in the literature. The explanation may be in the fact that the in situ investigation was done on lactating cows where the outflow rate from the rumen is high, which has a direct influence on effective protein degradability (rskov and McDonald, 1979, Grubić and Zeremski, 1993)).

Thus, only the values for maize and sunflower meals were close to the expected range. The remainder were lower than found in other investigations. Those values demonstrate once again that protein degradability is one of the most variable parameters in ruminant feeding.

Corresponding values from the literature, for the same feeds, are given in table 3. There is great variation in the results obtained in different in situ investigations. Several reasons may be responsible for that. The first source of variability is the chemical composition of the feeds and their protein content in particular. Another source of variation is feed processing, handling and storage techniques. Sniffen et al. (1979) suggested that the variation in technology, especially heat treatment, among manufactures of oil meals (and other feeds) was very high and that it significantly affected the protein degradability of products. Unfortunately, informamtion about the technological aspects of production, processing, handling and storage for the feeds investigated here was not available.

Table 2. Protein degradability parameters, effective degradability (ED) and undegradable protein (UIP) in the investigated feeds, %

Feed	Degradability parameters				ED	UIP
	a	b	c	t_o	(k=0.05)	
Wheat bran	12.21	86.42	0.0300	–	44.6	55.4
Maize meal	3.27	81.24	0.0561	5.21	28.0	72.0
Oat meal	15.38	81.84	0.0223	–	40.6	59.4
Soybean meal	12.31	88.45	0.0254	–	42.1	57.9
Sunflower meal	29.33	70.48	0.0637	–	68.8	31.2
Dried sugar beet pulp	2.26	73.98	0.0227	3.42	20.3	79.7
Pea grain	42.00	58.00	0.0941	6.50	56.9	43.1
Faba bean grain	6.00	94.00	0.0913	4.84	36.7	63.3

The second main source of variability is connected to the in situ technique as a method for degradability investigation. Although great care was taken to unify the method, there are still some differences in the way it is performed by various authors, which leads to different results.

According to Grubić et al. (1993) the factors, may be classified in to the following groups: (1) the influence of protein (nitrogen) nature in certain feeds; (2) the specific role and importance of the rumen microorganism population; (3) individual properties of animals; (4) diversity of data as a reflection of different scientific methodologies involved in degradability investigations.

Table 3. Undegradable protein in selected feeds as reported earlier A - Grubić et al. (1995), B - NRC (1988), C - Madsen & Hvelplund (1990) , D - Susmel et al. (1989), E - Kandylis & Nikokyris (1990), F - Van Straalen & Tamminga (1990), G - Michalet-Doreau (1992). The outflow rate (value k) was assumed to be 0.05 except in columns. D where it was 0.07 and F and G where it was 0.06.

Feed	A	B	C	D	E	F	G
What brain	28	29	37	–	20	40	19
Maize meal	63	52	69	43	69	57	61
Oat meal	30	17	16	–	–	24	17
Soybean meal	32	35	40	41	42	39	34
Sunflower meal	48	26	27	–	20	28	20
Dried sugar beet pulp	62	45	62	50	62	–	46
Pea grain	–	12	23	–	–	–	20
Faba bean grain	–	–	14	–	–	–	34

Knowledge of mechanisms how some of the factors influence protein degradability may reduce the large variation that exists within those data, allowing precise diet formulation and fulfiliment of protein needs in ruminants. Neverthe less, Nocek (1988) concluded that one method may not be the best to express degradability in all feeds. The differences between some of the existing methods and models are so big that they make serious problems in comparing various feeds. Susmel et al. (1990) showed that there are significant differences when degradability data from the same in situ experiment were fitted to different equations. In certain tables given by NRC (1985 and 1988) protein degradability values for some feeds (soybean meal, for example) have coefficients of variation as big as 60%. Therefore, it is not very surprising that data obtained in this in situ investigation are partially different from those found by other authors. Although there has been great progress in protein diegradability investigations in recent years, all problems connected with it are far from being solved.

CONCLUSION

Effective protein degradability values of some feeds using an expected ruminal outfow rate of 5% h were: wheat bran - 44,6% maize meal - 37.1%, oat meal - 40,6%; soybean meal - 42.1%; sunflower meal - 68.8%; dry sugar beet pulp - 21.2%; pea grain - 62.4% faba bean grain - 47.1%. The results for maize and sunflower meals are in agreement with the results of similar investigations, although most feeds investigated lower protein degradability than expected.

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RAZGRADIVOST PROTEINA NEKIH KONCENTROVANIH HRANIVA KOJA SE KORISTE U ISHRANI MLEČNIH KRAVA

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SADRŽAJ

Razgradivost proteina koncentrovanih hraniva i sporednih proizvoda koji se koriste ispitivana je pomoću in situ metode na dve krave u laktaciji fistulisane na buragu. Ispitivana hraniva i njihova efektivna razgradivost pri brzini odliva iz buraga od 5% su bila: pšenične mekinje - 44,6%, kukuruzna prekrupa 37,1%, ovsena prekrupa - 40,6%, sačma soje - 42,2%, sačma suncokreta - 68,8%, suvi rezanci šećerne repe 21,1%, zrno graška - 62,4, zrno boba 47,1%. Neki od dobijenih rezultata su u saglasnosti sa podacima iz sličnih istraživanja iako je većina imala nešto nižu razgradivost proteina nego što je bilo očekivano.