IN VIVO AND IN SITU PROTEIN DEGRADABILITY IN RUMEN AND MILK PRODUCTION OF DAIRY COWS

N. A. Todorov, I. R. Karabaliev, A. Petkov, E. Enev and T. Tashev

University of Zootechnics and Veterinary Medicine
Stara Zagora, 6000, Bulgaria

Introduction

The effect of protein degradation rate on protein flow to the duodenum and the milk production of dairy cows is contradictory (Erfle et al., 1986 and Zerbini et al., 1988). In this respect the ration composition and especially the carbohydrates fermentation rate are important (Nocek and Russell, 1988).

The aim of this experiment was to compare diets with different degradability of protein and carbohydrates in the rumen.

Materials and Methods

Six dairy cows fitted with rumen and duodenum re-entrant cannulae were used to estimate protein degradability and synthesis in the rumen when fed with two diets. Diaminopimelic acid was a microbial protein marker. Digesta flow to the duodenum was measured by a total continuous collection for 48 hours.

Other 24 Holstein cows divided in two equal groups were put to 60 days' production experiment with the same two rations.

The two isoenergy and isoprotein rations consist of equal quantities of maize silage (8 kg DM), mountain hay (1.66 kg DM) and concentrate (8.4 kg DM). First concentrate mixture contains sunflower oil meal (SM) as a protein source, and barley as a main grain, 2nd dried brewers grains (DBG) and maize. The aim was to synchronize protein with starch degradation.

In the experiment with the cannulated cows the intake was 86.6 and 87.3% of intake in the production experiment for SM and DBG-ration respectively.

In situ degradability of feeds was estimated according to Mehrez and Ørskov (1977), and calculated at .08 outflow rate.

TABLE 1. ORGANIC MATTER (OM), CARBOHYDRATES (CHO), CRUDE PROTEIN (CP) AND ETHER EXTRACT (EE) DIGESTIBILITY IN TWO PARTS OF GASTROINTESTINAL TRACT (GIT) OF DAIRY COWS

Items	SM-ration				DBG-ration			
	OM	CHO	CP	EE	OM	CHO	CP	EE
Intake (kg)	14.56	11.34	2.75	.47[a]	14.56	11.32	2.70	.54[b]
At duodenum (kg)	7.56	4.78	2.23	.55[a]	8.00	5.00	2.30	.70[b]
In feaces (kg)	3.95	3.05	.80	.10[a]	4.14	3.13	.81	.20[b]
Disappeared (kg)								
before duodenum	7.00	6.56	.52	−.08[a]	6.56	6.32	.40	−.16[b]
after duodenum	3.61	1.73	1.43	.45	3.86	1.87	1.49	.50
in whole GIT	10.61	8.29	1.95	.37	10.42	8.19	1.89	.34
Digestibility								
before duodenum	.48	.58	.19	−.17	.45	.56	.15	−.30[b]
after duodenum	.25	.15	.52	.96	.27	.16	.55	.93
in whole GIT	.73	.73	.71	.79[a]	.72	.72	.70	.63[b]

[a,b]Differences are significant at $p < .05$ if the average values have different letters

Results and Discussion

Digestibility of carbohydrates (CHO), crude protein (CP), ether extract (EE) and organic matter (OM) in the rumen of cows is slightly lower for DBG-ration, compared to SM-ration. All these substances, except EE are better digested in the intestines for DBG-ration, than for SM-ration (table 1).

There are no significant differences between the two experimental rations in total digestibility. The only exception is the lower digestibility of EE for DBG-ration.

It seems that microbial fat (EE) synthesis is twice as much when cows are fed with DBG-ration. The reasons for the differences between the diets in this respect are not clear.

The degradability of protein of a DBG-ration is significantly lower, compared to SM-ration. The *in vivo* data correspond to *in vitro* degradability (table 2).

There are significant differences in degradability of protein equivalent of non ammonia nitrogen and crude protein including NPN in diets (table 2). The degradability of crude protein *in vivo* is .73 for a SM-ration and .65 for a DBG-ration, and *in situ* .76 and .66 respectively.

It is evident that lower degradability of protein was compensated partially by reduced microbial protein synthesis in the rumen (table 2). The advantages of the feeds with low degradability are not so great as it is expected.

TABLE 2. PROTEIN[1] DEGRADABILITY AND SYNTHESIS IN RUMEN

Item	SM-ration	DBG-ration
Intake (g)	2195	2150
At duodenum (g)	2138	2203
feed	744[a]	946[b]
microbial(MP)	1394	1257
Degradability		
in vivo	.66[a]	.56[b]
in situ	.69[a]	.56[b]
Efficiency		
MP/OM[2]	.20	.19
MP/CHO[2]	.21	.20

[1] Protein equivalent of non ammonia nitrogen
[2] Disappeared before duodenum (see table 1) a,b as in table 1.

TABLE 3. DATA FOR PRODUCTION EXPERIMENT

Items	SM-ration	DBG-ration
Milk yield ($kg \cdot d^{-1}$)	27.9	29.5
Milk protein ($g \cdot d^{-1}$)	876	935
At duodenum* ($g \cdot d^{-1}$)		
NAN	395	404
AAN	344	358
ADAAN	220	232
Milk N/ADAAN	0.64	0.64

*Data from cannulated cows corrected for difference in intake. NAN=non ammonia nitrogen, AAN=amino acids N (0.8 microbial N+feed N), ADAAN=apparent digestible AAN.

The milk yield is higher for cows fed on DBG-ration, compated to SM-ration. It is corresponding to the amino acids apparently digested in the intestine (table 3). The results are supporting the new conception for protein evaluation (Jarrige, 1987). (Key Words: Protein, Degradability, Milk Production)

Literature Cited

Erfle, J.D., F.D. Sauer, S. Mahadevan and R.M. Teather. 1986. Response of lactating dairy cows to formaldehyde-treated soybean meal when fed with control or urea-treated corn silage. Canad. J. Anim. Sci. 66:85-95.

Jarrige, R. 1987. Situation and perspectives of the modern protein feeding systems for ruminants. In "Agriculture: Feed evaluation and protein requirement systems for ruminants" (ed. by R. Jarrige and G. Alderman). Office for official Publications of the European Committies, Luxemburg, pp.305-326.

Mehrez, A.Z. and E.R. Ørskov. 1977. A study of the artificial fibre bag technique for determining the digestibility of feed in the rumen. J. Agr. Sci. (Camb). 88:645-650.

Nocek, J.E. and J.B. Russell. 1988. Protein and energy as an integrated system. Relationships of ruminal protein and carbohydrate availability to microbial synthesis and production. J. Dairy Sci. 71:2070-2107.

Zerbini, E., C.E. Polan and J.H. Herbein. 1988. Effect of dietary soybean meal and fish meal on protein digesta flow in Holstein cows during early and mid lactation. J. Dairy Sci. 71:1248-1258.