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Ruminal degradability and mobile bag intestinal digestibility of individual amino acids of pasture forage

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Abstract: The *in sacco* (estimation of ruminal degradability of amino acids (AA)) and mobile bag technique (estimation of intestinal digestibility of AA) were performed with two dry cows; each of them was fitted with a large ruminal cannula and a T-piece cannula in the proximal duodenum.

The experimental procedure involved three steps:

1) incubation of feed samples for 16 hours in the rumen of cattle to obtain the undegraded residues,
2) incubation of the residues for 2.5 hours in an artificial stomach,
3) estimation of AA digestibilities of residues in the intestine using mobile bags.

Degradation of selected AA after 16 hours incubation in the rumen was following: threonin (Thr) 56 %, serin (Ser) 63 %, prolin (Pro) 80 %, glycin (Gly) 54 %, alanin (Ala) 64 %, cystin (Cys) 61 %, valin (Val) 61 %, methionin (Met) 54 %, isoleucin (Ile) 50 %, leucin (Leu) 47 %, tyrosin (Tyr) 53 %, phenylalanin (Phe) 76 %, histidin (His) 51 %, lysin (Lys) 52 % and arginin (Arg) 56 %. Intestinal digestibility of selected AA from pasture forage was following: Thr 79 % , Ser 76 %, Pro 24 %, Gly 77 %, Ala 82 %, Cys 63 %, Val 79 %, Met 85 %, Ile 80 %, Leu 80 %, Tyr 81 %, Phe 76 %, His 80 %, Lys 86 % and Arg 84 %, respectively. This project was supported by the Ministry of Agriculture of the Czech Republic (NAZV No.1B44037 and MZE0002701403.

Keywords: amino acids, forage, intestinal digestibility, ruminal degradability.

Abbreviation words: AA = amino acids, ADF = acid detergent fibre, ADL = acid detergent lignin, Ala = alanin, Arg = arginin, CP = crude protein, Cys = cystin, DM = dry matter, Gly = glycin, His = histidin, Ile = isoleucin, Leu = leucin, Lys = lysin, Met = methionin, NDF = neutral detergent fibre, OM = organic matter, Phe = phenylalanin, Pro = prolin, Ser = serin, Thr = threonin, Tyr = tyrosin, Val = valin.

OBJECTIVES

The aim was to determine ruminal degradability and intestinal digestibility of individual AA (Thr, Ser, Pro, Gly, Ala, Cys, Val, Met, Ile, Leu, Tyr, Phe, His, Lys, and Arg) of pasture forage.

INTRODUCTION

The requirement of protein for dairy cattle is primarily supplied from crude protein (CP) of dietary and microbial origin that escapes from the rumen. In high producing dairy cows, dietary CP that escapes from the rumen generally contributes between 30 and 50 % of total CP that enters the small intestine (Robinson et al., 1999). In modern protein evaluation systems, the protein value is expressed as the amount of AA absorbed in the small intestine. The absorbed AA originate from rumen microbial protein and rumen undegraded feed protein. Most of the resent research indicate that AA composition of undegraded CP differ from the AA composition of original feed CP (Cozzi et al., 1995). The quality of the CP (the AA composition) that reaches the small intestine for absorption plays an important role in maximizing milk production in high producing dairy cows (Piepenbrink and Schingoethe, 1998). Proteins in grass and grass silage are very susceptible to microbial breakdown and are often poorly utilized by the rumen microbes (Beever, 1993).

MATERIAL AND METHODS

The original sample was analysed for content of dry matter (DM), organic matter (OM), acid detergent lignin (ADL), acid detergent fibre (ADF), neutral detergent fibre (NDF), CP, fat, ash and individual AA.

Two non-lactating cows fitted with a large rumen cannula used for *in sacco* and mobile bag experiment were fed by standardized feed ration. The diet was consisted of 4 kg of hay, 10 kg of maize silage and 1 kg of ground barley with a mix of vitamins and minerals. The diet was given up twice a day.

The experimental procedure involved three steps (Frydrych, 1992; Homolka *et al*., 1996):

1) incubation of feed samples for 16 hours in the rumen of cattle to obtain the undegraded residues,
2) incubation of the residues for 2.5 hours in an artificial stomach,
3) estimation of AA digestibilities of residues in the intestine using mobile bags.

RESULTS

Chemical analyses. The average value of chemical composition (Table 1) of forage is in agreement with the values obtained by Elizalde et al. (1996).

Table 1. Chemical composition of estimated forage (g/kg DM).

	Chemical composition							
	DM	OM	ADL	ADF	NDF	CP	Fat	Ash
Origin feed	226.0	938.6	56.9	314.1	593.6	192.3	30.7	61.4

The content of individual AA of original sample was 8.4 g/kg DM for Thr, 8.7 g/kg DM for Ser, 10.3 g/kg DM for Pro, 8.3 g/kg DM for Gly, 14.2 g/kg DM for Ala, 3.3 g/kg DM for Cys, 9.5 g/kg DM for Val, 2.6 g/kg DM for Met, 6.2 g/kg DM for Ile, 13.2 g/kg DM for

Leu, 5.1 g/kg DM for Tyr, 16.6 g/kg DM for Phe, 2.7 g/kg DM for His, 8.7 g/kg DM for Lys, and 9.5 g/kg DM for Arg.

In sacco degradability and mobile bag digestibility. *In sacco* degradability and mobile bag digestibility of individual AA are showen in Table 2 and in Figure 1. The *in sacco* degradability of AA varied between 47 % and 80 % for Leu and Pro, respective. The intestinal digestibility was found from 24 % to 86 % for Pro and Lys, respective.

Table 2. *In sacco* degradability (%) determined after 16 hours of ruminal incubation and intestinal digestibility (%) of individual amino acids.

Amino acid	Rumen degradability (%)			Intestinal digestibility (%)		
	Cow 1	Cow 2	Mean	Cow 1	Cow 2	Mean
Thr	56.38	56.44	56	81.11	77.04	79
Ser	61.79	63.34	63	79.56	72.59	76
Pro	92.68	67.90	80	3.88	44.64	24
Gly	52.68	54.85	54	77.47	76.07	77
Ala	60.22	66.90	64	84.21	79.66	82
Cys	62.74	59.30	61	65.02	61.30	63
Val	59.58	63.18	61	81.79	77.17	79
Met	54.72	53.90	54	85.81	84.46	85
Ile	49.34	50.12	50	79.42	79.82	80
Leu	45.51	47.69	47	80.00	79.46	80
Tyr	50.83	55.69	53	82.80	80.12	81
Phe	74.35	77.01	76	80.07	72.03	76
His	48.93	53.55	51	84.51	76.16	80
Lys	46.93	56.58	52	87.05	84.25	86
Arg	56.93	54.12	56	82.40	85.98	84
Mean	*58.37*	*58.70*	*59*	*75.67*	*75.38*	*76*
Minima	*45.51*	*47.69*	*47*	*3.88*	*44.64*	*24*
Maxima	*92.68*	*77.01*	*80*	*87.05*	*85.98*	*86*

Figure 1. Averaged values of *in sacco* degradability (%) determined after 16 hours of ruminal incubation and intestinal digestibility (%) of individual amino acids.

CONCLUSION

The rumen degradation of AA determined after 16 hours of incubation ranged from 47 % (Leu) to 80 % (Pro). The smallest and the highest intestinal digestibility of AA was found between 24 % (Pro) and 86 % (Lys).

The results of this study demonstrated the variability of the *in sacco* degradability and intestinal digestibility of individual AA. However, for further investigations are required with use of a higher number of samples to obtain detailed knowledge of AA degradation and digestibility processes.

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