Dry Matter Degradation of Fresh Grass *In Situ* Depending on Vegetative Stage and Growth Number

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INTRODUCTION

During vegetation radical morphological and chemical changes in fresh grass occur. Therefore, vegetative stage is the crucial influencing factor on the feeding value of green fodder. It determines the proportion and composition of the cell wall components and the nature of the cell ingredients. The stem proportion increases at the expense of the leaf fraction accompanied by a considerable decrease in digestibility due to continuous formation of cell wall constituents and their lignification (Minson, 1990; Van Soest, 1994; Südekum et al., 1995; Gruber et al., 1997). Consequently, the feeding value and energy content decline and feed intake is reduced.

In a large research project the influence of the vegetative stage of fresh grass on digestibility, feed intake and milk production was investigated during three complete growing seasons. In this paper the dry matter degradation in the rumen – determined with the nylon bag-technique *in situ* – is presented.

MATERIALS AND METHODS

Experimental design

A meadow with a homogeneous botanical composition was divided into three sections to examine the vegetative process in the three growths. The time table for harvesting is shown in Table 1. To account for climatic changes the duration of the study was set for three years (2000, 2001, 2002). Every growth was harvested over a period of 7 weeks using the fresh grass of different maturities for the feeding trials.

Table 1: Experimental design of the harvest dates

1st growth						
feeding trial 1st growth						
May			June			
2	3	4	1	2	3	4

2nd growth						
1st cut: 4th week of May						
feeding trial 2nd growth						
July				August		
1	2	3	4	1	2	3

3rd growth						
1st cut: 4th week of May						
2nd cut: 4th week of July						
feeding trial 3rd growth						
A.	September				Oct.	
4	1	2	3	4	1	2

in situ-investigations

The *in situ*-investigations were based on the specifications of Orskov et al. (1980), Michalet-Doreau et al. (1987), Madsen and Hvelplund (1994), Huntington and Givens (1995) and NRC (2001). For incubations four ruminally fistulated steers were used. The diet consisted of 75 % forage (⅓ hay, ⅓ grass silage, ⅓ corn silage) and 25 % concentrates and was offered four times per day at energy maintenance level. The incubation times were 0, 3, 6, 10, 14, 24, 42, 65, 92 and 120 h (Mertens, 1993). Data were analysed according to the model of Orskov and McDonald (1979):

$deg = a + b \times (1 - \exp(-c \times (t - lag)))$ for $t > lag$

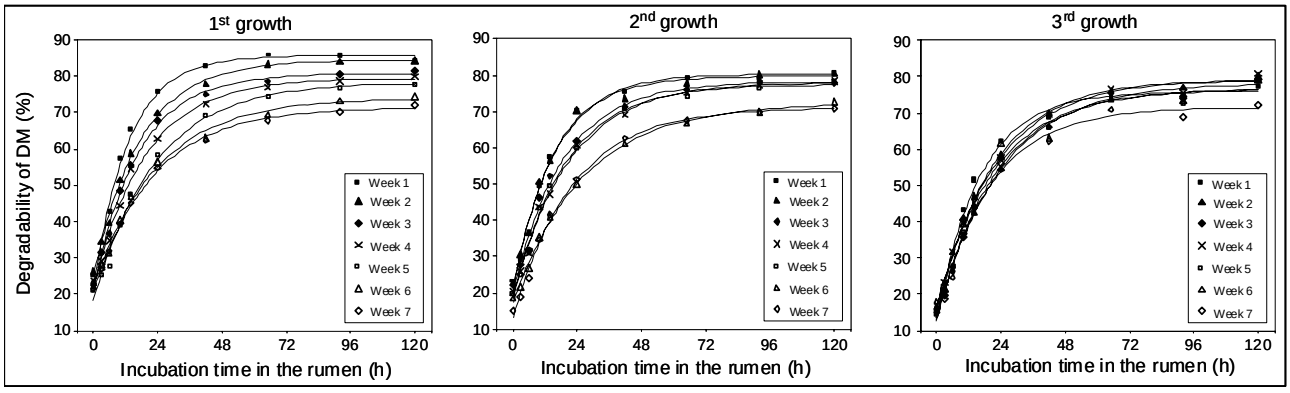
Effective degradabilities (ED2, ED5, ED8) for rumen outflow rates of 0.02, 0.05 and 0.08 (per h) were calculated according to the specifications of McDonald (1981) modified by Südekum (2005):

$ED = a + [(b \times c) / (k + c)] \times \exp(-k \times lag)$

RESULTS AND DISCUSSION

The results of the *in-situ*-investigations are shown in Table 2 and Figure 1. As expected the vegetative stage influenced the degradability of DM of the fresh grass significantly. However, growth number also had an impact on degradability. There were significant interactions between growth number and vegetative stage regarding many degradation parameters according to Orskov & McDonald (1979) i.e. influence of vegetative stage was different in the three growths.

Figure 1: Ruminal *in situ*-degradation of DM of fresh grass depending on growth number and vegetative stage (Gruber et al., 2008)



When accounting for all vegetative stages, potential degradability (a + b) was higher for the 1st growth than for growths 2 and 3 (79.2, 76.7 and 76.7 %, respectively). Whereas e.g. potential degradability of vegetative stages 7 differed marginally (71.4, 70.9 und 71.4 %), degradability of vegetative stage 1 from the 1st growth was higher than of 2nd and 3rd growth (85.7, 80.2 und 75.8 %). I.e. the higher nutritive value of fresh grass from the 1st growth, as stated in this study, is strongly influenced by the values of early vegetative stages. Consequently in terms of feed value it is particularly worthwhile to harvest the first growth early. However, research at our institute has shown that this comes at the expense of DM yield (Gruber et al., 2000; Gruber et al., 2006). On average of all growths the potential degradability decreased from 80.6 to 71.2 % during vegetation.
On average of all vegetative stages the proportion of fraction a (rapidly and completely soluble) slightly declines with growth number (22.0, 19.3 and 18.4 %) while there are marginal differences between proportions of the insoluble, potentially degradable fraction b (57.1, 57.4 and 58.3 %). As in potential degradability there are interactions regarding parameters a and b. During vegetation the decrease is higher for the 1st growth than in the 2nd and 3rd. On average of all growths fraction a decreased from 20.4 to 18.1 % during the 7 weeks of vegetation, fraction b from 60.2 to 53.1 %. Influence of vegetative stage was most obvious in degradation rate c. It decreased from 6.7 % per hour at vegetative stage 1 to 4.6 % at vegetative stage 7. In the 1st and 2nd growth this decline was comparatively linear while in 3rd growth this was the case only at the beginning and the degradation rate subsequently remained almost 4.5 %.
The effective degradability ED is a function of parameters a, b and c and accounts for passage rate of feed in the rumen, i.e. being lower than the potential degradability. E.g. ED5 (medium outflow rate) decreased from 54.2 to 42.5 % during vegetation, this decline being more pronounced in the 2nd and 3rd growth. On average of all vegetative stages ED5 for the three growths was 51.3, 48.0 and 44.9 %, respectively.

Table 2: Results of the *in-situ*-investigations (parameters of the degradation kinetics according to Orskov, 1979)

	a	**b**	**c**	**lag**	**a + b**	**ED2**	**ED5**	**ED8**
1st growth								
week 1	22,3	63,4	0,075	0,00	85,7	72,4	60,4	53,0
week 2	25,4	59,2	0,057	0,00	84,5	69,1	56,8	49,9
week 3	21,5	59,2	0,060	0,00	80,7	65,8	53,7	46,8
week 4	22,0	57,5	0,051	0,00	79,5	63,4	51,1	44,5
week 5	19,5	58,8	0,043	0,43	78,3	59,4	46,2	39,5
week 6	22,3	51,6	0,042	0,00	74,0	57,3	45,9	40,1
week 7	21,2	50,2	0,044	0,00	71,4	55,7	44,7	39,0
2nd growth								
week 1	20,6	59,6	0,065	0,00	80,2	66,3	54,4	47,4
week 2	21,0	58,7	0,066	0,00	79,7	66,0	54,3	47,5
week 3	20,2	58,0	0,053	0,00	78,2	62,3	50,0	43,3
week 4	19,6	58,5	0,048	0,21	78,0	60,6	47,8	41,1
week 5	19,1	58,2	0,051	0,33	77,4	60,7	48,1	41,3
week 6	17,7	54,5	0,038	0,23	72,2	53,3	41,0	34,9
week 7	16,5	54,4	0,045	1,39	70,9	53,2	40,6	34,0
3rd growth								
week 1	18,2	57,7	0,060	1,29	75,8	60,4	47,8	40,6
week 2	19,1	60,0	0,048	1,46	79,0	60,1	46,3	39,0
week 3	18,5	59,7	0,042	1,93	78,1	57,3	43,1	36,0
week 4	19,4	59,8	0,045	1,05	79,1	59,8	46,2	39,1
week 5	18,1	58,5	0,046	1,76	76,6	57,4	43,7	36,6
week 6	18,7	57,8	0,045	0,75	76,5	58,3	45,2	38,5
week 7	16,7	54,7	0,050	1,36	71,4	54,8	42,3	35,7

CONCLUSIONS

Based on the results of the study it can be concluded that during vegetation especially for the 1st growth there is a strong decrease in degradability of DM and consequently a significant interaction between growth number and vegetative stage exists. Degradability of the later growths is lower.

REFERENCES

The list of references can be requested from the first author.