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The effect of barley cultivar on *in vitro* digestibility and rumen degradability of NDF*

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ABSTRACT

The objective of this study was to determine the effect of winter, spring, and naked barley cultivars on *in vitro* true digestibility (IVTD) and NDF degradability in the rumen determined by the *in situ* method. Differences in IVTD and effective rumen degradability (ERD) of NDF between barley cultivars were revealed. The highest IVTD and ERD_{NDF} values were found for naked-, and the lowest, for winter cultivars. It is recommended to use the different nutritive values of each barley type (winter, spring, naked) in feeding tables instead of one common value.

KEY WORDS: barley, cultivar, grain, *in vitro* digestibility, NDF rumen degradability

INTRODUCTION

The chemical composition and rumen degradability parameters of individual barley cultivars are variable. In general, winter cultivars have a higher content of structural carbohydrates, which is responsible for the lower availability of nutrients in the rumen (Micek et al., 2005). The rate and extent of their fermentation in the rumen are, therefore, strongly correlated with some fibre components (Firkins et al., 2001) that are needed for proper nutritive evaluation of barley. The well-known variability in the nutritive value of barley is still not being taken into consideration in feeding tables for ruminants. The objective of this study, therefore, was to determine the effect of winter, spring, and naked barley cultivars on *in vitro* dry matter digestibility and NDF degradability in the rumen, and to find the most effective parameters affecting dry matter digestibility and rumen NDF degradability.

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MATERIAL AND METHODS

The chemical composition of five winter cultivars (Gregor, Gil and Sigra - multiline; Bombay and Tiffany - two-line), four spring cultivars (Stratus and Rudzik - brewery; Rodos and Rodion - fodder), and one naked spring cultivar (Rastik) was determined using standard methods (AOAC, 1995). Barley samples were also analysed for starch content by the method of Faisant et al. (1995) and NDF, ADF and ADL according to Goering and Van Soest (1970). Prior to the *in situ* and *in vitro* experiments, the barley samples were ground to pass through a 1.5 mm screen. *In situ* ruminal degradability was determined by the method of Michalet-Doreau et al. (1987), using 3 rumen fistulated heifers fed standard diets. The effective rumen digestibility (ERD) and the digestibility rate constants (A, B, C) were calculated according to Ørskov and McDonald (1979) at a ruminal outflow (k) of 0.06 h^{-1}. *In vitro* true digestibility (IVTD) was estimated in a Daisy^{II} Incubator (Ankom Co, Fairport, NY) based on the Van Soest et al. (1966) tube procedure (incubation in buffering ruminal fluid for 48 h). The data were subjected to one-way analysis of variance using the GLM procedure of SAS (SAS, 1995).

RESULTS

Barley cultivars differed in chemical composition (Table 1) and rumen DM degradability (Table 2), with the spring cultivars having generally higher susceptibility to DM degradation in the rumen. There were also significant differences between cultivars in rumen NDF degradability parameters (Table 2 and Figure 1). The average ERD_{NDF} of spring cultivars (53.4%) was significantly higher than that of winter ones (39.9%; $P<0.01$). Similarly, IVTD for spring (89.4%) was higher than for winter ones (86.6%; $P<0.05$).

Table 1. Chemical composition of barley cultivars, g kg^{-1}DM

Item	Winter cultivars[1]						Spring cultivars[2]					Naked
	1	2	3	4	5	mean	6	7	8	9	mean	
Crude protein	96	95	124	106	108	106	132	112	136	140	130	141
Starch	672	606	554	670	727	651	623	677	653	643	649	741
NDF	234	231	272	218	221	235	251	223	246	215	234	222
ADF	96	75	88	62	73	79	41	43	47	79	53	36
ADL	9	14	16	17	8	13	8	6	6	9	7	4

[1]1 - Gregor, 2 - Gil, 3 - Sigra, 4 - Bombay, 5 - Tiffany; [2]6 - Stratus, 7 - Rudzik, 8 - Rodos, 9 - Rodion

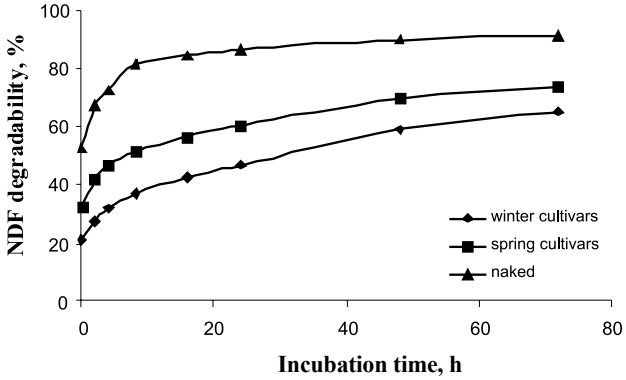

Figure 1. Effect of barley cultivar on ruminal NDF degradability

Table 2. *In vitro* true digestibility (IVTD) and *in situ* DM and NDF degradability parameters

Barley cultivars	IVTD %	DM degradability				NDF degradability			
		A %	B %	C % h^{-1}	ERD %	A %	B %	C % h^{-1}	ERD %
Winter									
Gregor	86.0	39.2	48.4	29.5	79.4	23.1	52.5	2.8	38.8
Gil	86.1	37.0	48.8	45.1	80.0	20.1	36.8	4.5	35.8
Sigra	81.9	30.0	54.0	32.5	75.6	18.2	55.6	2.1	32.4
Bombay	89.3	32.5	57.4	29.0	80.0	34.8	39.1	3.7	49.0
Tiffany	89.1	37.1	52.6	23.2	78.8	26.8	52.4	3.5	43.6
Mean	86.6	35.1	52.2	31.9	78.8	24.6	47.3	3.3	39.9
SD	3.0	3.8	3.8	8.1	1.8	6.6	8.6	0.9	6.5
Spring									
Stratus	88.7	37.5	52.0	51.7	83.9	40.7	33.5	4.2	54.4
Rudzik	91.2	38.9	52.4	62.5	86.7	43.6	29.4	6.5	57.9
Rodos	90.1	31.8	57.5	54.5	83.5	34.9	36.2	6.1	53.1
Rodion	87.6	32.5	57.5	26.0	79.1	27.9	51.6	3.8	48.0
Mean	89.4	35.2	54.8	48.7	83.3	36.8	37.7	5.2	53.4
SD	1.6	3.6	3.1	15.8	3.2	6.9	9.7	1.4	4.1
P[1]	*	NS	NS	*	**	**	*	*	**
SE	0.9	0.8	0.8	3.0	0.8	2.1	2.4	0.5	2.1
Naked	95.8	36.4	60.0	37.6	88.1	54.0	35.0	18.8	80.6

[1] effect of winter vs spring cultivars: NS - non significant, * P<0.05, ** P<0.01

The highest ERD_{NDF} and IVTD were found for naked barley (80.6 and 95.8%, respectively). IVTD was strongly correlated with ERD_{NDF} (r^2=0.88, P<0.01). A significant correlation between ERD_{NDF} and fraction A of NDF degradability

(Table 2; r^2=0.94, P<0.01) was also observed. ERD_{NDF} correlated better with ADF (r^2=0.70, P<0.05) than with NDF content.

DISCUSSION

The results of this study confirm the variation in DM digestibility and rumen NDF degradability among barley cultivars. This variability can strongly affect the precision of diet formulation (Firkins et al., 2001). The most important factor responsible for both NDF degradability and IVTD was the easily degradable fraction of NDF (A). On the other hand, ADF was the most significant chemical variable influencing the nutritive value of barley. The other chemical variables seem to be less important for its nutritive evaluation.

CONCLUSIONS

The use of three different nutritive value parameters for each of type of barley (winter, spring and naked) instead of one common value in feeding tables should be recommended.

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