Cereal Silages

3. Variation in feeding value among barley silage cultivars

Feed analysis results for barley silage can vary widely. In a typical year, it is not unusual to see crude protein (CP) levels ranging from 9 to 15%. Neutral detergent fibre (NDF) concentrations as low as 45% and as high as 60% are not uncommon.

While some of this variation is due to stage of maturity at harvest (see article **1C2**), changes in composition during ensiling and differences between cultivars can also affect nutritional quality. To evaluate the importance of these factors, we have conducted ensiling and rumen degradation trials using 3 common barley silage cultivars: Duke, Lacombe and Seebe.

Analysis of fresh and ensiled forages

All 3 cultivars were harvested at the soft dough stage and ensiled in silo bags - two bags for each cultivar, each containing 40-80 tonnes of forage. Table 1 summarizes analysis results for each cultivar before and 8 weeks after ensiling. Table 2 details mineral composition of the silages.

	BARLEY CULTIVAR					
	DUKE		LACOMBE		SEEBE	
	FR	SLG	FR	SLG	FR	SLG
DM%	30.2	31.7	33.2	31.4	35.0	33.6
CP%	14.3	11.9	12.4	12.2	11.4	11.7
ADF%	26.1	27.5	31.1	30.6	29.2	28.9
NDF%	50.1	50.9	56.7	54.1	53.8	50.7
pH	6.35	4.38	6.65	4.20	6.45	4.08

Table 1 : Composition of barley forages before (FR) and after (SLG) ensiling.

Based on ADF (acid detergent fibre) and NDF content, the Duke cultivar yielded the highest quality fresh forage with Lacombe the lowest and Seebe intermediate. Ensiling reduced fibre levels in Lacombe and Seebe, while those in Duke increased such that the Seebe silage had the lowest NDF content of the 3 cultivars. Similarly, although Duke had the highest CP% as fresh forage, its CP% decreased markedly during ensiling while the CP levels of the Lacombe and Seebe changed very little. All 3 cultivars produced well-preserved silage, as reflected in final pH.

	BARLEY CULTIVAR		
	DUKE	LCMB	SEEBE
Macrominerals, % in DM			
Calcium	0.84^{b}	0.94^{a}	0.54^{c}
Phosphorus	0.43	0.45	0.42
Magnesium	0.26^{b}	0.28^{a}	0.20^{c}
Potassium	0.21	0.22	0.20
Sodium	0.05^{b}	0.07^{a}	0.04^{b}
Chlorine	0.34	0.27	0.34
Sulphur	0.26^{a}	0.26^{a}	0.22^{b}
Trace minerals, mg/kg in DM			
Copper	5.37^{a}	4.86^{b}	4.95^{b}
Manganese	28.8^{b}	35.2^{a}	25.8^{b}
Zinc	55.2^{a}	53.5^{a}	40.2^{b}
Selenium	0.061^{b}	0.083^{a}	0.075^{ab}

Table 2 : Barley silage mineral composition. Values with different superscripts in the same row are significantly different from one another.

Rumen degradation of silages

High production is dependent upon high dry matter intake (DMI). DMI may be limited by both the amount of fibre in the diet and the rate at which that fibre is digested in the rumen. Our rumen degradation trials were aimed at determining whether some barley silage cultivars might be more readily digested in the rumen, promoting greater intakes and higher production.

Silage samples representing each of the three barley cultivars (table 3) were incubated in the rumens of fistulated cows to measure their degradation characteristics. For comparison, we also included samples of high- and medium-quality alfalfa silages.

	BARLEY CULTIVAR			ALFALFA	
	DUKE	LCMB	SEEBE	HI	MED
DM%	29.9	30.3	32.6	25.7	42.3
CP%	13.1	12.9	11.8	18.2	15.8
ADF%	28.3	32.0	29.9	27.6	28.1
NDF%	51.3	55.9	52.8	43.0	46.9
Lignin%	3.2	4.1	3.8	4.5	4.8

Table 3 : Composition of silage samples used for rumen degradability studies.

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As shown in figure 1 and table 4, rate of DM degradation was similar among the barley silages and the medium-quality alfalfa silage. However, high quality alfalfa demonstrated significantly higher DM degradation rate and effective degradability. Effective DM degradabilities were similar for Duke, Seebe and medium quality alfalfa silages. The larger soluble DM fractions and effective DM degradabilities of Duke and Seebe silages indicate that these silages would undergo relatively rapid digestion in the rumen which would promote relatively high levels of feed intake.

As shown in tables 1 and 3, fibre levels for the Lacombe cultivar were higher than the others, both before and after ensiling, and the Lacombe rumen incubation sample also contained more lignin. These higher fibre and lignin levels are reflected in a slighly (although insignificantly) lower DM degradation rate and a significantly lower effective DM degradability.

The alfalfa silage samples used in this study demonstrated rates of CP degradability which were, on average, more than twice as high as those for the barley silages (figure 2 and table 5). Among the barley cultivars, the rate of CP degradability for Duke was the highest.

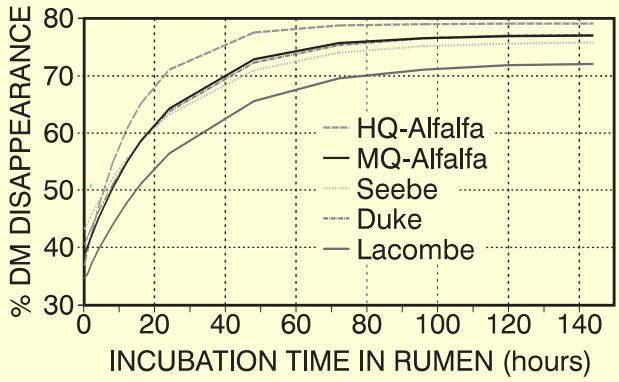

Figure 1 : Dry matter disappearance curves for barley and alfalfa silages.

	BARLEY CULTIVAR			ALFALFA	
	DUKE	LCMB	SEEBE	HI	MED
Soluble, %	37.9^{b}	33.1^{c}	41.6^{a}	35.9^{b}	37.3^{b}
Degradable, %	38.2^{b}	38.4^{b}	33.7^{c}	43.1^{a}	39.1^{b}
Rate, %/hr	4.16^{b}	3.59^{b}	3.92^{b}	6.77^{a}	4.49^{b}
Eff Degrad, %	55.1^{b}	48.8^{c}	55.2^{b}	60.1^{a}	55.3^{b}

Table 4 : Dry matter degradability statistics for barley and alfalfa silages. Values with different superscripts in the same row are significantly different from one another. Eff Degrad: Effective Degradability at a rumen outflow rate of 5%/hr.

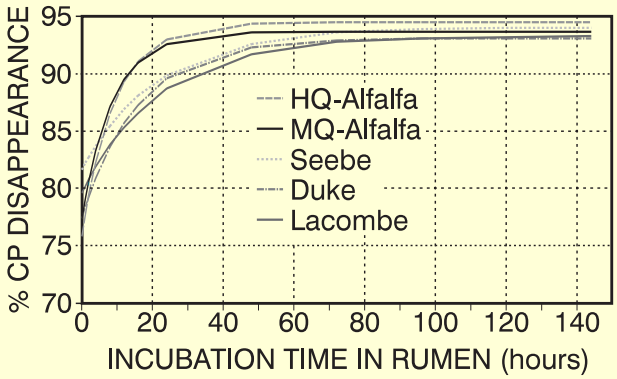

Figure 2 : Crude protein disappearance curves for barley and alfalfa silages.

	BARLEY CULTIVAR			ALFALFA	
	DUKE	LCMB	SEEBE	HI	MED
Soluble, %	77.4^{bc}	79.6^{ab}	81.6^{a}	75.8^{c}	77.3^{bc}
Degradable, %	15.7^{bc}	13.7^{cd}	12.4^{d}	18.7^{a}	16.4^{b}
Rate, %/hr	6.23^{ab}	4.51^{b}	4.61^{b}	10.60^{a}	11.29^{a}
Eff Degrad, %	85.9	86.1	87.1	88.2	88.5

Table 5 : Crude protein degradability statistics for barley and alfalfa silages. Values with different superscripts in the same row are significantly different from one another. Eff Degrad: Effective Degradability at a rumen outflow rate of 5%/hr.

Conclusion

Small grain cereal silages are important forage sources for dairy and beef cattle in western Canada. Identification of superior varieties which promote increased feed intake and animal performance is important to optimize production efficiency.

These experiments demonstrate that there may be significant variation in both chemical composition and digestion characteristics among cultivars of barley grown for silage. Based on our results, Lacombe would appear to be a less desirable cultivar for feeding to dairy cattle due to its higher fibre content and lower effective DM degradability.

researchers : Ali Nikkhah, Reza Khorasani and John Kennelly at the University of Alberta; Jim Helm at Alberta Agriculture, Food and Rural Development (AAFRD), Lacombe; and Rick Corbett at AAFRD, Edmonton.

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