DAIRY RESEARCH HIGHLIGHTS

Cereal Silages

4. Factors affecting silage intake and milk production

Intake is the key constraint limiting productivity on diets containing forages. The economic value of silage depends on the level of production it will support which is a direct result of the amount of feed consumed and the efficiency with which it is digested and metabolized. Here is a summary of the factors which influence silage intake and milk production on silage-based diets.

Silage conservation

Silage is often consumed to a lesser extent than hay of similar quality. Although this intake depression is commonly attributed to the higher moisture content of silage, it is more likely due to changes which occur in the ensiling process. But the moisture content of the crop as it goes into storage can have important effects on this process.

After cutting, plant cell respiration breaks down crop carbohydrates. Bacteria, yeasts and moulds further ferment water soluble carbohydrates to produce ethanol and organic acids, including lactic, acetic, propionic and butyric. Increasing acid levels lower silage pH. Some bacteria also break down plant protein, producing non-protein nitrogen (NPN) compounds, including ammonia (see articles **1A1** and **1P1**). Table 1 reports levels of fermentation end-products in silages made from 3 barley cultivars at the University of Alberta.

In a review of factors affecting the voluntary intake of silages by lactating cows, British workers found significant, positive correlations with concentrations of dry matter (DM), digestible organic matter, crude protein (CP), pH and lactic acid as a proportion of total acids. Significant negative correlations were found with levels of lactic, acetic and butyric acids, total acids and ammonia nitrogen.

When moisture content exceeds about 70%, seepage from the silo reduces the concentration of water soluble nutrients. High moisture levels also favour the growth of bacteria which inhibit pH reduction, degrade protein and produce acetic and butyric acids. Below about 55% moisture, it may be difficult to exclude oxygen from the silage, resulting in increased oxidative losses and heating.

FERMENTATION END-PRODUCT	BARLEY CULTIVAR DUKE	LCMB	SEEBE
Lactic acid, g/kg	87.9	83.4	90.3
Acetic acid, g/kg	18.3^{a}	15.9^{b}	14.2^{b}
Propionic acid, g/kg	0.34^{a}	0.32^{a}	0.25^{b}
pH	4.38^{a}	4.20^{b}	4.08^{b}
Ethanol, g/kg	4.64	4.52	4.14

Table 1 : Fermentation end-products in silages made from 3 barley cultivars. Values in the same row with different superscripts are significantly different from one another. LCMB is AC Lacombe.

The optimum moisture level for ensiling (55-70%) corresponds with the moisture content at which crop yields are near their maximum. Vern Baron at the Agriculture Canada Lacombe Research Centre has demonstrated that the maximum yield of whole plant barley is achieved when the crop is harvested at a moisture level of 58%. Harvesting at 70% reduced yield by 17%.

Physical fill

Lower quality forages are more slowly digested in the rumen, reducing the turnover time of rumen contents and their passage rate to the lower digestive tract. The resulting increase in physical fill limits further intake. We demonstrated this effect in a heifer feeding trial, the results of which are summarized in table 2.

	BARLEY CULTIVAR DUKE	LCMB	SEEBE	ALF-ALFA
DMI, % of BW	1.24^{b}	1.19^{b}	1.62^{ab}	1.74^{a}
Rumen fill, kg				
Solid	43.3^{a}	39.9^{ab}	37.8^{bc}	33.0^{c}
Liquid	7.1^{c}	8.7^{bc}	11.9^{ab}	11.6^{a}
Turnover, hrs	21.5	21.9	17.3	16.0

Table 2 : Dry matter intake (DMI), rumen fill and rumen DM turnover times in 527-557 kg heifers fed diets consisting of 20% concentrate and 80% silage derived from alfalfa or one of 3 barley cultivars. Values in the same row with different superscripts are significantly different from one another. LCMB is AC Lacombe.

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DMI of the diet containing alfalfa silage was significantly higher than those containing either Duke or AC Lacombe barley silage. DMI of the Seebe silage diet was intermediate but not significantly different from the diets containing either alfalfa or the other 2 barley cultivars. Rumen solid fill and DM turnover rate were negatively correlated with DMI: greater fill and slower turnover were associated with lower intakes.

Of the common measures of forage quality, Neutral Detergent Fibre concentration (NDF%) is considered the best index of intake potential, particularly at high intakes. We demonstrated the negative effect of dietary NDF% on dry matter intake (DMI) in a comparison of alfalfa, barley, oat and triticale silages (article **1C3**). The same relationship held true in the heifer trial where dietary intakes were lower for the higher NDF silages. NDF concentrations in these silages are reported in article **1C4**.

Milk yields and milk composition

Twenty early lactation Holsteins (8 in second lactation; 12 in 3rd+) were allocated to similar groups according to parity, date of calving and milk yield. Cows were assigned to 4 test diets following a 2-week adaptation period and were fed the test diets for 12 weeks. The forage in each ration was provided by either alfalfa silage or silage derived from one of the 3 barley cultivars referred to above.

As shown in table 3, there were no significant differences in yields of milk or milk components between cows offered the different silages. However, there was a tendency to lower yields from cows fed AC Lacombe silage which correlated with a significantly lower DMI by these cows. The lower

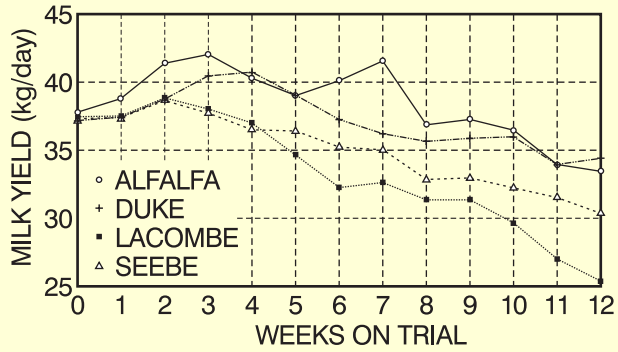

Figure 1: Effect of alfalfa silage versus silages from 3 barley cultivars on milk yield in early lactation cows.

	BARLEY CULTIVAR			ALF-ALFA
	DUKE	LCMB	SEEBE	
DMI, % of BW	3.00[ab]	2.86[b]	3.12[a]	3.11[a]
Yield, kg/day				
Milk	37.0	32.8	34.7	37.8
4% FCM	33.5	31.4	34.1	35.4
Fat	1.27	1.22	1.34	1.34
Protein	1.12	1.05	1.15	1.21
Concentration, %				
Fat	3.43	3.72	3.86	3.54
Protein	3.06[b]	3.28[a]	3.32[a]	3.21[ab]

Table 4 : Production responses from cows fed alfalfa silage or one of 3 barley silages. Values with different superscripts in the same row are significantly different from one another. LCMB: AC Lacombe; DMI: dry matter intake; FCM: fat-corrected milk.

fibre content of the Duke and Seebe cultivars relative to AC Lacombe was likely responsible for their higher DM intakes.

These results support our earlier findings (see article **1C3**) which demonstrated that good quality cereal silage can support production levels similar to those expected from alfalfa silage in early lactation cows. Although the milk and milk component yields summarized in Table 4 revealed no statistically significant diferences between barley culivars, some of the differences were quite large. And the strong correlation between DM intake and 4% fat-corrected milk emphasizes the importance of intake in supporting high levels of production.

Summary

Cereal silage has the potential to support levels of production equal to those expected from alfalfa silage given similar DM intakes. Realization of this potential depends on production practices aimed at producing the highest quality silage possible, including:

- selecting a variety and cultivar with the potential to yield high protein, low fibre forage;
- cutting at the soft dough stage, when crop moisture level should be in the 55-60% range;
- packing and covering the silage to exclude oxygen, thus reducing aerobic loss, promoting a rapid drop in pH and the production of high levels of lactic acid.

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