CANADA · ALBERTA LIVESTOCK RESEARCH TRUST INC.

DAIRY RESEARCH RESULTS
from the Agriculture and Agri-Food Canada Research Centre, Lethbridge

Hulless Barley

1. Production responses, digestibility and processing

Compared with corn, barley is considered to have several disadvatages in diets for lactating cows:

- its fibrous hull and lower starch content results in a lower energy value (NE for lactation is about 1.94 Mcal/kg vs. 2.04 for corn);
- its high NDF content may limit the amount of barley that can be included in the diet while maintaining minimum forage NDF requirements (see article 1N2);
- the rapid rate of barley starch digestion in the rumen (roughly 50% per hour vs. 5% per hour for ground barley and corn, respectively) increases the risk of acidosis.

Several new cultivars of hulless barley have been commercialized recently, making possible its routine inclusion in dairy diets. Removal of the hull has resulted in grain with crude protein levels similar to those in wheat accompanied by fibre and energy values comparable to corn. In the past few years, we have conducted several trials to evaluate the production potential and digestion characteristics of hulless barley in lactation diets.

Production responses

To determine the production potential of hulless barley, early lactation cows (72-133 DIM) were offered total mixed rations (TMRs) containing 30% barley silage, 10% alfalfa cubes, 10% protein/mineral/vitamin supplement and 50% steam-rolled grains: either barley, Condor hulless barley or corn. Chemical compositions of the grains and the complete diets are given in table 1.

	HULLESS BARLE Y	BARLEY	CORN
	---------- % of dry matter ----------		
Grain Only			
Dry Matter	90.3	90.0	90.4
Crude Protein	11.2	13.0	9.5
ADF	7.9	3.5	3.0
NDF	22.3	11.1	8.8
Starch	53.2	65.1	68.6
Total Diet			
Dry Matter	58.9	58.3	58.0
Crude Protein	16.3	16.5	16.4
ADF	14.8	10.7	10.2
NDF	34.2	28.7	27.7
forage NDF	22.3	22.6	22.7
Starch	30.6	36.1	37.7

Table 1 : Chemical composition of grains and complete diets fed in production trial.

Table 2 summarizes production responses to the 3 rations. Cows fed either type of barley consumed significantly less TMR than those fed corn. And those fed hulless barley produced significantly less milk than those fed corn. Production of first lactation cows fed barley was not different from either of the other 2 groups but 2nd+ lactation cows fed either type of barley also produced less milk than those fed corn.

Since the starch content of the hulless barley was similar to that of corn and significantly higher than that of barley, we had expected better production responses from the hulless barley diet. But when we measured the total tract digestibilites

	1st LACATION COWS			2nd + LACTATION COWS		
PRODUCTION MEASURE	BARLEY	HULLESS BARLEY	CORN	BARLEY	HULLESS BARLEY	CORN
Dry Matter Intake, kg/day	16.9^{b}	17.0^{b}	17.9^{a}	20.2^{b}	20.8^{b}	22.0^{a}
Body Weight Change, kg/day	+0.27	+0.24	+0.52	+0.21	-0.02	+0.22
Milk Yield, kg/day	25.3^{ab}	24.7^{b}	26.3^{a}	32.2^{b}	32.0^{b}	33.9^{a}
Milk Fat, %	3.54	3.68	3.65	3.38	3.43	3.35
Milk Protein, %	3.19	3.12	3.18	3.20	3.14	3.17
Feed Efficiency, milk kg/DMI kg	1.50	1.45	1.48	1.58	1.55	1.57

Table 2 : Results of a trial comparing barley, hulless barley and corn in TMRs for early lactation cows. Values with different superscripts in the same row and lactation group are significantly different from from one another. For an explanation of statistical significance, see article 1F2.

of the 3 diets, the reason for the disappointing production became clear: dry matter (DM) digestibility of the hulless barley diet was as much as 7% lower than the other 2 diets. As a result, the energy value of the hulless barley diet was also significantly lower. We observed a considerable amount of grain in the manure of cows on this diet, suggesting that its lower digestibility was partly due to escape of hulless barley from microbial degradation in the rumen.

Rumen degradability

To determine the extent to which low rumen degradability might have limited overall digestibility of hulless barley, we followed up on our production trial with a rumen disappearance study. Samples of each of the grains, either steam-rolled or ground, were incubated in the rumens of cows fed TMRs based on the same grain, as described above. The time course of rumen disappearance for each grain is illustrated in figure 1. Notice that both types of ground barley disappeared rapidly - after only 12 hours of incubation, 82% of the barley and 85% of the hulless barley had disappeared. The rate of disappearance of ground corn was much lower, as expected. When steam-rolled, the disappearance rate of all 3 grains declined. In particular, steam-rolling had a much greater effect on hulless compared with hulled barley.

The lower total digestibility of steam-rolled hulless barley and its reduced rumen disappearance rate are a reflection of the difficulty encountered in effectively rolling this grain. But grinding is not ideal either – the very rapid disappearance of ground hulless barley poses an increased risk of acidosis.

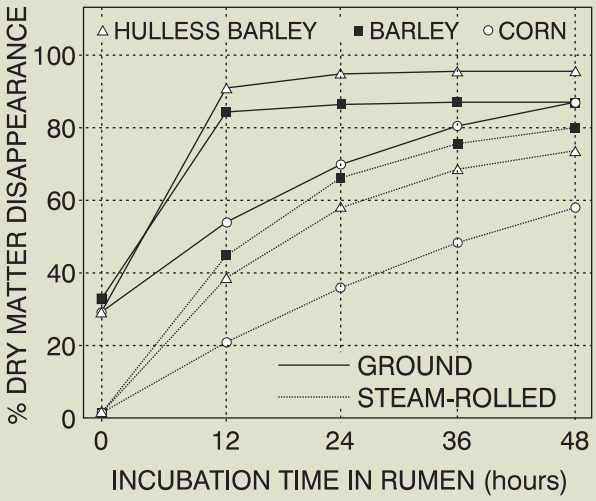

Figure 1 : DM disappearance from samples of ground or steam-rolled grains incubated in the rumen.

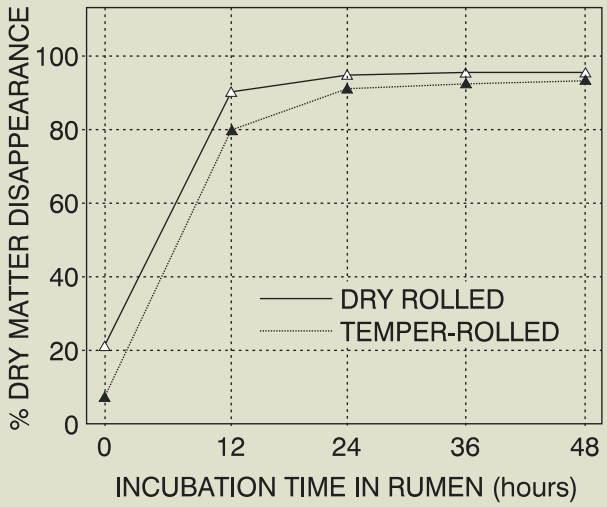

Figure 2 : DM disappearance from samples of dry rolled or temper-rolled hulless barley incubated in the rumen.

Dry rolling and temper-rolling

To determine whether other processing methods might produce better digestibility characteristics, we subjected Condor hulless barley to dry rolling or temper-rolling followed by rumen incubation. Temper-rolling involves adding water to dry grain and allowing it to soak for 16 hours before rolling. Water was added at 40, 60, 80, 120 and 160 grams per kg of grain to determine the optimum. The best fermentation characteristics were obtained at 120 g/kg – at this rate the grain was 79% DM before rolling.

Rumen disappearance results are shown in figure 2. Dry rolling produced results which were very similar to those shown in figure 1 for ground hulless barley. Temper-rolling improved rumen DM degradation characteristics:

- the soluble, very rapidly degradable fraction was reduced from 21 to 8% of grain DM;
- the slowly degraded fraction was increased from 74 to 86%;
- the rate of degradation of the slowly degraded fraction was reduced from 23 to 15% per hour;
- the effective rumen degradability of grain DM was decreased from 80 to 69%.

Further work is underway to determine whether these improvements in rumen degradation due to temper-rolling will result in improved production responses to feeding hulless barley.

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