Optimum Processing of Barley

Barley is the primary source of energy in Western Canadian lactation diets. But unless the grain is adequately processed by grinding or rolling, its contribution to the energy requirements of the lactating cow are quite limited. This is because the whole barley kernel is not extensively damaged during ingestion and its fibrous hull limits access to its starchy core by both microbes in the rumen and digestive enzymes in the lower digestive tract. Conversely, barley which is finely processed is rapidly digested in the rumen – an advantage for maximizing microbial protein synthesis but a disadvantage due to a higher risk of rumen acidosis. What is the optimum degree of processing for barley in high-grain lactation diets?

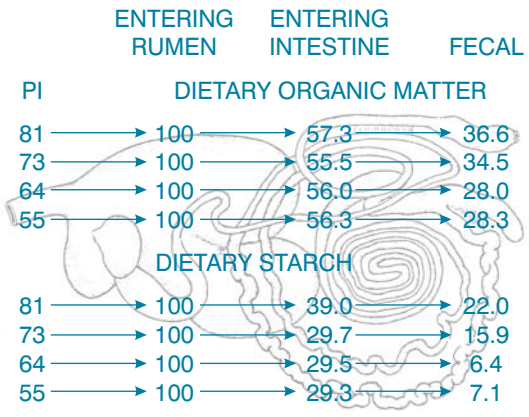
Processing index

Words like 'coarse' and 'fine' are too vague to define a particular degree of processing in the same way that 'fat' and 'thin' are ambiguous descriptions of an animal's body condition. Just as condition score allows us to more accurately define the amount of body fat carried by a cow, *processing index* can be used to describe degree of processing for a sample of grain.

As barley is rolled more finely, its bushel weight decreases. Processing index (PI) is the bushel weight of the barley after processing expressed as a percentage of its bushel weight before processing. For example, if a sample of barley had a bushel weight of 50 pounds before rolling and 35 pounds after, we would assign the rolled grain a PI of 70% (35/50). For comparison, steam-rolled barley samples from 10 Southern Alberta feedmills had PI values which varied from 63 to 79%, with most in the 65 to 70% range. Dry- or temper-rolled samples from 9 feedlots had PI values between 72 and 91%.

To determine the effect of PI on digestibility and production, lactation diets containing 30.5% barley silage, 8% alfalfa silage, 8% chopped alfalfa hay, 11% supplement and 42.5% steam-rolled barley were fed. Grain was rolled to a PI of 81%, 73%, 64% or 55%.

	PROCESSING INDEX, %			
	81	73	64	55
Rumen fermentation:				
pH	6.16	5.97	5.95	5.96
Acetic:Propionic	3.32	3.38	2.64	2.99
Microbial Nitrogen	40.9	49.2	53.8	50.0
Production responses:				
DM Intake, kg/day	18.7	21.4	21.7	20.1
Milk Yield, kg/day	25.6	28.1	30.8	29.0
Milk Fat, %	3.93	3.89	3.78	3.90
Fat Yield, kg/day	1.01	1.09	1.16	1.13
Milk Protein, %	3.15	3.30	3.29	3.34
Prot Yield, kg/day	0.81	0.93	1.01	0.97



The effects of varying PI on organic matter (OM) and starch dynamics in the cow's digestive tract are shown in the diagram on the left below. Fecal OM losses decreased at lower PI. Fecal starch losses were more than 3 times as high when PI was 81% than they were at 64 or 55%. This was due to the fact that 32% more starch (39 vs 29.5%) escaped the rumen when the diet contained grain with a PI of 81%.

Rumen fermentation and production responses are summarized in the table above. The highest milk yields in this trial were obtained with the diet containing barley rolled to a PI of 64%. This was the diet that produced the lowest fecal loss of both organic matter and starch, the lowest Acetic:Propionic ratio and rumen pH, the highest microbial nitrogen flow to the intestine and the highest dry matter (DM) intake. Although milk fat and protein tests on this diet were lower than those for some of the other diets, fat and protein yields were highest for the 64% PI diet due to the higher milk yields.

source: K.A. Beauchemin & L.M. Rode, Adv Dairy Tech 10:152 (1998)