Optimizing Particle Size of Dairy Cow Diets with the Penn State Particle Separator

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Dairy cows require adequate physically effective fibre (peNDF; Mertens, Feedstuffs, 2000) in the diet to maintain proper rumen function. The Penn State Particle Separator (PSPS, Lammers et al., J. Dairy Sci. 1996) was designed as a practical method for on-farm evaluation of peNDF. The sum of the fractions retained on the two sieves are assumed to provide a good estimate of peNDF. Our previous study (Yang and Beauchemin, Abstract, Advances Dairy Technology, 2001) showed that the peNDF content of the TMR was a good predictor of chewing activity of dairy cows fed barley-based diets. Further information is needed to develop guidelines for optimum peNDF content of dairy cow diets.

A study designed as a 4 $\times$ 4 Latin square was conducted using dairy cows fed diets varying in peNDF content, determined using the PSPS. The peNDF contents of the diets were 22, 31, 38 and 42% (DM basis). Eating time was not affected by the peNDF content, but rumination time was reduced by 13 and 35% when peNDF was reduced from 38 to 31 and 22%, respectively. Mean ruminal pH was similar for all diets. However, the time during which ruminal pH below 5.8, which is considered the threshold for sub-clinical ruminal acidosis, was decreased when the peNDF content was increased to 40%. Feed intake was not affected by the peNDF content. However, increasing peNDF content from 31 to 38% improved microbial N synthesis, and digestion of fibre and N in the total tract. Interestingly, starch digestion shifted from the rumen to the intestine when the peNDF content increased although total digestion of starch was not changed. The fraction retained on the second rather than the top sieve of the PSPS was moderately correlated to ruminating time (r =0.56). In contrast, the fractions retained on both sieves were negatively correlated to the time during which the ruminal pH was below 5.8 (r =-0.48), indicating a reduced risk of acidosis as particle size of the diet increased. In addition, the fraction retained on the second sieve of the PSPS was also moderately correlated to microbial N synthesis (r =0.51).

Increasing the peNDF content of the diet can reduce the risk of sub-clinical acidosis in dairy cows. These results indicate that the peNDF content measured using the PSPS should be at least 38% for barley and alfalfa forage based dairy cow diets.