Feedbunk Sorting Characteristics by Dairy Heifers Offered Total Mixed Rations Diluted with Low-Energy Forages

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Use of corn silage in the diets of pregnant dairy heifers offered for ad libitum intake can be problematic, primarily because corn silage exceeds the energy requirement for this class of livestock. Furthermore, the concentration of structural plant fiber (NDF) is too low, and does not serve the co-equally important function of limiting voluntary intake through the normal process of gut fill. As a result, heifers may gain excessive weight and become over-conditioned, which can negatively affect mammary development and first-lactation performance. One remedy for this problem is to dilute total mixed rations (TMR) with low-energy forages, increasing the NDF concentration of the diet, but also reducing energy density (TDN) and voluntary intake. While this approach is effective in controlling weight gains, inclusion of low-energy forages can result in aggressive efforts by heifers to sort and discriminate against these often less-desirable forages. Potentially, this can be a problem if small or passive animals can't reach the feedbunk until after substantial sorting has occurred. Two studies conducted recently by USDA-ARS and University of Wisconsin scientists at the Marshfield Agricultural Research Station have evaluated the sorting behaviors exhibited by pregnant dairy heifers offered a TMR comprised of corn silage and alfalfa haylage, but diluted with a variety of low-energy forages.

Study 1

In this experiment, pregnant dairy heifers were offered one of four diets: i) alfalfa haylage-corn silage (AH-CS) with no dilution (negative control); ii) AH-CS with eastern gamagrass haylage (EGG); iii) AH-CS with chopped wheat straw (WS); or iv) AH-CS with chopped corn fodder (CF). At the beginning of the trial, the EGG, WS, and CF diets were considered to be mostly non-sortable, moderately sortable, and highly sortable, respectively. Feeding management was consistent with University of Wisconsin recommendations for using straw in TMR diets, which includes feeding daily to a minimal amount of refusal. For Study 1, all low-energy forages were effective at reducing the energy density of the diet, as well as voluntary dry matter (DM) intakes and weight gains. Voluntary DM intakes for the (negative control) AH-CS diet were 24.4 lbs DM/day, while diluted diets averaged 22.1 lbs DM/day (9.5% less); weight gains were reduced from 2.6 to 2.0 lbs/day.

After disbursement, the concentration of feed particles retained on the top two screens (19 and 8 mm) of the Penn State Particle Separator, often described as physically effective fiber (pef), remained stable across all diets for 7 hours post-feeding. The highly sortable nature of the CF diet became obvious by 11 hours post-feeding (Figure 1), as heifers discriminated against large particles originating primarily from corn fodder. The sorting factor for the CF diet reached 1.36, or a 36% increase in pef at 15 and 20 hours post feeding. Furthermore, this observation obscures contrasting responses for large (>19 mm) and medium particles (>8 mm); concentrations of large particles increased by 3.5 times, but medium particles were preferred in CF diets, and declined to about half of their original concentration. The EGG diet contained eastern gamagrass haylage that has proven to be largely unsortable in past studies, and this response was again observed as there was little change in pef over time. The WS diet was moderately sortable, where the concentration of pef particles increased by ~10% throughout the day.

Figure 1. Sorting characteristics of pef by pregnant dairy heifers for alfalfa-corn silage diets as affected by time after feed disbursement. Initial concentrations of pef are shown parenthetically. Sorting factors were calculated as the concentration in the feedbunk divided by the concentration in the original diet. Sorting factors >1 (bold red line) indicate discrimination, and factors <1 indicate preference by heifers.

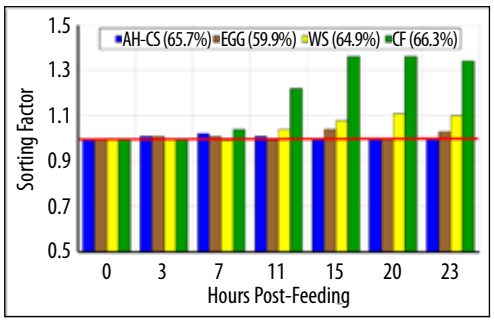


Figure 2. Concentrations of NDF in alfalfa-corn silage diets offered to pregnant dairy heifers as affected by time after feed disbursement.

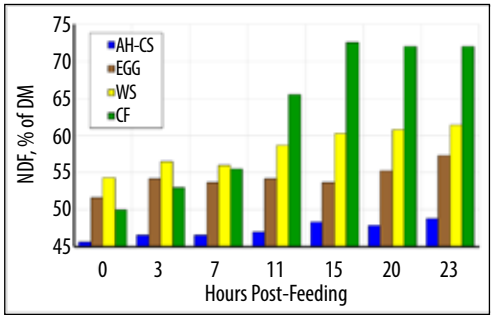
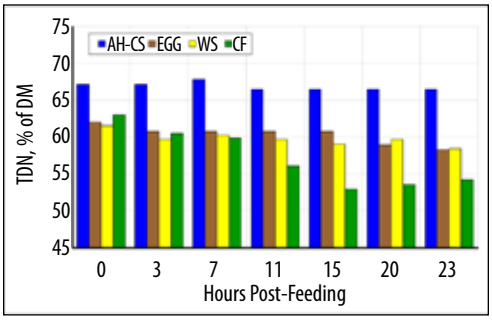


Figure 2 illustrates both the effect of dilution with low-energy forages, as well as effects of heifer sorting behaviors, on concentrations of NDF within the feedbunk. Dilution increased the initial NDF in the diet by 4.4-8.7 percentage units relative to AH-CS. Since there was only minimal sorting of AH-CS and EGG diets, concentrations of NDF were relatively stable across sampling times, increasing by only 3.2 and 5.7 percentage units during the 24-hour period after feed disbursement, and most of this increase occurred very late in the day. In contrast, increased NDF was observed at 11 hours post-feeding for the WS and CF diets, with total increases of 7.1 and 22.0 percentage units by the end of the day. These increases in NDF for feed remaining in the bunk are largely associated with discrimination against large particles that are likely to be more fibrous in nature than the preferred smaller feed particles. Figure 3 illustrates opposite responses for the energy density (TDN) of feed remaining in the bunk, where discrimination against larger particles are inherently more fibrous and less energy dense resulted in declining TDN over time, particularly for the highly sortable CF diet.

Figure 3. Energy density (TDN) of alfalfa-corn silage diets offered to pregnant dairy heifers as affected by time after feed disbursement.



Study 2

A second experiment compared poorly (LONG) and well-processed (SHORT) wheat straw as dilutants within a similar AH-CS base diet as described in Study 1. In Study 2, heifers also were stocked within research pens at 100, 125, and 150% of capacity. Figure 4 illustrates the effects of straw processing on sorting behaviors by heifers, where concentrations of pef particles increased over time regardless of processing, but the effect was more severe for the LONG diet. As a result, TDN declined over time by only 1.8 percentage units for the SHORT diet, but by 3 times that amount (5.4 percentage units) for the LONG diet (Figure 5).

Figure 4. Sorting characteristics of pef by pregnant dairy heifers for alfalfa-corn silage diets as affected by time after feed disbursement. Diets were comprised of: i) alfalfa haylage and corn silage plus poorly processed straw (LONG); or ii) an identical diet except straw was well processed (SHORT). Initial concentrations of pef are shown parenthetically. Sorting factors were calculated as the concentration in the feedbunk divided by the concentration in the original diet. Sorting factors >1 (bold red line) indicate discrimination.

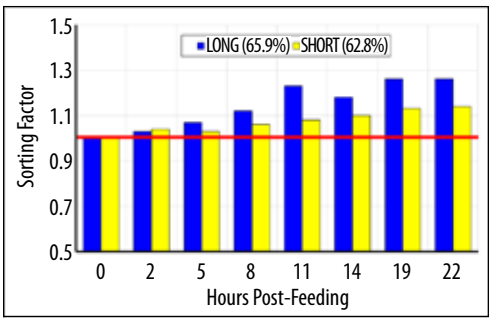
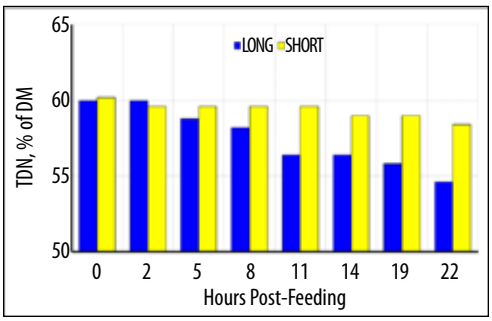


Figure 5. Energy density (TDN) of alfalfa-corn silage diets diluted with poorly (LONG) or well-processed straw (SHORT) and offered to pregnant dairy heifers as affected by time after feed disbursement.



Summary and Discussion

It is important to note the results presented here do not account for the amount of feed remaining in the feedbunk at any sampling time, which is not practical for measurement in large pen-based research trials. In neither study could heifer growth performance be related to the relative sortability of diets. This may be related to feeding management including a daily feed disbursement to a minimal percentage of refusals (<3%), which is consistent with University of Wisconsin recommendations for including straw in TMR diets. In addition, heifers were grouped within pens to minimize weight variability. The feeding approach used for these trials requires a higher standard of management, and it should not be inferred from these results that sorting behaviors or other compromised forms of animal care do not affect heifer growth performance.