Heifer Growth Affected by Diet Energy and Genomics

Al Kertz, PhD, PAS, DIPL ACAN
ANDHIL LLC
St. Louis, MO 63122
andhil@swbell.net
www.andhil.com

Doing heifer growth studies is difficult and challenging for several reasons. You need a large enough number of heifers not too dissimilar in weight and age, adequate research facilities, and usually long period of time especially if you are to follow them into lactation. Thus, there are not many heifer growth studies being done. But one place that has done some excellent heifer studies is at Marshfield, Wisconsin involving the University of Wisconsin and the USDA Dairy Forage Research Center.

There are two methods of feeding heifers. One is limit-feeding which entails using diet which is only fed once daily and not to the full appetite of the heifers. But there are negative behaviors which result, and feed costs may even be greater (Kertz 2009b). The other approach is to feed free choice but use straw or low quality forage to reduce energy density and intake to avoid over-conditioning or fattening (Kertz 2009a). In this particular study (Williams et al., 2022), residual feed intake (RFI) was also factored in. RFI is defined as the difference between an animal's energy intake minus its actual energy intake based on its maintenance and production requirements (NRC 2001). It is phenotypically independent of production and body size. If animals consume less than expected without suppressing production/growth, they have a negative RFI and are considered more efficient. But these measurements can be difficult, so using genomics to predict an animal's genetic is a potential option.

This was a fairly complex study in its design and execution—the description of Materials and Methods took 4.25 pages in the 14-page article. Thus, I will provide a very abridged version of how the study was designed and conducted. A total of 128 post-bred Holstein heifers within an age range of 14-20 months were stratified into 4 blocks of 32 heifers/block by initial body weight with days in gestation of low—20 ± 24 days, medium-low--48 ± 34 days, medium-high--60 ± 42 days, and high--74 ± 42 days. Within each weight block heifers were further allocated into low genomic RFI and high genomic RFI with 16 heifers/block. Overall, the mean genomic difference was -0.022 ± 0.346 of dry matter from precited intakes with a range of -0.802 to 0.744

Diets were formulated higher (48% corn silage, 52% alfalfa haylage and mineral added) or lower energy with 14% wheat straw added to 27% corn silage and 59% alfalfa haylage plus mineral added. Based on weekly analyses in this 120-day trial, protein was similar at 11.8% while NDF/ADF were 45.6/32.0 and 50.1/36.7 with calculated energy of TDN%/ME Mcal/lb of 62.7/1.09 and 57.0/0.99, respectively. Based on previous results for this research facility, expected daily gain (ADG) for these two diets were expected to be 2.2 lb and 1.87 lb, respectively.

There were 8 heifers per group in each free stall pen with foam-core mattresses bedded with a shallow layer of dried organic solids. There were also 4 blocks per treatment in this 2 x 2 study of diet energy level and genomic RFI. Diets were fed as TMR twice daily at 0900 and 1100 hours. Body measurements were taken at the beginning and at the end of this 120-day trial. In addition, fecal and total manure per pen were made during weeks 8 and 16 to estimate diet digestibility. All heifers were off the study at least 6 weeks before their first calving; and milk

production for the first 150 days in milk. Data also included calf body weight, calving ease score, and first-lactation monthly milk fat and protein.

Item	High energy-Low RFI	Low energy-Low RFI	High energy-High RFI	Low energy-High RFI
DMI, lb/day	24.4	22.0	24.2	22.0
Body weight, lb				
Initial	1013.6	1009.0	1005.7	993.3
Final	1319.7	1256.9	1318.1	1216.6
ADG, lb over 120 days	2.55	2.07	2.62	1.87
Initial Body length, inch	60.0	59.4	59.9	59.8
Gain	4.88	3.74	4.13	3.35
Initial Hip height, inch	54.8	55.0	55.6	54.8
Gain	1.38	1.42	1.46	1.06
Initial BCS	3.39	3.35	3.30	3.44
Gain	0.48	0.12	0.48	0.08
Feed Effic., DMI lb/lb gain	9.5	10.7	9.4	11.9
Digestibilities, %				
Dry matter	58.9	50.0	57.9	50.8
NDF	59.7	49.1	57.9	50.6
Calf weight, lb	81.4	79.5	81.3	77.3
Milk, lb over first 150 days	85.2	83.2	83.9	82.7
Fat, %	3.99	3.83	3.88	4.20
Protein, %	2.97	2.90	2.93	2.98

- **Dry matter intake (DMI)** was greater for the high energy diet reflecting its lack of straw and less gut fill effect on intake
- **Body weight** averaged about 1,000 lb at the start of this 120-day trial; and **average daily gain (ADG)** was greater for high versu low eenrgy diet and teneded to be greater for High RFI vs Low RFI. Daily gains over 1 kg (2.2 lb) are excesssive as at that ADG is the maximum amount of protein deposition. Greater ADG than 2.22 is simply fat deposition. So the best ADG was 1.87 lb on the low energy/high RFI treatment. Fatter heifers (and cows) trypically have more calving difficulties due to fat deposition restricting the birth canal. Fatter heifers and cows have more metabolic problems too, including more body condtion score (BCS) loss.
- **Body length and height** were not different between diets nor between RFI. That is not surprising since only 25% of height increase from birth to first calving occurs during the second year of heifer growth (Kertz et al.,1998). With such small frame increase, it is difficult to pick up statistical diferences with considerble variation during growth as well.

- **Feed efficiencies** were poorer/higher with the low energy diet. But that is deceptive as the low energy diet with straw would also likely have had more gut fill—but with less fattening too.
- **Lower dry matter (DM) and NDF digestibilities** were found on the low energy diet as expected since that diet contained straw.
- **Calf birth weight, milk and composition** did not differ by diet or RFI. This may not be too surprising since first-calf heifer numbers were low and varaion high. For instance, the coeficient of variation on daily milk produciton was over 5 %. What was surprising to me were the lower calf birth weights of about 80 lb versus female calves' birth weights of 85 lb in Kertz et al., (1997). Male calves in that database were an average 7 % greate in body weight. Since this study apparently included male calves, that makes the disparity between average birth weight even greater between these two studies.

The Bottom Line

A limitation of most heifer studies is that there are too few animal numbers to be able to detect subsequent differences in lactation data. This seems to be the case for RFI (residual feed intake) data too. However, this study did find excessive daily gains and body condition when a high energy diet was fed free choice versus a lower energy diet with 14% straw inclusion. The low energy diet with high RFI heifers had the most appropriate daily gain of 1.87 lb versus the other 3 treatments which had daily gains over 2.0 and up to 2.6 lb daily gains. Daily gains of 2.2 lb and over can result in undue fattening.

References

Kertz, A. F., L. F. Reutzel, B. A. Barton, and R. L. Ely. 1997. Body weight, body condition score, and wither height of prepartum Holstein cows and body weight and sex of calves by parity. A database and summary. J. Dairy Sci. 80:525-529.

Kertz, A. F., B. A. Barton, and L. F. Reutzel. 1998. Relative efficiencies of wither height and body weight increase from birth until first calving in Holstein cattle. J. Dairy Sci. 81:1479-1482.

Kertz, A. F. 2009a. Diluting heifer diets with straw studied. Feedstuffs, April 13 p. 12-13.

Kertz, A.F. 2009b. Limit feeding possible for growing heifers. Feedstuffs, November 9, p. 12-13.

NRC. National Research Council Nutrient Requirements of Dairy Cattle, 7th REVISED edition, 2001.

Williams, K. T., K. A. Weigel, W. K. Coblentz, N. M. Esser, H. Schlesser, P. C. Hoffman, R. Ogden, H. Su, and M. S. Akins. 2022. Effect of diet energy level and genomic residual feed intake on bred Holstein dairy heifer growth and feed efficiency. J. Dairy Sci. 105:2201-2214.