Utilization of TTNDFd and Starch Digestibility in the Formulation of Beef Cow and Developing Heifer Rations

IOWA STATE UNIVERSITY
Extension and Outreach
Iowa Beef Center

Garland Dahlke[a], Devin Jakub[a] ,Katana Lippolis, Erika Lundy[a], Patrick Wall[a] and John Goeser[b]

[a]Iowa State University, [b]Rock River Laboratory Watertown, WI & University of Wisconsin -Madison

Abstract

The objective of this trial was to evaluate the effectiveness of using the total tract neutral detergent fiber digestibility (TTNDFd) and starch digestibility methodology in the formulation of beef cow and replacement heifer rations. This methodology is ultimately applied to the estimation of energy availability to the animal with the accompanied performance as outlined by the NASEM 2016 Nutrient Requirements of Beef Cattle publication. Multiparous, Angus cows monitored during the last two months of gestation and replacement, Shorthorn heifers fed from seven to twelve months of age comprised the study with the cows receiving one of four mixed, dry ingredient based diets while the heifers received a corn silage based diet. Feed nutrient evaluation along with feed intake were documented and applied into the NASEM growth equations for these cattle. The results were then compared to actual performance of the animals. Along with TTNDFd/starch derived energy estimates, Acid detergent fiber (ADF) derived energy estimates which generally accompany commercial laboratory feed analysis reports were compared as well. A T-test between actual and projected growth was used to describe the extent of difference. The T-test between the TTNDFd/Starch derived results generally did not show any statistical difference between the actual and projected results for heifers P(T<=t) 0.15 with an average ADG bias of -0.06 Kg. The cow results over the four diets P(T<=t) ranged from 0.41 to 0.004with an average bias of 0.04 to 0.27 Kg overestimating ADG. The T-test between the ADF derived results generally showed a difference between the actual and estimated values for heifers P(T<=t) 0.0004 with an average ADG bias of 0.2 Kg. The cow results over the four diets likewise over estimated available energy substantially. Here the test ranged from P(T<=t) 0.03 to 0.0001with an average bias of 0.35 to 0.7 Kg ADG. Finally, the 2001 Dairy NRC* methodology using lignin to modify the NDF digestibility was also utilized yielding an accuracy that was better than the ADF method, but still not as good as the TTNDFd method. Looking forward, it appears that the TTNDFd methodology should be strongly considered in the evaluation of forages directed for beef cows and replacements and in the development of ration formulation software for beef offered high levels of fiber in their ration.

** The 2001 Dairy NRC methodology was intermediate to TTNDFd and ADF NE prediction, but left off of Table 3 to conserve space.*

Objective

The objective of this trial was to evaluate the accuracy of the total tract NDF and starch digestibility methodology in determining ration energy and subsequent performance in beef cows and replacement heifers.

Methods

Multiparous, Angus cows (n=48) at the Iowa State University McNay Research Farm due to calve in September were blocked by body weight and randomly assigned to one of four treatments. Empty cow weights ranged from 463 to 633Kg. Cows were limit fed during the last two months of gestation as shown in Table 1. Along with the cows, seven pens of six yearling, Shorthorn heifers weighing 262 to 311 Kg fed at the Iowa State Beef Nutrition Farm were also included in the trial. These heifers were penned by weaning contemporary group and fed ad libitum the ration given in Table 2. In the case of both trials, feed samples were collected once every two weeks and evaluated by Rock River Laboratory of Watertown, WI. The lab used the TTNDFd, as described by Combs et. al., and starch digestibility in the analysis. Empty body weights were determined at the start of the trial and then at calving for the cows. For the heifers, weights were determined at the start of their trial in mid November and then in February at the end, 98 days later. Using the NASEM 2016 Nutrient Requirements of Beef Cattle Guidelines, calculated empty weight change was compared to actual empty body weight change. Along with the TTNDFd results, the more common ADF method of calculating net energy concentration and the OARDC methodology outlined in the 2001 Dairy NRC was considered as well. A Students T-test was used to compare if a difference occurred between the estimated and actual weight change. The lack of a strong difference between measures would indicate the appropriate methodology .

Table 1 Cow Rations

Kg/Hd DM Basis	Pens 1, 5, 11, 15	Pens 2, 6, 12, 16	Pens 3, 9, 13, 17	Pens 4, 10, 14, 18
Grass Hay	7.9	7.8	7.8	9.1
Shell Corn		3.1	1.4	
Dry ,Corn Distillers			.4	2.3

Table 2 Heifer Rations

	% DM
Corn Silage	47.5
Hay	15.4
Sweet Bran	18.7
Dry Corn Distillers	17.7
Vit/Min	0.7

Results

The TTNDFd results were only generated for the hay and corn silage. Lab results also provided net energy for maintenance and growth based on ADF and lignin concentration for all feedstuffs. Table 3 provides a summary of the results. In all cases, the ADF derived energy over predicted performance or net energy yield. The lab results were used in the following manner to calculate Megacalories of net energy per Kg of metabolizable energy as:

ME = (Dig.nonstarchNFC x 4.2 + Dig.Starch x 4.2 + Dig.NDF x 4.2 + Dig.Cr.Pro x 5.6 + Dig.Fat x 9.4 + Volatiles x 5.1 - 0.3) x 0.82

Dig. Starch = starch x 7hr starch dig. *Dig. NFC = NFC x 0.98*
Dig. NDF = NDF x TTNDFd *Dig. Fat = Ether Extract - 1*
Dig CrPro = CrPro EXP(-1.2 x ADICP/CrPro *Volatiles= alcohol + vfa s*

Table 3 Actual and Predicted Growth

	Actual Wt Gain/Loss	TTNDFd Predicted	T value	ADF Predicted	T value
Cow Hay	-19 Kg	-17 Kg	0.42	0 Kg	<0.01
Cow Hay+Corn	-13 Kg	3 Kg	0.02	29 Kg	<0.01
Cow Hay+ Corn+Dist	-19 Kg	-8 Kg	<0.01	9 Kg	0.03
Cow Hay+ Distillers	-12 Kg	0 Kg	0.02	27 Kg	<0.01
Heifers	111 Kg	106 Kg	0.15	131 Kg	<0.01

Conclusions

Although TTNDFd and 7 hour Starch digestibility have been developed for the dairy cow, both measures provide an improved tool in the estimation of available feed energy for beef cows and developing heifers .