An Evaluation of Effective Fiber in Beef Feedlot Finishing Diets

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Summary

A study was designed to collect a database of Iowa feedlot rations for determination of effective neutral detergent fiber (NDF) in complete diets from fiber analysis and particle size determination of individual feed ingredients and compare this with particle size determination of mixed wet rations. Seventy-one beef finishing total mixed rations were collected by ISU Extension Beef Field Specialists across Iowa. Producers were asked to complete a form assessing the acidosis risk associated with each ration. The average NDF of these diets was 25.9%. Of the total mixed rations 1.33 % remained in the top tray (>.75 in.), 47.27 % remained in the middle tray (>.31 in.), and 50.88 % was smaller than the .31 in screen. The effective NDF (eNDF) calculated from the eNDF of the ingredients averaged 10.56%. Estimated eNDF from total diet NDF and the percentage of the total diet in the top and middle trays averaged 12.47%. The calculated eNDF from non-grain sources alone averaged 3.6%. The percentage of digestive deads was weakly related to the percentage of the ration in the bottom tray (r=.19), the percentage in the top tray (r=-.46) and the effective NDF of the ration (r=-.23). The percentage of bloat was related to the total NDF of the diet (r=.28) and the effective fiber from non-grain sources (r=-.23). The number of off-feed incidences was related to the dry matter of the ration (r=.38), the apparent eNDF (r=-.28) and the percentage of ration in the bottom tray (r=.24). This study confirms that there is some relationship between effective NDF of the diet, effective NDF from non-grain sources or diet particle size; and acidosis indicators. These relationships are weak, however, indicating that other factors such as feedbunk management, feed processing, feed presentation and feed mixing likely also play a role in the incidence of acidosis in feedlot cattle.

Introduction

In an effort to remain competitive and improve efficiencies, Iowa cattle feeders in the 1980s and 1990s have increased the proportion of grain and level of energy fed to beef finishing cattle. The average percentage of grain fed by Iowa cattle feeders using ISU Beef Feedlot Enterprise Records during the period 1977 to 1991 has increased by 30%. Although this increase has resulted in improved feed efficiencies, cattle often experience more symptoms of acidosis. This includes increased death losses from digestive diseases and common general conditions including founder, bloat and liver abscesses. A secondary problem is subacute acidosis, which may decrease performance and efficiencies without visible symptoms. In the early 1990s, Iowa State University Extension concentrated on education in the area of feedbunk management to help reduce the incidence of subacute acidosis. Now new knowledge has become available that may provide a new tool for acidosis prevention and feedbunk management.

The National Research Council recently revised its Nutrient Requirements of Beef Cattle (1996). Among the many revisions to this document was a new requirement for effective fiber or effective NDF (neutral detergent fiber). This concept was borrowed from the dairy industry, which has similar problems with acidosis and milk fat depression in the high producing dairy cow. The high producing dairy cow is fed diets with much lower percentages of grain than feedlot cattle, however. Effective fiber is ration fiber of sufficient particle size to stimulate normal rumen fermentation, including cud chewing and production of buffers from saliva. The dairy industry has developed the use of the Penn State Particle Separator to evaluate the effective fiber of lactating cow diets. Although the NRC has published effective NDF requirements for feedlot cattle practical recommendations for particle sizes of mixed diets have not been established.

The purpose of this study was to collect a database of Iowa feedlot rations to determine effective NDF of complete diets from fiber analysis and particle size determination of individual feed ingredients and compare this with particle size determination of mixed wet rations. This would allow quick, on farm or in-office determinations of ration adequacy for effective fiber to aid in trouble shooting with nutritionists or veterinarians in the field. A more rapid and lower cost response to acidosis diagnosis should reduce digestive deads and improve the competitiveness of Iowa feedlots.

Materials and Methods

Seventy-one beef finishing total mixed rations were collected by ISU Extension Beef Field Specialists across Iowa. For each ration, feed ingredients were also collected. In addition, producers were asked to complete a form

assessing the acidosis risk associated with each ration. Data on the form included: percentage loose stools, percentage founder, percentage liver abscesses, percentage digestive deads, percentage bloat and off-feed incidences (number per pen). For each of these items the average per pen and the highest incidence were reported. These data were received on 49 of the 71 diets. Only eight diets were associated with liver abscess data.

Each diet and ingredient was evaluated in duplicate for particle size by two separate technicians using the Penn State Particle Separator. Neutral detergent fiber (NDF) analysis was conducted on both ingredients, and TMRs were conducted in the lab of Dr. Jim Russell, Iowa State University, using wet chemistry methods. Effective NDF was defined as that fiber that remained on the middle and upper trays (>.31 inches). Diet effective fiber was calculated from the eNDF of the feed ingredients times the proportion of each ingredient in the diet as reported by the producer. Apparent eNDF was calculated as the NDF of the TMR times the proportion of the TMR with a particle size greater than .31 in. The eNDF from non-grain sources alone was also calculated. This was done because of unusually high NDF values determined on the grains in this study. The average NDF value of 90 corn samples was 18.72 +/- 7.08 %. This is nearly twice the NRC (1996) value of 10.8%.

Results and Discussion

Table 1 shows the NDF and particle separation means of the feedlot diets. The average NDF of these diets was 25.9%. Of the total mixed rations 1.33 % remained in the top tray (>.75 in.), 47.27 % remained in the middle tray (>.31 in.), and 50.88 % was less than .31 in. The effective NDF calculated from the eNDF of the ingredients averaged 10.56%. Estimated eNDF from total diet NDF and the percentage of the total diet in the top and middle trays averaged 12.47%. The difference in these numbers suggests that compared with the total ration, more forage relative to grain is in the bottom tray of these diets. The calculated eNDF from non-grain sources alone averaged 3.6%.

Table 1. Average NDF and particle separation values from 71 Iowa feedlot rations

Item	Mean	Std. Dev.	Minimum	Maximum
Percent Dry Matter	74.67	8.98	52.22	97.84
NDF, % DM basis	25.90	5.30	13.63	41.61
Percent in top tray	1.33	1.00	0.00	4.67
Percent in middle tray	47.27	19.84	8.95	81.70
Percent in bottom tray	50.68	20.56	12.00	90.10
Effective NDF	10.56	4.70	2.51	23.13
Apparent eNDF	12.47	5.70	2.57	25.38
eNDF from non-grain	3.60	2.82	0.11	15.90

The survey responses to acidosis indicators are summarized in Table 2. The percentage of digestive deads is typical of observed data at other feedlots (Dr. Mike Apley, Iowa State University). Other numbers are normal to low, except for liver abscesses. The eight feeders who reported liver abscess data may not be enough respondents for a representative sample.

Table 2. Indicators of acidosis from 49 Iowa feedlot rations

Item	Mean	Std. Dev.
Average percent of cattle with loose stools	6.04	6.96
Average percent founder	0.93	1.37
Average percent liver abscess	2.73	4.74
Average percent digestive deads	0.47	2.01
Average percent bloats	0.24	0.45
Number of off-feed incidences per pen	4.54	8.07
Highest percent loose stools	14.68	13.98
Highest percent founder	2.10	3.51
Highest percent liver abscesses	16.56	13.29
Highest percent digestive deads	0.53	0.61
Highest percent bloats	0.72	0.91
Highest off-feed incidence per pen	9.34	8.52

Simple correlations were calculated on NDF and particle separation data against acidosis indicators. Only weak relationships existed, suggesting that additional factors such as feed mixing, feed presentation, feed additives and feedbunk management are as important as the fiber characteristics of the diet. The percentage of digestive deads was weakly related to the percentage of the ration in the bottom tray (r=.19), the percentage in the top tray (r=-.46) and the effective NDF of the ration (r=-.23). Percentage bloat was related to the total NDF of the diet (r=.28) and the effective fiber from non-grain sources (r=-.23). The number of off-feed incidences was related to the dry matter of the ration (r=.38), the apparent eNDF (r=-.28) and the percentage of the ration in the bottom tray (r=.24).

Implications

This study confirms that there is some relationship between effective NDF of the diet, effective NDF from non-grain sources or diet particle size, and acidosis indicators. From the data collected in this study these relationships are weak, indicating that other factors such as feedbunk management, feed processing, feed presentation and feed mixing likely also play a role in the incidence of acidosis in feedlot cattle. We were unable to establish benchmarks to be used as guidelines for feedlot rations. However, the knowledge of typical values for a wide range of practical finishing diets, along with an overall assessment of feedbunk management practices may still be useful to the nutritionist in balancing and troubleshooting fiber levels in beef feedlot diets.

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