Feed Particle Separation Due to Feed Delivery and Time in Feed Bunk and Effects on Cattle Performance

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Summary and Implications

By utilizing a Penn State feed particle separation box, consistency of feed wagon deliveries can be assessed and performance differences between pens explained in some situations. This study revealed a feed wagon that tended to unload a slightly higher level of the bulkier feed ingredients toward the end of the unloading process and thus those animals receiving the first portions tended to have a higher caloric intake per unit of ration and subsequent greater rate of weight gain because of this bias. We therefore consider it imperative to evaluate a feed wagon's delivery characteristics prior to use in order to maintain an acceptable level of quality control in ration delivery.

Introduction

The use of the Penn State feed particle separation box (shaker box) has been used widely to assess feed delivery consistency from feed delivery systems such as TMR wagons. This evaluation procedure has gained most of its recognition in feeding dairy cattle, but does have application in feedyard ration delivery as well. Regardless of operation, quality control in feed delivery is an issue that requires vigilance to ensure proper feed provisions to the animals for which the diet was formulated. Likewise, concern arises that animals can and will sort through their ration to select the more appealing components. Often in dairy and other higher forage diets the concentrate components are preferred and consumed in higher proportions leaving the coarser roughage behind. This situation can lead to acidosis and productivity inconsistencies over the feeding period. The purpose of this trial was to explore the impact that higher concentrate feedyard diets have in ration consistency in regards to delivery and exposure time in the bunk.

Material and Methods

A ration (Table 1) being blended and delivered to seven pens of growing Angus bulls of similar pedigrees, compromising four contemporary groups was measured using a three sieve (4 box) Penn State shaker box to determine consistency in ration delivery to individual feed bunks (pens). Pens one and two contained one contemporary group. Pens three, four and five contained a second contemporary group. Pen 6 contained a group from the same farm as pens three, four and five, but were from first calf heifers. Pen seven then contained a forth contemporary group. Samples were taken at the time of feed delivery by catching feed coming from the mixer wagon with a bucket at each bunk and then shaken in the Penn State shaker box. Feed remaining in the top, middle-top, middle-bottom and bottom pans from the box was weighed and represented numerically as a percentage of the total feed sampled (Figure 1). The neutral detergent fiber (NDF) of feed remaining in the top box was considered to be 100 % effective. The NDF of the middle-top box was considered to be 66% effective, the NDF of the middle-bottom box was considered as 33% effective and the proportion passing through the 1/8 inch mesh was considered as zero in terms of effective NDF (eNDF). The basis for these percentages was determined by utilizing the guidelines provided in the 1996 NRC publication, "Nutrient Requirements of Beef Cattle" in terms of eNDF levels in the feeds used to compose a ration which was then shook out in the Penn State box to provide a standardization of box readings. Calculation of eNDF with a ration of 31.5% chemical NDF if a top box content weight is 15 units, a middle-top box weight is 40 units, a middle-bottom weight is 50 units and a bottom box weight is 30 would be 27.6% (Table 2). The next portion of the trial then involved sampling the delivered feed in the bunk every hour to assess sorting of ration by the bulls. Three hand-grab samples from each bunk were taken each hour after delivery until bunks were empty or cattle in the pen quit eating. These samples were also shaken as mentioned above and results were presented in terms of an overall eNDF value for each sample. Finally, actual bull performance in terms of raw feed dry matter provisions to live weight conversion was compared to ration delivery eNDF data to determine bias caused by feed wagon delivery.

Table 1. Ration Composition.

Feedstuffs	% of Ration DM	Nutrient (DM basis)
Fescue hay	17.6 %	80.0 % Dry Matter
Wet distillers grain	5.4 %	14.1 % Crude Protein
Dry distillers grain	14.6 %	5.3 % Fat
Dry corn grain	47.3 %	31.9 % NDF
Soy hulls	13.2 %	0.59 Mcal / lb NE g
Mineral/Vit.	1.8 %	

Table 2. Example Calculation.

	Screen Size	Weights		%	eNDF
Top Screen =	3/4 inch mesh	15g @	100 %	12.5	3.9
Middle- Top =	5/16 in	40g @	66 %	33.3	10.5
Middle-Bottom =	1/8 in	50g @	33 %	41.7	13.2
Bottom	0	15g @	0%	12.5	0
Total		120g			27.6

Figure 1. Original ration in white tray and the four Penn State shaker boxes on top.

Results and Discussion

Feed delivery effects on ration consistency were documented and provided in Table 3. As data indicates, the feed wagon tended to distribute a larger percent of finer ration components earlier and more bulky components later. This difference could not be detected with visual observation, but could be demonstrated with the Penn State shaker box. It is conceivable that the finer components composed primarily of the higher energy concentrates, mineral and finer ground forage may be distributed differently with different makes and models of feed delivery wagons. Therefore, it is recommended that this feed wagon aspect be understood prior to use and then precautions implemented. Potential solutions might include adding moisture to the ration or varying bunk filling order to minimize problems in ration consistency over the extended feeding period.

Table 3. Bunk Fill Order and eNDF Delivery.

Bunk Fill Order	--- eNDF Delivered --- Average	Standard Deviation	Bias
#1	11.11	1.93	-1.10
#2	11.37	0.10	-0.49
#3	11.17	1.47	-0.52
#4	12.36	0.07	-0.57
#5	13.00	0.64	0.13
#6	12.24	0.50	0.33
#7	12.68	0.76	2.17

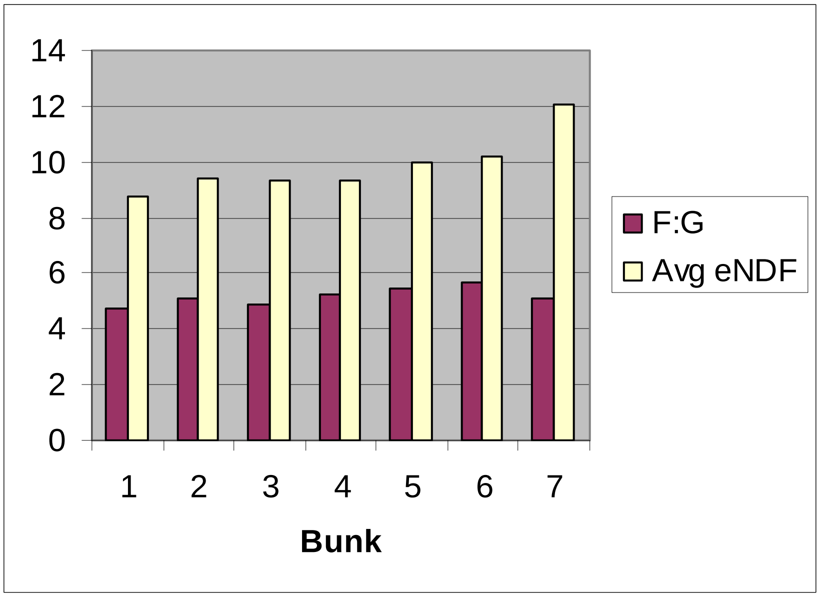
Bunk ration particle size over time was analyzed next. The three grab-samples taken each hour from each bunk were shaken and calculated in terms of eNDF level. Change in particle size was a function of animal selectivity and ration sorting while consumption took place. Cattle in this study tended to consume longer particles lengths early leaving the finer particles. This is somewhat different than observed in dairy cow diets where higher roughage diets are fed. Routine evaluation of particle length using a similar method in dairy cattle show that they tend to remove finer particles earlier than the coarser roughages. Table 4 illustrates the eNDF level over the time feed was in the bunk.

Table 4. Particle Size over Time in Feed Bunk.

Hours Post Delivery	Average eNDF	StDev.
0	11.84	1.46
1	10.59	1.24
2	9.58	1.47
3	9.61	1.22
4	9.30	1.04
5	9.77	1.77
6+	8.45	1.11

Bull performance at the end of the entire feeding period was calculated to provide a true estimate of the effects of the particle distribution bias caused by the feed wagon. As illustrated in Figure 2, apart from the contemporary group effects, there appears to be a general trend where the finer particle sizes are associated with a faster rate of gain and better conversion of feed to body weight. What is occurring is that the ration, although formulated to be the same for each bunk is not the same across all bunks. Finer particles tended to separate out from the mix and were delivered in slightly higher proportion in the first bunks that were filled. This has impact in that a higher concentration of energy, as well as some other nutrients that are more easily converted to body weight gain, are delivered to the early bunks than the particles that contribute to the higher eNDF fraction. Because of this issue, deliberate care needs to be provided when delivering feed to a given pen of cattle in order to prevent bias in performance. This can also be important in preventing nutritionally related health issues. Feed wagons can produce some level of delivery bias, and it is prudent to understand the extent this bias can occur under a given set of conditions. Management measures reducing this bias may include added moisture or other feed amendments that make ration components bind together, thus reducing this potential bias. In situations where a number of small bunks with the same ration are to be filled, it seems advantageous to load bunks in a different order each day in order to ensure each pen receives a comparable ration over time.

Figure 2. Feed Conversion and Feed Delivery.



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