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Grain Finishing Beef: Alternative Rations, Cattle Performance and Feeding Costs for Small Feeders

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Introduction

Even though many of the cattle finished in the United States are fed in large feedlots there are still many small finishing operations that lack the equipment and facilities of commercial feedlots and there are individuals that have an interest in fattening their own beef; 4-H projects or locker beef are prime examples. When finishing cattle, the nutritional requirements do not vary from large feeders to small feeders. However, a ration that is economically optimal for large feedlots may not be practical or economical for individuals who are only feeding one, two or maybe even a couple hundred head.

In the U. S. corn is the staple feed for fattening cattle. However, barley plays a key role as a feed grain in the Great Lakes region, the Northern Plains, the Mountain States, and the Pacific Northwest. Many research trials and years of experience by cattle feeders have documented that cattle average daily gains (ADG) are increased and that the amount of feed required for a pound of gain is decreased when grain is processed before feeding. Steam flaked corn has been shown to increase ADG by 5-19% depending upon overall ration and size and age of the cattle being fed (Zinn et al. and Corona et al.) In a study by Toland, it was found that digestibility of barley increased from 53% for whole barley to 85% for rolled barley which resulted in increased ADG and improved feed efficiency.

Obviously there is a cost to flake grain. A study in Nebraska found that for even relatively small feedlots, 5000 head capacity, there was an economic advantage if they had their own mill to steam flake corn rather than feeding it whole (Macken et al.). That economic advantage only increased for larger feedlots. Does that economic advantage still hold for an individual who may only be feeding a few head and who must pay to have someone else process the grain?

Most feedlots feed a complete mixed ration. The ration may include flaked corn or rolled barley, silage, ground hay, distillers grains, soybean meal, mineral supplements and other feed ingredients based on availability and costs. All of these ingredients are weighed and mixed and then fed in a uniform ration. By contrast, many small feeders may feed long stem hay and either dump the grain over the top of the hay or feed it in separate bunks. Are there the same ADG and feed efficiency differences between whole corn and steam flaked corn or rolled barley in these simple rations as in complete feedlot rations?

Objectives

The objectives of this fact sheet are to evaluate cattle performance and determine feeding costs for rations containing whole corn, steam flaked corn or rolled barley. Specific objectives are 1) to compare the expected cattle performance of feeding whole corn, steam flaked corn, or rolled barley in a simple ration with long hay as the only roughage and no protein supplement; 2) to determine the cost per pound of gain for each ration; 3) to create a decision framework for small cattle feeder to determine which grain is the most economical for them to feed based on the relative costs of the grains; and 4) to report on a cattle feeding trial at Utah State University that tried to replicate the rations proposed in this fact sheet.

Alternative Rations and Predicted Cattle Performance

Most individuals who are only feeding a few head are probably feeding bulk grain with a bucket or grain from a bag; Baled hay that has not been ground or chopped is probably also being fed. Table 1 contains six different rations that might be fed. Rations 1-3 are based on feeding about 70% grain and 30% hay while rations

4-6 have less than 40% grain and hay is more than 60% of the ration. The rations include the use of whole corn, steam flaked corn (SFC), and rolled barley. There are many different combinations of grains and forages that could be fed. These rations will document the expected differences between using whole corn, SFC, and rolled barley. The rations also were chosen because they illustrate the difference between the use of rations that contain a relatively high percentage of grain versus a relatively small percentage of grain in the ration.

The top portion of Table 1 lists the pounds of feed for each ration. For rations 1-3, 18 lbs. of whole corn, SFC, or rolled barley is fed with 6 lbs. of alfalfa hay in rations 1-2 and 6 lbs. of an alfalfa/grass hay mix for ration 3. Barley has a higher protein content than corn and therefore less alfalfa hay is needed to meet the protein requirement of the cattle. Research has shown cattle on a barley/alfalfa ration tend to be more susceptible to bloating. There is also 1 lb. of mineral supplement that contains an ionophore, such as Rumensin or Bovatec that is fed in the first three rations. Most feed dealers will sell this type of product in a 50-80 lb. bag and on these high percentage grain rations the product helps to control acidosis and also typically suppresses bloat. Rations 4-6 are based on feeding 10 lbs. of whole corn, SFC, or rolled barley and 16 lbs. of an alfalfa/grass hay. No mineral supplement is included in these rations.

The expected performance from each of these rations, reported at the bottom of Table 1, is based on feeding 850 lbs., medium frame, British breed, yearling steers to a finish weight of 1250 lbs. The "Taurus 2006 Ration Formulation and Analysis Program for Beef Cattle" Oltjen et al. was used to predict animal performance and it is based on the latest "Nutrient Requirements for Beef Cattle" National Research Council. In Table 1, **ADG** is the average daily gain in pounds per day, **F/G as fed** is the pounds of feed fed per pound of animal gain, sometimes referred to as feed efficiency in this fact sheet, and **Days Fed** is the number of days for the animal to reach 1250 pounds on each ration.

Table 1. Alternative Rations and Cattle Performance for 850-1250 lb. Yearling Steers.

Ration #	1	2	3	4	5	6
	All values are in pounds, except Days Fed					
Corn, Whole	18			10		
Corn, Flaked		18			10	
Barley, Flaked			18			10
Alfalfa, full bloom	6	6				
Alf/Grass Hay			6	16	16	16
Salt & Minerals	1	1	1			
ADG	3.00	3.25	2.85	2.10	2.25	1.95
F/G As Fed	8.25	7.66	8.85	12.44	11.68	13.51
Days Fed	133	123	140	190	178	205

From Table 1, it is apparent that cattle on a ration containing flaked corn will out preform the cattle on ration containing whole corn. Performance of cattle fed barley is expected to be a little lower than if they were fed whole corn. It is also obvious that cattle fed rations with the higher grain percentages will have higher ADG and will require less feed per pound of gain than those cattle fed on lower percentage grain rations.

Feed Cost Comparisons for Each Ration

The feed costs per pound of gain is calculated and displayed in Table 2 for rations 1 and 4 containing whole corn as the grain. (See Appendix Tables A1 and A2 for the same information for SFC and barley.) The price of alfalfa hay is varied from $100 to $250 per ton and the price of corn is varied from $3to $10 per bushel ($5.36 to $17.86 per cwt.). Obviously, as hay and grain prices increase, the feed cost of gain also increases. What also may surprise some is that only when hay is valued at $100 per ton or less and corn costs $10 per bushel or more is the ration containing more hay and less grain less costly per pound of gain. If one considers your time worth anything and the fact that you have to feed cattle longer on the higher hay/lower grain rations, then these rations are probably still more costly.

The ultimate question is "Which grain should be fed?" The answer is "It depends." It depends on what is available and at what price. Individual feeders must decide based on the relative prices of whole corn, SFC, and rolled or flaked barley. Table 3 is a general guide using the price of whole corn as the base and the other grains are priced relative to whole corn. The values in Table 3 are the prices for each grain which result in the same feed cost per pound of gain. This is based on the

Table 2. Feed Cost per lb. of Gain for Whole Corn and Hay Rations (18 lbs. Corn 6 lbs. Hay & 1 lb. Supplement in the Top of Each Cell and 10 lbs. of Corn & 16 lbs. of Hay in the Bottom of Each Cell).

	Corn Price, $ per cwt. and $ per bushel.							
	$5.36	$7.14	$8.93	$10.71	$12.50	$14.29	$16.00	$17.86
Hay Price $/ton	$3.00	$4.00	$5.00	$6.00	$7.00	$8.00	$9.00	$10.00
$100	0.49	0.60	0.71	0.81	0.92	1.03	1.13	1.24
	0.64	0.72	0.81	0.89	0.98	1.06	1.14	1.23
$125	0.52	0.62	0.73	0.84	0.95	1.05	1.16	1.27
	0.73	0.82	0.90	0.99	1.07	1.16	1.24	1.33
$150	0.54	0.65	0.76	0.86	0.97	1.08	1.18	1.29
	0.83	0.91	1.00	1.08	1.17	1.25	1.33	1.42
$175	0.57	0.67	0.78	0.89	1.00	1.10	1.21	1.32
	0.92	1.01	1.09	1.18	1.26	1.35	1.43	1.52
$200	0.59	0.70	0.81	0.91	1.02	1.13	1.23	1.34
	1.02	1.10	1.19	1.27	1.36	1.44	1.52	1.61
$225	0.62	0.72	0.83	0.94	1.05	1.15	1.26	1.37
	1.11	1.20	1.28	1.37	1.45	1.54	1.62	1.71
$250	0.64	0.75	0.86	0.96	1.07	1.18	1.28	1.39
	1.21	1.29	1.38	1.46	1.55	1.63	1.71	1.80

Table 3. Equal Price per cwt. for all Grains that Result in Equal Cost per lb. of Gain, Relative to Whole Corn Price per cwt.

	Whole Corn Price in $/cwt.							
	$5.00	$7.00	$9.00	$11.00	$13.00	$15.00	$17.00	$19.00
Ration 1, 2 & 3								
Steam Flaked Corn	$5.72	$7.89	$10.06	$12.22	$14.39	$16.56	$18.72	$20.89
Rolled Barley	$4.57	$6.47	$8.37	$10.27	$12.17	$14.07	$15.97	$17.87
Ration 4, 5 & 6								
Steam Flaked Corn	$6.22	$8.36	$10.50	$12.65	$14.79	$16.93	$19.07	$21.21
Rolled Barley	$3.79	$5.64	$7.50	$9.36	$11.22	$13.07	$14.93	$16.79

expected cattle performance reported in Table 1. For example if a feeder was planning on feeding 18 pounds of grain and was trying to decide between whole corn or steam flaked corn, ration 1 or 2, and the price of whole corn was $9.00/cwt. then if the price of steam flaked corn was less than $10.06/cwt. steam flaked corn could be fed for less total cost per pound of gain, but if it were greater than $10.06/cwt., then whole corn could be fed for less total cost per pound of gain. Similarly, if whole corn was $9.00/cwt. and if barley was less than $8.37/cwt., barley would be cheaper to feed and if barley were more than $8.37/cwt. then whole corn would be cheaper to feed. The relative feed costs that equate feed cost of gain differ between rations 1-3 and rations 4-6 because of the relative differences in the percentages of grain in the rations.

If you want the precise prices for SFC or rolled barley that result in equal total feed cost of gain for any price of whole corn, then you can use the appropriate equation below:

For rations 1-3

Price of SFC = $.31 + (1.083 * Price of whole corn)

Price of Barley = -$.18 + (0.95 * Price of whole corn)

For rations 4-6

Price of SFC = $.865 + (1.071 * Price of whole corn)

Price of Barley = -$.86 + (0.929 * Price of whole corn).

Regardless of how you will buy your grain (from the neighbor, in bulk from your coop, in 50 lb. bags from the local farm store) you can either use the values in Table 3 or the equations to determine which

grain will be most economical for you to feed. These relative feed values do change and so it would be wise to evaluate this decision each time you plan to start feeding a new pen of cattle on feed.

USU Experiment

In June 2013, a feeding trial was conducted at the Utah Agricultural Experiment Station beef farm located in Cache County Utah. The goal was to evaluate cattle performance and determine feeding costs for yearling steers fed on rations 1 and 2 and rations 4 and 5; the whole corn versus SFC ration comparisons. There were 44 head of yearling cattle that were initially weighed and sorted into each of the four ration treatment groups. However, these cattle were all heavier than the 850 lbs. that has been used in this fact sheet to predict animal performance. The cattle had initial weights that average 1,025 lbs. Also, the cattle were fed with a feed wagon and the alfalfa hay was ground prior to being fed. The cattle were a mix of steers and heifers and there was no alfalfa/grass hay available to truly duplicate rations 4 and 5. Therefore, this fact sheet will only report the results of seven yearling steers fed on ration 1 and seven yearling steers fed on ration 2.

Since the cattle were heavier when they were placed on feed, slightly more hay and grain were fed to achieve the targeted rates of gain displayed for rations 1 and 2 in Table 1: 19 lbs. of corn, whole ration 1 and steam flaked corn ration 2, was fed and 7 lbs. of ground alfalfa hay was fed with 1 lb. of a mineral supplement containing Rumensin. These rations were predicted to result in 3 lbs. ADG for the steers on ration 1 and 3.25 lbs. ADG for the steers on ration 2.

Actual performance matched very closely the predicted performance. After 83 days on feed the steers on ration 1 had gained on average 3.07 lbs. per day and the steers on ration 2 had gained 3.20 lbs. per day. Feed efficiency was 8.62 lbs. feed per lb. gain for the steers on ration 1 and it was 8.16 lbs. feed per lb. gain for ration 2. These results are consistent with prior research; steers fed SFC performed better than those fed whole corn. Part of the reduction in ADG and feed efficiency is the result of whole corn passing through the animal undigested and clearly observable in the manure (see Figure 1).

Before discussing the cost of gain for each of these rations, it is instructive to note the variation in performance of cattle on each ration. ADG ranged from 2.28 lbs/day to 4.33 lbs/day on ration 1 giving us a 2.05 lbs/day difference between the top performer and the bottom performer. The ADG ranged between 1.89 lbs/day and 4.22 lbs/day on ration 2, a difference of 2.33 lbs/day. These animals all faced identical environmental conditions and ate the same feed. The performance difference is largely affected by the individuals' genetic and physical potential. If you are feeding one animal, it is very tough to know if the animal will be a poor, average or excellent performer before you begin feeding. Therefore, don't be surprised if the performance you see from one individual head does not match the predicted performance.

What was the feed cost of gain differences for the USU feeding trial? All of the corn was purchased in bulk from an area feed dealer. Market price was paid for whole corn and SFC. The dealer also reported the price for corn purchased in 1,000 pound totes and for corn purchased in 50 lb. bags. The alfalfa hay was grown on Utah Agriculture Experiment Station farms, but it was priced at $200 per ton for this feeding trial. The mineral supplement was purchased from an area feed dealer at market price. The feed cost per pound of gain was as follows for each ration:

Ration 1,Whole Corn
bulk = $1.21, tote = $1.62, bag = $1.84
Ration 2, Steam Flaked Corn
bulk = $1.25, tote = $1.59, bag = $1.87.

A couple of observations can be made from this feed cost per pound of gain data: First, the more convenience you pay for (bags vs. tote vs. bulk) the higher will be your cost of gain; and Second, the cost of gain is nearly identical for whole corn versus SFC in this feeding trial when comparing bulk to bulk or bag to bag. Will that always be the case? While this feeding trial alone can't actually answer that question, consider this: the feed efficiency data on SFC versus whole corn is fairly well established. It probably isn't a stretch to think that feed dealers are aware of these differences and

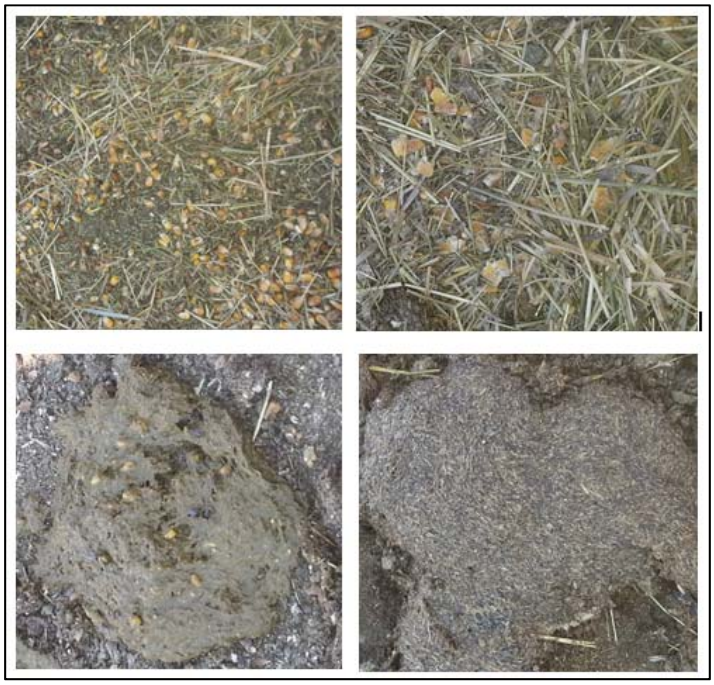

Figure 1. Top left: Ration 1; Top right: Ration 2; Bottom left: Manure from Ration 1; Bottom right: Manure from Ration 2.

price SFC accordingly. If it were too high priced, relative to whole corn, then no one would buy it. If it were too low priced relative to whole corn, well then the feed dealers would be good folks but not good businessmen.

Conclusion

There are a number of different rations that can be utilized to fatten cattle. A few simple rations that can be used by nearly any feeder with limited equipment and feeding facilities have been discussed in this fact sheet. To use these rations a feeder will not need any equipment to grind or mix their own feed. Research has shown that feeding steam flaked corn results in higher ADG and improved feed efficiency relative to whole corn. This fact sheet showed that to still be the case with simple rations of long hay and grain. However, SFC is more expensive to purchase than is whole corn. A decision framework was presented to allow smaller feeders to compare the relative cost of SFC and whole corn and determine which feed would result in the lower cost per pound of gain.

In a feeding trial at Utah State University during the summer of 2013, it was found that cattle had higher ADG when fed SFC compared to whole corn. However, when the relative cost of SFC and whole corn were considered, feeding whole corn compared to SFC resulted in nearly identical feed costs per pound of gain. Actual and relative costs of SFC and whole corn can and do vary over time and across geographic regions. Therefore, feeders could use the information in this fact sheet to determine which feed will be the most economical for them.

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Appendix

Table A1. Feed Cost per lb. of Gain for SFC and Hay Rations (18 lbs. SFC 6 lbs. Hay & 1 lb. Supplement in the Top of Each Cell and 10 lbs. of SFC & 16 lbs. of Hay in the Bottom of Each Cell).

	SFC Price, $ per cwt.							
Hay Price $/ton	$6.00	$8.00	$10.00	$12.00	$14.00	$16.00	$18.00	$20.00
$100	0.49	0.60	0.71	0.82	0.93	1.04	1.15	1.26
	0.62	0.71	0.80	0.89	0.98	1.07	1.16	1.24
$125	0.51	0.62	0.73	0.84	0.96	1.07	1.18	1.29
	0.71	0.80	0.89	0.98	1.07	1.16	1.24	1.33
$150	0.54	0.65	0.76	0.87	0.98	1.09	1.20	1.31
	0.80	0.89	0.98	1.07	1.16	1.24	1.33	1.42
$175	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33
	0.89	0.98	1.07	1.16	1.24	1.33	1.42	1.51
$200	0.58	0.69	0.80	0.91	1.02	1.14	1.25	1.36
	0.98	1.07	1.16	1.24	1.33	1.42	1.51	1.60
$225	0.60	0.72	0.83	0.94	1.05	1.16	1.27	1.38
	1.07	1.16	1.24	1.33	1.42	1.51	1.60	1.69
$250	0.63	0.74	0.85	0.96	1.07	1.18	1.29	1.40
	1.16	1.24	1.33	1.42	1.51	1.60	1.69	1.78

Table A2. Feed Cost per lb. of Gain for Rolled Barley and Hay Rations (18 lbs. Barley 6 lbs. Hay & 1 lb. Supplement in the Top of Each Cell and 10 lbs. of Barley & 16 lbs. of Hay in the Bottom of Each Cell).

	Corn Price, $ per cwt. and $ per bushel.							
Hay Price $/ton	$4.00	$6.00	$8.00	$10.00	$12.00	$14.00	$16.00	$18.00
$100	0.43	0.56	0.68	0.81	0.94	1.06	1.19	1.32
	0.62	0.72	0.82	0.92	1.03	1.13	1.23	1.33
$125	0.46	0.58	0.71	0.84	0.96	1.09	1.22	1.34
	0.72	0.82	0.92	1.03	1.13	1.23	1.33	1.44
$150	0.48	0.61	0.74	0.86	0.99	1.12	1.24	1.37
	0.82	0.92	1.03	1.13	1.23	1.33	1.44	1.54
$175	0.51	0.64	0.76	0.89	1.02	1.14	1.27	1.39
	0.92	1.03	1.13	1.23	1.33	1.44	1.54	1.64
$200	0.54	0.66	0.79	0.92	1.04	1.17	1.29	1.42
	1.03	1.13	1.23	1.33	1.44	1.54	1.64	1.74
$225	0.56	0.69	0.82	0.94	1.07	1.19	1.32	1.45
	1.13	1.23	1.33	1.44	1.54	1.64	1.74	1.85
$250	0.59	0.72	0.84	0.97	1.09	1.22	1.35	1.47
	1.23	1.33	1.44	1.54	1.64	1.74	1.85	1.95