Limit Feeding Concentrate Diets to Beef Cows as an Alternative to Feeding Hay

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Introduction

In years when hay and forage production is low due to drought hay prices often escalate, and in severe cases forage of any kind may be hard to obtain. In situations like this, some producers should consider limit feeding concentrate diets to cows. Depending on the price of grain, nutrients to maintain and grow cattle may be cheaper to purchase through concentrate feeds rather than roughage.

This nontraditional approach is often referred to as "program feeding" or "limit feeding." The basic principle is to feed corn (or some other concentrate energy source) and a supplement in just enough quantity to meet the animal's requirement for maintenance or a targeted level of weight gain. Generally, a very limited amount of roughage will be fed, or enough to keep the animal's digestive system healthy. The program is referred to as limit feeding because the diet is much more nutrient dense compared to hay or dry grass, and the amount consumed must be limited. Otherwise, there is no benefit in terms of feed cost savings and the animals get too fleshy.

Limit feeding is not for everyone. In fact, this technique may be limited to a small percentage of cattle producers in Oklahoma. Adoption is limited by the additional labor requirement, management skills, feed storage capacity, and the availability of feed bunks, feed delivery equipment, and a well drained dry lot or sacrifice pasture. The cost effectiveness of limit feeding will depend on each producer's price of alternative forage, the price of grain, and the price of the supplement needed for the hay or the limit feeding program. This fact sheet will focus on limit feeding beef cows and is intended to provide a few management tips to help producers evaluate the opportunity to utilize this technique.

Comparing feed energy sources

Nutrient content of corn grain is relatively consistent. According to the National Research Council (NRC996), corn is approximately 88 to 90 percent total digestible nutrients (TDN), 10 percent crude protein, and contains 1.02 megacalories (Mcal) of net energy for maintenance (NEm) per pound of dry matter (DM). However, harvested forage is extremely variable in nutrient content. Consequently, it is important to test hay for nutrient content in order to accurately evaluate and adjust the feeding program. The value of corn versus hay as an energy source is variable, depending on hay quality as well as the price of hay and corn (Table 1).

When low quality grass hay can be purchased for $50 per ton, the cost for energy from corn is approximately equal when corn is priced at $100 per ton. In the high quality hay example, energy from corn costs the same at approximately $85 per ton.

Table 1. Breakeven Prices.

Corn Cost ($/bushel)	*Cost per ton TDN*	*Low Quality Hay*	*High Quality Hay*
3	122	61	68
4	162	81	91
5	203	101	114
6	244	122	136
7	284	142	159
8	325	162	182

Low Quality = 50% TDN
High Quality = 56% TDN

Results from previous work

Results from studies conducted in Ohio (Loerch, 1996) are shown in Table 2. After each winter feeding period, cows were turned out to pastures and monitored for grazing weight gain and reproductive performance. Reports concluded that the limit-fed diets could reduce winter feed costs by nearly one-half when hay was expensive and grain was cheap, without sacrificing pasture performance or reproductive performance. It was noted that the cattle acted hungry, especially during the first few weeks of each trial. In fact, the cows consumed the bark off of trees that were located in the pens. Calf birth weights were slightly increased with the corn diet, but no difference was found in calving difficulty. Other studies conducted in Illinois and Kansas have also concluded that cow performance with limit feeding can be equal to traditional free choice hay and supplement diets.

Feeding management

Table 3 includes guidelines for rations based on corn grain, supplement, and a minimal amount of long stemmed hay. Using these guidelines, Table 4 demonstrates examples of limit-fed rations based on corn grain for a 1,200-pound cow with average milk production and in average body

Table 2. Animal performance and feed costs for cows limit-fed a concentrate ration or fed free choice hay[a].

	Item	*Limit-fed corn*	*Free choice hay*
Trial 1	Weight change, lbs.	4.4	-31
	DM intake, lbs.	15.6	32.2
	Hay, lbs.	2.6	32.2
	Corn, lbs.	10.4	-
	Supplement, lbs.	2.6	-
	Feed cost, $/day[b]	$.77	$1.50
Trial 2	Weight change, lbs.	-117.0	-51.7
	DM intake, lbs.	15.2	29.1
	Hay, lbs.	1.8	29.1
	Corn, lbs.	10.8	-
	Supplement, lbs.	2.6	-
	Feed cost, $/day[b]	$.75	$1.36
Trial 3	Weight change, lbs.	-48.5	-136.6
	DM intake, lbs.	17.0	29.5
	Hay, lbs.	2.2	29.5
	Corn, lbs.	12.6	-
	Supplement, lbs.	2.2	-
	Feed cost, $/day[b]	$.81	$1.37

[a] From Loerch, 1996, Journal of Animal Science, 74:1211. All studies were conducted from November through early April using spring calving beef cows with average initial weight of 1340 pounds.

[b] All costs calculated using the following values: corn = $2.00 per bushel, hay (9.5% CP and 72% NDF) = $80 per ton, supplement = $150 per ton.

Table 3. Guidelines for limit-fed rations based on corn grain.

	Amount to be fed		
Stage of Production	*Corn*	*38 to 44% Protein supplement*	*Long stemmed grass hay*
Gestating	.75% of body weight	2 lbs. per day	.5% of body weight
Lactating, avg. milk	1% of body weight	3 lbs. per day	.5% of body weight
Lactating, high milk	1.1% of body weight	3.5 lbs. per day	.5% of body weight

condition. Table 5 provides an example of a total mixed ration (TMR) we have used at the Range Cow Research Center, where chopped or ground hay, concentrate and liquid supplement are being blended in a feed mixer.

CAUTION: During drought years, some of the corn crop may be contaminated with aflatoxin, a toxic compound produced by molds. Make certain the grain you buy is not contaminated! See your local county Extension Agriculture Educator for more details on aflatoxin contaminated grain.

Supplements for limit-fed diets based on corn grain

These diets require added limestone as a source of calcium to offset the high phosphorus content of corn. Salt and Vitamin A should also be provided in the supplement or in a free choice mineral. Mineral supplements designed specifically for cattle grazing wheat pasture have high calcium, low phosphorus content, and should work well for cows receiving a limit-fed corn ration.

Vitamin A supplementation must not be overlooked in years when forage quality is low, in any type of feeding program.

Table 4. Limit-fed corn rations for gestating and lactating cows.

Ingredient	*Gestation*	*Early lactation*
	—Lbs. per day, as-fed basis—	
Grass hay[a]	6	6
Corn grain	9.0	12
Protein supplement (38-44%)	2.0	3
Limestone[b]	.2	.25

[a] Hay = 89% dry matter, 5% crude protein, and 48% TDN. Quantity of hay fed daily can be gradually reduced to around 4 pounds if whole shelled corn is fed. If processed corn is fed, begin feeding .75% of body weight and gradually reduce to .5%.

[b] Limestone is a calcium source and is not required if protein supplement contains at least 2.5% calcium.

Table 5. Total Mixed Ration (TMR).

Commodity	*% as fed*
Bermudagrass hay	32.5
Dry-distillers grains	25
Groud corn	29
Cottonseed meal	2.5
Liestone	2.0
Sodium Bicarbonate	1.0
Salt	0.5
Liquid Supplement	7.5
DM Composition	
DM%	90
NEmMcal/kg	1.69
Crude protein, %	16.5
ADF, %	21
aNDF, %	37
Ash, %	7
TDN, %	72

Conditions that lead to Vitamin A deficiency include situations where cattle are fed:

- High concentrate diets;
- Bleached pasture or hay grown during drought conditions;
- Feeds that have received excess exposure to sunlight, air, and high temperature.

Gestating beef cows need around 30,000 international units (IU) of Vitamin A per day, while cows in early lactation need 50,000 units of Vitamin A.

Several Oklahoma feed manufacturers have supplements formulated for this purpose. Table 5 includes a protein supplement specifically designed for limit feeding beef cows. This supplement, or a similar one, can be mixed with the corn or top dressed over the grain. For whole shelled corn diets, the supplement should be made in a 1/4 or 5/16-inch pellet.

Table 6. Protein supplement for limit feeding corn to beef cows.

Ingredient	*Percent, as-fed basis*	*Lbs. per ton*
Soybean meal, 47%[a]	59.00	1180
Wheat middlings	23.06	461.3
Limestone, 38%	5.00	100
Cane molasses	3.75	75
Salt	2.50	50
Urea	2.25	45
Dicalcium phosphate	3.00	60
Potassium chloride	1.00	20
Copper sulfate	.04	.7
Selenium 600	.15	3
Zinc oxide	.02	.4
Vitamin A, 30,000 units per gram	.15	3
Rumensin 80®[b]	.075	1.5
Total	100	2,000

[a] Cottonseed meal can be substituted for one-half the soybean meal.
[b] To provide 60 mg Rumensin per pound of supplement.

Additional management tips

Feeding diets high in grain to breeding females will require greater skill and discipline on the part of the herd manager. Acidosis, bloat, and founder are always a risk when high-grain diets are fed to ruminants. These risks can be minimized by the following management practices:

1. When starting the concentrate feeding program, gradually increase the amount of grain fed and reduce the amount of hay fed over a two week step-up period.
2. Provide plenty of feeding space to accommodate uniform consumption. A minimum of 30 inches of linear bunk space per cow should be used, more if the cows are horned.
3. Whole shelled corn is safer to feed compared to finely processed grain. If the grain must be processed, it should be coarsely rolled or cracked. Research from Illinois (Tjardes et al., 1998) found that limit-fed cows given whole shelled corn performed similar to cows fed cracked corn.
4. Long stemmed hay should be fed at a minimum DM level of .25 percent and up to .5 percent of body weight for cattle receiving whole shelled corn. If cracked or rolled corn is used, provide a minimum of .5 percent body weight hay DM, but do not exceed .75 percent. Feeding less hay reduces the cost, but increases the need for greater management intensity. As the cattle and the manager adjust to the program, the amount of hay fed can be gradually reduced to the minimum value suggested above.
5. Feeding an ionophore will help prevent acidosis and bloat as well as reduce the amount of feed needed by 7 to 10 percent. Rumensin® is currently the only ionophore cleared for feeding to beef cows, and should be fed at the rate of 100 to 200 mg per head per day.
6. Feed cattle at the same time every day. Altering the time of feeding, especially in limit feeding programs, greatly increases the risk of digestive upset. An ideal feeding situation is one where corn, hay, and supplement are placed in the bunk ahead of time. At the appropriate time of day, the cattle are given access to the feed by simply opening the lot gate.
7. Dry hay and grain rations are dusty and cows learn to shift the feed around to sort the concentrate into the bottom of the bunk. Liquid molasses-based supplements reduce this problem significantly. Also, if a total mixed ration is being fed (such as shown in Table 6), up to 35 percent water can be added in the feed mixer just prior to feeding. Obviously, the feeding rate needs to be adjusted accordingly.
8. Monitor body condition of cows closely and adjust amount of concentrate to maintain a body condition score of 5 for mature cows and 6 for first-calf heifers. See OSU Extension Bulletin E-869 for descriptions of body condition scores.

Alternatives to corn in limit feeding programs

Milo, wheat, soybean hulls, wheat middlings, and corn gluten feed are also good candidates to be incorporated into

limit feeding programs to maintain beef cows. However, be aware of the nutritional characteristics of each of these feeds and adjust the ration accordingly. Very few by-product feeds can be fed as a single ingredient in complete cattle rations.

If wheat is used, it should be blended with other commodities to reduce the risk of acidosis. As a conservative rule of thumb, feed wheat at no more than .5 percent of body weight. Approximately 15 to 20 percent of whole grain wheat escapes digestion. Therefore, wheat should be coarsely cracked or rolled.

In a programmed feeding situation where very limited roughage will be fed, wheat middlings should be blended with another commodity to reduce the risk of founder and bloat. Soybean hulls work well in combination with wheat middlings because soybean hulls contain very little flour or starch.

Corn gluten feed must also be blended with other commodities. The potential problem with feeding this commodity as the sole concentrate source is the high sulfur content. Beef cattle can tolerate diets with a maximum sulfur concentration of around .4 percent. Corn gluten feed typically contains .3 to .6 percent sulfur. Corn grain and soybean hulls both have relatively low sulfur content and work well when blended with corn gluten feed. Corn gluten feed must be dried at the wet milling plant before it can be shipped. Overheating during the drying process can reduce palatability and protein digestibility. Be aware of these potential sources of variation.

Soybean hulls may be the exception because as a single ingredient for a complete feed, they come close to providing adequate nutrients. However, depending on the source of hulls, this commodity is slightly low in protein for a limit-fed diet, and is slightly deficient in phosphorus and some of the trace elements.

Many producers in Oklahoma are not set up to handle bulk grain or other commodities and may not have the equipment and/or feed bunks necessary to feed grain. In these cases, commercial feeds made in 3/8 or 3/4-inch cubes should work well. Again, many feed manufacturers already have products on the shelf that are sufficient for this purpose. The following table is an example of a blend of by-products and corn that can be made into cubes and fed on the ground. This formula is designed to be fed with .5 percent body weight of hay, much like the corn diets shown above. Because of the high level of corn and soybean hulls, the pellets or cubes will be somewhat soft. Consequently, handling, auguring, etc. should be minimized to reduce the amount of fines.

Table 7. Complete feed to be used for beef cows in limit feeding program[a].

Ingredient	*Percent, as-fed basis*	*Lbs. per ton*
Wheat middlings	37.87	934.4
Soybean hulls	29.0	430.0
Corn grain	24.0	480.0
Cane molasses	4.75	95.0
Cotton seed meal, 41%	2.85	30.0
Limestone, 38%	.95	19.0
Salt	.5	10.0
Copper sulfate	.005	.1
Selenium 600	.03	.6
Vitamin A, 30,000 units per gram	.03	.6
Rumensin 80®[b]	.0156	.31
Total	100	2,000

[a] Feed at rate of 0.9% of body weight for gestating and 1.25% of body weight for lactating beef cows. Also provide .5% body weight grass hay on a daily basis.

[b] To provide 12.5 mg Rumensin per pound of feed.

Summary

Limit feeding concentrate diets to beef cows is a management technique that will need to be used in Oklahoma very infrequently. Grazing forages has always been and will continue to be the most economical and practical way to maintain beef cows. However, in unique situations limit feeding may be an economical alternative to purchasing expensive hay.

References

Loerch, S.C. 1996. Limit Feeding Corn as an Alternative to Hay for Gestating Beef Cows. J.Anim. Sci. 74:1211.

NRC, 1996. Nutrient Requirements of Beef Cattle (7th Edition). National Academy Press, Washington, DC.

Tjardes, K.E., D.B. Faulkner, D.D. Buskirk, D.F. Parrett, L.L. Berger, N.R. Merchen, and F.A. Ireland. 1998. The Influence of Processed Corn and Supplemental Fat on Digestion of Limit-Fed Diets and Performance of Beef Cows. J. Anim. Sci. 76:8.

Selk, G.E., K.S. Lusby. The Management of Beef Cattle for Efficient Reproduction. Oklahoma State University. E-869.

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