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Alternative Feeds for Beef Cattle

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Supplemental feed can be a major cost incurred to maintain beef cattle. Corn, grain sorghum or milo, cottonseed meal and soybean meal were traditionally used to provide supplemental energy (TDN, total digestible nutrients) and protein needed by cattle consuming forage diets. Cattle producers today, however, rely on an abundance of alternative or byproduct (co-product) feeds to supplement their cattle. These feeds will be described as alternative feeds throughout this publication.

Alternative feeds may provide nutrients needed by cattle at a lower cost than traditional feeds. The price of these feeds is usually based on the price of corn and a protein meal (such as soybean meal), supply and demand and how far the feed will be trucked from its origin to its destination. Several factors should be considered before deciding if and which alternative feed to use in cattle diets. Factors discussed relative to alternative feeds include the following:

- Supplementation Basics
- Composition (nutrient density)
- Mineral Supplementation
- Description
- Availability and Storage
- Feeding and Limitations

Supplementation Basics

Energy

Total digestible nutrients make up the majority of cattle diets. The exact TDN value of a diet is difficult to obtain because (1) TDN content of purchased feed is not displayed on feed labels, (2) TDN content derived from a forage or feed analysis is usually estimated from a prediction equation and (3) TDN values for many feeds change as the amount in the diet changes, especially when forage is replaced with alternative feeds and (4) variation within the nutrient composition of a feedstuff, as well as how the feedstuff was stored and processed, can affect its TDN.

Cattle producers can do little about most of the factors mentioned. However, cattle producers have the opportunity to have ingredients tested for nutrient composition, which can be used to make diet adjustments.

Changes in TDN associated with partially replacing one type of dietary ingredient with another are referred to as *associative effects* and can be positive or negative. Corn grain, for example, contains high levels of starch and TDN (Table 1). When corn is used as a supplement, high levels of starch and sugar are rapidly digested in the rumen, resulting in the rumen environment becoming more acidic. When high-starch supplements are fed to cattle consuming a forage-based diet, lower forage intake and digestibility can result once the starchy feed being used reaches a critical level. The impact of this negative associative effect is relative to the amount of grain fed as well as the type and quantity of forage. *Several experiments indicate that when the sum of the starch plus sugars are fed at levels above 0.4 percent of body weight, forage intake and digestibility may be reduced.*

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Adding grain (corn, grain sorghum or wheat) to the diet of cattle beyond a threshold of about 0.5 percent of body weight may be counterproductive if the goal is to maximize forage intake and digestibility. In these situations, it is often desirable to choose a supplement with a low level of starch that provides TDN in the form of highly digestible fiber, such as soybean hulls, corn gluten feed, wheat middlings and distillers grains (Table 1). The TDN in these feeds is in the same form as in the forage. Therefore, negative associative effects are not nearly as dramatic as those seen with starch-based supplements. However, using higher-starch feeds may be a viable option when they are competitively priced with the alternative feeds and when forage substitution is desirable. Although forage intake and digestibility are reduced by feeding high-starch feeds at greater than 0.4 percent body weight, total dietary energy intake can be greater, thus improving cattle performance.

Protein

Crude protein values for alternative feeds are included in Table 1. To maximize forage intake and digestion, protein requirements of cattle must be met. Protein supplements should be evaluated based on the digestive characteristics of the protein provided. A digestive characteristic of dietary protein is that it can be classified as either rumen degradable intake protein (commonly abbreviated as DIP or RDP) or rumen undegradable intake protein (commonly abbreviated as RUP or UIP). In previous years, RUP was called bypass protein.

Degradable intake protein requirements must be met to maximize intake and digestibility. If the diet is deficient in protein, a supplement high in DIP must be provided before TDN or UIP supplements are considered. Protein sources with high DIP values include those that have low UIP values in Table 1, such as soybean hulls, rice bran, corn gluten feed, wheat middlings and whole cottonseed. Soybean meal and urea are also high in DIP.

When DIP is adequate, supplementation of UIP may enhance the performance of growing calves. Feeds high in UIP include feather meal, blood meal, corn gluten meal and distillers grains.

Many producers will purchase ingredients by the truckload and mix supplements and diets on the farm. Storage space, ingredient turnover rate and feed price may all dictate type and quantity of ingredients and affect how protein feeding decisions are made. If a feed is high in UIP, this does not necessarily mean that DIP needs will not be met. Cattle are capable of cycling nitrogen from protein metabolism to the rumen, which can be used by the rumen microbes. Because many alternative feeds are moderate to high in crude protein, a diet that contains a high percentage of alternative feeds may have sufficient nitrogen recycling to the rumen for adequate diet digestion.

Table 1. Nutrient Concentration and Bulk Density of Feed Ingredients

Feed	DM	Protein		TDN	NDF	Fat	Ash	Ca	P	K	Mg	S
		CP	UIP									
Corn	88	9.8	55	88	19	4.3	1.6	0.03	0.31	0.33	0.11	0.14
Soybean hulls	91	12.2	42	80	66.3	2.1	4.9	0.53	0.18	1.29	0.22	0.11
Rice bran	90.5	14.4	49	70	33	15.0	11.5	0.10	1.73	1.89	0.97	0.20
Defatted rice bran	88	16.3		56		3.2		0.11	1.95	1.82	0.96	
Ricemill feed	91	6.8	32	42	60	6.4	17.2	0.08	0.60	2.20	0.57	0.30
Defatted ricemill feed	90	7.7		35		1.2		0.08	0.63	0.79	0.57	
Corn gluten feed	90	23.8	25	80	36.2	3.9	6.9	0.07	0.95	1.40	0.40	0.47
Wheat middlings	89	18.4	23	83	35	3.2	2.9	0.15	1.00	1.10	0.38	0.19
Whole cottonseed	92	24.4	30	90	51.6	17.5	4.2	0.17	0.62	1.24	0.38	0.27
Hominy	90	10.2	68	87	17	6.9	2.8	0.05	0.57	0.65	0.26	0.12
Wet brewers grain	26	29	64	74	45	9.3	4.3	0.35	0.68	0.15	0.22	0.32
Distillers dried grain	88	31	70	90	34	12.6	5.9	0.08	0.88	1.05	0.32	0.64
Wet distillers grain	33	30	70	90	31	12.7	5.5	0.08	0.85	0.99	0.32	0.58
Cottonseed hulls	91	4.1	50	45	90	1.7	4.0	0.15	0.09	0.87	0.14	0.09

Table values were acquired from the 1996 NRC Nutrient Requirements of Beef Cattle, Dairy One Feed Composition Library, and Arkansas feedstuff analysis results.

Minerals

Beef cattle should be provided with adequate levels of minerals year-round. When feeding some of the alternative feeds shown in Table 1, special attention should be given to the calcium-to-phosphorus ratio of the diet. All of the alternative feeds shown, except soybean hulls and cottonseed hulls, are relatively high in phosphorus. Although those feeds usually provide an inexpensive source of phosphorus, care must be taken to maintain a calcium:phosphorus ratio of at least 1 part of calcium to each part of phosphorus. Depending on the level of supplement fed, several of these feeds may need to be supplemented with a calcium source. Many of these feeds are also good sources of potassium, magnesium, sulfur and some trace minerals. Therefore, a lower cost mineral supplement can often be used because of the minerals provided in these alternative feeds. Commercially available mineral supplements that are 20 to 24 percent calcium and 0 to 4 percent phosphorus can often correct the calcium:phosphorus imbalance plus provide supplemental trace minerals and vitamins. Some alternative feeds can be excessive in minerals, and this too must be considered to avoid nutrition-related disorders (see FSA3071, *Nutritional Disorders in Beef Cattl*e).

Soybean Hulls

Description – Soybean hulls (seed coats) are a byproduct of soybean processing for soybean oil and soybean meal.

Availability and Storage – Currently, there is high demand for soybean hulls for feeding livestock species that can use highly-digestible, fibrous feeds.

Soybean hulls are dusty and are usually handled in bulk loose form, although pelletized forms are often available. Pelletized soybean hulls usually contain a lot of fines (loose particles). Hulls may be stored in open-fronted sheds or grain bins. They auger slower than grain, but this is a convenient way to store them if equipment for loading and unloading the bins is available.

Feeding and Limitations – As with other highly digestible fiber byproducts, the TDN value of soybean hulls depends on the amount fed and the type of diet (concentrate versus forage or roughage). When fed to growing cattle as a supplement to forage diets at 0.5 percent of body weight or less, soybean hulls are equivalent to corn in TDN content. Therefore, growing diets should be formulated using the same value of 90 percent TDN (dry matter basis) for both soybean hulls and corn.

When higher levels of soybean hulls are fed, TDN value is reduced. Soybean hulls fed alone have a high passage rate and a much lower digestibility than when *the diet includes at least one-third long-stem forage* to slow passage rate and increase ruminal retention time.

Like other high-fiber byproducts, soybean hulls have a lower TDN value than corn grain when fed at a level greater than 20 percent of diet dry matter in high-concentrate diets. Research indicates that soybean hulls can be used to replace conventional grain sources as supplements for cattle or as a creep feed. Soybean hulls are palatable to cattle. Sometimes, however, several days may be required to get cattle to consume desired amounts, especially when trying to start inexperienced, weaned calves on feed. Soybean hulls have been fed in free choice feeders to growing cattle producing gains of 2 pounds per day. Feeding free-choice soybean hulls may result in bloat (especially in the pelleted form).

Soybean hulls are not a replacement for cottonseed hulls. Soybean hulls are highly digestible fiber, while cottonseed hulls are not. Cottonseed hulls are very effective at helping sustain a healthy rumen, while soybean hulls are not.

Rice Bran

Description – Byproducts from processing rice include rice hulls, rice bran, rice polishings and broken rice grains. When harvested from the field, rice is in the form of paddy (or "rough") rice – the kernel is fully enveloped by the rice hull. After being dried, the first stage in milling is removal of the hull, yielding brown rice. Next, the outer layer is removed from the brown rice kernel to yield white rice. The separated brown layer is designated rice bran.

The composition of rice bran can be quite variable, due to the degree of milling and quantity of constituents. Rice bran is nutritious and supplies protein, energy and minerals (Table 1).

Both full-fat rice bran (commonly referred to as 12-12-12 for 12 percent protein, fat and fiber) and defatted rice bran are sold for cattle feed.

Availability and Storage – A large quantity of rice bran is produced in Arkansas. The high fat content of full-fat rice bran makes it more susceptible to rancidity during warm weather and less palatable. Rice bran is finely ground and has a powdery texture, making handling and storage in bins difficult due to stacking and bridging. Blending with other concentrates, such as grain, improves flow characteristics. Traditionally, rice bran was used as a cattle supplement. In recent years, rice bran has seen increased use in deer and other species supplements, which has affected its price and availability.

Feeding and Limitations – Small particle size, starch and fat content all add to the risk of digestive upset and the potential for nutritional imbalances. In general, beef cattle diets should not exceed 6 percent fat on a dry matter basis. Therefore, full-fat rice bran should be limited to no more than one-third of the diet. Research in Arkansas found that full-fat rice bran was best utilized at less than 0.5 percent body weight. Defatted rice bran has a lower energy value than full-fat rice bran; however, the fiber digestibility of defatted rice bran is improved in the absence of fat. Due to their moderate energy content and moderate to moderately-high protein content, these feedstuffs make a good forage substitute when forage supply is limited. Research in Louisiana evaluated free-choice access to full-fat rice bran, and rice bran intake appeared to be self-limiting around 1 percent body weight, which may be due to fat intake.

Rice Millfeed

Description – Rice millfeed is a product of rice bran (full fat or defatted) and rice hulls. Nutrient composition will be affected by the proportion of rice hulls to rice bran in the blend. There is considerable difference in the nutritive value of rice bran and rice millfeed (Table 1). Rice bran is much higher in crude protein and TDN content and is considerably more costly than rice millfeed.

Availability and Storage – As with rice bran, rice millfeed is readily available in the state. Handling characteristics are similar to rice bran, but rice millfeed has a longer storage life.

Feeding and Limitations – Rice millfeed is better suited for formulating complete diets, as opposed to being used as a supplement, because of its low protein and energy content. Rice millfeed is very palatable to cattle and could be used in combination with other feedstuffs during periods of drought as a forage substitute. Due to its small particle size, rice millfeed is not effective for maintaining a healthy rumen, so diets that include rice millfeed should also include a form of roughage, such as a hay or cotton-seed hulls, that will help maintain a healthy rumen. Research in Alabama showed rice millfeed can be utilized as an alternative to poultry litter-based diets for growing cattle.

Corn Gluten Feed

Description – Corn gluten feed is a byproduct of the wet milling industry that produces high-fructose corn syrup used by the soft drink industry.

Availability and Storage – Corn gluten feed is available in both dry (88 to 92 percent dry matter) and wet (55 to 70 percent dry matter) forms. The dry product is usually marketed as pellets. The wet form is usually restricted to areas relatively close to mills because of freight cost associated with transporting wet feed.

Feeding and Limitations – The moderate protein content (Table 1) and highly digestible fiber often make corn gluten feed an economical protein and TDN supplement for cattle. When corn gluten feed is included in a forage diet at 0.5 percent of body weight or less, the TDN value is equivalent to or greater than corn. The TDN value relative to corn grain decreases as the level in the diet increases. In high-concentrate diets, corn gluten feed has 85 to 90 percent of the TDN value of corn grain.

Generally, corn gluten feed should not make up more than 50 percent of the dry matter intake. Even at 50 percent, the TDN value will be less than when it is fed at lower levels.

Corn gluten feed can be quite variable from load to load. The pelletizing process can sometimes cause the product to have a burnt odor; therefore, corn gluten feed pellets may not be palatable, especially with receiving rations or creep feeds. Researchers have studied growth performance of calves with free-choice access to corn gluten feed. Feed conversions were reported to be very poor with free-choice access; therefore, avoid feeding corn gluten feed pellets as a free-choice supplement.

Wheat Middlings

Description – Wheat middlings or “midds” are a product of the flour milling process. Wheat middlings and wheat mill run are often used interchangeably by the industry. Wheat midds cannot contain more than 9.5 percent crude fiber.

Availability and Storage – Wheat midds are marketed in either pelleted or meal form. The meal form has a lower bulk density than pellets, resulting in some dust and logistical problems. Pelleted midds can be handled easily in conventional grain systems. Pelleting also improves palatability to cattle. Midds are moderately palatable to most cattle, but some animals may not readily consume them unless mixed with other feeds.

Feeding and Limitations – Generally, midds should not make up more than 50 percent of the total dry matter intake. Palatability may limit their use in some situations.

Whole Cottonseed

Description – Whole cottonseed is a byproduct of cotton production. Most of the cottonseed used by the beef industry has not been “delinted.” Whole cotton-seed can be fed to ruminants before or after the “lint”

has been removed. Cottonseed is high in TDN and protein content (Table 1). Cottonseed should be clean, free of foreign debris, white to whitish-gray in color and contain no more than 14 percent moisture.

Availability and Storage – Cottonseed supplies are seasonal, and price tends to be lowest in the fall. Cottonseed is light (20 to 25 lb/cubic ft). It is usually hauled in dump trailers or trucks with a bottom conveyor, especially non-delinted seed which does not flow well in mechanical systems. Cottonseed is usually handled with front-end loaders or manually with a shovel. Storing cottonseed that is too wet may cause heating or molding, as evidenced in a dark or black seed. Heating results in damage to protein, making it unavailable, and may eventually cause spontaneous combustion.

Feeding and Limitations – Several factors make cottonseed an ideal supplement for cattle. It is a good source of protein, TDN and phosphorus – three nutrients likely to be deficient in many feeding situations. Cattle usually eat cottonseed after they have adapted to it. At first offering, whole seed may need to be mixed with other ingredients, but after adaptation, cattle usually consume it readily. Cottonseed can be fed whole. Cottonseed does not flow well in self-feeders. It is usually fed from a trough or in small piles on a well-drained surface.

Because cottonseed is high in fat content and diets exceeding 6 percent fat (dry matter basis) can reduce forage digestibility, the quantity fed should be limited. In addition, gossypol, a potentially toxic compound found in cottonseed, limits its use. Gossypol is also found in cottonseed meal and cottonseed hulls. Fortunately, ruminant animals have the ability to detoxify gossypol, to some extent, during the fermentation process.

Clear guidelines regarding maximum tolerable levels of gossypol for cattle are not available. Maximum levels for feeding whole cottonseed generally should not exceed levels shown in Table 2. Although recommendations have been made for up to 10 percent whole cottonseed in the diet for developing young bulls, no recommendation is made here because research indicates potential reduced fertility in young, developing bulls and the relatively low potential cost savings versus risk when feeding whole cottonseed at the lower levels previously recommended.

Table 2. Whole Cottonseed Feeding Recommendations

	Percent of Animal Body Weight	Percent of Total Diet	Lb/Hd/Day
Mature Cows	0.5	20	5 to 7
Bulls (during the breeding season	0.33	15	5 to 7
Growing Cattle (over 8 weeks of age)	0.3	15	1.5 to 2.5

Always feed a good quality mineral-vitamin supplement free choice. In this case, the supplement should contain adequate calcium because cottonseed is low in calcium content.

Hominy

Description – Hominy is a byproduct of corn processing. It contains corn bran, corn germ and part of the starchy portion of either white or yellow corn kernels. Hominy is higher in TDN, protein, fat and fiber than corn grain (Table 1). The fat concentration can range from 5 to 12 percent, which will alter the TDN concentration.

Availability and Storage – Hominy is finely ground and can be stored, handled and fed similarly to ground corn.

Feeding and Limitations – Hominy is often used in rations as a replacement for corn. For finishing cattle, the maximum levels that can be added to the ration may be influenced by the fat content. Supplies should be fed within a month after purchase, especially during warm weather, to avoid the stale smell.

Brewers and Distillers Grains

Description – Brewers grains are spent grains (barley alone or a mixture of barley and other cereal grain or grain products) from the brewing of beer. Distillers grains are byproducts of the distilling industry. Corn is the most widely used grain in alcohol production, but rye, sorghum and wheat are sometimes used. In recent years, distillers grains volume has increased with the production of ethanol as an additive to automobile fuel.

Distillers grains with solubles consist of distillers grains plus the solubles of fermentation. Distillers grains are identified by the type of grain from which they are made, for example, corn or milo distillers.

Brewers and distillers grains are a good source of UIP for ruminants. They are rich in protein, TDN, minerals and vitamins (Table 1).

Availability and Storage – Brewers and distillers grains can be fresh (wet), dried, partially dried (modified) or ensiled. The dried product is the easiest to handle and store. Transportation cost must be considered when deciding to purchase wet or dried products. In recent years, supply and the cost of drying has permitted wet product to enter the state more economically than dried product. Wet brewers and distillers grains have a short storage life unless they are ensiled.

CAUTION – For an accurate comparison of the cost of wet grains vs. dry grains, the cost of wet grains should be adjusted to the same moisture level as dry grains. Most of the feeds in Table 1 contain about 90 percent dry matter, except wet brewers grains and wet distillers grains plus solubles. For example, if wet brewers grains (21 percent dry matter) were $35 per ton, the cost adjusted to 90 percent dry matter is $150 per ton.

The following formula may be used to adjust wet feed to a 90 percent dry matter basis.

$$\text{Price/ton of high moisture feed} \times \frac{0.9}{\text{\% dry matter in high moisture feed} \div 100} = \text{Price of high moisture feed adjusted to 90 percent dry matter}$$

For wet grains:

$$\$35/\text{ton} \times \frac{0.9}{0.21} = \$150 \text{ per ton}$$

Feeding and Limitations – Because of the higher protein content of brewers and distillers grains compared to other feedstuffs, they are typically higher priced; therefore, these feeds are usually preferred when both protein and energy supplementation are needed. Distillers grains are palatable to cattle. Because of the sulfur content, distillers grains should not exceed 40 percent of the diet (dry matter basis), and lower levels may be required if there are other sources of dietary sulfur.

Cottonseed Hulls

Description – Cottonseed hulls are the outer covering of cottonseeds. They are low in TDN and calcium and very low in protein and phosphorus (Table 1).

Availability and Storage – Non-pelleted hulls have been used for many years as a substitute for roughage. They are bulky and are difficult to transport and handle. Pelleted hulls are now available. In comparison to non-pelleted hulls, they are more digestible, require less transportation and storage space and are easier to handle.

Feeding and Limitations – Cottonseed hulls can be fed without further processing, but the use of pelleted hulls has increased in recent years because of ease of handling. In rations that contain high levels of TDN, pelleted hulls are not as effective as a roughage source for maintaining rumen health as non-pelleted hulls. Hulls are well liked by cattle, even when fed as the only roughage.

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