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Alternative Feeds for Beef Cattle

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Supplemental feed is the major cost of producing beef. Traditionally corn, grain sorghum, cottonseed meal and soybean meal have been used to provide supplemental energy (TDN, total digestible nutrients) and protein needed by cattle consuming forage diets. Arkansas cattle producers, however, are fortunate to have an abundance of alternative or byproduct feeds available.

Alternative feeds provide nutrients needed by cattle often at a lower cost than traditional feeds. Several factors should be considered, however, before a decision is made to use alternative feeds 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 usually make up the major portion of cattle diets. The TDN values of feeds are, however, often 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 estimated by using a prediction equation and (3) TDN values for many feeds change as the amount in the diet changes, especially when forage is replaced with concentrate.

Typical cattle producers can do little about the first two factors mentioned, but the third factor should be evaluated and the composition of the diet planned to optimize utilization of energy.

Changes in TDN value 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 fermented, resulting in a lower rumen pH. When starch intake reaches a critical level, this lowers feed intake and digestibility. 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 (Table 1) are fed at levels above 0.4 percent of body weight, forage intake and digestibility may be reduced*.

In reality, 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 dried 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.

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 degradable intake protein (DIP) or undegradable intake protein (UIP).

Degradable intake protein requirements must be met to maximize forage 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, cottonseed meal and urea are also high in DIP.

When DIP is adequate, supplementation of UIP enhances performance of young growing animals. Feeds high in UIP (formerly referred to as "bypass" protein) include feather meal, blood meal, corn gluten meal and distillers dried grains.

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: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 the diet 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.

Soybean Hulls

Description – Soybean hulls (seed coats) are a byproduct of soybean processing for soybean oil and soybean meal. During processing, soybeans are rolled or cracked to break the whole bean into smaller

Table 1. Nutrient concentration and bulk density of feed ingredients

Feed	Dry Matter	Concentrations in Dry Matter												
		Protein												
		CP	UIP	TDN	Starch-Sugars	ADF	NDF	Fat	Ash	Ca	P	K	Mg	S
Corn	90	9.8	55	90	75	2	11	4.1	1.5	.03	.32	.44	.12	.11
Soybean hulls	90	12.2	25	77	14	49	66	2.1	4.9	.53	.18	1.29	.22	.11
Rice bran	91	14.4	25	70	27	16	33	15.0	11.5	.10	1.73	1.89	.97	.20
Rice bran, defatted	88	16.3	--	56	--	18	--	3.2	--	.11	1.95	1.82	.96	--
Rice millfeed	91	6.8	32	42	9	50	60	6.4	17.2	.08	.60	2.20	.57	.30
Rice millfeed, defatted	90	7.7	--	35	--	53	--	1.2	--	.08	.63	.79	.57	--
Corn gluten feed	90	23.8	22	80	30	13	36	3.9	6.9	.07	.95	1.40	.40	.47
Wheat middlings	89	18.4	23	83	35	12	35	4.9	5.0	.15	1.00	1.13	.40	.19
Whole cottonseed	89	24.4	27	95	8	42	52	17.5	4.2	.17	.62	1.24	.38	.27
Hominy	90	11.5	53	91	52	13	23	7.7	2.0	0.5	.57	.65	.26	.10
Brewers' grain, wet	21	26.0	59	70	14	23	42	6.5	10.0	.29	.70	.58	.27	.34
Brewers' grain, dehydrated	90	29.2	50	66	14	31	49	10.8	4.0	.29	.70	.58	.27	.40
Corn distillers' dried grain	94	23.0	65	86	12	16	43	9.8	4.0	.11	.43	.18	.07	.40
Corn distillers' dried grain with solubles	90	30.4	52	90	16	21	46	10.7	4.6	.26	.83	1.08	.33	.44
Cottonseed hulls	90	4.2	50	42	--	65	88	1.7	2.9	.15	.09	.88	.14	.08

pieces so that the hulls can be removed. Soybean hulls are separated from the cracked seeds by an air stream. Hulls are usually toasted to destroy the urease activity and ground to the desirable particle size. Grinding the hulls decreases particle size and increases density for mixing and shipping purposes. Bulk density varies with fineness of grind, usually ranging from 20 to 24 pounds per cubic foot.

The protein content of the hulls varies widely, so the guaranteed analysis may be well below the actual protein content (Table 1). Testing each load may lead to large savings in protein supplement expenses. Soybean hulls are a good source of calcium, but relatively low in phosphorus content.

Availability and Storage – Currently, there is an increased availability of soybean hulls for feeding to cattle. Some processors sell soybean hulls directly to producers in a minimum 5 ton quantity.

Soybean hulls are dusty and usually handled in bulk although both meal and pelleted forms are often available. If the meal form is used, it is recommended that the producer wear a dust mask if working in an area with poor ventilation. Soybean hulls in the meal form work best in rations using wet ingredients because dust problems are minimized. 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. Feeding soybean hulls to grazing cattle is safer than feeding corn, because the possibility of acidosis is reduced or eliminated. They 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. At weaning, calves should usually be started on a commercial preconditioner, and then gradually shifted to soybean hulls.

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, where 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, supplying protein, energy and minerals (Table 1).

Full-fat rice bran and defatted rice bran are sold for cattle feed. The major difference in these feeds is that full-fat rice bran is higher in TDN content (Table 1). Because research is limited on the use of defatted rice bran for cattle, this discussion will be limited to recommendations for feeding full-fat bran.

Availability and Storage – In Arkansas there is a large quantity of rice bran produced. The high fat content 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.

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. It has a higher TDN value for forage fed cattle, however, when supplemented at 0.4 percent or less of body weight. At this level it has approximately the same TDN value as corn grain. A research trial showed that when rice bran was supplemented at 0.76 percent of body weight, the TDN value was less than that of corn fed at 0.6 percent of body weight. Because of its high phosphorus content, calcium supplementation may be required to maintain an adequate calcium:phosphorus ratio of the diet.

Rice Millfeed

Description – Rice millfeed may be highly variable in composition due to the varying amounts of rice hulls and rice bran included. Rice millfeed usually contains about two-thirds rice hulls and one-third rice bran. In recent years some processors have also produced a 50:50 mixture of hulls and bran for cattle feed. Also defatted rice bran has become available for cattle feed.

There is considerable difference in the nutritive value of rice bran and rice millfeed. Rice bran is much higher in crude protein and TDN content and considerably more costly than rice millfeed (Table 1).

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 designed more for maintenance rations due to its high content of rice hulls which contain only about 12 percent TDN. Due to its lower fat content, millfeed can be fed at higher levels than rice bran. Also, rice millfeed is less likely to become rancid or cause digestive upsets. The quantity of rice millfeed that can be fed to cattle is primarily regulated by the level of TDN and protein needed in the diet. To achieve desired performance, usually a TDN and protein source is needed in the diet when rice millfeed is fed. Rice millfeed is very palatable to cattle. "Founder" has occurred in growing cattle fed a free-choice mix of 25 percent corn and 75 percent rice millfeed.

Corn Gluten Feed

Description – Corn gluten feed is a byproduct of the wet milling industry which produces high-fructose corn syrup used by the soft drink industry. Corn gluten feed is that portion of the corn kernel that remains after extraction of starch, gluten and germ. It is composed primarily of bran (hull), the fibrous fraction of the kernel.

Availability and Storage – The recent switch of the soft drink industry to corn sweeteners (high fructose) has made corn gluten feed abundant. 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, although some mills sell it in the meal form. 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/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 that of 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 is low in calcium content so a calcium source may need to be added to the diet.

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. For cattle, midds are a good source of protein and TDN but are deficient in calcium, carotene and vitamin D. Nutrient composition may be more variable than that of other byproducts.

Availability and Storage – Wheat midds are marketed in either pelleted or meal forms. 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 their palatability to cattle. Midds are moderately palatable to most cattle, but some animals may not readily consume them unless they are 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. Relative to phosphorus, midds are low in calcium content, so supplemental calcium may need to be added to the ration.

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 cottonseed 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 prices tend 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 are

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 eventually may 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 does not need to be processed but may 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. Also, 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 vs. 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.

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, dried or ensiled; however, the dried product is the easiest to handle and store. Because the product is shipped into the state, transportation costs are usually prohibitive for the fresh product. Also, the fresh product deteriorates rapidly in hot weather.

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. For example, if wet brewers' grains (21 percent dry matter) were $35 per ton, their 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 high protein content of these grains and higher prices relative to other energy sources, they are generally considered as protein sources. However, when economically feasible, they are an excellent source of TDN. They may be included at 15 to 20 percent of the diet dry matter.

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 – Nonpelleted 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 nonpelleted 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 as nonpelleted hulls.

Hulls are well liked by cattle even when fed as the only roughage. Dry matter consumption of hulls may be up to 25 percent greater than for most other feed sources. When hulls are fed free-choice, the high rate of consumption increases nutrient intake significantly. Still, it is vital to provide supplemental protein, calcium, phosphorus, vitamin A, trace minerals and, in most cases, supplemental TDN to correct these deficiencies in hulls. With proper supplementation, cottonseed hulls may be a very economical source of roughage.

Feed Brokers and Manufacturers

Byproduct feeds are available from many different sources. A few feed brokers and manufacturers are listed for your information. This list is not inclusive, and this is not an endorsement.

Feed Brokers

J.W. Nutt Co.
2500 Crestwood
N. Little Rock, AR 72116
800-643-8349

Riceland Foods
P.O. Box 927
Stuttgart, AR 72160
870-673-5314

Feed Manufacturers

Archer Daniels Midland (ADM)
East 9th and Bond
Little Rock, AR 72202
800-255-9080

Planters Oil Mill
P.O. Box 7427
Pine Bluff, AR 71611
870-534-3631

Other sources of information on the availability and cost of feed byproducts may be found on the Internet at the following locations.

U of A Cooperative Extension Service
http://www.aragriculture.org/lvstkforg/livestock/beef/nutrition/commodity_feed_sources.asp

Oklahoma State University Feed Bulletin Board
http://www.ansi.okstate.edu/EXTEN/feedbull/

University of Missouri
http://agebb.missouri.edu/dairy/byprod/index.htm

Prices of various feeds (FOB Memphis) are updated weekly in the "Livestock Market Report" available at University of Arkansas Cooperative Extension Service offices throughout the state.

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