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Alternative Feeds for Beef Cattle

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Feed represents the largest single production expense for cattle operations. There are many different feedstuffs that can be included in rations for cattle, and there is nothing special about particular ingredients. What matters is the nutrients they provide. While beef producers rely heavily upon forages for the basis of a feeding program, forages often must be supplemented with energy or protein to meet the nutritional needs of cattle. Many alternative and by-product feeds are now available, often at a fairly low cost, to provide supplemental nutrition. This publication contains descriptions of many of the alternative and by-product feeds available in Virginia, and how they may be used in beef production systems.

Nutrients for Animal Nutrition

Beef cattle need many nutrients each day. However, the focus here will be on energy and protein. Energy values for a feed can be expressed in many different ways, but this publication will use TDN (Total Digestible Nutrients). Protein values of feeds are likewise expressed using various terms, but this publication uses Crude Protein (CP).

Animals cannot use the nutrients in a feed if they don't eat it. Consequently, the amount of feed consumed is very important. Factors that inhibit the level of voluntary feed intake, or Dry Matter Intake (DMI), are harmful to production. There is no single measure of a feed that tells you how much feed will be consumed, but there are characteristics of certain feeds that reduce voluntary intake by animals.

Ruminant animals, such as sheep and cattle, require fiber to maintain long-term digestive health and function. Pasture, hays, silages, and some by-product feeds have a high fiber level, but it is low in most grains. Normally, an animal will eat feed until it is full, and fiber is the component of a feed that fills it up, so fiber level relates directly to DMI.

Certain feeds may have mineral deficiencies or imbalances; however, these can quite easily be overcome with proper supplementation. Therefore, this publication will concentrate on energy (TDN), protein (CP), and intake as the noneconomic factors to be considered.

Feeds and the Nutrition Provided

Before investigating any alternative feeds, let us look at a few common and basic ones, so we have a basis of comparison. First, let us use good-quality hay as a baseline for roughage. Leafy, green, well-made hay can contain TDN that approaches 60 percent and CP around 15 percent. This kind of hay is often a grass-legume mix. Hay that is more mature, with a lot more stems and seedheads, is around 50 percent TDN and 10 percent CP. Animals eat less of this hay, since it contains a higher fiber content and they fill up faster. Straight alfalfa hay is readily consumed by cattle, and contains a high nutritive value if it is cut at an earlier stage of growth.

Corn is a readily available concentrate that is the basis of comparison for energy sources. It contains around 90 percent TDN, and most of the energy comes from starch. Corn is not high in protein, with around 9 percent to 10 percent CP. It is readily available from feed suppliers, is readily consumed by animals, and is a fairly low-cost source of feed energy.

Soybean meal, like corn, is readily available. It is the material that remains after the soybean oil is removed from whole soybeans, the oil being used in human foods and other products. Soybean meal has a TDN level of around 80 percent, but more importantly, it contains from 45 percent to 50 percent CP. Thus, just a small amount is needed to overcome a protein deficiency in most feeding situations. It is palatable and readily consumed by animals.

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By-product Feeds

Most all by-product feeds are what is left over after an ingredient to be used for human consumption is removed from a commodity. Because of this, the composition of a by-product can be quite different from the whole grain from which it is derived. Also, since a component of the grain is removed, all remaining components in the by-product are more concentrated. Table 1 lists examples of by-product feeds derived from various whole grains.

In most cases, the starch component of the raw material is removed. As a result of concentrating the remaining material, most by-product feeds are higher in fiber, fat, and protein than the raw product from which they originate. Although the rapidly-digested starch is removed from the feed, fiber in the form of cellulose remains and is highly digestible by ruminants such as cattle and sheep. Consequently, the energy (TDN) content of these feeds is not very different from the TDN of the whole grain from which these by-products originate. See Table 2 for some comparative energy and pro-

Table 1. Common By-product Feeds Derived from Food and Fiber Processing

Raw Product	By-product Feed	Component Removed
Soybean	Soybean Meal	Soybean Oil
	Soy Hulls	Dehulled Soybean Meal
Wheat	Middlings (Midds)	Flour (starch)
	Bran	Starch & Germ
Barley	Brewers' Grains	Starch → Alcohol
Corn	Distillers' Grains	Starch → Alcohol
	Gluten Feed	Starch → Sweeteners
	Hominy	Degermed Corn Meal
Cotton	Whole Cottonseed	Cotton Fiber
	Cottonseed Meal	Hulls & Oil
Sugar Beets	Beet Pulp	Sugar & Starch

Table 2. Nutrient Value of Selected By-product Feeds and Grains (Values are % of Dry Matter)

Feed	Dry Matter Content	TDN	Starch & Sugar	Crude Protein
Whole Soybeans	90	85	22	38
Soybean Meal	90	75	32	54
Soy Hulls	91	75	14	14
Ground Wheat	89	86	70	14
Wheat Midds	89	80	38	19
Wheat Bran	89	70		17
Ground Barley	88	80	60	12
Brewers' Grains	21 or 92	66	14	26
Cracked Corn	88	87	75	10
Distillers' Grains	25 or 91	89	14	29
Corn Gluten Feed	30 or 90	82	30	20
Hominy	90	92	52	12
Whole Cottonseed	90	87	55	22
Cottonseed Meal	92	77	15	44
Beet Pulp	91	74	40	10

tein values of selected by-product feeds. Be aware that these values are guidelines only. The nutrient content of by-product feeds has a large range due to different processing plants and the various procedures they use. Conventional feeds are much more consistent in nutrient content.

Supplementation Basics

Energy

TDN usually makes up the major portion of cattle diets. The TDN values of feeds, however, are 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, and starch is a major part of the concentrate feed.

Beef 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 energy utilization.

Changes in the 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 2). 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 2) are fed at levels above 0.4 percent of body weight, forage intake and digestibility may be reduced.

If the goal is to maximize forage intake and digestibility, adding grain (corn, barley, or wheat) to the diet of cattle beyond a threshold of about 0.5 percent of body weight may be counterproductive. 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, brewers' grains, and dried distillers' grains (Table 2). 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 2. To maximize forage intake and digestion, cattle must meet their protein requirements. However, forages used for hay or pasture in Virginia frequently contain enough protein to fulfill this need by cattle. Extra protein is rarely needed by mature cows, except perhaps lactating cows, but is more often needed by growing steers and heifers. When protein must be supplemented, usually energy is required also. Thus, a supplemental feed that contains higher levels of protein as well as energy will be needed.

Minerals

Beef cattle should be given adequate levels of minerals year-round. When feeding some of the alternative feeds shown in Table 2, pay special attention 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, you must be careful to maintain a calcium : phosphorus ratio of the diet of at least one 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, but not with phosphorous. Many of these feeds are also good sources of potassium, magnesium, sulfur, and some trace minerals. Therefore, a lower cost mineral supplement often can be used because of the minerals provided in these alternative feeds.

Specific Feeds and Their Use in Feeding Programs

There are many by-product feeds which may be available in local areas. The discussion below covers those feeds which are more widely available in Virginia.

Whole Cottonseed

Description: Whole cottonseed is a by-product of processing cotton for fiber. Whole seed can be fed to ruminants or processed for its oil content. In recent years, it has become widely used as feed. It is used heavily in the dairy industry as a source of fiber, protein, and energy. Cottonseed is high in TDN (90%) and crude protein (22%) and is a good feed for cattle. Supplies are seasonal and prices tend to be lowest in the fall.

Storage and Feeding: Cottonseed is light with a weight of 20 to 25 pounds per cubic foot. It is usually hauled in dump trailers or trucks with a bottom conveyor, or it can be hauled and stored in peanut-drying wagons. It will not flow well through bins and into augers. Cottonseed must be dry or it will mold during storage. Cottonseed does not need to be processed, can be mixed in diets, and fed in feedbunks or on a clean sod. Cattle usually will eat cottonseed after they are adapted to it. At first offering, whole seed may need to be mixed with other ingredients. However, after adaptation, cattle usually consume it readily. Feeding cottonseed at a level to meet the supplemental protein needs of growing cattle and beef cows is a common feeding system. Higher levels can be fed if whole seed is priced competitively as an energy supplement.

Limitations: High fat content (18%) and gossypol limit the level of cottonseed that can be fed. Whole cottonseed should be limited to 25 percent of the total dry matter intake for beef cattle. A practical feeding limit would be 3 lb/day for a stocker calf and 5 lb/day for a beef cow. Gossypol has been shown to reduce the reproductive performance of cattle, and the bull appears to be more sensitive than the cow or heifer. Gossypol levels will vary in whole cottonseed, but feeding the amounts listed above has not resulted in gossypol toxicity problems.

Cottonseed Hulls

Description: Cottonseed hulls are the outside portion of the whole cottonseed. They are separated from the whole seed during the further processing and production of cottonseed oil. The TDN level is around 45 percent, and the protein content is approximately 4 percent. They are high in fiber and are available as intact hulls or ground and pelleted.

Availability and Storage: As with most cotton by-products, cottonseed hulls are less expensive near the cotton gins. Pelleted hulls can be handled in normal grain handling augers and bins. However, unprocessed hulls will not flow through these systems.

Feeding and Limitations: The high fiber level and corresponding low energy content means that cottonseed hulls should be considered a fiber source. They are often used as a roughage substitute in total mixed rations (TMRs) for growing/finishing cattle. Cottonseed hulls should be considered an alternative where chopped hay in rations would typically be used. Cottonseed hulls also have enough gossypol to create problems with preruminants and bulls, thus the maximums mentioned for whole cottonseed should be used.

Soybean Hulls

Description: Soybean hulls (seed coats) are a by-product of soybean processing for soybean oil and soybean meal. During processing, soybeans are rolled or cracked to break the whole bean into smaller 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 the fineness of grind, usually ranging from 20 to 24 pounds per cubic foot. Pelleted soy hulls, which have a considerably higher bulk density, are also available.

The protein content of the hulls varies widely, so the guaranteed analysis may be well below the actual protein content (Table 2). 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.

The fiber in soy hulls is highly digestible by ruminants. This means that soy hulls are not a very effective fiber source and should not be used in a beef cattle diet as the only source of fiber.

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 five-ton quantity.

Soybean hulls are dusty and usually handled in bulk. Both loose and pelleted forms are available. Soybean hulls in the loose form work best in rations using wet ingredients because dust problems are minimized. Hulls may be stored in open-front sheds or grain bins. They auger more slowly 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 by-products, 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, the 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 the passage rate and increase ruminal retention time. Soy hulls have been offered to growing steers in self feeders with pasture or hay also available, resulting in rapid gains by cattle.

Like other high-fiber by-products, 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. Although soybean hulls are highly palatable to cattle, a short adaptation period may be needed before cattle will consume the desired amounts, especially when considering inexperienced, weaned calves.

Whole Soybeans

Description: Sometimes known as full-fat soybeans or raw soybeans, whole beans may be useful in certain feeding situations. Like whole cottonseed, whole soybeans have a high oil content, around 18 percent. Consequently, the energy value is quite high (94% TDN) while still possessing a fairly high protein level (40%). Soybeans contain two enzymes, a trypsin inhibitor and urease. Trypsin inhibitors do not affect ruminants and urease is only an issue when urea is the protein source in a ration. Trypsin inhibitors and urease are destroyed when soybeans and soybean meal are heat treated.

Normally, the value of soybeans as a cash crop far exceeds their feed value. However, for beans that contain a lot of foreign material, or beans that have been damaged during growing or harvesting, feeding may be an economically viable alternative.

Storage and Feeding: As long as they are dry, whole soybeans can be stored in grain-handling structures for an extended time period. Efficiency is enhanced by cracking or rolling prior to feeding. Soybeans are very dense, about 48 pounds per cubic foot.

Whole soybeans fit into a feeding program best where high energy as well as moderate protein is needed. This would occur with growing/finishing cattle in a feedlot or with cows during early lactation. Felton and Kerley (2004) successfully fed whole soybeans at up to 24 percent of the diet dry matter in a finishing trial with corn silage and corn. Cattle performance and carcass characteristics were excellent.

Limitations: A maximum of 25 percent of the daily ration dry matter can be used, due to the fat content of whole soybeans. They may be fed whole to feedlot cattle receiving a low-roughage, high-grain diet, but should be cracked or rolled for cattle fed a higher roughage level. Mature cows can utilize whole soybeans fairly efficiently. Cracked or rolled soybeans may spoil, especially in hot weather, due to rancidity. Thus, not more than a one- to two-week supply should be prepared prior to feeding.

Wheat Midds

Description: Wheat middlings are a by-product of milling wheat for flour. They are high in TDN (89%), protein (19%), and phosphorus (1.0%).

Wheat midds are available from flour mills across the United States. They are routinely used in commercial feeds. Their price is often attractive when higher protein content is needed in the ration.

Storage and Feeding: Wheat midds are light and bulky with a weight of 20 pounds per cubic foot. They are usually stored in flat-bed storage and loaded with a front-end loader. Wheat midds are moderately palatable to most cattle but some animals may not readily consume them unless they are mixed with other feeds. Pelleting improves their palatability to cattle. They make an excellent supplement for grazing cattle since they are high in energy, protein, and phosphorus, and their moderate levels of starch result in less depression in intake and digestibility of forage.

Limitations: Palatability may limit their use in some situations and levels should be limited to 50 percent of the total dry matter intake. At higher levels of feeding, the high phosphorus concentration needs to be balanced by adding calcium.

Hominy

Description: Hominy is a by-product of corn processing for human consumption. It contains corn bran, corn germ, and part of the starch. Hominy is higher in energy, protein, fat, and fiber than corn grain. The fat

concentration can range from 5 percent to 12 percent, which will alter the TDN concentration and the maximum levels that can be added to the ration. It is often used in rations as a replacement for corn.

Storage and Feeding: Hominy is finely ground and can be stored, handled, and fed similarly to ground corn. It is best to use up supplies in one month or less to avoid the stale smell.

Limitations: Hominy can be used in place of corn in beef cattle feeding programs.

Peanut Skins

Description: Peanuts skins are the thin, outer coat on the nut after shelling (not the hull). These are a by-product from peanut shellers and are usually available during the winter and spring. They are a good energy supplement for cattle, containing an estimated 60 percent to 80 percent TDN (not experimentally determined) and 17 percent crude protein.

Storage and Feeding: Peanut skins are light, bulky, and not likely to flow well in grain-handling facilities. They can be blown by wind and need to be hauled in covered vehicles and stored in closed facilities. Experiences indicate they can be stored and rancidity of the fat is not usually a problem. Peanut skins are usually mixed with grains and are readily consumed by cattle.

Limitations: Peanut skins are high in tannin (18%) that will negatively impact protein digestibility and may affect palatability, and they are high in fat (22%) that contributes to their energy content but limits the levels that can be fed. Research indicates that peanut skins may be used at up to 20 percent of the total diet of cattle, but protein levels may have to be increased to compensate for the protein binding by the tannin.

Corn Gluten Feed

Description: Corn gluten feed is a by-product of the wet milling which produces high-fructose corn syrup used as a sweetener for soft drinks. Corn gluten feed is that portion of the corn kernel that remains after the starch, gluten, and germ are extracted. It is composed primarily of bran (hull), the fibrous fraction of the kernel. Corn gluten feed can have high levels of sulfur, often more than 0.5 percent.

Availability and Storage: The recent switch by 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% dry matter) and wet (55% to 70% dry matter) forms. The dry product is usually marketed as pellets, although some mills sell it in the meal, or loose, form. The wet form is usually restricted to areas relatively close to mills because of freight costs associated with transporting wet feed.

Feeding and Limitations: The moderate protein content (Table 2) 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 percent 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. Like soy hulls, it can be successfully fed in a self feeder along with available hay or pasture. However, corn gluten feed may not flow through self feeders well, especially with humid conditions.

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 by-products of alcohol production. Most of the alcohol (ethanol) made is used as a gasoline extender. Corn is the most widely used grain in alcohol production, but rye, sorghum, and wheat are sometimes used.

When labeled "distiller's grains with solubles," the feed consists 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. Because they are by-products of a wet processing method, both brewers' and distillers' grains are available in wet and dry form.

Brewers' and distillers' grains are a good source of several nutrients for ruminants. They are rich in protein, TDN, minerals, and vitamins (Table 2).

Availability and Storage: Brewers' and distillers' grains can be fresh, dried, or ensiled; however, the

dried product is the easiest to handle and store. Also, the fresh product deteriorates rapidly in hot weather. Currently in Virginia, brewers' grains are more readily available than are distillers' grains, but nationally there are a great deal more distillers' grains available.

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 fed as a majority of the total diet, if economics are favorable.

MSG Pellets

Description: Many feed dealers are now providing a mixture of by-product feeds. An example is the MSG pellet. This consists of approximately equal parts of Wheat Midds, Soy Hulls, and Corn Gluten Feed, thus the MSG abbreviation. These three feeds all contain highly digestible fiber and are fairly palatable. Corn gluten feed is higher in protein, so the MSG blend contains a protein level of around 14 percent.

Economics of Alternative Feeds

There are several ways to look at the cost effectiveness of alternative feeds. One of the simplest is to compare the cost of nutrition provided by the alternative feed to that of corn and soybean meal. Table 3 provides this information for selected feeds.

The relative value provides a comparison of the feed of interest to corn at any price. A value of 1.00 means that the feed is equal to corn, while a value of 1.20 means that the feed is worth 20 percent more than the price of corn. If you have high-quality forages, you do not need to feed a protein supplement, and energy is the only nutrient of concern. If forages are low in protein, then both protein and energy must be considered in making the economic comparison.

To use the tables, simply multiply the appropriate relative value by the price of corn per ton and then compare this value to the price of the alternative feed. For corn at $100 per ton, the relative value of ground barley is $98 per ton for both nutrients, but only $84 per ton if energy is the only consideration. If barley can be purchased at less than $84 per ton, it is more economical than corn priced at $100 per ton, since it has a relative value of 0.84.

The spreadsheet available from the University of Wisconsin that is referenced at the end of this publication gives the user the opportunity to input a price of corn and soybean meal, and calculate the value of various other feeds based on the nutrition they provide. This feed-value spreadsheet can be very useful for producers who are looking for lower-cost ingredients for their feeding programs.

Quite often the comparison of interest is not to corn or soybean meal, but to a commercial feed product. By law, these manufactured feeds must possess a feed tag that provides certain information, including crude fiber, crude fat, and crude protein, with all values expressed on an as-fed basis. There is no direct information about the energy content of these feeds.

However, the energy content can be estimated by knowing that as fiber content goes up, energy content goes down. Thus, an estimate for feed TDN = 84 - (Feed tag Crude Fiber X 1.5).

Because the tag values are on an as-fed basis, the estimated TDN value is also an as-fed, not dry-matter, basis. To convert to dry-matter basis, divide the answer by 0.9, which is based on an assumed dry matter of commercial feeds of 90 percent.

Example calculation: When the feed tag crude fiber is 8 percent, the formula results in an estimated TDN of 72 percent on an as-fed basis, or 80 percent on a dry-matter basis. This example feed would be approximately equal in TDN (dry-matter basis) to corn gluten feed, and relative value can then be approximated from Table 3.

While alternative or by-product feeds can theoretically provide more economical nutrition, producers should not overlook the mainstays of corn and soybean meal. Both of these feeds are fairly low-cost sources of nutrition. In addition, they are readily available, easy to feed, and well liked by livestock. It may be smarter to purchase corn less expensively than to look to substitutes for corn in the feeding program. Purchasing directly from the grower or buying in large quantities, can provide substantial savings.

Summary

Supplements for cattle feeding programs in Virginia most often must provide energy, although extra protein may also be needed, especially for lactating cows and

growing cattle. Conventional feeds such as corn or soybean meal are readily available, as are a large number of by-product feeds. By-products are becoming more readily available as more dealers and feed mills are distributing them. Most by-products can be stored indefinitely if they are dry, while the wet products will deteriorate rapidly without special storage systems. Many by-products are better supplements to pasture or hay feeding systems than are the conventional feeds. Cost of nutrition provided should be evaluated before any supplemental feed is selected for a feeding program.

Sources

Material in this document was provided by similar publications from other states, including "Alternative Feeds for Beef Cattle" by George Davis Jr. at the University of Arkansas and "Using By-product Feeds in Supplementation Programs" by W.E. Kunkle, R.L. Stewart, and W.F. Brown published in the *Proceedings of 1995 Florida Beef Cattle Short Course.*

Table 3. Economic Value of Alternative Feeds Relative to Corn and Soybean Meal

	Dry Composition		Value ($/ton)*		Relative Value	
Feed Ingredient	**Energy (TDN%)**	**Protein (%)**	**Energy & Protein**	**Energy Only**	**Energy & Protein**	**Energy Only**
Ground shelled corn	87	10	121.14	121.14	1.00	1.00
Soybean meal (48% CP)	81	54	200.00	112.66	1.70	0.92
Hominy feed	92	12	132.62	126.54	1.10	1.05
Ground ear corn	80	9	110.11	112.38	0.91	0.93
Grain screenings	70	14	108.32	97.66	0.89	0.81
Wheat midds	80	19	129.76	112.26	1.07	0.92
Dried-brewer's grains	66	26	127.52	94.84	1.05	0.78
Wet br. grains (21% DM)	66	26	29.11	21.65	0.24	0.18
Dry corn gluten feed	82	28	149.84	116.91	1.24	0.97
Soy hulls	75	14	121.19	112.42	1.00	0.93
Cookie meal	97	10	132.98	135.00	1.10	1.11
Whole cottonseed	87	22	145.35	123.57	1.20	1.02
Ground wheat	86	14	129.07	122.00	1.07	1.01
Ground barley	80	12	118.19	113.46	0.98	0.84
Excellent hay	65	16	100.26	88.86	0.83	0.73
Medium-quality hay	55	10	81.26	74.84	0.67	0.62
Cottonseed meal	77	44	174.91	114.73	1.44	0.95
Peanut hulls	22	8	38.40	31.16	0.32	0.36
Cottonseed hulls	42	4	60.82	62.62	0.50	0.52
Corn silage (35% DM)	68	7	36.25	36.80	0.30	0.30
Corn silage (30% DM)	68	7	31.07	31.55	0.26	0.26
Corn silage (25% DM)	68	7	25.89	26.29	0.21	0.22
Sorghum silage (35% DM)	60	7	32.62	32.48	0.27	0.27
Cotton fiber by-product	50	4	66.24	69.56	0.55	0.57

*Value based on corn at $3.00 per bushel plus $14 per ton grinding charge (total price of $121 per ton) and on soybean meal priced at $200 per ton.

From: Alternative Feeds for Beef Cattle, Publication AG-520-4, North Carolina Cooperative Extension Service, 1994. Also available as electronic publication DRO-28 on-line at: *http://www.ces.ncsu.edu/drought/dro-28.html.*

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FEEDVAL4: Feed Comparative Values Calculated from Protein (UIP), TDN, Fat, Calcium and Phosphorus, University of Wisconsin spreadsheet used to calculate relative value of alternative feeds based upon price of reference feeds, *http://www.wisc.edu/dysci/uwex/nutritn/spreadsheets/Feedval4-FeedComparative.xls*

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