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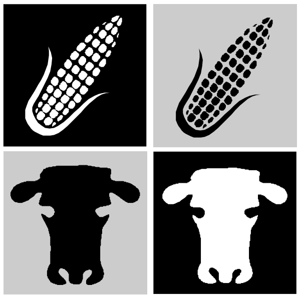

Feeding Corn to Beef Cattle

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Corn is commonly used as a feed grain in beef cattle diets throughout the United States. However, in many parts of North Dakota and other northern-tier states, feeding corn is less common. With the availability and improvement of shorter season corn varieties, corn production in North Dakota doubled from 1995 to 2001. In 2001, 81 million bushels of corn were produced, with producers in every county harvesting corn for feed grain.

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Feeding Value of Corn

Compared to other feed grains, corn is lower in protein and slightly higher in energy (Table 1). Corn contains approximately 70% starch on a dry matter basis. Other important fractions in the corn kernel include protein, fiber, and minerals.

The protein content of corn is approximately 55 to 60% escape or bypass protein. Escape protein is protein which is not fermented or degraded by the ruminal microorganisms, but is digested and absorbed by the animal in the small intestine. The remaining 40 to 45% of the protein in corn is rumen degradable protein. Rumen degradable protein is required by the ruminal microorganisms for use in growth and protein synthesis. Most research with corn indicates substantial benefit to providing rumen degradable protein in diets containing corn. Backgrounding or finishing diets containing high levels of corn require supplemental rumen degradable protein in the form of non-protein nitrogen (urea or biuret), natural protein sources such as sunflower meal, canola meal, or soybean meal, or a combination of non-protein nitrogen and natural protein.

Like all cereal grains, corn is low in calcium and relatively high in phosphorus (Table 2). Diets containing high levels of corn should include a supplemental calcium source such as limestone to prevent urinary calculi. The recommended calcium to phosphorus ratio in backgrounding and feedlot diets is a minimum of 2:1 (2 parts calcium to 1 part phosphorus).

Table 3 lists the nutrient content of corn harvested, stored, or processed by different methods. In

Table 1. Nutrient content of various feed grains (NRC, 1996).

	Corn	Barley	Wheat	Oats	Sorghum
TDN, %	90	88	88	77	82
NE_m, Mcal/lb	1.02	0.94	0.99	0.84	0.91
NE_g, Mcal/lb	0.70	0.64	0.68	0.55	0.61
CP, %	9.8	13.2	14.2	13.6	12.6
Escape Protein, % of CP	55	27	23	17	57
NDF, %	10.8	18.1	11.8	29.3	16.1
ADF, %	3.3	5.8	4.2	14.0	6.4

general, different harvest, storage, and processing conditions do not result in large differences in nutrient content. The advantages and disadvantages of the different harvest, storage, and processing methods are discussed in detail later in this bulletin.

Use of Corn in Rations for Beef Cattle

Corn can be used in many different types of backgrounding and finishing diets and it can serve as a supplement in forage-based diets for beef cows. However, corn is relatively low in protein and high in starch, which can negatively affect forage utilization, especially in diets based on lower quality forages. Consequently, corn grain should be used in forage-based diets at relatively low levels (less than 0.4% of body weight), in forage-based diets that have adequate crude protein (greater than 9% crude protein), or in combination with protein supplements.

Corn can serve as the sole grain source in backgrounding and finishing diets. Depending on desired cattle performance, the level of corn can be varied to supply additional energy in the diet of growing and finishing cattle. However, supplemental protein is needed in most corn-based backgrounding and finishing diets, because of corn's low crude protein content.

Table 2. Mineral content of major feed grains (NRC, 1996).

	Corn	Barley	Wheat	Oats	Sorghum
Calcium, %	0.03	0.05	0.05	0.01	0.04
Phosphorus, %	0.32	0.35	0.44	0.41	0.34
Potassium, %	0.44	0.57	0.40	0.51	0.44
Magnesium, %	0.12	0.12	0.13	0.16	0.17
Sodium, %	0.01	0.01	0.01	0.02	0.01
Sulfur, %	0.11	0.15	0.14	0.21	0.14
Copper, ppm	2.5	5.3	6.5	8.6	4.7
Iron, ppm	54.5	59.5	45.1	94.1	80.8
Manganese, ppm	7.9	18.3	36.6	40.3	15.4
Selenium, ppm	0.14	-	0.05	0.24	0.46
Zinc, ppm	24.2	13.0	38.1	40.8	0.99
Cobalt, ppm	-	0.35	-	0.06	-
Molybdenum, ppm	0.60	1.16	0.12	1.70	-

Table 3. Nutrient content of corn using different harvest, storage, or processing methods.

Corn Type	Dry Matter	TDN, %	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, %	Escape Protein, % of CP
Dry Rolled Corn	86	90	1.02	0.70	9.8	60
Ear Corn	87	83	0.92	0.62	9.0	60
Steam Flaked Corn	82	94	1.06	0.73	10.0	45
High Moisture Corn	75	90	1.02	0.70	10.0	40
High Moisture Ear Corn	75	83	0.92	0.62	8.7	40
High Moisture Snapped Corn	74	81	0.90	0.59	8.8	40

Table adapted from Stock, R., R. Grant, and T. Klopfenstein. 1995. Average composition of feeds used in Nebraska. G91-1048-A. University of Nebraska.

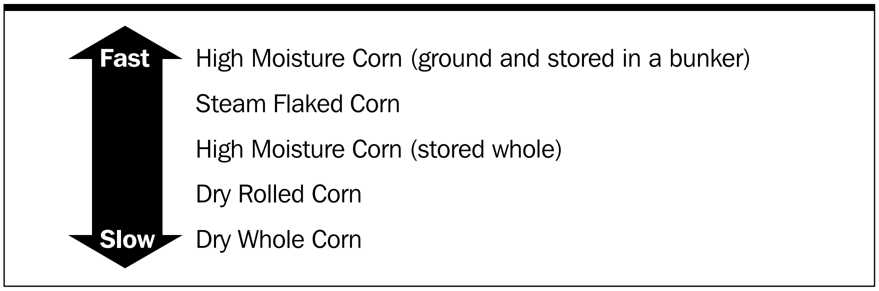
Processing Corn

Even though corn can be fed whole with satisfactory results, cracking or rolling prior to feeding will increase digestibility by 5 to 10%. In most instances, grinding or rolling corn will not markedly improve average daily gain, but proper processing will improve feed conversion efficiency. As the proportion of corn in the diet increases, the benefits of processing also increase, because corn is supplying a greater portion of the energy. When corn is fed whole, the animal must process the corn by mastication (chewing). Rolling or cracking corn for use in a mixed ration may facilitate better mixing.

Corn can also be steam flaked. Steam flaking increases the energy availability 7 to 15%, but is typically not cost effective due to the substantial capital investment required and the relatively high price of natural gas in North Dakota.

Figure 1 shows the relative rates of fermentation for various corn processing methods. Fine grinding corn should be avoided in beef cattle diets since fine ground corn ferments quickly in the rumen. At high levels, this can lead to digestive disturbances, acidosis, and founder.

Figure 1. Effect of corn processing on relative rates of ruminal starch digestion. Adapted from Stock and Britton (1993).



Effect of Corn Bushel Weight on Cattle Performance

Most research with light test weight corn indicates that it has similar feeding value to higher test weight grain. Data from the University of Nebraska indicates light test weight corn (46 to 48 pounds per bushel) has similar feeding value compared to normal test weight corn (55 to 56 pounds per bushel). Research conducted at South Dakota State University indicates that the net energy value of low test weight corn may be slightly higher than normal test weight corn.

High Moisture Corn

Corn can be harvested wet and stored as high moisture corn. For corn to be used in this manner, it should be harvested at 22 to 28% moisture for optimum storage. High moisture corn is similar in energy and protein content to dry corn and offers several harvest advantages:

- Yields are typically increased due to less ear drop in the field.
- High moisture corn allows for an earlier corn harvest, avoiding difficulties associated with adverse weather.
- No drying costs are encountered.

Producers should also realize that high moisture corn also has some disadvantages compared to dry corn:

- Marketing alternatives are limited. High moisture corn which is ground or rolled will only be marketable through livestock.
- High moisture corn may require additional storage and processing equipment.
- Improperly ensiled high moisture corn will result in excessive spoilage and storage losses.

High moisture corn tends to ferment faster and require better bunk management compared to dry corn. High moisture corn must be stored in an airtight silo (bunker, silage bags, or oxygen-limiting structure). For optimum storage and utilization, it should be processed (ground or rolled) prior to storage. Grinding or rolling and subsequent packing of the corn facilitates oxygen exclusion in the silo.

Price Considerations

Price comparisons for corn, barley, and oats on a cost per pound of crude protein and a cost per pound of total digestible nitrogen (TDN) basis are found in Table 4. Corn is typically priced competitively with barley on a cost per pound of TDN (or other measures of energy) basis. However, because of corn's relatively low protein content, the price per pound of crude protein for corn is typically higher than barley. Oats are generally more expensive on either a price per pound of TDN or protein basis compared to corn. As a general rule, corn should be used in rations as a cost effective source of energy but should not be purchased in situations where additional protein may be required since it is typically not priced competitively with other sources of protein.

When pricing corn, producers should take into account differences in moisture level, particularly with high moisture corn. Dry corn is typically traded at 15% moisture. High moisture corn can range from 22 to 28% moisture, which necessitates adjustment to a constant moisture necessary.

Immature and Frost Damaged Corn

In some cases, due to late planting or early frost, corn may need to be harvested before it is mature. Nutrient content of immature corn can be considerably different than mature corn. Table 5 compares the nutrient content of corn at various stages of maturity. In addition, harvesting may be difficult. Immature corn can be harvested as ear or snapped corn after it is dry, or it may be harvested wet and stored in a silo structure as earlage.

Frost damaged corn is generally lower in test weight than normal corn. However, feeding value is generally not markedly reduced. Frost damaged corn should be analyzed for nutrient content prior to feeding.

Summary

Corn is a useful feed ingredient. It is high in energy but relatively low in protein compared to other feed grains. For optimum dietary utilization, corn should be processed by rolling, cracking, or coarsely grinding prior to feeding. The decision to process corn should be based on efficiencies gained from processing compared to the cost of processing.

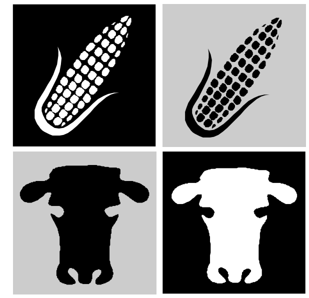


Table 4. Price comparison for various feed grains.

	Price Per Bushel					
Corn	**$1.50**	**$1.75**	**$2.00**	**$2.25**	**$2.50**	**$2.75**
Cost per pound of CP	$0.310	$0.363	$0.414	$0.466	$0.518	$0.570
Cost per pound of TDN	$0.034	$0.040	$0.045	$0.051	$0.056	$0.062
	Price Per Bushel					
Barley	**$1.25**	**$1.50**	**$1.75**	**$2.00**	**$2.25**	**$2.50**
Cost per pound of CP	$0.224	$0.269	$0.314	$0.359	$0.403	$0.448
Cost per pound of TDN	$0.034	$0.040	$0.047	$0.054	$0.061	$0.067
	Price Per Bushel					
Oats	**$1.00**	**$1.25**	**$1.50**	**$1.75**	**$2.00**	**$2.25**
Cost per pound of CP	$0.261	$0.326	$0.392	$0.457	$0.522	$0.587
Cost per pound of TDN	$0.046	$0.058	$0.069	$0.081	$0.092	$0.104

Assumes 56 pound bushel for corn, 48 pound bushel for barley, and 32 pound bushel for oats. Crude protein and TDN contents can be found in Table 1. Assumes DM content of 88% (12% moisture).

Table 5. Nutrient content of corn harvested at various stages of maturity.

Nutrient	Early Milk	Early Dough	Mid Dent	Mature
Crude Protein, %	16.6	12.5	10.7	10.9
Starch, %	47.4	55.0	58.7	63.7
Gross Energy, Kcal/lb	2073	2064	2086	2081
Bushel Weight, lb	35	47	55	58

Adapted from Feeding High Moisture Corn, G74-100, University of Nebraska.

For more information on this and other topics, see: www.ag.ndsu.nodak.edu

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