University of Idaho
College of Agriculture

Cooperative Extension System
Agricultural Experiment Station

Current Information Series No. 915

WHEAT

Its Nutritive Value for Beef Cattle

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Although wheat traditionally has been considered a human food cereal grain, it is an excellent energy source for most livestock. Its price, however, is higher than those of other cereal grains such as corn and barley because of governmental price support programs. As a result, wheat has been marketed as a livestock feed only when it has been overproduced or damaged by drought, plant diseases, or sprouting. The price of damaged wheat is discounted in the marketplace, making it competitive with those of other feed grains.

Wheat is considered the world's most important crop in the genus *Triticum*. Many species of wheat are grown in the United States and around the world, but most of these species can be characterized by (1) a hard or soft kernel, (2) a seed planted in spring or fall (winter wheat), and (3) a red, amber, or white color.

Nutrient composition of wheat

Starch and fat

Wheat is a high-starch cereal grain equal to corn in energy content for most animals (Table 1) and lower in fat. A low fat intake may adversely affect animal appearance and performance because of the low intake of essential polyunsaturated fatty acids. Animals deficient in essential fatty acids lack bloom and thriftiness. Their hair coat is dull and dry, and their skin is scaly with dandruff-like dermatitis at the early stages of the deficiency. Other dietary sources of polyunsaturated fat will eliminate this problem.

Table 1. Average composition of cereal grains from the northwestern United States (dry-matter basis).

	Corn	Barley	Wheat
Bushel weight (lb)	56	48	60
Total digestible energy (%)	90	86	90
Net energy (maintenance) (Mcal/lb)	1.02	0.96	0.99
Net energy (gain) (Mcal/lb)	0.71	0.66	0.68
Metabolizable energy (Mcal/lb)	1.48	1.41	1.45
Crude protein (%)	10.1	12.3	11.2
Crude fiber (%)	2.2	7.1	2.8
Ether extract (%)	4.2	2.0	2.2
Calcium (%)	0.02	0.06	0.10
Phosphorus (%)	0.35	0.39	0.34

Protein

Depending upon the wheat variety and climatic conditions during the growing season, the protein content of wheat may be higher than those of most other cereal grains. Soft white wheat grown in the Pacific Northwest usually has 10 to 11 percent crude protein, while hard red wheat grown in the Midwest may have 16 percent crude protein. In the Northwest, Nugaines soft white winter wheat is similar in crude protein content to Steptoe barley, generally in the 10 to 11.5 percent range.

Phosphorus and calcium

Wheat is relatively rich in phosphorus but deficient in calcium. Some of the phosphorus in wheat is unavailable to meet the nutritional needs of livestock because it is in the chemical form of phytic acid. The availability of phosphorus in phytic acid depends upon other dietary factors. These include overall dietary levels of calcium and fat. In addition, phytic acid-digesting enzymes (phytase, of bacterial origin) may release phosphorus from the free (noncomplexed) form of phytic acid for absorption in the small intestine. Because cattle can use a certain amount of the phosphorus in phytic acid, the total available phosphorus in high-wheat diets will usually meet cattle nutrient needs.

Phytic acid in the digestive tract can complex calcium, zinc, or both. Therefore, supplemental amounts of calcium and zinc are needed in diets high in wheat.

Bushel weight

The feeding value of wheat, like those of other cereal grains, is sometimes evaluated on a bushel-weight basis. The standard bushel weight for wheat is 60 pounds. If a standard volume-weight measure increases or decreases from this standard, the composition changes usually are reflected in the amount of starch per kernel. Wheat damaged by drought or an early killing frost, sprouted wheat, and wheat that contained excess moisture and then dried have lower bushel weights.

Wheat processing

Proper feed processing is critical for successful feeding of wheat in most livestock diets. Poor processing methods may lead to acidosis, a major digestive problem in the rumen. They may also cause feed-mixing problems.

The proper way to process wheat is to grind or roll it, cracking and breaking apart the kernel while preventing flouring as much as possible. Heat-processed wheat (steam flaked, steam rolled, or popped), unlike heat-processed corn or milo, has not been shown to have more nutritional value for cattle than dry rolled or ground wheat. This is probably because wheat starch is already highly digested in the rumen.

Problems with flouring

Wheat is prone to "flour" or become dusty. This causes the components in mixed feeds to separate into the smallest fines and the largest particles. When separation occurs in a mixed diet, variable intake of individual feedstuffs will cause variable nutrient consumption. Most cattle will not readily consume the fines unless the fines are physically held to the other feed particles through pelleting or another method such as the addition of molasses.

Ruminal microorganisms can readily digest wheat starch. Overly processed wheat containing a large amount of flour will be fermented rapidly within the rumen-reticulum area of the digestive tract. This can result in acidosis, which causes digestive upsets including free-gas bloat, founder (lactic acidosis), and sudden death syndrome as well as tissue damage such as rumen parakeratosis and liver abscesses.

The starchy portion of the wheat kernel is located within the endosperm, where the starch units are physically grouped into starch granules. Every cereal grain has its specific design of starch granules. The starch granules in wheat are less compact than those in corn or sorghum. Microorganisms in the rumen can easily attack the wheat starch granules, resulting in 96 percent of the wheat starch being digested in the rumen-reticulum. In contrast, 30 to 35 percent of the starch in ground corn or milo may bypass the rumen and be digested in the small intestine.

The key to successful feeding of wheat to ruminant animals is to crack the wheat kernel, not flour it. Cracked wheat presents enough of a barrier to the microbial population in the rumen to reduce the rate of starch digestion and of volatile fatty acid generation. This allows the ruminant animal to absorb the acids at a rate that maintains the proper acidity in the rumen-reticulum area of the digestive tract.

Feeding wheat to beef cattle

The feeding of soft white wheat (Gaines or Nugaines) to cattle on finishing rations has resulted in excellent performance. The palatability of the softer wheats is not a problem as it is with the hard red varieties (Burt). Soft wheats have been satisfactorily used as the only grains in high-concentrate and all-concentrate rations.

In most feeding situations, wheat levels of roughly 50 percent are usually safe. In trials conducted at the University of Idaho and elsewhere, finishing diets with 80 percent soft white winter wheat have been successfully fed to cattle when the following directions were followed:

- Feed a diet with a crude fiber content of at least 10.5 percent (a minimum of 10 percent roughage in the diet).
- Use coarsely cracked wheat to limit the formation of fines or flour, and completely mix the individual feeds instead of feeding them separately.
- Do not include potato waste in a diet formulation that is 80 percent wheat. Diets with 50 percent wheat or less may include a certain amount of potato waste.
- Adjust the time to reach full feeding of the high-wheat diet to allow the rumen microbial population to adapt to it.
- Arrange the feeding schedule so that cattle eat frequently throughout the day and night. During hot weather, cattle may not eat during the hottest times of the day. This can cause overeating at other feeding periods.
- To help curtail overeating, practice sensible feed bunk management, which includes having adequate feed bunk space and always having feed available.
- Use diets containing buffers (sodium bicarbonate or finely ground, reactive limestone) and an ionophore to help reduce acidosis.

Unless wheat is extremely cheap, limit most diets to no more than 50 percent wheat unless you have considerable experience feeding wheat to cattle. Caution should always be the rule when feeding high-wheat

diets. Closely observe the cattle and watch for acidosis and other digestive problems. When these problems occur, correct the feeding program.

Feeding damaged wheat

Sprouted wheat

Rain during harvest time can cause the wheat kernel to sprout in the head. Sprouting reduces the market grade of the wheat. U.S. grade standards discount wheat on the basis of the percentage of wheat kernels sprouted. Any sample with 2 percent or more sprouted wheat kernels is classified as sprouted. The grade is lowered as the percentage of sprouting increases. It is not uncommon to have more than 50 percent sprouted kernels when persistent wet conditions have occurred during the harvest season.

Feeding trials at both the University of Idaho and Washington State University have demonstrated that sprouted wheat has a feed value for cattle equal to that of nonsprouted wheat. The average daily gain and feed per pound of gain do not differ significantly between cattle fed normal and sprouted wheat (60 percent sprouted wheat kernels). The percentage of sprouted kernels in a sample affects the bushel weight but not the feeding value for feedlot cattle. Sprouted wheat in the diet also has no effect on the carcass characteristics of finished beef cattle.

During the feeding trials, there was a trend for improvement in the digestion coefficients for nitrogen-free extract and crude fiber in sprouted wheat compared with nonsprouted wheat (81 versus 76.4 percent and 46.8 versus 40.2 percent for nitrogen-free extract and crude fiber, respectively), but not for crude protein. These increases in digestibility may have offset the slight reduction in starch content of sprouted wheat.

It may be advisable to analyze sprouted wheat to establish whether it falls within the normal standards for nonsprouted wheat.

As the percentage of sprouted kernels increases, bushel weight decreases (Table 2). This reduction in density is likely caused by increased seed respiration (formation of CO_2 gas), with loss of starch. Therefore, some of the potentially digestible energy and total dry matter of sprouted wheat are lost. Some of this loss is reflected in the wheat's chemical composition. The percentages of crude fiber, ether extract (fat), and ash increase slightly with an increasing percentage of sprouting, while the highly available energy fraction (nitrogen-free extract) decreases slightly. This change in composition is not a major nutritional factor in feeding sprouted wheat to growing cattle.

Table 2. Chemical composition and test weight of Gaines soft white winter wheat at various degrees of sprouting.

	Percentage sprouted kernels			
	0	25	50	75
Bushel weight (lb)	59.3	56.2	55.8	54.2
Crude protein (%)	10.48	10.64	10.91	10.94
Crude fiber (%)	2.57	2.65	2.74	2.73
Nitrogen-free extract (%)	74.75	74.39	73.74	73.81
Ether extract (%)	1.32	1.40	1.37	1.42
Ash (%)	1.33	1.53	1.54	1.60

Source: Murray, G. A., and D. M. Huber. 1968. Sprouted and moldy wheat. Current Information Series no. 95. Idaho Agricultural Experiment Station, University of Idaho, Moscow.

Drought-damaged wheat

Drought affects both the yield and quality of wheat. Kernels of drought-stressed plants normally are smaller and have a reduced starch content. Their crude protein level may be higher or lower than normal, depending on when the drought occurred during plant development.

Bushel weight and chemical composition determinations should be conducted to evaluate feeding value. A lower bushel weight would reflect lighter kernels without the normal starch levels and with less energy per unit weight.

Some reports have indicated that cattle reduce their feed intake and gain when fed drought-damaged wheat. Others have found no performance differences. The performance of cattle fed drought-damaged wheat will likely depend upon the severity of the drought and its effect on the development and chemical composition of the wheat kernel. Use caution when feeding drought-damaged wheat to cattle. Reduce wheat levels to no more than 25 percent of the diet until its feeding value is established.

The feeding of drought-damaged wheat to cattle should cause no problems with nitrate toxicity. Wheat will not transfer nitrate nitrogen into the seed, even during drought stress.

Summary

Wheat can be fed to cattle as a substantial portion of their diet. Growth and feed efficiency of properly managed cattle on high-wheat diets are equal to those observed with corn or barley. However, high-wheat diets can cause rumen dysfunction in cattle that are not properly adjusted to a high-wheat diet. Proper processing and feed management are key factors in the successful feeding of wheat. Cattle fed sprouted or drought-damaged wheat usually perform well in the feedlot. Drought-damaged wheat should be evaluated carefully before being fed at high levels.

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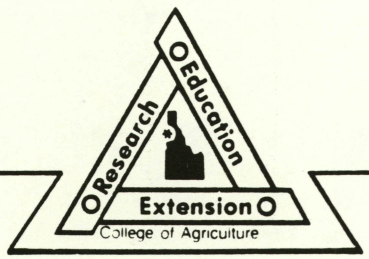

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