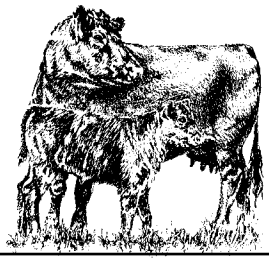

Western Beef Resource Committee *Fourth Edition*

Cattle Producer's Handbook

Nutrition Section 302

Composition of Common and Alternative Feedstuffs for Beef Cattle

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Feed Composition Analysis and Limitations of Table Values

Analysis of feed nutrient composition allows for a prediction about how animals will respond when those feeds are included in their diet. Nutrient composition is not constant and can vary for many reasons. An analysis of the actual feed to be used is much more accurate than the information in the tables provided in this publication, but tabular data can sometimes be helpful in making feeding decisions.

When using table values, one can expect organic components (crude protein, fat, and fiber) to vary as much as ±15 percent, mineral concentrations to vary as much as ±30 percent, and energy values to vary as much as ±10 percent. Consequently, values shown can only be used as general guidelines; however, they do not replace standard analytical procedures used to determine nutrient composition of feeds frequently used in individual feeding programs.

Values are listed on a **dry matter (DM) basis** and can be converted to an as-fed basis by multiplying the nutrient value by the percent dry matter. For example, if a feed is 12 percent crude protein (CP) on a DM basis and contains 88 percent DM, the feed would have 10.56 percent CP on an as-fed basis (0.88 x 12 = 10.56).

Nutrient Analysis of Byproduct and Alternative Feeds

The beef cattle industry uses many nontraditional feeds, including byproducts from other agricultural industries. These feeds may provide important economic advantages in ration formulation. However, the nutritional quality of the feedstuff and freedom from harmful residues and toxins are also key components of the decision making process.

Byproduct and alternative feedstuffs can vary widely in nutrient content, which makes a nutrient analysis or some assessment of the feed value (dry matter, energy, protein, and major mineral concentrations) critical to develop balanced, least-cost rations. A good guideline with byproduct or alternative feeds would be to ask for wet chemistry analysis to determine nutrient contest. If near infrared spectroscopy (NIRS) is used, make sure that the laboratory has calibrated its equipment for your specific feed; otherwise, the analysis will not provide accurate data.

Additional Considerations for Byproduct and Alternative Feeds

Cost—Actual byproduct cost is not the only factor to consider when feeding alternate feeds. There may be high labor, transportation, and storage costs associated with the feedstuff. Potatoes, for example, may have dry matter values as low as 10 percent and be difficult and costly to transport. Many of the cull fruits and vegetables are difficult to store, resulting in a high rate of spoilage, which further increases the cost of the feed delivered to the feed bunk. Byproduct or co-product feeds may require adaptations to current storage facilities.

Feed Quality—The variation in composition associated with byproduct feeds can result in difficult ration quality control. As discussed earlier, it is important to have each feed periodically analyzed for its chemical composition. The analysis should include dry matter, crude protein, fiber (neutral detergent fiber and acid detergent fiber), energy, minerals, and harmful residues and toxins if these are a concern. Keep in mind that a guaranteed analysis is sometimes provided by the seller.

All feedstuffs vary in nutrient composition because of a variety of factors, including but not limited to year

produced, source, moisture content, and milling and/or processing methods. Of these factors, water content has the greatest effect on feed value. The amount of feed that can be ingested is limited by moisture content and rumen capacity among other factors.

Other factors affecting intake include feed quality and the animal's gender, age, and physiological state. Thus, an animal may not be able to eat enough to fulfill its nutritional needs for growth and production, which could result in poor performance and reduced production. A good guideline is to limit high-moisture feeds to less than half of the total dry matter in the diet.

Chemical Residues and Anti-Nutritional Factors—Another factor that may affect quality of byproduct feeds could be presence of chemical residues. Registered pesticides are often applied to crops that are sources of byproduct feeds. Some of these pesticides are explicitly labeled, stating that no part of the treated plant is to be used for livestock or human consumption. On the other hand, consumption of many feeds from pesticide-treated crops is allowed after a specified waiting period. If there are residues in the feed, there is a good possibility they will accumulate in animal tissues, making meat or milk unmarketable for human consumption.

When purchasing byproduct feeds, you should request that the seller disclose which, if any, pesticides have been used. If you are unable to obtain this information, you should have a chemical analysis performed on the feed to determine if there are any potentially harmful chemicals or heavy metals present. Assistance in determining proper analyses and uses of feedstuffs can be found by contacting the Extension educator in your area.

Some feeds contain anti-nutritional factors or properties, toxic substances, or high concentrations of nutrients that may affect performance. For example, cull onions contain a toxic alkaloid that results in anemia in beef cattle. Also, large amounts of cull fruits or vegetables can be a laxative to cattle and must be fed in limited quantities to prevent negative effects on digestion.

Co-products of the ethanol industry, such as distiller's grains with solubles, can contain high concentrations of sulfur and fat. Further, the nutrient content can vary widely among batches or loads, so a feed analysis for each load or batch is recommended.

Palatability—Palatability should also be considered when purchasing byproducts. Alternate feeds should be used with caution and introduced into the ration gradually, no matter how desirable the feed is. Generally, animals react unfavorably to sudden, radical changes in their feed. Byproduct feeds that have limited palatability should be fed in small quantities, although their acceptance may increase when they are included in a complete mixed diet.

Pricing Feeds

Several methods will help producers evaluate conventional and alternative feeds according to water content and/or nutrients provided. Examples of adjusting feeds for dry matter content and determining the cost per unit nutrient are provided below. In these examples, conventional feeds along with alternate feeds will be used. The principles may be applied to any feedstuff. One important concept is not to pay for water in feeds. This method should be used to compare prices for two or more feeds on the basis of nutrient content per unit of dry matter.

Example #1: The market value of whole corn (88% DM; 88% TDN on a DM basis) is $110/ton and you want to determine a comparable price for high-moisture corn that contains 75 percent DM (93% TDN on a DM basis). The two feeds need to be compared on a cost per unit of energy basis.

Step 1. Determine how many pounds of TDN are in a ton of each feed.

Whole corn dry matter: 0.88 X 2,000 = 1,760 lb of dry matter in a ton of whole corn

Whole corn TDN: 0.88 X 1,760 = 1,548.8 lb of TDN in a ton of whole corn

HM corn dry matter: 0.75 X 2,000 = 1,500 lb of dry matter in a ton of HM corn

HM corn TDN: 0.93 X 1,500 = 1,395 lb of TDN in a ton of HM corn

Step 2. Set up an equation

$$\frac{\text{Price of whole corn}}{\text{lb TDN of whole corn}} = \frac{\text{Price of high-moisture corn}}{\text{lb TDN of high-moisture corn}}$$

or

$$\frac{\$110/\text{ton}}{1{,}548.8 \text{ lb TDN}} = \frac{x}{1{,}395 \text{ lb TDN}}$$

Step 3. Cross multiply.

$$(1{,}548.8)\,(x) = (\$110)\,(1{,}395)$$

Step 4. Divide both sides of the equation by pounds of TDN for whole corn.

$$x = \frac{(\$110)\,(1{,}395)}{1{,}548.8}$$

$$x = \$99.08/\text{ton}$$

When dry corn is $110/ton, high moisture corn should be $99.08/ton.

Since feeds fluctuate in moisture content, it is important to determine the actual value so you can ensure that you are paying a fair price for the product. In most cases, feeds differ in both dry matter and nutrient content. Thus, to

compare them economically, it is best to determine the cost per amount of nutrient each feed provides.

Example #2 demonstrates a comparison to determine if canola meal (CM) or safflower meal (SM) is the least expensive source of protein. The CM has 44 percent CP and 92 percent DM. The SM has 25.4 percent CP and 90 percent DM. The CM costs $150/ton and the SM costs $90/ton, both on an as-fed basis.

Step 1. First, adjust the CP percentage to an as-fed basis because the price is expressed on an as-fed basis. The process for canola meal will be presented first.

$$\frac{44\%\ \text{CP}}{100\%\ \text{DM}} = \frac{x}{92\%\ \text{DM}}$$

Step 2. Cross multiply.

$$(100)\,(x) = (44)\,(92)$$

Step 3. Divide both sides of the equation by 100.

$$x = \frac{(44)\,(92)}{100}$$

$$x = 40.48\%$$

The canola meal contains 40.48 percent CP on an as-fed basis. For safflower meal, repeat the steps above. The safflower meal contains 22.86 percent CP on an as-fed basis.

Step 4. Next, determine the cost per unit of CP provided. Cost per unit nutrient equals cost per ton divided by the nutrient content.

$$\text{Canola meal} = \frac{\$150/\text{ton}}{0.4048} = \$370.55/\text{ton of CP}$$

$$\text{Safflower meal} = \frac{\$90/\text{ton}}{0.2286} = \$393.70/\text{ton of CP}$$

Canola meal provides protein at a lower cost than safflower meal. Without comparing the cost per unit of nutrient, a producer may have chosen safflower meal.

Additional Resources

Lardy, G., and V. Anderson. 2009. Alternative Feeds for Ruminants: General Concepts and Recommendations for Using Alternative Feeds. NDSU Extension Publication AS-1182.

Preston, R. L. 2010. What's the Feed Composition Value of That Cattle Feed? 2010 Feed Composition Tables. BEEF Magazine. Available at: http://beefmagazine.com/nutrition/feed-composition-tables/feed-composition-value-cattle--0301/

Table 1. Composition of common, byproduct and unusual beef cattle feeds.

Feed name	Dry matter	Total digestible nutrients	Crude protein	Acid detergent fiber	Ca	P
	(%)	(TDN, %)	(%)	(ADF, %)	(%)	(%)
Low protein concentrates						
Bakery waste, dried	92.0	89.0	11.9	1.0	0.07	0.11
Barley bran	91.0	59.0	12.5	27.0	--	--
Barley, grain (heavy)	88.0	84.3	13.2	7.0	0.09	0.47
Barley mill run	90.0	70.0	11.7	20.0	--	--
Beet, pulp, dried	90.8	74.6	8.8	33.0	0.66	0.11
Beet, pulp, w/molasses	92.0	76.4	10.1	25.0	0.61	0.10
Beet, molasses	78.0	79.4	9.7	--	0.13	0.03
Citrus pulp	18.3	82.5	6.6	16.0	--	--
Citrus pulp, dried	90.0	77.0	6.9	23.0	2.07	0.13
Corn, grain, #2 (rolled)	88.0	90.4	10.1	3.0	0.01	0.28
Corn, ground w/ears	87.7	83.1	8.6	11.0	0.05	0.23
Corn stover	90.0	50.0	5.9	46.0	0.49	0.09
Oat, grain	90.0	76.9	12.2	16.0	0.11	0.39
Onions	10.0	63.0	12.6	28.0	1.80	0.21
Pea meal, dried	90.0	84.0	19.7	33.0	--	--
Potatoes, cull	21.0	80.0	10.0	3.0	0.03	0.24
Rye, grain	88.6	75.2	14.2	--	0.09	0.34
Safflower hulls	91.3	13.3	3.6	73.0	--	--
Screenings, grain, good	90.0	70.0	14.2	16.0	0.48	0.43
Screenings, refuse	90.0	56.0	11.5	40.0	0.46	0.32
Sorghum, milo, grain	88.8	83.1	12.4	9.0	0.05	0.33
Sunflower seeds, whole	94.0	83.0	17.9	39.0	0.18	0.56
Sweet potatoes	31.0	80.0	5.0	8.0	0.09	0.13
Triticale, grain	89.0	84.9	14.0	5.0	0.07	0.39

Table 1. (cont'd.)

Feed name	Dry matter	Total digestible nutrients	Crude protein	Acid detergent fiber	Ca	P
	(%)	(TDN, %)	(%)	(ADF, %)	(%)	(%)
Low protein concentrates (cont'd.)						
Turnip roots	9.0	86.0	12.0	34.0	0.65	0.31
Wheat	88.0	88.6	15.3	8.0	0.06	0.47
Wheat bran	89.0	70.0	18.0	14.0	0.12	1.32
Wheat mill run	90.0	74.0	17.0	11.0	0.10	1.13
Whey, dried	90.0	84.0	14.2	0.0	0.95	0.80
Whey, liquid	7.0	78.0	14.0	0.0	0.98	0.81
High protein concentrates						
Alfalfa seed screenings	90.0	86.0	34.4	15.0	--	--
Barley distillers dried grains	92.0	69.0	30.1	14.0	--	--
Barley malt sprouts	92.0	68.0	28.0	20.0	0.26	0.84
Beans, cull navy	90.0	85.0	24.0	8.0	0.15	0.60
Brewers grains, wet	24.0	67.0	26.0	23.0	0.29	0.54
Corn, distillers grain	92.0	84.0	29.5	20.0	0.10	0.40
Corn gluten meal	90.0	87.0	48.0	5.0	0.15	0.45
Cottonseed meal, solv-extd	92.0	75.0	44.8	20.0	0.17	1.31
Cottonseed, whole	93.0	98.0	24.9	29.0	0.15	0.73
Distillers dried grain (DDG)	93.0	88.0	25.0	17.0	0.11	0.43
Feather meal	90.0	63.0	87.4	1.0	0.20	0.75
Linseed meal, solv-extd	90.0	82.0	40.7	13.0	0.43	0.95
Rapeseed meal, solv-extd	91.0	68.0	41.0	16.0	0.67	1.04
Rye distillers dried grains	92.0	48.0	22.1	18.0	0.14	0.45
Safflower meal, solv-extd	92.0	55.0	23.9	43.0	0.37	0.80
Soybean meal, 44% CP, solv	89.0	84.0	49.9	10.0	0.30	0.68
Sunflower meal, solv-extd	93.0	65.0	50.3	30.0	0.40	1.10
Turnip tops	13.0	67.0	21.8	13.0	2.92	0.51
Yeast, brewers, dried	93.0	78.0	48.3	4.0	0.14	1.54
Non-protein nitrogen supplements						
Biuret	99.0	--	218.0	--	--	--
Urea	99.0	--	287.0	--	--	--
Energy supplements						
Fat	95.0	200.0	0.0	--	--	--
Roughages						
Alfalfa hay						
Early bloom	90.9	60.5	18.0	31.0	1.41	0.22
Mid-bloom	90.0	58.1	17.0	35.0	1.41	0.24
Mature	91.0	50.1	12.9	44.0	1.13	0.18
Barley hay	92.0	56.2	9.7	30.1	0.23	0.26
Barley straw	90.0	39.0	4.1	52.0	0.37	0.11
Brome hay, late bloom	89.0	55.0	10.0	43.0	0.30	0.35
Clover, Ladino hay	90.0	60.0	22.0	32.0	1.35	0.31
Corn stalks	80.0	54.0	5.0	43.0	0.45	0.15
Fescue hay, early bloom	92.0	48.3	9.5	39.0	0.30	0.26
Grass seed straw	90.0	55.7	6.0	39.8	--	--
Meadow hay	40.0	46.4	7.0	44.0	0.61	0.18
Oat hay	91.0	55.0	9.3	36.0	0.24	0.22
Oat straw	92.0	45.2	4.4	54.0	0.24	0.06
Orchardgrass hay, early blm	89.0	65.4	15.0	34.0	0.27	0.34
Pea hay	88.0	58.0	13.6	38.0	1.39	0.28
Prairie hay	91.0	46.4	7.0	47.0	0.40	0.15
Ryegrass hay	90.0	58.1	10.0	38.0	0.45	0.30
Rice straw	91.0	41.0	4.5	44.0	0.21	0.08
Sagebrush, browse	50.5	49.9	12.9	31.0	1.01	0.25

Table 1. (cont'd.)

Feed name	Dry matter	Total digestible nutrients	Crude protein	Acid detergent fiber	Ca	P
	(%)	(TDN, %)	(%)	(ADF, %)	(%)	(%)
Roughages (cont'd.)						
Sorghum sudangrass hay	91.0	56.2	8.0	42.0	0.55	0.30
Sweetclover hay	87.0	119.2	15.7	--	1.27	0.25
Timothy hay, mid-bloom	89.0	57.0	9.7	35.0	0.48	0.23
Triticale hay	90.0	56.0	10.0	41.0	0.30	0.26
Wheat hay	88.0	58.1	8.5	41.0	0.15	0.20
Wheat straw	90.0	41.0	3.6	52.0	0.19	0.09
Wheatgrass, crested, hay	93.0	64.8	12.4	36.0	0.33	0.21
Silages						
Alfalfa						
Early bloom	35.0	60.5	19.5	33.0	1.41	0.22
Mid-bloom	38.0	58.1	17.0	35.0	1.41	0.24
Full bloom	40.0	55.0	16.0	38.0	1.43	0.25
Corn, milk stage	34.0	67.2	8.0	32.0	0.40	0.27
Corn, well-eared, mature	33.0	70.3	8.1	28.0	0.23	0.22
Oat, dough stage	35.0	57.4	10.0	--	0.47	0.33
Pea vine silage	24.0	56.0	13.1	49.0	1.31	0.24
Sorghum silage	30.0	57.0	7.3	33.0	0.33	0.20
Sorghum sudangrass silage	28.0	27.5	10.8	42.0	0.46	0.21

*Values in this table were taken from various sources, including:

Nutrient Requirements of Beef Cattle, Update 2000; Nutrient Requirements of Dairy Cattle, 1989; Feedstuffs 1996 Reference Issue.

Kirk, J. H., and M. S. Bulgin. Byproducts and unusual feedstuffs in livestock rations: Some effects of feeding cull domestic onions (Allium cepa) to sheep. WREP No. 39. UI Caine Teaching Center, Caldwell, ID.

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"Grass Seed Residues for Beef Cattle Feed," Alberta Ag and Rural Development. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10353

Table 2. Composition of common mineral supplements for beef cattle.

Mineral supplement	DM	Ca	P	Mg	K	S
	(%)	(%)	(%)	(%)	(%)	(%)
Bone meal, steamed	95.0	24.0	12.0	0.6	0.19	0.21
Limestone	98.0	34.0	0.02	2.1	0.12	0.04
Calcium carbonate	99.0	38.0	0.04	0.05	0.06	--
Oyster shell	99.0	38.0	0.07	0.30	0.10	--
Magnesium carbonate	98.0	0.02	--	30.8	--	--
Magnesium oxide	97.0	3.07	--	56.2	--	--
Magnesium sulfate	98.0	20.0	--	--	--	26.6
Phosphate, deflourinated	100.0	32.0	18.0	0.08	0.42	--
Phosphate, diammonium	97.0	0.5	20.6	0.46	0.01	2.16
Phosphate, dicalcium	97.0	22.0	19.3	0.59	0.07	1.14
Phosphate, monocalcium	97.0	16.4	21.6	0.61	0.08	1.22
Phosphate, monosodium	97.0	--	21.8	--	--	--
Phosphate, sodium tripoly	96.0	25.0	--	--	--	--
Phosphoric acid, 75%	75.0	--	23.8	--	--	--
Potassium sulfate	98.0	--	--	--	44.8	18.3
Potassium chloride	100.0	0.05	--	--	50.5	0.19
Sodium sulfate	97.0	--	--	--	--	14.27

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