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Comparing Value of Feedstuffs

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Determining the nutrient concentration and cost of each nutrient in feedstuffs allows producers to evaluate ration quality and cost. In addition, cost determination can be very helpful when deciding which feed to purchase in cases of differing asking prices and nutrient quality.

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Once calculations have been made, producers can use the information to make appropriate decisions about which feedstuffs offer the lowest-cost rations that meet the animal's requirements. This publication is meant to be a step-by-step guide to calculating feed values to allow appropriate comparison of feedstuffs.

For the purposes of this publication, we will focus on calculations of energy and protein in traditional feedstuffs fed to livestock. Energy will be discussed in the form of total digestible nutrients (TDN, which is one measure of energy concentration in a feed), whereas protein will be discussed in the form of crude protein (CP). Both measurements will be evaluated on a dry-matter (DM; 0% moisture) basis. Use of a DM basis is critical because removing moisture allows producers to compare nutrient concentrations of feeds with varying moisture content.

Before you can begin to talk about comparisons of feedstuff value, you must submit samples of feedstuffs to a reputable nutrition laboratory to determine the actual nutrient concentration of the sample. The lab results received are only as good as the samples submitted, so be sure to submit representative samples (for instructions about taking feed samples, see NDSU Extension publication AS1064, "Sampling Feed for Analysis," *www.ag.ndsu.edu/pubs/ansci/livestoc/as1064.pdf*).

Examples of feedstuff nutrient profiles are listed in beef cattle and sheep National Research Council books and NDSU Extension publication AS1182, "Alternative Feeds for Ruminants," *www.ag.ndsu.edu/pubs/ansci/livestoc/as1182.pdf*. However, nutrient concentration of forages and feed byproducts are quite variable and book values likely will not reflect the true value of the feeds on individual farms.

Calculating the Amount of Dry Matter, TDN and CP in Your Feedstuffs

To calculate the amount of a feed you need to deliver to your livestock, you must convert the proportions in the feedstuff into pounds of nutrients contained in a certain weight of feedstuff (for this publication, we will use the unit weight of sale; that is, pounds or bushels as appropriate). Examples of calculating the amount of nutrients contained in different feedstuffs and their value per pound of TDN and CP are given in **Table 1**.

The focus of feed test results in this publication is the percent DM (column B), percent of TDN (column C) and percent of CP (column D). The unit of sale (column E) usually is defined as bushels or tons.

In the case of products being purchased on a bushel basis, knowing the bushel weight is important. For example, basing corn calculations on a test weight of 56 pounds per bushel will not be representative of lightweight corn purchased at 47 pounds/bushel. Similarly, comparing the cost of baled forages sold on a per-bale basis is very difficult if the bale weight is unknown or assumed.

Table 1. Examples of calculated DM, TDN and CP contents of various feedstuffs.

Column	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Formula		—	—	—		—	B × F	C × G**	D × G**	A ÷ G	A ÷ H	A ÷ I
	Cost	**Feed Test Results**			**Definition of Units**		**Nutrient Content Calculations**			**Feed Value Calculations**		
Feed	**$/Unit**	**DM %**	**TDN %***	**CP %***	**Unit of Sale**	**lb/unit**	**DM lb/Unit**	**TDN lb/Unit**	**CP lb/Unit**	**$/lb DM**	**$/lb TDN**	**$/lb CP**
Prairie hay, mature	100	90	46	4.9	Ton	2,000	1,800	828	88.2	0.056	0.121	1.13
Brome hay, midbloom	125	90	53	8	Ton	2,000	1,800	954	144	0.069	0.131	0.87
Alfalfa hay, midbloom	150	90	57	15.9	Ton	2,000	1,800	1,026	286.2	0.083	0.146	0.52
Corn silage	60	35	70	8	Ton	2,000	700	490	56	0.086	0.122	1.07
Mod. distillers grains	100	51	91	26	Ton	2,000	1,020	928	265.2	0.098	0.108	0.38
Corn, dry rolled	4	88	90	10	Bu	56	49.3	44.4	4.9	0.087	0.090	0.81
Barley grain	4	88	84	13.5	Bu	48	42.2	35.5	5.7	0.095	0.113	0.70

* Percentage of TDN and CP in feeds are indicated on a DM basis.

** Note: To make the appropriate calculations, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

While **Table 1** contains all the information and calculations to determine what feedstuffs will provide the lowest-cost energy and protein, looking at the table in its entirety can be overwhelming.

In the next sections we will break down the calculation steps individually, show some examples and leave room for you to calculate the pounds of nutrients present in some of your feedstuffs.

Step 1:

Calculate the pounds of dry matter in each unit of sale.

Feeds can vary in moisture content. Although water is an essential nutrient, purchasing and transporting of water in feed can be costly. To calculate pounds of dry matter, multiply the pounds in each unit of sale (column F) by the percent of dry matter (column B). This calculation **(Table 2)** removes all moisture from the feed and allows you to compare high-moisture products (corn silage, wet distillers grains, etc.) and dry products (hay, dry cereal grains, etc.) appropriately.

Table 2. Calculations for pounds of dry matter in each unit of sale.

Feed	*(Column F)* Pounds in Each Unit of Sale		*(Column B)* Percent Dry Matter		*(Column G)* Result, lbs DM**
Prairie hay	2,000	×	90	=	1,800
Corn silage	2,000	×	35	=	700
Barley	48	×	88	=	42.2

** Note: To make the appropriate calculation, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

The difference in pounds of dry matter in each ton of prairie hay and corn silage points out the dramatic impact that dry matter can have on how much your animals are eating. For every ton of prairie hay, dry feed amounts to 1,800 pounds, whereas for every ton of corn silage, dry product only amounts to 700 pounds.

In the case of very wet products, you may be offering large quantities of feed on an as fed-basis, but your animals may not be receiving the nutrients they need. For example, feeding 50 pounds of a 15 percent DM beet pulp would yield only 7.5 pounds of dry feed product.

▼ **Use Table 3 to calculate the pounds of dry matter in your feedstuffs.**

Table 3. Calculations for pounds of dry matter in your feeds.

Feed	*(Column F)* Pounds in Each Unit of Sale		*(Column B)* Percent Dry Matter		*(Column G)* Result, lbs DM**
____________	________	×	________	=	________
____________	________	×	________	=	________
____________	________	×	________	=	________
____________	________	×	________	=	________
____________	________	×	________	=	________

** Note: To make the appropriate calculation, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

Step 2:

Calculate pounds of TDN in each unit of sale.

Livestock do not require a certain amount of dry feed but rather require a certain amount of digestible feed. Similar to trucking water, purchasing and transporting indigestible feed can be costly. To calculate the pounds of TDN in each unit of sale, multiply the pounds of dry matter in each unit (column G) by the percent TDN in the feedstuff (column C). Calculations of pounds of TDN in each unit of sale are shown in **Table 4**.

Table 4. Calculations for pounds of TDN in each unit of sale.

Feed	*(Column G)* DM in Each Unit of Sale, lbs		*(Column C)* Percent TDN		*(Column H)* Result, lbs TDN**
Prairie hay	1,800	×	46	=	828
Alfalfa hay	1,800	×	57	=	1,026
Corn silage	700	×	70	=	490
Barley	42.2	×	84	=	35.4

** Note: To make the appropriate calculation, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

In this example, alfalfa hay was added to the calculation table to illustrate the difference in pounds of TDN per ton, compared with prairie hay. The TDN values of the two respective feedstuffs result in a difference of nearly 200 pounds of TDN in each ton.

Moving to barley, 35.5 pounds of TDN are present in each 48 pound bushel. Similarly, 1 ton of barley would have resulted in 1,478 pounds of TDN, which is almost 1,000 pounds more than corn silage on an as-fed basis.

▼ **Use Table 5 to calculate the pounds of TDN in your feedstuffs.**

Table 5. Calculations for pounds of TDN in your feeds.

Feed	*(Column G)* DM in Each Unit of Sale, lbs		*(Column C)* Percent TDN		*(Column H)* Result, lbs TDN**
		×		=	
		×		=	
		×		=	
		×		=	
		×		=	

** Note: To make the appropriate calculation, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

Step 3: Calculate the pounds of crude protein (CP) in each unit of sale.

Livestock also require a certain amount of protein to maintain productivity and rumen function. Protein is often one of the most expensive components of livestock feeding programs. To calculate the pounds of crude protein in each unit of sale, multiply the pounds of dry matter in each unit (column G) by the percent CP in the feedstuff (column D). Calculations of pounds of CP in each unit of sale are shown in **Table 6**.

Table 6. Calculations for pounds of CP in each unit of sale.

Feed	*(Column G)* DM in Each Unit of Sale, lbs		*(Column D)* Percent CP		*(Column I)* Result, lbs CP**
Prairie hay	1,800	×	4.9	=	88.2
Alfalfa hay	1,800	×	15.9	=	286.2
Corn silage	700	×	8.0	=	56
Barley	42.2	×	13.5	=	5.7

** Note: To make the appropriate calculation, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

For example, the high quality of the alfalfa hay is demonstrated by the amount of crude protein present in each ton, which is 3¼ times that of the prairie hay. We could have reached the same conclusion by simply looking at the percent of crude protein in each of the feedstuffs. However, the calculations are very important as we move to the next step of comparing the value of each feedstuff based on the purchase price or current value of the feedstuff.

▼ **Use Table 7 to calculate the pounds of CP in your feedstuffs.**

Table 7. Calculations for pounds of CP in your feeds.

Feed	*(Column G)* DM in Each Unit of Sale, lbs		*(Column D)* Percent CP		*(Column I)* Result, lbs CP**
________	________	×	________	=	________
________	________	×	________	=	________
________	________	×	________	=	________
________	________	×	________	=	________
________	________	×	________	=	________

** Note: To make the appropriate calculation, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

Calculating the Cost of Nutrients in Feedstuffs

Knowing how to determine the cost of individual nutrients can help you make informed decisions about your purchases, especially in cases where you are exploring the purchase of several types of feeds from several sources. To perform the calculations, you need to know the cost of each unit of sale and the pounds of each nutrient in the unit of sale (the calculations we just reviewed). Performing these calculations will allow for comparisons of all feedstuffs simultaneously. That is important because the end result for each feed is a cost per pound of each respective nutrient.

Table 8. Calculations for cost per pound of TDN and CP in feedstuffs.

	(Column A)	*(Column H)*	*(Column I)*	*(Column K)*	*(Column L)*
Calculation				**A ÷ H**	**A ÷ I**
Feed	**Purchase Price, $/Unit****	**lb TDN/Unit**	**lb CP/Unit**	**$/lb TDN**	**$/lb CP**
Prairie hay	$100	828	88.5	$0.12	$1.13
Alfalfa hay	$150	1,026	286.2	$0.15	$0.52
Corn silage	$60	490	56	$0.12	$1.07
Distillers grains, mod.	$100	928	265.2	$0.11	$0.38
Barley	$4	35.5	5.7	$0.11	$0.70

** Note: Prices shown are for example purposes only. Be sure to check local prices to make appropriate comparisons.

Based on the prices in **Table 8**, prairie hay offered a cheaper source of TDN, compared with alfalfa hay, but the alfalfa held a distinct advantage, considering the cost of crude protein. Barley and modified distillers grains had a similar value per pound of TDN in each feed, but the modified distillers grains was the cheapest source of protein among all feeds evaluated.

▼ **Use Table 9 to calculate the cost per pound of TDN and CP for your feedstuffs.**

Table 9. Calculations for cost per pound of TDN and CP in your feedstuffs.

	(Column A)	*(Column H)*	*(Column I)*	*(Column K)*	*(Column L)*
Calculation				**A ÷ H**	**A ÷ I**
Feed	**Purchase Price, $/Unit****	**lb TDN/Unit**	**lb CP/Unit**	**$/lb TDN**	**$/lb CP**

** Using the base asking price for each feedstuff alone can be misleading. Differences in transportation cost, shrink, storage, etc., also should be estimated and included in the per-unit asking price to represent true cost differences among feeds.

**Table 10. Record of feed nutrient content and value on a per-nutrient basis.
Use this table to record values of feed test and prices to track values through time.**

Column ID Formula	**A**	**B** —	**C** —	**D** —	**E**	**F** —	**G** B × F	**H** C × G**	**I** D × G**	**J** A ÷ G	**K** A ÷ H	**L** A ÷ I
	Cost	**Feed Test Results**			**Definition of Units**		**Nutrient Content Calculations**			**Feed Value Calculations**		
Feed	**$/unit**	**DM, %**	**TDN, %***	**CP, %***	**Unit of Sale**	**lb/unit**	**DM lb/Unit**	**TDN lb/Unit**	**CP lb/Unit**	**$/lb DM**	**$/lb TDN**	**$/lb CP**
North CRP Field, 2015	100	90	46	4.9	Ton	2,000	1,800	828	88.2	0.0555	0.121	1.13

* Percentage of TDN and CP in feeds are indicated on a DM basis.

** Note: To make the appropriate calculations, use the percentage as a decimal of 100 (for example, 90 % DM = 0.90) or divide the end result by 100.

Once all of the calculations are completed, you have a true value comparison of the feedstuffs in question based on nutrient profiles. When performing the calculations, using a delivered price for all feeds to arrive at your operation is helpful. In addition, include potential shrink (1 to 5%, depending on moisture, storage conditions, loss from trucking, etc.) and storage costs as discounts to prices.

With the costs of individual nutrients known, the next step will be to determine the needs of your animals and use this information to make a least-cost ration.

Be sure to contact your NDSU county Extension agent if you would like assistance with making these calculations for your feeds or ration formulation.

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Photos are courtesy of Dahlen and Redden.

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