1984

G84-694 New Protein Values for Ingredients Used in Growing Cattle Rations

Rick Stock
University of Nebraska - Lincoln, rstock3@Unl.edu

Terry L. Mader
University of Nebraska - Lincoln, tmader1@unl.edu

Terry Klopfenstein
Universitiy of Nebraska--Lincoln, tklopfenstein1@unl.edu

G84-694-A

NebGuide

Published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

New Protein Values for Ingredients Used in Growing Cattle Rations

This NebGuide assigns new protein values to feeds and describes two new systems for evaluating supplemental protein sources.

Rick Stock, Extension Feedlot Specialist
Terry Mader, Extension Beef Specialist
Terry Klopfenstein, Professor of Animal Science

Information about protein sources has changed greatly in the last 10 years. Words like "bypass," "escape," or "slowly degraded" have been used to describe some proteins. These terms have the same meaning and refer to a protein source's ability to escape breakdown in the rumen.

Ingredient tables usually only list the crude protein content of feeds. Although this has been a useful system, it does not adequately evaluate supplemental protein sources. Digestible protein values have helped describe some forages, but can be very misleading in evaluating supplemental protein sources.

The Fate of Proteins

Digestible protein entering the rumen is either broken down by the rumen microbes to volatile fatty acids and ammonia or it escapes breakdown and passes "as is" to the small intestine where it is digested and absorbed as amino acids and peptides. This latter protein is called bypass or escape, or sometimes is known as slowly degradable protein. The extent to which a particular protein source is broken down depends on its rate of rumen digestion. Soybean meal protein is broken down to a greater extent, and less escapes the rumen undigested compared to protein sources like dehydrated alfalfa, blood meal, meat

meal or corn gluten meal.

The rumen microbes require a certain amount of nitrogen in the form of ammonia. When feeding sources of protein that are slowly degraded, supplemental urea is used to meet the microbes' nitrogen needs. The microbes also need carbon chain fragments to form microbial protein. Most of these carbon chains are produced in the digestion of forages or grains. However, certain carbon chains (branched-chain fatty acids) may not be produced in sufficient quantities to provide for maximum microbial protein synthesis. Degradation of feed proteins can supply these limiting branched-chain fatty acids. This protein source is called rumen degradable or rapidly degradable protein.

Different Protein Sources Available

Protein sources can be divided into four categories: 1) high bypass or slowly degradable protein sources; 2) intermediate bypass protein sources; 3) low bypass protein sources; and 4) rapidly degradable protein sources.

High Bypass (60 to 80% Bypass) Protein Sources

Blood Meal (BM).

There are two methods of processing blood meal—flash dried (ring-dried) and conventional (cooker dried). Flash dried blood meal is dried rapidly and has more available lysine and methionine than cooker dried blood meal. Because of its high lysine content and the high cost of drying, blood meal is usually an expensive source of bypass protein. Feeding blood meal separately in a supplement or top-dressed on a ration sometimes causes palatability problems, but mixing it into the total ration has avoided this problem.

Meat Meal (MM).

The value of meat meal varies due to the amount of heat applied in drying and the amount of bone and hair contamination. Meat meal has the advantage of containing high amounts of phosphorus and fat. Palatability may be a problem if it is fed separately in a supplement or top-dressed on a ration, but not if it is mixed into the ration.

Fish Meal (FM).

Less research is available on the degradability of fish meal protein, but it appears to be a high bypass protein. Fish meal is high in essential amino acids and B-vitamins. Because of its high lysine content and low availability, the price is usually high. Excess oil in fish meal can lead to rancidity, and inadequate drying may allow molding.

Corn Gluten Meal (CGM).

A high protein product of the wet milling industry, corn gluten meal is a low lysine, high methionine protein source and benefits from being fed in conjunction with a high quality (high lysine) protein source such as blood meal, meat meal or dehydrated alfalfa.

Brewers Grains (BC).

Compared to corn gluten meal, the value of brewers grains is slightly lower due to its higher fiber content. Brewers grains is high in methionine and low in lysine, but does not need to be fed in conjunction with a high quality protein source. Brewers grains is the most palatable of the high bypass protein sources.

Distillers Grains (DC) or Distillers Grains plus Solubles (DGS).

Distillers grains contains the bypass protein fraction while the solubles contain the rapidly degraded protein fraction. Unfortunately the solubles are dried back on the grains in most cases, resulting in a lower bypass protein feed. As with corn gluten meal, distillers grains without solubles may benefit from being fed in conjunction with a high quality protein source.

Dehydrated Alfalfa, 20% protein (DEHY-20).

The amount of bypass protein in dehydrated alfalfa-20 depends on the amount of heat applied in dehydration. In order to make a high bypass, dehydrated alfalfa product, alfalfa must be cut and hauled directly to the dehydrating plant. Field wilting reduces the bypass content of dehydrated alfalfa because less heat is needed in the dehydrating drum to dry it. Sun-cured alfalfa requires even less heat, and therefore is a low bypass protein.

Intermediate Bypass (30 to 60% Bypass) Protein Sources

Dehydrated Alfalfa, 17% (DEHY-17).

Because of field wilting or the inclusion of sun-cured pellets, dehydrated alfalfa-17 contains less bypass protein than dehydrated alfalfa-20.

Cottonseed Meal (CSM).

Due to the price of cottonseed meal in the Midwest, it has not been widely used in Nebraska. The protein is low in lysine and methionine, but depending on price, cottonseed meal is used in beef supplements.

Linseed Meal (LM).

Linseed meal accounts for only a small part of the total plant proteins produced in the US.A. The protein content is relatively low and it is deficient in lysine. It is favored in some ruminant diets, however, because of its laxative nature.

Low Bypass (10 to 30% Bypass) Protein Sources

Proteins containing 10 to 30% bypass protein should be used in beef supplements only if they are available and economical. They may also have some value if a degradable protein source is needed. Low bypass protein sources include soybean meal, alfalfa (hay, haylage, sun-cured pellets), corn gluten feed, peanut meal, sunflower meal, safflower meal, feather meal and rape seed (Canola) meal.

Rumen Degradable (90 to 100% Degradable) Protein Sources

In certain feeding situations, the rumen microbes may need a specific amino acid or peptide, or additional carbon chains for maximum microbial protein synthesis. These situations occur when animals are grazing native winter range or low quality crop residues. Degradation of low bypass protein sources or rumen degradable protein sources will meet the microbe's specific needs. Rumen degradable protein sources include casein, whey, steep liquor and distillers solubles.

Although nonprotein nitrogen sources (urea, biuret) are completely broken down in the rumen, they supply only nitrogen to the microbes. They do not supply amino acids, peptides or any carbon chains. Animals consuming grain, silage, alfalfa or lush pasture do not need to be supplemented with rumen degradable protein.

Ration Formulation

Several systems that account for bypass protein have been proposed. Currently, AGNET uses a protein system based on protein values determined relative to the protein value of soybean meal. The new protein value is termed "soybean meal equivalent." In beef growing rations, this value is equal to the crude protein requirement. The soybean meal equivalent value for feedstuff is calculated as crude protein (%) times relative protein value (protein value relative to SBM). The soybean meal equivalent value is assumed as equal to the crude protein value except for protein sources that have been specifically tested. The soybean meal equivalent value for flash dried blood meal, for example, is 89.8% x 2.5 = 224.5% (dry matter basis) (*Table I*). Urea is zero. The computer balances for soybean meal

equivalent. When the soybean meal equivalent requirement is met, urea is used to complete the crude protein requirement. This system is currently being used in both ration and supplement formulation.

Table I. Protein sources and their protein values[a].

Protein Source	Crude Protein, %	Relative Protein Value[b]	Soybean Meal Equivalent[c]	Degradable Protein, %[d]
Urea	281	0	0	0
BM, flash dried	89.8	2.5	224.5	20.7
BM, cooker dried	89.8	2.0	179.6	20.7
Meat meal	53.8	1.8	96.8	22.7
Fish meal	66.6	2.0	133.2	24.5
Brewers grains	26.0	1.9	49.4	9.9
Corn gluten meal	65.9	2.0	131.8	23.2
Distillers grains (Corn)	29.5	2.0	59.0	10.4
Distillers grains (Milo)	33.2	1.6	53.1	10.4
Distillers grains & solubles (Corn)	29.5	1.5	44.3	14.9
Distillers grains & solubles (Milo)	33.2	1.2	39.8	14.9
Dehydrated alfalfa (20)	21.8	1.9	41.4	7.9
Dehydrated alfalfa (17)	19.7	1.5	29.6	9.3
Cottonseed meal	45.8	1.6	73.3	21.9
Linseed meal	38.6	1.6	61.8	18.5
Soybean meal	49.0	1.0	49.0	31.6
Alfalfa hay (mid-bloom)	15.9	1.0	15.0	9.8
Alfalfa haylage	21.5	1.0	21.5	13.3
Alfalfa, sun-cured pellets	16.3	1.0	16.3	10.0
Corn gluten feed, dry	24.5	.75	18.4	16.7
Corn gluten feed, wet	21.0	.75	15.8	15.0
Feather meal	92.1	.50	46.0	29.6
Peanut meal	51.5	1.0	51.5	33.2
Rape seed (Canola) meal	43.6	1.0	43.6	28.1
Safflower meal	23.9	1.0	23.9	15.4
Sunflower meal	50.3	1.0	50.3	32.4
Casein	90.9	0	0	90.9
Distillers solubles (Corn & Milo)	29.5	0	0	29.5
Steep liquor	47.0	0	0	40.0
Whey	16.0	0	0	16.0

[a]Dry matter basis.
[b]Protein value relative to the bypass value of SBM.
[c]SBME = Crude protein x Relative protein value
[d]Degradable protein = (Crude protein x Protein digestibility) x [1 - (.30 x Relative Protein Value)].

The AGNET system will not automatically balance for soybean meal equivalent unless the operator makes two changes in ration requirements. First, change the ration requirement for soybean meal equivalent from zero to match the crude protein requirement of the ration. Then, change the urea value from zero to some number between 1 and 100. These two changes will allow the computer to balance the ration using bypass protein values.

A second system takes into account the degradable protein required by the rumen microbes. The new protein value is termed "degradable protein." Although degradable protein is similar to digestible protein in forages, these terms are not synonymous. This is especially true for supplemental protein sources. Thus, digestible protein values should not be substituted for degradable protein values. In beef growing rations, the degradable protein requirement is 25% of the crude protein requirement. For example, if the crude protein requirement is 11.5%, then the degradable protein requirement is 11.5% x .25 = 2.88%.

The degradable protein value of forages is variable, and thus the forages are classified into five groups (*Table II*). The degradable protein value for immature, early-bloom, mid-bloom and mature forages and silages are 80%, 70%, 60% and 50% of their crude protein value, respectively. The degradability value for grains is 60% of their crude protein value. If the crude protein content of crop residues is greater than 4%, the degradable protein value is 50% of the crude protein value. If the crude protein value is less than 4%, the degradable protein value is zero. Thus, as forage quality decreases, the need for rumen degradable protein increases.

Table II. Protein values of major feedstuffs.

Feedstuff	Crude Protein, %	Soybean Meal Equivalent	Degradable Protein, %
Forages			
— Immature[a]	16	16	12.8
— Early-bloom[b]	13	13	9.1
— Midbloom[c]	10	10	6.0
— Mature[d]	6	6	3.0
Silages			
— Immature[a]	10	10	8.0
— Early-bloom[b]	9	9	6.3
— Mid-bloom[c]	8	8	5.4
— Mature[d]	7	7	3.5
Grains[c]	10	10	6.0
Crop residues[d]	>4	>4	2.0

Crop residues[e]	<4	<4	0

[a]Degradable protein = crude protein x .8.
[b]Degradable protein = crude protein x .7.
[c]Degradable protein = crude protein x .6.
[d]Degradable protein = crude protein x .5.
[e]Degradable protein = crude protein x 0.

The degradable protein value for protein sources is based on relative protein value, protein digestibility and the assumption that 30% of the protein in soybean meal is bypass protein. The degradable protein fraction based on relative protein value is determined as 1.0 - [.30 (bypass of SBM) x relative protein value]. This protein fraction times (crude protein x protein digestibility) would be the degradable protein value for a protein source. For example, the degradable protein value for flash dried blood meal would be [1.0 (.30 x 2.5)] x (89.8 x .92) = 20.7% degradable protein (dry matter basis) (*Table I*).

Similar to the ration balancing with soybean equivalent values, AGNET does not automatically balance for degradable protein. However, only one change is needed. Multiply the ration crude protein requirement by .25 (or 25%). Change the ration degradable protein value from zero to the new number.

File G694 under: BEEF
A-37, Feeding & Nutrition
Issued March 1984; 12,000 printed.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.