

Nutrition and Feed Terms

Acid detergent fiber (ADF): Fiber measurement extracted with acidic detergent in a technique employed to help appraise the quality of forages. Includes cellulose, lignin, ADIN, and acid-insoluble ash. ADF is highly correlated with cell wall digestibility. The higher the ADF, the lower the digestibility or available energy. Because ADF percentage in forages negatively relates to digestibility, ADF is used to calculate energy values. Low ADF forages are usually preferred, because it means higher net energy. As the plant matures, ADF increases.

Acid detergent insoluble nitrogen (ADIN): Protein or nitrogen that has become chemically linked to carbohydrates to form an indigestible compound. Also referred to as insoluble crude protein (ICP), unavailable protein (see), or heat-damaged protein.

Adjusted crude protein: Protein content adjusted for the amount of heat-damaged protein. Used in place of CP when ADIN makes up more than 10 percent of the CP content of a feed. If no heat damage has occurred, then the adjusted crude protein equals the crude protein.

Amino acids: The building blocks of proteins. Used extensively for milk and muscle protein synthesis. Used also for glucose synthesis in the liver.

Ammonia: A colorless nitrogen compound produced as protein and nonprotein nitrogen degrades or breaks down in the rumen. It can be used to synthesize bacterial protein.

Anion: A negatively charged ion or particle, such as chloride or sulfate. Anionic salts are nutritionally important in dry cow rations to aid in the prevention of milk fever.

Ash: The mineral matter present in feed. It is measured by burning the sample at 500° C until all organic matter is burned and removed.

Available protein: Determined by subtracting unavailable protein from crude protein.

Buffer: Chemical compound that resists changes in pH with the addition (or loss) of acid or base. Buffers, such as sodium bicarbonate, are supplemented to reduce the risk of rumen acidosis (low pH).

Cation: A positively charged ion or particle.

Cellulose: The principle carbohydrate constituent of plant cell membranes. It is made available to ruminants through the action of cellulolytic bacteria in the rumen.

Carbohydrates: Includes the sugars, starch, cellulose, gums, and related substances. Carbohydrates are the largest component in the dairy cow diet and contribute 60 to 70 percent of the net energy used for milk production. Their abbreviation, CHO, indicates that they contain carbon, hydrogen, and oxygen

Concentrate: A broad classification of feedstuffs that are high in energy and low in crude fiber (less than 18 percent). Included are cereal grains, soybean oil meal, cottonseed meal, and by-products of the milling industry such as corn gluten and wheat bran. A concentrate may be low or rich in protein.

Crude fiber (CF): That portion of feedstuffs composed of polysaccharides such as cellulose, hemicellulose, and lignin. These serve as structural and protective parts of plants (high in forages and low in grains). CF is no longer considered a viable measurement.

Crude fat: A measure of the fat content as determined by ether extraction. This measure may also contain plant pigments, esters and aldehydes. Fat content of by-products such as french fry waste should be checked frequently, since there can be considerable variation in these products.

Crude protein (CP): Total protein in a feed. To calculate the protein percentage, a feed is first chemically analyzed for nitrogen content. Since proteins average approximately 16 percent nitrogen, the percentage of nitrogen in the analysis is multiplied by 6.25 to give the percent CP.

Dietary cation-anion difference (DCAD): DCAD is the milliequivalent (meq) difference between the major cations and anions in a diet. The DCAD can be calculated when the percentages of Na, K Cl and S (DM basis) in the diet are known. DCAD, meq/100 grams of DM = $[(\%Na/.023) + (\%K/.039)] - [(\%Cl/.0355) + (\%S/.016)]$. Feeding diets with a negative DCAD (anionic diet) in late pregnancy may reduce milk fever problems through alterations in calcium metabolism.

Digestible dry matter (DDM): Estimates the percentage of forage that is digestible. It is calculated from ADF values and is similar to TDN. The more ADF a feed contains, the lower the DDM value will be. DDM values are calculated using the equation $DDM\% = 88.9 - (ADF\% \times 0.779)$.

Dry matter (DM): That part of feed, which is not water. Percent DM = 100% - moisture %. Feed values and nutrient requirements for ruminants are expressed on a dry matter or moisture-free basis to compensate for the large variation in moisture content of feeds commonly fed to cattle.

Dry matter intake (DMI): Estimates the maximum amount of forage dry matter a cow will eat. It is expressed as a percent of body weight and is calculated from NDF by: $DMI (\% \text{ of body weight}) = 120/NDF\%$.

Ensilage: Forage preserved by fermentation in a silo, pit, or stack, usually in chopped form. Also called silage.

Fiber: The cellulose portion of roughages (forages) that is low in TDN and hard to digest by monogastric animals.

Forage: The vegetative portion of plants in a fresh, dried, or ensiled state which is fed to livestock. Grasses and legumes cut at the proper stage of maturity and stored to preserve quality.

Green chop (fresh forage): Forages harvested (cut and chopped) in the field and fed directly to livestock. Also called zero grazing or soilage.

Hay: Dried forage (grasses, alfalfa, clovers) used for feeding farm animals.

High-moisture silage: Silage usually containing 70 percent or more moisture.

Legume: Clovers, alfalfa, and similar crops that can absorb nitrogen directly from the atmosphere through action of bacteria that live in their roots and use it as a nutrient for growth.

Lignin: A compound which, with cellulose, forms the cell walls of plants. It is practically indigestible.

Lipid: Any one of a group of organic substances that are insoluble in water though soluble in alcohol, ether, chloroform, and other fat solvents, and have a greasy feel. They are rich sources of dietary energy.

Minerals: Calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K) and sulfur (S) are normally expressed as a percentage of each in the feed.

Nonprotein nitrogen (NPN): Used by rumen microorganisms to synthesize protein.

Net energy (NE): Is the energy available to an animal in a feed after removing the energy lost as feces, urine, gas and heat produced during digestion and metabolism. NE is the most useful energy estimate for formulating rations. Often, other energy values are determined from ADF using regression equations. These equations were developed from digestion trials.

Net energy for lactation (NE_L): An estimate of the energy value of a feed used for maintenance plus milk production during lactation and for maintenance plus the last two months of gestation for dry, pregnant cows.

Net energy for maintenance (NE_M): An estimate of the energy value of a feed used to keep an animal in energy equilibrium, neither gaining nor losing weight.

Net energy for gain (NE_G): An estimate of the energy value of a feed used for body tissue gain (weight gain) above that required for maintenance.

Neutral detergent fiber (NDF): A measurement of fiber after digesting in a nonacidic, nonalkaline detergent as an aid in determining quality of forages. Contains the fibers in ADF, plus hemicellulose. Measures the structural part of the plant, the plant cell wall which consists of lignin, cellulose, and hemicellulose. NDF gives bulk or fill to the diet and is negatively correlated with feed intake. Because NDF can be used to predict intake, it is one of the most valuable analysis to have conducted on forages for dairy rations. Low NDF is usually desired. As maturity of the plant at harvest increases, cell wall content of the plant increases and NDF increases.

Nitrogen balance: Nitrogen in the food consumed minus nitrogen in feces and nitrogen in urine (nitrogen retention.)

Nitrogen-free extract (NFE): Consisting of carbohydrates, sugars, starches, and a major portion of materials classed as hemicellulose in feeds. When crude protein, fat, water, ash, and fiber are added and the sum is subtracted from 100, the difference is NFE.

Nonfiber carbohydrates (NFC): The highly digestible carbohydrate fraction of feeds consisting of starch, sugar, and pectin. Are the non-cell wall carbohydrates consisting primarily of starches, sugars and pectin that are rapidly fermented in the rumen. Subtracting percent (DM basis) NDF, CP, ether extract (fat) and ash from 100 provides an estimate of NFC percent in feeds. ($NFC\% = 100\% - [\%NDF + \%CP + \%fat + \%ash]$). In the absence of actual measured values, average values of the feedstuff are used in the equation. Also called nonstructural carbohydrates (NSC).

Non-protein nitrogen (NPN): All nitrogen fed to animals is not necessarily found in proteins. NPN reflects other sources of nitrogen. An important source of NPN in the ruminant diet is urea. Rumen bacteria can utilize NPN to produce microbial proteins, thus providing amino acids to the cow.

Protein degradability: The heat involved in the manufacturing processes of many byproducts can affect rumen protein degradability and total digestibility. Most commercial feed testing labs do not offer analysis of rumen degradable protein (RDP) because of procedural variability. That explains why most people have relied on feed composition tables like the NRC for both RDP and RUP. To determine RUP values, some commercial labs have started using in situ bag techniques. You need to be careful when using the results of in situ or in vitro procedures, because they determine rumen degradability in a certain rumen environment. It might not be similar to the actual rumen environment of the cows you are working with.

Protein equivalent: A term indicating the total nitrogen content of a substance in comparison with the nitrogen content of protein (usually plant). For example, the nonprotein nitrogen (NPN) compound, urea, contains approximately 45 percent nitrogen and has a protein equivalent of 281 percent (6.25×45 percent).

Relative feed value (RFV): Developed primarily for use with legume or legume/grass forages, RFV combines digestibility and intake estimates into one number for an easy and effective way to identify and market quality hay. RFV is expressed as a percent compared to full bloom alfalfa at 100 percent RFV. RFV above 130 are considered good dairy quality hay. The higher the value the better, RFV in the range of 150 is desirable. RFV is calculated by: $RFV\% = DDM (\%) \times DMI (\% \text{ of body weight}) / 1.29$.

Hay quality standards for legumes, legume-grass mixtures and grasses						
Quality	CP	ADF	NDF	DDM	DMI	RFV
	% of dry matter			%	% of BW	
Prime	>19	<31	<40	>65	>3.0	>151
1	17-19	31-35	40-46	62-65	2.6-3.0	125-151
2	14-16	36-40	47-53	58-61	2.3-2.5	103-124
3	11-13	41-42	54-60	56-57	2.0-2.2	87-102
4	8-10	43-45	61-65	53-55	1.8-1.9	75-86
5	<8	>45	>65	<53	<1.8	<75

Roughage: Consists of pasture, silage, hay, or other dry fodder. It may be of high or low quality. Roughages are usually high in crude fiber (more than 18 percent) and relatively low in NFE (approximately 40 percent).

Rumen degradable protein (RDP), known previously as degradable intake protein (DIP): Protein or nitrogen that is degraded in the rumen by microorganisms and incorporated into microbial protein or freed as ammonia.

Saturated fatty acids: A completely hydrogenated fat, each carbon atom is associated with the maximum number of hydrogens; there are not double bonds. Saturated fatty acids are solid at room temperature. Tallow is an example of a saturated fat, although approximately 50 percent of the fatty acids are unsaturated. Saturated fats tend to have less detrimental effects on rumen fermentation than unsaturated fats.

Silage: Green forage, such as grass or clover, or fodder, such as field corn or sorghum, that is chopped into a silo where it is packed or compressed to exclude air and undergoes an acid fermentation (lactic and acetic acids) that retards spoilage.

Soluble protein: The protein fraction composed of both non-protein nitrogen (NPN) and true protein, which is rapidly degraded in the rumen. It is normally expressed as a percent of the crude protein.

Total digestible nutrients (TDN): Denotes the sum of the digestible crude protein, digestible nitrogen-free extract, digestible crude fiber and 2.25 times the digestible ether extract (fat). This value is often calculated from ADF. It is less accurate than NE for formulating diets containing both forage and grain. Most rations are now formulated using NE; however, TDN is still used to calculate beef cow rations where the diet is primarily forage.

Total mixed ration (TMR): A blend of all feedstuffs (forages and grains) in one feed. A complete ration fits well into mechanized feeding and the use of computers to formulate least-cost rations.

Unavailable protein or insoluble crude protein: Calculated from nitrogen that is bound to the acid detergent fiber fraction of the feed. Normally, about 1% protein on a DM basis is found in this fraction. Values greater than 1% indicate heat damage.

Rumen undegradable protein (RUP), known previously as undegradable intake protein (UIP): Protein or nitrogen that is not degraded in the rumen by microorganisms but is available to be digested by the cow.

Unsaturated fat: A fat having one or more double bonds, not completely hydrogenated.

Urea: A nonprotein organic nitrogenous compound. It is made synthetically by combining ammonia and carbon dioxide.