Forage Nutritive Value

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Forage constituents may be broadly divided into ***cell contents*** or the non-structural component of the plant (protein, sugar, starch), and the structural components that make up the ***cell wall*** (cellulose, hemicellulose, and lignin). The detergent system for analysis divides forage constituents into three categories based upon solubility in detergent solutions. These categories are:

1) **Neutral detergent fiber (NDF)**: Neutral detergent fiber represents plant cell wall components (hemicellulose, cellulose, lignin), which are partially degradable depending on stage of maturity and degree of lignification. This is the residue left after a forage sample has been exposed to a neutral detergent. Neutral detergent fiber has been negatively correlated with dry matter intake; that is, the higher the NDF percentage, the lower the dry matter intake.
2) **Neutral detergent solubles:** Neutral detergent solubles, though not indicated on the forage analysis report, contain the cell contents and are comprised primarily of soluble carbohydrates, starches, organic acids, pectin, and the true proteins. These components are rapidly and nearly totally digestible.
3) **Acid detergent fiber (ADF):** Acid detergent releases hemicelluloses and fiber-bound protein from NDF. The remaining fiber residue, mostly cellulose and lignin, is referred to as ADF. Acid Detergen Fiber is more or less available depending on the stage of maturity of the forage. Although hemicelluloses goes into solution during the acid detergent procedure, it is not necessarily more digestible than cellulose, since lignin is more closely associated with hemicellulose. NOTE: Acid detergent fiber may be obtained without NDF determination. Acid detergent fiber has an inverse relationship with digestibility; that is, the higher the ADF percentage, the less digestible the forage is.

Grazing animals have various nutrient requirements depending on the kind (cattle, sheep, goats, horses) and class (mature, dry pregnant; lactating, growing) of animal. Although minerals and vitamins are important regarding overall health and performance of these grazing animals, energy and crude protein (CP) of the forage are typically the most important aspects of forage nutrition.

True proteins are complex structures comprised of amino acids. However, forage analyses commonly test for ***crude*** protein, which is a measure of the total nitrogen content of the forage X the constant factor 6.25. Consequently, crude protein includes non-protein nitrogen-containing compounds as well as true protein. Fortunately, the ruminal fermentation process can utilize some of these non-protein compounds as well as they use proteins.

Energy is derived directly from neutral detergent solubles for non-ruminants. Ruminants get their energy from the by-products of ruminal fermentation of both neutral detergent solubles, NDF, and ADF.

See Table 1 below to determine the nutrient requirements of various grazing animals.

Table 1. Crude protein (CP) and total digestible nutrients (TDN) percentage and mCal of digestible energy per pound of forage dry matter (DM) required in diets of different kinds and classes of grazing livestock.[1]

Animal kind/class	CP	TDN	mCal/lb DM
Growing beef steer			
450 lbs (1.5 lb/day gain)	11-13	65	1.3
650 lbs (1.7 lb/day gain)	10-11	68	1.4
Beef cow			
Lactating	10-12	60	1.2
Dry, pregnant	8-10	50	1.0
Sheep			
Lamb (finishing)	12	70	1.4
Ewe (lactating)	13	65	1.3
Ewe (maintenance)	9	55	1.1
Fallow deer			
Doe (lactating)	14-6	66	1.3
Growing buck	12-14	60-64	1.2-1.3
Meat-type goat			
Doe (lactating)	12	62	1.2
Growing buck	12-13	62-66	1.2-1.3
Horse (maintenance)	10-11	70	1.4

[1] Adapted from *Southern Forages*, 2nd ed., 1998.
[2] mCal of digestible energy per pound of forage dry matter estimated by multiplying TDN x 0.02.