

## Back to Basics: The ABC's of Forage Analysis.

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High quality forages are a staple in California dairy rations. It's important to know what you're paying for when buying forages, or what nutrients your home-grown forages are providing in the ration. Forages are typically variable in chemical composition. The primary reason for this variability is that forages are harvested at various stages of physiological maturity, but harvest methods, plant variety, soil fertility, and weather conditions also play important roles. One of the most crucial aspects of accurate forage analyses is obtaining a representative sample to send to the lab, something we'll cover in a future article. In this article, we'll cover three major components of feed analysis: dry matter, crude protein, and fiber (ADF & NDF). We'll delve deeper into the different components of forage analysis later, but for now, our intention is to bring a general understanding to the "what's and why's" of basic wet chemistry analysis.

CHEMISTRY ANALYSIS RESULTS		
Dry Matter		35.9
Moisture		64.1
PROTEINS		
	% DM	% CP
Crude Protein	7.7	
Adjusted Protein	7.7	
Soluble Protein	5.07	66.2
Ammonia (NPN)		
ADF Protein (ADICP)	0.79	10.3
NDF Protein (NDICP)	1.11	14.5
Rumen Degr. Protein	6.368	83.1
Rumen Deg. CP (Strep.G)		
FIBER		
	% DM	% NDF
ADF	29.19	68.2
NDF	42.80	
aNDFom		
NDR (NDF w/o sulfite)		
peNDF		
Crude Fiber		
Lignin	3.44	8.04
NDF Digestibility (12 hr)		
NDF Digestibility (24 hr)		
NDF Digestibility (30 hr)		
NDF Digestibility (48 hr)		
NDF Digestibility (240 hr)		
Indigestible NDF 120 HR		

### Dry matter and moisture

Dry matter (DM) is basically what remains when the water (moisture) is removed from a feed. For example, silages contain a fair amount of water. In our corn silage example (see table), DM accounts for 36% of the feed, meaning for every 100 pounds of silage fed, 64 pounds of that is water.

Why is that important? Because while water is an essential nutrient, water does not contain energy and energy intake is essential for milk production. This is why nutritionists compare feeds and formulate rations on a DM basis – to take water out of the equation. There are a number of other reasons to know the DM of a feedstuff. To continue with our silage example, one way we use DM is to buy and sell forages. We typically purchase corn silage on a 70% moisture/30% DM basis. At 36% DM, we would be giving away nutrients for free (or if purchasing, would be getting a really good deal). We also sell and purchase alfalfa hay on a 90% DM basis, and this may be how the chemical analyses are reported.\*\*

Dry matter content of forages also tells us something about harvesting conditions. Too much water (moisture) in hay and there will be mold. Too wet or too dry silages reflect harvesting practices that do not support proper fermentation, which is essential for preserving the nutrients in the silage.

**\*\*To covert nutrients (or energy) from “90% DM” to “100% DM” basis:**

Nutrient % on 90% DM basis ÷ 0.90 = Nutrient % on DM basis

### Examples

6.93% CP on 90% DM basis is 7.7% CP on 100% DM basis

54.5% TDN on a 90% basis is 60.5% TDN on 100% DM basis

## Crude protein

The next component on the lab results is titled proteins. For this article, we'll focus on crude protein (CP). From the results, we see that CP is 7.7% on a DM basis – just to review, 7.7% of the corn silage is protein when water is removed. If this were on a wet basis, the number would be much lower (2.76% Wet Basis), because the protein content would be diluted by the large amount of water.

Crude protein is an estimate of the protein content of a feedstuff, based on the amount of nitrogen measured in the lab. Nitrogen is a component of protein, and the lab method assumes that all protein contains 16% nitrogen (a slight error, because all proteins do not contain 16% nitrogen, and why it's labeled "crude" protein). By doing a little math ( $100/16$ ), this creates a conversion factor of 6.25 so that  $\%CP = \%nitrogen * 6.25$ .



Why is CP important? Nutritionists use CP to formulate balanced diets. The dairy cows, heifers, and calves on the farm all have dietary requirements for protein that is needed for maintenance and production (milk production, growth, gestation). The CP content of each individual feed is considered when formulating a ration.

## Fiber

The two measurements of fiber are **neutral detergent fiber (NDF)** and **acid detergent fiber (ADF)**. Hemicellulose, cellulose, and lignin make up NDF, while ADF includes only cellulose and lignin. The NDF components are also referred to as cell wall, and are what create the structure of plants.

Why are NDF and ADF important? One reason is that lignin is indigestible and its association with the cellulose and hemicellulose in the plant cell wall impacts the digestibility of the cellulose and hemicellulose. Cellulose and hemicellulose are structural carbohydrates that are digested by the rumen microbes. Digestibility is related to energy; if it is digested, the animal can obtain energy. For example, as the ADF content of alfalfa hay increases with maturity, its digestibility decreases so that the amount of energy obtained by the animal is less with high ADF hay compared with low ADF hay. This relationship between ADF content and digestibility is the basis for marketing hay in CA based on TDN content. Another example of this effect is BMR corn silage. BMR corn has lower lignin content, so that fiber digestion is often improved and thus giving BMR corn silage higher energy content when compared with conventional corn silage.

Your nutritionist will use NDF and ADF in various ways. The fiber (NDF & ADF) content of the diet is important to support milk fat production, enhance rumen function, and promote high DM intake. Acid detergent fiber is sometimes linked to energy calculations and NDF is often linked to DM intake.

## Take home message

It's imperative for nutritionists to test forages for quality parameters to formulate rations, but it's also helpful for you to be able to read your forage results and have a basic understanding of the different components. The concept of DM is something everyone working with feed on your dairy, including feeders, should understand.