

# Forage Analysis Definitions

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The following list provides definitions of nutrients that are reported from a forage analysis. Grass hay averages are summarized from forage analyses conducted by the UT Soil, Plant and Pest Center in Nashville, Tennessee, during 2018. Moisture is expressed on an as-received basis, and all other nutrients are expressed on a dry-matter basis.

## Primary Values – NIRS

**Moisture** – Percentage of the forage that is water. *Grass hay average: 9-21 percent*

**Dry Matter (DM)** – Percentage of the forage that is not water. *Grass hay average: 79-91 percent*

**Ash** – Total mineral content of the forage. Expressed as a percentage. *Grass hay average: 5-10 percent*

**Crude Protein (CP)** – Percentage of the estimated protein content of the forage as determined through total nitrogen content from true protein and non-protein nitrogen. *Grass hay average: 8-15 percent*

**Lysine** – Percentage of the amino acid lysine within the forage. *Grass hay average: unavailable*

**Fat** – Total fat content of the forage. Expressed as a percentage. *Grass hay average: 1.9-2.6 percent*

**Relative Forage Quality (RFQ)** – Indicator of forage quality based upon energy and fiber digestibility, which can be used to compare forage samples. *Grass hay average: 73-101*

**Ensiled pH** – The final pH of an ensiled forage, which can be used as an indicator of fermentation outcomes, and thus the safety and stability of the forage. *Grass hay average: unavailable*

## Calculated Energy Values – NIRS

**Digestible Energy (DE)** – Amount of energy in the forage that can be digested by the animal and is primarily used to quantify energy available to equine species. Expressed in MCal/kg. *Grass hay average: 1.8-2.2 Mcal/kg*

**Total Digestible Nutrients (TDN)** – Sum of all nutrients in the forage that can be digested and serve as sources of energy for ruminant animals. Expressed as a percentage. *Grass hay average: 52-62 percent*

**Net Energy for Maintenance (NE<sub>m</sub>)** – Amount of energy in the forage that is available for maintenance of cattle and serves as an indicator of voluntary forage intake. Expressed in MCal/lb. *Grass hay average: 0.5-0.6 Mcal/lb*

**Net Energy for Gain (NE<sub>g</sub>)** – Amount of energy in the forage that is available to be used for growth of cattle. Expressed in MCal/lb. *Grass hay average: 0.2-0.4 Mcal/lb*

**Net Energy for Lactation (NE<sub>l</sub>)** – Amount of energy in the forage that is available to be used for milk production of dairy cattle. Expressed in MCal/lb. *Grass hay average: 0.5-0.6 Mcal/lb*

## Carbohydrate Values – NIRS

**Acid Detergent Fiber (ADF)** – Portion of the forage containing highly indigestible cell wall components consisting primarily of cellulose and lignin. Expressed as a percentage. *Grass hay average: 35-44 percent*

**Neutral Detergent Fiber (NDF)** – Portion of the forage containing digestible (hemicellulose) and indigestible (cellulose and lignin; ADF) cell wall components. Expressed as a percentage. *Grass hay average: 59-70 percent*

**Lignin** – Portion of the forage containing the completely indigestible portion of the cell wall that offers little nutritive value. Expressed as a percentage. *Grass hay average: 4-7 percent*

***In-vitro* True DM Digestibility 48h (IVTDM48h)** – Estimate of rumen digestibility of the forage following a 48-hour incubation. Expressed as a percentage. *Grass hay average: 58-72 percent*

**Fructan** – Amount of fructose-containing sugar polymers in the forage, which are a highly digestible energy source. Expressed as a percentage. *Grass hay average: 0.8-2 percent*

**Starch** – Amount of starch in the forage, which is a highly digestible energy source. Expressed as a percentage. *Grass hay average: 0.5-3.0 percent*

**Sugar (Ethanol-Soluble Carbohydrates, ESC)** – Amount of ethanol-soluble carbohydrates in the forage, which include simple sugars, disaccharides, oligosaccharides and some fructans, but typically not polysaccharides. Represents a subset of WSC. Expressed as a percentage. *Grass hay average: 3-9 percent*

**Water-Soluble Carbohydrates (WSC)** – Amount of carbohydrates in the forage that can be extracted from feed with water and includes simple sugars, disaccharides, oligosaccharides and some polysaccharides. Expressed as a percentage. *Grass hay average: 5-11 percent*

**Non-Structural Carbohydrates (NSC)** – Amount of carbohydrates in the forage not contributing to the structure of the forage, which is determined by adding WSC + Starch. Expressed as a percentage. *Grass hay average: 7-13 percent*

**Non-Fiber Carbohydrates (NFC)** – Calculated value of carbohydrates of the forage that are not contained in the cell wall, which includes sugar, starch, pectin and fermentation acids. Expressed as a percentage. Calculated as 100 – crude protein (%) – NDF (%) – ash (%) – crude fat (%). *Grass hay average: 10-20 percent*

## Mineral Values – NIRS and Wet Chemistry

Minerals are expressed as a percentage or parts per million (ppm, mg/kg) of the forage and include:

**Calcium (Ca)** – *Grass hay average: 0.4-0.7 percent*

**Phosphorus (P)** – *Grass hay average: 0.1-0.2 percent*

**Magnesium (Mg)** – *Grass hay average: 0.2-0.3 percent*

**Potassium (K)** – *Grass hay average: 1.2-2.4 percent*

**Sulfur (S)** – *Grass hay average: 0.1-0.3 percent*

**Copper (Cu)** – *Grass hay average: 3-11 ppm*

**Zinc (Zn)** – *Grass hay average: 20-40 ppm*

**Manganese (Mn)** – *Grass hay average: 40-120 ppm*

**Iron (Fe)** – *Grass hay average: 140-200 ppm*

**Boron (B)** – *Grass hay average: 6-8 ppm*

## Nitrate Value – Wet Chemistry

**Nitrates (NO<sub>3</sub>)** – Amount of nitrates in the forage. Expressed in parts per million (ppm, mg/kg). Nitrate levels above 2,500 ppm can be toxic to ruminant animals.



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