Forage Analysis Definitions

J. A. Proctor, Graduate Research Assistant
Jennie Ivey, Extension Equine Specialist and Assistant Professor
Jason Smith, Assistant Professor and Extension Beef Cattle Specialist
Department of Animal Science

Gary E. Bates, Director, and David McIntosh, Coordinator
UT Beef and Forage Center

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_m) — 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_g) — 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_l) — 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 (IVTDMD48h) — 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_3) — 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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