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_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 (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:

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Grass hay average</th>
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</thead>
<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>0.4-0.7 percent</td>
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<tr>
<td>Phosphorus (P)</td>
<td>0.1-0.2 percent</td>
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<tr>
<td>Magnesium (Mg)</td>
<td>0.2-0.3 percent</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>1.2-2.4 percent</td>
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<tr>
<td>Sulfur (S)</td>
<td>0.1-0.3 percent</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>3-11 ppm</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>20-40 ppm</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>40-120 ppm</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>140-200 ppm</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>6-8 ppm</td>
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</tbody>
</table>

Nitrate Value — Wet Chemistry

Nitrites (NO₂⁻) — 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.