Livestock are most productive when fed a ration that meets their nutritional needs. Laboratory analysis of feeds is the best indicator for predicting animal performance on a ration before it is fed. This publication has been developed to provide producers with useful data that can help to:

- determine the nutrient content of a mixed feed or a particular ration component
- decrease feed costs through lower-cost rations and more efficient utilization
- evaluate forage production practices such as plant species selections, fertilizer schedules, and time of harvest (age of regrowth)
- set and monitor nutrient standards for local and imported feeds and feed by-products for marketing purposes

The results of the analysis can only be useful when the sample tested truly represents the lot of feed that the animals will eat. Poor sampling technique results in misleading feed analysis results to maximum benefit, contact your local Cooperative Extension Service livestock agent.

Glossary

antioxidant: a feed additive that inhibits one of the chemical reactions (oxidation) in fats that occur in the presence of oxygen, heat, or light and cause rancidity.

macrominerals: those minerals found in an animal’s body in concentrations higher than 100 ppm—they are calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), chloride (Cl), sodium (Na), and sulfur (S), and are usually expressed as percent of dry matter.

microminerals: those minerals found in an animal’s body in concentrations less than 100 ppm; just as important as macrominerals in maintaining health—they are copper (Cu), iron (Fe), zinc (Zn), selenium (Se), fluorine (F), manganese (Mn), cobalt (Co), iodine (I), molybdenum (Mo), nickel (Ni), and silicon (Si).

monogastric: a type of digestive system consisting of “one stomach”—includes humans, swine, poultry, horses, rabbits, dogs, and cats; monogastrics have limited ability to digest fiber and non-protein nitrogen sources; dietary starch and amino acids are essential.

ruminant: a type of digestive system consisting of a multicompartamental stomach including a forestomach (rumen, reticulum, and omasum) and an abomasum (true stomach)—includes cattle, sheep, goats, buffalo, and deer. Ruminants’ ability to digest fiber and use non-protein nitrogen sources is excellent.

non-protein nitrogen (NPN): compared to true protein, this fraction of the “crude protein” value refers to any nitrogen (N) which is not in the form of chains of amino acids—includes ammonia, ammonium phosphate, urea, and dietary nucleic acids. NPN is most effectively used by ruminants with a functioning rumen (i.e., not those suckling milk) and requires the presence of a readily available dietary carbohydrate source, such as molasses or grain.

ture protein: compared to non-protein nitrogen, this fraction of the crude protein consists of long chains of amino acids linked together; essential for diets of monogastrics.

This chart shows how the various nutrient components of a livestock forage or feedstuff are related to the values obtained from a livestock feed analysis. Some of the terms are defined on the back panel of this publication, and the components are described on the inside page.

Livestock feed analysis services are available from the CTAHR Agricultural Diagnostic Service Center through your local Cooperative Extension Service office, or from other commercial laboratories.
DM = Dry Matter

DM is the percentage of the feed that is not water (moisture). Fresh grass has higher moisture content and lower DM content compared to hay.

Ash = total inorganic matter

Ash is a measure of the total mineral content of the feed, but it does not tell us how much of each mineral is present.

NFE = Nitrogen free extract

NFE is a calculated value: the original sample weight minus the sum of weights of water, ether extract, crude protein, crude fiber, and ash.

EE = Ether Extract

EE, also termed crude fat, is the amount of fat and fat-soluble components in a feed. In addition to fats and oils, it includes plant pigments (chlorophyll, xanthophylls, carotene) and fat-soluble vitamins (A, D, E, K), but it does not tell us how much of each vitamin or fatty acid is present.

CP = Crude Protein

CP is an estimate of the level of protein in the feed based on the amount of nitrogen present. Since some, but not all, of the nitrogen is in the form of true protein, it is termed “crude” protein. CP also does not give individual amino acid profiles.

CF = Crude Fiber

CF is the insoluble carbohydrate remaining in the feed analysis process, when the sample is boiled in weak acid and alkali.

NDF = Neutral Detergent Fiber

The NDF value is the percent of total fiber in the feed. NDF is the plant cell wall components: cellulose, hemicellulose, lignin, silica, insoluble CP, and ash. Analysis for NDF, along with ADF, cellulose, and lignin, is replacing the older, more variable crude fiber analysis.

ADF = Acid Detergent Fiber

The ADF value is the percent of the least digestible parts of cell walls: cellulose, lignin, silica, insoluble CP, and ash.

Cellulose

Cellulose is the principal constituent of plant cell walls.

Lignin

Lignin is not true carbohydrate; it is a protective coating on the cellulose-hemicellulose structure of plant tissues, which apparently protects them from bacterial attack.

Lignin is found in straws, hulls, and over-mature hay. It is essentially indigestible by all livestock.

Lignin has no known nutritive value, except as a bulk factor. At high levels, it reduces digestibility of other nutrients in a ration.

Cellulose is digested well by ruminants, moderately by horses and rabbits, and poorly by swine and poultry.

ADF analysis has been replaced by NDF and ADF analysis for ruminant feedstuffs, but it is still used by the feed industry as a measure of fiber content for monogastrics.

NDF, or total fiber, influences level of intake. High levels will limit intake, but minimum levels are necessary to prevent fattening during pregnancy, and also to maintain a healthy rumen in ruminants. It is the fiber in the diet that stimulates rumination, chewing, and saliva production.

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Because fat has 2.25 times more energy per unit of weight compared to carbohydrates, feeds with high fat content are more energy dense and are added to diets to increase calories, provide essential fatty acids, and (in some cases) improve palatability. Fat is also helpful in lubricating and maintaining feeding equipment.

EE is usually higher in meat and fish by-products and whole seeds. If a feed is high in fat, it may be susceptible to rancidity, which causes off-flavors, low palatability, and potential toxic effects. Usually an antioxidant such as Vitamin E is added to prevent a feed from becoming rancid.

CP does not provide information about the type of protein in the feed. The feed industry has replaced CP with NDF analysis, and more recently, with ADF analysis.

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A feed with high CP values than whole grains. The protein quality of grasses declines more rapidly than that of legumes with plant age, and tropical forages decline more rapidly with plant age than temperate forages.

Although minerals are not digested by animals, some are essential to their health. In order to determine the individual mineral content, such as calcium and phosphorus, you must order mineral analysis of the sample (usually includes all macrominerals and some microminerals).

Expressing nutrients on a dry-matter basis allows comparison among feeds by correcting for “as-fed” moisture. Diets are formulated on DM basis, but ingredients are weighed out or mixed on an as-fed basis. When fresh forages and grasses make up the bulk of the diet, a large amount of water is consumed, which could limit intake of energy and protein sources.

How can I use this information?