NUTRITIONAL TERMS

PASTURE

Land where grasses and other plants grow for animals to graze.

DIET

Type and amount of feed and water an animal eats.

Nutrition

Involve various chemical reactions and physiological process which transform foods into body tissues and activities.

Animal Nutrition

Science of determining how animals use food in the body and all body processes that transform food into body tissues and energy for activity, and the process by which animal's grow, live, reproduce, and work. OR Science of nourishment of animals.

Feed

Materials that animal eat to obtain nutrients and nutrition.

Food

Any nutrient containing material that can be consumed and digested by animals.

(difference between food and feed is that food is any substance that is or can be consumed by living organisms, especially by eating, in order to sustain life while feed is food given to (especially herbivorous) animals.

Feedstuff

Ingredients in animal food that determine nutrient content.

Forages

Plant based sources of nutrition that are high in fiber, also called roughages.

Refer to the vegetative matter, fresh or preserved, utilized as feed for animals and include all fodders such as grasses, legumes, crucifers and other crops cultivated and used as hay or silage in a preserved form or utilized through grazing.

Fodder crops

Are cultivated plant species that are utilized as livestock feed . Fodder refers mostly the crops which are harvested and used for stall feeding.

Nutrient

A nutrient is defined as any food constituent or group of food constituents of the same general composition that aids in the support of animal life.

Ration

Total amount of food an animal needs within a 24 hour time frame.

Balanced ration

A ration that provides all of the nutrients needed by the animal in the right amount and proportion.

OR

Complete feed formulated to provide a specific animal species and class with appropriate amounts of all nutrients required for maintenance and a given level of performance.

Diet

The ingredients or mixture of feeds provided for an animal.

Digestion

The process of breaking down food from larger particles into smaller particles for use by the body in order to function.

Concentrates

Concentrates refer to animal feeds that are rich in energy and/or protein but low in fiber, such as corn, soybean meal, oats, wheat, molasses, etc.

Roughage

A high fiber feedstuff, usually low in energy and often utilized by ruminants.

Crude protein

The crude protein content of a feed sample represents the total nitrogen (N) in the diet, which includes not only true protein but also non-protein nitrogen (e.g., urea and ammonia in a feed; nitrate is not included in non-protein nitrogen).

In laboratory analysis, total N present in a feed sample is first determined and then the total amount of protein is calculated by multiplying the total N by a factor. This factor is 6.25 for forages because leaf and stem tissue proteins generally contain 16 percent nitrogen, or one part nitrogen to 6.25 parts protein.

TABLE: **Specific (Jones) factors for the conversion of nitrogen content to protein content**

Food	Factor
Animal origin	
Eggs	6.25
Meat	6.25
Milk	6.38
Vegetable origin	
Barley	5.83
Corn (maize)	6.25
Millets	5.83

Oats	5.83
Rice	5.95
Rye	5.83
Sorghums	6.25
Wheat: Whole kernel	5.83
Bran	6.31
Endosperm	5.70
Beans: Castor	5.30
Jack, lima, navy, mung	6.25
Soybean	5.71
Velvet beans	6.25
Peanuts	5.46

For seeds, this factor is different (e.g., 5.70 for wheat and 5.90 for other cereal grains).

Source: **Adapted and modified from Merrill and Watt (1973).**

Hay

Whole forage plants which are cut and dried for animal feed.

Haylage

Forage ensiled at relatively low moisture content (usually 40 to 50 %).

Palatability

Refers to the avidity with which an animal selects a component from among several different feed choices.

Silage

Forage preserved by fermentation in a silo or under conditions that exclude air.

Ensiled

Ensiled refers to the plant materials preserved by anaerobic fermentation and typically stored in a bag, bunker, wrapped bale or upright silo.

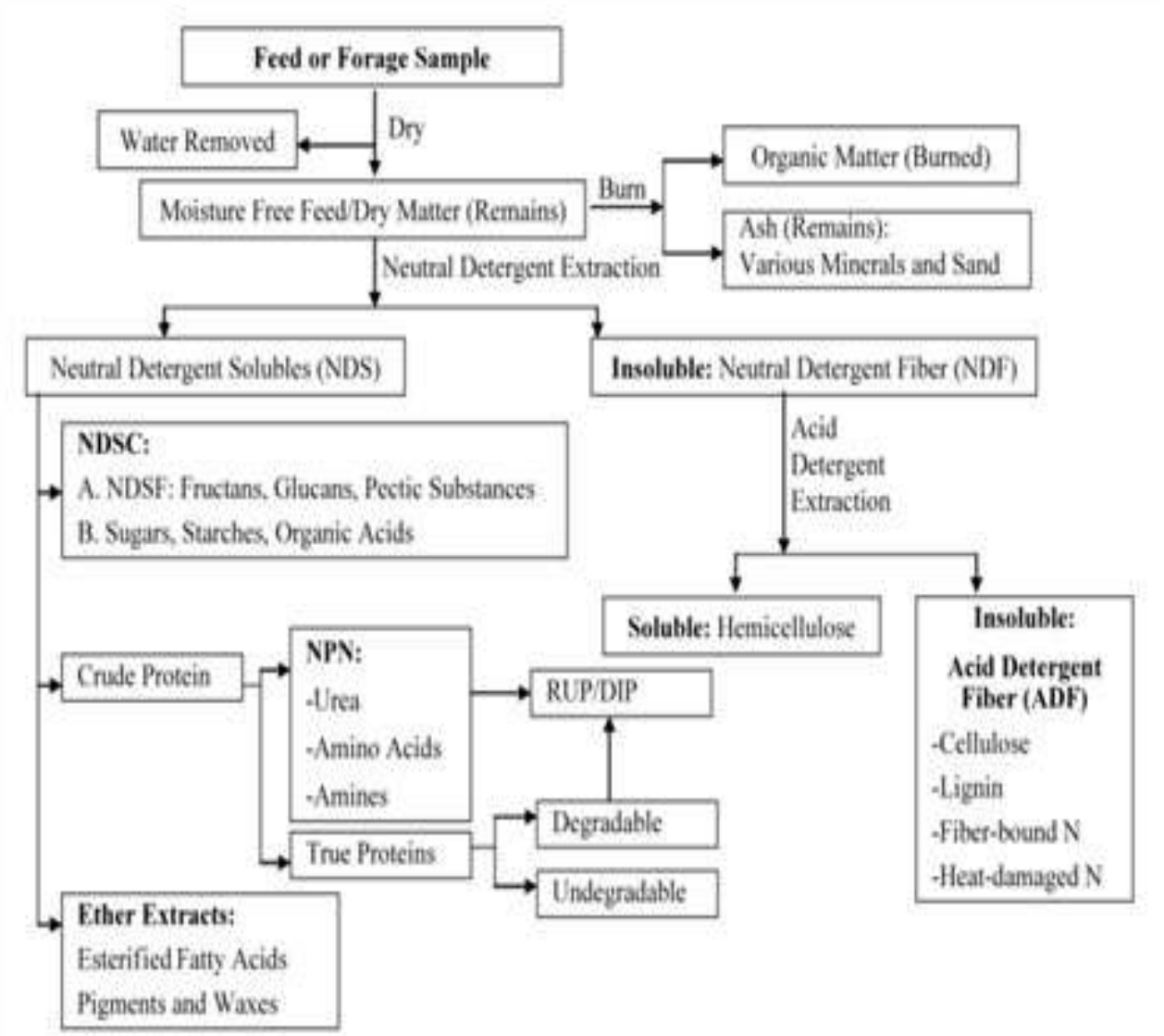
Ether extract

Ether extract is a portion of dry matter extracted with ether. It is a laboratory test to approximate the total fat (or crude fat) content of a feed and includes some waxes, pigments and other lipids to a minor degree in addition to true fats.

Crude fiber

- This older proximate method was used to divide carbohydrates into digestible and indigestible fractions.
- When CF content is higher, the energy content of the feed is lower because crude fiber is considered indigestible.
- Measuring crude fiber was one part of the original system of analyzing the “digestible” fraction in feedstuffs. This method uses sequential acid and alkali extraction. It was developed by Henneberg and Stohmann during the 1860s at the Weende Experiment Station in Germany, and is often referred to as the Weende System of proximate analysis.
- The CF extract was once used as a standard analysis for fibrous parts or the indigestible portion of carbohydrates in feeds. However, some of these substances are partially digestible by microorganisms in the rumen.
- Crude fiber accounts for most of the cellulose but only a portion of the lignin and no ash, so it underestimates true fiber and is less than acid detergent fiber (ADF). Thus, CF is not a good indicator of digestibility in ruminant animals, and the use of this parameter in feeds for ruminants is declining.
- Even though CF is not a very useful parameter for quantifying forage fiber where lignin content is substantial, the CF is a reasonable estimate of the fiber in grains because of their low lignin content. Thus, it is still commonly used for analysis of feeds for non-ruminants or monogastric animals (i.e., those that do not have a chambered stomach or rumen; for example, horses and pigs).

Laboratory analyses of the composition of feed or forage are used to assess their nutritive value (Figure 1). A typical feed analysis includes measurements of some important quality attributes or parameters (e.g., crude protein, fiber, digestibility, etc.) used to define nutritive value. Other parameters are analyzed under some special circumstances. For example, acid detergent insoluble crude protein (ADICP) is usually only measured if heat damage to the feed is suspected.



Abbreviations: *DIP = Degradable Intake Protein; NDSC = Neutral Detergent Soluble Carbohydrate; NDSF = Neutral Detergent Soluble Fiber; NPN = Non Protein Nitrogen; RUP = Rumen Undegradable Protein.*

Figure 1. A schematic that describes the partitioning of organic and mineral components in a feed and forage sample.

Detergent Fiber Analysis

Since crude fiber (CF) has been found to have an unsatisfactory relationship with animal performance, it has limited value in ruminant nutrition.

Most feed analysis laboratories do not use the proximate analysis system (of which CF was a part) and have replaced it with the Van Soest detergent fiber analysis system.

The technique of using detergents to separate digestible and indigestible parts of plant tissues was originally proposed by Van Soest in 1963.

The concept behind the detergent fiber analysis is that plant cell substances can be divided into less digestible cell walls (made of hemicelluloses, cellulose and lignin) and the highly digestible cell contents (containing starch and sugars). These two components are successfully separated by using two different detergent systems:

A neutral detergent solution of sodium-lauryl sulfate ($C_{12}H_{25}NaO_4S$) in disodium ethylenediaminetetraacetate ($C_{10}H_{14}N_2Na_2O_8$) and sodium borate ($Na_2B_4O_7$) with pH =7 .0 (Van Soest, 1963a); and

An acid detergent solution of cetyl-trimethyl-ammonium-bromide ($C_{19}H_{42}BrN$) in 1N sulfuric acid (Van Soest, 1963b; Van Soest and Wine, 1967).

In a sequential analysis, the feed sample is initially boiled in the neutral detergent solution to separate the neutral detergent soluble fraction (cell contents) from the neutral detergent insoluble fraction (cell walls). The cell

contents are highly digestible (about 98 percent) and include various sugars, starches, pectins and other soluble carbohydrates, proteins, non-protein nitrogenous compounds, lipids, water-soluble minerals and vitamins. The remaining dry matter is estimated and the proportion gives the neutral detergent fiber (NDF).

In sequential analysis, the NDF is then further fractionated by boiling in the acid detergent solution. Hemicellulose is solubilized during this procedure while lignin and cellulose remain insoluble. The residue remaining after boiling NDF in acid detergent solution is called acid detergent fiber (ADF). Cellulose is then separated (i.e., solubilized) by adding sulfuric acid. Only lignin and acid insoluble ash remain after this step. The residue is then combusted in a furnace, and the difference of the weights before and after ashing yields the amount of lignin that was present in the sample.

Generally,

NDF = Hemicellulose + Cellulose + Lignin + Ash

ADF = Cellulose + Lignin + Ash

Hemicellulose, cellulose and lignin are indigestible in non-ruminants, while hemicellulose and cellulose are partially digestible in ruminants.

NDF is a good indicator of the "bulk" fiber and has been used to predict feed intake. In contrast, ADF is a good indicator of digestibility (negatively correlated) and thus energy intake.

The detergent fiber analysis system is the most widely accepted method for forage analysis. However, many agencies still base part of their regulations on terms in the proximate.

Acid Detergent Fiber (ADF)

- The fibrous component represents the least digestible fiber portion of forage or other roughage. This highly indigestible part of forage includes lignin, cellulose, silica and insoluble forms of nitrogen but not hemicellulose.
- Forages with higher ADF are lower in digestible energy than forages with lower ADF, which means that as the ADF level increases, digestible energy levels decrease.
- During laboratory analysis, ADF is the residue remaining after boiling a forage sample in acid detergent solution. ADF is often used to calculate digestibility, total digestible nutrients (TDN) and/or net energy for lactation (NEl).

As-fed Basis

- Feed analyses reports often state results based on the feed?s natural state (i.e., including water) and/or on a dry matter basis.
- The term “As-fed Basis” is used to alert the reader that the analytical results of a feed sample are based on its natural state including water. That means it is affected by the sample?s moisture level before drying. This may also be referred to by the terms “As-is Basis” or “As-received Basis.”
- When comparing two or more analyses, it is generally best to utilize the data from the “Dry Matter Basis” rather than the “As-fed Basis” unless you are mixing a ration for feeding.