SDSU Extension

BEEF

Chapter 16

Feed Testing and Interpreting the Results

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Introduction

Understanding the nutrient content of feedstuffs is critical if a producer is to make good management decisions regarding how to meet the nutrient requirements of cattle. It is particularly important if there is significant variability in the composition of a feedstuff. Failure to account for that variability can lead to errors in ration formulation, resulting in performance losses or unnecessary expense. In order to properly meet cattle's nutritional needs and manage feed variability, producers need to understand how to accurately sample feedstuffs and interpret the laboratory analysis.

Sampling feeds

The first step in analyzing feedstuffs is getting a representative sample. The sample needs to accurately represent the entire lot of feed. The proper sampling technique depends on the feedstuff being analyzed.

Sampling Hay

Hay samples should be grouped based on similar type (alfalfa, grass or alfalfa/grass mixture), source, and harvest date. Baled hay should be probed with a hay probe that has a sharp cutting edge, because dull edges are more difficult to use and will not provide a representative sample. Random samples should be taken that will represent the entire field with a minimum of 20 cores per sample. The correct procedure to sample round bales would be to insert the probe at a right angle to the outside circumference of the bale. For rectangle bales, the probe should be inserted at a right angle into the center of the ends of bales. Core samples should be combined into a single sample and stored in a sealed container. A video produced by SDSU Extension demonstrating hay sampling procedures can be found at https://www.youtube.com/watch?v=uQT8w7bH-fuA&list=PL931E+63EC5D8403DE&index=64

When sampling ground hay, it is important to obtain small samples throughout the pile that includes more than the sides of the pile. Collect sample into a bucket. Many times the sample is too large to

Key Points

- Obtaining a representative sample is the first step in analyzing feedstuffs. Proper sampling techniques depend on the type of feedstuff.
- Accurate diet formulation can only occur when the nutrient contents of feedstuffs are known and understood.
- Typical laboratory analyses of feedstuffs include moisture content, crude protein, acid detergent fiber, neutral detergent fiber, total digestible nutrients and net energy.
- Commercial feeds are required to be labeled and these labels must contain information describing the feed product and details necessary for the safe and effective use of the feed. However they do not provide all the information that could be useful in determining feed and nutrient needs for a herd.

fit into a plastic sample bag. If that is the case, mix and quarter the sample and select quarters until the sample size is small enough to fit into the sample bag. The best way to accomplish this is to sample while the pile is being ground. It is much more difficult to accurately sample after grinding.

Sampling Silage and Fermented Feeds

Whether or not the samples should be taken before or after the ensiling process is complete is often the first question that must be answered when testing silage or other fermented feeds. Sampling prior to ensiling provides an early indication of forage quality and allows feeding management decisions to be made earlier. Post ensiling sampling provides the actual nutrients content of the feedstuffs being fed and accounts for any losses that occurred during ensiling and storage. Table 1 illustrates differences in the nutrient content of haylages and silages before and after ensiling. In this example, the nutrient composition is very similar between the two sampling times. However, it is important to understand that in these data, conditions were carefully controlled to ensure proper fermentation. Improper harvesting or storage practices can result in poor fermentation or excessive storage losses resulting in feedstuffs with significantly different feed values when fed.

Table 1: Forage quality analysis before and after ensiling. *Undersander et al., 2005.*

Forage type	Dry matter	Crude protein	ADF	NDF
Alfalfa haylage				
Before ensiling	44.1	19.9	32.3	40.5
After ensiling	42.4	20.7	34.8	40.4
Red clover haylage				
Before ensiling	45.5	15.9	32.1	45.9
After ensiling	46.6	15.9	33.7	48.9
Corn silage				
Before ensiling	34.4	9.7	29.2	49.5
After ensiling	34.1	11.1	29.0	48.8

Regardless of when sampling occurs or the type of storage facility, sub-samples need to be combined into a final sample of two to four quarts using clean plastic containers or bags. Silage that is exposed to oxygen at room temperatures will change in composition. The sample should be either submitted to the laboratory or frozen as soon as possible after sampling to make sure that the sample most closely represents the product being fed.

Sampling pre ensiling:

Take subsamples (three to five handfuls of forage) from several loads throughout the day. Samples should be immediately refrigerated or frozen. Each bag/silo/pile should be sampled and tested individually.

Sampling from tower silos:

Remove spoiled material from the top and first few feet of silage before sampling. Collect samples from both morning and evening feeding if possible and combine for one sample. While unloading, collect one to two pounds of silage at each time.

Sampling from a bunker:

The safest way to obtain a sample from a bunker silo is to shave/scrape the face of the silage bunker and create a small pile on the bunker floor well away from the silage face where the subsamples can be collected. This procedure reduces the risk of an avalanche of silage falling on an individual while taking samples. Due to safety considerations and the difficulty in obtaining a representative samples, it is not advisable to collect hand grab samples from the face of the pile.

Sampling from silo bags:

There are two options for collecting samples from silo bags. Hand grab samples can be collected from the across the face of the silage before and after feeding to get a more representative sample of the silage being fed. The second sampling method involves taking core samples (eight to 10 samples) along the sides of the bag. It is extremely important to seal those holes to limit oxygen infiltration.

Sampling Grains

Ideally, the grain sample would be taken from throughout the bin or pile, using a grain probe. However, if a grain probe is not available, collect numerous random small samples from 10 to 15 areas within the bin/piles or from the stream of grain as a truck is unloaded. These small samples should be combined and mixed into a representative sample (one quart) and sent to the laboratory for analysis.

Sampling By-Product Feeds

The extent that by-product feeds should be sampled and analyzed depends on the amount of variability in the feed. Some feeds such as soybean meal are relatively uniform in composition and likely will not need to be analyzed frequently. Other feeds may be much more variable from plant to plant or from load to load and will need to be tested more often to manage this variation. Some feeds may have nutrient characteristics or properties that limit the amount that can be fed. An example would be limiting the amount of distiller's grains that can be fed because of sulfur content. By-product feeds would be sampled much like grains or other feedstuffs, depending on the physical form of the feed. High moisture byproduct feeds should be bagged and frozen to prevent moisture loss and sample deterioration. As with any class of feed, the samples need to be taken randomly and then combined and sub-sampled so that the sample most closely represents the entire load or lot.

Interpreting feed analysis results

The ultimate goal of feed testing is to utilize the information provided in the feed analysis report to design feeding and management plans. Accurate diet formulation can only occur when feed nutrient contents are determined.

Feeds sample are analyzed using either wet chemistry or near infrared reflectance spectroscopy (NIRS). The equations used to calculate nutrient content with the NIRS method have been developed and validated using wet chemistry. NIRS analysis is typically faster and less expensive than wet chemistry. The type of feed must be specified to use NIRS and correspond to the reference feeds that were used to develop the equations. Mixed feeds such as bunk samples are usually better suited to be analyzed using wet chemistry.

Table 2 is an example laboratory analysis of a mixed alfalfa/grass hay sample. The exact format and values that are reported can vary depending on the laboratory used and the feedstuff being analyzed. The example represents a typical report.

- **Moisture Content:** Laboratory analyses are reported on As Received basis and Dry Matter basis. These values can be the most important part of the report for properly balancing a diet, especially when high moisture feeds are used. Dry Matter values are used in diet formulation and are higher than As Received values, since As Received values are diluted by moisture content.
- **Crude Protein:** Crude protein values are calculated based on the nitrogen content of the sample (both true protein nitrogen and non-protein nitrogen). There are other measures related to crude protein that are sometimes reported. These values describe how the protein is utilized by the animal and include:
  - » **Degradable Intake Protein (DIP)** is the fraction of crude protein that is degradable in the rumen.
  - » **Undegradable Intake Protein (UIP)** also referred to as "bypass protein" is the fraction of crude protein that is digested in the small intestine.

Table 2: Example of laboratory analysis of alfalfa/grass hay sample.

Laboratory Analysis	As Received Basis	Dry Matter Basis
Moisture, %	12.8	0.0
Dry Matter, %	87.2	100.0
Crude Protein, %	11.7	13.4
Acid Detergent Fiber, %	31.8	36.5
Neutral Detergent Fiber, %	45.1	51.7
Minerals		
Phosphorus (P), %	0.13	0.15
Calcium (Ca), %	1.24	1.42
Potassium (K), %	1.56	1.79
Magnesium (Mg), %	0.27	0.31
Calculated Values		
TDN, %	47.6	54.6
NE/Lactation, Mcal/lb	0.49	0.57
NE/Maintenance, Mcal/lb	0.45	0.51
NE/Gain, Mcal/lb	0.23	0.26
Digestible Dry Matter, %	---	60.5
Dry Matter Intake, % of body wt	---	2.32
Relative Feed Value (RFV)	---	108.8
Relative Feed Quality (RFQ)	---	103.0

» **Acid Detergent Protein or Heat Damaged Protein** occurs when nitrogen becomes chemically linked to the carbohydrates, affecting how the protein is digested and metabolized. This can occur if hay is harvested too wet or haylage is harvested too dry affecting fermentation. If heat damage is suspected, the feed analysis should report "adjusted" CP and those values used for diet formulation.

- **Acid Detergent Fiber (ADF)** is composed of cellulose and lignin and is an indicator of forage digestibility because it contains a high proportion of lignin, which is indigestible.

  » **Digestible Dry Matter (DDM)** is calculated from ADF on a dry matter basis (DDM = 88.9 – (%ADF x 0.779)). Forages higher in ADF are usually lower in energy and have lower digestibility. Acid detergent fiber is used to calculate Total Digestible Nutrients (TDN) and Net Energy for various feeds such as hays, haylage and silages.

- **Neutral Detergent Fiber (NDF)** is composed of hemicellulose, cellulose and lignin and is a predictor of feed intake.

  » **Dry Matter Intake (DMI)** is calculated from NDF on a dry matter basis (DMI = 120 ÷ %NDF). Forages high in NDF are usually of low quality and have low levels of intake.

- **Calculated Energy Values:** These values are used for formulating rations and are calculated from the ADF and NDF results.

  » **Total Digestible Nutrients (TDN)** is the sum of digestible fiber, protein, lipid and carbohydrate portions of the feeds. TDN is directly related to ADF and is normally used for beef cow diet formulations.

  » **Net Energy (NE)** is a more precise way to describe and predict how dietary energy is used by the animal. There are three NE values reported: NE for maintenance (NEm), NE for gain (NEg), and NE for lactation (NEl). Net Energy for maintenance is utilized for determining maintenance energy requirements, NEg is used in developing diets for growing and finishing cattle, and NEl is used by the dairy industry for lactating cow rations.

  » **Relative Feed Value (RFV)** was developed as an index to compare and rank forages. It is based on Digestible Dry Matter (DDM) and Dry Matter Intake (DMI) estimations, but does not utilize crude protein in those calculations. Relative feed value is often used when purchasing alfalfa to provide an indication of quality. Relative feed value should not be used to compare between different hay types and cannot be used in formulating diets.

  » **Relative Feed Quality (RFQ)** is similar to RFV but uses NDF digestibility rather than ADF to account for differences in fiber digestibility due to different growing conditions.

Commercial Feed Labels

Commercial feeds play an important role in meeting the nutrient requirements of cattle on most if not all farms and ranches. Supplemental minerals are nearly always provided by commercial feeds. Commercial protein and creep feeds are often used as well, especially when having the feed in a self-fed or pelleted form is desirable. Commercial feed companies can take advantage of more specialized weighing and mixing equipment to improve quality control and accuracy compared to what can be done on the farm or ranch.

All commercial feeds are required to come with a label, such as that shown in Example 1. The following items are required to be included on any commercial feed label. The descriptions correspond to the numbers on the example feed tag and include:

1. The product name and brand name of the feed.
2. If the product is medicated, that must be stated on the label.
3. The purpose statement indicates the intended class and usage for the particular feed. If the

feed is medicated, this section must also list the specific purpose of the medication.

4. The active drug ingredient and concentration, if the feed is medicated.
5. Guaranteed Analysis: Protein, fiber and fat concentrations are required to be listed. If minerals and vitamins are added to the feed, then the guaranteed analysis for these nutrients must be provided as well.
6. If non-protein nitrogen is added to the feed, the amount of crude protein provided by those ingredients must be specified.
7. The ingredients of the feed must be listed. These can either be listed as specific ingredients (Copper Sulfate, Copper Amino Acid Complex) or as a class of ingredients (Plant Protein Products.)
8. The name of the manufacturer.
9. Directions for use, including mixing instructions, if any, and how to achieve the proper dose of any included medications.
10. Caution and Warning statements would detail any withdrawal times or hazards.

It is important to remember that the label does not provide all of the information that would be useful. Calculated energy values such as NEg or TDN are not provided, which would be useful for feeds such as protein supplements that are fed at relatively high amounts of the ration. These values could be estimated from the crude fiber content or by knowing the primary ingredients.

There is also no way to determine the quality of the ingredients used simply by reading the label. Developing a good working relationship with the feed manufacturer will help ensure that the purchased feed is high quality and will perform as expected.

Example 1. Sample Feed Label

①Creep Feed Supplement

②MEDICATED

③FOR MIXING BEEF CREEP FEED

For increased rate of weight gain in pasture cattle (slaughter, stocker, feeder cattle and dairy and beef replacement heifers).

CAUTION: FEED AS DIRECTED

④ACTIVE DRUG INGREDIENT

Lasalocid (as Lasalocid Sodium)	530 g/ton

⑤GUARANTEED ANALYSIS

Crude Protein, (Min)	40%
⑥(This includes not more than 3.0% equivalent crude protein from non-protein nitrogen.)	
Crude Fat, (Min)	1.0%
Crude Fiber, (Max)	10.0%
Calcium (Ca), (Min)	3.0%
Calcium (Ca), (Max)	3.5%
Phosphorus (P), (Min)	0.90%
Salt (NaCl), (Min)	3.0%
Salt (NaCl), (Max)	4.0%
Potassium (K), (Min)	1.8%
Zinc (Zn), ppm, (Min)	435
Copper (Cu), ppm, (Min)	130
Selenium (Se), ppm, (Min)	2.5
Vitamin A, I.U./lb., (Min)	20,000
Vitamin D_3, I.U./lb., (Min)	5,000
Vitamin E, I.U./lb., (Min)	25

⑦INGREDIENTS

Plant Protein Products, Forage Products, Molasses Products, Dried Bakery Product, Processed Grain By-Products, Roughage Products (not more than 30%), Calcium Carbonate, Salt, Monocalcium/Dicalcium Phosphate, Ammonium Sulfate, Potassium Chloride, Sodium Selenite, Ammonium Chloride, Manganese Sulfate, Zinc Sulfate, Zinc Amino Acid Complex, Ammonium Sulfate, Ethylenediamine Dihydriodide, Cobalt Carbonate, Basic Copper Chloride, Copper Amino Acid Complex, Vitamin A Supplement, Vitamin D3 Supplement, Vitamin E Supplement, Mineral Oil

⑧Manufactured by:
Super Feed Company
2000 Feed Mill Road
Cowtown, USA

⑨DIRECTIONS FOR USE

This feed is designed to be used in mixing the following creep rations:

Ingredient, lbs.	Creep Protein Level 13%	16%
Grain*	1715	1525
Creep Feed Supplement	285	475
Total Lbs.	2000	2000
Lasalocid, g/ton	76	126

*Ground grain can be all corn, all grain sorghum (milo), up to 10% wheat, up to 50% barley, or up to 50% oats.

Feed one of the above rations continuously at a rate to provide not less than 60 mg nor more than 300 mg of lasalocid per head daily (0.21 to 1.07 lb. of this product). A rate of 3 pounds per day of mixed feed is recommended to supplement milk and pasture normally consumed by nursing calves. This feeding rate will provide the following milligrams of lasalocid per head daily.

3 lbs. of ration	Lasalocid (mg/hd/day)
13% Protein	113
16% Protein	188

This product contains 265 mg lasalocid per pound. Maximum intake of this medicated supplement is 0.75 lb/hd/day.

⑩CAUTION

The safety of lasalocid in unapproved species has not been established; do not allow horses or other equines access to lasalocid as ingestion may be fatal; feeding undiluted, mixing errors or inadequate mixing resulting in excessive concentrations of lasalocid could be fatal to cattle and sheep. Do not feed to lactating dairy cattle.

WARNING

A withdrawal period has not been established for this product in preruminating cattle. Do not use in calves to be processed for veal.

Example 1: Sample Feed Label

References

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