Ontario

MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

# Sheep Feeding Programs: Forage and Feed Analysis

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## Introduction

Forage and feedstuff analysis is an important management tool in the development of a proper sheep feeding program.

Knowledge of the quality of a feed helps determine the use of where, when and quantity of said feed. Evaluating feed quality without a laboratory analysis can be extremely misleading. Once we ran a "blind" test with some hay bales. We asked farmer participants at a nutrition conference to judge the protein content of the bales. Not surprisingly, guesses ranged from 6% to 20% as fed. Sensory evaluation of hay and other feeds may include the following:

- Stage of maturity
- Ratio of legumes to grass
- Ratio of leaves to stems
- Colour - bleached or green?
- Odour - smell musty?
- Presence of weed seeds

Provincially, forages supply about 90% of the nutrients consumed by sheep. Quality of forage determines the contribution of the forage to sheep and lamb performance. One must consider four aspects of this. These areas follow:

1. Intake. Fibre levels will affect voluntary consumption.
2. Digestibility. Quantity of nutrients absorbed through the digestive system.
3. Efficiency. Ratio of measurable animal production to nutrients supplied.
4. Anti-quality factors. Components of feed that inhibit #1 through #3 above.

## Step 1. Choose the Feeds to be Tested

The feedstuffs chosen for analysis should form the basis of the ration. This will usually include samples of each different type or cutting of hay, haylage, corn silage and any other roughages. The nutrient composition of roughages varies greatly from year to year and from farm to farm, making yearly analysis a necessity.

Homegrown grains should be tested every two years to check nutrient quality compared to expected values. Nutrient composition of feeds such as corn and soybean meal vary significantly, depending upon variety, weather and processing conditions. Frequent testing of the energy and protein ingredients in mixed feeds, such as sheep grower or lactating rations, is necessary to optimize formulation.

## Step 2. Collect the Feed Sample

Accurate feed analysis begins on-farm with proper feed sampling techniques. Collection of a representative feed sample, one truly indicative of the entire hay mow, grain bin or silo, is the most important step in feed analysis. Use these guidelines when collecting feed samples:

### Hay Samples

To sample hay properly, a Hay Core Sampler is a necessity. Many feed company representatives and veterinarians have core samplers. Place the hay corer into the middle of the narrow end of square bales, or the rounded side of large round bales, and drill to the centre of the bale. When sampling from large round bales, an extender is added to the core sampler so that the bale centre can be reached. Proper sampling practices ensure that the sample obtained will include the same proportion of leaves and stems as is present in the entire bale. Sample a minimum of 10-12 bales from different locations in the mow or storage area. Better yet, set aside bales that are to be sampled as you are storing the hay. This will avoid hay being buried under or behind other hay in the storage area, and allow a more representative sample to be collected. Mix the samples together in a clean, dry plastic pail. A two-handful subsample, sealed in a plastic bag and well labelled is sufficient for laboratory analysis. Flakes of hay or samples grabbed by hand are not representative samples and analytical results will be inaccurate. Many labs will refuse to accept inappropriate samples.

### Silage and High Moisture Grains

Silage and high moisture grain samples are best collected during harvesting. Collect a handful of silage from every third or fourth wagonload and place in a clean plastic bag. At the end of each day, mix the contents of the plastic bag, take a two-handful subsample and freeze it in a sealed freezer bag. Continue this practice each day of harvesting.

When the silo is filled, thaw all the subsamples, and mix them together in a clean, dry plastic pail or bag. Take a two-handful sample and place it in a clearly labelled plastic bag. Remove any air present by squeezing the bag, and then seal it securely. This will help to preserve the moisture content of the sample. A sample collected this way will represent the nutrient composition of the entire silo. Any feed variations that may exist, due to field differences, varying stages of maturity, or weather conditions, will be reflected in the sample.

If more than one type of haylage or silage is stored in the same silo, use a marker to indicate when the change occurs. There is no value in sampling and testing a silage if you do not know when you are feeding it. Egg cartons, or polystyrene cups are examples of markers which have been used successfully. Put these materials through the blower in liberal quantities whenever you start filling with a new type of silage. Then watch for these markers later when you are feeding the silage from the silo.

Ensiling affects some nutrient levels, particularly the Acid Detergent Fibre (ADF) content, from those measured in the fresh plant material. The ADF analysis is important as it is used to estimate energy content of roughages. An ADF estimate of fermented forage can be predicted using specialized equations, based on the ADF analysis of the fresh feed prior to ensiling. Labelling the sample as "fresh silage - sampled during ensiling" is therefore necessary to accurately predict the energy content of silage that will be fed.

If it is impossible to collect a silage or high moisture grain sample during harvesting, the next best practice is to sample from the silo itself. Samples should be taken over a two day period. Allow the silo unloader to run for several minutes, then grab several handfuls of freshly unloaded material and place them in a clean dry plastic bag. Mix all the subsamples at the end of the two day period and submit a two handful subsample for analysis. For pit or bunk silos, use a hay core sampler equipped with an extender and sample from several different sections across the face. Silage or high moisture grain samples collected from storage will only represent a small portion of the silo or bunk. Analysis of these samples, however, will provide a better estimate of the feed quality than would average Ontario or book values.

### Dry Grains

Sample dry grains by hand or with a grain probe. Sample from various areas in the storage bin, mix in a clean dry pail and grab a two handful sample. Place the sample in a clearly labelled plastic bag.

Now that all the samples are properly collected, you are ready to send them to the feed laboratory.

### Step 3. Submit the Feed Samples

Once the representative sample is properly collected, the process is not yet complete. Samples must be accurately labelled. Feed analysis laboratories require a completed "sample input" form to accompany the samples. The input form information and proper sample identification are extremely important to enable the lab to perform the correct analytical procedures. When submitting hay and/or haylage samples, indicate the type (grass, mixed or legume) and appropriate cutting (i.e. first, second, etc.) Follow these general guidelines to determine the type of hay or haylage being submitted for analysis:

Grass = < 25% legume (alfalfa, red clover, etc.) in the sample
Mixed = 25-75% legume in the sample
Legume = > 75% legume in the sample

Equations, specific for the type of forage, use the Acid Detergent Fibre (ADF) analysis to predict the energy content. Most laboratories use these equations and can provide an estimated energy value, expressed as Total Digestible Nutrients (TDN) and/or Net Energy (NE), for hay, haylage and corn silage samples. Correctly labelling forage samples ensures the appropriate energy estimating equation is used. Use of the wrong equation will under or overestimate the energy content of the forage and, ultimately, lead to deficiencies or excesses in the formulated ration.

Clearly label samples treated with a non-protein nitrogen (NPN) additive, such as urea or anhydrous ammonia. These feed samples must be dried differently to preserve the added NPN. If the sample is dried normally (oven dried), the NPN is lost and the resulting crude protein analysis will be inaccurate.

A good policy to follow when submitting samples is to include any and all information that you feel will help the laboratory do the best job possible.

Feeds can be analyzed by a feed laboratory. A list can be obtained from the OMAF Contact Centre.

### Step 4. Choose the Nutrients to be Analyzed

Choosing the proper nutrients to be analyzed is essential to accurately assess feed quality and provide the information necessary for ration formulation. The major nutrients commonly analyzed in feed samples are described below.

#### Dry Matter

The dry matter (DM) of a feed contains all the nutrients (except water) of importance in livestock nutrition. Once the feed dry matter content is known, the amount of feed (as fed) to be offered to the animals can be calculated.

#### Crude Protein

Crude Protein (CP) is based on a laboratory nitrogen analysis, from which the total protein content in a feedstuff can be calculated. Requirements for CP must be met in a ration designed to optimize production.

#### Energy

Energy is a major nutrient required for maintenance, growth, production and reproduction. Feed energy content is expressed as either Total Digestible Nutrients (TDN) or Net Energy (NE). Energy itself cannot be directly measured in a laboratory, but can be predicted for hay, haylage and corn silage from the Acid Detergent Fibre (ADF) analysis. Energy values for other feedstuffs are usually obtained from reference books.

#### Calcium and Phosphorus

Calcium (Ca) and Phosphorus (P) are two macro or major minerals required in a ration in relatively large amounts. Maximum productivity and good health depend on both the actual amounts of Ca and P supplied and the ratio of Ca:P. Hay and haylage are good sources of Ca but relatively poor in P. Grains are rich in P but contain little Ca.

#### Magnesium and Potassium

Magnesium (Mg) and Potassium (K) are also macro minerals present in feeds in variable amounts. Many roughages grown on Mg deficient soil are low in Mg. In general, hay and haylage provide an abundant source of Mg and K, whereas grains contain lower levels. Mg and K should be analyzed in feeds fed to ruminant animals.

### Manganese, Copper and Zinc

Manganese (Mn), Copper (Cu) and Zinc (Zn) are three micro or trace minerals. The levels of these three minerals vary considerably in feed. Copper should be routinely analyzed in feeds offered to sheep. Trace mineral analysis for Cu, Mn and Zn and other micro minerals is recommended when a related health and/or production problem exists or when a custom mineral formulation is desired. Consult a veterinarian for advice if a trace mineral deficiency or excess is suspected.

### Fibre

Acid Detergent Fibre (ADF) measures the least digestible portion of the fibre in feeds and is used in predicting the energy content of hay, haylage and corn silage. An increase in feed ADF content reflects a decrease in energy value.

Neutral Detergent Fibre (NDF) measures the total fibre or bulk component of a feedstuff. NDF is also used to predict feed intake; an increase in feed NDF results in decreased feed intake. Check with your nutritionist to see if NDF is being used in ration formulation.

### Selenium

Selenium (Se) is required in rations in only small amounts. The margin between the Se requirement and toxicity levels is very narrow. Analyze feeds for Se if you or your veterinarian suspect a deficiency or toxicity problem. Se analysis is difficult to perform since natural feeds contain quite low levels. Check with your feed lab before submitting samples for Se analysis.

### Digestible Protein and Acid Detergent Fibre-Nitrogen

Request a Digestible Protein (DP) or Acid Detergent Fibre-Nitrogen (ADF-N) test for any hay or ensiled haylage samples you suspect may have suffered heat damage. This test will estimate the adjusted crude protein value of a heat damaged hay or haylage. Only stored samples can be tested for DP or ADF-N as heat damage occurs during storage.

Adjusted Crude Protein (ACP) is the CP available for animal use. It is calculated when the ADF-CP is greater than 12% of the tested CP in a sample.

The following example illustrates how CP should be corrected when ADF-CP is greater than 12% of the total CP:

| Alfalfa-Grass Haylage | DM Basis |
|---|---|
| CP % | 16.5 |
| ADF-N% | .4 |

**Step 1.** Calculate ADF-CP from ADF-N

ADF-CP% = ADF-N% x 6.25
= .4 x 6.25
= 2.5%

**Step 2.** Determine ADF-CP as percentage of the total CP.

ADF-CP%, % of total CP = CP% in ADF ÷ CP% x 100

= 2.5% ÷ 16.5% x 100

$$= 15.2\%$$

**Step 3**. Calculate an adjusted CP (ACP)

$$\text{ACP\% of DM} = \text{CP\%} \times [100 - (\text{ADF-CP\%} - 12\%)] \div 100$$
$$= 16.5\% \times [100 - (15.2\% - 12\%)] \div 100$$
$$= 16.0\%$$

Note: If ADF-CP is 12 percent or less of CP, ACP = CP.

Digestible dry matter (DDM) is an estimate of the relative amount of forage that can be digested by animals. It is determined from % ADF by the following equation:

$$\% \text{ DDM} = 88.9 - (\% \text{ ADF} \times .779)$$

DDM is an in vivo (animal determination); therefore, it equals % TDN (total digestible nutrients).

% DDM = % TDN - for Cool-season Legume and Grass
%TDN = 87.84 - (ADF% x .7) for Corn Silage

Dry matter intake (DMI) is an estimate of the relative amount of forage an animal will eat when only forage is fed. DMI is determined from NDF by the following equation:

DMI as a % of body weight = 120 ÷ Forage NDF (of DM)

Relative feed value (RFV) is an index used to rank cool season perennial forage crops by their potential intake of digestible dry matter. The RFV index is used to allocate the correct forage to specific animal performance, to price hay (highest test value correlated with price at quality-tested hay auctions) and to assess forage management, harvest and storage skills.

$$\text{RFV index} = \text{DDM} \times \text{DMI} \div 1.29$$

Net EnergyL (lactation) (NEL) is more comprehensive measure of energy than TDN. Energy is expressed in megacalories (Mcal) per 100 pounds of feed DM. Since feed energy is used equally well for maintenance and milk production, NEL is used to formulate energy needs in dairy cattle diets. NEL is calculated from TDN.

$$NE_L \text{ (Mcal/lb)} = (\%\text{TDN} \times .01114) - .054$$

For small grain hay or silage, $NE_L$ is calculated as

$$NE_L \text{ (Mcal/lb)} = .3133 \times [2.86 - ((35.5 \div 100 - (\%\text{ADF} \times 1.67))]$$

Equations for estimating $NE_L$ of corn grain are:

Ear Corn
$$NE_L \text{ (Mcal/lb)} = 1.04 - (\%\text{ADF} \times .02)$$

Shelled Corn
$$NE_L \text{ (Mcal/lb)} = .905 - (\%\text{ADF} \times .003)$$

Net Energy (maintenance) ($NE_m$) and Net Energy (gain) ($NE_g$) are comprehensive measures of energy used to formulate rations. Calculation for $NE_g$ and $NE_m$ require calculation of NE (metabolizable energy) first.

$$\text{ME (Mcal/kg)} = 1.808 \times \text{TDN \%} \div 50$$

$$NE_m \text{ (Mcal/lb)} = [(1.37 \times ME) - (0.138 \times ME^2) + (.0105 \times ME^3) - 1.12] \div 2.205$$

$$NE_g \text{ (Mcal/lb)} = [(1.42 \times ME) - (.174 \times ME^2) + (0.0122 \times ME^3) - 1.65] \div 2.205$$

## Literature Cited

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