Nutrition

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Introduction

Feed costs account for approximately 80% of the expenses for an average Ontario farm. Therefore, it is imperative that producers evaluate and manage their feed resources to maximize farm profit and flock productivity. To this end, producers should work with extension personnel and nutritionists to build a solid nutritional program that includes feed analysis and ration formulation to meet the needs of the flock.

Feed Analysis

It is difficult to assess feed quality without performing a detailed chemical analysis to determine the quantity of nutrients present. A basic feed analysis will provide the producer with information on the dry matter (DM), fibre (neutral detergent fibre and acid detergent fibre), total digestible nutrients (TDN), protein, vitamin and mineral content of the feed. Knowing the level of nutrients that are available in a given feed allows for the formulation of rations that meet the nutritional requirements of animals in a given stage of production.

Water

It should be noted, however, that while formulating diets to meet the production needs of the flock is important in order to maximize productivity; all the planning and formulating can go to waste if water is not adequately supplied. It is essential that a fresh source of water be available to the flock at all times. This is particularly important for lactating ewes that require a large amount of water to produce adequate amounts of milk - and young lambs. It is recommended that one square foot of water surface be provided for every 40 ewes.

Dry Matter (DM)

Dry matter analysis actually measures the amount of moisture in the feed and is widely variable depending on the feed source. Hay and grain usually contain roughly 10% moisture, silage can contain anywhere from 50-75% and pasture plants are often 80-85% moisture. DM content is an important measurement, as it affects animal intake. For example, a ewe is that is capable of consuming 2 kg (4.4 lb) of leafy grass hay (10% moisture; 90% DM) can also consume 9 kg (19.8 lb) of leafy grass pasture (80% moisture; 20% DM). In both cases 1.8 kg (4 lb) of DM will be consumed. Therefore, expressing feed analysis, animal intake and nutrient requirement on a DM basis eliminates moisture as a variable in the comparison of different feeds and in the calculation of balanced rations.

Fibre

The fibre content of feed is expressed as Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF). NDF is a chemical estimate of the plant cell wall. The plant cell wall is composed largely of difficult to digest cellulose, whereas the inside of the cell contains much more soluble carbohydrates (e.g. starch). Although the animal can make use of both cellulose and soluble carbohydrates, cellulose is a more complex carbohydrate and takes longer to break down. Various types of plants will vary in proportion of cell wall versus cell contents, and generally as a plant matures the percentage of wall content will increase. A high NDF indicates that the feed has a large percentage of cell wall material. As NDF increases the animal's intake will decrease. This is because the more fibrous the feed, the bulkier it

is and the sooner the rumen will reach capacity. Very fibrous feed will also take longer to break down and be passed from the rumen. Therefore, feed intake will be restricted by the size of the rumen. If only very fibrous feeds (high NDF) are fed, the animal may not be able to eat enough to maintain production. ADF is a measure of the digestibility of the feed (i.e. how much of the feed can actually be used by the animal). ADF values are used to calculate other measures of energy content such as total digestible nutrients.

Total Digestible Nutrients (TDN)

TDN is a measure of the energy content of the feed and is reported as a percentage. How much energy an animal requires in their diet will depend on their age, sex and stage of production. The energy content can also be expressed as digestible energy (DE), which is measured in megacalories per kg (Mcal/kg). Energy is the nutrient that is most often below the level required for production (limiting nutrient) and energy usually accounts for the largest portion of feed costs. Most energy in sheep diets comes from the cellulose and hemicellulose in forage and the starches in grain. Fats and oil are very high in energy, but are not often used in sheep diets.

Protein

It is the quantity and not necessarily the quality of protein that is important in sheep rations. Proteins vary in how easily they can be broken down in the rumen, from being completely insoluble to 100% soluble. Most types of proteins fed to sheep are relatively soluble, meaning that the rumen bacteria can digest them. During bacterial digestion the nitrogen in the protein is released and used to maintain growth and reproduction of the microbe population. Microbes are constantly being passed out of the rumen into the abomasum and intestine, where they are broken down by the sheep's digestive enzymes. Once they are digested they are absorbed and utilized by the animal as a protein source. Therefore, the quality of protein fed to sheep can vary, but the quality of the microbial cell protein is consistent. Hence, relatively low quality (low cost) proteins can at times be used to supplement sheep rations. This includes non-protein nitrogen (NPN) sources, such as urea, which provide nitrogen to the rumen microbes, without having to be first broken down from a more complex true protein. In order for rumen microbes to utilize NPN, however, sufficient soluble carbohydrates (e.g. starch) must included in the diet. If there isn't enough energy or if the NPN is fed in excess of the microbes ability to use it, the animal may suffer from toxicity. NPN use as a protein source should be restricted to maintenance diets, as it will generally not meet the protein requirements for late gestation, lactation, or lamb growth.

Protein that is not soluble in the rumen passes intact to the lower digestive tract, where it will be digested and absorbed. This type of protein is called 'bypass protein' as it bypasses the rumen bacteria. Bypass protein is efficiently utilized and is a means of providing protein directly to the animal, rather than indirectly through the microbes. Bypass proteins tend to be higher quality and generally more expensive. Feeding a very high percentage of bypass protein and little soluble protein, however, is not advisable as it would result in poor microbe performance.

Minerals

Calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), salt (NaCl), cobalt (Co), iodine (I), copper (Cu), and selenium (Se) are the minerals most commonly analysed and are reported as percentages or parts per hundred (Ca, P, K, Mg, NaCl), parts per million (Co) or parts per billion (Se).

Calcium and phosphorous are expressed on feed tags as a ratio (Ca:P). Sheep can handle a Ca:P ratio anywhere from 1:1 to 7:1 as long as the minimum requirements of available calcium and phosphorous are being met. It is important that the Ca level is at least as high as the P in the diet. This is necessary as P interferes with the absorption of Ca, creating a deficiency in the animal even if the actual level in the diet is adequate. This is particularly important in growing animals and lactating ewes. Most grass and legume hays contain an adequate level of Ca while grains tend to have relatively high P levels. Ca and P are required for the maintenance of bone structure and proper muscle and nerve function. Signs of

deficiency include abnormal bone development (rickets), knock knees, slow growth, "runtiness", listlessness, depraved appetite (chewing on rocks, wood and bone) and "downer ewes". Ewes in late pregnancy should not be fed very high levels of dietary Ca (e.g. only alfalfa hay), as this may interfere with the release of body reserves of Ca required at the onset of lactation causing hypocalcaemia.

Magnesium is closely associated with the metabolism of Ca and P and is required for proper nervous system function. Normally feeds contain adequate levels of magnesium, however, deficiency can cause grass tetany.

Cobalt is an essential trace mineral that is needed in order for vitamin B2 to be manufactured by the rumen microbes. A deficiency in cobalt may cause sheep to become thin, unthrifty and anaemic. Co is often included in salt (blue salt block)

Iodine, another trace mineral, is required by the thyroid gland for regulation of food utilization. Deficiency in iodine can cause goiter, which is commonly seen in newborn lambs born to iodine deficient ewes. Goiter can be recognized in young lambs by abnormal swelling under the throat due to an enlarged thyroid gland, abnormal wool coat at birth, still births and neonatal mortality (also frequently added to salt blocks).

Copper is widely distributed in natural feedstuffs and deficiency is rare as the recommended daily intake is low (8-15 mg/kg DM). However, copper poisoning and toxicity are common. For this reason it is not advisable to feed mineral supplements for other livestock to sheep, as the tolerance for copper is generally higher in other species. Under normal conditions, the copper supplied in feed is adequate for sheep, however, high levels of molybdenum, iron and zinc can interfere with copper uptake.

Selenium is important because of its role, along with vitamin E, in the prevention of nutritional muscular dystrophy (white muscle disease). The minimum requirement of selenium for sheep is 100 parts per billion, and when fed to ewes at this level it will prevent white muscle disease in young lambs.

Vitamins

Vitamins can be broken down into two main groups: fat-soluble and water-soluble. Fat -soluble vitamins include vitamins A, D, E, and K, which can be stored in the liver and body fat during periods of abundant supply and rationed out from these organs when supplies become scant. Water-soluble vitamins, which cannot be stored for future use, include B-complex vitamins and vitamin C. B-complex vitamins are manufactured by rumen bacteria in adequate amounts on a daily basis, provided the animals are supplied with enough energy, protein and minerals to enable the bacteria to do so. Vitamin C is manufactured in the animals' tissue.

Vitamin A is not synthesized by ruminants and, therefore, needs to be supplemented in the diet. It is essential for sight and the maintenance of tissues (the lining of the digestive tract and the reproductive tract), lungs, eyes and skin. Vitamin A is provided through green forages. However, it is lost as stored hay ages. Therefore, vitamin A supplementation may be needed if you are feeding hay older than ~4-5 months.