Agnote

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Nitrogen Nutrition of Cattle in the Southern NT
(Part 1. Nitrogen Requirements, Sources and Use)

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NITROGEN REQUIREMENTS

Nitrogen is one of the major nutrients required by cattle. Under extensive pastoral conditions nitrogen is often a limiting factor to production. Understanding the role of nitrogen in the soil - plant - animal system can aid management decisions for improved production.

WHY NITROGEN IS REQUIRED

Nitrogen is essential for protein formation. In animals, proteins form the major part of muscle, skin and hair. Proteins also form part of enzymes that and hormones that are required for body growth and function and the deposition of non-proteins (e.g. bone).

THE RELATIONSHIP BETWEEN NITROGEN AND PROTEIN

Protein contains nitrogen. Nitrogen is contained in simple compounds called amino acids, which are the building blocks for proteins. Different combinations of these amino acids form all proteins.

Amino acids and therefore proteins contain 16% nitrogen. To calculate the crude protein (CP) content of a feed multiply the nitrogen content by 6.25 (since 6.25 x 16% = 100%).

PROTEIN REQUIREMENTS OF CATTLE

Mature cattle require 6-8% CP in the diet to maintain liveweight. Actively growing and lactating stock require more CP in their diet.

PROTEIN DIGESTION BY CATTLE

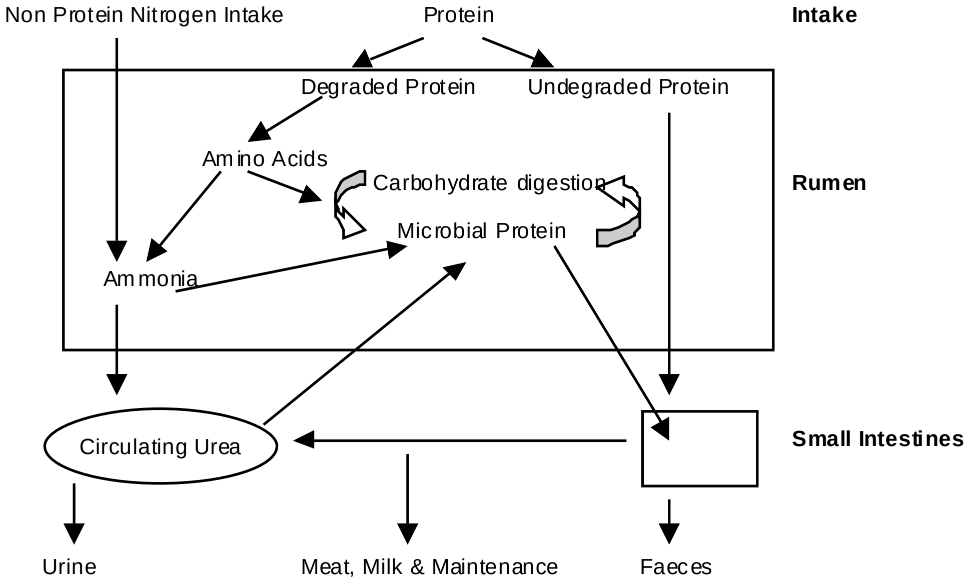

Figure 1. Pathway of the digestion and metabolism of dietary protein in ruminants[1]

On entry to the rumen, microbes break down plant protein. Microbes use protein to grow and reproduce. These microbes are passed from the rumen and digested in the abomasum, (fourth stomach). The majority of protein digested and used by cattle is microbial protein.

Some nitrogen from plant protein is broken down in the rumen and is absorbed across the rumen wall as the gas ammonia. The ammonia is absorbed into the bloodstream, converted to urea in the liver and recycled in saliva. Excess urea is excreted in urine.

Some proteins escape microbial breakdown in the rumen and are passed to the abomasum. These are called bypass proteins. Bypass protein is more efficiently digested than microbial protein because there is less nitrogen loss as ammonia.

Non protein nitrogen (NPN), such as urea, can be used by the microbes as a source of rumen degradable protein. The NPN is hydrolysed forming ammonia that is used by the microbes for growth and reproduction. The ammonia produced from NPN is indistinguishable from the ammonia produced from the degraded protein of plant material.

Proteins can be protected from breakdown in the rumen by plant substances called tannins, resulting in bypass protein. High dietary tannin content however results in some protein escaping digestion altogether, reducing feed value. This is the case for most native 'topfeed' species such as mulga.

SOURCES OF PASTURE NITROGEN

In soils, nitrogen differs from the other essential elements because it does not come from the soils parent material. Sources of pasture nitrogen are shown in the *nitrogen cycle,* (Figure 2).

Grasses, legumes and topfeed species convert nitrogen into plant protein. Grasses depend heavily on soil nitrogen. Legumes are able to fix atmospheric nitrogen in their root nodules. Some topfeed species are leguminous (e.g. acacias), whilst others are not.

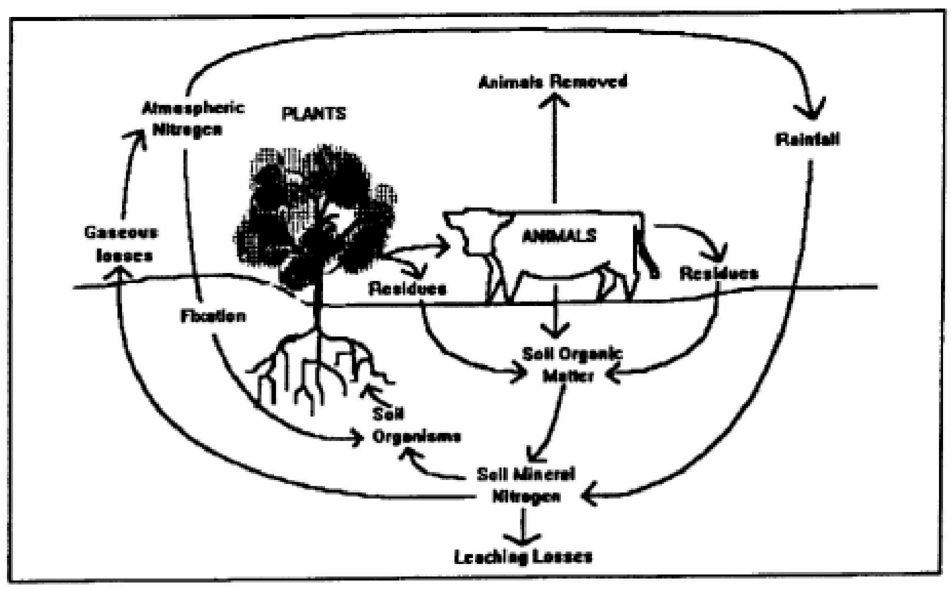

Figure 2. The nitrogen cycle[2]

SEASONAL EFFECTS ON PASTURE PROTEIN CONTENT

Pasture protein content varies with season (Figure 3). Pastures have their highest protein content after rain when they are actively growing. Plants have their highest protein content in actively growing tissue and in their seeds. Nitrogen can be moved throughout the plant, from old to new growth and from leaves and stems to the seeds. Protein content falls when plants set seed because nitrogen from leaves and stems is moved into the seeds.

The protein content of frost sensitive plants falls to or below maintenance levels immediately after being frosted. The protein content of 'topfeed' is more stable than that of most pastures because trees remain green all year round. The protein content of forbs is generally higher than grasse s in Central Australia.

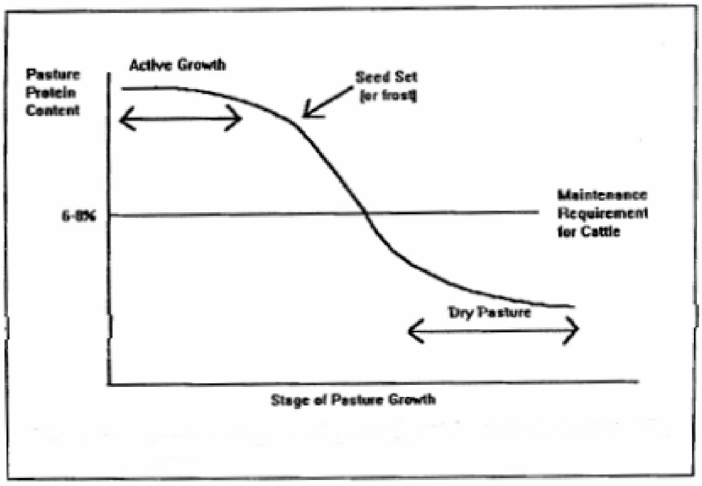

Figure 3. Stylised diagram of pasture protein content changes with season

EFFECTS OF LOW DIETARY PROTEIN LEVELS

Protein levels often fall below maintenance requirements in dry feed. Less protein slows rumen microbial activity because microbes cannot grow and reproduce as quickly as normal. With a smaller microbial population the time taken to breakdown feed increase and the amount of microbial protein flowing to the fourth stomach decreases. Feed intake is reduced because the time that feed spends in the rumen is increased.

Cattle introduced to protein deficient diets will immediately reduce their feed intake consequently live-weight decreases.

MEANS OF MEASURING DIETARY PROTEIN LEVELS

Dietary protein levels can be measured by sampling pasture and cattle faecal. Both methods have their advantages and disadvantages.

Sampling pasture for protein content works best when there are relatively few species on offer. However, cattle are usually still able to select plant parts of higher protein content than samples show. Variance in samples can occur due to the plant's stage of growth and the seasonal conditions. 'Topfeed' protein levels can be misleading because high tannin content can result in much of the protein being unavailable for digestion.

When analysed for nitrogen, faecal samples are useful indicators of dietary protein levels. Faecal nitrogen levels of between 1.2% - 1.4% indicate a diet sufficient in protein for liveweight maintenance. Faecal samples can be misleading when there is mucus in the faeces. This occurs most when cattle are on roughage diets of low digestibility. The passage of faeces through the large intestine is aided by shedding a much greater than normal amount of the mucus lining. The mucus lost contains protein and raises faecal nitrogen levels. Measured faecal nitrogen levels are also misleading when the diet has a high tannin content. Undigested protein bound by tannins passes from the animal and raises faecal nitrogen levels.

A new technique to investigate protein levels in the pasture is faecal Near Infrared Reflectance Spectroscopy (NIRS). The concentration of nitrogen in the faeces can be used to predict the dietary CP. This technique is able to differentiate between supplementary nitrogen and nitrogen sourced from plant material. A disadvantage with faecal NIRS is that it cannot measure the nutrients of a non-grass source. This means feed such as mulga, gidgee, succulents or saltbush cannot be analysed. Samples must be fresh for an accurate analysis and at the time of publication there is only one laboratory in Australia that currently carries out the analysis.

SUMMARY

This Agnote gives a broad overview of the sources and role of nitrogen in the nutrition of cattle in the southern NT. Agnote No. 600, J60 discusses supplementary feeding of nitrogen.

[1] -Adapted from Jeffery M and McIntosh F(2000*). Northern Nutritional Update Workshop; Technical Manual,* DPI Publications, Brisbane QLD

[2] -Adapted from Briggs, D. (1977). "*Soils*," Butterworths; London/Boston.

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