CHAMPION Feed Services Ltd.

Types and Sources of Protein

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Take Home Messages

- ✓ The protein needs of the beef animal can be met from a variety of sources.
- ✓ Virtually all feed grains and forages contain significant amounts of protein.
- ✓ Often protein supplementation may only be required for the younger animal with its lower feed intake relative to its potential for growth.
- ✓ Close examination of the diet on a dry matter basis will reveal the need for protein or perhaps specific amino acid supplementation when it is required.
- ✓ Your nutritionist can help determine the most cost effective way to meet these needs.

Introduction

Proteins are organic complexes made up of amino acids and are differentiated from other compounds of life by the fact that they contain nitrogen. Proteins are distributed throughout the tissue of both plants and animals, playing a diversity of roles, and are essential for life. Typically, proteins contain about 16% nitrogen. Crude protein content of a feedstuff is determined by measuring the nitrogen content and multiplying the result by 6.25.

Types of Protein

In the ruminant animal, protein intake can be divided into three general categories. A small portion of the total is usually indigestible. Of the remainder, some will be broken down in the rumen and is often referred to as soluble, or rumen degradable protein. This fraction is commonly described as degradable intake protein (DIP). The third fraction is digested in the small intestine and is described as bypass, or undegraded intake protein (UIP). It is important that the diet contain a significant amount of rumen degradable protein since this is the fraction of protein used directly by the rumen microorganisms as they grow and multiply.

Rumen degradable protein breaks down in the rumen, producing ammonia which supplies the nitrogen requirements of the rumen microorganisms. These microbes continuously pass from the rumen and are digested in the small intestine, providing the ruminant animal with a significant portion of its total protein needs. Typically the digestive system of the functional ruminant can handle considerably more protein than the rumen microbes are able to produce. Bypass protein in the diet is resistant to degradation in the rumen and passes into the small intestine where it is digested along with the microbial protein. This allows for increased productivity.

The proportion of rumen degradable to bypass protein varies considerably from one feedstuff to another. Protein 'quality' is a description used to identify the suitability of the proportions of these two fractions along with the amino acid content of the bypass portion. Protein quality cannot be described in absolute terms because the needs of the beef animal vary depending upon age as well as stage and intensity of production.

Sources of Protein

Protein sources may be broadly categorized into four groups (**Table 1**). Non-protein nitrogen (NPN) may be used as a source of nitrogen to supply the rumen microorganisms with the protein they need for their growth. Protein from plant materials makes up the largest portion of the typical feedlot diet, and the quality of this protein will vary with the source. The third source of protein utilized by the ruminant is from animal sources. Typically, animal source proteins have high bypass characteristics. Finally, specific amino acid compounds are manufactured synthetically and may be fed in certain situations.

Non-Protein Nitrogen

Perhaps the most common source of NPN in the ruminant diet is urea. When urea enters the rumen it is rapidly converted to ammonia and is then available for the production of microbial protein. There is a limit to the amount of ammonia which can be utilized by the rumen microbes, so care must be taken with its addition to the ration so that an excess is not supplied. If the combined ammonia in the rumen from soluble protein sources and NPN exceeds the needs of the rumen microbes, small excesses can be excreted. However if the surplus of ammonia gets too large, toxicity may occur.

Ammoniated feeds, usually forages, may be another source of NPN. In addition, other ammonium containing compounds are available as potential sources of nitrogen in the ruminant diet. For example, monoammonium phosphate is routinely used in low calcium, high phosphorus mineral supplements.

NPN can be a valuable source of nitrogen in high energy ruminant diets provided the rest of the protein in the ration is not highly rumen degradable. Adding NPN in this circumstance could improve performance since high energy diets generally have a fairly high rate of passage which means that there is less time for natural protein sources to degrade in the rumen.

Plant Protein

Virtually all plant materials will contain some protein. The protein content will vary depending upon the type of plant and stage of maturity. Legumes are typically higher in protein than the grasses. Protein content declines as the plant matures. Often protein is concentrated in the seeds of plants.

Storage and processing of plant materials may change the fractions of protein. An ensiled forage will typically contain more rumen degradable protein than the same crop harvested at the same stage of maturity and preserved as hay. Heat treatment may be used to increase the bypass fraction. However, excessive heating may render protein indigestible.

A variety of materials are used to provide supplemental protein from plant sources. Many of these materials are by-products of the food processing industry. The oilseed crops such as soybeans, canola, sunflowers, safflowers and flax are processed to extract oil for food and occasionally for industrial purposes. The residual meals are excellent sources of supplemental protein.

Other sectors of the food processing industry also produce important by-products. Wheat milling produces wheat shorts, bran and mill run. Alcohol production provides distillers grains and solubles from a variety of feed stocks including corn, rye and wheat. Gluten production for the bakery industry yields small amounts of high protein meals. Wet milling of corn for corn oil production yields several fractions which may be used in beef diets. The process water contains high protein solids. This liquid material may be used directly in liquid beef supplements or it may be dried and sold as a mill by-product.

The production of barley malt produces the by-product, malt sprouts, which can be a valuable source of supplemental protein. The brewing industry generates a wet brewers mash which can be a useful protein source for cattle.

A number of crops may be harvested specifically to provide supplemental protein for beef animals. Dehydrated alfalfa meal may be used in some diets. Similarly, the pulse crops such as peas, beans and lentils may sometimes become a part of a feedlot ration.

Animal Protein

Plant protein sources are by far the most important in feedlot and backgrounding diets. However, under certain circumstances, animal protein sources may be of value. Materials like fish meal and meat meal are important components of monogastric diets but are usually not price competitive with alternate protein sources available for beef cattle rations. Other animal source materials which potentially might be available for beef feeding include blood meal and feather meal. Typically, these materials are too expensive to be used in practical diets.

Synthetic Amino Acids

As the protein requirements, and more specifically, the amino acid requirements, of the beef animal become better defined, the potential for use of synthetic amino acid compounds increases. Materials which supply specific amino acids in a form that escapes degradation in the rumen can be used to more precisely meet requirements. This potentially will allow for more efficient use of total protein input into the diet as well as enhanced productivity.

Summary

The protein needs of the beef animal can be met from a variety of sources. Virtually all feed grains and forages contain significant amounts of protein. Often protein supplementation may only be required for the younger animal with its lower feed intake relative to its potential for growth. Close examination of the diet on a dry matter basis will reveal the need for protein or perhaps specific amino acid supplementation when it is required. Your nutritionist can help determine the most cost effective way to meet these needs.

Table 1. Typical protein content of some common protein supplements for beef cattle (as fed basis).

Ingredient	Dry Matter %	Protein (%) or Equivalent	Undegraded Intake (Bypass) Protein %
Non-Protein Nitrogen Sources:			
Anhydrous Ammonia	99.9	512.5	0.0
Monoammonium Phosphate	97.0	68.8	0.0
Urea	99.9	281.0	0.0
Plant Protein Sources:			
Canola Meal	92.0	37.6	12.1
Corn Gluten Meal	91.0	60.3	35.6
Corn Distillers	91.0	27.7	20.4
Dehydrated Alfalfa Meal	90.0	15.6	7.2
Field Peas	90.0	23.4	5.1
Linseed Meal (flax)	90.0	34.5	12.1
Malt Sprouts	93.0	26.1	9.4
Safflower Meal	92.0	23.4	n/a
Soybean Meal	90.0	46.7	16.4
Sunflower Meal	90.0	23.3	4.7
Wet Brewers Mash	21.0	5.5	3.2
Wheat Mill Run	89.0	16.4	3.7
Wheat Distillers	93.0	31.5	n/a
Animal Protein Sources:			
Blood Meal	90.0	84.4	63.3
Feather Meal	90.0	77.2	54.1
Fish Meal	90.0	61.1	36.7
Meat Meal	95.0	55.3	3.0

Sources: (1, 2, 3, 4, 5)

References

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