Protein, Bypass Protein and the Fate of Nitrogen

C J. Sniffen
Department of Animal Science
Michigan State University
East Lansing, MI 48824

The price of feeds have increased significantly in the last few years. Farmers are continuing to try to find ways to cut feed costs. Several things have happened in ration formulation that are going to allow us to formulate rations less expensively. We are improving our knowledge on balancing for nonstructural carbohydrate, NDF, fat and protein fractions. This will allow us to improve our accuracy in formulating rations to optimize rumen fermentation and reduce the purchase of expensive protein and fat sources. The discussion of the protein system needs to be in terms of the carbohydrates consumed. We can then examine the opportunities to fine tune the protein fractions and save money.

In the development of rations the first consideration is the environment; if it is hot, limited bunk space, limited stall space, uncomfortable stalls, restricted feed access or feeding to an empty bunk. The consideration will be given to limiting the NSC. If the NSC source has the potential of a high rate of fermentation (corn silage finely chopped and wet and HMC wet and finely ground) then we want to limit NSC. If the forage sources are unstable which might lead to erratic eating then consideration again should be given to limiting NSC. Nocek recommends an optimum 41% of the dry matter. Mertens suggests a minimum of 30% of the dry matter. These numbers translate into 1.4% to 1.1% of body weight. When there is an optimum environment we can feed the animals at 1.4% of body weight. When there are constraints from the environment or the fermentability of the starch we have to include bicarb or non starch sources such as added fat or highly digestible fiber. These types of additives can be expensive and increase the UIP requirement. The objective is to feed as much fermentable material to the cow as possible so that the UIP requirement can be reduced. Many times this will reduce the ration cost. However, it is essential to have a top feeding management program.

What about the protein systen in Dairy NRC 89 compared to NRC 85 protein system? The efficiency of utilization of absorbed protein for milk was increased from .65 to .70 in the 1989 NRC. This will effectively decrease the protein content of the ration. For a 1300 lb cow producing 80 lbs of milk, the total protein concentration in the ration will be 15%. This same cow will be a 16% ration for the 1985 efficiency. With the 1989 system, the environment, fermentation in the rumen, and ration DIP and UIP amino acid profile will need to be under good control in order for me to recommend the reduction of the ration protein content below 16%.

The bypass protein requirements for the rapidly growing young calf is too high. The system underestimates microbial growth in the rumen. The microbial yield equation is:

$$\text{Microbial protein yield, g/day} = (26 * \text{TDN(kg/da)} - 32)6.25$$

There is limited data from young calves and at low TDN intake the intercept of -32 has a large impact. It is recommended that the bypass protein content of the calf for the first 4 to 8 weeks post weaning be 38 to 40% of a 16% CP ration.

The rumen part of the model in NRC is not well understood. The above equation was developed by regressing grams of microbial protein at the small intestine on Kg of TDN intake. In order to develop a nutrition program that reflects this relationship it is necessary to have TDN intake. Unfortunately the ingredient TDN has to be corrected for fat that exceeds 3.5%. This can be done with the following equation:

$$\text{Adjusted TDN} = \text{TDN} - (\%\text{EE} - 3.5) * .85 * 2.25$$

The adjusted TDN will be a lower value. For example whole cottonseed (20% EE) has a book TDN value of 96%. The adjusted TDN is 64%. So if a producer substitutes 6 - 7 lbs of WCS in the ration it will decrease the microbial yield because the ration is not as fermentable. This means that the bypass protein will need to be increased. It is also important that there be a separate nutrient constraint for fermentable TDN or carbohydrate.

With alfalfa based diets there is usually excess protein for the amount of fermentable TDN in the ration. The model assumes that only 90% of the protein degraded in the rumen will be used. It is not unusual to be 1.5 lbs of protein in excess of rumen requirement. This translates into an increased energy cost to the cow as well as an increased energy cost for reproductive failure. Our challenge here is to do a better job of controlling protein degradability in forages.

There is an increasing number of farmers feeding bypass protein. We have found an increasing incidence of not supplying enough DIP for the rumen. This is especially true when the forage sources is corn silage and hay. We have found that not only do we have to supplement the ration with more DIP but also we need to increase the soluble protein up to 50% of the DIP in early lactation. We have also found that we cannot supply all of the DIP from the soluble protein of the forage or from urea, we need some from protein sources such as soy or canola meal. We have found that it is important to supply peptides to the rumen. It is important to point out that when the rumen is not getting enough soluble and DIP there will be a reduction in the ration NEL due to poor digestion in the rumen. Some of the symptoms are low DMI, dry manure, excessive particulate matter in the manure and low fat test, to name a few. The current models do not make adjustments in the evaluation phase; we need to make changes in the current programs.

It is interesting to note that we assume that 80% of the dietary protein at the small intestine is digested. In the case of heat damaged distillers or forages, this factor is wrong. We need to use the unavailable protein estimate, ADF protein, to adjust the digestion coefficient at the small intestine.

The excitement in the new protein system is that it has been used very intensively by Chalupa, Galligan and Jim Ferguson in Pennsylvania. They have been doing field studies where they have used the model and have increased productivity and improved reproductive efficiency. I have been using the model along with protein solubility measurements and have significantly improved productivity on many farms. The second part of this is that we have decreased the protein concentrations in the ration down to 16 to 17% crude protein from 18 to 19% and have increased milk significantly, as well as minimize body weight loss.

We may have an opportunity to decrease the protein content of the ration even more if we can better quantitate the factors optimizing microbial growth and the amino acid requirement of the dairy animal. This means dollars. A study was just finished at Cornell where the ration was balanced for protein degradability and amino acids. The ration crude protein was 16% and the cows responded with peaking over 140 lbs/day with little loss in condition.

Summary

We need to implement the new system as quickly as possible so that we can begin to "speak the same language" and refine the system as we gain experience. It needs to be emphasized that the full set of equations need to be incorporated into the new ration programs. Calculating percentages of total protein for the fractions is not adequate. We will lose the dynamics of the protein system.

References

National Research Council. 1985. Ruminant Nitrogen Usage. Natl. Acad. Sci. Natl. Acad. Press. Washington, D.C. National Research Council 1989. Nutrient Requirements of Dairy Cattle. Natl. Acad. Sci. Natl. Acad. Press. Washington, D.C.

CVM Update: Milk Testing

The following HHS News Release P90-63, dated December 27, 1990, was issued by the Food and Drug Administration:

The Food and Drug Administration has informed dairy states that in early 1991 it will launch a nationwide program to test raw milk for veterinary drug residues.

FDA said the new program, called the National Drug Residue Milk Monitoring Program, will meet a need for a flexible test system that can look for various residues as needed and as new testing technologies are developed. The program also will supplement the customary, routine tests of raw and processed milk carried out by the states through the National Conference on Interstate Milk Shipments for penicillin and penicillin-related drug products.

Although FDA has monitored NCIMS testing and has conducted its own month-long surveys, this will be the first time the agency has been directly involved in the routine testing of milk for residues. In this new effort, the agency plans to use the latest analytical methods to study a continuous stream of milk samples. The plan has been developed by three parts of FDA – its Center for Veterinary Medicine, its Center for Food Safety and Applied Nutrition and its Office of Regulatory Affairs with state milk control officials representing the National Conference on Interstate Milk Shipments.

Information collected under the plan will be used in federal, state and local dairy farmer and industry education and compliance efforts.

Under the plan, 250 locations in the nation's dairy states will be chosen on a random basis for monitoring raw (unpasteurized) milk for specific types and amounts of drug residues.

Initially, milk will be tested for the presence of eight sulfa drugs using a high pressure liquid chromatography methodology and for three tetracycline drugs using microbiological and liquid chromatography methods. FDA said these drugs are of most concern because they have been widely misused. As newer analytical methods become available, milk will be monitored for additional drugs. The system will add another layer of protection for consumers.

Throughout the year, one raw milk sample will be collected every week at each of five of the 250 locations. Collections will be made from farm bulk tank trucks making deliveries to the locations – processing plants or stations where milk is either received or transferred. Refrigerated samples will be shipped immediately to an FDA laboratory for testing. Collections generally will be carried out by a state milk regulatory official. The collections will be coordinatd by an FDA regional milk specialist. The specialist will provide all collection, packaging and shipping materials and may assist with or carry out collection activities if necessary.

When violative residues are found, the agency will relay the information to state milk officials immediately and help states trace the source of the problem.

Through a memorandum of understanding with the National Conference on Interstate Milk Shipments, the agency has long monitored the sampling and testing of milk by state milk control agencies, and will continue to do so. Under this program, 50 states and the District of Columbia test samples of milk from every U.S. dairy farm a minimum of four times every six months.