West Central News

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Determining Rumen Undegradable Protein Percent

Some of the protein we feed to the cow will escape degradation to single amino acids and ammonia by the rumen bacteria. This amount varies with the form and shape of the protein, which we can manipulate. It also varies with the rate of passage of material from the rumen. Cows with very high intakes pass material out of the rumen faster, so exposure to bacterial enzymes that breakdown the protein is reduced. For solvent extracted soybean meal, only about one-third of the protein will make it to the intestine intact. If we heat the soy proteins, we can cause a chemical reaction to occur between aldehyde groups on the sugars of the bean meal and free amino groups on the soy proteins. This renders the protein nearly indestructible to microbial enzymes.

The bond between amino acid and the reducing sugar can be fully reversed when exposed to the acid conditions of the rumen – if the heat treatment was not severe. With increased heating of the proteins the reaction continues and the bond between the sugars and the amino acids becomes stronger. The products of these reactions are not totally recoverable upon acid hydrolysis in the abomasum – this protein gets past the anus as well as the rumen. Soy proteins are highly valued in animal nutrition because they are rich in the amino acid lysine. Unfortunately, the exposed amino group of lysine is highly reactive, making this amino acid among the most likely to form bonds with the reducing sugars. This means that heating the protein to increase bypass is most likely to affect digestible lysine content when done incorrectly.

The rumen undegradable fraction of protein can be determined in cows fitted with rumen and duodenal cannulas. It is laborious, complex, expensive, and suffers from great variability. It also varies with the particular ration fed to the test cow – because passage rate and the types of bacteria in the rumen fluid are unique to that diet. In situ and in vitro techniques have been developed. These techniques all utilize an assumed rate of passage for the protein out of the rumen. For in situ methods the size of the bag and the size of the pores of the bag used to hold the protein sample in the rumen, particle size of feed sample, placement in the rumen, and washing procedures used can all impact the bypass number obtained. In vitro conditions involve incubating the protein sample in a test tube with rumen fluid or enzymes isolated from bacteria. The diet of the donor cow, buffers used in the test, particle size of the protein sample, and the amount of time the protein is exposed to the enzymes will affect these tests. Tests have also been developed based on protein solubility. Results depend on the choice of solvent, incubation time and the particle size of the protein sample. Near infrared reflectance spectroscopy (NIRS) has also been used recently – but calibration and validation of the accuracy of the technique remains controversial.

One frustration to me as director of research and development at West Central has been the desire of some nutritionists to have me nail down the RUP percent for SoyPLUS®, so they can compare it to the RUP of other soy protein sources. My answer is that it depends. It depends on the test you wish to use and the rate of passage of the diet fed to the cow. Values for SoyPLUS protein for one in vitro test suggests RUP is 50-54%. Some in situ test results suggest SoyPLUS protein is 68-70% bypass. I suppose if we were smarter marketers, we would use the higher numbers in our advertisements. However, given West Central's heritage of producing research based products, they have chosen to utilize an average of many determinations as the value for RUP in their literature. I am proud of the fact that SoyPLUS bypass and digestibility values in the NRC and CPM models are based on peer reviewed published research. I hope you are too.