Protein Requirements in Beef Cattle Rations

By

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Feed is a major cost in a beef operation, and protein is a good portion of that feed cost. To reduce cost, it is important to have some knowledge of the feed ingredients and how they are utilized by the digestive system of beef cattle or ruminants. Feed cost can be reduced by formulating and feeding rations that meet the nutrient requirements of beef animals at the various stages of growth and production. The aim of this article is to provide some basic information on degraded and undegraded intake protein and their implications in formulating feeds for cattle.

The stomach of a typical cow consists of four compartments namely the rumen, reticulum, omasum and abomasum. They are closely linked together and function as a single unit as can be seen in the photo below. The abomasum or true stomach leads into the small intestine. In general, feeds consist of carbohydrate, fats, protein, water, vitamins and minerals. Amino acids are the building blocks of protein. The major end products of digestion in the rumen are ammonia derived from amino acids and fatty acids derived from the fermentation of carbohydrate. Fatty acids are absorbed by the body to produce about 50-70 percent of the daily energy requirement for the animal. In addition, they are constituents of milk fat.

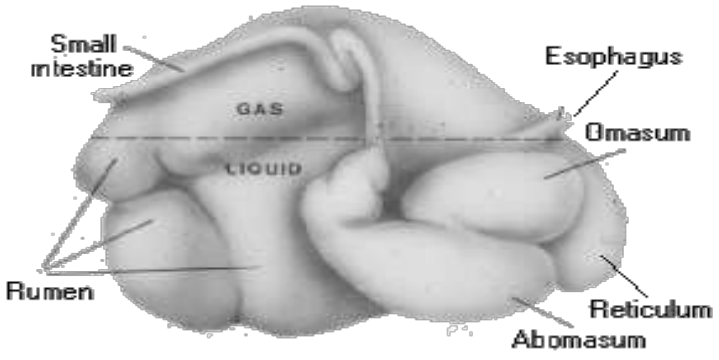

Photo of the ruminant stomachs, as seen from the right side

Picture displayed with permission from Dr. Richard Bowen, Colorado State University

Degraded Intake protein

The rumen is the largest compartment which contains billions of bacteria, protozoa, molds and yeasts collectively referred to as microbes. When feed enters the rumen through the esophagus, the soluble protein portion is easily digested by microbes to ammonia. This soluble portion is called degraded intake protein (DIP). In addition, feedstuffs such as silage and urea contain non protein nitrogen (NPN) which is converted to ammonia in the rumen. Microbes use the ammonia to form their own protein in the presence of energy. As rumen digestion progresses the microbes flow into the small intestine where they are digested and absorbed. There is a natural limit to the amount of microbes produced in the rumen and consequently, this restricts the amount of microbial protein entering the small intestine. There is also a limit to the amount of ammonia they can use. Overfeeding degradable protein sources such as grains results in excess ammonia production in the rumen. This excess ammonia is absorbed by the rumen wall or is lost through urine. This may represent a loss of money.

Undegraded Intake Protein

When feed enters the rumen, there is a portion of the protein that is not easily digested in the rumen. It will escape fermentation or degradation in the rumen and reach the small intestine with its amino acids intact. This is called undegraded intake protein (UIP) or bypass protein. It is then digested in the small intestine and the amino acids are absorbed via the gut wall into the blood stream. Sources of bypass or undegraded protein are distiller's grains, brewers grains, and corn gluten meal to mention a few. These feed ingredients are less degradable in the rumen because of the process of heating and particle size change. Furthermore, the exposure of feed to microbial digestion such as in the production of ethanol can increase the level of bypass protein in the byproduct like distiller's grains. These processes render the feed ingredients more resistant to digestion by microbes in the rumen.

Implications for Formulating Feeds

It can be seen from the discussion above, two categories of protein reach the small intestine of the animal. One is microbial protein and the other is bypass protein. It is important to understand this because during certain stages of production, cattle need more protein than what is supplied by microbial protein synthesis. If we want to increase the amount of protein reaching the small intestine for growth and production, we need to supply a source of high by pass protein. A balance of rumen soluble protein (DIP) and bypass protein (UIP) is needed for optimum performance in beef cattle. Rations with high levels of bypass protein may not provide enough nitrogen to rumen microbes for optimal microbial growth and feed digestion. Rations with high levels of soluble protein and /or NPN may not supply enough protein to the small intestine. Animal Nutritionists usually balance rations to contain about 30-40% available bypass protein and 60-70 % rumen soluble protein. The use of bypass protein in a feeding program should be based on the farm resources and cost advantage.