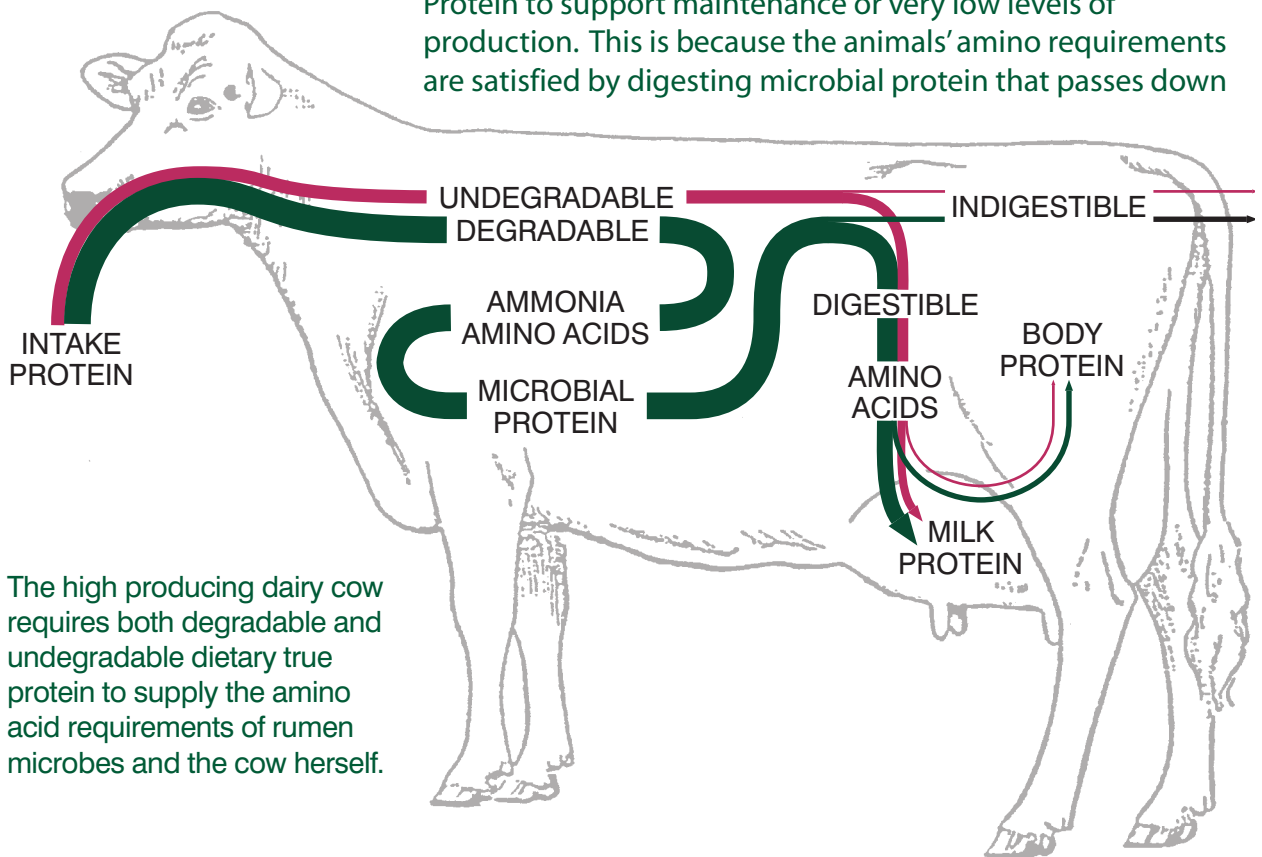


# The Role of Protein in Dairy Cattle Nutrition

Dairy cattle manufacture a huge array of different proteins, ranging from milk *casein* to *actin* in muscle, *hemoglobin* which carries oxygen in blood and *pepsin* which digests dietary protein in the small intestine. To synthesize these proteins, the animal requires amino acids, the basic subunits of all proteins. Of the 20 common amino acids, 10 are essential—they must be available from the digestive tract because animals cannot make them.

Ruminant animals do not require dietary amino acids or True Protein to support maintenance or very low levels of production. This is because the animals' amino requirements are satisfied by digesting microbial protein that passes down

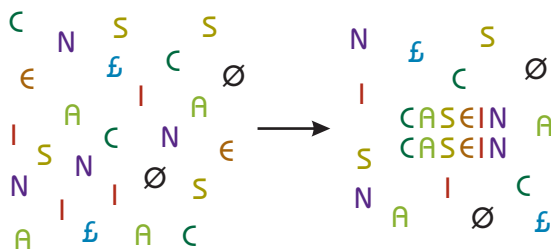


The high producing dairy cow requires both degradable and undegradable dietary true protein to supply the amino acid requirements of rumen microbes and the cow herself.

the digestive tract from the rumen. Rumen bacteria are able to manufacture *microbial protein* from dietary Non-protein Nitrogen sources that yield ammonia after entering the rumen. For example, urea is broken down to ammonia by bacteria that produce the enzyme urease.

continued...

## The Role of Protein in Dairy Cattle Nutrition (continued)



In this illustration, letters of the alphabet represent amino acids. Synthesis of milk protein requires equal proportions of the 6 letters that spell the word CASEIN. Here, the letter E is limiting so only two words can be synthesized. The other letters are surplus and cannot be used.  
(source: Hélène Lapierre)

To support anything beyond very low production, a few of the essential amino acids are required in the diet to support the efficient processing of forages by rumen microbes. At the very high levels of production expected of today's lactating dairy cow, high quality protein which is resistant to microbial degradation must also be fed. Such *Rumen Undegradable Protein* must be digestible in the small intestine and must

supply a mixture of amino acids which complements the amino acids provided by microbial protein.

The blend of amino acids available to the cow is a combination of those released by intestinal digestion of both microbial and undegraded feed proteins. The total amount of protein available to the animal for metabolism is referred to as *Metabolizable Protein*. When the blend of amino acids available in Metabolizable Protein is not exactly what the cow requires, excess amino acids are broken down in the liver, much of the nitrogen (N) being released as urea and excreted. This process is illustrated in the diagram on the left.

*Net Protein* is that fraction of metabolizable protein which contributes to lean tissue growth and milk production. Another major fraction is required for tissue turnover, a process by which tissues are continually replaced by new tissue.