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Importance of Bypass or Protected Protein in Dairy Cattle

Shamim Ali
Assistant Professor, KCVAS-Guru Angad Dev Veterinary & Animal Science University, Amritsar, Punjab

SUMMARY

The rumen degradable protein is used to synthesize microbial protein which is a valuable metabolizable protein source for animals. The metabolizable protein consists of bypass protein and microbial protein. Although the microbial protein alone is likely sufficient to meet the needs of cattle at or near maintenance young growing cattle and lactating cows need bypass protein in addition to microbial protein to meet their metabolizable protein. The extensive degradation of valuable protein in the rumen by the microorganisms results in some losses of nitrogen as urea in urine. The feeding of protected protein is to avoid the degradation of high quality of proteins results in reducing the wasteful ammonia production in the rumen. There are different procedures such as heat treatment, chemical treatment/modification, and inhibition of proteolytic activity which are commonly used to make protected protein. Utilization of nutrients post ruminally eliminates the energy losses associated with the fermentation and protein losses incurred in the transformation of dietary protein to microbial protein. The protection of rapidly degradable proteins by either heat or formaldehyde makes more protein or amino acids available for the host.

INTRODUCTION

In high producing dairy cattle particularly during early lactation the amount of energy and protein required for maintenance of body tissues and milk production often exceeds the amount of energy available from diet results in a negative energy balance. Hence supplementation of protected protein in the diets of lactating animals increases the milk yield due to proportionate increase in the supply of amino acids to the host post-ruminally. The ruminants derived their amino acids supply jointly from dietary protein which escapes rumen degradation and microbial protein synthesized in the rumen. The amount of protein and amino acids that escapes rumen degradation vary greatly among different feeds depending on their solubility and the rate of passage to the small intestine. The proteins are hydrolyzed into peptides and amino acids by rumen micro-organisms. However most of the amino acids rapidly degraded to organic acids, ammonia and carbon dioxide. The ammonia produced is the primary nitrogenous nutrient for bacterial growth. Some species of ruminal bacteria use peptides directly for synthesis of microbial protein. Ruminal degradation of proteins can be reduced by decreasing retention times in the rumen. The factors known to influence this include level of food intake, specific gravity, particle size of diet, concentrate to roughage ratio and rate of rumen digestion. As the same with other nutrients the amount of protein which reached the small intestine depends upon food intake. The breakdown of proteins by microorganisms as mentioned earlier, gives rise also to intermediate products such as free amino acids in the rumen. The low concentration of free amino acids in the rumen usually suggest rapid utilization, but increased concentration after feeding imply that proteolysis occurs faster than does subsequent utilization of free amino acids (Chalupa, 1975). The free amino acids in the rumen can be assimilated directly by microbes and be absorbed through the rumen but most are deaminated to yield ammonia and other intermediate products (Hoover and Miller, 1991). For free amino acids to bypass the rumen in significant amounts, supplements greatly in excess of animal requirements would have to be fed. However, this means there is no case for commercial application of free amino acids supplements for ruminant diets. The microbial protein alone is likely sufficient to meet the needs of cattle at or near maintenance. Young growing cattle and lactating cows need bypass protein in addition to microbial protein to meet their metabolizable protein. The reason behind the attempts to protect dietary protein as mentioned earlier is to avoid the degradation of high quality proteins and to further reduce wasteful ammonia production in the rumen. There are several procedures such as heat treatment, chemical treatment/modification, and inhibition of proteolytic activity and identification of naturally protected protein (Ferguson, 1975) can be used to protect protein. The use of these techniques in comparison to the usual sources of dietary proteins improves the supply of amino acids without an increase in ammonia production, resulting in a better performance by the animal (Koufman and Lupping, 1982). Post ruminal utilization of nutrients eliminates energy losses associated with fermentation and protein losses incurred in the transformation of dietary protein to microbial protein. Protection from ruminal degradation enables more amino acids to reach the intestine and therefore provide more absorbable amino acids per unit of absorbable energy. Heat treatment and use of chemical treatment such as formaldehyde have been shown to increase the percentage as well as the total of both dietary protein and amino acids escaping degradation in the rumen. Different studies showed that diet containing higher amounts of ruminally undegradable proteins or ruminally protected amino acids resulted in increased milk production while other studies show little or no response.

Heat treatment

The heat treatment has been used to increase the undegradable protein of common feedstuffs such as soybeans and grains The high temperature and extended heating time may increases the acid detergent insoluble nitrogen content by the Maillard reaction between sugars and amino acids The resulting peptide linkages from heating are more resistant to enzymatic hydrolysis. Moderate heat may increase the protein flow to the small intestine, excessive heat may decrease the quantity of some amino acids and lower the digestibility of protein in the small intestine (McNiven *et al*. 2002)

Formaldehyde treatment

The treatment of proteins with formaldehyde is most widely used process at the present time and it has been exploited commercially. Treatment of high quality proteins results in the formation of cross-links with amino group and makes the protein less susceptible to microbial attack (Czerkawski, 1986).The treatments of protein rich feedstuffs with formaldehyde has been shown to increase the protein digested in the intestine and nitrogen retention. The concentration of amino acids in the plasma is generally increased depending on tissue demands and the balance of amino acids supplied (Ferguson, 1975). The protection of rapidly degradable proteins by either heat or formaldehyde might make more protein or amino acids available for the host animal.

Protected amino acids

The use of protected amino acids, in contrast to protected proteins does not reduce the excess of ammonia in the rumen and thus the load on the liver. When protected amino acids are used, response can mainly be expected in the main production parameters such as milk yield and milk content, growth rate etc, and less liver stress due to excessive level ammonia (Chalupa, 1975, Ferguson, 1975). The primary methods developed to prevent fermentative digestion of amino acids are structural manipulation to produce amino acid analogs and coating with resistant materials Various analogs of amino acids have been tested for resistance to ruminal degradation.

Coating of protein source particles with insoluble substances

The coating of protein sources with insoluble substances like blood meal (Orskov, 1992) or fats (Sklan and Tinsky, 1993) have been used.The coating of soybean meal with lipid substances (Fish oil, beef tallow) is a protective method against microbial degradation in the rumen. The coating of protein with lipid substances decreased the ruminal degradability. The effect of protection increased with increasing amount of coating agent (Manterola *et al*. 2001).

CONCLUSSION

The dietary protein in ruminants can be protected to avoid the degradation of high quality proteins and to reduce wasteful ammonia production in the rumen. The protection of proteins from ruminal degradation enables more amino acids to reach the intestine and therefore provide more absorbable amino acids per unit of absorbable energy that can be achieved by following different procedures such as heat treatment, chemical treatment/modification, and inhibition of proteolytic activity and identification of naturally protected protein.

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