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Director's Digest

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UTILIZATION OF ANIMAL BYPRODUCT PROTEIN BY THE LACTATING DAIRY COW

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INTRODUCTION

Absorbed amino acids (AA) from the small intestine of dairy cows are supplied by microbial protein synthesized in the rumen, undegraded (bypass and escape are used synonymously) dietary protein and endogenous protein (Figure 1). Microbial protein usually accounts for the largest proportion of the total amino acid-nitrogen entering the small intestine. Microbial protein synthesis in the rumen is mainly dependent on the nitrogen and energy supply to the rumen microbes, which is determined by quantity and ruminal fermentability of protein and carbohydrates. If the energy supplied by the diet is not sufficient, there may be a corresponding decrease in microbial protein synthesis due to less ammonia uptake by the microbes. Therefore, deficiency of energy may lead to a reduced intestinal protein supply and at the same time may precipitate excessive ammonia levels in the rumen, especially when feeding highly degradable proteins.

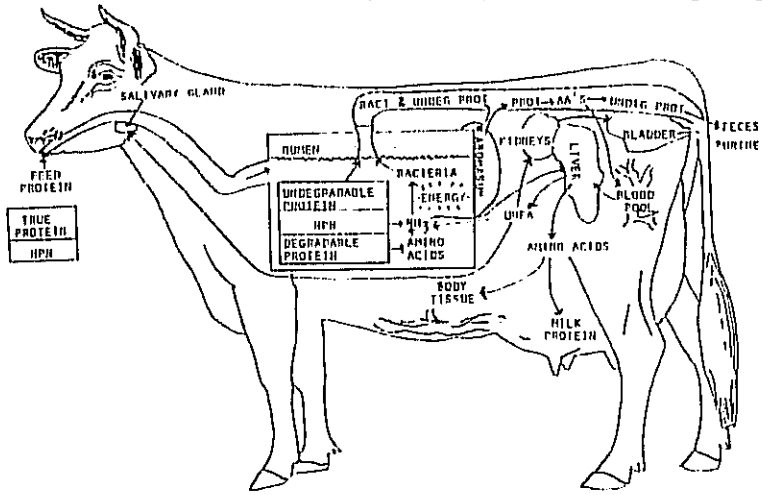

Figure 1. Schematic summary of protein metabolism in the lactating dairy cow.

Use of high ruminal bypass proteins such as animal proteins in diets fed to lactating cows with high protein requirements may improve the amino acid supply to the animal and concurrently decrease the surplus of ammonia, thereby reducing stress on liver metabolism.

Even when nutrients are non-limiting in the rumen, the rumen system may not supply sufficient microbial protein to meet the animals need for maximum production. Under conditions of high production (fast growth, late pregnancy, or early lactation), the animal depends on an additional exogenous supply to the duodenum, e.g. feeding proteins that because of their physical state escape ruminal fermentation. The fact that protein passes through the rumen undegraded and reaches the small intestine for digestion does not necessarily mean that it is digested efficiently nor, once digested, that the amino acid profile is such that it provides a better balance of amino acids for milk production. Feeding animal byproduct proteins which are resistant to microbial degradation in the rumen will only be successful in affecting animal performance if 1) proteins are not denatured to the extent that intestinal absorption of amino acids is diminished so that the net effect on amino acid supply is reduced and 2) the animal has the metabolic capacity to respond to an increase of amino acid supply; that is, requirements for amino acids have not been met.

Animal Byproduct Proteins

Animal proteins or byproducts of animal processing such as fish meal, meat and bone meal, blood meal and feather meal have been shown to be high ruminal bypass proteins. Erfle et al. (1983) pointed out that although fish meal is generally resistant to microbial degradation in the rumen, there are considerable differences in degradability of various fish meals due to processing. Moderate heat, as used in the processing of fishmeal, can result in a decrease in the rate of ruminal proteolysis of fish protein (Chen et al.,

1987). Fish meal has shown a positive response in milk yield when compared to soybean meal or other usual protein supplements. Oldham et al. (1981) observed an advantage of fish meal compared to urea, soybean meal and formaldehyde treated soybean meal for milk production.

Klopfenstein and Goedeken (1986) indicated that protein degradability of blood meal, meat meal and feather meal was 17.6, 36.1 and 30.9%, respectively. Bas et al. (1989) showed that high ruminal bypass proteins such as lignosulfonate treated soybean meal, blood meal and feather meal can potentially improve amino acid supply (Figure 2) to ruminants.

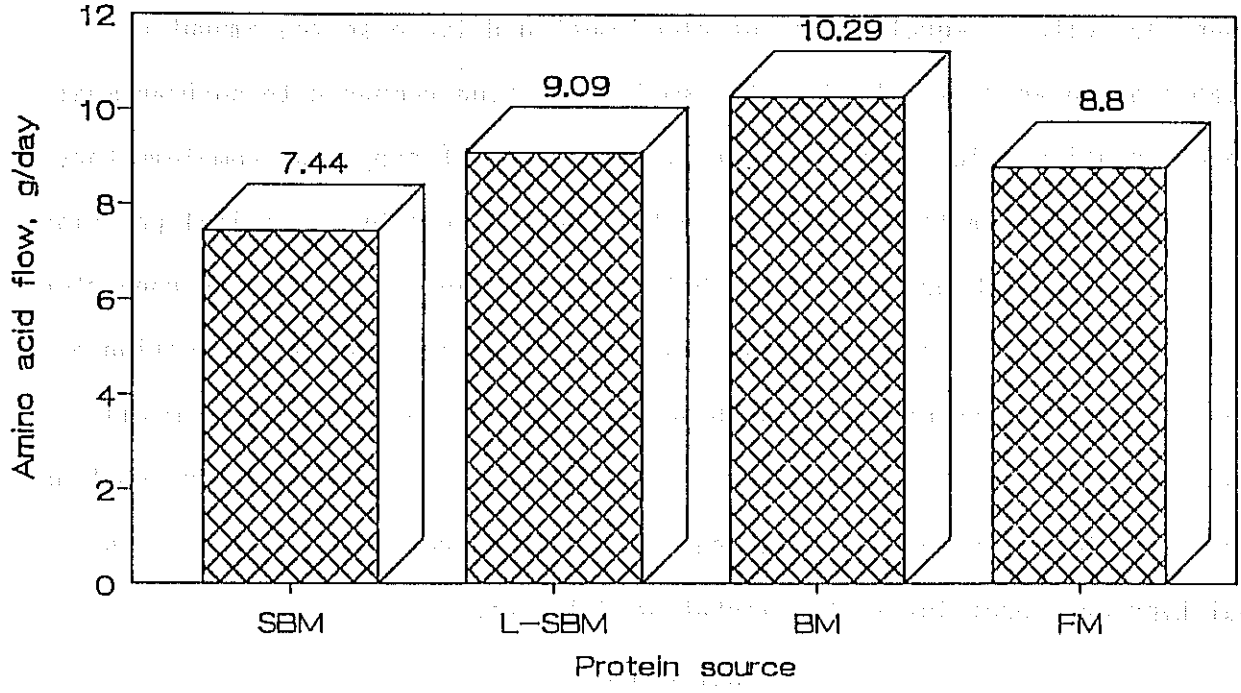

Figure 2. Total amino acid flow from fermenters provided with soybean meal (SBM), lignosulfonate-treated soybean meal (L-SBM), blood meal (BM) and feather meal (FM) as the major dietary N source for ruminal bacterial metabolism.

Animal byproducts could serve as sources of high ruminal bypass protein but data on their effects are limited. Varying amino acid composition and palatability are potential difficulties. Craig and Broderick (1983) reported no advantage of meat meal over urea or soybean meal in diets of 15% crude protein for cows

producing in excess of 30 kg/d. Klopfenstein and Goedeken (1986) found that performance of steers in a growth experiment indicated that calves consuming blood meal, feather meal and a combination of the two animal proteins gained faster than steers fed urea. The improved protein efficiency for blood meal and feather meal compared to either fed alone may be due to sulfur amino acids supplied by the feather meal and/or other amino acids supplied by blood meal. Waltz et al. (1989) found that feather meal or blood meal alone did not increase the supply of available amino acids to the small intestine of lactating cows over that supplied by untreated soybean meal. However, the combination of feather meal with an equal amount of blood meal did increase the amount of available amino acids supplied to the small intestine compared to soybean meal. These observations signify the potential importance of supplying complementary amino acids to the small intestine from the high ruminal bypass animal proteins. Currently, a research project at the University of Minnesota is being conducted to determine milk production response in early lactation when a combination of animal byproduct proteins (meat and bone meal, blood meal and feather meal) is fed as a protein supplement compared to soybean meal. This type of information is necessary before recommendations can be made with confidence for feeding animal byproduct proteins to the lactating dairy cow.

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