

**THE INFLUENCE OF VARIOUS LEVELS OF  
SUPPLEMENTAL STARCH AND DEGRADABLE  
INTAKE PROTEIN ON PRAIRIE HAY INTAKE  
AND DIGESTION BY BEEF STEERS**

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**Summary**

A study was conducted to determine the effect of varying the amount of supplemental degradable intake protein (DIP) and starch on prairie hay intake and digestibility. In general, DIP increased forage intake, whereas starch decreased intake. Diet digestibility also improved with increasing DIP; however, the effect of starch on digestion depended on the level of feeding. Digestible dry matter intake (which estimates total energy input) responded dramatically to DIP but not to starch. These results illustrate the positive effect of DIP on forage intake and digestibility; however, supplying additional starch within a DIP level appeared to have minimal effect on altering total energy supply.

(Key Words: Steer, Intake, Protein and Starch Supplementation.)

**Introduction**

Supplements with high crude protein concentration increase the forage intake and digestibility of forages containing less than 7% crude protein. However, because protein is expensive, it is important to quantify how much is needed to achieve a given level of response. Recent studies at KSU have determined the amount of degradable intake protein (DIP; i.e., ruminally available protein) required to maximize the use of low-quality, tallgrass-prairie forage. However, it is unclear how the addition of energy in the form of starch will affect the response to DIP supplementation. This study was designed to evaluate the interaction between supplemental starch and DIP with regard

to their effect on prairie-hay intake and digestibility.

**Experimental Procedures**

Thirteen Angus Hereford steers (average initial body weight = 570 lb.) were used in a four-period, 13-treatment, incomplete, Latin square. The treatments were arranged in a 3 x 4 factorial arrangement with a negative control. Within the supplementation treatments, there were three levels of supplemental starch (corn starch grits; 0, .15, and .30% BW) and four levels of supplemental DIP (casein; .031, .062, .092, and .123% BW). Supplements were placed in the rumen of each steer prior to feeding prairie hay (5% CP) at 115 % of the previous 5-day average intake. Each period consisted of a 14-day adaptation followed by a 9-day sampling period. Digestibility was determined via total fecal collection.

**Results and Discussion**

Forage intake generally responded positively to increasing DIP supplementation (Figure 1). In contrast, addition of supplemental starch within a DIP level typically resulted in reduced forage intake. Previous KSU research determined that forage intake would be maximized when approximately 11% of the digestible material in the total diet was present as DIP. In our study, this level was approximated at the highest level of DIP supplementation. Thus, we would predict maximum forage intake for the group receiving the highest level of DIP and no supplemental starch.

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As noted for forage intake, the effect of increasing DIP on diet digestion was generally positive (Figure 2). However, response to increasing starch was somewhat variable. This probably was due to conflicting effects of starch on fiber digestion versus total diet digestion. The starch added to the rumen was more highly digestible than the forage material. If the addition of starch within a DIP level had no effect on forage digestion, we would expect the total diet digestion to increase slightly. This occurred in some instances, particularly at the intermediate levels of DIP supplementation. In contrast, if the starch addition depressed forage digestion sufficiently, the total diet digestion should decrease, compared to forage alone. This appeared to be the case for the high level of starch addition when DIP supplementation was low.

tion and roughly represents the total energy supply (Figure 3). Because of the positive effects of DIP supplementation on forage intake and digestion, the total DDMI generally increased with increasing DIP supplementation. However, because of the variable and, at times, conflicting effects of starch on intake and digestion, total DDMI remained relatively constant with increasing starch addition. As a result, little improvement in total energy supply would be expected with starch addition within a DIP level. These results suggest that ruminally available protein is more limiting to the utilization of low-quality forage than is ruminally available energy. Therefore, supplementation programs for livestock consuming low-quality forage should give first consideration to providing adequate DIP.

Total digestible dry matter intake (DDMI) is the product of intake and diges-

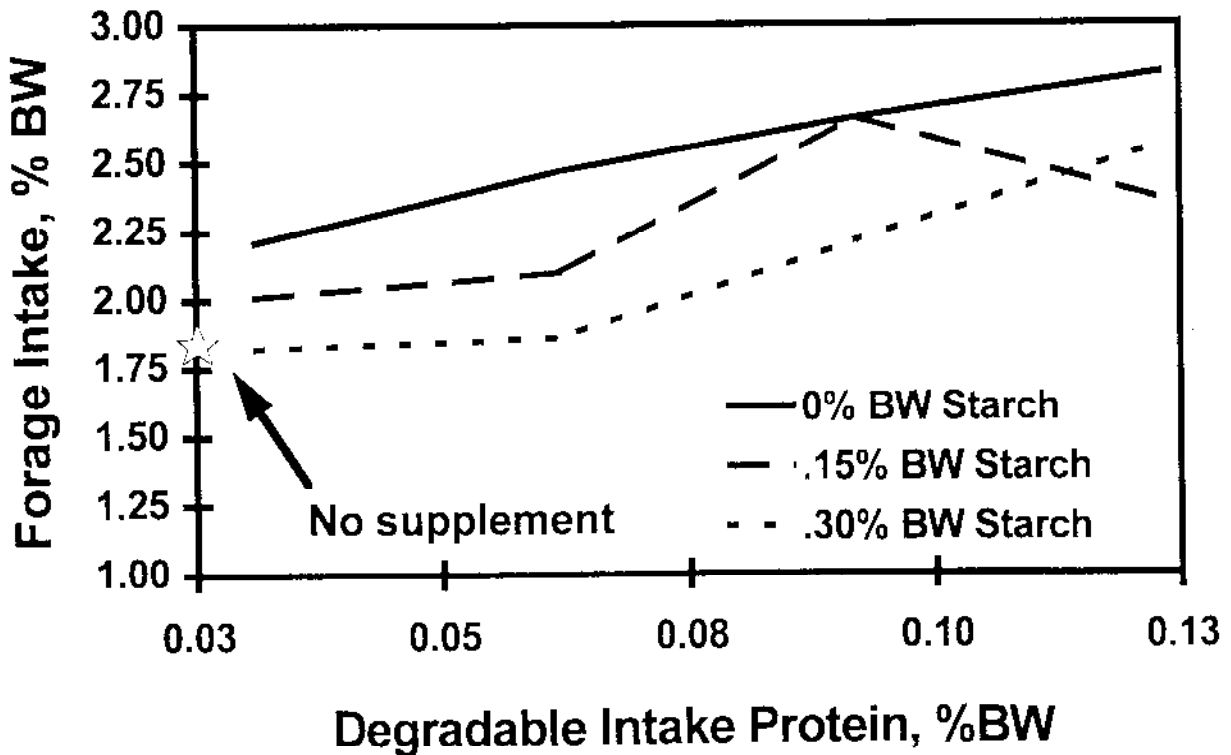


Figure 1. Effects of Level of Supplemental Starch and Degradable Intake Protein on Forage Intake

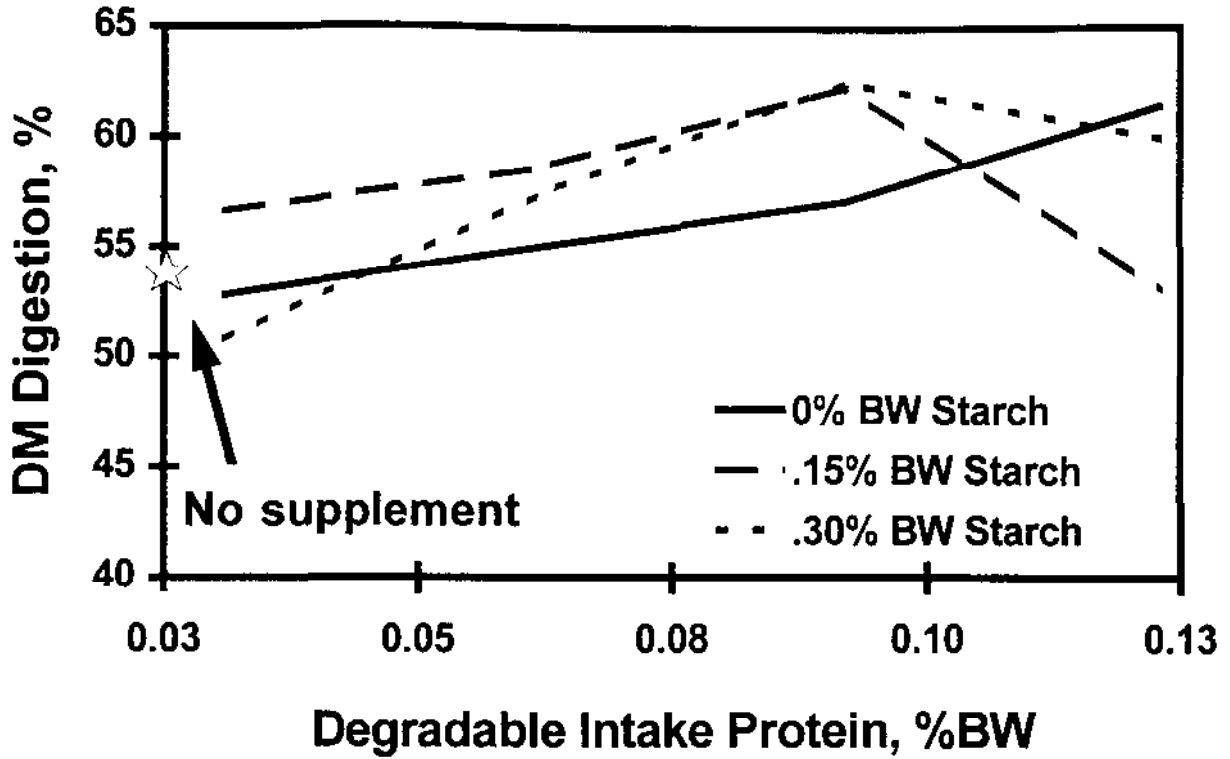


Figure 2. Effects of Level of Supplemental and Degradable Intake Protein on Dry Matter Digestion

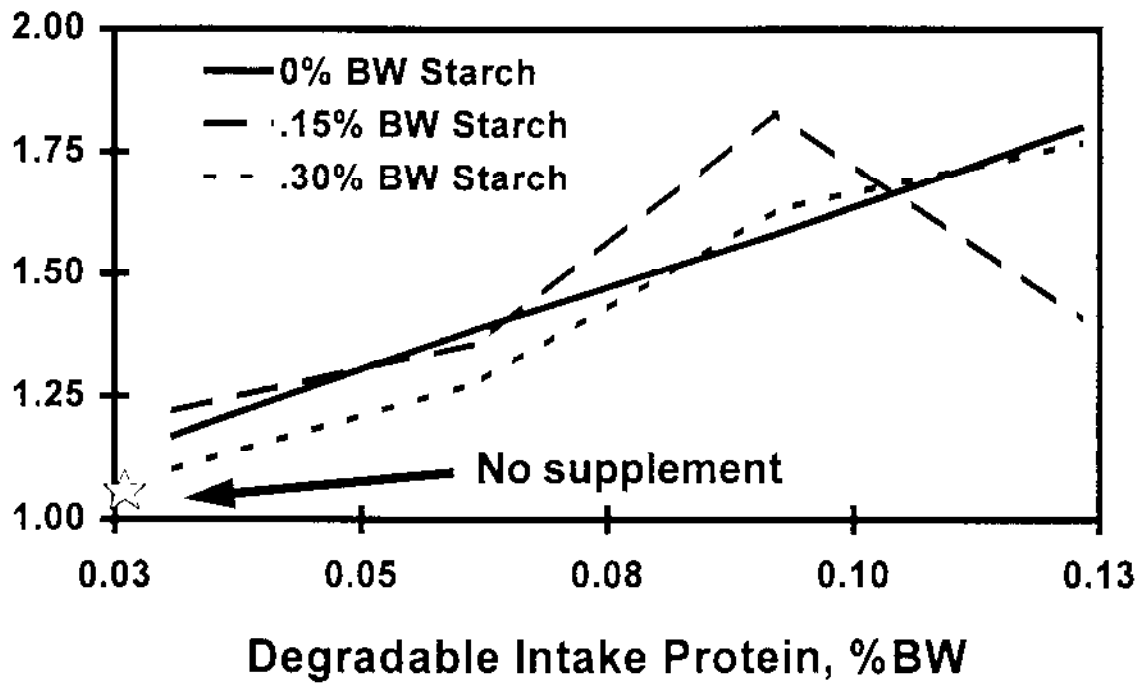


Figure 3. Effects of Level of Supplemental Starch and Degradable Intake Protein on Total Digestible Dry Matter Intake