# INFLUENCE OF SOURCE AND AMOUNT OF DIETARY PROTEIN ON THE PERFORMANCE AND REPRODUCTIVE FUNCTION OF FIRST-CALF HEIFERS[1]

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## Summary

Increasing the amount of dietary protein above the NRC requirement increased weight gain of nursing first-calf heifers. Feeding a protein source with higher ruminal escape potential and increasing protein in the diet both improved calf gains. No significant changes in reproductive function or milk production were observed from either source or amount of dietary protein.

(Key Words: Beef Cows, Protein, Escape Protein, Reproduction, Milk.)

## Introduction

Prolonged postpartum anestrus, particularly in first-calf heifers, is a major obstacle to optimum reproductive efficiency in beef herds. Research at other universities has shown positive effects on return to estrus by increasing dietary protein from a source with high ruminal escape (bypass) potential. Our objectives were to determine the effects of source and amount of dietary protein on the performance and reproductive function of suckled first-calf beef heifers.

## Experimental Procedures

Forty Angus × Hereford 2 year-old first-calf heifers with an average weight of 788 lbs and body condition score (BCS; 1 = emaciated, 9 = obese) of 4.5 were stratified by calving date and allotted randomly to four dietary treatments. Treatments were arranged as a 2 × 2 factorial experiment with nursing heifers receiving either 100 or 150% of the NRC minimum requirement for dietary crude protein, primarily either from soybean meal/urea (low escape = L) or corn gluten meal/bloodmeal/urea (high escape = H) resulting in four treatments: 100-L, 100-H, 150-L, and 150-H. Compositions of the diets are shown in Table 1. Diets were formulated to be isocaloric and met the NRC minimum net energy standard. Diets were fed individually for 100 days or until cows were observed in standing estrus. Days on trial did not differ among treatments and averaged 97 days. Cows were weighed and body condition was scored again at calving. At trial completion cows were fed their normal diets at mid-afternoon, allowed access to water overnight, and weighed and scored for body condition the following morning. Calves were kept with their dams overnight and weighed at the same time as the cows. Serum samples for progesterone analysis were collected three times weekly. Concentration of luteinizing hormone (LH) was determined in blood serum collected every 12 minutes for 6 hours via an indwelling jugular catheter approximately 35 days after calving. At approximately 61 days postcalving, each cow and her calf were separated overnight, and cows were milked mechanically the following morning to estimate daily milk production. Cows were palpated by experienced technicians for pregnancy

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determination and fetal aging after exposure for 60 days to fertile bulls.

## Results and Discussion

Increased protein in the diet above NRC requirement tended (P = .09) to increase weight gain of cows but source of protein had no effect (Table 2). Cows fed greater amounts of dietary protein had a positive, though non-significant, change in body condition score. Both increased dietary protein and use of a protein source with higher ruminal escape potential increased calf gains (P = .003 and .05, respectively). This response may be partially explained by corresponding numerical improvements in milk production. Mean concentration of LH tended to be lower (P = .12) in cows fed higher escape protein sources. Days required postcalving for serum progesterone to exceed 1 ng/ml, LH pulse frequency, LH pulse amplitude, and estimated fetal age were all unaffected by dietary treatment (Table 3). Conception rate of the 100-L group was numerically, but not statistically, lower than that of the other dietary groups. When protein was fed to meet the calculated NRC requirement, a protein source with higher ruminal escape potential improved calf performance. Increasing the amount of dietary crude protein enhanced both cow and calf gains.

**Table 1. Diet Compositions (100% Dry Matter Basis)**

| Feedstuff | 100-L | 100-H | 150-L | 150-H |
|---|---|---|---|---|
| Prairie Hay | 57.81 | 57.87 | 55.68 | 55.92 |
| Corn | 33.76 | 35.60 | 24.76 | 30.06 |
| Soybean Meal | 6.05 | | 17.33 | |
| Corn Gluten Meal | | 2.35 | | 6.69 |
| Bloodmeal | | 1.69 | | 4.86 |
| Molasses | 1.42 | 1.42 | 1.43 | 1.44 |
| Urea | .49 | .49 | .50 | .50 |
| Salt | .22 | .22 | .22 | .22 |
| Monocalcium phosphate | .11 | .22 | | .17 |
| Limestone | .11 | .11 | .06 | .11 |
| Trace mineral premix | .03 | .03 | .03 | .03 |
| Cow intake/day: | | | | |
| Lb dry matter | 18.34 | 18.32 | 18.18 | 18.10 |
| Lb crude protein | 2.23 | 2.07 | 3.08 | 2.96 |

**Table 2. Effects of Source and Amount of Dietary Protein on Cow and Calf Performance**

| Item | 100-L | 100-H | 150-L | 150-H | P-values[a] A | S | A × S |
|---|---|---|---|---|---|---|---|
| Initial weight | 770 | 814 | 790 | 776 | | | |
| Cow gain, lb/day | .62 | .55 | .68 | 1.06 | .09 | .36 | .17 |
| Initial BCS[b] | 4.72 | 4.55 | 4.50 | 4.30 | | | |
| BCS change | –.17 | –.05 | + .15 | + .05 | .23 | .96 | .53 |
| Calf gain, lb/day | 1.23 | 1.32 | 1.43 | 1.69 | .003 | .05 | .34 |
| Milk production, lb/day | 10.4 | 11.4 | 11.2 | 13.0 | .27 | .21 | .72 |

[a]Statistical probability of a treatment effects due to protein amount (A), source (S), or interaction (A × S).
[b]BCS = body condition, 1 to 9 scoring system.

**Table 3. Effects of Source and Amount of Dietary Protein on Reproductive Characteristics**

| Item | 100-L | 100-H | 150-L | 150-H | P-values[a] A | S | A × S |
|---|---|---|---|---|---|---|---|
| Serum LH conc., ng/ml | .79 | .69 | .80 | .69 | .91 | .12 | .96 |
| LH pulse frequency/6 hr | .60 | .40 | .56 | .30 | .73 | .29 | .90 |
| LH pulse amplitude, ng/ml | 1.17 | 1.28 | 1.54 | .87 | .53 | .27 | .86 |
| Days to $P_4$ > 1 ng/ml[b] | 88 | 84 | 81 | 86 | .60 | .98 | .30 |
| Conception rate, % | 56 | 80 | 90 | 80 | .24 | .83 | .24 |

[a]Statistical probability of a treatment effect due to protein amount (A), source (S), or interaction (A × S).
[b]Days required postcalving for serum progesterone to exceed 1 ng/ml, indicating normal estral activity.