EFFECT OF CRUDE PROTEIN IN RATION ON THE REPRODUCTION OF HIGH PRODUCING DAIRY COWS; A PRELIMINARY REPORT

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Story in Brief

Forty-five high producing dairy cows were fed normal (17.7%) and high (22.6%) crude protein diets from 10 ± 4 until 145 days after calving. Feeding the high protein diet increased plasma urea levels by 10 mg percent. Milk production was not altered by the diet fed. The nutritional stress on the cows as measured in terms of body weight change and body condition was negligible and similar between diets. Regardless of diet, the average interval to first postpartum estrus was comparable and in the normal range. About 70% of cows on each diet became pregnant while on the experiment. While data are too limited to make definite conclusions, cows fed high protein diets appear to be less fertile.

Introduction

Genetic progress has substantially increased the milk producing ability of dairy cows. At the same time the nutritional demands on a cow to support her ability to produce milk have increased. For example, in the first 2 to 3 months of lactation it is common for cows not to be able to consume enough feed to maintain both their body weight and produce milk. Thus during the first phase of lactation when milk production increases, it is common for cows to be in a negative nutritional balance and lose body tissue until their feed intake increases sufficiently to meet metabolic demands. To counteract this situation, NRC recommendations for high producing dairy cows (66 to 110 lb milk/day) range from 14 to 22% crude protein. Maintaining adequate crude protein benefits milk production by increasing feed consumption and digestibility. It may also help offset the cow's utilization of her own tissues in early lactation.

Recently, some limited evidence has been published suggesting that rations formulated to meet the crude protein needs of high producing cows may be detrimental to reproductive performance. Rations containing 16% or more crude protein may impair fertilization and/or cause early embryonic mortality (Folman et al., 1981; Jordan and Swanson, 1978). If this apparent conflict between metabolic needs and reproduction is real, it may be necessary to reduce the crude protein fed to high producing dairy cows while they are being bred.

The objectives of this research are to evaluate the effect of dietary crude protein concentration on: 1) the onset of the estrous cycle and fertility 2) plasma urea and β-hydroxybutyrate concentrations 3) body condition and weight changes and 4) milk production during the first 145 days of lactation.

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Materials and Methods

The experiment is being conducted during 3 successive fall-winter calving periods. The information in this report pertains only to the first year of the experiment. Holstein and Ayrshire cows in their second or later lactation expected to produce in excess of 60 lb of milk/day by the second week of lactation were used. During each period (month) of the calving season, cows were alternately assigned to receive either a 15 or 20% crude protein ration. While these were the expected experimental protein levels, there were variations in the rations that are explained in results. These are considered normal and high protein levels for cows averaging 60 to 70 lb of milk/day. Cows were distributed between rations within periods depending on number of lactations and breed. Those in second and third lactations constituted one lactation group and those with more than three lactations another group. Cows were maintained in dry lots and milked twice daily.

Feeding of the experimental diets began 10 $\pm$ 4 days after calving. During the 1- to 2-week period prior to being fed experimental diets, cows were gradually adjusted from ad libitum silage and 25 lb of concentrate to a complete ration of 15% crude protein composed of 50% concentrate and 50% roughage (40% ground alfalfa hay and 10% cottonseed hulls). The experimental rations were similar to the diets fed just prior to the experiment except that ground alfalfa hay constituted only 30% of the total mixture. The cows were fed the experimental diets three times per day to the limit of consumption.

Overall animal performance was evaluated weekly in terms of weight change, body condition score, and concentration of urea and β-hydroxybutyrate in the blood plasma. Condition scoring was as described by Aalseth et al. (1983). Plasma urea levels were used as an indicator of crude protein level effects on nitrogen metabolism. Concentration of β-hydroxybutyrate was interpreted as an indication of degree of fat catabolism resulting from nutritional stress. Daily milk production was recorded. Weekly milk fat percentage was the average of four consecutive milkings each week.

To determine the onset of ovarian activity cows were 1) palpated at weekly intervals until they were bred, 2) bled weekly until first estrus to determine plasma progesterone levels and thus corpora lutea activity and 3) observed twice daily (early morning and late evening) for estrus activity. Cows were bred artificially by experienced inseminators at the first estrus greater than 55 days postpartum and at subsequent heats. Insemination was about 12 hr after the first observation of estrus activity. The effects of the two rations on days from parturition to conception, total percent of cows becoming pregnant while on experimental diet, percentage of cows pregnant to first, second and third services, and services per conception were determined.

Results and Discussion

The results reported here are considered preliminary as only 45 cows have completed the experiment during the first year of the 3-year experiment. Within each treatment, the data have been combined for number of lactations, calving periods, and breed of cow due to limited data. The actual diet consumed by the cows averaged about 17.7 and 22.6% for the two treatment groups over the entire experiment. While at the

start of the experiment the diets were at the level designed, there were unexpected increases in the crude protein of the dietary constituents used. In addition, both diets were actually more conducive to producing body tissue than milk. This was evident in that cows in both groups lost little weight and body condition over the experiment. Also, there was little difference in body condition and weight change between diets (Table 1). Furthermore, milk production was in general less than expected and the small difference between groups was evident before the cows began eating the experimental rations (Table 1). This response was due in part to a deficiency of effective fiber in the rations. Such was also reflected in a depressed fat test (Table 1), and 8 out of 46 cows developed displaced abomasums. One of the 8 cows had to be eliminated from the experiment due to poor recovery.

Table 1. Productive and reproductive performance of cows as influenced by level of crude protein in the diet.

	Crude Protein					
	15%		n[f]	20%		n
Number of cows/diet	22			23		
Feed consumption lb/day[a]	38.4	± 6.6[d]		42.0	± 8.7	
Milk production lb/day[b]	47.6	± 9.6		52.6	± 14.3	
Milk fat %[c]	2.9	± 0.7		3.2	± 0.6	
Body weight change lb.[c]	+0.3	± 35.6		−0.7	± 37.5	
Body condition score[c]	5.1	± 0.9		4.9	± 1.0	
Days to first estrus	33.1	± 16.9	22	37.5	± 22.7	23
Percent pregnant	73		22	69		23
Services/Conception[e]	1.50	± 0.89	16	1.94	± 1.24	16
% Cows pregnant 1st service	45.5		22	47.8		23
% Cows pregnant 2nd service	20		10	8.3		12
% Cows pregnant 3rd service	14.3		7	28.6		7

[a] Average values for experiment based on weekly average feed consumption/day - mean of 19-20 weekly values for cows on diet
[b] 4% fat corrected milk production based on weekly average milk production/day - mean of 19-20 weekly values for cows on diet
[c] Average values for experiment - Mean of 19-20 weekly values for cows on diet
[d] Standard deviations
[e] Based on cows becoming pregnant during the experiment
[f] Number of cows bred

Based on body weight, lactation number and milk production, protein consumption by the cows fed the two rations in relation to NRC requirements was calculated (Figure 1). A 15% crude protein diet was chosen as normal as it should be about 100% of requirement for cows producing 60 to 70 lb of milk per day. However, depressed milk production, which did not peak during the experiment, and an unexpected increase in dietary crude protein levels resulted in cows consuming higher levels of protein than desired. In fact, most of the cows fed the diet designated to be normal in crude protein were exposed to crude protein levels that may have been detrimental to reproduction. While

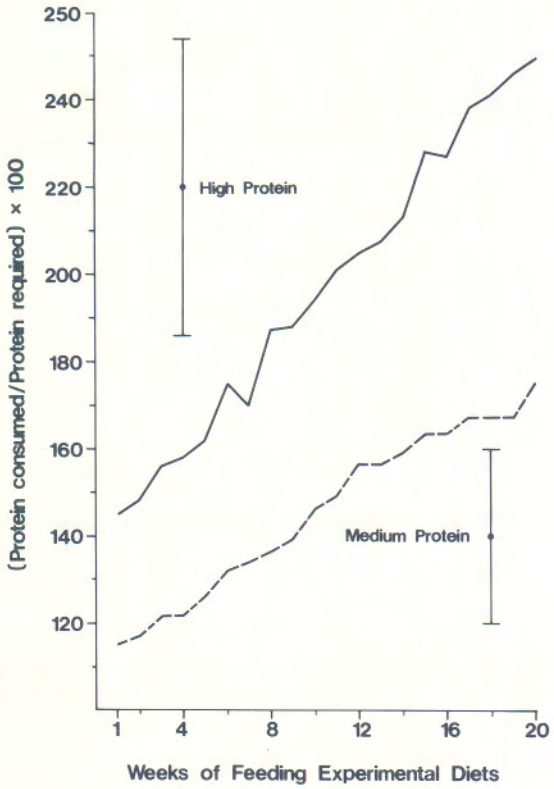

Figure 1. Consumption of dietary crude protein in relation to NRC requirements, based on lactation number, body weight and milk yield. Average standard deviations are shown.

crude protein levels were high there was a difference in the physiological response to each diet. A 10 mg% increase in plasma urea levels due to feeding 5% more crude protein indicated an alteration in nitrogen metabolism (Figure 2). A similar response was observed by Claypool et. al. (1980) and Folman et. al. (1981). Also the urea levels increased rapidly during the first week of feeding the high protein diet indicating that nitrogen metabolism was rather quickly affected by dietary protein levels. Feed intake was also enhanced by feeding the higher protein ration (Table 1). This is a common response to higher levels of protein.

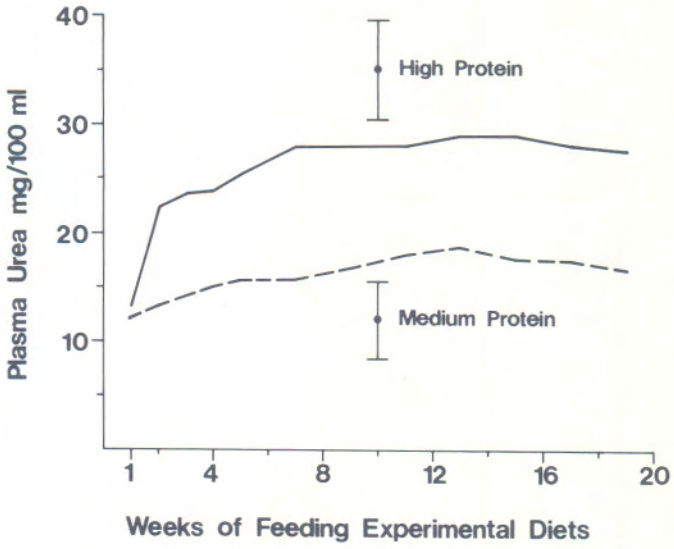

Figure 2. Average plasma urea levels as affected by percent crude protein in the diet. Average standard deviations are shown.

Days to onset of estrus activity did not seem to be affected by diet and could be considered normal (Table 1). Regardless of diet, approximately 70% of cows became pregnant during the experimental feeding period. Services per conception averaged 1.5 for those cows fed the normal protein diet and 1.9 for those fed the high protein diet (Table 1). Since a limited number of cows were used, the data on services per conception were not considered conclusive. However, it is interesting that this trend and these values are comparable to the observations of Jordan and Swanson (1978) and Folman et al. (1981). The percent cows pregnant to first service was in the low normal range and comparable between diets. With successive inseminations, the fertilization rate appeared to become quite low (Table 1). In fact, the conception rates of cows fed both the normal and high protein diets seemed to be depressed. Opportunity for fertilization may be reduced and/or the chance of early embryonic mortality may be increased by high protein diets. Future data from this project will provide sufficient information to arrive at a confident conclusion as to whether or not a high level of dietary crude protein does interfere with reproduction in dairy cows.

Literature Cited

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