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Protein Intake and Dairy Cow Fertility[1]

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With increasing levels of milk production, dairymen have been encouraged to feed higher levels of protein that contain a greater proportion of bypass protein. The concentration of protein in the diet of high-producing cows can be expected to increase in the future as management technology and genetic selection further enhance milk-producing ability. The new 1989 NRC publication on nutrient requirements of dairy cattle suggests 17 to 19% protein in the ration dry matter for early lactating cows as well as a requirement for absorbed protein. The requirements for absorbed protein are expressed as UIP (undegraded intake protein) and DIP (degraded intake protein). The UIP or bypass protein recommended for lactating dairy cows varies from 32 to 35% for low-producing cows and up to about 40% for high-producing cows. The greatest efficiency in protein utilization should occur in this range.

The exact relationship of high protein to reproduction is not well defined. There are probably other more important factors involved. Protein requirements must be supplied for good reproduction. A good balance of both degradable and undegradable protein (bypass) might support equal production with less total protein in the ration and, in addition, reduce high blood urea nitrogen levels sometimes associated with reduced reproduction. It seems apparent that the key to good reproductive performance in dairy cattle is good nutrition in early lactation under suitable management conditions. The most critical period with regard to nutrient balance and supply to the high producing cow is from the time of parturition until peak milk production.

Protein that bypasses or escapes the rumen is degraded to amino acids and absorbed from the small intestine. The degraded protein or ammonia not utilized by the rumen microbes is absorbed from the rumen into the blood stream and converted to urea by the liver. This safeguards the animal, since ammonia is toxic while urea is not. The urea is then excreted in the urine or recycled to the rumen in the saliva or by passage through the rumen wall.

During recent years, a number of scientists have suggested that feeding rations high in protein may have an adverse effect on reproductive performance of dairy cows. Production of ammonia from dietary protein metabolism in amounts exceeding the body's ability to detoxify or convert the ammonia to urea may affect reproductive processes negatively. Since urea synthesis and gluconeogenesis (the formation of glucose from noncarbohydrate sources) are operating near maximum at peak production, cows receiving excess protein in their diet would need extra energy for the conversion of ammonia to urea, thereby

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creating a possible energy shortage. In addition, a high concentration of ammonium ions may depress gluconeogenesis.

Several researchers have attempted to better define the effect of different levels of ration protein on reproductive performance in dairy cattle.

COMPARISON: TWO LEVELS OF PROTEIN

Carroll et al. used 57 early lactating cows to compare the effect of 13 and 20% protein rations on the reproductive performance of dairy cattle. The results are in Table 1.

Cows fed the 20% protein ration had higher protein intake, ruminal ammonia and urea nitrogen concentration in plasma and vagina mucus. There was no significant difference between low and high protein groups in days to first observed estrus, days to first service (55 vs 59), days open, or services per conception. Days to first estimated ovulation were longer (22 vs 17) in the high vs low protein groups.

Oklahoma workers used 146 Holstein and Ayrshire cows to investigate the reproductive performance when using two levels of protein (15% or 20% total protein ration dry matter). Rations contained sorghum silage and concentrate with additional protein provided by soybean meal. The forage-grain ratio was 45:55. Cows were observed visually for heat twice daily. Breeding began at 55 days postpartum. Cows were eliminated from the trial due to chronic uterine infection or other severe illness. Numbers eliminated were not related to protein level. The results are in Table 2.

While milk production was enhanced by the 20% protein diet, milk fat and milk protein percentages were not affected by diet. Actual decreases in body weight and condition were small. Plasma urea nitrogen increased rapidly, with cows on the 20% protein diet maintaining a 10 mg/dl advantage after the fourth week on the experiment. This study is in agreement with a review by Huber where the reproductive performance of dairy cows fed diets with different levels of protein were reported and concluded no relationship between reproduction and level of ration protein.

COMPARISON: THREE LEVELS OF PROTEIN

Jordan and Swanson used three levels of protein (13%, 16% and 19% protein) in rations consisting of soybean meal, barley, silage and alfalfa hay to study the effect of protein level on reproductive performance. Rations were formulated to contain 30:70 forage-grain ratio in the dry matter. Heats were determined by visual observation and aided by progesterone tests. Breeding of the 15 cows per treatment started at 45 days postpartum. The results are in Table 3.

Cows receiving the 19.3% CP rations had 27 days to first estrus, while the 16.3% and 12.7% CP groups averaged 41 days. Delaying the time of breeding to 45 days may have biased the results for the high-protein group because of their earlier expression of estrus.

COMPARISON: FORMALDEHYDE AND TWO LEVELS OF PROTEIN

Folman et al. used three groups of 20 cows in an experiment to study two levels of protein, 16% and 20.0, while using a forage-grain ratio of 22:78. One of the low protein rations contained formaldehyde-treated soybean meal. Treating with formaldehyde increased the bypass protein content of the soybean meal. Cows were visually checked for heats four times daily and bred only when showing standing heats. Breeding started at 60 days postpartum. The results are in Table 4.

The authors reported that three cows in the 20% protein group were inseminated four to seven times and then culled before confirmation of pregnancy. These cows may have had other problems that were not reported. However, these cows were included in the group data. The conception rate was the lowest for the higher protein group. Increasing the bypass protein content of the lower protein ration had a positive effect on reproductive performance as well as increasing milk production.

In another experiment, Kaim et al. included data from 224 cows. Low-protein rations contained soybean meal treated or untreated with formaldehyde, whereas the high protein ration

contained only untreated soybean meal. Breeding commenced at 60 days. Cows not seen in heat were excluded from the experiment. The results are in Table 5.

Older cows appear to be affected more by the high protein than younger cows. It was indicated that the older cows lost an average of 80 pounds body weight during the first nine weeks as compared with 55 pounds for the younger cows. Since no difference was obtained from the formaldehyde-treated soybean meal, the results were pooled.

Table 1. The effect of two levels of protein on certain production and reproductive measures.

Measurements	13%	20%
Milk yield (4% FCM), lb)	57.4	58.5
Dry matter intake, lb	36.7	35.4
Days to first observed estrus	24.0	27.0
Days open	72.0	82.0
Conception rate, % (lst serv.)	64.0	56.0
Pregnancy rate, %	96.0	93.0
Services per conception	1.5	1.8
Blood urea nitrogen (mg/dl.)	8.2	20.9

Table 2. Reproductive performance of dairy cattle fed either moderate or high protein diets.

	Ration Crude Protein (%)	
Measurement	**14.5**	**19.4**
Days open	80	80
Days to first observed estrus	41	38
Average number services/90 days experiment breeding period		
All cows	1.55	1.47
Cows conceiving	1.39	1.40
Percent pregnant on experiment	87.0	85.0
No significant differences.		
Howard, Aalseth, Adams and Bush.		
Cows were eliminated if treated for ovarian cysts.		

Table 3. The effect of three levels of protein on certain reproductive parameters.

	Ration Crude Protein (%)		
Measurement	**12.7**	**16.3**	**19.3**
Days open	69	96	106
Days to first observed estrus	36	45	27
Service/conception	1.47	1.87	2.47

Table 4. The effect of formaldehyde treatment and two levels of protein on certain reproductive parameters.

	Ration Crude Protein (%)		
Measurement	**16.0-F**	**16.0**	**20.3**
Days Open	84	98	102
Days to first standing estrus	37	40	38*
Service/conception	1.45	1.79	2.25*
Conception rate (%)	69.0	56.0	44.0
Milk production (lb)	89.0	85.6	84.5

Table 5. The effect of two levels of protein on certain reproductive parameters.

	Ration Crude Protein (%)	
Measurement	**15-16%**	**19-20%**
Days to first estrus	41	39
Service/conception	1.75	2.30
First service conception rate	0.55	0.49
Pregnant at 126 days (%)	79.0	65.0
Values are significantly different, mainly due to differences seen in cows past third lactation.		
Kaim, Folman, Neumark, and Kaufmann.		