FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

FRED D. BISPLINGHOFF, D.V.M.
Director Technical Services

7150 ESTERO BLVD. • APT. 906
FT. MYERS BEACH, FL 33931
AREA CODE 813 — 463-4744

Date: June, 1992 No.: 239

ROLE OF ANIMAL PROTEINS AND FATS IN RATIONS FOR DAIRY CATTLE ON PASTURE

Dr. Lawrence D. Muller and Lisa A. Holden
Department of Dairy and Animal Science
The Pennsylvania State University

Introduction

Pastures have been part of the landscape of the United States for many centuries, but until recently the utilization of pastures on dairy farms had been decreasing. As economic and environmental pressures on dairy operations increase, the use of pastures as a significant part of the yearly forage supply has increased, particularly in the Northeast and the upper Midwest. Dairy producers are "rediscovering" that pasture is an underutilized resource and that proper management of pastures can contribute to maximizing profit and optimizing milk production. The resurgence in pasture usage is generally on smaller dairy farms (<60 to 80 cows) and involves the concept of controlled, intensive grazing in which cows rotationally graze several paddocks.

One of the major challenges faced by dairy producers using intensive grazing systems is proper supplemental feeding for maximum production at the lowest cost. In a recent Penn State survey of dairy producers using intensive pasture systems, the major management problems identified were variation in pasture yield, balancing rations, and estimating feed intake (Parker, et al. 1991). Confined feeding systems utilize known quantities of stored forages in nutritionally balanced rations which consistently meet the nutrient requirements of the cows. In contrast, the amount of pasture available and consumed, and the nutrient composition of the pasture vary throughout the grazing season. Consequently, managing a grazing system and providing supplementation to balance changing pasture quality and quantity is challenging and requires frequent monitoring and altering of supplemental feedstuffs, unlike managing a more stable confined feeding system.

Most grazing research with dairy cattle has been conducted in Europe, Australia, and New Zealand with smaller cows producing less milk and receiving limited amounts of supplements, therefore the results of these studies may have limited application to the conditions in the U.S. Research in the U.S. studying the supplementation of high producing dairy cows under grazing conditions is limited; however, there are some indications that feeding ruminally resistant proteins and possibly fat could increase productivity of grazing cows.

Pasture Quality

With proper grazing management, the nutritional quality of pasture can equal or exceed the quality typically found in stored forages. Typical nutrient composition values for a grass based pasture system during the spring, summer, and fall are shown in Table 1. For comparison, the NRC (1989) recommended nutrient content of total rations is presented. This comparison illustrates that grain supplements should provide energy and

UIP, but not necessarily more total protein, in order to meet NRC recommendations and achieve high levels of milk production. The range of values in Table 1 may differ due to species and maturity of grass, inclusion of legumes, weather changes during the growing season, and grazing management. Because changes in pasture composition occur rapidly (Holden et al. 1992; Abdalla, et al. 1988) within the three seasons shown in Table 1, frequent forage sampling and quality analysis and corresponding frequent supplement changes are necessary. An example of the changes in composition of an orchardgrass based system throughout the grazing season is shown in Figure 1.

Pasture Quantity

Like quality, the quantity of pasture available changes throughout the grazing season. Many agronomic estimates of available pasture have been made for a variety of species, soil conditions, environmental conditions, fertilization schemes, and management strategies. In general, pasture availability is highest in the spring, intermediate in the fall, and lowest in the summer. Since pasture dry matter intake (DMI) is highly correlated with availability, pasture DMI's follow the same trend as availability. An example of the changes in pasture DMI for an orchardgrass based system at Penn State throughout the grazing season is shown in Figure 2 (Holden et al., 1992).

Protein

Although the protein in well managed, high quality pasture can be high (Table 1 and Figure 1), the protein present can be too high in rumen degradable intake protein (DIP) and too low in rumen undegradable intake protein (UIP) to achieve high milk production. Research at Penn State using ruminally and duodenally cannulated cows has shown high rumen ammonia and lower total nitrogen post-ruminally in cows grazing grass pastures compared to feeding the same grass as silage or hay (Holden et al., 1991). This and other research (Beever et al., 1986; Thomson, 1982) strongly suggests that high producing cows on pasture may have inadequate protein entering the small intestine (from bacterial protein synthesis in the rumen and /or protein escaping ruminal degradation) or that the protein lacks the essential amino acids to support high milk production. Limited research (Welch et al., 1990) indicated that supplementation of rumen UIP from animal protein sources in the grain ration when pasture is the only source of forage is beneficial.

In addition to the high DIP in pasture and apparent inefficient utilization of nitrogen by the high producing cow, high quality pasture may have inadequate non-structural carbohydrates (NSC) to utilize the readily available nitrogen for maximal rumen microbial protein synthesis. Based on research with stored forages, it is becoming clear that a coupling of ruminally available protein and carbohydrate is needed to optimize microbial growth and , in turn, milk production. The method of providing grain and feeding frequency may be an important factor in improving the protein and energy utilization.

Pasture research at Penn State has provided additional information suggesting that microbial protein and UIP may be limiting for high milk production. Lactation curves clearly show that high producing cows (averaging 40+kg milk/cow/day) in early lactation do not maintain "normal" lactation curves (Hoffman, 1991). During the first 6 to 8 weeks in early spring when pasture quality is the highest (as measured by the "standard" measures of crude protein, fiber, etc.), lactation curves declined at approximately twice the "expected" rate of decline. This high rate of decline corresponds to the period when the DIP in pasture is highest.

Fat (Energy)

The rapid decrease in milk production by high producing cows in the early spring and a generally less than optimal body condition often observed in cows grazing on a grass based pasture system suggests that supplemental animal fat may be beneficial. In addition, NRC (1989) recommends that metabolizable energy (ME) requirements of grazing animals need to be increased 3% for each kilometer the cow must walk to get to pasture, and an additional 10% for good pasture and 15% for sparse pasture. Supplemental fat may be just what is needed to obtain these additional ME requirements. Penn State research (Holden et al., 1992) has shown that DMI of high producing cows grazing an orchardgrass based system were lower than NRC recommendations (when 10% added DM for grazing is included) for early spring, but DMI met or exceeded NRC recommendations for the rest of the grazing season. However, since the energy value of pasture may be somewhat lower than optimal (Table 1), meeting DMI requirements may not meet energy requirements. Cows fed supplemental fat (beef tallow) and grass silage based diets had an increase in milk yield from 16 to 22 kg milk/day with added fat (Clapperton and Steele, 1983); however, research on supplemental fat as an energy source with high producing cows under grazing systems is limited.

Conclusions

Managing a grazing system and providing supplemental feeds for cows on pasture differs greatly from a confined feeding system. Due to the low amount of UIP in pasture, providing sources of high UIP in the grain supplement may be beneficial for grazing dairy cows. In addition, added fat in the grain supplement may provide the adddition energy needed for activity during grazing, and may help to increase milk production and maintain better body condition of high producing cows on pasture.

References

Abdalla, H. O., D. G. Fox and R. R. Seaney. 1988. J. Anim. Sci. 66:2663

Beever, D. E., H. R. Losada, S. B. Cammell, R. T. Evans, and M. J. Haines. 1986. British Journal of Nutrition 56:209-225

Clapperton, J. L. and W. Steele. 1983. J. Dairy Sci. 66:1032.

Hoffman, K. 1991. M.S. Thesis. The Pennsylvania State University.

Holden, L. A., L. D. Muller, G. A. Varga and P. J. Hillard. 1991. J. Dairy Sci. (Suppl. 1) 74:309.

Holden, L. A., L. D. Muller, G. A. Varga and S. L. Fales. 1992. J. Dairy Sci. (abstract accepted).

Parker, W. J., L. D. Muller, S. L. Fales and W. T. McSweeny. 1991. J. Dairy Sci. (Suppl. 1) 74:314.

Thomson, D. J. 1982. Forage Protein in Ruminant Animal Production., Occasional Publ. No. 6, British Soc. Anim. Prod.

Welch, J. G., R. H. Palmer, A. M. Bueche and W. M. Murphy. 1990. In Proceedings of Dairy Feeding Systems Symposium, NRAES. 38. Harrisburg, PA.

Table 1. Average nutrient composition of grass pasture and the NRC nutrient requirements.

Nutrient	Spring	Summer	Fall	NRC[a]
Crude protein, % of DM	20-30	20-25	20-30	13-17
Soluble protein, % of CP	20-35	20-35	20-35	
Degradable protein, % of CP	70-80	65-75	70-75	60-67
NDF, % of DM	40-50	45-55	40-55	27-33
Est. Net Energy, Mcal/kg	1.50-1.58	1.39-1.47	1.45-1.54	1.61-1.69

[a] Recommendations for total ration. Adapted from NRC, 1989

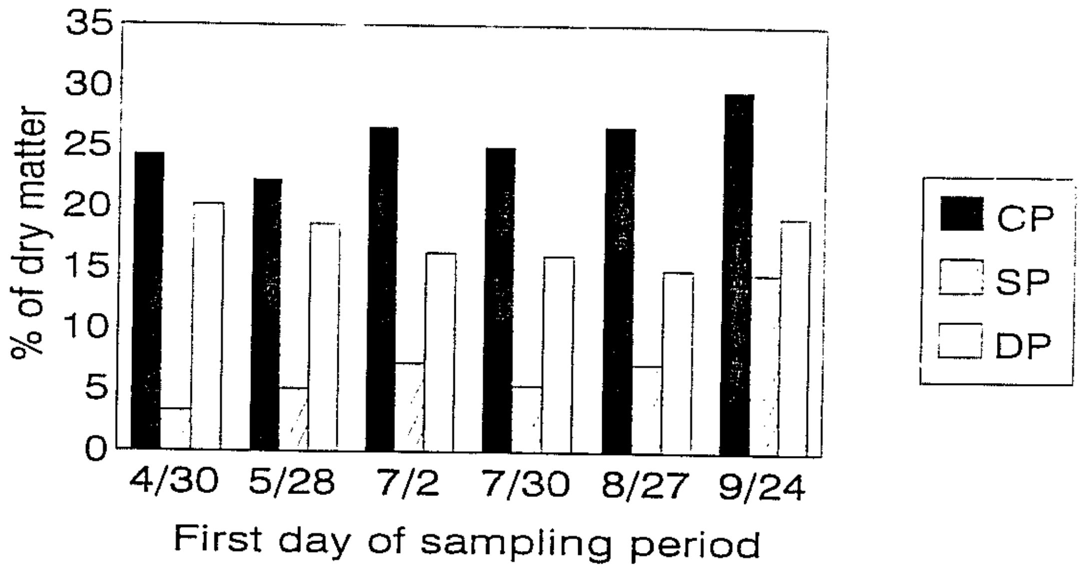

Figure 1. Crude protein (CP), soluble protein (SP), and degradable protein (DP) in pasture

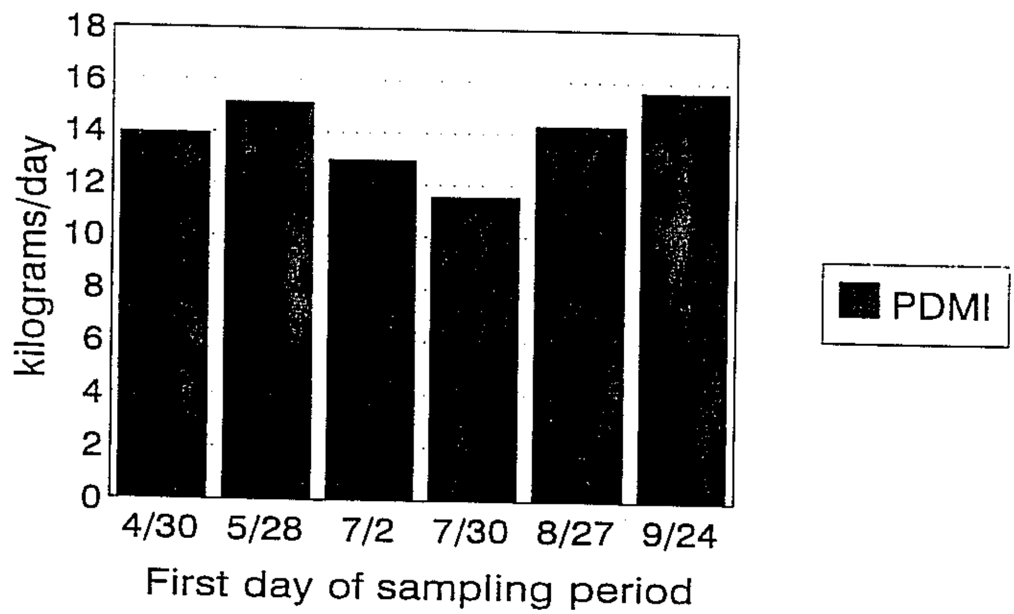

Figure 2. Pasture dry matter intake (PDMI).

Table 1. Average nutrient composition of grass pasture and the NRC nutrient requirements.

Nutrient	Spring	Summer	Fall	NRC[a]
Crude protein, % of DM	20-30	20-25	20-30	13-17
Soluble protein, % of CP	20-35	20-35	20-35	
Degradable protein, % of CP	70-80	65-75	70-75	60-67
NDF, % of DM	40-50	45-55	40-55	27-33
Est. Net Energy, Mcal/kg	1.50-1.58	1.39-1.47	1.45-1.54	1.61-1.69

[a] Recommendations for total ration. Adapted from NRC, 1989

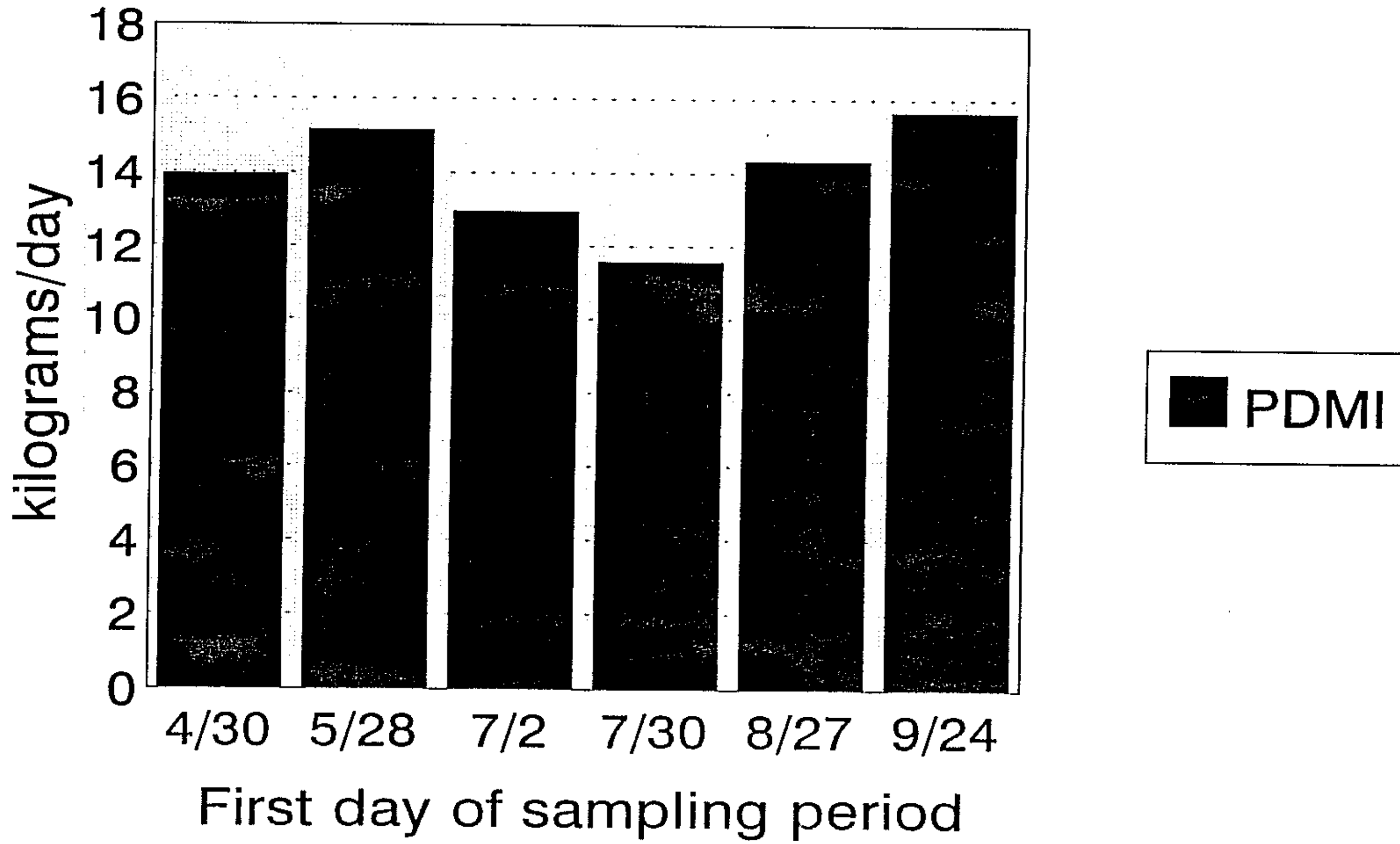

Figure 2. Pasture dry matter intake (PDMI).

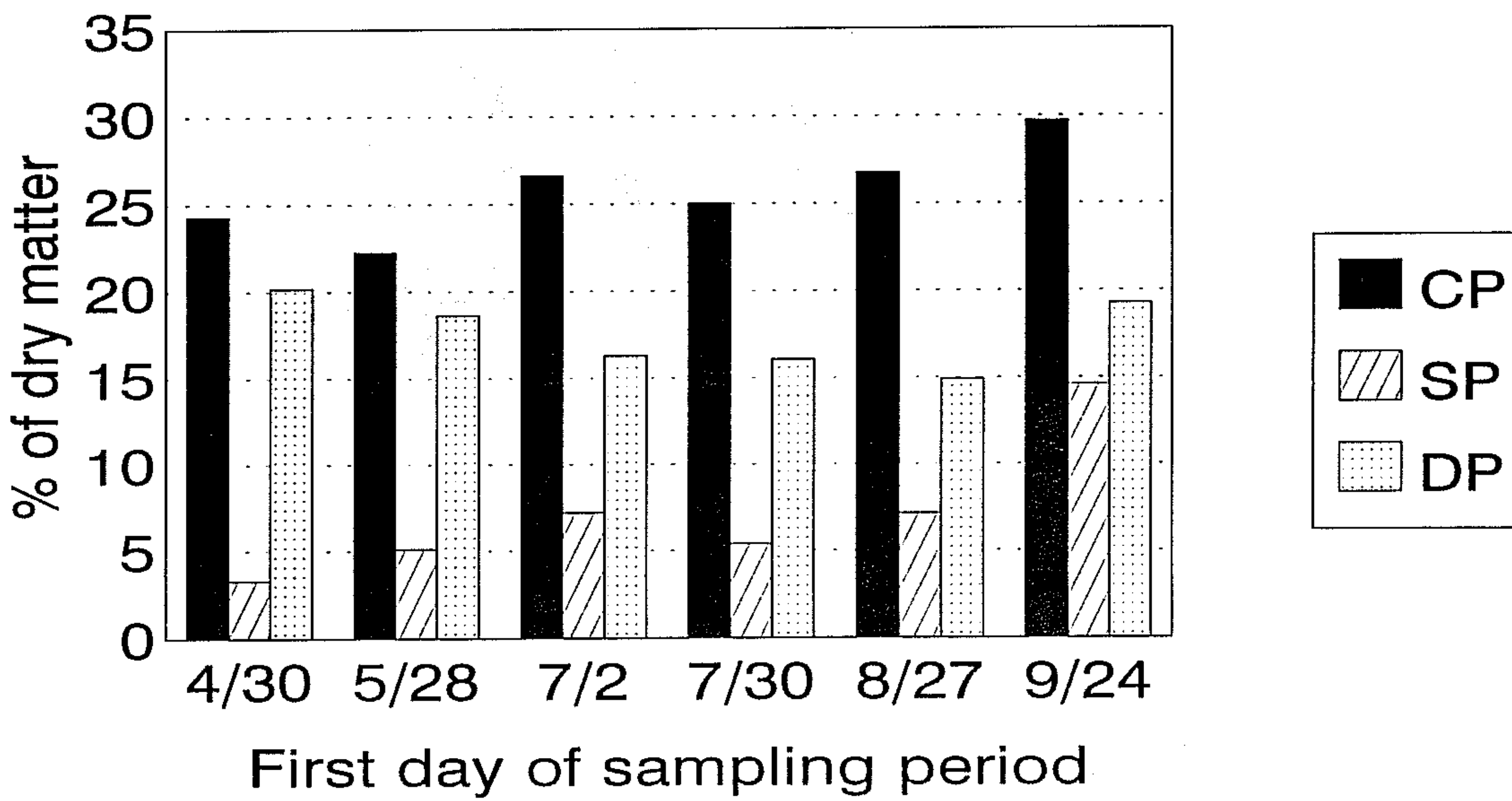

Figure 1. Crude protein (CP), soluble protein (SP), and degradable protein (DP) in pasture