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Nutrient requirements of dairy cattle revised

Abstract

The 1988 National Research Council's (NRC) Nutrient Requirements of Dairy Cattle have been revised. Adjustments have been made in the recommended requirements for net energy for lactation (NEL); crude protein (CP); calcium (Ca); phosphorus (P); and vitamins A, D, and E. In addition, suggestions are made for using undegraded intake protein (UIP) and degraded intake protein (DIP) for diet formulation.; Dairy Day, 1988, Kansas State University, Manhattan, KS, 1988;

Keywords

Kansas Agricultural Experiment Station contribution; no. 89-107-S; Dairy; Nutrient requirement; Crude Protein; Calcium; Phosphorus; Vitamins; Energy

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K**S****NUTRIENT REQUIREMENTS OF DAIRY CATTLE REVISED****U****J.R. Dunham**

Summary

The 1988 National Research Council's (NRC) Nutrient Requirements of Dairy Cattle have been revised. Adjustments have been made in the recommended requirements for net energy for lactation (NEL); crude protein (CP); calcium (Ca); phosphorus (P); and vitamins A, D, and E. In addition, suggestions are made for using undegraded intake protein (UIP) and degraded intake protein (DIP) for diet formulation.

Introduction

The NRC subcommittee on Dairy Cattle Nutrition is given the charge to review research and modify feeding recommendations from time to time. The 1988 NRC Nutrient Requirements of Dairy Cattle were released recently as the most appropriate guide for formulating dairy cattle diets. Most of the revisions are rather minor, but should be used for adjusting feeding programs.

Energy

The energy requirements for lactating and dry cows are designated NEL. The requirements for maintenance and milk production were unchanged. However, the 1988 publication provides an allowance for weight gain. When the NEL requirement is expressed on the basis of concentration of dry matter in the total ration, the recommendation is 0.76 Mcal NEL/lb for cows fresh from 0-3 wk. This recommendation indicates the importance of feeding high-energy rations soon after freshening.

The energy requirements for growing heifers is expressed on the basis of net energy maintenance (NEM) and net energy gain (NEG). Both energy recommendations were increased significantly.

Protein

The recommended crude protein (CP) requirement for maintenance was increased by 10 to 25%, whereas the requirement for milk production did not change. Expressed as a percentage of the total ration dry matter, the CP recommendation is 17 to 18% for cows at high levels of milk production.

A recommendation is made for the first time for UIP and DIP. UIP has been referred to as by-pass or insoluble protein, whereas DIP usually was called soluble protein. The UIP content of the total protein is recommended to be from 36 to 42%. However, the subcommittee cautioned that the UIP content of feeds has not been measured extensively, and there may be great variations among samples of individual feeds.

Calcium

A significant increase was made in the calcium (Ca) recommendations for maintenance and milk production of lactating cows and for maintenance of dry cows and growing heifers. These

increased Ca recommendations are approximately 15% higher than previously. The subcommittee pointed out that the ratio of Ca:P is of little concern, provided the requirements for both are met. The recommendation for the Ca content of rations for heifers 3 to 6-mo old was increased by 30%.

Phosphorus

The maintenance requirement for phosphorus (P) was unchanged but the recommendation for milk production was increased about 10%. The P requirement was reduced for dry cows by about 10%. The recommended P content of rations for heifers 3 to 12-mo old was increased 50 to 100%.

Vitamins

The vitamin A requirement was unchanged, except for dry cows for which the recommendation was increased 25%. The recommended vitamin D requirement was increased 320% for lactating and dry cows. For the first time, vitamin E requirements were recommended for cows and growing heifers at the rate of 7 and 11 IU/lb of dry matter, respectively.

Nutrient Requirements

The 1988 NRC Nutrient Requirements of Dairy Cattle are expressed in two forms: daily requirements and concentration per lb of dry matter. Tables 1 and 2 are abbreviated nutrient requirement recommendations. More detailed information may be obtained from "Nutrient Requirement of Dairy Cattle," Sixth Revised Edition 1988, National Academy Press, 2101 Constitution Ave., N.W. Washington, DC 20418.

Table 1. Daily Nutrient Requirements of Dairy Cattle

Live weight (lb)	Energy			Protein			Minerals		Vitamins	
	NEM (Mcal)	NEG (Mcal)	NEL (Mcal)	CP (lb)	UIP (lb)	DIP (lb)	Ca (lb)	P (lb)	A (1,000 I.U.)	D (I.U.)
----- Small-Breed Growing Females -----										
300	3.43	1.58		1.26	0.67	0.33	0.040	0.023	5.77	0.90
500	5.03	2.05		1.60	0.62	0.73	0.047	0.033	9.62	1.50
700	6.47	2.46		2.07	0.61	1.14	0.052	0.039	13.46	2.10
----- Large-Breed Growing Females -----										
300	3.43	1.81		1.29	0.79	0.35	0.043	0.025	5.77	0.90
500	5.03	2.30		1.82	0.72	0.73	0.050	0.035	9.62	1.50
700	6.47	2.74		1.94	0.68	1.11	0.055	0.041	13.46	2.10
900	7.81	3.15		2.52	0.67	1.50	0.063	0.046	17.31	2.69
----- Maintenance of Mature Lactating Cows ¹ -----										
900			7.27	0.879			0.036	0.026	31.0	12.0
1100			8.45	1.082			0.045	0.031	38.0	15.0
1300			9.57	1.275			0.053	0.037	45.0	18.0
1500			10.66	1.461			0.061	0.043	52.0	20.0
----- Maintenance of Mature Dry Cows -----										
900			9.45	1.536			0.059	0.036	31.0	12.0
1100			10.98	1.753			0.072	0.044	38.0	15.0
1300			12.45	2.034			0.086	0.052	45.0	18.0
1500			13.86	2.305			0.099	0.060	52.0	20.0
----- Milk Production - Nutrients/lb of Milk -----										
Fat (%)										
3.5			0.31	0.079			0.0030	0.0018		
4.0			0.33	0.086			0.0032	0.0020		
4.5			0.36	0.092			0.0035	0.0021		
5.0			0.38	0.100			0.0037	0.0023		

¹To allow for growth of young lactating cows, increase the maintenance allowances for all nutrients except vitamins A and D by 20% during the first lactation and 10% during the second lactation.

Table 2. Recommended Nutrient Content for Dairy Cattle in the Total Ration Dry Matter

Cow wt (lb)	Fat (%)	Wt gain (lb.d)	Lactating cows					Early lactation (wk 0-3)	Dry pregnant cows	Growing heifers		
			Milk yield (lb/day)							3-6 mo	6-12 mo	>12 mo
900	5.0	0.50	14	29	43	58	74					
1,000	4.5	0.60	18	36	55	73	91					
1,300	4.0	0.72	23	47	70	93	117					
1,500	3.5	0.82	26	52	78	104	130					
Energy												
NEL, Mcal/lb			0.65	0.69	0.73	0.78	0.78	0.76	0.57			
NEM, Mcal/lb										0.77	0.72	0.63
NEG, Mcal/lb										0.49	0.44	0.37
Protein												
CP, %			12	15	16	17	18	19	12	16	14	12
UIP, %			4.5	5.4	5.7	6.0	6.3	7.2		8.9	5.4	3.2
DIP, %			7.9	8.8	9.7	10.4	10.4	9.7		4.5	6.2	7.0
Fiber (minimum)												
CF, %			17	17	17	15	15	17	22	13	15	15
ADF, %			21	21	21	19	19	21	27	16	19	19
NDF, %			28	28	28	25	25	28	35	23	25	25
Minerals												
Ca, %			0.43	0.53	0.60	0.65	0.66	0.77	0.39	0.52	0.41	0.29
P, %			0.28	0.34	0.38	0.42	0.41	0.49	0.24	0.31	0.30	0.23
Mg, %			0.20	0.20	0.20	0.25	0.25	0.25	0.16	0.16	0.16	0.16
K, %			0.90	0.90	0.90	1.00	1.00	1.00	0.65	0.65	0.65	0.65
Na, %			0.18	0.18	0.18	0.18	0.18	0.18	0.10	0.10	0.10	0.10
Cl, %			0.25	0.25	0.25	0.25	0.25	0.25	0.20	0.20	0.20	0.20
Vitamins												
A, IU/lb			1,450	1,450	1,450	1,450	1,450	1,800	1,800	1,000	1,000	1,000
D, IU/lb			450	450	450	450	450	450	640	140	140	140
E, IU/lb			7	7	7	7	7	7	7	11	11	11