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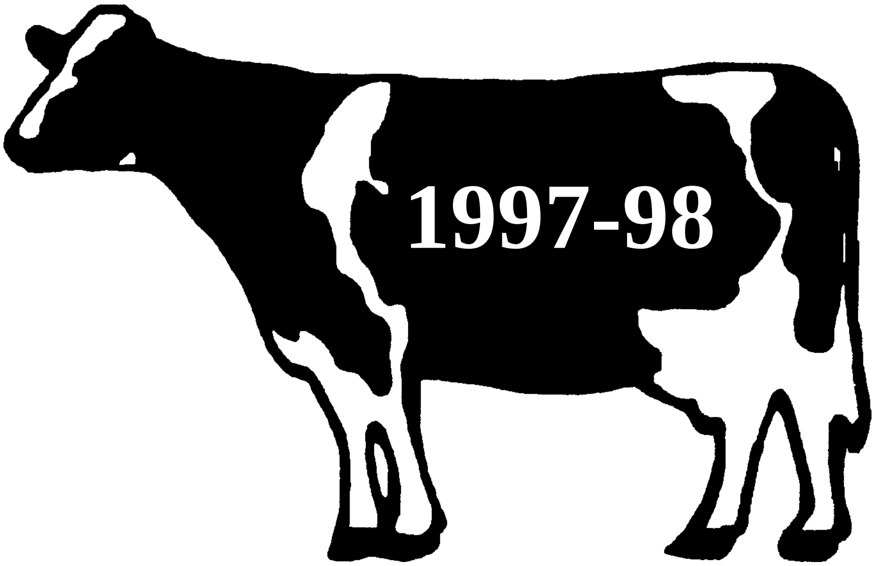

Dairy Report

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Time of Initiating Dietary Fat Supplementation on Lactation and Reproduction

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Summary

Forty-two Holstein cows (21 multiparous) were assigned by calving date and parity to three dietary sequences to evaluate how time of beginning fat supplementation to diets affects lactation and reproductive performance. The dietary sequences were: 1) control, no supplemental fat from 1 to 98 days in milk (DIM); 2) Control diet from 1 to 28 DIM, then 3% supplemental fat (calcium salts of long-chain fatty acids) from 29 to 98 DIM; or 3) 3% supplemental fat from 1 to 98 DIM. Feeding supplemental fat did not enhance mean milk and 4% fat-corrected milk (FCM) yields, although efficiency of FCM production was higher in cows fed supplemental fat. Milk fat percentage was unchanged; protein percentage was depressed with fat supplementation. Feeding supplemental fat reduced both dry matter intake (DMI) and energy balance but there were no differences among treatments on time to resumption of ovarian cyclicity or conception rate. Concentrations of progesterone during the first two ovulatory cycles tended to be greater in fat-supplemented groups. Lactational and reproductive performance were not greatly enhanced by feeding supplemental fat starting either at parturition or 29 DIM, although efficiency of 4% FCM production was enhanced.

Introduction

High milk production per cow contributes to the profitability of a dairy farm. However, an antagonistic association between milk production and reproduction in lactating dairy cows has been documented. Negative energy balance (EB) often accompanies high levels of milk production in early lactation and has been negatively correlated with reproductive performance. High milk production has been found to be antagonistic to expression of estrous behavior. In nulligravid heifers, negative EB reduced luteal secretion of progesterone but did not reduce the concentrations of peak P_4 or duration of estrous behavior.

Adding fat to the diet potentially could be beneficial to milk production and reproductive performance. Earlier studies indicate the inclusion of prilled fat at 2% of dietary DM in dairy cattle rations beginning at parturition had little effect on rumen fermentation, variable effects on milk yield and composition and beneficial effects on conception rate. Some researchers suggest fat should be fed minimally or not at all, during the first 5 to 6 wk of lactation, based on the reported lack of response then. Others found that fat supplementation did not enhance lactation performance, due to depressed intake during early lactation and improved persistency of lactation was obtained when fat addition was not started until 35 DIM.

Frequently, progesterone insufficiency during the early and mid-luteal phase of the estrous cycle is cited as a possible cause of embryo mortality. Reported effects of fat supplementation on progesterone concentrations have been variable. Progesterone concentrations during the luteal phase after breeding were higher in cows fed 5% prilled long-chain fatty acids, but conception rates were not different from controls. Time of partially hydrogenated tallow addition to diets did not influence reproduction.

The objective of this study was to determine how time of initiating supplementation of a rumen inert fat to increase energy density of the diet affects early lactation and reproductive performance.

Procedures

Forty-two Holstein (21 multiparous) cows were blocked by parity and assigned randomly at parturition to one of three diets: control, no supplemental fat (C); supplemental fat starting at 29 DIM (C-CaFA); or supplemental fat starting at parturition (CaFA). Three C and two C-CaFA cows were removed from the study due to reasons not related to the dietary treatments. The cows were fed individually their assigned TMR once daily for ad libitum intake in a tie-stall barn from parturition to 98 DIM. The control diet was 48:52 forage to concentrate (DM basis with no supplemental fat). Supplemental CaFA (Megalac®, Church & Dwight Co., Inc., Princeton, NJ) was added to the control diet at 3% of concentrate DM and fed beginning at parturition (CaFA) or at 29 DIM (C-CaFA). The control and fat-containing diets were similar except for energy density. Composition of feed ingredients and TMR were determined at the beginning of the experiment (Table 1).

Cows were milked twice daily and production was recorded electronically. A daily composite of milk samples from

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Table 1. Ingredient and nutrient composition of diets.

	Diets	
	Control	CaFA[a]
Ingredient	--- (% of DM) ---	
Alfalfa haylage	16.0	16.0
Corn silage	32.0	32.0
Corn, ground shell	24.6	23.2
Soybean meal, 44% CP	16.1	15.8
Corn distillers, dry	5.1	5.0
Blood meal	.9	.9
Soybean hulls	1.9	1.9
Mineral-vitamin mix[a]	3.4	2.2
CaFA[b]	—	3.0
Composition[c]		
DM, %	69.6	69.8
CP	17.8	17.5
RUP[d]	6.2	6.1
NDF	30.1	29.8
NE_L[d], Mcal/kg	1.69	1.82

[a]Mineral and vitamin mix formulated to meet or slightly exceed requirements of NRC.
[b]Calcium salts of long-chain fatty acids, Megalac® (Church and Dwight Co., Princeton, NJ).
[c]Dietary composition calculated from composition of individual ingredients.
[d]Calculated from values in NRC, except for NE_L of CaFa for which a value of 6.52 Mcal/kg was used (Andrew, S.M., H.F. Tyrrell, C.K. Reynolds, and R.A. Erdman. 1991. Net energy for lactation of calcium salts of long-chain fatty acids for cows fed silage-based diets. J. Dairy Sci. 74:2588).

a.m. and p.m. milkings were taken weekly and analyzed for fat and protein (Milko-Scan Fossomatic, Foss Food Technology Corp., Eden Prairie, MN).

Body weight and body condition score (BCS) were determined weekly. Assessment of BCS (1=emaciated, 5=obese) was based on appearance and palpation of the loin and pelvic regions. Dry matter intake (DMI), net energy intake (NE_L) and net energy balance (NEB) were determined weekly.

Blood samples were collected twice weekly from 2 wk postpartum until 4 wk after first service. Concentrations of progesterone in blood plasma were used to determine postpartum interval to first ovulation, ovarian cyclicity and corpus luteum competency.

The breeding program was initiated at 8 wk postpartum. Cows were given 25 mg $PGF_{2\alpha}$ (Lutalyse®, The UpJohn Co., Kalamazoo, MI) on the Monday morning after they reached this stage of lactation. Cows were bred by standard AI procedures based on observed estrus. The $PGF_{2\alpha}$ treatment was repeated at weekly intervals on cows not detected in estrus, for a maximum of three treatments. Conception rate was defined as the percentage of inseminated cows diagnosed pregnant. The pregnancy rate was defined as the percentage of total cows in the group diagnosed pregnant.

Results

Mean milk yield and 4% FCM during the experimental period were similar among diets (Table 2). However, efficiency of FCM production, lb FCM/lb DMI, was higher in the CaFA groups compared with the C group. Milk fat percentage was not affected by diet. Milk protein percentage was lower in cows fed CaFA (Table 2).

The DMI and DMI as a percentage of body weight were higher in the C group compared with the C-CaFA and CaFA groups (Table 3). Average daily net EB was higher in the C cows compared to those in the CaFA supplemented groups due to greater DMI. The amount of BW and BCS loss postpartum, and the intervals until the cows started to gain back BW and BCS, were similar among diets (Table 3). Also, the change in BW and

Table 2. Effect of time of initiating dietary fat supplementation on lactation performance.[a]

	Diets[b]			
	Control	C-CaFA	CaFA	SEM
Number of cows	11	12	14	
Milk yield, lb/d	65.8	64.7	64.2	1.0
4% FCM, lb/d	61.9	60.4	60.2	.9
FCM/DMI, lb/lb	1.35[c]	1.48[d]	1.57[e]	.03
Milk composition				
Milk fat, %	3.63	3.61	3.66	.05
Milk protein, %	3.18[c]	3.08[d]	3.05[d]	.03

[a]Least square means for the experimental period (1 to 98 DIM).
[b]CaFA = Calcium salts of long-chain fatty acids, Megalac® (Church and Dwight Co., Princeton, NJ); C = Control.
[c,d,e]Means within a row with different superscripts differ ($P < .01$).

Table 3. Effect of time of initiating dietary fat supplementation on DMI, body measures, total cholesterol, and EB.[a]

	Diets[b]			
	Control	C-CaFA	CaFA	SEM
Number of cows	11	12	14	
DMI				
Mean, lb/d	47.5[c]	41.4[d]	40.0[d]	.7
% of BW	3.83[c]	3.40[d]	3.27[d]	.05
Body weight				
Mean, lb	1210	1214	1219	8.4
Interval to nadir, d	35.1	46.8	33.5	5.3
Change to nadir, lb	-87.6	-101.6	-96.1	15.2
Change to 8 wk, lb	4.6	-58.5	-33.2	24.2
BCS				
Mean	2.97[e]	3.14[f]	3.21[f]	.05
Interval to nadir, d	45.0	42.0	50.5	4.6
Change to nadir	-.71	-.77	-.82	.13
Change to 8 wk	-.50	-.50	-.43	.15
Net energy balance mean, Mcal/d	6.82[e]	5.29[f]	4.79[f]	.47

[a]Least square means for the experimental period (1 to 98 DIM).
[b]CaFA = Calcium salts of long-chain fatty acids, Megalac® (Church and Dwight Co., Princeton, NJ); C = Control.
[c,d]Means within a row with different superscripts differ ($P < .05$).
[e,f]Means within a row with different superscripts differ ($P < .01$).

BCS from parturition to the start of the breeding program at 8 wk was not different between diets.

Peak concentrations of progesterone in plasma during the first estrous cycles were greater in the C-CaFA group compared with those in the C group (Table 4). Other comparisons of progesterone concentrations were not statistically improved by CaFA supplementation.

The postpartum intervals to first and second ovulation based on progesterone profiles and first AI were similar among all cows (Table 4). Reproductive performance, including percentage of cows ovulating by 98 DIM and first service conception rate were similar among diets. Although numerically more CaFA cows were pregnant by 98 DIM, the numbers were not adequate for a good statistical test.

[1]Jung-Ho Son, former graduate student; William Chapman, graduate student; Rick Grant, Associate Professor and Extension Dairy Specialist; Larry Larson, Associate Professor, Animal Science, Lincoln.

Table 4. Effect of time of initiating dietary fat supplementation on reproductive measures.[a]

	Diets[b]			
	Control	C-CaFA	CaFA	SEM
Number of cows	11	12	14	
First ovulation cycle				
Peak progesterone[c], ng/ml	8.88[d]	12.74[e]	10.23[de]	1.05
Luteal phase[f], ng/ml	5.62	8.03	6.51	.81
Second ovulation cycle				
Peak progesterone, ng/ml	9.52	13.28	11.10	1.17
Luteal phase, ng/ml	5.71	8.80	7.28	1.00
Postpartum intervals to				
First ovulation[g], d	29.4	40.0	31.4	3.8
Second ovulation[g], d	50.0	61.4	53.5	3.4
First AI, d	61.6	63.2	62.6	3.2
Conception rate at first AI, %	36.4 (4/11)[h]	18.2 (2/11)	35.7 (5/14)	
Performance to 98 DIM				
Ovulated, %	100 (11/11)	100 (12/12)	92.85 (13/14)	
Pregnancy rate, %	36.4 (4/11)	36.4 (4/11)	50.0 (7/14)	

[a]Least square means.
[b]CaFA = Calcium salts of long-chain fatty acids, Megalac® (Church and Dwight Co., Princeton, NJ); C = Control.
[c]Average of two highest concentrations in each cycle.
[d,e]Means within a row with different superscripts differ (P < .05).
[f]From samples collected d 8 to 16 after ovulation.
[g]Based on progesterone profiles.
[h]Number of animals.

A Soyhull:Soy Lecithin:Soapstock Mixture for Early Lactation Dairy Cows

William Chapman
Rick Grant
Larry Larson[1]

Summary

The effectiveness of soyhull:soy lecithin:soapstock mixture as an energy source for early lactation dairy cows was evaluated. Thirty-seven Holstein cows were blocked by parity and assigned to one of two dietary regiments, 1) Control with no supplemental fat or 2) Soy lecithin and soapstock fat source added at 3% of DM. Lecithin and soapstock were mixed 1:1 on a DM basis and added to soyhulls at a ratio of 15:85. Dry matter intake did not differ between treatment groups. Cows fed fat produced more pounds of milk and 4% fat-corrected milk. Supplemental fat fed increased the pounds of protein and fat, although the milk fat and protein percentages were lower. There was no treatment effect on body condition score (BCS) or body weight. Net energy balance (NEB) was more positive in the fat-supplemented cows. Efficiency of fat-corrected milk production did not differ between groups. In summary, soyhull:soy lecithin:soapstock is an economical fat source that can be used in a dairy cow diet to increase energy density.

Introduction

Early lactation cows experience varied degrees of negative energy balance. Milk production increases at a faster rate than dry matter intake, adding to the severity of the negative energy balance. Fat supplementation can help minimize the negative energy balance by increasing the diet's energy density while minimizing metabolic problems, such as acidosis, caused by overfeeding concentrates.

Several fat sources are available. Two criteria are used in determining whether a fat source is economical to use by a

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dairy producer, 1) the price of the fat source and 2) its benefits and negative effects. Soybean lecithin and soapstock are two coproducts of the soybean oil refining process. Currently, there are more lecithin and soapstock produced than demanded. The price of these coproducts is economical, but the production responses are not fully understood. Previous work at Nebraska suggested soy lecithin and soapstock in a ratio of 1:1 and fed at 3% of the dietary DM did not depress dry matter intake of lactating dairy cows. The objective of this study was to evaluate the effect of soy lecithin and soapstock as dietary energy sources in early lactation cows.

Procedures

Thirty-seven early lactation Holstein dairy cows were paired by parity and calving date. Pairs were then assigned randomly to one of two dietary regimens: 1) Control diet with no supplemental fat; or 2) lecithin and soapstock added at 3% of the dietary DM. Both diets were isonitrogenous with similar fiber contents. The dietary variable was a lecithin and soapstock mixture (1:1, DM basis) as supplemental fat added to the diet at 0 or 3% of DM. Soyhulls were mixed with the lecithin and soapstock mixture at a ratio of 85:15 (DM basis), as determined by earlier studies conducted at Nebraska. Soyhulls are an excellent fiber source and aid in the handling of lecithin and soapstock. The control diet contained the same amount of soyhulls, alfalfa haylage and corn silage as the treatment diet to give animals equal amounts of fiber from similar sources. All animals were fed individually a total mixed ration (TMR) once daily. Feed samples were collected each week and pooled for analysis (Table 1).

All cows were fed a common diet for the first 3 wk of lactation. At the end of the adaptation period, cows were started on treatment regimen and remained on treatment until 14 wk postpartum. Cows had water and TMR offered ad libitum. Body condition scores (BCS) and body weights were taken weekly and evaluated. Milk weights were taken daily and weekly averages calculated. Milk samples were taken weekly to determine fat and protein percentages. Data was analyzed as a split - plot in time using the General Linear Model of SAS.

Results

As expected, older cows had higher DMI and produced more milk and 4% fat-corrected milk (FCM) than heifers. Because cows and heifers responded similarly to the supplementation of soy lecithin and soapstock, results are expressed as general responses to treatment.

Cows supplemented with fat tended to have higher intakes than those without fat supplementation (Table 2). All animals increased in DMI over time. Fat supplementation increased milk production (Figure 1) and FCM. Animals supplemented with fat in the diet produced more pounds of milk fat, but at a lower percentage due to the dilution effect of increased production. All animals increased in daily pounds of milk protein produced over the time of the trial. Pounds of milk protein was greater in animals supplemented with fat. Protein percentage responded in a similar manner as fat percentage with fat-supplemented cows having lower protein percentages due to dilution resulting from increased production. Although there were no differences in body condition scores, there was a slight increase in condition throughout the trial. There were no treatment effects on body weight;

Table 1. Dietary ingredients and nutrient composition of the diets.

	Diet	
	Control	Lecithin and Soapstock
	------- (% of DM) ------	
Ingredient		
Alfalfa haylage	18	18
Corn Silage	22.5	22.5
Ground Alfalfa	4.5	4.5
Corn	21.4	17.5
Soyhulls	17.1	—
SH:SL:SS[1]	—	20.1
SoyPass	4.7	4.7
Soybean Meal	8.8	9.7
Vitamin-mineral mix[2]	3.0	3.0
Composition		
DM%	60.5	60.1
CP	17.6	17.7
ADF	27.6	27.4
NDF	41.2	40.5
EE	2.91	5.68
NFC	28.9	26.8
NE_L[3] Mcal/lb	0.73	0.77

[1]Soyhull:Soy lecithin: Soapstock mixture (85:7.5:7.5) DM basis.
[2]Supplement contained 15.2% Ca, 7.2% P, 4.1% Mg, 4% Na, 3000 ppm of Zn, 1750 ppm of Mn, 400 ppm of Cu, 441,000 IU/lb of vitamin A, 79,380 IU/lb of vitamin D_3, and 1323 IU/lb of vitamin E.
[3]Calculated using values in NRC.

Table 2. Summary of lactational performance.

	Parity			
	1		2	
Treatment	Control	Fat	Control	Fat
Number of Animals	7	8	11	11
DMI[1], lbs	44.1[a]	47.3[a]	59.7[b]	64.9[b]
Milk, lbs	54.2[a]	65.8[b]	76.9[c]	89.3[d]
4% FCM, lbs	51.0[a]	60.2[b]	71.1[c]	78.5[d]
Fat, lbs	1.94[a]	2.26[b]	2.69[c]	2.87[d]
Fat, %	3.62[a]	3.44[b]	3.51[a]	3.20[b]
Protein, lbs	1.65[a]	1.92[b]	2.34[c]	2.58[d]
Protein, %	3.08[a]	2.92[b]	3.04[a]	2.89[b]
BCS[2]	3.00	3.11	3.03	3.03
Body Weight, lbs	1098[a]	1058[a]	1262[b]	1303[b]
NEB[3], Mcal/d	7.53[a]	9.10[b]	11.63[c]	15.37[d]
Efficiency (FCM/DMI)	1.17	1.29	1.21	1.22

[a,b,c,d]Means within a row with different superscripts differ ($P < 0.05$)
[1]Dry matter intake
[2]Body condition score
[3]Net energy balance

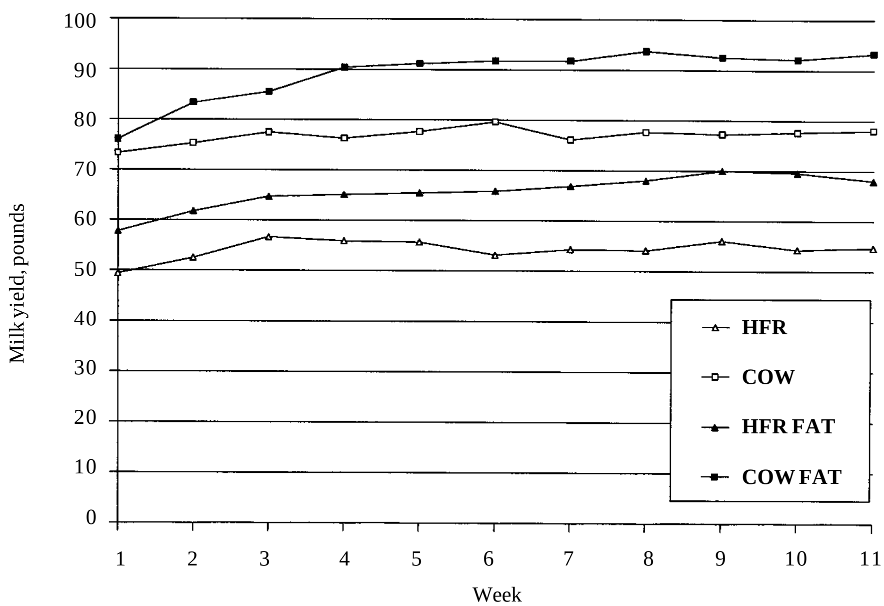

Figure 1. Milk production by week of the trial.

all animals increased in weight over the treatment period. Animals supplemented with fat were in a more positive energy balance than the controls. Energy balance increased in all animals over time. There were no differences in efficiencies; all animals decreased in efficiency over time.

In summary, soy lecithin and soapstock showed positive production responses when compared with no fat supplementation in the diet. Soy lecithin and soapstock are effective and economical sources of lipid for producers to increase the energy density of the diet.

[1]William Chapman, graduate student; Rick Grant, Associate Professor and Extension Dairy Specialist; Larry Larson, Associate Professor, Animal Science, Lincoln.

Nonenzymatically Browned Soybeans for Dairy Cattle

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Summary

A lactation trial was conducted in which 60 Holstein cows were assigned to one of five total mixed rations from wk 3 to 18 of lactation. Diets were 1) 4.5% added lipid (fat) from soybean oil, 2) 1.5% added lipid from nonenzymatically brown soybeans and 3% soybean oil, 3) 3% added lipid from nonenzymatically browned soybeans and 1.5% soybean oil, 4) 4.5% added lipid from nonenzymatically browned soybeans and 5) 4.5% added lipid from calcium salts of long-chain fatty acids (Megalac®). During the final 9 wk of the trial, dry matter intake and 4% fat-corrected milk (FCM) yield were reduced by 11 and 15%, respectively, for the soybean oil diet compared with the other diets. Milk C18:2 and C18:3 fatty acids were increased as nonenzymatically browned soybean inclusion in the diet increased. All percentages of the nonenzymatically browned soybeans tested resulted in FCM similar to the calcium salts of fatty acid diet and higher than the soybean oil diet, but with more desirable milk fatty acid profiles.

Introduction

Lipid inclusion in dairy cow rations increases the energy density of the diet, enabling early lactation cows to attain full milk yield potential. More recently, lipids have been included in the diet in an attempt to alter the fatty acid (**FA**) composition of milk fat, improving its nutritional value and physical properties. Lipids, especially those containing polyunsaturated FA, have an adverse effect on ruminal microflora and fiber digestibility. When fed at high concentrations in the diet, these lipids resulted in reduced yields of milk and milk constituents. Ruminal hydrogenation of FA has been avoided by treating mixtures of lipid and protein with formaldehyde.

Induced nonenzymatic browning (Maillard reaction) has been used to improve protein utilization efficiency by ruminants. Protection of the oilseed's protein fraction may indirectly protect the lipid fraction as well. This temperature- and moisture-controlled process may also reduce FA release by binding unsaturated FA peroxides with amino groups of proteins. No data exist concerning the effect of this processing on ruminal fermentation, fiber digestibility and milk production and composition. If the nonenzymatic browning process results in a better protection of the lipid fraction from ruminal degradation than a simple roasting, a higher proportion of the polyunsaturated FA would be

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delivered postruminally and be available for milk fat synthesis.

The objective of this experiment was to determine the effect of lipid from nonenzymatically browned soybeans (**NEBB**) on milk FA profiles and long-term lactational performance of dairy cows.

Procedures

Sixty Holstein cows, blocked by parity and calving date, were assigned randomly to one of five treatments. Dietary treatments were 1) 4.5% added lipid from soybean oil (SBO), 2) 1.5% added lipid from NEBB and 3% SBO, 3) 3% added lipid from NEBB and 1.5% SBO, 4) 4.5% added lipid from NEBB and 5) 4.5% added lipid from calcium salts of long chain fatty acids (**CaFA**; Megalac; Church & Dwight Co., Inc., Princeton, NJ; Table 1). All diets were fed twice daily as total mixed rations in amounts to ensure 10% refusals. Diets were formulated to be isonitrogenous (19.0% CP) and consisted of 50% forage (1:4 alfalfa:corn silages, DM basis). Soypass (nonenzymatically browned soybean meal) was used as the supplemental CP source and 0.8% urea was added to ensure the requirement for soluble CP was met for all diets. Beginning at 63 days in milk, all cows received BST (Posilac, Monsanto, St. Louis, MO) every 2 wk for the remainder of the trial.

A common diet was fed to all cows for 3 wk postpartum during a covariate period. The covariate diet contained 50% forage (1:4 alfalfa:corn silages, DM basis) and no supplemental lipid. The experimental period began at 4 wk postpartum and lasted for 18 wk. Cows were housed in tie stall barn and were removed twice daily for milking, exercise and estrus detection.

Results

Dietary nutrient profiles are in Table 1. The SBO diet was a negative control diet, containing 4.5% added lipid readily and rapidly available in the rumen. The CaFA diet was a positive control diet,

Table 1. Ingredient and nutrient composition for lactation trial.

Item	1	2	3	4	5
	(% of DM)				
Ingredient					
Alfalfa silage	12.5	12.5	12.5	12.5	12.5
Corn silage	37.5	37.5	37.5	37.5	37.5
Corn, ground	24.1	23.8	24.6	24.5	23.7
Treated soybeans	—	7.5	15.0	22.5	—
Soybean oil	4.5	3.0	1.5	—	—
Megalac	—	—	—	—	5.3
Soypass	18.8	12.7	6.4	0.8	18.8
Urea	0.8	0.8	0.8	0.8	0.8
Mineral-vitamin mix[2]	1.8	2.2	1.7	1.4	1.4
Composition					
DM, %	52.3	52.5	52.6	52.7	52.9
CP	19.2	19.0	18.9	18.9	19.1
RUP[3], % of CP	46.7	47.1	47.3	47.7	46.9
RDP[4], % of CP	53.3	52.9	52.7	52.2	53.0
Soluble CP, % of CP	34.3	32.3	30.9	30.0	34.1
NDF	29.2	29.5	29.5	29.7	29.1
ADF	18.2	18.4	18.4	18.6	18.1
Added lipid[5]	4.5	4.5	4.5	4.5	4.5
NE_L[6], Mcal/kg	1.91	1.94	1.94	1.94	1.96

[1]Diet 1 = 4.5% lipid from soybean oil (SBO), Diet 2 = 1.5% lipid from nonenzymatically browned soybeans (NEBB) + 3% lipid from SBO, Diet 3 = 3% lipid from NEBB + 1.5% lipid from SBO, Diet 4 = 4.5% lipid from NEBB, and Diet 5 = 4.5% lipid from Megalac.
[2]Supplement contained 15.2% Ca, 7.2% P, 4.1% Mg, 4% Na, 3000 ppm of Zn, 1750 ppm of Mn, 400 ppm of Cu, 200,000 IU/kg of vitamin A, 36,000 IU/kg of vitamin D_3, and 600 IU/kg of vitamin E.
[3]Rumen undegradable protein; calculated using tabular values of NRC (1989), and a value of 70% RUP for Soypass and NEBB.
[4]Calculated as 100 - RUP.
[5]Amount of lipid added to diets from NEBB, SBO or Megalac. Does not include lipid from other dietary ingredients.
[6]Calculated energy content based on NRC (1989) values for individual ingredients.

Table 2. Performance responses during the 18-week lactation experiment.

	Diet[1]					
Item	1	2	3	4	5	SE
DMI						
lb/d	50.9	55.6	52.7	55.1	53.8	2.6
% of BW	4.5	4.6	4.6	4.7	4.4	0.2
Milk yield, lb/d	71.4	75.6	69.9	70.3	69.5	3.5
Milk fat						
%	2.7[c]	3.0[b]	3.5[a]	3.4[a]	3.5[a]	0.1
lb/d	2.0[b]	2.2[a]	2.4[a]	2.4[a]	2.4[a]	0.2
Milk protein						
%	2.9	2.8	2.7	2.8	2.7	0.1
lb/d	2.13	2.13	1.92	1.98	1.92	0.09
4% FCM, lb/d	59.5	65.2	64.8	65.3	64.8	3.3
FCM/DMI, lb/lb	1.18	1.18	1.23	1.20	1.20	0.15
Body condition score	3.01[b]	3.17[a]	3.05[b]	3.05[b]	3.10[ab]	0.04
Body weight, lb	1133	1217	1133	1162	1222	41
NEB[2], Mcal/d	17.1	19.1	17.3	19.3	18.1	1.9

[a,b]Means with different superscripts differ ($P < 0.05$).
[1]Diet 1 = 4.5% lipid from soybean oil (SBO), Diet 2 = 1.5% lipid from nonenzymatically browned soybeans (NEBB) and 3% SBO, Diet 3 = 3% lipid from NEBB and 1.5% SBO, Diet 4 = 4.5% lipid from NEBB, and Diet 5 = 4.5% lipid from calcium salts of long-chain fatty acids.
[2]Net energy balance.

Table 3. Intake and FCM responses during the last 9 weeks following dietary adaptation.

	Diet[1]					
Item	1	2	3	4	5	SE
DMI						
lb/d	50.9^{b}	58.2^{a}	55.3^{ab}	58.2^{a}	55.3^{ab}	2.4
% of BW	4.39^{b}	4.68^{ab}	4.75^{ab}	4.84^{a}	4.45^{ab}	0.16
4% FCM, lb/d	55.8^{b}	65.5^{a}	64.4^{a}	64.8^{a}	62.8^{a}	3.1

[a,b]Means with different superscripts differ ($P < 0.05$).
[1]Diet 1 = 4.5% lipid from soybean oil (SBO), Diet 2 = 1.5% lipid from nonenzymatically browned soybeans (NEBB) and 3% SBO, Diet 3 = 3% lipid from NEBB and 1.5% SBO, Diet 4 = 4.5% lipid from NEBB, and Diet 5 = 4.5% lipid from calcium salts of long-chain fatty acids.

Table 4. Effect of lipid supplementation on weight percentages of fatty acids in milk.

	Diet[1]					
Fatty acid	1	2	3	4	5	SE
4:0	4.17^{a}	3.52^{ab}	2.99^{b}	3.10^{ab}	3.62^{ab}	0.46
6:0	1.05^{c}	1.71^{a}	1.65^{ab}	1.60^{ab}	1.42^{b}	0.10
8:0	0.49^{c}	0.88^{b}	0.96^{ab}	1.08^{a}	0.85^{b}	0.07
10:0	1.02^{c}	1.69^{b}	1.85^{ab}	2.08^{a}	1.54^{b}	0.14
12:0	1.43^{c}	2.19^{a}	2.35^{a}	2.48^{a}	1.92^{b}	0.16
14:0	7.89^{b}	9.05^{a}	9.09^{a}	8.96^{a}	8.35^{b}	0.45
14:1	0.77^{a}	0.77^{a}	0.63^{b}	0.61^{b}	0.60^{b}	0.05
16:0	26.03^{b}	25.61^{b}	26.58^{b}	24.22^{b}	35.73^{a}	0.75
16:1	1.77^{a}	1.27^{b}	1.02^{c}	0.79^{c}	1.28^{b}	0.09
18:0	15.01^{b}	16.20^{a}	16.62^{a}	16.54^{a}	10.78^{c}	0.66
18:1	33.49^{a}	27.87^{b}	24.07^{c}	23.78^{c}	27.48^{b}	1.01
18:2	5.62^{d}	8.35^{c}	10.52^{b}	12.76^{a}	5.62^{d}	0.53
18:3	0.59^{d}	1.06^{c}	1.52^{b}	1.92^{a}	0.73^{d}	0.08
20:0	1.85^{a}	0.61^{b}	0.43^{b}	0.56^{b}	0.88^{ab}	0.48

[a,b,c]Means with unlike superscripts differ ($P < 0.05$).
[1]Diet 1 = 4.5% lipid from soybean oil (SBO), Diet 2 = 1.5% lipid from nonenzymatically browned soybeans (NEBB) and 3% SBO, Diet 3 = 3% lipid from NEBB and 1.5% SBO, Diet 4 = 4.5% lipid from NEBB, and Diet 5 = 4.5% lipid from calcium salts of long-chain fatty acids.

containing 4.5% added lipid from a ruminally inert source.

Table 2 summarizes the average performance response during the entire experiment. Dry matter intake, body weight, energy balance and milk production were unaffected by diet. However, performance responses during the last 9 week (Table 3) revealed the SBO diet resulted in less intake and 4% FCM production compared with the other diets. The reduction in FCM yield reflects the responses observed in milk fat synthesis. Milk fat percentage and daily milk fat production increased linearly as SBO was reduced and NEBB increased. Furthermore, the highest dietary concentrations of NEBB resulted in milk fat production similar to the positive control diet. These results indicate a reduced negative impact of SBO on ruminal fermentation as dietary NEBB concentration increased.

The effect of lipid source on milk FA content is shown in Table 4. The SBO diet significantly reduced the content of short and medium chain FA (C6:0 to C14:0) compared to the NEBB diets. Dietary SBO has been shown to depress fiber digestibility and acetate to propionate ratio, which directly and indirectly decreases the acetate supply to the mammary gland for de novo synthesis of short chain FA.

The amount of C18:3 and C18:2 increased linearly as SBO was replaced with incremental levels of NEBB. The amount of C18:1 was highest for the SBO diet. Our data compares with studies in which the lipid in soybeans was unprotected (raw or extruded soybeans), partially protected (roasted soybeans) or fully protected (formaldehyde or aldehyde treated-soybeans). Feeding 20% roasted soybeans (approximately 4% added lipid) resulted in similar C16:0 and C18-series FA, compared with a diet containing 4% SBO. Likewise, feeding 3.4% SBO, 16% raw soybeans or 16% roasted soybeans demonstrated roasting did not spare the unsaturated FA in soybeans from hydrogenation in the rumen.

Transfer of C18:2 FA to milk was calculated. The transfer of C18:2 to milk was 12.4% for the diet containing 4.5% lipid from NEBB. We estimated the degree of ruminal protection of the oil in the NEBB by comparing this value to the amount obtained when formaldehyde-treated SBO was fed. The reported range in transfer of C18:2 for formaldehyde treatment was 19 to 37%, meaning we have potentially achieved protection of between 38 and 74% of formaldehyde treatment in our study. Assuming formaldehyde treatment confers 100% protection to C18:2, then, on average, the oil in NEBB would be approximately 50% protected.

The results of these experiments clearly indicate the lipid from NEBB is substantially more protected in the rumen than free oil. Milk fat secretion was similar to a ruminally inert source of lipid, but with more desirable milk FA composition. The NEBB resulted in increased efficiency of transfer of C18:2 FA compared with roasted soybeans, which are commonly fed to lactating dairy cows in the US.

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Feather and Blood Meal Combination for Lactating Dairy Cows

Serhan Haddad
Rick Grant[1]

Summary

An 18-week lactation experiment was conducted to determine the effect of supplemental feather and blood meals (85:15, DM basis) fed at two dietary CP concentrations on intake and milk protein production. Forty-eight Holstein cows were grouped by parity and assigned randomly at 3 weeks postpartum to one of four diets following a 2-week covariate period. Diets consisted of 50% alfalfa silage and 1) no feather: blood meal (CP = 17.6%; rumen undegradable protein (RUP) = 5.1%), 2) 4% feather:blood meal (CP = 17.6%, RUP = 6.3%), 3) no feather:blood meal (CP = 19.6%, RUP = 6.3%) and 4) 4% feather:blood meal (CP = 19.6%, RUP 6.9%). According to NRC (1989), diet 1 was deficient in RUP, diets 2 and 3 were adequate and diet 4 was excessive for both CP and RUP. Intakes of DM and CP (% of BW) were depressed by 11% with supplemental feather:blood meal at both CP concentrations. Addition of feather: blood meal increased RUP intake (% of BW) with the 17.6% CP diet, but had no effect on intake with the 19.6% CP diet. Supplemental feather:blood meal increased milk, milk protein and 4% FCM production with the 17.5% CP diet, but depressed these same variables with the 19.6% CP diet. Feather:blood meal supplementation improved efficiency of FCM production at both CP concentrations, but efficiency of milk protein production was increased by feather:blood meal only for the 17.6% CP diet. There was no influence of diet on average body weight or body condition score or change in body weight or body condition score throughout the experiment. Average net energy balance was positive for all diets. Results of this experiment indicate a feather:blood meal mixture improves production of milk protein when fed in a diet meeting the NRC requirements for CP and RUP and containing alfalfa as the sole forage. When supplementation results in excessive dietary CP and RUP, milk protein production declines.

Introduction

High quality alfalfa, which comprises a large dietary component for lactating dairy cows, typically contains CP in excess of 18 to 20%. To effectively utilize this alfalfa, however, a dietary source of RUP is needed to compensate for the high ruminal degradability of CP from alfalfa (>75%). Wisconsin researchers using early lactation dairy cows examined the impact of adding fish meal to diets containing 70% alfalfa silage. This research showed increased milk yield and body weight gain for cows fed fish meal compared with those fed soybean meal. The same laboratory had previously demonstrated cows fed alfalfa silage produced less milk protein than cows fed corn silage-based diets supplemented with soybean meal to equalize dietary CP concentration.

Compared with other animal protein coproducts such as fish meal, feather meal is often the most economical source of CP. Despite the favorable economics, there is little use of feather meal by the dairy industry. A primary problem has been the lack of a definitive lactation experiment to demonstrate the potential effectiveness of feather meal as a source of dietary RUP in alfalfa-based rations.

Also, the amino acid (AA) balance of the supplemental RUP source must be considered. Milk protein will increase only if there is an increased, balanced supply of AA to the small intestine, or, perhaps, if there is an excessive, unbalanced supply of AA. In most instances, a balanced supply of AA, relative to milk protein production requirements, would be more economical than overfeeding a RUP supplement with poor AA balance.

For the lactating dairy cow, feather meal has a higher RUP value than soybean meal. However, feather meal may not be a balanced source of RUP with respect to AA. Feather meal contains only 2% lysine, whereas blood meal contains 8.3%. Research with beef cattle has clearly demonstrated a mixture of approximately 85% feather meal and 15% blood meal (**FBM**) elicits a greater growth response than feather meal alone. Feeding a 1:1 FBM instead of soybean meal increased both intestinal supply and absorption of AA in lactating dairy cows. However, no lactation experiment utilizing alfalfa as the sole dietary forage has been conducted to determine if FBM supplementation would result in increased milk protein production.

The objectives of this experiment were to determine the impact of FBM on milk and milk protein production, intake and body condition during the first 20 weeks of lactation.

Procedures

Forty-eight Holstein dairy cows were grouped by parity and randomly assigned at 3 wk postpartum to one of four experimental diets following a 2-wk covariate period. The diet fed during the covariate period consisted of 50% alfalfa silage and 50% of a concentrate mixture comprised of corn, soybean meal and a mineral and vitamin supplement. No FBM was fed during the covariate period. The experimental diets were arranged as a 2$\times$2 factorial with dietary CP concentrations of 17.5% or 19.5% (DM basis) and RUP supplementation of either 0 or 4% FBM (DM basis). The FBM consisted of 85% hydrolyzed feather meal and 15% blood meal (DM basis). The ingredient and nutrient composition of the diets are shown in Table 1. Diets were formulated to be essentially isocaloric and to contain 50% high-quality alfalfa silage. These diets were fed from 3 to 20 wk of lactation.

Cows were housed in a tie-stall barn equipped with individual feed boxes. All diets were fed twice daily as TMR to promote maximal intake. Cows were removed twice daily from the barn for milking, exercise and estrus detection for a total of approximately 4 h. Feed samples were composited weekly for nutrient analyses.

Cows were milked twice daily and yield was recorded electronically. A daily composite of milk samples from a.m. and p.m. milkings was taken once weekly and analyzed for fat, total protein and lactose. Body weight and body condition score (1 = emaciated to 5 = obese) were recorded weekly.

Results

According to the NRC (1989) for early lactation cows, the low CP - FBM diet was deficient in undegradable intake protein (5.1% versus requirement of 6.1%). The low CP + FBM diet nearly met the undegradable intake protein requirement (6.3% versus requirement of 6.1%), whereas the high CP - FBM diet met the requirement, but by using excessive CP concentration supplied primarily by alfalfa and soybean meal. The high CP + FBM diet supplied both CP and undegradable intake protein in excess of NRC requirements (6.9% of DM). These diets were designed and formulated to test the effect of FBM on lactational performance and to evaluate the NRC concept of undegradable intake protein for alfalfa-based diets containing high concentrations of CP.

Dry matter intake was depressed by 16% with added FBM at 19.6% CP, but not at 17.6% CP (Table 2). However, when expressed as a percentage of body weight, intake was depressed 11% by addition of FBM at both CP concentrations.

Intake of dietary CP was increased with the higher CP diets, as expected (Table 2). Addition of FBM reduced CP intake, which reflected the changes observed for dry matter intake. However, due to differences among the diets in RUP concentration, RUP intake was least for the low CP - FBM diet, and similar for the other three diets (Table 2).

The effects of dietary CP concentration and the addition of FBM to early lactation diets are summarized in Table 3. Higher dietary CP concentration resulted in increased milk production. Addition of FBM increased milk production for cows fed the 17.6% CP diet, however, milk production for cows fed the 19.6% CP diet decreased. Although milk protein percentage was unaffected by diet (Table 3), addition of FBM to the

(Continued on next page)

Table 1. Ingredient and nutrient composition of experimental diets.

	Low CP		High CP	
Item	-FBM[1]	+FBM	-FBM	+FBM
Ingredients	(% of DM)			
Alfalfa silage[2]	50.0	50.0	50.0	50.0
Corn, ground	40.6	45.4	35.1	41.3
Soybean meal, 44% CP	8.7	—	14.2	4.1
FBM	—	4.0	—	4.0
Minerals and vitamins[3]	0.7	0.6	0.7	0.6
Composition				
DM, %	60.1	59.9	60.0	59.8
CP	17.7	17.5	19.8	19.4
RUP	5.1	6.3	6.3	6.9
ADF	20.2	19.7	20.2	20.1
NDF	28.6	27.9	28.3	28.3
NFC[4]	40.2	42.7	39.7	40.7
EE	3.6	3.9	3.8	3.8
NE_L,[5] Mcal/kg	1.72	1.72	1.73	1.72

[1]FBM = Hydrolyzed feather meal:blood meal, 88:15 (DM basis).
[2]Alfalfa silage contained (DM basis): 41.9% DM, 19.0% CP, 32.2% ADF, 43.5% NDF, and 1.46 Mcal NE_L/kg.
[3]Supplemented to contain 15.2% Ca, 7.2% P, 4.1% Mg, 4% Na, 3000 ppm of Zn, 1750 ppm of Mn, 400 ppm of Ca, 200,000 IU/kg of vitamin A, 36,000 IU/kg of vitamin D_3, and 585 IU/kg of vitamin E.
[4]Nonfiber carbohydrate.
[5]Net energy for lactation; calculated using values of the NRC (1989).

Table 2. Nutrient intake of experimental diets.

	Low CP		High CP		
Item	-FBM[1]	+FBM	-FBM	+FBM	SE
DM intake					
lb/d[b,c]	51.2	51.8	56.7	48.7	1.9
% of BW[b]	4.53	4.22	4.78	4.15	0.16
CP intake					
lb/d[a,b,c]	9.0	9.0	11.2	9.5	1.3
% of BW[a,b]	0.80	0.74	0.95	0.81	0.09
RUP intake					
lb/d[a,b,c]	2.6	3.3	3.5	3.3	0.2
% of BW[a,b,c]	0.23	0.27	0.30	0.29	0.01
NDF intake					
lb/d[b,c]	14.3	14.5	15.9	13.7	0.7
% of BW[b]	1.27	1.18	1.34	1.16	0.04

[a]Low CP (17.5%) vs. high CP (19.5%) ($P < 0.05$).
[b]Added FBM vs. no FBM ($P < 0.05$).
[c]CP × FBM interaction ($P < 0.05$).
[1]FBM = Hydrolyzed feather meal:blood meal, 85:15 (DM basis).

17.6% CP diet increased milk protein production by 13%. In contrast, addition of FBM to the 19.6% CP diet depressed milk protein production by nearly 20%. The efficiency of milk protein production from dietary protein was highest for the 17.6% CP + FBM diet.

The highest production of 4% FCM was for the high CP diets (Table 3). Addition of FBM increased FCM production for the 17.6% CP diet, but decreased FCM production for cows fed the 19.6% CP diet. This response reflects changes observed for milk yield. The efficiency of FCM production (FCM/DMI, kg/kg) was highest for the high CP diets (Table 3). Addition of FBM improved the efficiency of FCM production at both dietary CP concentrations. This reflected the reduction in feed intake observed when FBM was added to the ration.

The average body weight of cows throughout the entire experiment was unaffected by treatment and averaged 538 kg (Table 3). Also, there was no impact of diet on change in body weight from weeks 3 to 20 of lactation (first to last week of experiment) which averaged 67 kg. Similarly, there was no effect of diet on body condition score throughout the experiment (Table 3). The change in body condition score from weeks 3 to 20 of lactation averaged 0.20 and was unaffected by diet. Net energy balance was positive for all diets (Table 3) when averaged over the entire experiment; however, addition of FBM reduced net energy balance for both dietary CP concentrations.

Table 3. Lactational performance as influenced by diet.

	Low CP		High CP		
Item	-FBM[1]	+FBM	-FBM	+FBM	SE
Milk, lb/d[a,c]	71.7	79.8	82.2	73.6	3.0
Milk fat					
%[a]	3.22	3.53	3.59	3.47	0.08
lb/d[a]	2.29	2.82	2.98	2.56	0.13
Milk protein					
%	2.95	3.01	3.05	2.87	0.08
lb/d[c]	2.13	2.42	2.53	2.12	0.13
4% FCM, lb/d[a,c]	63.3	74.3	77.6	68.6	3.1
FCM/DMI, lb/lb[a,b]	1.25	1.43	1.37	1.42	0.04
Milk protein/CP intake, lb/lb[c]	0.236	0.264	0.224	0.225	0.009
BW, lb	1139	1234	1186	1186	24
BCS[2]	3.03	3.03	3.00	3.08	0.08
NEB,[3] Mcal/d[b]	11.04	7.63	10.69	7.56	1.05

[a]Low CP (17.5%) vs. high CP (19.5%) ($P < 0.05$).
[b]Added FBM vs. no FBM ($P < 0.05$).
[c]CP × FBM interaction ($P < 0.05$).
[1]FBM = Hydrolyzed feather meal:blood meal, 85:15 (DM basis).
[2]Body condition score (1 = thin, 5 = obese).
[3]Net energy balance.

In conclusion, the evaluated combination of feather and blood meal, when fed in 17.5% CP diet based on alfalfa, is an excellent source of escape protein for lactating dairy cows.

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Impact of Nonfiber Carbohydrate Concentration on Forage Fiber Digestion

Rick Grant
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Summary

The effect of dietary nonfiber carbohydrate concentration (30, 35, 40 or 45% of DM) on in vitro digestion kinetics of NDF from alfalfa and corn silages at pH 5.8 or 6.8 is quantified here. Ash-free NDF was determined at 0, 3, 6, 9, 12, 24, 30, 36, 48, 72 and 96 h of fermentation. Kinetic parameters were estimated using logarithmic transformation and linear regression. The apparent rumen NDF digestion for alfalfa silage at high pH was greatest between 30 and 40% nonfiber carbohydrate (NFC). At pH 5.8, NDF digestion was greatest at 35% NFC. For corn silage, NDF digestion was greatest at 30% NFC at either low or high pH. The optimum dietary NFC concentration for maximum rumen fiber digestion for a particular forage will be a function of the mean rumen pH characteristic of a given diet. Understanding the interactions among forage source, rumen pH and dietary NFC content will aid in formulating rations maximizing rumen fiber digestion and optimizing dairy performance.

Introduction

Carbohydrates comprise the largest single dietary component for dairy cows (up to 75% of DM). The two carbohydrate fractions include structural carbohydrates (NDF), and nonfiber carbohydrates (**NFC**), primarily comprised of starch, sugars, pectin and beta-glucans.

A diet's NFC content is estimated commonly by subtracting CP, NDF and ether extract from organic matter with a correction for CP bound to NDF. Although the optimum dietary concentration of NFC for lactating dairy cows is uncertain, recent research with alfalfa-based diets fed to high-producing dairy cows suggested diets should contain more than 30% NFC, with a negligible benefit of feeding 42% versus 36% NFC.

Milk production and ruminal fiber digestion responses to varying dietary concentrations of NFC appear to be a function of ruminal degradability of NFC, ruminal pH and forage fiber source. Lower dietary NFC was associated with higher ruminal NDF digestibility when pH also increased; however, ruminal NDF digestion was unaffected by lowered NFC content when ruminal pH was unchanged. In a Wisconsin study, researchers measured ruminal pH below 6.0 during the first 8 h postfeeding, for over 50% time for dairy cows fed diets containing 42% and 35% NFC. Additionally, the diurnal range in ruminal pH observed in lactating dairy cows falls between 6.8 and 5.5, with ruminal pH below 6.2 for 70% to 80% of the day. Consequently, the interaction between ruminal pH and NFC concentration is crucial for determining optimal NFC content in lactation diets.

The limited research conducted to-date suggests forage source may influence the optimal dietary NFC concentration. Some research indicates 40% NFC was optimal for diets containing alfalfa silage, corn silage and 50:50 mixtures of each. Other research with alfalfa-based diets suggests the optimal content may be closer to 35%. Previous research has demonstrated differences among forage sources concerning the negative effect of starch on NDF digestion. We have found raw corn starch decreased fractional rate of NDF digestion for alfalfa hay, but observed little starch effect for bromegrass hay.

The objective of this experiment was to determine the effect of dietary NFC concentration on kinetics of NDF digestion for two common forages at low and high pH.

Procedures

Forage and concentrate substrates were dried at 55ºC for 48 h and ground through a 1-mm screen using a Wiley mill. Chemical composition of the late bud-stage alfalfa silage, physiologically mature corn silage, soybean hulls, corn and soybean meal is listed in Table 1. The individual ingredients were combined in varied proportions to create substrates representing isonitrogenous diets containing either 30, 35, 40 or 45% NFC with either alfalfa silage or corn silage as the forage (Table 2). To achieve these calculated NFC concentrations in the substrates, soybean hulls were substituted incrementally for the corn grain.

A 300-mg sample of each of the eight substrates was weighed into 50-ml polypropylene tubes for measurement of in vitro NDF digestion kinetics as described previously by our laboratory. The entire experiment was replicated three times. The fermentation pH was adjusted to 6.8 or 5.8 with 1 *M* citric acid. Fermentation times were 0, 3, 6, 9, 12, 24, 30, 36, 48, 72 and 96 h. Neutral detergent fiber was measured at each time.

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Table 1. Nutrient composition of substrate ingredients.

Ingredient	CP	ADF	NDF	Ash	EE	NFC[1]
	(% of DM)					
Alfalfa silage	19.0	35.1	45.1	10.8	3.8	21.3
Corn silage	8.5	25.0	46.0	3.9	3.0	34.6
Corn grain	10.0	3.8	9.0	2.1	4.3	74.6
Soybean hulls	12.1	50.0	67.0	5.1	2.1	13.7
Soybean meal	47.6	4.9	10.6	6.9	1.5	33.4

[1]Calculated as (100-CP-NDF-Ash-EE).

Table 2. Ingredient and nutrient composition of substrates used for in vitro experiment.

	Alfalfa				Corn			
Item	30	35	40	45	30	35	40	45
	(% of DM)							
Ingredients								
Alfalfa silage	50.0	50.0	50.0	50.0	—	—	—	—
Corn silage	—	—	—	—	50.0	50.0	50.0	50.0
Corn grain	14.7	22.9	31.3	39.6	—	6.1	14.6	24.8
Soybean hulls	25.0	16.7	8.3	—	26.5	19.5	11.0	—
Soybean meal	10.3	10.4	10.4	10.4	23.5	24.4	24.4	25.2
Composition								
CP	18.5	18.4	18.3	18.4	18.5	18.5	18.6	18.5
ADF	30.7	27.4	23.5	19.7	27.2	24.0	19.9	15.1
NDF	41.0	36.9	32.0	26.2	42.3	38.4	33.1	27.1
EE	3.2	3.4	3.6	3.8	2.4	2.5	2.7	2.9
Ash	7.6	7.4	7.2	7.0	4.9	4.7	4.5	4.2
NFC	29.7	33.9	39.2	44.5	31.5	35.5	40.9	47.1

Table 3. Effect of forage, NFC, and pH on apparent extent of NDF digestion (%).

		NFC			
Forage	pH	45	40	35	30
Alfalfa	6.8	25.2	28.7	27.6	28.4
Alfalfa	5.8	12.9	17.2	23.3	21.7
Corn silage	6.8	21.6	22.9	23.3	26.2
Corn silage	5.8	11.4	13.9	14.2	17.7

Results

The impact of pH, forage source and NFC content on apparent rumen fiber digestion is shown in Table 3. For alfalfa silage, NDF digestion was greatest between 30 and 40% NFC at pH 6.8, compared with 35% NFC at pH 5.8. For corn silage, NDF digestion was greatest at 30% NFC for either pH.

It appears the optimum dietary NFC content for maximum rumen NDF digestion, for a particular forage, will be a function of the average rumen pH for cows fed a given diet. For example, two diets could contain the same content of NFC, yet have substantially different effective NDF contents and consequently very different rumen pH. Understanding the interactions among forage source, pH and NFC content will ultimately aid dairy producers in formulating lactation diets for maximum rumen fiber digestion and optimum performance.

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Sulfite Liquor-Treated Meat and Bone Meal for Dairy Cows

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Summary

The effect of sulfite liquor treatment of meat and bone meal on acceptability and dry matter intake was investigated in 20 lactating Holstein dairy cows. Cows were housed in a tie-stall barn with individual feed boxes physically divided into two equally sized accessible compartments offering a supplement containing treated or untreated meat and bone meal simultaneously. None of the cows had been fed meat and bone meal previously. When cows were first exposed to meat and bone meal, there was relatively little consumption in 30 minutes. Even after seven days of receiving meat and bone meal as a topdressed supplement, consumption was still only 2.9 lb for the treated meat and bone meal. After one week of topdressing, however, cows fed the treated meat and bone meal consumed nearly 62% more than cows fed the untreated meal. Over time, a clear increase in preference for the treated meat and bone meal was noted, whereas intake of the untreated product remained low. Topdressing 8 lb of a grain mix containing 25% treated meat and bone meal onto a basal ration resulted in an average daily dry matter intake of 54 lb. Topdressing the same amount of grain mix containing untreated meal resulted in a dry matter intake of only 50.5 lb., an 8.1% difference. Sulfite liquor treatment of animal protein coproducts has the potential to improve their palatability and use by lactating dairy cows.

Introduction

Animal protein coproducts can economically supply both crude protein and escape protein to dairy diets. However, poor palatability is an often-cited problem when feeding some of the products, such as meat and bone meal, blood meal and feather meal, to lactating cows. If palatability is a problem, intake may be reduced, resulting in lower milk production. Protein supplements containing animal protein coproducts, such as meat and bone meal, are commonly topdressed onto basal rations in the Midwestern U.S., and reduced palatability and subsequent lowered intake is a real potential problem. This study was conducted prior to the Food and Drug Administration's proposed ban on ruminant-to-ruminant feeding of meat and bone meal. However, it is our belief that the concept of treating any low-palatability animal protein coproduct feed to increase its acceptability could be beneficial to dairy producers who rely on topdressed protein supplements. Recent surveys of Nebraska dairies indicate that 15 to 20% of dairies topdress a protein supplement.

Procedures

Palatability Trial

Twenty cows in mid- to late lactation were housed in a tie-stall facility with individual feed boxes physically divided into two compartments of equal size and accessibility. None of the cows had been fed meat and bone meal previously. After one week of adaptation to the facilities, cows were allowed access to 10 lb of two grain mixes each containing 25% meat and bone meal (treated or untreated) for 30 minutes. The meat and bone meal was treated with sulfite liquor. Consumption of the two products was measured. Any remaining grain supplement was mixed with a basal total mixed ration. For the next seven days, 5 lb of each mix was topdressed onto the basal ration for each cow. Following one week of meat and bone meal consumption, the palatability trial was repeated to test for any effect of adaptation on palatability and preference by the cows.

The grain supplement contained 25% meat and bone meal, 25% corn and 50% sunflower meal. The undegradable and degradable protein contents were 43.7 and 56.2 and 35.9 and 64.1% of CP, respectively, for grain supplements containing treated and untreated products. The basal total mixed ration contained 50% forage (1:1 mixture of alfalfa and corn silages) and 50% of a concentrate mix of rolled corn, sunflower meal, minerals and vitamins. For cows in these later stages of lactation, requirements for degradable and undegradable protein were met for both diets.

Dry Matter Intake Trial

The two meat and bone meal grain mixes and diets described above were fed to the same 20 cows for 2-week periods to measure effect on daily dry matter intake in a crossover design. Each day, 8 lb of the appropriate grain mix were topdressed onto the basal total mixed ration. Cows were paired by days in milk and assigned randomly to the two dietary sequences. Dry matter intake was measured daily. In addition, consumption of the topdressed grain mix and total ration within 30 minutes was measured on days 1, 5, 9 and 14 of each period. This approach allowed a realistic estimate of how the topdressed grain supplements influenced acceptability of the total diet under practical feeding conditions.

Results

Palatability Trial

As shown in Table 1, there was relatively little consumption when cows were first exposed to the meat and bone meal. Even after seven days of receiving the meat and bone meal as a topdressed supplement, consumption was still only 2.9 lb for the treated meal. However, on both days 1 and 8, cows offered the treated meat and bone meal consumed significantly more than cows offered the untreated product. On day 1, cows fed the treated meat and bone meal consumed only 16% more supplement ($P < 0.10$), but nearly 62% more by day 8 ($P < 0.05$).

The low initial acceptance of the meat and bone meal products reflects the fact that both were new ingredients to the cows. Initially, 13 of 20 cows preferred the treated meat and bone meal in the protein supplement. By day 8, 17 of 20 cows preferred the treated meat and bone meal. The mean as-fed intake of untreated meat and bone meal did not differ between days 1 and 8 ($P > 0.10$); however, the as-fed intake of the treated meat and bone meal did increase (2.1 vs 2.9 lb, $P < 0.05$). Over time, there was a clear increase in preference for the treated meat and bone meal, whereas intake of the untreated product remained low.

Table 1. As-fed intake of treated or untreated meat and bone meal supplement in 30 minutes.

	Meat and bone meal	
Day of experiment	Treated	Untreated
	----------(lb/cow)----------	
1	2.1^{a}	1.8^{b}
8	2.9^{c}	1.1^{d}

[a,b]Means within a row differ ($P < 0.10$).
[c,d]Means within a row differ ($P < 0.05$).

Dry Matter Intake Trial

As shown in Figure 1, as-fed intake of the topdressed supplement and the basal total mixed ration was consistently greater ($P < 0.05$) on days 1, 5, 9 and 14 for the treated meat and bone meal product. There was no significant ($P > 0.10$) change in preference for the two products within a feeding period. Apparently, the cows had grown accustomed to the meat and bone meal by this time in the experiment (day 9). Previous research with other animal protein coproducts indicates adaptation can occur within about 10 days.

A significant ($P < 0.08$) period effect was detected for the as-fed intake of

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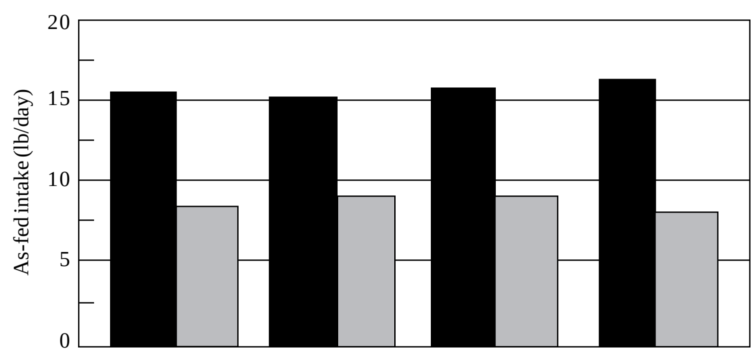


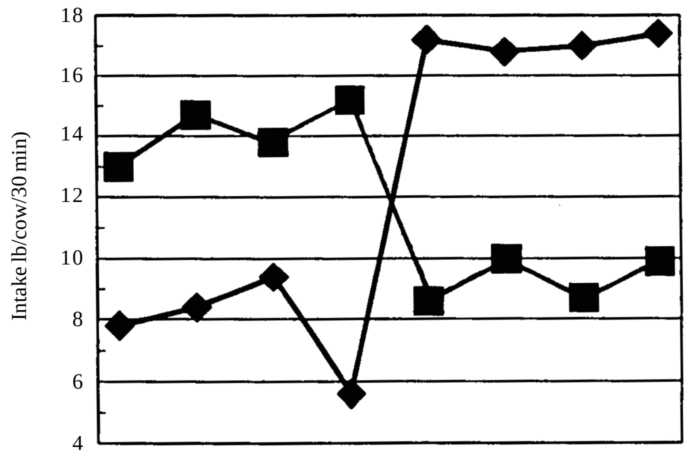
Day of experiment	1	5	9	14
Treatment M&BM	15.4	16.1	15.7	16.3
Untreated M&BM	9.0	9.5	9.5	8.4

Figure 1. Intake of supplement containing treatment or untreated meat and bone meal.

supplement and total mixed ration in 30 minutes. Cows were fed the treated meat and bone meal during period 1 consumed more of it than cows fed the same product during period 2. There was less apparent effect of period on the untreated meat and bone meal. Why there was an effect of period on intake of the treated product is uncertain.

Topdressing 8 lb of treated meat and bone meal on a total mixed ration resulted in an average daily dry matter intake (average of 14-day period) of 54.5 lb/d (4.21% of body weight), whereas topdressing the same amount of untreated meat and bone meal resulted in a dry matter intake of only 50.5 lb/d (3.75% of body weight). Both means were significantly different ($P < 0.05$). This represents an 8.1 to 12.2% increase in dry matter intake for cows supplemented with the treated meat and bone meal. Individually, 19 of 20 cows consumed more dry matter when supplemented with treated meat and bone meal and 18 of 20 cows consumed more dry matter when expressed as a percentage of body weight.

Figure 2 illustrates the changes in as-fed intake in 30 minutes that occurred over time during the crossover trial. It appears that cows fed the treated meat and bone meal slowly increased their intake over the 2-week period.



Day of experiment	1	5	9	14	15	19	23	27
Group A cows Treated M&BM d 1-14 ■	13.0	14.7	13.8	15.2	8.5	10.0	8.6	9.9
Group B cows Treated M&BM d 15-28 ◆	7.8	8.4	9.4	5.6	17.2	16.8	17.0	17.4

Figure 2. As-fed intake of total mixed ration within 30 minutes.

Intake for the untreated product was more variable and lower for each period.

The treated meat and bone meal supplement was significantly more palatable to the dairy cows used in this study when tested in a true cafeteria style experiment. Furthermore, topdressing of a protein supplement containing 25% treated meat and bone meal, as commonly practiced in the upper midwest, resulted in substantially improved daily dry matter intake and 30-minute consumption (acceptability) compared with the untreated product.

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The OTHER Causes of Infectious Diseases

David R. Smith[1]

Summary

Many diseases are named for the infectious agents associated with them. For example: Salmonellosis is a diarrheal disease which sometimes follows infection with Salmonella species; colibacillosis is a diarrhea of newborn animals which sometimes follows infection with Escherichia coli; and coliform mastitis is an inflammation of the udder for infection with coliform bacteria. Naming diseases after the associated infectious agent is useful because we recognize that for many diseases, infection with a particular organism is necessary for the disease to occur. However, infection with the agent of a disease is usually not enough to cause an outbreak of the disease. Other factors may be necessary before the disease is expressed. Unfortunately, during disease outbreak investigations the diagnostic focus is often only on identifying the agent(s) involved. This approach may fail to reveal other important component causes of the disease and may miss potential methods of disease control or prevention.

Introduction

As a new graduate veterinarian, I was asked by a dairy client about the cause of mastitis. Quite sure of my answer, I informed the producer that mastitis was an infectious disease and therefore its only cause is bacterial infection of the mammary tissue. Although my answer was technically correct, I was to soon find out it was not very useful. Later, during a particularly hot week in July, an outbreak of acute mastitis occurred on that producer's farm. *Klebsiella spp.* was cultured from the mastitic quarters of several cows. These coliform bacteria were infecting the tissues and the cows were becoming very sick. Knowing the name of the bacteria, however, did not help us to gain control of the outbreak.

We observed the sick cows were all housed in the same part of the tie-stall barn, and became suspicious that the bedding might be the source of the bacteria. However, all of the cows were on the same bedding and the bedding source had been the same for some time. Upon further inspection, we found a leaking water cup in the area of the sick cows. The bedding under these cows was soaked. When the leaking water cup was fixed and dry bedding installed, the epidemic stopped.

What caused that outbreak of mastitis? Some will still argue it was the entry of the bacteria and subsequent infection of the mammary gland that caused this outbreak; I, on the other hand, was beginning to feel my earlier answer was not good enough. Clearly, other factors were involved in the outbreak. Recognizing the role of those factors was necessary to stop the epidemic. For example, the use of sawdust bedding may have increased the risk for that type of coliform mastitis on this farm. We were able to see that the cows laying in the wet bedding were at greater risk for mastitis than those on dry bedding. The weather conditions may have helped incubate the organism in the moist sawdust; heat stress may have reduced the cow's resistance to fight the infection before it led to disease. It is likely all these factors were component causes of the outbreak. In this case, when the leaking water cup made the bedding wet, a sufficient cause was completed and cows got mastitis. By fixing the plumbing, we stopped the outbreak. Can a leaking water cup cause an infectious disease like mastitis? Sometimes it is useful to think so.

Epidemiologists are interested in how and why diseases occur in populations. They use the information they gather from observing disease occurrence to try to understand the causes of disease. Epidemiologists work within a frame of reference allowing any factor that contributes to the risk of a disease to be considered a cause. Rather than thinking narrowly about a single cause of a disease, they think broadly, identifying the often multiple and interrelated causes of a disease. The following examples of recently conducted investigations illustrate how consideration of the cause of infectious diseases often goes beyond the agent involved. It may also become apparent that the cause of a disease depend on the level of organization (e.g. geographical area, herd, individual, organ, tissue or cellular-level) from which you view the disease.

Causes of Winter Dysentery

Winter dysentery is a diarrhea disease of dairy and beef cattle. The disease can spread rapidly in the adult herd. Typically, the entire course of an outbreak is one to two weeks. Few animals die, but production and body condition suffer and the outbreak is not pleasant for those working around cattle suffering from explosive diarrhea. We conducted several investigations of winter dysentery in dairy herds (Smith, 1997, PhD dissertation, The Ohio State University) to answer two questions: 1) What factors increase a dairy herd's risk for winter dysentery? 2) Within a herd affected by winter dysentery, what factors increase an individual animal's risk for winter dysentery? The first question is concerned with characteristics of the herd; the second with the characteristics of the individual animal.

To answer the first question we compared the characteristics of winter dysentery-affected (case) herds, to the characteristics of similar but unaffected (control) herds. By this study design we presumed the differences between case and control herds were due to factors associated with winter dysentery. We found some case herds were more likely to have a greater percentage of animals responding immunologically (having antibody responses) to recent exposure to bovine coronavirus (BCV) than control herds. Other case herds were more likely to have a greater percentage of animals responding immunologically to recent exposure to bovine viral diarrhea virus (BVDV) than control herds. From these findings we speculated these infectious agents may be related to outbreaks we diagnose as winter dysentery.

There were other differences noted between the herds as well. Case herds were more likely than control herds to house their cattle in tie-stall, or comfort stall, barns rather than free-stall barns. Case herds were also more likely than control herds to use the same equipment to handle manure and feed.

Both BCV and BVDV are shed from respiratory tissues and found in the feces. It makes sense that the spread of these agents would be easier when cattle are housed head to head, as is common in tie-stall barns. Similarly, when manure handling equipment is used to handle feed, the feed is easily contaminated with fecal contents and these agents could rapidly be spread throughout the herd. We speculated the presence of the infectious agent is one component cause for winter dysentery and other component causes include the means to readily spread the agent throughout the herd.

When we compared the sick animals in the herds to their unaffected herdmates, we found no difference in exposure to the infectious agents among those getting sick and those not. What was different was whether the animals were pregnant and other factors relating to the their ability to respond immunologically to BCV. Pregnant animals were less likely to get sick; perhaps because pregnant dairy cattle are past the stresses of production or because of changes that occur in the immune profile during pregnancy. It appeared that while most of the individuals in a herd experiencing winter dysentery were exposed to the agent, the immune profile of the individual may have determined who got sick.

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Causes of Calf Scours in a Dairy

An outbreak of scours (diarrhea) in baby calves was investigated in an Ohio dairy (Smith, unpublished). Thirty-six of 47 calves born alive over a three month period developed scours severe enough to require treatment while they were housed in the nursery. The median onset of scours was at 13 days of age. Rotavirus and *cryptosporidia* spp. had been isolated from the feces of several of the sick calves. Currently no specific treatments exist for either of these agents and preventive measures primarily rely on hygiene and adequate colostrum intake. Because of the farm's excellent records, we were able to look for non-infectious risk factors in these calves. The records were analyzed using a method known as survival analysis, which considers the time from birth until scours developed or until the calf left the nursery untreated.

The age of the dam, breed of the calf and many factors measured did not explain an individual calf's risk for scours during this outbreak. Surprisingly, even after adjusting for their birth-weight those calves with assisted deliveries recorded were less likely to develop scours.

Knowledge of the farm's operations helped make sense of this risk factor. Calves with assisted births received special attention. They were often processed (navels dipped, scours vaccines administered) within minutes of birth because the workers were there already. More importantly the dam was milked and colostrum was given right away. Calves with unassisted births were often not handled until it was convenient. Also, some of the calving scores may not have reflected the true difficulty of the birth. For example, some calving's during the day may have been assisted for convenience and some calves born overnight may have been recorded as unassisted deliveries, even though they may have experienced a prolonged labor. Those calves born unassisted at night might not get processed until many hours later.

Also, other factors probably played a role in this scours epidemic. At the herd-level, this one had a much higher calving rate than normal, resulting in a more crowded nursery, and more environmental contamination by pathogens. Recognizing that on this farm, early attention to newborn calves resulted in less risk for scours emphasized the importance of the control procedures already in place and provided a method that could be used to control scours in the future.

Conclusion

When faced with infectious disease outbreaks a strong effort is often made by producers and their veterinarians to secure a diagnosis of the offending infectious agent. While this effort is important, a diagnosis of the contributing causes for infectious disease outbreaks is sometimes more useful. The next time you are faced with an infectious disease problem, do not be satisfied with a causal agent diagnosis. Ask, what other factors could be contributing to the cause of this disease? The answers may be enlightening.

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Test Day Genetic Evaluations

Claudia H. Gadini
Jeffrey F. Keown[1]

Summary

Genetic evaluations for sires and cows may, in the future, use test day information rather than composite 305-day mature equivalent records.

Introduction

Genetic evaluations of dairy cattle are based on yields standardized to 305-days, twice-a-day milking on a mature equivalent basis. The record is also adjusted for the shape of the lactation curve in the beginning and end of the lactation, age at calving, herd level, parity and previous days open.

Several attempts have been made to find a measure more suitable than the 305-day standardized yield to serve as the basis for genetic evaluation of dairy cattle, either for developing proper adjustment factors, to limit costs of recording or to account for short-term effects on yield traits. Lactation yields or 305-day yields are an aggregated measure from regularly taken measurements of milk, fat and protein test day yields. Because the test day methodology accounts for variation during the lactation, test day yields have become a primary data source for genetic evaluations.

Procedures

In order to use the test day yields in genetic evaluations, the genetic and environmental relationships among milk, fat, protein and somatic cell score must be estimated along with individual heritability estimates. Newer computer technology has reduced the major obstacle to using a Test Day Model for sire and cow evaluations, and our ability to estimate the parameters used in these evaluations has improved.

The data used in this analysis consisted of 104,153 lactations from the Mid States Dairy Processing Center in Ames, IA. The data included only first lactation Holstein records of cows that freshened between 1989 and 1993 in the eight Midwestern states.

Results

These first lactation cows peaked in milk production about the seven weeks after freshening. Maximum fat yield (pounds) was reached at 30 days after freshening and maximum protein yield (pounds) at week 12. Somatic cell count was highest at the beginning and end of the lactation with the lowest counts occurring mid lactation.

Estimates of genetic correlations between consecutive test days for milk, fat and protein yields were large, but became significantly smaller as the time interval between test days increased. This data may be interpreted to suggest the test day yields for production traits may not be associated with the same genes. There may be different genes expressing themselves at different times during the lactation. If this is the case, when using a test day model for genetic evaluations each test day may need to be treated as a different trait. On the other hand, there are high genetic correlations between test day somatic cell scores throughout the lactation, implying the same genes may be involved throughout the location for the expression of somatic cell score.

We found positive genetic correlations between milk yield and somatic cell scores. This implies selecting for extremely high milk bulls could result in an increase in somatic cell scores. Therefore, when selecting sires it may be advisable to avoid those high production sires with a corresponding high genetic evaluation for somatic cell score.

The use of individual test day information for genetic evaluation is gaining in popularity. Within a few years the use of test day data for genetic evaluations will be common place. Genetic evaluations in the future will be more accurate because all data will be used rather than a composite calculation. Using all the information will be a giant step forward in evaluating sires and cows.

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Income and Herdlife

Shylaja Jagannatha
Jeffrey F. Keown[1]

Summary

The economic returns of herdlife (the length of time that a cow remains productive and returns a profit) may be over-estimated, since few studies have estimated herdlife effects under normal management practices.

Introduction

Most studies on the importance of herdlife have worked strictly on an individual cow basis. These models assume that when a cow is not replaced when she leaves the herd. We thought it would be interesting to replicate more closely what actually occurs on producers' farms, looking at herdlife on the basis of replacing animals if they left the herd. In other words, "let's always have the same number of cows in the herd and deal with replacements".

We felt dealing with a real-life situation and having a fixed herd size with replacements would furnish more useful results. However, this type of study adds complexity as replacement costs and the probabilities of cows dying at various ages must be taken into account. We used a standard five lactation planning horizon. Over a five-year period there could have been as many as four cows in a given slot in the herd. A cow could freshen, die and be replaced and then second cow could function for two lactations, die and then be replaced again. There are any number of possibilities for replacing cows.

Procedures

Modeling herdlife to include replacement cows was challenging as not only income and expenses needed to be included to analyze income and herdlife, but also replacement costs had to be considered. Among other costs considered were: income from the sale of calves, salvage value of cows, feed costs for the producing cow and feed costs for the dry period. As many factors as possible were taken into account so that the total lifetime costs = heifer rearing costs + feed costs + breeding costs + labor costs. To estimate income, total lifetime costs were subtracted from the sale of milk total income.

We calculated varying values for the price of milk (low or high), feed prices (low or high) and cull cow prices (low or high) and generated figures from the DHI records using replacements or not putting replacements in the stall under varying economic conditions.

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Table 1. Means ($) for different combinations of prices by number of calvings survived by a cow.

Prices used in profit function			Number of lactations survived by a cow				
Milk*	Feed*	Cull cows*	1	2	3	4	5
			Not replacing cows				
Low	High	High	-153	568	1270	1926	2717
Low	High	Low	-283	418	1108	1764	2555
Low	Low	High	-65	827	1693	2513	3486
Low	Low	Low	-195	677	1531	2351	3324
High	High	High	-63	829	1698	2528	3512
High	High	Low	-193	679	1536	2366	3350
High	Low	High	24	1089	2121	3114	4281
High	Low	Low	-105	939	1959	2952	4119
			Replacing Cows				
Low	High	High	1492	1753	2057	2373	2717
Low	High	Low	1140	1427	1781	2163	2555
Low	Low	High	2158	2448	2767	3102	3486
Low	Low	Low	1806	2122	2492	2892	3324
High	High	High	2179	2460	2779	3122	3512
High	High	Low	1826	2134	2504	2912	3350
High	Low	High	2844	3155	3489	3851	4281
High	Low	Low	2493	2829	3214	3641	4119

*Milk prices: High 12.94/cwt; Low 11.95/cwt.
*Feed prices: High 135 Price Feed Index; Low 105 Price Feed Index.
*Cull cows: High .52/lb; Low .40/lb.

Results

Table 1 summarizes the returns of various herdlifes at varying economic assumptions as calculated by 1) having a cow replaced (this is the way that a producer views the dairy operation) and 2) not replacing the cow. The top set of figures are when cows are not replaced. As can be seen from the top set of figures, in nearly every case if a cow dies after the first lactation the income is negative. This means a cow must survive to the second lactation before generating any income unless both the milk and cull cow prices are high and feed prices are low. Even with these positive variables, the income generated is only $24. After the first lactation all incomes increase under each scenario until the fifth lactation.

Table 1 also shows the same high versus low prices, but replaces the heifer that did not survive to the second lactation. We then attributed the income generated by the second and subsequent cows to the first cow or stall. For example, in the low milk price, high feed cost, high cull price scenario, if a cow died after the first lactation, even though she may not have generated any income, her replacements generated $1,492 over the remaining four lactations. Likewise, if she died after the second lactation her replacements generated $1,753 in income. If the cow died after the third lactation the income generated was $2,057, death after the fourth generated $2,373 and if the cow lived for all five lactations the income generated was $2,717. The last figure is the same on both parts of the table for a cow also staying in the herd for five lactations.

This study let us examine the economic value of herdlife. The scenario at the top of Table 1 — no replacements, puts a greater premium on herdlife. The value of herdlife to production shows the value of one additional day of herdlife when the cow is not replaced is $2.28. When replacements are taken into account, however, the cost is only 95 cents.

We feel the value of herdlife should be calculated using a scenario that more closely represents what is done on a dairy farm. Even though a producer will not generate any income over feed and rearing costs if a cow leaves the herd after one lactation, the value of replacements filling that stall or slot will generate income under any pricing system for a five lactation planning horizon.

[1] Shylaja Jagannatha, former Graduate Student; Jeffrey F. Keown, Professor and Extension Dairy Specialist, Animal Science, Lincoln.

Maternal Genetic and Cytoplasmic Effects in Dairy Cattle

Lucia G. Albuquerque
Jeffrey F. Keown[1]

Summary

Both genetic and non-genetic material may be inherited from the female side of the pedigree in dairy cattle. A research project was conducted to study this effect.

Introduction

Over the years, there has been considerable discussion of the potential role of cytoplasmic inheritance in dairy cattle. It is well known that the genetic make-up of animals is found in the nucleus of the sperm and egg. The sperm cell soley consists of nuclear material; the egg cell, however, is quite large. Is there a possibility that the egg, because of its size, could carry extra genetic material, such as viruses which could affect the offspring from a given female? If so, it would be important to estimate the egg's influence on the production traits, especially milk and fat.

In order to conduct this research, we need to trace cow parentage to the maternal line, since cytoplasmic inheritance is only possible this way.

Procedures

The data for this study consisted of lactation records of New York Holstein cows. The analysis used 138,869 lactation records from 68,063 cows freshening from 1980 through 1991. Several statistical models were fit to see if there was any evidence of a substantial maternal inheritance pattern for yield traits.

Results

For all traits, maternal effects varied from .8 to 1% of the total variance for milk, fat and fat percentage. These effects do not seem to be important contributors to the phenotypic variances of milk, fat and fat percentage. The reason these effects may not be important is that in dairy cattle the only environmental influence of the dams on their calves is from conception to birth. In beef cattle, or other species where mothering ability would be a more important factor in raising young, maternal effects might play a more important role. The conclusions of this study show it does not seem important, or justified, to change sire and cow evaluations to account for these effects in dairy cattle genetic evaluations.

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Financial and Management Survey of Nebraska Dairy Producers

Doug Jose
Rick Grant[1]

Summary

A financial and management survey of Nebraska dairy producers was mailed to all dairy producers enrolled in the DHIA testing program (385 producers). A total of 61 fully completed, useable surveys were returned. The survey data were grouped by herd size (<60, 60 to 80 or >80 cows) and milk production (<17,000 lb, 17 to 19,500 lb or >19,500 lb). The information gathered in this survey, together with other information, has been incorporated into a Cooperative Extension publication entitled, "Dairy Economics in Nebraska," available at county extension offices. The information will be help dairy producers, extension staff and agribusiness professionals make profitable management decisions. This data will help dairy producers adjust their operations, such as expansion of herd size, and provide basic data for new operations. Also, this information will allow producers to assess their financial status and compare their business to the rest of the industry.

Introduction

The dairy industry is undergoing major structural changes and economic adjustments. The industry is becoming more market-oriented as government price supports decline. Increased competitiveness has kept milk prices fairly stable, but increased grain and other input costs continue to put increase pressure on narrow profit margins.

(Continued on next page)

Table 1. Results of Nebraska financial survey by herd size and milk production level.

	Herd Size			Rolling Herd Average (lb)		
	<60	60-80	>80	<17,000	17,000-19,500	>19,500
Number of herds	18	15	28	15	19	27
Number of cows	49	67	140	56	106	115
SD	7	6	49	10	55	59
Range	34-58	60-79	83-262	40-68	34-250	43-262
Rolling herd avg, lb	17,210	17,565	20,376	14,579	18,299	21,779
SD	1,419	1,839	1,005	831	384	791
Milk sold, 1000 lb/farm	778	1,059	2,382	794	1,508	2,193
Net farm income, $	16,327	18,267	28,102	13,564	14,709	34,457
SD	18,235	30,782	38,645	21,705	34,848	34,350
Net farm income from dairy, $	11,556	15,988	21,516	9,741	9,636	28,915
SD	14,190	25,970	34,423	14,318	32,121	29,134
Net worth, $	304,634	437,485	591,514	344,838	402,339	621,558
Debt:asset ratio	.45	.25	.46	.42	.47	.34
Family living costs, $	18,695	18,155	20,130	14,643	22,992	21,430
Itemized dairy expenses, $/cwt milk sold						
Depreciation	1.79	1.59	1.58	2.12	1.91	1.17
Purchased feed	4.20	4.13	4.56	3.80	4.97	4.17
Interest paid	.96	.89	.70	1.13	.77	.61
Hired labor	1.16	.39	1.12	1.14	1.15	.81
Rents and leases	.71	1.02	.86	.68	.89	.90
Taxes	.33	.23	.35	.34	.35	.43
Veterinary feeds	.87	.40	.67	.53	.62	.56
Total expenses	**10.33**	**8.84**	**10.14**	**10.11**	**10.99**	**8.94**
Total cost of producing milk, $/farm	85,363	125,486	129,911	90,098	227,179	136,197
Cost/cwt milk sold, $	10.58	11.50	11.67	10.68	11.05	11.78
Expanded business in past 2 years, %	33	20	43	20	37	41
Labor hours/cow	99.8	69.0	75.0	59.0	71.0	100.0
Hired labor hours	3,335	767	3,305	951	1,211	4,277
Unpaid labor hours	2,996	3,881	6,623	2,240	4,944	6,553

SD = standard deviation.

Producers often express the need for more comparative data with which to evaluate their financial situation. This survey was designed to provide information for producers and agribusiness to allow profitable management decisions.

Procedures

As part of a regional research project, a survey was conducted during 1994-95 to assess financial performance of Nebraska dairy enterprises. The survey was mailed to all 385 DHIA-enrolled producers and 61 fully completed surveys were returned. The mean herd size of survey respondents was 95 cows with a rolling herd average of 18,926 pounds of milk per cow. The state averages for the same time period were 91 cows and 18,676 pounds milk per cow. We were confident our sample accurately represented the population of Nebraska dairy producers.

Herds were grouped into herd size categories as less than 60, 60 to 80 or greater than 80 cows. Herds were also grouped by milk production as shown in Table 1.

Results

Rolling herd average and net farm income increased with increasing herd size. Net worth increased with herd size and debt-to-asset ratio was equal for small and large herds and lowest for medium-sized herds. Family living costs increase with increasing herd size. Total cost of producing milk per unit of milk sold increased with herd size. Use of total mixed rations, forage analysis and nutritional consultants increased with larger herds. In five years, 30% to 37% of all operations expect to increase herd size, to 68, 88 and 176 cows for small, medium and large herds, respectively.

When farms were grouped by rolling herd average, herd size and net farm income increased as milk production increased. Debt-to-asset ratio was lowest for herds with highest rolling herd average. In five years, producers anticipated herd sizes of 85, 119 and 167 cows for low, medium and high production herds. This information should be useful for dairy producers, extension specialists and agribusiness professionals when assessing the financial position of dairy producers and to allow producers to compare their business with the rest of the Nebraska dairy industry.

[1]Doug Jose, Professor, and Extension Farm Management Specialist, Agricultural Economics; Rick Grant, Associate Professor, and Extension Dairy Specialist, Animal Science.

Free-Stall Design and Maintenance

Gerald R. Bodman[1]

Introduction

Across the United States, free-stalls have become the accepted way of housing large groups of dairy cows. Properly designed and maintained free-stalls provide cows with a clean, dry and comfortable resting area and reduce the risk of injury, due to being stepped upon by other cows. When properly constructed, maintained and ventilated, free-stalls also reduce diseases of the udder, urinary tract and reproduction system. If your current system allows cows to lie in the alleys or spend significant time standing in the alleys or halfway into the stalls, you may benefit from evaluating and altering your stalls.

Stalls should be designed to provide cow comfort while the cow is lying down. Additionally, the stall must allow the cow to enter and lie down as well as arise and exit easily. Difficulty in any of these aspects will result in reduced stall usage. Select a stall divider and design which provides adequate space for the cow to lunge or thrust forward as she stands. The space may be either to the side (through the stall divider) or forward (through the front stall partition).

Soiled bedding should be removed from stalls at least daily. Many dairymen routinely groom stalls as cows are moved for milking. Clean, fresh bedding is normally added to the stalls every one to two weeks. As the level of bedding diminishes during each cycle, cows tend to lie further into the stalls. This forward positioning leads to more soiling of stalls, dirtier cows, increased risk of udder infections and more difficulty for the cow to stand. Keeping stalls well-bedded is essential to animal health and comfort. A word of caution: do not overfill stalls! Excess bedding results in more waste and both a large pile of bedding at the front of the stall and excess slope make standing up more difficult for the cow.

Free-stalls for mature Holstein and Brown Swiss cows should be 4 ft wide (center-to-center of stall partitions) by 7 ft 6 in to 8 ft long (front of space accessible by the cow to alley side of curb). The stall partitions should be 42 to 45 inches above the curb.

(Continued on next page)

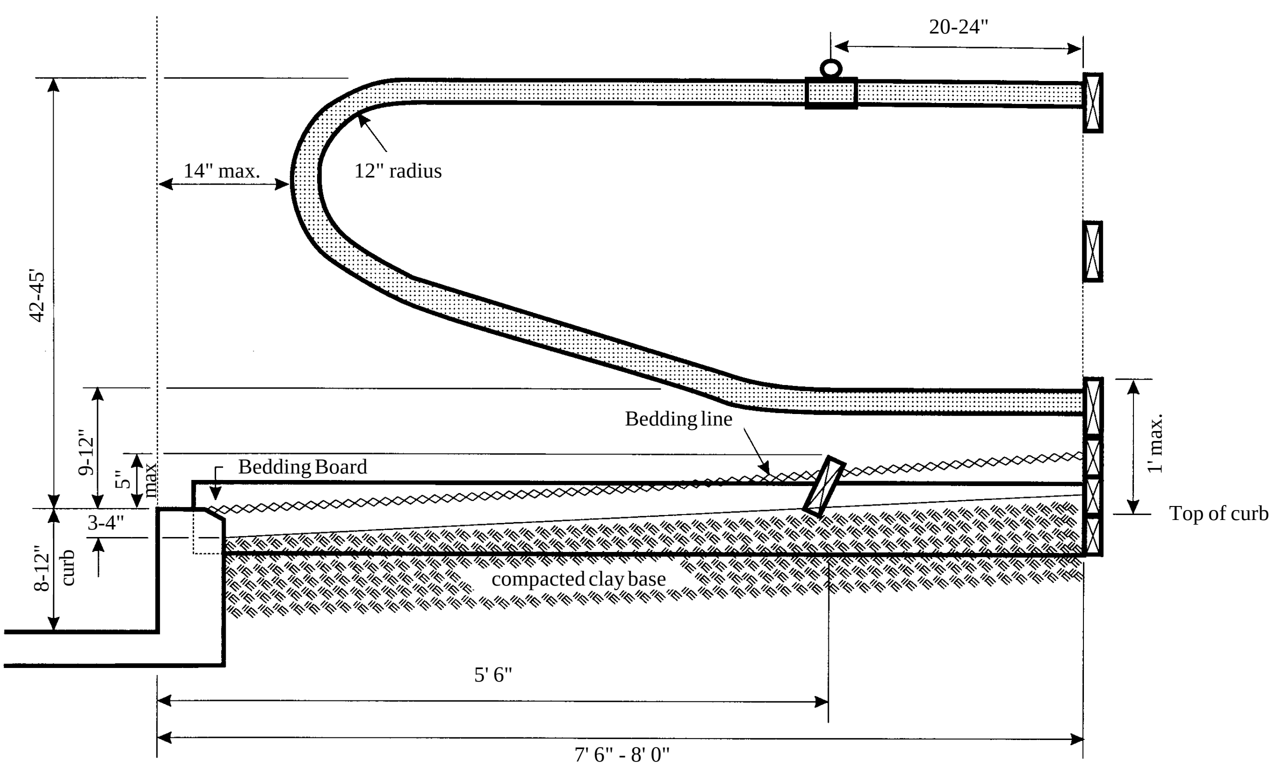

Figure 1. Typical free-stall dimensions.

Brisket Boards

To reduce the risk of cows lying too far forward in the stall, many producers have installed brisket boards. A brisket board is usually made from a 2 x 6 or 2 x 8 tilted at a 45-degree angle and attached to a support system consistent with the stall design.

Personal observations and calls from dairymen indicate many brisket boards are being improperly installed too high, creating problems similar to excess bedding being “stored” at the front of the stalls. The results of improper installation range from cows lying in the stalls at an angle to complete refusal of cows to use free-stalls. Both choices mean dirty cows and more labor.

Brisket boards should be installed so the **top** corner of the 2 x 6 or 2 x 8 is 66 inches from the alley side of the curb. The top of the brisket board should be a **maximum** of 5 inches above the top of the curb or 2 inches above the average height of bedding. Use the bedding height midway through your re-bedding cycle to determine average or normal bedding height.

The problem observed in the field is that 2 x 8 or 2 x 10 brisket boards are being installed with the board’s bottom 2 inches above the curb. In some instances, the brisket boards are mounted so the top edge is against the bottom rail of the stall divider. Consequently, as bedding is worked out of the stall, the brisket board exerts pressure on the cow’s neck and throat, making it difficult for her to be comfortable when lying straight forward in the stall. Also, the incorrect height makes it nearly impossible for the cow to lunge forward to rise to a standing position without placing significant, and presumably painful, pressure on the neck and throat. To avoid the discomfort or pain, many cows elect to lie elsewhere or try to lie in the stalls at an angle. Both alternatives lead to dirty cows.

Bedding Boards

Bedding boards are useful in reducing stall maintenance. Bedding boards, 2 x 8’s or 2 x 10’s positioned directly beneath the stall divider, are installed so the top edge is 2 to 3 inches above the curb. To prevent entrapment as bedding is worked out of the stall, the bottom edge should extend down to, preferably one or two inches into, the firm (soil) stall base. This will prevent cows from getting their feet and legs caught beneath the boards.

Bedding boards effectively prevent holes from forming beneath the dividers by restricting bedding movement as cows stretch their legs outward into the next stall. Several dairymen have reported a significant reduction in teat injuries and lacerations after installing bedding boards. The reduction occurs because the boards prevent a cow from compressing the teats of an adjacent cow between her foot and the stall base. When cows extend their legs into the next stall, the boards elevate her legs so contact is above the stall base. To prevent entrapment, the space between the top of the boards and the bottom rail of the divider should be at least 12 inches.

Another benefit of bedding boards is to provide a place for cows to brace their feet as they begin to rise. Some dairymen have observed an increased use of stalls by older cows after bedding board installation.

Shoulder Rails

Shoulder rails (sometimes referred to as training or backup rails) serve several functions. With suspended loop-style free-stall dividers, their primary purpose is structural — to stiffen and support the dividers. Another function is to prevent cows from standing too far forward in the stalls. When properly installed, the rail should allow the cow to easily lie down and arise, but should prevent standing with the rear feet inside the curb.

The correct position/location for the shoulder rail is a function of stall length, divider height, bedding practices and cow size. In most instances, the shoulder rail will be approximately 20 to 24 inches from the front of the stall.

Curbs

The overall width of the free-stall curb should be 6 to 8 inches. The inside corner should be well-rounded and/or beveled to reduce injury risk as bedding levels decline. The top should be flat or have a very slight slope toward the alley. Narrow curbs and curbs with rounded tops make entry and exit into the stall more difficult by preventing the cow from using the curb as a step. The outside corner of the curb, i.e., alley side, should form a 90 degree angle and be left “sharp” or eased (rounded) just enough to reduce the risk of chipping.

Curbs should be 8 to 12 inches high as measured from the alley surface. Low curbs increase stall maintenance by allowing manure to enter the stall during alley scraping. Low curbs also increase the risk of cows lying just “halfway” into the stall, such as within their front quarters in the stall, rear quarters in the alley. Excessive curb height increases the risk of teat injury as cows step up into the stall.

The front of the stall should be as open as feasible for ventilation, but framed sufficiently to prevent cows from crawling between stalls. Stalls located against a wall should have at least a 16-inch-high opening the full width of the stall. The opening should begin no more than 1 foot above the curb to ensure good airflow around the cow.

Proper design and maintenance of free-stalls will result in cleaner, healthier cows. This translates into better quality milk and reduced labor at milking. Our goal is to encourage cows to lie in the stalls except when eating or being milked. Good ventilation of the cow space is essential.

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Horizontal Silos Design

Gerald R. Bodman[1]

Introduction

Horizontal silos (trenches or bunkers) are a cost-effective way to store large quantities of high-quality forage. Proper design enhances manageability and reduces losses.

While large silos cost less per ton to construct, they may be more costly to operate. This is especially true if the herd size is excessive and the feeding rate is inadequate to maintain feed quality of the exposed face.

Locate silos for easy year-round access. A north-south orientation will generally result in the least problem with snow accumulation.

Slope the floor 0.5% (6 inches per 100 feet) toward the open end. This slope is sufficient to drain off precipitation and melted snow and still allow safe operation of loading equipment across-the-slope. Except in rare instances, a concrete floor is a must. The concrete should be: a) made with air-entraining cement, gravel (not limestone) aggregate and fibermesh to help control cracking; b) formulated for a minimum compressive strength of 4,000 psi; c) placed on a solid, well-drained base; d) at least 6 inches thick; and e) kept cool and damp-cured for at least seven days. During finishing the surface should be troweled to consolidate the top surface and then given a medium broom finish (like medium to coarse sandpaper) for added traction.

Sidewalls should be smooth, as air tight as feasible and tilted outward with an 8:1 slope (one foot horizontal per eight feet vertical). Vertical walls are easier to construct but reduce lateral compression during packing and generally increase spoilage. Pressure preservative treated wood may not be used for feed storages (or feed bunks). Except for emergency storage, bales of hay, straw or similar products are unacceptable as a sidewall. The preferred material is concrete. Concrete sidewall panels must be of a thickness consistent with panel height, spacing of supports, depth of soil backfill and contain reinforcing steel. In heavy soils, place a perforated tile with an overlying gravel layer at the base of the wall.

Several methods are available to determine the appropriate width, height and length of horizontal silos. One method, based solely on dry matter, is as follows:

Daily Silage Needs: Note: Consult a Dairy Nutritionist or Feed Specialist to determine the proper amount of dry matter (DM) intake for your needs.

Total daily DM intake in pounds = ______________________________

Daily DM removal from silo = Total daily DM intake × 1.1
(Assumes 10% DM loss between silo and consumption by cows)

= ____________________ Pounds DM/day × 1.1 = ________________ (A)
(Daily DM removal)

Dry Matter Removal Rate:

Select face removal rate:

6 inches per day recommended
3 inches per day minimum — winter
4 inches per day minimum — summer

inches/day ________________________ (B)
(Face removal rate)

DM removal rate:

$$\frac{\text{Daily DM removal (A)}}{\text{Face removal rate (B)}} = \frac{(\qquad\qquad)}{(\qquad\qquad)}$$ = pounds DM/inch ______________________ (C)

(Continued on next page)

Horizontal Silo Width and Depth:
(Use either Method I or Method II)

Method I: Select width and depth from Table 1

Table 1. Horizontal silo capacity.

Depth in feet	Silo floor width in feet: 16	20	30	40	50	60	70	80	90	100
	pounds DM per inch of face removal									
8	150	185	280	375	465	560	655	745	840	935
10	185	235	350	465	585	700	815	935	1,050	1,165
12	225	280	420	560	700	840	980	1,120	1,260	1,400

Assumes 65% moisture, silage density of 40 pounds per foot. Capacities rounded to nearest 5 pounds.

Match the DM removal rate (C) to the closest value listed in Table 1

Method II:

Select sidewall depth: (8 feet - 12 feet typical) ft ____________________ (D)
(Silo depth)

Calculate width: 16 feet minimum for packing, 30 feet recommended(for labor efficiency)

$$\frac{\textit{(DM removal rate (C))} \times 12}{\textit{(Silo depth (D))} \times 40 \times 0.35} = \frac{(\qquad\qquad) \times 12}{(\qquad\qquad) \times 40 \times 0.35} = ft \text{ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (E)}$$

(Silo width)

(Round up to the nearest whole number)

Horizontal Silo Length:

Select storage period: = Number of days ____________________ (F)
(Storage period)

Calculate silo length:

A.) Initial silo length calculation = $\frac{\text{(Face removal rate(B))} \times \text{(Storage period(F))}}{12}$

$$= \frac{(\qquad\qquad) \times (\qquad\qquad)}{12}$$

= ________________________ ft
(Silo length)

B.) Number of horizontal silos needed = $\frac{\text{Single silo length}}{150} = \frac{(\qquad\qquad)}{150}$ ____________________ (G)
(Number of silos needed)

(Round up to the nearest whole number)

(If calculation (A) is less than 150 ft. then "1" is the answer to (G))

C.) Individual silo length $\frac{\text{Single silo length (part A)}}{\text{Number of silos needed (G)}} = \frac{(\qquad\qquad)}{(\qquad\qquad)}$ = ft ____________________ (H)
(Silo length)

(Round up to the nearest whole number)

If different sized silos are used to meet seasonal feeding or harvesting needs, calculate the size of the smaller silo, deduct total capacity from annual needs and proceed with design of remaining silo(s).

Good design, coupled with the use of good quality materials and construction practices and performance of maintenance on an as needed basis, will yield a silo with low maintenance and long service-life. Good design based on sound criteria results in an easy-to-manage storage.

[1]Gerald Bodman, Extension Agricultural Engineer - Livestock Systems, Biological Systems Engineering, Lincoln.

Horizontal Silos Assessment and Management

Gerald R. Bodman[1]

Introduction

Providing high-quality feed for an expanded dairy herd has led many dairymen to consider horizontal silos. Horizontal silos have several advantages over tower silos including lower construction costs, lower maintenance and faster feed removal. In some jurisdictions, there is also a significant tax difference. In most instances, a horizontal silo allows a longer length of cut, which is especially critical with hay crop forage to ensure high-quality fiber to maintain better rumen function, reduce risk of acidosis and bolster production of butterfat. Disadvantages include less flexibility in filling, higher losses and a requirement to work out-of-doors during snow or rain. The disadvantages can be minimized by using a cab-equipped tractor for removal, good design and construction and proper filling practices to minimize losses.

Silo Types

Horizontal silos are divided into two types. Bunker silos, which are generally set on top of the ground, and trench silos, which are built into the ground. Reinforced concrete panels supported by concrete pilasters or soil are used to form sidewalls in bunker silos. Trench silos are built into the ground. For trend silos, sidewalls may be soil or concrete. A concrete floor is required in nearly all instances to ensure all-weather access to feed. Generally, trench silos are considered safer due to reduced risk of operators driving over the edge as it is filled.

Horizontal silos are particularly well-suited to corn silage because of the once-per-year filling and all-at-once nature of the harvest. Management of hay crop silages is more difficult because of several-times-per-year harvesting methods and increased spoilage rates. Spoilage is reduced by harvesting at higher moisture contents to facilitate packing. Harvesting at higher moisture levels (60-65%) also reduces field losses, compared to haylage (30-40% moisture) because of lower leaf loss.

When stored in a horizontal silo, high-moisture corn poses a special challenge. A re-cutter screen is recommended in the chopper to enhance packing and exclude air. Generally, a horizontal silo is not a good choice for whole-kernel, high-moisture corn with post-storage processing.

The recommended practice is to use separate and smaller silos for feeding hay silage and high-moisture corn during the summer months. A smaller silo, both shallower and narrower, allows a faster feed removal rate and keeps day-to-day deterioration at an acceptable level. Some dairymen simply discontinue feeding of high-moisture corn during the summer. Because bunk life is more critical during warm weather, more frequent feeding is justified.

As dairies expand, many producers convert to horizontal silos to effectively store and handle substantial quantities of feed. For many, this means learning new management skills.

The storability of forages is influenced by length of cut, moisture content, filling practices, quality of cover and packing methods. Of these factors, packing is the one most often overlooked or found to be inadequate. Once filling begins, the silo should be continually packed. Place silage in layers no more than 12 inches thick. A heavily weighted wheel tractor is best for packing. Single tires are preferable to duals. Well-lugged tires are beneficial. The packing tractor should be operated at a slow speed to give time for forage particles to be pressed together and interlocked. Each layer of silage should be rolled at least twice before placing the next layer. The entire silo should be rolled at least two additional times at the beginning and end of each day. Track-mounted equipment is fine for pushing and leveling silage but should not be relied upon for packing due to lower contact pressures and a general inability to identify low and soft spots.

As filling is completed, the silo should be finished with a slightly rounded top. This helps assure good drainage. If the top of the silage is below the top of the silo walls, the forage mass should still have a slight slope towards one or both ends to allow escape of drainage water. Allowing water to pool along the edges increases the risk of seepage and spoilage.

Black 6-mil thick plastic is the preferred cover for the silage. The cover should be solidly weighted to reduce billowing and "pumping" of air during windy conditions. Used junk car tires laid on so they are touching each other is the preferred method for weighting the cover. Larger truck or tractor tires allow more billowing due to the larger, open, non-weighted centers. Tires should have holes cut in the low side to prevent water accumulation. Allowing water to collect in tires will significantly increase mosquito problems. Other products used successfully for weighting the plastic include sawdust and ground limestone.

The storage area should be fenced to prevent stray animals, e.g., deer, and loose livestock from walking across the surface. Some producers have used an electrically charged wire 4 to 6 inches above the ground to help discourage raccoons and similar animals.

If possible, feed should be removed from the silage in a manner which preserves a smooth front face. Loose silage should be cleaned up at least daily. Mechanical unloaders, which continually shave the exposed face and avoid loosening of large quantities of silage, are available but are generally too slow and impractical.

Good, quality feed can be stored in horizontal silos. Proper filling methods, good coverage and care during unloading will keep losses at an acceptable level.

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Dairy Research Herd Annual Report

Erin L. Marotz[1]

The University Dairy Research Herd consists of approximately 130 milking cows and 60 replacement heifers. The milking cows are currently averaging between 72 and 76 pounds per day. Our DHIA rolling herd average is 22,245 lb of milk, 845 lb of fat and 710 lb of protein. The dairy unit employs seven people, including the manager. The employees work a schedule of seven days on and two days off. This allows us to have a crew of four people at the dairy on any given schedule. The manager works a standard five-day work week and does all of the fill-in work for sick or vacationing employees.

In the last 12 months, the dairy personnel have participated in various research projects, given many tours, and worked to update facilities. All nutrition research takes place in a 40-cow tie-stall barn equipped with individual feeding boxes. This allows us to monitor daily feed intake, as well as daily milk production, rumen activity and milk composition. Some research trials have included work with a brown midrib sorghum for higher fiber digestibility, soyhulls with soapstock and lecithin for higher fat content and wet corn gluten feed. These cows in the Nutrition Research Barn may be there for as many as 20 weeks at a time, let out only to be milked and monitored for estrous activity. This means cow comfort is a real concern. In the past, the stall consisted of a concrete base with a 3/4 inch rubber mat on the concrete. This was not very comfortable to the cows and caused swollen hocks and leg and hip injuries. In 1997, we removed the rubber mats and put down multi-celled rubber-filled mattresses. These mattresses are filled with ground rubber and seamed much like an air mattress and covered by a wax-impregnated polypropylene cover. We have conducted only one trial on these new mattresses, but the cows that were on them for 20 weeks showed no swollen hocks or leg injuries. We have also mounted ceiling fans in the barn to increase air movement.

In the summer of 1996 we constructed a 30 x 100 ft greenhouse facility, which is used as a maternity barn and heifer housing. The greenhouse is covered by two layers of plastic with an air cushion between them. The plastic is translucent so a shade cloth is not needed in the summer. The sides of the barn roll up as curtain side walls and allow air to flow freely through the barn. Although the cows have taken to the barn quite nicely as it is warmer in the winter and cooler in the summer. The expected life of the plastic is 3 to 5 years, we did have to replace the top layer about 9 months after it was put on.

1996 saw a dramatic increase in the number of tours the dairy unit has given. With the dairy unit's incorporation into programs such as Get Smart and Ag Awareness, we were visited by over 1,000 school children, plus visitors from college classes, area dairy producers and foreign travelers.

Many of you may know the dairy unit was constructed at the old ordinance plant near Mead. In late 1997, the ordinance buildings will be demolished. This process may take 18 months to 3 years to complete. While it will dramatically enhance the appearance of the dairy, it will be difficult to manage around, as some of the buildings are still used as cattle housing and storage facilities. Our primary focus in the next few years will be to find alternative housing and storage.

The Dairy Research Unit will continue to both conduct research trials pertinent to dairy producers and be a source of information for audiences from school children to producers. If you have any questions about the research we are conducting, or if you would like a tour of the dairy unit, please stop by or give us a call at (402) 624-8068.

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[1]Erin L. Martoz, Manager, Dairy Research Unit, Agricultural Research and Development Center, Mead.

New Publications Available for 1996 through 1997

The following Dairy publications have been published since 1996 and provide timely information for dairy producers. If you would like a copy of a NebGuide, please contact your local Extension office or write:

Bulletins
P.O. Box 830918
University of Nebraska
Lincoln, NE 68583-0918

G95-1265	Guidelines for Using Computerized Concentrate Feeders for Dairy Herds
G96-1298	Milk Urea Nitrogen Testing
NF 96-270	Handling Feed Moisture in Ration Formulation and Inventory Control
G96-1306	Feeding Dairy Cows to Reduce Nitrogen, Phosphorus and Potassium Excretion into the Environment
NF97-317	Managing Dairy Cows to Avoid Abomasal Displacement
NF 96-252	Controlling Feed Costs on Your Dairy Farm
EC 96-824	Dairy Economics in Nebraska - An Analysis of Costs and Returns and Comparisons with Other States
G96-1285	Dairy Health Management for Optimum Production and Reproductive Performance
G95-1253	Basic Principles of Mastitis Control
G95-1271	Mastitis is a Disease -- Control is an Everyday Task

For a comprehensive listing of available dairy publications, visit our web site at:
http://www.ianr.unl.edu/ianr/anisci/anscdept.htm

Up to 10 single NebGuide titles are free to Nebraskans; additional titles or copies are available at a charge of $.25 per piece. A $1.50 shipping and handling charge will be added to copies ordered from the address above. Copies obtained from your local Extension office do not usually have a shipping free imposed.

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As an Animal Science major you may be interested in Block & Bridal to build leadership, communication and organizational skills while you meet new friends with similar interests.