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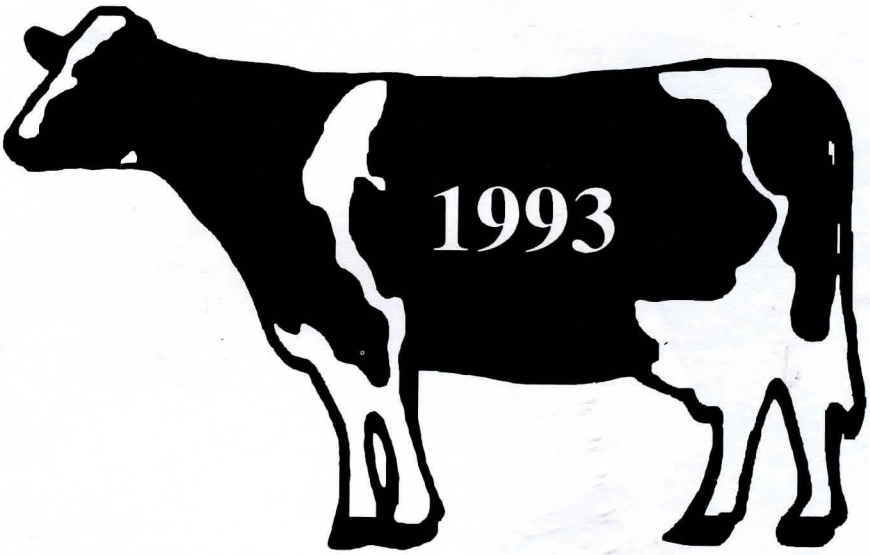

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Dairy Report

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The Agricultural Research Division
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln
Darrell W. Nelson, Director

This Dairy Report
is Dedicated
to the Memory of

CRAWFORD WILSON NIBLER

Crawford W. Nibler, 88, died in Lincoln on Sunday, June 6, 1993.

Nibler, professor emeritus, retired from the Department of Animal Science in 1970 after 41 years of service to the University of Nebraska - the last 25 years as an extension dairy specialist. During his time on the University faculty, Nibler established an impressive record of service and commitment to both the University and the Nebraska dairy industry.

Nibler was an instructor of dairy husbandry from 1929 to 1932 at the University. From 1932 to 1945, he served as an Agricultural Agent for Kimball and Scottsbluff counties before returning to Lincoln to serve as an Extension Dairy Specialist until his retirement in 1970. He played a major role in developing Extension Service programs designed to help farmers during the difficult drought and Dust Bowl years of the 1930s.

From 1945 to 1970, milk yield per cow in Nebraska increased from 9,623 to 11,939 pounds yearly — much of this progress was due to Nibler's leadership and education of Nebraska's dairy producers. He promoted enrollment of herds into production testing programs, use of artificial insemination, and participation of youth in 4-H Dairy Clubs. Nibler authored numerous extension circulars and popular press articles that covered topics including nutrition, breeding, milk quality, and calf management. He was a pioneer in the use of radio and television for promoting extension programs. In recognition of his dynamic leadership of the dairy industry, and high level of citizenship, Nibler received two prestigious awards in 1963: the USDA Superior Service Award and the DeLaval Extension Award from the American Dairy Science Association.

Even after his retirement, Nibler remained active in Nebraska's dairy industry. In 1989, he became the first person to be inducted into the Holstein Association's Dairy Hall of Fame in recognition of "devoting his entire life to the betterment of the dairy industry of Nebraska." Nibler was also actively involved in the Japanese Agricultural Training Program from 1973 to 1984, visiting Japan in 1974 to meet former students and promote the program.

C. W. Nibler was a leader in dairy extension for many years, respected and admired by University peers and dairy producers alike. His innovative programs, often the first of their kind in the state, and his dedicated service to the dairy industry won the gratitude and respect of dairy producers throughout Nebraska.

ACKNOWLEDGMENTS

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To simplify technical terminology, trade names of products or equipment sometimes are used. No endorsement of product is intended nor is criticism implied of products not mentioned.

Effect of Intrauterine Infusions of Blood Serum and Colostrum on Conception Rate in Repeat Breeder Dairy Cows

Larry L. Larson[1]

Summary

Lactating Holstein cows returning for a second or greater service were assigned randomly to one of the following postinsemination treatments: 1) control, no treatment (n=39); 2) blood serum (n=40); or 3) colostrum (n=40). Intrauterine serum or colostrum infusions, 25 ml each, were performed 1-day postinsemination.

Conception rates in the control (51.3%) and serum (47.5%) groups were greater than in the colostrum (30.0%) group. Average intervals from time of treatment to conception were affected by the treatments (Control, 16.5 days; Serum, 25.0 days; and Colostrum, 45.3 days). These data indicate that postinsemination intrauterine infusions of blood serum had no effect, but colostrum infusions reduced conception rates.

Introduction

Postpartum bacterial endometritis (inflammation of the uterine lining) can cause infertility in cows and contribute to economic losses in the dairy cattle industry because it prolongs the time to first estrus, delays uterine involution, increases the number of services per conception and prolongs calving interval. In addition, unnecessary intrauterine therapy and milk disposal after antibiotic treatment causes more economic loss.

The natural uterine defense mechanism involves phagocytosis by white blood cells and tissue macrophages of invading micro-organisms. Blood serum contain factors (opsonins), attributed to antibodies, essential for phagocytosis. Uterine phagocytosis is inhibited by manual removal of the fetal membranes, trauma, disinfectants, antibiotics and high progesterone concentrations in the blood.

Intrauterine infusions of the mare's own blood plasma increased conception rates in repeat breeder mares. It was suggested that blood plasma-derived opsonins improved the uterine defense system by increasing phagocytosis of the organisms causing endometritis. The phagocytic index of blood of horses is higher than for cows and is stimulated by oxytocin and estrogen and inhibited by dexamethasone. Solutions of antiseptics used as intrauterine infusions markedly inhibited phagocytosis of neutrophils. Colostrum whey products have been reported to benefit the treatment of uterine infections and to improve conception rates. Because the antibodies found in blood serum and colostrum are similar, it is possible that either one could serve as a source of the antibodies. Also, antibodies derived from the same herd or from the same animal might be more beneficial than commercial products derived from animals subjected to different conditions.

Therefore, this study examined the effect of a single postinsemination intrauterine infusion of either blood serum or colostrum on conception rates.

Procedures

Cows and Treatments

Cows returning for a second or greater service were assigned randomly to one of the following treatments: 1) control; 2) blood serum; or 3) colostrum. Approximately 25 ml of the assigned experimental solution was infused into the uterus on the day following artificial insemination (approximately 24 hours postinsemination). No treatment was given to the controls. Conception rates were confirmed by rectal palpation.

Preparation of Blood Serum

Blood was collected via jugular catheter from six multiparous (second or greater lactation) Holstein cows during the estrus phase of the estrous cycle. Blood was cooled immediately and allowed to clot. Serum was separated by centrifugation at 1,520 × g for 20 minutes. The serum was pooled and 25-ml portions were frozen. The serum was thawed just prior to infusion. The blood serum contained 78 mg total protein/ml which included approximately 38 mg immunoglobulin/ml.

Preparation of Colostrum

First day colostrum (approximately 1 quart from first or second milking after calving) was collected from 6 multiparous cows and cooled immediately. The milk fat was separated and discarded and the remaining colostrum was pasteurized by heating in a water bath to 140°F for 30 minutes. The colostrum from the 6 cows was pooled and 25-ml portions were frozen. The colostrum was thawed just before infusion. The defatted colostrum contained approximately 90 mg immunoglobulin/ml.

Results

Conception rates for the control (51%) and blood serum-infused (48%) cows were not different. However, conception rates were reduced for the cows infused with colostrum (30%). Because of the possible carryover effect of the treatments, we also determined the average number of days between the day the cows were treated and the day they conceived. These intervals were: Control, 17 days; Blood Serum, 25 days; and Colostrum, 45 days. These results indicate fewer colostrum-infused cows conceived at the time of treatment and the colostrum-treated nonpregnant cows did not return to heat as soon, or conceived at a lower rate at the repeated service than the controls.

It was concluded that intrauterine infusion of the products used in this study were not beneficial in repeat breeder cows. In fact, the use of colostrum was detrimental, increasing the time needed to re-establish a pregnancy in Holstein cows.

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[1]Larry L. Larson, Associate Professor, Animal Science, Lincoln.

Early Lactation and Reproductive Responses to Rumen Inert Fat Supplementation in Holstein Cows

Jung-Ho Son
Rick Grant
Larry L. Larson[1]

Summary

Thirty-seven Holstein cows were assigned randomly at parturition to receive one of the following diets: Control (C, 0 to 14 weeks); supplemental rumen inert fat at 3% of total ration dry matter (DM) starting at parturition (F, 0 to 14 weeks) or C-F fat supplementation starting at 5 weeks postpartum (C, 0 to 4 weeks then F, 5 to 14 weeks). Milk yield and dry matter intake (DMI) were measured daily. Milk composition, body weight and body condition score were determined weekly. Feeding a supplemental rumen inert fat at 3% of ration DM did not improve overall mean milk yield and reduced DMI during the first 14 weeks of lactation compared to the control diet. Mean milk yield was similar, but DMI was slightly greater when the feeding of supplemental fat was begun at 5 weeks postpartum compared with starting at parturition. Dietary fat supplementation increased peak progesterone concentrations in the blood during the luteal phase of the estrous cycle, but did not affect the postpartum intervals to first ovulation or first service. The supplemental fat also did not affect the first service conception rates.

Introduction

High milk production per cow is an important factor contributing to the profitability of a dairy farm. Negative energy status often accompanies high milk production levels in early lactation and has been correlated with measurements of reproductive performance in dairy cows. An antagonistic association between milk production and reproduction in lactating dairy cows has been documented.

Energy balance (EB) is quantified using measures of milk production (quantity and composition), dietary intake (quantity and composition) and body weight. At least 80 percent of dairy cows have negative energy balance (NEB) during early lactation. In lactation dairy cows, EB influenced follicular development and had an inverse relationship to days to first postpartum ovulation. Energy balance is also correlated positively with progesterone concentration in the blood and conception rates.

If feed presented to cows is adequate, ingestion of calories, not milk yield, is the major determinant of EB in postpartum cows. Two approaches to maximize energy density of the diet fed to early lactation cows are: 1) increasing the nonstructural carbohydrate content of the diet, or 2) supplementing rumen inert fat.

Fat addition to the diet has been examined primarily for its potential benefits on lactation, but it could also be beneficial to reproduction. However, results have been inconsistent. In some studies fat supplementation in early lactation has not been beneficial apparently due to depressed feed intake.

The present study was designed to determine the effect of feeding supplemental fat starting at either parturition or at 5 weeks postpartum on lactation and reproductive performance.

Procedures

Thirty-six Holstein cows were blocked by age and assigned randomly at parturition to one of three experimental dietary treatments: 1) control diet, 2) supplemental fat diet starting at parturition, or 3) control diet for 4 wks and then switched to the supplemental fat diet.

The cows were individually fed their assigned total mixed ration ad libitum once daily in a tie-stall barn from parturition to 14 wks postpartum. The control diet was 50:50 forage to concentrate (dry basis). The forage portion was 50% alfalfa haylage and 50% corn silage (dry basis). Supplemental fat was added to the control diet at 3% of total ration dry matter. Therefore, the two diets were similar except for energy density (Crude protein = 18%, Undegraded intake protein = 35% of CP, Nonfiber carbohydrates = 42%, Neutral detergent fiber = 30%). Milk yield and DMI were measured daily. Milk composition, body weight and body condition score (BCS, 1 = very thin to 5 = very fat) were determined weekly. Status of the reproductive tract was examined twice weekly via rectal palpation from 2 wks postpartum until uterine involution was complete.

Blood samples were collected twice weekly. Progesterone concentrations in blood plasma were used to determine postpartum interval to first ovulation,

ovarian cyclicity and corpus luteum competency.

Results

Lactation performance is given in Table 1. Feeding a supplemental rumen inert fat at 3% of ration DM did not improve mean milk yield and DMI during the first 14 weeks of lactation. Mean milk yield was similar, but DMI was slightly greater when the feeding of supplemental fat was begun at 5 weeks postpartum compared to starting at parturition.

Reproductive performance is given in Table 2. Results suggest that fat supplementation starting at either parturition or at 5 weeks postpartum increased peak concentrations of progesterone in the blood, but did not alter the postpartum intervals to first ovulation and first service, or conception to first service.

[1]Jung-Ho Son, Graduate Student; Rick Grant, Assistant Professor and Extension Dairy Specialist; and Larry L. Larson, Associate Professor, Animal Science, Lincoln.

Table 1. Effect of supplemental rumen inert fat on lactation performance[1]

	Diet		
	Control	Fat	Control-fat
Number of cows	12	14	11
Milk yield, lb	66.5[a]	64.9[ab]	63.5[b]
Milk fat, %	3.70	3.77	3.60
Milk protein, %	3.19[a]	3.09[b]	3.11[ab]
Milk lactose, %	5.03[a]	4.72[b]	4.82[b]
Body weight, lb	1201[a]	1221[b]	1229[b]
BCS[2]	2.93[a]	3.19[b]	3.16[b]
DMI, lb	45.9[a]	40.0[c]	41.9[b]

[abc]Means within a row with different superscripts are statistically different (P<.05).
[1]Unadjusted means for the entire 14 wk feeding period starting at parturition.
[2]Body condition score (1 = very thin to 5 = very fat).

Table 2. Effect of supplemental rumen inert fat on reproductive traits

	Diet		
	Control	Fat	Control-fat
Postpartum intervals to			
First ovulation, days	28.8	39.1	31.5
First service, days	61.6	63.2	62.6
Peak progesterone			
First cycle, ng/ml	8.52	10.12	12.37
Second cycle, ng/ml	9.73	10.91	13.81
Conception to first service, %	36.4	35.7	25.0

Effect of Prostaglandin $F_{2\alpha}$ and Oxytocin Administration Postpartum on Interval to Placental Release in Holstein Cows

Larry L. Larson[1]

Summary

Holstein cows (n=192) were assigned randomly at parturition to a control (C, no treatment), or a treatment (T) group. Treated cows received both 30 mg prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) and 100 IU oxytocin injected intramuscularly (IM) as soon as feasible postpartum. Incidence of twins, stillbirths and abnormal calf presentations, dystocia score, calf birth weight, lactation number, cow body weight and cow body condition score did not interact with the treatment to influence the time of placental release. Treatment had no effect on the percentage of cows retaining fetal membranes greater than 12 hours. There was no difference between control and treated groups in subsequent incidence of uterine infections or intervals to first service, but subsequent reproductive performance was improved by the treatment based on first service conception rate and days open. These results indicate that postpartum administration of $PGF_{2\alpha}$ and oxytocin does not reduce the interval to placental release, but may benefit subsequent reproductive performance.

(continued on next page)

Introduction

A range of 8 to 30 percent of all spontaneous calvings by dairy cattle are reported to result in the retention of the fetal membranes. Retained fetal membranes can result in uterine infections, delayed uterine involution and increased days open. Numerous factors including sanitation, abortions, premature births, induced calving, dystocia, poor body condition, disease, multiple births, inadequate nutrition and uterine motility contribute to placental retention incidence.

The cause of non-infectious placental retention has been postulated to be an imbalance or insufficiency of hormones near term, resulting in delayed placental maturation. Among the mechanisms proposed for retained placentas is a disturbed synthesis of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) in the placentomes. Placental retention has been induced by administering a prostaglandin secretion inhibitor and the time needed for placental release reduced by $PGF_{2\alpha}$ treatment. Also, it was reported that Holstein cows with retained placentas had lower concentrations of a prostaglandin metabolite than those cows without retained placentas. Administering $PGF_{2\alpha}$ within one hour after calving reduced placental retention after induction of parturition in dairy cattle, but not in beef cattle.

Oxytocin is also involved in the parturition process. Oxytocin causes prolonged, strong uterine contractions which help to expel the fetus. Once the fetus is delivered, uterine contractions continue and eventually expel the fetal membranes. Stress might inhibit oxytocin release. However, injection of oxytocin alone within three to six hours after calving failed to reduce placental retention in a herd where the incidence was already low.

Various treatments with corticosteroids, prostaglandins, estrogens and oxytocin have been used without appreciably reducing placental retention. The objective of this study was to determine the effect of a combined treatment of $PGF_{2\alpha}$ and oxytocin on the incidence of placental retention and subsequent reproductive performance.

Procedures

Cows were assigned randomly at parturition to either a control group (100 cows) or treatment group (92 cows). Control cows were not treated and calving management followed routine procedures. Treated cows received both 30 mg $PGF_{2\alpha}$ (Lutalyse, The Upjohn Co., Kalamazoo, MI) and 100 IU oxytocin (Anpro Pharmaceutical, Arcadia, CA) injected IM as soon as feasible postpartum. The estimated hours after calving at time of treatment administration and the estimated time of placental release were recorded. Factors that might contribute to the incidence of fetal membrane retention were also recorded. These included dystocia score (1=no assistance needed to 4=extremely difficult or cesarean), calf birth weight, health of the calf, cow body weight, body condition score of the cow (1=very thin to 5=obese) and lactation number.

Results

Administration of $PGF_{2\alpha}$ and oxytocin as soon as feasible after calving did not reduce the percentage of cows retaining fetal membranes greater than 12 hours (Table 1). The hour after calving at which the treatment was administered varied from 0 to 12 hours. Time of treatment had no effect on the variables measured, so the data from all cows were used in the analyses. Factors that could influence the incidence of placental retention were not different between the control and treated groups (Table 1). Possible carryover effects of the treatment were also examined and the results varied (Table 2). There was no difference between control and treated groups on subsequent incidence of uterine infections or interval to first service. However, subsequent reproductive performance was improved in the treated group based on first service conception rate and days open.

The routine administration of $PGF_{2\alpha}$ and oxytocin to all cows at parturition will not significantly reduce the overall incidence of placental retention. However, this treatment might have some long-term benefits on subsequent rebreeding.

---

[1]Larry L. Larson, Associate Professor, Animal Science, Lincoln.

Table 1. Potential factors affecting placental retention

	Treatment group	
	Control	Treated
Cow:		
Number	100	92
Lactation number	2.13	2.36
Body weight, lb	1335	1333
Body condition score (1 to 5)	3.18	3.13
Calf:		
Female, %	52.1	45.1
Birth weight, lb	97	95
Twinning rate, %	5.0	1.1
Stillbirth, %	6.0	8.7
Dystocia score (1 to 4)	1.33	1.45

Table 2. Subsequent reproductive performance

	Treatment group	
	Control	Treated
Abnormal vaginal discharge, %	26.3	27.0
Cystic ovaries, %	18.2	34.8
Interval to first service, days	72.8	76.2
Conceived to first service, %	25.0	36.4
Days open[a]	133	122

[a]Means are statistically different (P<.05).

Feeding Vitamin A at High Concentrations Does Not Improve Lactation or Reproduction

Tammy. A. Tharnish
Larry L. Larson[1]

Summary

Four trials involving 168 Holstein cows were conducted to evaluate the effect of vitamin A supplementation at concentrations well above National Research Council (NRC) recommendations (1 million or 2 million IU/day) compared with 100,000 IU/d on lactation and reproductive performance. Feeding supplemental vitamin A at these high concentrations did not affect milk yield, somatic cell counts, dry matter intake or body weight change in any of the trials. The high vitamin A supplementation also had no effect on circulating concentrations of progesterone or on most measures of reproductive performance examined in the trials. Thus, it was concluded that providing vitamin A at high concentrations is not warranted.

Introduction

Vitamin A is important for many physiological processes including reproduction, maintenance of healthy epithelial tissues, improved mammary health and functioning of the animal's immune system. Although vitamin A is a required nutrient, extremely high concentrations can be detrimental.

Required and upper safe levels of vitamin A for various domestic species have been reported by the NRC. The suggested requirement of vitamin A for pregnant and/or lactating cows is 1,273 to 1,773 IU/lb diet with an upper limit of 30,000 IU/lb diet. Therefore, cows consuming 44 lb/day dry matter (DM) would have an estimated daily requirement of 56,000 to 78,000 IU with an upper safe limit of 1,320,000 IU vitamin A.

A Pennsylvania study found that cows receiving 170,000 IU/day compared with 50,000 IU/day of supplemental vitamin A during the dry period and early lactation produced significantly more fat-corrected milk during the first six weeks of lactation. The supplemental vitamin A was in addition to the naturally occurring nutrients in the feedstuffs. Others reported that milk yield and serum vitamin A concentration were correlated positively, providing additional evidence that increasing vitamin A might improve milk yield.

A Nebraska field trial (D.J. Kubik and F.G. Owen, 1988, personal communications) involving 80 Holstein cows in four herds found that milk yield was increased 3.5 percent by feeding supplemental vitamin A at 1,020,000 IU, compared with 292,000 IU/day. The participating dairy producers also reported improved cow health and reproductive performance.

Therefore, the purpose of our study was to examine the effect of supplementation of dietary vitamin A at concentrations well above NRC recommendations on milk yield and several measures of reproductive performance.

Procedures

Four trials were conducted. Trials 1 and 2 examined the effect of short-term (3 or 4 wk treatment periods) daily supplementation of 1 or 2 million IU compared to 100,000 IU vitamin A to pregnant cows. Cows were housed in a tie-stall barn and individually fed a total mixed ration (TMR), 50:50 forage to concentrate DM, for ad libitum intake. The forage was corn silage and alfalfa haylage (63:37, DM basis). The concentrate mix contained 71% cracked corn, 20% soybean meal, 1% urea, 2% soyhulls, buffer, and supplemental minerals. The TMR was formulated to meet NRC recommendations.

Supplemental vitamin A was provided in a 100-g premix which was added on top and blended lightly into the TMR daily for each cow individually. Milk yield and feed intake were recorded daily. Milk composition and body weight of the cows were determined weekly.

Trials 3 and 4 compared the effect of long-term (fed from parturition to 120 days in milk) daily supplementation of either 1 million or 100,000 IU vitamin A per cow. In trial 3, cows were managed in a free-stall housing system and the concentrate portion of the diet containing the appropriate vitamin A was fed individually via electronic feeders. The forage mix was group fed once daily for ad libitum intake. In trial 4, cows were maintained in tie-stalls and individually fed a TMR containing their vitamin A treatment.

Results

Lactation Performance

Neither short-term nor long-term supplementation of vitamin A at 1 million IU or 2 million IU/day affected lactation performance. Measures evaluated included milk yield, milk composition, somatic cell counts, total dry matter intake, dry matter intake as a percentage of body weight, and change in body weight.

(continued on next page)

Reproduction

Short-term supplementation of 1 million or 2 million IU/day of vitamin A to pregnant cows did not significantly affect circulating blood progesterone concentration, although there appeared to be a trend of reduced progesterone with higher vitamin A. Subsequent calving performance measurements (gestation length, dystocia score, live births and interval to placental release) were not affected.

Long-term supplementation of 1 million IU/day of vitamin A from parturition to 120 days in milk did not affect postpartum intervals to uterine involution, first ovulation or first service, progesterone concentrations in blood and first service conception rate. The percentage of cows potentially pregnant based on milk progesterone concentrations on day 22 after breeding was much greater than the confirmed conception rates, especially in the high vitamin A supplementation groups. The high vitamin A groups had a higher incidence of failed or delayed luteolysis or abnormal estrous cycles following synchronization of estrus with a prostaglandin.

It was concluded that supplementation with vitamin A at levels well above NRC recommendations does not have pronounced beneficial or detrimental effects on lactation or reproductive performance.

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[1]Tammy A. Tamish, former Graduate Student, and Larry L. Larson, Associate Professor, Animal Science, Lincoln.

Replacing Forage Fiber with Soyhulls

Susan Weidner
Rick Grant[1]

Summary

Thirty Holstein cows in early and midlactation were fed one of five total mixed rations (TMR) for 12 weeks, in which Soyhulls (SH) replaced 25 percent or 42 percent of the forage (alfalfa:corn silages, 1:1 dry basis). Within each level of soyhull replacement, 0 or 33 percent of the silage was replaced with coarsely chopped alfalfa hay. All diets contained the same levels of crude protein (CP) and energy compared to the Control diet, which contained 60 percent silage and no soyhulls. Increasing the level of forage replaced with soyhulls in diets for early lactation cows from 25 to 42 percent increased dry matter intake (DMI), milk yield, and fat-corrected milk (FCM) production. Replacing 33 percent of the alfalfa:corn silage mixture with coarsely chopped alfalfa hay at the 42 percent level of soyhull replacement for forage increased DMI, milk and milk protein yields in early lactation cows. Midlactation cows fed the same diet performed equally to Control cows. Soyhulls can successfully replace 42 percent of the dietary forage DM when fed in combination with coarsely chopped hay in place of silage.

Introduction

Supplying adequate amounts of energy to the dairy cow supports optimal milk production throughout lactation. Feeding high quality forage, with lower fiber and higher dry matter digestibility, supplies energy without the negative effects of acidosis, decreased feed intake, and depressed milk fat percentage often found when high levels of grain are fed. However, when forage supplies are limited or of poorer quality (such as last year in Nebraska) due to winterkill or less than optimal growing conditions, the dairy producer may be forced to locate an alternative fiber source.

A byproduct of soybean processing, soyhulls are both an energy and a highly digestible fiber source. Most research has focused on feeding soyhulls as a replacement for high-starch concentrates to reduce acidosis. The potential effects of replacing forage fiber with high levels of soyhulls have not been investigated. Previous researchers speculated that improved fiber digestibility may result from adding hay to diets high in soyhulls to slow down their rate of passage from the rumen. Our objective was to determine the effect on performance of adding coarsely chopped alfalfa hay to diets in which soyhulls replaced 25 or 42 percent of the forage DM during early and midlactation.

Procedures

Thirty Holstein cows, grouped by stage of lactation, were assigned to one of five treatments. Early lactation cows averaged 34 days in milk, whereas midlactation cows averaged 151 days in milk. The five diets are described in Table 1.

The Control diet contained 60% forage (alfalfa:corn silages, 1:1 dry basis) and 40% concentrate including 1% Megalac® (Church & Dwight, Princeton, NJ) to represent a diet typically fed to lactating dairy cattle. The low soyhull

Table 1. Nutrient composition of diets[a]

Diet	Composition				Feedstuffs					
	DM	CP	NDF	NE_L	Alfalfa haylage	Corn silage	Alfalfa hay	SH	Shelled corn	SBM: DDG[b]
	(% of DM)			Mcal/lb	(% of DM)					
Control[c]	61.9	16.0	29.5	.77	30.0	30.0	---	---	16.9	17.8
Low soyhull - hay	66.8	16.5	31.7	.77	22.5	22.5	---	15.0	17.2	18.6
Low soyhull + hay	76.3	15.5	32.2	.76	12.6	12.6	19.8	14.8	18.9	17.1
High soyhull - hay	72.9	16.7	33.3	.77	17.4	17.4	---	25.3	15.1	20.6
High soyhull + hay	82.6	16.8	34.2	.76	7.5	7.5	20.1	25.0	17.0	18.6

[a]All diets contained 4.2 to 4.3% mineral and vitamin supplement to meet or slightly exceed requirements.
[b]SBM:DDG = soybean meal, 44% CP:Distillers dried grains.
[c]Control diet contained 1% Megalac®(Church and Dwight, Princeton, NJ).

without hay diet contained the same silage mixture as the Control diet, with 25 percent of the silage replaced by soyhulls. The low soyhull diet with hay had 25 percent of the silage replaced with soyhulls in combination with 33 percent of the silage replaced by coarsely chopped alfalfa hay. The high soyhull diet without hay had 42 percent of the silages replaced by soyhulls, and the high soyhull diet with hay also had 33 percent of the silage replaced with chopped hay. All diets were fed as total mixed rations (TMR) once daily and were formulated to contain equal levels of CP and energy. Diets were fed for 12 weeks, with cows housed in a tie-stall barn. Daily milk yields were recorded electronically and composite p.m. and a.m. milk samples were collected twice weekly and analyzed for fat and protein percentages. Cows were body condition scored every 4 weeks and rumination activity was measured by continuous observations for 24 hours once every 4 weeks.

Results

Intake of DM and neutral detergent fiber (NDF) was greatest for early lactation cows fed the high soyhull plus hay. These same cows also produced the greatest amount of milk and milk protein (Table 2). Milk fat and 4% FCM production for this diet equalled the Control diet which would commonly be fed to lactating cows. All cows gained BW during the trial, and cows fed the Control diet

Table 2. Performance of early lactation dairy cows

Item	Diet				
		Low soyhull		High soyhull	
	Control	- Hay	+ Hay	- Hay	+ Hay
DMI, % of BW	4.11[d]	4.19[cd]	4.30[c]	4.46[b]	4.68[a]
NDF intake, % of BW	1.21[d]	1.32[c]	1.38[c]	1.50[b]	1.61[a]
Milk yield, lb/day	78.5[c]	77.0[c]	73.4[d]	82.5[b]	88.6[a]
Milk fat, lb/day	2.7[a]	2.3[b]	2.1[c]	2.7[a]	2.7[a]
Milk protein, lb/day	2.3[b]	2.3[b]	2.1[c]	2.4[b]	2.6[a]
4% FCM, lb/day	73.6[a]	66.2[b]	60.2[c]	74.1[a]	77.6[a]
Body condition score	3.0[a]	2.7[ab]	2.6[ab]	2.3[b]	2.3[b]

[abcd]Means within a row with different superscripts are statistically different (P<.05).

Table 3. Performance of midlactation dairy cows

Item	Diet				
		Low soyhull		High soyhull	
	Control	-Hay	+Hay	-Hay	+Hay
DMI, % of BW	3.90[b]	3.69[c]	3.61[c]	3.57[c]	4.48[a]
NDF intake, % of BW	1.15[b]	1.17[b]	1.15[b]	1.19[b]	1.53[c]
Milk yield, lb/d	62.0[a]	62.0[a]	58.9[b]	57.8[b]	64.2[a]
Milk fat, lb/d	2.3[a]	2.2[a]	1.7[b]	1.7[b]	2.4[a]
Milk protein, lb/d	1.6[d]	2.0[b]	1.9[bc]	1.8[c]	2.2[a]
4% FCM, lb/d	58.7[a]	57.1[a]	47.8[b]	47.6[b]	61.5[a]
Body condition score	3.3	3.1	3.2	2.9	2.9

[abc]Means within a row with different superscripts are statistically different (P<.05).

Table 4. Chewing activity of early and midlactation dairy cows

Item	Diet				
		Low soyhull		High soyhull	
	Control	-Hay	+Hay	-Hay	+Hay
Eating, min/day	229[a]	217[a]	215[a]	184[b]	223[a]
Ruminating, min/day	408[a]	382[ab]	357[b]	286[c]	383[ab]
Total chewing, min/day	637[a]	599[ab]	572[b]	470[c]	606[ab]

[abc]Means within a row with different superscripts are statistically different (P<.05).

(Continued on next page)

had the highest body condition scores.

For midlactation cows, intake of DM and neutral detergent fiber (NDF) was also greatest for the high soyhull plus hay diet (Table 3). Milk yield, milk fat, and 4% FCM production for this same diet was similar to the Control diet, whereas production of milk protein was greater. As in early lactation, all cows gained BW during the trial with no differences in body condition score (average = 3.0).

Rumination (cud chewing) time was maintained relative to the Control diet for the high soyhull plus hay diet (Table 4), indicating that this diet contained adequate effective fiber even though 42 percent of the silage was replaced with soyhulls.

In summary, early lactation cows fed a diet in which 42 percent of the silage was replaced with soyhulls and an additional 33 percent was replaced with chopped hay produced 10 lb/day more milk than cows fed a Control diet of 60 percent silage with no soyhulls. Performance of midlactation cows fed the same diet was identical to cows fed the Control diet, while protein yield increased 29 percent. When high quality forage is limited, the percentage of dietary NDF from forage can be reduced successfully to 45 percent with the inclusion of 42 percent soyhulls and 33 percent coarsely chopped alfalfa hay in place of silage. Feeding strategies such as this will help Nebraska dairy producers maintain high levels of milk production during years when tonnage of high-quality forage is limited.

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[1]Susan Weidner former Graduate Student, and Rick Grant, Assistant Professor and Extension Dairy Specialist, Animal Science, Lincoln.

Effect of a Soyhull:Soy Lecithin:Soapstock Mixture on Performance of Lactating Dairy Cattle

Drew Shain
Rick Grant
Terry Klopfenstein
Rick Stock[1]

Summary

Thirty-two Holstein dairy cows were fed four diets of equal crude protein (CP) and energy that contained either high levels of nonfiber carbohydrates (NFC; 43% of ration dry matter, DM) and no added fat, 1% ruminally inert fat, a 6% level of soyhull:soy lecithin:soapstock (SLS), or a 12% level of SLS (all on a DM basis). Efficiency of 4% fat-corrected milk (FCM) production was greatest for cows fed SLS at 6 percent of dietary DM. The SLS mixture was an excellent source of fiber and vegetable fat for inclusion in diets of lactating dairy cattle.

Introduction

Combining three common byproducts of soybean processing could create a high-fiber and -energy feed for ruminants. Soybean hulls typically contain 67 to 70 percent neutral detergent fiber (NDF) that is highly digestible. Crude soy lecithin and soapstock are byproducts of soybean oil processing and are available as potential dietary fat sources. Previous research with dairy and beef cattle demonstrated the effectiveness of soybean hulls as a highly digestible fiber substitute for dietary grain. The effect of crude soy lecithin and soapstock on ruminal fiber and protein digestion, and subsequent animal performance, is unclear.

None of the reported research used a soyhull and fat mixture similar to the unique product developed and used in our study. Therefore, the objectives of this research were:

1) to formulate a mixture of soybean hulls, soy lecithin, and soapstock (SLS) with acceptable mixing and handling characteristics, and
2) to evaluate the effectiveness of SLS as an energy source for lactating dairy cattle.

Procedures

The details of formulating the SLS mixture were reported in the 1993 Nebraska Beef Report, pp. 34-35. Product used in this trial was mixed in 1,200 lb batches at the University of Nebraska Agricultural Research and Development Center at Mead, NE, and contained 15 percent (wt/wt, DM basis) of a 4:1 ratio (DM basis) of soy lecithin:soapstock. The SLS product contained 88.5% DM, 9.6% CP, 60.8% NDF, and 15.5% ether extract (fat).

After an initial period of 2 weeks, during which all cows were fed a common diet, 32 Holstein cows were allotted to one of four treatments according to age, calving date, and initial 4% FCM production. Each diet was fed to five multiparous (two or more lactations) and three primiparous (first lactation) cows. Cows averaged 23 days in milk at the beginning of the initial period. Experimental diets were fed for 10 wk. Dietary treatments as shown in Table 1 were:

Table 1. Nutrient composition of diets

Item	Diet			
	HS	Low SLS	High SLS	Ca-FA
	(% of DM)			
Ingredients				
Alfalfa silage	16.5	16.5	16.5	16.5
Corn silage	33.5	33.5	33.5	33.5
SLS[a]	--	6	12	--
Ca-FA[b]	--	--	--	1
Corn, rolled	28.5	20.9	15.5	25.2
Soybean meal, 44% CP	15.2	15.9	16.3	15.8
Distillers dried grains	4.2	4.5	3.9	5
Composition				
CP	17.1	17.4	17.5	17.3
NDF	28.5	31.5	34.3	28.7
NFC	43.0	38.1	34.6	40.3
EE (fat)	3.5	4.5	5.3	4.6
NE_L, Mcal/lb	.80	.80	.81	.80

[a]SLS = Soyhulls:soy lecithin:soapstock mixture.
[b]Ca-FA = Calcium salt of fatty acid (Megalac®, Church & Dwight, Princeton, NJ).

Table 2. Mean performance of cows fed experimental diets

Item	Diet			
	HS	Low SLS	High SLS	Ca-FA
DM intake, % of BW	4.41[b]	4.40[b]	4.73[a]	4.55[b]
Fat intake, % of BW	.15[c]	.20[b]	.25[a]	.20[b]
Milk yield, lb/day	68.2[b]	78.1[a]	71.3[b]	69.4[b]
Milk fat, %	3.74	3.58	3.61	3.69
Milk protein, %	3.18[ab]	3.09[b]	3.23[a]	3.13[b]
4% FCM, lb/d	65.0[b]	72.7[a]	67.1[b]	66.1[b]
Efficiency, FCM/DMI	1.24[a]	1.25[a]	1.12[b]	1.24[a]
Energy balance, Mcal/d	10.8[b]	12.2[b]	16.3[a]	11.6[b]
Body condition score	2.71	2.67	2.73	2.51

[abc]Means within a row with different superscripts are statistically different (P<.05).

1) high starch, 0% supplemental fat (**HS**);
2) 1% added ruminally inert fat (**Ca-FA**; Megalac®, Church and Dwight, Princeton, NJ);
3) 6% SLS (**Low SLS**); and
4) 12% SLS (**High SLS**).

The HS diet contained 43% NFC and 3.5% fat; the low SLS diet contained 4.5% fat (1% added vegetable fat); the high SLS diet contained 5.3% fat (approximately 2% added vegetable fat); the Ca-FA diet contained 4.6% fat (1% added ruminally inert fat for comparison with 1% added vegetable fat). All diets were fed as total mixed rations and formulated to contain equal levels of CP and energy.

Daily milk yields were recorded electronically. Composite afternoon and morning milk samples were collected twice weekly and analyzed for fat and protein percentages. Cows were scored for body condition and energy balance was calculated weekly.

Results

For all diets, level of intake was very high. One explanation may be the small particle size of the diets. As planned, fat intakes as a percentage of body weight were similar for low SLS and Ca-FA diets. Because cows fed Low SLS and Ca-FA diets consumed equal amounts of fat, yet cows fed the Low SLS diet outperformed cows fed the Ca-FA diet, the ability of soyhulls to reduce the negative associative effects of starch on fiber may have improved performance.

Cows fed the Low SLS diet produced consistently more milk throughout the 10-week experiment than did cows fed the other diets. Cows fed the High SLS diet consumed more feed than cows fed HS and Ca-FA diets but produced similar amounts of milk. Therefore, efficiency of 4% FCM production was the lowest for cows fed the High SLS diet. Although body condition score did not differ among treatments, it was higher numerically for the High SLS diet than for the other diets (2.73 vs 2.63). Changes in body condition score may have reflected changes in energy balance more closely had cows been fed the diets for a longer time.

The dietary fat levels in this experiment were chosen to avoid a decrease in milk protein and to feed SLS at levels that reflect practical feeding situations. Changes in milk protein percentages in our study reflected changes in milk yield. Actual production of milk protein was unaffected by diet. A commonly accepted upper level of vegetable fat addition is 2 percent of ration DM to avoid excessive negative effects of ruminally available fat on fiber digestion. The SLS product seems to be an effective fiber and fat source for lactating dairy cattle, subject to constraints often found with vegetable fats. All diets used in these experiments contained ≥ 50 percent forage, and the product needs to be fed with a wider range of forage levels to fully determine its potential use and limitations as a byproduct feed for dairy cattle. For Nebraska dairy producers, this combination of soybean byproducts found in abundance in Nebraska holds great promise as an economical, effective means of incorporating fat and fiber into the ration of high-producing cows.

[1]Drew Shain, Graduate Student and Research Technician; Rick Grant, Assistant Professor and Extension Dairy Specialist; Terry Klopfenstein, Professor; and Rick Stock, Associate Professor, Animal Science, Lincoln.

Tallow and Feather Meal:Blood Meal Supplementation of Alfalfa-Based Diets for Early and Midlactation Dairy Cows

Rick Grant
Larry Larson
Jung-Ho Son
Susan Weidner[1]

Summary

Alfalfa-based diets containing 0 or 5% hydrolyzed feather meal:blood meal (FTH:BM, 85:15, dry basis) and 0 or 3% tallow were compared to an alfalfa diet containing only 2.3% FTH:BM for effects on reproductive and lactational performance. All diets contained 18% crude protein (CP) and .79 Mcal/lb net energy of lactation (NE_L). Therefore, the diets tested source of energy, rather than energy level, on performance. Diets containing 5% FTH:BM lowered dry matter (DM) and CP consumption while increasing intake of escape protein. Diets containing 3% tallow improved fiber intake and milk yield. Milk fat percentage was highest, and protein lowest, for the 3% tallow diets. Adding 3% tallow to alfalfa-based diets during early lactation improved milk yield more than adding 5% FTH:BM. The 3% tallow diets also had the greatest beneficial residual effect on milk yield during midlactation when tallow was no longer fed. However, the first service conception rates were highest when 3% tallow and 5% FTH:BM were fed together. Average blood progesterone levels, associated with reproductive performance, were highest for the 5% FTH:BM diets. The FTH:BM diets promoted more rapid body reconditioning of early lactation cows which coincided with improved reproductive performance.

Introduction

High quality alfalfa contains high levels of CP and energy, and low fiber levels. Previous research suggests that a source of escape ("bypass") protein added to alfalfa-based diets may improve milk production responses because much of the CP in alfalfa is rapidly degraded in the rumen (*i.e.* low in bypass). Feather meal, when properly hydrolyzed, has the potential to be an excellent source of escape protein in dairy cattle diets; however, little research has been done. Previous experience at the University of Nebraska suggests that an 85:15 mixture of FTH and BM promotes maximum daily gain in beef cattle. Therefore, we wanted to test this same escape protein mixture for effectiveness in stimulating milk production. The few trials which have examined the effect of adding tallow to alfalfa-based diets have been inconclusive. Therefore, the objectives of this trial were to:

1) determine to what extent added tallow and/or FTH:BM improve lactation and reproductive performance of early lactation cows fed alfalfa-based diets, and
2) measure the impact of these same supplements as a part of early lactation diets on subsequent midlactation performance when cows are fed diets in which the sole forage is high quality alfalfa.

Procedures

Thirty-five lactating Holstein cows were assigned to one of five diets (Table 1) at two weeks postpartum. Cows were housed in a tie-stall barn equipped with individual feed boxes. All five diets were fed as total mixed rations (TMR) twice daily to promote maximal DM intake for a period of 12 weeks. The high-fat, high escape protein diet contained both 3% tallow and 5% FTH:BM (HF-HE), and tested the usefulness of both supplements for early lactation diets. The high-fat, low escape protein (HF-LE) and the low-fat, high-escape protein (LF-HE) diets tested the relative importance of energy from tallow or nonfiber carbohydrates (NFC = starch, sugars, pectin) vs. escape protein level for diets containing over 60% of the forage as alfalfa. The low-fat, low escape protein (LF-LE) diet served as a negative control, containing neither tallow or FTH:BM. A low-fiber alfalfa haylage diet tested the utility of high quality (RFV = 150) alfalfa as an energy source for early lactation. This diet also served as the midlactation diet (weeks 13 to 16) to determine if early lactation feeding regimen influenced the performance of cows consuming high-alfalfa diets during midlactation. Intake and milk yield were measured daily. Milk composition, and body condition score were measured weekly. Energy balance was calculated every 4 weeks and averaged for the entire 12-week early lactation period.

Results

Dry matter intake was higher for diets containing 0 vs. 5% FTH:BM (Table 2). Intake of DM was least for the diet containing both tallow and FTH:BM and for the diet containing only alfalfa as a forage. Diets containing 5% FTH:BM depressed CP consumption; however, intake of escape CP was increased. Fiber intake was higher for diets containing 3% vs. 0% tallow. Milk yield was highest for diets containing 3% tallow. There was no effect of FTH:BM on milk yield when fed at either 0 or 3% tallow. The high-alfalfa diet, which contained nearly 60% alfalfa, supported milk production equivalent to low fat diets. Milk fat percentage was greatest for the 3% tal-

low diets which reflects their higher NDF levels (Table 1). Milk fat for the high-alfalfa diet was similar to low fat diets, reflective of similar NDF levels. Added FTH:BM had no effect on milk fat. Milk protein percentage was depressed with the addition of 3% tallow which is typical of many high fat diets. The alfalfa diet supported intermediate levels of milk protein. Due to greater fat tests, fat-corrected milk yield was improved for high fat diets. Efficiency of FCM production was best for the 3% tallow diets and the high-alfalfa diet. Feather meal:blood meal at 2.3% of ration DM appeared beneficial when added to a diet containing 58% alfalfa as the sole dietary forage.

Net energy balance was positive for all diets (Table 3) and tended to reflect milk yield. There was no effect of FTH:BM on energy balance, whereas body condition score was greatest for diets which contained FTH:BM. Given that all energy balances were positive, and that condition scores were highest for FTH:BM diets, it appears that FTH:BM is beneficial in promoting more rapid reconditioning of early lactation cows. Average blood progesterone, positively related to reproductive efficiency, was higher for diets containing FTH:BM. First service conception rate was highest for diets containing both tallow and escape protein (Table 4). Improved reproductive performance coincided with better body condition during early lactation.

Finally, the 3% tallow diets had a positive residual effect (Table 5) on midlactation milk yield when all cows were fed the 58% alfalfa diet. In summary, although 3% tallow increased milk yield during early lactation, a combination of tallow and FTH:BM promoted reconditioning and improved reproductive performance.

[1]Rick Grant, Assistant Professor and Extension Dairy Specialist; Larry Larson, Associate Professor; Jung-Ho Son, Graduate Student; and Susan Weidner, former Graduate Student, Animal Science, Lincoln.

Table 1. Composition of experimental diets

	Diet[1]				
Item	HF-HE	HF-LE	LF-HE	LF-LE	LFAH-HE
	(% of DM)				
Ingredients					
Alfalfa haylage	40.8	40.8	32.7	32.7	58.0
Corn silage	24.5	24.5	16.7	16.7	---
Corn, shelled	24.5	17.9	40.8	35.0	36.6
SBM, 44% CP	2.0	12.4	2.0	13.9	1.5
FTH:BM	5.0	---	5.0	---	2.3
Tallow	3.0	3.0	---	---	---
	(% of DM)				
Composition					
CP	18.3	18.2	18.0	18.4	18.6
Escape CP, % of CP	40.0	30.5	41.0	30.0	35.0
NDF	35.0	33.4	29.7	27.5	28.7
NFC	38.6	36.5	46.0	44.5	42.0
NE_L, Mcal/lb	.80	.80	.79	.80	.79

[1]All diets contained 1.2 to 1.8% mineral and vitamin supplement to meet or exceed requirements.

Table 2. Mean performance of dairy cows during early lactation

	Diet				
Item	HF-HE	HF-LE	LF-HE	LF-LE	LFAH-HE
DMI, % of BW	3.82^{c}	4.35^{a}	4.24^{b}	4.33^{a}	3.80^{c}
CP intake, % of BW	$.70^{b}$	$.79^{a}$	$.76^{a}$	$.80^{a}$	$.72^{b}$
Escape CP intake, % of BW	$.29^{a}$	$.24^{b}$	$.31^{a}$	$.24^{b}$	$.26^{ab}$
Milk yield, lb/day	72.8^{a}	75.2^{a}	69.7^{b}	67.0^{b}	69.0^{b}
Milk fat, %	3.78^{a}	3.73^{a}	3.35^{c}	3.69^{b}	3.50^{bc}
Milk, protein, %	2.76^{c}	2.86^{b}	2.95^{a}	2.96^{a}	2.80^{bc}
4% FCM, lb/day	70.8^{a}	71.4^{a}	62.8^{b}	63.5^{b}	63.5^{b}
Efficiency, lb FCM/lb DMI	1.41^{a}	1.33^{ab}	1.17^{b}	1.21^{b}	1.39^{a}

[abc]Means within a row with different superscripts are statistically different (P<.05).

Table 3. Energy balance and body condition score during early lactation

	Diet				
Item	HF-HE	HF-LE	LF-HE	LF-LE	LFAH-HE
Net energy balance, Mcal/d	4.10^{d}	6.95^{cd}	10.69^{a}	8.88^{b}	4.10^{d}
Body condition score	2.9^{a}	2.6^{b}	2.9^{a}	2.4^{b}	2.6^{b}

[abcd]Means within a row with different superscripts are statistically different (P<.05).

Table 4. Reproductive performance

	Diet				
Item	HF-HE	HF-LE	LF-HE	LF-LE	LFAH-HE
Mean progesterone for weeks 2 to 12, ng/ml	5.0^{a}	3.8^{b}	5.2^{a}	3.2^{b}	3.8^{b}
1st service conception rate	71.4^{a}	14.0^{b}	28.6^{b}	20.0^{b}	28.6^{b}

[ab]Means within a row with different superscripts are statistically different (P<.05).

Table 5. Residual effect of early lactation diet on performance during midlactation

	Diet during early lactation				
Item	HF-HE	HF-LE	LF-HE	LF-LE	LFAH-HE
Milk yield, lb/d	78.3^{a}	72.8^{a}	65.5^{b}	71.7^{ab}	64.6^{b}
Milk fat, %	3.67^{b}	3.43^{b}	3.55^{b}	4.18^{a}	4.07^{a}
Milk protein, %	2.85^{c}	2.99^{b}	3.18^{a}	3.13^{a}	2.95^{b}
Efficiency, lb FCM/lb DMI	1.22^{a}	1.05^{b}	1.08^{b}	1.28^{a}	1.34^{a}

[abc]Means within rows with different superscripts are statistically different (P<.05).

Effect of Fat from Whole Soybeans on Performance of Dairy Cows Fed Rations Differing in Fiber Level and Particle Size

Rick Grant
Susan Weidner[1]

Summary

Two trials were conducted to determine effects on intake, performance, and chewing activity of added fat in early lactation diets that differed in fiber level and particle size. In trial 1, whole raw soybeans (WRS) were added at 11.6% of ration dry matter (DM) to alfalfa silage-based total mixed rations (TMR) containing either finely chopped silage or the same silage with 8.1% coarsely chopped alfalfa hay to increase particle size. Soybean addition decreased dry matter intake (DMI) for fine silage. With silage plus hay, WRS addition decreased milk yield, but increased fat content so that fat-corrected milk (FCM) yield was unchanged. In trial 2, TMR based on alfalfa and corn silage contained either 25 or 29% neutral detergent fiber (NDF) and 0 or 11.6% WRS. Addition of WRS did not affect milk yield or composition, but low fiber decreased fat test and chewing activity. When approximately one pound/day of supplemental fat from WRS was fed, higher dietary NDF and larger particle size promoted greater intake with no effect on FCM yield.

Introduction

Maximum energy intake during early lactation allows cows to attain optimal production of solids-corrected milk. Feeding strategies that increase energy density of the ration include higher percentage of nonfiber carbohydrates (NFC; starches, sugars, pectins) and use of supplemental fat. Feeding of excessive NFC predisposes cows to rumen acidosis, off-feed problems, and milk fat depression. Supplemental fat may effectively increase the energy density of diets for early lactation cows and avoid metabolic problems associated with high NFC intakes (>40% of ration DM). By partially replacing dietary NFC, supplemental fat permits lower NFC intake and potentially higher intakes of fiber.

Oilseeds, such as WRS, are becoming a commonly used source of fat, containing an average of 18 to 20% fat. In fact, soybeans could be the most abundant, economical fat source for most Nebraska dairy producers. One key limitation to feeding WRS has been depressed feed intake. Our objective was to determine if feeding adequate effective fiber (level • particle size) could overcome this negative intake response often seen when feeding raw soybeans.

Procedures

Trial 1

Eight Holstein cows in early lactation were used in a replicated 4 × 4 Latin square design. Cows averaged 16 days in milk when assigned to diets (Table 1). Diets were:

1) alfalfa silage finely chopped to a 1/4-inch theoretical cut length with 11.6% added WRS (AS+WRS);
2) the same silage without WRS (AS-WRS);
3) the same silage with 8.1% coarsely chopped alfalfa hay to increase particle size and 11.6% WRS (ASH+WRS); and
4) the same mixture of silage and hay without WRS (ASH-WRS).

All diets were fed as total mixed rations (TMR) and formulated to be equal in crude protein (CP) and energy. Experimental periods were 28 days; the last 7 days were used for sample and data collection. Diets were fed once daily, and milk yields were recorded electronically. Composite p.m. and a.m. milk samples were collected twice during week 4 of each period and analyzed for milk fat and protein. Chewing activity was measured by continuous observation over 24 hours during week 4 of each period.

Trial 2

Eight Holstein cows in early lactation (average 17 days in milk) were used in a replicated 4 × 4 Latin square design. Diets were: 1) low fiber, 25% NDF with 11.6% WRS (LF+WRS); 2) 25% NDF without WRS (LF-WRS); 3) high fiber, 29% NDF with 11.6% WRS (HF+WRS); and 4) 29% NDF without WRS (HF-WRS). All diets (Table 2) were fed as TMR and were formulated to be nearly equal in energy within a fiber level and to contain the same level of CP. All aspects of trial 2 were identical to trial 1.

Results

In trial 1, addition of 11.6% WRS decreased daily DMI by approximately 7%, but increasing the particle size of the forage eliminated this negative effect (Table 3). In trial 2, feeding a 29% NDF diet appeared to lessen the negative ef-

fect of added fat from WRS on DMI compared with use of 25% NDF. Addition of 11.6% WRS decreased milk yield for cows fed ASH in trial 1, but milk fat content increased simultaneously. Thus, 4% fat-corrected milk (FCM) yield was similar among diets. In trial 2, neither NDF percentage nor WRS addition influenced actual or 4% FCM yields or milk protein percentages. As ration NDF increased, however, milk fat test increased. Adequate effective fiber (larger particle size, higher NDF) promoted greater rumination activity.

With adequate effective fiber, the reduction in DMI commonly associated with added WRS was eliminated. If reductions in feed intake can be avoided by ensuring adequate dietary fiber levels, then whole raw soybeans could be an economical and effective source of fat for Nebraska dairy producers. These short-term experiments indicate that effective fiber must be considered when fat from WRS is added to diets for early lactation dairy cows.

[1]Rick Grant, Assistant Professor and Extension Dairy Specialist; and Susan Weidner, former Graduate Student, Animal Science, Lincoln.

Table 1. Composition of diets for trial 1

	Diet[1]			
Item	AS+WRS	AS-WRS	ASH+WRS	ASH-WRS
	(% of DM)			
CP	18.5	18.9	18.4	18.7
NDF	29.5	29.6	29.3	29.4
Fat	6.0	3.8	6.0	3.7
NE_L, Mcal/lb	.78	.78	.78	.78
	(% composition, DM basis)			
Alfalfa silage	52.2	52.8	44.1	44.6
Alfalfa hay	---	---	8.1	8.2
Corn, shelled	34.0	36.3	34.0	36.3
SBM, 44% CP	---	8.8	---	8.8
Whole raw soybeans	11.6	---	11.6	---
Vitamin-mineral mix	2.2	2.1	2.2	2.1

[1]AS = Alfalfa silage, WRS = whole raw soybeans, ASH = alfalfa silage plus chopped alfalfa hay to increase particle size of forage.

Table 2. Composition of diets for trial 2

	Diet[1]			
Item	LF+WRS	LF-WRS	HF+WRS	HF-WRS
	(% of DM)			
CP	17.5	17.8	17.8	17.9
NDF	25.0	25.5	28.8	28.8
Fat	5.7	3.5	5.7	3.5
NE_L, Mcal/lb	.81	.80	.79	.78
	(% composition, DM basis)			
Alfalfa silage	19.5	19.7	24.3	24.8
Alfalfa hay	19.5	19.7	24.3	24.8
Corn, shelled	40.0	42.4	30.9	33.4
SBM, 44% CP	6.8	15.7	6.6	14.7
Whole raw soybeans	11.7	---	11.7	---
Vitamin-mineral mix	2.5	2.5	2.3	2.3

[1]LF = Low fiber, 25% NDF ration, HF = high fiber, 29% NDF ration, WRS = whole raw soybeans.

Table 3. Performance of cows for trials 1 and 2

	Trial 1[1]				Trial 2[2]			
Item	AS+WRS	AS-WRS	ASH+WRS	ASH-WRS	LF+WRS	LF-WRS	HF+WRS	HF-WRS
DMI, % of BW[bcdef]	3.3	3.6	3.3	3.4	3.7	4.2	3.7	3.9
Milk yield, lb/d[abc]	66.2	64.8	56.2	66.2	67.9	72.8	70.6	67.5
Milk fat, % [ad]	3.67	3.77	4.07	3.80	3.57	3.57	4.01	3.91
Milk protein, %[bc]	3.07	3.06	2.95	3.19	3.31	3.50	3.42	3.45
4% FCM, lb/day	61.7	63.7	57.3	62.8	65.3	69.7	69.0	67.3
Rumination time, min/day[ab]	326	328	536	530	337	336	599	578

[a]AS vs. ASH (P<.10).
[b]0% vs. 11.6% WRS, trial 1 (P<.10).
[c]Interaction of silage particle size and WRS (P<.10).
[d]LF vs. HF (P<.10).
[e]0% vs. 11.6% WRS, trial 2 (P<.10).
[f]Interaction of fiber percentage and WRS (P<.10).
[1]AS = Alfalfa silage, WRS = whole raw soybeans, ASH = alfalfa silage plus chopped alfalfa hay.
[2]LF = Low fiber, 25% NDF ration, HF = high fiber, 29% NDF ration, WRS = whole raw soybeans.

Corrective Mating

Jeffrey Keown
Octavio Huerta[1]

An intensive research project was undertaken to estimate the heritabilities of the various non-production traits evaluated by 21st Century Genetics. This study also attempted to evaluate the results of corrective mating. We were fortunate to obtain all of the Mating Appraisal for Profit (MAP) data from 21st Century Genetics.

The heritabilities (h^2) that we estimated from these data are given in Table 1.

Table 1. Estimates of heritabilities (h^2) for the linear type traits when animal model was used combining dam records and daughter records

Trait	h^2
Basic form	.41
Strength of body	.28
Dairyness	.17
Stature	.36
Body depth	.33
Rump-side view	.30
Rear legs-side view	.19
Foot angle	.10
Fore udder attachment	.18
Udder depth	.43
Rump width	.25
Rear legs-rear view	.14
Rear udder height	.20
Rear udder width	.16
Suspensory ligament	.12
Teat placement	.23
Disposition	.12
Milkout	.20

The traits that have the largest heritabilities are basic form, udder depth, stature and body depth. These are the traits for which a producer should be able to make the most progress. The traits that have the largest heritabilities are those easiest to evaluate and observe. It is easy to measure udder depth, stature, basic form and body depth. These traits can be measured objectively and therefore are similar to the production traits. They can be measured, observed, and put into a reasonable scoring system. The traits with the lowest h^2 are traits that are more difficult to measure, such as foot angle, rear legs-rear view, rear udder width, suspensory ligament and rear legs-side view. These traits are, therefore, more difficult to change by corrective mating. This does not mean that you can't use a sire high in one of these traits to correct a weakness of a cow, but it is more difficult and the results are not as easily predicted.

These results raise the question of how you should use the non-production traits in a mating program. You should always select on the production traits first and then selectively mate the cows based on the non-production traits that you would like to correct. This method gives you the opportunity to breed for the traits most profitable and increases the probability of correcting for any non-production or type traits.

The evaluation of corrective matings data were inconclusive. The three traits that resulted in the most corrective mating changes were rear legs-side view, rump-side view and basic form. These traits also had high or relatively high heritabilities. Why did the data not demonstrate more positive results in the corrective mating of other traits? One reason was that we were working with a population that did not have a control group. By this we mean that we were unable to compare a population undergoing corrective mating with a population that was mated randomly. We may have obtained different results if we could have made such a comparison. Also, when working with any trait one must realize that there are many environmental factors that have a direct influence on the measurement. An injury early in life, such as an udder injury, may alter the udder's appearance, but does not affect the cow's genetic potential. A similar effect could be found in a cow with poor feet, but when proper trimming procedures are used, the cow looks better even though genetically she may have the genes for poor feet. These problems always confound any project on corrective mating.

Again, the best recommendations that we can make to producers are

1) select on the production traits that make you the most profit, for example, PTA dollars, milk, fat or protein pounds;
2) Always select sires in the top 85th percentile;
3) Delete those sires from your production list that you feel will not transmit the non-production traits that are needed for improvement in your herd; and
4) Differentially mate the sires remaining in your production group to correct the weaknesses you see in your herd.

The best advice is to select on production and cull on the non-production or type traits.

[1]Jeffrey Keown, Professor and Extension Dairy Specialist, and Octavio Huerta, former Graduate Student, Animal Science, Lincoln

Sire By Herd Interaction

Jeffrey Keown
George Dimov[1]

Many of you are probably thinking "What is a sire x herd interaction?" and "What would that type of research have to do with my farm?" I hope as you read this article you'll realize that it does greatly affect your herd's profit potential.

Using data supplied from the USDA, the sire x herd interaction has to be re-estimated to see if the figures being used for National sire and cow rankings are correct. Why should this concern Nebraska producers? If the sire x herd interaction is incorrect, then sires sampled in only a few herds or in one part of the country may be over- or under evaluated. We can all remember one or two sires that started out on the top of the USDA listing and then dropped.

The current term was not estimated using the new model for sire evaluations adopted several years ago. The Animal Model (currently used by USDA) may not be as prone to over- or underestimating sires as the Modified Contemporary Comparison Method. The sire x herd interaction term is used to help account for similar treatment that certain sires' daughters may receive in the same herd. If a producer gives preferential treatment to certain daughters of favorite sires, then the genetic evaluations may be overestimated. This could be especially true for non A.I. sires or for sires that are being proven by a syndicate. This interaction term has sometimes reduced the proof on sires whose proofs were based only on a few herds or where a large proportion of the daughters were located in only a few herds.

We have been working with data from California to see if there are differences in this interaction term. Preliminary results show that the value may be near 1 percent. Currently, USDA is using a figure of 14 percent in its evaluation system. The figure of 14 percent was calculated over 20 years ago. If the new figures turn out to be much lower, as preliminary results suggest, then it could affect genetic evaluations in two ways:

1) Rankings of some sires currently used will be increased.
2) Rankings of cows in herds may also be affected.

It is obvious how the first effect would be seen by users of A.I., but the most important change could be the cow's rankings. This ranking would affect the future selection of bull mothers to sire the next generation of A.I. sires. If the rankings of cows change, the A.I. organizations may be selecting bull mothers from a different group of herds than at present. This change could have a direct influence on the genetic potential of the next generation of A.I. sires. If our figures are different than the ones currently used by USDA, then they will in all probability use the results from our study in the national evaluation system.

A side project to this research has been the re-estimation of the heritabilities for milk and fat. The heritabilities from our study are 0.246 for milk pounds and 0.245 for fat pounds. These heritabilities are also a little different from others that we have found.

The next step in this project is to use data from other parts of the country besides California. We currently have data from New York, Pennsylvania and Wisconsin. There may be a difference in the sire x herd interaction in different parts of the country. We also plan to differentiate among the sires that are coded A.I. sampled, Syndicate or the result of natural service. The interaction term may differ by type of sampling. This is a project that uses computer technology and the national data base, and certainly has a direct economic impact on our dairy producers through A.I. usage.

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[1]Jeffrey Keown, Professor and Extension Dairy Specialist; and George Dimov, Postdoctoral Researcher, Animal Science, Lincoln.

Days Open and Days Dry Analysis

Jeffrey Keown
Shaylaja Jagannatha[1]

Have you ever wondered if days open, days dry and season of the year in which your cows freshen directly affect your Income Over Feed Costs (IOFC)? Have you ever wondered if these factors differ with different production levels for your cows? I am certain that each of you has at one time or another thought about these questions. We are currently in a research project that addresses these questions using your dairy records as supplied by the Dairy Records Processing Center in Ames, Iowa.

There were two major objectives of this project:

1) to determine if management of days open should vary depending on production level;
2) to find the optimum days open for different freshening seasons.

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The data consisted of records for over 50,000 cows that freshened in 1990 and 1991. Cows were assigned to above average, average and below average production levels based on the difference from herdmates. Those cows greater than 1,500 pounds above herdmates were put into the above average group, those 1,000 to 1,500 pounds were put into the average group, and those less than 1,000 pounds below herdmates were put into the below average group. We also stratified the cows by freshening season — winter (November, December, January), spring (February, March, April), summer (May, June, July) and fall (August, September, October).

Some interesting trends were observed in the 1990-1991 data. Producers are avoiding the winter months for freshening. Less than 10 percent of our data consisted of cows that freshened in the winter months. Also, less than 10 percent of the cows that freshened in the winter months were bred back within five months. Cattle that freshened during the winter had the longest calving interval. This is probably due to two factors. First, these cattle should be bred back in the spring when producers are usually busy planting, and therefore not observing heats as regularly. Secondly, after spring planting, the warmer summer months cause a drop in fertility and heat activity. These two factors are related to an increase in days open for winter freshening cows.

By comparison, over 20 percent of cows calving in the spring were bred back before 90 days whereas only 7 percent of cows calving in the fall were bred back in 135 days. These data suggest that as far as conception rate and days open are concerned, cattle freshening in the spring perform better.

One conclusion of this study is that there is no difference in optimum days open based on the production level of the cow. The days open are determined more by the season that the cow freshens than by production level.

Our data also indicate that a dry period of 51 to 60 days is the most appropriate regardless of production level or season of freshening. This is an interesting result since many producers feel that a cow needs an additional number of days dry if she produces more milk. This is not the case. Therefore, try to maintain 51 to 60 days dry for all the cattle in your herd.

The optimal number of days open for a cow does vary by the season of freshening. The optimum days open for spring calvers is about 135 to 150 days; for those calving in the summer, it is 61 to 75 days, and for fall calvers, it is 76 to 90 days. We did not have enough data in 1990-1991 to form any conclusions on winter calvers because so few cows freshened in the winter.

Let's take a look at income over feed cost figures. A cow that freshens in the summer generates an additional $685 in IOFC compared to one freshening in the winter. Summer is also better than spring by $338 and finally a summer freshener exceeds a fall freshener by $410. Remember we are dealing with IOFC. With the rise of milk prices in the fall, a summer calver will be peaking when prices typically peak, thereby resulting in more income.

We plan to do additional studies in this area using DHI records in order to develop guidelines for making management decisions based on IOFC factors. Because we are using Mid States DHI records for this study, the results can directly benefit Midwest producers.

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[1]Jeffrey Keown, Professor and Extension Dairy Specialist and Shaylaja Jagannatha, Graduate Student, Animal Science, Lincoln.

Mastitis Research

Jeffrey Keown[1]

The University dairy herd at Mead will be one site for a multi-state mastitis research project. This project, in conjunction with several other university research herds, will attempt to:

1. identify the proper dosage and drugs to be used to treat specific infections,
2. identify what level of severity of an infection should be treated, and
3. identify if treatment should be undertaken at all or if the animal should be allowed to let her own body system fight the infection.

The answers to all three of these questions will be valuable to extension personnel throughout the country when answering producer's questions about mastitis. Many individuals are currently recommending not treating any cow for mastitis. They feel that the risk of having drug residues in the milk along with the penalties if the milk gets into the bulk tank are too risky. This is probably an extreme point of view, but one that

should be considered. This research project should help to answer this question.

To gather sufficient data to clearly answer these questions will take time. This project has an anticipated life span of five years but we won't need to wait that entire period to get preliminary results. These preliminary results will be put in the DHI newsletter so you'll be kept informed of the project's progress.

The project will entail taking quarter samples from all cows soon after they freshen (within the first six days). These samples will then be analyzed at the Veterinary Diagnostic Lab at the University and cultured to see which organisms are present. These samples will then be used as a base point to compare any mastitis infections that occur subsequently. Whenever a cow has a quarter or quarters infected, we will then quarter culture the cow before any treatment is performed. The treatment method will be recorded along with the drug used, dose and length of administration. Fourteen days after treatment the cow will again be quarter cultured to see if the treatment has been effective. Any other infection appearing after one month from the original treatment will require the same testing and treatment records.

I think after understanding the protocol, it becomes apparent that this project will give us insight into the three questions we are trying to answer. When our data is combined with other University herds, we should be in a strong position to make appropriate treatment recommendations.

This project is part of an S-251 regional research project and went through a rigorous peer review. These projects are set up regionally to answer a few specific questions and must be completed within five years. After five years the project is terminated and if the researchers involved in the previous project want to address another question of concern to dairy producers, they can write another project and go through the peer review at a regional and national level to obtain funding. The funding for these regional projects comes from the USDA Agricultural Research Division. Each region and state is allocated money to be distributed to the many regional projects at land grant universities. Currently the University of Nebraska-Lincoln, Institute of Agricultural and Natural Resources is involved in 61 regional projects with a total of approximately 850,000 dollars of funding. We also have seven projects dealing with animal health with a total of 200,000 dollars in funding. All of these projects from work on plant diseases, to mastitis, to investigating bovine viral diarrhea have a direct benefit to producers and consumers.

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[1]Jeffrey Keown, Professor and Extension Dairy Specialist, Animal Science, Lincoln.

Where Do You Rank?

Jeffrey Keown[1]

The USDA publishes figures on farm expenses and income annually. The most recent figures available are for 1991 (Table 1). The information is presented for farms of varying economic classes. Economic class refers to gross farm income. Look at your gross receipts and see if you fit within the average for your income level.

The comparison of your farm should raise several questions. Are certain expenses for gross farm income larger than the average? If so, how can you begin to reduce these expenses? Are there areas you feel you should have more control over? Are certain expense areas larger than average because you don't manage these areas well? If you have several employees, let them look at these figures and explore with them ways to reduce expenses.

One of the areas dairy producers often neglect is maintaining proper financial records. Dairy Herd Improvement (DHI) is developing a farm accounting system that will give you the figures listed in Table 1. This information would be sent to the Dairy Records Processing Center (DRPC) by the producer (the DHI Supervisor would not be involved). The DRPC would then summarize your costs and expenses and, either monthly or quarterly, send information *only* to the producer. No one would have access to any producer's records except that producer. This program is in the developmental stage and will not be available for at least a year. Currently, DHI does a good-to-excellent job in making management recommendations, but does a poor job offering financial package options to producers. This area will be addressed in future DHI decisions and programming development.

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Table 1. Farm operation income statement for dairy farms by economic class, 1991

	Gross farm earnings					
	$500,000 or more	$250,000-$499,999	$100,000-$249,999	$40,000-$99,999	Less than $40,000	All farms
	(Dollars per farm)					
Gross cash income	1,030,174	321,268	148,028	71,800	23,959	159,779
Livestock and milk sales	982,149	295,147	137,979	65,298	22,381	148,956
Crop sales (incl. net CCC loans)	24,770	14,201	5,336	2,882	786	5,545
Government payments	5,376	3,973	2,063	840	313	1,707
Other farm-related income	17,879	7,947	2,649	2,779	478	3,571
Less: Cash expenses	846,782	251,077	118,396	57,670	21,552	128,718
Variable	749,654	209,696	96,297	45,532	17,426	107,549
Livestock purchases	40,568	9,347	4,488	4,129	1,266	5,983
Feed	369,045	75,898	36,109	15,894	5,583	43,523
Veterinary services and supplies	34,428	12,735	5,899	2,224	671	5,795
Other livestock-related expenses	9,810	1,457	904	621	291	1,171
Seed and plants	7,834	5,197	2,783	1,461	728	2,474
Fertilizer and chemicals	25,958	16,873	8,033	3,471	1,313	7,102
Labor	124,888	31,537	9,472	2,679	498	13,209
Fuels and oils	17,518	8,009	4,605	2,639	1,183	4,315
Repairs and maintenance	37,181	17,963	9,534	4,154	2,646	8,701
Machine-hire and custom work	32,001	10,837	4,668	2,536	1,052	5,228
Utilities	23,577	7,996	4,334	2,599	1,033	4,458
Other variable expenses	26,846	11,845	5,467	3,123	1,163	5,592
Fixed	97,127	41,381	22,099	12,137	4,126	21,169
Real estate and property taxes	10,001	5,289	3,425	2,349	1,225	3,191
Interest	48,173	20,089	11,315	6,356	1,727	10,642
Insurance premiums	11,198	4,899	2,691	1,619	609	2,600
Rent and lease payments	27,756	11,104	4,668	1,813	565	4,736
Equals: Net cash farm income	183,392	70,190	29,631	14,130	2,407	31,061
Less: Depreciation	65,748	28,522	16,011	7,909	2,741	14,638
Labor, non-cash benefits	8,293	1,938	753	249	39	930
Plus: Value of inventory change	24,817	14,109	5,889	3,369	2,799	6,224
Nonmoney income	7,735	5,930	4,202	3,342	2,803	4,018
Equals: Net farm income	141,903	59,769	22,959	12,684	5,229	25,735

Source: Farm Costs and Returns Survey, USDA (1991).

The Dairy Forage and Enterprise Records System Demonstration Herd Project

H. Doug Jose
Rick Grant[1]

A demonstration herd project has studied the impact of using quality feeds on the production and profitability of Nebraska dairy herds. The first phase involved 28 herds and was conducted from 1987 to 1989. The second phase involved 12 of the original set of herds and was conducted from 1991 through 1992. The overall objective of the project was to increase profitability by improving forage quality and feeding efficiency.

The objective of the first phase was to feed cows to their genetic potential at the most economic input cost and to implement changes in management practices that did not require capital expenditures. Cooperators were required to sample and analyze all forages. Suggested changes in feeding methods and feed rations were based on feed quality, availability of alternative feeds and the existing feed storage and handling facilities.

The objective of the second phase was to develop a profitable dairy-forage system unique to each producer and to institute a dairy enterprise records system to measure indices of financial management and relate them to dairy herd performance. Cooperators were required to identify three to five major goals for their farm for the project period and complete a dairy-forage questionnaire which analyzed integral components of forage management and feeding strategies.

A forage allocation budget was used in the second phase to specify planned forage acquisition and to allocate forages to specific groups of cows. It was updated throughout the year and used to develop feeding strategies. Cooperators sampled and analyzed all forages. A

dairy enterprise records system was developed using a computer spreadsheet. Quarterly telephone conference calls were conducted with the cooperators. These calls involved University specialists, dairy fieldmen, dairy industry representatives and extension agents. Focus topics included herd health and milk quality, milk marketing, forage machinery use, harvesting techniques, and forage production practices. On-site herd visits were made at least twice a year.

Results

Over the two-year period of phase I, the average milk production for all 28 herds increased from 15,100 lbs to 17,000 lbs per cow per year. This was an increase of 12 percent or 2.5 times increase for all the Nebraska DHIA herds for the same period. Grain ration costs were reduced by 28.5 percent. Even with the increased production, the feed costs per cow per year were reduced 11.4 percent. A summary of the economic benefits is presented in Table 1.

In phase II, the average milk production of herds actively developing dairy-forage systems increased by 3.4 percent for the years 1990-1991. During 1991-1992, these producers improved milk production by 3.9 percent. These values are greater than the State DHIA average increase of 1.2 and 1.8 percent for these two years. Concurrently, the relative feed value of forage fed on these farms increased from 134 to 152. Successful implementation of a dairy-forage system on a dairy farm involves:

1) proper forage allocation,
2) preplanned feeding options, and
3) continuously comparing forage inventory to projected needs and adjusting harvesting or hay purchasing plans accordingly. A summary of the production costs is presented in Table 2.

Table 1. Annual Economic Benefits per Cow for Phase I Demonstration Herds

	All herds	Herds that improved forage	Herd that didn't improve forage
Value of Increased Production	$ 153	$ 178	$ 124
Decreased Feed Costs	81	91	52
Total Benefits	$ 234	$ 269	$ 176

Conclusions

1. The benefits of improving forage quality are substantial.
2. In most cases feed costs can be reduced through more effective use of available feedstuffs without any added capital costs.
3. Using a forage inventory worksheet to arrange a dairy-forage system and feeding properly balanced diets to specific groups of livestock increases milk production, on average, more than the typical increase in Nebraska DHIA herds over time.
4. Dairy farms exhibit a wide range in production costs and profitability. Analysis of the production costs for an individual farm will provide a basis for a comparison of the operation to group averages. The operator can then identify areas where improvements need to be made as well as the competitive strengths of the operation.
5. Most of the individual profitability factors were consistent with overall net farm income. The farms in the high net farm income group had lower feed costs, lower operating expenses, and lower labor costs than the low profit half group. The high profit group also had a higher average selling price of milk indicating they received more quality bonuses for their milk.
6. The high profit group fed forages and grains more effectively. They used less feed per cwt. of milk than the low profit half.

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

Table 2. Demonstration Herd Project Group Averages, 1991

	Average (11 farms)	High 1/2[a] (5 farms)	Low 1/2[a] (5 farms)
Dairy Income:			
1. Net milk produced, lbs	1,316,250	1,624,608	1,032,305
2. Average price received/cwt milk produced	$11.39	$11.72	$11.13
3. Net livestock receipts	29,351	$27,393	#25,268
Variable Expenses:			
4. Total cash cost/cwt milk produced	$11.78	$10.33	$13.44
5. Total feed expense/cwt milk produced	$6.33	$5.19	$7.42
6. Total other operating expenses/cwt milk produced	$3.10	$3.09	$3.38
7. Total cost of labor/cwt milk produced	$3.13	$2.86	$2.95
8. Total semen cost/cwt milk produced	$.24	$.23	$.29
Labor:			
9. Total labor hours/cwt milk produced	.51	.44	.49
10. Total labor hours/milking cow	91.31	80.81	89.40
11. Return/hour for all hours of labor and management	$2.47	$3.42	$.56
Feed Cost and Consumption:			
12. Total pounds of feed fed/cwt milk produced	169.05	148.00	188.71
13. Total pounds of grain, comp. feed and supplement fed/cwt milk	49.70	36.73	57.75
14. Total pounds of forage fed/cwt milk produced	119.34	111.27	130.96
15. **Net Farm Income**	($ 4,794)	$ 29,269	($ 41,700)

[a]Based on Net Farm Income

Changes in Dairy Production and Consumption

H. Doug Jose[1]

Nebraska Dairy Industry

There are 1,450 licensed dairy producers in Nebraska who produce about 1.3 billion pounds of milk annually. The milk has a farm value $150 to $175 million. Processing in the state adds another $600 to $700 million value to the raw milk. In total, the dairy industry contributes nearly $1 billion to the economy of Nebraska. And, there is potential to grow. In addition to the milk that is produced in the state, another 500 million pounds of raw milk is imported from other states annually for processing in Nebraska.

Production Trends

One significant trend in the dairy industry is the regional shift in production. Milk production in Nebraska, as shown in Figure 1, peaked in 1983 at 1,415 million pounds and fell to 1,225 million pounds in 1994 in response to the Dairy Diversion program. From 1985 to 1990, production remained relatively steady and declined slightly the last two years.

In the Northern Plains region, of which Nebraska is a part, milk production has remained relatively stable through the 1980s and 1990s. This has been the pattern for all regions of the U.S. except three — the Southern Plains, Mountain and Pacific. In these regions, production has increased by about 40 percent in the last ten years. The Pacific region (California, Oregon and Washington) now accounts for 19 percent of total U.S. production. In 1982, the Pacific's regional share was 14 percent. The trends in regional production for the three largest producing regions are shown in Figure 2. The Pacific region surpassed the Northeast in 1990 and now ranks second only to the Lakes region.

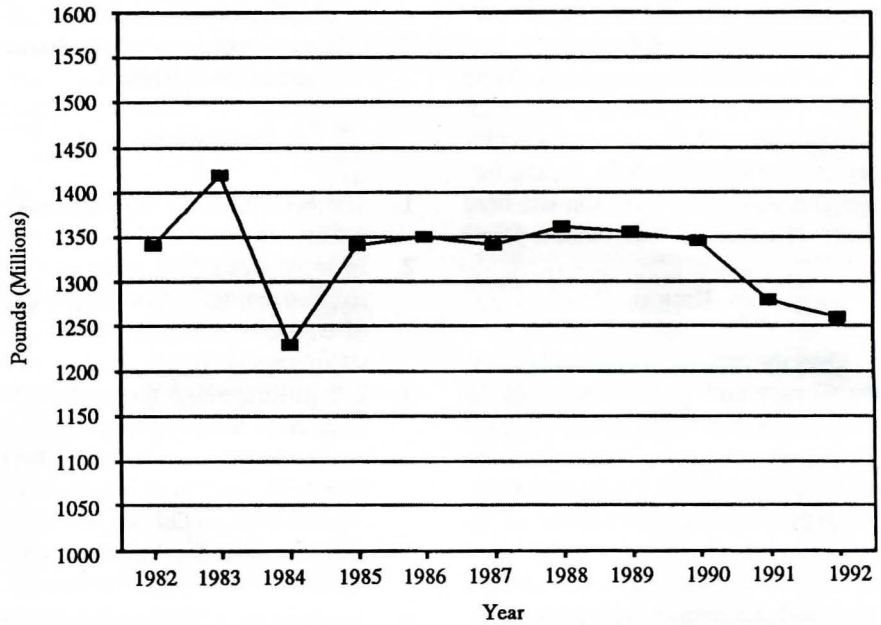

Figure 1. Total milk production in Nebraska, 1982-1992.

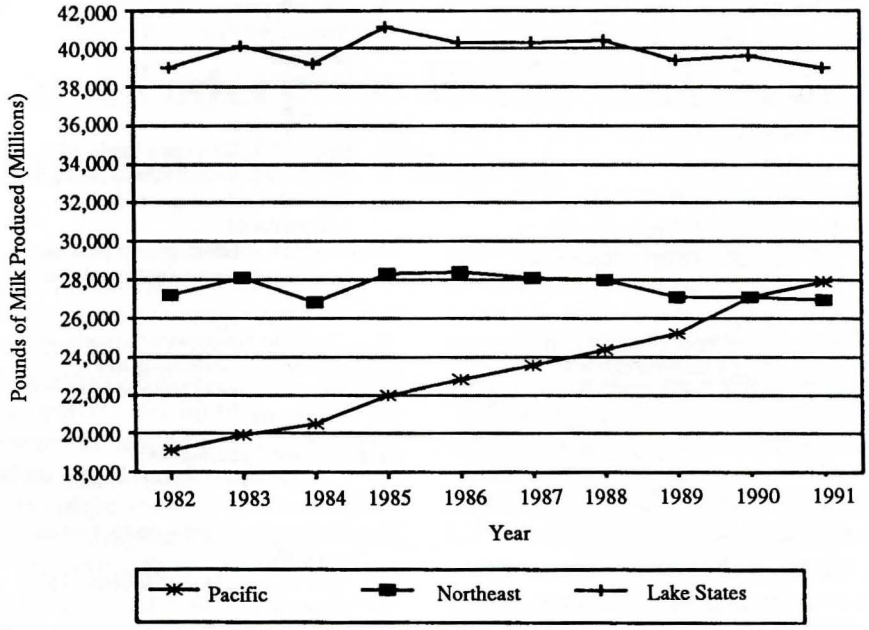

Figure 2. Ten year trends for the three top producing regions.

Milk production per cow continues to increase at the rate of 2 to 3 percent per year. Based on DHI data, the average production per cow in Nebraska continues to lag behind national average production levels. However, the rate of production increases has been greater in Nebraska since 1985 than for the national DHI. In 1985, the Nebraska production per cow was about 90 percent of the national average. That has now increased to over 92 percent.

Consumption Trends

While production per cow has increased 2 to 3 percent per year, commercial disappearance has been increasing at the rate of about 1.5 percent per year. A five-year moving average of the annual disappearance is shown in Figure 3. Disappearance increases have been due mainly to population increases.

There have been two major trends in dairy product consumption in the past few years. Fluid milk consumption has remained relatively stable at about 230 pounds per capita per year. There has been significant change in the composition of that milk. In 1980, 60 percent of the fluid milk consumed was whole milk and 40 percent was skim or lowfat milk.

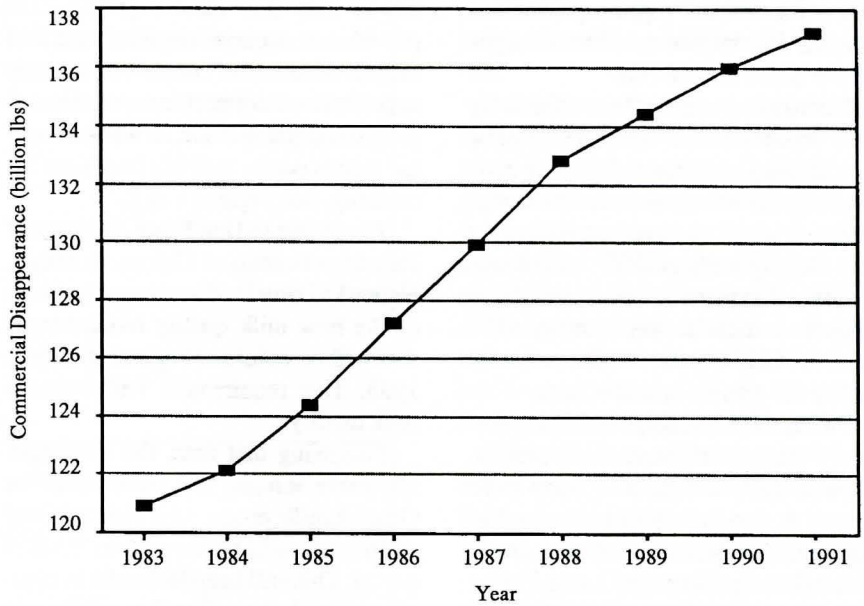

Figure 3. Five year moving average of commercial disappearance for U.S. milk.

By 1992 those percentages had reversed. Skim and lowfat milk now accounts for 60 percent of the consumption.

The consumption of most manufactured dairy products has remained stable the past 10 to 15 years with the exception of cheese. Total cheese consumption has increased from 19 pounds per capita in 1980 to over 25 pounds in 1992. A major contributor to the increase has been the consumption of mozzarella cheese which has increased from 3 pounds per capita in 1980 to 7.5 pounds in 1992. The consumption of cheddar cheese has increased by 3 pounds per capita over the same period.

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The Somatic Cell Count and Milk Quality

Duane N. Rice[1]

Summary

This report provides information about an important issue that Nebraska dairy producers must know and try to address. Consumer concerns about the safety and quality of food derived from animals continues and thus, a response to improve is essential. This information directly relates to the production of better quality milk by controlling mastitis, the cause of high somatic cell counts.

Importance of Milk Quality

Milk quality continues to be an important issue in the dairy industry. Antibiotic residues are monitored with greater scrutiny than ever before. Milk quality as it relates to shelf life, taste and texture, as well as cheese yields, receives attention at both wholesale and retail levels. Sporadic reports of illness from consuming both raw and processed milk and milk products continue to make headlines.

Current national and Nebraska emphasis is on total herd health management such as the Milk and Dairy Beef 10-Point Quality Assurance Program. The goal of the program is to have producers manage well enough to reduce the need for extensive use of medications.

Our University of Nebraska programs in dairy production support national efforts and are team-oriented interdisciplinary efforts involving several Institute of Agriculture and Natural Resources departments. Animal health and sanitation are emphasized and requires genetic, physiological, nutritional, economic,

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environmental and disease prevention analysis and implementation throughout the entire animal life.

Extension specialists have effectively used demonstration herds to monitor farm activity over two to five year periods. Progress over these periods are valuable, and when analyzed carefully can help identify management weaknesses affecting food quality and production volumes critical to profitability. The Somatic Cell Count (SCC) and milk quality are a part of these efforts.

The somatic cell count (SCC) is commonly used to measure milk quality. Somatic cells are animal body cells present at low levels in normal milk. High levels of these cells indicate abnormal, reduced milk quality caused by an intramammary bacterial infection (mastitis).

Most cells in a somatic cell count are leukocytes (white blood cells), and some are cells from the udder secretory tissue (epithelial cells). The epithelial cells are part of the normal body function and are shed and renewed in normal body processes. The white blood cells serve as a defense mechanism to fight infection and help repair damaged tissue.

Milk markets routinely rely on somatic cell counts to help ensure a quality product. They also monitor SCC to comply with state and federal milk quality guidelines. Most of these markets pay a premium for low SCC, good quality milk. You can appreciate the reasons for paying a bonus for quality milk, when the relationship between mastitis (high SCC) and milk composition is understood. All of the chemical changes in milk composition, due to mastitis, tend to reduce milk quality. For example, milk with high SCC causes a rise in whey proteins and a decrease in casein, resulting in considerably decreased cheese yields. Shorter (or decreased) shelf life and adverse milk flavors are the common results of an elevated SCC score. Generally, high SCC increases undesirable components and decreases the desirable components in milk.

It is a good management practice to monitor bulk tank SCC over long periods of time (months and years). This provides an accurate ongoing record of the effectiveness of controlling mastitis to determine if correct (downward trend) progress is being made, or when elevating trends occur, mastitis levels are increasing. See Figures 1 & 2.

According to Dan Borer, Director of Nebraska Bureau of Dairies & Foods, Nebraska Dairy Producers must be aware of the new milk quality requirements that will be enforced beginning July 1, 1993. This requirement will improve milk quality.

Following that date, the maximum allowable somatic cell count level for Grade A milk, produced in Nebraska and nationwide, will be lowered to 750,000 per ml. This will keep Nebraska in compliance with the national requirements for Grade A milk production, and will also keep Nebraska dairymen and processors eligible for participation in the Interstate Milk Shippers (IMS) program. States that do not meet the IMS program requirements, may be prevented from selling milk beyond their state boundaries, without additional inspection by receiving states. Nebraska depends and needs out-of-state markets for both Grade A milk and cheese products.

As previously mentioned the major factors that cause elevated SCC in milk are udder infections, and thus should be controlled, not only to enhance milk quality, but to increase cow production at the same time. Dairy production becomes more profitable when mastitis infections are reduced or eliminated.

The normal SCC in milk is generally below 200,000 per ml, but may be below 100,000 per ml in first lactation animals or in especially well-managed herds. An elevation above 250,000-300,000 per ml is considered a caution level and indicates bacterial infection in at least some of the cows contributing milk to the producer's bulk tank.

The new lower SCC standard (750,000/ml - July '93) will be a challenge for some dairymen and the Nebraska Department of Agriculture would like to help. For this reason, Nebraska's Bureau of Dairies and Foods will begin a new practice of sending "a preliminary notice" when a producer has a first-time somatic cell count violation. Normally, a notice is not sent until the producer is placed on a warning status, i.e., when two of the last four samples are in violation. It is desired that by sending the preliminary notice it will allow a little

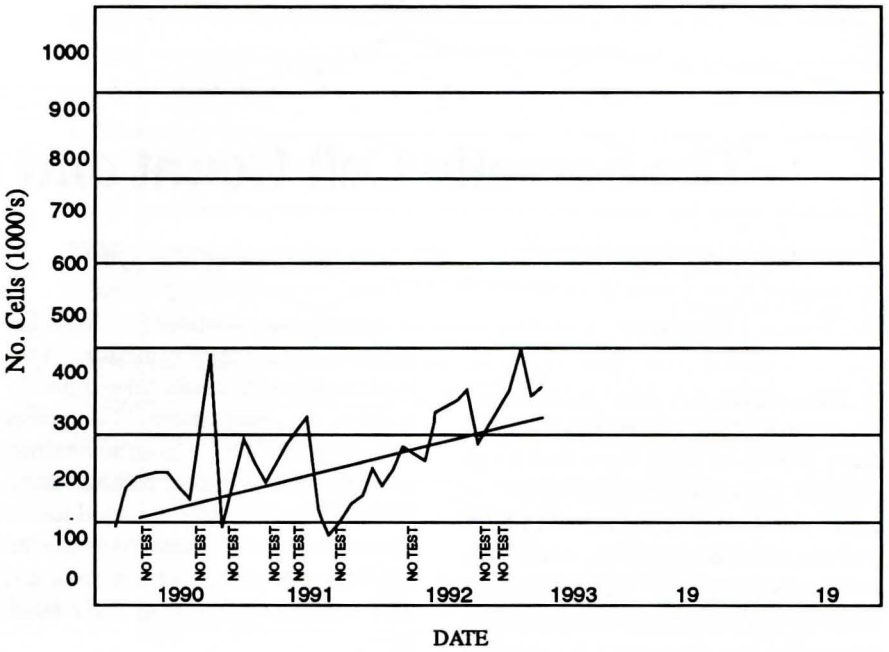

Figure 1 An increasing SCC trend, due to poor mastitis control.

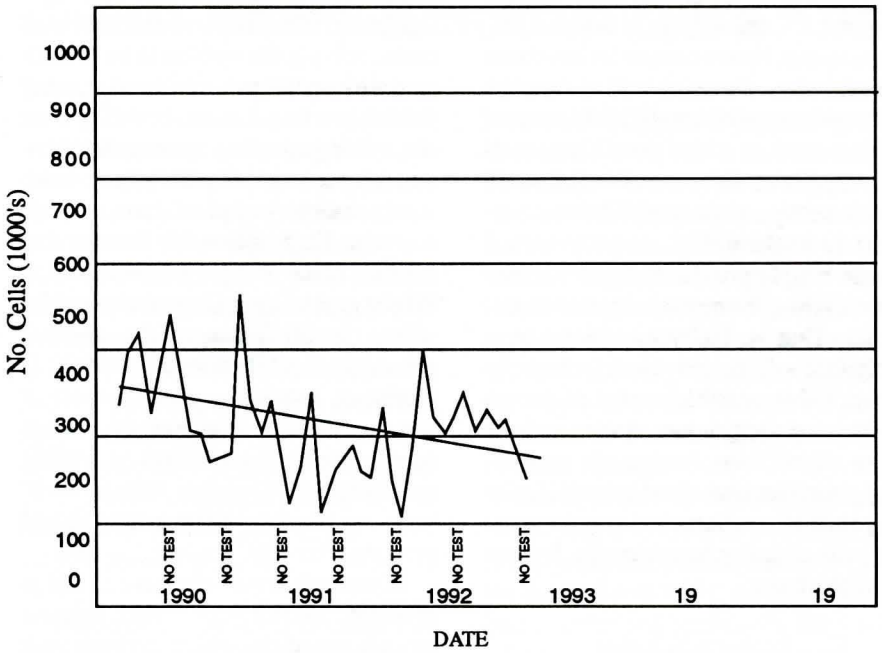

Figure 2 A decreasing SCC trend, indicates improving mastitis control.

more time for dairymen to identify their problem cows and take appropriate action.

Producers with high SCC problems should participate in the Dairy Herd Improvement Association (DHIA) program, as the mastitis control information that can be available and used is valuable. DHIA's SCC evaluation identifies specific high count cows, which can help determine which animals contribute very high counts to the tank milk. This information provides opportunity for better dairy farm management.

Mastitis Control Measures are necessary to keep somatic cell counts low. Producers should work with their veterinarian, coop fieldmen and/or University of Nebraska Cooperative Extension if help is needed to implement and maintain these strategies.

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Do You Have Extraneous Voltage?

Gerald R. Bodman, P.E.[1]

Summary

Do your lights dim when other equipment starts? Do you occasionally get a shock when you touch certain pieces of equipment or surfaces? Do animals seem reluctant to drink? Do your cows seem nervous when they enter the milking area? If your answer to any of these questions is "yes," you could have an extraneous voltage problem on your farm. Extraneous voltage is defined as an out-of-place voltage within the animal environment. A voltage between two surfaces which people or animals can touch simultaneously can result in a shock which causes muscular or physiological responses. A shock is the result of current flowing through the body.

Potential Problems

Human discomfort and safety concerns and the risk of adverse effects on animals are reduced when voltages are eliminated from metallic equipment. Extraneous voltage can affect animals in various ways. Some of these include:

- behavioral changes, i.e., animals act differently
- reduced feed or water intake
- lapping, rather than sipping, water
- increased steppiness, kicking or general uneasiness during milking
- poor milk let-down
- uneven milkout
- irritated and inflamed teats
- reduced milk production
- increased urination and defecation
- lack of response to therapeutic treatment
- slowed growth
- increased susceptibility to disease

Though not as common, and presently less well documented, there is reason to believe that under some circumstances, cows can also experience reduced reproductive performance and various feet and leg problems. While it's important to consider extraneous voltage as a possible cause of any herd problems early on in the investigation, recognize that each of the listed symptoms can be caused by conditions or factors that are not of an electrical nature.

The list of potential ailments or outward signs could easily be expanded. Experience suggests that some animals can be affected adversely by extraneous voltage even if external signs are not visible. The reaction to extraneous voltage as a source of stress varies between animals and between farms. Seldom, if ever, will all the listed signs be observed or manifested in a given installation.

Primary Causes

What causes extraneous voltage? Most on-farm sources are the result of improper selection, installation and maintenance of electrical wiring and equipment. Improperly installed, deteriorated or corroded lighting fixtures,

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receptacles, switches, etc. can allow current leakage from the "hot" wires to the grounds or neutrals.

The *National Electrical Code* (NEC) is State law. It requires that all service entrances be grounded, i.e., equipped with a grounding electrode system. All metallic equipment, receptacles, etc. within 8 feet of the ground or floor surface which could potentially become energized must be bonded together to reduce shock hazards. Grounding conductors must extend to the electrical service panel. Separate ground rods may not be used to ground individual pieces of equipment. However, an additional ground rod may be used to complement a grounding conductor between the equipment and service entrance.

Grounding (safety) and grounded (neutral) conductors may not be interconnected except at the service entrance panel. Failure to keep grounds and neutrals separate is a common error and a major cause of extraneous voltage. Interconnections allow more current to flow on the grounding system. Many subpanels are incorrectly wired with only three conductors. All subpanels must be serviced via four conductors if both 115 and 230 V loads are to be served.

Reversed polarity where the "hot" and neutral wires are connected to the wrong terminals of a receptacle or piece of equipment can electrify an equipment enclosure. Such conditions cause serious risk of personal injury as well as extraneous voltage.

Keep all electrical equipment free of dirt and debris. Materials such as cobwebs, silage particles and insect nests are relatively non-conductive when dry, but allow current leakage when damp. Improperly grounded and faulty well pumps, water heaters and motors are other common voltage problem sources.

Undersized conductors and poor connections increase voltage drop. Improper material selection—for example, using Type NM or NM-B cable (Romex®) in wet or damp environments such as encountered in livestock buildings or basements—increases the risk of current leakage. Such materials are not allowed in agricultural buildings.

Voltages can also be imposed on a farm via the power company neutral system, i.e., the voltage is from an off-farm source. Power companies have been identified as the source of extraneous voltage in approximately 25-35 percent of the situations investigated. These voltages might be the result of deficiencies in the utility company distribution conductors or the utility company neutral might simply provide the path for current to flow from one customer to another. That is, faulty conditions on a neighbor's farm can cause you problems. Other possible causes of excess voltage on the primary system include poor connections, inadequate grounding, poor three phase load balance, faulty capacitors, undersized conductors, shorted or leaky transformers, broken insulators, etc.

Problem Solution

The best solution is to properly diagnose the source or cause of the elevated voltage and eliminate or correct the deficiency. Correctly diagnosing a voltage source requires a systematic approach, appropriate equipment, proper testing, and a working knowledge of electrical system design and operation principles. Safe procedures are necessary in all instances.

The separation of primary and secondary neutrals to prevent imposition of voltage from the primary system onto a farm is not recommended except as a temporary measure. Neutral separation should only be used—as a temporary solution—until the real cause can be corrected. Separation of neutrals without appropriate testing to confirm the need for such action is not recommended under any circumstances.

Primary and secondary neutrals are interconnected to enhance safety. Separation from the power company neutral makes the farm depend upon its own grounding system to dissipate high voltage, such as lightning. Separating the neutrals at a farm with improper or inadequate grounding, on-farm voltage sources, poor on-farm wiring, etc. can increase voltage problems and result in hazardous conditions.

Other devices are available to correct extraneous voltage problems. Proper design and installation are essential in all cases. Among the options to be considered are installing a 4-wire service, using an isolation transformer; investing in an electronic grounding system; and constructing an equipotential plane—with voltage ramps—within the animal environment. Each option has its own distinct set of advantages and drawbacks. Proper grounding is always required for safety. In all instances the on-farm grounding should be consistent with NEC minimum requirements. However, in some cases depending upon the voltage source, increasing on-farm grounding can increase extraneous voltage problems. Again, appropriate testing should precede corrective actions.

If you suspect an extraneous voltage problem, contact your power supplier and a licensed electrician to check your electrical system. The power company is responsible for its electrical system with limited authority on the customer's premises. You, as owner, are responsible for maintenance of the electrical system on your side of the meter. Use a licensed electrician to help assure good practices consistent with NEC requirements. (Note: Experience indicates that a license, by itself, does not assure knowledge of proper farm wiring materials and methods.) There is an increasing frequency of insurance companies refusing to write policies on improperly wired buildings.

Conclusion

Good electrical system installation and maintenance will reduce the risk of extraneous voltage and personal injury. Do your part to assure a safe and efficient electrical system. If you suspect a problem, seek help. Include extraneous voltage as one factor to be considered when troubleshooting dairy herd performance problems. Use a planned approach to systematically rule out each potential cause.

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Dairy Research Herd Annual Report

Erin Marotz[1]

The University Dairy Research Herd consists of 122 milking cows, 10 dry cows and approximately 150 replacement heifers. The milking herd is currently averaging between 65 and 70 pounds of milk per day (as of July, 1993). Our rolling herd average (RHA) stands at 19,849 pounds milk, 766 pounds fat and 641 pounds protein. The July management level milk is at an all-time high of 71.5 pounds. Our current RHA is up from 18,404 pounds milk and is still rising. Our current goal is to be over 20,000 pounds of milk by January 1, 1994.

Research in the herd remains our primary goal and reason for existence. The nutrition research barn is a 40-cow tiestall with individual feeding boxes. Nutrition research is done year-round with approximately 120 cows on different experiments. Research in progress involves the effect of tallow and escape protein supplementation of early lactation diets on lactational and reproductive performance, the use of brown midrib sorghum for midlactation cows, the proper supplementation of diets containing different levels of fiber with different fat sources, and chemical treatment of straw to improve its digestibility. For the past seven years, a breeding project has involved the whole herd. Originally, one-half of the cows were bred to minus-type and one-half to plus-type sires. Since then, daughters of minus-type sires are bred to minus-type sires and plus-type daughters are bred to plus-type sires. This project will continue for several generations to determine the relationship between type, performance, and longevity.

Another experiment which uses the entire herd in the outside lots is a Vitamin E and Selenium study. A long-term regional experiment on mastitis resistance and treatment using the entire herd will begin in Fall, 1993. This experiment is planned to last five years. The young stock is currently being used to evaluate different feed additives and coccidiosis preventatives. Cooperative experiments have been done with the departments of Veterinary Science and Entomology. By the end of 1993, all of the manure from the Dairy Unit will be composted with waste from the Sheep Unit and Beef Feedlot as part of the Integrated Farm established at ARDC this past year. This approach should generate much practical information for Nebraska's dairy producers as focus is shifted to the area of waste management.

Our approach to reproduction with the milking herd includes breeding at 60 days postpartum. All cows fresh 60 days are injected with $PGF_{2\alpha}$ on Monday and heat detected and bred during the week. All cows not bred during the week are then reinjected the following Monday. Those cows not in heat for two injection periods are then palpated to determine the cause of anestrus. This program has helped to keep our days open at 108 and our calving interval at a relatively efficient 388 days. Reproductive efficiency is improving and is one of the areas of concentration for the future. The replacements are bred to calve at 24 months of age with an average weight of 1,200 pounds post-calving. Currently our age at calving is 2 years, 1 month with a weight of 1,230 pounds. The milking herd is relatively young with an average age of 3.1 years. Thirty-two percent of the herd is first-calf heifers. Nearly 70 percent of the herd is registered and the remaining are identified Grades with the majority eligible for the Qualified Entry program.

The general layout for the research herd includes approximately 40 cows in the nutrition barn. One outside lot groups first calf heifers separately and one outside lot holds older lactation cows. These two lots have freestall housing with exercise lots and in-line bunk feeding. The dry cows and pregnant heifers are pastured and/or drylotted year-round with winter feeding of corn silage and grass hay. Plans include separation of pregnant heifers from the dry cows. Breeding heifers are drylotted from 13 months of age until diagnosed pregnant. Heifers 6 months to 13 months of age are on pasture year-round with supplemental feeding in winter months. Young replacements are grouped with 5 to 7 head per pen and baby calves are weaned at 6 weeks of age.

The facilities have been improved in the last year to improve operation efficiency. In 1992, a new in-line bunk system was installed for the replacement heifers and close-up dry cows. This has improved feeding efficiency and we now feed a TMR consisting of haylage, corn silage, and grain twice daily to the milking herd. Top producing cows get extra grain from the computer feeders. Improvements being considered for 1993 and early 1994 include renovating our South lot freestalls, building a new hay storage shed, building a silage bunker, and building an addition to the Nutrition Research Barn. Currently our forage is stored in plastic bags, upright silos, and a Harvestore. These improvements will help with cow comfort, labor and facility use.

Management changes have included increasing the number of times the milk cows are fed to two times daily. The transition cow ration has been changed to more closely resemble the milking herd ration. In the future we hope to intensify pasture use and perhaps initiate pasture research.

In the future the dairy research herd will continue to improve labor efficiency, facility usage, and the overall performance of the entire operation. The dairy herd benefits from an excellent full-time crew and also from the assistance of the professors of nutrition, reproduction and genetics. The future looks bright for the research herd in terms of goals, plans, and future research experiments benefitting dairy producers throughout the industry.

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New NebGuides Available for 1991 through 1993

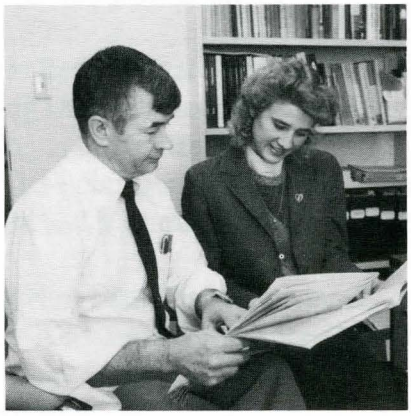
The following Dairy NebGuides have been published since 1991, and provide timely information for dairy producers. If you would like a copy of a NebGuide, please contact your local Extension office or write:

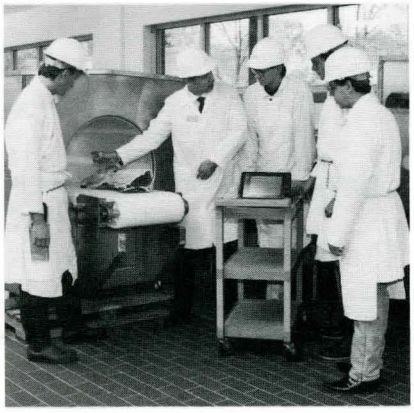
Bulletins
P.O. Box 830918
University of Nebraska
Lincoln, NE 68583-0918

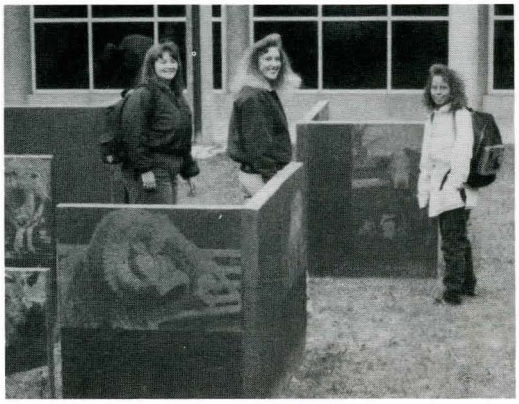
G91-1027	Protein and Carbohydrate Nutrition of High Producing Dairy Cows
G91-1032	Dairy Cow Health and Metabolic Disease Relative to Nutritional Factors
G91-1034	Evaluating the Feeding Value of Fibrous Feeds for Dairy Cattle
G91-1040	The Use of Animal Drugs in Dairy Management
G91-1048	Average Composition of Feeds Used in Nebraska
G91-1063	How to Reduce Heat Stress in Dairy Cattle
G92-1070	Feeding Dairy Cattle for Proper Body Condition Score
G92-1077	Feeding to Maximize Milk Solids
G92-1101	Dairy 10-Point Quality Control Program -- Mastitis Treatment Records
G92-1111	Mineral and Vitamin Nutrition of Dairy Cattle
G92-1114	Hiring Non-Farm Dairy Personnel
G92-1118	Forage Allocation System for Dairy Producers -- Using a Forage Inventory and Allocation Worksheet
G93-1138	Water Quality and Requirements for Dairy Cattle
G93-1139	Using the Dairy Herd Analyzer Program to Troubleshoot Management Problems
G93-1143	How to Use the National Genetic Evaluations for Somatic Cell Scores
G93-1148	Common Infectious Diseases that Cause Abortions in Cattle
G93-1151	The Somatic Cell Count and Milk Quality

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 fee imposed.

Build a career in Animal Science







Nebraska's nationally recognized Animal Science Department has up-to-date facilities, caring professors, and a first-rate academic program on which students can build a strong foundation for a career. The department is housed in new, technologically advanced facilities that provide for hands-on experience related to applied and basic science, research, meats, business, and livestock production. Students can prepare for leadership positions in science or in production agriculture as well as more non-traditional positions in the agri-business sector.