DAIRY DAY 1990

Report of Progress 608

Agricultural Experiment Station
Kansas State University, Manhattan
Walter R. Woods, Director

The 1990 Annual

KSU DAIRY DAY

Fifth in the series:
Marketing Milk in the 90s

Pottorf Hall — CICO Park (Riley County Fairgrounds)

8:00 A.M.	Registration - VISIT EXHIBITS
10:00	WELCOME - Dr. Jack Riley, KSU
10:15	CHALLENGES OF THE 90s - Dr. John Shirley, KSU
10:30	HEIFER RESEARCH - Dr. Jim Morrill, KSU
10:45	MILK MARKETING IN THE 90s - Dr. Robert Cropp, University of Wisconsin
11:30	PANEL: COOPERATIVE MILK MARKETING IN KANSAS
NOON	COMPLIMENTARY LUNCH (Courtesy of Exhibitors)
12:45 P.M.	NATIONAL SCHOLARSHIP WINNERS
1:00	KANSAS QUALITY MILK AWARDS - Dr. J. R. Dunham, KSU
1:15	IMPLICATIONS: THE 1990 FARM BILL - Dr. Robert Cropp, University of Wisconsin
2:00	QUESTIONS for Dr. Cropp
2:30	VIEW EXHIBITS - Adjourn

FOREWORD

Members of the Dairy Commodity Group of the Department of Animal Sciences and Industry are pleased to present this Report of Progress, 1990. Dairying continues to be a viable business and contributes significantly to the total agricultural economy of Kansas. Wide variation exists in the productivity per cow, as indicated by the production testing program (DHIA) in Kansas. Nearly one-half of the dairy herds (n=1,503) and dairy cows (n=98,000) in Kansas are enrolled in DHIA. Our 1990 testing program shows that all DHI-tested cows average 17,020 lb milk compared with 10,660 lb for all nontested cows. Profits are higher this year than they were in 1989, primarily because of lower feed costs and higher milk prices. Dairy herds enrolled in DHIA continue to average more income over feed cost ($1,296/cow) than nontested herds ($688/cow). Much emphasis should be placed on furthering the DHIA program and encouraging use of its records in making management decisions.

With our herd expansion program, which was begun in 1978 after we moved to the new Dairy Teaching and Research Center (DTRC), we peaked at about 210 cows. The herd expansion was made possible by the generous donation of 72 heifers and some monetary donations by Kansas dairy producers and friends. Herd expansion has enabled our research efforts to increase, while making the herd more efficient. Our rolling herd average reached 18,000 lb in April, despite many research projects that do not promote production efficiency.

The excellent functioning of the DTRC is due to the special dedication of our staff. Appreciation is expressed to Richard K. Scoby (Manager, DTRC), Gregory Kropf (Asst. Manager, DTRC), Dan Umsheid, Mary Rogers, Charlotte Kobiskie, Bill Hanson, Robert Resser, Kathy Snyder, Becky Wolfe, and Lloyd Manthe. Special thanks are given to Neil Wallace, Natalie Brockish, Betty Hensley, Lois Morales, and Cheryl Armendariz for their technical assistance in our laboratories.

As demonstrated, each dollar spent for research yields a 30 to 50 percent return in practical application. Research is not only tedious and painstakingly slow but expensive. Those interested in supporting dairy research are encouraged to consider participation in the Livestock and Meat Industry Council (LMIC), a philanthropic organization dedicated to furthering academic and research pursuits by the Department. More details about LMIC are provided later in this publication. Appreciation is expressed to Charles Michaels (Director) and the Kansas Artificial Breeding Service Unit (KABSU) for their continued support of dairy research in the Department. Appreciation also is expressed to the College of Veterinary Medicine for their continued cooperation. This relationship has enabled us to develop cooperative research and establish an exemplary herd health program.

J.S. Stevenson, Editor
1990 Report of Progress

1990 AGWAY INC. YOUNG SCIENTIST AWARD PRESENTED TO JEFFREY S. STEVENSON

Jeffrey S. Stevenson, Associate Professor in the Department of Animal Sciences at Kansas University received the 1990 Agway Inc. Young Scientist Award, presented on June 26, 1990 at the 85th annual meeting of the American Dairy Science Association (ADSA) at North Carolina State University, Raleigh.

Stevenson's research has focused on establishing breeding protocols to reduce days open and reduce the variation in calving intervals in dairy cattle. His work in demonstrating the reduced efficacy of prostaglandin $F_{2\alpha}$ in the lactating dairy cow compared with the dairy heifer has shed new light on the problems associated with synchronizing estrus. His published work also has shown that age of the corpus luteum has an effect on the luteolytic efficacy of prostaglandin $F_{2\alpha}$. Stevenson has demonstrated the benefits gained by the administration of gonadotropin-releasing hormone (GnRH) at the time of artificial insemination. He also found the positive effects of using exogenous GnRH in postpartum cows, especially those suffering from periparturient disorders. His work with suckled cows and milked dairy cows elucidated the reestablishment of the positive feedback of estrogen on the secretion of luteinizing hormone (LH) involved in the initiation of postpartum estrous cycles. Other studies include examining the interaction of thyroid and its secretions with sexual behavior in cattle.

Stevenson was born in Salt Lake City, Utah. He received his B.S. in Dairy Science from Utah State University in 1975 and his M.S. in Dairy Science in 1977 from Michigan State University. He completed his Ph.D. at North Carolina State University in 1980. He was subsequently appointed Assistant Professor in the Department of Animal Sciences and Industry at Kansas State University. In 1986, Stevenson was promoted to the rank of Associate Professor. His current responsibilities include teaching undergraduate courses in dairy science and farm animal reproduction. He also teaches graduate courses in hormonal control of reproduction and radioimmunoassay techniques.

Stevenson also served as major professor for 7 M.S. students and 1 Ph.D. student and currently has 2 Ph.D. candidates and 2 M.S. candidates working in his laboratory. Stevenson has authored or coauthored 52 journal publications, 4 symposia papers, 7 popular articles, and 55 articles appearing in Kansas Agricultural Experiment Station Reports of Progress for Dairy Day, Swine Day, and Cattlemen's Day. As a member of the ADSA for 15 years, Stevenson has served as a member of the Physiology Committee.

BIOLOGICAL VARIABILITY AND CHANCES OF ERROR

Variability among individual animals in an experiment leads to problems in interpreting the results. Although the cattle on treatment X may have produced more milk than those on treatment Y, variability within treatments may indicate that the differences in production between X and Y were not the result of the treatment alone. Statistical analysis allows us to calculate the probability that such differences are from treatment rather than from chance.

In some of the articles herein, you will see the notation "P<.05". That means the probability of the differences resulting from chance is less than 5%. If two averages are said to be "significantly different", the probability is less than 5% that the difference is from chance or the probability exceeds 95% that the difference resulted from the treatment applied.

Some papers report correlations or measures of the relationship between traits. The relationship may be positive (both traits tend to get larger or smaller together) or negative (as one trait gets larger, the other gets smaller). A perfect correlation is one (+1 or -1). If there is no relationship, the correlation is zero.

In other papers, you may see an average given as 2.5 ± .1. The 2.5 is the average; .1 is the "standard error". The standard error is calculated to be 68% certain that the real average (with unlimited number of animals) would fall within one standard error from the average, in this case between 2.4 and 2.6.

Using many animals per treatment, replicating treatments several times, and using uniform animals increase the probability of finding real differences when they exist. Statistical analysis allows more valid interpretation of the results, regardless of the number of animals. In all the research reported herein, statistical analyses are included to increase the confidence you can place in the results.

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MANAGING THE HIGH-PRODUCING HERD. V. CHALLENGES OF THE 90s

John E. Shirley

The decade of the 1980s was a transition period for the Dairy Industry in the United States. The decade began with a large milk surplus and low prices and ended with milk shortages and record high prices. The dairy industry experienced drastic governmental action through the milk set-aside and whole herd buy-out programs instituted to reduce the milk surplus and the establishment of the National Dairy Board accompanied by a check-off program to fund advertising and research. The decade ended with a butter surplus and moves by marketing agencies to lower or drop premiums for fat and install premiums for milk protein or solids-not-fat.

We enter the 90s with a lean industry in terms of cow numbers and herds but a relatively efficient one in that production per cow is at an all time high. Application of existing management practices and the adaptation of new technology will continue to push production per cow upward at a time when governmental involvement in bolstering milk prices is losing popularity.

The current decade is promising, but will cause us to make some hard decisions in order to maintain a strong position in the marketplace. Past actions of the National Dairy Board have had a positive influence on milk sales, consumer attitudes toward dairy products, and new product development. However, the industry must be willing to continue a strong advertising and research program and adjust to consumer demands. This aspect of our industry is not a "now and then" program but one that requires constant attention.

Issues that cloud the horizon include antibiotics and other drug residues in milk, the fat-protein premium question, standards for somatic cell counts, adaptation of biotechnologies such as rBST, supply-demand equalization programs, federal order programs, and market oriented shifts in product demand, along with a host of issues surrounding governmental involvement in agriculture and activities of our milk marketing cooperatives.

These issues must be addressed and logical decisions made, if we plan to be a growth industry during the 90s. Now is not the time to give in to "what's good for me today" thinking. Decisions should be made that will provide a strong foundation for future development and continued solvency of the Dairy Industry.

DAIRY CALF AND HEIFER RESEARCH AT KSU

J.L. Morrill[1]

Summary

At Kansas State University, we are conducting research concerning nutrition and feeding management of calves, heifers, and dairy steers with emphasis in the following areas: 1) development of feeds and management practices to stimulate rumen development and allow earlier weaning, concomitant with satisfactory growth; 2) vitamin supplementation to improve performance of growing dairy animals, with emphasis on increasing efficiency of the immune system; 3) determination of nutrients needed by growing heifers to achieve desired rates of growth required to reach adequate size at freshening at 22 to 24 mo of age, without getting too fat; 4) study of feeding programs designed to produce lean, tender, flavorful meat from surplus dairy bulls, with emphasis on methods to monitor body composition in the live animal; and 5) investigation of protein sources for milk replacers.

Introduction

The success of the programs to raise young dairy animals impacts on the overall efficiency and profit of the dairy in several ways. To reach their inherited ability to produce milk, heifer calves need to remain healthy. Fairly rapid growth is necessary if the heifer is to be bred early enough to freshen near two years of age and be of the desirable size. Low mortality and involuntary culling of growing heifers allows more choice when deciding which heifers to keep for herd replacements. Also, the increased awareness of the desirability of surplus bulls from the large breeds for meat production has made those animals more valuable for sale or for feeding on the dairy farm. The overall goals of our research with young dairy animals have been to discover ways to improve health and performance of growing calves, heifers, and surplus bulls, with emphasis on earlier development of the rumen, improvement of the function of the immune system, refinement of the requirements for nutrients needed for optimum growth of dairy heifers, and development of improved programs for feeding and management of surplus bulls intended for meat production.

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[1]The contributions of the following to this research effort are gratefully acknowledged: K. Anderson, A. Beharka, E. Bortone, M. Daccarett, D. Isbell, D. Kropf, G. Kropf, T. Nagaraja, S. Pruiett, P.G. Reddy, P. Reddy, R. Scoby, J. Shirley, J. Stevenson, and J. Velazco.

Feeding and Management of the Early-Weaned Calf

The ability of the calf to consume and utilize dry feed, which is less expensive than milk or milk replacer, is completely dependent on the proper functioning of the rumen; however, the rumen is not functional at birth and its development is dependent on several factors. A major effort of our calf research has been directed toward a better understanding of what affects consumption of dry feed by young calves and the various factors responsible for development of the size, absorptive ability, and microbial population of the rumen. By improved control of these factors, we hope to be able to wean calves earlier and, thus, reduce labor, feed cost, and incidence of disease and prevent a depression in growth that often occurs when calves are weaned. Currently, we are investigating the requirement of the pre-weaned and early-weaned calf for fibrous feeds, and rumen escape protein and are trying to determine ways to increase energy concentration of calf starters without depressing intake. One approach we have found very useful is the use of properly processed whole soybeans. We are continuing to investigate processing conditions required for economical, optimum, heat treatment of beans. Other approaches have been to investigate the use of ionophores and products to stimulate the development of beneficial microorganisms in the rumen.

Vitamin Supplementation

During the past decade, we have conducted several studies to determine the vitamin E requirement of young dairy animals. We have shown that the calf requires more vitamin E than had been suggested and that vitamin E, when added to what had been considered to be an adequate diet, was effective in improving the efficiency of the immune system. More recently, we have compared the efficiency of various forms of vitamin E.

In many cases, a deficiency or excess of one nutrient will affect the utilization of another nutrient. Currently, we are investigating the effect of excess vitamin A on the requirements for vitamin E and the relationship between vitamin E, vitamin C, and carotene. Carotene is the precursor of vitamin A and some research in recent years suggests that the cow has a need for carotene, apart from its vitamin A requirement. The very young calf, unlike the cow, does not have the ability to make vitamin C itself, and we are trying to determine when and how much supplementary vitamin C might be useful. By better understanding the needs of the calf and heifer for nutrients, we hope to improve health and reduce dependence on antibiotics and other types of medicines, the use of which is becoming more restricted.

Heifer Growth Requirements

Several studies have shown that lifetime efficiency of heifers is greater if they freshen first at 23-24 mo of age. Fairly rapid growth is required if heifers start coming into heat to be bred early enough and are at the right size when freshening at that age. Too rapid growth, especially before the heifer reaches puberty, will adversely affect development of the mammary system and future production. Based on the hypothesis that in some cases when heifers were reported to have become too fat, the problem was feeding excess energy or some other nutrients instead of a balanced diet, we initiated a project to evaluate NRC requirements for growing heifers. This is a long-term project, but as reported last year (Report of Progress 580, pp 22-25), heifers fed 115% of NRC requirement tended to grow more rapidly without excessive fattening, came into heat and freshened earlier, and produced as much, if not more, milk than heifers fed 100% of NRC requirements. We are now investigating the effect of changing from 100% of NRC requirements to 115% or from 115% to 100% at 12 mo of age. Results from this experiment are not yet available.

Dairy Beef

Dramatic changes are occurring in the United States concerning the type of beef desired, with more emphasis on lean meat and more concern about cholesterol and other dietary factors. An increased awareness of the desirability of the Holstein steer for producing meat that is lean, tender, and flavorful is reflected by the large numbers of Holstein steers in Kansas feedlots. Many of these come from as far away as California to be fed out here because of the availability of grain and protein supplement. Recently, we began a research project to compare various methods that might be used to estimate body composition in live Holstein steers with actual measurements determined after slaughter. Measurements are made when the animals are 3, 6, 9, or 12 mo of age and some of the animals are slaughtered at those ages to obtain carcass information. Availability of a rapid, harmless, economical method to determine body composition in the live animal will allow us to monitor growth as affected by time and by various diets and, thereby, more efficiently develop feeding and management programs for production of a specific type of product.

Milk Replacer Protein Supplements

Justification for use of milk replacers for calves is based on the possible economic advantage of using all milk produced for human food or converting surplus milk in one season or geographical area to manufactured products that can be stored for use at another time or in another area when milk is scarce. Of the major components in milk, the fat can be replaced by non-milk sources without too much difficulty, and the carbohydrate (lactose) is available in large amounts as a byproduct (dry whey) of the cheese industry. The protein is the most difficult component to replace, because limitations on use of protein by the young calf require a very digestible protein, with the correct amino acid balance and free of antinutritional factors. We have conducted research to evaluate commercial sources of milk replacer protein of plant and animal origin and are beginning a project on use of a wheat protein product for milk replacers.

EFFECT OF RUMEN DEGRADABILITY OF PROTEIN AND FAT ON THE GROWTH AND DEVELOPMENT OF DAIRY CALVES

D. E. Isbell and J. L. Morrill

Summary

Sixty heifer and 34 bull calves were fed starter diets containing either control or extruded soybean meal (SBM) and either 2.5% or no bypass fat from birth to 8 wk of age. There were no interactions between the type of SBM and the amount of fat. There were no significant differences between the calves fed control or extruded SBM with or without fat supplementation, although the trends favored the calves fed extruded SBM with no bypass fat.

Introduction

Increasing the energy intake of young calves is difficult because of the limitation of feed consumption. Because fat is so high in energy, it could be added to calf starters to increase energy intake, if feed intake were not depressed. Addition of too much fat is known to depress consumption; however, if some of the fat bypassed the rumen, normal consumption might be maintained even when fat is added.

In some cases, it is advantageous to have part of the dietary protein escape rumen fermentation. In this way, the value of high quality protein can be maintained and the amount of protein nitrogen converted to ammonia, and possibly lost, can be reduced. Increasing the amount of protein that escapes ruminal degradation could result in improved protein nutrition or allow decrease of dietary protein.

This experiment was conducted to evaluate the effect of increasing the amount of dietary protein that escaped rumen degradation by extrusion processing of soybean meal (SBM) and of adding rumen-inert fat to calf starters.

Procedures

Sixty heifer and 34 bull calves were used from birth to 8 wk of age. They were fed colostrum for 3 d and then whole milk and could consume calf starter ad libitum. Calves were weaned when they had eaten 1.5 lb or more starter for 3 consecutive days.

The calves were assigned to blocks of four by age, then calves within a block were assigned randomly to one of four starter diets, which were formulated to contain no rumen bypass fat[1] with either

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[1]Energy Booster 100™, Milk Specialties Co., Dundee, IL 60118.

control SBM (group 1) or extruded SBM[2] (group 2) or 2.5% rumen bypass fat with either control SBM (group 3) or extruded SBM (group 4).

The amount of starter diet each calf consumed was recorded daily. Twice daily, each calf was assigned a value for general appearance and consistency of feces (1, normal to 4, watery). All calves were weighed weekly. At birth and at 8 wk of age, wither height, length, and heart girth measurements were recorded. At 8 wk of age, blood was collected for metabolic evaluation using the SMA-12 analysis, which measures 14 blood metabolites.

Results and Discussion

There were no significant interactions between type of protein supplement and energy concentration for any of the factors measured.

Feed consumption

Average weekly feed consumption is shown in Figure 1. From wk 5 through wk 8, groups 3 and 4 tended to consume less feed than groups 1 and 2, with consumption of group 4 being less ($P<.05$) than that of group 2 at wk 8. Starting at wk 3, there was a trend for group 2 to consume more feed than the other three groups during each week. Total feed consumption for the 8-wk period was 111, 117, 108, and 108 lb for groups 1, 2, 3, and 4, respectively.

Weight gain

Average weekly gains for the four groups are shown in Figure 2. There were no differences in gains except at wk 5, when group 2 gained more ($P<.01$) than group 3. Total gains for the 8-wk period were 70, 72, 68, and 69 lb for groups 1, 2, 3 and 4, respectively.

Fecal scores

There were no significant differences in fecal scores among the four groups for any of the weeks during the 8-wk trial. The average fecal scores for the 8 wk were 1.2, 1.2, 1.2, and 1.2 for 1, 2, 3, and 4, respectively.

Body measurements

Body measurements for the four groups are shown in Table 1. There were no differences in wither height at birth. At 8 wk, groups 3 and 4 were shorter ($P<.05$) than group 1. There were no statistical differences in the increase in wither height from birth to 8 wk, but groups 1 and 2 grew more than groups 3 and 4.

There were no significant differences in either length of body or heart girth measurements at birth or at 8 wk and no differences in the increase in length or heart girth from birth to 8 wk.

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[2]Extruded at 300° F with an Insta Pro Dry Extruder, Model 2000. Triple F Products, Des Moines, IA 50322.

Blood metabolites

The serum sodium concentration of group 1 was less (P<.05) than that of group 4. The reason for this is not apparent. There were no other differences between the four groups for any of the other metabolites.

There were no statistical differences between the growth of calves that received the bypass fat and those that did not. However, the trend favored the calves not receiving additional fat. They tended to have higher gains (71 vs 68 lb), higher feed consumption (114 vs 108 lb), and greater increases in wither height (3.4 vs 3.0 in) and heart girth (6.6 vs 6.2 in).

There were no statistical differences between calves on the extruded and control SBM. However, calves that received the extruded SBM tended to have higher feed consumption (112 vs 110 lb), higher gains (70 vs 68 lb), and a greater increase in length (5.0 vs 4.4 in).

The reason for lack of response to added fat is not known. Possibly, the response would have been different if smaller amounts of fat had been added or different feed mixtures had been used. Further research is underway to study the effect of adding various types of fat to calf starters.

Table 1. Body Measurements of Calves in Four Treatment Groups

	No bypass fat		2.5% bypass fat		
Item	1[1]	2[2]	3[1]	4[2]	SE
Height					
Birth	29.8	29.4	29.2	29.3	0.70
8 wk	33.1[a]	32.9[ab]	32.0[b]	32.2[b]	0.78
Increase	3.3	3.5	2.8	2.9	0.63
Length					
Birth	28.7	28.4	28.2	28.2	0.82
8 wk	32.9	33.7	32.9	33.1	0.94
Increase	4.2	5.3	4.7	4.9	1.06
Heart girth					
Birth	31.5	31.1	31.1	30.9	0.98
8 wk	37.9	37.8	37.4	37.0	1.06
Increase	6.4	6.7	6.3	6.1	0.80

[a,b] Means in same row with different superscripts differ significantly (P<.05).
[1]Starter contained control SBM.
[2]Starter contained extruded SBM.

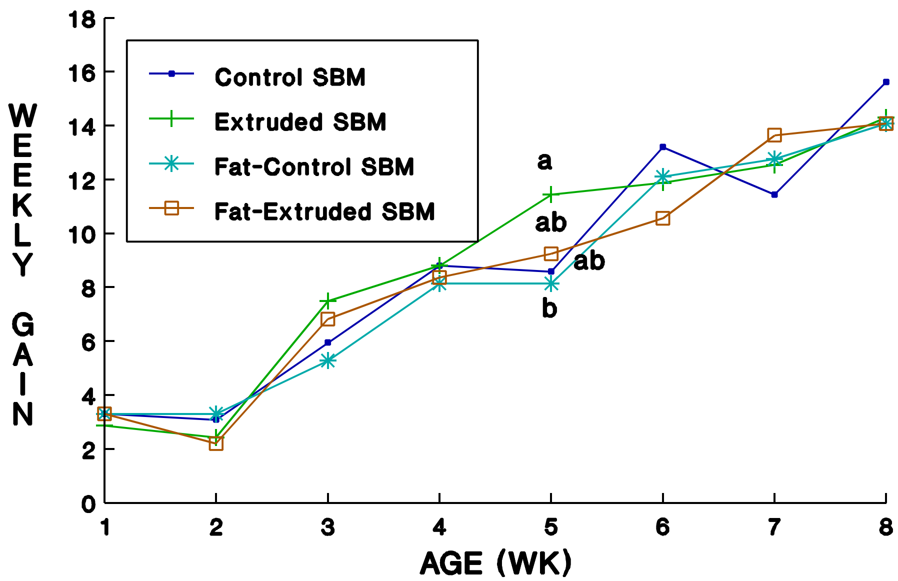


Figure 1. Feed consumption (lb) of calves in four treatment groups (see text). Means within a week with different superscripts differ (P<.05).

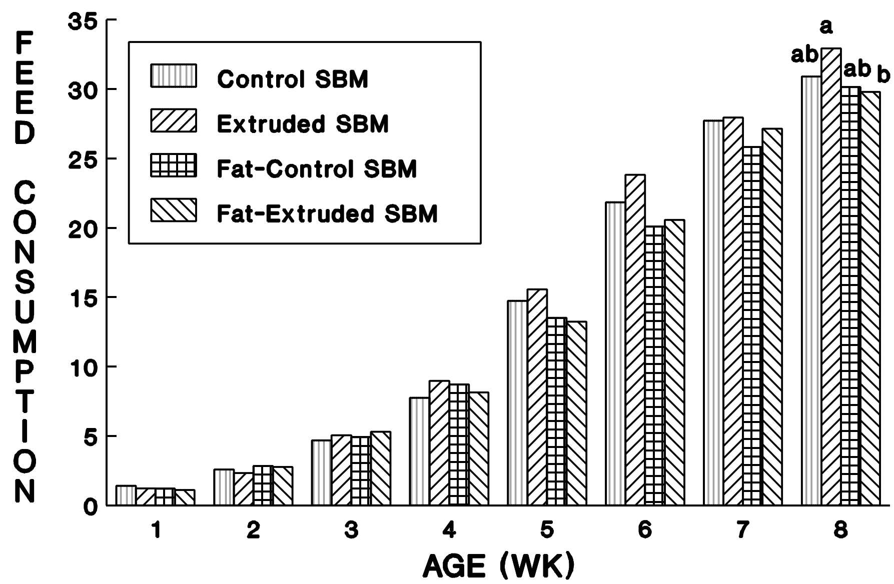


Figure 2. Weekly gains (lb) of calves in four treatment groups (see text). Means within a week with different superscripts differ (P<.01).

EFFECT OF PHYSICAL FORM OF DIET ON RUMINAL MICROBIAL AND METABOLIC DEVELOPMENT IN YOUNG CALVES

A. A. Beharka, T. G. Nagaraja, and J. L. Morrill

Summary

Eight, ruminally cannulated, newborn, Holstein, bull calves were assigned to receive either finely ground or unground (chopped hay and normally ground grain) diet to study the effects of diet form on ruminal microbial and metabolic development. The difference in diet particle size caused a difference in ruminal pH and a shift in the bacterial population, as evidenced by decreased cellulolytic and increased amylolytic bacterial counts for the ground diet.

Introduction

Both the producer and the calf benefit by rapid development of the calf's ruminal function. Early ruminal development can lead to increased consumption of dry feed and early weaning, resulting in reduced labor and feed costs. Ruminal development is largely influenced by the consumption of dry feed and the products of its digestion. In addition, studies have shown that roughage is beneficial to ruminal development; however, calves are notoriously inconsistent consumers of roughage.

The feeding of a complete calf diet, in which ground roughage and concentrate are incorporated into a pellet, has become more common because it guarantees a constant roughage intake and facilitates feeding. However, limited research is available on how diet particle size influences ruminal metabolic and microbial development in the neonatal calf. This study was conducted to examine the effect of diet particle size on ruminal microbial numbers, fermentation characteristics, and liquid dilution rates in neonatal calves.

Procedures

Eight, ruminally cannulated, Holstein, bull calves were paired by birth date and birth weight, and calves of a pair were assigned randomly to receive either a finely ground or unground (chopped hay and grain) diet form. Diets varied in particle size but were identical in composition (75% grain mix : 25% alfalfa hay). Calves were fed milk at 8% of birth weight until weaning at 5 wk of age. Feed intake was equalized for each pair of calves. Calf health and fecal scores were recorded daily, and calf weight was recorded weekly.

When the calves were 2, 4, 6, 7, and 10 wk of age, ruminal fluid samples were collected 2-hr postfeeding on 3 consecutive days for determination of pH, VFA, L(+) lactate, ammonia, and buffering capacity and for bacterial enumerations. During weeks 6, 8, and 10, calves were dosed with chromium EDTA to measure liquid flow rates.

Results and Discussion

Birth wt were similar for calves fed the ground and unground diets (mean = 86 lb), but calves fed the ground feed tended (P=.12) to be heavier at 10 wk of age than calves fed the unground feed, even though feed intakes were similar. However, calves fed the unground diet tended (P =.13) to be healthier, based on fecal scores and general appearance, than calves fed the ground diet.

Ruminal pH was affected by age (P<.01) and was lower (P<.10) in calves fed the ground diet than the unground diet (Figure 1). Total VFA concentration increased with age (P<.01) and appeared to be higher with the ground diet. Liquid flow rates (8.3%/hr) were not affected by diet form or calf age. Ammonia concentration decreased with age (P< .01) but did not differ between diets.

Calves fed the ground diet had lower numbers (P<.10) of cellulolytic bacteria and higher (P< .10) amylolytic counts (Figure 2) and tended to have higher total bacterial counts. Diet particle size did not influence number of proteolytic and lactate-utilizing bacteria.

Conclusion

Calves fed the ground diet tended to be heavier and have higher fecal scores (lower dry matter) than calves fed the unground diet. The smaller particle size of the ground diet caused a reduction in rumen pH. The lower rumen pH may have decreased cellulolytic bacteria because of their sensitivity to low pH. Amylolytic bacteria, which are pH tolerant, increased in number in calves fed the ground diet.

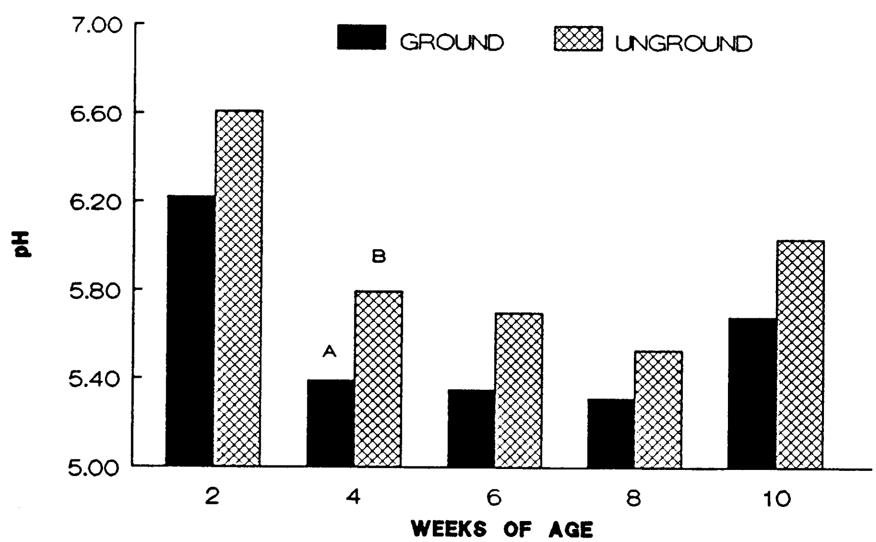


Figure 1. Ruminal pH (diet effect, P<.05; age effect, P<.01) in calves (n=8 per diet) fed ground and unground diet forms. Bars with different superscripts differ (P<.05).

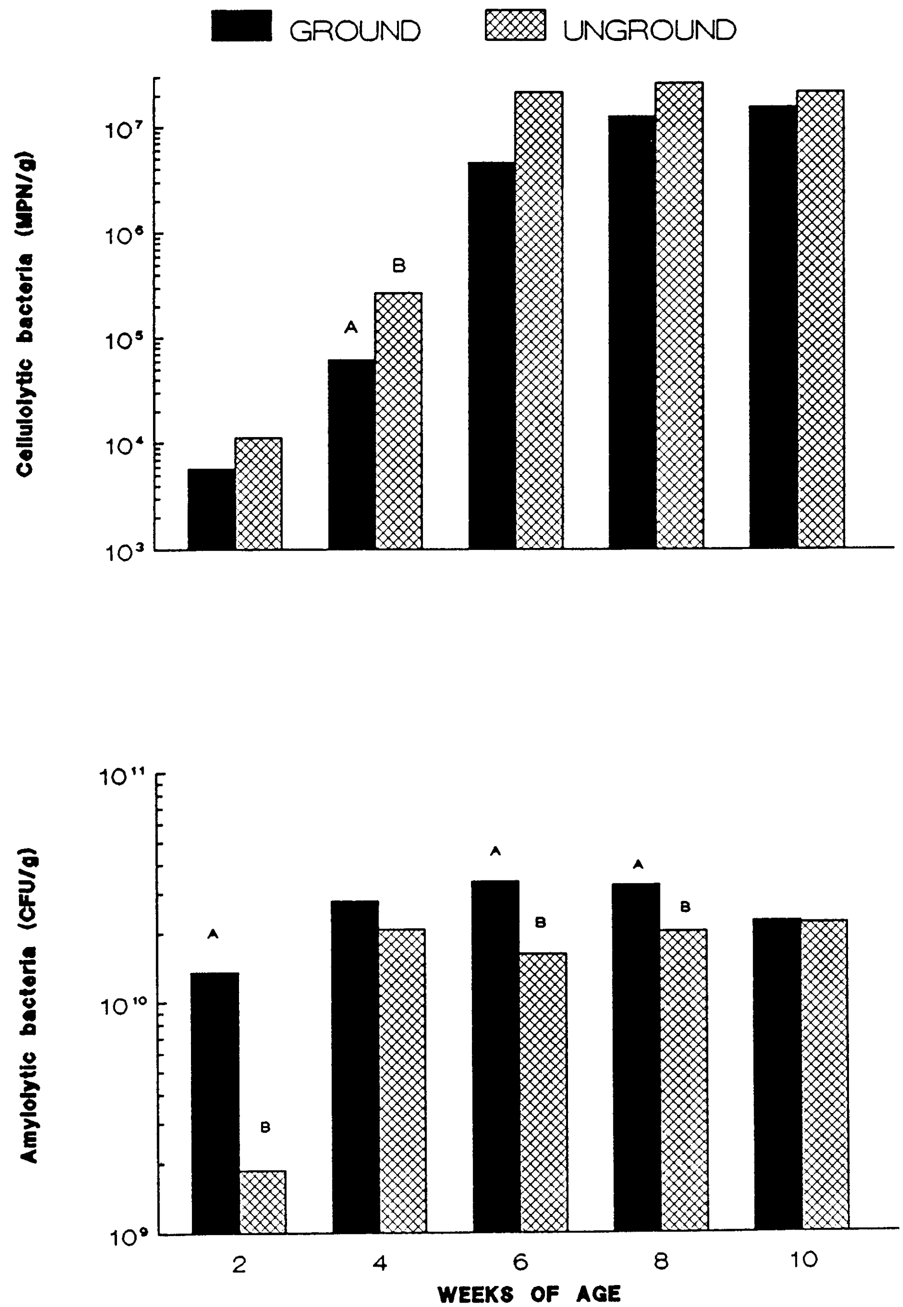


Figure 2. Semilog plots of cellulolytic (diet effect, P<.10) and amylolytic bacteria (diet effect, P<.10) in calves (n=8 per diet) fed ground and unground diet forms. Bars with different superscripts differ (P<.05).

PERFORMANCE AND RUMINAL MICROBIAL AND METABOLIC DEVELOPMENT OF YOUNG CALVES FED DIETS CONTAINING ASPERGILLUS ORYZAE EXTRACT

A. A. Beharka, J. L. Morrill, and T. G. Nagaraja.

Summary

Seventy-three, neonatal, Holstein, heifer calves in one experiment and 45 neonatal, Holstein, bull calves in another were used to study the effects of dietary Aspergillus oryzae extract (Amaferm) on calf performance. Forty of the heifer calves were selected to study the effects on ruminal microbial and metabolic development. In general, Amaferm-supplemented calves had greater ruminal microbial activity than the calves fed no Amaferm. For the most part, growth and feed intake were not affected.

Introduction

Many feed additives of microbial origin have come into the market. These additives contain either the microorganisms, the dry products of microorganisms, the medium in which they grew, and/or the residues of their metabolism. The microorganisms used are molds, yeast, and/or bacteria. One such product is Amaferm, a fermentation extract of the mold Aspergillus oryzae[1]. The addition of Amaferm to the adult ruminant diet has been reported to increase digestion of dry matter, fiber, and crude protein in vivo and in vitro. Milk production and percentage milk fat have been increased by Amaferm supplementation in dairy cows.

Amaferm supplementation would be beneficial to the neonatal calf, if dry feed consumption could be stimulated at an early age, resulting in accelerated rumen motility, muscle development and ruminal microbial activity. In addition, early dry feed consumption can lead to early weaning, which is beneficial because of reduced labor and feed costs and because calves that have been weaned have fewer digestive disorders.

Amaferm has been shown to stimulate rumen bacterial activity. If Amaferm could stimulate microbial development, a resulting increase in ruminal metabolic activity should occur and an increased dry feed intake and early weaning might be possible. Therefore, the purpose of this study was to determine the effects of supplemental Amaferm on calf performance and ruminal microbial and metabolic development.

[1]Biozyme Enterprises, Inc., St. Joseph, MO 64504.

Procedures

Seventy three, neonatal, Holstein, heifer calves (Exp. 1) and 45 neonatal, Holstein, bull calves (Exp. 2) were assigned to four starter diets formulated to obtain Amaferm consumption of .5, 1, or 3 g per calf per day plus a control. Calves were fed milk at 8% of birth weight daily and allowed to consume starter and a mixture of 1/3 alfalfa and 2/3 brome hay ad libitum. Weaning occurred when calves consumed 550 g of starter on 2 consecutive days. Calf weight gain and feed consumption were recorded weekly. Forty of the heifer calves were selected randomly to study the effect of Amaferm on microbial and metabolic development (Exp. 3). Ruminal fluid samples were collected 3 h postfeeding via stomach tube at 2, 4, 6, 8, and 10 wk of age for analysis of fermentation products and for bacterial enumerations.

Results and Discussion

Amaferm-supplemented calves and control calves had similar dry feed intakes and weight gains with the exception of the subset of 40 heifer calves used for microbial and metabolic enumerations (Table 1). All heifer calves supplemented with Amaferm were weaned at least 1 wk earlier ($P<.10$) than unsupplemented calves (Table 2), with no apparent decrease in health (measured by fecal and general appearance scores) or feed intake.

In Exp. 3, Amaferm-supplemented calves had higher ($P<.05$) total VFA concentrations than control calves (Figure 1); however, supplementation did not affect the acetate to propionate ratio. Despite the higher VFA concentration, the ruminal pH of Amaferm supplemented calves and control calves was similar. Calves supplemented with Amaferm had higher ($P<.10$) anaerobic bacterial populations than control calves (Figure 1). In addition, counts of bacteria that digest pectin and hemicellulose were also higher ($P<.10$) and cellulolytic bacteria tended to be higher for calves supplemented with Amaferm vs control calves (Figure 1).

Conclusion

Amaferm-supplemented calves were weaned earlier than control calves, with no weight loss or increased incidence of illness, and had higher microbial activity in the rumen than calves fed no Amaferm. Calf weight gain, feed intake or dry feed-to-gain ratios were unaffected by Amaferm supplementation for the 10-week trial, except in the heifer subset.

Table 1. Average Weekly Dry Feed Intake and Weight Gain of Control or Amaferm-Supplemented Calves

	Treatment				
Item	Control	Low Amaferm	Moderate Amaferm	High Amaferm	SE[1]
Intake, lb					
Exp. 1 - Heifers (n=73)	17.2	19.1	18.3	19.1	2.2
Exp. 2 - Bulls (n=40)	18.7	19.1	19.4	17.6	5.5
Exp. 3 - Heifers (n=40)	15.4[a]	19.4[b]	19.4[b]	20.5[b]	1.5
Gain, lb					
Exp. 1 - Heifers	7.9	8.4	8.4	9.0	1.8
Exp. 2 - Bulls	8.4	9.7	9.5	8.8	3.3
Exp. 3 - Heifers	7.5[a]	8.8[bc]	7.7[ab]	9.2[c]	1.8

[1]Standard error.
[abc]Means within row with different superscripts differ (P<.10).

Table 2. Effect of Amaferm on Weaning Date of Control or Amaferm-Supplemented Calves

	Treatment			
Item	Control	Low Anaferm	Moderate Amaferm	High Amaferm
	---------------------------- Week weaned	----------------------------		
Exp. 1 - Heifers	5.40[a]	4.55[b]	4.60[b]	4.63[b]
Exp. 2 - Bulls	5.50	4.73	4.75	5.10
Exp. 3 - Heifers	5.67[c]	4.50[d]	4.13[d]	4.18[d]

[ab]Means within row with different superscripts differ (P<.05).
[cd]Means within row with different superscripts differ (P<.01).

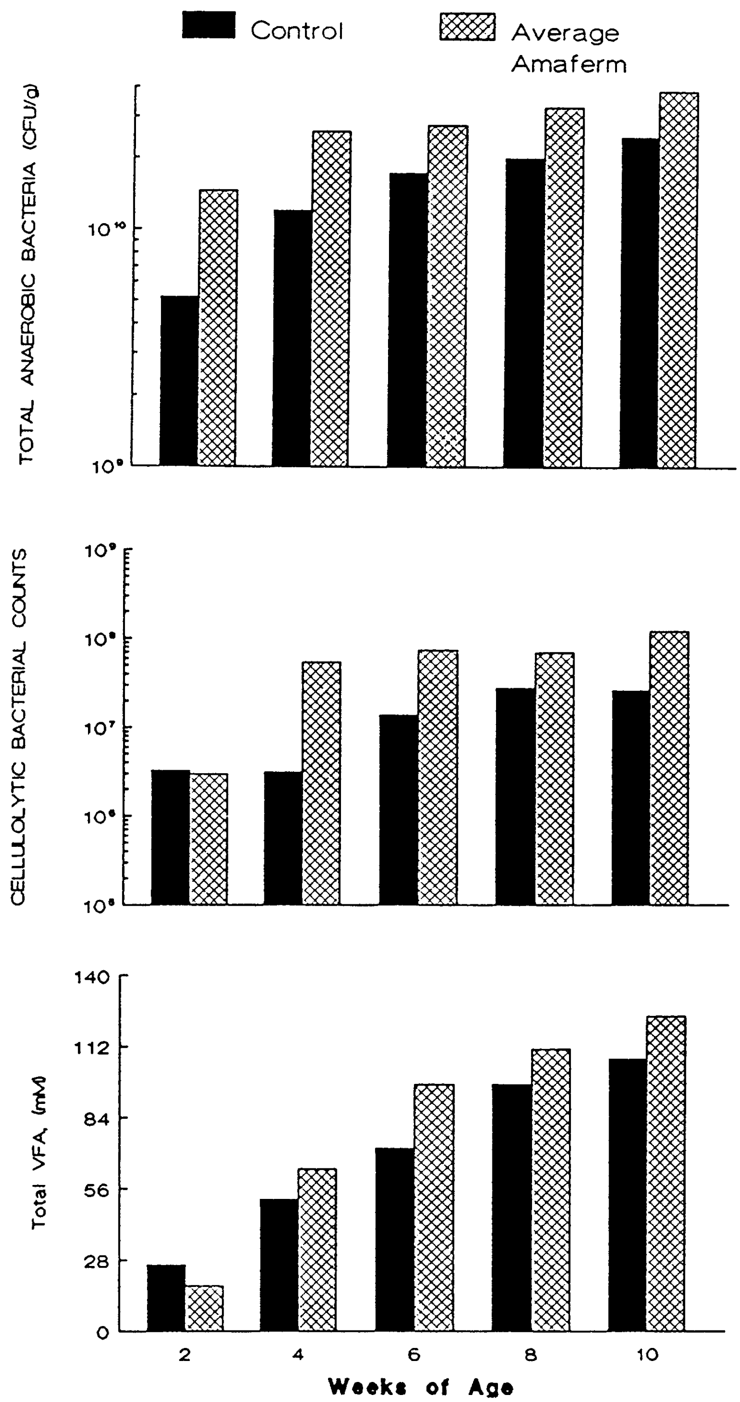


Figure 1. Ruminal VFA (treatment effect, P<.05) and semilog plots of total anaerobic (treatment effect, P<.10)) (CFU/g) and cellulolytic bacteria (treatment effect, P<.10) (MPN) in Amaferm supplemented or unsupplemented calves.

COMPARISON OF GROWTH AND PRODUCTION OF HOLSTEIN HEIFERS RAISED ON 100% OR 115% OF THE NRC REQUIREMENTS

E. J. Bortone, M. G. Daccarett,
J. L. Morrill, A. M. Feyerherm[1], and J. E. Shirley

Summary

One hundred and ten Holstein heifers from the KSU Dairy Research Unit were used in this experiment. They were fed either 100% (control) or 115% (enhanced) of NRC requirements for energy, protein, major minerals, and vitamins from 6 mo of age to shortly before calving. Heifers in the enhanced group calved at an earlier age, had larger heart girths, and were heavier than controls. At this time, 46 of the heifers have completed at least 50 days in lactation. Based on their projected 305-2X-ME records, the heifers in the enhanced group have produced slightly, but not significantly, more milk and milk fat.

Introduction

Some studies have shown that optimum age at first calving should be between 22.5 and 23.5 mo. It has been demonstrated that, after milk yield, age at first calving was the most important variable affecting lifetime profitability. Current recommendations suggest that replacement heifers should weigh from 1,200 to 1,300 lb at freshening. To achieve this weight, they must gain approximately 1.6 lb per day. Other studies show the importance of body size (weight, height, girth, and body length), which is positively correlated with milk production.

Body size must not be confounded with condition or degree of fatness. Fat heifers are not desirable because they will produce less and also will be more susceptible to metabolic and reproductive disorders, such as ketosis and dystocia. One of the major problems with overconditioned heifers is reflected later when high energy intake during the prepuberal period (3 to 9 mo of age) increases fat deposition in the mammary gland, inhibiting the proper development of secretory tissue. Therefore, overfeeding high energy can cause overconditioning. This research was conducted to compare the performance of Holstein heifers reared on a diet that was not only high in energy but also high in protein, major minerals, and vitamins.

Procedures

Holstein heifers from the KSU Dairy Research Unit were assigned to one of two treatments at 6 mo of age. Heifers in the control group were fed 100% of the 1988 NRC requirements of energy, protein, major minerals, and vitamins for large breed, growing, dairy heifers to gain about 1.6 lb/day. Heifers in the enhanced group were fed 115% of those same requirements. Body size measurements

[1]Department of Statistics.

(height, girth, and body length) were recorded. Body condition scores were recorded using a .5 scale from 1 (severely underconditioned) to 5 (severely overconditioned). Individual body weights were recorded each week. Rations were formulated weekly based on the average body weight of the heifers in each group. The total mixed ration (TMR) consisted of alfalfa hay, brome hay, milo, trace mineralized salt, and calcium and phosphorous supplements.

Approximately 3 wk before the expected date of calving, all heifers were moved to the maternity pen of the KSU Dairy Research Unit and were fed a ration consisting of 10 lb of concentrate, 10 lb of alfalfa, 10 lb of forage sorghum silage, and free choice prairie hay until parturition. After freshening, they were moved to the production facilities and were fed a TMR consisting of chopped alfalfa hay, forage sorghum silage, and corn-based concentrate mix, balanced for production of 70 lb of 4% fat-corrected milk.

Projected DHIA 305-2X-ME records for milk and milk fat from the 46 heifers with more than 50 days in lactation were used.

Results and Conclusions

Results of growth and production are shown in Table 1. Enhanced heifers were younger at time of calving, 23.85 vs 22.65 mo (P=.0087).

Differences in height and body length were not significant (P=.29 and P=.11, respectively).

Body condition scores were higher and heart girth and body weight were also greater for enhanced heifers (P=.008, P=.006 and P=.0373, respectively).

The heifers in the enhanced group produced slightly, but not significantly, more milk and milk fat (P=.82 and P=.67, respectively).

In conclusion, the group fed 115% of the NRC requirements calved at an earlier age, had higher body condition scores, and were heavier at calving. Heifers in the enhanced diet produced slightly more than the control group. However, this higher production was not statistically significant.

This experiment will continue through the first and second lactation. The data gathered will allow a better understanding of the effect that nutrition of replacement heifers has on subsequent milk production and, hence, total lifetime performance.

Table 1. Growth and Production of Heifers Fed 100% or 115% of the NRC Requirements

	Treatments		
Variables	Control (100%)	Enhanced (115%)	SE
Age at calving[a], mo	23.8	22.6	.3
Body condition score	3.3	3.5	.1
Height, in	54.0	54.7	.7
Heart girth[a], in	77.5	80.2	.6
Body length, in	64.0	66.2	.7
Body weight[a], in	1289	1355	18
Fat, lb	652	665	32
Milk, lb	17796	17973	848

[a]Significant treatment effect (P<.05).

SORGHUM GRAIN FOR LACTATING DAIRY COWS

C. A. Galdamez , J. E. Shirley, and A. J. Gallegos

Summary

Forty-seven Holstein cows in early lactation were utilized to evaluate the effects of supplementing concentrate diets of sorghum grain on milk production, milk composition, somatic cell count, and body condition. At 21 d postpartum, cows were randomly assigned to receive four concentrate diets consisting of 1) corn, 2) sorghum, 3) sorghum plus 1 lb tallow, and 4) sorghum plus wheat in a 70:30 ratio. All concentrates were combined with chopped alfalfa hay in a total mixed diet and fed twice daily. Treatments included a 7-day preliminary period and a 16-week experimental period.

Cows fed the sorghum plus tallow diet produced 14% more milk than cows fed either corn or sorghum alone and 10% more than cows fed the 70:30 sorghum plus wheat diet. Milk fat was unaffected by diet, although cows receiving the sorghum plus wheat diet tended to produce milk with less fat (3.3% vs 3.5% for the other diets). Body weight and body condition tended to be higher for cows fed the sorghum plus wheat combination. The addition of tallow or wheat to grain sorghum-based diets appears to improve its value for high-producing cows.

Introduction

Sorghum grain has received limited attention by dairy researchers, even though its supply is plentiful. Sorghum grain is often used in diets for cows in mid and late lactation but is uncommon in early lactation diets. The restricted use of sorghum grain in dairy cattle diets is primarily due to its rumen fermentation characteristics, low energy value, and low digestibility relative to corn grain.

In early lactation, milk production increases faster than dry matter intake, creating a negative energy balance as evidenced by extensive body weight loss. Restricted energy intake during this period depresses peak milk yield and total lactation yield. Body tissue support of lactation is a temporary mechanism and must be replaced by increased nutrient intake within 60 to 90 d postpartum, if high production is to be maintained. Nutrient intake during early lactation is limited by appetite but can be somewhat enhanced by increasing the nutrient density and digestibility of the diet.

Grain sorghum is relatively low in net energy and total tract digestibility of nitrogen and starch and lowers ruminal degradation of starch relative to corn. These characteristics contribute to the lower feeding value observed for sorghum grain versus corn. The long-term approach to improving grain sorghum for use by the dairy cow involves changes in its genetic makeup. Short term improvements can be accomplished by the use of complementary dietary components. Wheat-sorghum grain combinations, for example, offer promise because wheat starch is highly degradable in the rumen.

Tallow is relatively inexpensive and can be successfully used to increase the energy density of lactating cow diets, as long as fat in the diet does not exceed 5% of the total ration dry matter.

Procedures

Forty-seven Holstein cows were used in a lactation study at the Kansas State University dairy unit to compare the effects of four different concentrate diets on milk production, milk composition, somatic cell count, and body condition. Cows were randomly assigned to four groups at 21 d postpartum and group-fed a total mixed diet of chopped alfalfa hay plus the experimental concentrate diet. The concentrates were 1) corn, 2) sorghum grain, 3) sorghum grain plus 1 lb tallow, and 4) sorghum grain plus wheat in a 70:30 ratio. Diets were isonitrogenous and isocaloric. Cows were fed twice daily, 40% of the diet in the a.m. and 60% in the p.m. for a period of 16 wk. A 7-day preliminary period was used to obtain data for covariate analysis. Cows were weighed on two consecutive days at the beginning and end of the study and once weekly during the study. Body composition scores were recorded weekly. Individual milk weights were recorded daily, and milk samples (a.m.+p.m.) were collected weekly for analysis of milk fat, protein, lactose, total solids, and somatic cell (SCC).

Results and Discussion

Cows fed grain sorghum plus tallow produced 14% more milk (Table 1) than cows receiving corn or grain sorghum alone and 10% more than cows fed the 70% sorghum plus 30% wheat concentrate. Because all diets were calculated to be isocaloric and isonitrogenous, it appears that the increased production realized by adding tallow to grain sorghum resulted from an over-evaluation of the energy value of grain sorghum and/or a positive physiological effect of fat relative to milk production. Potentially, dietary fat would not stimulate insulin production to the degree obtained by dietary starch; thus, fat would not be as lipogenic as starch. This would increase the availability of energy to the mammary gland, thus enhancing milk production. Conversely, only a slight increase in milk production was observed when wheat was added to a grain sorghum-based concentrate. Wheat supplies rumen soluble starch and increases glucogenic precursors, which should stimulate insulin production and enhance lipogenesis in adipose tissue. The net effect should be a decrease in percentage milk fat and an increase in body weight. In effect, cows fed the sorghum-wheat mixture did gain more and produced slightly more milk with slightly less milk fat.

Results from this study suggest that the value of grain sorghum for high-producing dairy cows may be enhanced by adding tallow or wheat. However, the addition of wheat had a negative impact on milk fat production. This effect may be overcome by supplementing the grain sorghum-wheat mixture with tallow. This three-way combination offers the potential to enhance milk production over the grain sorghum-tallow combination. The next experiment will examine this potential.

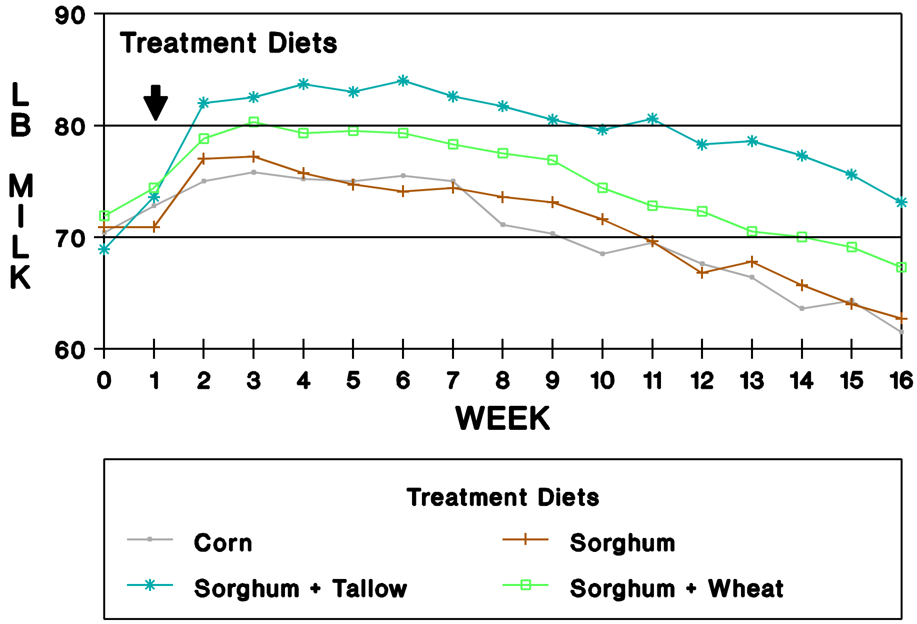


Figure 1. Milk Production.

Table 1. Treatment Effect on Milk Yield, Milk Composition, and Body Condition

	Treatments				
Parameter	Corn	Sorghum	Sorghum-Tallow	Sorghum-Wheat	SE[c]
Milk yield[a]	71.1	71.2	81.2	73.5	2.98
4% fat-corrected milk[a]	65.5	65.2	74.8	66.5	3.25
Wt change[b], lb	65.7	89.9	70.7	102.4	21.8
Avg body score	2.81	2.72	2.70	2.90	.05
Milk composition					
Fat, %	3.50	3.49	3.51	3.36	.09
Protein, %	3.07	3.00	2.99	3.03	.03
Lactose, %	4.94	4.92	4.94	4.94	.04
Total solids, %	12.33	12.16	12.18	12.07	.15
SCC (× 1000)	136	200	164	84	105

[a]lb/cow/d.
[b]Scale 1 to 5.
[c]Standard error.

EFFECT OF PARTURITION AND RECOMBINANT BOVINE SOMATOTROPIN (rBST) ON THE METABOLIC PROFILE OF DAIRY COWS

J. M. Estrada and J. E. Shirley

Summary

Blood samples were collected from 16 Holstein cows around parturition to obtain baseline values of various hormones and metabolites. At 90 ± 3 days postcalving, cows were divided into two groups (8 cows/group) and injected with either saline (control) or 25 mg rBST/d for 28 consecutive days. Blood was sampled on days 0, 1, 5, 10, 15, 30, and 45 after the beginning of treatment and analyzed for insulin, glucagon, growth hormone, glucose, and blood urea nitrogen (BUN). Milk production and composition were recorded as well as body weights and condition scores. Cows receiving rBST had higher milk yields than control cows during the treatment period. Milk lactose percentage also increased for cows on rBST, but other milk components remained unchanged. Plasma insulin decreased, and glucagon, growth hormone, glucose, and BUN increased from 10 days prepartum to 10 days postpartum. During the treatment period, insulin and glucagon decreased slightly for the rBST group, growth hormone increased for both rBST and control groups, and glucose and BUN were similar between rBST and control groups. Body weights and body condition scores decreased after parturition but remained unchanged during the injection period.

Introduction

The ability of somatotropin or growth hormone to stimulate milk production has been known since 1937. With the development of recombinant technologies (biotechnology), substantial amounts of somatotropin are available for large-scale use in dairy cattle. Recombinant bovine somatotropin (rBST) increases milk production in dairy cows by shifting nutrient flow away from body fat stores to meet the needs of the mammary gland for increased milk production. Parturition and initiation of lactation are associated with metabolic and hormonal changes that redirect nutrients required for milk production. Potential use of rBST in commercial dairy herds demands a full understanding of the metabolic and hormonal changes that occur during treatment. The objectives of the present study were: 1) to determine if selected metabolic and hormonal changes normally associated with parturition and initiation of lactation are similar during treatment with rBST and 2) to determine the effect of rBST treatment on milk production and composition, body weight, and body condition score of dairy cows.

Procedures

Blood samples were collected from 16 Holstein cows (8 primiparous and 8 multiparous) on 5, 10, and 15 days before projected calving date, and on days 5, 10, 15, 30, 60, 75, and 82 postcalving to obtain baseline values of various hormones and metabolites. Body weights and condition during early lactation were also noted. Cows were paired at 90 days postcalving according to milk production, days in milk, and milk fat percentage and allotted randomly to two treatment groups: saline (control) or 25 mg rBST/day. Cows were injected for 28 consecutive days, and blood samples were taken at 0, 1, 5, 10, 15, 30, and 45 days after the beginning of treatment. Blood plasma was analyzed for insulin, glucagon, growth hormone, glucose, and blood urea nitrogen (BUN).

Milk yields were recorded daily. Milk composition was analyzed every 3 wk from the beginning of lactation until 90 days postcalving and weekly during the rBST treatment period for milk fat, protein, lactose, and solids non-fat (SNF) percent and for somatic cell counts (SCC). Cows were group-fed twice daily a total mixed ration (TMR) consisting of 50% concentrate mix, 25% corn silage, and 25% alfalfa hay, to meet NRC requirements. Water was available ad libitum. Body weight and body condition score (scale 1 to 5; 1 = extremely thin, 5 = excessively fat) were recorded during every blood sampling and weekly during the injection period.

Results and Discussion

Milk Production and Composition

Four percent fat- corrected milk (FCM) yield showed a typical lactation curve until 90 days postpartum. Fat-corrected milk yield increased (P<.01) for cows on rBST when compared to control cows (33.2 vs 28.4 kg/day). Cows on rBST treament also maintained higher persistency of production through 1 wk after treatment was terminated (Figure 1). Milk lactose percentage increased (P<.05) during the treatment period for rBST compared to the control group. Fat, protein, and solids non-fat (SNF) percentages remained unchanged during the injection period. Somatic cell counts (SCC) appeared to be lower for the rBST group than for the control group, but differences were not significant (Figure 2).

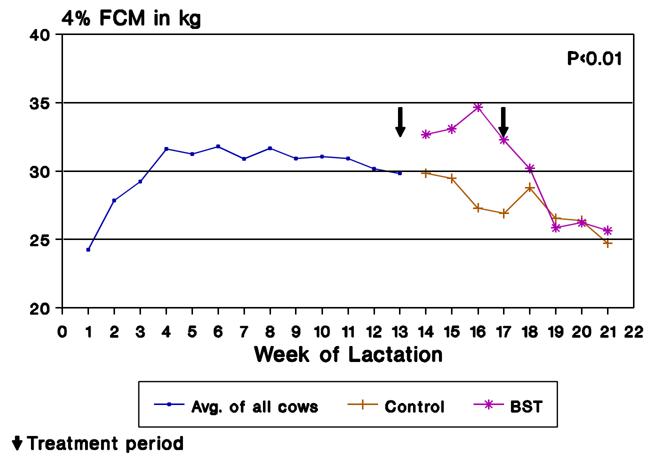


Figure 1. Milk production for control and rBST treated cows (4% FCM).

Hormone and Metabolic Traits

Insulin concentration in plasma decreased significantly from 10 days prepartum to 5 days postpartum, as expected, and then increased (P<.01) to prepartum levels by day 30 of lactation. In contrast, glucagon concentration increased 2.5 times from day 5 prepartum to day 10 postpartum (P<.05; Figure 3) and then decreased by 50% by day 30 postpartum.

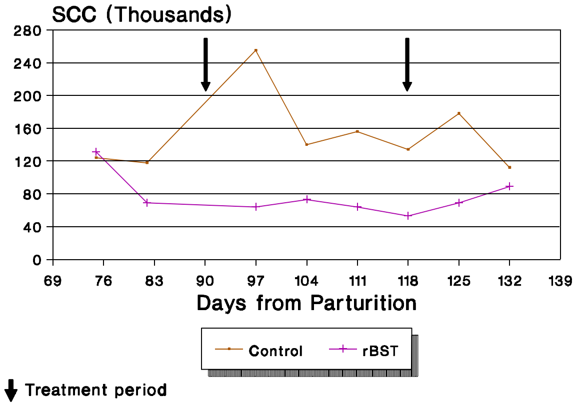


Figure 2. Somatic cell count for control and rBST during treatment period.

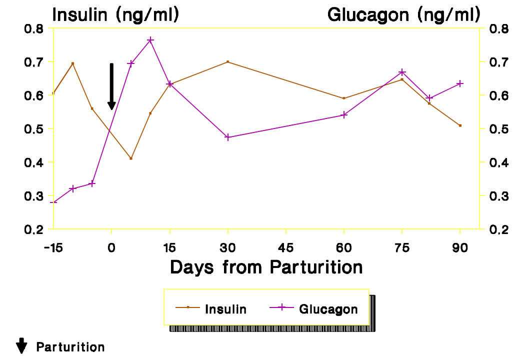


Figure 3. Concentrations of plasma insulin and glucagon periparturient and in early lactation.

Plasma insulin and glucagon (see Figure 3) stabilized at about the same concentration after 60 days postpartum. Plasma insulin and glucagon appeared to decrease for the rBST group compared to the control group (Figure 4). Insulin to glucagon ratios were similar for rBST and control groups during the injection period. Plasma growth hormone (GH) increased abruptly between 10 and 5 days prepartum and continued to increase through day 5 postpartum (Figure 5). Growth hormone declined to prepartum levels by day 15 postpartum. Growth hormone increased from day 1 to about day 15 of treatment for both rBST and control groups, and there was no difference between groups. Growth hormone was not increased for the rBST group because blood was sampled between 20 and 24 hours after injection.

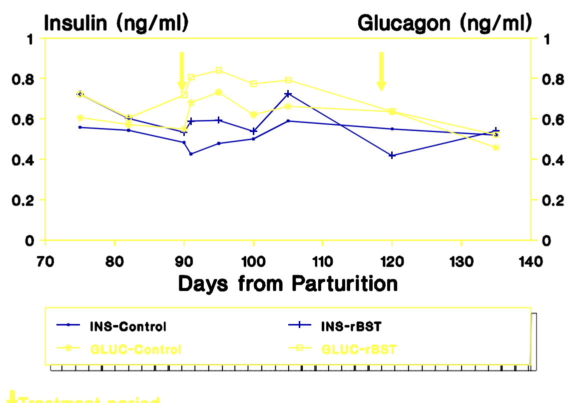


Figure 4. Concentrations of plasma insulin and glucagon during rBST treatment.

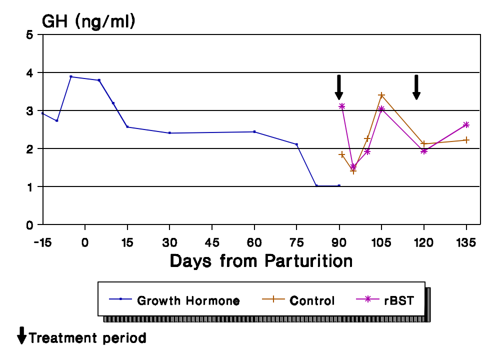


Figure 5. Concentrations of plasma growth hormone periparturient and during rBST treatment.

Plasma glucose concentration decreased slightly at parturition, then increased (P<.05) from day 5 postpartum to day 30 postpartum, reflecting the increase in dry matter intake observed. Glucose concentration remained stable from day 30 to day 90. No significant difference was noted between the control and rBST groups relative to plasma glucose concentration (Figure 6). Blood urea nitrogen (BUN) increased (P<.05) from day 5 prepartum to day 30 postpartum, reflecting the increase in protein intake that follows parturition. No significant BUN changes occurred during the treatment period for rBST or control groups (Figure 7).

Body Measurements

Body weight appeared to decrease from day 5 prepartum to day 15 postpartum, and then increased slowly during the first part of lactation. Body condition scores decreased (P=.06) from day 5 prepartum to day 30 postpartum and increased thereafter. No significant changes were found between control and rBST groups for body weights or body condition scores during the injection period.

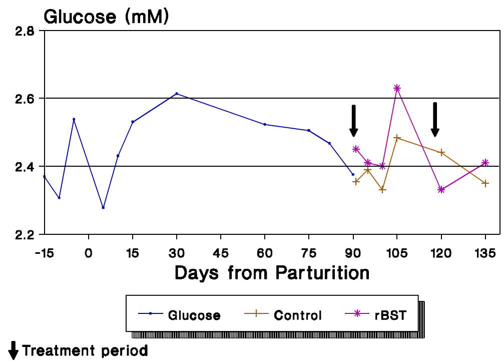


Figure 6. Plasma glucose levels periparturient and during rBST treatment.

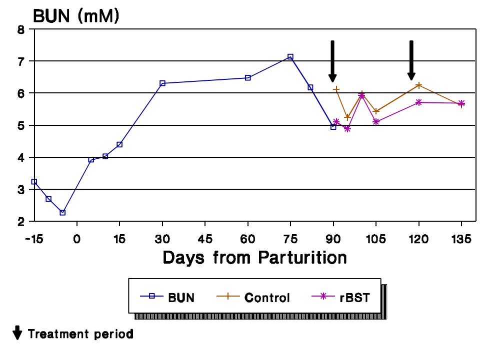


Figure 7. Blood urea nitrogen levels periparturient and during rBST treatment.

Conclusions

Periparturient data indicate the dramatic metabolic changes that occur during parturition and the onset of lactation to accomodate the needs of milk production by shifting from an anabolic to a catabolic state. As illustrated, milk production increased during supplementation with rBST, but these data suggest that the metabolic changes that occur during rBST treatment are not as pronounced as those occurring around parturition. Cows on rBST treatment were able to maintain body weight and body condition score during the injection period. Adequate nutrient supplementation will allow cows to maintain body weight when treated with rBST under the conditions of this study. Full response to rBST will require competent nutritional, reproductive, health, and overall management. Additional information on the mode of action of rBST will be important in determining management systems for commercial dairy herds.

EFFECT OF INOCULANTS AND NPN ADDITIVES ON DRY MATTER RECOVERY AND CATTLE PERFORMANCE: A SUMMARY OF 22 TRIALS

K. K. Bolsen, A. Laytimi,
R. Pope, and J. G. Riley

Summary

Results from 22 trials comparing dry matter (DM) recovery and cattle performance of inoculated or nonprotein nitrogen (NPN)-treated silages to controls were summarized using paired t-test analysis. Inoculants consistently improved DM recoveries and gains per ton of crop ensiled in both corn and forage sorghums. The use of NPN adversely affected nutrient preservation and gain per ton of crop ensiled, particularly for the wetter forage sorghums.

Introduction

Silage additives have received fairly wide acceptance in the U.S. A recently published guide to over 150 commercial additives indicated that microbial inoculants were the most frequent active ingredients in the products marketed today. Inoculants should promote a faster and more efficient fermentation of the ensiled material, which would increase both the quantity and quality of the silage as feed. Urea, anhydrous ammonia, and other commercial nonprotein nitrogen (NPN) sources have been added to low-protein crops (i.e., corn and sorghum) to increase their protein equivalent and decrease supplemental protein costs.

Research with inoculant and NPN additives using the farm-scale silos in Manhattan and at the Fort Hays and Southeast Branch Experiment Stations began about 15 years ago. Summarized here are results of 22 trials in which dry matter recovery and cattle performance from inoculant and NPN silages were compared to untreated (control) silages.

Procedures

In 19 of the 22 trials, silages were made by the alternate load method. In three sorghum trials, control and treated silages were made on consecutive days. Further details of all other procedures are given in KAES Reports of Progress 377, 394, 413, 427, 448, 470, 494, 514, 539, and 567. Products from 10 companies were used in the corn silage trials and products from eight companies in the sorghum trials.

Statistical analysis of the data from the 12 corn silage trials and 10 forage sorghum trials was conducted using paired t-test. Only overall mean comparisons were made between paired observations for the five criteria measured.

Results

A summary of treatment means for control and treated silages and significance levels is shown in Table 1.

The 16 inoculated corn silages had a 1.45 percentage unit higher (P<.001) DM recovery compared to untreated silages, and the inoculated silages supported a .07 lb faster (P<.01) daily gain and a 3.5 lb increase (P<.001) gain per ton of crop ensiled.

The addition of Cold-flo ammonia did not influence any of the five criteria in the corn silage trials (P<.05); however, there was a strong trend for both DM recovery and gain per ton of crop ensiled to be lower; 2.2 percentage units and 6.3 lb (P<.07), respectively.

When untreated and inoculated forage sorghums were compared, inoculants increased (P<.01) DM recovery, improved (P<.03) feed conversion, and produced 4.9 lb more (P<.001) gain per ton of crop ensiled. The NPN-treated forage sorghum silages had a 4.8 percentage unit lower (P<.001) DM recovery, although cattle performance was not significantly affected. Two of the six NPN-treated silages (urea and anhydrous ammonia) underwent clostridial fermentations and were of very poor quality.

Table 1. Summary of Treatment Means for Dry Matter Recovery and Cattle Performance from Inoculant and NPN Additions to Corn and Forage Sorghum Silages

Crop and Silage Treatment	Number of Silages	DM Recovery[1]	Avg. Daily Gain, lb	Daily DM Intake, lb	Feed/lb of Gain, lb	Gain/Ton of Crop Ensiled, lb
Corn						
Control	12	90.35	2.42	17.10	7.09	99.8
Inoculant	16	91.8	2.49	17.25	6.99	103.3
Probability Level	--	.001	.01	NS	NS	.001
Control	3	91.5	2.29	17.20	7.52	96.3
NPN	3	89.4	2.22	17.55	7.84	90.0
Probability Level	--	NS	NS	NS	NS	.07
Forage Sorghum						
Control	8	83.3	1.70	13.40	8.24	71.0
Inoculant	9	85.2	1.73	13.15	7.84	75.9
Probability Level	--	.01	NS	NS	.03	.001
Control	6	84.3	1.70	12.92	8.24	72.5
NPN	6	79.5	1.66	12.75	8.60	65.5
Probability Level	--	.001	NS	NS	NS	NS

[1]As a percent of the crop dry matter ensiled.

RATE AND EXTENT OF TOP SPOILAGE IN HORIZONTAL SILOS[1]

J. T. Dickerson, G. Ashbell[2], K. K. Bolsen, and C. Lin

Summary

A survey of 30 horizontal silos in western Kansas showed extensive, additional, organic matter loss in the top 18 inches of ensiled material. Covering with plastic reduced this loss from 41 to 27 perentage units.

Alfalfa silage also was studied in 55-gallon drums either uncovered or covered with plastic. Drums were stored outside, and samples were collected at four times. Analysis of pH and DM content showed that covered silage was well preserved and of high quality, whereas uncovered silage was of poor quality and deteriorated steadily over time. Changes occurred more rapidly in the top third of the uncovered drums.

In a typical horizontal silo, over 20% of the silage may be within the top 3 ft. Protecting this area immediately after filling should greatly increase storage efficiency.

Introduction

Horizontal silos are an economically attractive means of storing large amounts of fermented feeds. By design, these structures allow vast areas of the silage mass to be exposed to environmental and climatic effects. Past researchers have reported dry matter (DM) losses of over 40% in the top 20 inches of whole-plant corn stored in uncovered horizontal silos. The conventional method of protecting the top layer has been to cover it with plastic sheeting and tires. However, to date, controlled experiments under simulated farm-scale conditions have not adequately characterized the rate and extent of DM and nutrient losses occurring in the top layer.

Our objectives were to determine the extent of losses in the top 3 ft of farm-scale horizontal silos and to develop a laboratory model to study the rate and extent of these losses.

Procedures

[1]Appreciation is expressed to Mr. Russell Smith, Servi-Tech, Inc., Dodge City and Mr. Les Chyba, Scott Pro, Inc., Scott City for assistance in collecting the survey data presented in this report.

[2]Visiting researcher from The Volani Center, Bet Dagan, Israel.

Survey

Thirty bunker and trench silos in western Kansas were sampled, each at three locations across the width of the silos. Sample depths were 0 to 18 inches (depth 1), 18 to 36 inches (depth 2), and a representative silage sample from the face (at least 4 to 6 ft from the top) (depth 3). Analyses included pH and DM and ash contents.

Laboratory Model

First-cut alfalfa (1/10 bloom, 36.3% DM) was swathed, wilted, precision chopped, and packed to equal densities into 16, 55-gallon drums. Each drum was divided by plastic netting into thirds. A perforated, 1-in PVC pipe was placed at the bottom of each drum and connected through an air-lock to drain percolated water. Treatments were uncovered and covered with two sheets of .1 mm plastic secured with tape. Drums were stored outside and opened at 2, 4, 7, and 12 wk (two drums/treatment/opening time). Samples were analyzed for pH and DM content.

Results and Discussion

Survey

The increases in additional organic matter (OM) losses at the top two depths in the 30 farm-scale silos are shown in Table 1. Ash was used as an internal marker. Additional OM losses averaged 39 percentage units higher in the top 18 in compared to depth 3 (face). Covering with plastic reduced additional OM losses from 41 to 27 percentage units. Corn and forage sorghum silages in the survey had similar additional OM losses in the top 3 ft.

Laboratory Model

The covered alfalfa silage was well preserved and of high quality, whereas uncovered silage was of poor quality and had deteriorated steadily over time. The effects of covering and time on pH of the alfalfa silages as shown in Figure 1. Silage pH was highest ($P<.05$) in the top third of uncovered silage by week 2 (7.36) in comparison to silage stored in covered drums (4.63). This higher pH progressed to the middle third of uncovered silage by week 7 (6.04 vs 4.70). Shown in Figure 2 are the effects of covering and time on DM recovery of the alfalfa silages. Covered silages stored in drums retained more ($P<.05$) DM than uncovered silages and were relatively unaffected over time. Lower ($P<.05$) DM recoveries occurred by week 2 in uncovered silages (85.6% of the DM ensiled) and steadily decreased (P.<05) through week 12 (33.9% of the DM ensiled). Silages in the middle and bottom thirds of uncovered drums exhibited lower ($P<.05$) DM recoveries by week 7 (middle), and week 12 (bottom), respectively (76.4 and 64.2% of the DM ensiled).

As expected, covering silages with plastic optimized DM (and nutrient) retentions. However, the rate and extent that uncovered silages deteriorated should be a concern to producers using horizontal silos to store ensiled feeds. In a typical 100 x 40 × 12 ft horizontal silo, depending upon silage density, over 20% of the silage mass is within the top 3 ft. These data indicate that protecting the silage in this portion immediately after filling should greatly increase storage efficiency.

Table 1. Additional Silage Organic Matter Losses at Top Two Depths in Horizontal Silos

	Depth, in	
Crop and Treatment	0 to 18	18 to 36
Crop	---------- % Unit increase in OM loss ----------	
All crops (n=30)	39	6
Whole-plant corn (n=14)	38	7
Forage sorghum (n=13)	38	3
Treatment		
Covered (n=5)	27	2
Uncovered (n=22)	41	6

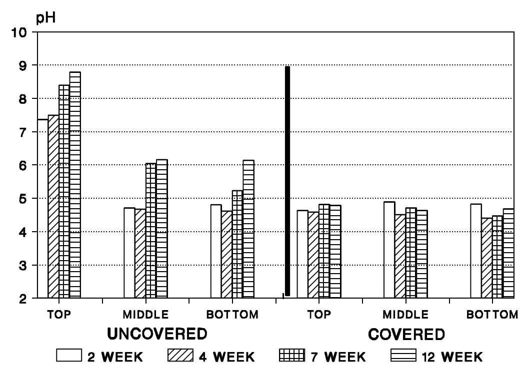


Figure 1. Effects of Covering and Time on pH of Alfalfa Silages.

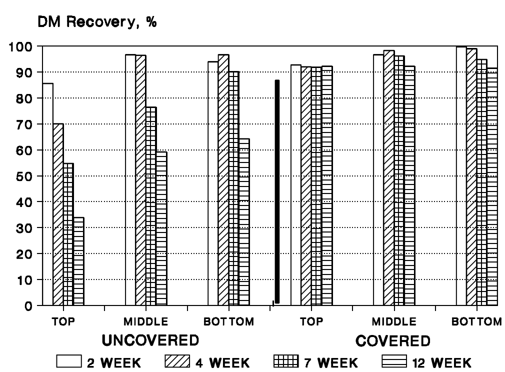


Figure 2. Effects of Covering and Time on DM Recovery of Alfalfa Silages.

EFFECT OF LIQUID HAY SILAGE ADDITIVE PLUS® AND LIQUI TEEM® ON THE NUTRITIVE VALUE OF ALFALFA HAYLAGE IN DIETS OF HOLSTEIN COWS IN EARLY LACTATION

J. E. Shirley, A. J. Gallegos, J. M. Estrada,
C. A. Galdamez, K. K. Bolsen, and L. Carver

Summary

Alfalfa haylage was ensiled in concrete stave silos in June, 1989 using the alternate load technique. One silo was treated with 60 lb Liquid Hay Silage Additive Plus® (LHA+) and 0.085 ounces Liqui Teem® per ton of chopped alfalfa. Both silos were sealed until the feeding phase began in November 1989. Forty-eight cows in early lactation were paired by age, days in milk, body weight, and pre-treatment milk production and allotted randomly to treatment for 70 days. Cows within treatment groups were housed together and received a total mixed ration ad lib. The appropriate haylage constituted the sole forage in the diet. Both groups received a corn-soy based concentrate formulated to complement the alfalfa haylage in meeting NRC requirements for 80 lb of 4% fat-corrected milk. Pretreatment means for milk production were 80.5 lb and 71.3 lb for control and treated haylages, respectively. Cows fed control haylage produced 64.9 lb milk testing 4.0% fat, 3.18% protein, 4.86% lactose, and 12.74% total solids, whereas cows fed treated haylage produced 62.7 lb milk testing 4.0% fat, 3.32% protein, 4.82% lactose, and 12.87% total solids. Treatment means approached significance only in the case of milk protein, ($P<.09$). Cows receiving treated haylage were more persistent (96.6%) in milk production over the 70-day treatment period than control cows (92.5%).

Introduction

It is widely known that alfalfa is the most important forage crop in North America because of its high yield and excellent feeding value. These characteristics make its use as hay, meal, or silage desirable in rations. Efficient conservation of the most desirable forage nutrients during harvesting and storage is one of the farmer's most difficult tasks. Preservation of alfalfa as silage decreases field losses because less drying time is required and minimum leaf shattering occurs. However, storage losses are generally greater for silage than for hay. Because alfalfa is high in protein and low in fermentable carbohydrates, the use of additives may improve its fermentation pattern and increase its silage quality.

Additives are not a substitute for good silos or for effective chopping, packing, and sealing practices. However, when forages are ensiled with 70% moisture, additives may be used to provide the carbohydrates needed to produce lactic acid, lower pH, and improve silage quality. Besides adding soluble carbohydrates, microbial cultures may be inoculated into silages to improve fermentation and acid production.

Procedures

A second cutting of a well established alfalfa field was harvested at a stage of maturity between late bud and 10% bloom, with a 65% moisture content, and chopped to a particle size between 1\2 in and 3/8 in. Two 16 x 50 ft concrete stave silos were filled in June 1989 using the alternate load technique. One of them was treated with 60 lb of Liquid Hay Silage Additive Plus® (LHA+) and .085 ounces of Liqui Teem® per ton of chopped alfalfa diluted in 2.5 gal. of water.

A lactation study was carried out for 70 days in which 48 cows in early lactation were paired by age, days in milk, body weight, and pretreatment milk production and were assigned randomly to treatment. Each group of cows was housed together and received a total mixed ration formulated to meet NRC requirements for 80 lb of milk at 4% fat. Cows were fed ad libitum. Alfalfa haylage constituted the sole forage in the diet and was supplemented with a corn-soybean based concentrate. Milk production and feed intake were recorded daily, and bi-monthly composited milk samples were collected for analysis of milk fat, protein, lactose, and total solids percentage and somatic cell counts (SCC).

Results and Discussion

Preliminary results on the changes in silage temperature (Table 1) indicated that by day 7 both silos reached peak temperature (39.8^{0}C), but treated silage started decreasing in temperature much faster than control silage and approximated the initial temperature by day 42.

Table 1. Silage Temperature Change

	Days post-filling						
Silage[a]	1	3	7	14	21	28	42
	---------------------- Change above initial temperature (^{0}C) -------------------------						
Control	4.0	7.2	8.6	8.2	7.7	6.2	3.1
LHA+	4.0	7.0	7.6	6.5	5.6	4.8	1.7

[a]Initial temperature: Control = 31.2
LHA+ = 32.2^{0}C

There was no difference in dry matter digestibility between treatments (Table 2). Treated silage appeared to be higher but this was due to the 75% dry matter digestibility of the additive itself. Dry matter recovery was considerably higher for treated than control silage. Feed intakes for control and treated silages were 49.3 lb and 48.4 lb of dry matter, respectively. The control formulation had 39.7% of silage in the diet, whereas the treated formulation had 38.4%.

Table 2. Characteristics of Experimental Silages

Item	Control	LHA+
DM digestibility, %	61.3	63.4*
DM recovery, %	84.2	87.4
Silage DM	33.6	34.6
Silage pH	4.96	4.85

*94.3% silage and 5.7% LHA+ on a DM basis.

Fat-corrected milk (4%) yield and composition were unaffected by treatment (Table 3). Milk protein content was the only factor that approached significance. Treatment had no effect on SCC, but cows fed treated alfalfa haylage were more persistent (96.9%) than control cows (92.5%).

The conclusions of the present study are that treatment had no effect on the nutritive value of alfalfa haylage, but ensiled forage had a considerably higher dry matter recovery when treated.

Table 3. Effect of Alfalfa Haylage on Milk Production and Composition

Item	Control	LHA+	SE
Milk production, kg/d	29.2	28.3	1
4% FCM, kg	29	28	.8
Milk composition			
Fat, %	4.00	3.96	.11
Protein, %	3.18	3.31	.06
Lactose, %	4.85	4.82	.04
Total solids, %	12.71	12.80	.16
SCC (× 1000)	164	307	98
Milk persistency, %	92.5	96.9	

INFLUENCE OF VARIOUS DOSES OF GONADOTROPIN-RELEASING HORMONE ON PROGESTERONE SECRETION AND REPRODUCTIVE STATUS OF REPEAT BREEDERS

M. O. Mee and J. S. Stevenson

Summary

Previously, we have demonstrated that gonadotropin-releasing hormone (GnRH or Cystorelin®) improved pregnancy rates when administered at the time of AI in repeat-breeding dairy cows. In our present study, we wished to determine the effect of various doses of GnRH on progesterone secretion and subsequent reproductive status of repeat breeders. Dairy cows (n=32) were inseminated according to the am-pm rule and injected with either saline or 50, 100, or 250 µg GnRH immediately following breeding. Concentrations of progesterone in serum were higher during 30 days after estrus in all cows receiving GnRH (50, 100, or 250 µg) at the time of breeding compared to cows given only saline. The proportion of cows that were assumed to be pregnant (with high progesterone concentrations) through 30 days after estrus were similar among the four doses. However, at uterine palpation (42 to 54 days after AI), only 1 of 4 saline-treated cows with high progesterone was actually pregnant compared to 11 of 14 GnRH-treated cows with high progesterone. We believe that GnRH administration at the time of breeding in repeat-breeding dairy cows increased progesterone concentrations, which may have influenced pregnancy rates.

Introduction

Repeat-breeding dairy cattle are a source of frustration and economic loss to the dairy enterprise. Repeat breeders are those cows that fail to become pregnant after two or more breedings and continue to show normal estrus every 18 to 24 days. There are many potential causes of repeat breeding that range from errors in heat detection to hormone imbalances, particularly, inadequate amounts of progesterone produced by the corpus luteum after estrus. Without sufficient progesterone secretion from the corpus luteum, the pregnancy is lost and the cow returns to estrus.

Previous research at KSU (1988 Dairy Day, KAES Rep. Prog. 554, pp 16-18) and elsewhere has demonstrated a 10 percentage point improvement in pregnancy rates when GnRH is administered immediately following AI in repeat breeders compared to those given saline at breeding. In our present experiment, we wanted to determine the: 1) concentrations of LH and FSH in repeat-breeding dairy cows after saline or 50, 100, or 250 µg GnRH was administered at the time of breeding; 2) effect of GnRH on serum concentrations of progesterone during 30 days after breeding; and 3) pregnancy rates after GnRH administration.

Procedures

Thirty-two, lactating, Holstein cows eligible for third service (repeat breeders) were assigned to different doses of GnRH following detection of estrus. Doses of 50, 100, or 250 µg GnRH were dissolved in an equal volume of saline. Cows were checked for estrus 2×/day and inseminated 12 hr after first detected estrus by one technician, utilizing semen from one sire (9H924). Immediately following breeding, cows were injected with one of the three doses of GnRH or saline alone.

Blood was collected at the time of breeding and GnRH injection (0 hr) and again 2 hr later to determine the effect of GnRH dose on serum concentrations of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) released from the pituitary gland. In addition, blood was collected every other day beginning 4 days after breeding until 30 days postbreeding and analyzed for concentrations of progesterone in serum. This enabled us to indirectly monitor corpus luteum (CL) function in response to the various doses of GnRH. Cows that did not return to estrus within 18 to 24 days were palpated for pregnancy between 42 and 54 days after breeding.

Results and Discussion

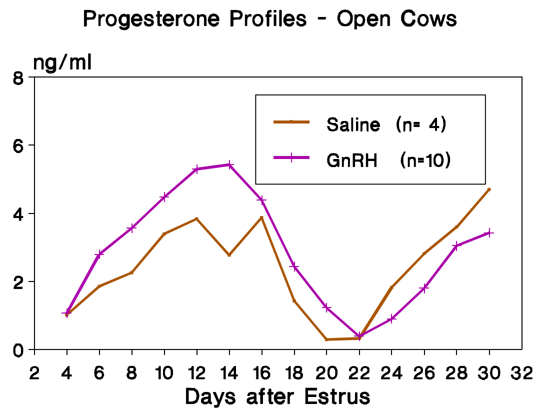
Table 1 summarizes the changes in serum LH and FSH at 0 hr and 2 hr after GnRH for cows receiving different doses of GnRH. Overall concentrations of LH and FSH were similar at 0 hr in all cows before dose injections. However, 2 hr after injection of GnRH, there was an increasing dose response in concentrations of LH, with cows injected with 250 µg having the highest concentrations of LH in serum. There was no dose effect of GnRH on concentrations of FSH in serum.

Table 1. Concentrations (ng/ml) of LH and FSH in Blood Serum at 0 hr and 2 hr after Dose of GnRH

			Dose of GnRH, µg			
Hormone		Saline	50	100	250	± SE
LH	0 hr	1.7	1.4	1.6	1.3	.5
	2 hr[a]	1.4	2.2	2.7	4.7[b]	.5
FSH	0 hr	.5	.5	.5	.5	.1
	2 hr	.5	.6	.6	.4	.1

[a]There was an increasing dose response of GnRH on concentrations of LH 2 hr after injection.
[b]Different (P<.05) from all other doses at 2 hr after GnRH.

Serum concentrations of progesterone for cows failing to become pregnant after GnRH and recycling 18 to 24 days later (open cows) and cows assumed to be pregnant (high progesterone cows) are illustrated in Figure 1. Open cows treated with GnRH (50, 100, or 250 µg) had higher (P<.10) average concentrations of progesterone that rose sooner after GnRH than open cows given only saline. Likewise, high progesterone cows (those cows that had elevated progesterone concentrations through 30 days postestrus) given GnRH (50, 100, or 250 µg) had higher ($P<.05$) average concentrations of progesterone than high progesterone cows given only saline. We believe that GnRH directly or indirectly enhanced the ability of the developing CL to secrete more progesterone. It is possible that GnRH modifies the function of pre- or postovulatory follicles on the ovary, possibly enhancing subsequent characteristics of the developing CL.



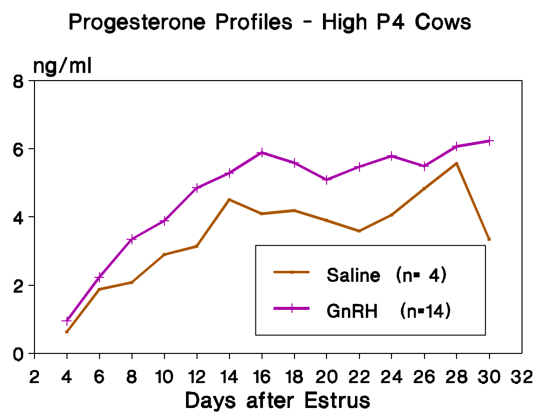


Figure 1. Concentrations of progesterone in serum of cows failing to become pregnant after the treatment service (Open Cows) and cows having high concentrations of progesterone through day 30 after estrus (High P_4 Cows).

Table 2 summarizes the reproductive status of the 32 repeat breeders in this study. The proportion of cows that had high concentrations of progesterone through 30 days after estrus was similar among treatments. However, when the uterus of cows was palpated between 42 and 54 days after estrus, only one cow that received saline was pregnant, indicating that three pregnancies were lost between 30 days after estrus and uterine palpation. Only three pregnancies were lost in cows receiving GnRH (one pregnancy lost at 50 µg, two pregnancies lost at 100 µg, and no pregnancies lost at 250 µg). Overall, six pregnancies were lost during the 12 to 24 days between uterine palpation and the end of blood collection, indicating that late embryonic death might account for some of the extended intervals often seen between breedings.

Table 2. Reproductive Characteristics of Repeat Breeders[1]

		Dose of GnRH, µg		
Characteristic	Saline	50	100	250
Recycled[2]	4	3	3	4
High progesterone[3]	4	5	5	4
Pregnant at palpation[4]	1	4[a]	3[a]	4[a]
Pregnancies lost[5]	3	1	2	0

[1]Thirty-two cows were used in this study with eight cows represented at each dose.

[2]Includes those cows that failed to become pregnant after the treatment breeding and returned to estrus 18 to 24 days after breeding.

[3]Includes those cows that had high progesterone concentrations through day 30 after breeding and were assumed pregnant.

[4]Cows that were actually pregnant 42 to 54 days after breeding as verified by uterine palpation per rectum.

[5]Total number of pregnancies that were lost during the period beginning 30 days after until to uterine palpation per rectum.

[a]A greater proportion (P<.10) of repeat breeders given GnRH at the time of breeding were pregnant compared to controls.

In summary, a greater (P<.10) proportion of repeat breeders given GnRH at breeding were pregnant at uterine palpation than those given only saline (11 vs 1). We believe that administration of GnRH at the time of breeding in repeat-breeding dairy cows increased serum concentrations of progesterone, which appeared to enhance later embryonic survival. Therefore, we continue to recommend the use of GnRH as a profertility aid in repeat-breeding dairy cattle.

BODY CONDITION DICTATES COW PERFOMANCE

A. J. Gallegos, J. M. Estrada, and J. E. Shirley

Introduction

Research has shown that body condition influences milk production, reproduction, feed intake, health, and longevity - in a word, productivity. For this reason, body condition scoring should be considered a very important tool in dairy herd management today. The increase in herd size and substantial modifications in dairy cattle nutrition systems, such as the generalized use of high energy feedstuffs and the utilization of total mixed rations (TMR), have made possible feeding cows in large groups. Under these conditions, feeding of high energy diets often extends into late lactation and the dry period, resulting in overconditioned cows at parturition. Studies have demonstrated that overconditioned cows are susceptible to metabolic problems and calving difficulties. Usually overconditioning occurs in the last third of lactation, when milk production is decreasing and nutrient levels are not reduced accordingly. Another way of overconditioning cows is by overfeeding during the dry period.

What is Body Condition Scoring?

Body condition scoring is a management tool to assist dairy producers in evaluating their feeding program. Body condition reflects the energy reserves of the cow. Adequate body reserves are necessary to maintain health, production, and reproduction of the cow. In dairy cattle, fat covering over the loin, rump, and tailhead as well as over the hook and pin bones, is an indicator of the amount of body reserves or stored energy. The body's fat covering changes with stage of lactation. Body condition scoring utilizes a numeric scale from 1 to 5, with 1 being extremely thin and 5 excessively fat. Conveniently, it can be divided by half, quarter, or tenth scores in between.

Experience has shown us the normal pattern of body condition throughout a complete productive cycle in dairy cows. Because of their metabolism, cows are more efficient at gaining weight while they are still lactating. Thus, body tissue lost during early lactation can be more economically replaced during mid to late lactation than during the dry period. This contradicts the idea of using the dry period to add needed weight to the cow for the next lactation. For this reason, management should enphasize the replenishing of body reserves during mid and late lactation.

Condition Scores at Different Stages of Lactation

Figure 1 presents the recommended body scores at the different stages of lactation.

Dry Off

Body reserves should be replenished in late lactation. Cows should be dryed off with a body condition of 3.5-4.0. This score should be maintained (no change in wt) until parturition to allow the cows to calve with adequate but not excessive body reserves. Cows that gain weight over the dry period are more susceptible to metabolic disorders after calving than cows that maintain weight. Thus, adequate energy should be provided to maintain body condition but avoid overconditioning, because late lactation and dry cows can add large amounts of body fat by eating more energy than they require for the amount of milk they produce. To minimize infectious and metabolic diseases, major changes in diet (e.g., grain feeding) should be made slowly beginning 2-3 wk before expected parturition. On the other hand, cows underconditioned at calving will not express their productive potential and will fail to show heat and/or conceive because of insufficient body reserves needed for their metabolic and productive processes.

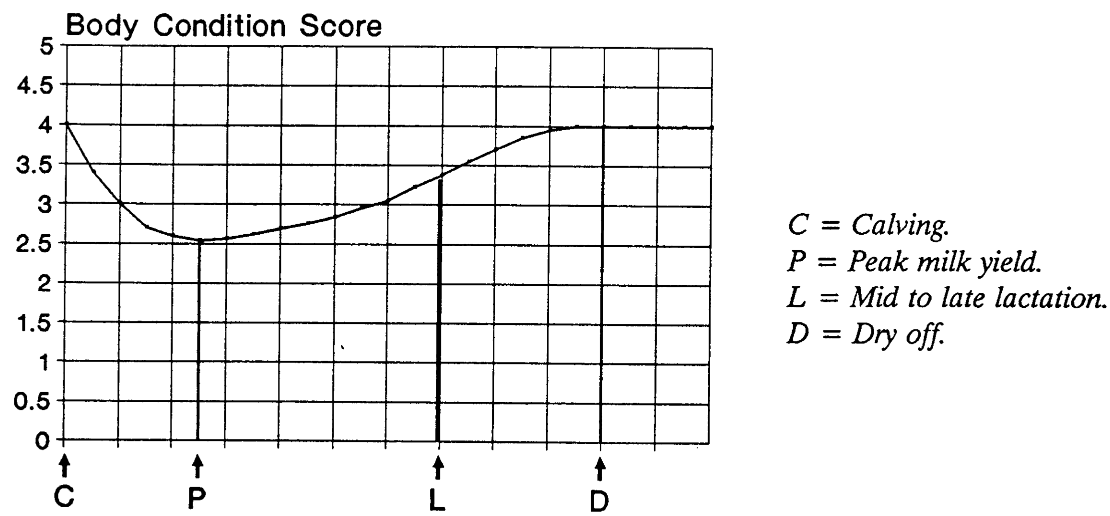


Figure 1. Desirable condition scores at different stages of lactation.

Calving

Cows need to be in optimum body condition (3.5-4.0) to achieve maximum peak milk yield. Each lb of body fat can provide enough energy for the production of 7 lb of milk. However, overconditioning (scores greater than 4) leads to calving difficulties, metabolic disorders, and susceptibility to diseases. Cows that are fat at freshening have reduced appetites because of the inhibitory effects of body fat mobilization on intake. Low dry matter intake and rapidly increasing production (peak milk yield is reached before peak dry matter intake) will keep the cow in a negative energy balance. Fresh cows will lose body fat because they are unable to eat enough to meet the energy requirements for their high milk production. This will cause a normal drop in condition. If nutrient reserves are not restored prior to calving (condition score less than 3 at calving) milk yield is reduced. Therefore, feeding practices should maximize dry matter intake to minimize changes in body condition.

Peak lactation

Daily loss of 1 to 1½ lb of body weight is expected during early lactation because mobilization of body reserves is essential then to achieve peak milk yield. When peak production is reached, high-producing cows should show a condition score around 2.5. High producing cows will lose condition more drastically and may drop to lower body scores than medium or low producers. Thin cows that are not high producers are energy deficient. Cows with good body condition (3.0) that are not peaking as high as expected may be receiving diets deficient in protein, minerals, or water. At peak lactation, cows should be fed to maximize intake of high energy diets in order to maximize production and to allow them to begin increasing body reserves. If a body condition score drops more than 1.5 points during early lactation, the amount of dry matter intake is probably not optimum.

Mid to late lactation

During mid and late lactation, cows should be restoring body reserves gradually to finally achieve the body condition score desired for the next lactation while they are still milking. After 120 days postpartum, cows should be restoring lost condition at a rate of ½ to 1 lb per day. Therefore, cows should maintain condition and maximize production. If cows are 3.5 or above, then reduce energy intake to avoid overconditioning and fat cow problems. If scores are 3.0 or lower, then cows are receiving inadequate energy.

Body condition applies only a herd basis, because little variation may occur with individuals doing the scoring. However, the body score system has values established (1 to 5), where extreme scores (1 and 5) should not be reached and cattle should be in desirable condition according to stage of lactation. Careful ration balancing and management of cows at various stages of lactation will ensure proper body condition.

When Should Body Scoring Be Done?

Ideally, cows should be scored at least once every 2 mo. In most herds, especially those in free-stall housing, this becomes a major undertaking. There are times when cows should be scored for body condition and the scores written down, if good use is to be made of the information. These times include:

For cows:	*Desired score*	*Reasonable range*
-At calving	4.0	3.5-4.0
-At 5-6 wk after calving (peak milk yield)	2.5	2.5-3.0
-At 150-200 days after calving (in mid lactation)	3.0	3.0-3.5
-At dry off	4.0	3.5-4.0
For heifers:		
-At 6 mo of age	2.5	2.5-3.0
-At breeding	3.0	3.0-3.5
-At calving	3.5	3.0-4.0

Body Condition Score Guideline

Condition score 1: Short ribs are sharp to the touch. Bones of the chine, loin, and rump regions are prominent. Hook and pin bones protrude sharply, with a very thin coverage of flesh. Severe depression below tailhead and no fatty tissue felt between pin bones.

Condition score 2: Short ribs can be felt but are not prominent. Individual bones in the chine, loin, and rump regions are visually distinct and easily distinguished by touch. Hook and pin bones are prominent, but the depression between them is less severe. Area below tailhead and between pin bones is depressed, but bony structure has some covering of flesh.

Condition score 3: Short ribs appear smooth and can be felt by applying slight pressure. The back bone appears as a round ridge; firm pressure is necessary to feel individual bones. Hook and pin bones are rounded. Area between pin bones appears smooth, without signs of fat deposit. No visible cavity around tailhead.

Condition score 4: Short ribs appear flat or rounded and are distingishable only by firm palpation. Ridge formed by backbone in chine region is rounded and smooth. Loin and rump regions appear flat. No depression is visible in loin between backbone and hipbone. Hooks are rounded and the span between them is flat. Area of tailhead and pin bones is rounded, with evidence of fat deposit. Patches of fat present around pin bones.

Condition score 5: Bony structures of backbone, short ribs, and hook and pin bones are not apparent; subcutaneous fat deposit very evident. Tailhead appears to be buried in fatty tissue. Skin is distended.

KSU DAIRY COMPUTER PROGRAMS

J. R. Dunham

Eight Lotus 1-2-3 worksheets have been developed to assist dairy producers to feed and manage their herds. The following is a description of the worksheets.

LACT-COW. This worksheet balances the ration for lactating cows at various production levels for NEL, protein, calcium, phosphorus, and vitamin A. Recommendations are also made for trace mineral salt, bicarb, and magnesium oxide. The worksheet calculates the grain, protein supplement, and additive requirements on a per cow per day basis and a total grain mix basis. Other calculations include: dry matter intake, undegraded protein intake percentage, total ration protein and fat percentages, and feed cost per day. An example printout is shown in Table 1.

DRY-COW. This worksheet balances the ration for dry cows with various body condition scores for NEL, protein, calcium, phosphorus, and vitamin A. Recommendations are also made for trace mineral salt. Recommendations are made for grain, protein supplement, and additives on a per cow per day basis and a total grain mix basis.

HEIFER. This worksheet balances the ration for heifers of various sizes and rates of gain for NEM, NEG, protein, calcium, phosphorus, and vitamin A. Recommendations are made for grain, protein supplement, and additives on a per head per day basis and a total grain mix basis. Estimated feed cost per pound of gain is calculated.

STEER. This worksheet balances the ration for steers of various sizes and rates of gain for NEM, NEG, portein, calcium, phosphorus, and vitamin A. Recommendations are made for grain, protein supplement, and additives on a per head per day basis and a total grain mix basis. Estimated feed cost per pound of gain is calculated.

DHA. The Dairy Herd Analyzer (DHA) worksheet uses data from the DHIA Herd Summary (DHIA-202) to evaluate the potential losses in a dairy herd due to 1) reproduction, 2) nutrition, 3) milk quality, and 4) genetics. This information is useful in managing a dairy herd to improve profitability.

RFV. The Relative Feed Value (RFV) worksheet calculates the relative feed value of forages using the ADF and NDF analyses. The RFV information is useful when comparing the feeding value of forages for either buying or selling.

COST-RETURN. This worksheet calculates the cost of producing milk and the return to labor and management. This information is useful in management to evaluate the potential profitability with various production levels, milk prices, input costs, and investment levels.

FEED-VAL. This worksheet calculates the value of various feeds compared to corn and soybean meal at a given price. This information is useful when purchasing feeds.

The KSU DAIRY COMPUTER PROGRAMS may be obtained from KSU Dairy Extension.

Table 1. Example Printout of LACT-COW Worksheet.

```
    KSU DAIRY RATION --- LACT-COW            SEE INSTRUCTIONS @ A95
J. A. DAIRYMAN        ANYWHERE, KS                    DATE:  09/20/90
DATA INPUT                      Age-yrs Body-wt  Milk/day  Fat%     FCM
         Animal Data               3.00  1,300   70.0      4.0     70.0

Enter Feed Codes from Table Beginning @ K3.
=====================================================================
FORAGES               Lbs/day --DM%-- --NEL---Prot % --CA%--    --P%--
  1 Alfalfa Hay         10.0     90.0%  0.60   19.7%    0.75%    0.26%
  2 Alfalfa Haylage
 14 Corn Silage         40.0     33.0%  0.70    8.4%    0.34%    0.20%
  6 Brome Hay

TOP DRESS             Lbs/day --DM%-- --NEL---Prot %-----CA%------P%--
 18 Cottonseeds with
 51 Soybeans             4.0     88.0%  0.96   42.8%    0.29%    0.68%
 22 Fat                  0.5     98.0%  2.60
 27 Grain Mix
 47 Soy Hulls

GRAINS                --Ratio----DM%----NEL---Prot %----CA%-------P%--
 32 Milo                30.0     88.0%  0.84    9.0%    0.03%    0.33%
 45 Shelled Corn        30.0     88.0%  0.92   10.0%    0.03%    0.31%
 61 Wheat               40.0     89.0%  0.92   14.4%    0.05%    0.45%

PROTEIN SUPPLEMENT    --Ratio----DM%----NEL---Prot %----CA%-------P%--
 12 Corn Glut Meal-61   75.0     90.0%  0.94   67.2%    0.54%    0.54%
 50 SOYBEAN MEAL-SOL    25.0     89.0%  0.88   49.9%    0.30%    0.68%

PHOSPHORUS SUPPLEMENT  (enter % CA & P)                 23.0%    18.0%
CALCIUM SUPPLEMENT     (enter % CA)                     38.0%
VITAMIN PREMIX      A units/lb (1,000)  1000 D units/lb(1000)      500
=====================================================================
DATA OUTPUT (solved for NEL, Protein, Ca, P, Vitamins A)

                                 --DM-- --NEL----Prot-  --Ca--    --P--
Nutrients needed/day-             46.00  36.87  8.29     0.37     0.22
Forages/day----------             22.20  14.64  2.88     0.11     0.05
    Forage Dry Matter Intake      1.71%      Forage NDF Intake    0.85%
    Free Choice Forage
GRAIN MIX INGREDIENTS  DRY   AF-basis % of Mix  TON    2 TON    5 TON
    Corn Glut Meal-61   2.43    2.70  11.47%    229      459     1147
    SOYBEAN MEAL-SOL    0.81    0.91   3.87%     77      155      387
    Milo                4.88    5.55  23.59%    472      944     2359
    Shelled Corn        4.88    5.55  23.59%    472      944     2359
    Wheat               6.51    7.31  31.10%    622     1244     3110
    -lbs Phos Supp.             0.39   1.65%     33       66      165
    -lbs Ca Supp.               0.36   1.55%     31       62      155
    -lbs Bicarb                 0.38   1.63%     33       65      163
    -lbs Mag Oxide              0.19   0.82%     16       33       82
    -lbs T M Salt               0.11   0.46%      9       18       46
    -lbs Vit Premix             0.06   0.26%      5       10       26
                        RATION SPECIFICATIONS
    DM Intake --(lb)--          47.2     Grain Mix --(lb)--      23.5
    DM Intake--(%BW)--           3.6     Grain Mix + Top---      28.0
    NDF-(lb/body cwt)-           1.1     Grain + Top (%)---      53.0
    NDF--(% of DM)----          30.5     Grain Prot-(%AF)--      16.6
    Protein-(% of DM)-          17.6     Grain Prot-(%DM)--      18.6
    UIP--(% of Prot)--          36.1     Grain NEL--(DM)---      0.84
    NEL--(Mcal/lb DM)-          0.78     Grain Ca--(%DM)---      1.19
    Calcium-(% of DM)-          0.79     Grain Phos-(%DM)--      0.71
    Phos--(% of DM)---          0.47     Fat--(% of DM)----      5.16
```

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