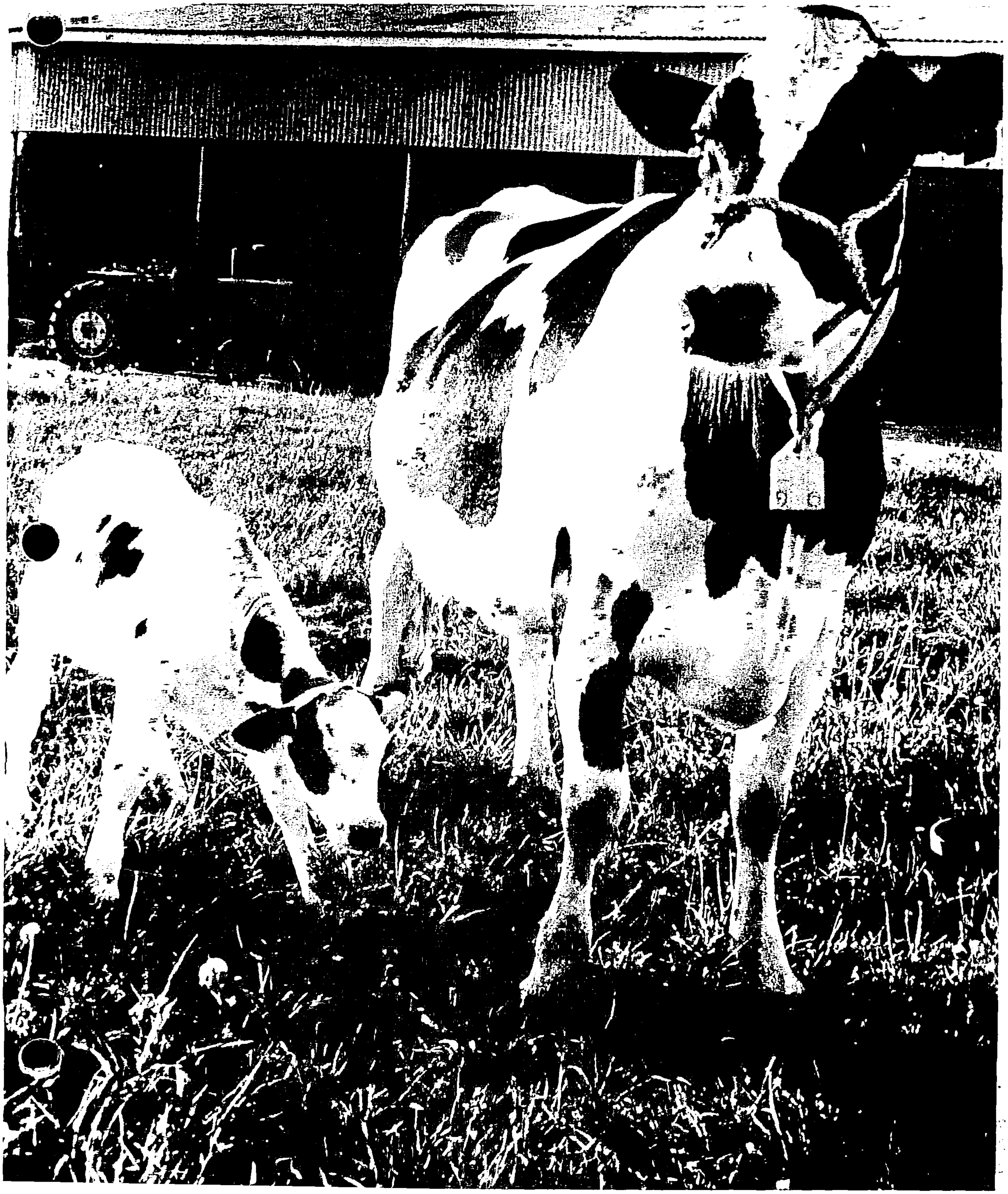
Report of Progress 527, Kansas Agricultural Experiment Station, Walter R. Woods, Director

DAIRY DAY 1987



DAIRY DAY — 1987

MANAGING THE HIGH-PRODUCING HERD

PART 2: "The Springer and Fresh Cow"

Morning Session — Manhattan Firestation Headquarters

9:00	Registration — View Poster Displays*
	Refreshments — Courtesy of AMPI, MID-AM, and Kansas Mastitis Council
9:45	Welcome — Dr. Don Good
10:00	The College of Agriculture - Dean Walter Woods
10:15	"Developing a High-Profit Herd" — Dr. John Shirley
10:30	"Dry Cow Management" — Mr. Jim Smith
11:00	"Periparturient Disorders in Dairy Cows" — Dr. Jeff Stevenson
11:30	"Feeding and Managing Early Fresh Cows" — Dr. Dick Dunham

Lunch — KSU Dairy Club

Afternoon Session — Manhattan Firestation Headquarters

1:00 Annual Meeting of Kansas Mastitis Council
Doug Forsberg, presiding

2:00 Quality Milk Awards — Bob Crawford, West Agro, Inc.

2:30 Tours (At your leisure):
1. Dairy Teaching and Research Center
2. Kansas DHI Laboratory, 628 Pottawatomie
3. Kansas Artificial Breeding Service Unit (KABSU), 1401 College Avenue

*Poster Displays:

1. Cow-side Milk Progesterone Testing
2. AI Repro-fresher Clinics
3. Selectronic Barn Sheets — DHIA
4. Inoculants for Various Silages
5. Yields of 79 Forage Sorghum Hybrids
6. Starch Utilization in Steers
7. Performance of Calves Fed Corn or Sorghum Silage

FOREWARD

Members of the Dairy Commodity Group of the Department of Animal Sciences and Industry are pleased to present this Report of Progress, 1987. 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. About one-half of the dairy herds in Kansas are enrolled in DHIA. Our 1987 DHI program shows that tested cows average 15,396 lb milk compared with 8,651 lb for all nontested cows. This means that dairy cows enrolled in DHIA average more income-over-feed cost ($1,034/cow) than nontested cows ($537/cow). Much emphasis should be placed on furthering the DHIA program and encouraginng 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 is approximately 16,000 lb, despite many research projects that may not promote production efficiency.

The excellent functioning of the DTRC is because of the special dedication of our staff. Appreciation is expressed to Bill Carinder (Unit supervisor), Jim Smith (herdsman), Dan Umsheid, Mary Rogers, Charlotte Kobiskie, Bill Hanson, Robert Resser, Don Allen, Mark Sellens, and Lloyd Manthe. Special thanks are given to Neil Wallace, Natalie Brockish, Tammi DelCurto, and Cheryl Armendariz for their technical assistance in our laboratories. A special thanks to Bill Carinder who, after 8 years of service at the DTRC, recently left for a new job and greener pastures in Iowa.

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.

This Dairy Day Report is dedicated to Dr. Charles L. Norton who served for 19 years as Department Head and Dairy Industry leader in Kansas and for 10 years as Professor of Dairy Science after the merger of the Department of Dairy and Poultry Science with the Department of Animal Sciences and Industry in 1977. A dedicatory citation for Dr. Norton is found on the next page. Thanks, Dr. Norton, for your leadership to our industry.

J. S. Stevenson, Editor
1987 Report of Progress

DEDICATED TO

DR. CHARLES L. NORTON

Dr. Norton was born in Neponset, Illinois. He received the B.S. degree from the University of Illinois and the Ph.D. degree in Animal Science from Cornell University in 1944. He served on the faculty of Cornell University from 1944 to 1947. He began his administrative career as Head of the Dairy Department at the University of Rhode Island in 1947. He served as Head of the Dairy Department at Oklahoma State University from 1950-1958 and at Kansas State University from 1958-1977. Since 1977, he has been serving as Professor of Animal Sciences and Industry at Kansas State University, devoting 100% of his time to teaching, advising, and coaching the dairy cattle judging team.

He is an active member of numerous professional organizations including Dairy Shrine, Gamma Sigma Delta, National Association of Colleges and Teachers of Agriculture, Council for Agricultural Science and Technology, and the American Dairy Science Association. He has been a member of ADSA since 1940. He has served as a member of the Program, Resolutions, Nominations, and Membership Committees. He also served as member and Chairperson of the Borden Award Selection Committee and the Dairy Cattle Type Committee. He was elected to the Production Division Offices and the Board of Directors. He also served as Advisor to the Student Affiliate Division. On numerous occasions, he was a judge of presented papers and evaluator of club yearbook and display entries at the national meetings.

Dr. Norton has received several awards recognizing his outstanding performance in teaching and advising. He was named the Outstanding Instructor in Agriculture at Oklahoma State University in 1957, the Faculty of the Semester at Kansas State University in 1978 and in 1984, and the Dedicatee, Little American Royal at Kansas State University in 1977 and in 1986. He was awarded the Faculty Award of Merit by Gamma Sigma Delta in 1983. The Student Affiliate Division of the American Dairy Science Association named him Outstanding Advisor in 1977.

Dr. Norton has taught numerous courses, ranging from introductory animal science to various areas of dairy production, and to dairy cattle judging and senior seminar. He serves as Advisor/Counselor, as Advisor to the Dairy Science Club and as Coach of the Dairy Cattle Judging Team. Dr. Norton is an approved judge for all breeds of dairy cattle and was formerly a classifier of Brown Swiss cattle.

Dr. Norton has a superb knowledge of the dairy cattle industry. This knowledge, blended with a sincere, gentle, caring manner, and seasoned with a touch of wit and good humor, makes the learning process exciting and more meaningful. Dr. Norton shows respect for each student, which, in turn, causes each student to respect and admire him. He possesses a unique gift of encouragement that makes each person try to do his or her best.

The advise and counsel of Dr. Norton has had a profound and positive influence on the attitude, direction, and development of many persons whom he has coached, taught, or advised. As one of his former students stated "his advice and counsel were not always easy to accept, but they were always honest, fair and in the best interest of each student."

We will miss Dr. Norton's presence in our day-to-day activities in the Department. We wish him and his wife, Audrey, enjoyment in their retirement and look forward to seeing them from time to time as they remain in Manhattan.

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 mean that the difference in production between X and Y was not the result of the treatment alone. Statistical analysis lets researchers calculate the probability that such differences are from treatment rather than from chance.

In some of the articles that follow, 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 traits 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 a mean or average given as $2.50 \pm .10$. The 2.50 is the mean or average; .10 is the "standard error". The standard error is calculated to be 68% certain that the real mean (with unlimited number of animals) would fall within one standard error from the mean, in this case between 2.40 and 2.60.

Many animals per treatment, replicating treatments several times, and using uniform animals increases 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 here, statistical analyses are included to increase the confidence you can place in the results.

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OVERVIEW - DEVELOPING A HIGH PROFIT HERD

J.E. Shirley

Dairy Day - 1986 was the first of a 5-year series dealing with the development of a high profit dairy herd. The program accented replacement heifer management with respect to nutrition, reproduction, breeding, health, housing, and some general management concepts. Dairy Day - 1987 stresses the dry and early lactation period in a cow's production cycle.

Management implies that action is taken to control an event, whereas a lack of management implies that an event occurs uncontrolled. Successful dairy producers anticipate needs and act to provide those needs prior to an event. Rather than reacting to an event, they act to control it in a positive way. To correctly anticipate needs, one must have knowledge of the business and the desire to continually assess and evaluate each element of the operation with respect to its impact on the whole.

The impact of dry-cow management programs on subsequent lactation performance has been quantitated and found to be of great significance. Equally important to lactational performance are management programs for the periparturient and early lactating cow. The condition of the cow when she begins lactating and the presence or absence of disease during early lactation have a direct effect on milk production and reproductive performance.

Dairy Day - 1987 presentations provide a positive approach to "Dry Cow" and "Early Lactation Cow" management. Problem prevention is always a better approach than problem solving.

KSU

DRY COW MANAGEMENT PROGRAM

J.F. Smith

Summary

Dry cows do not require the intensive daily management of cows in early lactation, but the handling of mastitis treatments, feeding regimen, and grouping are of utmost importance in determining how the cows will perform in the subsequent lactation. The dry period is the time we allow for the cow to regenerate milk-secreting tissue, combat mastitis, and prepare for the next lactation.

The body condition of each cow should be moderate before drying off. Each quarter should be treated with a commercial dry cow mastitis treatment, then the cow should be separated from the milking herd for observation and fed a diet specifically formulated for the dry period. The final stages of the dry period are used to prepare the cow for acute changes that occur at calving, including exposure to different feeds, and increasing grain intake 2 weeks before calving. Increased grain intake during the final 2 weeks allows the rumen to adjust so maximal intake of dry matter is achieved sooner after calving. This helps offset the negative energy balance that dairy cows experience during early lactation. Following these general guidelines during the dry period will decrease problems encountered at or near calving, which, in turn, will allow the cow to reach her maximum genetic potential.

Background

Problems incurred at or near the time of calving greatly affect the performance of cows. Dystocia, metritis, ketosis, displaced abomasum, milk fever, fat cow syndrome, mastitis, and various reproductive disorders all restrict a cow from reaching her maximal efficiency. Properly identifying these obstacles and designing a plan of action unique for each herd are essential because no two herds are alike. The feeding and management of the dry cows has great bearing on how well they perform in the subsequent lactation.

General Guidelines of a Dry Cow Program

A good dry cow program must begin before the expected dry date. The dry period should be used for maintaining body condition and as a recuperation period between lactations. Moderate body condition should be attained during late lactation, not during the dry period. The dry period is the proper time to generate body stores because of higher feed efficiency. However, restricting energy intake in late lactation is necessary at times to avoid overly fat cows entering the dry period. But, it is important to remember that feeding below maintenance requirements during the dry period to reduce body stores can be harmful to the cow and the development of the fetus. Determine a dry-off date from breeding records or pregnancy exams and stay in the range of 46-65 days. Reducing dry periods to fewer than 40 days does not allow enough time for milk-producing cells to regenerate in the mammary glands. Longer than 80 days increases the chances of clinical mastitis and metabolic disorders. Your goal should be 50-60 days. Cows that conceive before 85 days postpartum should be dried-off near the 60-day mark and those that conceive after 85 days, nearer the 50-55 day mark. On the day of dry off, the cow should be milked out completely and treated in each quarter with an approved dry cow antibotic infusion treatment using good sanitary procedures. Flexible collodion for the final teat dip sets up a more lasting barrier to help decrease rate of re-infection during the critical first 2 weeks of the dry period.

Dipping teats twice a day for the first 10 days of the dry period also helps prevent re-infection, but is not always practical. After dry treatment, cows should be moved from milking herd into a separate pen for dry cows, where they are fed separately from the milking herd and observed daily. Problem cows with mastitis should be remilked and retreated as necessary. The feeding program should meet the maintenance requirements of the cow and unborn calf. Severe deficiencies or excesses of energy, protein, minerals, or vitamins can result in more metabolic disorders at or near time of calving.

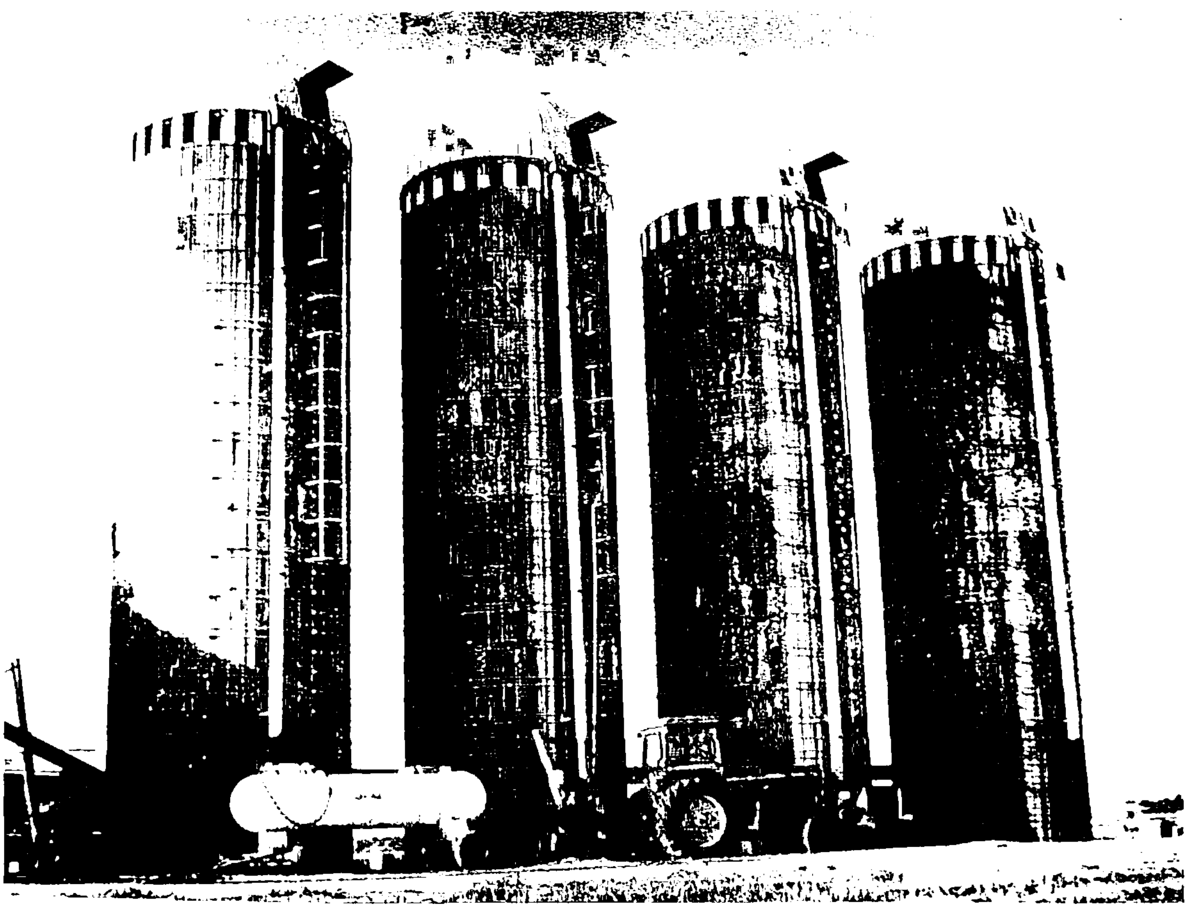
The nutrient requirements for dry cows are summarized in Table 1. The best feed for dry cows is long, dry hay, grass, or cereal hay. Alfalfa should be avoided because of its high calcium content that predisposes the cow to milk fever at calving time. Dry cows need only 0.97 lb salt per day, which can be provided in the grain mix that supplements the hay. If more salt is fed, it can lead to excessive udder edema. Allowing dry cows free access to granular salt and minerals can lead to a dietary imbalance. Supply the proper amount of nutrients to meet their requirements with forage and a grain mix that has the mineral package to complement the forage.

Table 1. Nutrient requirements of dry cows

Ingredient	First 6 weeks		Last 2 weeks
	Body Condition 4	Thin	
Protein, % D.M.	11	11	12
NE_L, Mcal/lb D.M.	0.50	0.65	0.65
ADF, %	27	24	24
NDF, %	35	32	32
Calcium, %	0.45	0.45	0.45
Phosphorus, %	0.35	0.35	0.35
Trace Salt, %	0.25	0.25	0.25
Vitamin A, U/lb D.M.	1500	1500	1500
Vitamin D, U/lb D.M.	750	750	750
Vitamin E, U/lb D.M.	7	7	7

About 2 weeks before expected calving date, grain intake of the cow should be gradually increased to a total of 1% of her body weight by the day of calving. The other consideration during the warmup period is introducing any ensiled feed currently fed to the milking string. Warming up or challenge feeding the dry cow allows the rumen microbial population to adjust to the higher grain intake and fermented feed that will be fed at freshening.

Cows should be observed closely prior to calving for problems such as severe edema, swollen quarters, or going off feed. At time of calving, the cow should be isolated to a clean, freshly bedded maternity pen, and assistance should be rendered if needed. Immediately after calving, worming of the cow should be performed to remove internal parasites. If mastitis is a problem at freshening and handling of the nearly term cow is possible, pre-dipping for 10-14 days before calving will aid in preventing new infections. At Kansas State University, the dry period is also the time when we vaccinate our herd. This point should be discussed with your local veterinarian to determine its feasibility in your herd.



PERIPARTURIENT DISORDERS IN DAIRY COWS

J.S. Stevenson

Introduction

The economic climate in the dairy industry requires producers to operate efficiently to remain competitive. Attention to details and understanding of reproduction, metabolism, digestive functions, milk secretion, and all aspects of husbandry are essential. To be successful, producers must minimize reproductive failure because reproductive performance affects the quantity of milk produced per cow per day of herd life, the number of potential replacements needed to maintain a constant herd size, and the longevity of the cow in the herd. In practice, this translates into well-designed programs of herd health, milking, feeding, and reproductive management that minimize involuntary culling of problem cows by maintaining healthy, profitable cows. The purpose of this review is to focus on the interrrelationships of various periparturient disorders in dairy cows and highlight their collective impact on reproductive performance, milk yield, and predisposition to other diseases.

Periparturient Health

The term "periparturient" stems from the word "parturition" and the prefix "peri," which literally but vaguely means "around." This phase generally includes the dry period and the first 3 to 4 weeks after calving. The milk-secreting and future reproductive capability of the dairy cow is related to periparturient events. Parturition is one of the most critical stages of the reproductive cycle and is a period of significant death rate, as well as potentially severe debilitating injury to dam and newborn calf. Future efficiency of reproduction and milk yield can be affected adversely at this time. Therefore, major efforts should be directed toward minimizing health problems that generally arise during the periparturient period.

Keeping cows healthy is one of the most important steps in maintaining good fertility and efficient milk yield. Healthy cows produce more milk, rebreed sooner, and have lower culling rates than their unhealthy herdmates. An example of the reproductive performance of healthy cows from eight dairy herds is illustrated (Table 1). Healthy cows were first bred at about 70 days, had conception rates greater than 55%, had fewer than 100 days open or 382-day calving intervals, and were culled at rates less than 12%. Good sanitation and a herd-health program designed to maintain healthy cows was essential to this achievement. Studies have shown that herd health programs return added profit to dairy producers, even though veterinary costs per cow increase. Some of the periparturient disorders that are described below can be prevented and/or reduced by careful management and cooperation between veterinarian and producer.

Table 1. Reproductive performance of healthy dairy cows

Trait	First lactation	Later lactations
No. cows	69	134
Days to first estrus	50	55
Days to first service	68	70
Conception at first service, %	59	71
Days open	95	84
Services per conception	1.6	1.4
% culled	4.4	11.2
% culled for reproduction	1.5	4.7

Source: Adapted from Oltenacu et al. 1984. J. Dairy Sci. 67:1783.

Dystocia or Calving Difficulty

Incidence of dystocia is about 6% (Table 2). While dystocia is primarily a function of the size of the calf and pelvic area of the dam, other factors related to the calf, dam or sire, nutrition, season, disease, and endocrine aspects are implicated.

Calving difficulty is increased with large birthweight calves, male calves, twins, malpresentations, stillbirths, heifers and young cows, lack of energy consumed during the dry period, and fall and winter months of the year.

The implications of dystocia on disease, culling, milk yield, and reproduction are many. Dystocia generally increases the risk of retained placenta, metritis, culling, death, milk fever, and cystic ovaries. Cows that have had dystocia have longer calving intervals and produce less milk during the first month of lactation. Cows that require surgical delivery of a dead claf at parturition generally experience a 5 to 9% loss in milk yield.

Twinning

Twinning occurs about 3% of the time in dairy cattle (Table 2). Factors that alter the rate of twinning include breed, season, cow family, age, and inbreeding. Twinning increases with age of the cow, during fall and spring months, and in certain cow families, where daughters of twinning cows will produce more twins themselves than daughters of cows that never twinned.

Cows that bear twins have increased risk for stillbirth, retained placenta, metritis, displaced dystocia, abomasum, culling, aciduria and ketonuria. Subsequent reproductive performance is impaired as calving intervals are prolonged and milk yield is decreased slightly after birth of twins.

Table 2. Incidence of common periparturient disorders summarized from the literature

Disorder	Unweighted mean, %	Range	No. calvings	No. herds	No. references
Dystocia	5.8	0.9-13.7	40,828	218	8
Twinning	3.3	1.6-5.8	56,470	2,265	6
Stillbirth	4.1	1.4-6.3	45,835	2,264	4
Retained placenta	9.4	2.0-17.8	>55,000	>225	11
Cystic ovaries	12.3	3.0-29.4	>20,00	>196	9
Anovulation[1]	5.5	2.3-22.5	15,918	130	11
Reproductive tract infections[2]	17.4	8.5-24.2	13,271	137	3
Metritis	21.3	10.7-36.4	>15,167	>60	5
Milk fever	5.9	1.4-10.8	40,568	161	6
Ketosis	5.4	3.5-7.4	4,249	63	2
Displaced abomasum	1.4	1.2-1.7	15,808	103	4
Mastitis	6.9	2.3-16.8	28,730	123	4
Abnormal health status[3]	36.9	19.9-81.6	2,933	17	7

[1]Delayed intervals to first postpartum ovulation longer than 4 wk postpartum.

[2]Variously combined specifically diagnosed infections of the reproductive tract.

[3]Includes cows with one or more disorders listed above.

Stillbirth

Occurrence of stillbirth is about 4% (Table 2). Stillbirth generally refers to birth of a dead fetus; however, a broader definition is often used to include calves found dead at calving (some of which may not have been truly stillborn). The highest risk for stillbirth is in heifers and young cows and may result from an oversized fetus, overly fat dam, and increased incidence of twinning.

Cows with stillbirths have increased risk for a prolapsed uterus, retained placenta, metritis, aciduria, and displaced abomasum. No evidence has been found for direct relationships between stillbirth and milk yield or reproductive performance.

Retained Placenta

Incidence of retained placenta is about 9% (Table 2). Retention of the placenta or fetal membranes for 8 to 12 hr and up to 24 hr in some studies is the definition generally used for retained placenta. Causes of retained placenta include deficiency of selenium, vitamin E, vitamin A, ß-carotene, and protein during the late dry period. Increased placental retention occurs as cows age and at calvings during warm seasons and periods of extreme heat stress. Occurrence of induced parturition, twinning, milk fever, ketosis, dystocia in heifers, and increased calving difficulty in all cows are associated with increased risk for retained placentas.

Retained placentae often lead to serious infections of the reproductive tract and increased risk for ketosis, displaced abomasum, culling and death. Milk yield following placental retention is slightly reduced in some cases, as well as reproductive performance. Calving intervals are prolonged and pregnancy rates are decreased. Much of these effects on reproduction are indirectly manifested through the increased rate of reproductive tract infections that follow placental retention.

Cystic Ovaries

Occurrence of cystic ovaries is about 12% (Table 2). This would include both types of cysts that predominate in dairy cows, the thin-walled or follicular cyst and the thick-walled or luteal cyst. Peak occurrence is between 31 and 60 days after calving, in which 47% of the diagnoses are made. Cysts are likely to occur in cows having a previous history for cysts. Although cystic ovarian disease has a low heritability in dairy cattle, its incidence has been reduced in Sweden by selecting against its occurrence in bull studs.

Incidence of cystic ovaries is increased with age, in winter months, during periods of high nutrient intake (early lactation), and especially when cows have a uterine infection. High milk yield does not cause cystic ovaries, which are more likely caused by an endocrine imbalance. Possible endocrine causes include the lack of LH and specific ovarian follicular receptors for LH and FSH, which bind the gonadotropins to growing follicles in preparation for final follicular maturation and ovulation.

Occurrence of cysts in cows increases the risk for culling and reduces reproductive performance by prolonging calving intervals and reducing conception rates. Milk yield appears to be higher in cystic cows compared with noncystic cows. However, when yield is adjusted for the length of the calving interval, a 2.5% loss in milk yield is observed. The increased yield is a result of prolonged lactation length in the absence of the negative effect of pregnancy on milk production.

Anovulation

Anovulation (prolonged intervals to first ovulation and estrus) occurs in about 5 to 6% of dairy cows (Table 2). Since most dairy cows first ovulate between 2 and 4 weeks after calving, any delay beyond 4 weeks is defined as delayed ovulation or anovulation. Anovulation declines in its incidence with increasing age. It is generally associated with poor general health of the cow, fatty liver, ketosis, uterine infections, and delayed uterine involution. Cows with the most negative energy balance (inadequate feed intake and large loss in body weight) and those prone to various metabolic diseases because of poor body condition are at risk for anovulation. Reproductive performance is impaired because cows are slow to begin estrous cycles, and, thus, have delayed conception and prolonged calving intervals. There is no reported effect of anovulation on milk yield.

Reproductive Tract Infections and Metritis

Incidence of infections of the reproductive tract is about 17% and where metritis was specifically diagnosed, it occurred in about 21% of cows after calving (Table 2). These types of infections affect the vagina, cervix and uterus and could be diagnosed at any time after calving. Reproductive tract infections, and specifically metritis, increase as cows get older and tend to occur most often after summer and early fall calvings.

Several health problems increase the risk for uterine infections including milk fever, retained placenta, displaced abomasum, ketonuria, and aciduria. In addition, overly fat cows, twinning, stillbirth, prolonged gestations, induced parturition, and dystocia generally increase metritis.

Milk yield losses of 2 to 5% are reported for cows with reproductive tract infections. Reproductive performance is adversely altered because calving intervals are prolonged, fertility is reduced, and anovulation becomes more common (in cows with metritis). Reproductive tract infections and metritis increase the risk for displaced abomasum, ketonuria, and aciduria in cows that also have a retained placenta.

Milk Fever

Incidence of milk fever or parturient paresis is about 6% (Table 2). Occurrence of milk fever increases when high-calcium feeds are offered during the dry period. Older cows and all cows with high milk production are at greater risk for milk fever. In some cases, increased risk of milk fever is associated with metritis and retained placenta. Prevention of milk fever by feeding low calcium-containing feeds during the dry period is essential. Some studies suggest that feeding high protein early in the dry period, lower levels of phosphorus than calcium in the dry period, and lead feeding in the late dry period will prevent milk fever.

Milk fever generally increases the risk for dystocia, retained placenta, ketosis, and mastitis, and tends to increase calving intervals and slightly reduce milk yield (-.5%).

Ketosis

Reported incidence of diagnosed ketosis in dairy cows is about 5% (Table 2). Ketosis can occur as uncomplicated cases caused by feeding diets high in energy (glucogenic) or by underfeeding (marked negative energy balance). Ketosis also occurs as complicated cases where ketosis and one or more other diseases are diagnosed in combination. Cows with a previous history of ketosis or those having milk fever, displaced abomasum, or retained placenta are at increased risk for ketosis. Overfeeding and long dry periods of excess feeding that lead to overly fat cows increase cases of ketosis at and after calving. Although older cows have greater risk for ketosis, most studies conclude that high milk production is not a cause of ketosis.

A strong relationship exists between displaced abomasum and ketosis. It is difficult to determine which factor leads to the other. In addition, of those cows in one study with ketonuria (ketosis), 82% had at least one other concurrent problem, most of which was metritis, displaced abomasum, and retained placenta. Whereas conception rates may be reduced in ketotic cows, there is no evidence for a direct effect of ketosis on milk yield.

Displaced Abomasum

Displaced abomasum occurs in about 1.4% of dairy cows around calving (Table 2). About 26% of the time, it is diagnosed during the first 7 days after calving, with 63% and 82% of the diagnoses made by the end of the second and third weeks, respectively. Cows become more susceptible to displaced abomasum with increasing age, particularly if it occurred previously in earlier lactations. Except for high milk yield, many factors increase the risk for displaced abomasum including uncomplicated ketosis, twinning, stillbirth, retained placenta, metritis, aciduria, and ketonuria.

Milk yield in cows with abomasal retention is reduced by 1.4 to 9.8%. Limited research indicates that cows with a displaced abomasum have more risk for metritis, ketosis, and possibly reduced fertility as a result of various complications associated with abomasal displacement.

Mastitis

Occurrence of periparturient mastitis is about 7% (Table 2). About 45% of the cases of mastitis occur during the first 15 days after calving. Older cows are at increased risk for mastitis. However, of those cases diagnosed within 48 hr postpartum, first and second lactation cows were infected 1.4% of the time, whereas third or greater lactation cows were infected 3.4% of the time. Limited studies suggest that cows with ketosis and milk fever may be more suscepible to mastistis than healthy cows. High milk yield or the potential for high yield does not appear to increase the risk for mastitis. However, few data are available and are limited to clinical cases in which cows were either treated locally or systemically for mastitis. Subclinical cases, indicated by a possible intramammary infection or elevated somatic cell counts in milk, have not been well studied to determine the potential predisposing effect of high milk yield.

There is no evidence to suggest that mastitis directly influences reproductive performance. Indirect effects are possible since cows with mastitis may have other associated problems, which when variously combined, may decrease health and reproductive performance. Cows with subclinical mastitis have decreased milk yield; however, more research needs to be done during the periparturient period to explain the interrelationships between mastitis, milk yield, and other diseases or disorders.

Abnormal Health Status

Many studies have examined the effects of variously combined health and disease factors (abnormal health status) that potentially interact with milk yield and reproductive performance. In those studies, many of the previous diseases or disorders cited above were considered. In total, the average incidence of cows with abnormal health is about 37%. This means over one-third of all cows suffer from at least one or more health problems during the periparturient period.

Any type of health problem increases the risk for culling or death by 2 to 5X. Cows in their first lactation are at greater risk to be culled than older cows. Milk yield in abnormal cows with poorer health is less (up to 3% less in a 305-day lactation), as well as having less fat during the first 50 days.

Reproductive performance of abnormal cows is reduced markedly. Table 3 illustrates the reproductive performance in one large herd in which cows with and without previous reproductive disorders were contrasted. Every reproductive trait was reduced, resulting in 21% of the abnormal cows never conceiving compared to only 6% of the normal cows. For cows conceiving, calving intervals were 24 days longer in abnormal than normal cows.

Table 3. Health status and reproductive performance in a large dairy herd

Trait	Normal	Abnormal[1]
No. cows	695	306
Calving to first estrus, days	59	62*
Calving to first service, days	64	66
Conception at first service, %	45	29*
Calving interval, days	373	397*
Services per conception	2.0	2.6*
Pregnancy rate, %	94	79*

Source: Stevenson and Call, unpublished data.

[1]Cows were classified abnormal if one or more of the following were diagnosed: retained placenta, cystic ovaries, prolonged anestrus, twinning or uterine infection based on palpation or the presence of a purulent discharge at anytime, including breeding.

*P<.05.

Conclusions

A summary of the effects of various periparturient disorders on reproductive performance and milk yield of the concurrent lactation is shown in Table 4. All reproductive and metabolic disorders examined either directly or indirectly decrease reproductive efficiency, except mastitis. Milk yield was only impaired significantly in cows that required surgical assistance at calving. However, there are marginal losses of milk yield as a consequence of retained placenta, metritis, or reproductive tract infections, or general, abnormal health status. Of the metabolic disorders, only displaced abomasum significantly reduced milk yield.

Most disorders occur as part of a complex, rather than appearing as a single abnormality. Cows with one disorder are at increased risk for other disorders, including many metabolic or reproductive ones. It also appears evident that actual milk yield or potential for high milk production does not predispose cows to increased risk for any disorder examined, except milk fever. This is encouraging, because milk fever may be the disorder that is most readily prevented by good dry cow management.

All research suggests that preventive measures that limit the incidence of one disorder may decrease directly or indirectly the risk and incidence of other interrrelated problems. More research is needed to better understand the cause of these disorders, thus, allowing better designed preventive herd health measures to be adopted on the farm to improve the general health and overall productivity of dairy cattle.

Table 4. Suggested implications of various disorders on reproduction and milk yield during the lactation in which the disorder was detected

Disorder	Reproduction	Concurrent milk yield[1]
Dystocia [2]	Indirect decrease	First 30 d decrease
Twinning[2]	Decrease	Slight decrease
Stillbirth[2]	Indirect decrease	Unknown
Retained placenta	Indirect decrease	Possible -.4%
Cystic ovaries	Decrease	Possible -2.4%
Anovulation	Indirect decrease	No effect
Reproductive tract infections	Decrease	Possible -2 to 5%
Metritis	Decrease	Possible -3 to 5%
Milk fever	Indirect decrease	Possible -.5%
Ketosis	Indirect decrease	No effect?
Displaced abomasum	Indirect decrease	-1.4 to -9.8%
Mastitis	Unknown	No effect?
Abnormal health status	Decrease	Possible -3%

Source: Summarized from the literature.

[1]Magnitude of decrease is shown if at least one study identified such a possibility.

[2]Surgical delivery associated with stillbirth decreased milk yield by 5 to 9%.

KSU

FEEDING AND MANAGING EARLY LACTATION COWS

J.R. Dunham

Summary

Feeding and managing dairy cows during the prepartum and early lactation periods have more effect on total lactation yields than all other factors. It is during this time that the pattern of milk production is established for the entire lactation. The full production potential of high producing cows cannot be realized unless these periods are given special consideration.

Introduction

The profitability of a dairy cow is closely related to the level of milk production during the first 120 days of lactation. The next 120 days is usually a break-even period, and the last 65 days of lactation will usually pay for feed costs. Therefore, the goal for a profitable dairy should be to establish feeding and management programs that will allow dairy cows to reach their full production potential during early lactation.

Summit Milk Yield

Summit Milk Yield (SMY) is an estimate of the peak of the lactation curve, which is made by the DHI program. SMY is important, since the total lactation yield is affected by its magnitude. In fact, total lactation yield increases approximately 300 lb for each 1 lb increase in SMY. Any practice that will increase SMY will have a long-term effect.

The Stage of Lactation Profile (SOLP), which is reported on the DHIA Herd Summary, indicates that cows decline in production level at a rather constant rate of about 0.1 lb/day, regardless of the SMY level. Therefore, high production in late lactation cannot be expected, unless production was high early in lactation. Figure 1 shows the relation between SMY, SOLP, and Rolling Herd Average (RHA).

A comparison of the average SMY of heifers, other cows, and all cows as shown on the DHIA Herd Summary in Table 1 illustrates the importance of feeding and management programs to SMY. In high-producing herds, the SMY, as would be expected, is higher than in low-producing herds. In addition, the difference between average SMY of heifers and cows in high-producing herds is greater. This suggests that high-producing herds are fed and managed in a manner that will allow cows to express their potential. Or, in low-producing herds, production of cows is similar to that of heifers because of nutritional limitations. Hence, feeding and management programs of early lacation cows are of critical importance.

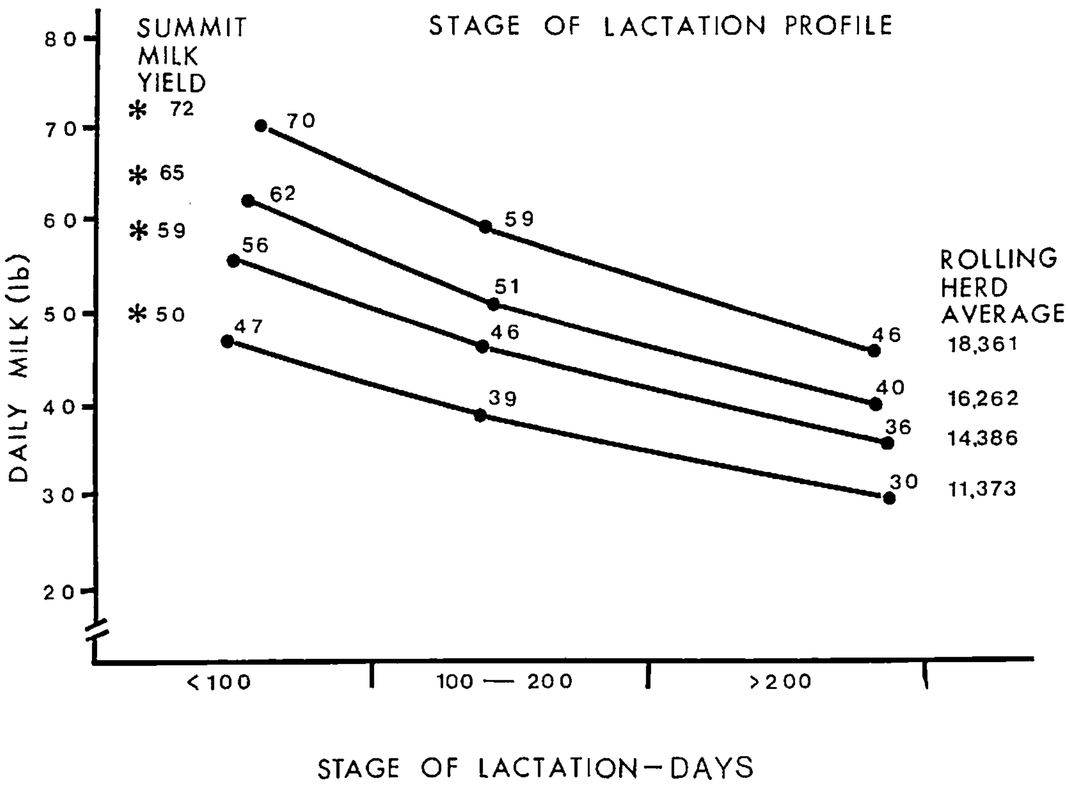


Figure 1. Comparison of Summit Milk Yield, Stage of Lactation Profile, and Rolling Herd Average.

Table 1. Comparison of Summit Milk Yield of first lacatation heifers, other cows, and all cows with Rolling Herd Average (RHA)

RHA	Summit Milk Yield: First	Others	All	Difference Others - First
		- lb -		
11405	41.4	53.6	49.8	+ 12.2
14609	50.8	66.3	60.6	+ 15.5
16160	53.9	71.5	65.5	+ 17.6
17610	57.6	76.7	70.0	+ 19.1
19744	63.6	84.6	77.2	+ 21.0

Dry Period

The dry period should be considered when reviewing feeding and management programs for early lactation cows, since it will affect the next lactation. Cows should be dry for 45 to 60 days. There is no advantage in cows being dry longer than 60 days, but dry periods of less than 45 days in length will lower production in the next lactation.

Special attention should be given to first lactation heifers. Many heifers will be milking almost as well at dry-off time as they were in early lactation, and most will be milking better than the older cows (Figure 2). Therefore, it is always tempting to milk the heifers a little longer at the end of lactation. If these heifers are not given a long enough dry period to gain body condition, then the performance in the second lacation may be disappointing.

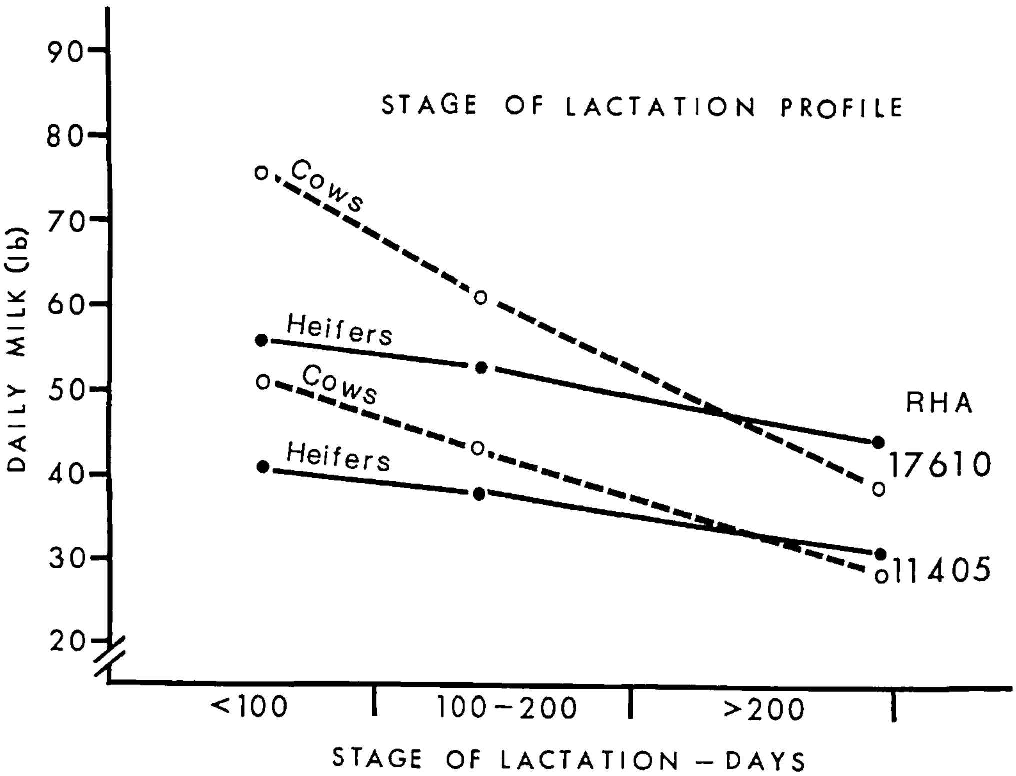


Figure 2. Comparison of Stage of Lactation Profile of cows and heifers.

Cows should go dry in good body condition. A body condition score of four on a scale of one to five would be ideal. Cows in this condition will have a covering of fat over the entire body but not to the extent of being patchy around the hips and pins. It is a good management practice to separate thin dry cows from those that are in good condition and feed according to body condition.

Care should be taken to avoid over-conditioning dry cows, since many postpartum problems are associated with fat cows. For this reason, corn silage is not recommended for dry cows because of its higher than required energy content. Also, alfalfa should be fed only in limited amounts to avoid milk fever.

A good dry cow feeding program should be based on a grass-type forage with enough grain, protein, and mineral supplement to meet nutritional requirements (Table 2).

Table 2. Nutrient requirements of dry cows

Nutrient	First 6 weeks Body Condition 4	Thin	Last 2 weeks
Protein, % D.M.	11	11	12
NE_L, Mcal/lb D.M.	0.50	0.65	0.65
ADF, %	27	24	24
NDF, %	35	32	32
Calcium, %	0.45	0.45	0.45
Phosphorus, %	0.35	0.35	0.35
Trace Salt, %	0.25	0.25	0.25
Vitamin A, U/lb D.M.	1500	1500	1500
Vitamin D, U/lb D.M.	750	750	750
Vitamin E, U/lb D.M.	7	7	7

The 2 to 3-week prepartum period is a critical time for adjusting cows to the lactating cows' ration so that they will readily consume large amounts of dry matter after calving. The rumen microbes need this time to adjust to the types of forages fed and to high energy rations. This is particularly necessary if ensiled forages are to be fed. Adaptation to high energy rations should be made by increasing grain consumption up to 1% of body weight.

Cows and heifers in the prepartum period should be observed closely for indications of mastitis. Those individuals showing enlarged quarters should be milked before calving, and a treatment program should be initiated. In addition, springers showing excessive udder edema should be milked on a regular basis before calving. Prepartum milking will reduce intramammary pressure and will alleviate the accumulation of fluids in the mammary tissues. A good supply of colostrum should be on hand for the calves of cows and heifers that have been milked prepartum.

Early Lactation Feeding

The goal of early lactation feeding is to maximize dry matter intake as soon as possible after calving. As indicated in Table 3, early lactation cows are quite responsive to increased dry matter intake, which is important in improving SMY.

Table 3. Expected milk response to each additional pound of dry matter intake

Production (lb/day)	Days Postpartum 42	98	154	210	266
			- lb milk -		
40	1.7	1.7	1.6	1.4	1.0
60	2.2	1.9	1.7	1.5	1.3
80	2.2	2.0	1.8	1.5	1.4
100	2.4	2.2	1.8	1.6	1.4

Early lactation cows should be challenged soon after calving with additonal grain to meet their requirements for milk production. Limiting grain consumption at this time will restrict the SMY and thus total lactation yield. Table 4 lists the diet specifications for early lactation cows. Using computerized feeders to measure grain consumption, researchers have shown that cows will increase grain consumption gradually after calving, if given the opportunity. If grain consumption is limited for 2 weeks or more following calving, digestive upsets may occur when additional grain is fed.

Table 4. Specifications for total ration dry matter for early lactation cows

Item	Amount
D.M./body cwt.	3.7 lb
Forage D.M./body cwt.	1.5 lb
NE_L	0.72 Mcal/lb
Protein	18%
Crude Fiber	12%
Acid Detergent Fiber	15%
Neutral Detergent Fiber	28%
Calcium	0.7%
Phosphorus	0.45%
Buffer	0.75%
Trace Mineral Salt	0.25%
Vitamin A	1500 U/lb
Vitamin D	750 U/lb
Vitamin E	7 U/lb

Managing the feeding program of early lactation cows is important in maintaining cows on high energy rations. Buffer should be fed to prevent acidosis and to keep cows on feed. Sodium bicarbonate or an equivalent amount of buffer should be included at the rate of 1.5% of the grain mix.

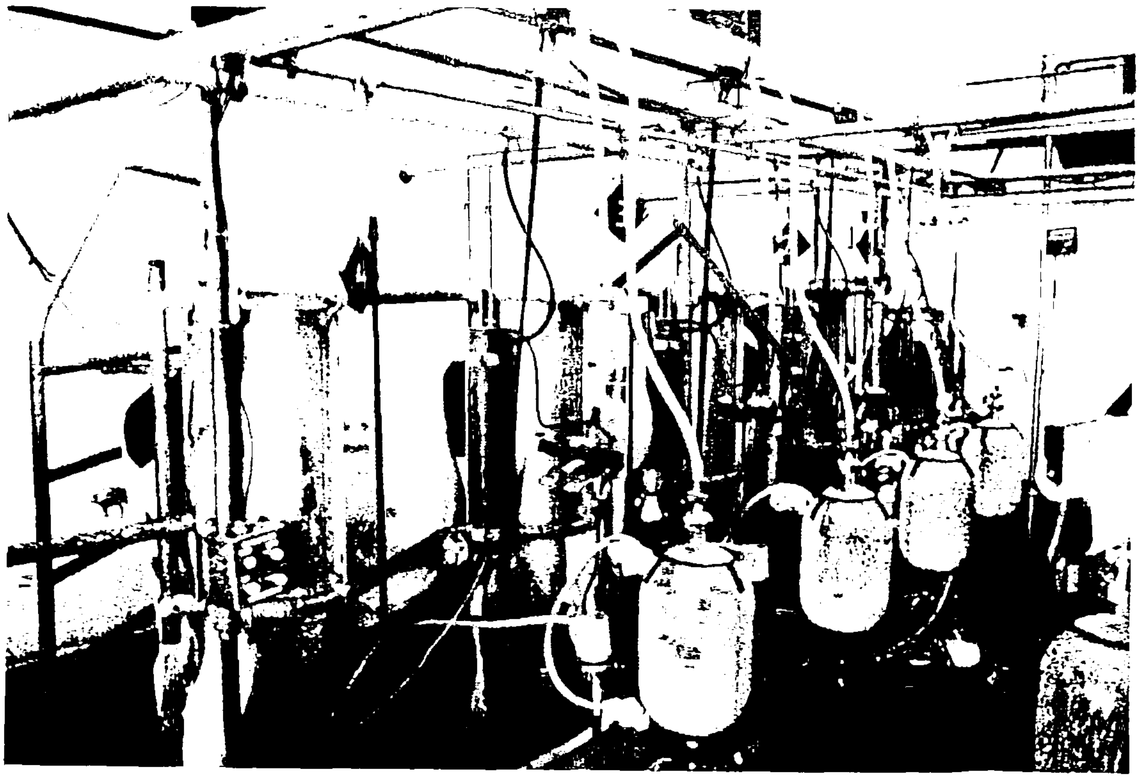
Maintaining adequate length of fiber is also necessary for keeping cows on feed and for maintaining milkfat tests. Chopping forages less than 3/8 inch in length can lead to digestive disturbances, since finely chopped forages will not act as fiber in the rumen.

Early lactation cows will respond to feeding high levels of protein. Since most fresh cows have more ability to milk than eat, body weight is normally lost during early lactation. This loss of body weight is a source of energy for milk production, provided enough protein is fed. Table 5 indicates the production response expected after increasing the protein percentage in the total ration dry matter.

Table 5. Increase in milk production from changing protein percentage

Protein before supplementation	Protein after supplementation 14%	16%	18%	19%
	- lb -			
12%	5.9	9.0	10.6	11.0
14%		3.1	4.6	5.1
16%			1.5	2.0
18%				0.4

Other management practices can affect feed intake. Feeding more than twice daily will provide fresher feed, which will be more readily consumed. Separating first-lactation heifers from cows will reduce competition and allow heifers to consume more feed. Providing fresh water within close walking distance will also increase feed intake. Using tanks for watering in addition to automatic waterers during hot weather may improve feed intake.



EFFECT OF PRODUCTION ON REPRODUCTION

E.P. Call

Summary

The genetic antagonsim that exists between production and reproduction is overcome by sound management practices. Kansas Holstein herds were ranked by quartile and analyzed by comparing various reproductive traits. Higher producing herds suffered less reproductive loss based upon the factors considered. The most significant differences concerned the average days dry, average days open on cows not yet serviced, percent of cows open more than 120 days since fresh, and average age at first calving. An adequate record system will identify potential reproductive problems, and a sound Preventive Herd Health Program (PHHP) will minimize actual losses from disease and cows not yet bred. All herds, regardless of production level, would benefit by calving heifers at 24 mo.

Introduction

While dairy producers have long suspected that higher producing cows have more reproductive problems, it was not until 1982 that Iowa State researchers showed a genetic antagonism between production and reproductive characteristics. However, research at the same institution demonstrated that the negative effect could be overcome by sound management. Factors that contribute to reproductive losses include: (1) days to first breeding, (2) days dry, (3) age at first calving, (4) services per conception, (5) calving interval, (6) percent of cows not serviced by 120 days, (7) average days open for cows not serviced, and (8) disease and nutritional entities. A sound Preventive Herd Health Program (PHHP) and adequate records have been shown to be essential in minimizing reproductive losses.

Procedures

Holstein herds participating in the Kansas Dairy Herd Improvement Program (DHIA) were ranked by quartile and summarized for various reproductive parameters. These herds had rolling herd averages (RHA) as of February, 1987 and reported reproductive information. Reproductive losses were calculated based upon the following measurements as described in DyS 87-6, Focus on Dairy: Repro-losses. Extension Dairy Science, Kansas State University, 1987: (1) calving interval, (2), days dry, (3) services per conception, and (4) age at first calving.

While percent of cows not serviced by 120 days and average days open for cows not yet serviced also contribute to reproductive losses in elongated calving intervals, no measure could be applied to estimate the economic loss from these factors.

Results and Discussion

The data are summarized in Table 1. Ranking dairy herds by RHA is based upon the long-accepted fact that higher producing cows convert feed into milk more efficiently and, therefore, are more profitable. RHA is also an effective way to rank herds to demonstrate the effect of production on reproduction but does not identify specific or individual cow problems.

Surprisingly, reproductive losses per cow declined as RHA increased, with the low quartile experiencing $152 yearly loss per cow, whereas the high group averaged $109. There were no differences among groups for calving interval, days to first service, and services per conception. Main effects were average days dry and age of first-calf heifers. The obvious differences among the groups, which was not included in the economic analysis, were the average days open for cows not bred (124 to 77) and the percent of cows open more than 120 days (32 to 14).

Table 1. Average reproductive characteristics of 582 Kansas Holstein herds with 42,365 cows grouped by level of rolling herd average (RHA). February, 1987

Rolling herd avg -milk- (lb)	Min. calving interval (days)	Calving to first service (days)	Open cows (%)	Open cows (days)	Open cows (%>120 days)	Services/ conception	Dry period (days)	Reprod. losses/ cow ($)
12,015	403	85	37	124	32	1.8	73	152
14,679	403	81	31	100	27	2.0	67	140
16,524	405	81	28	84	19	2.0	63	124
18,686	405	80	27	77	14	2.1	60	109

CONCENTRATIONS OF PROGESTERONE AND CONCEPTION RATES IN HOLSTEIN HEIFERS AFTER hCG ADMINISTRATION DURING THE FIRST 3 WEEKS AFTER ESTRUS

R.E. Stewart, M.O. Mee, and J.S. Stevenson

Summary

We conducted two experiments to determine the effects of administering human chorionic gonadotropin (hCG) on day 4 or on days 15, 16, and 17 after estrus on conception rates and progesterone secretion by the corpus luteum in Holstein heifers. In the first experiment, 60 heifers received hCG or saline on day 4 after estrus and AI. Conception rates were similar between groups. Concentrations of progesterone were increased in treated pregnant and nonpregnant heifers 7 and 14 days after treatment compared with pregnant and nonpregnant controls.

In the second experiment, 62 heifers received hCG or saline on days 15, 16, and 17 after estrus and AI. Conception rates again were similar between groups. Concentrations of progesterone were higher in treated pregnant heifers on days 16, 17, and 21 after estrus and in treated nonpregnant heifers on days 17 and 21 compared with pregnant and nonpregnant controls. We conclude that stimulation of the newly formed or mature corpus luteum by hCG increased production of progesterone without affecting conception rates.

Introduction

Human chorionic gonadotropin (hCG) is luteotrophic (sustains the function of the corpus luteum) in cows and increases progesterone synthesis by corpora lutea. Since some studies have shown that concentration of progesterone after estrus and AI tend to be higher in cows that remain pregnant than in those that keep cycling, stimulation of the corpus luteum with hCG should have a beneficial effect on conception rates. Early administration of hCG (3 days after estrus and AI) in one study increased progesterone without affecting conception rates. Other experiments involving the administration of hCG 15 days after estrus have reported increased progesterone, prolonged cycle duration and increased pregnancy rate in a low-fertility herd, but decreased pregnancy rate in a high-fertility herd. The objectives of our study were: (1) to determine if production of progesterone from a developing or mature corpus luteum is altered by administering hCG to bred heifers, (2) to determine if increased progesterone in bred heifers influences conception, and (3) to ascertain if production of progesterone from a corpus luteum is affected by the stage of luteal development and(or) the presence of an embryo.

Procedures

Estrous cycles of 122 heifers in two experiments were synchronized using a two injection PGF_2-alpha scheme. In Exp. 1, 60 heifers received 5,000 IU hCG im (n=31) or 5 ml saline (control; n=29) once on day 4 after estrus (day 0) in November 1984 (n=17), March 1985 (n=17), April 1985 (n=11), or January 1986 (n=15). Blood collected prior to hCG or saline administration on day 4 and 7, 14, and 21 days later was analyzed for progesterone.

In Exp. 2, 62 heifers received 1,000 IU hCG im (n=33) or 1 ml saline (control; n=29) once daily on days 15, 16, and 17 after estrus in February (n=10), April (n=19), July (n=14), or August (n=19), 1986. Blood was collected prior to hCG and 1, 2, and 6 days after the first of three hCG treatments.

Results and Discussion

Exp. 1. Conception rates are summarized in Table 1. Conception of treated heifers (55%) tended (P=.16) to be lower than that of controls (72%). Concentrations of progesterone in treated and control pregnant heifers were similar in blood samples collected before treatment on day 4 after estrus. However, treated pregnant heifers had higher (P<.01) progesterone than pregnant controls 7 days (6.3 $\pm$ .5 vs 2.6 $\pm$ .4 ng/ml) and 14 days (6.2 $\pm$ .5 vs 5.1 $\pm$ .4 ng/ml; P<.10) after treatment. Concentrations of progesterone in serum were similar in both groups 21 days after treatment. Nonpregnant treated and control heifers also had similar concentrations of progesterone prior to treatment on day 4. Progesterone in treated nonpregnant heifers was higher (P<.01) than in nonpregnant controls 7 days (7.0 $\pm$ .5 vs 3.8 $\pm$ .6 ng/ml) and 14 days (6.2 $\pm$ .5 vs 3.7 $\pm$ .6 ng/ml) after treatment. Progesterone concentrations were similar between treated pregnant and nonpregnant heifers on the day of treatment and 7 and 14 days later. By 21 days after treatment with hCG, pregnant heifers had higher (P<.001) progesterone than nonpregnant heifers (5.7 $\pm$ .5 vs 1.6 $\pm$ .5 ng/ml) because of maintenance of pregnancy.

Table 1. Conception rates of heifers treated with hCG or saline 4 days postestrus

	Conception rate (%)		
Trial	hCG	Saline	Trial total
November 1984	5/9 (56)	8/8 (100)	13/17 (77)
March 1985	3/8 (38)	7/9 (78)	10/17 (59)
April 1985	5/6 (83)	4/5 (80)	9/11 (82)
January 1986	4/8 (50)	2/7 (29)	6/15 (40)
Treatment total	17/31 (55)*	21/29 (72)	38/60 (63)

*Tended to be less than saline-treated heifers (P=.16).

Exp. 2. Table 2 summarizes the conception rates in this study. Conception rates were similar between hCG-treated heifers (67%) and controls (59%). Concentrations of progesterone were similar between pregnant treated and control heifers before first day of treatment (day 15 after estrus). On the second and third days of treatment (days 16 and 17), progesterone was higher ($P<.05$) in treated pregnant heifers than in pregnant controls (4.5 ± .2 vs 3.7 ± .3 ng/ml and 5.4 ± .2 vs 3.8 ± .3 ng/ml). On day 21 (4 days after the end of treatment), treated pregnant heifers still had higher ($P<.01$) progesterone than pregnant controls (6.1 ± .2 vs 3.7 ± .3 ng/ml). Concentrations of progesterone were similar in nonpregnant treated and control heifers prior to initiation of treatment on day 15 and on the second day of treatment (day 16). On days 17 and 21, concentrations of progesterone were higher ($P<.01$) in treated nonpregnant heifers than in nonpregnant controls (5.5 ± .3 vs 3.4 ± .3 ng/ml and 3.8 ± .3 vs 1.3 ± .3 ng/ml). Treatment with hCG also apparently delayed luteolysis in nonpregnant heifers. Treated pregnant and nonpregnant heifers had similar concentrations of progesterone on each day of treatment, but on day 21 (4 days after the end of treatment) pregnant heifers had higher ($P<.001$) progesterone than nonpregnant heifers (6.1 ± .2 vs 3.8 ± .3 ng/ml) because of maintenance of pregnancy.

One-time stimulation of the newly formed (day 4) corpus luteum by hCG (5,000 IU) increased production of progesterone but did not appear to affect conception. Repeated daily stimulation of the mature corpus luteum by hCG (1,000 IU on days 15, 16, and 17) prior to luteolysis increased concentrations of progesterone (and delayed luteolysis) without affecting conception rates of heifers.

Table 1. Conception rates of heifers treated with hCG or saline 15, 16, and 17 days postestrus

Trial	Conception rate (%)		
	hCG	Saline	Trial total
February 1986	4/6 (67)	1/4 (25)	5/10 (50)
April 1986	8/10 (80)	6/9 (67)	14/19 (74)
July 1986	3/7 (43)	5/7 (71)	8/14 (57)
August 1986	7/10 (70)	5/9 (56)	12/19 (63)
Treatment total	**22/33 (67)**	**17/29 (50)**	**39/62 (63)**

GONADOTROPIN-RELEASING HORMONE IMPROVES CONCEPTION RATES OF REPEAT-BREEDERS WITH PREVIOUS REPRODUCTIVE DISORDERS

J.S. Stevenson and E.P. Call

Summary

An experiment examining the benefit of treating repeat-breeders with 100 µg GnRH (Cystorelin®) at the time of third or fourth insemination was conducted in 513 dairy cows of which 93 (abnormal cows) had been diagnosed previously (during the 60 to 90 days postpartum) as having reproductive disorders, including retained placenta, uterine infections, prolonged anestrus, and cystic ovaries. Treatment with GnRH improved conception in normal and abnormal repeat-breeding cows by 13 percentage points or 42%.

Introduction

Three types of cows contribute greatly to long calving intervals in dairy herds. These include: (1) cows that do not show estrus or are not observed in heat until 2-3 months after freshening, (2) cows that are found nonpregnant at pregnancy checks, and (3) repeat-breeding cows. Successful treatments for the first two problems were addressed previously in our research at Kansas State University (see pp 66-70, 1986 Dairy Day, KAES Rep. Prog. 506).

Use of GnRH (Cystorelin®) at the time of insemination has increased conception rates of repeat-breeders in our previous work at KSU (see pp 26-27, 1984 Dairy Day, KAES Rep. Prog. 460). However, the mechanism of GnRH's action in the cow is not well understood. Furthermore, the previous health status of cows given GnRH at repeat breedings has not been documented to determine if it is less healthy cows that respond to GnRH at insemination. The objective of our study was to determine if GnRH would improve conception rates in cows with previous reproductive disorders.

Procedures

From November 1985 to August 1986, cows (n=513) in one large commercial dairy herd with (n=93) or without (n=420) previous reproductive disorders were given 100 µg GnRH (i.m.) after insemination or were left untreated at third and fourth services. Previous reproductive problems included retained placentae (26% of abnormal cows or 4.7% of all cows), uterine infections (27% or 4.9%), cystic ovaries (31% or 5.6%), and prolonged anestrus (16% or 2.9%). As cows were diagnosed (during first 60 to 90 days after calving), various veterinary treatments were employed to resolve the reproductive problem. Cows were not assigned randomly to treatment, but were treated according to the discretion of the herdsman or of any of three inseminators. Treatment was based on the knowledge that GnRH might improve conception rates of repeat-breeders.

Results and Discussion

Our results are summarized in Table 1. Treatment with GnRH tended to improve (P=.13) conception rates from 12 to 25% in cows previously diagnosed with reproductive disorders (abnormal cows) and increased (P<.05) conception rates from 36 to 47% in normal cows. Overall, conception rates improved by 13 percentage points or 42% when GnRH was administered at the time of AI. The effect of health status on conception rates was dramatic but not surprising, since conception rates in normal cows (40%) were higher (P<.001) than those in abnormal cows (15%).

Table 1. Conception rates (%) of repeat-breeders given GnRH with (abnormal) or without (normal) prior reproductive disorders

Treatment	Normal	Abnormal	Total
GnRH	68/145 (47)	6/24 (25)	74/169 (44)[a]
Untreated	100/275 (36)	8/69 (12)	108/344 (31)
Total	168/420 (40)[b]	14/93 (15)	182/513 (35)

[a]Different from untreated cows (P<.05).

[b]Different from abnormal health status cows (P<.0001).

These results provide further evidence that GnRH is an effective treatment for repeat-breeding dairy cows. A summary and update of all work utilizing GnRH for treatment of repeat-breeders is found in this publication (pp 70-71). Although it is not yet clear how GnRH improves fertility, further work is underway to better understand the physiology of GnRH's action.

INFLUENCE OF PREBREEDING PROGESTERONE PLUS PROSTAGLANDIN F_2-ALPHA ON ESTRUS AND FERTILITY IN LACTATING DAIRY COWS

M.O. Mee, R.E. Stewart, J.S. Stevenson, and E.P. Call

Summary

Progesterone administered before breeding may increase estrous expression and subsequent fertility in lactating dairy cows. Holstein cows (n=302) were assigned randomly at calving to three groups. Cows received no treatment (controls), one injection of prostaglandin F_2-alpha (PGF), or progesterone plus one injection of PGF (PRID + PGF). The average interval to estrus was 5 days shorter in PRID + PGF cows compared to cows given only PGF. In addition, more cows were observed in estrus 2 to 5 days after treatment in the PRID + PGF group compared to the PGF group. Average days from calving to conception were reduced in PRID + PGF cows by 15 to 20 days compared to control and PGF cows. We concluded that prebeeding progesterone in combination with PGF appears to enhance fertility.

Introduction

Several studies have attempted to synchronize estrus to allow for convenient breeding of dairy cows at first service at approximately 60 days postpartum. Most of these studies have used prostaglandin F_2-alpha (PGF) and a few studies have incorporated progesterone plus PGF in estrous synchronization. A previous attempt at the KSU dairy to synchronize estrus failed to show any benefit of utilizing two injections of PGF given 11 days apart. Furthermore, there is little information on the effects of progesterone in estrous synchronization. It has been demonstrated that cows with increased progesterone levels in their blood during the estrous cycle before breeding have better conception rates than herdmates with lower progesterone levels prior to breeding. This suggests that progesterone may have a prebreeding role for increasing fertility. Therefore, the objectives of this study were: (1) to determine the feasibility of using one injection of PGF to regress the corpus luteum (CL) prior to first service and (2) to examine further the prebreeding role of progesterone prior to CL regression on estrous expression and subsequent fertility.

Procedures

This study utilized 302 lactating Holstein cows in the KSU dairy herd. Cows were assigned randomly at calving to three groups. Group 1 consisted of 112 control cows that were inseminated at the first observed estrus after 42 days postpartum. Group 2 consisted of 97 PGF cows given one injection of PGF (25 mg Lutalyse®) between 56 and 62 days postpartum. Group 3 consisted of 93 PRID + PGF cows. Cows in this group had a progesterone-releasing intravaginal device or PRID inserted into the vagina at approximately 54 days postpartum. A PRID is a silastic coil impregnated with 1.13 grams of crystalline progesterone. The PRIDs remained in place for 7 days with an injection of PGF (25 mg Lutalyse®) given 24 hr prior to PRID removal. Cows in Groups 2 and 3 were inseminated at the first observed estrus after Lutalyse®. This allowed for all treated cows to be inseminated for the first service around 60 days postpartum.

Blood was collected at 0, 24, and 48 hr after PGF injection and analyzed for concentrations of progesterone in serum. This enabled us to monitor the success of CL regression. Blood also was collected at the time of PRID insertion and removal.

Results and Discussion

As illustrated in Figure 1, more PRID + PGF cows were observed in heat 2 to 5 days after PGF injection, resulting in a more synchronous estrus compared to PGF cows. This result suggests that PRID + PGF synchronizes more heats than one injection of PGF. However, progesterone may be enhancing behavioral signs of heat. Missed heats and PGF failure may have contributed to the wide distribution of observed heats in the PGF group.

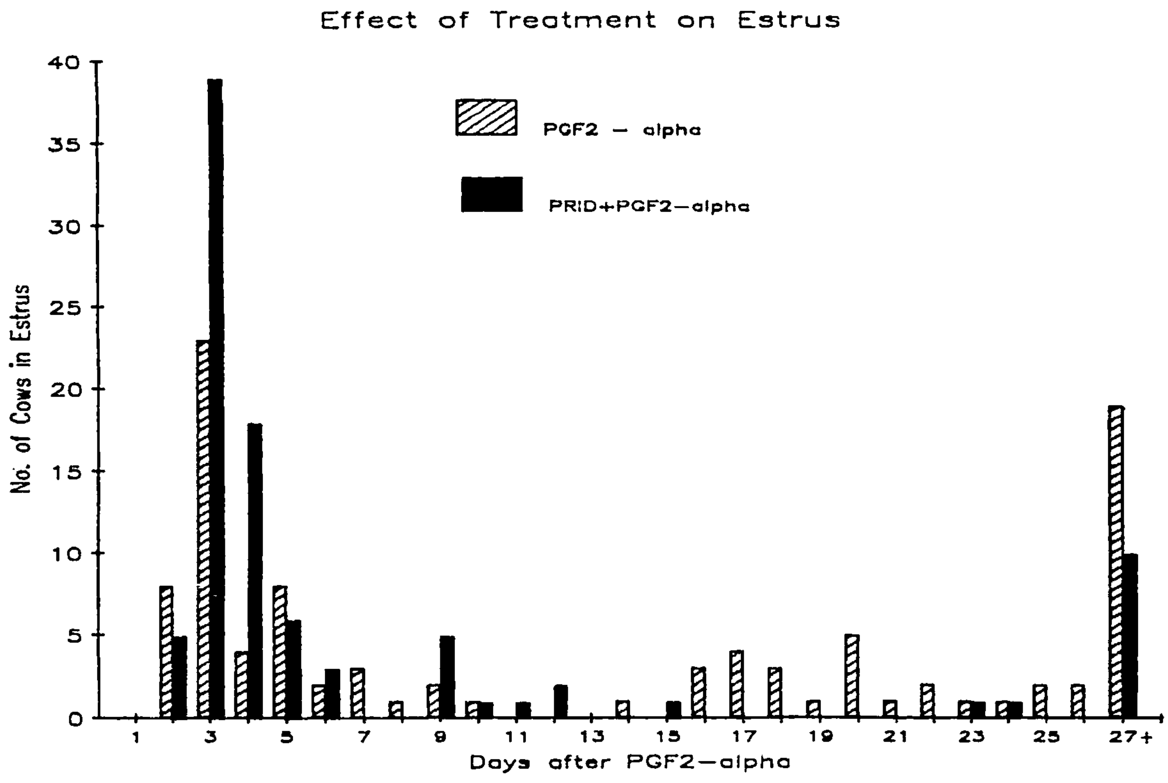


Figure 1. Distribution of heats after one injection of PGF or a 7-day progesterone-releasing intravaginal device (PRID) and PGF 1 day before PRID removal.

In addition, the average interval to estrus after PGF injection was reduced (P<.05) from 16 to 11 days in the PRID + PGF group compared to the PGF group.

Results of the reproductive traits examined are illustrated in Table 1. The average interval to first breeding was 10 days longer in the PGF group compared to controls. Conception rates were similar in all groups; however, in the PRID group, conception rates tended to be higher in those cows conceiving 2 to 5 days after treatment compared to those conceiving 6 or more days after PGF (53 vs 32%). The reasons for this finding are unknown, but it could be related to the stage of the estrous cycle when the PRIDs were inserted and/or the failure of CL regression after PGF administration. Interestingly, this effect was not observed in the PGF treatment group, since conception rates were similar 2 to 5 days and after 6 or more days (44 vs 46%).

The PRID + PGF group averaged 20 fewer days to conception than the PGF group and 15 days fewer than controls. In addition, fewer services per conception were required in the PRID + PGF group compared to the other groups. Fewer days between first service and conception were observed in the PRID + PGF group compared to the other groups.

Table 1. Reproductive measures of cows after treatment

Item	Control	PGF	PRID + PGF
No. cows	112	97	93
Interval to 1st service, d	65	75[a]	69
Conception rates at 1st service, %	38	45	47
2 to 5 d, %		44	53
≥ 6d, %		46	32
First service to conception, d	42	39[b]	23[a]
Days open	107	112[b]	92[a]
Services per conception	2.1	2.0	1.7[a]

[a]Different from control (P<.05).

[b]Different from PRID + PGF (P<.05).

The results of this study are preliminary, with further studies needed to investigate the role of progesterone. However, our data suggest that one injection of PGF results in reproductive performance similar to that of untreated controls and, therefore, provides no economical benefit. It appears that estrous synchronization and fertility can be enhanced by administering progesterone before breeding in combination with PGF.

FURTHER STUDIES UTILIZING HORMONES TO ALTER ESTROUS CYCLES AND FERTILITY

J.S. Stevenson, R.E. Stewart, and E.P. Call

Summary

In one large dairy herd, we examined the reproductive performance of 943 cows following early postpartum hormonal therapy utilizing gonadotropin-releasing hormone (GnRH or Cystorelin®) and prostaglandin F_2-alpha (PGF). None of our hormonal treatments improved reproductive efficiency in this herd, whereas earlier studies at the KSU Dairy Teaching and Research Center had proved beneficial. However, cows given PGF to induce estrus at the beginning of the breeding period had similar reproductive performance to control cows, suggesting a potential use for one injection of PGF to allow the breeding of more cows by a target date after calving (e.g., by 65 days).

Introduction

Several studies have reported that GnRH, given between 10 and 18 days after freshening, will: (1) help the uterus return to normal more rapidly, (2) shorten the interval to the cow's first ovulation after calving, (3) shorten the average interval to the first observed heat, and (4) reduce calving intervals. In addition, some reports suggested that PGF, when administered between 14 and 28 days after calving, will: (1) increase conception rates at first services and (2) shorten calving intervals (see pp 40-42 in the 1985 Dairy Day, KAES Rep. Prog. 484). The benefits of these hormonal treatments appear to be associated with estrous cycles. A direct effect on the reproductive tract is suggested, but the mechanism of therapeutic benefit is not well understood. The objective of this experiment was to reaffirm our earlier work using a large commercial herd and to determine if one injection of PGF given early in the breeding period could promote improved calving intervals compared to nontreated, control cows bred as they showed heat spontaneously.

Procedures

During the fall of 1985, 1,049 cows were assigned randomly as they calved between September 23 and December 17 to five experimental groups: (1) GnRH (100 µg or 2 cc Cystorelin®) injected (im) once between 11 and 25 days postpartum, (2) early PGF (25 mg or 5 cc Lutalyse®) injected (im) once between 11 and 25 days, (3) late PGF given once between 25 and 40 days, (4) breeding PGF given once between 48 and 59 days (beginning of the breeding period), and (5) no hormonal treatment. All cows were milked 3X daily for 4 min and 15 sec. Breeding began at the first observed heat after 40 days postpartum except for cows in the fourth experimental group (breeding PGF), in which inseminations were carried out after cows were given PGF and detected in heat. In the breeding PGF group, PGF was administered 6 days after breeding began in each breeding group.

Results and Discussion

Results of this study are summarized in Table 1. Only 943 of the 1,049 cows (90%) treated were inseminated at least once. Intervals from calving to first estrus and first service were unaffected by hormonal treatments. Most cows, on the average, were first inseminated by 75 days postpartum. Calving to conception intervals in controls averaged 100 days or projected to an acceptable 380-day calving interval. Cows given one injection of PGF to initiate the breeding period had calving to conception intervals of 105 days or 385-day calving intervals similar to control cows. In contrast, treatments with GnRH and PGF prolonged conception intervals by 11 to 21 days. We have not observed previously a detrimental effect of these treatments and cannot explain why this occurred.

The remaining reproductive traits examined were similar among treatment groups except for services per conception. Cows given the late PGF treatment (25 to 40 days after calving) tended to require more services and also had the longest intervals to conception (Table 1).

Table 1. Reproductive performance

Trait	GnRH	Early PGF_2-alpha	Late PGF_2-alpha	Breeding PGF_2-alpha	Control
No. cows bred once	211	215	190	109	218
Calving to first estrus	69.1	71.4	64.7	70.0	68.3
Calving to first AI	72.6	76.7	71.3	71.6	72.2
Calving to conception	111.7*	111.7*	121.2*	105.0	100.4
Conception at first AI, %	37.4	35.3	35.3	41.3	41.7
No. cows pregnant	177	177	159	93	189
Conception rate, %	83.9	82.3	83.7	85.3	86.7
Services/conception	2.2	2.2	2.6$^+$	2.1	2.0

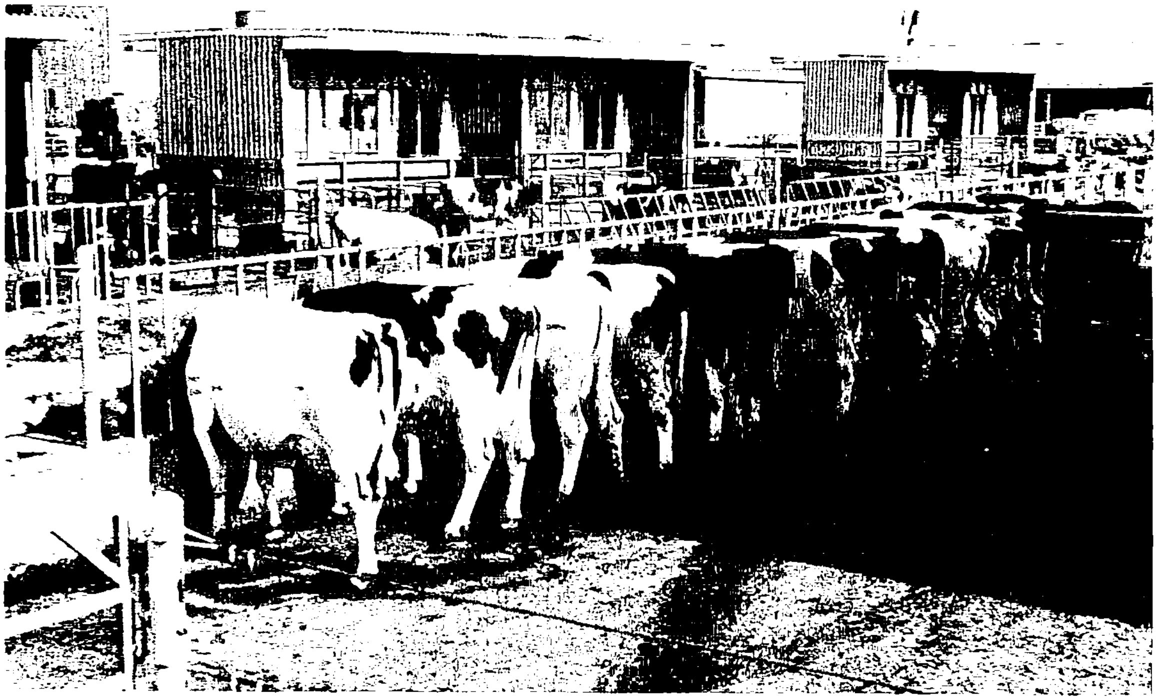
*Different from control (P<.05).

$^+$Different from control (P=.09).

Other experiments have shown improvements for cows given GnRH at 8 to 18 days after calving. In addition to our recent data (see pp 40-42, 1985 Dairy Day, KAES Rep. Prog. 484), reproductive performance of abnormal cows in New York, and of cows with retained placentas in Ontario, was improved by GnRH when early breeding was practiced.

Results of other studies, however, have not been quite as promising. In two Colorado herds in which early breeding was practiced, treatment with 250 µg GnRH improved fertility in only one herd. Another study in a Florida herd practicing 3X daily milking also reported that various doses of a GnRH analogue (Buserelin®) had no effect on reproductive performance. A Canadian study found 250 µg GnRH given on day 15 to be detrimental because it increased the incidence of uterine infection and irregular cycling — unless PGF was given 10 days later.

We are uncertain why GnRH or PGF treatments given early postpartum are not consistently effective in all herds, but it is apparently due to a number of factors including dose and management. It appears that consistent results are possible when using doses of 200 to 250 µg GnRH in herds where early breeding is practiced (starting at 40 to 50 days postpartum) and cows are milked twice daily.



PERFORMANCE OF EARLY WEANED CALVES FED LASALOCID[1]

K.L. Anderson, T.G. Nagaraja, J.L. Morrill, P.G. Reddy, T.B. Avery[2], and N.V. Anderson[2]

Summary

Twenty-two newborn, bull calves were used to determine the effects of lasalocid on growth and feed intake of early-weaned calves from week 1 to 12. Calves were assigned to lasalocid or control groups on day 3. Lasalocid-fed group received lasalocid in milk from day 4 to 7 and in milk and pre-starter from days 7 to 14 and in starter feed from weeks 2 to 12. Lasalocid-fed calves had a significantly higher feed consumption and greater weight gain than calves that did not receive lasalocid. The difference became apparent only after 6 wk of age. Lasalocid appears to be a beneficial feed additive for newborn calves.

Introduction

Early weaning of dairy calves contributes to early development of ruminal microbial activity because of increased intake of dry feed. Because of the rapid development of ruminal microbial activity, it may be beneficial to feed ionophore antibiotics to young calves. In addition to the benefits associated with altered ruminal fermentative characteristics, ionophore antibiotics may also contribute to the control of coccidiosis in growing calves. The effect of ionophore antibiotics such as lasalocid on growth performance of newborn calves has not been previously determined. Therefore, we incorporated lasalocid into milk and dry feed of calves raised on an early-weaning program and monitored dry feed intake, growth, and incidence of coccidiosis.

Procedures

Twenty-two Holstein bull calves were separated from their dams within 24 h after birth and fed colostrum until 3 d of age. The calves were then divided into two treatment groups, control or lasalocid-fed, and fed whole milk (8% birth wt.) until weaned at 3 wk of age. Calves in both groups were fed a pre-starter diet (Table 1) from d 3 until they reached a daily intake of 227 g. They were then fed a mixture of 227 g of pre-starter daily and all the calf starter (Table 2) they would eat until 6 wk of age, after which they were given ad libitum access to only the starter diet. Lasalocid-fed calves were given lasalocid (Bovatec® liquid premix, 20% w/w suspension, Hoffmann-LaRoche Inc., Nutley, N.J.) in milk at 1 mg/kg body weight daily from d 4 to 7, and at .5 mg/kg body weight daily during wk 2. Calves in this group had access to unmedicated pre-starter from d 3 to 7, but during wk 2

[1]Financial support was provided by Hoffmann-LaRoche Inc., Nutley, NJ.
[2]Dept. of Surgery and Medicine.

they had access to pre-starter containing lasalocid (88 mg/kg pre-starter). After 2 wk of age, lasalocid-fed calves were given medicated pre-starter (88 mg/kg per-starter) and starter (44 mg/kg starter) diets. The lasalocid concentration in the dry feeds was calculated to provide a daily intake of 1 mg of lasalocid/kg body weight.

Daily feed intake and weekly weight gain of all calves were monitored from birth to 12 wk of age. Feces of each calf were evaluated daily. Rectal fecal samples were also obtained from each calf at 4, 8, and 12 wk of age, and examined for coccidiosis.

Results

The body weights, weight-gain and feed consumption and daily intake of lasalocid of calves are shown in Table 3. The body weights of lasalocid-fed calves were significantly greater at 5, 7, 8, 9, 10, 11, and 12 wk of age than those calves that did not receive lasalocid. Accordingly, weekly weight gains were higher for lasalocid-fed than for control calves. Overall, lasalocid-fed calves weighed about 10 kg more than control calves at the end of the 12 wk period. Calves fed lasalocid consumed more feed after 6 wk of age than calves that did not receive lasalocid. However, at 1 to 4 wk of age, feed consumption was similar in both groups of calves. Daily lasalocid intake from 2 to 4 wk of age was less than the expected dose of 1 mg/kg body weight. However, after 6 wk of age because of increased dry feed consumption, lasalocid intake averaged 1.5 mg/kg body weight.

Fecal scores of calves were not affected by the treatment. Also, fecal examination at 4, 8 and 12 wk of age revealed no evidence of coccidiosis in calves of either group.

Table 1. Composition of Pre-starter diet[a]

Ingredient	%
Dried whey	46
7-60[b]	23
Dried skim milk	19
Sodium calcinate	12
Lasalocid[c]	+ or -
Additives[d]	+

[a]Calfweena® Merricks, Union center, WI.
[b]A mixture of milk solids and fat containing 7% protein and 60% animal fat.
[c]Pre-starter with lasaloci contained 88 mg lasalocid/kg.
[d]Includes preservative, vitamins, minerals, and flavoring compounds.

Table 2. Composition of starter diet[a,b]

Ingredient	%
Alfalfa, ground	25
Corn, cracked	30.1
Oats, rolled	20
Soybean meal	18.4
Molasses, wet	5
Dicalcium phosphate	.7
Limestone, ground	.3
Salt	.25
Trace mineral salt	.25
Vitamins[c]	+
Lasalocid[d]	+ or -

[a]As fed basis.

[b]Pellet, 4.8 mm diameter.

[c]2200 IU vitamin A, 330 IU vitamin D, and 110 IU vitamin E per kg.

[d]Starter with lasalocid contained 44 mg lasalocid/kg.

Table 3. Body weight, weekly weight gain and feed intake, and daily lasalocid intake of control or lasalocid-fed calves

Age	Body weight, kg		Weekly weight gain, kg		Weekly dry feed intake, kg		Lasalocid intake
(wk.)	Control	Lasalocid-fed	Control	Lasalocid-fed	Control	Lasalocid-fed	(mg/kg body wt./day)
0	41.3	42.0	-	-	-	-	-
1	43.0	44.5	1.6	2.5	.6	.4	1.0
2	43.9	45.1	.8	.5	.9	.7	.7
3	46.4	47.7	2.6	2.8	2.2	1.7	.4
4	47.7	49.2	1.3	1.4	4.5	4.4	.7
5	50.5	54.1†	2.8	4.9*	6.9	8.0	1.1
6	58.2	60.8	7.6	6.7	9.9	11.6†	1.4
7	63.8	67.7†	5.6	7.0†	13.2	14.7	1.4
8	70.0	74.6†	6.2	6.9	16.0	17.6	1.5
9	76.8	81.5†	6.9	7.0	17.5	20.0†	1.5
10	82.8	89.0*	6.0	7.3†	18.8	22.8*	1.6
11	90.7	96.2*	7.1	7.0	20.0	23.6*	1.5
12	95.7	104.9**	6.1	9.0**	22.2	24.6†	1.5

†Different from control (P<.1).

*Different from control (P<.05).

**Different from control (P<.01).

EFFECT OF SUPPLEMENTAL POTASSIUM AND BUFFER IN STARTERS FOR EARLY-WEANED CALVES

Paula Flynn, J.L. Morrill,
P.G. Reddy, and J.J. Higgins[1]

Summary

Sixty Holstein heifers were used from birth to 8 weeks of age to study the effect of amount of potassium (K) in the diet and of adding a buffer to the starter. Starters were formulated with and without 1% trona, a natural ore buffer, at K concentrations of .9, 1.25, and 1.5% of the dry matter. To supply adequate fiber, yet allow formulation of the starter containing .9% K, 20% prairie hay was included. All calves were fed milk and a prestarter, using an early weaning procedure. Growth and feed consumption data and evaluation of health and metabolic activity were used as response criteria. Overall, calves fed 1.25% K consumed the same amount, whether fed buffered or nonbuffered starter. At other K levels, calves fed nonbuffered starters consumed more. Growth of calves fed buffered starter with 1.5% K was depressed. Metabolic data supported the conclusion that this buffer was not beneficial with this type of starter. Increasing the amount of K did not significantly increase calf response, but there was a trend for gains to increase as K increased to 1.25% in both buffered and nonbuffered starters. Since these calves were not heat stressed, opportunity for maximum benefit from added K did not exist.

Introduction

Although potassium is the third most abundant mineral in the animal body and has many vital functions, little research has been done on the K requirements of calves. The National Research Council currently recommends K at .8% of ration dry matter for all dairy animals. Recent research suggests that K requirements of dairy cows are increased during hot weather. In general, forages are good sources of K, thus high roughage diets usually contain ample amounts, but high concentrate diets may benefit from supplemental K.

Using an early weaning program developed here at Kansas State, we have observed rapid development of rumen fermentation and a beneficial effect of addition of buffer to the starter ration. For years, sodium bicarbonate has been the buffer most commonly used in feeds for ruminants. Recently, several new buffers have become available for use. One of these is trona, a natural ore and thus economical, which is supposed to have characteristics similiar to sodium bicarbonate; however, little information is available concerning the use of this buffer in diets for dairy animals.

[1]Dept. of Statistics.

The objective of this study was to determine the effects of different amounts of K and of use of trona in starter diets for early weaned dairy calves.

Procedures

Sixty Holstein heifer calves were used from birth until 8 weeks of age. They were balanced according to time of birth and assigned to one of six rations. The starter fed to half of the calves contained 1% of the trona buffer. The remaining calves were fed non-buffered starters. Within each group, the starters were formulated to contain either .9%, 1.25%, or 1.5% K, using potassium chloride and potassium sulfate to supply supplementary K. Other minerals were balanced equally as nearly as possible. To control composition of feed consumed, hay and concentrate were mixed together, and the resulting starter was pelleted. To allow formulation of the starters containing the lowest amount of potassium, it was necessary to limit the amount of alfalfa to 5%; prairie hay was used at 20% of the starter mixture.

After receiving colostrum for 3 days, all calves were fed milk at 8% of birth weight daily until 3 weeks of age in two daily feedings. For 1 week, they were fed milk once daily at 4% of birth weight, then weaned. To encourage them to eat dry feed, a prestarter[2] was provided until they consumed .5 lb prestarter daily, then .5 lb prestarter was mixed with all the starter they would consume each day until they were 6 weeks of age.

Daily feed consumption and weekly body weight gains were recorded. Fecal consistency scores and general appearance ratings were recorded twice daily. Blood samples were collected at 2, 3, 4, 6 and 8 weeks of age to allow evaluation of the metabolic status of the animals.

Results and Discussion

The amounts of weight gained and of feed consumed are shown in Table 1. Feed consumption and weight gains were depressed, compared to our usual results. This happened partly because the prairie hay, which was used because it was lower in K than alfalfa, was not as palatable as alfalfa. Overall, the amount of dietary K had no significant effect on weight gains or feed consumed when calves were fed the nonbuffered starters. There was a trend for weight gains to increase as K concentration in feed increased. Among calves fed buffered starters, those fed starters containing the most K gained the least. That group consumed less starter than calves fed the other levels of K, but the differences were not statistically significant.

After week 1, when starter consumption was very low, calves fed nonbuffered starter consumed more feed each week than calves fed buffered starter, with the differences being significant ($P<.05$) during weeks 6, 7 and 8 (Table 2).

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[2]Calfweena, Merricks.

Fecal consistency scores were not affected by treatment (Table 1).

Results of analyses of blood samples are shown in Table 3. Treatments were without significant effect on blood pH, bicarbonate (HCO_3), CO_2 content, or base excess, and those values listed are within normal range. These data indicate that, in general, the calves were not experiencing metabolic stress and, therefore, buffer would be of less benefit.

Potassium concentrations of red blood cells (Table 3) decreased with age, but were not affected by amount of K in the feed.

Results of earlier studies have suggested that addition of buffer to calf starters would be beneficial, and earlier results here at Kansas State have suggested that this would be especially true in our early weaning program. It is known that buffers will be less beneficial in diets that contain more roughage than in low roughage diets. The diets that we fed contained 25% hay, thus reducing the need for a buffer. Apparently in this study, the starter was less palatable than starters usually used here, so feed consumption was lower, probably rumen fermentation was less active, and the need for a buffer was reduced. Thus, the lack of a beneficial effect of a buffer in this study does not suggest a general recommendation against use of buffers in calf starters.

Very few of the calves in this study were subjected to heat stress. Had that been the case, perhaps the higher concentrations of potassium would have been beneficial. The data are not conclusive in showing a K need greater than .8% of the dry matter. Most diets containing significant amounts of forages will supply more than this amount.

Table 1. Mean weekly weight gains, feed consumed, and fecal consistency scores[a]

Item	Nonbuffered Starter			Buffered Starter		
	1.5% K	1.25% K	.9% K	1.5% K	1.25% K	.9% K
Weight gain, lb	6.6 ± .13[c]	6.4 ± .13[c]	6.2 ± .13[bc]	5.7 ± .13[b]	6.6 ± .13[c]	6.4 ± .13[c]
Feed consumed, lb	16.9 ± .88[c]	16.1 ± .86[bc]	16.9 ± .88[c]	13.9 ± .95[b]	16.1 ± .95[bc]	15.2 ± .95[b]
Fecal score[d]	1.1 ± .04	1.1 ± .04	1.2 ± .04	1.2 ± .04	1.1 ± .04	1.1 ± .04

[a]Mean ± SE.
[b,c]Means within rows with unlike superscripts differ ($P<.05$).
[d]1 = normal to 4 = watery.

Table 2. Effect on buffer on feed intake, (lb.)

Week	Nonbuffered Starter	Buffered Starter
1	1.32	1.32
2	1.98	1.76
3	4.62	4.4
4	9.46	8.8
5	19.1	17.6
6	27.7[a]	24.4[b]
7	31.9[a]	29.5[b]
8	37.2[a]	33.0[b]

[a,b]Means within a row with different superscripts differ ($P<.05$).

Table 3. Mean blood gas, pH, and red blood cell potassium concentrations

Item	Nonbuffered Starter			Buffered Starter		
	1.5% K	1.25% K	.9% K	1.5% K	1.25% K	.9% K
pH	7.371	7.372	7.372	7.372	7.373	7.370
pCO_2 (mmHg)	52.49	50.86	52.75	52.82	52.84	52.56
Base excess (meq/L)	4.55	4.18	4.87	4.84	4.89	4.48
HCO_3 (meq/L)	29.27	28.78	29.58	29.69	29.57	29.23
Red blood cell K (%)	.178	.188	.172	.179	.203	.174

USE OF EXTRUDED SOY FLOUR IN MILK REPLACERS FOR CALVES

D.P. Dawson, J.L. Morrill,
P.G. Reddy, and K.C. Behnke[1]

Summary

Oil-extracted, desolventized soy flour without additional heat treatment was used to prepare protein supplements for calf milk replacers by extrusion processing. Various combinations of temperature, moisture, calcium concentration, sulfur, and acid were used to prepare 32 different products. These products were tested for trypsin inhibitor and antigenic activity and the most promising one was chosen for further testing. This product alone or with supplementary amino acids or amino acids and citric acid was used to provide 70% of the protein in experimental milk replacers. These replacers were compared to an all-milk replacer, using growth and metabolic responses of young Holstein bull calves. The extruded soy protein was inferior to milk protein but calf performance was sufficient to indicate a potential for this kind of product in areas where milk products are prohibitively expensive. Amino acid supplementation of this soy product was not beneficial. Acidification had some benefit in the young (<3 week old) calf, but was not beneficial later.

Introduction

In many countries, milk is not produced in adequate amounts to meet the demand for human consumption. Even in areas where it is possible to increase milk production, maximum returns result when milk is used to supply food for humans. Thus, it would be desirable to have a feed containing no milk products for young calves and use all saleable milk products for human food. Milk replacers are available for feeding calves but the best ones use protein and carbohydrate only from milk, and all contain a large amount of milk products. Certain non-milk sources of fat are efficiently used by calves and milk carbohydrate (lactose) is readily and economically available in the United States from dried whey, but milk protein has proved to be especially difficult to replace. Most of the non-milk protein in milk replacers is from soybeans. The economical products usually give poor results and even the more expensive products do not give results as good as milk protein. Many human food products are made using extrusion processing of soy protein. It seemed possible that the increased temperature, high pressure, and large shear forces involved in extrusion processing might destroy trypsin inhibitors and antigenic activity of soybeans and be an economical way to improve their use by calves. This experiment was designed to test that hypothesis by producing many different products and evaluating them, with or without further supplementation, for use in calf milk replacers.

[1]Department of Grain Science and Industry.

Procedures

Oil-extracted, desolventized soy flour was used as the raw material. This flour was processed, with or without various additives in different combinations, in a Wenger X-20 extruder. The additives were calcium chloride, fumaric acid, and organic sulfur. The extruder was operated to provide different temperatures and amounts of steam added in the barrel. The various combinations used resulted in the production of 32 different products. These products were tested for content of trypsin inhibitor and certain soy antigens. One sample had very low trypsin inhibitor activity and no activity for antigens tested and was chosen for further evaluation. Soy flour prepared under the same conditions as this sample was used to supply 70% of the protein in an experimental milk replacer. In two other experimental replacers, this soy flour was supplemented with .7% lysine and .7% methionine or with those amino acids and 1% citric acid. Those replacers were compared to a milk replacer containing all milk protein, using neonatal Holstein bull calves in a growth and nitrogen balance study.

Results and Discussion

The 32 products produced contained trypsin inhibitor at various concentrations between the original 147 units/mg and zero, and glycinin and ß-conglycinin activity from 0 to 85% of the original. The sample chosen contained 1 unit/mg trypsin activity and no activity for antigens tested.

Calves fed the all-milk replacer (control) grew faster throughout the 6 weeks of the experimental period. Calves fed the experimental soy flour without additives lost weight between 1 and 2 weeks of age but during the last 4 weeks gained almost as much as the calves fed the control replacer. Those calves fed experimental soy flour supplemented with amino acids and citric acid gained slightly between 1 and 2 weeks of age but grew at a slower rate than those fed the control or experimental replacer without supplements during the remainder of the experiment. The calves fed experimental milk replacer with amino acids only lost considerable weight from 1 to 2 weeks of age and finished with lowest weight of any group.

Feces of calves on control milk replacer were more liquid during the second week of the experiment than feces from other calves, possibly because the mineral content of the replacer was higher. Other data collected supported the growth data and suggested that, while inferior to milk protein, the experimental soy flour has potential for supplying protein for calf milk replacers in areas where milk proteins are unavailable. Amino acid supplementation was not beneficial but acidification was beneficial during the first 2 weeks of life.

EFFECT OF RUMINAL PROTOZOA ON PERFORMANCE OF EARLY-WEANED CALVES

K.L. Anderson, T.G Nagaraja, J.L. Morrill,
P.G. Reddy, T.B. Avery, and N.V. Anderson

Summary

Twenty newborn bull calves assigned to two groups, protozoa-free or protozoa-inoculated, were used to determine the effects of ruminal protozoa on performance of early weaned calves. Calves in the protozoa group were inoculated via stomach tube with a suspension of ruminal protozoa at weekly intervals until a viable population was established. Calves were evaluated weekly for weight gain and feed intake. Feed intake and weight gain were not significantly different between the groups but tended to be higher in protozoa-inoculated than protozoa-free calves.

Introduction

Calves weaned early consume dry feed at an earlier age than conventionally weaned calves. This accelerated dry feed consumption contributes to an earlier ruminal microbial development. We have determined that adequate bacterial populations are present in the rumen of calves at a very early age, and subsequent bacterial development is stimulated by increased dry feed consumption. However, no ruminal protozoa were detected in the calves weaned early, perhaps because those calves were isolated from adult ruminants. Ruminal establishment of protozoa in the young ruminant appears to require some form of physical contact with adult ruminants.

Because common dairy management practices include raising calves in relative isolation from mature ruminants, calves may likely remain protozoa free for many weeks. It is not known what influence protozoa may have on growth of newborn calves. Therefore, we investigated the influences of protozoa on growth and performance of early weaned calves.

Procedures

Twenty newborn, Holstein bull calves were separated from their dams within 24 h postpartum and placed in individual calf hutches. Calves were assigned to two groups, protozoa-free and protozoa-inoculated, and physical contact of calves between groups was prevented. Colostrum was fed to all calves until 3 d of age, and then whole milk (8% birth wt.) was fed until calves were weaned at 3 wk of age. Calves in both groups were fed a prestarter diet from day 3 until they reached a daily intake of 227 g. They were then fed a mixture of 227 g of prestarter daily and all the calf starter (2) they would eat until 6 wk of age, after which they were given ad libitum access to only the starter diet. Beginning at 1 wk of age, calves in the faunated group were ruminally inoculated via stomach tube with a suspension of ruminal protozoa. The inoculation was repeated weekly until a viable ruminal protozoa population was established. This required up to 6 wk for many of the calves. The protozoal suspension was prepared from ruminal fluid collected from a steer fed 50% grain and 50% alfalfa diet. The ruminal fluid was strained through a layer of cheesecloth and 1500 ml was mixed with 750 ml of mineral buffer (pH 6.8) and .1% oxytetracycline in a 2 l separatory funnel, and incubated at 39 C. After 1 h of incubation, the white layer of protozoal sediment was removed and suspended in mineral buffer and inoculated into the rumen.

Results and Discussion

Although calves were given a heavy inoculum of protozoal suspension, repeated administration was required to get the protozoa established in the rumen. In most calves, protozoa were consistently present only after 5 wk of age (Table 1). Possibly, this was due to unfavorable conditions in the rumen of young calves. The ruminal protozoal numbers tended to increase weekly after 6 wk of age (Table 1). Because many calves did not have a viable population of protozoa until 6 wk of age, performance data of calves from 6 wk of age are presented.

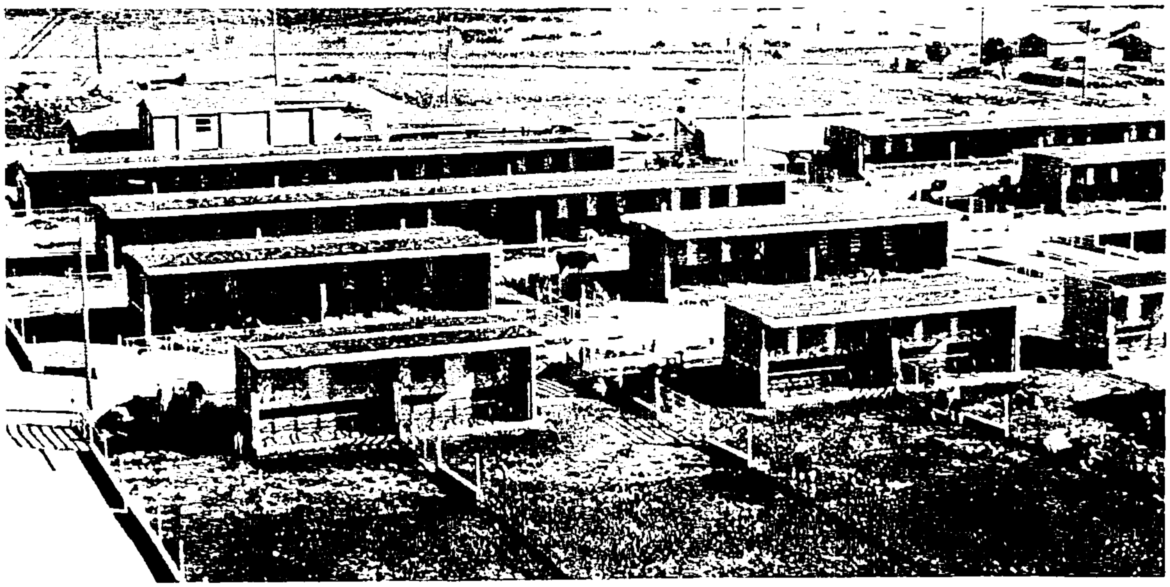
Calves inoculated with protozoal suspension consistently had higher body weights and feed intake, and in most instances, higher weekly weight gain than protozoa-free calves; however, differences were not significant (Table 2). Previous research has shown that ruminal protozoa may have positive, negative, or no effect on weight gain and performance of ruminants. These conflicting data on the role of ruminal protozoa have remained largely unexplained. Apparently, there are several factors, or a combination of factors, that determine effects of protozoa on performance.

Table 1. Ruminal protozoal counts in calves inoculated with protozoal suspension

Age, week	Number per gram of ruminal fluid
1	0
2	88
3	44
4	180
5	40
6	140
7	195
8	668
9	460
10	448
11	626
12	132.3

Table 2. Weekly body weight, weight gain, and feed intake of protozoa-free or protozoa-inoculated calves

Age, wk	Body weight, kg		Weekly weight gain, kg		Weekly feed intake, kg	
	protozoa-free	protozoa-inoculated	protozoa-free	protozoa-inoculated	protozoa-free	protozoa-inoculated
0	41.0	41.2	—	—	—	—
6	56.2	60.8	4.1	5.8	10.7	12.3
7	62.6	68.0	6.4	7.2	13.1	15.2
8	69.0	74.2	6.3	6.2	15.3	17.3
9	75.7	80.9	6.7	6.7	18.4	18.3
10	84.0	87.1	8.4	6.2	20.9	21.1
11	91.9	96.7	7.9	9.5	23.2	24.0
12	100.5	106.1	8.6	9.6	24.7	26.3



EVALUATION OF A CALF STARTER SUPPLEMENT

J.L. Morrill and P.G. Reddy

Summary

An experimental calf starter made from a pelleted commercial type supplement and feeds readily available on the farm was compared to a conventional pelleted calf starter in an attempt to demonstrate an economical alternative to commercial calf starter. Calves fed the experimental starter consumed as much starter and gained as much weight as calves fed the conventional starter, thus demonstrating a potential for savings on feed cost. The project is continuing in an attempt to improve the starter composition.

Introduction

A dairy calf starter usually contains several ingredients, including grains, protein supplements, molasses, and vitamin and mineral supplements. It may also contain hay, a buffer, an ionophore, some types of medication, and other ingredients. Because of the many ingredients involved, most of which are used in very small amounts, dairymen often purchase complete calf starters, even though the grains, which make up a major part of the starter, may be readily available on the farm. If they could purchase in one mixture all of the needed supplements and mix this on the farm with their own grains, a reduction in feed cost should be possible. To facilitate proper mixing and to avoid fine particle size in the finished feed (which calves do not like), the supplement mixture should be pelletted. The purpose of this study was to formulate and test such a pelleted supplement mixture.

Procedure

Twenty eight Holstein or beef crossbred calves were assigned to one of two groups at 1 day of age. Assignments were made so that the groups were balanced with respect to breed and sex. All calves were fed colostrum during the first day of life, than transition milk for 2 days, each at 8% of birth weight. They were then fed milk at 8% of birth weight daily in two equal feedings until daily dry feed consumption was 1.3% of birth weight, then milk was fed at 4% of birth weight once daily, then the calves were weaned. The calves were fed an all-milk prestarter until consumption was 0.5 lb daily, then a mixture of 0.5 lb prestarter daily and all the starter they would consume until they were 5 weeks of age. From then until the calves were 8 weeks of age, when the experiment ended, they could consume calf starter ad libitum.

Calves in one group were assigned to a control calf starter (Table 1). This starter has been used in several experiments and has given good results, thus, it was used for comparison. Calves in the other group were fed the experimental starter. General appearance and fecal consistency scores were recorded for all calves twice daily, and the calves were weighed weekly. Amount of dry feed consumed was recorded daily.

Results and Discussion

Starter consumption and weight gains are shown in Table 2. Fecal consistency and general appearance scores did not differ between groups. Although Holstein bulls fed experimental starter consumed more starter and gained more weight than control calves, little significance can be attributed to these differences because of the small numbers involved. An appropriate conclusion is that the calves fed the experimental starter performed at least as well as calves fed the control starter. This demonstrated that the supplement mixture can be used successfully when mixed with home-grown grains, molasses, and hay pellets, all of which the dairyman may have or can easily obtain in bulk quantities.

Some calves separated and left alfalfa pellets. Smaller sized alfalfa pellets were not readily available but an experiment is underway to determine the effect of using 1/4 inch pellets that have been rolled to make the particle size of the entire starter more uniform and eliminate sorting. For those desiring to do so, the alfalfa pellets could be left out of the mixture. Expecially if that is done, the calves should have access to hay.

Table 1. Ingredient composition of calf starters

Ingredients	Conventional[1] (%)	Experimental (%)
Corn, rolled	30.00	34.00
Oats, rolled	20.00	15.00
Sorghum grain, rolled	7.50	
Alfalfa hay, ground	25.00	
Alfalfa hay, pelleted		25.00
Soybean meal	10.00	
Molasses, dry	5.00	
Molasses, liquid		8.00
Dicalcium phosphate	.70	
Limestone, ground	.30	
Salt	.25	
Salt, trace mineral	.25	
Vitamin premix[2]	1.00	
Supplement mixture[3]		18.00

[1]Pelleted, 3/16 inch.
[2]Supplied 100,000 IU of vitamin A, 15,000 IU vitamin D/pound premix in ground corn carrier.
[3]Contained (%): Soybean meal, 92.8; sodium bicarbonate, 2.5; dicalcium phosphate, 1.64; trace mineral salt, 1.48; limestone, 0.62; micronutrient premix, 0.96. Micronutrient premix supplied (per pound of supplement mixture): Vitamin A, 5,680 IU; vitamin D, 810 IU; vitamin E, 142 IU; lasalocid, 62 mg. Pelleted, 3.16 inch.

Table 2. Total starter consumption and body weight gains of calves

Calves	Number of Animals	Starter consumption (lbs)		Weight gain (lbs)	
		Control	Experimental	Control	Experimental
Holstein bulls[1]	8	75.9	106.8	55.1	82.5
Holstein heifers	14	91.5	91.6	54.6	56.5
Beef crossbred	6	51.8	58.3	45.3	43.2

[1]Starter consumption and weight gains were greater ($P<.05$) with Holstein bulls fed experimental starter than Holstein bulls fed control starter.

RUMENSIN FOR THE LACTATING DAIRY COW[1]

J.C. Kube, R.A. Frey, and J.E. Shirley

Summary

Two Holstein cows were fed Rumensin for 12 weeks, beginning approximately 90 days postpartum. Milk production increased 7%, whereas percentage fat in milk decreased 10.3%. Percentage protein in milk increased 9.6% in the early stages and decreased 10.2% in the late stages of the study. Daily fat yield did not change, whereas protein yield increased in the early stages, but did not change in later stages. Fat corrected milk (FCM) did not change with treatment, but dry matter intake (DMI) tended to increase when Rumensin was fed. Acetate concentration did not change whereas propionate concentration increased, causing a significant decrease in ruminal acetate:propionate ratio. Rumen pH showed a nonsignificant numerical increase.

Introduction

Rumensin, an ionophore, is used in the beef industry to increase efficiency of gain. Rumensin affects the microflora in ruminant animals by shifting the population to a higher proportion of propionate-producing bacteria. Normally, this is not desirable in lactating cows because of the negative effect that high rumen propionate concentration has on fat content in the milk. This was a preliminary study to determine the proper dose of Rumensin prior to examining the effect of a combination of Rumensin and bovine somatotropin on milk production when treatments will begin shortly after peak lactation.

Procedure

Two third-lactation Holstein cows were ruminally fistulated and housed in tie stalls. At approximately 90 days in milk, Rumensin was added to the diet in an increasing and then decreasing step-wise fashion as follows:

Early	Late
Week 1 = 0 Rumensin	Week 9 = 450 mg/day
Week 2 = 150 mg/day	Week 10 = 300 mg/day
Week 3 = 300 mg/day	Week 11 = 150 mg/day
Week 4 = 450 mg/day	Week 12 = 0 mg/day

Week 5-8 = maintained on high (450-600 mg/day) level of Rumensin. Ruminal samples were collected three times per week during weeks 1-4 and weeks 9-12.

Results and Discussion

Milk production data are presented in Table 1 and ruminal traits and DMI are summarized in Table 2.

[1] Rumensin® is an experimental product not approved by the U.S. Food and Drug Administration (FDA) for use in lactating dairy cows.

Table 1. Effect of level of Rumensin on various milk traits

Trait	Stage	Level of Rumensin (mg/day) 0	150	300	450
Milk yield (lb/day)		41.6^{a}	44.0^{b}	44.5^{b}	44.1^{b}
Fat (%)		3.88^{a}	3.48^{b}	3.59^{b}	3.57^{b}
Fat (lb/day)		1.59	1.52	1.57	1.55
F.C.M. (lb/day)		40.4	40.4	41.1	40.8
Protein (%)*	Early	2.80^{a}	3.0^{b}	3.04^{b}	3.07^{b}
	Late	3.24^{a}	3.04^{b}	3.00^{b}	2.91^{b}
Protein (lbs/day)*	Early	1.22^{a}	1.41^{b}	1.43^{b}	1.40^{b}
	Late	1.22	1.22	1.23	1.25

^{a,b}Values in same row with different superscripts are different (P<.01).
*Stage by treatment interactions. Listed by stage.

Table 2. Effect of level of Rumensin on various rumen traits

Traits	Level of Rumensin 0	150	300	450
Rumen pH	5.42	5.96	6.32	6.27
Acetate (mmole)	69.6	68.9	72.1	70.1
Propionate (mmole)	21.2^{a}	23.5	23.7	27.0^{b}
Acetate:Propionate	3.33^{a}	3.00	3.06	2.68^{b}
DMI	30.2	33.2	39.8	38.5

^{a,b}Values in same row with different superscripts are different (P<.01).

Milk production traits (yield, % fat, % protein, lb protein) changed significantly at the initial (150 mg) level of Rumensin but did not change thereafter. Propionate concentration increased and acetate:propionate ratio decreased as the level of Rumensin increased. Plausible explanations for these results include: 1) The increase in propionate concentration in the rumen resulted in an increase in the rate of milk and milk protein synthesis, while fat synthesis did not change. This would explain why fat percent decreased while daily milk fat yield did not change. 2) Rumensin is noted to have a protein-sparing effect that may have caused an increase in protein synthesis in the mammary gland during earlier lactation. In the later stages, glucogenic (glucose-like) nutrients were in adequate supply, removing the benefits of rumensin and causing no change in protein yield. 3) These changes may be from the benefit of Rumensin as a coccidiostat. The initial level of Rumensin may have eliminated subclinical coccidiosis, allowing the cows to produce more milk.

GLUCOSE, STARCH, AND DEXTRIN UTILIZATION IN THE SMALL INTESTINE OF STEERS

K.K. Kreikemeier, D.L. Harmon,[1] T.B. Avery,[2] and R.T. Brandt, Jr.[1]

Summary

Holstein steers (775 lbs) were surgically fitted with abomasal and ileal cannulae, portal and mesenteric venous catheters, and an elevated carotid artery. These steers were used to study starch digestion in the small intestine. Glucose, corn starch, and corn dextrin were infused into the abomasum at various levels and ileal digesta samples were collected. Disappearance of carbohydrate (CHO) in the small intestine was determined using Cr:EDTA as an indigestible marker. Blood samples were collected from the portal vein and carotid artery during carbohydrate infusion. Blood flow was determined, and net glucose absorption across the small intestine was calculated. Glucose infusions resulted in higher arterial glucose concentrations and increased net glucose absorption than either starch or dextrin infusions. Increasing infusion rates above 20 g/h for both starch and dextrin resulted in no further increases in net glucose absorption. Even though the enzymatic processes for starch and dextrin hydrolysis became saturated at a low infusion rate, the amount of starch and dextrin disappearing in the small intestine increased with higher infusion rates. This was accompanied by an increased volatile fatty acid (VFA) concentration in the ileal fluid with starch and dextrin infusions, but not when glucose was infused. Data from these experiments support two concepts: (1) microbial fermentation is involved in small-intestinal starch appearance and (2) starch and dextrin hydrolysis in the small intestine of steers is more rate limiting than glucose absorptive capacity.

Introduction

Feed grains are composed of about 70% starch, and because of the amount of grain fed, starch is the primary energy source in the diet of lactating dairy cows. Digestion of starch can occur either by microbial fermentation in the rumen and hindgut, or by enzymatic hydrolysis in the small intestine. Total tract starch digestion in dairy cows ranges from 80-95% and is affected by grain type, as well as processing method. Overprocessing of grain will increase its digestibility, but may result in reduced fiber digestion, lower milk fat, and increased potential for acidosis. Underprocessing, however, results in decreased starch digestion and poor feed efficiency. Starch hydrolysis in the small intestine of dairy cows may be beneficial. Increased glucose absorption (versus VFA production) may promote milk production as well as lowering the incidence of ketosis in dairy cows. However, as the amount of starch escaping ruminal fermentation increases, so does fecal starch excretion. This indicates that small-intestinal starch digestion becomes limiting in ruminant animals. Therefore, a series of experiments was conducted to evaluate small-intestinal starch digestion and to determine factors that may be limiting.

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[2]Department of Surgery and Medicine

Procedures

Two groups of four Holstein steers (group 1, 660 lbs; group 2, 890 lbs) were surgically fitted with abomasal and ileal cannulae, portal and mesenteric catheters, and an elevated carotid. A temporary catheter was placed in the carotid artery during sampling periods. Glucose, corn starch, and corn dextrin were infused abomasally at 0, 20, 40, and 60 g/h. Ileal digesta samples were collected, and disappearance of CHO within the small intestine was determined with Cr:EDTA as an indigestible marker. Simultaneous blood samples were collected from the portal vein and carotid artery, and glucose absorption across the small intestine was calculated. Portal blood flow was determined by a primed continuous infusion of para-amino-hippuric acid (PAH) into a small mesenteric vein.

Two experiments were conducted with the first group of steers. Glucose (exp 1) and corn starch (exp 2) were continuously infused into the abomasum at 0, 20, 40, and 60 g/h for 10 h. Steers were infused with 250 ml of solution per hour, consisting of tap water, CHO, and Cr:EDTA. Steers were fed chopped alfalfa hay at 1.5% of body weight (dry matter basis). Animals and treatments were randomized to an 8-period crossover design for each experiment. During the infusion period, 7 ileal digesta samples and 5 sets of blood samples were collected from each steer. Ileal digesta was analyzed for VFA concentration, dry matter, starch, glucose, and chromium. Plasma samples were analyzed for glucose and PAH.

The second group of steers was infused with glucose (exp 3), corn starch (exp 4), and corn dextrin (exp 5). Infusions, digesta and blood collections, lab analysis, and animal care were identical to those in experiments 1 and 2. Animals and treatments were randomized to a 4 x 4 Latin square design for experiments 3 and 4, whereas experiment 5 was an 8-period crossover design.

Results and Discussion

Exp. 1. Steers consumed 9 lbs of alfalfa hay daily (dry matter basis) during the glucose infusions (table 1). Increasing levels of abomasal glucose infusion resulted in glucose passing the ileum into the large intestine, yet there was no change in ileal fluid VFA concentration. This indicated that there was little microbial fermentation of glucose in the small intestine. Arterial glucose concentration as well as net glucose absorption continued to increase with higher glucose infusions. The amount of glucose absorbed was approximately equal to the amount of glucose disappearing in the small intestine.

Exp. 2. Steers consumed 7.25 lbs. of alfalfa daily (table 2). Even though corn starch was infused, both free glucose and starch passed the ileum. The amount of starch that escaped small intestinal digestion increased with increasing amounts of starch infusion. In addition to starch passing the ileum, there was a continual increase in ileal fluid VFA concentration. This indicates that small-intestinal starch digestion included microbial fermentation. Arterial glucose and net glucose absorption increased as the infusion rate was raised from 0 to 20 g/h, with no additional change with increased levels of infusion. It appears that the process for small-intestinal starch hydrolysis became saturated at the 20 g/h infusion level.

The results of experiments 3 and 4 (tables 3 and 4) conducted with group 2 steers are similar to trends observed in the first 2 experiments. The final experiment (table 5) was the infusion of corn dextrin. Dextrin is partially hydrolyzed starch, consisting of straight chain glucose polymers with an average chain length of 17 glucose units. By infusing dextrin, we eliminated any granular characteristics as well as branch points that are found in starch. These characteristics may limit enzymatic hydrolysis of the starch granule. When corn dextrin was infused, steers consumed 11.5 lbs of alfalfa hay daily. At higher levels of infusion, free glucose as well as dextrin flowed past the ileum to the large intestine. There was an increase in ileal fluid VFA concentration, whereas arterial glucose levels and net glucose absorption both plateaued at the 20 g/h infusion rate.

Regardless of the type of CHO infused, increased infusion rates resulted in increased amounts of small intestinal disappearance. When glucose was infused, most of the disappearance could be accounted for by glucose absorption. With starch and dextrin infusions, arterial glucose and glucose absorption plateaued at 20 g/h infusion rate. This was accompanied by a continual increase in ileal fluid VFA concentration. Therefore, it is probable that a large amount of starch digestion in the small intestine is by microbial fermentation. It also appears that enzymatic processes responsible for starch and dextrin hydrolysis are more rate limiting than the glucose absorptive capacity of the small intestine.

Table 1. Effect of abomasal glucose infusions on small intestinal disappearance and net portal glucose absorption (Exp. 1)

Item	Infusion rate, g/h				SE
	0	20	40	60	
Daily feed, lbs	9.2	9.7	9.2	8.6	0.4
Glucose flowing past ileum, g/h[ab]	0	0.8	8.0	20.6	1.5
VFA in ileal fluid, mM	20.8	21.3	22.0	21.3	1.5
Arterial glucose, mM[a]	4.1	4.5	4.6	5.0	0.1
Net portal glucose absorption, g/h[a]	-2.5	13.4	18.2	34.2	5.5

[a]Linear effect P<.01, [b]Quadratic effect P<.01.

Table 2. Effect of abomasal starch infusions on small intestinal disappearance and net portal glucose absorption (Exp. 2)

Item	Infusion rate, g/h				SE
	0	20	40	60	
Daily feed, lbs	7.5	7.5	6.6	7.5	0.4
Glucose flowing past ileum, g/h[a]	0	0.5	0.9	1.1	0.1
Starch flowing past ileum, g/h[ab]	0	1.3	13.3	26.2	1.8
VFA in ileal fluid, mM[a]	23.3	26.2	28.9	30.2	1.9
Arterial glucose, mM[a]	4.1	4.3	4.4	4.3	0.1
Net portal glucose absorption, g/h[a]	-5.7	5.0	2.1	6.3	3.2

[a]Linear effect P<.05, [b]Quadratic effect P<.05.

Table 3. Effect of abomasal glucose infusions on small intestinal disappearance and net portal glucose absorption (Exp. 3)

Item	Infusion rate, g/h				SE
	0	20	40	60	
Daily feed, lbs	12.5	13.0	10.4	12.3	1.3
Glucose flowing past ileum, g/h[a]	0	0	4.90	13.8	2.8
VFA in ileal fluid, mM	23.9	25.8	27.9	20.5	2.8
Arterial glucose, mM[a]	4.4	4.9	5.1	5.1	0.1
Net portal glucose absorption, g/h[a]	-7.3	19.8	20.0	36.6	7.9

[a]Linear effect P<.01.

Table 4. Effect of abomasal starch infusions on small intestinal disappearance and net portal glucose absorption (Exp. 4)

Item	Infusion rate, g/h				SE
	0	20	40	60	
Daily feed, lbs	11.9	13.2	13.2	13.0	0.9
Glucose flowing past ileum, g/h[a]	0	0.7	2.3	2.7	0.5
Starch flowing past ileum, g/h[a]	0	5.5	10.9	26.1	4.1
VFA in ileal fluid, mM	26.9	30.9	29.8	29.6	2.3
Arterial glucose, mM[a]	4.1	4.2	4.3	4.4	0.1
Net portal glucose absorption, g/h[ab]	-6.7	8.5	12.0	12.1	1.9

[a]Linear effect P<.01, [b]Quadratic effect P<.01.

Table 5. Effect of abomasal glucose infusions on small intestinal disappearance and net portal glucose absorption (Exp. 5)

Item	Infusion rate, g/h				SE
	0	20	40	60	
Daily feed, lbs	11.0	13.2	9.9	16.6	1.4
Glucose flowing past ileum, g/h[ab]	0	0	0.4	1.0	1.3
VFA in ileal fluid, mM[a]	22.3	24.7	22.4	30.7	3.2
Arterial glucose, mM[ab]	4.3	4.6	4.7	4.6	0.1
Net portal glucose absorption, g/h[ab]	-7.3	14.4	14.3	9.4	4.6

[a]Linear effect P<.05, [b]Quadratic effect P<.05.

RELATIVE FEEDING VALUE OF THREE FORAGE-BASED DIETS FOR HOLSTEIN HEIFERS

J.E. Shirley, J.L. Morrill, and W.H. Carinder

Summary

Soybeans interseeded with grain sorghum and harvested as a mixed forage silage crop can be used successfully as a feed for growing dairy heifers. However, daily gain is greater when grain sorghum silage plus alfalfa hay or prairie hay supplemented with milo grain and soybean meal is fed.

Introduction

Replacement heifer programs should be cost effective but yield a heifer large enough to be bred to calve by 24 months of age and with a well developed mammary gland relatively free of internal fat. A daily gain of 1.6 to 1.8 lbs appears to be optimum to achieve the desired bodyweight to be bred by 14 months of age. Feed cost to achieve the above physical goals often accounts for 60% of the total cost in a replacement heifer program. Forage may constitute the majority of a heifer's dry matter intake during the growing phase, if it supplies adequate energy, protein, mineral, and vitamins.

Grain sorghum silage and prairie hay are abundant feed sources in Kansas and are frequently used in the diets of replacement heifers. However, grain sorghum is relatively low in protein, deficient in calcium, low in potassium, and potentially adequate in energy for growing heifers diets, whereas prairie hay is adequate in potassium, low in calcium and phosphorus, marginal in protein, and low in energy. Soybeans are well adapted to Kansas conditions and offer a forage that is abundant in protein, calcium, and potassium but relatively low in energy and phosphorus. Silage composed of a mixture of soybeans and grain sorghum should provide sufficient protein, energy, calcium, phosphorus, and potassium to meet the needs of growing dairy heifers. This trial was designed to ascertain the value of soybean-grain sorghum silage relative to sorghum silage or prairie hay as a feed for growing dairy heifers.

Procedures

Seventy-two Holstein heifers were sorted into light and heavy weight groups and distributed among treatment groups according to age and body weight. Treatment groups were soybean-grain sorghum silage (S-GSS), grain sorghum silage plus alfalfa hay (GSS-AH), and prairie hay (PH). Each treatment group contained two replications (one light and one heavy), with 12 head per replication.

Forages were supplemented with milo and soybean meal in a ratio to provide isocaloric and isonitrogenous diets. Calcium, phosphorus, potassium, trace mineral salt, and Rumensin were balanced across treatment groups. Trace mineral salt was also provided free choice.

All animals were introduced to the appropriate treatment for 1 week prior to the experiment. Heifers were fed to gain 1.6 lbs per day over the 97-day experimental period. Experimental rations (Table 1) were adjusted for growth one time during the trial. Ten percent feed above requirements was fed daily to provide room for growth between the major feed adjustment periods.

Soybeans and grain sorghum were interseeded at the rate of 100 lbs of soybeans and 20 lbs of grain sorghum per acre with a grain drill. The mixture was harvested when the grain sorghum reached the early dent stage and ensiled in a concrete stave silo until fed.

Table 1. Experimental rations[1]

Treatment	Light Heifers[2]		Heavy Heifers[3]	
	DM[4]	As Fed[5]	DM	As Fed
	lbs per head per day			
A. S-GSS				
Soybean-G. Sorg. Sil.	13.0	26.26	16.45	33.24
Milo carrier[6]	2.41	2.74	1.74	1.98
B. GSS-AH				
Sorghum sil.	7.50	17.13	8.63	19.72
Alfalfa hay	6.61	7.72	8.27	9.66
Milo carrier	1.10	1.25	1.10	1.25
Dicalcium phosphate	.05	.055	.063	.066
Calcium carbonate	.008	.009	.0275	.0275
Potassium chloride	.04	.044	.088	.088
C. PH				
Prairie hay	10.45	12.00	12.30	14.13
Milo carrier	1.10	1.25	1.10	1.25
Milo	3.30	3.75	3.21	3.65
Soybean meal	1.95	2.19	2.28	2.56
Dicalcium phosphate	.077	.077	.077	.077
Calcium carbonate	.055	.055	.066	.066
Potassium chloride	.286	.286	.341	.341

[1]Rations shown are the initial rations which were adjusted to allow for increased heifer wieght over time.

[2]Light heifers — initial weight less than 700 lbs.

[3]Heavy heifers — inital weight greater than 700 lbs.

[4]DM = dry matter basis.

[5]As fed = as fed basis.

[6]Milo carrier — ground milo was used as a carrier for rumensin, salt, and vitamins.

Results and Discussion

Holstein heifers fed grain sorghum silage plus alfalfa hay gained more weight per day (2.2 lbs) than those fed prairie hay plus milo grain and soybean meal (2.0 lbs) or soybean-grain sorghum silage alone (1.5 lbs; Table 2). However, heifers fed soybean-grain sorghum silage appeared to increase in wither height more than heifers on the other diets. This suggests that sufficient nutrients were available in the soybean-grain sorghum diet to support a desirable growth rate without excess body fat accumulation. Apparently, the additional body weight gain (above 1.5 lbs per day) observed in heifers fed grain sorghum silage plus alfalfa hay and those fed prairie hay supplements with milo grain and soybean meal was due to fat accumulation rather than skeletal growth.

Data in this report are from one study and will be supplemented with an identical study during the winter of 1987-88. Conclusions drawn at this time are preliminary and should be treated as such.

Table 2. Weight gain and wither height change of Holstein heifers fed various forage-based diets for 97 days

Diet	Daily Gain	Change in Wither Height
Soybean-Grain Sorghum Silage	1.5 lbs	1.5 inches
Sorghum silage plus alfalfa hay	2.2 lbs	1.25
Prairie hay plus milo grain and soybean meal	2.0 lbs	1.34

KSU

A LOOK AROUND THE DAIRY INDUSTRY: BACKWARD AND FORWARD

C.L. Norton

A Look at the Past

It was the late President Harry Truman, renowned for his interest in history, who said that those who ignore history are doomed to relive it. Our interest in dairy events of the past half century is to develop a base from which to consider what we may expect in the next several decades.

Many of us have been privileged to have experienced some very remarkable changes in agriculture, particularly in the dairy industry. Fifty years ago, American agriculture was recovering from the effects of the dust bowl days and record breaking heat, and breaking the grip of the depression. Federal government agencies were set up to help deal with the dilemma (programs of Roosevelt's New Deal): the Works Progress Administration (WPA), Social Security, Rural Electrification Administration (REA), and the Agricultural Adjustment Act (AAA). At least two of these programs have had a lasting and telling effect on our society.

In those days of the mid-30's, there were approximately 24 million U.S. dairy cows that averaged 4,184 lb of milk and 165 lb of butterfat. The stage was set for an historic period in American agriculture.

The following chronology is by no means complete, but many current commonplace methods and practices originated or were in their infancy during this time span:

1937 - Federal Milk Marketing Orders were established, providing milk pricing stability.
Field baling of hay was in its infancy.

1938 - The Commodity Credit Corporation (CCC) bought butter.
Hybrid seed corn was becoming available.
A forage field chopper was marketed by the Fox River Tractor Company.
Artificial insemination in the U.S. was getting under way.
Elevated milking parlors were introduced.

1939 - New York World's Fair. The Dairy World of Tomorrow featured the Borden Company Rotolactor.

1940 - The American Dairy Association (ADA) was formed in St. Paul, Minnesota.
The first mechanical barn cleaner was advertized.
The Purebred Dairy Cattle Association (PDCA) was formed in July at Peterborough, N.H.

1941 - Gonadotropic hormones were first used in the laboratory.
Blood typing was developed and implemented as a method to confirm parentage.

1942 - First uniform dairy scorecard was copyrighted by PDCA.

1944 - The war years slowed progress.
The shift to bulk tanks began.
The number of U.S. dairy cows reached 25,661,000 - the greatest number in history.

1945 - Front end loaders on tractors appeared.
Penicillin and other antibiotics became available.
Urea was introduced as a protein substitute.

1946 - Silo unloaders were being tested.

1947 - Milk replacers were put on the market.
Thyroprotein experiments were being conducted in selected land grant universities.

1948 - The ring test for brucellosis was perfected at the University of Minnesota.

1949 - Pipeline milkers were used in California.
The Dairy Shrine Club was organized at Waterloo, Iowa.
AAA set the dairy support price at 75-90% of parity.

1950 - The tax on colored oleo was eliminated with President Truman's signature.

1951 - The first calf resulting from embryo transfer was born.
The USDA was conducting long-term crossbreeding studies of dairy cattle.

1952 - Dr. C.F. Huffman, Michigan State University, suggested the role of microorganisms in ruminant digestion.

1953 - The American Dairy Association (ADA) approved the year-round set aside.

1954 - Landmark research on the control of milk fever by feeding non-legume hay during the dry period was reported.
Secretary of Agriculture Benson reduced dairy price supports to 75% of parity.

1955 - Benson ended the tie-up between Farm Bureau and Extension service personnel.

1956 - The USDA Animal Disease Laboratory was established at Ames, Iowa.

1957 - The diet-heart controversy heated up because of the American Heart Association claims against animal fats.
Herringbone milking parlors were reported in use in New Zealand.

1958 - Herdmate comparisons replaced daughter - dam comparisons.

1959 - "Cow pools" got a lot of press.

1960 - Minimum tillage research was starting.
Forage testing was paying off for dairymen.
President Eisenhower signed a bill boosting the price support level from $3.06 to $3.22 per cwt.
Liquid manure handling works for hogs, why not dairy cattle?

1961 - The outlook was for a yearly U.S. production of 127 billion lb of milk. If butter consumption were at the 1935-39 level, 155 billion lb would be required.
DHIA average production: 10,327 lb of milk; 401 lb of fat. For the first time, the national average exceeded 400 lb.
Free-stall housing was initiated in state of Washington.

1962 - Trend towards heavier grain feeding intensified.

1963 - Naturally proven sires were giving way to carefully selected young sires.
The idea of cow leasing got attention.
Rubber mats in tie stalls saved bedding costs.

1965 - Cow index was used to rank cows.
Electronic data processing was established on dairy records.
National DHIA was organized.

1967 - Techniques for synchronizing estrus was developed.
"Standby pool" of milk pricing was proposed.
Wisconsin legislature approved allowing oleo manufacturers to use yellow color.
President Johnson signed a bill curbing dairy imports.

1968 - "Repeatability factor" was first used in bull proofs.
Dairymen, Inc. and Mid-America Dairymen cooperatives were created.

1969 - The Holstein Association approved the red and white herdbook and permitted the registration of "off-color" black and whites.

1971 - PD Dollars was the new USDA-DHIA index for ranking AI bulls.

1972 - California set 8.7% non-fat solids standard for whole milk.
Teat dipping and dry cow treatment were initiated to help control mastitis.
Mechanized feeding came to stall barns.
Prostaglandin was developed to control the cow's estrous cycle.

1973 - Conclusion on dairy crossbreeding: don't do it.
UDIA streamlined national dairy promotion efforts by placing National Dairy Council (NDC) under the same umbrella as American Dairy Association (ADA) and Dairy Research, Inc. (DRINC).
Bovine ova transfer became available on a commercial basis.
Calf hutches were widely accepted.

1974 - Hoard's Dairyman editorial sounded the alarm for increased farm debt, which had jumped at a great rate. It said many dairymen would benefit from sound counseling on their financial affairs.

1975 - Modified Contemporary Comparison (MCC) replaced Herdmate Comparison in determining Predicted Difference (PD).
Oleo controversy was over; Minnesota and North Dakota removed tax.
Beecher Arlinda Ellen established a new world record for milk production: 50,314 lb in 305 days.

1979 - "On the farm computer" began to become a part of the dairyman's management program.
Greater use was made of consultants on feeding, breeding, construction, and use of fertilizers.

1981 - Warnings appeared in the press to watch our financial health.

1982 - Cheese yield pricing (component pricing) of milk was proposed.
Results of the use of bovine somatotropin (bSt) or bovine growth hormone (bGH) were reported.
Bull proofs were updated with a new base because of genetic gain.
Imitation dairy products and imported casein continued to plague the dairy industry.

1983 - Biogas production (methane from manure) gained increased attention.
End-product pricing (equity pricing) of milk continued to progress.
President Reagan signed into law the Dairy and Tobacco Adjustment Act (Milk Diversion Program), designed to cut milk production and lower milk support program costs.

1984 - Contracts were signed by 37,888 dairymen to reduce production for 15 months. A 50¢/cwt assessment was established to finance incentive payments.
The Dairy Promotion and Research Board was established; Ivan Strickler, Iola, KS was elected president, with a 36-person board of directors composed of dairy producers; a budget was set at $130 billion; and a 15¢/cwt assessment was set.
DHI Quality Certification was implemented.

1986 - Commercial domestic sales of dairy products increased significantly.
Agricultural exports suffered declines.
Farm credit agencies were in deep trouble.
Export of frozen embryos was an expanding industry.

1987 - There were threats of international trade wars, which have a direct effect on agricultural products.

A Look to the Future

In considering what lies ahead, one is reminded of the old saw about the economist who was proud of the fact he'd predicted seven of the last two recessions. Furthermore, our collective memory is usually so short that one can predict almost with impunity what will transpire in the future.

1. Expect to see much better management - herd management, financial management, labor management.

2. Dairymen of the future will be more astute in finances. (The survivors will be those who were better financial managers.)

3. There will be greater use of higher PD bulls. Some breeders have been slow to accept this philosophy, but not the more successful ones. "Using the numbers" with good judgment will prevail.

4. Use of on-farm computers will increase. (There will be widespread use of computer feeding among the better herds.)

5. More extensive use will be made of consultants. (An increasing number of dairymen will pay retainers for expert advice.)

6. There will be greater use of total mixed rations.

7. Use of by-pass protein will increase (based on protein solubility) for high-producing cows.

8. The use of bovine somatotropin (bSt) will have a modest impact on the dairy industry.

9. It will be a long time before the U.S. resorts to milk production quotas like Canada and Europe. A two-price system may be acceptable

10. If the U.S. is to ever compete successfully in the world dairy economy, our marketing aggressiveness and effectiveness must improve markedly.

11. Although it is unlikely to occur, the most effective way of improving U.S. milk production efficiency would be for each dairy operation to be on a production testing program.

12. There will be ample headroom in the average production per cow, partly because of the continued reduction of support prices, which will reduce the number of marginal dairy herds.

USDA-DHIA SIRE SUMMARIES — AI ADVANTAGE

E.P. Call

Summary

USDA-DHIA Sire Summaries are published semiannually and provide the dairy industry with an accurate evaluation of the transmitting ability of bulls for milk and milk components. Genetic potential is established at the time of conception. Therefore, current service sires represent the primary means of improving the genetic base of the future herd. Based upon first evaluation of daughters of AI and non-AI bulls, the data clearly indicate the genetic superiority of bulls selected by the AI industry. Dairy producers are strongly urged to select service sires from the Active AI bull listings.

Introduction

The need to progeny test dairy bulls to evaluate their transmitting ability for production traits became apparent more than 50 years ago. Milk production is a sex-limited trait (bulls don't give milk), and the heritability for milk is about 25% (h^2=.25). Early methods to rank the genetic ability of bulls included simple daughter averages adjusted for age and length of lactation and daughter-dam comparisons. Both systems failed to accurately evaluate bulls, since environmental influences accounted for about 75% (e^2=.75) of the variation among cows' production. Artificial insemination (AI), high speed computers, and increased enrollment of producers into the National Dairy Herd Improvement Program (NDHIP) provided the mechanisms for the USDA-DHIA Sire Summary Program.

The Predicted Difference System

The Predicted Difference (PD) System provides the means to: (1) rank bulls with one another and (2) estimate the inferiority or superiority of a bull's future daughters compared with the genetic base (breed average). The current genetic base is 1982 or PD82, which means that a zero bull (PD = 0) is an average sire for two-year old cows calving in 1982. The equation used to calculate PD is:

$$PD82 = R(D - MCA + SMC) + (1-R)AM$$

Where: R = Repeatability or accuracy of the information, based upon no. of daughters and distribution among herds.

D = Average production of daughters.

MCA = Average production of contemporaries or herdmates.

SMC = Average sire merit for contemporaries - adjusts for genetic level of herdmates.

AM = Ancestor merit - adjusts for differences in genetic ability of ancestors.

Evaluating Bulls Based Upon PD82

The July, 1987, USDA-DHIA Sire Summary serves as an excellent example that real differences exist among bulls. The most accurate comparison of groups of bulls is based upon the first evaluation, which involves two-year old daughters without selection pressure that would occur later in the Active AI group. As shown in Table 1, either within breed or among breeds, the AI group has a distinct advantage overall. While the main advantage of the PD system is to rank bulls for selection purposes, monetary benefits may also be estimated. For example, in Table 1, the average PD$ superiority of a daughter by an AI bull is + $56 compared to the average daughter of a non-AI bull. This means that on average, daughters of AI bulls will have $56 more milk sold for each lactation.

The AI advantage is even greater when the Active AI bulls are selected as a group, as noted in Table 2. All breeds considered, the active AI bulls' daughters are + $125 superior to the average daughters of non-AI bulls. These differences are real and have economic impact on the dairy herd. Selecting bulls based upon the PD system assures that the herd of tomorrow will be better genetically and more profitable. Cows selected for milk production convert feed into milk more efficiently.

Read More About It

1. Sire Summary List (DyS-2977). North Central Regional Publication 137. July, 1987. Kansas State University. Manhattan (Extension Dairy Science).

2. Sire Evaluation Procedures for Yield Traits. NCDHIP Handbook. 1986. Kansas State University, Manhattan (Extension Dairy Science).

Table 1. Comparison of first-evaluation AI-proved bulls with contemporary non-AI sires. July, 1987.

	AI Predicted Difference				Non-AI Predicted Difference			
Breed	M	%F	F	$	M	%F	F	$
Ayrshire	+343	-.05	+ 6	+29	- 71	-.05	-9	-19
Brown Swiss	+271	-.04	+ 6	+24	+105	+.01	+6	+15
Guernsey	+482	-.03	+19	+58	- 32	+.00	-2	- 5
Holstein	+436	-.02	+13	+46	-125	+.00	-4	-14
Jersey	+327	+.00	+16	+44	+ 4	-.01	-2	- 3
All Breeds*	+432	-.02	+13	+44	-104	+.00	-4	-12

*No. of bulls: AI = 706; Non-AI = 1,707

Table 2. Comparison of active, proved AI bulls with all non-AI sires. July, 1987.

Breed	AI Predicted Difference				Non-AI Predicted Difference			
	M	%F	F	$	M	%F	F	$
Ayrshire	+432	-.03	+12	+44	- 79	-.03	- 7	-15
Brown Swiss	+719	-.01	+27	+84	-165	+.01	- 5	-17
Guernsey	+756	-.04	+29	+89	-151	+.00	- 7	-20
Holstein	+865	-.01	+30	+96	-320	+.01	-11	-35
Jersey	+764	-.03	+33	+95	-176	+.01	- 7	-22
All Breeds*	+831	-.01	+29	+93	-291	+.01	-10	-32

*No. of bulls: AI = 668; Non-AI = 13,118

Charles Michaels, Director of the Kansas Artificial Breeding Service Unit (KABSU).

EARLY LACTATION SOMATIC CELL COUNT SHOULD BE LOW

J.R. Dunham

Summary

Cows and heifers in milk for fewer than 50 days, as shown on the DHIA Somatic Cell Count report, should have a lower average Somatic Cell Count than cows in milk for more than 300 days, if the dry cow mastitis treatment and management programs are effective.

Introduction

The DHIA Somatic Cell Count (SCC) average for a dairy herd is a good evaluation of a mastitis control program. Since leucocytes migrate to the mammary system during periods of subclinical mastitis, the SCC average indicates the amount of subclinical mastitis in a herd. A realistic goal for a herd average SCC is less than 200,000.

In many herds with average SCC over 400,000, the average SCC of early lactation cows is higher than that of late lactation cows. This indicates a problem during the dry period, either dry cows are not being cured of mastitis or they are becoming re-infected with mastitis during the dry period.

Evaluating the Dry Cow — Mastitis Control Program

The DHIA SCC report summarizes the herd on each test day according to the stage of lactation of each cow. This summary is the Days in Milk SCC Average shown in Table 1.

Table 1. Days in milk and Somatic Cell Count average

	SCC Average	
Days in Milk	Your Herd	Mid-States Top 25%
Fresh under 50 days	497,000	178,000
Fresh 50 to 100 days	390,000	159,000
Fresh 101 to 200 days	435,000	166,000
Fresh 201 to 300 days	444,000	183,000
Fresh over 300 days	466,000	206,000

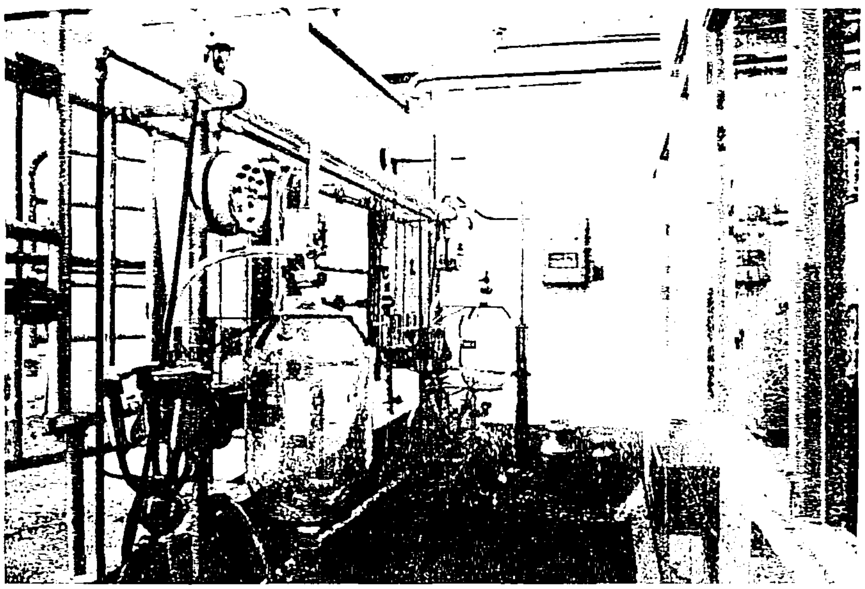
The effectiveness of a dry cow mastitis control program can be evaluated by comparing the SCC average of cows fresh less than 50 days with that cows fresh over 300 days. If this report shows a consistently higher average SCC for early fresh cows, than an evaluation of the dry cow program should include:

1. Drying Cows Off. Cows should be turned dry by discontinuing milking abruptly. Those cows producing more than 40 lb at dry-off should be fed less grain to decrease milk flow.

2. Dry Cow Treatment. Every quarter should be treated with a dry cow preparation shown to be effective by sensitivity tests. Sanitary procedures during treatment must be followed. Cows showing high SCC during late lactation should be re-treated 10-14 days following dry-off.

3. Lots and Housing. The lots and housing facilities must be clean and as dry as possible for springing heifers and dry cows.

4. Prepartum Milking. Springing cows and heifers making up udders that show signs of mastitis should be milked prepartum, and a treatment program should be initiated.



UPDATE ON HEAT DETECTION AIDS

J.S. Stevenson and E.P. Call

Background

Poor heat detection is a major cause of reproductive failure in most dairy herds. About one-half of the heat periods are undetected, resulting in prolonged calving intervals. In many cases, the problem is serious enough that some producers have compromised their breeding goals by utilizing natural mating exclusively or maintaining clean-up bulls. The result of these compromises means loss in genetic superiority of future replacement heifers and the potential for serious injury or death of farm help or family.

Heat Detection Aids

Several methods utilizing heat detection aids have been promoted to improve the number of heat periods identified (efficiency) as well as to increase the accuracy of heat detection. These methods have included various detection aids (e.g., teaser animals, heat mount detectors, tail paint, and estrous synchronization). Increased costs are associated with obtaining such detection aids in addition to the cost of labor for visual observation and maintenance of the aids. Better training of people and more frequent observation for heat will increase heat detection rates. Aggressive teaser animals (vasectomized bulls or hormone-treated steers or cows) promote or instigate estrous behavior and increase detection rates compared with casual visual observation. However, hidden costs associated with maintenance of teaser animals are real, and there is an increased chance of injury in confined, concrete lots. Synchrony of estrus (e.g., by PGF_2-alpha or its analogs) facilitates detection of more animals because of increased mounting behavior of many cows or heifers in heat simultaneously. Although supplementary use of heat detection aids might increase detection rate, there is no substitute for careful observation. Since most mounting activity occurs between 6 pm and 6 am, a minimum of two heat detection periods should be used. Success in AI programs is achieved when at least one person is responsible for heat detection.

Economic Evaluation of Detection Aids

Using selected references, a recent Texas study evaluated various detection methods to determine the least costly ones. Summarized in Table 1 are expected detection rates based on type of method and frequency of observation.

Table 1. Heat detection aids and expected detection rates[1]

Detection method	Frequency of observation	Expected[2] heat detection rate (%)
Teaser bull	3X/day	85-100
	2X/day	80-90
Heat mount detectors or tail paint	3X/day	80-90
	2X/day	75-85
	Casual	55-65
Prostaglandins	3X/day	80-90
	2X/day	75-85
Prostaglandins + heat mount detectors	3X/day	80-90
	2X/day	75-85
Visual observation	3X/day	70-80
	2X/day	65-75

[1]Adapted from Holmann et al. (1987) J. Dairy Sci. 70:186-194.

[2]The dairy producer's skill and attention to detail largely determine the heat detection rate attained with each method.

Because there are different time committments and other costs associated with the various detection methods, the preferred method depends on the value of labor and the ability to achieve actual expected detection rates.

The study concluded that, if a producer believes the value of his labor is greater than $2.25 per hour, heat mount detectors or tailhead painting would be the methods of choice. If, however, the value of labor is less than $2.25, using unaided, visual observation 3X/day would be the most economical.

In order for heat mount detectors to be more cost effective than tailhead painting, they must increase detection rate by 10%. The above methods were 25 to 50% less costly than using a teaser bull or prostaglandins. The authors suggested that only dairy producers who are extremely poor at managing the alternative heat detection methods can justify the use of teaser bulls or prostaglandins as their routine heat detection method. One cost variable not examined in this study was the cost of the improved genetic gain that can result when groups of heifers are synchronized with prostaglandins for convenience of insemination by superior sires selected for calving ease. Costs of convenience are difficult to evaluate because they often correspond to quality of life.

Based on the results of the Texas study, break-even costs of labor suggest that tail paint or heat mount detectors with routine observation are more economical than unassisted visual observation under a wide range of dairy situations. The study concluded that a large proportion of producers continue to use unassisted visual detection methods because they place low value on labor for estrous detection.

UPDATE ON GONADOTROPIN-RELEASING HORMONE TREATMENTS FOR REPEAT BREEDERS

J.S. Stevenson

Summary

In three of six studies involving over 1,650 cows, treatment of lactating dairy cows with 100 μg GnRH (2 cc Cystorelin®) at the time of third or fourth insemination improved conception rates by 12 percentage points. When all six studies are considered, rates improved by 10 percentage points. These data provide strong evidence for continued use of GnRH at the time of insemination for repeat breeders.

Review of Experiments

Table 1 summarizes six published studies in which GnRH was administered at repeat services. Three of the studies did not demonstrate significantly higher conception rates after GnRH treatment, but two of these had a limited number of cows. In the last study (Stevenson et al., 1987), the health status of cows was known prior to treatment. GnRH was found to be equally effective for increasing conception rates in cows with previous reproductive problems as it was in cows with a normal health status, compared to untreated cows in each health status (see pp 24-25 in this publication).

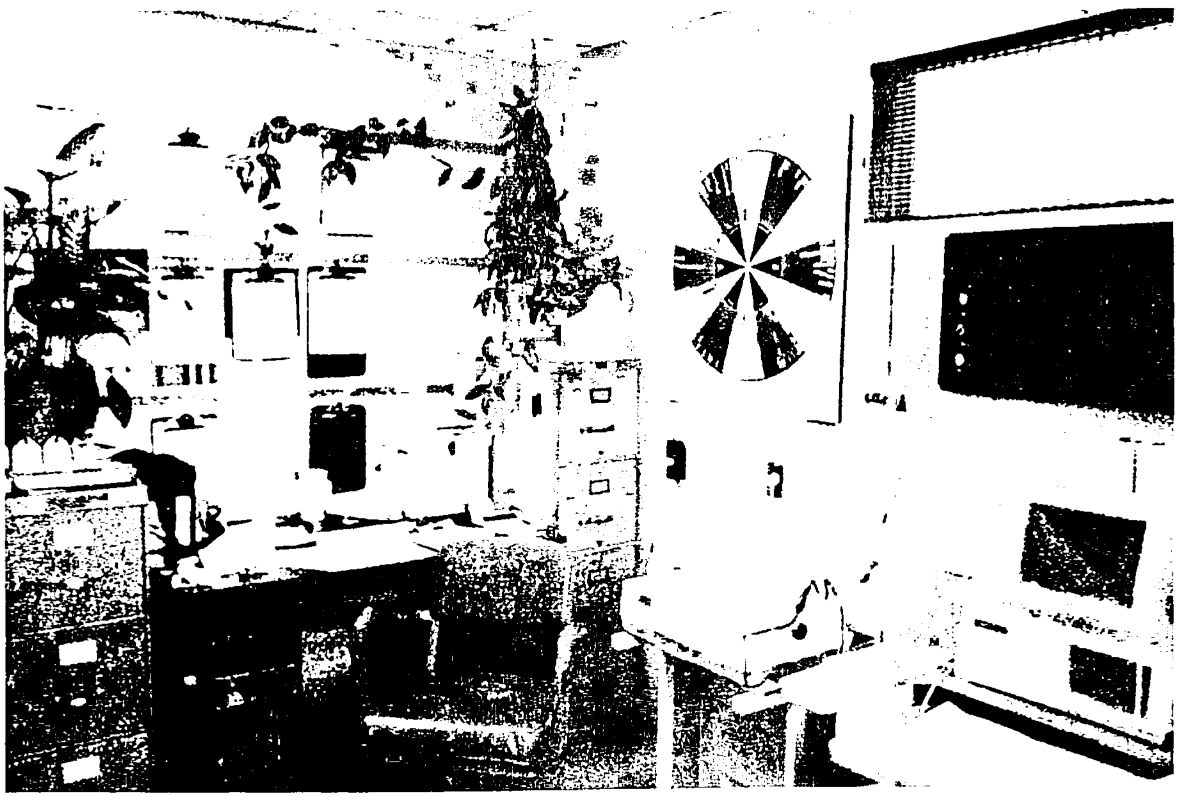
Some methodologies were different in the six studies. In most cases, GnRH was administered immediately after insemination. However, in the study by Pennington et al. (1985), GnRH was given within 2 hr of first detected estrus and cows were inseminated at various intervals after GnRH. The timing of GnRH and AI, relative to detected estrus, was varied in our early work (Stevenson et al., 1984). In spite of these differences, positive effects of GnRH occurred at the recommended dose of GnRH or Cystorelin® (100 μg), when it was given at the time of AI following third or fourth service.

Use of GnRH also increased conception rates of dairy cows at first and second services in several studies. However, based on preliminary work in Israel (personal communication, Y. Folman), it appears that timing of GnRH administration relative to the onset of estrus and the timing of insemination may be critical to its potential success. We are continuing to study these variables in our research. We suggest that the potential advantages for using GnRH be considered relative to its cost and the possibility of no positive response with GnRH use at any service, because of presently unknown factors in some herds.

Table 1. Conception rates of repeat-breeding dairy cows treated with GnRH

No. cows studied	% pregnant Control	% pregnant GnRH	Reference
185	48	73*	Lee et al. (1983) Am. J. Vet. Res. 44:2160.
97	51	66	Stevenson et al. (1984) J. Dairy Sci. 67:140.
92	46	55	Pennington et al. (1985) Bov. Pract. 20:14.
961	38	47*	Phatak et al. (1986) Theriogenology 26:605.
209	46	44	Lewis (1987) J. Anim. Sci. 65(Suppl. 1):185.
513	36	47*	Stevenson et al. (1987) J. Anim. Sci. 65(Suppl 1):418.
2,057	40	50	Weighted average = +10% points

*Higher conception rates than control (P<.05).



COW-SIDE MILK PROGESTERONE TESTING

E.P. Call and J.S. Stevenson

Summary

Cow-side milk progesterone tests are effective in determining the presence of an active corpus luteum (CL) on the ovary. The test is best used as an adjunct to the Preventive Herd Health Program (PHHP) as a means of identifying cows that have not yet been detected in heat and are candidates for synchronization with prostaglandin (PGF). Several test kits are on the market, and all involve similar chemical principles. However, each test has its own protocol, so read and follow directions EXACTLY. A "control" or "standard" sample must be run with each test for comparison.

Introduction

Current technology provides procedures by which progesterone may be estimated in blood or milk. Since progesterone is the product of the corpus luteum (CL), such tests are of benefit in assessing the reproductive status of the cow, if the procedure is cost-effective, reliable, and conducive to on-farm use. Such "cow-side" tests are available and in use. Success or failure of the tests depends primarily on the way in which the results are to be used in management. For example, if the test is to determine pregnancy with an accuracy greater than 90%, the results will be disappointing. If the procedure is used to detect when a cow should be bred, the producer will be misled.

When To Use Test

Cows not yet bred. The greatest benefit of the cow-side test comes from evaluating the status of a cow not yet bred. For example, cows not yet serviced by 60 days or so after calving have the potential of not conceiving by 85 days. Since synchronization programs using prostaglandins (PGF) are effective if cows have functional CLs, a positive progesterone test would identify such cows. The alternative is to identify such cows via ovarian palpation per rectum. The economic benefits are savings of $1.00 - $2.00 per day for cows that are open 85 to 115 days. Also, the average herd calving interval may be reduced by one-half day for each day the interval from calving to first service is shortened.

Table 1 suggests the chances of identifying cows with an active CL based upon the stage of the 21-day estrous cycle. On the average, a cow will have positive progesterone 62% of the time. When a negative test is obtained, another test should be performed in 5-10 days. If the second test is negative, the cow should be examined per rectum to determine ovarian status.

Cows diagnosed cystic. Some cows have luteinized cysts that produce progesterone. If the cow-side test were positive, then PGF could be administered immediately. If the cyst were not luteinized, Gonadotropin-Releasing Hormone (GnRH) or Cystorelin® would be used, followed in 10 days with PGF.

Pregnancy diagnosis. Cows with a positive progesterone test 21-23 days after service have about 75% chance of having a terminal pregnancy. Conversely, cows with a negative test at the same time have a 95% change of being open and should be watched closely for signs of heat. The lowered accuracy (75%) of the positive group results from embryonic abortion after 21-23 days and errors in heat detection at the time of the service. The economic benefit from the cow-side test 3 weeks after service would come from increasing heat detection pressure on those cows suspected to be open.

Heat check -- when to service. The cow-side test is NOT designed to determine the best time for servicing the cow. Remember — the cow-side test only indicates the presence or absence of a CL. Cows with a negative test should be observed closely for signs of heat. As noted in Table 1, an open cycling cow is expected to have low progesterone during 38% (or 8 days) of the 21-day cycle. Cows with low progesterone would be expected to have a functional CL within 10 days, but a cow-side verification test would be indicated before using PGF.

A Word About Synchronization

Using PGF to synchronize cows with active CL (positive progesterone) has been shown to be effective about 90% of the time. However, only one-half of the cows will be identified in standing heat within 3-4 days of PGF injection. These cows, of course, should be bred according to normal procedures. Those cows not detected in standing heat could be time bred at 72 and 96 hr after PGF. In rare cases, such cows may show heat symptoms 5-7 days after PGF and should be re-bred accordingly.

Table 1. Chances of detecting progesterone in milk in relation to to the stage of the estrous cycle in cows[1]

Days of estrous cycle	% of estrous cycle	Progesterone in milk
1 to 4 days	19%	No
6 to 17	62	Yes
18 to 21	19	No

[1]Assumption is made that the cow is cycling and not pregnant.

HOW IMPORTANT IS EXTRA SOLIDS-NOT-FAT IN YOUR MILK?

H.A. Roberts

Introduction

Milk with high solids-not-fat is valuable to the consumer for its flavor and nutritional value and to the manufacturer of milk products, especially relating to cheese yield. Solids-not-fat consists of all solids in milk other than fat. Protein is the most important component of milk because of its nutritional value and its functional properties. Other components, such as milk fat and lactose, also contribute to milk quality and impart certain characteristics to milk products but to a lesser degree.

Milk Composition

The average composition of whole raw milk is:

Protein	3.5%
Lactose	4.9%
Fat	3.5%
Ash	0.7%
Water	87.4%
Total	100.0%

NOTE: The composition values vary depending upon the source of information.

Milk Fat

The major advantage of milk fat is the delicate, pleasant flavor it imparts in fluid milk and other dairy products. Milk fat percentage shows a greater variation than any other constituent in milk. There is a direct relationship between the amount of fat and the amount of solids-not-fat in milk. As milk fat increases, solids-not-fat also increases; however, this relationship is not in direct proportion. In general, an increase of 1% in fat is accompanied by an increase of about 0.4% in solids-not-fat of mixed, whole, raw milk.

Protein

Protein is an important element of the solids-not-fat portion of milk. Approximately 80% of the protein in milk is classified as casein. Casein has many functional properties in dairy products, such as cheese, and many other food and non-food products. The remainder of the protein (approximately 20%) is whey protein (lactalbumin), which remains in the serum after casein is precipitated.

This protein is found in whey during the cheese making operation. Both of these proteins are of excellent quality, although we hear more about casein than whey protein. It has been calculated that the protein in one quart of milk is approximately equivalent to the protein in 5 ounces of meat or fish, 5 large eggs, 4 ounces of cheese, or 16 slices of bread. Milk protein contains most of the essential amino acids needed for growth and maintenance of life.

Lactose

Lactose (milk sugar) is the principle carbohydrate and a major component in milk. Lactose differs from other sugars, such as sucrose, in functional properties because it has a low relative sweetness. It is about 20% as sweet as sucrose. A number of benefits are derived from lactose in milk and milk products, but they are not as well defined as those of milk fat and protein. It does play a significant part in the overall good flavor of milk.

Ash (Minerals)

The mineral content of milk, especially calcium, is important nutritionally. It is reported that milk and milk products provide about 75% of the calcium in the human diet. Other minerals include phosphorus, magnesium, iron, iodine, sodium, and potassium.

Importance of Components of Milk

Today greater emphasis is being placed on the solids-not-fat in milk, especially protein. Therefore, more and more areas of the United States are utilizing component pricing of milk from the producer, which considers fat and solids-not-fat or protein. The importance of components of milk varies with the planned usage for that milk.

Fluid Milk

The promoters of high-solid fluid milk look at the nutritional value and the preference for the taste of fluid milk that has a high content of solids-not-fat. Today, greater concern is placed on nutrition than ever before. In milk and other dairy products, calcium and protein are the major constituents. Over the past few years, there has been a gradual trend to consume less whole milk and more lowfat milk. The need for calcium has been well documented because calcium deficiency has been linked to the bone disease known as osteoporosis. Calcium also has been suggested as a possible factor in the prevention of high blood pressure. The need for protein is well established as a body-cell building block and an essential component of overall nutriton. It is generally accepted that extra solids in fluid milk, especially skim and lowfat milk, make a richer tasting drink. Proponents of more solids in milk also support the opinion that high-solids milk sells better. Opponents feel that the extra cost of fortified-solids milk would have a direct effect on consumption.

Manufactured Milk

For milk used in manufactured dairy products, a greater and more direct effect can be realized by using high solids milk in most cases. Butter production is the exception, since only butterfat is used. In cheese making (hard and cottage cheese), protein (casein) is the most significant milk component used. However, in making hard cheeses, milk fat is also important. In the manufacturing of nonfat dry milk and ice cream, all the solids-not-fat portion of the milk is used. Quality and yield of cheese are the two most important concerns of any cheese maker to maximize his profits. Cheese yields (or the amount of cheese manufactured from a given weight of milk) are directly related to the amount of protein (casein) in raw milk. Thus, the cost of producing a pound of cheese is reduced if high-solids (protein) milk is used, since fixed costs remain unchanged.

Read More About It

Campbell, John R. and Marshall, Robert T. 1975. The Science of Providing Milk for Man. First Edition. McGraw-Hill Book Company.

Ladd, George W. and Dunn, John R. 1979. Estimating Values of Milk Components to a Dairy Manufacturer. J. Dairy Sci. 62(11):1705.

Higher Milk Solids Debated. 1986. Dairymen's Digest, Associated Milk Producers, Inc., March.

EMERGING PATHOGENS IN DAIRY AND FOOD PRODUCTS

D.Y.C. Fung

Summary

Most people working with dairy and food products are familiar with pathogens such as Staphylococcus aureus, Salmonella, Clostridium perfringens, and Clostridium botulinum. There are several new ones that may not be too familiar to the general public. They are described in this summary.

Yersinia enterocolitica

Yersinia enterocolitica is a gram-negative, short, rod-shaped bacterium found in animal intestines. It has been isolated from feces and lymph nodes of healthy and sick animals and humans. It is also found in contaminated milk, cheese, poultry and meat products, and seafoods. The organism can cause gastroenteritis. It is destroyed by standard pasteurization. Since it is a psychrotroph, it is of concern for refrigerated foods in general.

Campylobacter jejuni

Campylobacter jejuni is a gram-negative, spirally curved, rod-shaped bacterium. It causes abortion in cattle and is second only to brucellosis in terms of economic loss to the farmer. It is claimed that this organism causes more cases of gastroenteritis than even Salmonella. Foods incriminated include raw milk, pork, ground beef, and poultry products.

Listeria monocytogenes

Listeria monocytogenes is a gram-positive, short rod. In humans, listeria may produce meningoencephalitis with or without bacteremia. In one major outbreak in 1985, 300 cases were reported with 85 deaths. The organism has been found in cheese and meat products and is of great concern to the dairy industry at this moment.

All these emerging pathogens are killed by proper cooking of food (for example cooking meat to internal temperature of 70C for 10 min). The major problems are recontamination of processed food and undercooking of food. Good sanitation practices, proper food cooking, and handling will reduce greatly risks of food poisoning by these and other pathogens in foods.

OFF-FLAVORS OF ULTRA HIGH TEMPERATURE (UHT) TREATED MILK

W.G. Ikins

Introduction

Ultra high temperature (UHT) treated milks are products that have been subjected to temperatures greater than 130°C for at least one second. A UHT heat treatment of 138°C for 2 seconds can be utilized to pasteurize milk, or in other words to destroy all of the pathogens. This product is not microbiologically sterile, but is thought to keep better than conventionally pasteurized milk. UHT sterilized milk is treated with a more severe heat treatment to produce a product in which all pathogens are destroyed and other microorganisms that may produce undesirable changes during storage are inactivated. These milks receive a heat treatment ranging from 130°C for 8 seconds to 150°C for 2 seconds.

UHT sterilized milk can be packaged aseptically in flexible cartons and stored at room temperature for months. While this characteristic has made UHT sterilized milk a popular product with consumers in Western Europe, the same cannot be said for its commercial success in the U.S. Part of the reason for this lack of acceptance is the different flavor of the high temperature treated milk.

Processing UHT Milk

The heating times of UHT processed milk are so short that an in-container process is not possible. If the holding time of the milk at high temperatures is not carefully controlled, the delicate flavor of the product will be greatly affected. Therefore, a heat exchanger system in which the milk is in a continuous flow must be utilized. There are two general types of heat exchangers: direct and indirect.

The direct heating of milk can be performed in two ways. With either method, the milk is preheated indirectly by coming into contact with plates that have been heated by the out-going product. Steam is injected into the product to produce the desired temperatures. The second process involves the spraying of the product into a chamber containing steam at the desired temperature. The condensed steam dilutes the milk constituents and must be subsequently removed. The milk is cooled from the sterilization temperature and concentrated by spraying it into a vacuum chamber.

The indirect methods of producing UHT processed milk utilize corrugated plates, tubes, or scraped plates to insulate the product from the heating medium, which is usually steam or pressurized hot water. Once again, out-going product is used to warm the in-coming product and the in-coming product is used to cool the out-going product.

The Flavor of UHT Milk

Some researchers have maintained that UHT milk has a purer flavor than conventionally processed milk. It is true that some aromatic compounds in fresh milk responsible for weedy, barny, or feedy odors can be removed during UHT processing. This occurs when milk is sprayed into a vacuum chamber during the cooling process. However, UHT milk still has two major flavor characteristics that influence how consumers regard this product: cooked and stale flavors.

Immediately after processing, UHT milk has a cabbage-like odor, which rapidly dissipates, giving way to a slight cooked flavor. The cooked flavor initially present slowly decreases during the first 3 weeks following processing and then begins to level off. Two weeks after processing, an unpleasant oxidized or stale flavor can be detected and becomes progressively more obnoxious with the age of the UHT milk.

The development of off-flavors, especially stale and/or oxidized flavor, is the most important factor limiting the acceptability of UHT milk. Stale flavor has been described as a paintey, pastey, or cardboard-like defect. There is a great deal of disagreement concerning the compounds responsible for stale flavor. In the dairy chemistry laboratories at Kansas State, we are working on isolating and identifying the compounds involved. In addition, we feel we have discovered a way to greatly reduce the concentrations of these compounds in UHT milk. This project has received a tremendous boost this summer with the acquisition of a mass spectrometer, a sophisticated instrument that fractures and identifies separated chemical compounds.

Read More About It

1. Mehta, R.S. 1980. Milk processed at ultra-high-temperatures. A review. Journal of Food Protection 43:212.

2. Bassette, R., Fung, D.Y.C., and Mantha, V.R. Off-flavors in milk. CRC Critical Reviews in Food Science and Nutrition 24 (1):1.

KSU

RESEARCH IN PROGRESS

Double Inseminations and Cystorelin® for Repeat-Breeding Cows

J.S. Stevenson, J.F. Smith, and E.P. Call

Long-standing recommendations for improving conception rates in lower fertility dairy cows have suggested that double breeding might increase conception. However, little information exists to verify that recommendation. We have demonstrated that these repeat-repeat breeders have increased conception rates when Cystorelin® (100 µg or 2 cc) is administered at the time of insemination. Therefore, the objective of this on-going experiment is to test further the benefit of single and double inseminations followed by Cystorelin® or no further treatment. Cows with at least two previously unsuccessful inseminations will be eligible for treatment in each of four treatment groups: 1) single AI, 2) single AI + Cystorelin®, 3) double AI (first AI at normal time and the second AI given 12 hr later), 4) double AI + Cystorelin® after the first breeding. Upon concluding this study, a recommendation for breeding repeat-breeders should be available.

Effect of Time of Adminstration of Lasalocid on Performance and Ruminal Development of Early Weaned Calves

S. Pruitt, T.G. Nagaraja, J.L. Morrill, P.G. Reddy
T.B. Avery, and N.V. Anderson

Recent research at Kansas State University has shown the beneficial effect of lasalocid in diets for early weaned calves. In that study, lasalocid was given in milk during the first 2 wk of age, and thereafter, lasalocid was made available through pre-starter and starter diets. Significant differences in feed intake and weight gain between the lasalocid-fed and control group were apparent only after 5 wk of age. Therefore, it may be possible to obtain the observed benefit of lasalocid through pre-starter or even starter diets. To determine the time of administration of lasalocid to calves required to elicit the maximum benefit, 48 bull calves will be used. Calves will be assigned to one of four treatments: (1) lasalocid fed in milk, pre-starter, and starter diets, (2) lasalocid fed in pre-starter and starter diets, (3) lasalocid fed in starter diet only, and (4) no lasalocid in milk, pre-starter, or starter diet. Four calves in each group will be ruminally cannulated at 3 days of age. Ruminal samples from each calf will be collected at weekly intervals from 1 to 12 wk of age to measure fermentative and microbial changes. Feed intake, weight gain, and health of all calves will be monitored.

Role of Ruminal Ciliated Protozoa in Subacute Acidosis in Cattle

D.W. Goad, T.G. Nagaraja, and T.B. Avery

Grain overfeeding causes fermentation products of ruminal microorganisms to shift from volatile fatty acid to lactic acid. Ciliated protozoa in the rumen may have an important role in regulating starch metabolism because of their ability to ingest starch and metabolize it slowly to volatile fatty acid, protecting it from rapid bacterial fermentation to lactate. Six ruminally cannulated steers will be assigned to one of two groups: faunated (a normal microbial population including protozoa) or defaunated (a protozoa-free microbial population). The animals will be overfed with an all-grain diet and ruminal samples will be collected to determine pH, osmotic pressure, fermentation product concentration (lactic acid and volatile fatty acids) and changes in microbial populations. Blood will be monitored for changes in pH, blood gases, packed cell volume, and lactic acid concentration. Comparison of ruminal changes in faunated and defaunated steers will indicate the role of ruminal ciliated protozoa in starch fermentation and subacute acidosis.

Use of Progestins and Pulsatile GnRH to Reestablish Ovarian Function in Early Postpartum Dairy Cows

M.O. Mee and J.S. Stevenson

On the average, dairy cows begin to cycle within 14 to 28 days after calving, but are not observed in heat until 35 to 42 days postpartum. Subnormal luteal function often occurs in cows during the natural resumption of ovarian cycles. We are examining presently the effect of a short-term "priming" with a progestin in combination with pusatile gonadotropin-releasing hormone (GnRH or Cystorelin®) on the life span and function of the corpus luteum (CL) after an induced ovulation. Blood samples will be used to examine hormone concentrations, CL function, and duration of ovarian cycles. Our results should provide information concerning the effects of progestin priming on the initiation of normal follicular and luteal function and further understanding concerning the mechanisms associated with the reestablishment of normal ovarian cycles.

Ruminal and Blood Changes Associated with Induced Subacute Acidosis in Cattle

D.W. Goad, T.G. Nagaraja, T.B. Avery, and D.L. Harmon

Subacute or "chronic" acidosis occurs when animals are deprived of a grain diet for some time and begin refeeding suddenly or when the proportion of grain consumed increases in relation to the roughage level. Unlike acute lactic acidosis, the symptoms of subacute acidosis are subtle; rumen pH decreases slightly and animals tend to go off feed or have reduced intake resulting in decreased performance. Six ruminally cannulated steers fed either a high grain (80%) or a high roughage (80%) diet will be overfed with an all-grain diet to determine the changes that occur in the rumen and blood during subacute acidosis. Ruminal samples will be collected to measure pH, osmotic pressure, and fermentation products (lactic acid and volatile fatty acids). Starch-fermenting and lactic acid-utilizing bacteria and rumen ciliate protozoa will be enumerated to determine microbial population changes. Blood samples will be analyzed for pH, blood gases, packed cell volume, and lactic acid concentration.

Thyroidal Imbalances and Effects on Reproduction and Nutrition in Holstein Heifers

R.E. Stewart, M.O. Mee, and J.S. Stevenson

Conception rates and estrous behavior in cattle decrease during the hot months of the year, possibly because the cows become hypothyroid. Hypothyroidism in cows has been associated with increased late abortion, stillbirth, and weak calves; retained placentas; and decreased milk production. Removal of the thyroid gland inhibits libido in bulls and estrous behavior in cows without altering gamete production. Feeding thyroprotein restored sexual behavior in both sexes. We plan to conduct preliminary experiments using Holstein heifers. Estrous cycles of the heifers will be synchronized using two injections of PGF_2-alpha. Heifers will be housed indoors in tie stalls and have a catheter inserted in the jugular vein. Using automatic infusion pumps hooked to the catheters, saline, propylthiouracil, and thyroxine will be infused continuously over approximately 40 days (starting at estrus following synchronization) causing heifers to be euthyroid, hypothyroid, or hyperthyroid. Heifers will be moved into outside pens and watched for estrus at least 4X daily from day 17 to day 22 of the cycle. Pedometers also will be used during the duration of the experiment to record daily activity. Feed intake and body weight will be measured daily, and feed/gain ratio will be calculated. Daily blood samples will be collected and assayed for progesterone, thyroid hormones (T_4 and T_3), thyrotropin (thyroid-stimulating hormone or TSH), estradiol, and testosterone. This preliminary work will document the effects of hypo- and hyperthyroidism on estrous behavior, weight gain, daily activity, and hormonal concentrations in heifers.

Effect of Acidification of Milk Replacers on Nitrogen Utilization by Young Calves

P.G. Reddy, J.L. Morrill, and J.F. Smith

It has become common in recent years to acidify calf milk replacers to decrease pH from about 6.4 to about 5.3. The original reason was primarily to prevent spoilage when milk replacers were fed ad libitum to groups of calves. There is some indication that acidification will increase utilization of milk replacers, regardless of how they are fed; however, there are insufficient data regarding this question. It is possible that response from acidification will depend on the type of milk replacer, e.g., whether it does or does not form a curd in the abomasum. Thus, the objective of this study is to determine the performance and nitrogen retention by calves fed either sweet or acidified milk replacers based on dry skim milk or on whey protein concentrate.

Day-old Holstein bull calves are moved to a metabolism crate, fed colostrum for 3 days, and then assigned to one of the experimental replacers. At 2 1/2 and 5 1/2 weeks of age, nitrogen retention is being determined by total collection of feces and urine for 3 consecutive days. Fecal scores and general condition evaluations are being recorded at each feeding time. Calves are weighed weekly.

Effect of Lasalocid in Ration for Growing Heifers

J.L. Morrill, D.E. Isbell, and P.G. Reddy

Lasalocid is a polyether ionophore antibiotic that is cleared for use in rations for growing dairy heifers. Potential advantages of lasalocid include a beneficial shift in production of ruminal volatile fatty acids, an increased ruminal protein bypass, control of coccidia, and a beneficial effect on mineral metabolism. However, more information is needed concerning the effect on response of young heifers. A study in progress is examining the effect of lasalocid on growth, feed consumption, rumen metabolism, and body composition of heifers from 10 to 24 week of age.

Lymphokine-Activated Killer Cells: Efficacy in Bovine Herpesvirus Type-1 Induced Respiratory Disease

P.G. Reddy, F. Blecha[1], J.L. Morrill, and H.C. Minocha[2]

Our recent research with bovine recombinant interleukin-2 (rIL-2) showed that calves receiving rIL-2 and bovine herpesvirus-type 1 (BHV-1) vaccine withstood a challenge with BHV-1 much better than calves receiving vaccine alone. Serum neutralization titers to BHV-1 were increased sixfold in calves vaccinated and treated with rIL-2 compared to calves that were only vaccinated (70 vs 427). However, even though the dose of rIL-2 that we used (25 µg/kg of body weight for 5 days) clearly had a positive effect on the health of the calves, the lymphokine treatment did produce some serious side effects. Calves receiving rIL-2 became anorexic, developed diarrhea, and exhibited a mild fever. One to two days after the rIL-2 regimen, the adverse side-effects abated. Therefore, the objective of the present research was to determine the dose of rIL-2 that enhances the animal's ability to resist a BHV-1 challenge without causing any side effects.

Twenty-five 4- to 6-month-old calves were allotted by weight to one of five treatment groups: a control and 4 levels of rIL-2. At the start of the experiment (day 0), all calves were vaccinated with a modified-live BHV-1 commercial vaccine. Calves received their respective dose of rIL-2 on days 0, 1, 2, 3, and 4. On day 20, all calves will be challenged with BHV-1. Lymphokine-activated killer cell cytotoxicity against BHV-1 infected target cells, lymphocyte proliferative response to phytomitogens, interleukin-2 production from concanvalin A-stimulated lymphocytes, and antibody response to BHV-1 will be determined on days 0, 5, 15, 20, 23, 26, and 29. Shedding of BHV-1 in nasal secretions will be determined from days 20 to 29. Clinical assessment of calves will be conducted throughout the experiment.

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[1] Anatomy and Physiology.
[2] Laboratory Medicine.

The Livestock and Meat Industry Council, Inc. is a nonprofit, educational, and charitable corporation, which receives and distributes funds that play an important role in programs of the Department of Animal Sciences and Industry. The council is controlled by industry people. Funds generated by the LMIC help accomplish many teaching and research goals.

Funds contributed to the Council are deposited with the Kansas State University Foundation and are used as directed by the Council's Board of Directors or by its Project Review Committee. Donors receive credit from both organizations.

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The Council's individual projects are numerous. The LMIC recently funded research in the Departments of Agricultural Engineering and Animal Sciences and Industry to study sulfur dioxide as a grain preservative. Funds from the Harry Burger Student Enrichment Fund help support the dairy judging team. The LMIC helped fund the research that led to the development of lasalocid by scientists in the Department of Animal Sciences and Industry.

If we are to continue research, our industry needs to supplement state and federal funds. Our industry needs to help support its own research and teaching programs to train tomorrow's industry leaders.

The LMIC is asking stockmen, agribusinessmen, and friends of the livestock and meat industry for liberal contributions. Gifts can be cash, livestock, other gifts-in-kind, and land. Land gifts can be set up as a unitrust that affords the donor a tax deduction and provides for a life income. This offers you the opportunity to invest in your future and in your children's future. All contributions are tax deductible and all contributors become Council members. Checks should be made to the KSU Foundation, LMIC Fund and mailed to:

Livestock and Meat Industry Council, Inc.
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