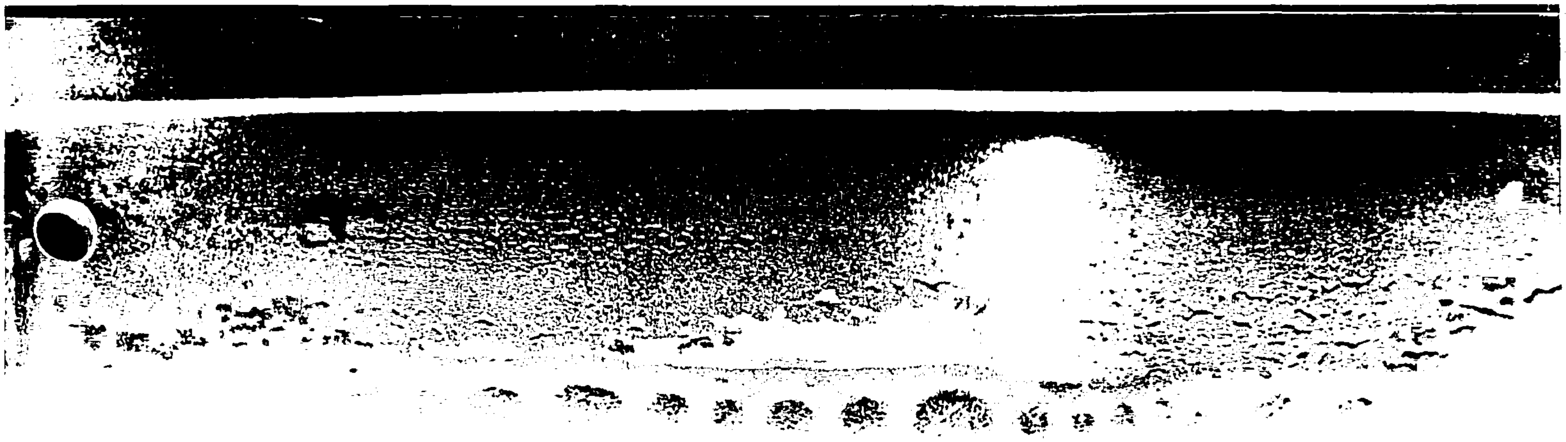


D A I R Y D A Y 1 9 8 6

Report of Progress 506, Kansas Agricultural Experiment Station, Walter R. Woods, Directo

DAIRY DAY -- 1986

MANAGING HIGH PRODUCING HERDS

"The Calf and Heifer Program"

Morning Session — Manhattan Firestation Headquarters

9:00 Registration
Refreshments -- Courtesy of AMPI, MID-AM, and Kansas Mastitis Council
9:45 Welcome -- Dr. Don Good
10:00 Overview: Developing A High-Profit Herd -- John Shirley
10:15 Replacement heifers: Birth to Breeding --Jim Morrill
10:45 Replacement heifers: Health Program -- Tom Avery
11:00 Replacement heifers: Sire Selection -- Keith Heikes
11:10 Replacement heifers: Breeding Management -- Ed Call
11:25 Replacement heifers: Breeding to Calving -- Jim Morrill
11:40 Replacement heifers: "How I manage" -- Panel discussion
Dick Dunham, Moderator
Ron Funk, Dairyman
Mike Currie, Dairyman

Noon Hour Session — Manhattan Firestation Headquarters

Lunch
Annual Meeting -- Kansas Mastitis Council, Darrell York, Presiding
Quality Milk Awards
Regulatory Update, Archie Hurst, Kansas Dairy Commissioner

Afternoon Session -- Dairy Teaching and Research Center

1:00 Demonstrations:
Maternity Barn -- Cow Care at Calving
Newborn Calf Care
Milk Progesterone Test
Milking Parlor -- SCC and Sanitation
Culturing Techniques
Selecting Antibiotics
Treatment Techniques
Cow Lots -- Computer Feeding System -- Experimental results
2:30 Open House
Kansas Artificial Breeding Service Unit (KABSU)
Dairy Processing Plant -- Call Hall

FOREWARD

Members of the Dairy Commodity Group of the Department of Animal Sciences and Industry are pleased to present this Report of Progress, 1986. 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. DHI program shows that cows on test average 15,025 lb milk compared with 8,525 lb for all nontested cows. This means that dairy cows enrolled in DHIA average more income-over-feed cost ($1,033/cow) than nontested cows ($537/cow). Much emphasis should be placed on furthering the DHIA program and encouraging use of its records in making management decisions.

With our herd expansion program that was begun in 1978 after moving to our 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), Ken Frantz (former herdsman), Jim Smith (new herdsman), Dan Umsheid, Mary Rogers, Charlotte Kobiskie, Bill Hanson, Robert Resser, Don Allen, Mark Sellens, and Lloyd Manthe. Special thanks is given to Steve Galitzer, Neil Wallace, Natalie Brockish, Elaine Carpenter, and Angie Hylton for their technical assistance in our laboratories.

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

This Dairy Day Report is dedicated to Dr. Don L. Good who has served as Department Head and Animal Industry leader in Kansas for the past 20 years. A dedicatory citation for Dr. Good is found on the next page. Thanks Dr. Good, for your leadership in our industry.

J. S. Stevenson, Editor
1986 Report of Progress

DEDICATED TO DR. DON L. GOOD

The 1986 Dairy Day is dedicated to Dr. Don L. Good, who as a long-time staff member is well-known to nearly everyone involved in animal agriculture in Kansas.

He was born October 8, 1921, on a general livestock farm in Van Wert County, Ohio, the fourth of five children. Like many other farm families of that era, the Goods survived due to careful budgeting and sheer industry. The work ethic and personal integrity were a family tradition.

Dr. Good entered Ohio State University in 1939. His education was interrupted in his senior year when he served in World War II in the European & Pacific theaters. Returning to OSU he was on the livestock and meats judging teams and was high individual in livestock judging at the American Royal and placed second in the International contest. Following graduation in 1947, Don joined the KSU faculty in September, 1947. His assigned responsibility besides teaching was coaching the livestock judging team and managing the purebred beef cattle herds. He received a master's degree in animal husbandry at K-State in 1950, and later took a leave of absence to complete his doctorate at the University of Minnesota in 1957.

At the outset of his coaching career, Don established himself as a competitor. He had high standards of achievement for his teams, which resulted in winning teams in 14 major contests during a 17-year period.

Don Good is widely known as a livestock judge having judged many times at major national and international shows. More importantly, however, Don has been a leader in implementing needed changes in type and showing procedures. For example, he broke the ice when he selected an Angus/Charolais steer as grand champion at the International in 1969. He was an early and strong proponent of correlating live animal performance in the showring with carcass merit. Don's pioneering attitude and willingness to take risks and criticism have kept him in the forefront of his profession.

Dr. Good was appointed head of the KSU Department of Animal Husbandry in 1966. His enthusiasm and "can-do" attitude were immediately felt as he began building a first-rate department with excellent faculty.

In 1977, the K-State Dairy and Poultry Department was merged into the Department of Animal Sciences and Industry with Dr. Good as head. The combined department now has more than 50 faculty, two academic buildings, and eight research centers.

Under Good's leadership, annual state support of animal science research has increased by more than one-half a million dollars. Don Good marshalled university, industry, and legislative support for the 7.2 million dollar renovation of Weber Hall. This project will enhance the teaching and research efforts of all commodity groups within the Department.

Dr. Don Good's success can be attributed to his appreciation of a balanced teaching, research, and extension thrust and a recognition of the needs and desires of the faculty and staff in the various commodity groups within the Department. The Dairy Commodity group expresses appreciation for Dr. Good's efforts in relocating the DHI laboratory, initiating Dairy Day as an annual event, his leadership in forming a consortial arrangement with Nebraska, Missouri, Oklahoma, and Iowa in the Dairy Research and Teaching areas, his continuing support of the Dairy Teaching and Research Center and Dairy Processing Plant.

Dr. Good has been the recipient of many prestigious awards. In 1973 he received the American Society of Animal Science award for outstanding teaching. The same year he received the K-State Distinguished Teacher Award. Recently he was cited by ASAS for "distinguished service to the animal industry" as well as receiving the Honorary Fellow Award. In 1985 he was selected by the American Polled Herford Association to receive the Hall of Merit Public Affairs Award.

Don and Jane Good have three children. Linda is completing her Ph.D. at Oklahoma State University in clothing, textiles, and merchandising. Craig and his wife, Amy, produce registered SPF Durocs and Yorshires at Olsburg, Kansas. They have two children, Laura and Grant. Gary, a handicapped son, resides at the Kansas Neurological Institute, Topeka.

CITATION FOR CHARLES L. NORTON RECIPIENT OF THE 1986 ADSA-PURINA MILLS, INC. TEACHING AWARD

The 1986 recipient of the Purina Mills, Inc. Teaching Award is Charles L. Norton, Professor of Animal Sciences and Industry at Kansas State University. Even though a considerable portion of his 42-year career has been spent as Head of Department, he always found time and made special effort to be involved with students.

Dr. Norton has taught numerous courses ranging from introductory animal science, to various areas of dairy production, 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.

The recipient 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 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."

Employers speak in unison with high praise for employees who were former students of Dr. Norton's. The high level of performance and the personal and professional growth of these individuals are evidence of the high caliber of instruction and personal guidance provided by Dr. Norton.

His concern and caring for students continue after commencement. He maintains contact with alumni by serving as editor for the Animal Sciences Newsletter. This newsletter is mailed semi-annually to over 5,000 individuals. The purpose of the newsletter is to keep alumni informed of departmental happenings and to share information about alumni with other alumni.

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 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 Department at the University of Rhode Island in 1947. He served as Head of 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 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. He served, on numerous occasions, as judge of presented papers and evaluator of club yearbook and display entries at the national meetings.

Dr. Norton is an approved judge for all breeds of dairy cattle and a classifier of Brown Swiss cattle.

On behalf of the Selection Committee, it is a privilege to present the 1986 recipient of the Purina Mills Inc. Teaching Award, to Charles L. Norton.

BIOLOGICAL VARIABILITY AND CHANCES OF ERROR

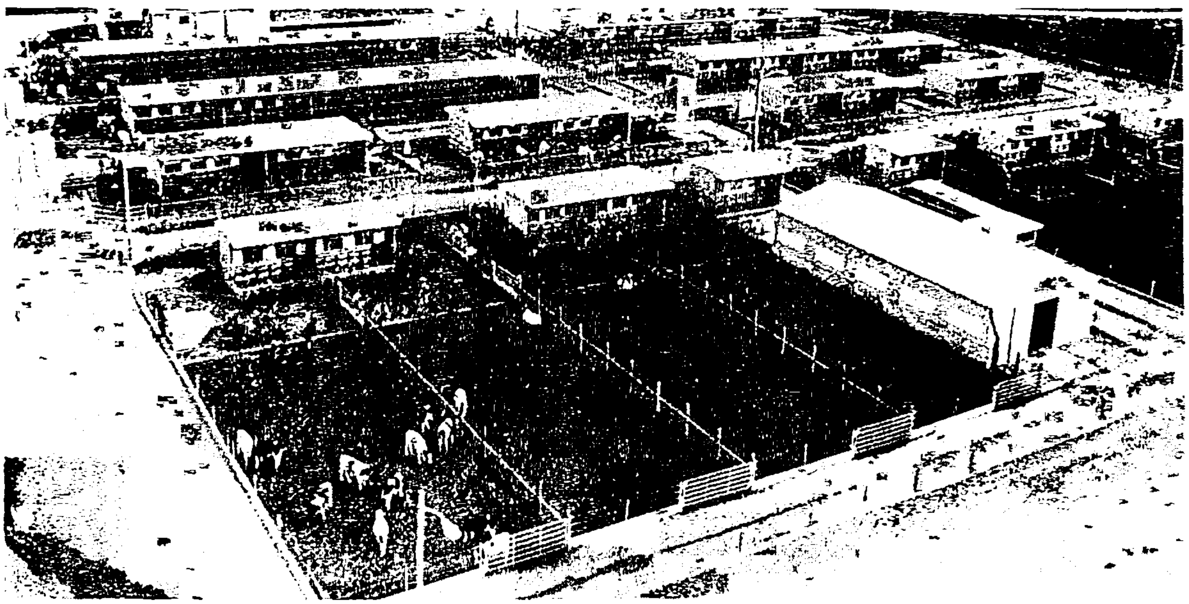
Variability among individual animals in an experiment leads to problems in interpreting the results. Although the cattle on treatment X may have produced more milk than those on treatment Y, variability within treatments may mean that the difference in production between X and Y was not the result of 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.



KSU Dairy Teaching and Research Center

CONTENTS

Mini-Reviews and Updates

OVERVIEW: DEVELOPING A HIGH PROFIT HERD

J.E. Shirley

The present surplus of dairy products has led to a decrease in farm-level milk receipts. Future reductions in the federal milk price support program, together with a predictable increase in feed grain and protein supplement prices, dictates that only the efficient producers will survive. By exercising known management options in the areas of herd health, reproduction, and nutrition, dairymen can increase production per cow, decrease feed cost, and thereby, increase profitability.

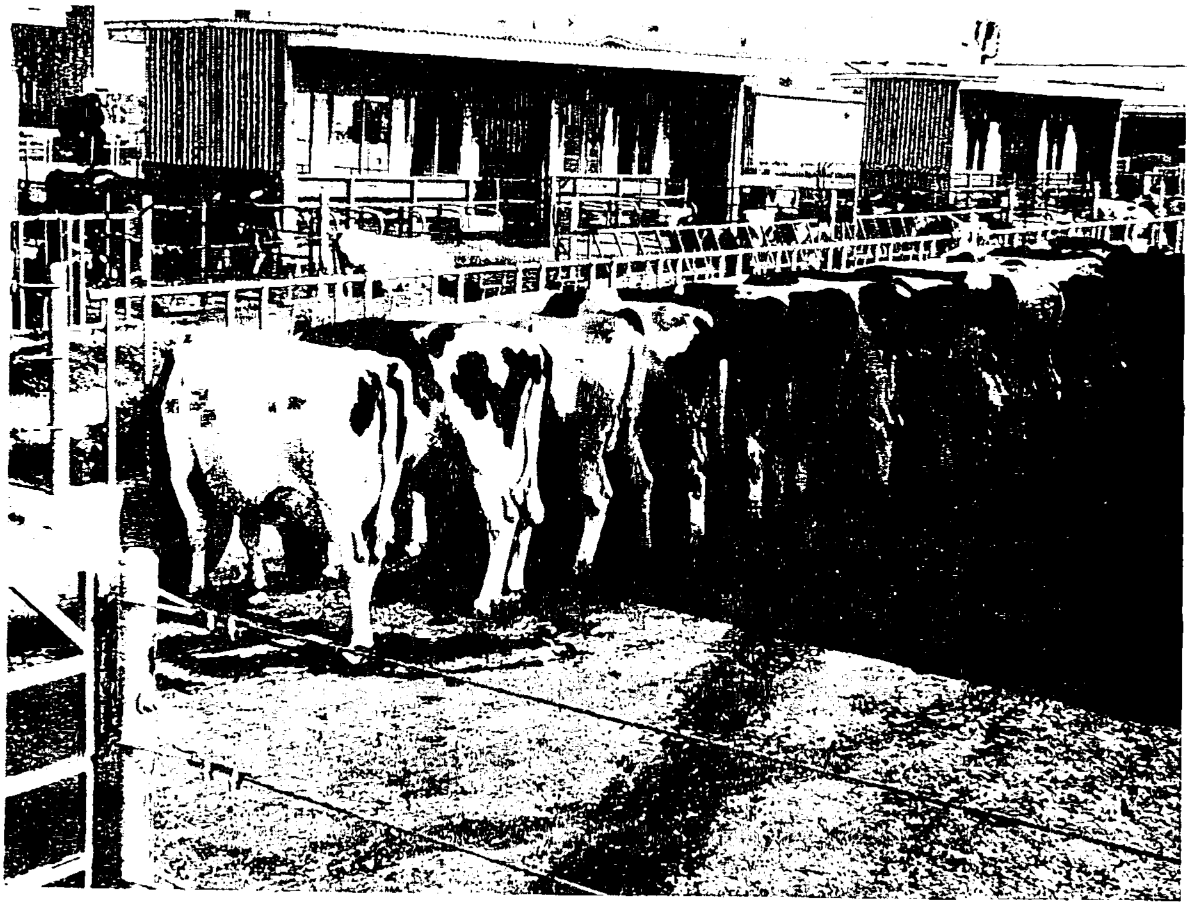
Major management efforts need to be directed toward replacement heifer programs, planned matings, estrous detection, care of the periparturient cow, sanitation, and allocation of concentrate among cows according to milk production. These efforts require only manager time. Other efforts, such as a preventive herd health program (PHHP), require an increase in operational cost but will result in substantial returns per dollar invested.

The term "management" as it relates to agricultural enterprises can be defined as the "combining of land, labor, capital, and management in such a way as to maximize net income or minimize net loss, consistent with the goals of the operator." This definition implies that the manager must manipulate all aspects of a dairy herd simultaneously, rather than concentrating on one aspect at a time. For example, a strong feeding program is ineffective if the cows are not rebred to maintain a 12- to 13-month calving interval. The term "goals" implies that a successful business manager must 1) establish goals that will accommodate a level of income sufficient to cover all costs and provide a return to management and capital investment, 2) develop a logical plan to achieve these goals, and 3) take the actions necessary to meet the goals.

The development of a high-profit herd is a worthy goal, and Kansas dairy producers have the ability to achieve this goal. Each producer will use a different approach but all will adhere to some basic concepts in the process of developing a high-profit herd. These basic concepts include such items as 1) cost-effective balanced diets for each segment of the herd, 2) a breeding program that provides genetically superior replacement females, 3) a herd health program that prevents as well as treats diseases, 4) a reproductive program that accommodates a calf every 12.6 months from mature cows and an average age at first calving of 24 months for replacement heifers, 5) a milking program that emphasizes labor efficiency and milk quality, 6) a record system for production and economic data, 7) continuous monitoring of each phase of the operation by the manager, and 8) simultaneous manipulation of all aspects of the dairy herd.

The average Kansas dairy cow has the genetic potential to produce at least 18,000 pounds of milk annually. This level of production is within reach if known management techniques are applied. Most of this production increase can be achieved without additional capital input. In fact, some of the techniques, such as the allocating adequate grain to high producers and removing excess grain from low producers, will result in a net reduction of capital outlay.

Approximately 45% of the animals in a typical dairy herd consist of replacement females that represent the future success (or failure) of the operation. Therefore, our program for Dairy Day — 1986 accents management of the replacement female - the stepping stone to a high-profit herd.



DAIRY REPLACEMENT HEIFER NUTRITION

J. L. Morrill

The Challenge

Proper nutrition and management are necessary to provide adequate numbers of healthy herd replacements. Satisfactory heifer programs must take into consideration care of the dam and characteristics of the newborn calf, including the deficiency of circulating antibodies at birth and the lack of a functioning rumen.

Care of the Dam

Nutrition. Nutrition of the dry cow is very important because of the effect this has on the next lactation as well as on the developing fetus. Several points should receive special attention. (1) Provide adequate protein and energy to meet requirements. (2) Increase concentrate intake gradually during the last part of the dry period, so that rumen microorganisms will be adapted to the ration to be fed after freshening. Do not allow cows to get too fat. (3) Be sure intake and balance of minerals are correct. A calcium-phosphorus ratio of about 1.4:1 is recommended.

Housing. By nature, the cow attempts to isolate herself from other animals to deliver her calf, and this practice helps prevent contamination of the newborn calf with infectious agents. With increased confinement, this is not possible, and special precautions should be taken to provide a clean environment for the calf during and following calving, when it is highly susceptible to diseases. A clean, well bedded, well ventilated stall should be provided in a location where the cow can be observed frequently with a minimum amount of disturbance.

Other. The udder of the cow should be cleaned before the calf nurses. It is especially important that bacteria do not gain entrance to the intestines before absorption of colostrum takes place.

Care of the Newborn Calf

The newborn calf should be checked as soon as possible to be sure that it can breath normally. Some calves die because of placental membranes over the nostrils or in the throat. Disinfect the navel with tincture of iodine; it may be desirable to repeat this one day later. Be sure that the calf receives colostrum as soon as possible, either directly from the dam, by bottle, or by tube. Calves are able to absorb intact immunoglobulins directly into the blood stream for only a short time. Efficiency of absorption begins to decrease by 4 h after birth and has decreased markedly by 12 h after birth. The importance of colostrum cannot be over emphasized. It is by this means that the calf receives antibodies to help fight infection. The greater the amount of colostrum given at first feeding, up to 2 quarts, the higher the immunoglobin concentration of serum in the calf. The calf should receive at least 4 quarts of high quality colostrum during the first day of life. Measurement of plasma protein at 24 to 36 h after birth will give a good indication of the amount of immunoglobulins absorbed from colostrum. Concentrations greater than 5.5 grams per 100 ml indicate an acceptable level of protection.

Often injections of vitamins are given at this time. Suggested amounts (I.U.) would be: Vitamin A = 500,000; Vitamin D = 75,000; Vitamin E = 50.

The calf can be separated from the dam soon after birth or at any time up to 3 days, depending on individual management. In any case, give the calf colostrum during the first 3 days. Immunoglobulin in the colostrum is beneficial in the digestive tract, even beyond the time when immunoglobulins are absorbed into the blood stream, to help prevent attachment of pathogenic bacteria on the lining of the intestine. Permanent identification (ear tattoo) and ear tag or neck chain identification should be completed before the calf is separated from the dam.

Nutrition of Calf to 3 Months of Age

Liquid Feed

Milk or colostrum. Milk or colostrum are unsurpassed as the liquid feed for calves. An average cow produces about 80 lb of colostrum. Properly diluted, this is enough to feed a calf for about 15 days. If only heifer calves are kept, there may be adequate colostrum to feed until the calves are 4 wk of age. Added to this will be some mastitic milk and milk unsaleable for other reasons. Excess colostrum can be frozen or preserved by allowing it to ferment at environmental temperature. Before use, the colostrum should be diluted at the rate of two parts colostrum to one part water. Some other suggestions concerning fermented colostrum include: (1) store it in plastic containers; (2) don't use colostrum containing antibiotics, which prevent fermentation; (3) stir the fermenting colostrum daily; and (4) don't use colostrum over 3 wk old.

Milk replacer. Some milk replacers also will give good results and may be more economical. These are two things to remember in economic appraisals of milk replacers. (1) Milk replacers are usually much lower in fat content than milk and, thus, are much lower in energy. (2) Milk replacers, when mixed as recommended, often contain more water than milk does and, thus, are not equivalent to milk, even if they were equal on a dry matter basis. A rule of thumb for comparison is—if 25 lb of a good milk replacer (at least 12% fat) can be purchased and mixed for less cost than the value of 160 lb of the milk it replaces, it may be economical to use the replacer. If not, it will not be economical to use the replacer and there would be no other reason to use it. If the decision has been made to use a milk replacer, only a high quality one should be used. Higher calf mortality and unthrifty calves are a high price to pay for a few cents saved in purchase price. The replacer should contain at least 22% protein and 12% fat. Higher fat levels will be beneficial to the calf. Almost without exception, the protein and carbohydrate should come from properly processed milk products such as dried skim milk, dried whey, whey protein concentrate, dried buttermilk, etc. Some other proteins can be utilized by the calf in limited amounts but these must be evaluated on an individual basis. Other types of fat, if properly processed, can replace milk fat. Most milk replacers will contain the proper amount and types of supplementary vitamins and minerals.

Mastitic milk. Mastitic milk can be fed to calves, if the following precautions are observed:

1. Don't feed to calf less than 2 days of age.
2. Don't allow calves to suckle each other.
3. Don't feed to calves intended to be slaughtered soon for meat.
4. Don't feed milk from cows with coliform or Pasteurella mastitis.

Feeding level and frequency. For desirable growth of herd replacements, milk or reconstituted milk replacer should be fed daily at a level of 8 to 10% of birth weight. The higher level would be advised when calves are not doing well, but not scouring, or to compensate for lower energy content of milk replacer. Overfeeding of milk is undesirable because of increased incidence of digestive upsets and because dry feed consumption will be decreased.

Considerable research and experience during recent years have shown that calves perform essentially the same whether fed milk once or twice daily. Young calves should be checked frequently, so one of the best reasons for feeding calves twice daily is that the calves are observed at least that often.

Feeding equipment. For feeding of milk or milk replacer, equipment may range from an open pail to an automatic feeder costing several thousand dollars. For smaller operations, a pail, nipple pail, or nipple bottle are recommended. The nipple pail, especially, is harder to clean, and unless care is taken, may be a source of infection. The nipple bottle is easier to clean than the nipple pail and makes measurements of milk easier. An advantage of the open pail is that it allows "stimulation" of dry feed consumption. Stimulation refers to the act of putting dry feed in the bucket used to feed milk just when the calf finishes drinking milk. In this way, it is taught to eat dry feed. If a pelleted feed that does not break apart in milk is used, the pellets can be put in the milk at the time the milk is given to the calf.

When to wean. With conventional feeding programs, calves are usually weaned after 6 wk of age. Age, size, and health should also be taken into consideration but the most important criterion is dry feed consumption. The healthy calf that is eating at least 1.5 lb of dry feed before weaning can be weaned successfully. Using prestarter and an early weaning program, developed at Kansas State University, calves are being weaned at 2 to 3 wk of age with good results. Advantages of early weaning include reduced sickness, labor required, and feed cost.

Dry Feed

Starter. The rumen of the newborn calf is nonfunctional because of small size and lack of absorptive ability and microbial population. Furthermore, liquid feed does not go into the rumen because of the esophageal grove, which directs the liquid into the abomasum. Development of the rumen takes place when dry feed is consumed and is fermented within the rumen. Thus, in order to hasten rumen development and the time when the calf can be weaned, consumption of dry feed at an early age is important. A good calf starter will contain several ingredients that add to its palatability. Some recommendations concerning calf starters are as follows:

Protein	at least 16%
Net Energy (NEm)	.86 Mcal/lb
Net Energy (NEg)	.54 Mcal/lb
Corn, cracked	at least 30%
Molasses	5%
Wheat Bran	10 to 15%, if starter is pelleted
Oats	15 to 25%
Vitamin A	1000 I.U./lb
Vitamin D	140 I.U./lb
Vitamin E	25 I.U./lb

The mixture should be fed as a coarsely ground, cracked, or rolled mash or as a pellet. Calves do not like a finely ground mixture, so if the particle size is small, the mixture should be pelleted. A soft pellet (but not one that crumbles easily) of about 3/16 inch in diameter is desirable.

If desired, hay can be ground and incorporated into a pelleted total mixed ration at a level of 20 to 25%, or the hay can be chopped and fed along with the concentrate mixture in meal form. An example of a starter that has given good results is shown in Table 1.

Dr. Jim Morrill showing one of his early-weaned calves

Table 1. Example of a good calf-starter diet

Ingredient	% of Diet
Alfalfa, ground	25
Corn, cracked	30
Oats, rolled	20
Sorghum grain, rolled	8.5
Soybean meal	10.0
Molasses, dry	5.0
Dicalcium phosphate	.7
Limestone, ground	.3
Salt	.25
Trace mineral salt	.25
Vitamins A and D	**

*Pellet, 4.8 mm (3/16 inch) diameter
**1000 I.U. Vitamin A and 140 I.U. Vitamin D per lb

Prestarter. Research at Kansas State University and elsewhere has led to the use of a special feed (prestarter) in an early weaning program. This prestarter, which contains milk solids, supplementary fat, and additives, is very palatable to very young calves and, thus, encourages dry feed consumption. The prestarter is pelleted and a small amount can be added directly to milk to stimulate dry feed consumption.

Roughage. Rumen papillary development will not be normal unless calves have access to fibrous feed. The best source is good quality legume-grass hay provided free choice. If a fibrous starter is used, hay may not be necessary for the first few weeks. In either case, hay should be fed after the calves are weaned. Feeding silage to young calves is neither desirable nor practical. Calves on pasture have the advantages of exercise and sunlight but must be fed the proper amount of supplemental feed. They also may pick up internal parasites.

Feeding program. Dry feed should be available to young calves at all times. To encourage consumption, the feed should be kept fresh by feeding in small amounts and changing feed when necessary. If prestarter is used, it should be provided by itself until consumption is 0.5 lb per day. Then a mixture of 0.5 lb of prestarter and whatever amount of starter the calf will eat should be provided until 6 wk of age.

From 6 wk until 12 wk of age, the calf should be allowed to consume all of the concentrate it wants from a self feeder and roughage in the usual form. This concentrate mixture can be calf starter or it may be a less complex grower mixture for calves over 8 wk of age. It is desirable to avoid several stress conditions at once. For example, do not move calves from individual pens to group pens and change feed at the same time. A gradual change from one feed to another is recommended.

Feeding Heifers From 3 Months to Freshening

Calf starter should be formulated to contain ingredients that make it more palatable; however, these ingredients also make it more expensive. There is no point in continuing use of this type of mixture beyond the time when a calf would eat approximately 4 lb per day of a less expensive mixture. Depending on the individual calf and the type of mixture, this usually will be around 8 to 12 wk of age. Often the concentrate mixture fed to the lactating cows will be adequate for calves after 12 wk of age.

Growing heifers need concentrates that provide nutrients not supplied by roughages, thus, the quality of the roughage determines the amount and type of concentrate mixture. Heifers should be bred to freshen no later than 24 months of age. They can be fed so that they will be large enough to freshen even at 21 months of age, and they usually will produce well, but difficulty in calving will likely be a problem. At no time should heifers be allowed to get too fat, since this is expensive and will decrease future production.

Assuming that a weight of 1200 lb at 24 months of age is desirable for Holsteins, a calf weighing 230 lb at 12 wk of age will need to gain an average of 1.5 lb per day during the period from 3 months to 24 months of age. To achieve an average age at calving of 24 months, breeding must commence soon after 13 months of age. A reasonable goal is to have heifers weighing 700 lb at 13 months of age. This requires an average daily gain of 1.5 lb from 3 months to 13 months of age. Since Holstein heifers begin coming into heat at about 600 lb body weight, the heifer would have had several heat periods before breeding. For reproductive efficiency, the heifers should be gaining weight at breeding time.

The above figures are presented as guidelines and should be modified to fit the management programs of the individual dairyman. When possible, roughage and concentrates should be fed together in a complete, mixed ration, with the proportions of roughage and concentrate changed as the need changes. One problem often experienced when concentrates are fed separately is the difficulty in providing the proper amount of concentrate mixture to each heifer, since heifers within a lot often differ in size and aggressiveness. Self-feeding of concentrates and roughage, when the heifers are young, and of mixtures of concentrates and ground hay or straw along with roughage, when heifers are older, offers several advantages. The ratio of concentrate mixture and ground hay or straw can be changed as the heifers grow older and the mixture of grain needed decreases.

Graduate research assistants, Paul Dawson, P. G. Reddy and Paula Flynn tend to one of the calves at the Calf Research Unit

Calf hutches at the KSU Dairy Center

REPLACEMENT HEIFERS -- HEALTH PROGRAM

T. B. Avery [1]

Summary

Common disease causing agents are identified and a sample replacement heifer health program is presented. Written objectives are useful for evaluation of heifer rearing.

Introduction

Replacement heifer health involved most of the general herd health program but has several additional problems. Examples of specific disease conditions encountered by replacement heifers are shown in Table 1.

Table 1. Specific disease conditions

Pneumonia	Diarrheas
Parainfluenza	Rotovirus
Infectious Bovine Rhinotracheitis	Coronavirus
Bovine Respiratory Syncytial Virus	Bovine Viral Diarrhea
Pasteurella Multocida	Salmonella sp.
Pasteurella Hemolytica	E. coli
Hemophilus somnus	Coccidia
Corynebacterium pyogenes	Cryptosproidia
	Nutritional
Parasites	Antibiotic
Lice	
Grubs	Miscellaneous
Internal	Ringworm
	Pinkeye

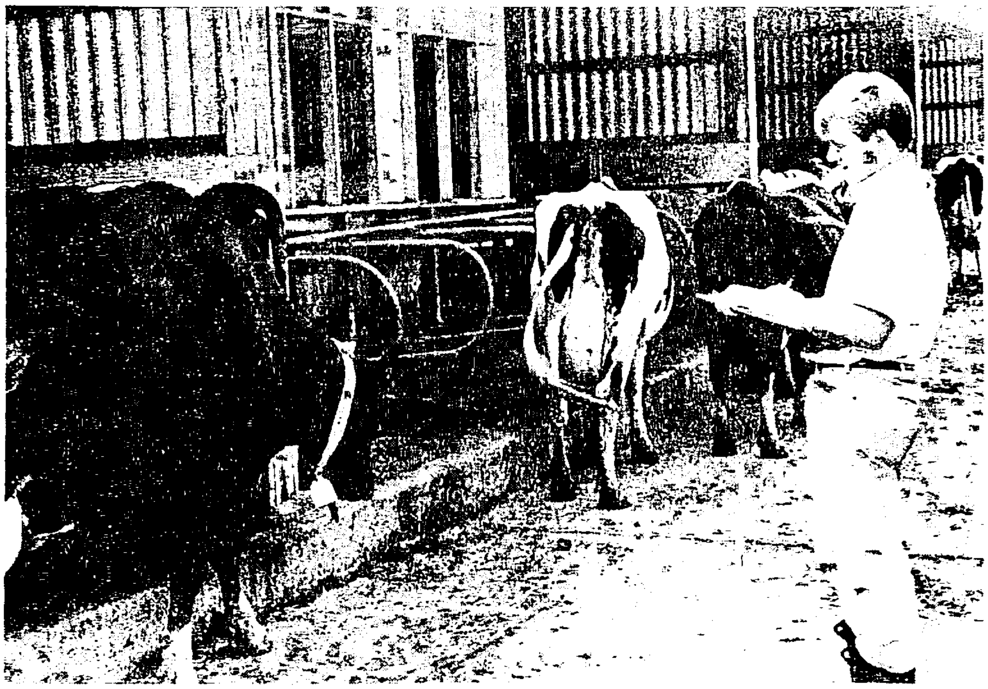
General Concepts

Adequate colostral intake and immunoglobin absorption is the foundation for successful calf rearing. Nutritional intake sufficient for weight gain is probably the next most critical need for a healthy calf. Housing and population density are important because they have a tremendous effect on how the disease agent interacts with the calf. A sample preventative vaccination program is illustrated in Table 2.

[1] Dept. of Surgery and Medicine

Table 2. Sample preventive herd health procedures

Age	Disease	Procedure
7 wk	BVD	Killed vaccine
	IBR-PI3	Intranasal vaccine
	H. somnus	Bacterin
4-6 mo	Brucellosis	Strain 19 (reduced dose)
	Clostridia sp.	7-way
	Supernumerary teats	Removal
	(Calves should be dehorned before 4 mo of age)	
6 mo	BVD	Killed vaccine
	IBR-PI3	Intranasal vaccine
	H. somnus	Bacterin
Pre-breeding	BVD	Killed vaccine
	Clostridia sp.	7-way
	Leptospirosis sp.	5-way
	IBR	Intramuscular
	Internal parasites	Fecal flotation



Keith Heikes, Dairy Specialist at the Kansas Artificial Breeding Service Unit (KABSU), classifying a cow

USING AI CALVING-EASE BULLS

ON REPLACEMENT HEIFERS

K. A. Heikes

Summary

For maximal genetic progress in a dairy, proven AI sires should be selected to use on replacement heifers. To minimize problems at calving, these sires should be selected from bulls that are breed average or better for calving ease.

Introduction

By failing to use AI when breeding heifers, many dairy producers miss a golden opportunity to increase the genetic potential of their herd. Reasons often given include lack of facilities for AI or lack of time to do proper heat detection. With the increased availability of products for estrous synchronization, AI of heifers is now much easier.

By not breeding their heifers to AI calving-ease bulls, dairy producers have 1/3 of their heifer crop each year sired by natural -service bulls that are of questionable genetic quality. In the July 1986 USDA Sire Summary for Holstein bulls, non-AI Holstein bulls had an average Predicted Difference (PD) OF -362 lb milk, -12 lb fat, and -38 $. In comparison, active AI Holstein bulls averaged +818 lb milk, +28 lb fat, and +95 $.

Genetics

The heifer pen on every dairy should contain the best genetic potential on the farm. By mating these replacement heifers to AI sires, even greater genetic progress can be made. DHI records indicate that the average cow has only three calves in her lifetime. By using top AI sires on heifers, the chances of having a heifer calf by a highly plus-proven bull are increased greatly.

Most dairies also experience a higher conception rate when breeding heifers rather than cows. Thus, the more costly (and higher PD) bulls should be used on heifers.

Another consideration for the use of AI sires is the ability to avoid inbreeding. By having a wide selection of calving-ease sires from which to choose, most inbreeding can be avoided.

Calving Ease Summary

The National Association of Animal Breeders (NAAB), with the help of cooperating dairy producers and DHIA, annually publishes a Calving Ease Summary for Holstein bulls. This summary ranks bulls by expected percent of Difficult First Births in Heifers (%DBH) and gives the degree of accuracy for this estimate.

Breed average for %DBH in Holsteins is 10%. Examples are given in Table 1. By selecting bulls that are expected to be 10% or less DBH, a dairy producer should encounter fewer difficult calvings from his heifers. Remember, even bulls with 2 or 3% %DBH will have some calves that cause problems and require assistance.

The maximum %DHB that a producer sets is dictated by individual herd goals. A practical guideline to follow is to avoid using bulls that are above average (11% or higher) for %DBH. By selecting bulls that are breed average or better, dairy producers leave themselves a larger group of sires from which to select. In contrast, if only the top few calving-ease bulls of the breed are used, there is little room for selection of production or type traits.

An accuracy figure was published for the first time with the NAAB Calving Ease Summary this year (Table 1). Accuracy is the reliability that can be placed on %DBH. The closer the accuracy is to 100, the higher the reliability. As a rule, the higher number of direct comparisons a bull has, the higher his accuracy figure is for calving ease. The amount of calving ease information on a bull's sire and maternal grandsire also are used in calculating the accuracy figure.

Producers should remember that even though a bull has a high accuracy figure for calving ease and is ranked as a calving-ease bull, some difficult calvings will still be encountered. A bull with 7% DBH means just that - 7% of his calves born from first-calf heifers will be difficult births, even if the accuracy is 99%. The accuracy figure only indicates that his %DBH is an accurate ranking.

Table 1. Examples of USDA sire summary and calving-ease information for eight active Holstein AI bulls[1]

Name of Bull	PD Milk	PD Fat	PD $$	Calving Ease %DBH	Calving Ease %Accuracy
A	1,531	37	152	5	63
B	1,735	50	185	6	84
C	1,682	57	194	7	100
D	1,220	38	135	9	58
E	1,197	32	124	9	82
F	1,530	36	140	11	95
G	1,545	39	156	15	96
H	2,010	35	177	17	95

[1]Source: Hoard's Dairyman Bull List, Hoard's Dairyman, August 25, 1986.

REPLACEMENT HEIFERS - BREEDING MANAGEMENT

E. P. Call

Summary

Records are the backbone of any breeding program. Artificial insemination (AI) is essential to maximizing genetic gain and minimizing calving problems and breeding costs. In addition, AI allows controlled calving - calving at the dairyman's discretion - not Mother Nature's! Adequately grown heifers should be added to the breeding list during the 13th month of age and serviced to meet the herd's calving goal. Feeding and handling systems should not change during the month preceding and during the breeding period, in order to minimize stress on the reproductive system.

Economic loss because of delayed calving beyond 24 months of age is about $30 per month. With an average age of first calving in Kansas DHI herds of 29 months, the annual loss to Kansas dairy producers exceeds $2 million annually.

Introduction

Calving two-year olds at more than 24 months of age renders an economic hardship on the dairy operation. Current costs of rearing heifers to 24 months of age is near $600 in variable cost plus another $125 in fixed costs for a total investment of about $725 plus the replacement value of the heifer. The cost for delaying calving beyond 24 months is $30 per month. In the average Kansas DHI herd, first-lactation cows calve at 29 months, resulting in a loss of $150 per two-year old, which translates into a statewide loss of more than $2,000,000 per year.

Identification

Replacement heifers are often referred to as "lost souls." In fact, on many farms, replacements become lost because of inadequate identification and/or the press of the daily routine.

Breeding of replacement heifers starts with the correct breeding date and service sire for the dam and carries on to the most important day in each heifer's life - birth day. Recording calf identification, sire, dam, and date at that time will ensure maximal accuracy of this information through the life of the heifer.

The DHI program provides an optimal system for a complete and accurate identification program. The following DHI forms are a part of the recording and retrieving system for proper heifer identification:

DHIA 217 - Calving and Breeding Information (record all calving and breeding dates).

DHIA 202 - Monthly Herd Summary (summarizies heifer calves born each month and urges complete identification).

DHIA 226 - Replacement Females Inventory . . . (semi-annual review of all heifers in the herd along with age - provides guidelines for grouping heifers to breed by age).

DHIA 211 - 21 Day Repro-calendar (provides a record of heats-not-bred (HNB) and breeding dates with anticipated date of next heat).

DHIA 212 - Management Guidelines -- Heifer Option (A monthly reminder of heifers that have reached breeding age and springing heifers).

DHIA 200 - Monthly Individual Cow Report (lists heifers to calve during next month - encourages challenge feeding before due date).

Breeding Systems

Replacement heifers may be bred by artificial insemination (AI) or naturally. For progressive herds looking to the future, 100% commitment to AI is necessary for the following reasons:

1. Cost - AI service/conception is about one-half (1/2) the cost of bull maintenance.
2. Genetic gain - a young bull has about one chance in 12 (8%) of siring daughters above breed average. Bulls in the +80 percentile will sire nearly 70% of their daughters above breed average.
3. Calving ease - AI bulls are screened for calving difficulty and selection can reduce dystocia in first calf heifers.
4. Discrimination - Through AI, the dairy producer decides the right age and weight at which to breed each heifer. Bulls will indiscriminately service any heifer in heat.

AI - Which Way to Go?

Time and heat detection. The time-honored system to breed heifers with AI is to watch for heat and plan AI accordingly. Requirements for this system are:

1. Time and labor to heat check over weeks
2. Close proximity of heifers
3. Facilities for AI of heifers
4. Record system to record HNB and anticipate next cycle

This system has worked well for more than 40 years and has provided near 95% calf crop. Some 5% of all heifers fail to settle, generally from abnormalities of the reproductive system.

Synchronization and AI. Recent advances in reproductive research have provided dairy producers with the opportunity to synchronize heat periods and provide AI for groups of heifers over a much shorter time span. The main benefit of synchronization is that time and labor are reduced, but these are partially offset by drug cost.

Two synchronization schemes are available:

1. Prostaglandin $F_{2}\alpha$ (PGF) -Estrumate® and Lutalyse®. These compounds destroy luteal tissue (corpus luteum or CL or yellow body) in a manner similar to the natural destruction of the CL about 16-17 days after the last heat period.

2. Progestins - Synchromate B®. Progestins have a totally suppressing effect on reproduction. As long as the compound is intact (ear implant), all estrous cycles cease. Once the implant is removed, then the normal cyclic activity resumes and the heifers are in heat after 24 hr.

Both programs are effective in synchronizing a large majority of cycling heifers into heat in a short period of time. The main question becomes: Whether to time AI or heat check and AI? Both programs have schemes by which heat detection can be eliminated. However, practical experience suggests:

1. Use heat check and AI after synchronization; then
2. Time AI for those heifers not detected during the heat-check period; finally,
3. Heat check one (1) day later and re-inseminate any heifer seen in heat.

Note: Follow label directions exactly in the proper administration of the respective drug.

Management Considerations

At this point, it is assumed that growth rates have been adequate and heifers have reached the desired breeding weight during the 13th month of age. Also, heat periods-not-bred (HNB) have been recorded (as many as five). In fact, it is advised to palpate the reproductive tract per rectum of any well-grown heifer not seen in heat by 13 months to check for infantile (free-martin?) organs or utero-ovarian abnormalities. Any heifer (large breed) 13 months of age and over 700 lb should be on the breeding list. Some producers may want seasonal calving or to avoid calving during certain periods. Using the DHIA 226 (Heifer Inventory) or the Management Guidelines -- Heifers (DHIA 212), the month of service may be designated well in advance, or heifers may be grouped for synchronization during a given time period.

The reproductive process is multi-faceted and even slight alterations may lower breeding efficiency. Observe the following management guidelines:

1. Have heifers growing during the breeding period.

2. Avoid making sudden changes in feeding and handling systems within the month preceding and during the breeding period.

3. Plan on repeat heats. Conception rates vary tremendously but 60% would be optimum on first service; 80% conception during a 25-day breeding season; and 90% pregnancy rate after three (3) services.

4. Heat detection is the key to high breeding efficiency. Twice daily heat checks, especially early morning and late evening, other than times of feeding, along with DHIA 211 - 21 Day Repro-Calendar will provide maximal results. While rump patches and chalking, along with teaser (gomer) animals, may help under certain conditions, it is the "Eye of the Master" that makes the final decision - to use AI or not to use AI.

5. Even with all other factors being well managed, improper AI technique

may result in less-than-adequate (or acceptable) breeding results. Generally, heifers settle more efficiently than lactating cows. With heifer AI, an attainable goal for services/conception (S/C) would be 1.3. If S/C is greater than 1.5, then the heifer AI program should be reviewed, including the AI technique itself.

Jim Smith (herdsman) and Dr. E. P. "Ed" Call, Extension Dairy Specialist, working on a problem breeding cow

Elaine Carpenter, research assistant, performing an assay in the Endocrinology lab

INTRODUCING A COMPUTER FEEDING SYSTEM AT VARIOUS LACTATIONAL STAGES FOR DAIRY COWS

J. C. Kube, J. E. Shirley,

K. D. Frantz, and J. S. Stevenson

Summary

Lactating dairy cows were introduced to a computer feeder in early ($\leq$ 120 days in milk or D.I.M.), mid (120-220 D.I.M.), and late (>220 D.I.M.) lactation. Cows in the mid- and late-lactation groups adjusted quicker and exhibited a smaller decrease in production, relative to the early lactation group.

Introduction

Computer-controlled feeders are increasing in popularity nationwide and are creating some interest among dairy producers in the midwest. Computer-controlled feeders allow dairy producers with small to medium-sized herds to feed their cows according to production without dividing cows into groups or dispensing feed in the parlor. Many times, a producer considers only the cost of purchasing the computer feeder, but should realize that there is an additional expense involved in adjusting the cows to the feeder. This trial was designed to establish some guidelines as to when to introduce cows to a computer feeder, while holding production as close to normal as possible.

Procedures

One-hundred and seven Holstein cows were divided into three groups according to their days in milk (D.I.M.). All cows continued to receive free choice alfalfa hay. The mid- and late-lactation cows also received 20 lb corn silage per day. All cows received the same milo and soybean meal-based concentrate, and each was allotted the same amount before and after the change. The early cows had free choice concentrate out of a self-feeder, whereas the mid and late cows received their concentrate out of the bunk, two times per day before switching to the computer feeder.

Results and Discussion

The changes in milk traits from 3 days before the feeder was turned on to 10 days after are recorded in Table 1. The only significant changes were a drop in milk yield and an increase in percentage milk fat in the early group, and a drop in percentage milk fat in the mid group. Somatic cell count (SCC) and milk cortisol were measured to indicate the level of stress on the cows during the changeover. There was a trend toward increased SCC and decreased milk cortisol. Our results fail to indicate an increased level of stress throughout the trial.

Table 1. Absolute and percentage change in milk traits for cows newly exposed to a computer feeder at three stages of lactation[a]

Milk Trait	Lactation		
	Early	Mid	Late
Yield, lb	-4.3[b]	1.6	-0.4
% change	-6.7	4.0	-1.9
Fat, %	0.16[b]	-0.37[b]	-0.10
% change	5.0	-9.4	-2.5
Protein, %	-0.04	-0.09	-0.06
% change	-1.3	-2.7	-1.6
Somatic cells, 10^3	40	92	186
% change	15.5	49.2	63.9
Cortisol, ng/ml	-0.23	-0.09	-0.25
% change	-21.6	-9.8	-24.2

[a]Changes in milk traits were calculated from an average of each trait for 3 days on self or bunk feeders and an average of that trait for 10 days after changing cows to the computer feeder.

[b]Significant increase or decrease in milk yield or milk fat after changing cows to the computer feeder.

The feed intake data are recorded in Table 2. These data explain why there was a drop in milk production and an increase in percentage milk fat in the early group. These cows ate less concentrate and more alfalfa hay during their adjustment period. The mid and late groups showed some drop in concentrate intake, but were able to maintain production because their needs were not as critical as those of the early group.

Table 2. Dry matter intake (lb)

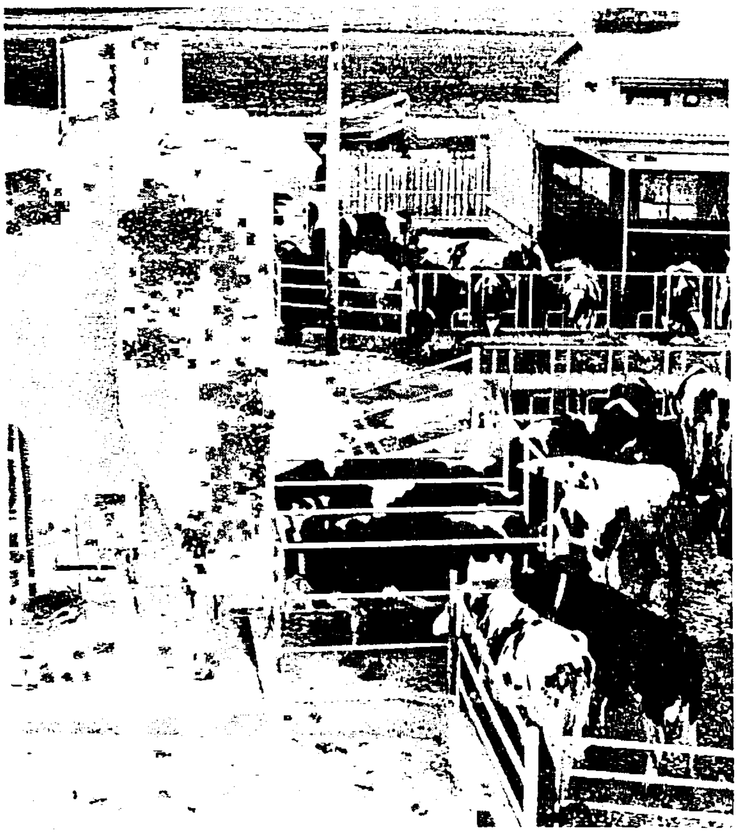
Group		Day of Trial		
		-3 to 0	0 to 4	5 to 15
Early	Alfalfa Hay	F.C.	19.1	17.6
	Concentrate	F.C.	22.2	23.0
Mid	Alfalfa Hay	F.C.	16.1	11.0
	Corn Silage	7.0	7.0	7.0
	Concentrate	22.6	15.0	15.5
Late	Alfalfa Hay	F.C.	20.7	12.8
	Corn Silage	7.0	7.0	7.0
	Concentrate	8.7	6.6	8.1

F.C. = Free Choice

Conclusions

1. Cows introduced to a computer feeder in the mid- to late-lactational states will maintain production.

2. Cows introduced to a computer feeder in early lactation will exhibit a decrease in production and may not return to the pre-computer-feeder level of milk yield during the current lactation.



A view of computer feeding stations at the KSU Dairy Center

IS A COMPUTER FEEDER NECESSARY IN THE DRY COW LOT?

J. C. Kube, J. E. Shirley, and K. D. Frantz

Summary

Springing heifers and dry cows were introduced to a computer feeder either 2 wk before their estimated freshening date or at calving. There was no significant difference in milk production, percentage milk fat, percentage milk protein, or somatic cell count (SCC). Lead feeding with a computer feeder resulted in a 40% decrease in concentrate consumption over bunk feeding during the dry period.

Introduction

When purchasing a computer feeder, dairymen must decide if a feed station is necessary in the dry cow lot. This trial was designed to determine if there is a benefit to having a feed station.

Procedures

Twenty-six springing heifers and 22 cows were challenge-fed either by the computer feeder or in a bunk starting 2 wk before the expected calving date. The computer-fed group started at 5 lb of grain intake per day. This level was increased daily to acheive 1% of body weight of grain intake by the expected calving date. The bunk-fed group received 16 lb of grain per day until calving. Both groups were housed in the same lot after calving and managed equally. Milk production and composition, SCC, and bodyweight were monitored for the first 9 wk of lactation.

Results and Discussion

Differences in production are shown in Table 1. Cows and heifers that were lead-fed by the computer feeder produced less milk with a lower percentage milk fat, but a higher percentage milk protein and a lower SCC. These values were not significantly different. The small difference may be explained by the fact that bunk-fed animals consumed more grain during their last 2 wk of gestation (Table 2). Table 3 illustrates the body-weight changes following calving. The computer-fed group gained more weight in the first 9 wk of lactation than the group that was bunk-fed.

Table 1. Differences in measured milk parameters[a]

	Averages over the first 9 weeks of lactation			
Group	Milk Weight lb	Milk Fat %	Milk Protein %	SCC (1000's)
Heifers	-3.1	-.32	+.03	-7
Cows	-4.6	-.13	+.15	-83

[a]The difference between the computer-fed group and the bunk-fed group. Positive (+) number indicates that the computer feeder group had a higher value. Negative (-) number means the computer feeder group had a lower value.

Table 2. Grain intake during last 2 weeks of gestation

Item	Computer Lead-Fed	Bunk Lead-Fed
Days lead fed (average)	12.3	13.7
Total grain intake (lb)	86.5	219.6
Average grain intake per day (lb)	7.0	16.0

Table 3. Body weight (lb) of computer-fed (CF) and bunk-fed (BF) cows and heifers

	Heifers				Cows			
Week	CF		BF		CF		BF	
-2	1181		1210		1454		1503	
1	1016		1076		1313		1379	
5	1054	+77[a]	1087	+37[a]	1298	+14[b]	1346	-22[b]
9	1093		1113		1327		1357	

[a]Two values are significantly different ($P<.05$).

[b]Two values are close to being significantly different ($P<.07$).

It appears that the animals that were computer-fed consumed more grain in their first 9 wk of lactation than their counterparts, as noted by their advantage in body weight gain. Bunk-fed cows were mobilizing body reserves stored before calving, which accounted for their slightly higher milk production. It should be noted that the animals in the bunk group happened, by chance, to be larger than the animals in the computer group. This may explain some of their advantage in milk production.

Economics

The amount of money that would be saved by the lower intake of grain by the computer-fed group is shown in Table 4.

Table 4. Grain savings with computer feeder compared to bunk feeding

Computer Lead Fed Group	Bunk Lead Fed Group
7.00 lb Daily intake (Table 2)	16.00 lb Daily intake (Table 2)
x 4.5¢/lb[a]	x 4.5¢/lb[a]
31.5¢/hd/day	72¢/hd/day
x14 days	x14 days
$ 4.41/hd/year	$10.08/hd/yr

$10.08
-4.41
$5.67 savings/head/year

[a]Assumes concentrate cost at $90/ton.

Recommendations

1. Production does not increase with the use of a computer feeder in the dry cow lot.

2. Some feed savings is expected with the use of a computer feeder in the dry cow lot.

3. Cows did not show any signs of problems in adjusting to the computer feeder after calving.

Therefore having a computer feed station in the dry cow lot is not necessary, if the dairyman can still lead-feed the cows by some other means. If there is no other means of lead feeding, a computer feeder may be economical.

EFFECT OF DIET ON RUMINAL LACTIC ACID UTILIZATION AND LACTIC ACID-UTILIZING BACTERIA

G.W. Miller and T.G. Nagaraja

Summary

The effect of diet on in vitro lactic acid utilization rate and counts of lactic acid-utilizing bacteria was determined in ruminally cannulated steers. The steers were adapted to an alfalfa diet and gradually switched to an all-grain diet. The in vitro lactic acid fermentation rate increased with increased grain intake. Concurrently, the proportion of lactic acid-utilizing bacteria also increased. The increased population of lactic acid-utilizing bacteria is responsible for preventing lactic acid accumulation in the rumen of cattle adapted to consume a high-grain diet.

Introduction

Ruminal acidosis is a metabotic disease caused by the excessive ingestion of feeds that contain readily fermentable carbohydrates. Carbohydrates in high grain diets are fermented to lactic acid by ruminal bacteria and protozoa. If the lactic acid is not utilized fast enough, it increases in concentration, lowers ruminal pH, and leads to acidosis. The utilization of lactic acid is dependent upon the establishment of lactate- utilizing bacteria in the rumen. In most management systems, this is achieved by a gradual increase in the concentrate portion of the diet. The purpose of this experiment was to determine the effect of diet on rate of lactate fermentation and on the counts of lactate-utilizing bacteria.

Procedures

Three ruminally cannulated steers were adapted to an alfalfa (dehydrated pellets) diet and gradually switched to 50:50 and 0:100 alfalfa:grain diets (12% crude protein) at 2-wk intervals. The composition of the grain portion of the diet was corn (49.3%), milo (49.3%), dicalcium phosphate (0.75%), trace mineral salt (0.5%), and vitamins A and D (0.2%). The diet was fed in equal amounts 12 times a day. Ruminal fluid samples were collected from steers on 100:0, 50:50, and 0:100 alfalfa:grain diets. In each sampling period, samples were collected from each steer on 3 consecutive days. Ruminal fluid samples were strained through four layers of cheesecloth and used to determine in vitro lactate fermentation rate and counts of total viable anaerobic and lactate-utilizing bacteria. The in vitro lactate fermentation rate was determined by incubating ruminal fluid in a buffered medium containing sodium lactate under anaerobic conditions. The fermentation rate was determined by the rate of disappearance of lactate during a 2-h incubation.

Results and Discussion

In vitro lactate fermentation rate and counts of total anaerobic and lactate-utilizing bacteria are shown in Table 1. With increasing amounts of grain in the diet, the in vitro lactate fermentation rate for L(+) and D(-) lactic acid, respectively, increased from 16.2 mg/100 ml ruminal fluid/hour and 18.0 mg/100 ml ruminal fluid/hour at 100% alfalfa diet to 106.1 and 80.4 mg/100 ml ruminal fluid/hour at 100% grain diet. Concurrently, the proportion of lactic acid-utilizing bacteria increased from 9.0 to 39.7% of the total bacterial population. Increased grain intake also increased the total bacterial counts.

Gradual adaptation of cattle to a high-grain diet results in increased numbers of lactic acid-utilizing bacteria. Higher numbers of these bacteria metabolize lactic acid produced as a result of the high grain diet and, therefore, prevent accumulation of lactic acid in the rumen.

Table 1. Dietary effect on bacterial counts and in vitro lactate disappearance rates

Diet (%)		Bacterial Counts[1]			In Vitro Lactate Disappearance Rates[2]	
Alfalfa Pellets	Grain	Total Anaerobic	Lactic Acid-utilizing counts	%	L(+)	D(-)
100	0	13.4	1.2	9.7	16.2	18.0
50	50	47.2	4.6	9.9	66.3	30.5
0	100	74.5	29.6	39.7	106.1	80.4

1 In billions per gm of ruminal dry matter.

2 Mg of lactate/100 ml of rumen fluid/h.

RUMINAL MICROBIAL DEVELOPMENT IN CONVENTIONALLY OR EARLY WEANED CALVES

K.L. Anderson, T.G. Nagaraja, J.L. Morrill
T.B. Avery[1], J.E. Boyer[2] and S.J. Galitzer

Summary

Calves weaned at 4 wk of age had higher dry feed intake, resulting in greater ruminal microbial activity than calves weaned at 6 wk of age. Adequate microbial populations appear to be present very early in the rumen of calves, and subsequent development is stimulated by increased dry feed consumption. Our data suggest that the earlier dry feed is introduced into the calves' rumen, the earlier microbial development occurs, resulting in higher ruminal metabolic activity.

Introduction

The rumen of a newborn calf is not anatomically developed or fully functional, but develops as the calf matures. Dry feed consumption stimulates this development. Because maturation of the rumen enables the calf to consume fiber and starch, it is desirable to accelerate this process.

An early weaning program has been worked out by previous research at Kansas State. This program is specifically intended to encourage dry feed consumption by young calves, enabling them to be weaned by 4 wk of age (Table 1). Because calves are conventionally weaned at 6-11 wk of age, this experiment was conducted to detect differences in microbial population and fermentation products that may occur in the rumen of calves on the early weaning program.

Procedures

Eight bull calves were removed from their dams within 24 hours postpartum and placed in calf hutches. The calves were fed colostrum until 3 days of age, and then fed whole milk, at 8% body weight, until weaned. At 3 days of age, the calves were ruminally cannulated and placed into one of two treatment groups. Calves in the early-weaning group were weaned at 4 wk of age. The second (conventionally weaned) group was fed a calf starter ad libitum and weaned at 6 wk of age.

Ruminal fluid was collected 3 h after feeding from all calves at 3 and 7 days of age, and thereafter at weekly intervals through 8 wk of age, and then at 10 and 12 wk of age. The rumen fluid was analyzed to determine the size of microbial populations. This included total aerobic and anaerobic bacteria, individual groups of bacteria that produce lactic acid, and those that digest or utilize

[1]Dept. of Surgery and Medicine
[2]Dept. of Statistics

cellulose, starch, lactic acid, and casien. Also, populations of methane-producing organisms and protozoa were monitored.

Results and Discussion

Total anaerobic bacteria tended to increase in numbers as the calves aged, while total aerobic bacteria decreased (Table 2). The early-weaned calves had a significantly larger population of lactic acid-producing Lactobacillus at 6 wk of age and a significantly larger population of lactate utilizing bacteria at 5 wk of age than the control group. This coincided with the higher lactic acid concentration also found in the early-weaned calves at about this age.

Early-weaned calves also had larger populations of starch-digesting bacteria at 6 and 7 wk of age than the conventionally weaned calves (Table 3). This may have been associated with the higher feed intake of the early-weaned calves (Table 1).

Casein-fermenting bacteria increased as the calves aged, but no significant difference was found between the two groups.

Cellulose-digesting bacteria were dectected in calves of both groups as early as 3 days of age, and their increase was dependent on increased feed consumption. No significant difference in the numbers of these bacteria was detected between the two groups (Table 3).

Methane-producing organisms were also detected in some calves of both groups as early as 3 days of age. The methanogen population increased as the calves matured (Table 3), but the nature of these organisms makes them dependent upon the metabolic activity of other rumen microbes. Therefore, as microbial activity in the rumen increased, methanogenic populations increased. Higher numbers of methanogens between 5 and 8 wk of age in early-weaned calves were indicative of greater metabolic activity than in calves in the conventionally-weaned group.

No protozoa were detected in calves of either group. The isolation of the calves from older ruminants and the low pH of the rumen for the first several weeks of age probably made conditions unfavorable for protozoal establishment.

Table 1. Average daily feed intake[1]

Treatment Group			Age (Weeks)								
	.5	1	2	3	4	5	6	7	8	10	12
Early-Weaned	0	30	40	140	360	910	1360	1820	1910	2590	3000
Conventionally Weaned	0	0	0	40	140	230	500	950	1450	1910	2630

[1]Kilograms of dry feed.

Table 2. Total anaerobic and aerobic bacteria

Treatment Group	Age (weeks) 1	2	4	6	12
Anaerobic[1]					
Early-Weaned	5.3	3.2	6.3	11.0	3.6
Conventionally Weaned	3.7	2.1	6.0	3.9	8.0
Aerobic[2]					
Early-Weaned	250	110	3	6	1
Conventionally Weaned	530	95	3	3	1

[1]In billions of bacteria per gram of rumen fluid.

[2]In millions of bacteria per gram of rumen fluid.

Table 3. Starch digesting, cellulose digesting, and methane-producing bacteria

Treatment Group	Age (weeks) 1	2	4	6	12
Starch digestors[1]					
Early-Weaned	3.1	1.9	5.7	10.0	4.8
Conventionally Weaned	.8	1.9	5.5	2.8	9.1
Cellulose disgestors[2]					
Early-Weaned	0.4	.003	.14	16.0	1200
Conventionally Weaned	.04	.009	.58	6.6	7000
Methane producer[3]					
Early-Weaned	.0004	.0001	.06	120	73000
Conventionally Weaned	.0004	.002	.04	21	47000

[1]In billions of bacteria per gram of rumen fluid.

[2]In ten thousands of bacteria per gram of rumen fluid.

[3]In hundred thousands of bacteria per gram of rumen fluid.

RUMINAL METABOLIC DEVELOPMENT IN CONVENTIONALLY OR EARLY WEANED CALVES

K. L. Anderson, T. G. Nagaraja
and J. L. Morrill

Summary

Accelerating the weaning age of calves appeared to increase their ruminal metabolic activity. This was indicated by the lower ruminal pH and increased, total volatile fatty acid concentration of calves weaned at 4 wk of age compared with those weaned at 6 wk of age.

Introduction

A relationship between dry feed consumption and rumen development of newborn calves has been well established. Although the rumen has an innate ability to develop, feeding only liquid or low amounts of dry feed will greatly decrease the rate of ruminal development. An early weaning program has been shown to increase feed consumption of calves and thereby allow weaning by 4 wk of age. The objective of this investigation was to monitor changes in the metabolic products in the rumen of early-weaned or conventionally weaned calves from birth to 3 mo of age.

Procedures

Eight bull calves were removed from their dams within 24 hours postpartum and placed in calf hutches. The calves were fed colostrum until 3 days of age, and then fed whole milk, at 8% body weight, until weaned. At 3 days of age, the calves were ruminally cannulated and placed into one of two groups. Calves in one group were placed on the early weaning program and weaned at 4 wk of age. The second group comprised the conventionally weaned calves. They were fed a calf starter ad libitum and weaned at 6 wk of age.

At 1, 4, 8 and 12 wk of age, ruminal fluid was collected from all calves at 0, 1, 2, 3, 4, 6, 8 and 12 h postfeeding. The samples were analyzed for pH, and volatile fatty acid (VFA), lactic acid, and ammonia concentrations.

Results and Discussion

Calves in both groups exhibited similar trends for ruminal pH during the 12-hour sampling periods, with the pH decreasing for 1-3 hours postfeeding, and then gradually increasing to prefeeding levels by 12 hours. However, early-weaned calves consistently had lower ruminal pH than the conventionally weaned group (Table 1). This indicated a higher metabolic activity in the early-weaned calves. Concurrently, the total VFA concentration peaked at 1-3 hours postfeeding and then decreased. Again, early-weaned calves consistently had higher total VFA concentrations than calves in the conventionally weaned group (Table 2).

Milk was the major portion of the calves' diet at 1 wk of age, and this resulted in a high proportion of acetate in the rumen. As dry feed consumption of the calves gradually increased and milk consumption stopped, the overall proportion of acetate deminished and the proportion of propionic acid increased. No significant difference in the proportions of acetic acid or propionic acid was found between the two groups. On the other hand, the proportion of butyric acid was significantly higher in early-weaned calves than in the control group. Low pH stimulates the production of butyric acid, thus, the lower pH of the early-weaned calves may be associated with their higher percentage of butyric acid.

Lactic acid concentrations were highest at 4 wk of age for both groups and then decreased by the 8th week of age. Although no significant difference between the two groups was found, there was a trend toward higher lactic acid concentrations in the early-weaned calves (Table 3). Ruminal ammonia concentration decreased as the calves aged. This is indicative of increased bacterial utilization and ruminal absorption of ammonia. Although no significant difference in ammonia concentration was found between the two groups, milk intake has been shown to increase ruminal ammonia concentrations, and unweaned calves generally have higher ruminal ammonia than weaned calves.

Table 1. Ruminal pH

Treatment Groups	Age in Weeks 1	4	8	12
Early-Weaned	6.8	5.8	5.7	6.0
Conventionally weaned	6.8	6.1	6.2	6.2

Table 2. Total ruminal volatile fatty acid concentrations (mM)

Treatment Groups	Age in Weeks 1	4	8	12
Early-weaned	20.2	67.4	100.9	110.2
Conventionally weaned	22.9	50.9	91.6	89.5

Table 3. Total ruminal lactic acid concentration (mM)

Treatment Group	Age in Weeks 1	4	8	12
Early-weaned	.04	2.3	.19	1.0
Conventionally weaned	.10	.35	.06	.02

Dr. T. G. "Nag" Nagaraja and Kevin Anderson, graduate research assistant, prepare to sample through a rumen fistula in a research calf

EVALUATION OF HIGH-ENERGY CALF STARTER FOR EARLY-WEANED CALVES

W. H. Carinder, P. G. Reddy, and J. L. Morrill

Summary

An experimental calf-starter diet containing roasted whole soybeans, buffer and dehydrated alfalfa pellets was compared with a conventional calf starter for young calves on an early-weaning program. Overall means for weight gains, dry feed consumption, and fecal scores were similar for the two treatments. However, calves fed the experimental calf starter showed a trend toward higher gains at 4 and 5 wk of age. More fat than necessary in the diet and feeding of prestarter until 8 wk of age may have precluded finding significant benefits with the experimental starter.

Introduction

Whole soybeans processed by roasting have not been evaluated in the early-weaning program. Ground alfalfa has been used as an ingredient in calf starters for many years; however, some dairy producers do not have ground hay available for use. One possible substitute is ground, pelleted, dehydrated alfalfa. Formerly, some dehydrated alfalfa was not palatable for young calves. Currently lower temperatures and less heat are used to dehydrate alfalfa, resulting in a product that is apparently more palatable. In some experiments, adding sodium bicarbonate to calf starters has improved calf growth, but this ingredient has not been used in a starter for an early-weaning system.

Studies are needed to evaluate roasted whole soybeans, dehydrated alfalfa, and sodium bicarbonate in a starter used in an early-weaning system.

Procedures

Thirty Holstein heifer calves (15 per group) were allotted at birth to two treatments: 1) a conventional calf starter, or 2) an experimental calf starter. The ingredient compositions of the calf starters are presented in Table 1. The conventional starter was pelleted (3/16 in diameter). Calves were fed colostrum for 3 days after birth, then milk at 8% of birth weight until weaning. All calves were stimulated to eat dry feed by putting a small amount of prestarter[1] in their milk. Prestarter was available ad libitum until consumption reached 0.5 lb daily, then a small amount of starter was added daily to 0.5 lb prestarter. Starter was increased as consumption increased. Each calf was weaned when consuming 1.5 lb dry feed per day. Chopped prairie hay was available ad libitum. Calves were on experiment for 8 wk. Weekly weight gains; consumption of prestarter, starter, and hay; and fecal scores were recorded.

[1]Calf-weena pellets, Merricks, Inc., Union Center, Wisconsin.

Results and Discussion

Results on weight gains; consumption of prestarter, starter, and hay; and fecal scores at different weeks of age and the overall means are presented in Table 2. There were no significant differences between treatments for any of the responses measured. However, calves fed the experimental calf starter tended ($P<.10$) to gain more weight at 4 and 5 wk of age, to have higher ($P<.05$) fecal scores at 3 wk, and to show lower ($P<.05$) hay consumption after 6 wk of age.

More fat than necessary and feeding of prestarter until 8 wk of age may have precluded any significant benefits with the experimental starter. The trend toward higher weight gains at 4 and 5 wk of age could have been due to the buffer and(or) roasted soybean meal in the diet. The benefits of including these two ingredients in the starter might be increased by limiting the feeding of prestarter (rich in protein) to 5 or 6 wk of age.

The conventional calf starter was chosen because it has been used, with satisfactory results, in several experiments at KSU. We may conclude from these results that the experimental starter would also be an acceptable starter. Several factors may have reduced benefits from the conventional starter. These include more fat than necessary in the experimental diet, feeding the concentional starter in pelleted form, and feeding of prestarter until 8 wk of age. Further research is needed to evaluate the experimental starter with less fat, in pelleted form, and when the prestarter is limited to 4 or 5 wk of age.

Table 1. Ingredient composition of calf starters

Ingredient	Conventional	Experimental
Corn, rolled	30.0	17.1
Oats, rolled	20.0	29.1
Soybeans, roasted		24.3
Sorghum grain, rolled	7.5	10.3
Alfalfa hay, ground	25.0	
Dehydrated alfalfa, pelleted		9.6
Molasses, dried	5.0	5.0
Soy oil		1.0
Sodium bicarbonate		0.9
Soybean meal	10.0	0.5
Dicalcium phosphate	.70	
Limestone, ground	.30	
Salt	.25	
Salt, trace mineral	.25	
Mineral and vitamin premix		2.2
Vitamin and selenium premix	1.00	

Table 2. Weight gains, feed consumption, and fecal scores of calves fed different calf starters

Item	Treatment[1]	Weeks of Age 1	2	3	4	5	6	7	8	Overall Change[2]
Weight gains (lb)	1	3.7	0.0	5.3	6.4	5.7	11.0	11.0	12.3	55.2
	2	2.6	0.2	4.8	9.0**	8.8**	11.2	10.8	12.8	60.3
Starter	1	0.2	0.4	2.0	4.6	10.1	18.3	26.6	31.9	93.9
Consumption (lb)	2	0.2	0.4	2.0	5.9	12.8	20.2	25.5	31.0	98.1
Prestarter	1	1.5	1.3	2.4	2.2	2.9	2.9	3.1	3.1	19.4
Consumption (lb)	2	1.3**	1.5**	2.4	2.4	2.9	2.9	2.9	3.1	19.2
Fecal scores	1	1.2	2.2	1.2	1.1	1.1	1.0	1.0	1.0	1.2
	2	1.2	2.1	1.6*	1.2	1.1	1.0	1.0	1.0	1.3
Hay	1	.02	.02	.40	.59	1.01	1.32	1.69	1.67	6.82
Consumption (lb)	2	.04	.04	.15	.48	.62	.75*	1.06*	1.14**	4.4*

[1] 1=Conventional starter diet, 2=Experimental starter diet.

[2] Cumulative change for all traits and average of fecal scores from birth to weaning.

*P<.05.

**P<.10.

SOYBEAN PRODUCTS AS A PROTEIN SOURCE IN MILK REPLACERS FOR CALVES

D.P. Dawson, J.L. Morrill, P.G. Reddy, and H.C. Minocha

Summary

Studies were conducted to evaluate two commercial soy products and one experimental soy flour as protein sources in calf milk-replacers. Further tests were conducted to produce an improved product. None of the products were as good as milk protein, with the difference being greatest in the very young calf. Calves fed milk replacers containing soy products commonly used today will not perform as well as calves fed good quality, all milk-protein, milk replacers.

Introduction

Soybeans have widespread use as an inexpensive protein source for people and livestock. One area where soy has failed to provide a high quality protein source is in milk replacers for preruminant dairy calves. It would be more efficient to use soy proteins for calves rather than milk, which can be used for human consumption. This is of particular importance in areas of the world where animal protein is in short supply.

There has been extensive study of the problems associated with the use of soy products in milk replacers. Some improvements have been made, such that it is now common to replace a portion of the milk protein in a milk replacer with soy protein.

We conducted two studies to improve soy products for use in milk replacers for dairy calves.

Procedures - Trial 1

Nitrogen retention, allergic response to soy proteins, and growth were monitored in calves given one of four milk replacers. Diets were similar in all aspects except protein source. Protein (22%) was supplied by all milk sources, diet AM; or with 25% of the protein from milk sources and 75% from either soy protein concentrate (Procon-100), diet SPC; commercial soy flour (Lauhoff soy flour), diet CSF; or an experimental soy flour, diet ESF. The experimental soy flour was produced by heating raw soy flakes until trypsin inhibitor (TI) was reduced to <1 unit/mg.

Results and Discussion

All diets containing soy protein resulted in a marked allergic reaction. This was seen as increased blood levels of IgG antibodies to the soy proteins and as villous atrophy in the small intestine. Nitrogen retention and growth of calves given the AM control diet were better than those of calves given the three soy-containing diets, particularly in the first 2 wk. The SPC and ESF diets produced similar responses among calves, which were better than those from the CSF-fed calves. The calves' performance improved considerably as they reached 2 wk of age. For the remaining 4 wk of the trial, calves on diets AM, SPC, and ESF grew at similar rates, with diet CSF remaining inferior.

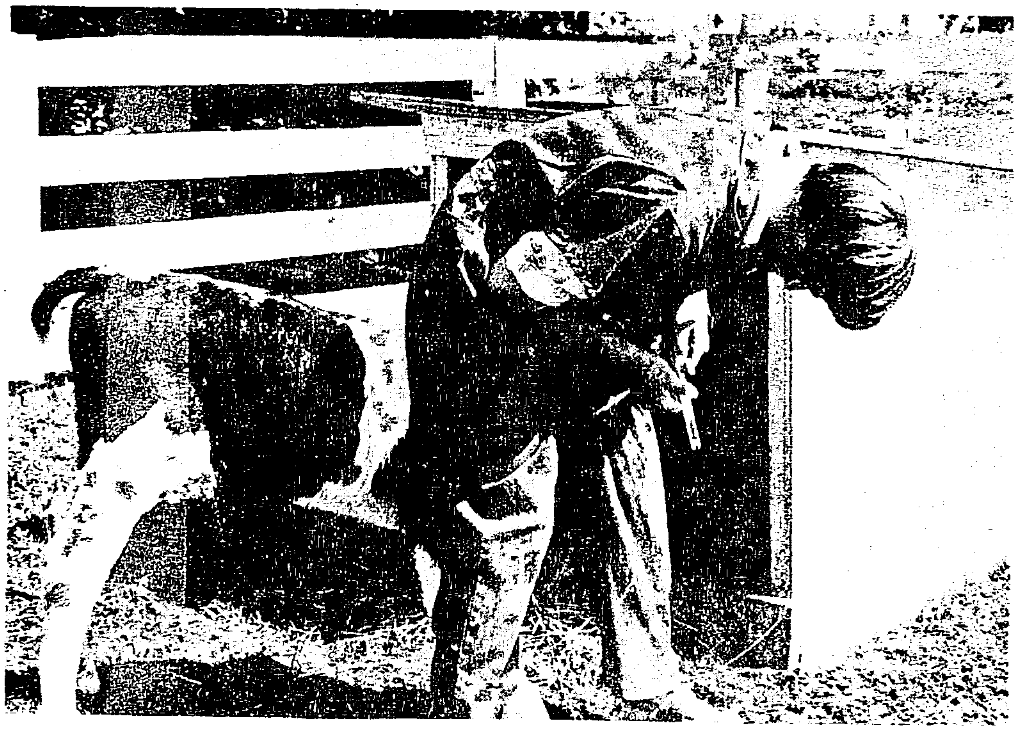
Calves are unable to adequately use any of these soy products during the first 2-3 wk of life. As their digestive systems develop, calves can use diets based on soy protein concentrate or this experimental soy flour with an efficiency similar to the all milk-protein diet. The commercial soy flour proved an inferior protein source to others in this trial. The experimental soy flour diet resulted in calf performance comparable to that produced on the soy protein concentrate diet. The choice of which of these products to use could be left to the economics of processing.

Procedures - Trial 2

Oil extracted, desolventized soy flakes (enzyme-active soy flour), without further heat treatment, were used as the starting point for a study on the effects of extrusion processing on TI and antigenicity. Varied in the extrusion processing were temperature, moisture, pH, ionic concentration, and sulfur. Thirty-two products were tested for TI content and for the presence of known antigens.

Results

One product was produced with no detectable TI or antigens. This product is currently undergoing further study.



Graduate research assistant, Paul Dawson, prepares to sample blood from a research calf

EFFECT OF BUFFERS AND SUPPLEMENTAL POTASSIUM IN DIETS OF EARLY-WEANED CALVES

K.J. Jordan, J.L. Morrill, P.G. Reddy,

J.J. Higgins[1], and N.V. Anderson[2]

Summary

Potassium chloride added to the prestarter and/or potassium bicarbonate added to the starter fed to early weaned calves helped maintain normal blood alkalinity and normal levels of blood gases, and resulted in a trend toward increased feed consumption. Potassium bicarbonate added to the starter tended to improve weight gains.

Introduction

A program for young calves has been developed here that results in earlier dry feed consumption, earlier development of rumen fermentation, and allows earlier weaning. Because active rumen fermentation is established earlier, a buffer in the feed may be helpful to prevent excess rumen acidity. Also, potassium may be deficient in rations that do not contain liberal amounts of roughage. This experiment was designed to evaluate the effect of addition of potassium salts to the prestarter and/or starter used in the program.

Procedures

Thirty-six day-old Holstein calves were assigned to one of four treatment groups. Diets were control prestarter or prestarter containing 1.5% potassium chloride (KCl), each fed with either control starter or starter containing 2% potassium bicarbonate ($KHCO_3$). The control prestarter and control starter were the same as used by Morrill et al. (1985 Dairy Day, Report of Progess 484, page 1), except that dehydrated alfalfa was used in the starter instead of alfalfa hay. Weight gains and feed consumption to 6 weeks of age were recorded and venous blood was sampled weekly for determination of pH, blood gases, and sodium and potassium in serum, and red blood cells.

Results and Discussion

Treatment means for feed consumed and weight gained were not significantly different, but there was a trend for more starter consumption and weight gain when buffered starter was fed (Table 1). Buffered starter and KCl in the prestarter were helpful in maintaining homeostasis in the blood (Table 2). Serum and red blood cell levels of sodium and potassium were not affected by diet.

[1]Dept of Statistics
[2]Dept of Surgery and Medicine

Table 1. Effect of ration on feed consumption and weight gains

Diet	Weekly Feed Consumed, lb Prestarter	Weekly Feed Consumed, lb Starter	Weight Gain, lb
Control prestarter, control starter	2.16	7.41	.77
Control prestarter, $KHCO_3$ starter	2.18	8.71	.95
KCl prestarter, control starter	2.13	7.68	.79
KCl prestarter, $KHCO_3$ starter	2.22	8.38	.88

Table 2. Effect of ration on blood parameters

Diet	pH	HCO_3[1]	CO_2[2]	BE[3]
Control prestarter, control starter	7.337[a]	27.59[a]	52.79[a]	2.57[a]
Control prestarter, $KHCO_3$ starter	7.352[a]	29.05[b]	54.48[a]	4.14[b]
KCl prestarter, control starter	7.352[a]	28.87[b]	54.18[a]	4.00[b]
KCl prestarter, $KHCO_3$ starter	7.350[a]	29.15[b]	54.89[a]	4.14[b]

[1] Venous blood bicarbonate (meg/liter).
[2] Venous blood partial pressure of carbon dioxide (mm Hg).
[3] Venous blood base excess (meg/liter).
[a,b] Means in a column bearing different superscripts differ ($P<.05$).

Recommendations

Based on results of this experiment and others, buffer should be added to starters used in early weaning programs. Either sodium bicarbonate or potassium bicarbonate would be useful. Studies are underway to determine optimum levels of potassium and to evaluate other buffers. Until more results are available to use as a guide, 2% sodium or potassium bicarbonate should be used, and this is more critical if long hay is not available.

VITAMIN E REQUIREMENTS OF DAIRY CALVES[1]

P. G. Reddy, J. L. Morrill, H. C. Minocha[2],

R. A. Frey[3], and J. S. Stevenson

Summary

Thirty-two Holstein heifer calves receiving conventional rations were supplemented with 0 (control), 125, 250, or 500 IU vitamin E/calf/day. The objective was to determine the optimum requirement based on their performance from birth to 24 wk of age. Results on weight gains, feed consumption, serum enzymes indicative of cell membrane damage, immune responses, and metabolic profile indicated that supplementation of calves receiving conventional rations with 125 to 250 IU/day may maximize their performance.

Introduction

The vitamin E requirement of dairy calves has not been determined nor has the effect of supplementation on the immune response been studied adequately. Earlier studies indicated that calves fed conventional rations do not receive adequate amounts of vitamin E and supplementation could enhance their general performance and immuno-competency. The objective of this research was to study the performance of calves from birth to 24 wk of age when supplemented daily with graded amounts of vitamin E.

Procedures

Thirty-two Holstein heifer calves were used from birth to 24 wk of age. Calves were allotted at birth to four treatments: 0 (control), 125, 250, or 500 IU supplemental vitamin E. All calves received colostrum for the first 3 days and then milk at 8% of birth weight until weaning at 6 wk. They were housed in hutches until 8 wk of age and had free access to water and a conventional calf starter. Then they were moved to group pens, where they had access to alfalfa hay and were individually fed a concentrate ration. The ingredient and chemical composition of calf starter and concentrate are shown in Table 1.

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[1]Partial financial support from Hoffman-La Roche, Nutley, NJ

[2]Dept. of Laboratory Medicine

[3]Dept. of Anatomy and Physiology

Table 1. Ingredient and chemical composition of dry feeds

Ingredients %	Calf Starter	Concentrate
Corn, rolled	30.00	41.00
Oats, rolled	20.00	25.00
Sorghum grain, rolled	7.50	
Wheat bran		10.00
Alfalfa hay, ground	25.00	
Soybean meal	10.00	17.00
Molasses, dry	5.00	4.00
Animal fat		2.00
Dicalcium phosphate	0.70	
Limestone, ground	0.30	0.28
Salt, plain	0.25	0.25
Salt, trace mineral	0.25	0.25
Vitamin and selenium premix[1]	1.00	
Vitamin premix[2]		0.22
Chemical Composition		
Crude protein, %	15.61	16.15
Ether extract, %	3.36	3.64
Acid detergent fiber, %	19.95	13.14
Vitamin E, IU/kg	21.60	75.20

[1]Included 220,264 IU Vitamin A, 33,039 IU Vitamin D, 0.2159 g sodium selenite/kg premix.

[2]2.2 million IU Vitamin A and 2.2 million IU of Vitamin D/kg.

Weight gains were recorded weekly until 8 wk of age and then monthly. Consumption of calf starter and concentrate mixture were recorded daily. Jugular blood was sampled at frequent intervals for determination of various serum enzymes, immune responses, metabolic profile, and hematological traits.

Results and Discussion

Data on the performance, serum enzymes, immune responses, and metabolic profile are presented in Table 2.

Overall weight gains were significantly higher in calves supplemented with 125 or 250 IU than in control calves; gains of calves given 500 IU were intermediate. Total consumption of concentrate was similar in all groups, but calves given 500 IU showed a trend toward lower consumption. Higher weight gains but similar feed consumption in calves given 125 or 250 IU, compared with control calves, resulted in increased feed efficiency.

Table 2. Effect of supplemental vitamin E on the performance, serum enzymes, metabolic profile, and immune response of calves

Item	IU of Supplemental Vitamin E/calf/day 0	124	250	500	S.E. of Mean
Overall weight gains, kg	125[a]	144[b]	143[b]	131[ab]	5.4
Concentrate consumption, kg	370	387	367	324	26.3
Fecal scores[1]	1.4	1.4	1.3	1.4	0.04
Creatine kinase, IU/l[1]	184.1	169.6	170.0	174.8	8.9
Glutamic oxalacetic transaminase, IU/l[1]	66.8[a]	56.1[b]	62.2[a]	61.3[ab]	2.0
Lactic dehydrogenase, IU/l[1]	971[a]	845[b]	894[ab]	884[ab]	31.7
Serum α-tocopherol, IU/dl[1]	88.5[a]	166.5[b]	269.0[c]	289.0[c]	8.6
Lymphocyte stimulation indices[1]					
Phytohemagglutinin	31.6[a]	39.5[ab]	39.9[b]	35.2[ab]	2.9
Concanavalin A	29.2[a]	37.2[b]	34.5[ab]	36.3[b]	2.2
Pokeweed Mitogen	20.3[a]	24.5[ab]	23.2[ab]	26.9[b]	1.5
Lipopolysaccharide	3.7[a]	5.8[b]	5.0[ab]	5.9[b]	0.6
Serum cortisol, ng/ml[1]	5.2[a]	3.3[b]	2.9[b]	3.9[b]	0.4
Serum anti BHV-1 antibody ($x10^4$)[2]	1.5[a]	7.5[b]	3.0[ab]	6.8[ab]	
Serum glucose, mg/dl[1]	92.8[a]	105.3[b]	108.6[b]	105.8[b]	3.2

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

[1]Least square means averaged across weeks.

[2]ELISA (IgG) titers determined at 24 wk of age in response to a commercial modified live intra nasal bovine herpes virus type 1 vaccine at 7 and 21 wk of age.

Unsupplemented calves had lower blood vitamin E and elevated serum enzymes, indicating that cell membranes were prone to damage. Lymphocyte blastogenic responses to various T and B-cell mitogens were lower in unsupplemented calves, compared with some supplemented groups. Serum anti-bovine herpes virus type-1 antibody (IgG) response to booster vaccination was higher in calves given 125 IU than in control calves. Overall concentrations of cortisol in serum were higher in unsupplemented calves than in supplemented calves, partially explaining the reasons for higher immune response in supplemented calves.

It is concluded that supplementation of conventional rations with 125 or 250 IU vitamin E per animal per day can increase the performance of calves.

EFFECT OF MILK INTAKE AND METHOD OF WEANING ON CALF PERFORMANCE AND STRESS IN AN EARLY-WEANING PROGRAM

Paula Flynn, P.G. Reddy, J.L. Morrill,
and J.S. Stevenson

Summary

Feeding milk at 8% of birthweight and gradual weaning resulted in the most consistent increases in weekly weight gain, highest overall weight gain, and greatest increases in dry feed consumption during an 8-wk trial compared to feeding milk at 8% and abrupt weaning, at 10% and gradual weaning, or at 10% and abrupt weaning. By 8 wk, the 8% gradually-weaned calves also had higher levels of serum protein and lower levels of urea nitrogen in blood than calves in other treatment groups. Therefore, the 8% gradual-weaning program was determined to be the most appropriate for early weaning of dairy calves.

Introduction

The amount of feed a calf will consume and its ability to utilize that feed efficiently dictate when it can be weaned. Dry feed and the resulting products of fermentation are responsible for the development of the rumen. Stimulation of the calf to consume dry feed at a young age, thus, causing it to develop a functional rumen early in life should allow for earlier weaning. However, there is controversy as to the appropriate level of milk that allows for both optimal stimulation of dry feed consumption and growth. Feeding a high level of milk will cause an initial increase in growth, but may depress dry feed consumption of the calf, which eventually may result in unsatisfactory growth rates. Feeding a lower level of milk, though producing early slower gains, may cause the calf to begin consuming dry feed at an earlier age, allowing for earlier rumen development and eventually resulting in greater gains.

Weaning is a well known stressor to the calf. Abrupt weaning may initially present a great deal of stress to the calf, but in turn cause it to increase dry feed consumption at a faster rate. Gradual weaning may be less stressful than abrupt weaning, but may delay first dry feed consumption.

The following experiment was designed to determine which level of milk, 8% or 10% of birth weight, and which type of weaning regimen, abrupt or gradual, would result in the greatest productivity and least stress for the early-weaned calf.

Procedures

Forty calves were assigned to receive daily diets of milk fed in two equal daily portions at either 8% or 10% of birth weight. Calves were then weaned abruptly or gradually. Calves were stimulated with an all-milk prestarter, which was offered ad libitum to a maximum of 0.5 lb per day, after which calves were fed 0.5 lb prestarter per day and as much starter (16% protein) as they would consume. Feed was weighed back daily, fecal consistency and general appearance were scored twice daily, and calves were weighed weekly. Abruptly weaned calves were weaned at 3 wk of age or when consuming 0.5 lb dry feed, whichever came first. Gradually weaned calves were weaned using the same criteria; however, they were fed their A.M. portion of milk for 1 additional wk. Blood was collected and analyzed for cortisol, blood metabolites, and lymphocyte stimulation index at various times during the 8-wk trial. In 16 calves (four/treatment), 1.03 IU adrenocorticotropin (ACTH)/ kg metabolic body weight was administered at 4 wk of age to assess adrenal function as a measure of stress by monitoring cortisol in serum.

Results and Discussion

Dry feed consumption and body weights during the trial are shown in Tables 1 and 2, respectively. Excluding wk 4, the 8%, gradually-weaned calves ate more dry feed than calves in any other group. After wk 4, these calves also weighed more. There were no differences in fecal scores among treatments. Overall, the lymphocyte stimulation index, which is used as an indicator of the calf's ability to resist disease, and cortisol levels, which are used as an indicator of stress, were both highly variable and no difference among treatments was seen. Cortisol levels, however, were lower for the gradually weaned calves than for abruptly weaned calves 24 h after weaning, indicating that the gradually weaned calves were less stressed than the abruptly weaned calves at that time. Serum protein was higher in 8% gradually-weaned calves at 4 and 8 wk of age than in other groups. Blood urea nitrogen was lowest for the 8% gradually-weaned group at 8 wk of age, possibly indicating better rumen function for these calves.

Table 1. Weekly dry feed consumption (pounds)

	Weeks of Age								
Treatment	1	2	3	4	5	6	7	8	Trial Mean
8%-Abrupt	1.1	1.5	4.4[ab]	12.5[b]	20.9[ab]	29.5[b]	31.5[a]	33.2[a]	16.9[b]
8%-Gradual	1.3	2.0	6.2[b]	12.1[b]	22.9[b]	30.4[b]	35.9[b]	38.7[b]	18.7[c]
10%-Gradual	.7	1.1	2.9[a]	7.7[a]	18.1[a]	26.0[a]	30.8[a]	33.0[a]	15.0[a]
10%-Abrupt	1.1	1.5	3.9[ab]	10.6[b]	19.1[a]	25.5[a]	32.6[a]	35.6[a]	16.3[b]

[a,b,c]Means within column with unlike superscript differ ($P<.05$)

Table 2. Weekly body weight (pounds)

		Weeks of Age								
Treatment	Birth	1	2	3	4	5	6	7	8	Trial Mean
8%-Abrupt	88	92^{ab}	94^{ac}	98^{a}	103^{a}	113^{a}	127^{a}	138^{a}	149^{a}	111^{a}
8%-Gradual	92	94^{bc}	97^{bc}	105^{b}	113^{b}	124^{b}	137^{c}	152^{c}	168^{c}	120^{c}
10%-Gradual	84	87^{a}	91^{a}	97^{a}	104^{a}	111^{a}	123^{a}	137^{a}	149^{a}	109^{b}
10%-Abrupt	94	99^{c}	101^{b}	109^{b}	110^{b}	119^{b}	132^{b}	147^{b}	160^{b}	119^{c}

^{a,b,c}Means within column with unlike superscript differ (P<.05)

Concentrations of cortisol in serum after the ACTH challenge are found in Table 3. The ACTH challenge involves stimulating the adrenal gland by injecting exogoneous ACTH and collecting blood at specific times postinjection. These samples are then analyzed for cortisol. There was a general trend throughout treatments for levels to peak at 1.5 to 2.0 h postinjection. Calves in the 10% abruptly weaned group had the lowest concentrations of cortisol, indicating that these calves were least stressed at this time during the trial.

Table 3. Concentrations of cortisol in serum of 4-wk old calves after adrenocorticotropin (ACTH)

		Time after Injection (hours)						
Treatment	0	0.5	1.0	1.5	2.0	2.45	4.0	Mean
8%-Abrupt	4.1	18.7^{b}	18.2	17.5	20.6^{b}	16.8	13.9	15.7^{b}
8%-Gradual	2.2	16.0^{ab}	18.2	18.2	17.5^{ab}	17.9	14.5	14.9^{b}
10%-Gradual	1.4	15.4^{ab}	16.8	19.0	18.1^{ab}	17.5	14.2	14.6^{b}
10%-Abrupt	2.7	12.5^{a}	14.0	15.7	13.1^{a}	13.9	13.4	12.2^{a}

^{a,b}Means within column with unlike superscript differ (P<.05)

Recommendations

Results of this trial indicate that milk fed at 8% of birth weight and gradual weaning produced the most beneficial results in an early weaning program.

INFLUENCE OF MULTIPLE DAILY INJECTIONS OF OXYTOCIN ON REPRODUCTIVE AND MILK CHARACTERISTICS OF POSTPARTUM DAIRY COWS

R. E. Stewart and J. S. Stevenson

Summary

Release of oxytocin at the time of suckling or milking may delay onset of estrous cycles in postpartum cows. Twenty lactating Holsteins were used in this study to determine if multiple daily injections of oxytocin would prolong postpartum anestrus. Cows received either oxytocin or saline (controls) intravenously through indwelling jugular catheters four times daily for 28 days following calving. Treatment with oxytocin did not lengthen intervals to ovulation or estrus or alter secretion patterns of luteinizing hormone, cortisol, progesterone, or 13,14-dihydro-15-keto prostaglandin $F_{2}\alpha$ in serum. Although milk production, percentage protein, and somatic cell counts were similar between treatment groups, oxytocin appeared to increase ($P<.10$) percentage of fat (3.99 vs 3.68%) in milk. Involution of the reproductive tract (uterus and cervix) was also similar between oxytocin-treated and control cows. We concluded that oxytocin alone does not prevent the occurrence of estrus and ovulation in dairy cows or hasten the rate of cervical and uterine involution.

Introduction

Initiation of normal estrous cycles in postpartum cows is a major factor in maintaining yearly calving intervals that are associated with higher and more efficient milk production. Lactating cows require more time after calving to begin estrous cycles than nonlactating cows, and suckling has a stronger inhibitory effect than milking on the re-establishment of estrous cycles. In additon, four times daily milking prevents estrous cycles longer than twice-daily milking. Hormones released at milking or suckling, such as cortisol, prolactin, and oxytocin, could be involved in this inhibitory process. Studies examining the roles of prolactin and cortisol have shown slight effects on postpartum hormonal secretion but no effects on re-establishment of estrous cycles. However, there is little information on how oxytocin, the milk let-down hormone, affects postpartum reproductive function. Uterine involution is completed earlier in milked cows than in nonlactating cows, probably because of the smooth muscle stimulation by oxytocin. The objectives of our study were to determine the effects of multiple daily injections of oxytocin on 1) postpartum intervals to ovulation and estrus, 2) postpartum hormonal secretion, and 3) involution of the reproductive tract.

Procedures

This study utilized 20 cows of mixed parity that calved during January and February, 1985. Cows were balanced for previous milk production and assigned randomly at calving to receive either oxytocin (100 mU) or saline four times daily (0530, 1030, 1730, and 2230 h) via jugular catheters for 28 days. Cows were milked twice daily (0130 and 1330 h). Involution of the reproductive tract was determined by twice weekly palpation until gross involution was completed. Cows were weighed once weekly for 8 wk. Daily milk production and weekly protein and fat percentages and somatic cell counts were recorded for each cow.

Blood was collected thrice weekly and analyzed for concentrations of progesterone in serum. This enabled us to determine intervals to first and second ovulations. Blood also was collected on day 12 postpartum every 15 min for 6 h to monitor changes in luteinizing hormone, cortisol, and 13,14-dihydro-15-keto-prostaglandin $F_{2\alpha}$ (a serum-stable metabolite of prostaglandin $F_{2\alpha}$). Intervals to first estrus were determined by checking for estrus throughout the day, as well as early morning and evening heat checks.

Results and Discussion

Intervals to ovulation and estrus were similar for oxytocin-treated and control cows (Table 1). One cow from each treatment remained anovulatory during the experiment. In addition, no cows were observed in heat before the first ovulation (estrous cycle). As shown in Table 1, most cows had two estrous cycles before 60 days postpartum.

Table 1. Postpartum intervals (days) to ovulation and estrus[a]

Treatment Group	No. Cows	First Ovulation	No. Cows	Second Ovulation	No. Cows	First Estrus
Control	9	26 $\pm$ 6	9	52 $\pm$ 8	9	53 $\pm$ 9
Oxytocin	9	27 $\pm$ 6	8	51 $\pm$ 8	5	48 $\pm$ 9

[a]Mean $\pm$ SE.

Rate of involution of the reproductive tract was not increased by adminstration of oxytocin. However, younger cows had smaller cervices and shorter intervals to completion of cervical involution than older cows. These differences tended to become less as gross involution approached completion.

Changes in body weight were not influenced by treatment, but older cows lost more weight early postpartum, whereas younger cows maintained their body weight.

Daily milk yield, percentage fat and protein, and somatic cell counts are shown in Table 2. Percentage fat in milk tended to be higher ($P<.10$) in oxytocin-treated cows than in controls. Older cows produced more milk (70.8 vs 44.8 lb/day) and had higher butterfat (4.18 vs 3.65%) than younger cows. Oxytocin did not affect milk yield, percentage protein, or somatic cell count.

Table 2. Daily milk yield and milk constituents

Milk traits	Treatment Group Control	Oxytocin
Daily milk yield, lb	56.7 ± 1.8	51.1 ± 1.8
Milk fat, %	3.68 ± .21	3.99 ± .22[a]
Milk protein, %	3.02 ± .08	3.00 ± .09
Somatic cell count, 10^3	294 ± 219	369 ± 233

[a]Different from control (P<.10).

Since calves generally nurse five to six times daily, the four daily injections of oxytocin were equally spaced around the twice-daily milkings to simulate the release of oxytocin caused by suckling or milking. The dosage of oxytocin administered was sufficient to cause milk let-down because milk leaking from teat ends of treated cows was observed after injections of oxytocin. The results of this study indicate that oxytocin alone does not appear to inhibit reestablishment of postpartum ovarian cyclicity, but it is possible that oxytocin is part of an inhibitory complex of hormones originating in the brain or pituitary that delays the onset of estrous cycles after calving.

KSU

MILK FLAVOR QUALITY ON THE FARM

H. A. Roberts

Introduction

Milk consumption is influenced by the quality and flavor of the milk a person drinks. Today the consumer evaluates milk solely on its taste and keeping quality. Since the flavor of milk cannot be improved after it leaves the dairy farm, it is of the utmost importance to produce milk with the best flavor quality possible.

Milk is a highly perishable food and must be produced under conditions that will ensure keeping quality. Generally speaking, dairymen are doing a good job of producing high quality milk but we need to be aware that problems may occur with feeding, cow health, cleaning, sanitizing and general handling of the milk.

It is important to know what is good tasting milk and then use this standard to produce top quality milk free of off flavors.

Following are brief discussions regarding some of the milk flavor problems that still exist today, with suggestions on how to reduce these problems.

Feed Flavor

Feed flavor continues to be one of the major milk flavor problems. With a little care, this difficulty can be avoided.

Causes: This flavor defect is caused by the cow eating or inhaling odors of strong feeds such as certain grasses, corn silage, green forage, and others just prior to milking. Also a sudden change in feeding routine can cause this problem.

Prevention: The best way to prevent feed flavor in milk is to withhold any objectionable feed for approximately 2 hours before milking. Some very strong, objectionable feeds should be withheld for up to 4 hours before milking. When changing feeding routine, do so gradually over a period of a few days.

Rancid Flavor

This defect is characterized by a soapy, bitter taste and a strong odor in the late stages of development. Rancidity can cause many flavor problems and is very difficult to control.

Causes: A number of circumstances can cause this defect, making it difficult to trace. A late-lactation or low-producing cow could be the major problem. Only one of these cows could cause this flavor defect in the herd's bulk milk. The way the milk is handled is another source of the problem. Excessive agitation, foaming, freezing, high blend temperatures, and improper installation and operation of milk handling equipment are some of the possible causes.

Prevention: Remove the low-producing or late-lactation cow from the herd. Check for proper installation of the milk handling equipment. Handle milk in the best possible manner to prevent some of the causes listed above.

High Acid and Malty Flavor

These defects are not as common as others, but they can cause some serious problems. High acid will produce a sour or acid taste and a strong odor. Malty defect will be noticed mainly by its strong malty odor. Both of these defects are caused by high bacterial counts in the milk.

Causes: These defects are both caused by poor cooling practices and/or dirty equipment.

Prevention: Equipment that is properly cleaned and sanitized using recommended cleaning procedures is a must. Cooling the milk to 40°F or below (but not freezing) as soon as possible after milking and holding at cold temperatures until it is picked up is important. Poor refrigeration equipment or failure to turn on refrigeration for any length of time could cause these problems.

Unclean Flavor

This is a flavor defect that develops from a change in the bacterial flora in raw milk. A large population of psychrotrophic bacteria (those that grow at refrigeration temperatures) could cause this defect.

Causes: Improperly cleaned and sanitized milk handling equipment is the usual cause of this problem. Strong odors or a cow with ketosis may also be responsible.

Prevention: Clean and sanitize all milk handling equipment prior to use.

Other Flavor Defects

Oxidized defect: This defect is noticed only in winter months or during dry lot feeding. To prevent this problem, feed green feed. Supplementing feed with Vitamin E may help reduce this problem. Many times, only one or two cows may cause the defect.

Flat defect: This is milk with low solids, resembling milk that has had water added. Dairymen need to evaluate their feeding programs and be sure water is not added to the milk.

Salty defect: Milk will have a salty taste. This defect is caused by late lactation cows or cows that may have mastitis. Such cows should be removed from the herd.

It is highly recommended that dairymen work closely with their county agent, fieldman, and extension personnel at the University to help guarantee quality milk for the consumer. Consistently high quality milk is no accident. To produce it requires constant effort.

Dr. Ike Jeon injecting a sample in the gas-liquid chromatograph

KSU

AVAILABILITY OF CALCIUM IN DAIRY AND OTHER HUMAN FOODS

Ike J. Jeon

Introduction

In 1985 the annual sales of dairy products on the average grew 3.3%, and is expected to grow 6.4% in 1986, according to the U.S. Department of Commerce. This positive growth was attributed in part to increased consumer awareness on the reported role of calcium in combating hypertension (high blood pressure) and osteoporosis (a brittle bone disease common in older women). A recent report suggested that many consumers are seeing the publicity that many cases of hypertension may be the result of too little calcium intake, not too much sodium. Consumers are also well aware that a calcium-deficient diet can result in the development of osteoporosis, a progressive loss of bone mass that leaves the skeleton fragile and vulnerable to fractures. The gradual loss in bone mass begins in the mid-30's but the damage is not apparent until at least 20 years later, when a significant amount of loss has occurred.

Needed Calcuim Intake and Amount in Food

The current recommended daily allowance (RDA) for calcium, set by the Food and Nutrition Board of the National Academy of Sciences, is 800 milligrams for adults. However, some nutritionists believe that a daily intake of 1,000 to 1,200 milligrams would be appropriate for women who have not yet reached menopause and 1,500 milligrams for post-menopausal women. A careful selection of diet is required to provide such an intake of calcium. As shown in Table 1, milk

Table 1. Calcium Content in Selected Foods

Food	Calcium, mg
Sardines, with bones, canned in oil (3 oz.)	401
Milk, whole or skim (1 cup)	298
Yogurt, plain and low fat (1 cup)	293
Cheese, Swiss (1 oz)	270
Cheese, American Cheddar (1 oz)	211
Collard greens, cooked (1/2 cup)	152
Cottage cheese, lowfat (1 cup)	138
Broccoli, cooked (5 1/2 in stalk)	103
Ice cream (1/2 cup)	90
Spinach, cooked (1/2 cup)	83
Green beans (1 cup)	62
Bread, whole wheat or white (1 slice)	35

and dairy products are among the best sources of calcium in the American diet. For example, one cup of whole milk contains about 300 milligrams of calcium, so drinking two to three cups of milk a day would meet the RDA calcium requirement.

Calcium-fortified Foods

Although dairy products are already good sources of calcium, some companies are currently test marketing calcium-fortified dairy products. For example, Borden Incorporated is test marketing "Hi-Calcium Milk", which is fortified with tricalcium phosphate. The milk contains 1,000 milligrams of calcium per serving of whole milk; a low-fat version provides approximately two-thirds that amount. The California Milk Advisory Board, meanwhile, is testing "Vital 15", a calcium-enriched milk. The product, to be made available to all California processors, provides 400 milligrams of calcium per serving. There are also several calcium-fortified, non-dairy foods currently on the market. These include soft drinks, drink mixes, bread, and flour. Most are prominently labeled and advertised as having added calcium. However, some nutritionists caution that when dairy products are replaced with calcium-fortified foods, other important nutrients may be lost from a balanced diet. This may be particularly true with the oral administration of calcium pills.

It should be noted that taking in plenty of calcium does not necessarily mean that the body is absorbing enough calcium. Many factors are known to affect calcium absorption into the body. For example, consuming too much phosphorus may interfere with calcium absorption. Cigarette smoking may affect calcium absorption as well. Vitamin D, commonly added to milk, is known to be necessary for calcium absorption. Therefore, a balanced diet is essential not only for an adequate calcium intake but also for proper absorption of calcium and keeping the body nutritionally sound.

Read More About It

1. News from the National Dairy Council, Media Memo, Spring, 1984. p. 2-17.
2. Dairymen's Digest. Calcium may be the key to blood pressure control. January, 1985. p. 24.
3. Dairy Record. Keeping the calcium message alive. July, 1984. p. 9.
4. Prepared Foods. Consumer attitudes and health concerns impact dairy sales. August, 1986. p. 49.

AFLATOXIN IN MILK AND DAIRY PRODUCTS

W. G. Ikins

Introduction

Aflatoxins are toxic compounds that are produced by certain strains of molds, namely, Aspergillus flavus and Aspergillus parasiticus. These molds may invade stressed crops in the field or proliferate in improperly stored feed. Dairy cows are one of the many species of animals that may suffer both long-term and short-term adverse effects from consuming aflatoxin contaminated feed. In addition, dairy cows metabolize the toxin to a slightly different form, a portion of which is secreted into milk and can be consumed by humans.

Toxic Effects of Aflatoxins

Aflatoxin B_1 (AFB_1) and aflatoxin G_1 (AFG_1) are produced in the greatest amounts by molds. AFB_1 is one of the most toxic compounds known to man. Oral doses of AFB_1 have been demonstrated to decrease the feed intake of dairy cows, reduce weight gain, and significantly reduce milk production. The liver and gall bladder appear to be the primary target organs for the toxic effect of aflatoxin, with calves being more sensitive than more mature cows. Of greater concern than the short-range effects are the long-range effects of repeated exposure of cows and humans to low doses of aflatoxins. AFB_1 is one of the most powerful cancer causing agents ever tested on experimental animals and also has been shown to cause birth defects. Aflatoxin M_1 (AFM_1), the form of toxin that is found in milk, is the result of the cows' body chemically altering AFB_1 in order to excrete it more easily. The short-term toxicity of AFM_1 appears to be the same as that of AFB_1 on experimental animals, but AFM_1 is not nearly as carcinogenic as AFB_1.

Aflatoxin in Dairy Cattle Feed

Most crops that are commonly used for dairy cattle feed are succeptible to invasion by the aflatoxin-producing molds. This is particularly true if the crops have been stressed by drought, insect attack, weed infestation, insufficient nutrients, and other factors. Perhaps more importantly, feed storage conditions that promote mold growth, such as excessive humidity and insufficient aeration, will also promote the production of aflatoxin. Corn has consistently had a problem with aflatoxin contamination, particularly in the southeastern U.S. Cottonseed and peanut meal have also been identified as likely sources of aflatoxin exposure for dairy cattle in the U.S. These meals are produced as a byproduct of oil production from the seeds. Because the toxin has little affinity for the oil, it becomes concentrated in the meal.

Aflatoxin M_1 in Milk and Milk Products

The amount of AFM_1 secreted in milk is directly related to the amount of AFB_1 ingested by the cow. Although the amount of AFM_1 secreted into milk depends on the individual cow and the experimental conditions, the levels are generally less than 5% of the AFB_1 ingested in the feed. Elimination of an aflatoxin-contaminated diet results in a relatively rapid disappearance of the AFM_1 in milk. AFM_1 has been reported to decrease and then become undetectable 4 days after removal of contaminated feed.

AFM_1 remains relatively stable during the processing of milk. Bulk pasteurization of milk at 62°C for 30 min has been demonstrated to result in only minor losses of toxin. A high temperature, short-time pasteurization treatment (71°C for 40 sec) appeared to slightly increase the proportion of destroyed AFM_1 toxin. Spray drying of milk to produce a dried milk powder, however, reduced the AFM_1 concentration by 85%.

During the separation of cream from skim milk, a large majority of the AFM_1 detected in whole milk remained in the skim milk. This is thought to be due to the chemical association of AFM_1 with milk proteins. Because cheese is mainly protein, the concentration of AFM_1 in cheese made from contaminated milk is often higher than the concentration in the original milk. In addition, molds capable of producing aflatoxin can grow on the surface of some cheeses under optimal growing conditions.

Read More About It

1. Applebaum, R. S., Brackett, R. E., Wiseman, D. W., Marth, E. H. 1982. Aflatoxin: Toxicity to dairy cattle and occurrence in milk and milk products. J. of Food Prot. 45(8):752-777.

2. Brackett, R. E. and Marth Elt. 1981. Fate of aflatoxin M_1 in cheddar cheese and process cheese spread. J. Dairy Sci. 64 (Suppl. 1): 65.

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FORAGE ANALYSIS USING NEAR-INFRARED SPECTROSCOPY (NIRS)

L.H. Harbers

Introduction

It has been over 15 years since an analytical instrument was developed that could rapidly determine the concentration of organic compounds from the spectra produced by the bonding between carbon and certain molecules. The instrument is based on the principle that those molecules absorb energy in the infrared region and produce harmonics seen at lower wavelengths, namely the near-infrared region. Compounds may be quantitized by a computer that rapidly analyzes the absorption bands in the near-infrared compared to a standard. Peaks from compounds such as water, protein, fat, and carbohydrate may be detected. Those can be translated into components such as moisture, crude protein, crude fat, acid detergent fiber, etc. All this can be accomplished in minutes rather than hours or days required for the normal routine analyses presently available.

The Instrument

The instrument consists of several parts with associated equipment. The major part includes near-infrared scanning sensor with either a scanning monochrometer (research equipment) or rotating filters (routine unit). A computer, complementary software, and printer are also needed. The associated equipment would consist of a grinder and sample cups. A chemical laboratory would be necessary to analyze reference standards used as a learning set for the instrument.

The advantages of such an instrument are several. The analyses are rapid - one person can pack, scan, and empty 400 samples daily. It would take several technicians 3 or 4 months to make these determinations. Dr. Frank Barton III, USDA labs in Athens, Georgia, predicts that near-infrared spectroscopy (NIRS) will be the instrument of choice for forage analyses in the 21st century. It is a nondestructive method that can analyze for any organic compound at concentrations of about 1% or more of the dry matter of forage. It is valuable for analyzing the small samples generated by plant breeders, and regression equations useful for feed formulation can be generated by the computer.

There are several disadvantages to such a system. The initial cost of a research instrument would be between $75-100,000, although an instrument for routine analyses would cost much less. A minimum of 30 reference standards with data obtained by routine means would be necessary as a learning set. Other disadvantages are that each forage would need its own set of standards, and equations in the computer would need to be updated.

Forage Testing Programs Using NIRS

Several states use NIRS units for testing forage samples. Wisconsin has mobile and stationary units plus one commercial unit. A farm-industry- university program was mandated through their state legislature under the hay making task force that pioneered auctions of quality-tested hay on a statewide basis. Virginia has a centralized unit testing 13-16,000 samples yearly. Florida has a centralized unit calibrated for each forage. It tests alfalfa, some grasses and clovers, corn and sorghum silage, but not pastures, grains, and NH_3-treated silages. Kansas has NIRS units in the Grain Science department, where extensive testing of wheat has been underway for several years under the direction of Dr. Dave Wetzel.

A National Forage Research Project Network has already been established with the following objectives concerning NIRS:

1) Test and validate NIRS for determining forage quality.
2) Test and validate NIRS for other ingredients.
3) Define infrared spectral properties for feed utilization in ruminants.
4) Facilitate transfer of NIRS technology.
5) Establish and maintain a reference of feedstuffs for calibration.
6) Establish standards for conducting NIRS analyses.

The advantages of such a modern system outweigh the disadvantages. The usefulness of such a system for Kansas agriculture seems straightforward. Its initiation, execution, and ultimate success would appear to require a joint effort among farmers, industry, the universities, and the state legislature.

Neil Wallace prepares buffers in the rumen microbiology laboratory

KSU

RATION FIBER ANALYSIS

J. L. Morrill

For many years, fiber in dairy rations was measured and expressed as crude fiber. More recently acid detergent fiber (ADF) and neutral detergent fiber (NDF) have been used. The crude fiber (CF) determination uses acid and alkali treatment and is an attempt to simulate reactions within the digestive tract, whereas the newer techniques use detergents and attempt to divide the plant cells into their component parts. Thus, NDF is resistant to breakdown by a certain detergent in neutral solution and represents the structural part of the cell, the cell wall. Acid detergent fiber is resistant to breakdown by a certain detergent in acid solution and contains cellulose and lignin, the most undigestible carbohydrate fractions.

During the past two decades, ADF has tended to replace CF as a way of expressing fiber levels in rations. More recently, research has indicated that NDF measurement may be more useful than either CF or ADF, especially for high-producing cows. As production increases the energy requirement increases, and it becomes more difficult to provide sufficient fiber in the ration, regardless of the fiber method used. Also, since all of the fiber determinations are based on chemical methods, they do not express particle size of the feedstuff. Ruminants require a certain amount of coarsely textured feed to support normal rumen fermentation. Dr. D.R. Mertens has proposed some guidelines for fiber content of dairy rations, depending on daily milk production (Table 1). Probably, these will be modified as more research results are available, and in the future, rations will be balanced by considering both ADF and NDF.

Table 1. Recommendations for fiber content of dairy rations

Milk Production lb/day	ADF %	NDF %
<30	31	45
30-46	28	39
46-64	24	33
>64	21	27
Dry	34	49

BYPASS PROTEIN - THEORY AND CONCEPT

D.L. Harmon and T.G. Nagaraja

Background

The ruminant animal has the unique advantage of microbial digestion in the rumen. This relationship between host animal and microbial population presents some unique advantages and disadvantages to the animal in terms of using dietary nutrients. The greatest advantage, obviously, is the utilization of dietary fiber. The microbes digest these feedstuffs and derive energy for their growth and maintenance while producing volatile fatty acids for the energy needs of the host animal. Other important products of this microbial digestion are the microbes themselves. They supply the major portion of the animal's protein needs as microbial protein. However, it is inefficient to feed an animal natural protein. The microbes also have the ability to utilize compounds such as urea to provide nitrogen for the synthesis of microbial protein, when dietary protein is less digestible to them. The term "bypass protein" describes dietary protein that, either by some means of alteration or because of type of protein, is resistant to degradation by the rumen microbes. This undigested dietary protein would "bypass" the rumen and would be potentially available to meet the protein needs of the host animal after digestion in the small intestine.

Advantages of Bypass Protein

A thorough understanding of the utilization of dietary protein would allow diets to be formulated whereby nitrogen needs of the microbes could be met by cheaper sources of nitrogen, such as urea, and the more costly natural protein would be used by the host animal. Bypass values for several proteins are listed in Table 1. A value of 25% for soybean meal, for example, indicates that approximately 75% of soybean meal would be degraded in the rumen and 25% would bypass to the small intestine for utilization by the host animal. Values range from a low of 25% for soybean meal to 80% for blood meal. Protein sources such as blood meal, dehydrated alfalfa, and brewers dried grains that have been heated during drying tend to have increased the bypass value.

Applications of Bypass Protein

To apply the concept of bypass proteins, one must remember that if the protein requirement of an animal is being met by feeding a particular protein source, then replacing this protein source with a high "bypass" protein would not result in an improvement in animal performance. Performance cannot be improved if adequate protein is already being fed. The best use of "bypass" protein would be to lessen the cost of dietary protein while maintaining the same stage of production. For example, soybean meal that would be 75% degraded in the rumen could be replaced by a combination of urea and a bypass protein to more optimally meet the nitrogen needs of the rumen microorganisms and the protein needs of the host animal. One should not pay a premium for a high bypass protein supplement expecting increases in animal performance, but instead should decrease the costs of natural protein in the diet and maintain animal productivity.

Much more information is needed on protein sources regarding their rumen degradability and on animal responses to these types of proteins fed in combination with urea before we can fully utilize these concepts to optimize animal production efficiency.

Table 1. Bypass estimates of protein sources

Protein source	% Bypass
Blood Meal	80
Meat Meal	64
Corn Gluten Meal	60
Brewer's Dried Grains	55
Distiller's Grains	54
Dehydrated Alfalfa	50
Distiller's Grains plus Solubles	49
Soybean Meal	25

REVIEW OF PRODUCTION RESPONSES FROM COWS FED CALCIUM SALT OF ISOBUTYRIC AND MIXED 5-CARBON VOLATILE FATTY ACIDS

J. R. Dunham

Background

Recent developments in dairy cattle nutrition have resulted in the marketing of a calcium salt of isobutyric and mixed 5-carbon volatile fatty acids (IsoPlus®). The FDA approved product has been neutralized with calcium to form a dry salt of the acids, which are found naturally in the rumen. The following review of research results is intended as a guide for feeding IsoPlus®.

Research Results

A summary of demonstration trials in 34 commercial herds is shown in Table 1. In these trials, the experimental cows were fed 3 oz IsoPlus® daily either top-dressed or in total mixed rations. The rolling herd average of the farms ranged between 16,038 to 22,500 lb. Forages fed varied from mostly corn silage to mostly alfalfa haylage or hay. The milk production summary includes those cows and heifers in milk at the start of the trials and those cows and heifers that freshened after the beginning of the trials.

Table 1. Summary of demonstration trials in 34 commercial herds

Stage of Lactation	Months after Feeding IsoPlus®	Number of cows	Response, lb milk/day
Cows and heifers all stages	1	1651	+0.7
	2	1434	+1.3
	3	1177	+1.7
Fresh heifers	1	202	+2.2
	2	146	+2.3
	3	75	+2.8
Fresh cows	1	462	+3.0
	2	322	+3.7
	3	161	+4.2

Discussion

As shown in Table 1, the greatest response to feeding IsoPlus® occurred in fresh cows. Fresh heifers were less responsive. University studies have shown an average response of 4.2 lb of 4% fat-corrected milk/day during 305 lactation studies. However, the greatest response from IsoPlus® was during the first 32 wk of lactation, when nutritional stress was the greatest. Feeding IsoPlus® does not affect feed intake, milk composition, or reproduction.

Recommendations

1. Herds producing less than 16,000 lb milk/cow/year should initiate improved feeding and management programs before feeding IsoPlus®.

2. The most economical returns can be expected in high-producing herds with feeding systems that can control intake of IsoPlus® at 3 oz/cow/day during the first 225 days of lactation.

3. The decision to include IsoPlus® in a feeding program should be based upon the cost of the additive in relation to the value of increased milk produced.

Dr. J. R. "Dick" Dunham at work in his office, assisting a dairy producer to balance his dairy ration.

KSU

FEED ADDITIVES

J. R. Dunham

Background

Feed additives are ration ingredients used in relatively small amounts to fortify certain nutrients or to affect a specific physiological function. The decision to include any additive should be based upon the economic response expected. The following guidelines are designed to help identify situations where additives may be considered.

Minerals

Calcium and phosphorus supplements are required in almost all rations because of the demand for milk production. The basis for selecting calcium and phosphorus supplements depends on the content of these elements in the supplement in relation to requirements for supplementation.

Magnesium may need to be supplemented at the rate of 0.5% magnesium oxide in the grain mix in certain rations containing mostly grass-type forages.

Potassium chloride fed at the rate of 0.5% of the grain mix may be beneficial during hot weather, when most of the forage is corn silage.

Salt added to the grain mix at the rate of 0.5% will provide adequate amounts of sodium and chlorine.

Trace Minerals

Most feeds grown in Kansas contain adequate amounts of trace minerals. However, a trace mineral premix or trace mineralized salt is recommended to ensure adequate levels. Most commercial mineral supplements are fortified with trace minerals.

Selenium supplements have received considerable attention in the Great Lakes region, but Kansas-grown feeds are believed to contain more than adequate amounts of selenium.

Vitamins

Vitamins A and D should be supplemented in grain mixes at the rate of 2,000 I.U. and 1,000 I.U., respectively, per pound of grain mix. The recommended rate for calf starters is 1000 I.U. A and 140 I.U. D, respectively.

Vitamin E is recommended in calf starters at the rate of 25 mg (I.U.)/lb.

Beta Carotene, a precursor of vitamin A, is not a recommended additive when vitamin A is supplemented adequately.

Niacin supplemented at the rate of 12 gm/day has been shown to be beneficial for ketotic-prone cows. However, feeding trials have not demonstrated a consistent production response when niacin was supplemented at the rate of 6 gm/day with adequate feeding programs.

B-Complex vitamins may be beneficial for cows recovering from digestive disturbances.

Amino Acids

Methionine Hydroxy Analogue (MHA) may be beneficial when supplemented at the rate of 25 to 35 gm/day in milk-fat-depressing rations. Response is most likely when rations are composed of more than 50% grain and less than 17% acid detergent fiber. Other measures to correct a depressed milk-fat test would probably be more practical.

Fats

Fats are a concentrated source of energy, which may be beneficial to high-producing cows. However, adding more that 5% fat to the grain mix may depress digestibility of fiber. Feeding 5 to 6 lb/day of ground soybeans or whole cotton seeds may be the most economical means of supplementing fat, provided the supplemental protein is needed.

Buffers

Sodium bicarbonate (bicarb) or sodium sesquicarbonate (s-carb) should be supplemented at the rate of 1.5% of the grain mix when the ration contains 50% or more grain mix. Feed intake can be improved when high energy rations are properly buffered to prevent low rumen pH (acidosis).

Magnesium oxide fed at the rate of 0.75% of the grain mix in combination with the normal amount of bicarb or s-carb is recommended for maintaining milk-fat tests.

Medications

Antibiotics fed at the rate of 20-40 ppm on a day basis in milk replacers are beneficial for improved growth of baby calves. Considering the low level of antibiotics permissible in lactating cow rations (75 mg/day), it is doubtful that cows will respond to feeding antibiotics.

Zinc methionine supplemented at 4.5 gm/day may be beneficial in herds experiencing foot problems associated with concrete.

Organic iodine (EDDI) has been fed to prevent foot rot. However, it is no longer permissible to feed EDDI as a medication. Feeding EDDI at the rate of 10 mg/head/day is permissible as a source of iodine.

Rumen Stimulants

Isoacids fed at the rate of 1.5 oz/day, 2 wk prepartum and 3 oz/day during the first 225 days of lactation may produce an economical return through improved feed efficiency. Heifers are less responsive than second lactation and older cows.

Monensin supplemented at the rate of 150 to 200 mg/day to growing heifers larger than 400 lb on high forage rations can improve daily gains and feed efficiency. Monensin is not approved or recommended for lactating cows.

Yeast may be a beneficial additive to rations of stressed or sick animals, but research evidence has not substantiated its value.

Enzyme additives will likely be destroyed by rumen fermentation, which will negate any benefit.

Aspergillus oxyzae may be beneficial if added to rations at 3 gm/day when temperatures exceed 90°F. Improved feed intake, higher milk production, and lower body temperatures have been reported during periods of high temperatures.

Table 1. Summary of recommended additives

Additive	Amount	Comments
Calcium	0.60% calcuim in total ration	Most rations require supplementation
Phosphorus	0.40% phosphorus in total ration	Most rations require supplementation
Magnesium Oxide	0.5% in grain mix	Recommended when feeding grass forages in eastern Kansas
	0.75% in grain mix	In combination with bicarb or s-carb for milk-fat test
Potassium Chloride	0.5% in grain mix	Recommended during hot weather, when no alfalfa is fed
Salt	0.5% in grain mix	Recommend trace mineralized salt, if other sources of trace minerals are not fed.

Table 1. Summary of recommended additives (continued)

Trace Minerals	Trace mineral premix or 0.5% trace mineralized salt	Most commercial minerals are adequately fortified.
Vitamin A	2000 I.U./lb grain mix	For lactating and dry cows
	1000 I.U./lb grain mix	For calves and heifers
Vitamin D	1000 I.U./lb grain mix	For lactating and dry cows
	140 I.U./lb grain mix	For calves and heifers
Vitamin E	25 mg(I.U.)/lb grain mix	For calves and heifers
Niacin	12 gm/day	For ketotic-prone cows
MHA	25 to 35 gm/day	Maintains milk-fat test when ration contains more than 50% grain
Fats	<5% of grain mix, 5-6 lb/day ground soybean or whole cotton seeds	High producing cows may benefit from additional energy
Sodium bicarbonate	1.5% of grain mix	For cows fed more than 25 lb grain/day
S-carb	1.5% of grain mix	For cows fed more than 25 lb grain/day
Antibiotics	20-40 ppm in milk replacer	Improves growth
Zinc methionine	4.5 gm/day	For foot problems associated with concrete
Isoacids	3 oz/day	For fresh cows through 225 days in milk
Monensin	150 to 200 mg/day	For heifers larger than 400 lbs

FIELD APPLICATION OF EXOGENOUS HORMONES - GONADOTROPINS AND PROSTAGLANDINS

E. P. Call

Summary

Prostaglandin $F_{2\alpha}$ (PGF) and gonadotropin-releasing hormone (GnRH) have provided new dimensions in resolving certain reproductive maladies. Effective when used properly, these hormones have the advantage of mimicking the physiological activity of natural hormones without the negative, overriding effects of synthetic products. Effective use of the hormones requires accurate diagnoses. Moreover, side effects are nil except when PGF is mistakenly administered to pregnant animals. The effect of PGF in humans must be recognized. Current research under way gives promise that GnRH may have beneficial effects in the early postpartum cow suffering from problems around the time of calving.

Introduction

Profitability in the dairy industry is dependent upon level of production (rolling herd average - RHA) and average calving interval. The nearer the average calving interval is to 365 days, the greater percentage of the time that cows are in the early part of lactation when feed is converted into milk most efficiently. Ideally, dairy cows should reproduce regularly without need of any treatment measures. However, the stress of high production under total confinement, often times with a wide ratio of cows per man unit, dictates the need of therapeutic measures to overcome reproductive inefficiency.

Two factors account for the majority of reproductive losses in a well-managed dairy herd, namely,

1. Days to first breeding (first service)
2. Cows not bred

Other disorders, such as repeat breeding, cystic follicles, uterine infections, and embryonic wastage, frequently receive more discussion, but in total, affect overall efficiency to a lesser degree than open cows, not yet bred.

A genetic antagonism exists between reproduction and production. In addition, it is a common belief among dairymen that higher producers are more difficult to settle. Table 1 illustrates the relationship among reproductive traits and production, as measured by rolling herd average (RHA) or yearly production per cow. While antagonism may be real, higher RHA herds overcome the detrimental effects. The only negative relationship noted is a small increase in services per conception. Most noteworthy are the average days open and the percent of cows open more than 120 days.

Table 1. Average reproductive characterization of 637 Kansas Holstein herds with 44,422 cows grouped by level of rolling herd average (RHA)

RHA Milk (lb)	Minimum Calving Interval[a] (days)	Days to First Breeding (days)	Open Cows[b] (%)	Open Cows[b] (days)	Open Cows[b] (%>120 d)	Serv/ Concep- tion	Dry Period (days)	Dry Period (%>70 d)
11,373	402	85	38	133	35	1.7	82	42
14,386	398	82	31	109	30	1.8	70	32
16,262	400	80	27	87	21	1.9	65	24
18,361	396	76	29	78	16	2.0	63	22

Source: Call (1985).

[a]Assumes last reported service was successful.

[b]Cows not yet reported bred since calving.

Use of Prostaglandin $F_2\alpha$ (PGF)

Prostaglandin $F_2\alpha$ provides an ideal system for synchronizing cows with functional corpora lutea (CL). While introduced as an effective program for synchronizing groups of cattle, PGF is used most effectively in lactating dairy cows after rectal confirmation of a functional CL. Recent work at Kansas State University (Lucy et al., 1986) showed poor synchronization after the double injection scheme in lactating dairy cows, 50 to 60 days postpartum. However, field studies (Table 2 and 3) have demonstrated the value of PGF in cows with palpable CL both in situations of heat detection failure (not bred by 60 days) and open at pregnancy examination. Critical to the economic success of using PGF in the aforementioned situations is double breeding (72 and 96 hr) cows that are not observed in heat. On the average, cows treated in experiments noted in Table 2 and 3 were detected in heat about 50 percent of the time by the 17 dairy producers cooperating in the studies.

Table 2. Fertility of dairy cows with palpable corpus luteum after PGF treatment for unobserved estrus (Experiment 1)

Item	Control	PGF
First service conception, %	39	43
By estrus, %	39	45
By appointment (72 + 96 hr), %	—	40
Standing estrus, %	—	56
Total services/conception	1.99	1.88
Total conception rate, %	88	86

Source: Plunkett et al. (1983).

With any treatment protocol, success is never 100 percent. However, acceptance of a protocol is based upon average economic benefits gained. In the data presented in Table 2, PGF-treated cows settled 22 days earlier than control cows. In cows open at pregnancy exam (Table 3), the PGF-treated cows had a 17-day advantage over controls. Considering all costs and a $3.00 per day loss for each day open after 85 days, the treatment program is cost-effective, even though 12 to 18 % of the treated cows were culled open.

Table 3. Fertility of dairy cows open at pregnancy examination with palpable corpus luteum after PGF treatment (Experiment 2)

Item	Control	PGF
First service conception, %	52	44
By estrus, %	52	32
By appointment (72 + 96 hr), %	--	54
Standing estrus, %	—	44
Total services/conception	1.73	1.63
Total conception rate, %	84	81

Source: Plunkett et al. (1983).

While not well documented, the use of PGF has been reported to be effective in the following disorders:

1. Retained placenta
2. Metritis
3. Pyometra
4. Mummified fetus
5. Illicit matings with palpable CL prior to 90 days (preferably at 8 to 10 days)
6. Repeat breeders - 8 to 10 days after a non-mated repeat estrus
7. Cystic follicles - 8 to 10 days after administration of GnRH (Cystorelin®)

Use of Gonadotropin-Releasing Hormone (GnRH)

GnRH (Cystorelin®) is labeled as a treatment for cystic follicles. Cystic follicles are classified as "thin walled" cysts (TWC) and luteal cysts (LFC). While LFC may respond directly to PGF, differential distinction rectally is difficult. The preferred protocol is to administer GnRH (2 cc im) at diagnosis followed by PGF 8 to 10 days later. If the cow is on the breeding list, she should be serviced at the estrus following PGF. If there is no estrus by 72 hr after PGF, she should be double bred at 72 and 96 hr.

GnRH is an effective treatment for repeat breeders (3rd service). Stevenson et al. (1984) have shown that GnRH (im) immediately after breeding (artificial insemination - AI) had a significant effect (improved conception) on cows returning for the third service. A non-significant improvement was noted on second service, with no improvement on first service. A multi-herd experiment at Wisconsin showed even more dramatic results on third-service cows. The combined data are presented in Table 4.

Fernandez et al. (1977) demonstrated that cows receiving GnRH 14 days after calving underwent significantly faster uterine involution, but this did not result in any practical benefits such as reduced days open or improved conception rate. More recent data from the K-State dairy herd indicated an improvement in days open postpartum and services per conception when GnRH (day 10 to 14) or PGF (day 20 to 24) were administered to "abnormal" cows, but not to "normal" cows (Table 5). Cows with any puerperal problems were classified as "abnormal". Supporting the K-State work is a Cornell report, which showed similar beneficial results from injecting GnRH 2 to 3 weeks after calving (Table 6).

Adopting the routine use of GnRH treatment of cows postpartum awaits more definitive results from a large herd experiment now underway.

Table 4. Effect of treating repeat-breeder cows (3rd service) with gonadotropin releasing hormone (GnRH) at time of insemination[1]

Treatment	Cows	Pregnant[2] No.	%
GnRH	261	176	67.4
Saline	255	124	48.6

[1]Combined data: Kansas State University and University of Wisconsin.

[2]Diagnosed by rectal palpation

Table 5. Reproductive measures of cows after treatment with gonadotropin-releasing hormone (GnRH) and/or prostaglandin (PGF) in the postpartum period

Item	GnRH	PGF	GnRH-PGF	Control
First service conception, %	40	42	38	29
Normal cows	42	48	44	35
Abnormal cows	31	21	29	13
Days from calving to conception	88*	86*	96	115
Normal cows	92	83	82	97
Abnormal cows	85*	90*	109	133
Services per conception	1.7*	1.8*	2.1*	2.3
Normal cows	1.7*	1.6*	1.7*	2.2
Abnormal cows	1.7*	1.9*	2.4	2.4

Source: Benmrad and Stevenson (1985).

*Significant improvement compared with control cows (P<.05).

Table 6. Results of treating cows with gonadotropin-releasing hormone (GnRH) 2 to 3 weeks after calving

Characteristic	Normal Cows		Abnormal Cows	
	GnRH	Control	GnRH	Control
Cycles prior to conception	3.6	3.1	2.9	4.3
Services per conception	2.0	1.9	1.5	2.6
Pregnant by 85 days (%)	47	56	50	0
Days open	94	102	87	121

Source: Foote et al. (1985)

Read More About It

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KSU

MILK PROGESTERONE KITS: ON-FARM USE

J. S. Stevenson and E. P. Call

Background

Diagnosing pregnancy in dairy cattle is an essential part of good management. The objective of this procedure is not to identify pregnant cows, but to identify the nonpregnant cows, those that become the breeding challenge. Economics dictate that verifying the pregnancy or "open" status of the cow is essential. Estimated losses of $1 to $3 per cow per day when conception is delayed beyond 85 days postpartum emphasize the importance of inseminating cows early to allow for 12 to 13-month calving intervals.

A number of diagnostic tools are available and increasing scientific knowledge and technology will provide for improved pregnancy diagnosis in the future through use of cowside tests. These available procedures include: 1) continuous detection of estrus to identify inseminated cows that return to heat 18 to 24 days post breeding (repeat heats); 2) palpation of the uterus and its contents per rectum (sometime after day 35 of suspected pregnancy depending on the expertise of the clinician); 3) radioimmunoassays (RIA) of progesterone in milk, blood serum, and plasma; and 4) enzyme-linked immunoassays (ELISA) for progesterone in milk, blood serum, and plasma. At least five chemical cowside test kits are now available that use the ELISA-type tests for detecting progesterone in milk and one for blood serum in heifers (see reference 3).

How They Work

Progesterone is a hormone that is produced by the corpus luteum (CL) or yellow body on the ovary. The CL develops from residual cells that remain at the site where the follicle ruptured on the ovarian surface and released the ovum (egg). Progesterone is secreted by the CL during the estrous cycle (detectable in milk or blood around 4 days after heat) and is present in milk or blood until the CL regresses (3 to 4 days before the next heat) or until the calf is born. Progesterone, as part of its normal metabolism and clearance from the blood, enters the mammary gland and is present in milk. The sampling procedure for the milk progesterone test relies on the fact that 21 to 24 days after insemination, concentrations of progesterone in milk, serum, or plasma will be low or nondetectable in cows that failed to conceive, whereas levels of progesterone should be comparably high in pregnant cows. A recent article described how the cowside milk progesterone works (see reference 1).

Accuracy of Cowside Tests

When the cowside test indicates low progesterone in milk 21 to 24 days after breeding, you can be about 90 to 100% certain that the cow is open, according to results of several studies (see reference 2). A high progesterone reading suggests that conception has occurred. The accuracy of detecting pregnant cows ranges from 68 to 95%, with an average of 84% (see reference 2). The reduced accuracy is because high concentrations of progesterone alone do not confirm pregnancy. Progesterone can be high (21 to 24 days after breeding) when cycles are abnormally long (>21 days) because of uterine infection and(or) embryonic death. Approximately 15 to 20% of all pregnancies are terminated prematurely by early embryonic death. Remember that progesterone is not unique to pregnancy, because it is secreted by the CL during the estrous cycle as well.

Things to Remember About Cowside Tests

The following important points should be remembered when using cowside tests: 1) follow the directions of each test kit exactly — each is different, 2) continue to involve your veterinarian in your preventive herd health program (PHHP), 3) continue to palpate all cows for pregnancy even after a positive cowside test, and 4) remember that the best pregnancy test is a good heat detection program.

The most benefit from these cowside tests may be in supporting clinical findings of palpations per rectum. On occasion, it is difficult to determine the status of ovarian structures, especially follicular cysts. It is difficult for even the skilled clinician to distinguish between follicular (thin-walled) cysts and luteal (thick-walled) cysts. These cowside tests might be used to confirm the presence of luteal tissue, whether it be from a thick-walled luteal cyst or an indeterminant CL. In addition, weekly tests of low progesterone over a 3-wk period would indicate if a cow were anestrus (not cycling).

Cowside milk progesterone tests can be useful tools to both dairy producers and practicing veterinarians. They will not replace a comprehensive, reproductive, herd health program nor a good, heat detection program on the farm but can supplement them both. Several ideas for using these cowside tests have been suggested in other publications (see references 2 and 3).

Read More About It

1. Nebel, R. L. 1986. Here's how cowside milk progesterone tests work. Hoard's Dairyman 131(9):466, May 10, 1986.

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RESEARCH IN PROGRESS

Effects of Bovine Growth Hormone with Monensin on the Performance of Lactating Dairy Cows

J. C. Kube and J. E. Shirley

Bovine growth hormone (bGH) partitions nutrients to the mammary gland, enabling the dairy cow to increase efficiently milk production. The dairy cow meets her energy requirements in early lactation by mobilizing adipose tissue and increasing dry matter intake. If a cow received bGH during peak milk production when body reserves are minimal, she would have to depend on her diet for the additional energy. Cows in this stage of lactation are usually on a high concentrate diet, so it would not be advisable to further decrease the forage to concentrate ratio. Monensin increases the efficiency of feed utilization at the rumen level and increases propionate production by the microflora in the rumen. Propionate is a major source of energy in the ruminant through the glucogenic pathway and has a negative effect on milk fat production. In this trial, rumensin will be fed concurrently with bGH injections to cows in early to mid lactation. Milk, milk fat, and protein production will be measured and other metabolic functions will be monitored. It is hypothesized that monensin fed concurrently with daily bGH injections will result in an increase in feed efficiency, without a decrease in milk fat production.

Small-Intestinal Starch Digestion in Steers

K.K. Kreikimeier and D.L. Harmon

Holstein steers (250-300 kg) will be fitted surgically with abomasal and ileal cannulae, hepatic portal and mesenteric catheters, and an elevated carotid artery. These steers will be used to study starch digestion and absorption in the small intestine. Various levels of glucose, dextrin, and starch will be infused into the abomasum and ileal digesta samples will be collected. Dissappearance of carbohydrate through the small intestine can then be determined and accompanying samples of portal venous, mesenteric venous, and carotid arterial blood will be used to measure the absorption of various metabolites (glucose and volatile fatty acids) resulting from the carbohydrate infusion. This will enable the determination of the amount of carbohydrate utilization and what steps may be limiting it in the small intestine of cattle.

Effect of Supplementary Potassium and Buffered vs Nonbuffered Starter Rations on Calf Performance under Stressful and Nonstressful Temperature Conditions

P. Flynn, P.G. Reddy, and J.L. Morrill

Studies have shown that during periods of heat stress, the potassium requirement of lactating cows increases over that currently recommended by NRC. There is little information concerning the potassium requirements of the calf, especially during times of high temperature conditions. Since a symptom of potassium deficiency is a decrease in feed intake, it is important to know the requirement of the calf to allow for optimum feed intake, growth, and development. In addition, current research at Kansas State has shown that a buffer in the starter ration of dairy calves is very beneficial in helping to prevent acidosis, which may occur as the calf's feed consumption increases and the rumen develops.

We formulated three rations that contain the following concentrations of potassium: 0.9%, 1.25%, and 1.5%. A buffered and a nonbuffered ration were formulated for each level of potassium. The buffer used was trona, a natural buffer, which has not been extensively tested. These feeds are being fed to calves from 1 day of age until 8 wk of age. Growth and feed consumption will be monitored, along with hematological, hormonal, and immunological parameters.

Merlin Dellen (KABSU) adds liquid nitrogen to semen storage refrigerator

Early Postpartum Hormonal Therapy and Fertility

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

We demonstrated earlier that either gonadotropin-releasing hormone (GnRH or Cystorelin®) or prostaglandin $F_2\alpha$ ($PGF_2\alpha$ or Lutalyse®) reduced days open and services per conception when given to dairy cows at 10 to 14 days (GnRH) or 20 to 24 days ($PGF_2\alpha$) postpartum. These treatments were particularily effective in cows that had periparturient problems (e.g., dystocia, retained placenta, ketosis, etc.). We are evaluating further these treatments in a large commercial herd. Treatments are: 1) GnRH given once between days 10 and 24, 2) $PGF_2\alpha$ given once between days 10 and 24, 3) $PGF_2\alpha$ given once between days 26 and 38 postpartum, and 4) untreated controls. We will evaluate reproductive traits including conception and pregnancy rates, days open, and culling rates.

Dr. David Harmon and Kelly Kreikemeier, graduate research assistant, prepare to sample blood through catheters

Measurement of Ruminal and Intestinal Nutrient Utilization in Ruminants

K.L. Gross and D.L. Harmon

Four mature wether lambs are being maintained by total intragastric nutrient infusions to measure ruminal and intestinal nutrient utilization. Known quantities of volatile fatty acids (acetate, propionate, and butyrate), buffers, macrominerals, and vitamins are infused into the rumen, while protein (casein) and microminerals are infused into the abomasum. The lambs also are fitted with blood sampling catheters in the hepatic portal vein (portal-drained viscera), anterior mesentric vein (mesenteric-drained viscera), a mesenteric vein, and an artery. Blood samples are used to evaluate ruminal and intestinal absorption and utilization of volatile fatty acids, glucose, ammonia, urea, as well as pancreatic production of the hormones, insulin, and glucagon.

Progesterone Priming and Fertility

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

Several studies suggest that fertility is improved when progesterone is given to cows after insemination. Other studies have shown that prebreeding progesterone or progestins improved fertility when coupled with prostaglandin $F_2\alpha$ to induce regression of the corpus luteum before insemination. Progesterone is delivered via an intravaginal releasing device that remains in place for 7 days. About 24 h before the device is removed, prostaglandin $F_2\alpha$ is administered. A second treatment consists of using prostaglandin $F_2\alpha$ alone. In both of the previous treatments, prostaglandin $F_2\alpha$ is given between 56 and 62 days postpartum and cows are inseminated when detected in estrus. Control cows are bred when the first spontaneous heat occurs after 6 wk postpartum. Our results should provide information concerning the effect of progesterone priming on fertility, as well as on reducing intervals to first service and subsequent calving intervals.

Dr. Jeff Stevenson examining a cow on a reproductive study

Luteal Function in Bred Heifers

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

Increased understanding of luteal function will help us better control the estrous cycle and allow insemination of dairy cattle at the convenience of the dairy producer. A study in progress is examining the role of gonadotropin-stimulated luteal function at various stages of the estrous cycle and early pregnancy. Heifers are treated with human chorionic gonadotropin on days 3 to 5 or 14 to 16 after insemination. Fertility and progesterone in serum are assessed to determine the influence of enhanced luteal function on pregnancy rates and secretion of progesterone by the early and mature corpus luteum.

Effect of Supplementary Vitamins A and E and Selenium During the 60-Day Immediate Prepartum Period of Cows and Heifers on Udder Health During the Subsequent Lactation

J. F. Smith, P. G. Reddy, J. E. Shirley, J. L. Morrill, and H. C. Minocha

Proper nutrition, including vitamin supplementation during the dry period, is an important factor in determining the level of production achieved in the subsequent lactation. Major negative effects on milk production include mastitis, general health of the host animal, and metabolic imbalances in the early stages of lactation. An experiment is being conducted to determine the effects of additional vitamin A, vitamin E, and selenium during the dry period on milk production, incidence of mastitis, and response of the immune system. Cows are assigned to one of eight groups receiving supplementary vitamins during the dry period. Heifers, 60 days prepartum, are assigned accordingly. Data collected during their first 90 days of lactation include summit milk yield, total milk production, monthly somatic cell counts, and incidence of clinical mastitis. Calving difficulty scores and evaluations of the immune system and reproductive tract function also will be recorded.

Effect of Bovine Herpesvirus-1 and Parainfluenza-3 Virus Interactions on the Immune Response of Calves

A. Ghram[1], P.G. Reddy, J.L. Morrill, and H.C. Minocha[1]

The effect of mixed viral interactions on the replication of bovine herpesvirus-1 (BHV-1) and bovine parainfluenza-3 (PI-3) viruses and their subsequent effect on clinical and immunological responses of the calves is being investigated. Eight unvaccinated calves, about 3 months of age with <1:10 maternal antibodies to BHV-1 and PI-3 were selected. Two calves per group were inoculated intranasally and intratracheally (1 ml/route) with media containing 10^8 PFU/ml of BHV-1 or PI-3 or both. Two additional calves served as controls and were inoculated with media without virus. Calves are being observed for clinical response such as rectal temperature, nasal discharge and cough; serum antibody titers to respective viruses; propagation of viruses in nasal passages; cell-mediated immune responses by lymphocyte blastogenesis using phytohemagglutinin and UV-inactivated viruses, direct cytotoxicity by ^{51}Cr-release assay; and production of interferon and interleukin-2. In addition, serum samples are being analyzed for cortisol concentrations. Pathogenesis and immune response of calves inoculated with mixed viruses will be compared with response of calves infected with individual viruses.

[1] Dept. of Laboratory Medicine

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

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The Council's individual projects are numerous. The LMIC recently funded research in the Departments of Agricultural Engineering and Animal Science 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 funds 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 from the unitrust. 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:

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Kansas DHIA, Manhattan, KS
Lincoln Grain, Inc., Atchinson, KS
Livestock Meat Industry Council (LMIC), Manhattan, KS
Merrick's, Union Center, WI
Milk Specialities, Inc., Dundee, IL
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